TECHNICAL HANDBOOK SERVICE

PREFACE

In order that you may obtain the maximum benefit from your Mullard Technical Handbook, we ask you to read carefully this short description of the Handbook Service and how it is organised.

By following the simple suggestions given you will ensure that your Handbook is always up to date, and will avoid much unnecessary correspondence and work both at your end and ours.

THE HANDBOOK

The Mullard Technical Handbook is published in seven volumes plus a general index.

You may possess the complete Handbook, or only one or more of the volumes. Should you wish to obtain any volumes not in your possession, please write to Mullard Central Technical Services for subscription terms, quoting the serial number of your existing Handbook.

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Each volume has a separate index, and is sent out complete with section dividers and all current data sheets in their correct positions. As new or revised sheets are issued, copies are sent to all subscribers, together with a list indicating the position in which each sheet should be filed.

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In order to ensure that these sheets reach the correct individual you are earnestly requested, immediately upon receipt of your Handbook, to detach and mail to us the "Acknowledgment of Receipt Card" which you will find just inside the cover. Please make sure that the name and full address to which supplements should be sent are clearly given in the space provided.

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Neglect of this simple task may lead to loss of data sheets, and an incomplete Handbook congested with out-of-date information.

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CORRESPONDENCE

Correspondence concerning the Handbook Service should be addressed to:

Mullard Limited,
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When writing, please quote the SERIAL NUMBER which is given on the introduction page of each Handbook. This number links up with our records and mailing system, and is repeated in the address on every set of supplementary sheets issued. By quoting this number you will save us a great deal of work and avoid delays in answering your letters.

TECHNICAL HANDBOOK SERVICE

CONTENTS

Volume 1

Part I

Receiving and amplifying valves (current types)

Part II

Special quality receiving valves
Television picture tubes (current types)
Miscellaneous valves

Volume 2

Maintenance type receiving and amplifying valves
Maintenance type cathode ray tubes

Volume 3

Part I

Cathode ray tubes
Photoconductive cells
Photoemissive cells
Camera tubes
Photomultiplier tubes
Image converter tubes

Part II

Switching and indicating gasfilled diodes
Voltage stabiliser and reference level tubes
Decade counter and indicator tubes
Small thyratrons and trigger tubes
Large thyratrons and ignitrons
Power rectifiers (valves)

Part III

Transmitting and industrial heating valves
Quartz crystal units

Volume 3A

Communications magnetrons
Industrial magnetrons
Klystrons
Travelling wave tubes
Disc seal triodes
Microwave components

Volume 4

Part I

Transistors (AC107 to AUY10)

Part II

Transistors (BC107 to GET898)

Part III

Transistors (OC16 to 2N3572)

Part IV

Semiconductor diodes
Photodiodes and phototransistors

Part V

Rectifier diodes
Rectifier diode stacks

Part VI

Thyristors
Thyristor stacks

Volume 5

Fixed capacitors
Variable capacitors
Fixed resistors
Variable resistors
Non-linear resistors
Electromechanical components
Ultra-high vacuum devices
Tuners
Piezoxide components

Volume 6

Part I

Permanent magnets
Wound ferrite assemblies
Magnetic recorder heads
Ferroxcube multi-aperture devices
Ferroxcube storage cores
Ferroxcube switch cores
Memory systems

Part II

Ferroxcube rods, tubes and beads
Ferroxcube U-cores and yokes
Ferroxcube toroids
Ferroxcube transformer cores
Ferroxcube pot cores

Part III

Vinkors
High frequency vinkors

Part IV

IEC size vinkors
IEC size transformer pot cores

Volume 7

Integrated circuits

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

Mullard Technical Handbook

GENERAL INDEX TO VOLUME TWO

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

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

Issue No. or Date	*Type No.*	*Pages*
Sept 67	Preface	4
Oct 67	General Index Vol. 2	3
Receiving and Amplifying Valves (*Maintenance Types*)		
2	AZ31	2
Apr 60	CCH35	D1
3	DAF91	4
Sept 61	DAF96	D1–D3
1	DCC90	2
1	DF91	2
2	DF96	2
3	DK91	4
Feb 60	DK92	D1–D2
2	DK96	2
2	DL92	4
2	DL94	4
Sept 61	DL96	D1–D3
2	DM70	4
Apr 59	E80CC	D1–D4
Mar 61	E80F	D1–D2
Apr 59	,,	D3
Sept 62	E80L	D1–D4
Dec 58	E83F	D1–D3
Sept 59	E90CC	D1–D3
Apr 59	E92CC	D1–D3
Dec 65	E130L	D1–D3
Dec 65	,,	C1–C6
Mar 60	E180CC	D1–D3

Issue No. or Date	*Type No.*	*Pages*
Receiving and Amplifying Valves (*Maintenance Types*)—contd.		
Sept 60	E182CC	D1–D2
Oct 59	,,	D3
Oct 59	,,	C1–C2
July 64	,,	C3–C4
Oct 63	E186F	D1–D4
Oct 63	,,	C1
Feb 63	E188CC	D1–D4
July 64	,,	C1–C6
Oct 63	E280F	D1–D2
Jan 64	,,	D3
July 63	E288CC	D1–D2
4	EA76	2
2	EAF42	2
2	EBC33	2
Nov 58	EBC41	1
2	EBF80	4
Apr 65	EC86	D1–D2
July 63	EC88	D1–D2
June 61	EC90	D1–D2
July 61	EC91	D1–D2
4	ECC32	2
1	ECC33	2
1	ECC35	2
1	ECC84	4
May 62	ECC86	D1–D2
July 61	ECC91	D1–D2
Nov 62	ECC189	D1–D2

Mullard Technical Handbook

GENERAL INDEX TO VOLUME TWO

Receiving and Amplifying Valves *(Maintenance Types)*—contd.

Issue No. or Date	*Type No.*	*Pages*
May 60	ECH35	D1–D3
2	ECH42	4
Dec 65	ECH81	D1–D4
Dec 65	,,	C1–C12
1	ECL83	4
Dec 58	EF36 (obsolete) / EF37A	1–2
Feb 60	,,	3–4
May 60	EF39	D1–D2
Dec 58	EF40 / EF41	2
Dec 58	EF50	2
1	EF55	2
Mar 60	EF83	D1–D2
Feb 60	EF89	D1–D2
Feb 60	,,	C1–C6
Mar 61	EF97	D1–D2
July 60	EF98	D1–D3
May 62	EH90	D1–D2
May 62	,,	C1–C8
2	EL33	2
Jan 64	EL34	D1–D2
Apr 62	,,	D3–D4
Jan 60	,,	D5
Jan 60	,,	C1–C14
4	EL37	4
3	EL38	4
2	EL41	4
Dec 58	EL42	1
3	EL81	2
Jan 64	EL84	D1–D2
Feb 61	,,	D3–D4
Feb 61	,,	C1–C16
Aug 64	,,	C17–C18
2	EL85	4
Oct 60	EL86	D1–D3

Receiving and Amplifying Valves *(Maintenance Types)*—contd.

Issue No. or Date	*Type No.*	*Pages*
May 62	EL91	D1–D4
May 62	,,	C1–C9
Feb 60	EL821	D1–D2
Feb 64	EL822	D1–D2
2	EM34	2
May 62	EM84	D1–D2
Nov 58	,,	C1
7	EY51	2
3	EY84	8
3	EZ35	2
Nov 58	EZ40	D1
2	EZ41	2
Aug 59	EZ81	D1–D2
Aug 59	,,	C1–C6
2	GZ30	2
2	GZ32	2
1	GZ33	2
2	GZ34	6
Oct 58	GZ37	D1–D2
June 60	M8080	D1–D6
June 60	M8081	D1–D6
May 62	M8082	D1–D2
Apr 60	,,	D3–D6
May 62	,,	C1–C9
Apr 60	M8091	D1–D4
Sept 59	,,	C1–C6
June 60	M8212	D1–D6
May 66	,,	C1
May 62	M8248	D1–D6
1	PABC80	1
July 63	PC97	D1–D2
2	PCC84	4
1	PCL83	4
Aug 60	PL81	D1–D2
2	PL82	2

GENERAL INDEX TO VOLUME TWO

Issue No. or Date	*Type No.*	*Pages*
Receiving and Amplifying Valves (*Maintenance Types*)—contd.		
May 62	PY33	D1–D2
Mar 60	PY82	D1–D2
2	UAF42	2
Dec 58	UB41 UBC41	2
1	UBC81	4
2	UBF80	4
2	UCH42	4
1A	UCL83	1–2
1	,,	3–4
2	UF41	2
3	UL41	2
2	UY41	2
Dec 65	YL1000	D1–D7
Dec 65	,,	C1–C6
1	6AL5	3
1	6U8	4
Apr 61	5636	D1–D6
Apr 61	5718	D1–D6
Apr 61	5899	D1–D6
Apr 61	5902	D1–D6
Dec 65	6080	D1–D3
Dec 65	,,	C1
Mar 61	6205	D1–D6
Cathode Ray Tubes (*Maintenance Types*)		
Jan 64	AW21–11	D1–D6
Jan 64	,,	C1–C2
Aug 67	AW36–20Z	D1–D3
Aug 67	AW43–80Z	D1–D3

Issue No. or Date	*Type No.*	*Pages*
Cathode Ray Tubes (*Maintenance Types*)—contd.		
Aug 60	AW43–88	D1–D4
Aug 60	AW43–89	D1–D4
Feb 62	AW47–91	D1–D4
1	AW53–80	4
Aug 60	AW53–88	D1–D4
Aug 60	AW53–89	D1–D4
Sept 67	D13–19 BE GH GM GP	D1–D5
Sept 67	D13–21 BE GH GM GP	D1–D6
4	DB7–5 DG7–5 DP7–5	2
4	DB7–6 DG7–6 DP7–6	2
Dec 60	DB10–78 DH10–78 DP10–78	D1–D5
Dec 60	,,	C1–C3
Mar 59	DG7–36	D1–D2
Mar 59	,,	C1–C3
Oct 59	DG13–34	D1–D3
Dec 60	DH13–78 DN13–78	D1–D4
Aug 67	MW43–69Z	D1–D3
Aug 67	MW43–80Z	D1–D4
1	MW53–20	4
Jan 61	MW53–80	D1–D4

TRIODE PENTODE

6U8

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

HEATER

V_h	6.3	V
I_h	450	mA

MOUNTING POSITION

Any

CAPACITANCES

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

Pentode section

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

Triode section

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

CHARACTERISTICS

Pentode section

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

Triode section

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

6U8

TRIODE PENTODE

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

TYPICAL OPERATING CONDITIONS

As a frequency changer

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

Triode section as an oscillator

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

LIMITING VALUES

Pentode section

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

Triode section

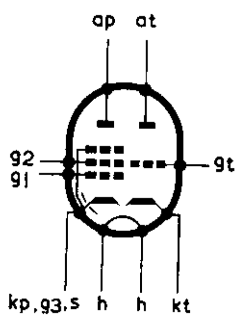
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.7	W
I_k max.	20	mA
R_{g-k} max.	1.0	MΩ
V_{h-k} max. (cathode negative)	90	V
V_{h-k} max. (cathode positive)	90	V
R_{h-k} max.	20	kΩ

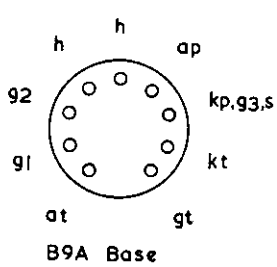
TRIODE PENTODE

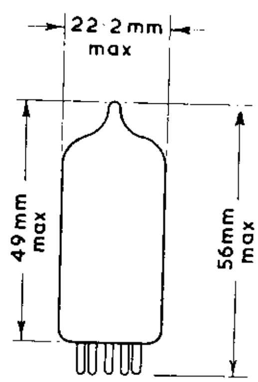
6U8

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

3222







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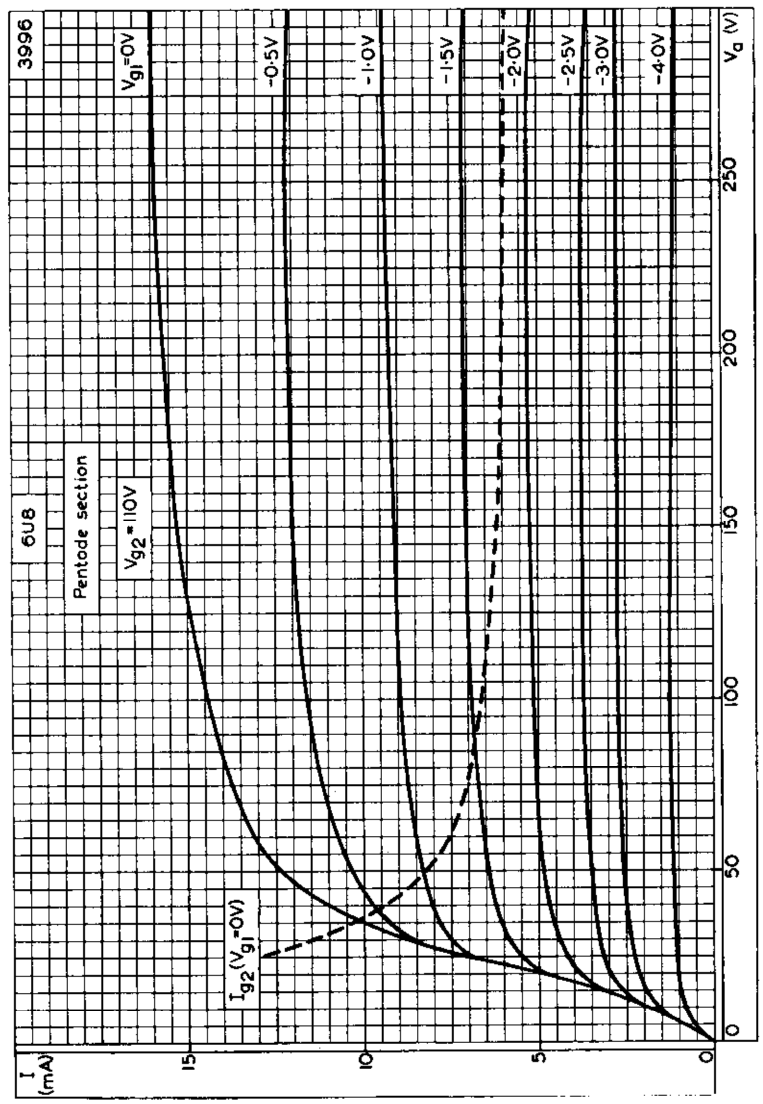
TRIODE PENTODE

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.

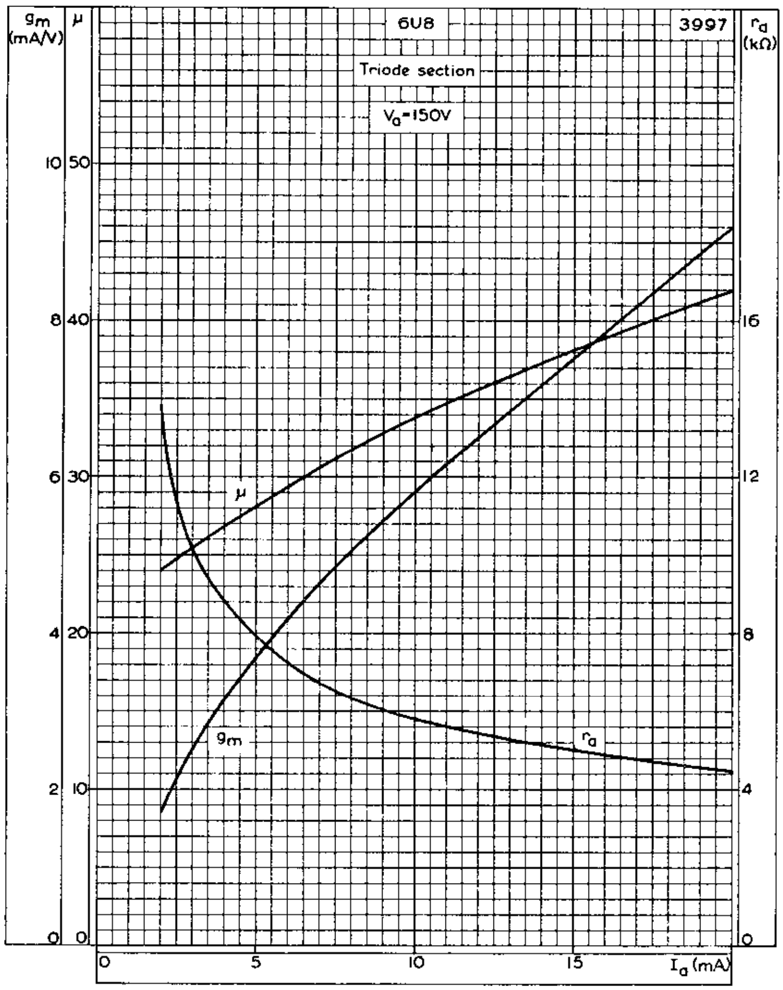


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE FOR PENTODE SECTION WITH CONTROL-GRID VOLTAGE AS PARAMETER

TRIODE PENTODE

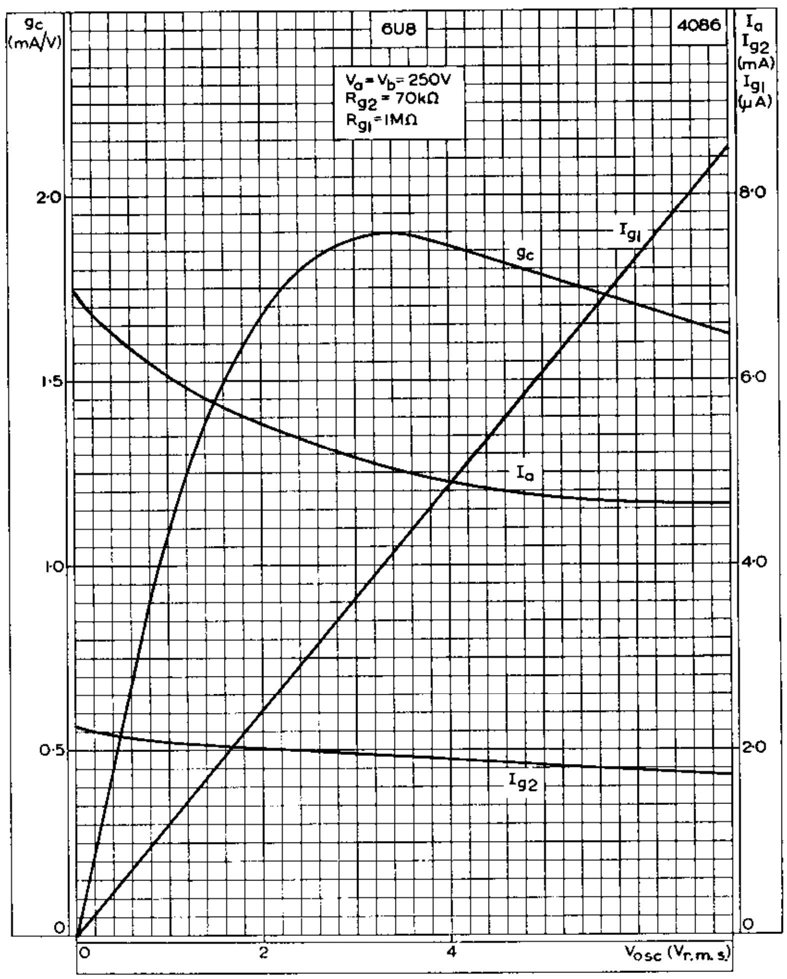
6U8

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.



MUTUAL CONDUCTANCE, AMPLIFICATION FACTOR AND ANODE IMPEDANCE PLOTTED AGAINST ANODE CURRENT FOR TRIODE SECTION

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.

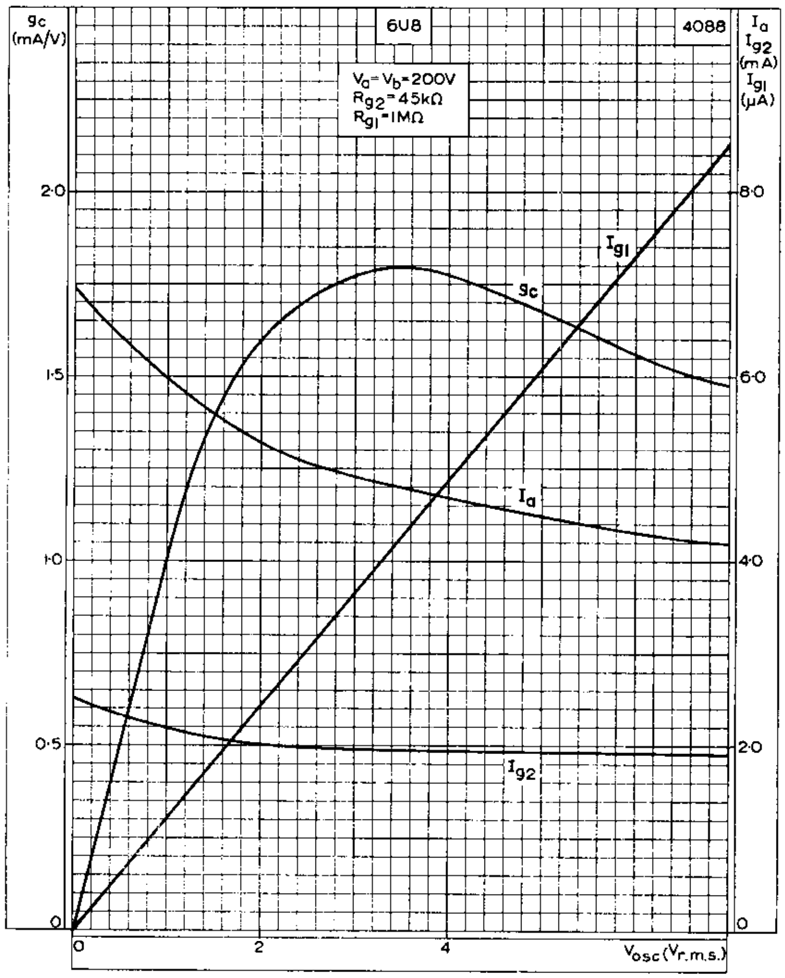


PERFORMANCE CURVES FOR USE AS A FREQUENCY CHANGER
$V_a = V_b = 250V$

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.

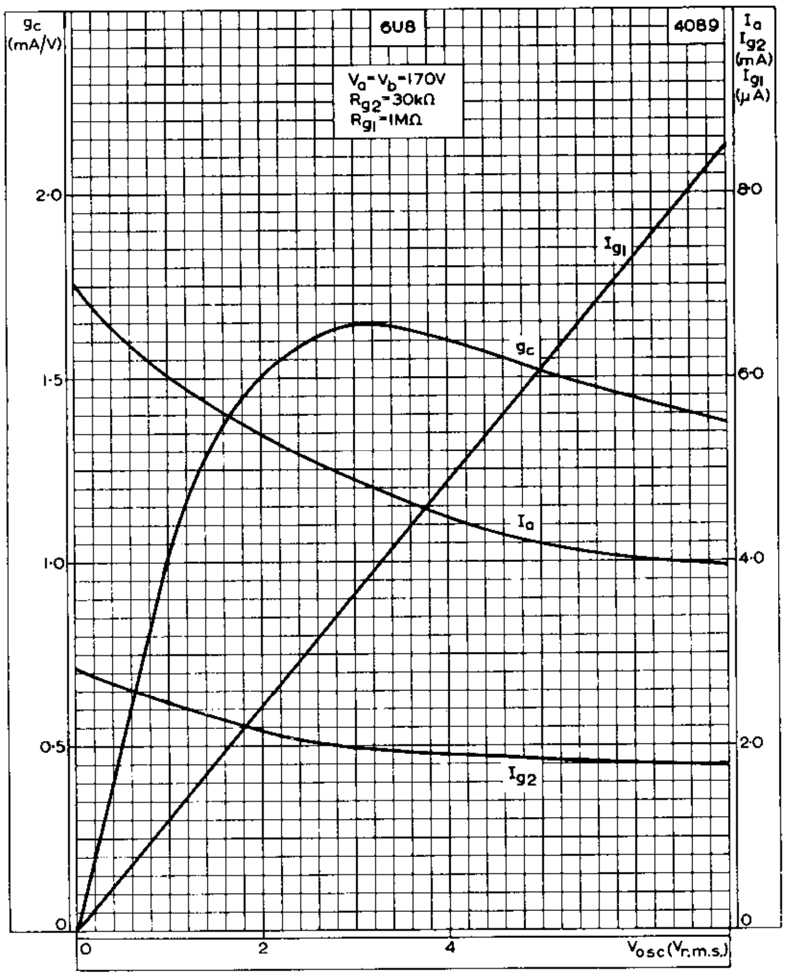


PERFORMANCE CURVES FOR USE AS A FREQUENCY CHANGER
$V_a = V_b = 200V$

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.



PERFORMANCE CURVES FOR USE AS A FREQUENCY CHANGER
$V_a = V_b = 170V$

FULL-WAVE RECTIFIER

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

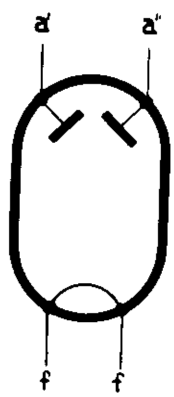
AZ31

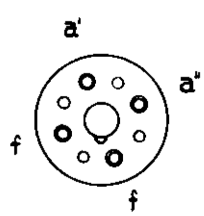
FILAMENT

V_f	4.0	V
I_f	1.1	A

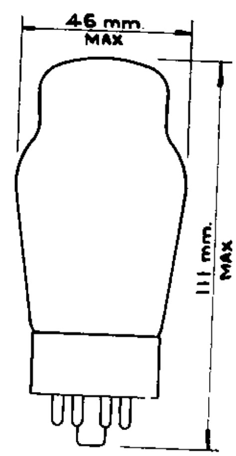
LIMITING VALUES

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





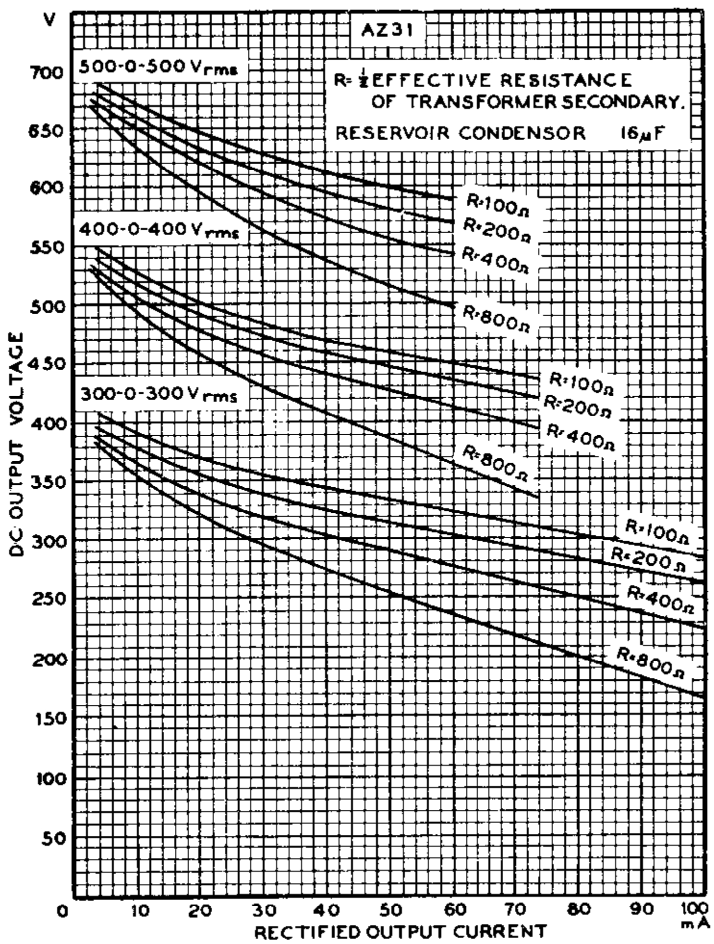
OCTAL BASE



AZ31

FULL-WAVE RECTIFIER

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



RECTIFIER CHARACTERISTICS

TRIODE HEXODE

CCH35

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

HEATER

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

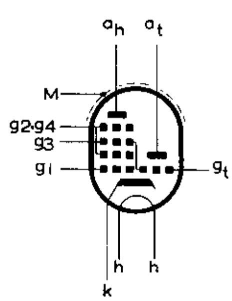
I_h	200	mA
V_h	7.0	V

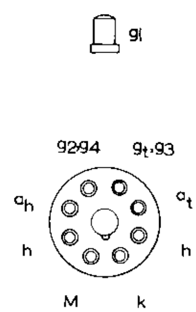
CHARACTERISTICS

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

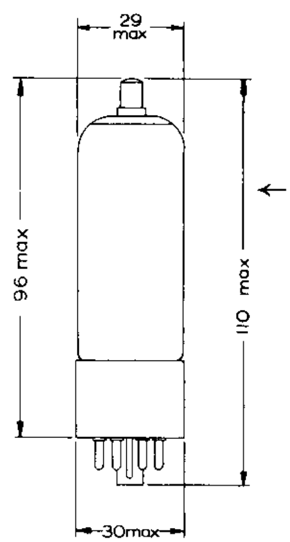
Except for the heater voltage and current, the ECH35 and CCH35 are identical.

6710





Octal base



All dimensions in mm

MINIATURE DIODE PENTODE

DAF91

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

FILAMENT

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	pF
c_{in}	2.0	pF
c_{out}	2.8	pF
c_{ad-all}	1.5	pF

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 40mV for an output of 50mW 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).

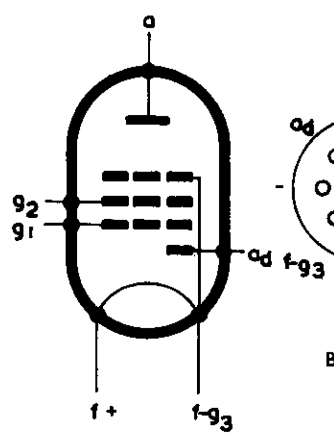
V_b (V)	R_a (kΩ)	I_a (mA)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$)	D_{tot} (%)	R_{g1}* (MΩ)
90	220	0.25	11.0	5	1.0	0.68
90	470	0.13	11.5	5	0.8	1.5

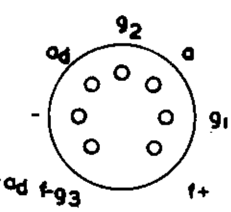
* Grid resistor of following valve.

MINIATURE DIODE PENTODE

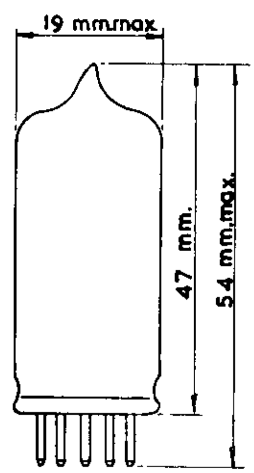
DAF91

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





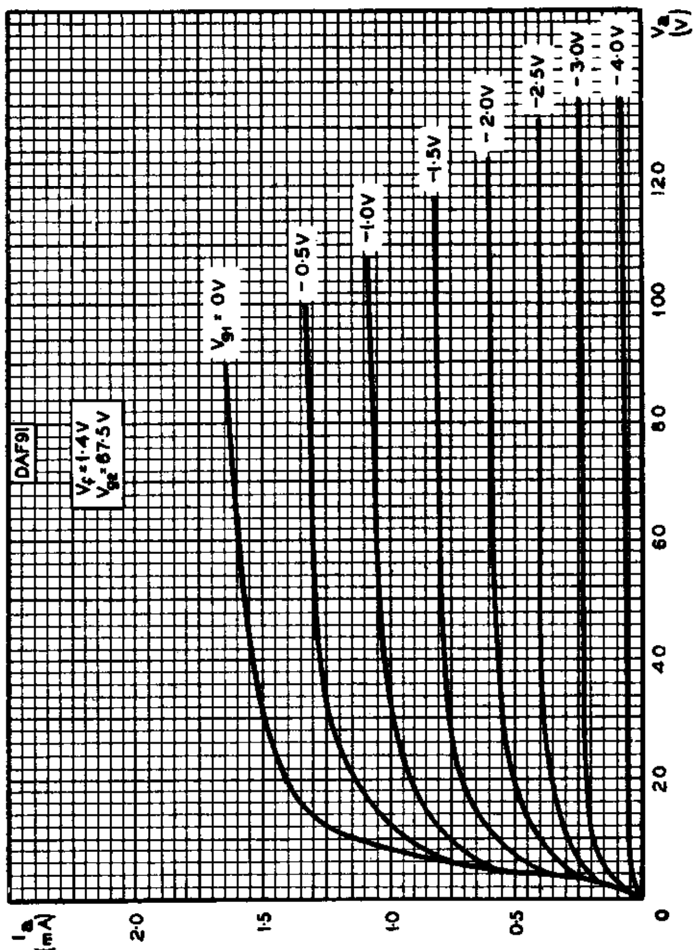
B7G BASE



DAF91

MINIATURE DIODE PENTODE

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



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

DIODE A.F. PENTODE

DAF96

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

FILAMENT

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

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

CAPACITANCES (measured without external shield)

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

CHARACTERISTICS

Pentode section

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

Diode section

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

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER

Pentode connection

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

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

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

***Grid resistor of following valve.

DAF96

DIODE A.F. PENTODE

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER

Triode connection (g_2 to a)

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

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

**Grid resistor of following valve.

LIMITING VALUES

Pentode section

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

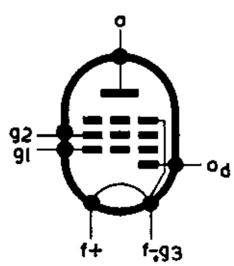
This valve can be used without special precautions against microphony in circuits in which the input voltage, V_{in} , is not less than 20mV for an output of 50mW from the output stage.

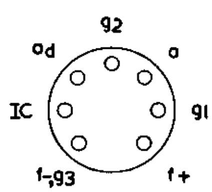
Diode section

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

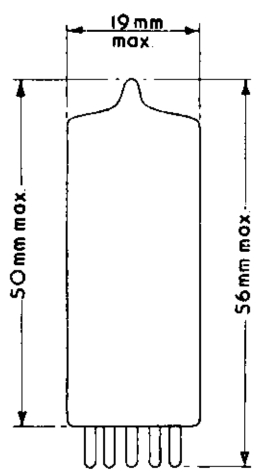
DIODE A.F. PENTODE

DAF96





B7G Base



2375

MINIATURE DOUBLE TRIODE

DCC90

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

FILAMENT

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	pF
c_{g-f} (each section)	0.9	pF
c_{a-f} (each section)	1.0	pF
c_{a-g} (each section)	3.2	pF

CHARACTERISTICS (each section)

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

DCC90

MINIATURE DOUBLE TRIODE

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

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

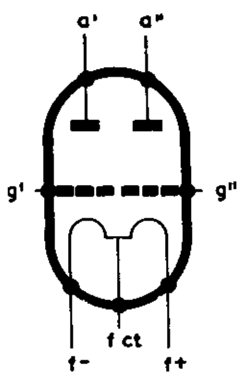
V_a	135	V
*V_g	−20	V
R_{g-f}	4.0	kΩ
R_k	570	Ω
$v_{in(pk)}$	2×45	mA
I_a	2×15	mA
I_g (approx.)	2×2.5	mV
p_g (approx.)	200	kW
P_{out} (approx.)	2.0	W

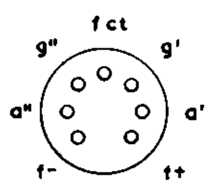
* Obtained from fixed supply, or by means of cathode or grid resistor of valve shown.

LIMITING VALUES (Intermittent operation)

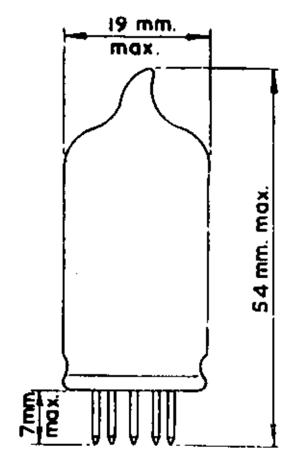
V_a max.	135	V
V_g max.	−30	V
I_a max.	2×15	mA
I_g max.	2×2.5	mA
p_a max.	2×1.0	W

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





B7G BASE



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} ($g_m = 10\mu A/V$)	−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

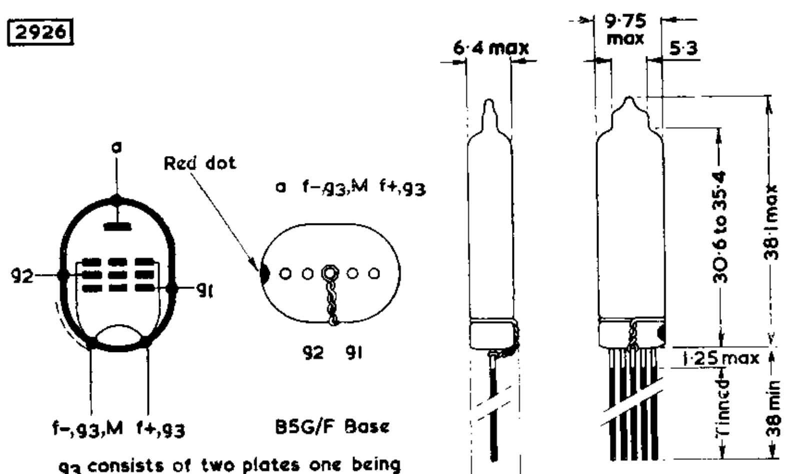
SUBMINIATURE R.F. PENTODE

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
$V_{g1}I(_{g1}=+0.3\mu A)$		>0	V

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

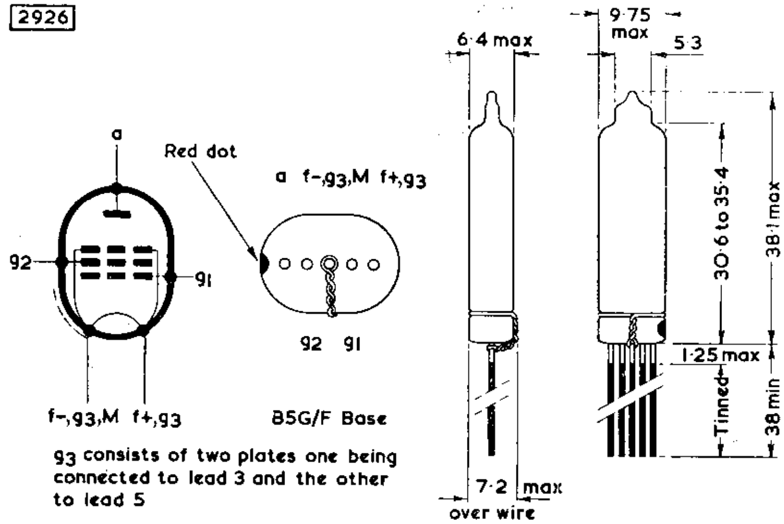
V_a max.	90	V
$V_{g2(b)}$ max.	90	V
V_{g2} max.	67.5	V
I_k max.	2.5	mA

DF61

SUBMINIATURE
R.F. PENTODE

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

2926



All dimensions in mm

SUBMINIATURE R.F. PENTODE

DF62

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

FILAMENT

Suitable for d.c. operation only

V_f	1.25	V
I_f	100	mA

CAPACITANCES

c_{a-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
$V_{g1}(I_{g1}=+0.5\mu A)$	−0.5	V

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

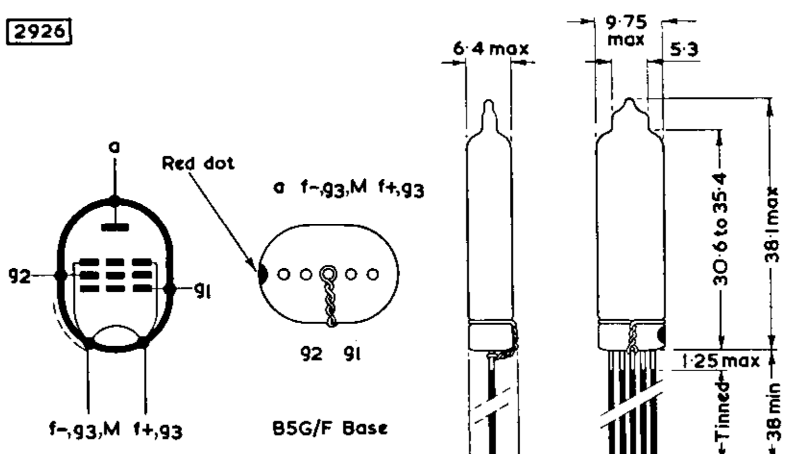
V_a max.	90	V
V_{g2} max.	90	V
I_k max.	6.5	mA

DF62

SUBMINIATURE
R.F. PENTODE

Subminiature sharp cut-off r.f. Pentode for use in 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 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

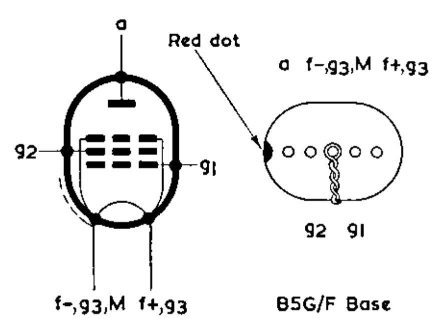
V_a max.	90	V
$V_{g2(b)}$ max.	90	V
V_{g2} max.	67.5	V
I_k max.	2.5	mA

DF63

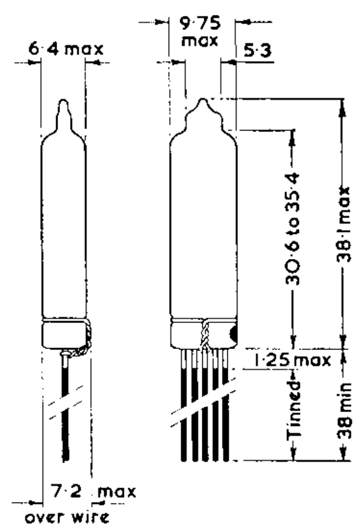
SUBMINIATURE VARIABLE-MU R.F. PENTODE

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

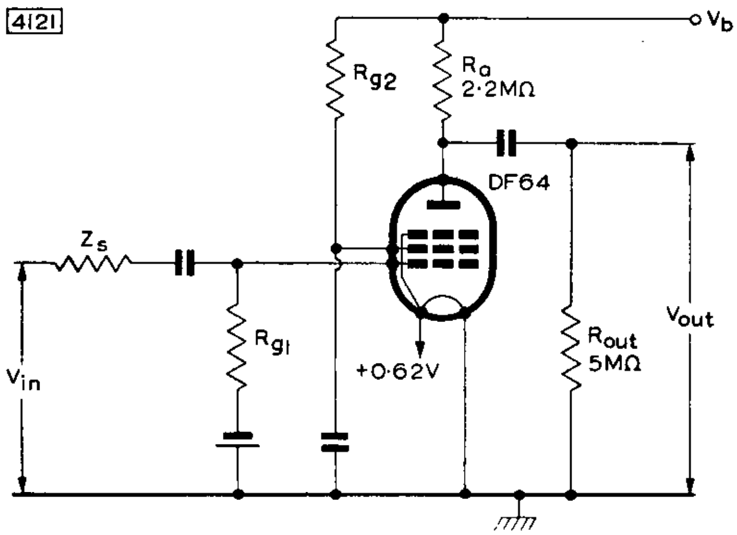
V_a max.	45	V
V_{g2} max.	45	V
I_k max.	75	μA

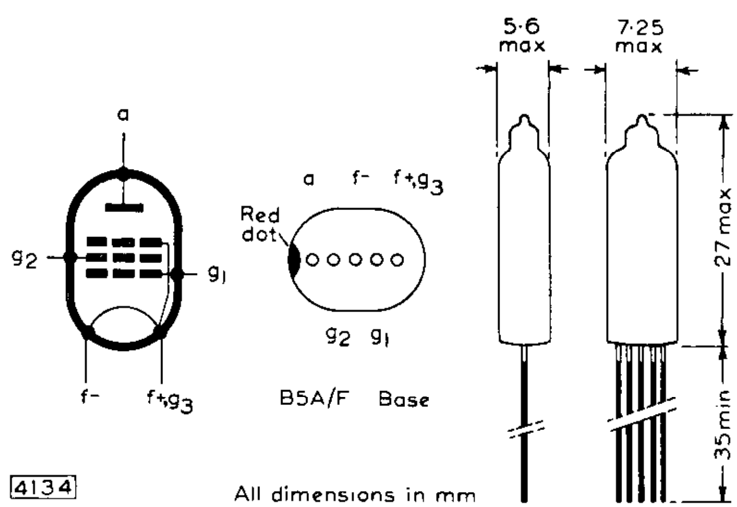
DF64

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	$\mu\mu F$
c_{in}	1.6	$\mu\mu F$
c_{out}	2.2	$\mu\mu F$

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	$\mu A/V$
r_a	>2.0	$M\Omega$
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	$M\Omega$
R_{g2}	2.0	$M\Omega$
V_{g1}	−0.625	V
I_k	16	μA
V_{out}/V_{in}	33	
R_{out}	5.0	$M\Omega$

(*b*) With grid current biasing

V_b	22.5	V
R_a	1.0	$M\Omega$
R_{g2}	2.7	$M\Omega$
R_{g1}	10	$M\Omega$
Z_s	0	
I_k	16	μA
V_{out}/V_{in}	35	
R_{out}	5.0	$M\Omega$

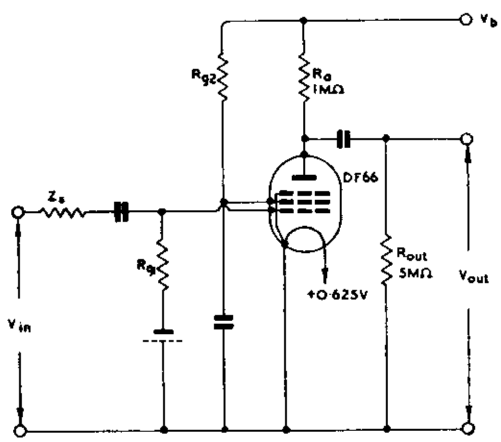
LIMITING VALUES

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

DF66

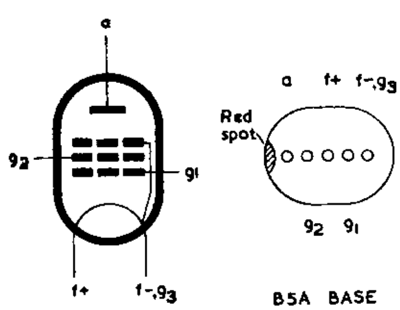
SUBMINIATURE A.F. VOLTAGE AMPLIFYING PENTODE

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

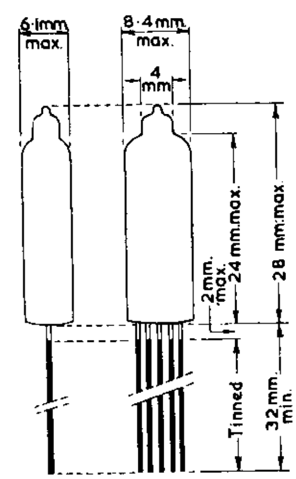


472

Circuit of DF66 as Resistance Coupled A.F. Amplifier



458



MINIATURE VARIABLE-MU R.F. PENTODE

DF91

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

FILAMENT

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

V_f	1.4	V
I_f	0.05	A

CAPACITANCES

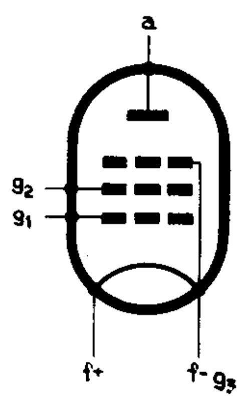
c_{a-g1}	<0.01	μμF
c_{in}	3.6	μμF
c_{out}	7.5	μμF

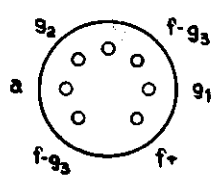
OPERATING CONDITIONS AS R.F. OR I.F. AMPLIFIER

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

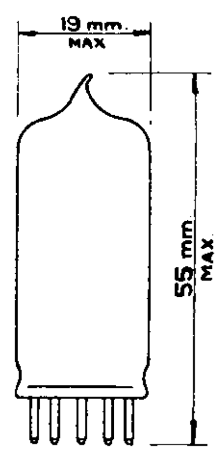
LIMITING VALUES

V_a max.	90	V
$V_{g2(b)}$ max.	90	V
V_{g2} max.	67.5	V
V_{g1} max.	0	V
I_k max.	5.5	mA





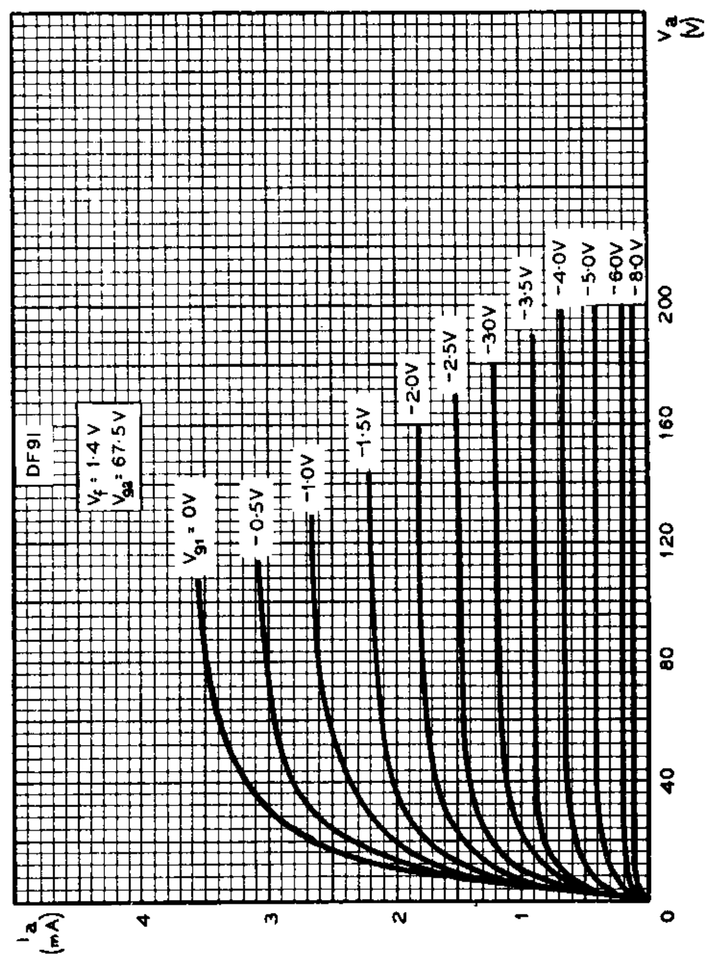
B7G BASE



DF91

MINIATURE VARIABLE-MU R.F. PENTODE

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



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

MINIATURE I.F. PENTODE

DF96

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

FILAMENT

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

	Series	Parallel	
V_f	1.3	1.4	V
I_f	24	25	mA

CAPACITANCES

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

OPERATING CONDITIONS AS I.F. AMPLIFIER

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

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

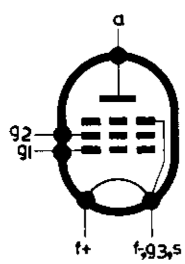
LIMITING VALUES

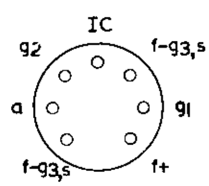
V_b max. (absolute)	110	V
V_a max.	90	V
p_a max.	250	mW
V_{g2} max.	90	V
p_{g2} max.	100	mW
I_k max.	2.2	mA
R_{g1-k} max.	3.0	MΩ
V_{g1} max. ($I_{g1}=+0.3\mu A$)	0	V

DF96

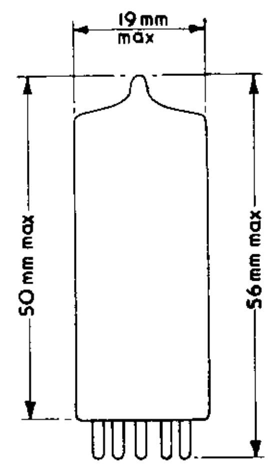
MINIATURE I.F. PENTODE

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





B7G Base



2380

MINIATURE HEPTODE FREQUENCY CHANGER

DK91

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

FILAMENT

Suitable for d.c. operation only.

V_f	1.4	V
I_f	50	mA

CAPACITANCES

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

OPERATING CONDITIONS

V_a	45	67.5	90	90	V
V_{g2+g4}	45	67.5	45	67.5	V
V_{g3}	0	0	0	0	V
R_{g1}	100	100	100	100	kΩ
r_a	600	500	800	600	kΩ
g_c	235	280	250	300	μA/V
V_{g3} (g_c=5 μA/V)	−9	−14	−9	−14	V
I_a	0.7	1.4	0.8	1.6	mA
I_{g2+g4}	1.9	3.2	1.9	3.2	mA
I_{g1}	150	250	150	250	μA
I_k	2.75	5.0	2.75	5.0	mA

OSCILLATOR SECTION

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

LIMITING VALUES

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

DK91

MINIATURE HEPTODE FREQUENCY CHANGER

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

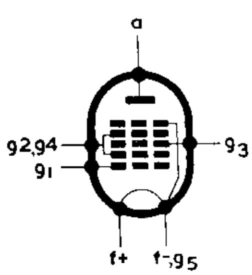
In these circuits—

C designates a decoupling capacitor.

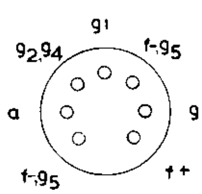
L_C is a filament choke of 12μH inductance and with a d.c. resistance of less than 0.5Ω.

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 18.7Mc/s and having an intermediate frequency of 465kc/s the booster circuit should resonate at 4.75Mc/s. Suitable values are: C=100pF, L_B=11μH.

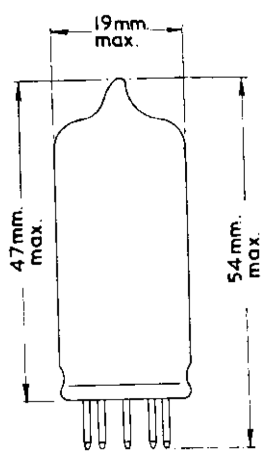
L_D is the short wave coil and should have a Q of approximately 115 at 6.5Mc/s.



533



B7G BASE

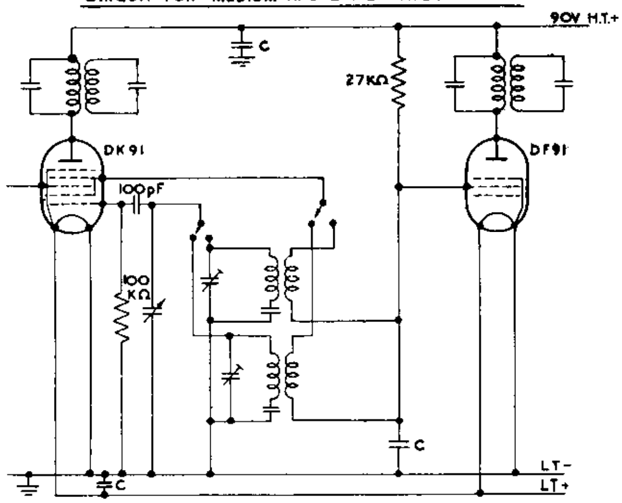


MINIATURE HEPTODE FREQUENCY CHANGER

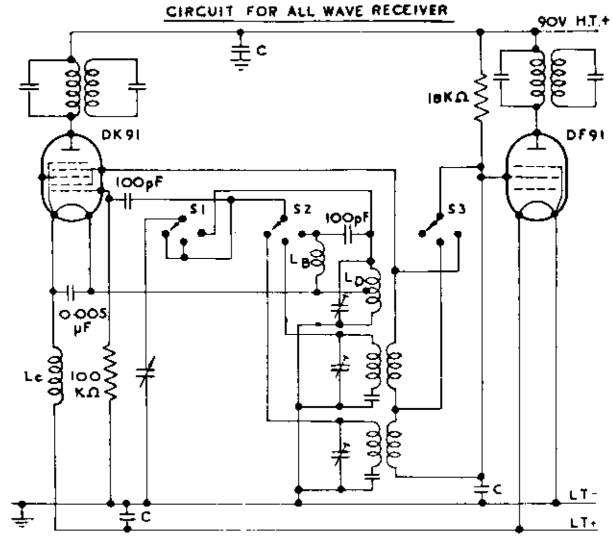
DK91

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

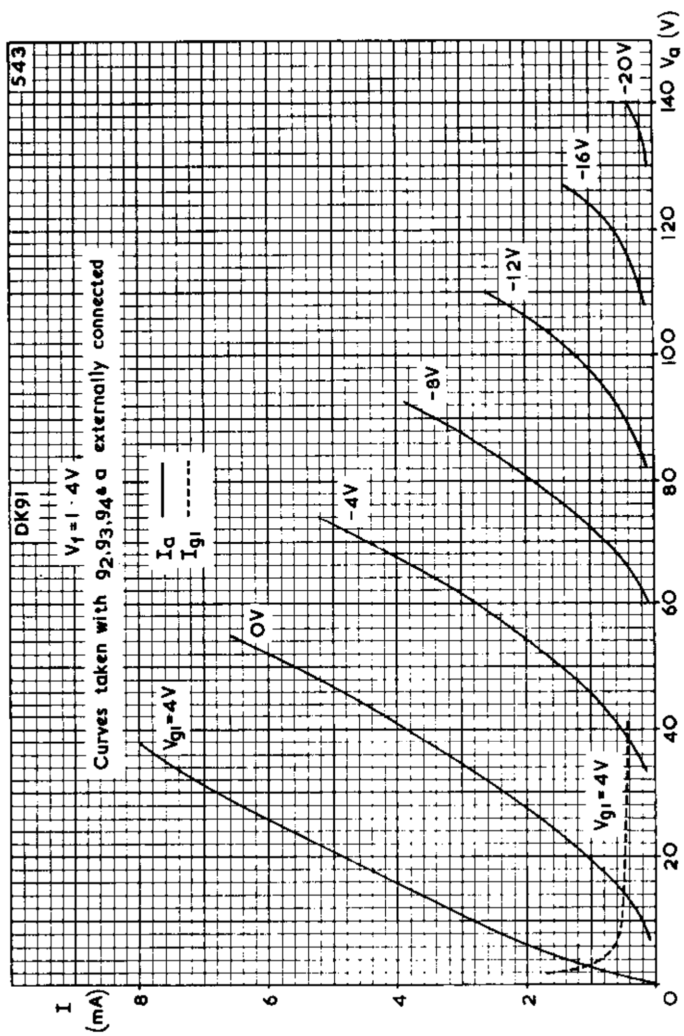


063

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

MINIATURE HEPTODE FREQUENCY CHANGER

DK96

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

FILAMENT

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

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

CAPACITANCES

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

TYPICAL OPERATING CONDITIONS

*$V_a = V_b$	64	85	V
V_{g3}	0	0	V
R_{g4}	0	120	kΩ
R_{g2}	18	33	kΩ
R_{g1-f+}	27	27	kΩ
V_{g4}(approx.)	64	68	V
V_{g2}(approx.)	35	35	V
$V_{g1(r.m.s.)}$	4.0	4.0	V
I_k	2.45	2.4	mA
I_a	550	600	μA
I_{g4}	120	140	μA
I_{g2}	1.6	1.5	mA
I_{g1}	85	85	μA
g_c	275	300	μA/V
r_a	750	800	kΩ
V_{g3} (for 100 : 1 reduction in g_c)	–4.5	–6.5	V

OSCILLATOR SECTION (With g_1 connected to f+)

$V_a = V_b$	64	85	V
V_{g4}	64	64	V
V_{g3}	0	0	V
V_{g2}	35	35	V
V_{g1}	+1.4	+1.4	V
I_{g2}	1.7	1.7	mA
$g_{m(g1-g2)}$	600	600	μA/V
μ_{g1-g2}	7.5	7.5	

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

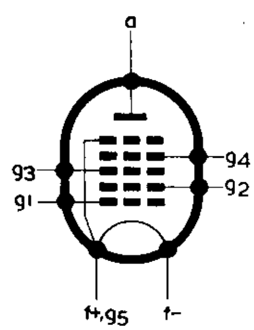
DK96

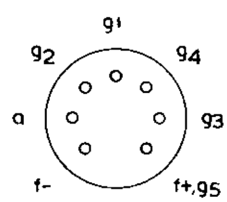
MINIATURE HEPTODE FREQUENCY CHANGER

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

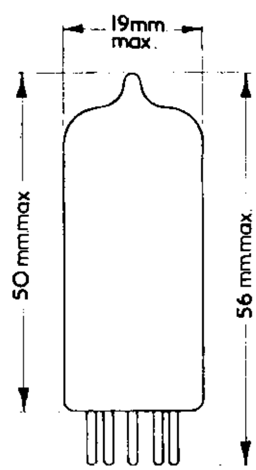
LIMITING VALUES

V_b max. (absolute)	110	V
V_b max.	90	V
V_a max.	90	V
p_a max.	150	mW
V_{g2} max.	60	V
p_{g2} max.	100	mW
V_{g4} max.	90	V
p_{g4}	30	mW
I_k max.	2.6	mA
R_{g3-f} max	3.0	MΩ
R_{g1-f} max.	100	kΩ
V_{g3} max. ($I_{g3}=+0.3\mu A$)	+1.0	V
V_{g1} max. ($I_{g1}=+0.3\mu A$)	0	V





B7G Base



2389

MINIATURE OUTPUT PENTODE

DL94

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

FILAMENT

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

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

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

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

	Series	*Parallel*	*Single-Section*	
V_f	2.8	1.4	1.4	V
I_f	50	100	50	mA

MOUNTING POSITION Any

CAPACITANCES (Measured without external screening)

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

CHARACTERISTICS

	Filament Connection *Series*	*Parallel*	
V_a	90	90	V
V_{g2}	90	90	V
V_{g1}	−4.5	−4.5	V
I_a	7.7	9.5	mA
I_{g2}	1.7	2.1	mA
g_m	2.0	2.15	mA/V
μ_{g1-g2}	7.5	7.5	
r_a	120	100	kΩ

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER

Series filament connection.

V_a	90	V
V_{g2}	90	V
V_{g1}	−4.5	V
$I_{a(0)}$	7.7	mA
$I_{g2(0)}$	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
$I_{a(0)}$	6.9	9.5	mA
$I_{g2(0)}$	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

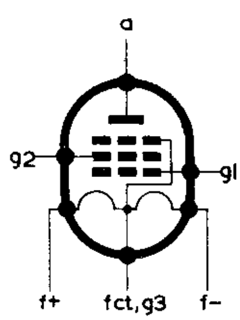
V_a max.	90	V
p_a max.	1	W
V_{g2} max.	90	V
p_{g2} max.	0.3	W
*I_k max.	12	mA
R_{g1-f} max.	1.0	MΩ

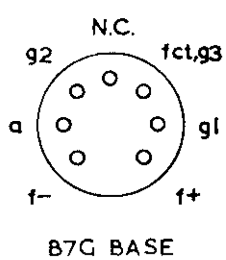
*I_k max. for each 1.4-volt section of filament is 6mA.

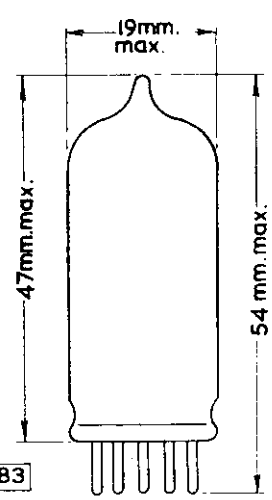
MINIATURE OUTPUT PENTODE

DL94

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





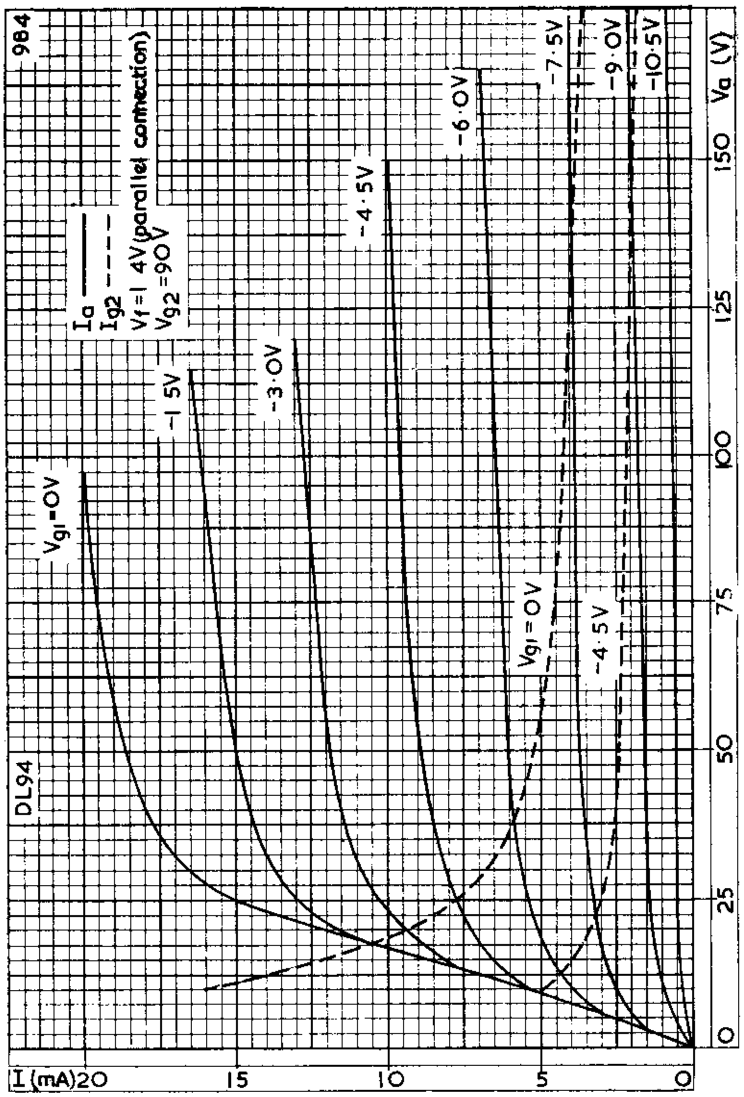


983

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.

OUTPUT PENTODE DL96

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

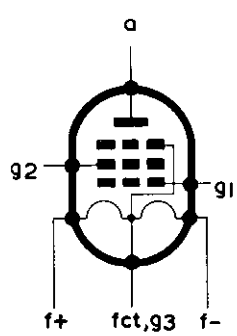
All filament sections in parallel

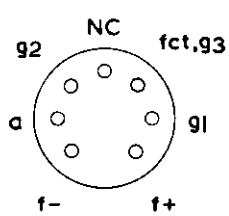
V_b	67.5	90	V
V_a	61.5	81.5	V
V_{g2}	61.5	81.5	V
V_{g1}	−5.8	−8.5	V
$I_{a(o)}$	2×0.75	2×1.0	mA
I_a (max. sig.)	2×3.4	2×5.0	mA
$I_{g2(o)}$	2×140	2×180	μA
I_{g2} (max. sig.)	2×0.95	2×1.3	mA
$R_{a\ a}$	20	16	kΩ
$V_{in(g1-g1)r.m.s.}$	11.4	15.8	V
P_{out}	220	440	mW
D_{tot}	3.0	2.6	%

LIMITING VALUES

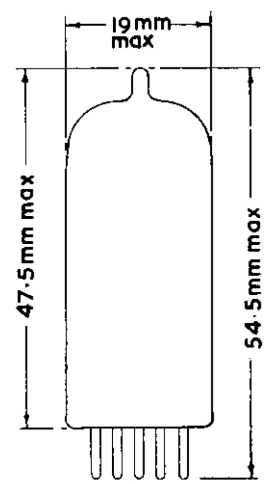
V_b max. (absolute)	110	V
V_b max.	90	V
V_a max.	90	V
p_a max.	600	mW
V_{g2} max.	90	V
p_{g2} max.	200	mW
*I_k max. (parallel filament connection)	6.0	mA
R_{g1-f} max.	2.0	MΩ

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





B7G Base



3373

SPECIAL QUALITY DOUBLE TRIODE E80CC

Special quality double triode having separate cathodes, for use in industrial equipment where stability of characteristics and long life are required.

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

HEATER

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

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

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

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

MOUNTING POSITION — Any

CAPACITANCES[2]

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

*Each section

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

E80CC SPECIAL QUALITY DOUBLE TRIODE

CHARACTERISTICS[3] (each section)

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

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

I_a	≦4.3	mA
g_m	≦1.8	mA/V
$-I_g$	≧1.0	μA

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

With cathode bias

V_b (V)	R_a (kΩ)	I_a (mA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	V_{out}* ($V_{r.m.s.}$)	D_{tot}* (%)	R_{g1}† (kΩ)
400	47	4.4	1.2	18.5	60	4.2	150
350	47	3.8	1.2	18.5	50	4.1	150
300	47	3.15	1.2	18.5	40	4.0	150
250	47	2.45	1.2	18.5	30	3.8	150
200	47	1.86	1.2	18.5	20	3.3	150
400	100	2.3	2.2	20	63	3.7	330
350	100	1.95	2.2	20	52	3.6	330
300	100	1.65	2.2	20	42	3.5	330
250	100	1.3	2.2	20	32	3.4	330
200	100	1.0	2.2	20	22	3.1	330
400	220	1.15	3.9	21	58	3.2	680
350	220	0.99	3.9	21	47	3.1	680
300	220	0.83	3.9	21	38	3.0	680
250	220	0.67	3.9	21	29	2.6	680
200	220	0.52	3.9	21	19	2.3	680

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

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

SPECIAL QUALITY DOUBLE TRIODE **E80CC**

BALANCE AND CUT-OFF CHARACTERISTICS

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

INSULATION

Between heater and cathode

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

LIMITING VALUES[4] (each section)

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

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

SHOCK AND VIBRATION RATINGS

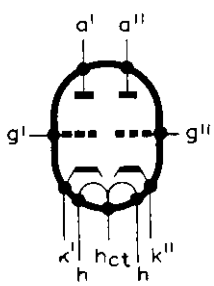
The E80CC can withstand vibrations of 2.5g and 50c/s for 96 hours and is proof against impact accelerations of approximately 450g.

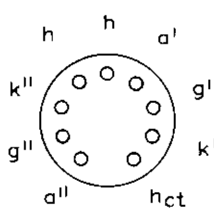
OPERATING NOTES

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

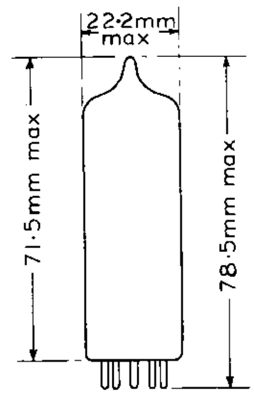
E80CC SPECIAL QUALITY DOUBLE TRIODE

5110





B9A Base



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

SPECIAL QUALITY A.F. AMPLIFYING PENTODE

E80F

Special quality a.f. amplifying pentode for use in general industrial applications where stability of characteristics and long life are required.

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

HEATER

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

V_h[1]	6.3	V
I_h	300	mA

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

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

MOUNTING POSITION Any

CAPACITANCES[2] (measured with an external shield)

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

CHARACTERISTICS[3]

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

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

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

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

E80F

SPECIAL QUALITY A.F. AMPLIFYING PENTODE

OPERATING CONDITIONS

As r.c. coupled a.f. amplifier

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

*Grid resistor of following valve.

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

As an electrometer pentode

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

INSULATION

Between heater and cathode

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

SHOCK AND VIBRATION RATINGS

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

LIMITING VALUES[4] (absolute ratings)

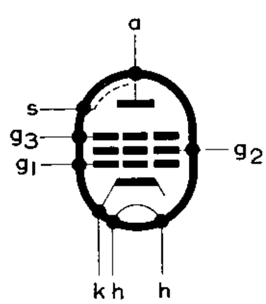
$V_{a(b)}$ max.	600	V
V_a max.	300	V
p_a max.	1.3	W
$V_{g2(b)}$ max.	600	V
V_{g2} max.	200	V
p_{g2} max.	400	mW
$-V_{g3}$ max.	100	V
$-V_{g1}$ max.	100	V
I_k max.	9.0	mA
R_{g1-k} max.	See page C7	
V_{h-k} max. (cathode positive)	120	V
V_{h-k} max. (cathode negative)	60	V
R_{h-k} max.	20	kΩ
T_{bulb} max.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

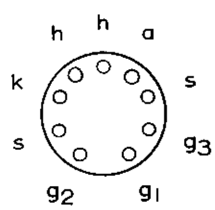
SPECIAL QUALITY A.F. AMPLIFYING PENTODE

E80F

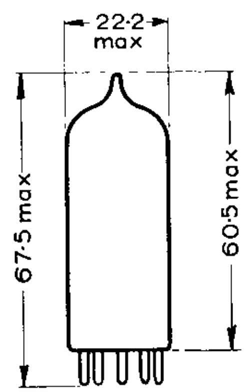
OPERATING NOTE

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





B9A Base



4747

All dimensions in mm

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

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SPECIAL QUALITY OUTPUT PENTODE

E80L

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

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

HEATER

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

V_h[1]	6.3	V
I_h	700	mA

The maximum variation of heater current at $V_h = 6.3$V is ± 35mA. In order to achieve a useful valve life with the heater in a series connected chain, the absolute maximum variation of heater current due to voltage fluctuations and component tolerances should be $< \pm 1.5\%$.

MOUNTING POSITION

Any

CAPACITANCES[2]

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

CHARACTERISTICS[3]

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

E80L SPECIAL QUALITY OUTPUT PENTODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

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

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

OPERATING CONDITIONS AS SINGLE VALVE CLASS 'A' AMPLIFIER

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

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

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

INSULATION

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

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

ABSOLUTE MAXIMUM RATINGS

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

SHOCK AND VIBRATION

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

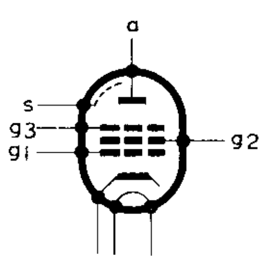
E80L SPECIAL QUALITY OUTPUT PENTODE

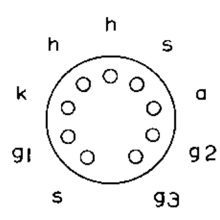
OPERATING NOTES

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

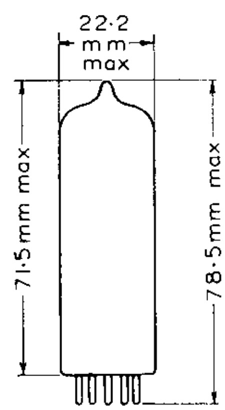
V_{a-k}	200	V
V_{g2-k}	200	V
R_a	1.0	kΩ
R_k	130	Ω

5263





B9A Base



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

SPECIAL QUALITY 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 <±1.5%.

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

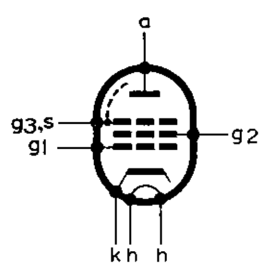
OPERATING NOTES

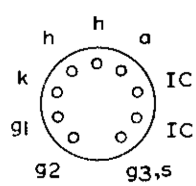
The hum voltage referred to g_1 has a maximum value of 500μV(r.m.s.) with a grid leak of 500kΩ.

SPECIAL QUALITY
HIGH SLOPE PENTODE

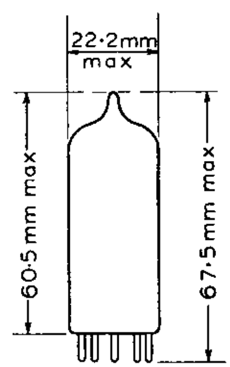
E83F

5167





B9A Base



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

SPECIAL QUALITY DOUBLE TRIODE

E90CC

Special quality double triode with common cathode for use in computers where stability of characteristics and long life are required.

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

HEATER

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

V_h[1]	6.3	V
I_h	400	mA

The maximum variation of heater current at $V_h = 6.3V$ is $\pm 20mA$. In order to achieve a useful valve life with the heater in a series connected chain the absolute maximum variation of heater current due to voltage fluctuations and component tolerances should be $< \pm 1.5\%$.

CAPACITANCES[2] (measured without an external shield)

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

*Each section

CHARACTERISTICS[3] (each section)

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

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

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

INSULATION

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

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

SPECIAL QUALITY DOUBLE TRIODE

E90CC

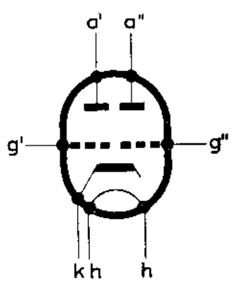
LIMITING VALUES[4] (absolute ratings) each section

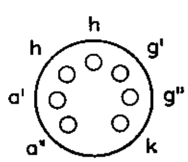
$V_{a(b)}$ max.	600	V
V_a max.	300	V
p_a max.	2.0	W
I_k max.	15	mA
$*i_{k(pk)}$ max.	75	mA
$-V_g$ max.	100	V
$*-v_{g(pk)}$ max.	200	V
$+V_g$ max.	0	V
I_g max.	250	µA
$*i_{g(pk)}$ max.	1.0	mA
R_{g-k} max. (cathode bias)	1.0	MΩ
R_{g-k} max. (fixed bias)	500	kΩ
V_{h-k} max.	100	V
T_{bulb} max.	170	°C

*Max. averaging time = 10ms.

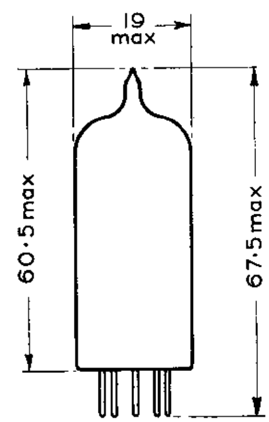
OPERATING NOTES

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





B7G Base



5770

All dimensions in mm

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

SPECIAL QUALITY DOUBLE TRIODE

E92CC

Special quality double triode for use in computers where stability of characteristics and long life are required.

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

HEATER

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

V_h[1]	6.3	V
I_h	400	mA

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

MOUNTING POSITION

Any

CAPACITANCES[2]

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

*Each section

CHARACTERISTICS[3] (each section)

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

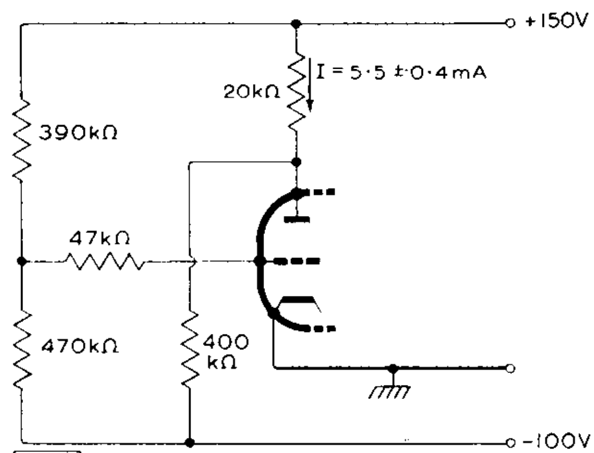


Fig.1

E92CC SPECIAL QUALITY DOUBLE TRIODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Average	*Initial range*	*End of life**	
I_a (V_a = 150V, V_g = −1.7V)	8.5	4.5 to 12.5	—	mA
g_m (V_{a-k} = 150V, R_k = 200Ω)	6.0	4.5 to 7.5	—	mA/V
I_a (V_b = 150V, V_g = −10V, R_a = 20kΩ, R_g = 47kΩ)	—	<100	100	μA
$V_{g'} \sim V_{g''}$ (V_b = 150V, I_a = 100μA, R_a = 20kΩ, R_g = 47kΩ)	—	<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_{hm} = 1.0MΩ	<15	30	μA
Insulation between any two arbitrary electrodes	>100 [redacted]	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 end of life values.

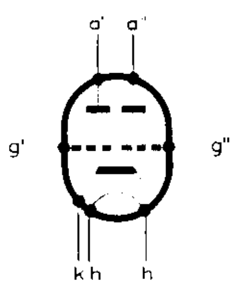
LIMITING VALUES[1] (absolute ratings) each section

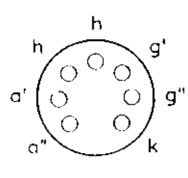
$V_{a(b)}$ max.	600	V
V_a max.	300	V
p_a max.	2.0	W
$+V_g$ max.	500	mV
$-V_g$ max.	100	V
†$-v_{g(pk)}$ max.	200	V
I_k max.	15	mA
†$i_{k(pk)}$ max.	75	mA
I_g max.	250	μA
†$i_{g(pk)}$ max.	1.0	mA
R_{g-k} max. (self bias)	1.0	MΩ
R_{g-k} max. (fixed bias)	500	kΩ
V_{h-k} max.	100	V
T_{bulb} max.	170	°C

†Maximum duration = 10ms

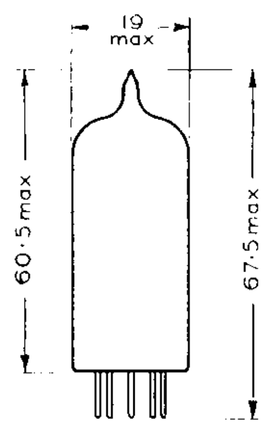
OPERATING NOTE

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





B7G Base



5770

All dimensions in mm

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

SPECIAL QUALITY OUTPUT PENTODE

E130L

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

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

HEATER

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

V_h [1]	6.3	V
I_h	1.7	A

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

CAPACITANCES[2]

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

CHARACTERISTICS[3]

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

OPERATING CONDITIONS AS CLASS 'A' AMPLIFIER

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

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

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)[4]

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

SPECIAL QUALITY OUTPUT PENTODE

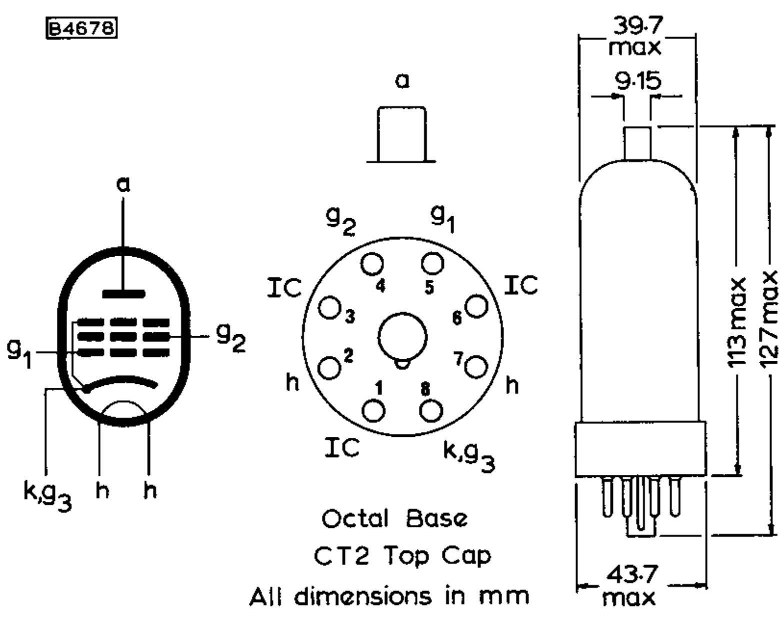
E130L

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

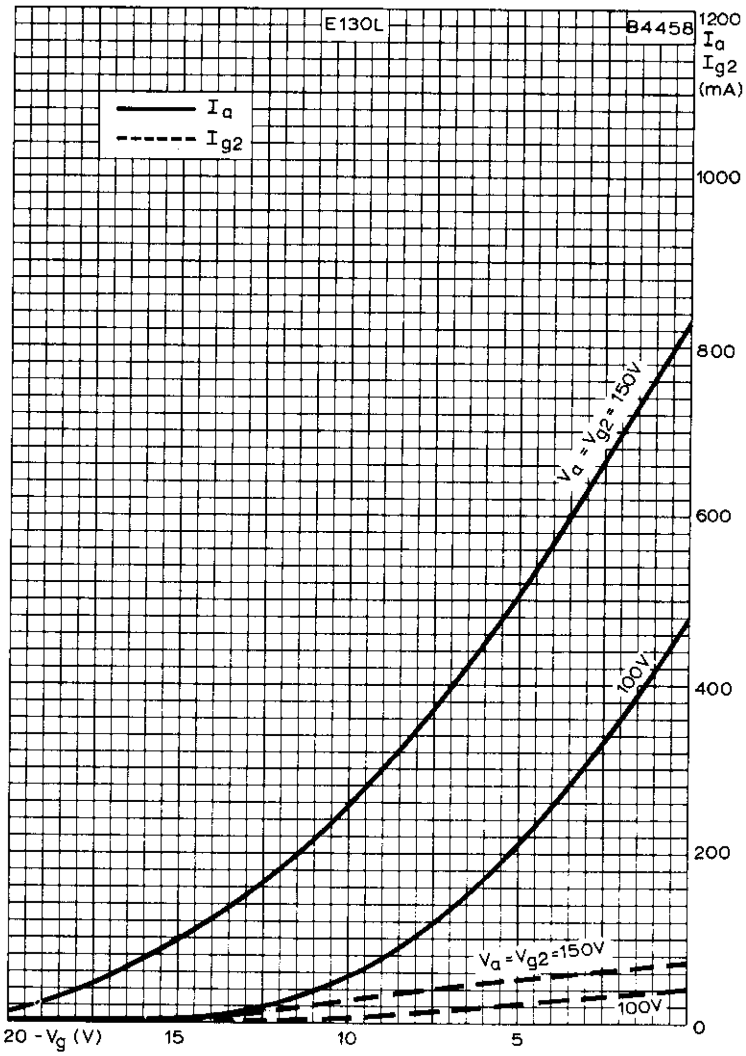
*Max. duration 4ms, I_k max. =150mA.

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

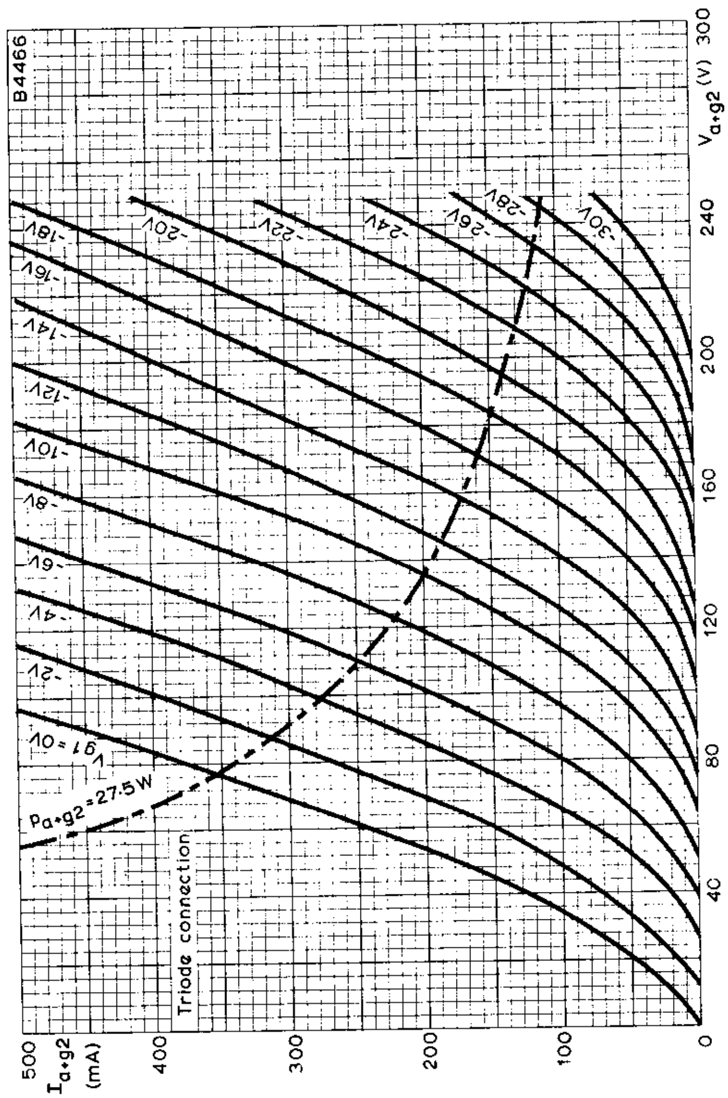
B4678



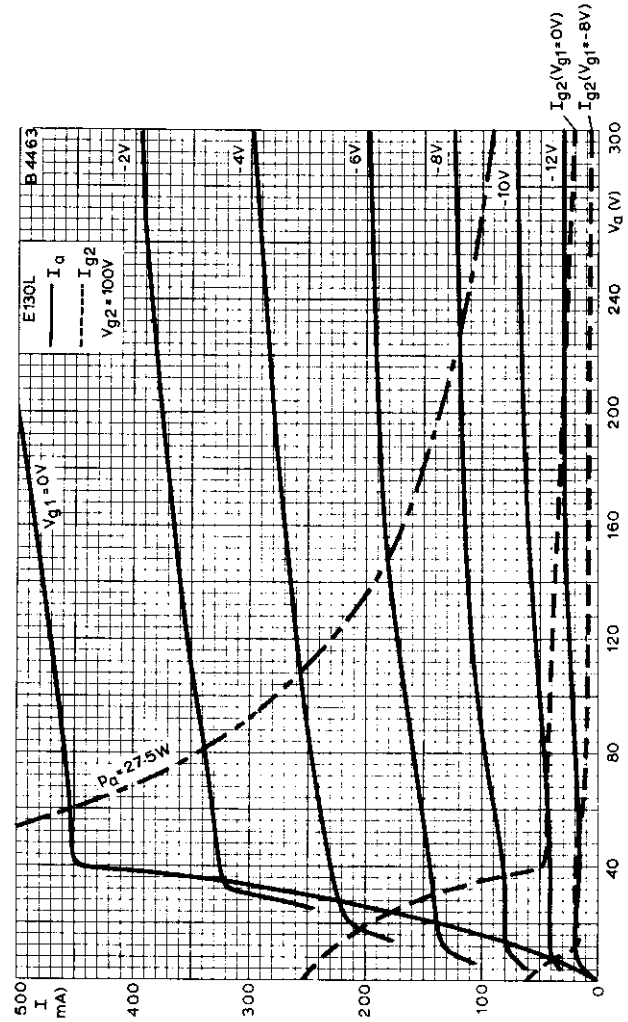
Octal Base
CT2 Top Cap
All dimensions in mm



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

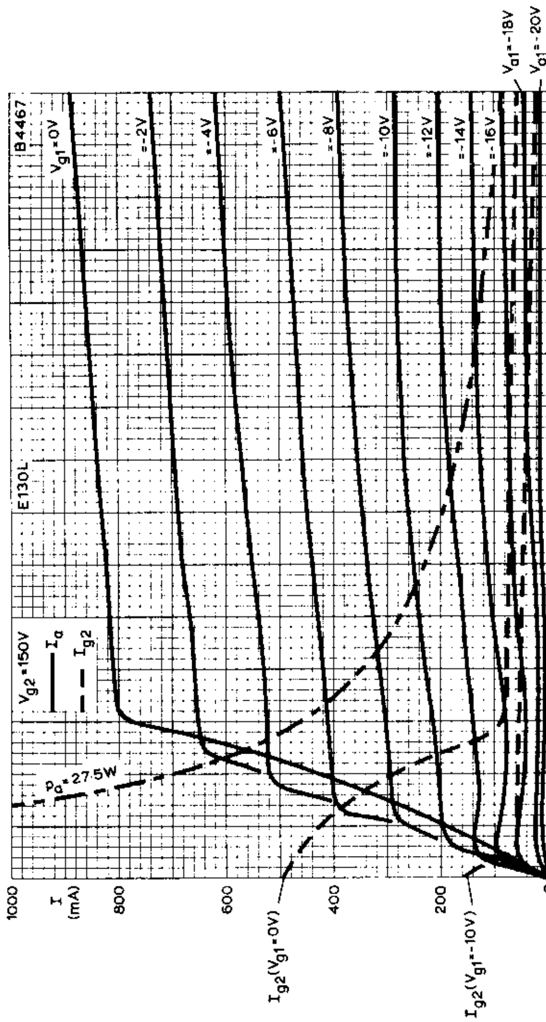


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE
WITH CONTROL-GRID VOLTAGE AS PARAMETER



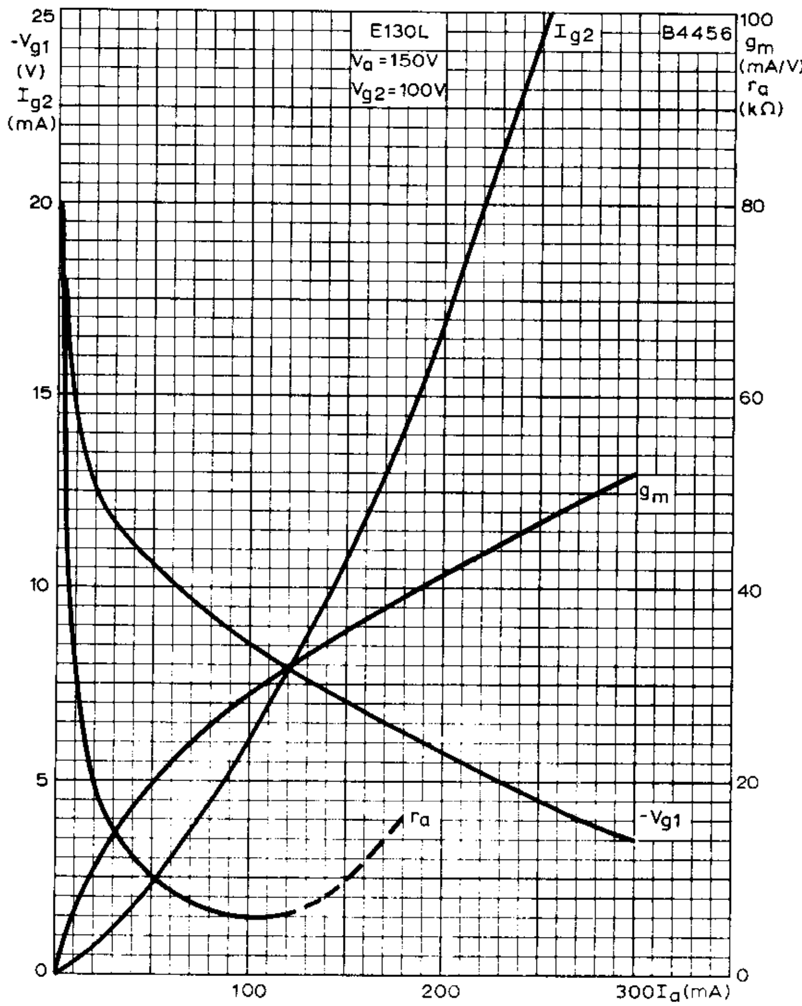
ANODE AND SCREEN CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

$V_{g2} = 100V$

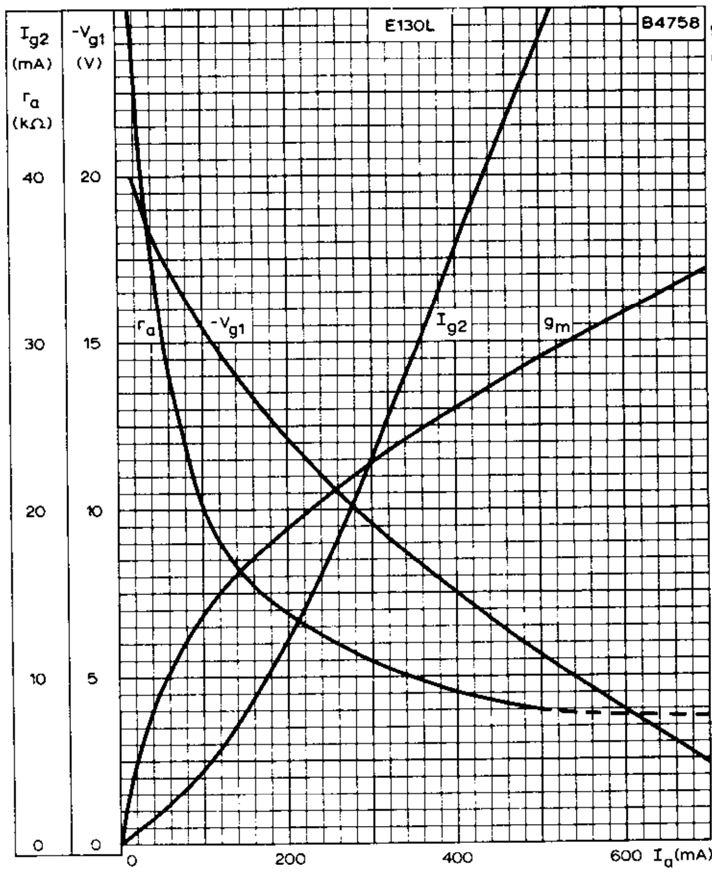


ANODE AND SCREEN CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER

$V_{g2} = 150V$



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



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

SPECIAL QUALITY DOUBLE TRIODE

E180CC

Special quality double triode, with separate cathodes, for use in computer circuits. This valve will maintain its emission capabilities after long periods of operation under cut-off conditions.

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

HEATER

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

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

	Series	*Parallel*	
V_h[1]	12.6	6.3	V
I_h	200	400	mA

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

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

CAPACITANCES[2] (measured without an external shield)

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

*Each section

CHARACTERISTICS[3] (each section)

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

E180CC SPECIAL QUALITY DOUBLE TRIODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

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

INSULATION

	Initial range	*End of life**	
Between heater and cathode measured at $V_{h-k} = 200V$ (cathode positive) $R_{lim} = 1.0M\Omega$			
Leakage current	<15	30	μA
Between any two electrodes measured at 275V	>100	20	MΩ

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

LIMITING VALUES[4] (absolute ratings) each section

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

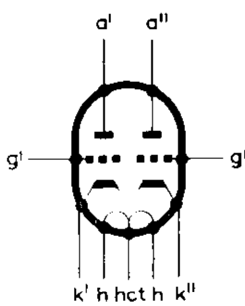
†Maximum duration = 10μs. Duty cycle = 1%

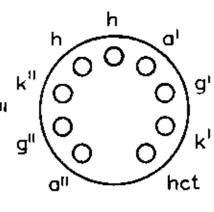
**In the interests of reliability, the bulb temperature should always be kept as low as possible.

SPECIAL QUALITY DOUBLE TRIODE E180CC

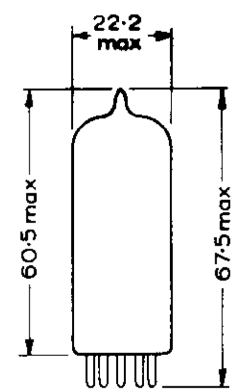
OPERATING NOTE

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





B9A Base



5033

All dimensions in mm

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

SPECIAL QUALITY DOUBLE TRIODE

E182CC

Special quality double triode for use in computer circuits. This valve will maintain its emission capabilities after long periods of operation under cut-off conditions.

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

HEATER

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

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

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

CAPACITANCES[2] (measured without an external shield)

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

*Each section

CHARACTERISTICS[3] (each section)

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

E182CC

SPECIAL QUALITY DOUBLE TRIODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

(each section)

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

INSULATION

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

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

LIMITING VALUES[4] (absolute ratings) each section

$V_{a(b)}$ max.	600	V
V_a max.	300	V
p_a max.	4.5	W
$p_{a'} + p_{a''}$ max.	8.0	W
$-V_g$ max.	100	V
$+V_g$ max.	1.0	V
*$-v_{g(pk)}$ max.	200	V
*$+v_{g(pk)}$ max.	30	V
I_g max.	8.0	mA
*$i_{g(pk)}$ max.	200	mA
I_k max.	60	mA
*$i_{k(pk)}$ max.	400	mA
R_{g-k} max. (fixed bias)	500	$k\Omega$
R_{g-k} max. (self bias)	1.0	$M\Omega$
V_{h-k} max.	120	V
$v_{h-k(pk)}$ max.	200	V
T_{bulb} max.	160	°C

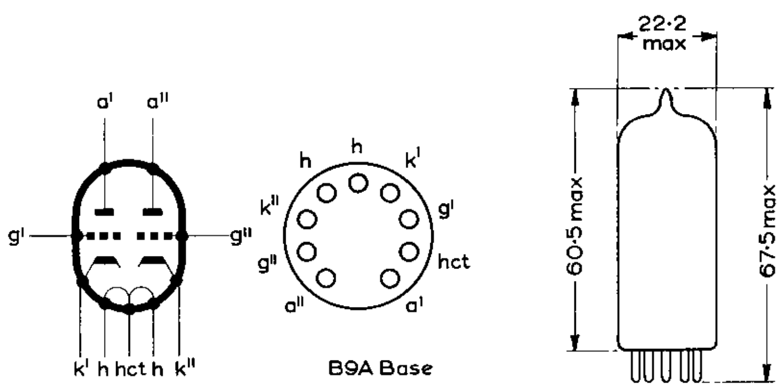
*Duty factor = 1%, max pulse duration = 10μs.

SPECIAL QUALITY
DOUBLE TRIODE

E182CC

OPERATING NOTE

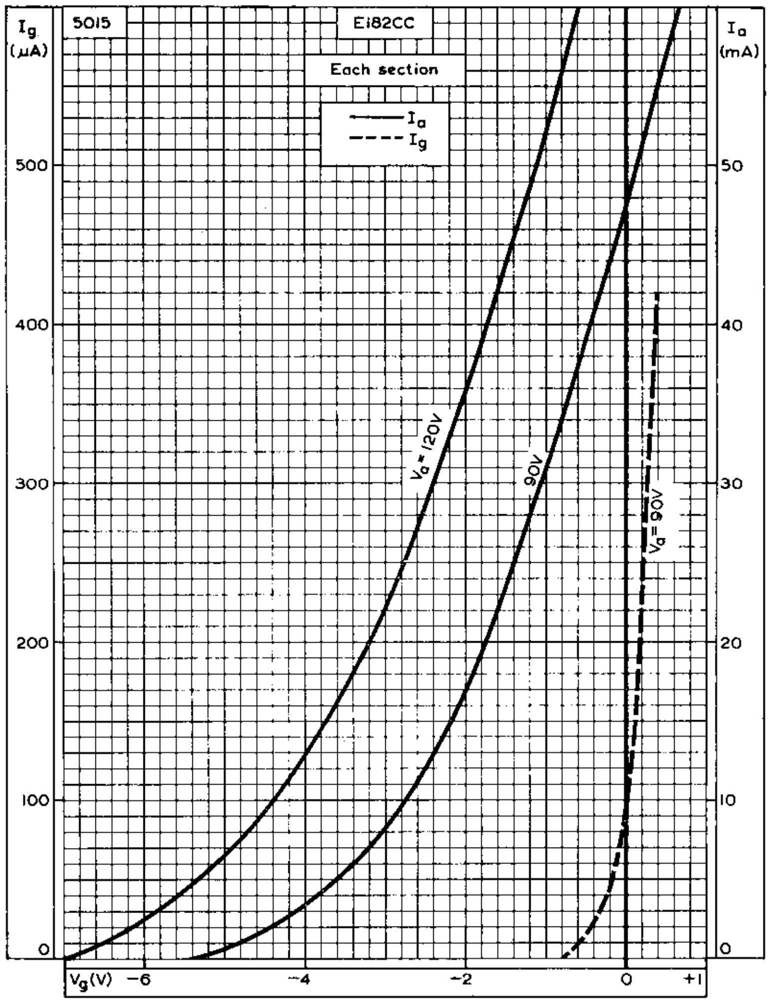
The E182CC is not intended for applications which are critical with regard to microphony or hum.



5032

All dimensions in mm

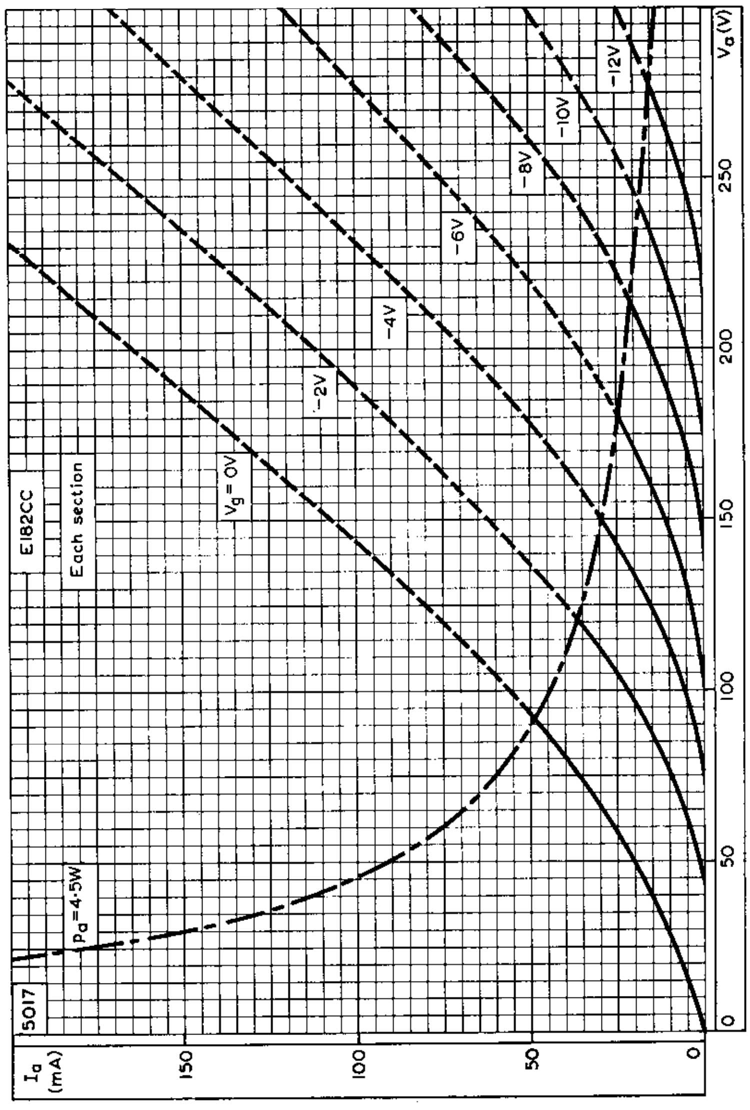
The bulb and base dimensions of this valve are in accordance with BS448, Section B9A.



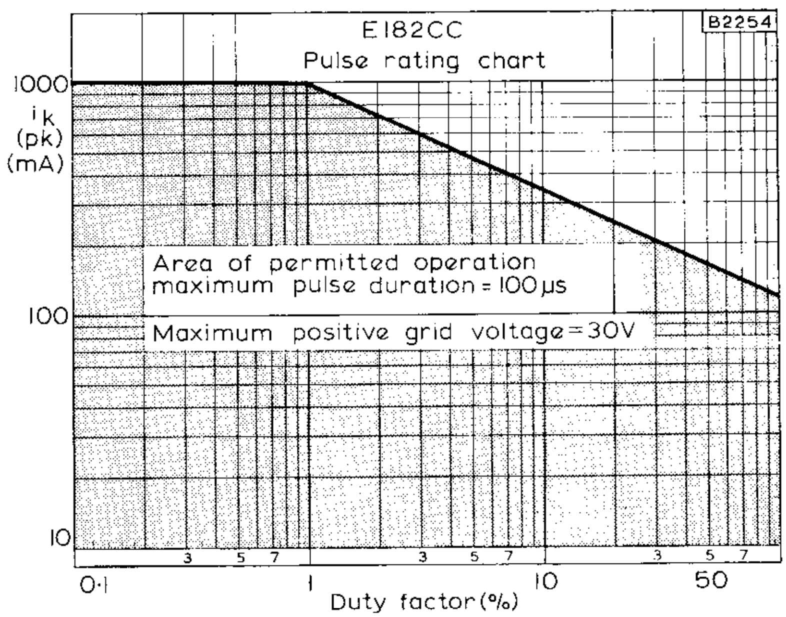
ANODE AND GRID CURRENTS PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER.

E182CC

SPECIAL QUALITY DOUBLE TRIODE



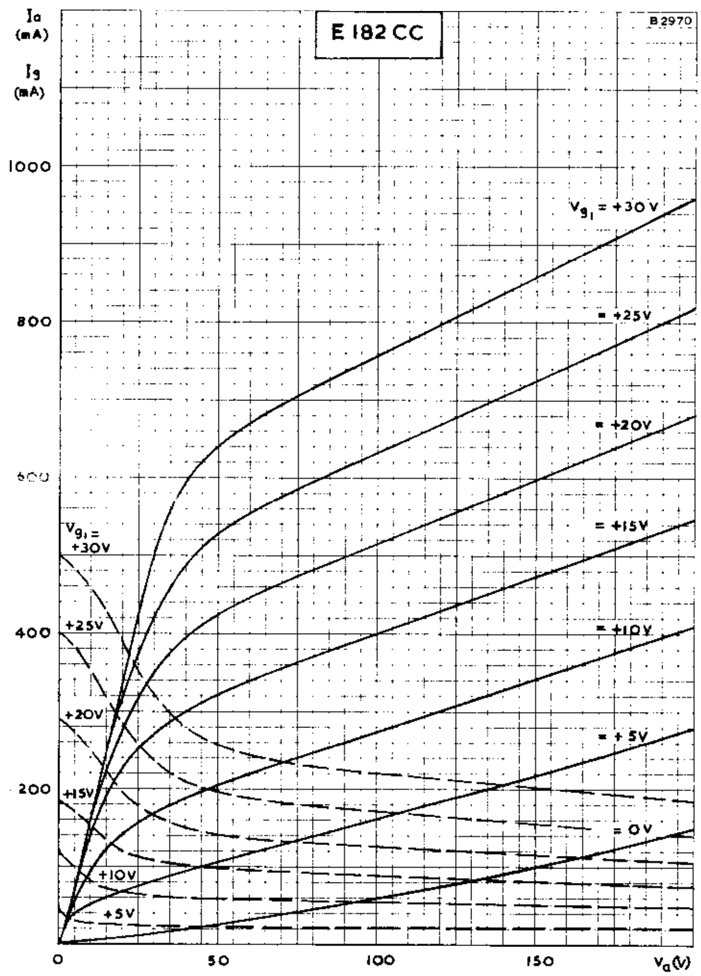
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER.



PULSE RATING CHART

E182CC

SPECIAL QUALITY
DOUBLE TRIODE



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

GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

SPECIAL QUALITY PENTODE

E186F

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

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

HEATER

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

V_h[1]	6.3	V
I_h	320	mA

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

CAPACITANCES[2] (shielded)

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

CHARACTERISTICS[3]

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

OPERATING CONDITIONS AS R.F. AMPLIFIER

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

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

E186F SPECIAL QUALITY PENTODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

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

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

SHOCK AND VIBRATION RATINGS

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

SPECIAL QUALITY PENTODE

E186F

ABSOLUTE MAXIMUM RATINGS[4]

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

OPERATING NOTES

1. Hum

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

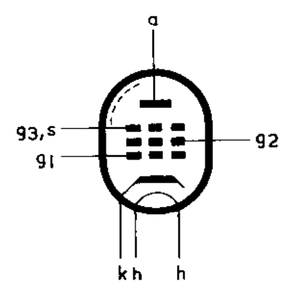
V_h	6.3	V
V_b	207	V
V_{g3}	0	V
V_{g2-e}	150	V
R_a	2.0	kΩ
R_k	78	Ω
C_k	1000	μF
R_{g1-k}	500	kΩ

2. Microphony

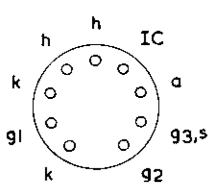
The microphonic noise voltage measured at the anode has a maximum value of 500mV over the frequency range 50 to 2000c/s and has a maximum value of 200mV at a frequency of 50c/s measured under the following conditions:

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

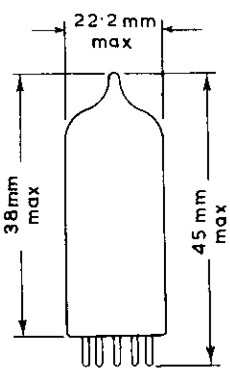
E186F SPECIAL QUALITY PENTODE



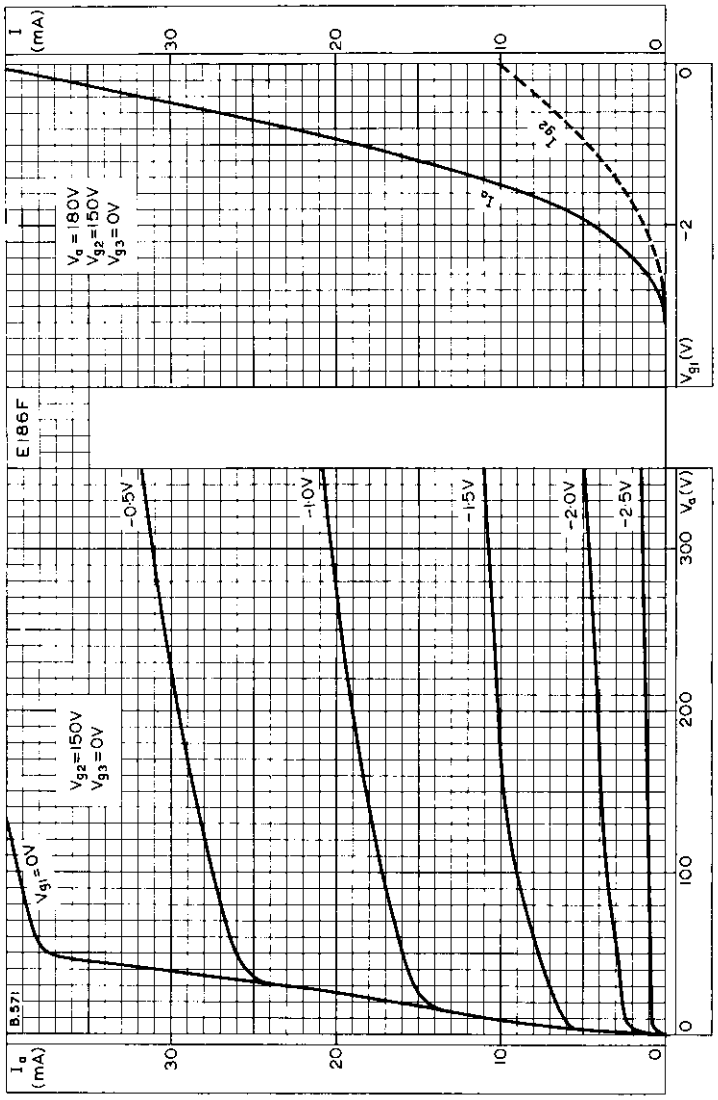
B562



B9A Base



SPECIAL QUALITY PENTODE **E186F**



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

SPECIAL QUALITY DOUBLE TRIODE

E188CC

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

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

HEATER

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

V_h[1]	6.3	V
I_h	335	mA

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

CAPACITANCES[2] (unshielded)

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

Grounded-grid operation

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

*each section

CHARACTERISTICS[3] (each section)

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

E188CC SPECIAL QUALITY DOUBLE TRIODE

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

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

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

OPERATING CONDITIONS AS ADDITIVE MIXER

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

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

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

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

SPECIAL QUALITY DOUBLE TRIODE E188CC

SHOCK AND VIBRATION

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

ABSOLUTE MAXIMUM RATINGS[4] (each section)

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

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

OPERATING NOTES

1. Hum

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

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

2. Microphony

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

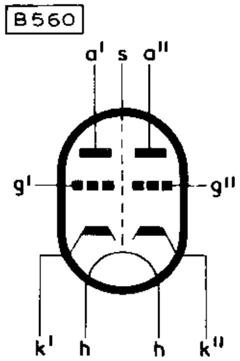
V_h	6.3	V
V_b	100	V
$V_{g(b)}$	+9.0	V
R_a	2.0	kΩ
R_k	680	Ω
C_k	1000	µF
Peak acceleration	2.5	g

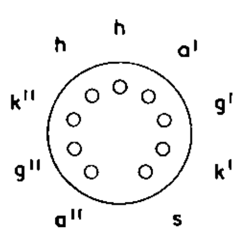
E188CC SPECIAL QUALITY DOUBLE TRIODE

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

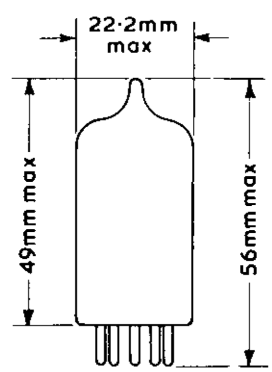
V_h	6.3	V
V_b	270	V
R_a	18	kΩ
R_{g-k}	1.0	MΩ
R_k	180	Ω
C_k	50	μF
Peak acceleration	0.5	g

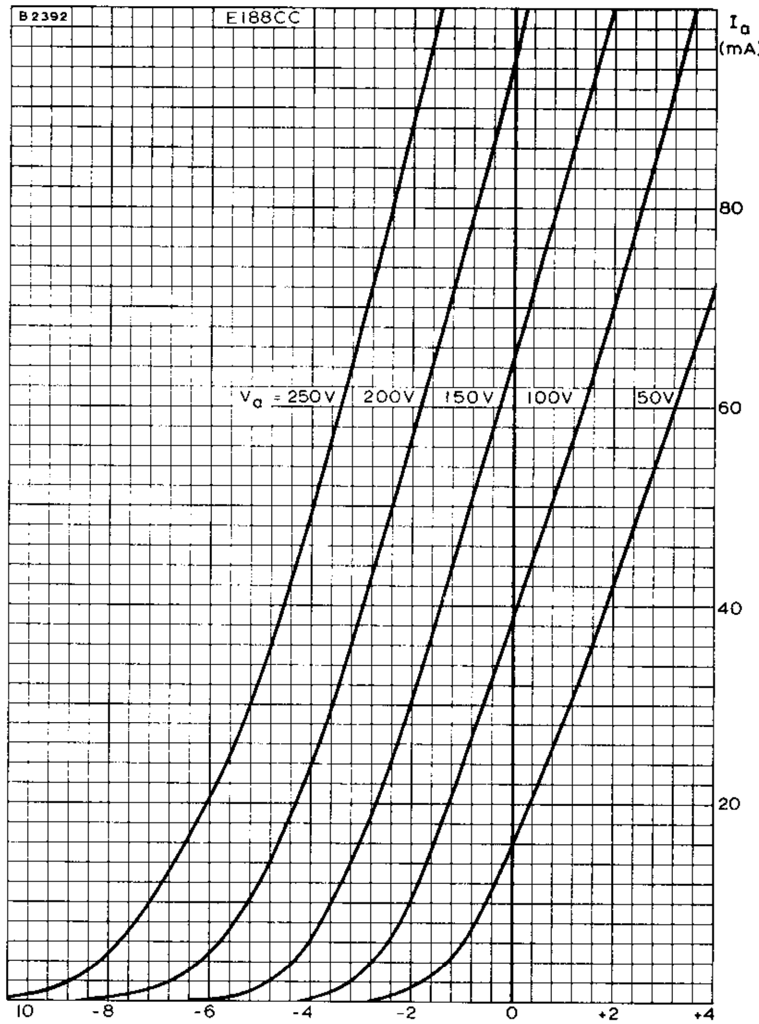
B560





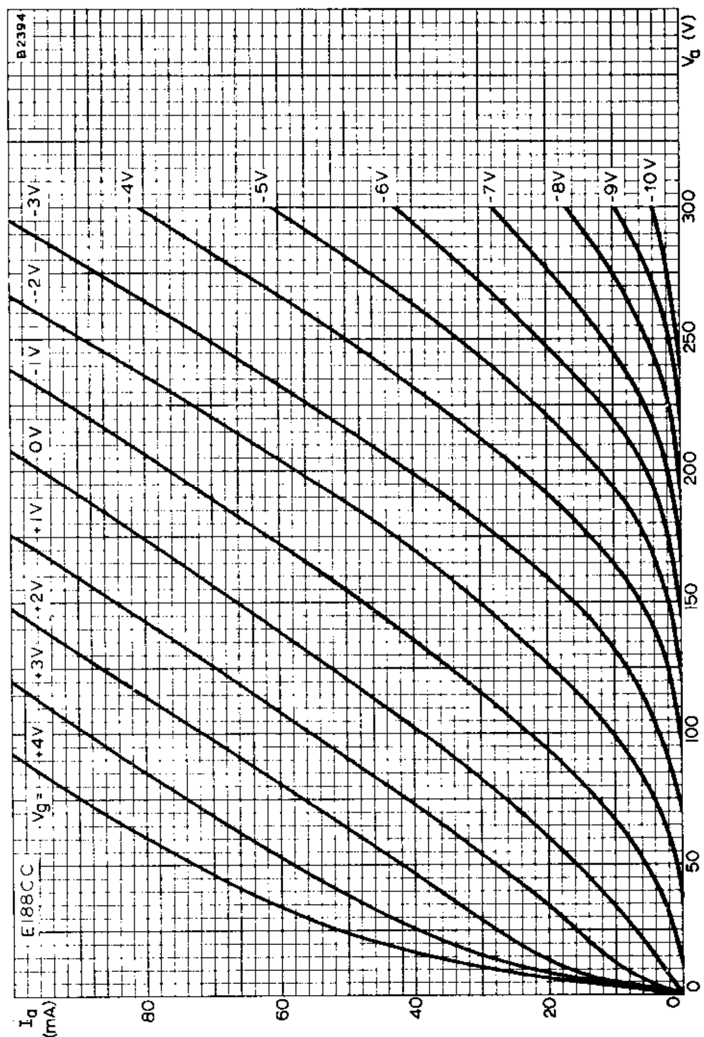
B9A Base



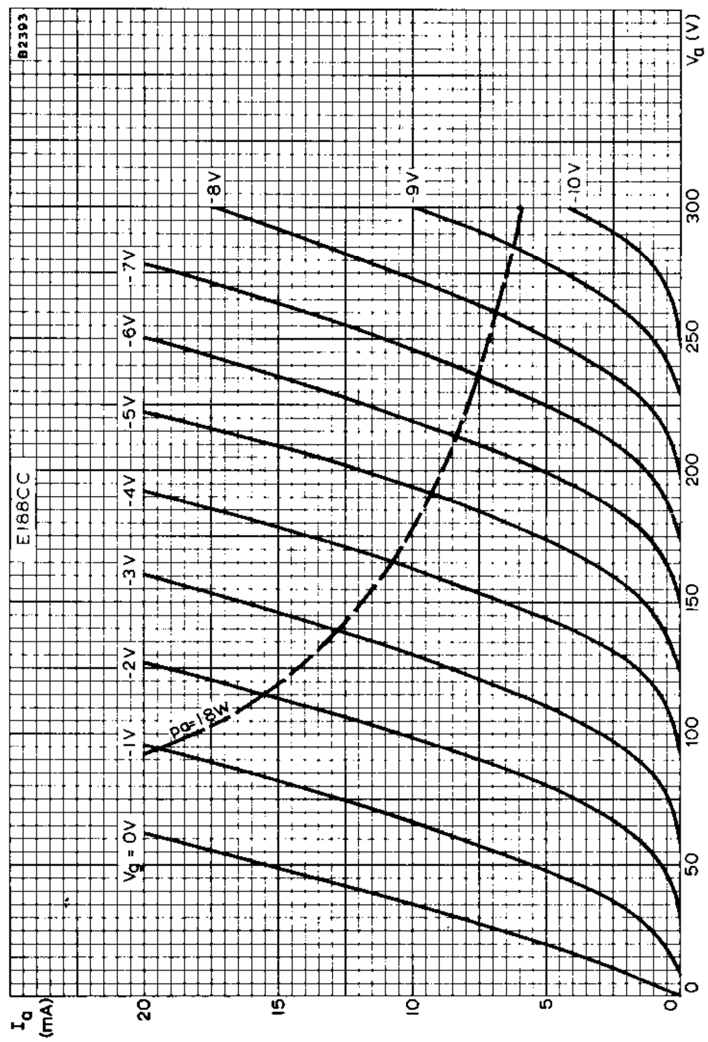


ANODE CURRENT PLOTTED AGAINST GRID VOLTAGE WITH ANODE VOLTAGE AS PARAMETER

E188CC SPECIAL QUALITY DOUBLE TRIODE

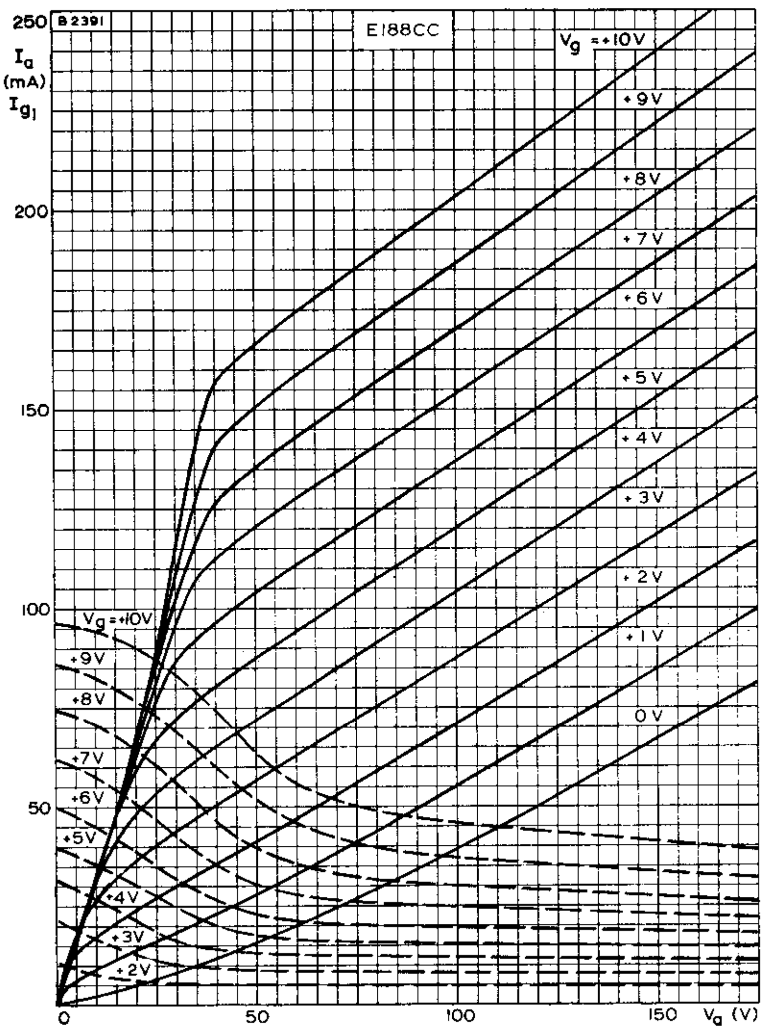


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

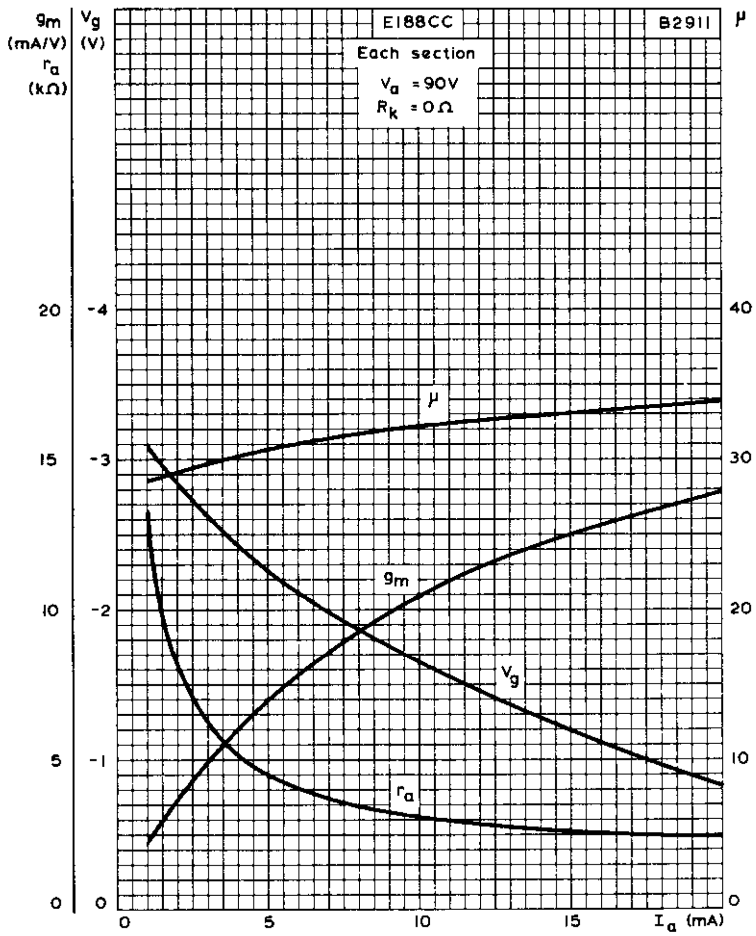


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER IN THE REGION OF THE ORIGIN.

E188CC SPECIAL QUALITY DOUBLE TRIODE

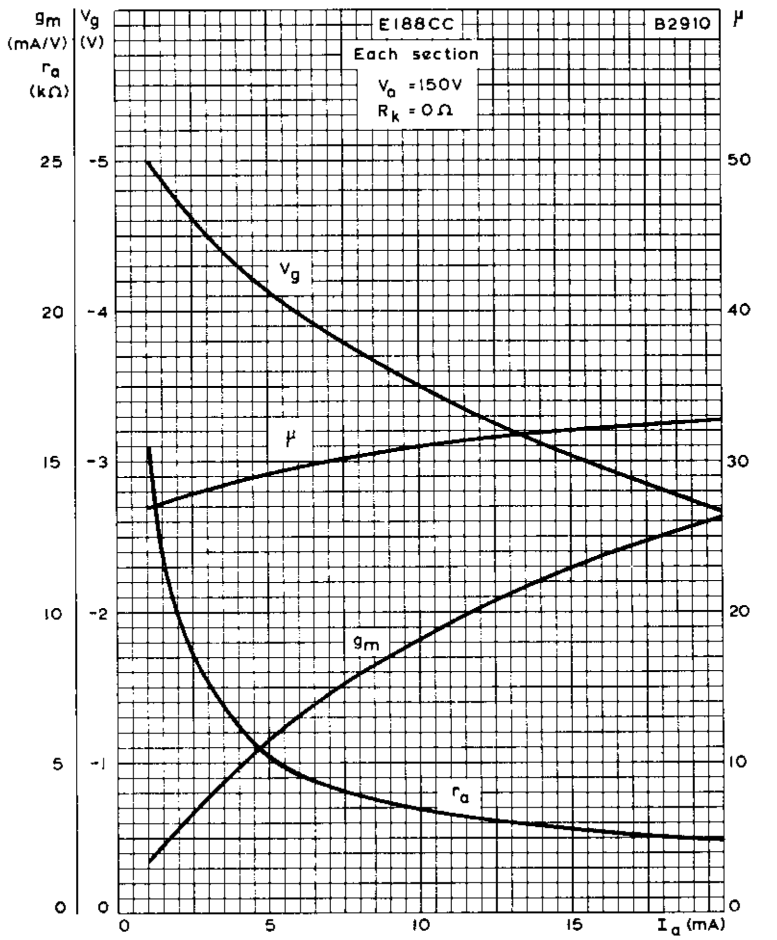


ANODE AND GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH POSITIVE GRID VOLTAGE AS PARAMETER



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

E188CC SPECIAL QUALITY DOUBLE TRIODE



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

SPECIAL QUALITY PENTODE

E280F

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

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

HEATER

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

V_h[1]	6.3	V
I_h	315	mA

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

CAPACITANCES[2]

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

CHARACTERISTICS[3]

Pentode connected

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

Triode connected
(g_2 to a, g_3 to k)

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

E280F

SPECIAL QUALITY PENTODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

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

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

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

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

*Pins 1 and 3 strapped together.

**Measured without external shield.

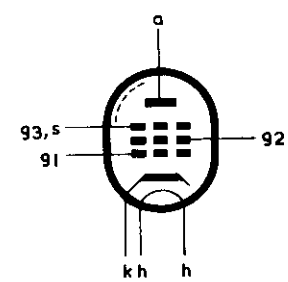
†Gain bandwidth product $= \dfrac{g_m}{2\pi(c_{in(w)} + c_{out} + 5pF)}$

SPECIAL QUALITY PENTODE

E280F

ABSOLUTE MAXIMUM RATINGS[4]

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



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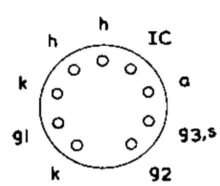
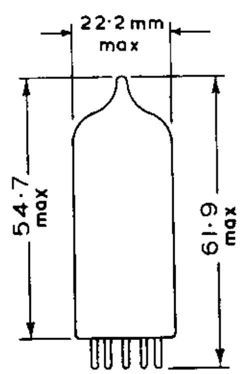


B9A Base



SPECIAL QUALITY TRIODE

E288CC

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

PRELIMINARY DATA

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

HEATER

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

V_h[1]	6.3	V
I_h	475	mA

CAPACITANCES[2] (measured without external shield)

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

*each section.

CHARACTERISTICS[3] (each section)

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

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

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

E288CC

SPECIAL QUALITY TRIODE

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

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

SHOCK AND VIBRATION

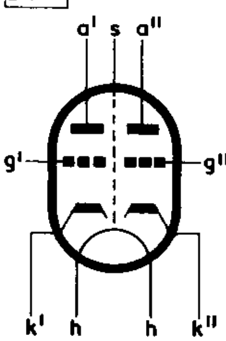
The E288CC can withstand vibrations of 2.5g and 50c/s for 96 hours, and is proof against impact accelerations of approximately 500g.

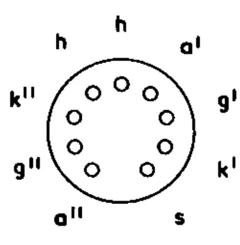
ABSOLUTE MAXIMUM RATINGS[4] (each section)

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

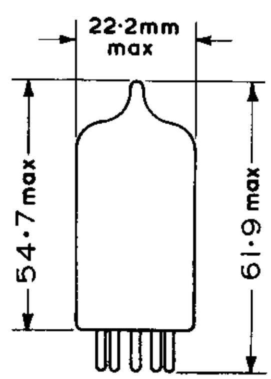
*Maximum duty factor 0.01, maximum pulse duration 10µs.

B1606





B9A Base



SUBMINIATURE SINGLE DIODE

EA76

Indirectly-heated subminiature diode with 6.3V heater.

HEATER

V_h	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

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

COOLING

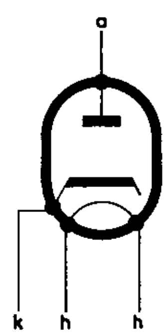
In operation this valve may become very hot and therefore, in the interests of long life, it should be adequately cooled. A suitable method is to mount the valve in a metal clip which conducts the heat away to the chassis.

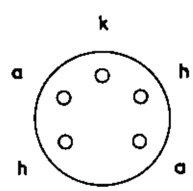
CAPACITANCES

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

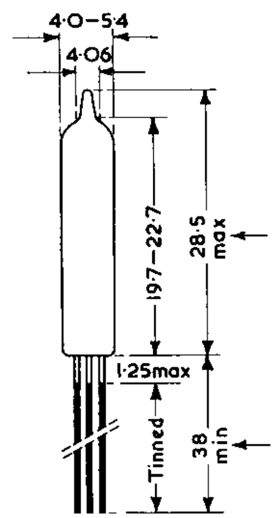
LIMITING VALUES

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





BSB/F Base



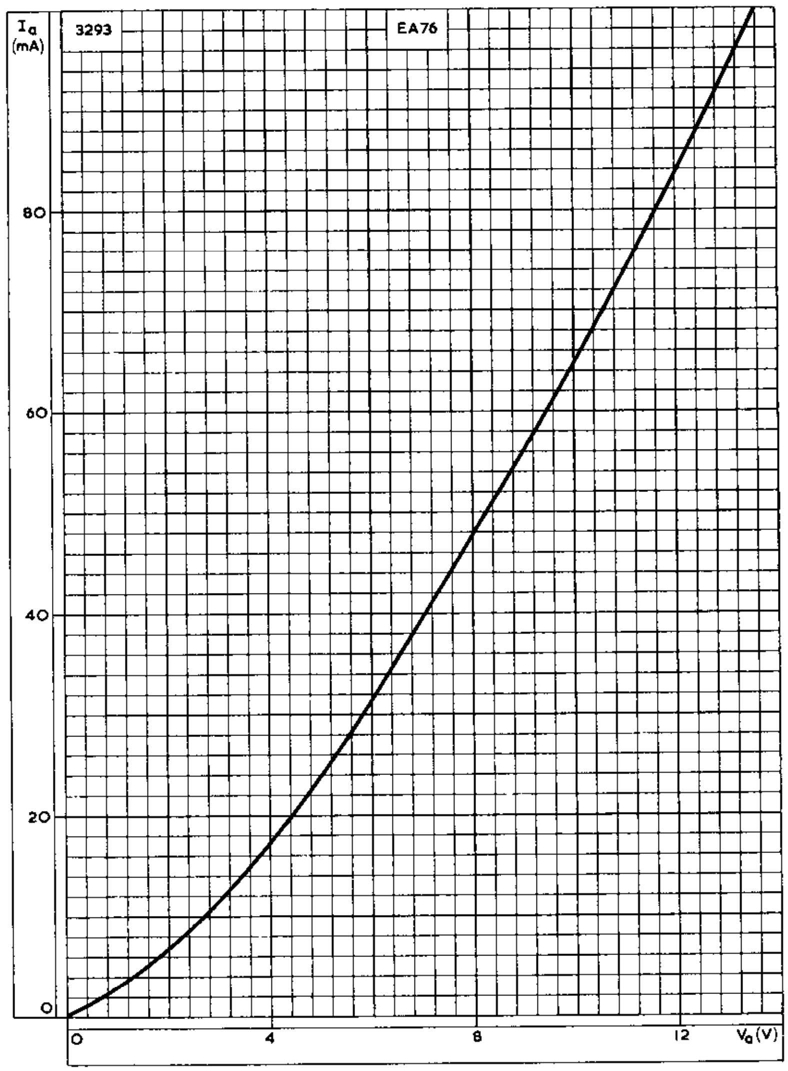
3274

All dimensions in mm

EA76

SUBMINIATURE SINGLE DIODE

Indirectly-heated subminiature diode with 6.3V heater.



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

SINGLE DIODE R.F. PENTODE

EAF42

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

HEATER

V_h	6.3	V
I_h	0.2	A

MOUNTING POSITION

Any

CAPACITANCES

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

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

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

* For 100 : 1 reduction in mutual conductance.

LIMITING VALUES

Pentode Section

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

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

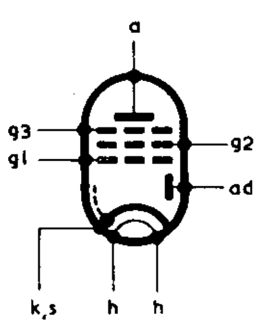
EAF42

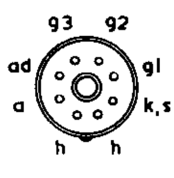
SINGLE DIODE R.F. PENTODE

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

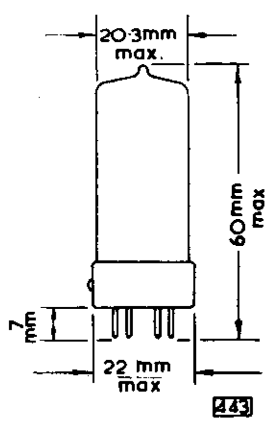
Diode Section

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





B8A BASE



DOUBLE DIODE TRIODE

EBC33

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

HEATER

This valve is suitable for DC/AC operation.

V_h	6.3	V
I_h	0.2	A

CAPACITANCES

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

CHARACTERISTICS

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

OPERATING CONDITIONS AS RESISTANCE-COUPLED A.F. AMPLIFIER

V_b (V)	R_a (kΩ)	I_a (mA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	V_{out}* (V)	D_{tot} (%)	R_{g1}** (kΩ)
300	47	2.8	1.2	19.5	45	5.8	150
250	47	2.3	1.2	19.0	34	5.5	150
200	47	1.8	1.2	18.5	26	5.2	150
100	47	0.5	4.7	13.0	8	10.0	150
300	100	1.5	2.2	22.0	49	5.2	330
250	100	1.27	2.2	22.0	41	5.2	330
200	100	1.0	2.2	21.5	31	5.0	330
100	100	0.32	6.8	16.5	14	10.0	330
300	220	0.83	3.9	23.5	52	4.8	680
250	220	0.69	3.9	23.5	41	4.6	680
200	220	0.53	3.9	23.0	31	4.5	680
100	220	0.2	10	19.0	20	10.0	680

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

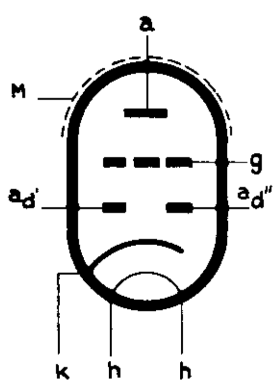
LIMITING VALUES

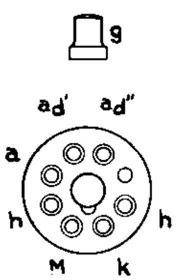
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.5	W
V_{ad} max.	200	V
I_{ad} max.	0.8	mA
I_k max.	10	mA
V_g max. ($I_g=0.3\mu A$)	−1.3	V
R_g max. (Self bias)	3.0	MΩ
R_g max. (Fixed bias)	1.0	MΩ
V_{h-k} max.	150	V
R_{h-k} max.	20	kΩ

EBC33

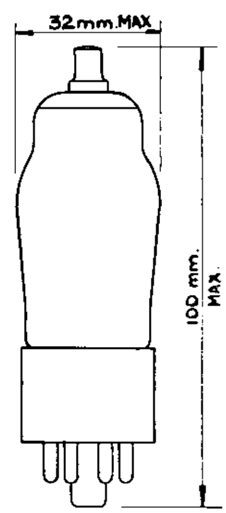
DOUBLE DIODE TRIODE

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





OCTAL BASE



DOUBLE DIODE TRIODE

EBC41

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

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

CAPACITANCES

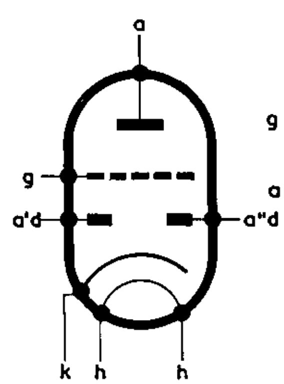
$c_{a'd-gt}$	<0.007	pF
$c_{a''d-gt}$	<0.03	pF
c_{ad-at}	<0.01	pF

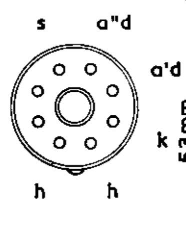
Triode section

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

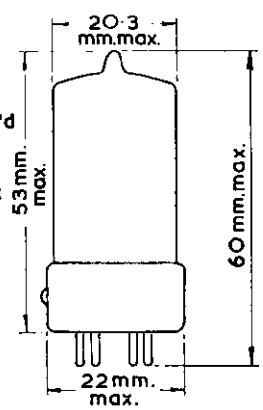
Diode sections

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





B8A BASE



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DOUBLE DIODE PENTODE

EBF80

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

HEATER

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

V_h	6.3	V
I_h	0.3	A

MOUNTING POSITION

Any

CAPACITANCES

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

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

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

OPERATING CONDITIONS AS RESISTANCE COUPLED A.F. AMPLIFIER

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

*D_{tot} = 5%

**Grid resistor of following valve

EBF80

DOUBLE DIODE PENTODE

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

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

g_2 connected to a, g_3 connected to k.

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

*$V_{out}=5\ V_{(r.m.s.)}$.
**Grid resistor of following valve.

LIMITING VALUES

Pentode Section

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

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

Diode Sections (each section) ←

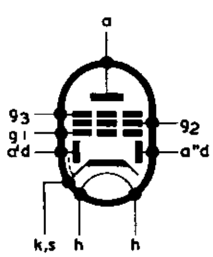
P.I.V.	350	V
I_{ad} max.	0.8	mA
$i_{ad(pk)}$ max.	5.0	mA
R_{h-k} max.	20	k Ω
V_{h-k} max.	100	V

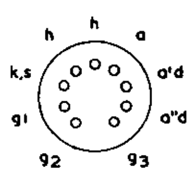
This valve can be used without special precautions against microphony if the input voltage, V_{in}, is not less than 25 mV for an output of 50 mW from the output valve.

DOUBLE DIODE PENTODE

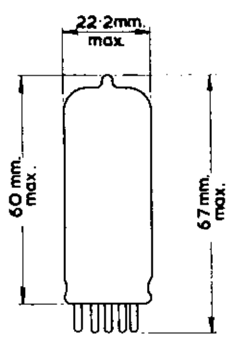
EBF80

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





B9A (Noval) BASE

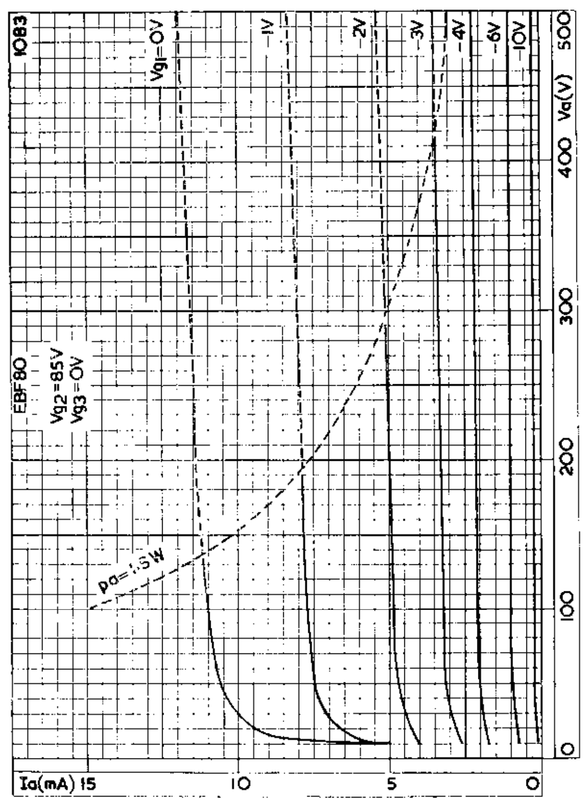


706

EBF80

DOUBLE DIODE PENTODE

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



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

U.H.F. TRIODE

EC86

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

HEATER

V_h	6.3	V
I_h	200	mA ←

CAPACITANCES ←

Unshielded

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

Shielded

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

CHARACTERISTICS

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

OPERATING CONDITIONS

As grounded-grid amplifier

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

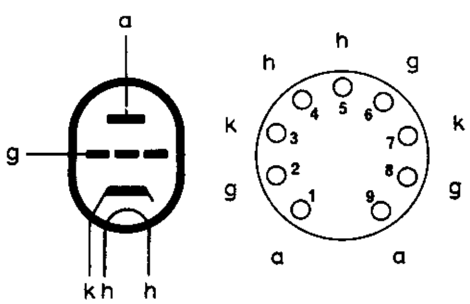
As self-oscillating mixer

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

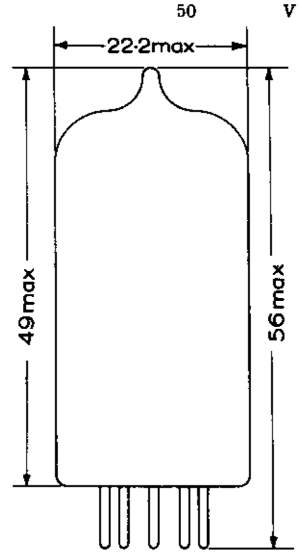
DESIGN CENTRE RATINGS

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

B4187



B9A Base



All dimensions in mm

U.H.F. TRIODE

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

EC88

HEATER

V_h	6.3	V
I_h	165	mA

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

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

CHARACTERISTICS

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

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

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

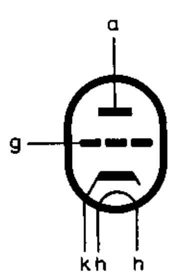
V_b	200	V
R_a	6.8	kΩ
I_a	9.0	mA
I_g	52	µA
$V_{osc(r.m.s.)}$	2.0	V
R_g	47	kΩ
g_c	5.4	mA/V
$g_{m(eff)}$	7.0	mA/V

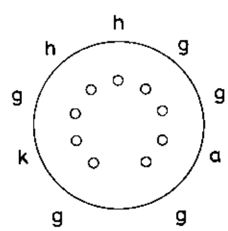
EC88

U.H.F. TRIODE

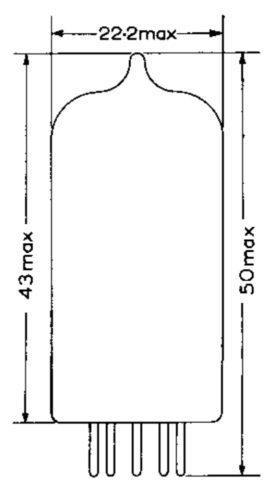
DESIGN CENTRE RATINGS

$V_{a(b)}$ 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

GROUNDED GRID TRIODE

EC91

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

HEATER

V_h	6.3	V
I_h	300	mA

CAPACITANCES ←

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

*External shield connected to grid.

CHARACTERISTICS

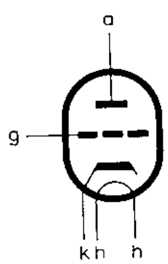
V_a	250	V
I_a	10	mA
V_g	−1.5	V
g_m	8.5	mA/V
μ	90	←
r_a	10.5	kΩ←
R_{eq}	400	Ω

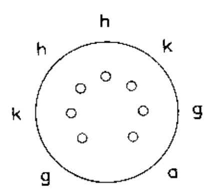
LIMITING VALUES

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

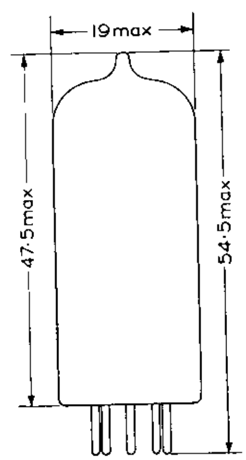
EC91

GROUNDED GRID TRIODE





B7G Base



All dimensions in mm

8665

DOUBLE TRIODE

ECC32

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

HEATER

V_h	6.3	V
I_h	0.95	A

CAPACITANCES

c_{a-a}	0.8	μμF
c_{a-g} (each section)	4.3	μμF
c_{g-k} (each section)	4.3	μμF
c_{a-k} (each section)	2.0	μμF

CHARACTERISTICS (each section)

V_a	250	V
V_g	−4.6	V
I_a	6.0	mA
g_m	2.3	mA/V
μ	32	
r_a	14	k Ω

OPERATING CONDITIONS AS RESISTANCE-CAPACITY-COUPLED AMPLIFIER

V_b (V)	R_a (k Ω)	I_a (mA)	R_k (k Ω)	$\frac{V_{out}}{V_{in}}$	V_{out}* (V)	D_{tot} (%)	R_{g1}** (k Ω)
400	47	3.9	1.2	21	67	3.7	150
350	47	3.4	1.2	20.5	57	3.6	150
300	47	2.9	1.2	20	48	3.5	150
250	47	2.4	1.2	19.5	37	3.4	150
200	47	1.9	1.2	19.5	26	3.2	150
400	100	2.1	2.7	25	81	3.0	330
350	100	1.8	2.2	25	69	2.9	330
300	100	1.6	2.2	24.5	54	2.8	330
250	100	1.3	2.2	24.5	44	2.6	330
200	100	1.05	2.2	24	32	2.4	330
400	220	1.1	3.9	27.5	81	2.3	680
350	220	0.95	3.9	27.5	68	2.2	680
300	220	0.85	3.9	27	56	2.2	680
250	220	0.7	3.9	27	45	2.1	680
200	220	0.55	3.9	26.5	34	2.0	680

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

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

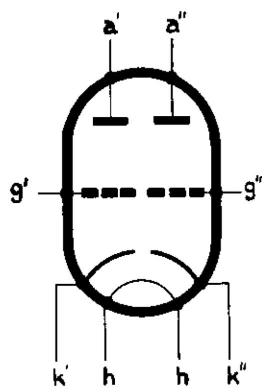
LIMITING VALUES (each section)

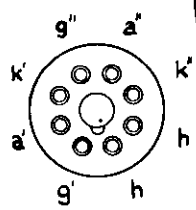
V_a max.	300	V
p_a max.	5	W
I_k max.	50	mA
R_{g-k} max.	1.5	M Ω
V_{h-k} max.	50	V
R_{h-k} max.	20	k Ω

ECC32

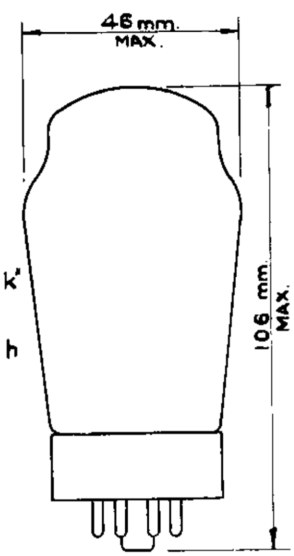
DOUBLE TRIODE

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





OCTAL BASE



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DOUBLE TRIODE

ECC33

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

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

V_h	6.3	V
I_h	0.4	A

CAPACITANCES

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

CHARACTERISTICS (each section)

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

LIMITING VALUES (each section)

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

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

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

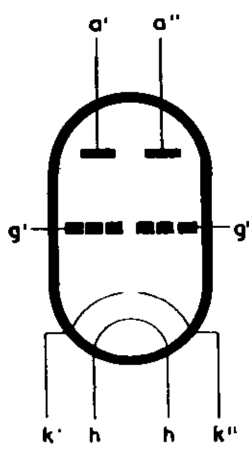
*Output voltage at the start of I_g. At output voltages lower than those shown the distortion is approximately proportional to voltage.

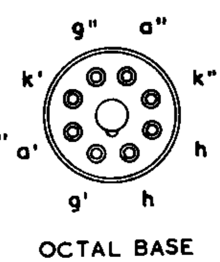
**Grid resistor of following valve.

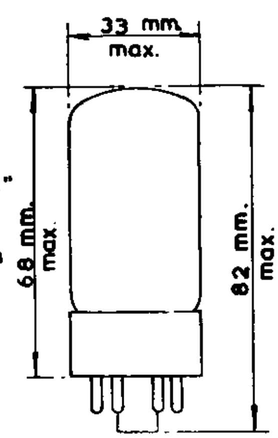
ECC33

DOUBLE TRIODE

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







DOUBLE TRIODE

ECC35

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

HEATER

V_h	6.3	V
I_h	0.4	A

CAPACITANCES

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

CHARACTERISTICS (each section)

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

LIMITING VALUES (each section)

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

ECC35

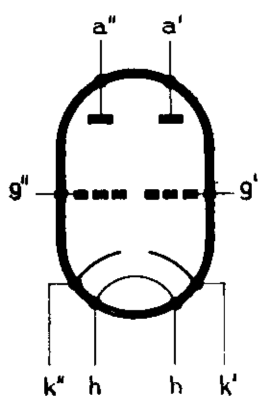
DOUBLE TRIODE

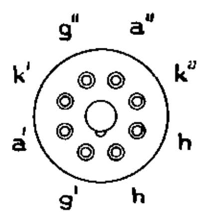
High-gain double triode with separate cathodes for use in paraphase A.F. voltage amplifiers.

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

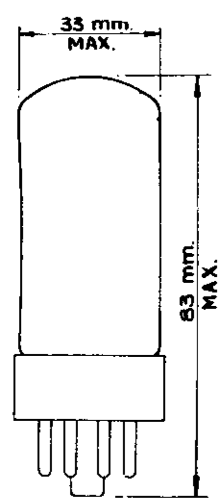
V_b (V)	R_a (k Ω)	I_a (mA)	R_k (k Ω)	$\frac{V_{out}}{V_{in}}$	V_{out}* ($V_{r.m.s.}$)	V_{out}† ($V_{r.m.s.}$)	D_{tot} (%)	R_{g1}‡ (k Ω)
400	100	1.3	2.7	40.5	37.5	66.2	10	330
350	100	1.1	2.7	40.5	32.2	57.0	10	330
300	100	1.0	2.7	40	28.0	48.7	10	330
250	100	0.8	2.7	40	23.2	41.1	10	330
200	100	0.65	2.7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

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





OCTAL BASE



DOUBLE TRIODE

ECC84

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

HEATER

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

V_h	6.3	V
I_h	330	mA

CAPACITANCES (measured without external shield)

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

Grounded cathode section

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

Grounded grid section

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

CHARACTERISTICS (each section)

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

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

ECC84

DOUBLE TRIODE

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

TYPICAL OPERATING CONDITIONS

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

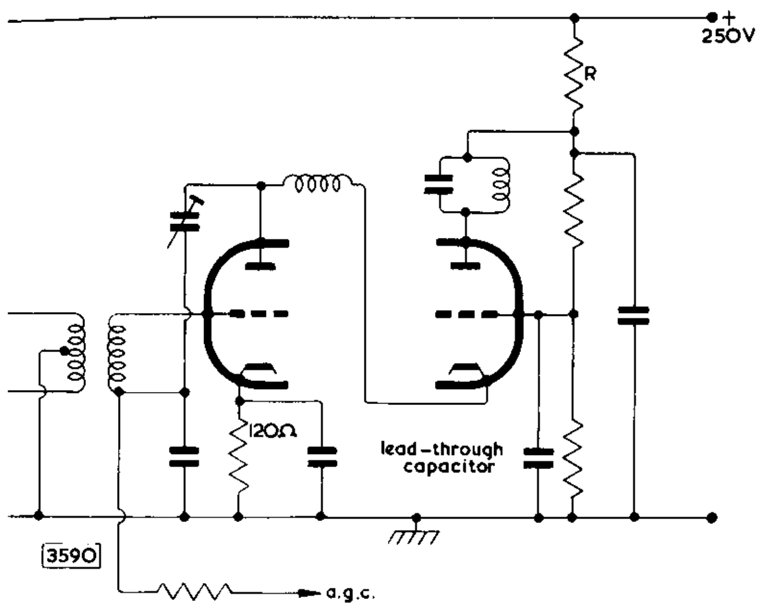


Fig 1

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

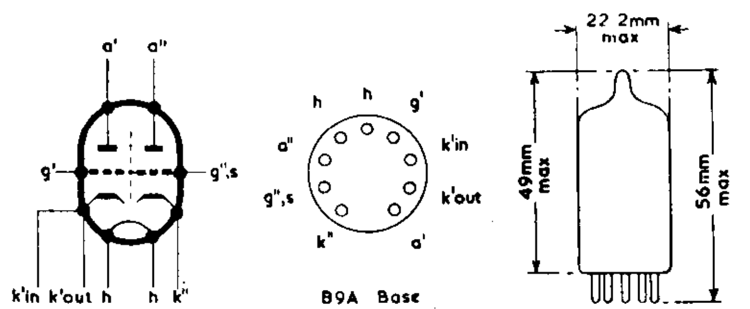
DOUBLE TRIODE

ECC84

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

LIMITING VALUES (each section unless otherwise specified)

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



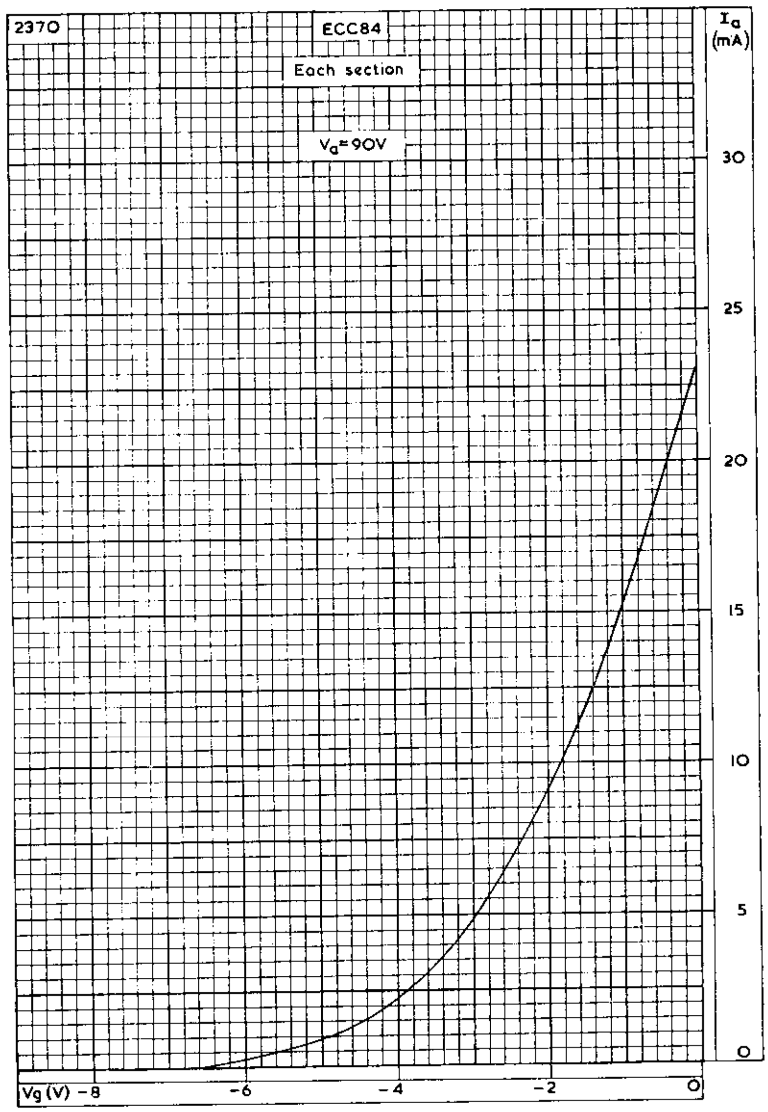
1390

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

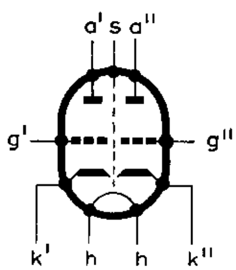
ECC86

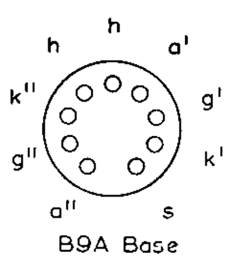
R.F. DOUBLE TRIODE

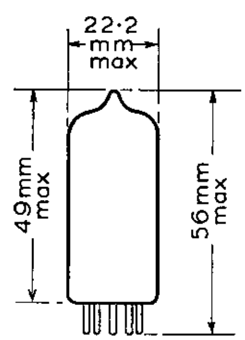
DESIGN CENTRE RATINGS

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







V.H.F. DOUBLE TRIODE

ECC91

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

HEATER

V_h	6.3	V
I_h	450	mA

CAPACITANCES

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

*Each section.

CHARACTERISTICS (each section)

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

OPERATING CONDITIONS—CLASS "C" TELEGRAPHY PUSH-PULL

As r.f. amplifier

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

As a frequency trebler

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

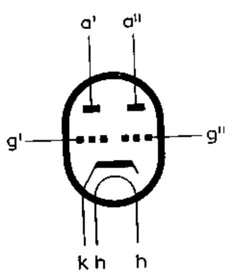
*This bias is obtained by grid current bias, or a combination of grid current and fixed or cathode bias.

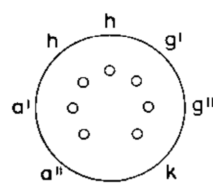
ECC91

V.H.F. DOUBLE TRIODE

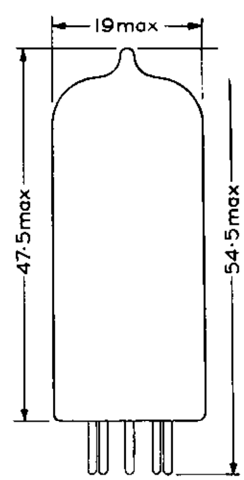
LIMITING VALUES

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





B7G Base



All dimensions in mm

8417

V.H.F. DOUBLE TRIODE

ECC189

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

HEATER

V_h	6.3	V
I_h	365	mA

CAPACITANCES

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

CHARACTERISTICS (each section)

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

DESIGN CENTRE RATINGS (each section)

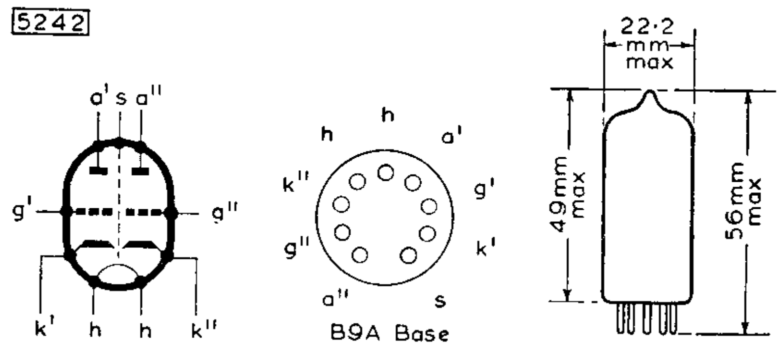
$V_{a(b)}$ max.	550	V
V_a max.	130	V
p_a max.	1.8	W
I_k max.	22	mA
$-V_g$ max.	50	V
$R_{g'-k}$ max.	1.0	MΩ
$R_{g''-k}$ max.	500	kΩ
$V_{h-k'}$ max.	50	V
$V_{h-k''}$ max. (cathode positive)	150	V
R_{h-k} max.	20	kΩ

ECC189 V.H.F. DOUBLE TRIODE

NOTE

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

5242



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

TRIODE 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

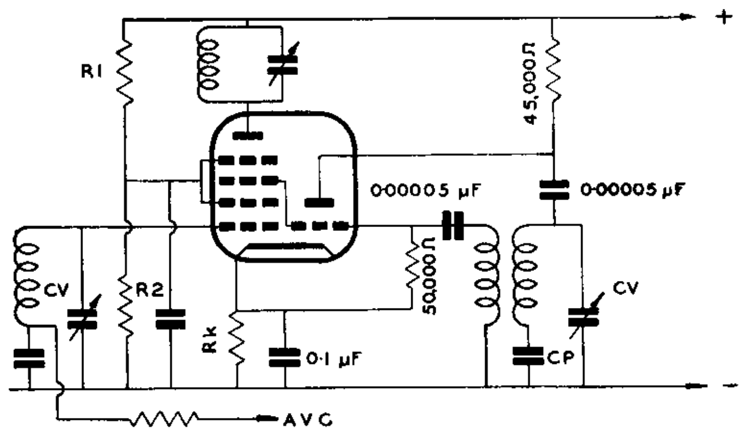
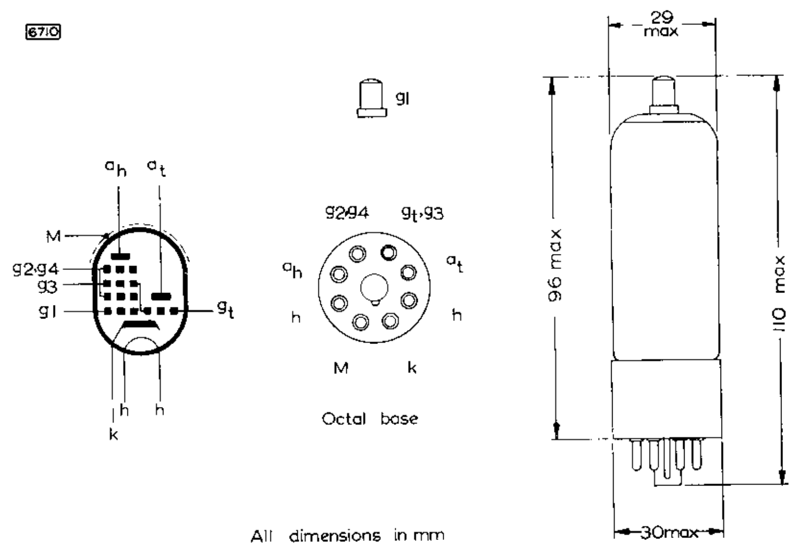


Fig. 1.—ECH35 as frequency changer with screen grid fed by a potentiometer.



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_{g1+g3}	47	kΩ
I_{gt+g3}	200	µA
I_a	4.8	mA

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

ECH42

TRIODE HEXODE FREQUENCY CHANGER

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

CHARACTERISTICS

Triode Section

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

TYPICAL OPERATING CONDITIONS AS PHASE INVERTER

(see Fig. 2)

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

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

LIMITING VALUES

Hexode Section

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

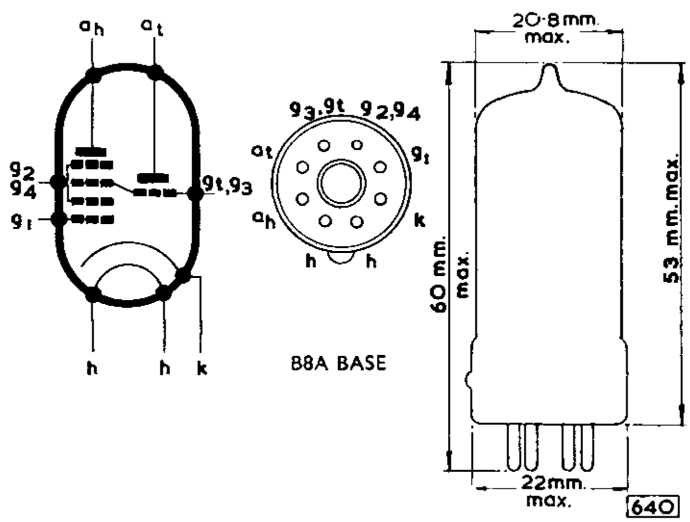
Triode Section

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

TRIODE HEXODE FREQUENCY CHANGER

ECH42

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



ECH42

TRIODE HEXODE FREQUENCY CHANGER

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

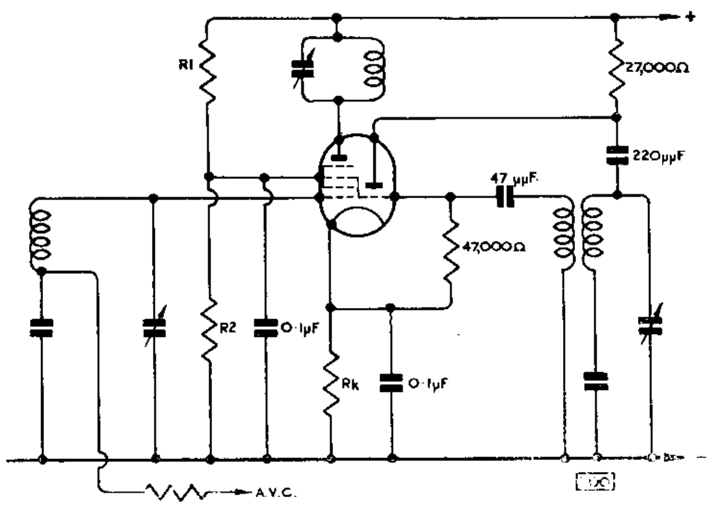


Fig. 1—ECH42 as Frequency Changer

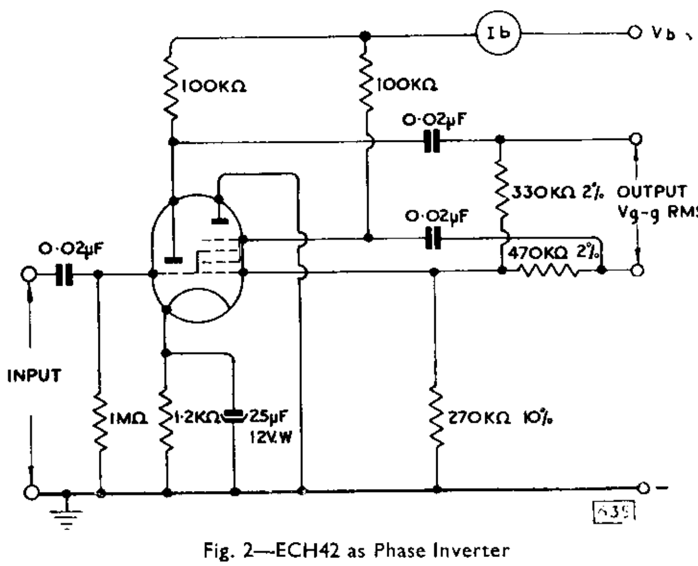


Fig. 2—ECH42 as Phase Inverter

Triode heptode primarily intended for use as a frequency changer.

HEATER

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

V_h	6.3	V
I_h	300	mA

CAPACITANCES

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

Heptode section

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

Triode section

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

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

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

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

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

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

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

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

CHARACTERISTICS

Triode section

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

Heptode section

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

OPERATING CONDITIONS OF TRIODE SECTION AS R.F. OSCILLATOR

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

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

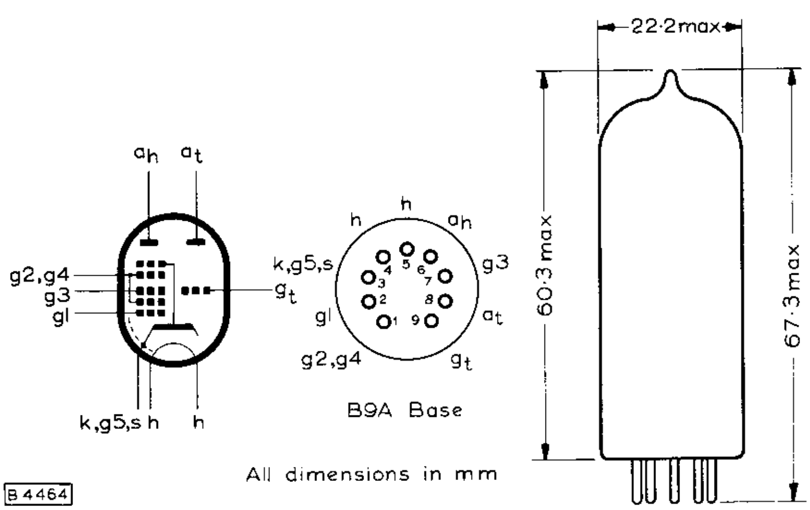
Triode section

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

Heptode section

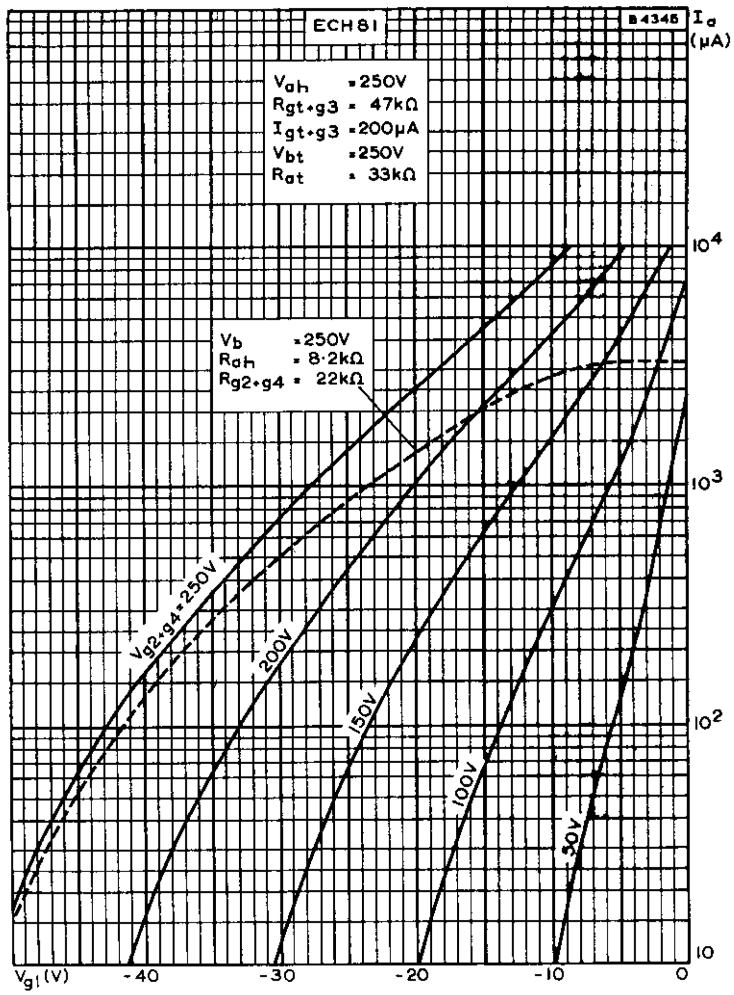
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.0	W←
$V_{g2+g4(b)}$ max.	550	V
V_{g2+g4} max.	125	V
V_{g2+g4} max. (I_a <1mA)	300	V
p_{g2+g4} max.	0.8	W←
I_k max.	18	mA←
R_{g1-k} max.	3.0	MΩ
*R_{g3-k} max.	3.0	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

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

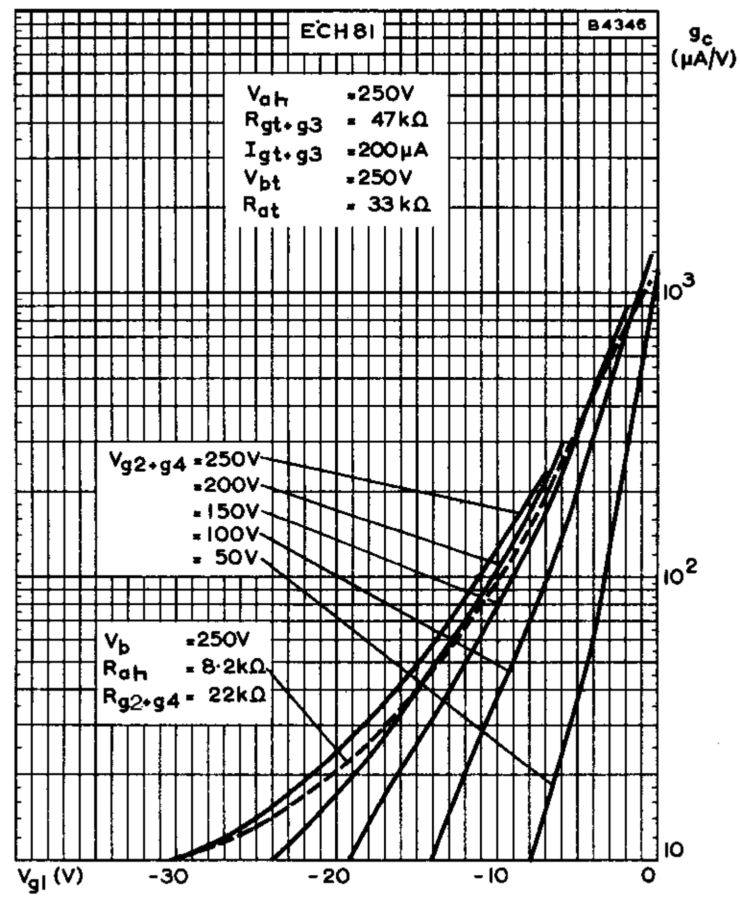


All dimensions in mm

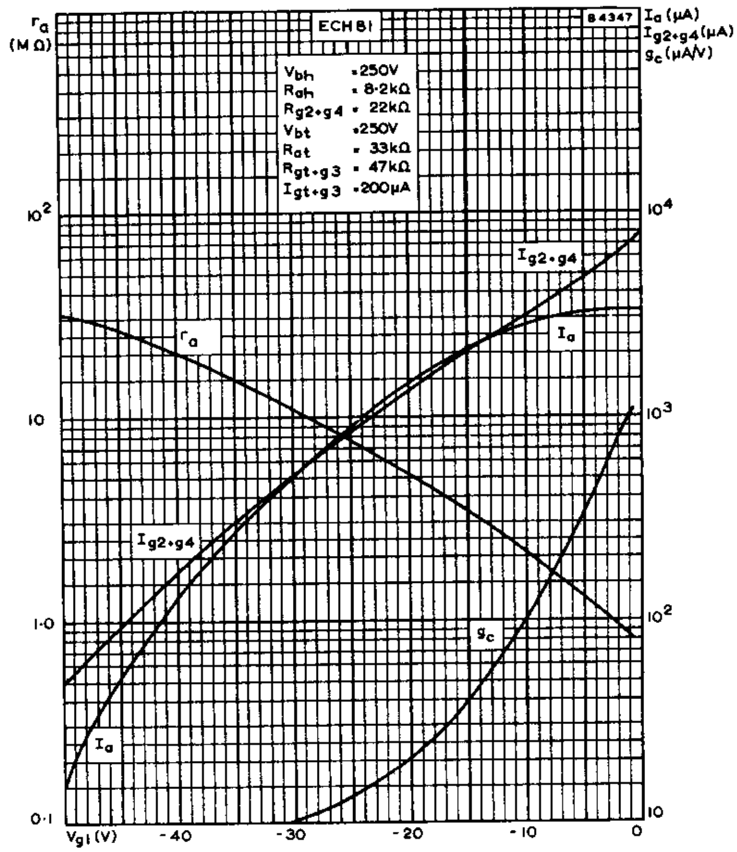
B4464



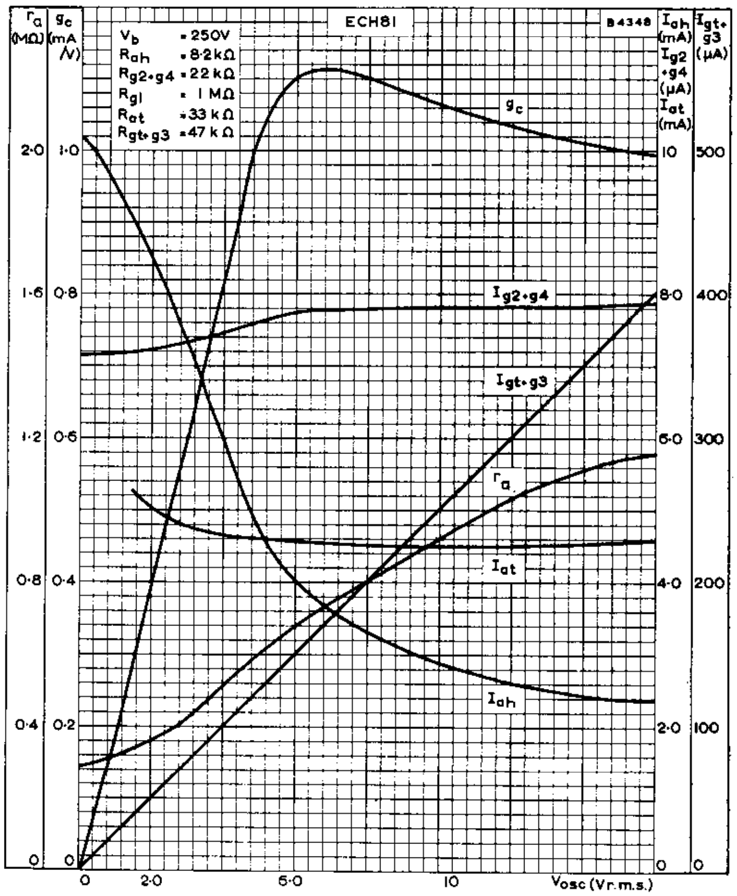
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WHEN USED AS A FREQUENCY CHANGER



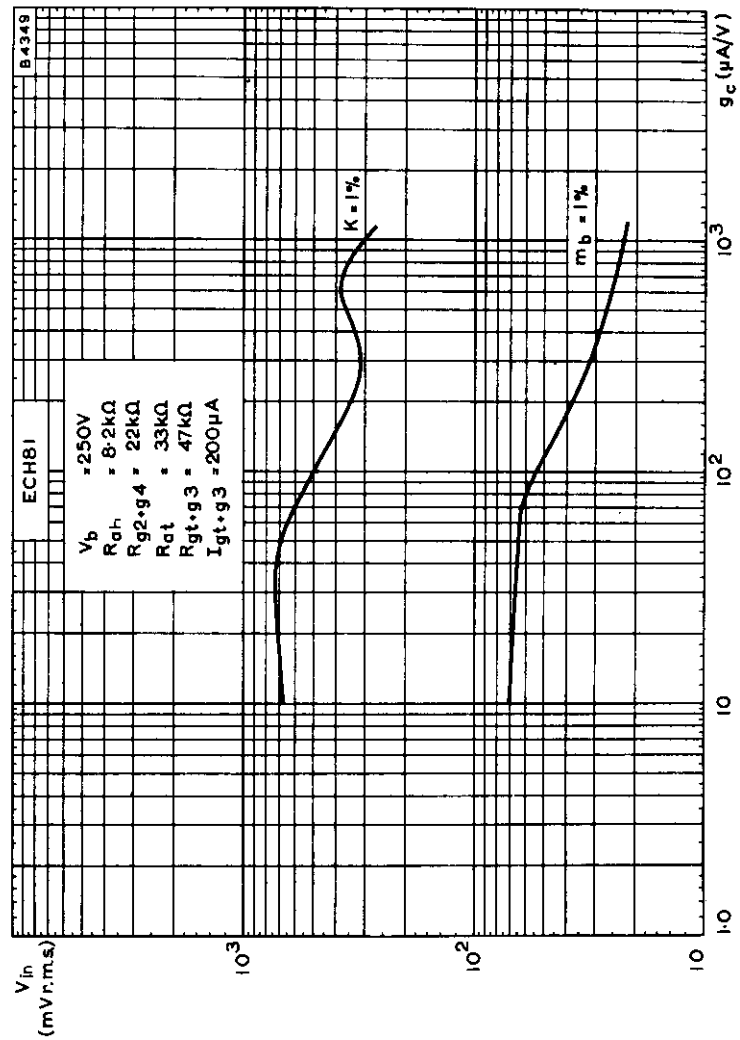
CONVERSION CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WHEN USED AS A FREQUENCY CHANGER



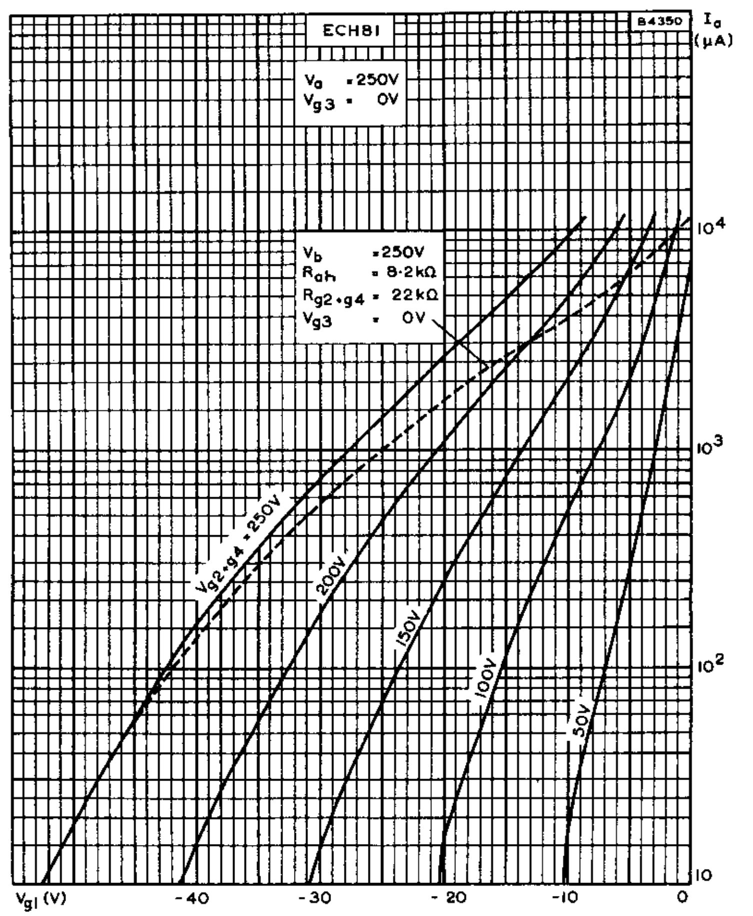
ANODE AND SCREEN-GRID CURRENTS, CONVERSION CONDUCTANCE ANODE IMPEDANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE WHEN USED AS A FREQUENCY CHANGER



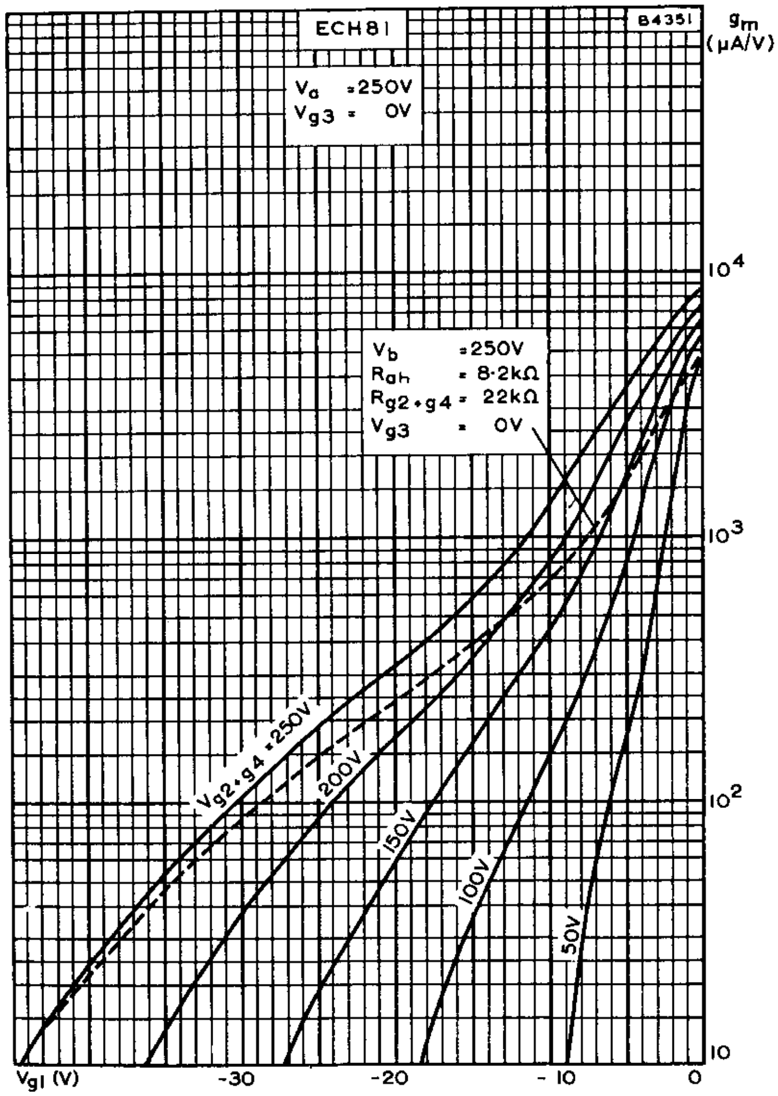
ANODE, SCREEN AND OSCILLATOR GRID CURRENTS, CONVERSION CONDUCTANCE, AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST OSCILLATOR VOLTAGE



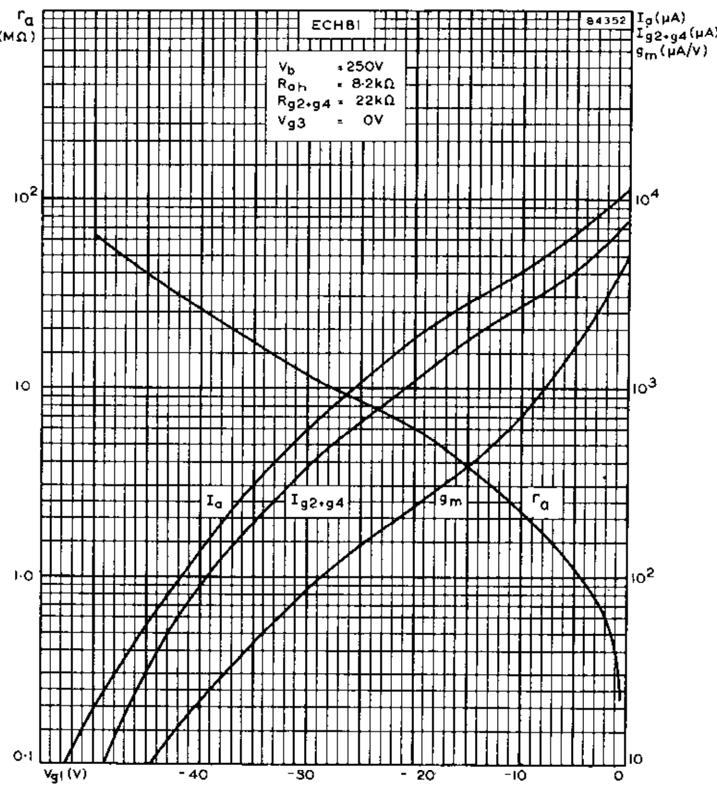
INDICATING THE R.M.S. VALUE OF THE VOLTAGE OF AN INTERFERING SIGNAL AT THE GRID PRODUCING 1% CROSS AND HUM MODULATION AS A FUNCTION OF THE CONVERSION CONDUCTANCE



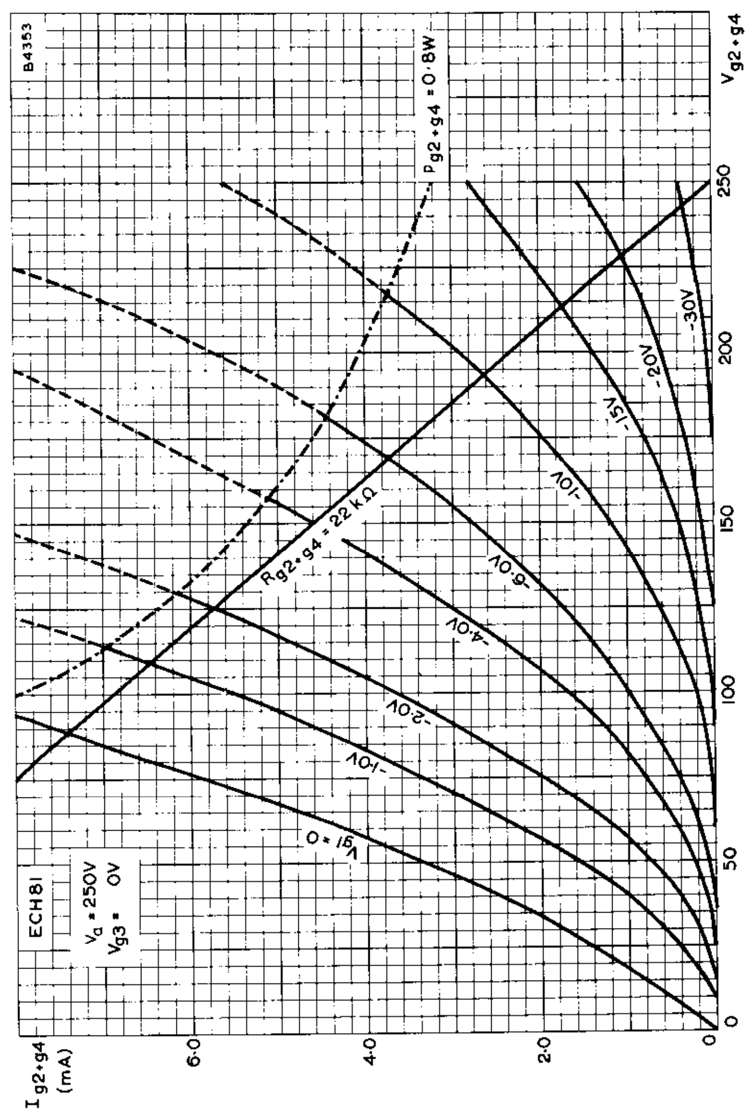
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR HEPTODE SECTION



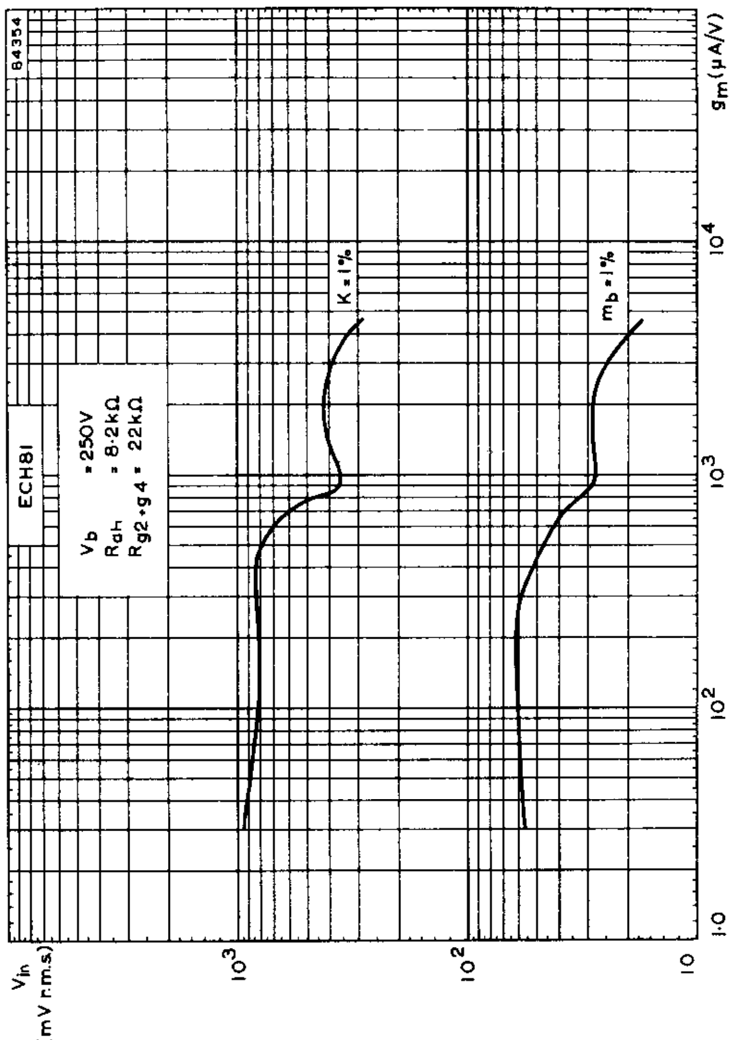
MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR HEPTODE SECTION



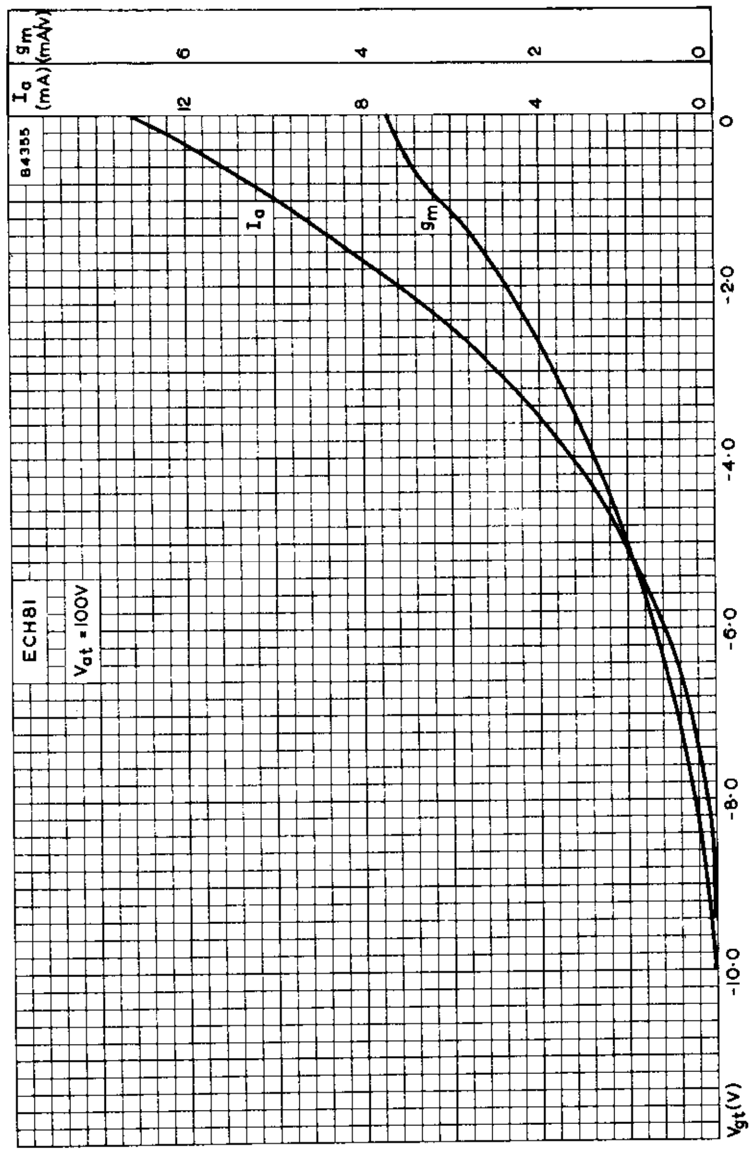
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE, AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR HEPTODE SECTION



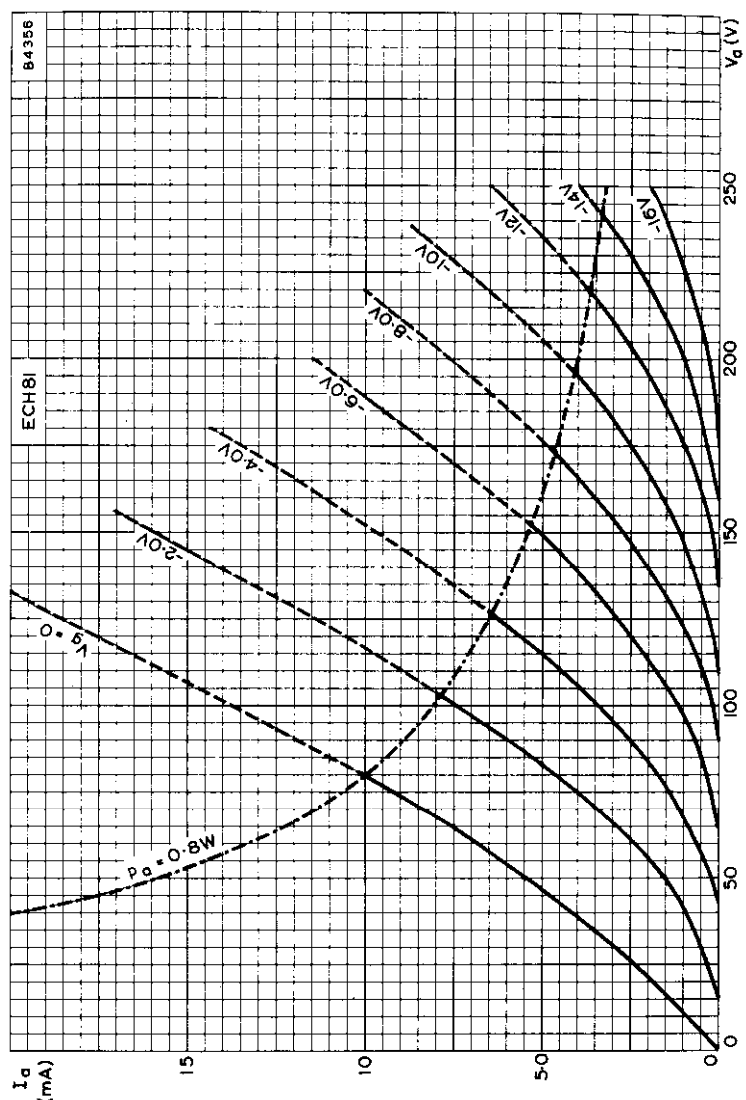
SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER FOR HEPTODE SECTION



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



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



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

TRIODE PENTODE

ECL83

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

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

V_h	6.3	V
I_h	600	mA

MOUNTING POSITION Any

CAPACITANCES (measured without an external shield)

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

Pentode section

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

Triode section

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

CHARACTERISTICS

Pentode section

V_a	170	200	V
V_{g2}	170	200	V
I_a	30	27	mA
I_{g2}	5.0	4.4	mA
V_{g1}	−9.5	−13	V
g_m	5.5	5.0	mA/V
r_a	53	65	kΩ
μ_{g1-g2}	10	10	

Triode section

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

ECL83

TRIODE PENTODE

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

PENTODE SECTION AS AUDIO OUTPUT VALVE

Single valve class 'A'

V_a	170	200	V
V_{g2}	170	200	V
V_{g1}	−9.5	−13	V
$I_{a(o)}$	30	27	mA
$I_{g2(o)}$	5.0	4.4	mA
R_k	270	410	Ω
R_a	5.5	7.5	kΩ
$V_{in(r.m.s.)}$	5.0	5.2	V
P_{out}	2.2	2.5	W
D_{tot}	10	10.5	%

Two valves in class 'AB' push-pull

V_a	170	200	V
V_{g2}	170	200	V
*R_k	180	220	Ω
$I_{a(o)}$	2×24	2×25	mA
I_a (max. sig.)	2×27.5	2×29	mA
$I_{g2(o)}$	2×3.8	2×3.9	mA
I_{g2} (max. sig.)	2×6.25	2×8.5	mA
R_{a-a}	6.5	7.5	kΩ
$V_{in(g1-g1)r.m.s.}$	17	23.5	V
P_{out}	5.0	7.2	W
D_{tot}	3.6	4.2	%

*Common cathode bias resistor

TRIODE SECTION AS A.F. VOLTAGE AMPLIFIER

V_b (V)	R_a (kΩ)	I_a (μA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$)	R_{g1}* (kΩ)
170	100	650	1.8	49	15.3	330
200	100	720	2.2	47	17.7	330

$\frac{V_{out}}{V_{in}}$ measured with an input of 100mV

V_{out} measured for a total harmonic distortion of 5%

*Grid resistor of following valve.

TRIODE PENTODE

ECL83

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

LIMITING VALUES

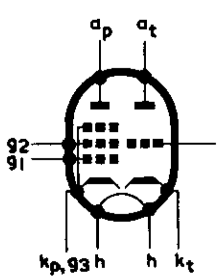
Pentode section

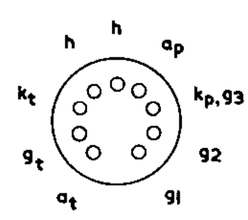
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	5.4	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	1.2	W
p_{g2} max. (speech and music)	2.4	W
I_k max.	45	mA
R_{g1-k} max. (self-bias)	500	kΩ
R_{g1-k} max. (fixed bias)	250	kΩ
V_{h-k} max. (d.c. cathode positive or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max.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

Triode section

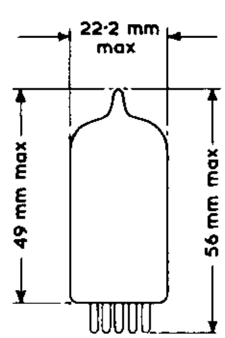
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	3.5	W
I_k max.	15	mA
R_{g1-k} max. (fixed bias)	1.0	MΩ
R_{g1-k} max. (grid current biasing)	22	MΩ
V_{h-k} max. (d.c. cathode positive or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max. (d.c. cathode negative)	100	V

3749





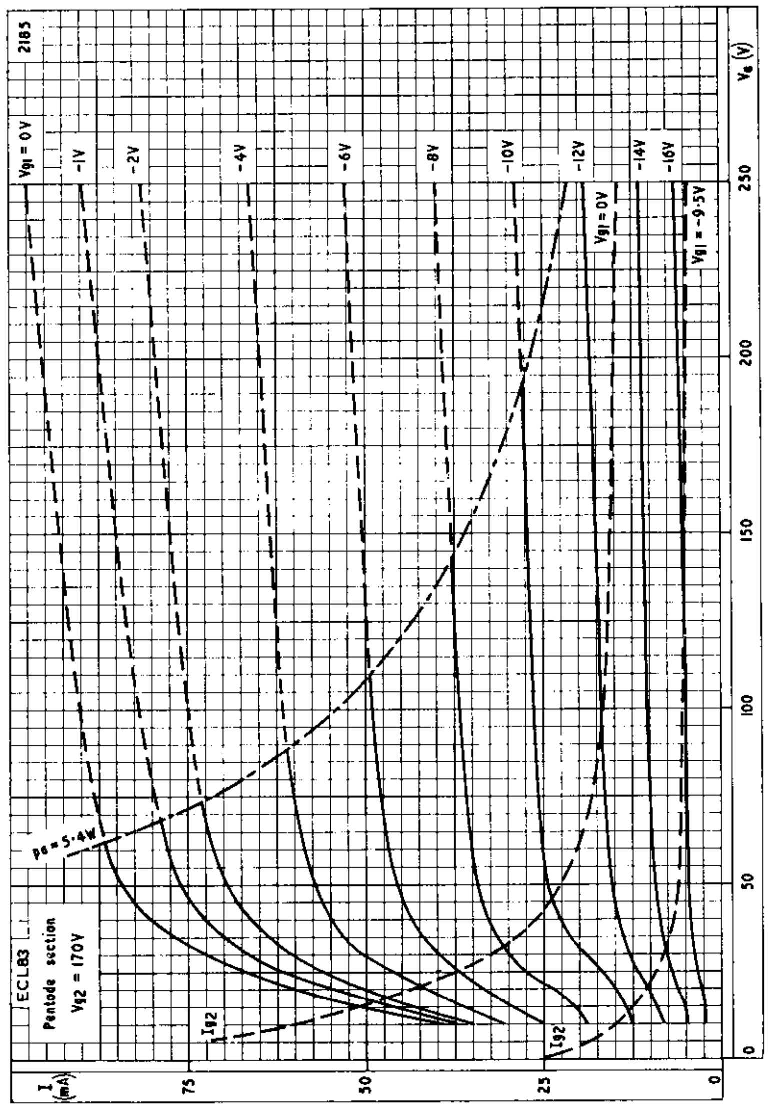
B9A Base



ECL83

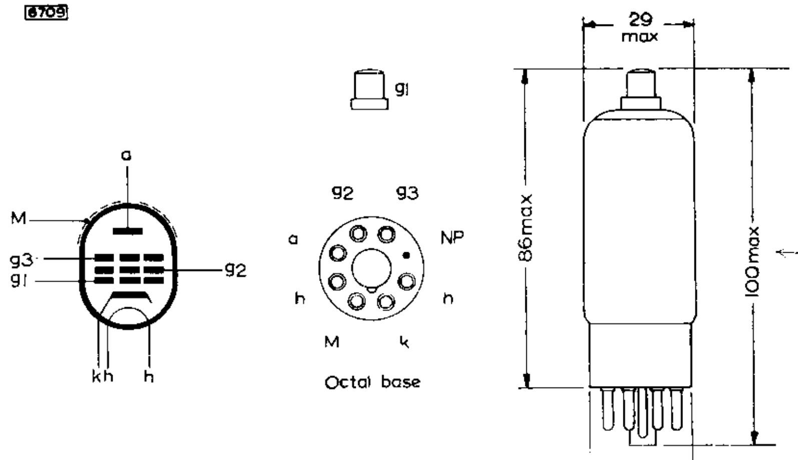
TRIODE PENTODE

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

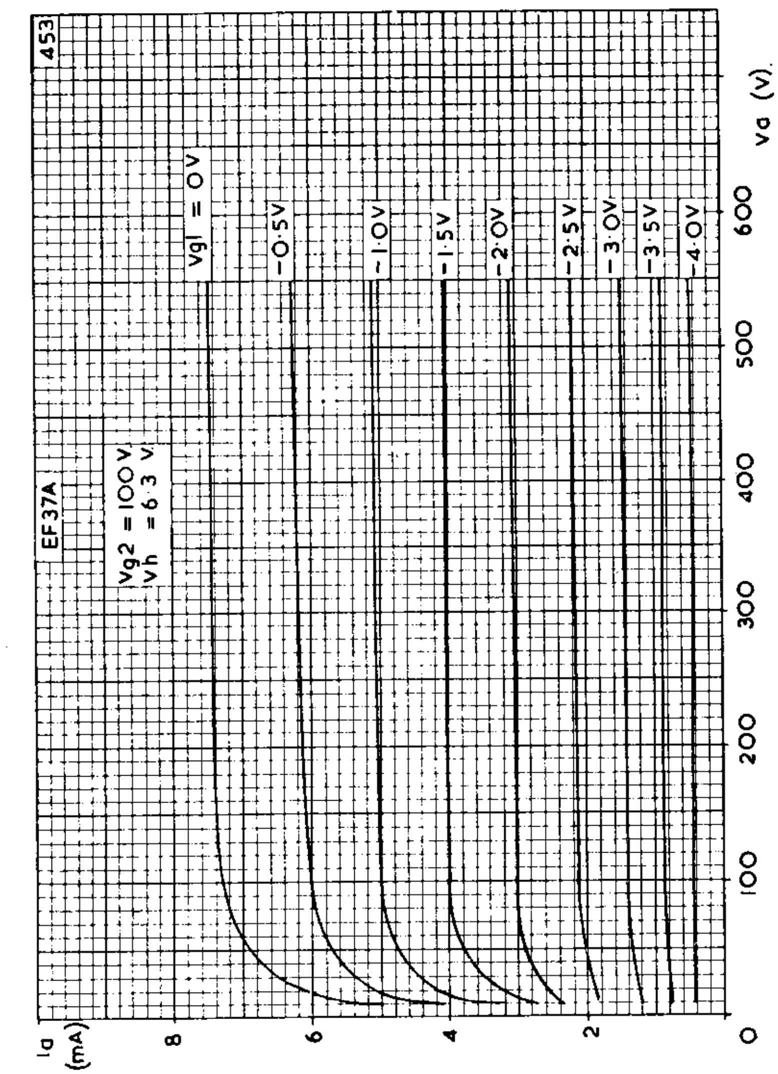


ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 170V

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

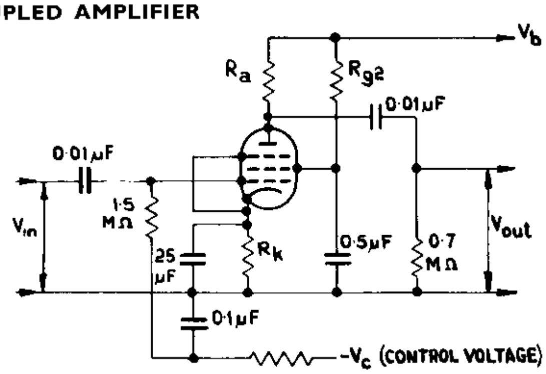
CAPACITANCES

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

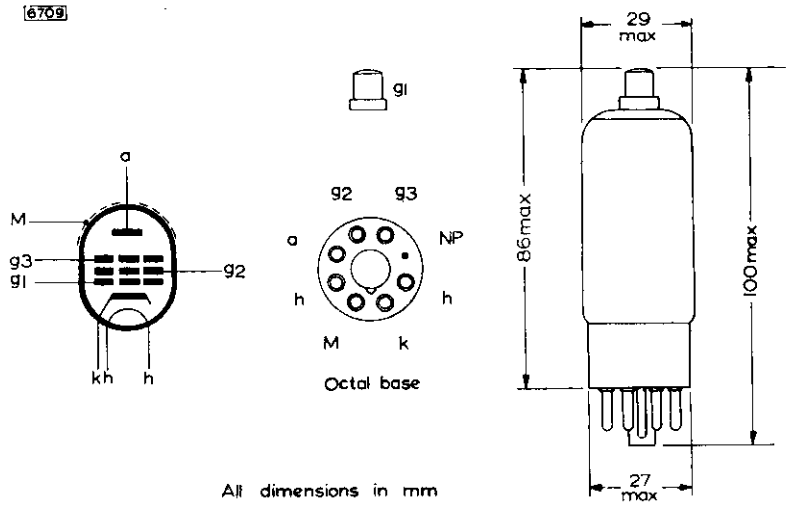
EF39

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

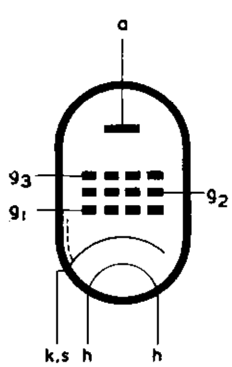
Low noise pentode primarily intended for use in high gain r.c. coupled a.f. voltage amplifier stages.

EF41
OVERLEAF

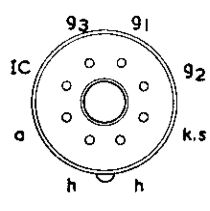
Except for heater to cathode voltage ratings, basing and dimensions, the EF40 is identical to the EF86.

LIMITING VALUE

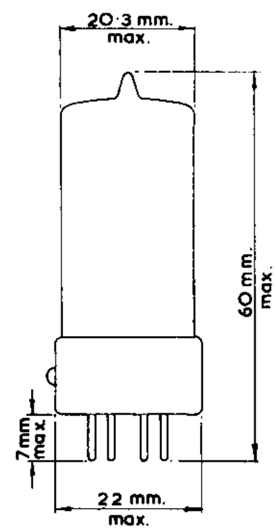
V_{h-k} max.	50	V



277



B8A BASE



EF41

VARIABLE-MU R.F. PENTODE

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

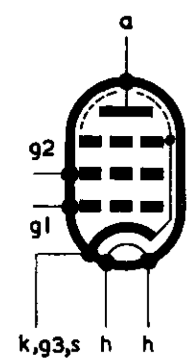
Except for capacitances, basing, dimensions and heater to cathode voltage ratings the EF41 is identical to the EF39.

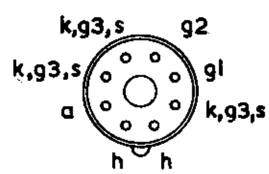
CAPACITANCES

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

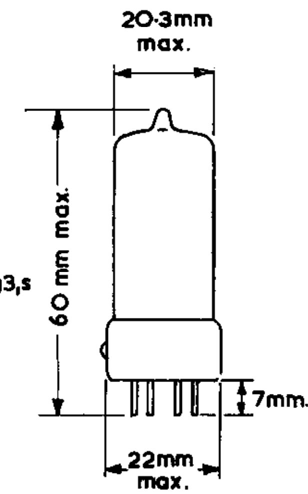
LIMITING VALUE

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





B8A Base



106

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

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.	
$c_{a\text{-}g1}$	—	—	0.007	pF
$c_{g1\text{-}g2}$	—	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
$V_{g1\text{-}c}$	−2	−1.55*	**	††	V
V_{g3}	0*	0	−30*	−20*	V
I_a	10	10	10	10	mA
I_{g2}	3.0	3.0	5.5	4.0	mA
g_m	6.5	6.5	5.2	6.0	mA/V
r_a	1.0	1.0	0.1	0.2	MΩ
$\mu_{g1\text{-}g2}$	75	—	—	—	
R_{eq}	1.4	—	—	—	kΩ
Input damping (f = 50Mc/s)	4.0	—	—	—	kΩ
Output damping (f = 50Mc/s)	50	—	—	—	kΩ
R_k	0	32	0	32	Ω
C_k	0	50	0	50	pF
V_{g1} (for 10 : 1 reduction in g_m)	—	−4.5	**	††	V
V_{g3} (for 10 : 1 reduction in g_m)	−53	—	−55.5	−51.5	V

* Valve not controlled by a.g.c.

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

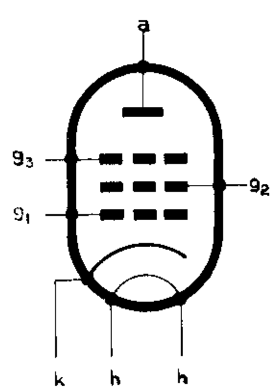
†† V_{g1} is obtained from V_{g3} by means of a potentiometer of 50kΩ and 4kΩ.

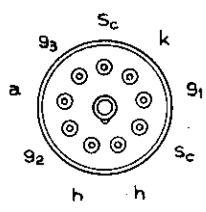
EF50

R.F. PENTODE

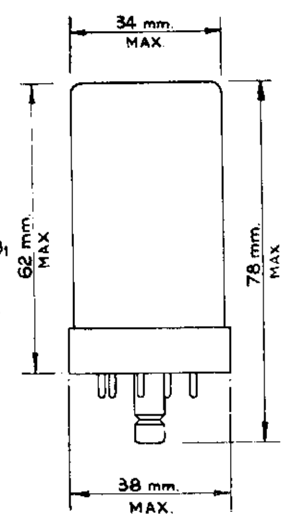
LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	3	W
I_k max.	15	mA
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	1.7	W
V_{g1} max. (I_{g1} = +0.3µA)	−1.3	V
V_{g3} max. (I_{g3} = +0.3µA)	−1.3	V
R_{g1} max.	3	MΩ
R_{g3} max.	3	MΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ





B9G BASE



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	pF
c_{in}	15	pF
c_{a-g1}	0.15	pF

OPERATING CONDITIONS

V_a	250	250	V
V_{g2}	250	150	V
I_a	40	10	mA
I_{g2}	5.5	1.0	mA
R_k	100	360	Ω
g_m	12	7.0	mA/V
μ_{g1-g2}	28	27	
r_a	55	100	kΩ

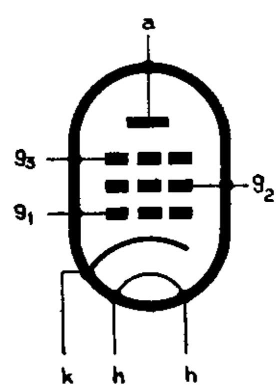
LIMITING VALUES

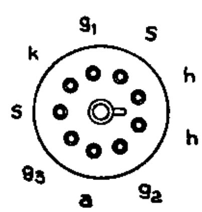
$V_{a(b)}$ max.	500	V
V_a max.	300	V
$V_{g2(b)}$ max.	300	V
V_{g2} max.	250	V
p_a max.	10	W
p_{g2} max.	2.0	W
V_{h-k} max.	150	V
R_{g1-k} max.	700	kΩ
$i_{k(pk)}$ max. (with 50μs. pulse, 500 p.p.s.)	1.5	A

EF55

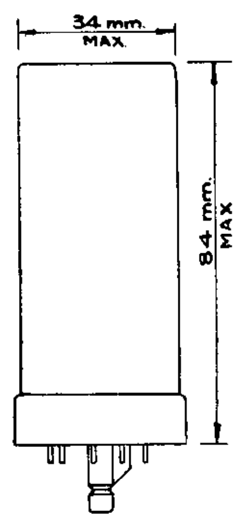
VIDEO FREQUENCY PENTODE

Single-ended r.f. pentode with very high mutual conductance and sharp cut-off.





B9G BASE



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

VARIABLE-MU R.F. PENTODE

EF89

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

PRELIMINARY DATA

HEATER Indirectly heated.

V_h	6.3	V
I_h	200	mA

CAPACITANCES

c_{in}	5.5	pF
c_{out}	5.1	pF
c_{a-g1}	<0.002	pF
c_{g1-g2}	2.1	pF
c_{g1-h}	0.05	pF

CHARACTERISTICS

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

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

TYPICAL OPERATING CONDITIONS

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

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

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

EF89

VARIABLE-MU R.F. PENTODE

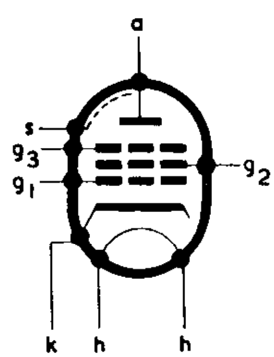
Variable-mu pentode for use as r.f. or i.f. amplifier in f.m./a.m. receivers.

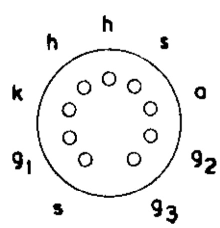
LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	2.25	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	450	mW
I_k max.	165	mA
*R_{g1-k} max.	3.0	MΩ
R_{g3-k} max.	10.	kΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ

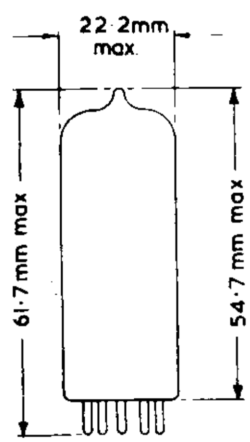
*With grid current biasing, R_{g1-k} max.$=$22MΩ.

1971





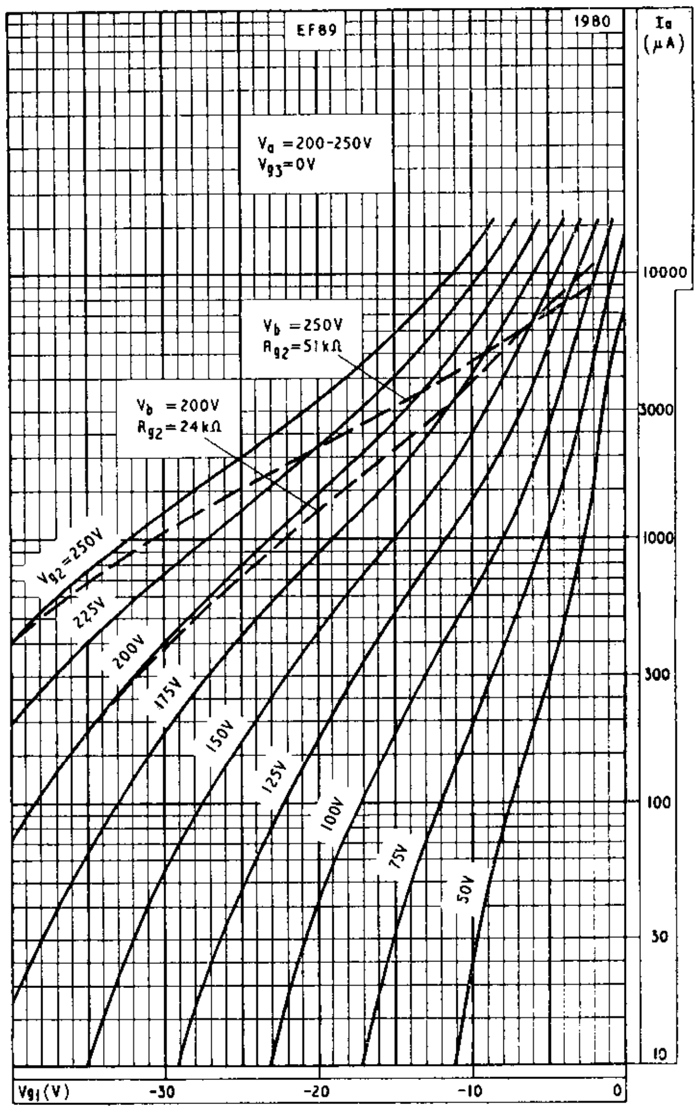
B9A
Noval Base



VARIABLE-MU R.F. PENTODE

EF89

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

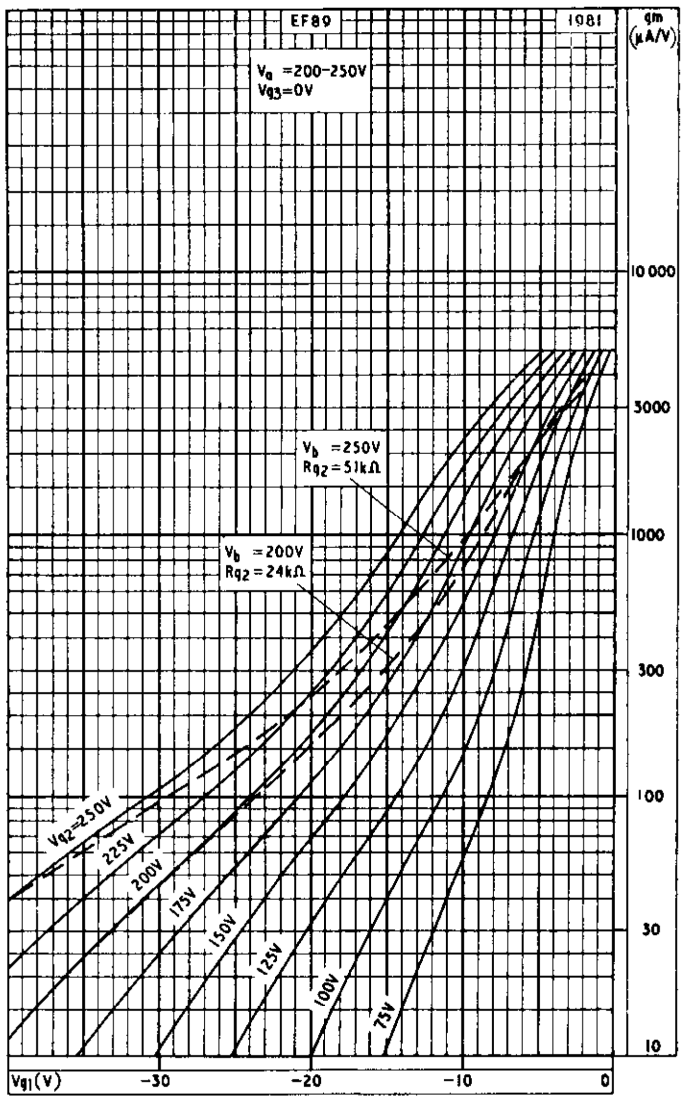


ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE FOR VARIOUS SCREEN-GRID VOLTAGES

EF89

VARIABLE-MU R.F. PENTODE

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

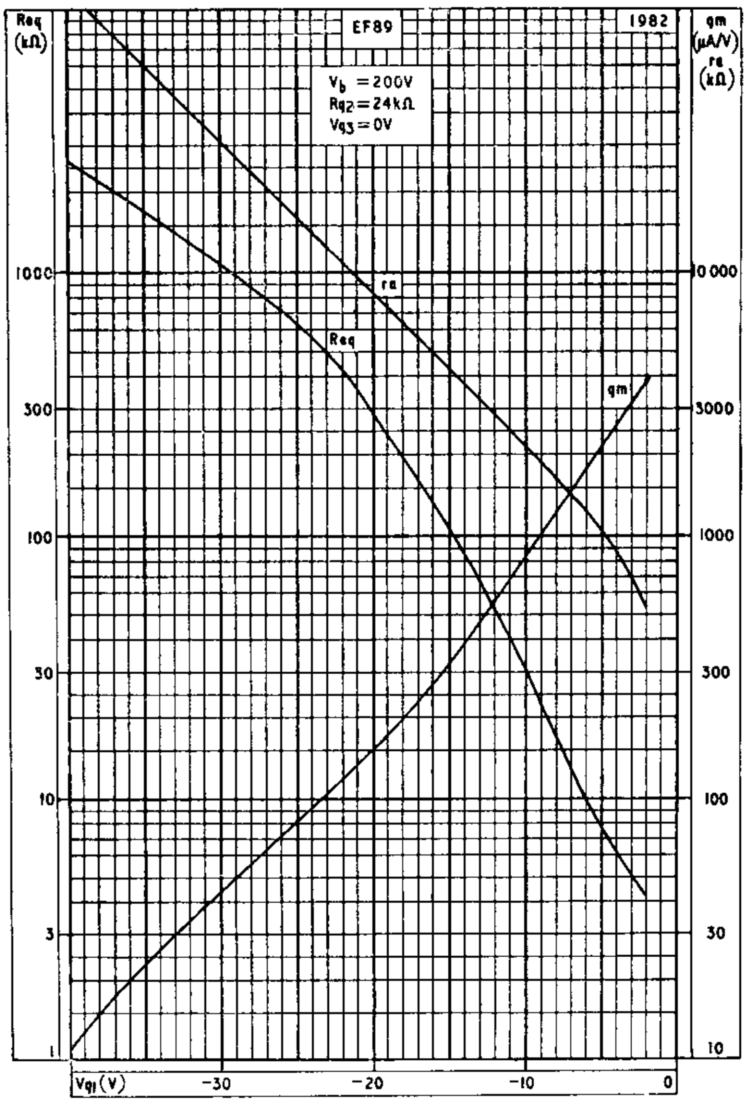


MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL GRID VOLTAGE FOR VARIOUS SCREEN-GRID VOLTAGES

VARIABLE-MU R.F. PENTODE

EF89

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

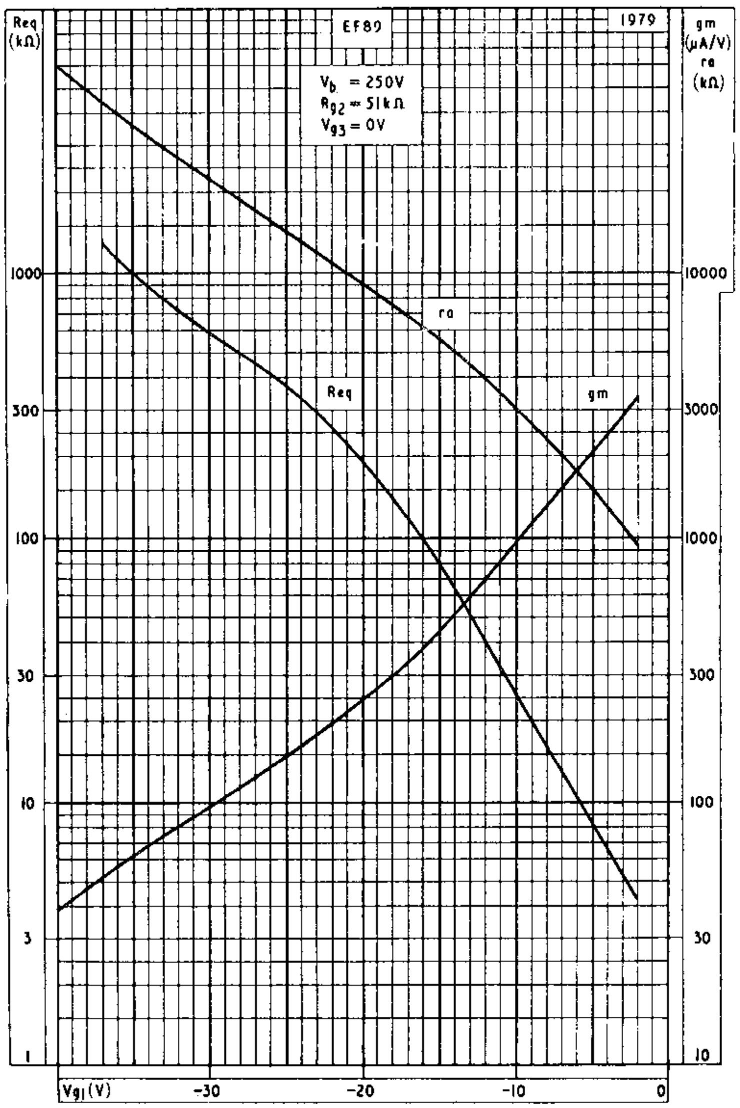


MUTUAL CONDUCTANCE, ANODE IMPEDANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE V_b = 200V

EF89

VARIABLE-MU R.F. PENTODE

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

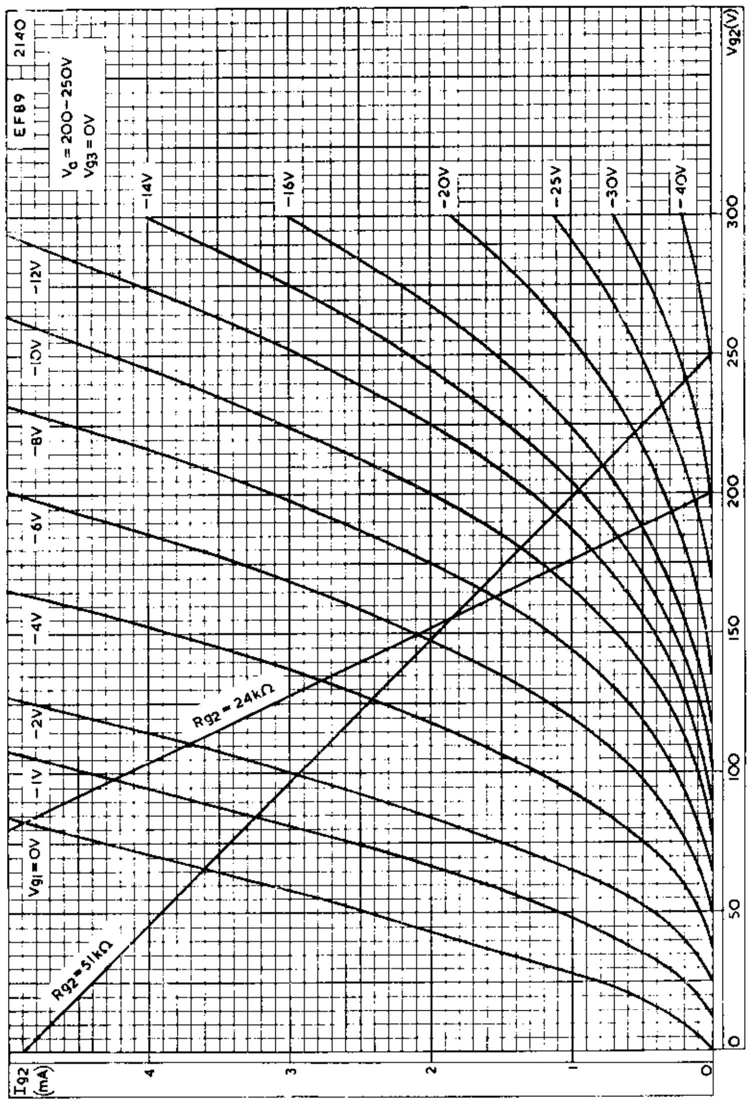


MUTUAL CONDUCTANCE, ANODE IMPEDANCE AND EQUIVALENT NOISE RESISTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE V_b=250V

VARIABLE-MU R.F. PENTODE

EF89

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

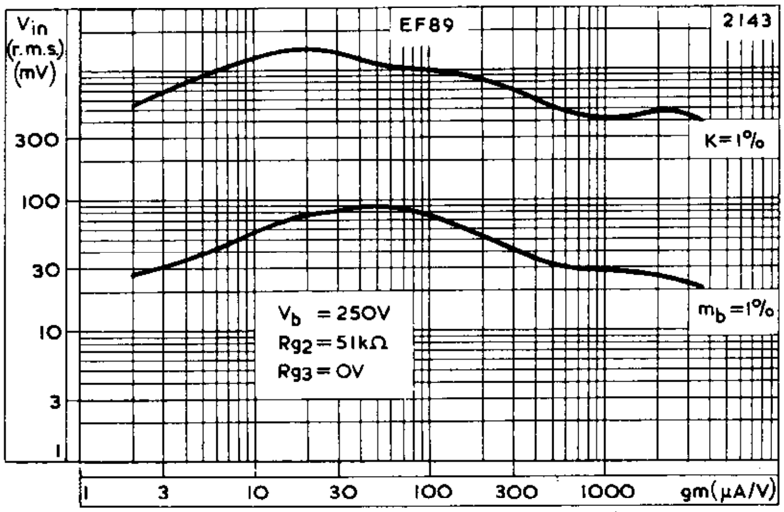


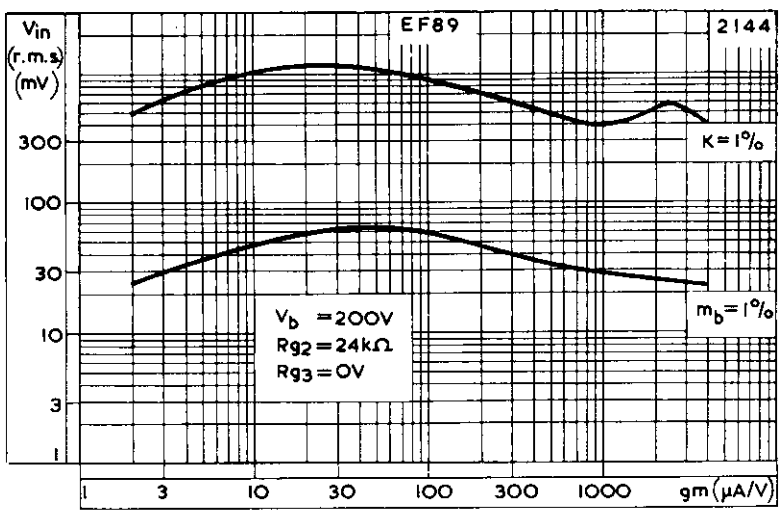
SCREEN-GRID CURRENT PLOTTED AGAINST SCREEN-GRID VOLTAGE FOR VARIOUS CONTROL-GRID VOLTAGES

EF89

VARIABLE-MU R.F. PENTODE

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





CROSS MODULATION AND MODULATION HUM CURVES

R.F. PENTODE

EF91

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

HEATER

Suitable for series or parallel operation

V_h	6.3	V
I_h	300	mA

CAPACITANCES

	Unshielded	Shielded	←
c_{in}	7.1	7.1	pF
c_{out}	2.1	3.1	pF
c_{a-g1}	<20	<10	mpF

CHARACTERISTICS

V_a	250	V
V_{g3}	0	V
V_{g2}	250	V
V_{g1}	−2.0	V
I_a	10	mA
I_{g2}	2.6	mA←
g_m	7.6	mA/V
r_a	>500	kΩ←
μ_{g1-g2}	70	
R_{eq}	1.2	kΩ
r_{g1} (f = 50Mc/s)	6.5	kΩ←
V_{g3} for cut-off (I_a<50μA)	−120	V←

OPERATING CONDITIONS AS MIXER

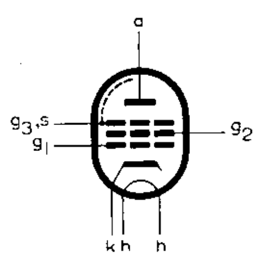
V_b	250	V
V_{g3}	0	V
R_k	470	Ω
R_{g1}	1.0	MΩ
I_a	6.0	mA←
I_{g2}	1.5	mA←
I_{g1}	2.0	μA←
$V_{osc\ (r.m.s.)}$	4.0	V←
g_c	2.5	mA/V
$g_{m(eff.)}$	3.2	mA/V←
r_a	880	kΩ←

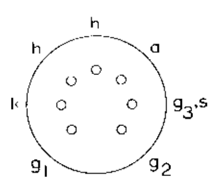
EF91

R.F. PENTODE

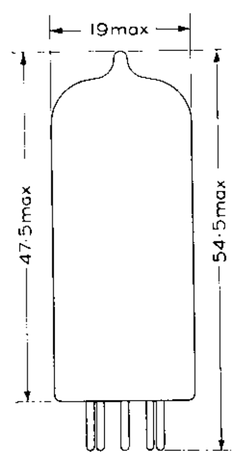
LIMITING VALUES

$V_{a(b)}$ 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.	650	mW
$-V_{g1}$ max.	50	V
I_k max.	15	mA
R_{g1-k} max.	250	kΩ ←
V_{h-k} max.	150	V
T_{bulb} max.	210	°C ←



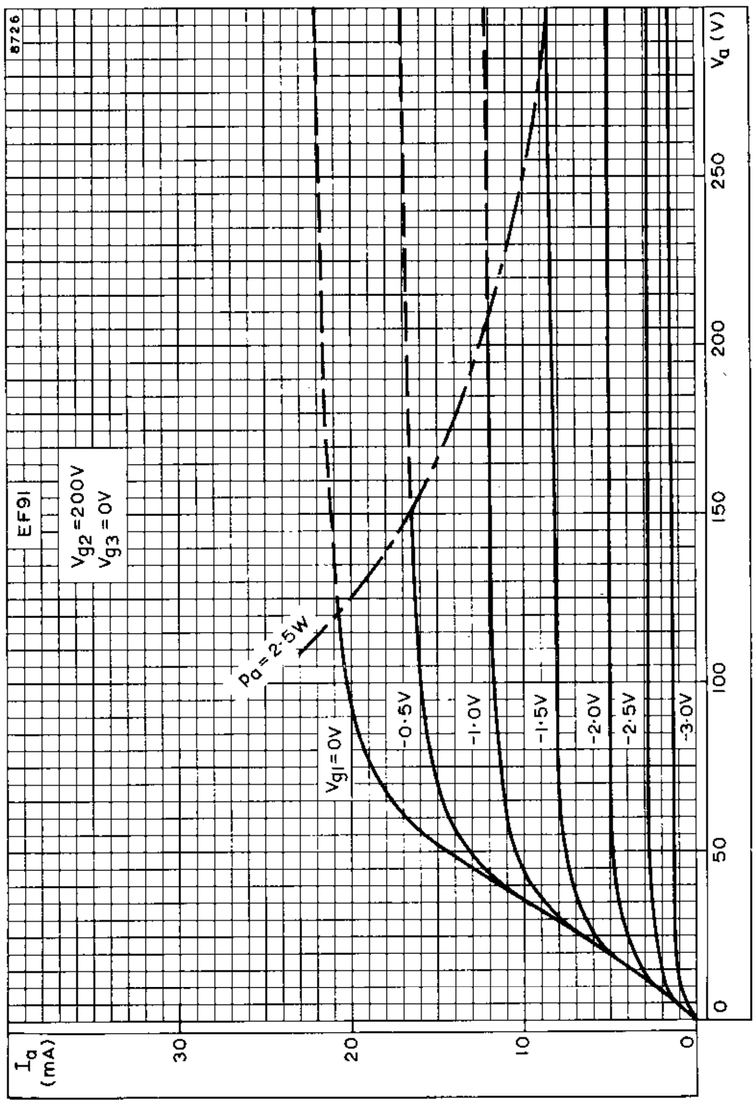


B7G Base

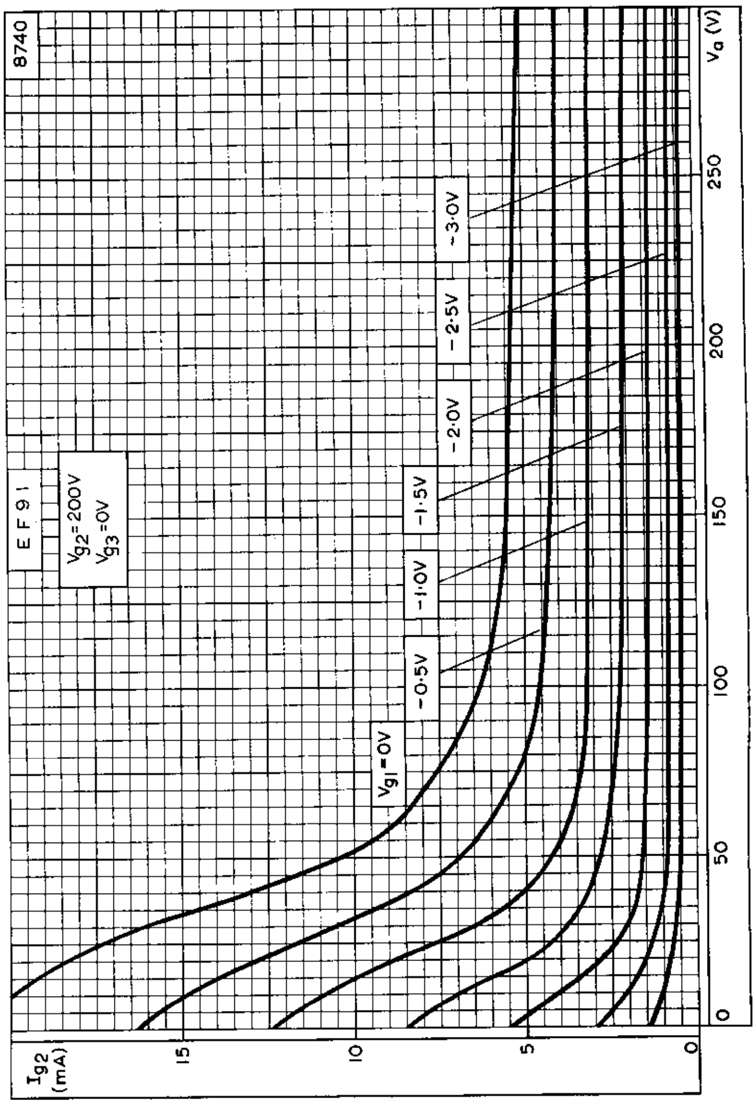


All dimensions in mm

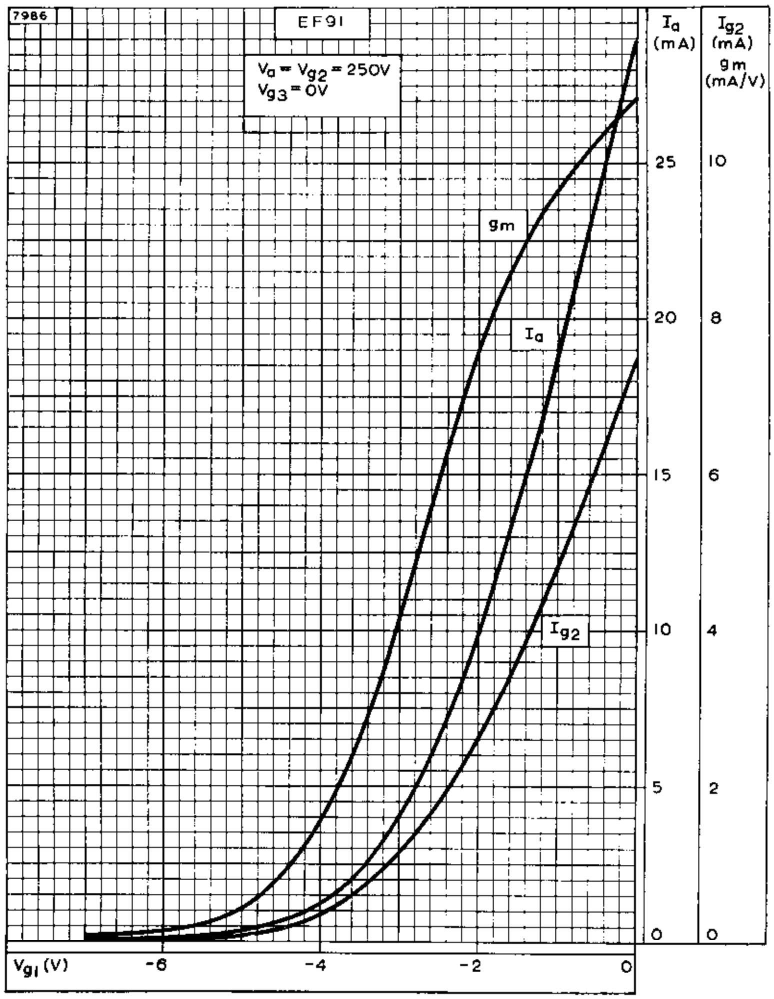
8723



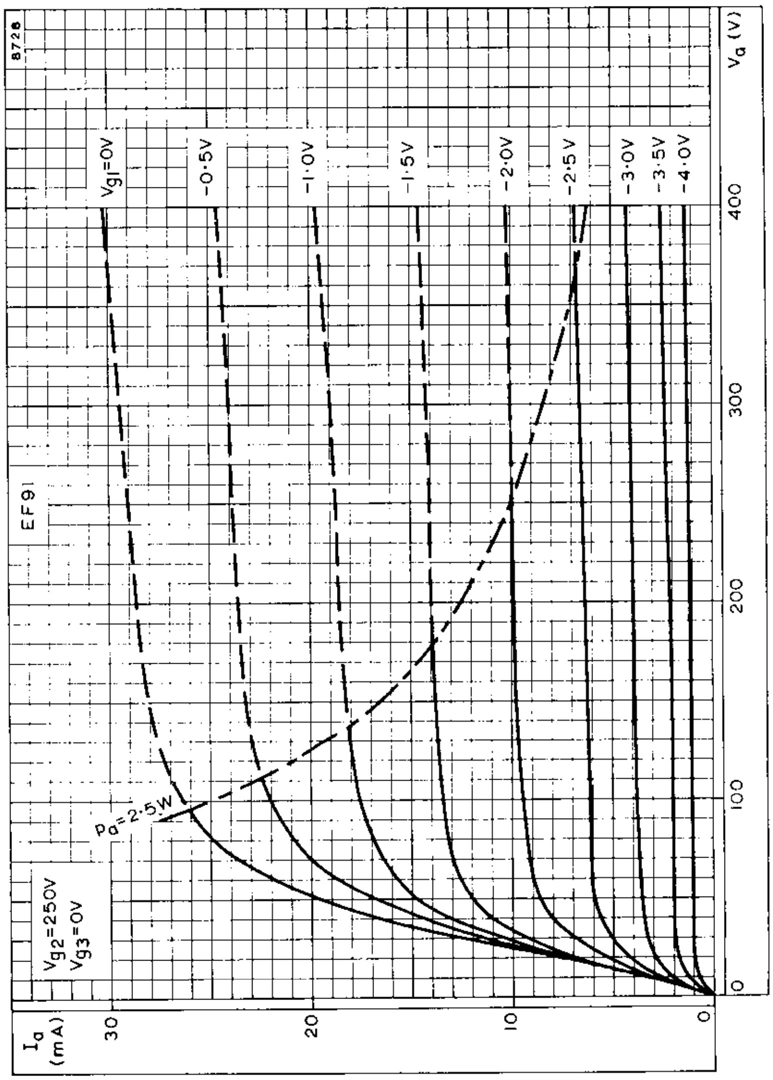
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$



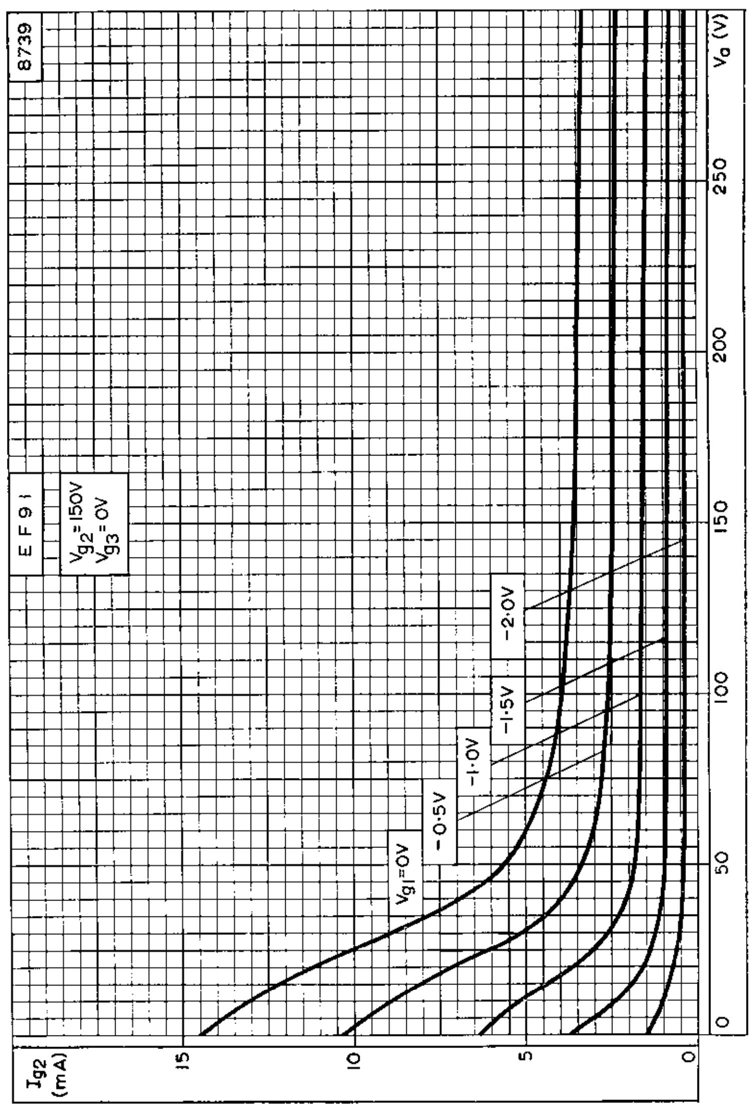
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 200V$



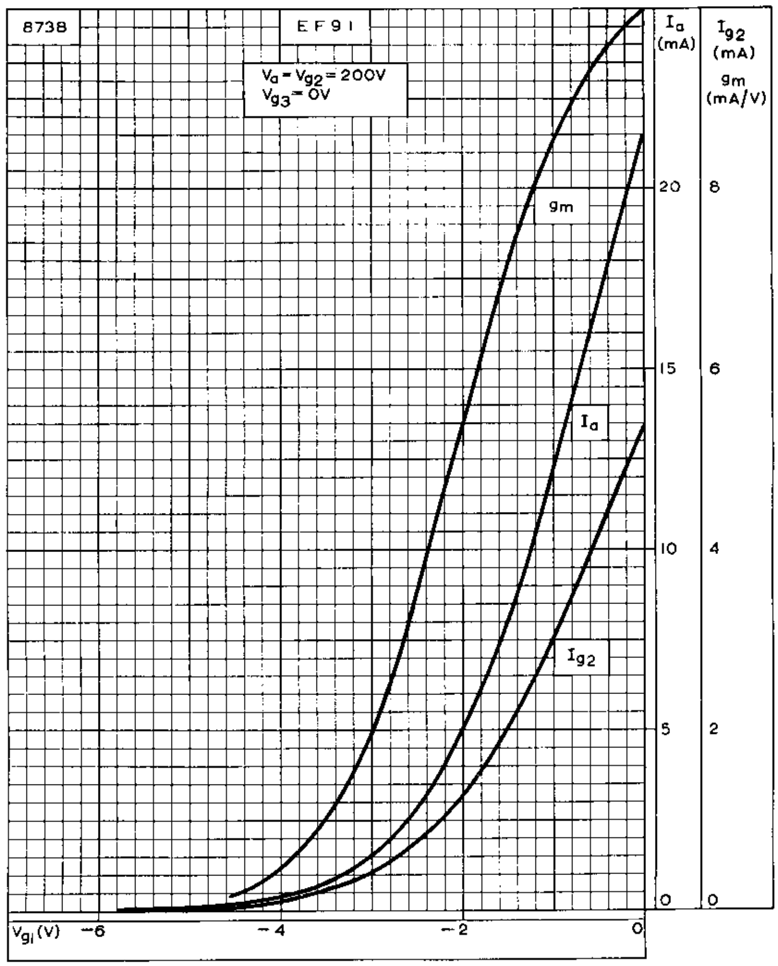
ANODE CURRENT, SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 250V$



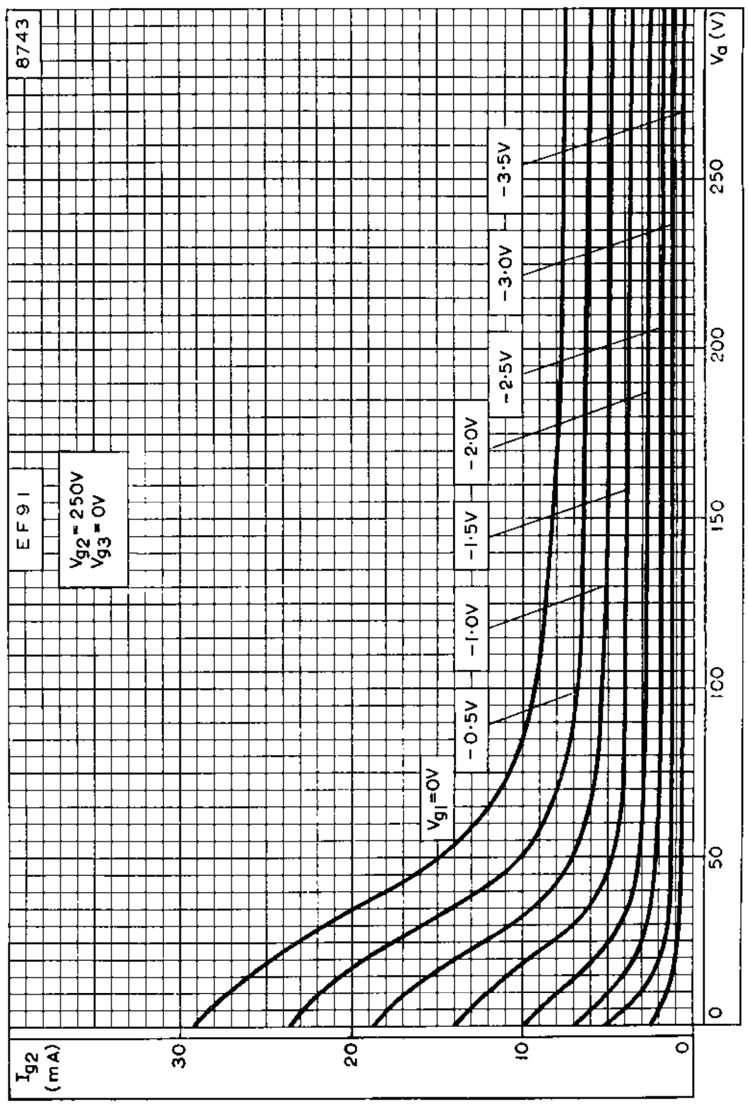
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 250V



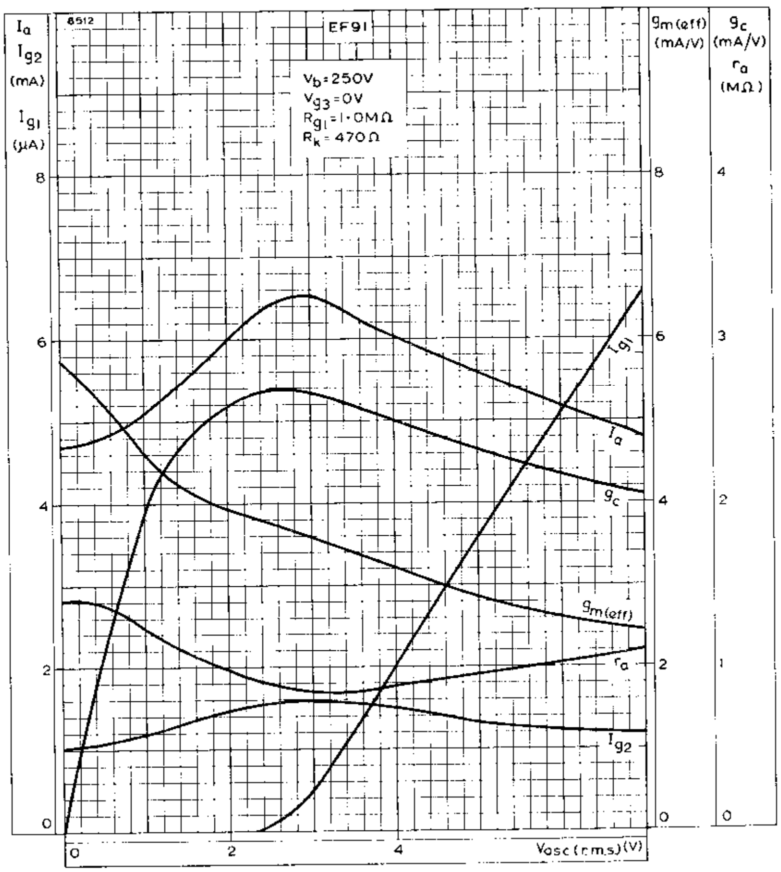
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 150V



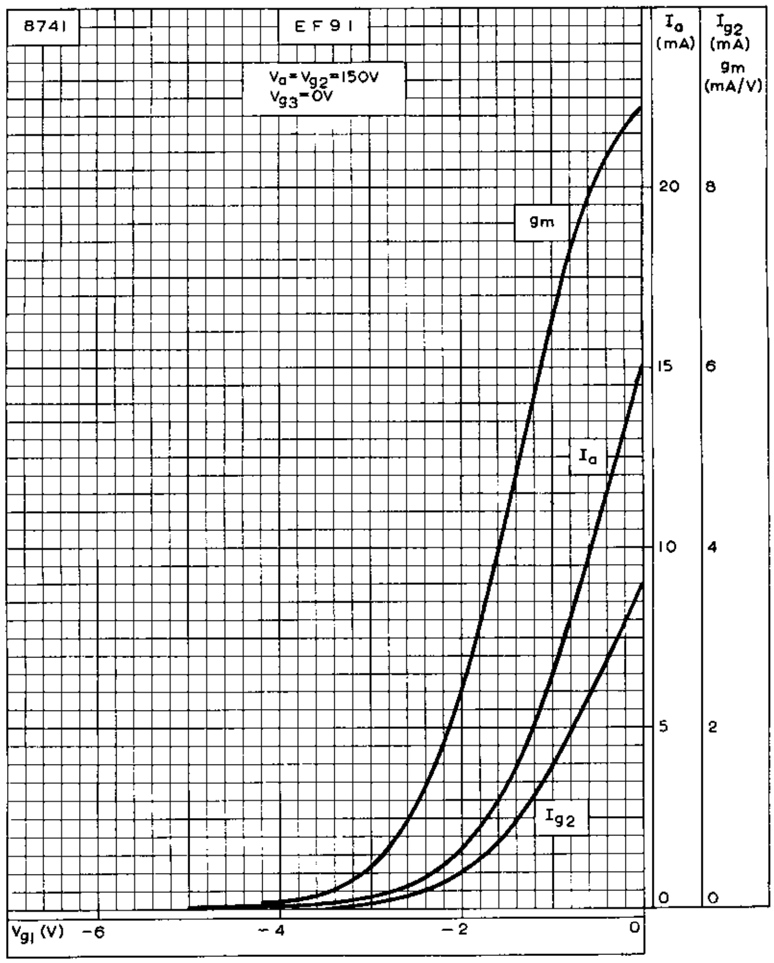
ANODE CURRENT, SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 200V$



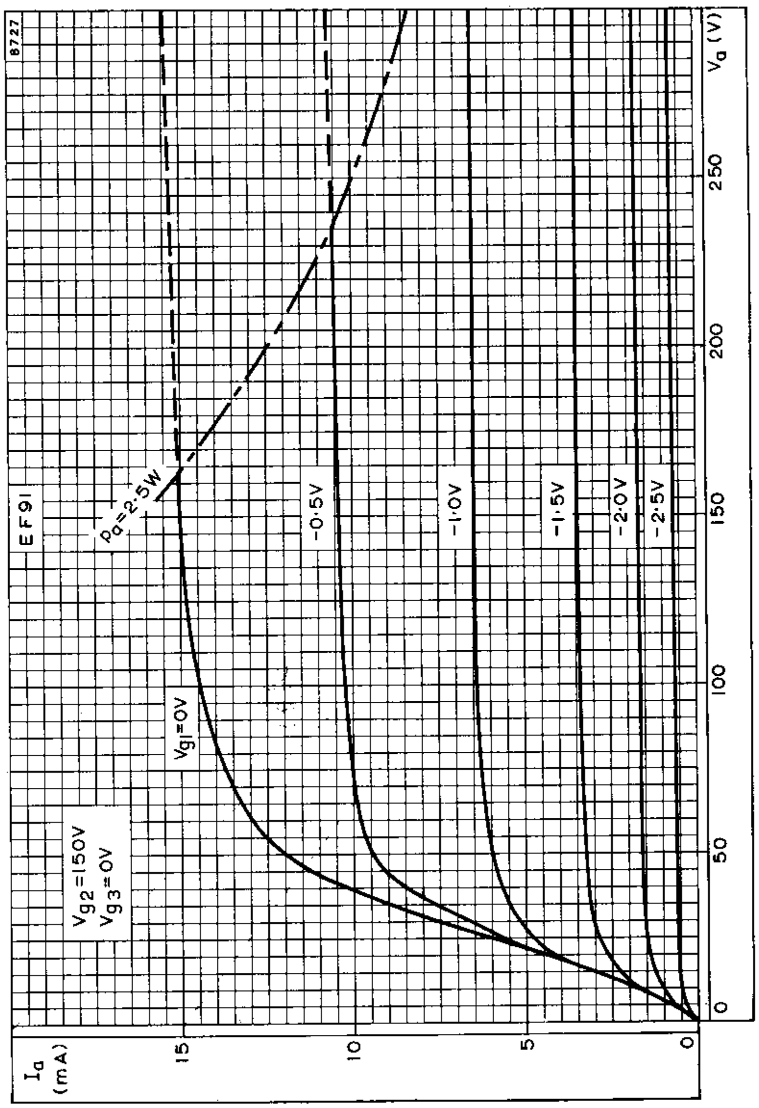
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 250V$



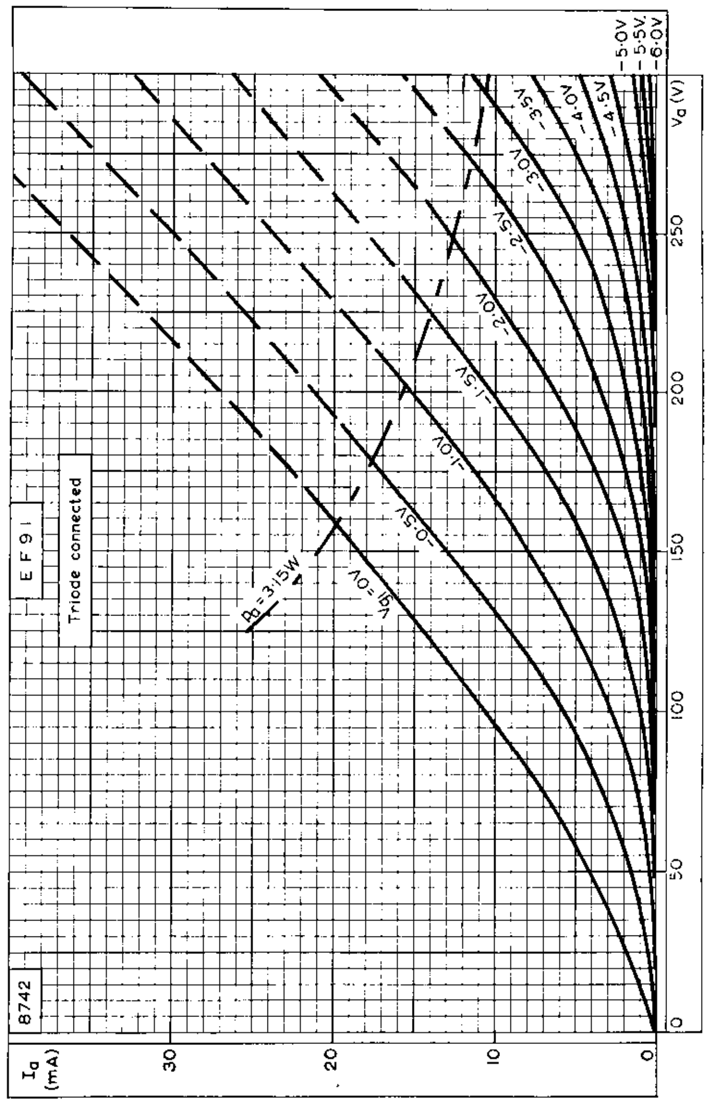
PERFORMANCE CURVES WHEN USED AS FREQUENCY CHANGER



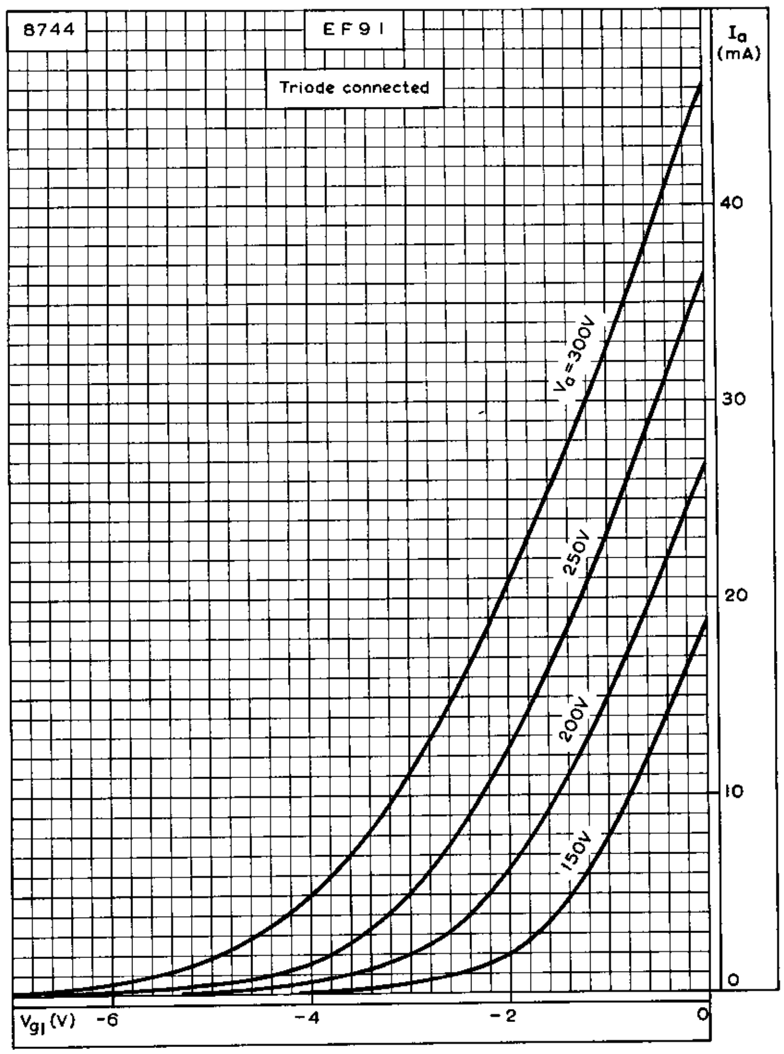
ANODE CURRENT, SCREEN-GRID CURRENT AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 150V$



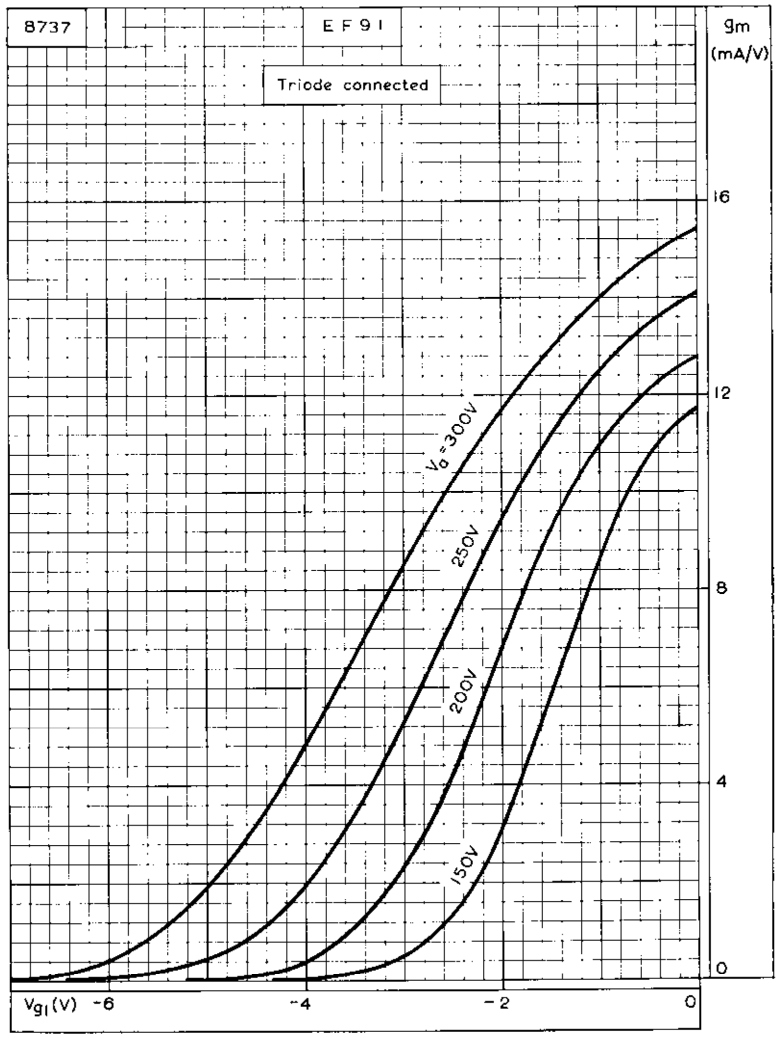
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL GRID VOLTAGE AS PARAMETER. V_{g2} = 150V



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



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



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

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

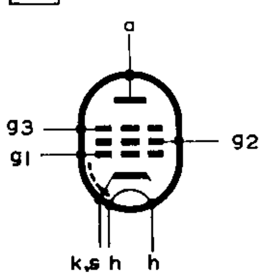
EF97

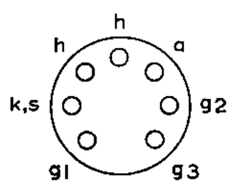
R.F. PENTODE

LIMITING VALUES

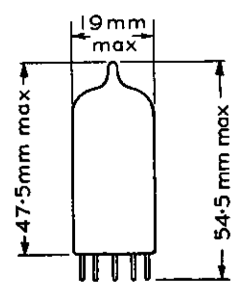
V_a max.	50	V
p_a max.	500	mW
V_{g3} max.	50	V
V_{g2} max.	50	V
p_{g2} max.	500	mW
I_k max.	15	mA
R_{g1} max.	22	MΩ
R_{g3} max.	5.0	MΩ
V_{h-k} max.	50	V

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 $R_{g1} = 10M\Omega$

EF98

PENTODE

OPERATING CONDITIONS AS A TRANSISTOR DRIVER STAGE

(driven by triode section of ECH83)

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

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

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

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

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

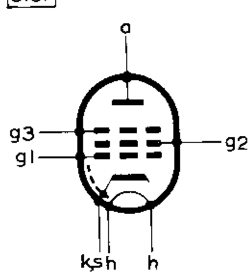
$V_a = V_b$	6.3	12.6	25	V
R_{g3}	100	100	100	kΩ
R_{g2}	12	6.8	22	kΩ
$V_{osc(r.m.s.)}$	6.0	6.0	12	V
V_{g1}	*	*	*	V
I_a	0.25	1.05	1.1	mA
I_{g2}	300	950	900	µA
g_c	310	675	705	µA/V
r_a	80	45	65	kΩ

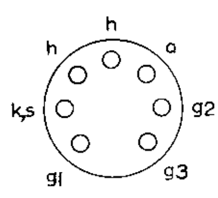
*Obtained by grid current biasing, R_{g1} = 10MΩ.

LIMITING VALUES

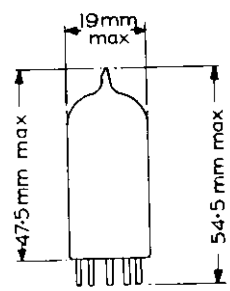
V_a max.	50	V
p_a max.	500	mW
V_{g3} max.	50	V
V_{g2} max.	50	V
p_{g2} max.	500	mW
I_k max.	15	mA
R_{g1} max.	22	MΩ
R_{g3} max.	100	kΩ
V_{h-k} max.	50	V

5101





B7G Base



DUAL-CONTROL HEPTODE

EH90

Dual-control heptode for use in television receivers.

HEATER

V_h	6.3	V
I_h	300	mA

CAPACITANCES

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

CHARACTERISTICS

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

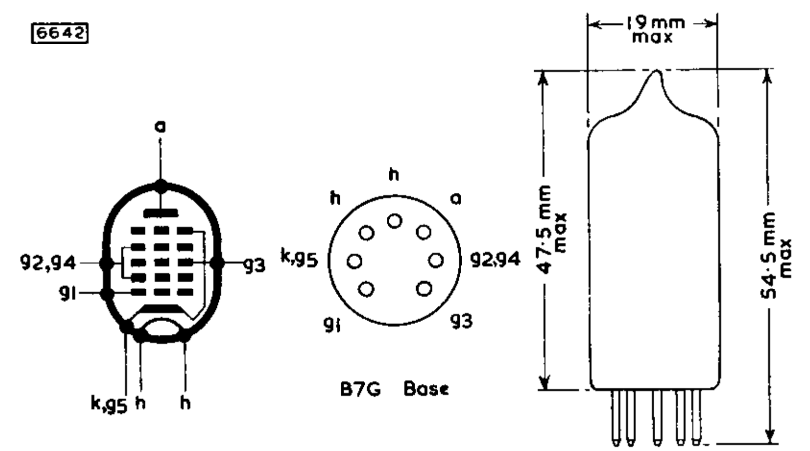
DESIGN CENTRE RATINGS

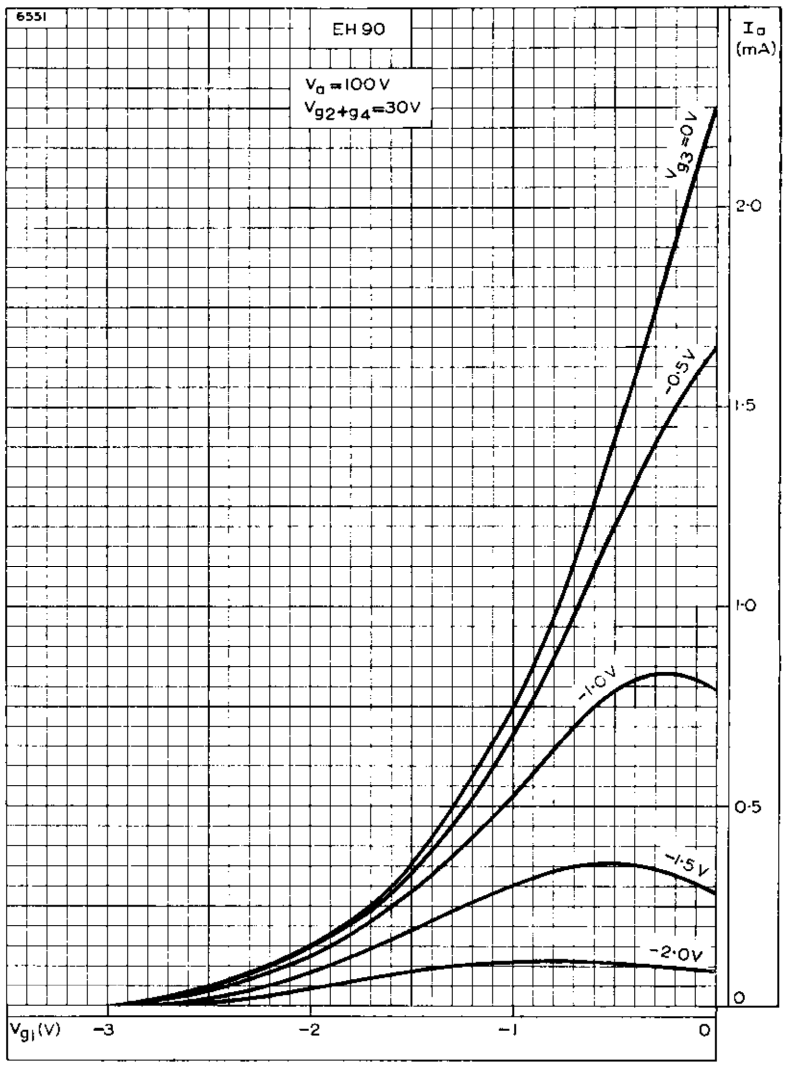
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	1.0	W
$V_{g2+g4(b)}$ max.	300	V
V_{g2+g4} max.	100	V
p_{g2+g4} max.	1.0	W
I_k max.	14	mA
R_{g1-k} max.	470	kΩ
R_{g3-k} max.	2.2	MΩ
R_{g3-k} max. ($V_{g2+g4} \leq 30V$)	5.0	MΩ
V_{h-k} max. (cathode positive)	200	V
V_{h-k} max. (cathode negative)	100	V

EH90

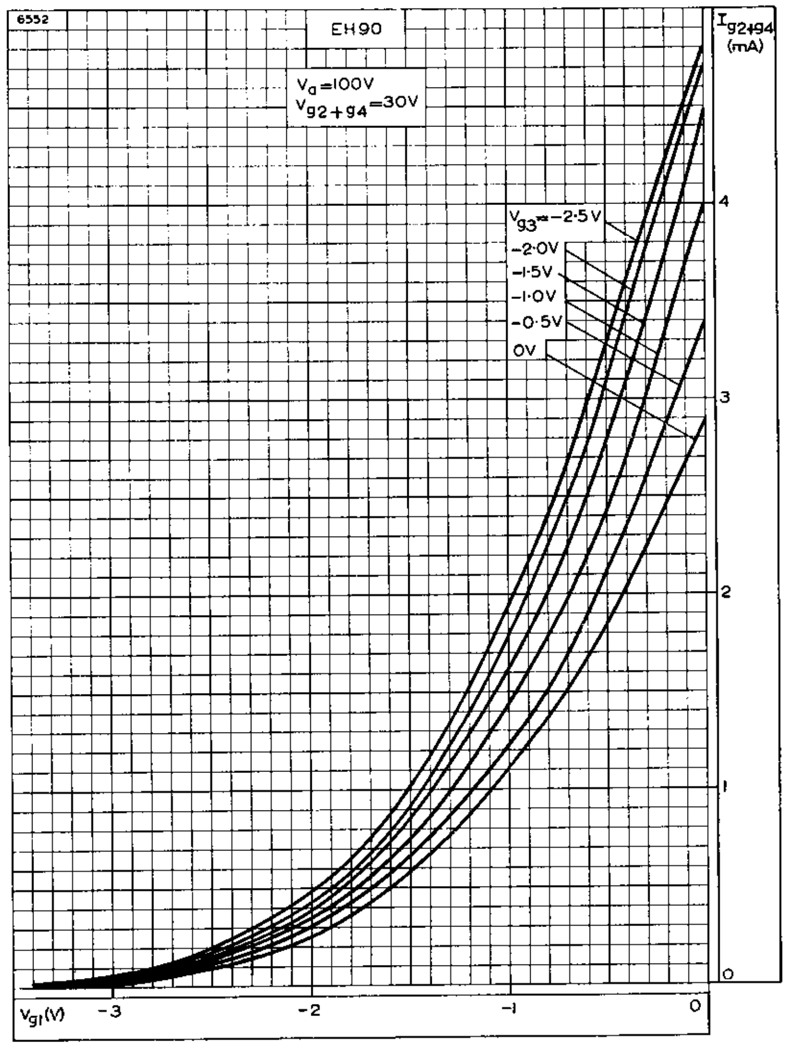
DUAL-CONTROL HEPTODE

6642

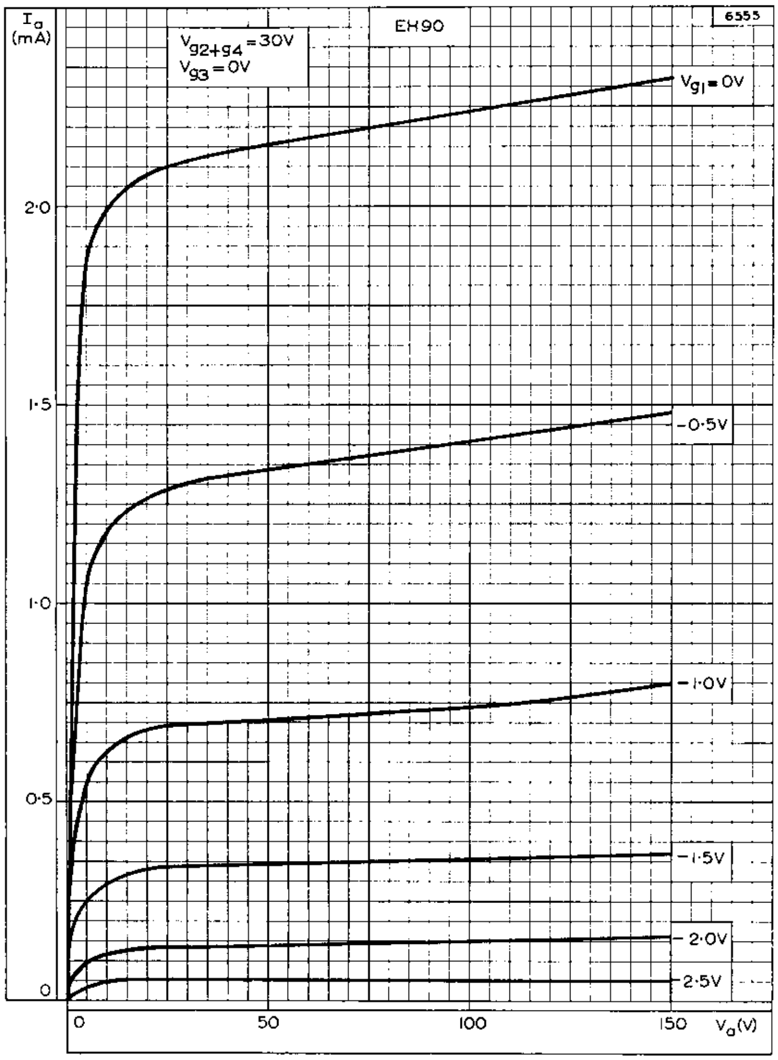




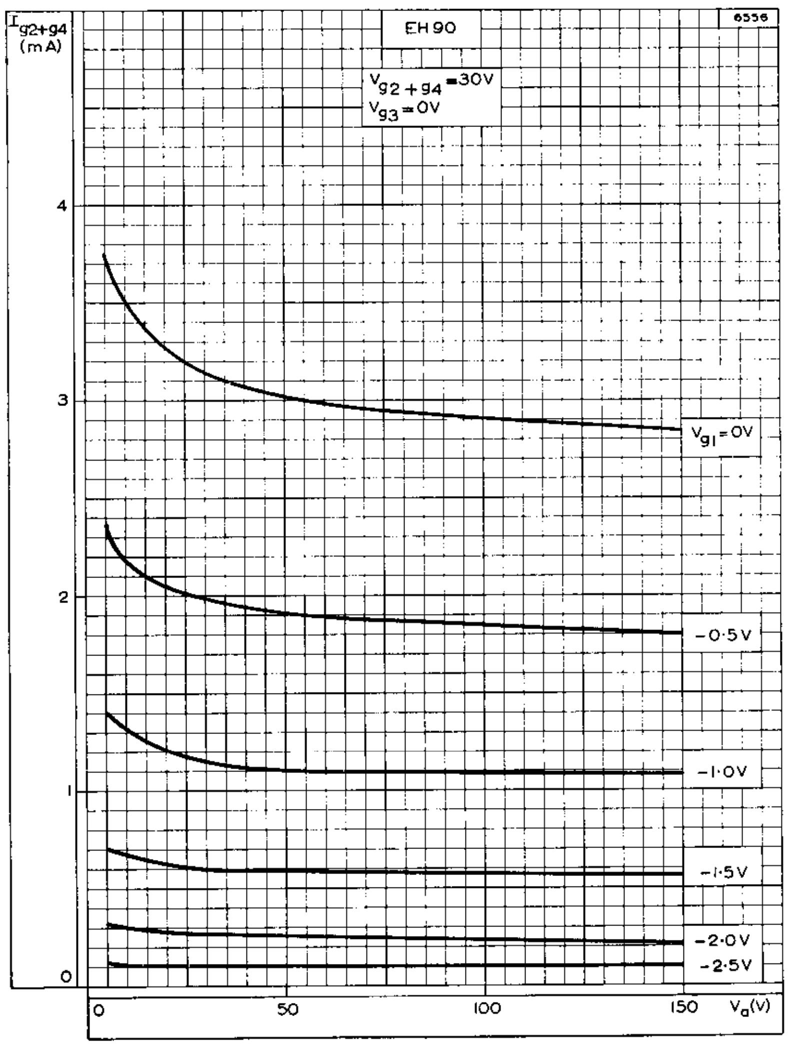
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID (g_1) VOLTAGE WITH CONTROL-GRID (g_3) VOLTAGE AS PARAMETER



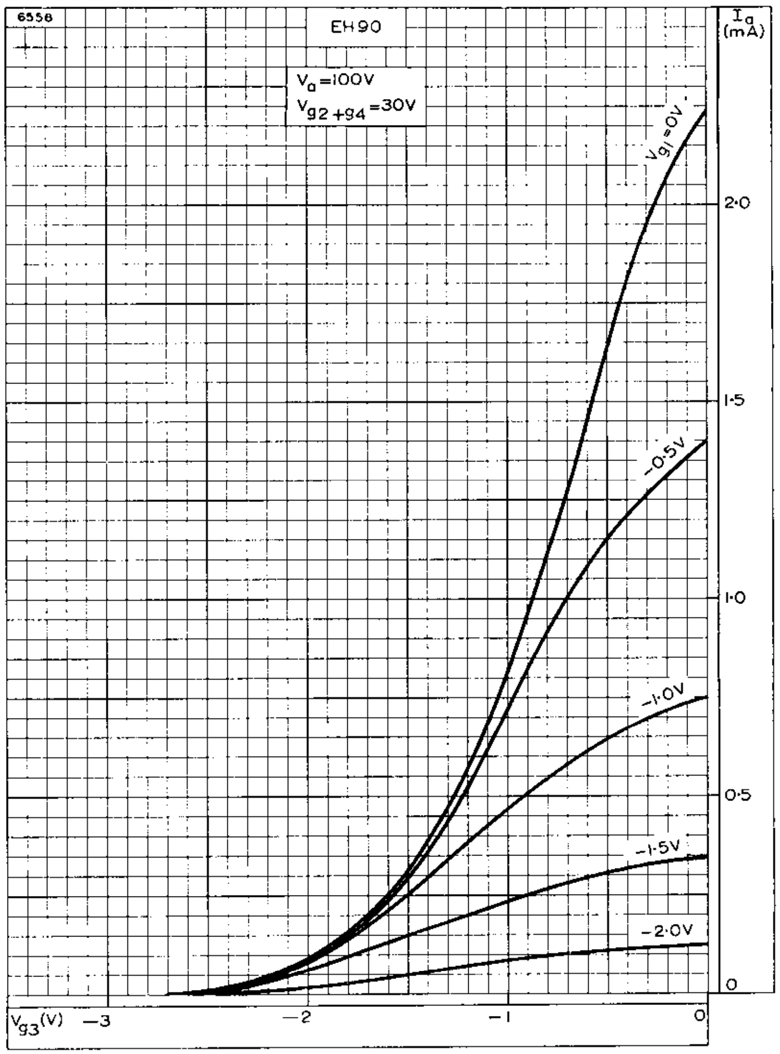
SCREEN-GRID CURRENT PLOTTED AGAINST CONTROL-GRID (g_1) VOLTAGE WITH CONTROL-GRID (g_3) VOLTAGE AS PARAMETER



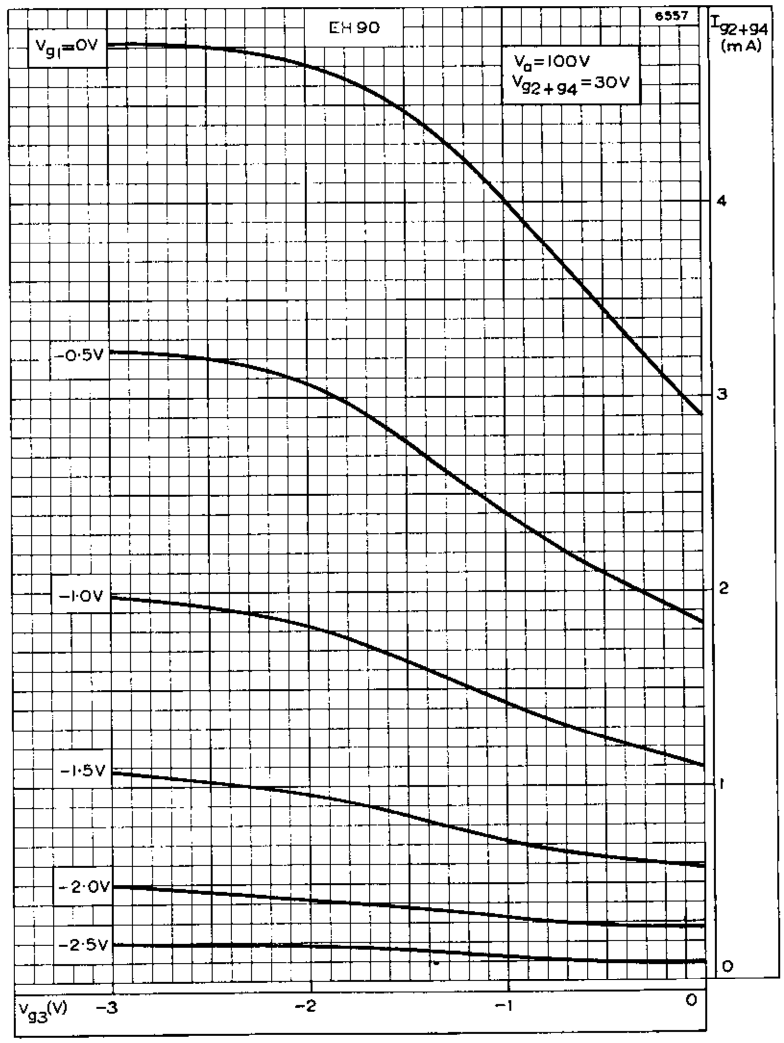
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID (g_1) VOLTAGE AS PARAMETER



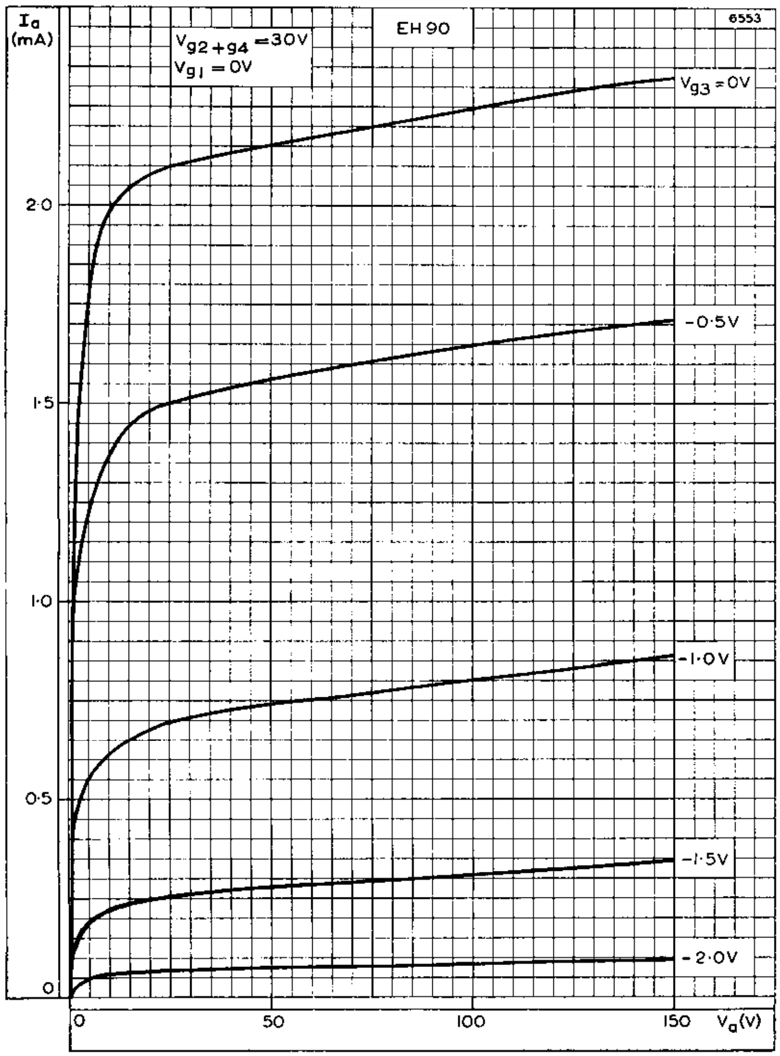
SCREEN-GRID CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID (g_1) VOLTAGE AS PARAMETER



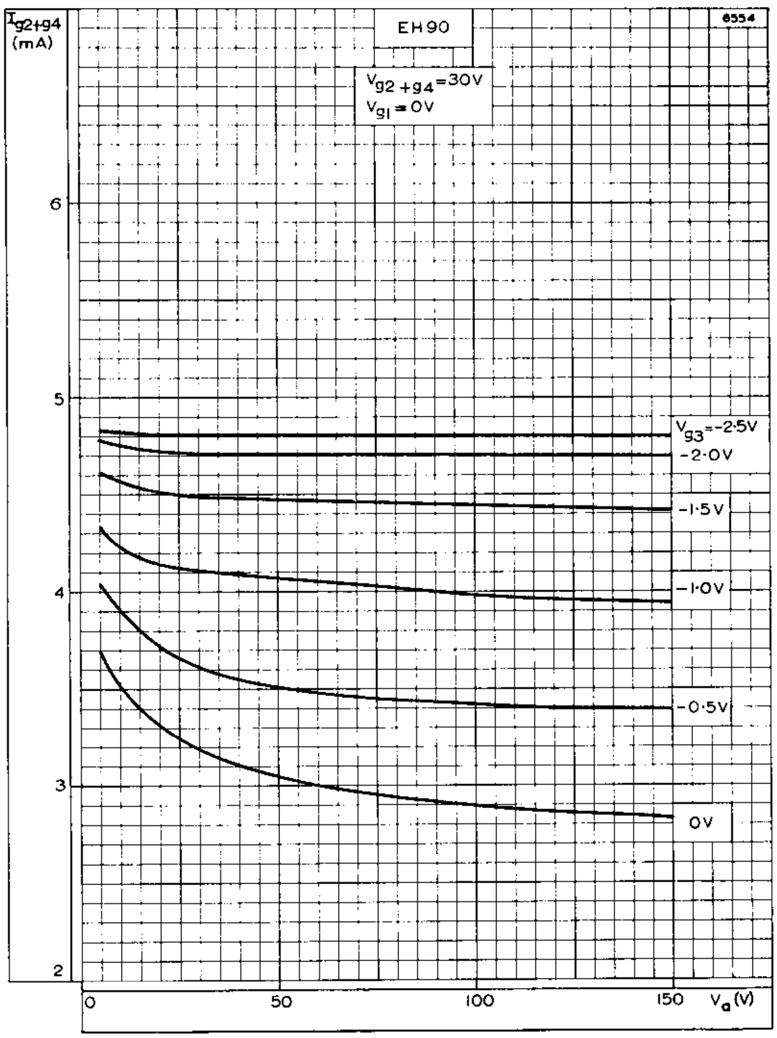
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID (g_3) VOLTAGE WITH CONTROL-GRID (g_1) VOLTAGE AS PARAMETER



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



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



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

OUTPUT PENTODE

EL33

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

HEATER

V_h	6.3	V
I_h	0.9	A

CAPACITANCE

c_{a-g1}	1.0	μμF

OPERATING CONDITIONS AS CLASS "A" AMPLIFIER

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

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

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

OPERATING CONDITIONS AS TRIODE (g_2 connected to a)

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

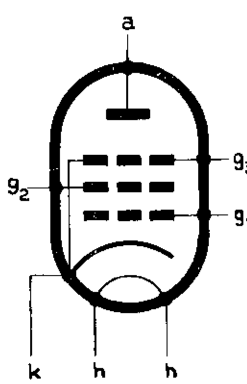
EL33

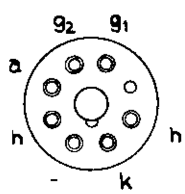
OUTPUT PENTODE

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

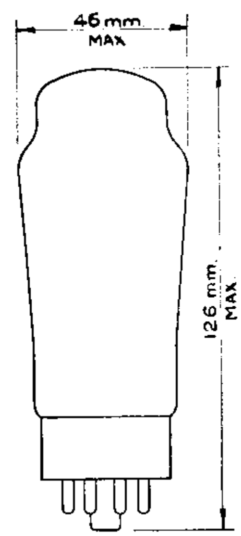
LIMITING VALUES

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	9.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	275	V
p_{g2} max. (zero sig.)	1.2	W
p_{g2} max. (max. sig.)	2.5	W
I_k max.	55	mA
V_{g1} max. ($I_{g1} = 0.3\mu A$)	−1.3	V
R_{g1-k} max.	1.0	MΩ
V_{h-k} max.	50	V
R_{h-k} max.	5.0	kΩ





OCTAL BASE



OUTPUT PENTODE

EL34

Output pentode rated for 25W anode dissipation, intended for use in a.c. mains operated equipment.

HEATER

V_h	6.3	V
I_h	1.5	A

CAPACITANCES

c_{out}	8.4	pF
c_{in}	15.2	pF
c_{a-g1}	<1.0	pF
c_{g1-h}	<1.0	pF
c_{h-k}	11	pF

CHARACTERISTICS

Pentode connection

V_a	250	V
V_{g2}	250	V
V_{g3}	0	V
I_a	100	mA
I_{g2}	15	mA
V_{g1}	-12.2	V
g_m	11	mA/V
r_a	15	kΩ
μ_{g1-g2}	11	
V_{g1} max. ($I_{g1} = +0.3\mu A$)	-1.3	V

Triode connection
(g_2 connected to a)

V_a	250	V
I_a	70	mA
V_{g1}	-15.5	V
g_m	11.5	mA/V
r_a	910	Ω
μ	10.5	

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER

Pentode connection

V_a	250	300	V
V_{g2}	250	300	V
V_{g3}	0	0	V
R_k	106	190	Ω
R_a	2.0	3.5	kΩ
I_a	100	83	mA
I_{g2}	15	13	mA
$V_{in(r.m.s.)}$ (P_{out} = 50mW)	500	450	mV
$V_{in(r.m.s.)}$	8.0	8.2	V
*P_{out}	11	11	W
*D_{tot}	10	10	%

*P_{out} and D_{tot} are measured at fixed bias and therefore represent the power output available during the reproduction of speech and music. When a sustained sine wave is applied to the control-grid the bias across the cathode resistor will readjust itself as a result of the increased anode and screen-grid currents. This will result in a reduction in power output of approximately 10%.

EL34

OUTPUT PENTODE

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

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

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

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

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

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

Fixed bias

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

*Screen-grid resistor common to both valves.

Cathode bias

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

*Screen-grid resistor common to both valves.

OPERATING CONDITIONS FOR TWO VALVES IN PUSH-PULL

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

With R_k bypassed

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

With R_k unbypassed

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

EL34

OUTPUT PENTODE

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

Fixed bias

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

Cathode bias

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

DESIGN CENTRE RATINGS

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

Triode connected

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

OUTPUT PENTODE

EL37

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

HEATER

V_h	6.3	V
I_h	1.4	A

CAPACITANCES

c_{out}	9.0	pF
c_{in}	17.5	pF
c_{a-g1}	1.0	pF

OPERATING CONDITIONS AS PENTODE

V_a	250	V
V_{g2}	250	V
V_{g1}	−13.5	V
I_a	100	mA
I_{g2}	13.5	mA
R_k	120	Ω
g_m	11	mA/V
r_a	13.5	kΩ
μ_{g1-g2}	10	
R_a	2.5	kΩ
$V_{in\ (r.m.s.)}$ (P_{out} = 50mW)	0.45	V
P_{out} (D_{tot} = 10%)	10.5	W
$V_{in\ (r.m.s.)}$ (start of I_{g1})	10.8	V
D_{tot} (start of I_{g1})	13.5	%
P_{out} (start of I_{g1})	11.5	W

OPERATING CONDITIONS — TWO VALVES IN PUSH-PULL
(Self Bias)

V_a	250	325	V
V_{g2}	250	325	V
$I_{a(o)}$	2×59	2×77	mA
I_a (max. sig.)	2×68	2×90	mA
$I_{g2(o)}$	2×7.5	2×9.75	mA
I_{g2} (max. sig.)	2×18	2×30	mA
R_k	130	130	Ω
R_{a-a}	4.0	4.0	kΩ
P_{out}	20	35	W
$V_{in\ (g1-g1)\ (r.m.s.)}$	29	43	V
D_{tot}	2.25	4.4	%

EL37

OUTPUT PENTODE

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

OPERATING CONDITIONS — TWO VALVES IN PUSH-PULL
(Fixed Bias)

V_a	350	400	V
V_{g2}	350	400	V
$I_{a(0)}$	2×40	2×50	mA
I_a (max. sig.)	2×118	2×138	mA
$I_{g2(0)}$	2×5	2×6	mA
I_{g2} (max. sig.)	2×29	2×36	mA
V_{g1}	−31	−36	V
R_{a-a}	3.25	3.25	kΩ
P_{out}	46	69	W
$V_{in\ (g1-g1)\ (r.m.s.)}$	43.4	49	W
D_{tot}	2.8	2.5	%

OPERATING CONDITIONS AS SINGLE VALVE, TRIODE CONNECTED
(Grid 2 connected to anode by 100 Ω resistor)

V_a	300	400	V
I_a	50	37.5	mA
V_{g1}	—26	—39	V
g_m	6.5	4.5	mA/V
μ	9.0	9.0	
r_a	1.4	2.0	kΩ

OPERATING CONDITIONS AS PUSH-PULL PAIR, TRIODE CONNECTED (Self Bias)

V_b	350	435	V
V_a	320	400	V
$I_{a+g2(0)}$	2×56	2×70	mA
I_{a+g2} (max. sig.)	2×64	2×80	mA
p_{a+g2}	2×18	2×28	W
R_k	245	245	Ω
R_{a-a}	4.0	4.0	kΩ
$V_{in\ (r.m.s.)}$	2×21.5	2×27.2	V
P_{out}	12.5	20.6	W
D_{tot}	4.1	4.3	%

LIMITING VALUES — PENTODE CONNECTED

$V_{a(b)}$ max.	800	V
V_a max.	400	V
$V_{g2(b)}$ max.	800	V
V_{g2} max.	400	V
V_{g1} max. ($I_{g1} = +0.3\mu A$)	−1.3	V
V_{h-k} max.	75	V
R_{h-k} max.	5.0	kΩ

OUTPUT PENTODE

EL37

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

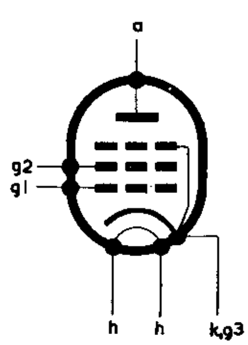
R_{g1-k} max. (cathode bias)	500	kΩ
R_{g1-k} max. (fixed bias)	100	kΩ
p_a max.	25	W
p_{g2} max.	6.0	W
I_k max.	200	mA

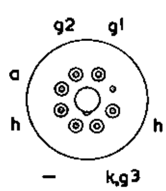
LIMITING VALUES — TRIODE CONNECTED (NORMAL APPLICATIONS)

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

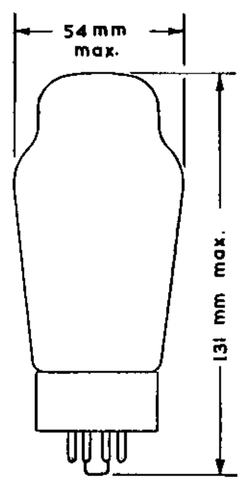
LIMITING VALUES — TRIODE CONNECTED (IN CATHODE-COUPLED PUSH-PULL DRIVER STAGE FOR LARGE POWER TRIODES)

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





OCTAL BASE

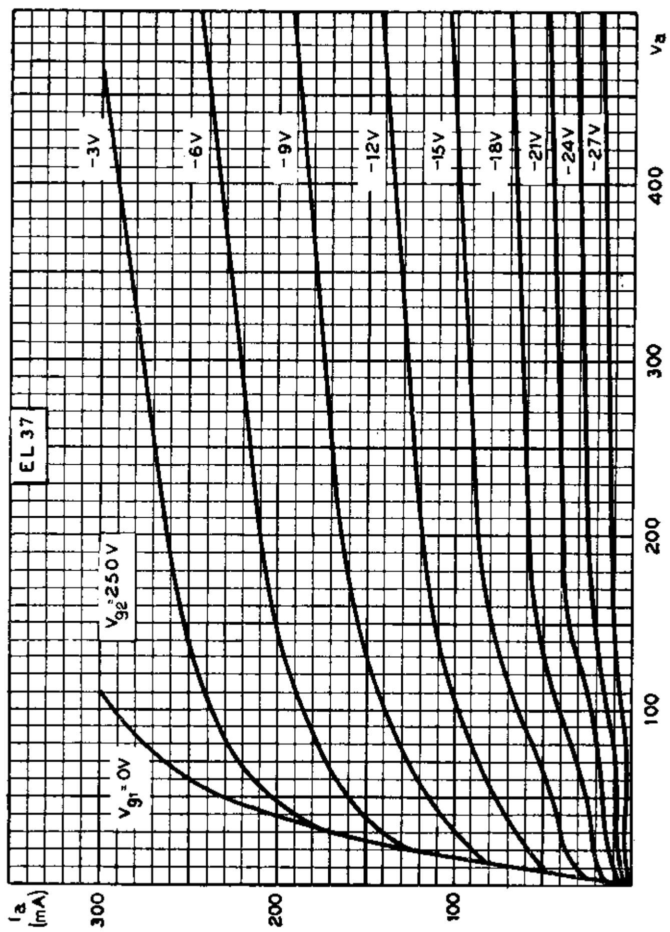


473

EL37

OUTPUT PENTODE

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



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

OUTPUT PENTODE

EL38

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

HEATER

	V_h	6.3	V
	I_h	1.4	A

CAPACITANCES

	c_{in}	18	pF
	c_{out}	8.0	pF←
	c_{a-g1}	<1.2	pF

CHARACTERISTICS

	V_a	275	V
	V_{g2}	275	V
	I_a	91	mA
	I_{g2}	11	mA
	V_{g1}	-9	V
	g_m	14	mA/V
	μ_{g1-g2}	16.5	
	r_a	20	kΩ

OPERATION AS LINE OUTPUT PENTODE

Circuit design

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

	V_a	90	V
	V_{g2}	275	V
	I_a	150	mA

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

	V_a	90	V
	V_{g2}	275	V
	V_{g1}	-1	V
	I_a	225	mA

Typical circuit (See circuit on page 3)

	V_b	300	V
For EL38	I_a	64	mA
	I_{g2}	18	mA
	R_k	120	Ω
For EBC33	I_a	0.8	mA

N.B.—Above figures measured under synchronised conditions.

LIMITING VALUES

	$V_{a(b)}$ max.	1.2	kV
	V_a max.	800	V
	$v_{a(pk)}$ max.	8	kV
	$V_{g2(b)}$ max.	800	V
	V_{g2} max.	400	V
	p_a max.	25	W
	p_{g2} max.	8	W
	I_k max.	200	mA
	V_{g1} max. ($I_{g1}=+0.3\ \mu A$)	-1.3	V
	R_{g1-k} max. ($p_a<25W$)	500	kΩ
	R_{g1-k} max. ($p_a<9\ W$)	800	kΩ
	V_{h-k} max.	100	V
	R_{h-k} max.	20	kΩ

EL38

OUTPUT PENTODE

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

CIRCUIT VALUES (see circuit on page 3)

Resistors

	Value	Wattage	Tolerance
R_1	47 kΩ	¼ W	20%
R_2	330 kΩ	¼ W	10%
R_3	50 kΩ	1 W	Potentiometer
R_4	680 Ω	¼ W	10%
R_5	820 kΩ	¼ W	20%
R_6	120 Ω	1 W	20%
R_7	500 Ω	4 W	Potentiometer
R_8	2.2 kΩ	¼ W	20%
R_9	2.5 kΩ	4 W	Potentiometer
R_{10}	2.7 kΩ	4 W	20%
R_{11}	100 Ω	¼ W	20%

Capacitors

	Value	Tolerance	Wkg. Voltage
C_1	0.1 μF	20%	350V
C_2	0.0022 μF	20%	350V
C_3	0.01 μF	10%	350V
C_4	0.001 μF	10%	350V
C_5	0.004–0.006 μF	—	500V

Transformers

T1 Ratio 1 : 3 (step-up into grid circuit)
T2 Ratio 4 : 1 primary inductance $\not<$1 H

Deflector coils

Resistance 3 Ω
Inductance 6.5 mH

To provide full scan for 9″ picture tube (V_{a2}=7kV) with peak to peak current swing of 500 mA.

Notes

(i) Synchronising pulses may be applied negatively to the anode or positively to the grid of the EBC33.

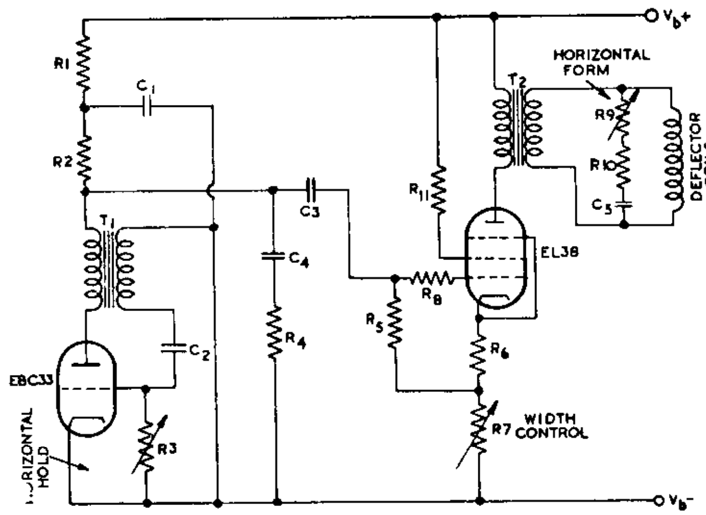
(ii) The decoupling components (R_1 C_1) in the anode circuit of the EBC33 are necessary only if there is ripple on the h.t. line.

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

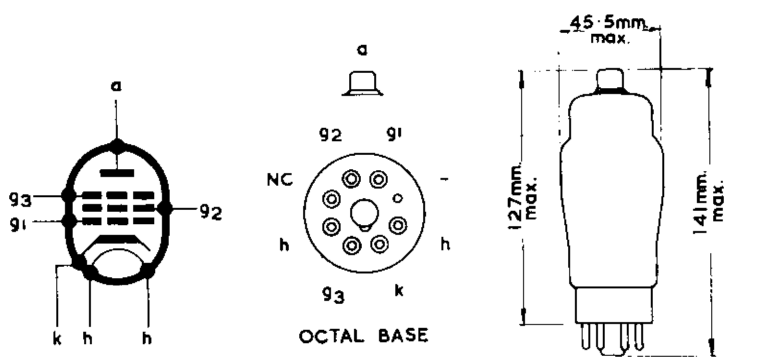
OUTPUT PENTODE

EL38

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



LINE TIME BASE CIRCUIT



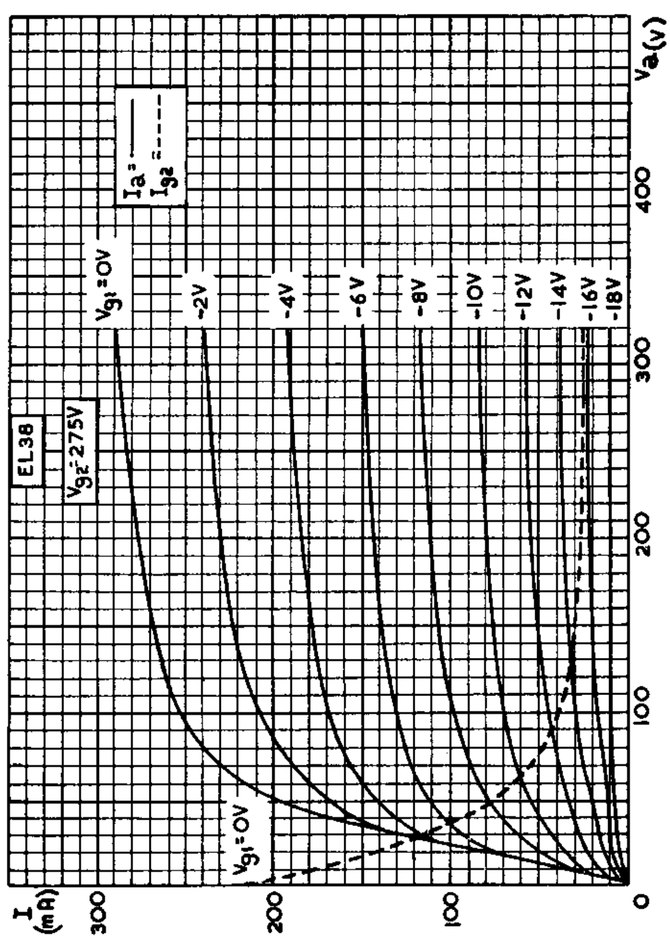
OCTAL BASE

732

EL38

OUTPUT PENTODE

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



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

OUTPUT PENTODE

EL41

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

HEATER

V_h	6.3	V
I_h	700	mA

MOUNTING POSITION

Any

CAPACITANCES

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

CHARACTERISTICS

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

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER

Pentode connection

V_a	250	V
V_{g2}	250	V
V_{g1}	–7	V
R_k	170	Ω
I_a	36	mA
I_{g2}	5.2	mA
R_a	7	kΩ
$V_{in\ (r.m.s.)}$ ($P_{out}=50mW$)	0.32	V
P_{out} ($D_{tot}=10\%$)	4.2	W
$V_{in\ (r.m.s.)}$ ($D_{tot}=10\%$)	3.7	V
P_{out} ($\eta=50\%$)	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
$I_{a(0)}$	2×25	2×30	mA
I_a (max. sig.)	2×30	2×36	mA
$I_{g2(0)}$	2×3.5	2×4	mA
I_{g2} (max. sig.)	2×8	2×9.5	mA
R_k	140	140	Ω
R_{a-a}	9	9	kΩ
P_{out}	9	13	W
$V_{in\ (g-g)\ (r.m.s.)}$	14	17	V
D_{tot}	2.5	2.5	%

OPERATING CONDITIONS FOR TWO VALVES IN PUSH–PULL

Triode connection (g_2 connected to a)

V_a	250	300	V
$I_{a\ (0)}$	2×27.5	2×33	mA
R_k	150	150	Ω
R_{a-a}	10	10	kΩ
P_{out}	2.5	4	W
$V_{in\ (g-g)\ (r.m.s.)}$	5.4	6.7	V
D_{tot}	1	1	%

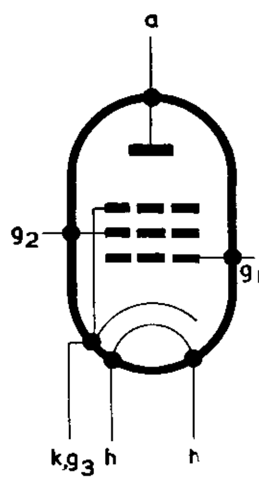
LIMITING VALUES

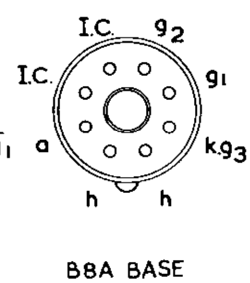
$V_{a\ (b)}$ max.	550	V
V_a max.	300	V
p_a max.	9	W
$V_{g2\ (b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} (zero sig.) max.	1.4	W
p_{g2} (max. sig.) max.	3.3	W
I_k max.	55	mA
V_{g1} max. ($I_{g1}=+0.3\mu A$)	−1.3	V
R_{g1-k} max.	1	MΩ
V_{h-k} max.	50	V
R_{h-k} max.	20	kΩ

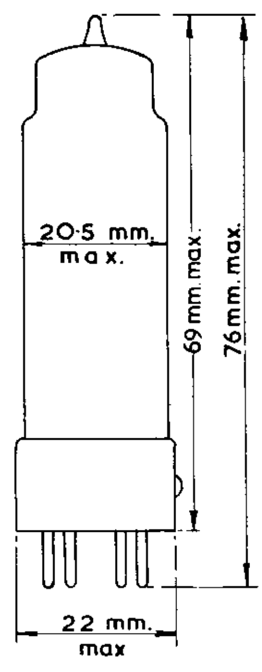
OUTPUT PENTODE

EL41

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





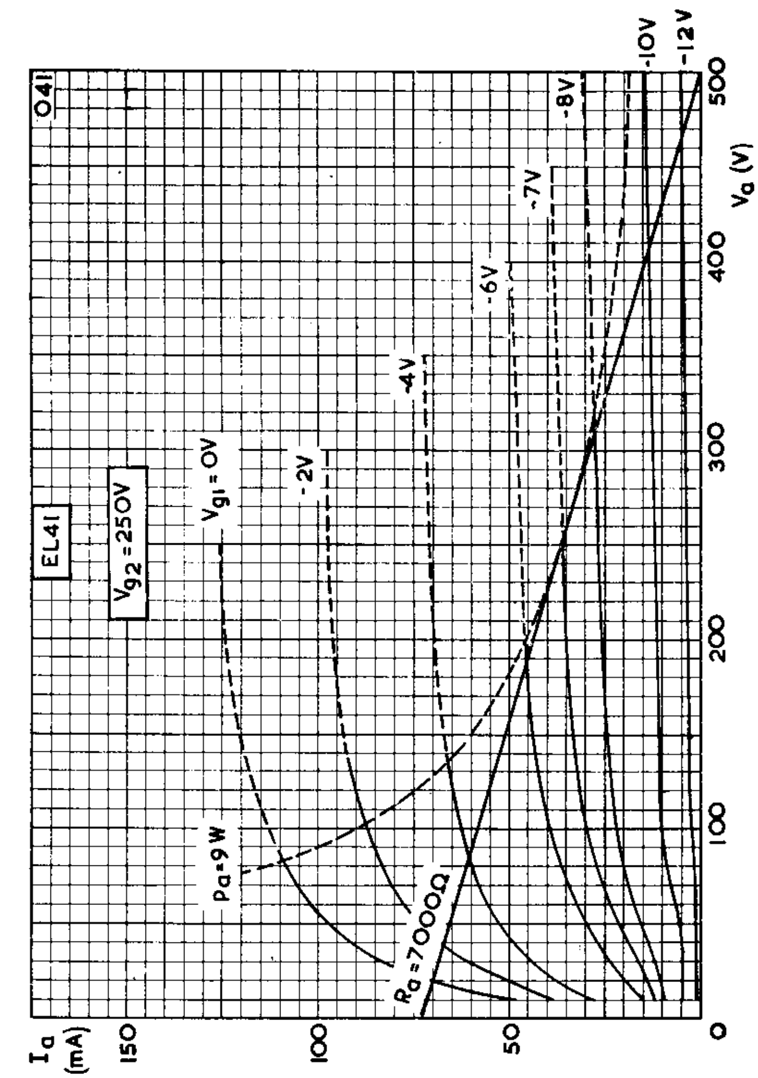


852

EL41

OUTPUT PENTODE

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



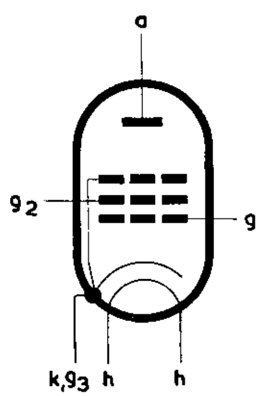
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

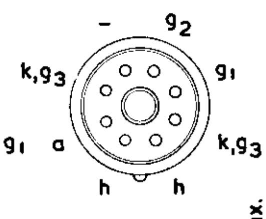
OUTPUT PENTODE

EL42

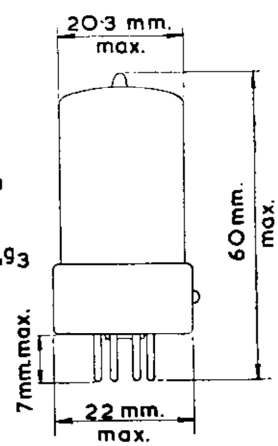
Output pentode with an anode dissipation of 6W, suitable for use in car radio receivers.

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



128

OUTPUT PENTODE

EL81

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

HEATER

V_h	6.3	V
I_h	1.05	A

CAPACITANCES (measured without external shield)

Pentode connected

c_{in}	14.7	p
c_{out}	6.0	pF
c_{a-g1}	<0.8	pF
c_{a-k}	<0.1	pF
c_{g1-h}	<0.2	pF

Triode connected

c_{in}	8.7	pF
c_{out}	11.4	pF
c_{a-g1}	6.6	pF

CHARACTERISTICS

Pentode connected

V_a	250	V
V_{g3}	0	V
V_{g2}	250	V
V_{g1}	-38.5	V
I_a	32	mA
I_{g2}	2.4	mA
g_m	4.6	mA/V
r_a	15	kΩ
μ_{g1-g2}	5.1	

Triode connected (g_2 connected to a, g_3 connected to k)

V_a	250	V
V_{g1}	-38	V
I_a	40	mA
g_m	5.5	mA/V
r_a	1.0	kΩ
μ	5.5	

EL81

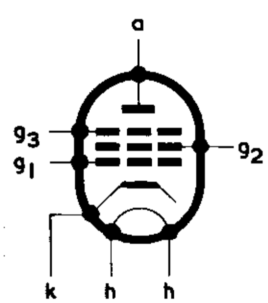
OUTPUT PENTODE

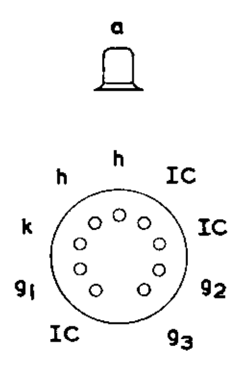
Output pentode suitable for use in the line time base of television receivers or as a series regulator valve in stabilised power supply units.

LIMITING VALUES

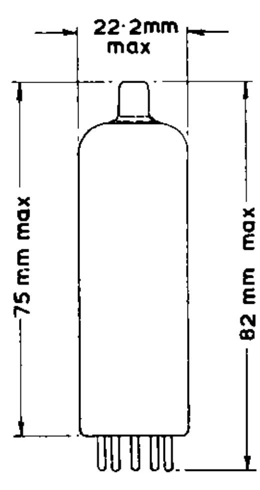
$V_{a(b)}$ max.	550	V
V_a max.	300	V
*$v_{a(pk)}$ max.	7.0	kV
p_a max.	8.0	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	300	V
p_{g2} max.	4.5	W
p_{a+g2} max.	10	W
I_k max.	180	mA
V_{g1} max. ($I_{g1} = +0.3\mu A$)	−1.3	V
R_{g1-k} max.	500	kΩ
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ
T_{bulb} max.	185	°C

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





B9A Base



2710

OUTPUT PENTODE

EL85

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

HEATER

V_h	6.3	V
I_h	200	mA

CAPACITANCES

c_{a-g1}	<0.2	pF
c_{in}	4.3	pF
c_{out}	5.1	pF

CHARACTERISTICS

V_a	200	225	250	V
V_{g2}	200	225	250	V
I_a	22.5	26	24	mA
I_{g2}	3.6	4.1	4.1	mA
V_{g1}	−9.4	−10.8	−13.5	V
g_m	3.2	3.2	3.1	mA/V
r_a	90	90	100	kΩ
μ_{g1-g2}	11	11	11	

OPERATING CONDITIONS AS SINGLE VALVE CLASS "A" AMPLIFIER

V_a	200	225	250	V
V_{g2}	200	225	250	V
R_k	360	360	470	Ω
V_{g1}	−9.4	−10.8	−13.5	V
I_a	22.5	26	24	mA
I_{g2}	3.6	4.1	4.1	mA
R_a	9.0	9.0	11	kΩ
$V_{in(r.m.s.)}$ (P_{out} = 50mW)	800	800	700	mV
P_{out}	2.0	2.6	2.55	W
$V_{in(r.m.s.)}$	6.4	7.2	7.5	V
D_{tot}	10	10	10	%

OPERATING CONDITIONS FOR TWO VALVES IN CLASS "AB" PUSH-PULL (Cathode bias)

V_a	200	250	V
V_{g2}	200	250	V
$I_{a(0)}$	2×16	2×20	mA
I_a (max. sig.)	2×17.5	2×22.1	mA
$I_{g2(0)}$	2×2.9	2×3.3	mA
I_{g2} (max. sig.)	2×4.4	2×7.1	mA
*R_k	310	310	Ω
R_{a-a}	12	12	kΩ
P_{out}	4.0	6.8	W
$V_{in(g1-g1)r.m.s.}$	19	24.4	V
D_{tot}	4.5	5.4	%

*Common cathode bias resistor.

EL85

OUTPUT PENTODE

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

OPERATING CONDITIONS FOR TWO VALVES IN CLASS "B" PUSH-PULL (Fixed bias)

V_a	200	250	V
V_{g2}	200	250	V
V_{g1}	−17.5	−23	V
$I_{a(o)}$	2×5.0	2×5.0	mA
I_a (max. sig.)	2×15	2×19	mA
$I_{g2(o)}$	2×0.8	2×0.9	mA
I_{g2} (max. sig.)	2×5.0	2×7.3	mA
R_{a-a}	16	16	kΩ
P_{out}	3.9	6.8	W
$V_{in(g1-g1)r.m.s.}$	24.4	32	V
D_{tot}	3.5	4.3	%

P_{out} and D_{tot} are measured with fixed bias and therefore represent the power output available during the reproduction of speech and music. When a sustained sine wave is applied to the control-grid the bias across the cathode resistor will readjust itself as a result of the increased anode and screen-grid currents. This will result in approximately 10% reduction in power output.

R.F. OPERATING CONDITIONS FOR SINGLE VALVE, CLASS "C"

R.F. amplifier

f	50	100	Mc/s
V_a	300	300	V
V_{g2}	175	175	V
V_{g1}	−30	−30	V
I_a	19.8	20.2	mA
I_{g2}	4.1	3.9	mA
I_{g1}	1.1	0.9	mA
P_{load}	3.8	3.1	W
η_{load}	64	51	%

Frequency doubler

f_{out}	50	100	Mc/s
V_a	300	300	V
V_{g2}	175	175	V
V_{g1}	−60	−60	V
I_a	19.8	20.3	mA
I_{g2}	3.7	3.5	mA
I_{g1}	1.5	1.2	mA
P_{load}	2.7	2.0	W
η_{load}	45	33	%

Frequency trebler

f_{out}	50	100	Mc/s
V_a	300	300	V
V_{g2}	175	175	V
V_{g1}	−100	−100	V
I_a	19.6	20	mA
I_{g2}	3.6	3.4	mA
I_{g1}	1.8	1.6	mA
P_{load}	2.1	1.7	W
η_{load}	36	28	%

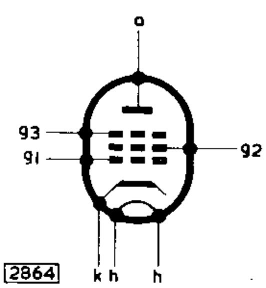
OUTPUT PENTODE

EL85

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

LIMITING VALUES

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



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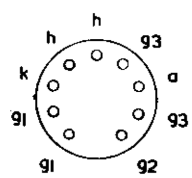
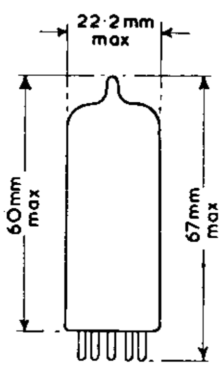


B9A Base

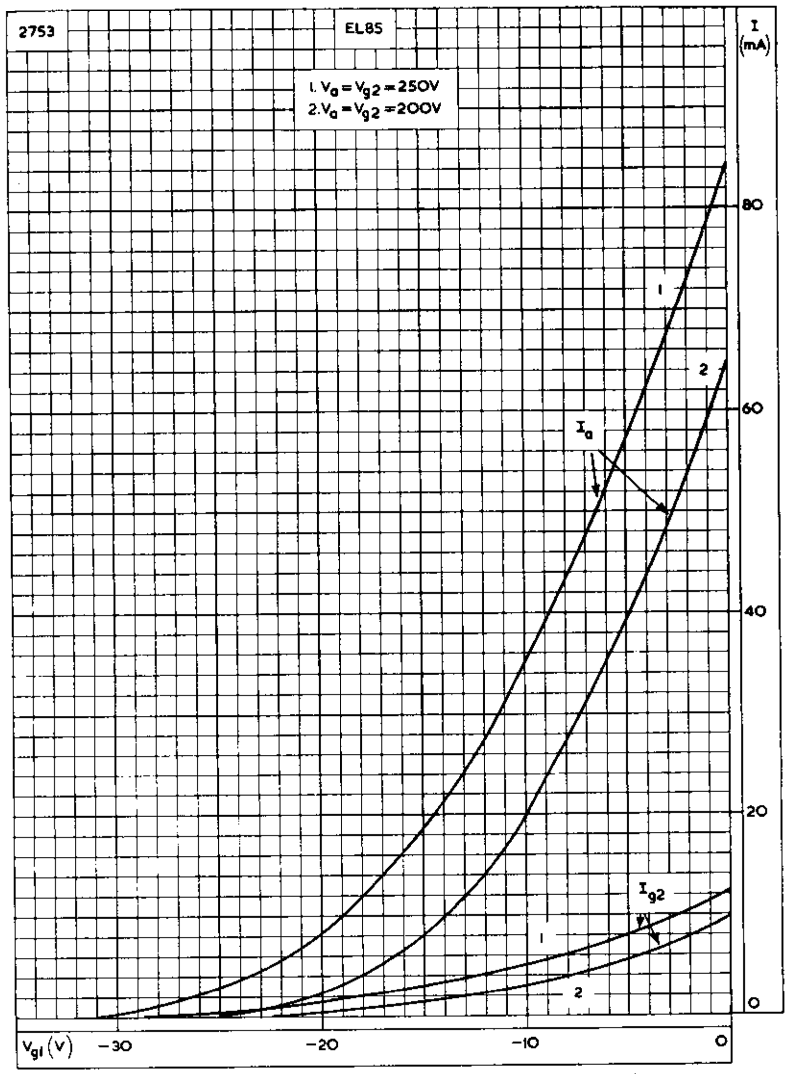


FOR R.F. APPLICATIONS IT IS RECOMMENDED THAT PINS 1 AND 2 SHOULD BE STRAPPED TOGETHER AND PINS 6 AND 8 BE CONNECTED SEPARATELY TO THE CHASSIS

EL85

OUTPUT PENTODE

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



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

OUTPUT PENTODE

EL86

Low impedance output pentode suitable for use in single-ended push-pull output stages and series regulators.

HEATER

V_h		6.3	V
I_h		760	mA

CAPACITANCES (measured without an external shield)

c_{in}		13	pF
c_{out}		6.8	pF
c_{a-g1}		<600	mpF
c_{h-g1}		<250	mpF

CHARACTERISTICS

Pentode connection

V_a	100	170	V
V_{g2}	100	170	V
V_{g1}	−5.0	−12.5	V
I_a	57	70	mA
I_{g2}	3	3.5	mA
g_m	13	11	mA/V
μ_{g1-g2}	9	8	
r_a	23	26	kΩ
V_{g1} max.		−1.3	V

Triode connection (g_2 connected to a)

V_a	100	170	V
V_{g1}	−5.0	−12.5	V
I_a	60	74	mA
g_m	14	12	mA/V
μ	9	8	
r_a	645	665	Ω

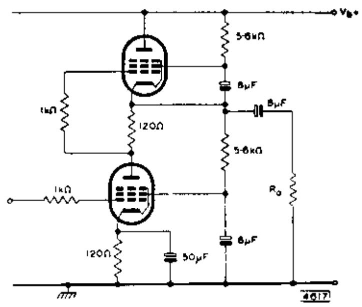
OPERATING CONDITIONS AS SINGLE VALVE CLASS 'A' AMPLIFIER

$V_{a(b)}$	200	V
$V_{g2(b)}$	200	V
R_k	215	Ω
R_a	2.5	kΩ
R_{g2} (unbypassed)	470	Ω
I_a	64	mA
$I_{g2(o)}$	3.2	mA
$V_{in(r.m.s.)}$ (P_{out} = 50mW)	520	mV
$V_{in(r.m.s.)}$	7.0	V
P_{out}	5.3	W
D_{tot}	10	%
I_{g2} (max. sig.)	11.4	mA

EL86

OUTPUT PENTODE

OPERATING CONDITIONS FOR TWO VALVES IN SINGLE ENDED PUSH-PULL



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

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

Speech and music

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

Continuous sine wave drive

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

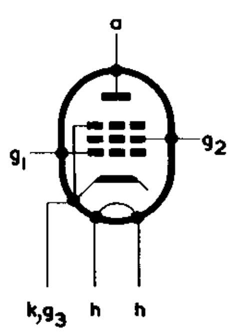
OUTPUT PENTODE

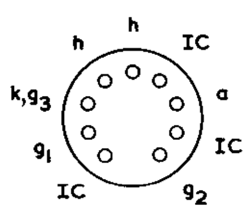
EL86

LIMITING VALUES

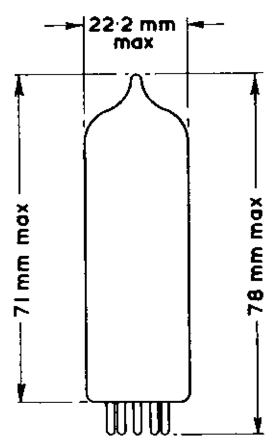
$V_{a(b)}$ max.	550	V
V_a max.	250	V
V_{a+g2} max.	250	V
p_a max.	12	W
p_{a+g2} max.	13	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	1.75	W
I_k max.	100	mA
R_{g1-k} max.	500	kΩ
V_{h-k} max.	200	V
R_{h-k} max.	20	kΩ

2834





B9A Base



OUTPUT PENTODE

EL91

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

HEATER

V_h	6.3	V
I_h	200	mA

CAPACITANCES

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

CHARACTERISTICS

Pentode connection

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

Triode connection (g_2 connected to a)

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

OPERATING CONDITIONS AS SINGLE VALVE AMPLIFIER

Pentode connection

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

OPERATING CONDITIONS FOR 2 VALVES IN PUSH-PULL

Pentode connection

Cathode bias

V_{a-k}	250	V
V_{g2-k}	250	V
R_k (per valve)	820	Ω
R_{a-a}	15	kΩ
$I_{a(0)}$	2×14.5	mA
$I_{g2(0)}$	2×2.0	mA
$V_{in(g1-g1)r.m.s.}$ (P_{out} = 50mW)	1.8	V
$V_{in(g1-g1)r.m.s.}$	19.8	V
P_{out}	5.8	W
D_{tot}	2.5	%
$I_{a(max.\ sig.)}$	2×21.5	mA
$I_{g2(max.\ sig.)}$	2×5.0	mA

Fixed bias

V_{a-k}	250	V
V_{g2-k}	250	V
V_{g1}	−16	V
R_{a-a}	15	kΩ
$I_{a(0)}$	2×10	mA
$I_{g2(0)}$	2×1.4	mA
$V_{in(g1-g1)r.m.s.}$ (P_{out} = 50mW)	2.1	V
$V_{in(g1-g1)r.m.s.}$	21.5	V
P_{out}	5.6	W
D_{tot}	1.7	%
$I_{a(max.\ sig.)}$	2×19.5	mA
$I_{g2(max.\ sig.)}$	2×4.7	mA

P_{out} and D_{tot} are measured at fixed bias and therefore represent the power output available during the reproduction of speech and music. When a sustained sine wave is applied to the control grid, the bias across the cathode resistor will re-adjust itself as a result of the increased anode and screen-grid currents. This will result in approximately 10% reduction in power output.

OPERATING CONDITIONS AS R.F. AMPLIFIER

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

OPERATING CONDITIONS AS FREQUENCY DOUBLER

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

OPERATING CONDITIONS AS FREQUENCY TREBLER

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

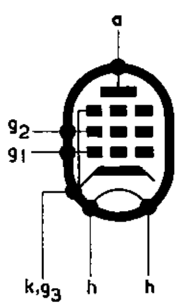
EL91

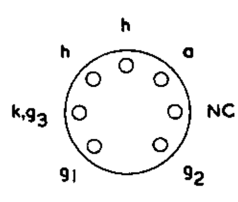
OUTPUT PENTODE

DESIGN CENTRE RATINGS

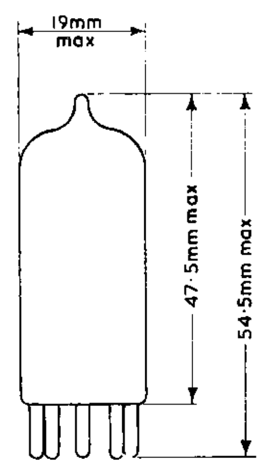
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	4.0	W
p_{a+g2} max.	4.5	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	600	mW
$-V_{g1}$ max.	100	V
I_{g1} max.	3.0	mA
I_k max.	20	mA
R_{g1-k} max.	500	kΩ
V_{h-k} max.	150	V

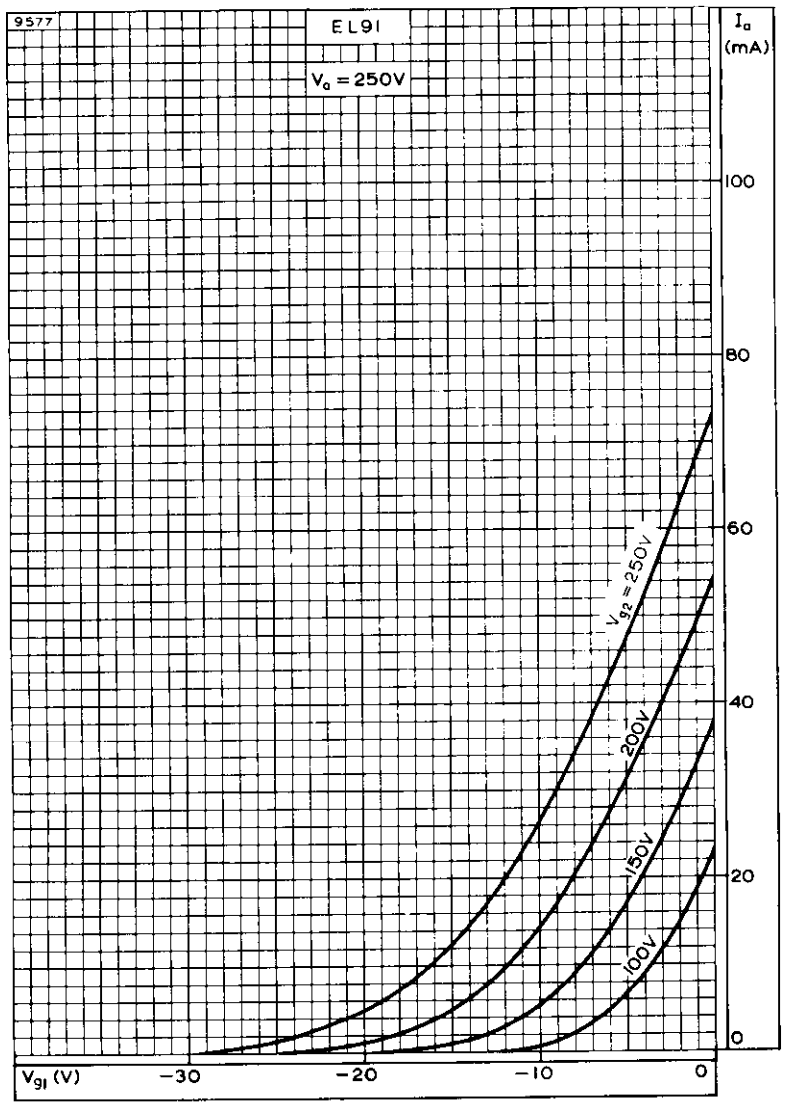
2831



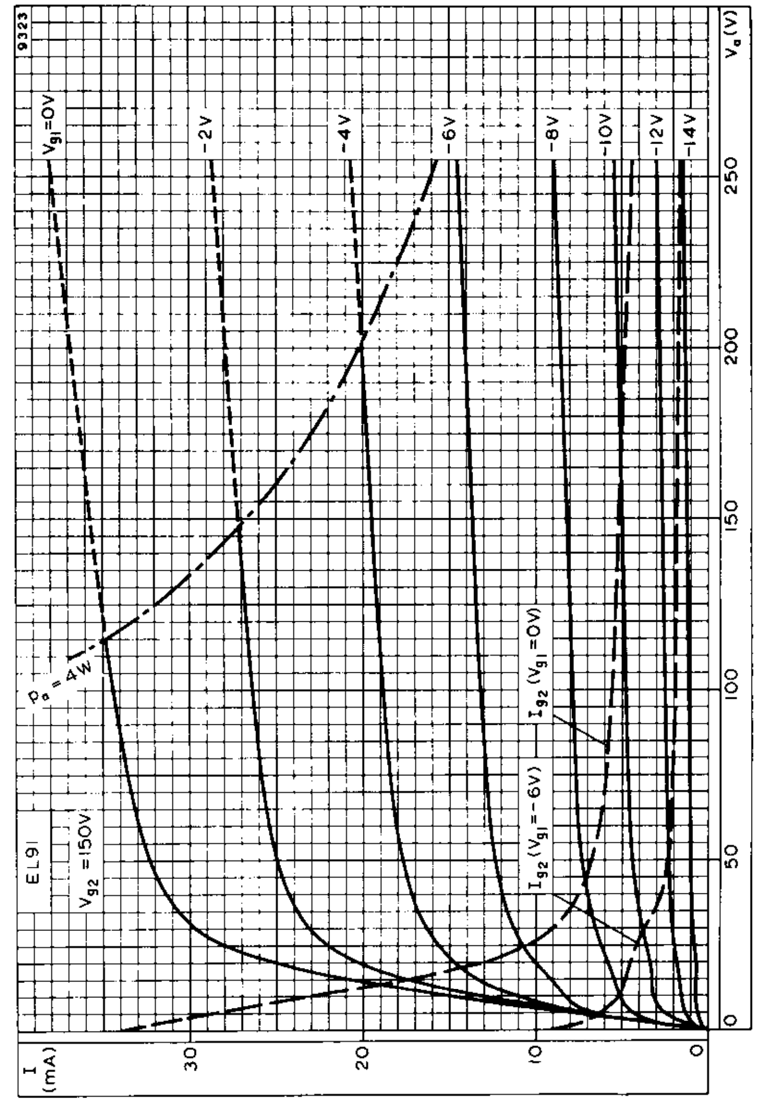


B7G Base

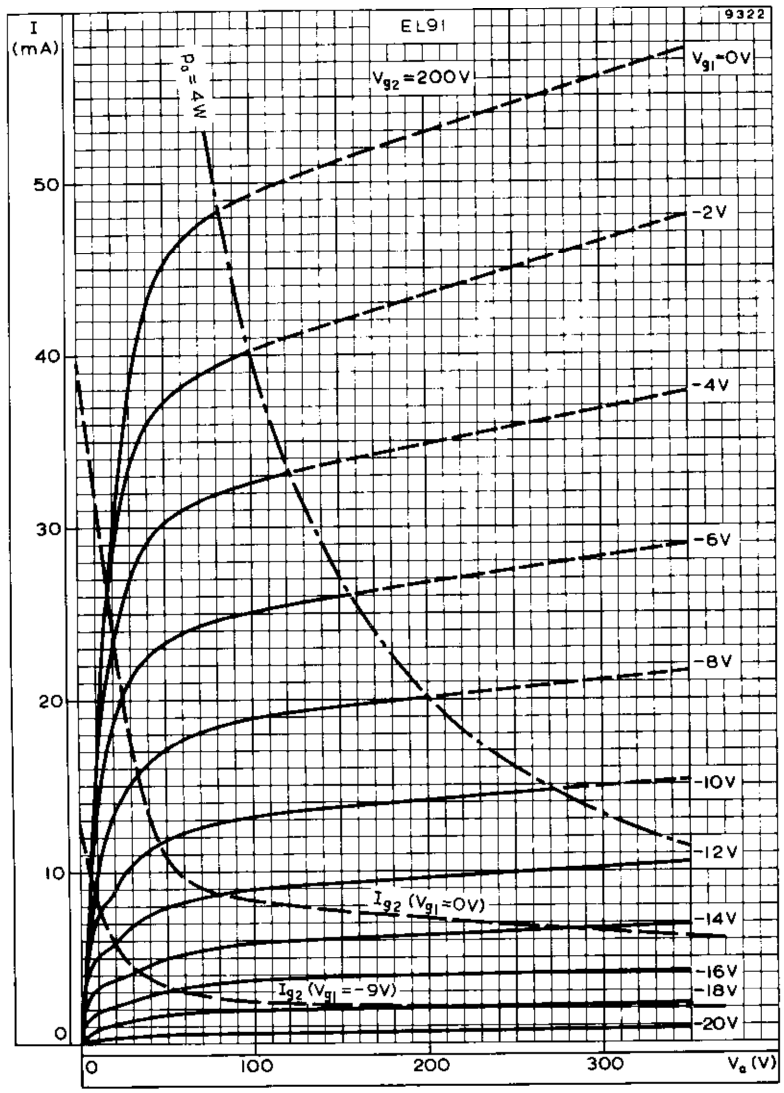




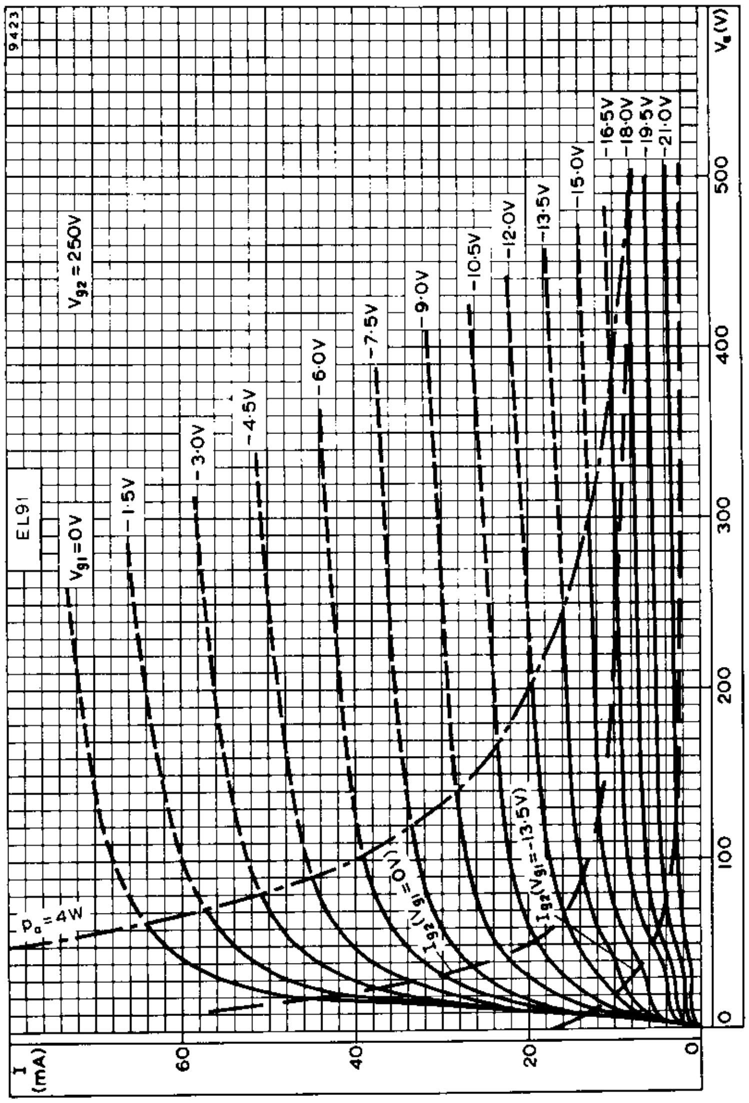
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER



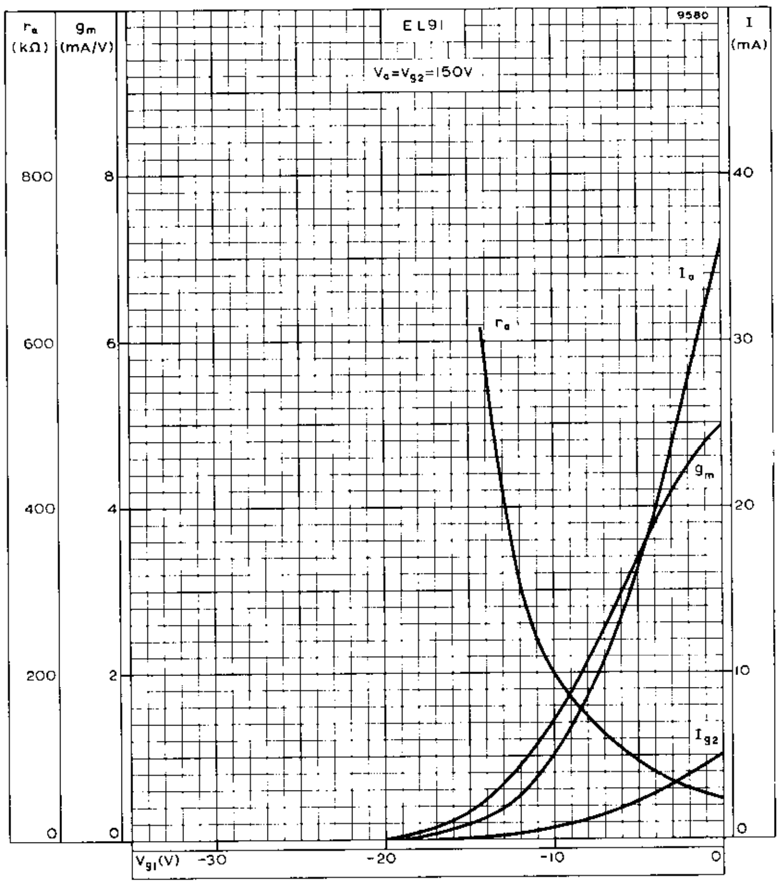
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 150V



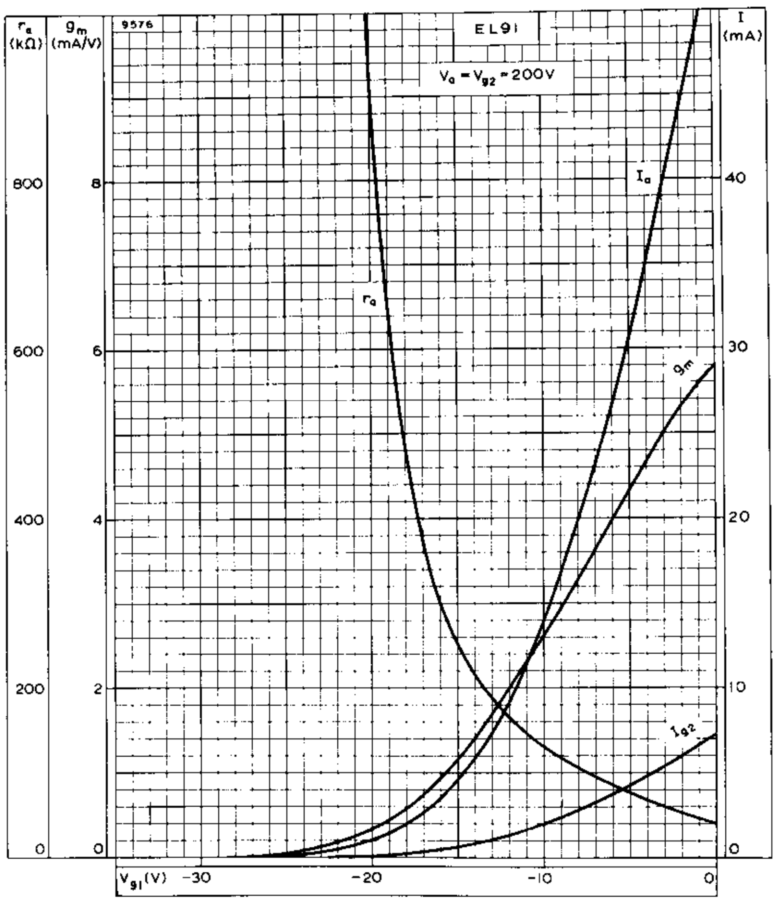
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 200V



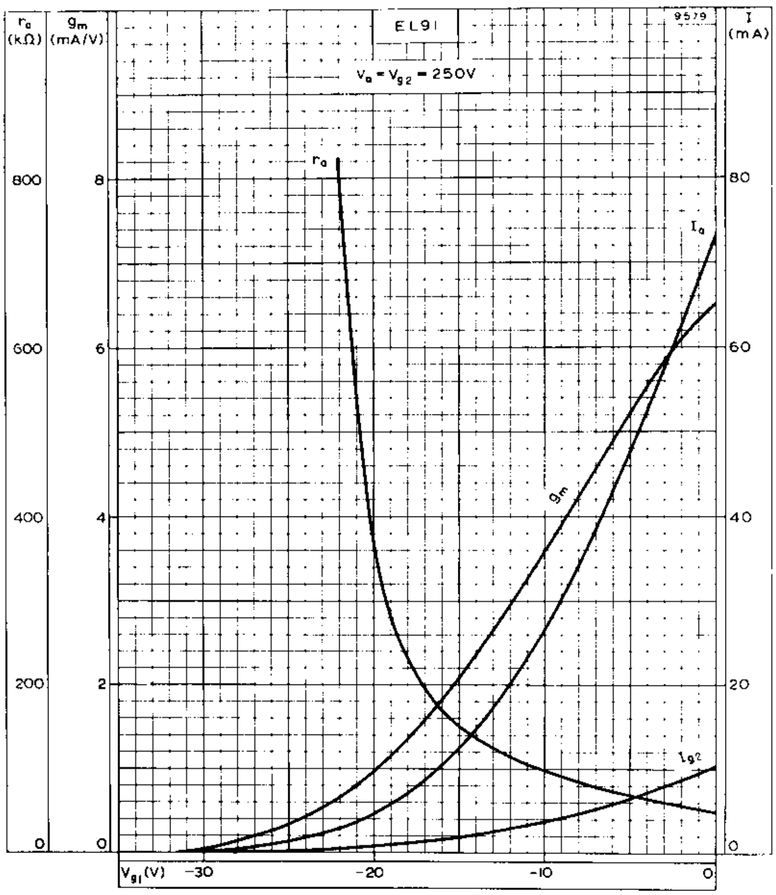
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 250V$



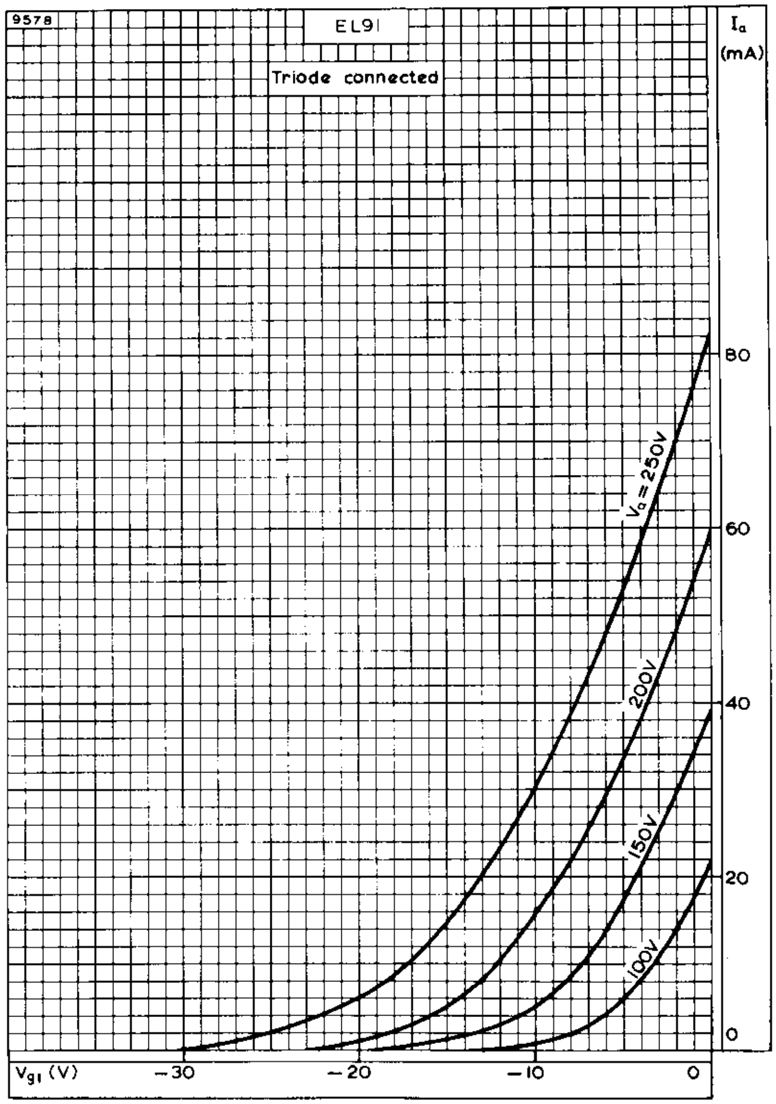
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 150V$



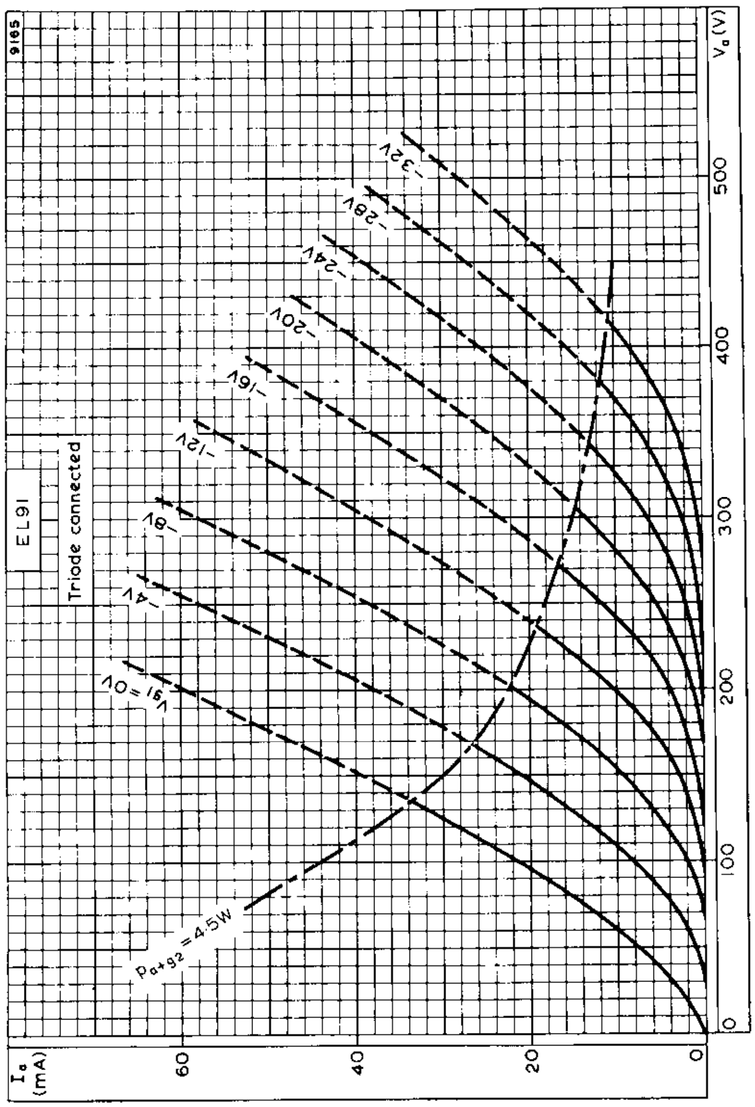
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 200V$



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



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



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

VIDEO OUTPUT PENTODE

EL821

Video output pentode having a high mutual conductance, particularly suitable for use in high definition television equipment.

PRELIMINARY DATA

HEATER

V_h	6.3	V
I_h	0.75	A

CAPACITANCES (measured without an external shield)

c_{in}	14	μμF
c_{out}	5.0	μμF
c_{a-g1}	<0.25	μμF
c_{h-k}	7.0	μμF

CHARACTERISTICS

V_a	250	250	V
V_{g3}	0	0	V
V_{g2}	200	250	V
I_a	40	40	mA
I_{g2}	6.5	6.0	mA
V_{g1}	−2.5	−4.5	V
g_m	13	11	mA/V
r_a	60	50	kΩ
μ_{g1-g2}	26	26	
Bulb Temperature at 20°C Ambient, in free air and without external screening can	203	205	°C

LIMITING VALUES (design centre)

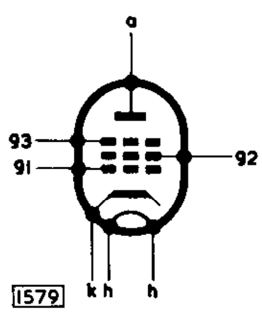
$V_{a(b)}$ max.	550	V
V_a max.	275	V
p_a max.	12	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	275	V
p_{g2} max.	2.5	W
I_k max.	60	mA
R_{g1-k} max. (cathode bias)	220	kΩ
R_{g1-k} max. (fixed bias)	100	kΩ
V_{h-k} max.	90	V
Bulb Temperature max.	230	°C
Maximum ambient temperature at $p_a + p_{g2} = 14.5$ W and without external screening can and at normal altitudes	20	°C
*Maximum temperature opposite the anode at any point 15 mm from the bulb, with $p_a + p_{g2} = 14.5$ W and without external screening can and at normal altitudes	30	°C

* Measured by placing a Mercury thermometer at the specified distance from the valve.

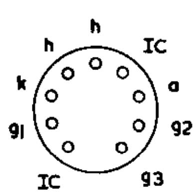
EL821

VIDEO OUTPUT PENTODE

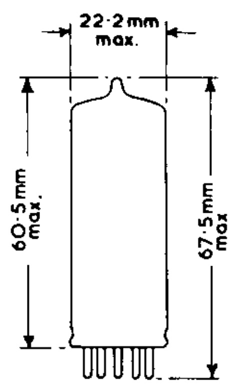
Video output pentode having a high mutual conductance, particularly suitable for use in high definition television equipment.



1579



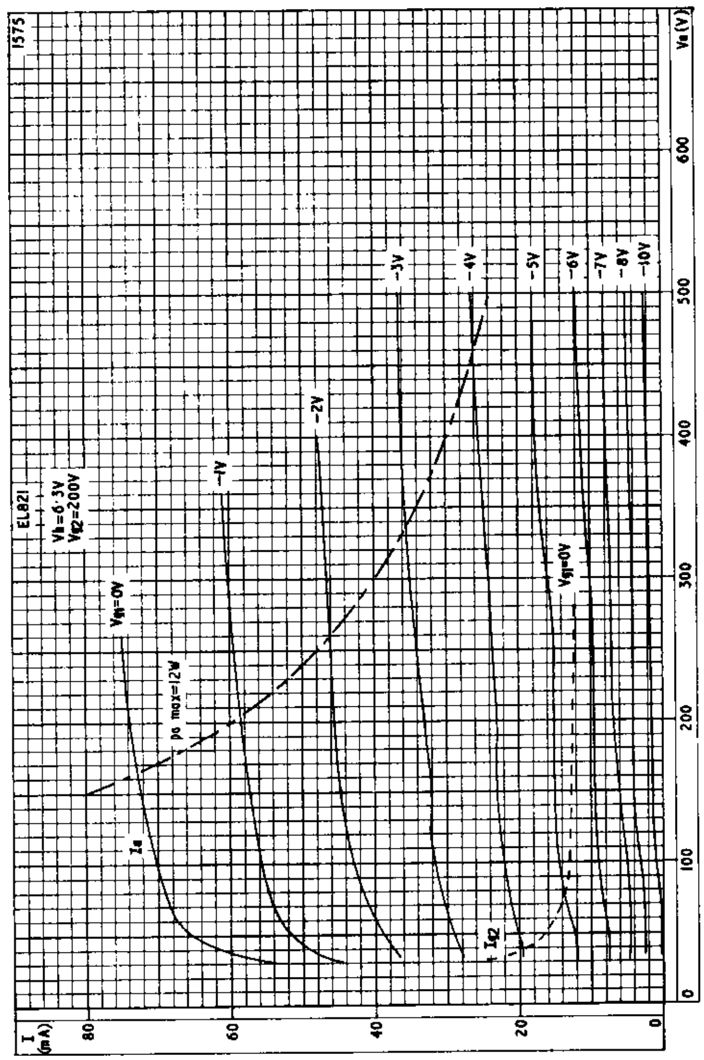
B9A
Noval Base



VIDEO OUTPUT PENTODE

EL821

Video output pentode having a high mutual conductance, particularly suitable for use in high definition television equipment.

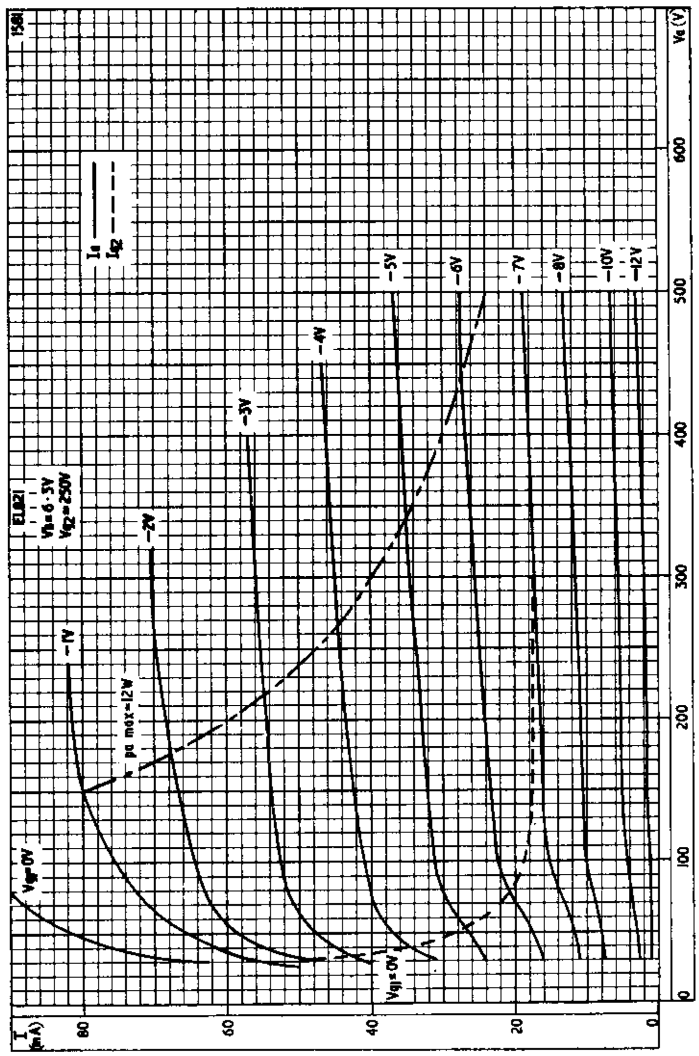


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE FOR SCREEN-GRID VOLTAGE OF 200 V

EL821

VIDEO OUTPUT PENTODE

Video output pentode having a high mutual conductance, particularly suitable for use in high definition television equipment.



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

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	

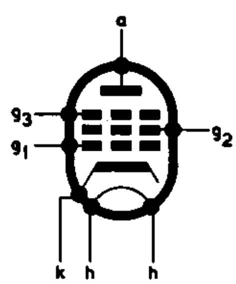
EL822

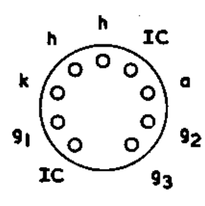
VIDEO OUTPUT PENTODE

DESIGN CENTRE RATINGS

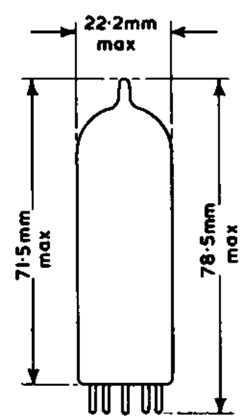
$V_{a(b)}$ max.	550	V
V_a max.	275	V
p_a max.	12	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	275	V
p_{g2} max.	2.5	W
I_k max.	60	mA
R_{g1-k} max.	100	kΩ
V_{h-k} max.	90	V
T_{bulb} max.	220	°C

3310





B9A Base



ELECTRON BEAM INDICATOR

EM34

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

HEATER

This valve is suitable for DC/AC operation.

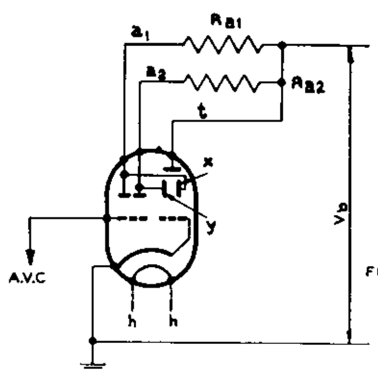
V_h	6.3	V
I_h	0.2	A

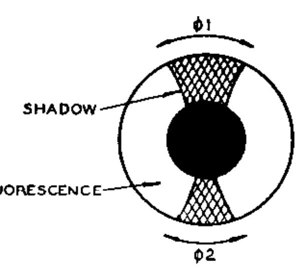
OPERATING CONDITIONS

V_b	200	250	V
R_{a1}	1.0	1.0	MΩ
R_{a2}	1.0	1.0	MΩ
I_t	0.55	0.75	mA
V_g ($\varnothing_1$ max.) (1)	0	0	V
V_g ($\varnothing_2$ max.) (2)	0	0	V
V_g ($\varnothing_1$ min.) (5)	−4.2	−5.0	V
V_g ($\varnothing_2$ min.) (6)	−12.5	−16.0	V

(1) and (2) Max. angle of the shadows produced by the deflector plates x′, x″ and y′, y″ respectively.

(5) and (6) Min. angle (5°) of the shadows produced by the deflector plates x′, x″ and y′, y″ respectively.





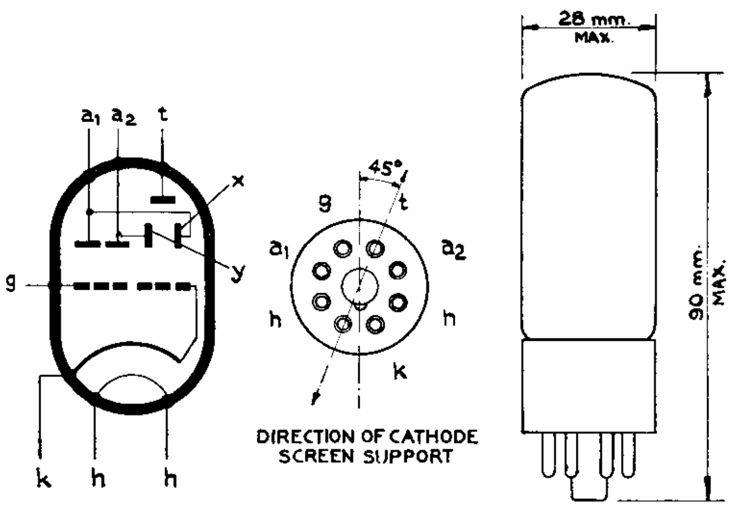
EM34

ELECTRON BEAM INDICATOR

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

LIMITING VALUES

$V_{a1(b)}$ max.	550	V
V_{a1} max.	275	V
$V_{a2(b)}$ max.	550	V
V_{a2} max.	275	V
$V_{t(b)}$ max.	550	V
V_t max.	275	V
V_{h-k} max.	100	V
R_{h-k} max.	20	kΩ
R_{g-k} max.	3.0	MΩ



OCTAL BASE

VOLTAGE INDICATOR

EM84

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

HEATER

V_h	6.3	V
I_h	210	mA

MOUNTING POSITION

Any

TYPICAL OPERATING CONDITIONS

(deflection electrode connected to anode)

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

*Length of column

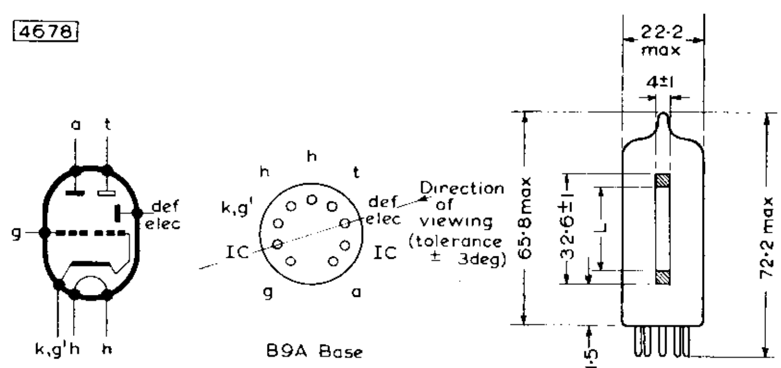
DESIGN CENTRE RATINGS

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

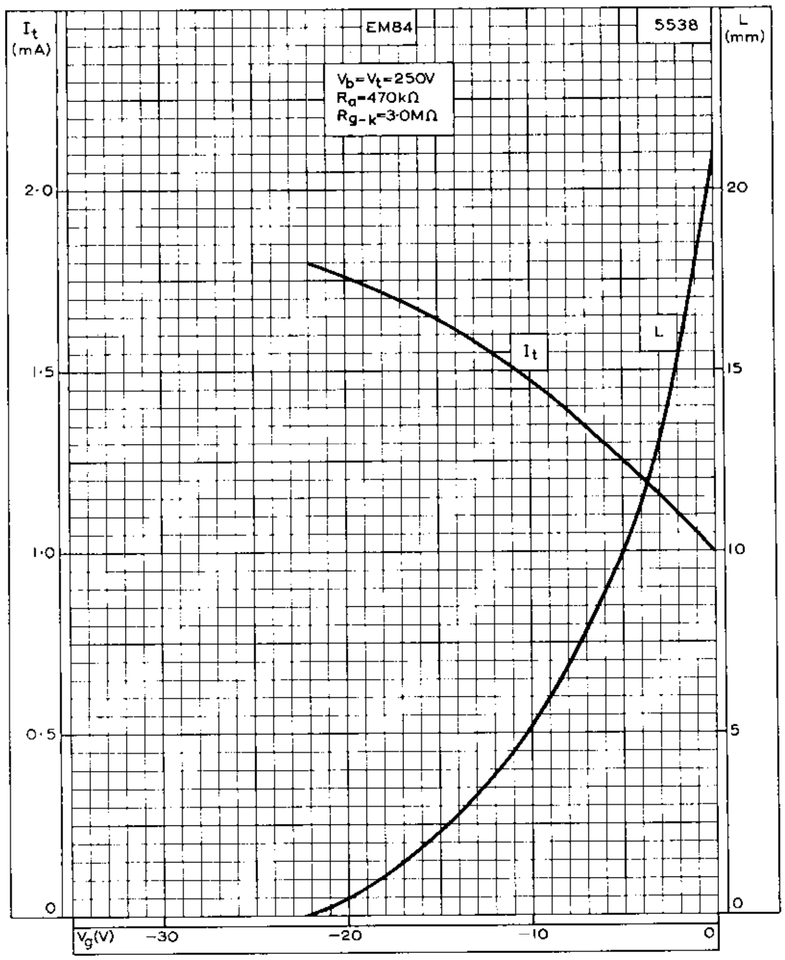
EM84

VOLTAGE INDICATOR

4678



All dimensions in mm



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

HALF-WAVE RECTIFIER

EY51

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

HEATER

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

MOUNTING POSITION

Any

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

CAPACITANCE

c_{a-k}	0.8	pF

LIMITING VALUES

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

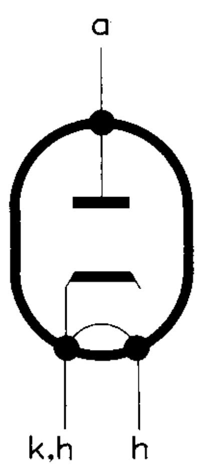
*Max. pulse duration 5.0% of a line scanning cycle with a maximum of 5.0μs

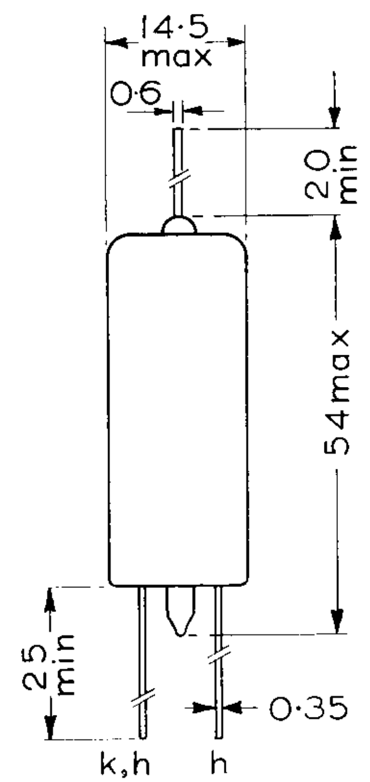
EY51

HALF-WAVE RECTIFIER

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

4778





All dimensions in mm

HALF-WAVE RECTIFIER

EY84

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

HEATER

V_h	6.3	V
I_h	1.0	A

LIMITING VALUES

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

Capacitor input

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

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

Choke input

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

L min. (at 50c/s) — See choke regulation curves

CHARACTERISTICS

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

TYPICAL OPERATION OF TWO EY84 AS FULL-WAVE RECTIFIER

Capacitor input

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

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

Choke input

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

OPERATING NOTES

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

Rating chart 1

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

EY84

HALF-WAVE RECTIFIER

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

Rating chart 2

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

Rating chart 3

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

Capacitor input filter circuits

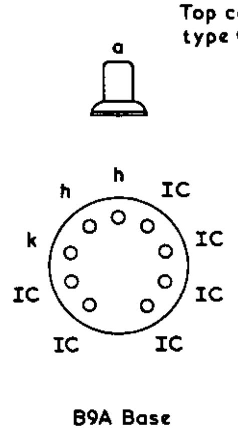
Reference should be made to rating charts 2 and 3 and the regulation curves. The circuit is set-up and the input and output voltage and output current are measured. If the operating conditions lie within the boundary lines of the regulation curves an improvement in the rectification efficiency may be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

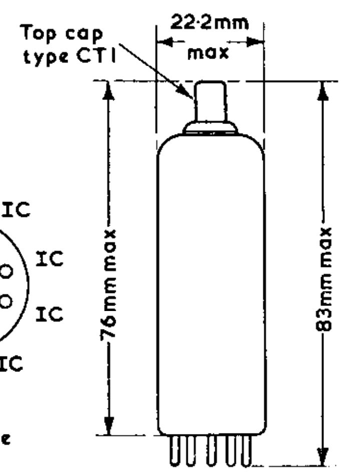
Comparison of the calculated rectification efficiency $\frac{V_{out}}{\sqrt{2} \times V_{in(r.m.s.)}}$ with rating chart 3 will show whether the limiting resistance must be increased to lower the rectification efficiency to the area of safe operation. Operation within this area indicates that the limiting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

Choke input circuit

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

3367

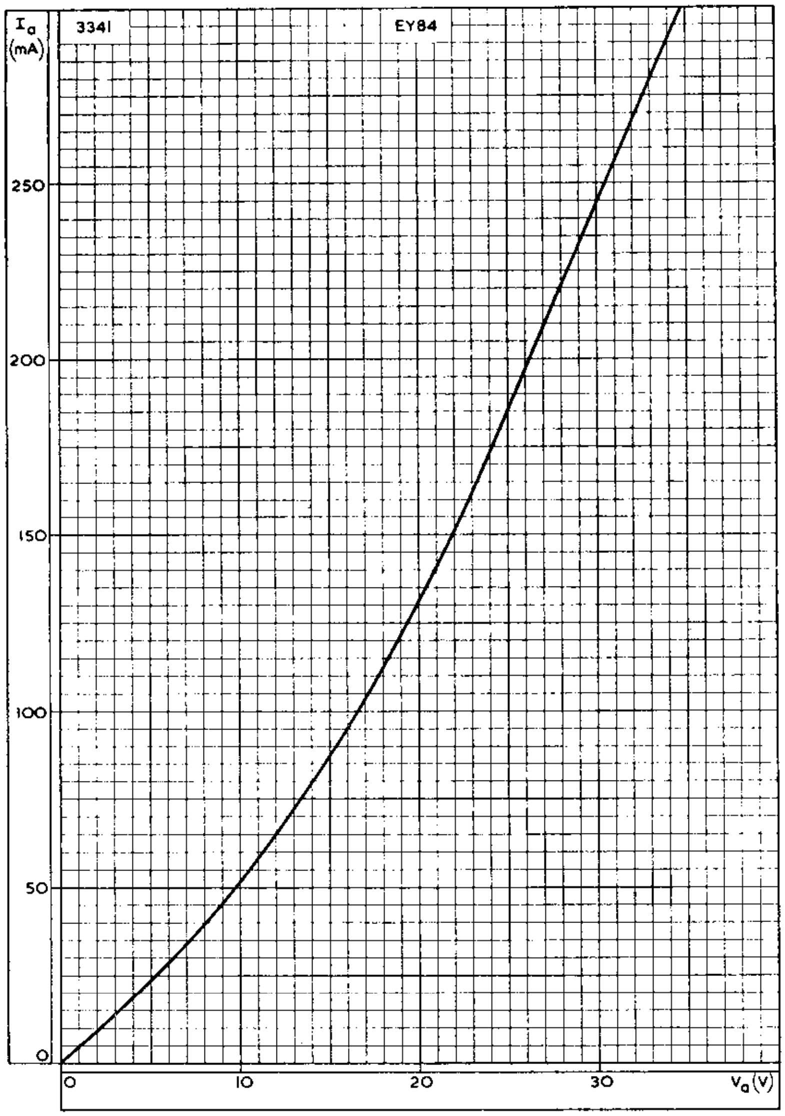




HALF-WAVE RECTIFIER

EY84

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

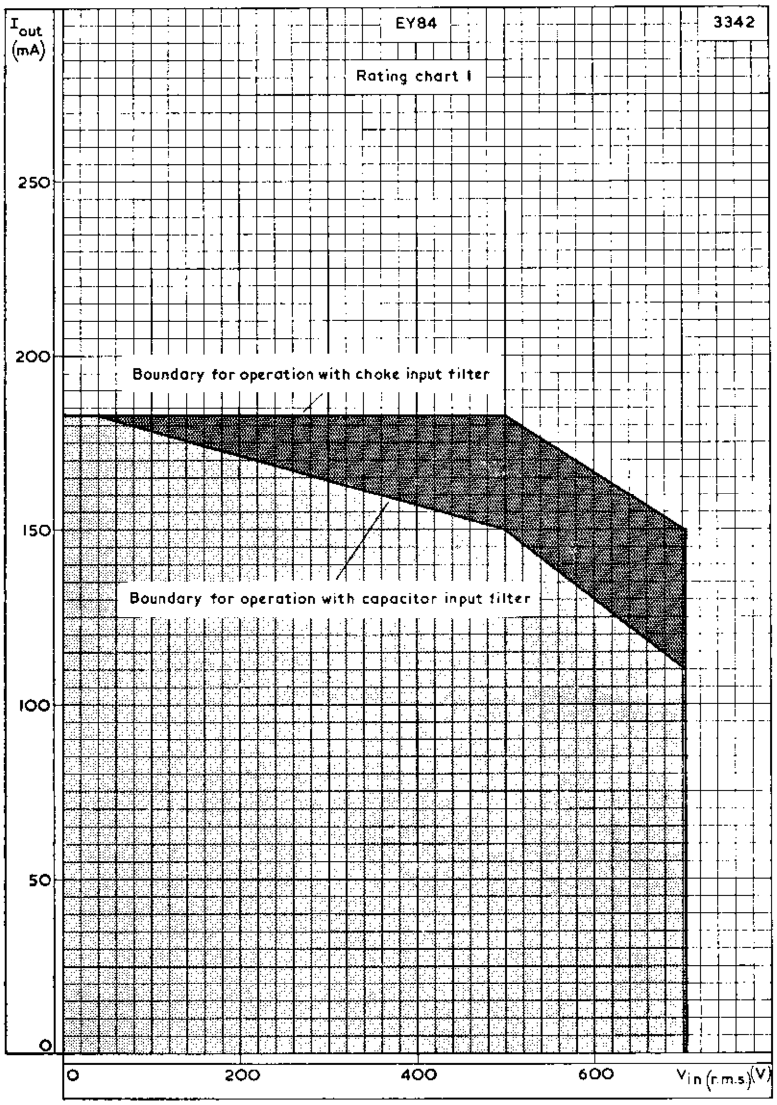


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

EY84

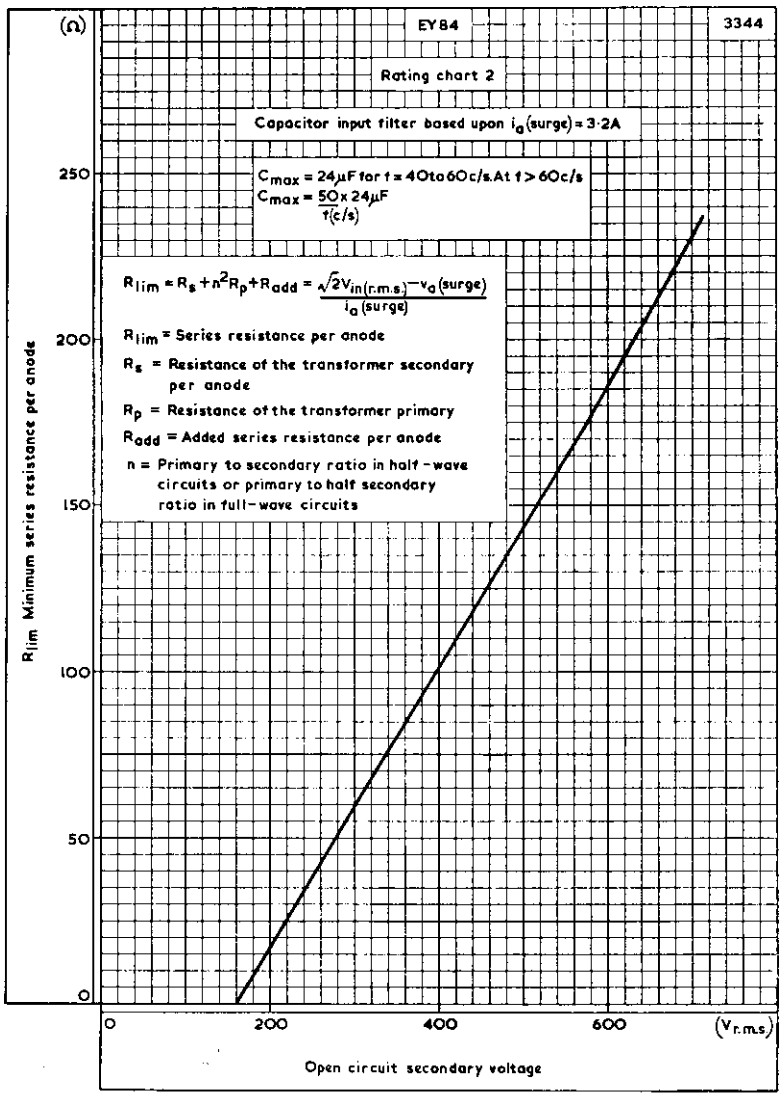
HALF-WAVE RECTIFIER

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



BOUNDARY OF OPERATION WITH CAPACITOR OR CHOKE INPUT FILTER

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

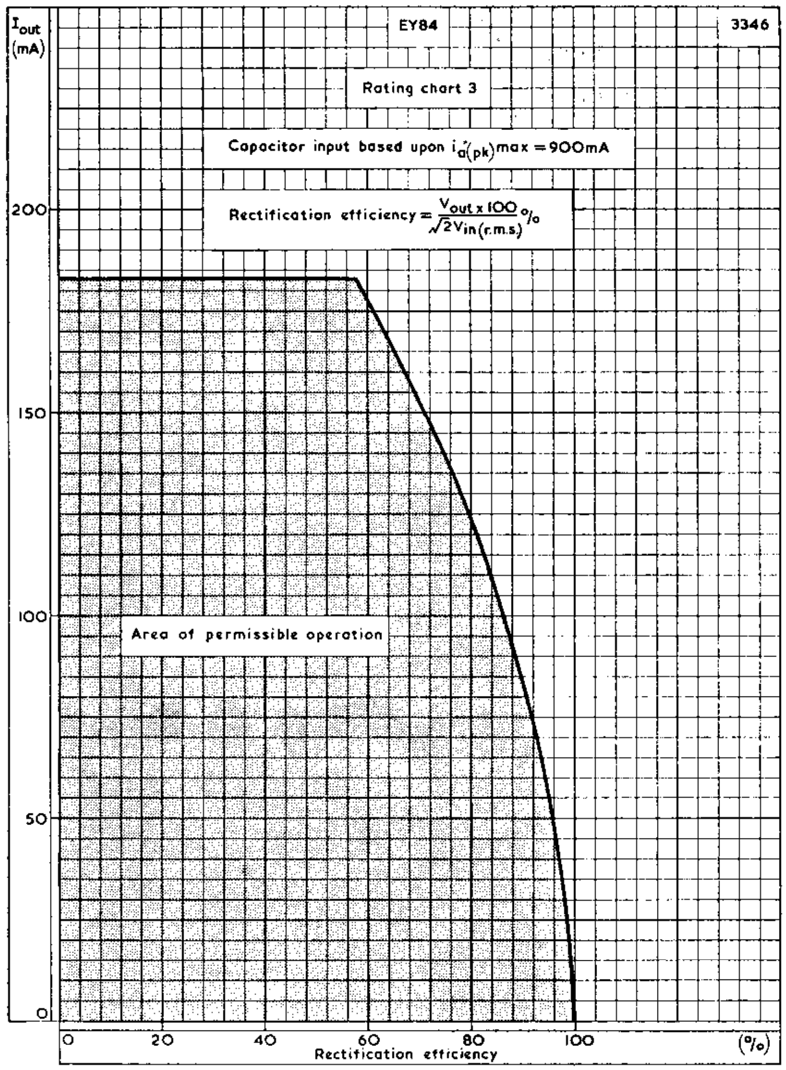


MINIMUM SERIES ANODE RESISTANCE PLOTTED AGAINST OPEN CIRCUIT SECONDARY VOLTAGE

EY84

HALF-WAVE RECTIFIER

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

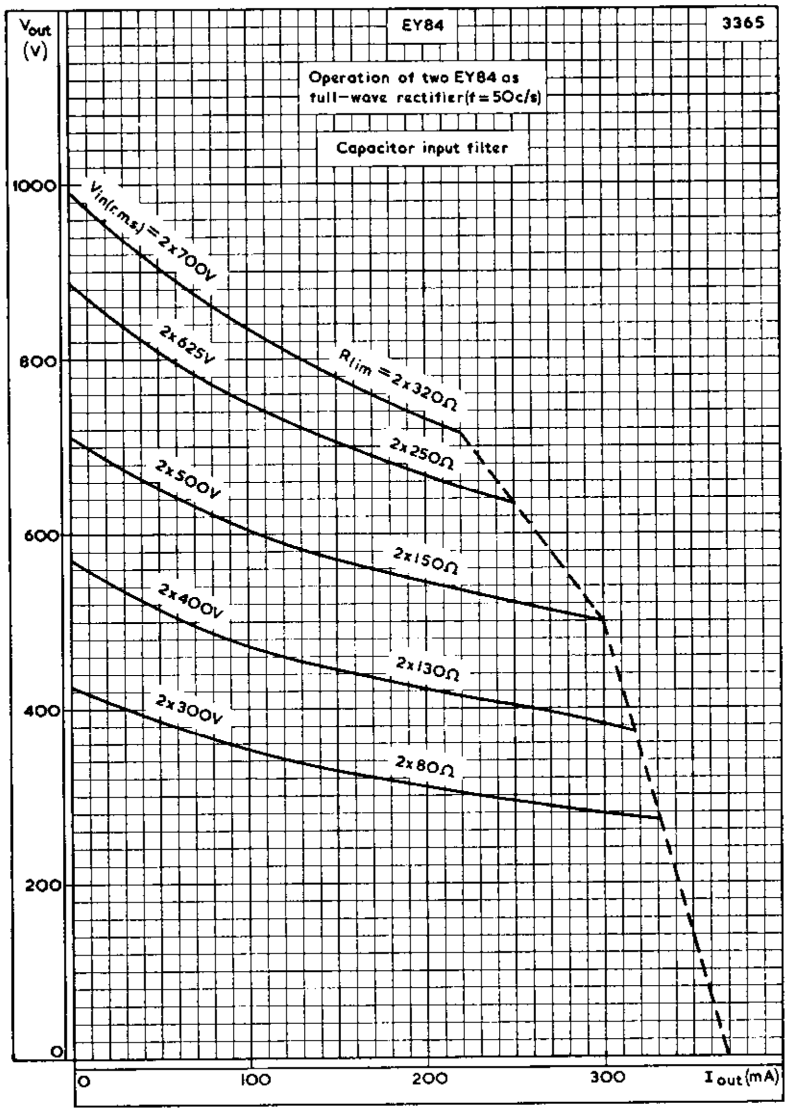


OUTPUT CURRENT PLOTTED AGAINST RECTIFICATION EFFICIENCY

HALF-WAVE RECTIFIER

EY84

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

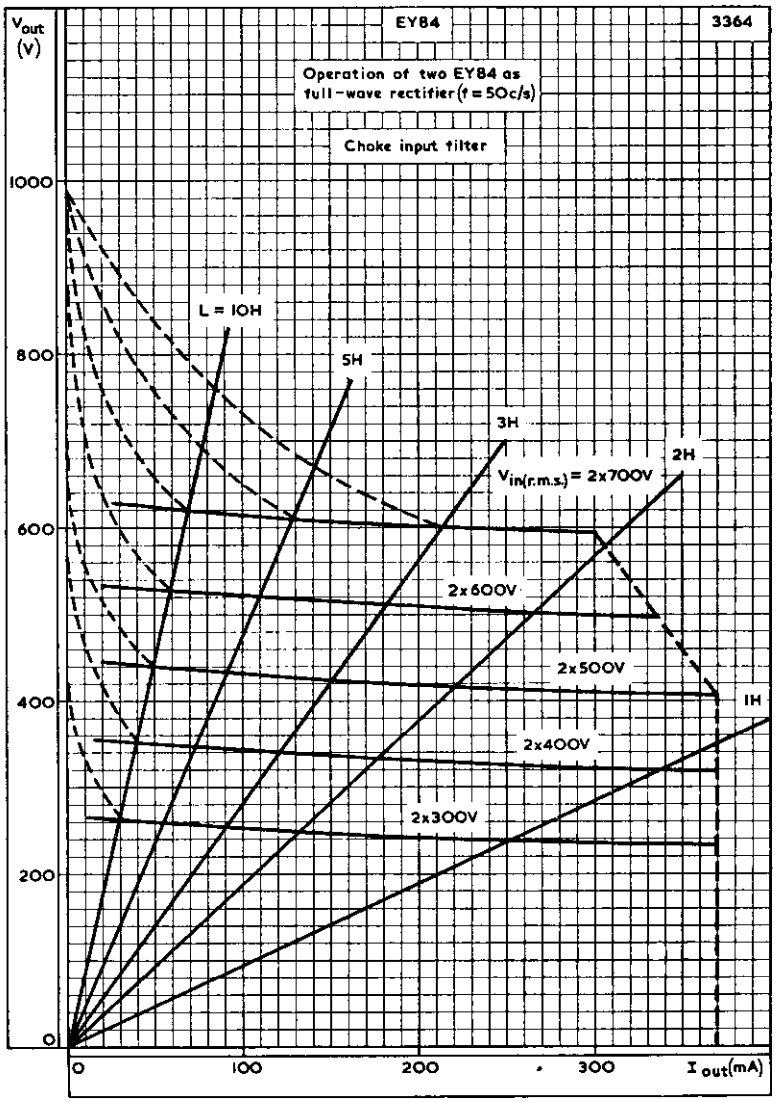


CAPACITOR INPUT FILTER REGULATION CURVES

EY84

HALF-WAVE RECTIFIER

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



CHOKE INPUT FILTER REGULATION CURVES

FULL-WAVE RECTIFIER

EZ35

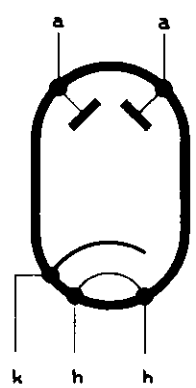
Indirectly-heated power rectifier with 6.3 V. heater for use in A.C. mains-operated equipment.

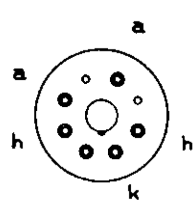
HEATER

V_h	6.3	V
I_h	0.6	A

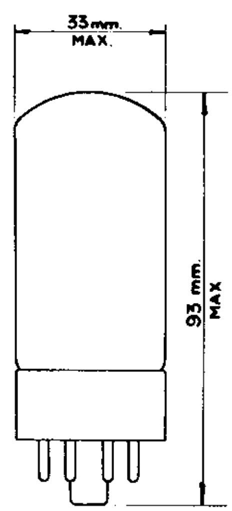
LIMITING VALUES

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





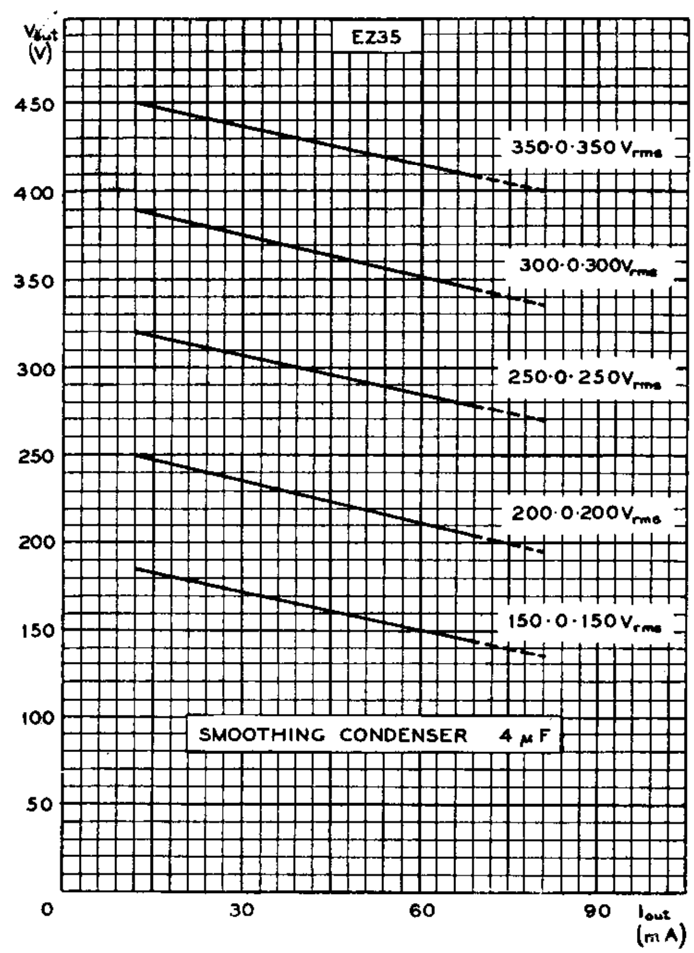
OCTAL BASE



EZ35

FULL-WAVE RECTIFIER

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



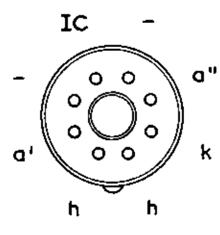
OUTPUT VOLTAGE PLOTTED AGAINST INPUT CURRENT WITH ANODE VOLTAGES AS PARAMETER

FULL-WAVE RECTIFIER

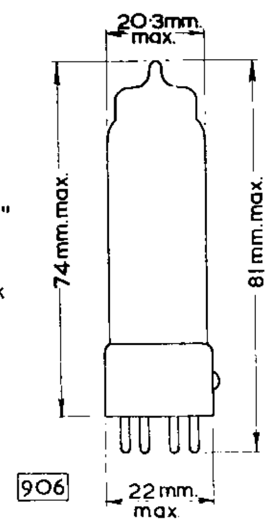
EZ40

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

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



B8A BASE



FULL-WAVE RECTIFIER

EZ41

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

HEATER

V_h	6.3	V
I_h	0.4	A

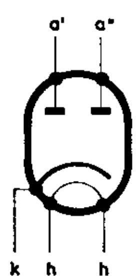
MOUNTING POSITION

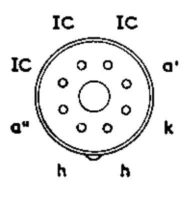
Any

LIMITING VALUES

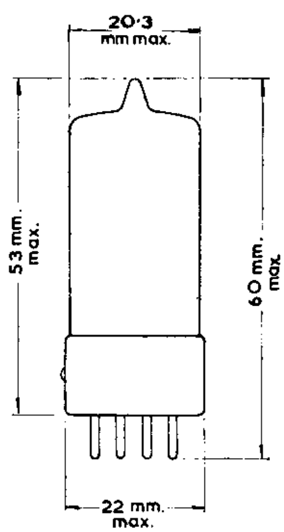
$V_{a\,(r.m.s.)}$ max.	2×250	V
I_{out} max.	60	mA
$v_{h-k\,(pk)}$ max.	350	V

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





B8A BASE



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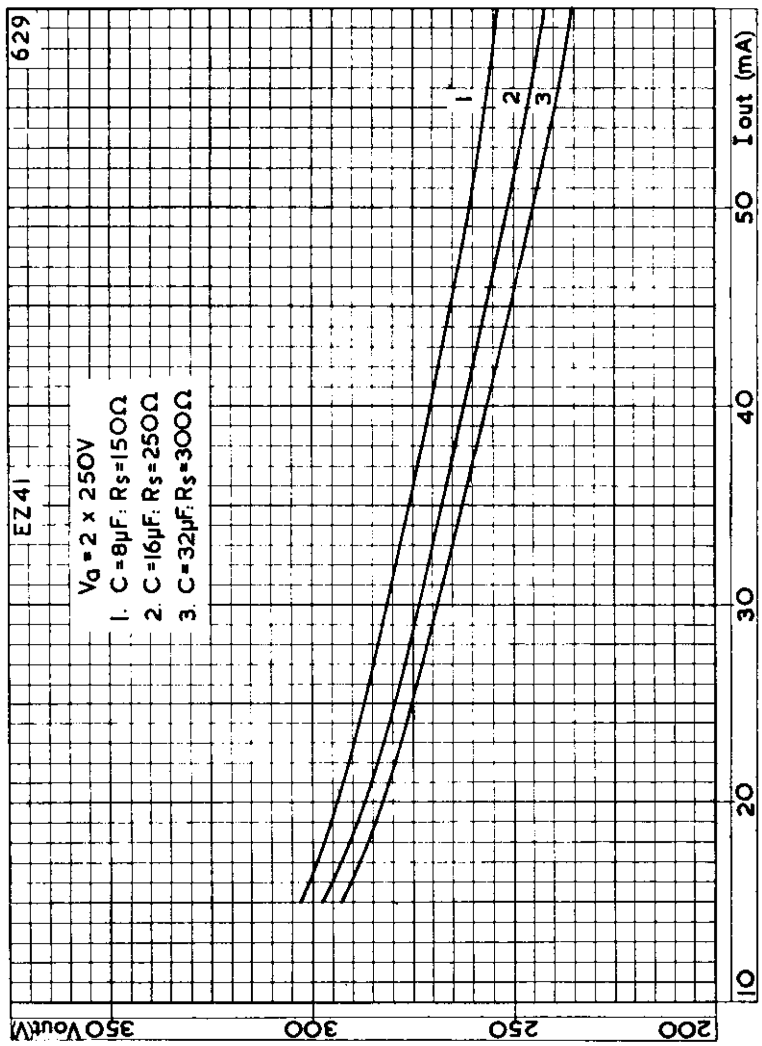
EZ41

FULL-WAVE RECTIFIER

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



FULL-WAVE RECTIFIER

GZ30

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

HEATER

V_h	5.0	V
I_h	2.0	A

LIMITING VALUES

P.I.V. max.	1.4	kV
$i_{a(pk)}$ max.	375	mA
I_{out} max.	125	mA
C max.	50	μF
L min.	5	H

TYPICAL OPERATING CONDITIONS ←

Capacitor Input

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

Choke Input

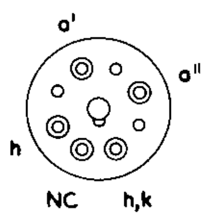
$V_{a(r.m.s.)}$ (V)	I_{out} (mA)	L (H)	V_{out} (V)
2×250	125	10	205
2×300	125	10	249
2×350	125	10	295
2×400	125	10	340
2×450	125	10	384
2×500	125	10	429

GZ30

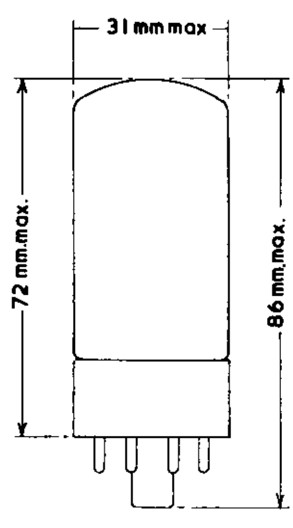
FULL-WAVE RECTIFIER

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

1332



Octal Base.



FULL-WAVE RECTIFIER

GZ33

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

HEATER

V_h	5.0	V
I_h	3.0	A

LIMITING VALUES

P.I.V. max.	1.4	kV
$i_{a(pk)}$ max.	750	mA
i_a surge max.	2.5	A

Capacitor input

$V_{a(r.m.s.)}$ max.	500	V
I_{out} max.	250	mA
C max.	60	μF

Choke input

$V_{a(r.m.s.)}$ max.	500	V
I_{out} max.	300	mA
L min.	10	H

TYPICAL OPERATING CONDITIONS

Capacitor input

$V_{a(r.m.s.)}$ (V)	I_{out} (mA)	C (μF)	$R_{lim.}$ min. (per anode) (Ω)	V_{out} (V)
2×300	250	8	140	271
2×400	250	8	200	375
2×500	250	8	250	479
2×300	250	60	140	289
2×400	250	60	200	388
2×500	250	60	250	493

Choke input

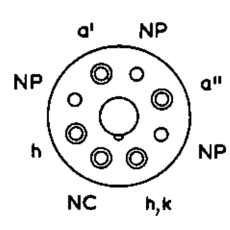
$V_{a(r.m.s.)}$ (V)	I_{out} (mA)	L (H)	V_{out} (V)
2×300	300	10	242
2×400	300	10	332
2×500	300	10	421

GZ33

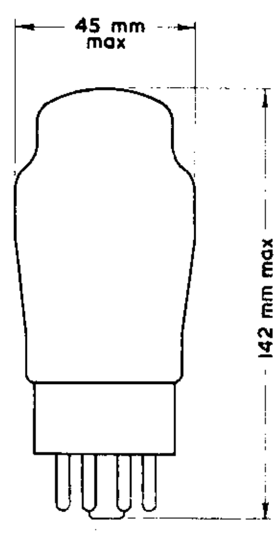
FULL-WAVE RECTIFIER

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

3361



Octal Base



FULL-WAVE RECTIFIER

GZ34

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

HEATER

V_h	5.0	V
I_h	1.9	A

LIMITING VALUES

P.I.V. max.						1.5	kV
$i_{a(pk)}$ max.						750	mA
C max.						60	μF
$V_{a(r.m.s.)}$	2×300	2×350	2×400	2×450	2×500	2×550	V
Capacitor input							
I_{out} max.	250	250	250	250	200	160	mA
R_{lim} min. (per anode)	50	75	100	125	150	175	Ω
Choke input							
I_{out} max.	250	250	250	250	250	225	mA
R_{lim} min. (per anode)	0	0	0	0	0	0	Ω

TYPICAL OPERATING CONDITIONS

Capacitor input

$V_{a(r.m.s.)}$ (V)	I_{out} (mA)	C (μF)	R_{lim} (per anode) (Ω)	V_{out} (V)
2×300	250	60	75	330
2×350	250	60	100	380
2×400	250	60	125	430
2×450	250	60	150	480
2×500	200	60	175	560
2×550	160	60	200	640

Choke input

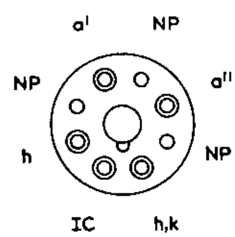
$V_{a(r.m.s.)}$ (V)	I_{out} (mA)	L (H)	R_{lim} (per anode) (Ω)	V_{out} (V)
2×300	250	10	0	250
2×350	250	10	0	290
2×400	250	10	0	330
2×450	250	10	0	375
2×500	250	10	0	420
2×550	225	10	0	465

GZ34

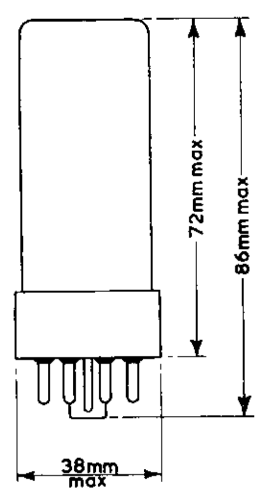
FULL-WAVE RECTIFIER

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

5305



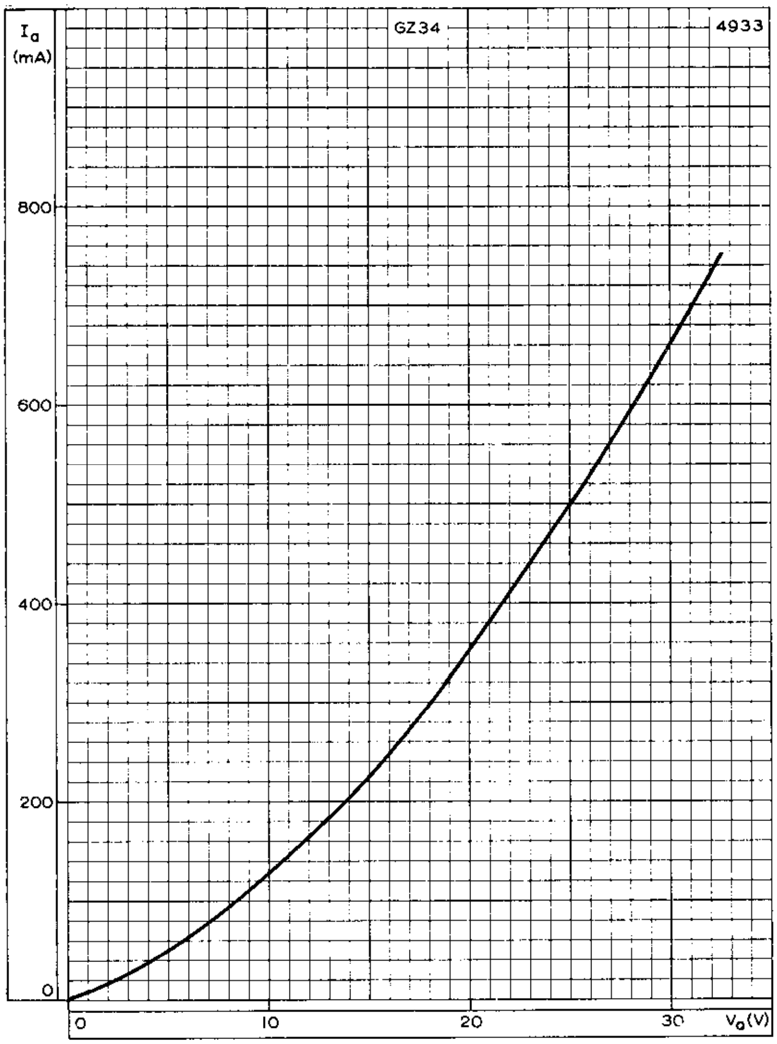
Octal Base



FULL-WAVE RECTIFIER

GZ34

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

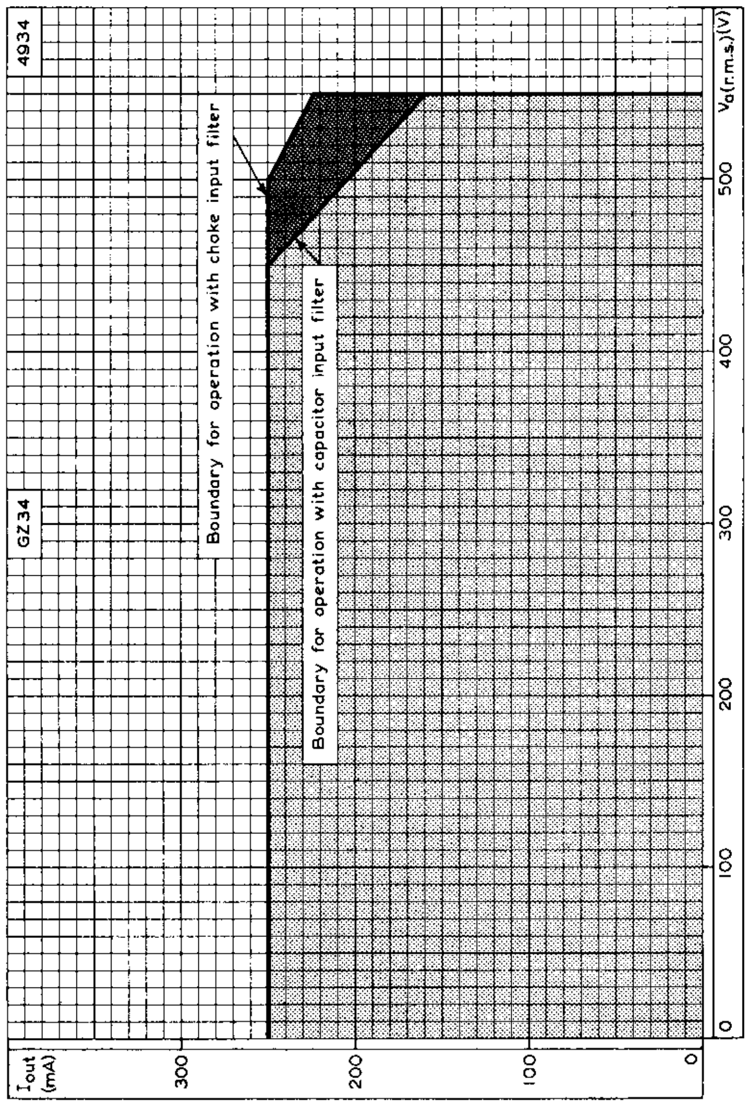


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

GZ34

FULL-WAVE RECTIFIER

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

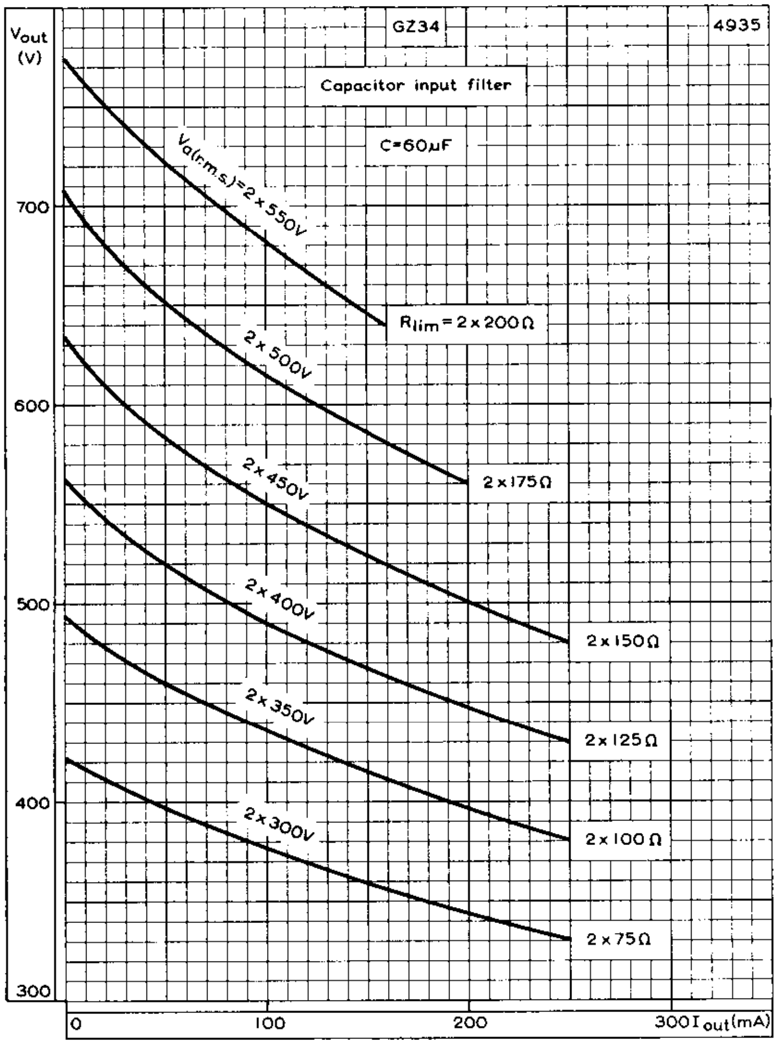


BOUNDARY OF OPERATION WITH CAPACITOR OR CHOKE INPUT FILTER

FULL-WAVE RECTIFIER

GZ34

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

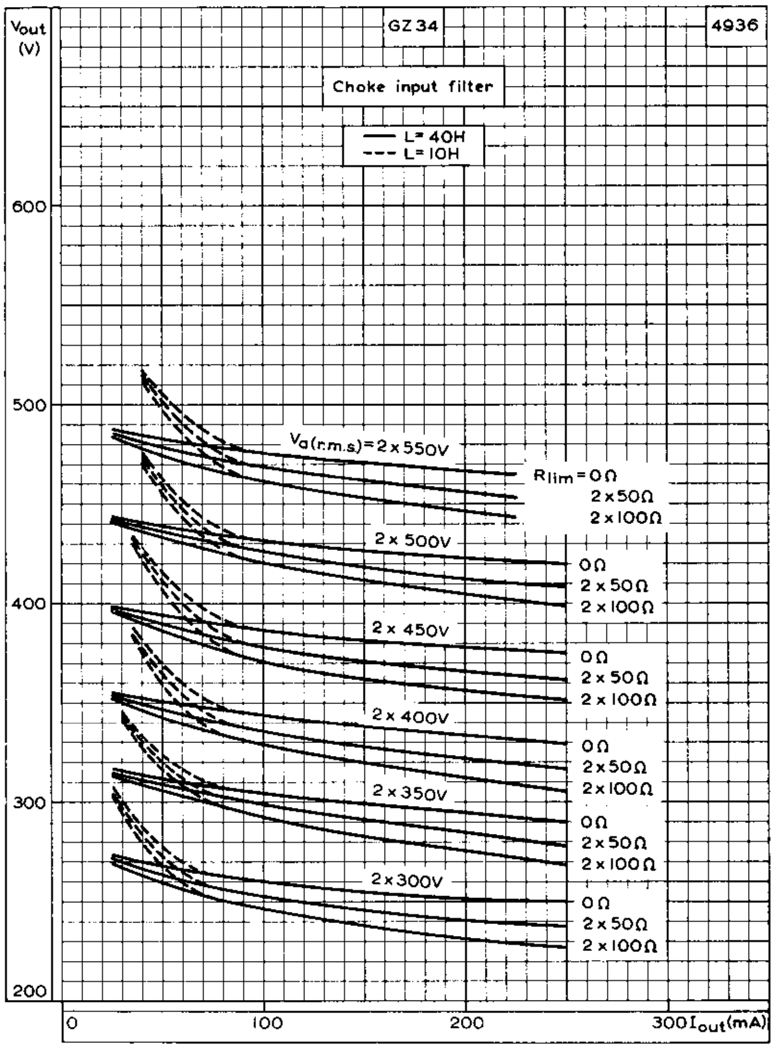


CAPACITOR INPUT FILTER REGULATION CURVES

GZ34

FULL-WAVE RECTIFIER

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



CHOKE INPUT FILTER REGULATION CURVES

FULL-WAVE RECTIFIER

GZ37

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

HEATER

V_h	5.0	V
I_h	2.8	A

LIMITING VALUES

Capacitor input

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

Choke input

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

TYPICAL OPERATING CONDITIONS

Capacitor input

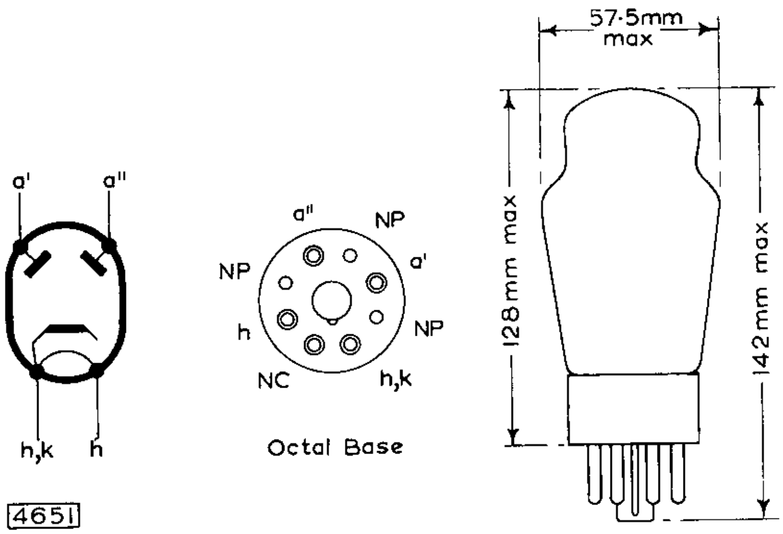
$V_{a(r.m.s.)}$	2×300	2×400	2×500	V
I_{out}	250	250	250	mA
C	4	4	4	μF
R_{lim} min (per anode)	75	75	75	Ω
V_{out} approx.	238	358	486	V

Choke input

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

GZ37

FULL-WAVE RECTIFIER



4651

SPECIAL QUALITY R.F. POWER TRIODE

M8080

Special quality power triode for use as an r.f. power amplifier or oscillator in equipment where mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

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

HEATER

V_h[1]	6.3	V
I_h	150	mA

CAPACITANCES[2] (measured without an external shield)

c_{in}	1.5	pF
c_{out}	1.2	pF
c_{a-g}	1.4	pF

CHARACTERISTICS[3]

V_a	250	V
I_a	10.5	mA
V_g	−8.5	V
g_m	2.2	mA/V
μ	17	
r_a	7.7	kΩ
R_k	0	Ω

LIMITING VALUES[4] (absolute ratings)

f max.	150	Mc/s
$V_{a(b)}$ max.	550	V
V_a max.	330	V
p_a max.	3.8	W
$-V_g$ max.	110	V
I_g max.	5.5	mA
I_k max.	21	mA
R_{g-k} max. (cathode bias)	1.0	MΩ
R_{g-k} max. (fixed bias)	250	kΩ
V_{h-k} max.	150	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	170	°C

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_a (V)	V_g (V)	R_k (Ω)	V_{h-k} (V)
6.3	250	−8.5	0	0

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP A								
Insulation								
a-rest measured at −300V	0.25	—	100	—	—	—	—	MΩ
g-rest measured at −100V	0.25	—	100	—	—	—	—	MΩ
Reverse grid current, R_{g1} max. = 500kΩ	0.25	—	—	0.5	—	—	—	μA
GROUP B								
Heater current	0.65	—	138	162	—	—	—	mA
Heater cathode leakage current	0.65	—	—	—	—	—	—	
V_{h-k} = 100V (cathode negative)	—	—	—	10	—	—	—	μA
V_{h-k} = 100V (cathode positive)	—	—	—	10	—	3.0	—	μA
Anode current	0.65	10.5	6.5	14.5	—	—	—	mA
	—	—	—	—	9.0	12	1.22	mA
Mutual conductance	0.65	2.2	1.75	2.65	—	—	—	mA/V
	—	—	—	—	2.0	2.4	0.157	mA/V
Group qaulity level[10]	1.0	—	—	—	—	—	—	

GROUP C

Anode current. $V_g = -30V$	2.5	—	—	50	—	—	—	μA
Reverse grid current. $V_h = 6.9V$, $V_{a-e} = 250V$, $V_{g-e} = 0V$, $R_k = 810\Omega$	2.5	—	—	1.0	—	—	—	μA
Microphonic noise at the anode at 50c/s and 2.5g min. peak acceleration. $V_b = 250V$, $R_a = 2k\Omega$, $V_{g-e} = 0V$, $R_k = 810\Omega$, $C_k = 1000\mu F$	2.5	—	—	7.0	—	—	—	mV (r.m.s.)
Group quality level[10]	6.5	—	—	—	—	—	—	

GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances (unshielded). No applied voltages; pin 2 connected to pin 7	6.5	—	—	—	—	—	—	
c_{in}	—	—	1.35	2.25	—	—	—	pF
c_{out}	—	—	0.98	1.62	—	—	—	pF
c_{a-g}	—	—	1.2	2.0	—	—	—	pF
Mutual conductance. $V_a = 100V$, $V_g = 0V$	6.5	3.25	2.5	4.0	—	—	—	mA/V
	—	—	—	—	2.82	3.68	0.33	mA/V
Change of mutual conductance. $V_a = 100V$, $V_g = 0V$, $V_h = 5.7V$	6.5	—	—	15	—	—	—	%
Amplification factor	6.5	17	15.5	18.5	—	—	—	
	—	—	—	—	16.15	17.85	0.66	
Power oscillation. $V_a = 300V$, $R_g = 8.5k\Omega$, f = 150Mc/s	4.0	—	1.8	—	—	—	—	W

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	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, $f = 170 \pm 5$c/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. $V_{a-c} = 250V$, $R_k = 500\Omega$, $V_{h-k} = 150V$ (cathode negative)

Stability life test end point

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

Intermittent life test

Running conditions. $V_{a-c} = 250V$, $R_k = 500\Omega$, $V_{h-k} = 150V$ (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. = 500kΩ	500 hours	2.5	—	0.5	µA
	1000 hours	4.0	—	0.5	µA
Mutual conductance	500 hours	2.5	1.6	2.65	mA/V
	1000 hours	4.0	1.5	2.65	mA/V
Average change in mutual conductance	500 hours	—	—	15	%
Sub-group (b)					
Anode current	500 hours	4.0	5.5	14.5	mA
	1000 hours	6.5	5.0	14.5	mA
Insulation as in group A	500 hours	4.0	50	—	MΩ
	1000 hours	6.5	30	—	MΩ
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

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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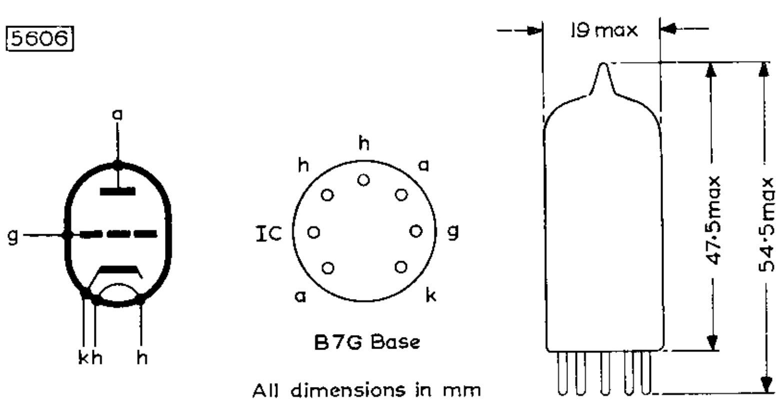


The bulb and base dimensions of this valve are in accordance with BS448 Section B7G.

SPECIAL QUALITY
V.H.F. DOUBLE TRIODE

M8081

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

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

HEATER

V_h [1]	6.3	V
I_h	450	mA

CAPACITANCES[2] (measured without an external shield)

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

*Each section

CHARACTERISTICS[3] (each section)

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

* Fixed bias operation is not recommended

LIMITING VALUES[4] (absolute ratings)

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

TEST CONDITIONS (unless otherwise specified)

V_h	V_{a-e}	V_{g-e}	R_k	C_k
(V)	(V)	(V)	(Ω)	(μF)
6.3	100	0	50	1000

Voltages are applied simultaneously to both sections. The measurements apply to each section, unless otherwise stated.

TESTS	*A.Q.L.*[5] (%)	*Individuals*[6] *Bogey*[9]	*Individuals*[6] *Min.*	*Individuals*[6] *Max.*	*Lot average*[7] *Min.*	*Lot average*[7] *Max.*	*Lot standard deviation*[8] *Max.*	
GROUP A								
Insulation								
a-rest, measured at −300V	0.25	—	100	—	—	—	—	MΩ
g-rest, measured at −100V	0.25	—	100	—	—	—	—	MΩ
Reverse grid current								
$R_g$max. = 1MΩ, V_{a-e} = 250V,								
R_k = 500Ω both sections strapped	0.25	—	—	0.5	—	—	—	μA
GROUP B								
Heater current	0.65	—	420	480	—	—	—	mA
Heater to cathode leakage current	0.65	—	—	—	—	—	—	
V_{h-k} = 100V cathode negative	—	—	—	10	—	—	—	μA
V_{h-k} = 100V cathode positive	—	—	—	10	—	—	—	μA
Anode current	0.65	—	6.5	11.5	—	—	—	mA
Mutual conductance	0.65	—	4.0	7.5	—	—	—	mA/V
Anode current V_{g-e} = −30V, V_{a-e} = 250V	0.65	—	—	75	—	—	—	μA
Group quality level[10]	1.0	—	—	—	—	—	—	

GROUP C

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

GROUP D

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

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
$V_h = 6.9V$, 1 minute on 3 minutes off. No other voltages applied, 2g min. peak acceleration, f = 170c/s for 33 hours in each of 3 mutually perpendicular planes.								
Post fatigue tests								
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	2.5	—	—	20	—	—	—	μA
Reverse grid current as in group A	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	3.5	7.5	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	35	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	4.0	—	—	—	—	—	—	
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	2.5	—	—	20	—	—	—	μA
Reverse grid current as in group A	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	3.5	7.5	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	35	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	4.0	—	—	—	—	—	—	

GROUP F

Stability life test[14]

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

Stability life test end points

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

Intermittent life test

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

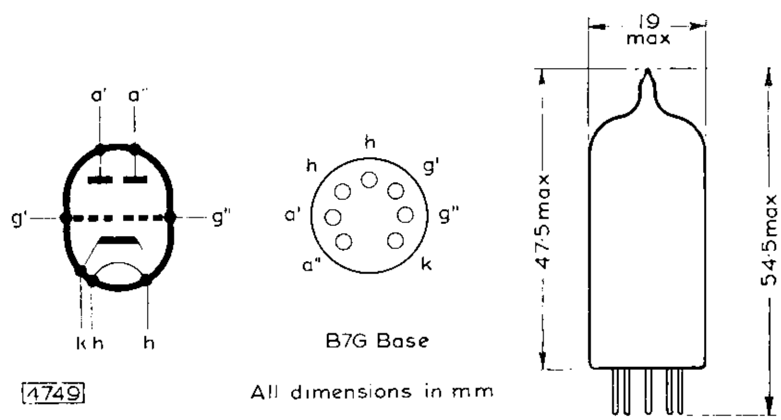
Intermittent life test end points

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

M8081

SPECIAL QUALITY
V.H.F. DOUBLE TRIODE

	A.Q.L.[5] (%)	Min.	Max.	
GROUP G				
Valves are held for 28 days and retested for inoperatives[16]	0.5	—	—	
Reverse grid current as in group A.	0.5	—	0.75	μA



All dimensions in mm

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

SPECIAL QUALITY OUTPUT PENTODE

M8082

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

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

HEATER

V_h[1]	6.3	V
I_h	200	mA

MOUNTING POSITION

Any

CAPACITANCES[2] (measured with an external shield)

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

CHARACTERISTICS[3]

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

ABSOLUTE MAXIMUM RATINGS[4]

f max.	100	Mc/s
$V_{a(b)}$ max.	550	V
V_a max.	300	V
p_a max.	4.75	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	275	V
p_{g2} max.	800	mW
$-V_{g1}$ max.	110	V
V_{g1-g2} max.	300	V
I_{g1} max.	3.3	mA
I_k max.	23	mA
R_{g1-k} max. (fixed bias)	220	kΩ
V_{h-k} max.	150	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	180	°C

TEST CONDITIONS (unless otherwise specified)

V_h (V)	$V_{a(b)}$ (V)	V_{g2-e} (V)	V_{g1-e} (V)	R_k (Ω)	R_{g1} (Ω)	C_k (μF)
6.3	250	250	0	740	0	1000

TESTS	A.Q.L.[5]	Individuals[6]			Lot average[7]		Lot standard deviation[8]	
	(%)	Bogey[9]	Min.	Max.	Min.	Max.	Max.	
GROUP A								
Insulation								
a-rest, g_2-rest measured at −300V; g_1-rest measured at −100V	0.25	—	100	—	—	—	—	MΩ
Reverse control-grid current R_{g1} max. = 500kΩ	0.25	—	—	0.5	—	—	—	μA
GROUP B								
Heater current	0.65	—	184	216	—	—	—	mA
Heater to cathode leakage current								
V_{h-k} = 100V cathode alternately positive and negative	0.65	—	—	10	—	—	—	μA
V_{h-k} = 100V cathode positive	—	—	—	—	—	3.0	—	μA
Anode current	0.65	15	12	18	—	—	—	mA
	—	—	—	—	13.9	16.1	0.86	mA
Screen-grid current	0.65	2.0	1.3	2.7	—	—	—	mA
	—	—	—	—	1.74	2.26	0.2	mA
Mutual conductance	0.65	2.55	1.95	3.15	—	—	—	mA/V
	—	—	—	—	2.33	2.77	0.17	mA/V
Group quality level[10]	1.0	—	—	—	—	—	—	

GROUP C

Anode current. $V_{g1-e} = -50V$	2.5	—	—	50	—	—	—	μA
Change in mutual conductance. $V_h = 5.7V$	2.5	—	—	15	—	—	—	%
Reverse control-grid current. $V_h = 6.9V$, $V_{a-e} = 300V$, $V_{g2-e} = 235V$	2.5	—	—	1.0	—	—	—	μA
Microphonic noise at the anode at 50c/s 2.0g min. peak acceleration, $V_{a(b)} = 250V$, $R_a = 2k\Omega$, $V_{g2-e} = 250V$.	2.5	—	—	15	—	—	—	mV (r.m.s.)
Group quality level[10]	6.5	—	—	—	—	—	—	

GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances (shielded). No applied voltages	6.5	—	—	—	—	—	—	
c_{in}	—	—	3.5	5.0	—	—	—	pF
c_{out}	—	—	5.8	7.2	—	—	—	pF
c_{a-g1}	—	—	—	300	—	—	—	mpF
Amplification factor (μ_{g1-g2})	6.5	—	10	14	—	—	—	

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP E								
Fatigue[14]								
V_h = 6.9V, 1 minute on, 3 minutes off. No other voltages applied, 5g min. peak acceleration, f = 170c/s, for 33 hours in each of 3 mutually perpendicular planes.								
Post fatigue tests								
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	2.5	—	—	20	—	—	—	μA
Reverse control-grid current R_{g1} max = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	1.8	3.2	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	25	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	4.0	—	—	—	—	—	—	
Shock[15]								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	2.5	—	—	20	—	—	—	μA
Reverse control-grid current R_{g1} max = 500kΩ	2.5	—	—	1.0	—	—	—	μA
Mutual conductance	2.5	—	1.8	3.2	—	—	—	mA/V
Microphonic noise as in group C	2.5	—	—	25	—	—	—	mV (r.m.s.)
Sub-group quality level[10]	4.0	—	—	—	—	—	—	

GROUP F

***Stability life test*[14]**

Running conditions. $R_{g1} = 100k\Omega \pm 20\%$, $R_k = 740\Omega \pm 10\%$, $V_{h-k} = 150V$ (cathode negative)

Stability life test end point

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

Intermittent life test

Running conditions. $R_{g1} = 100k\Omega \pm 20\%$, $R_k = 740\Omega \pm 10\%$, $V_{h-k} = 150V$ (cathode negative)

Intermittent life test end points		A.Q.L.[5] (%)	*Min.*	*Max.*	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	184	216	mA
Heater to cathode leakage current. $V_{h-k} = \pm 100V$	500 hours	2.5	—	30	µA
	1000 hours	4.0	—	30	µA
Reverse control-grid current. R_{g1} max = 500kΩ	500 hours	2.5	—	1.0	µA
	1000 hours	4.0	—	1.0	µA
Mutual conductance	500 hours	2.5	1.7	3.2	mA/V
	1000 hours	4.0	1.6	3.2	mA/V
Average change in mutual conductance	500 hours	—	—	15	%
Sub-group (b)					
Insulation as in group A	500 hours	4.0	50	—	MΩ
	1000 hours	6.5	30	—	MΩ
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

M8082

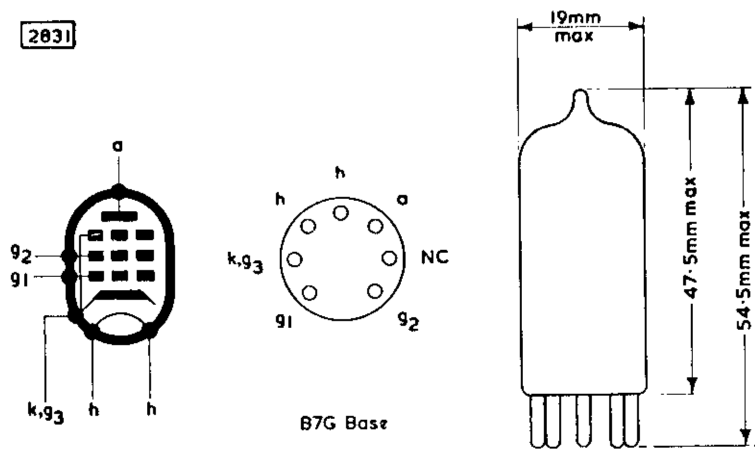
SPECIAL QUALITY OUTPUT PENTODE

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

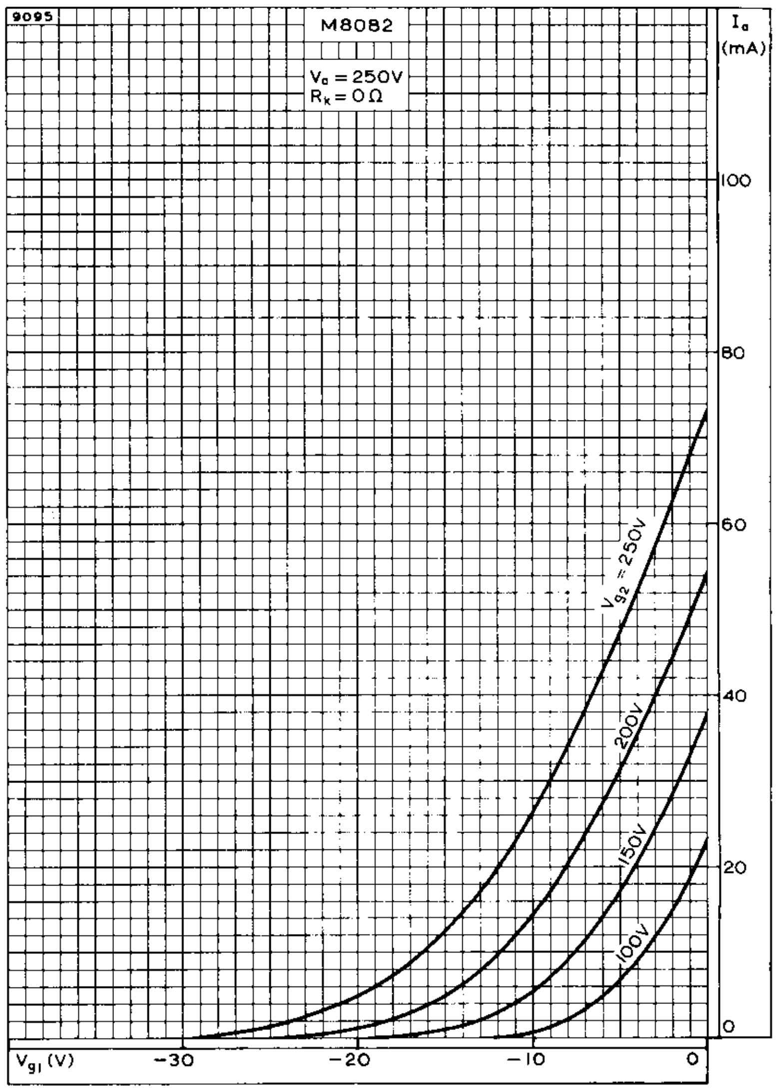
GROUP G

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

2831



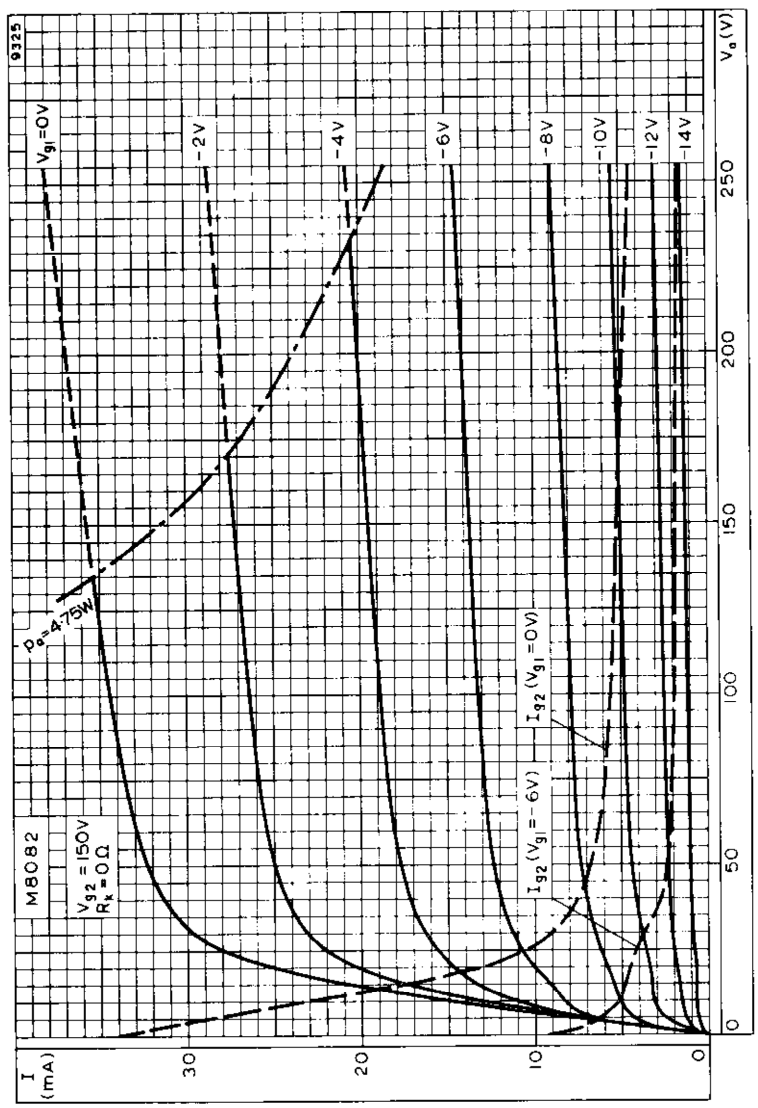
The bulb and base dimensions of this valve are in accordance with BS448, Section B7G



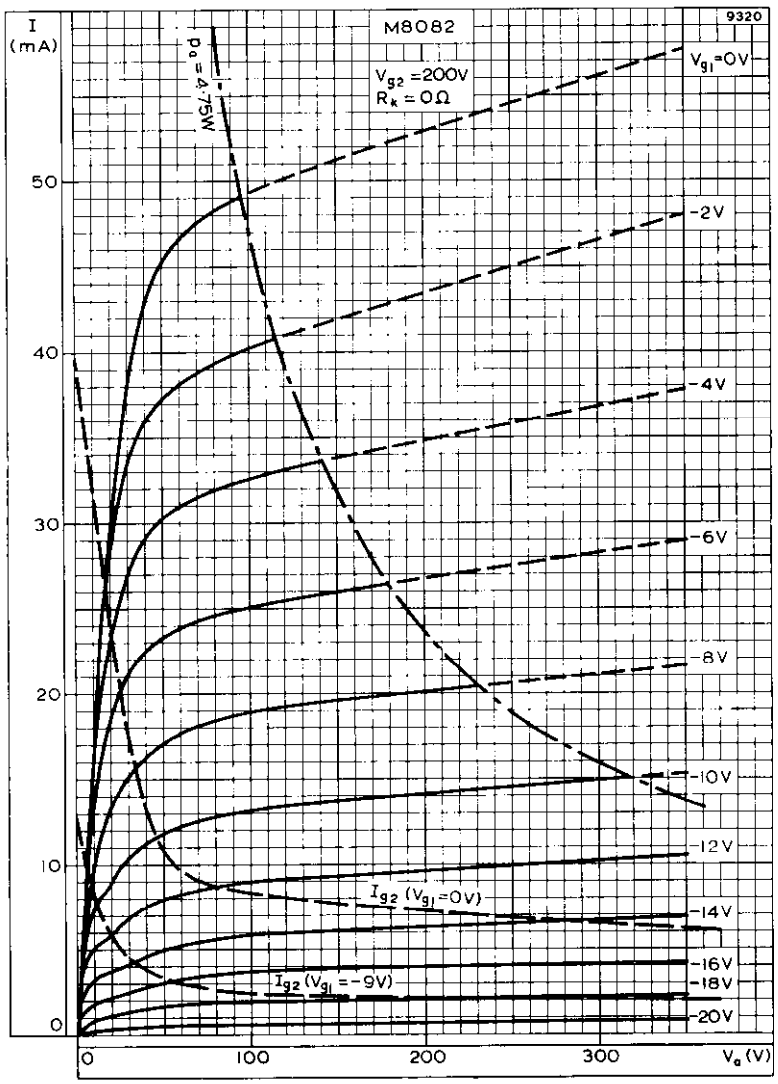
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE WITH SCREEN-GRID VOLTAGE AS PARAMETER

M8082

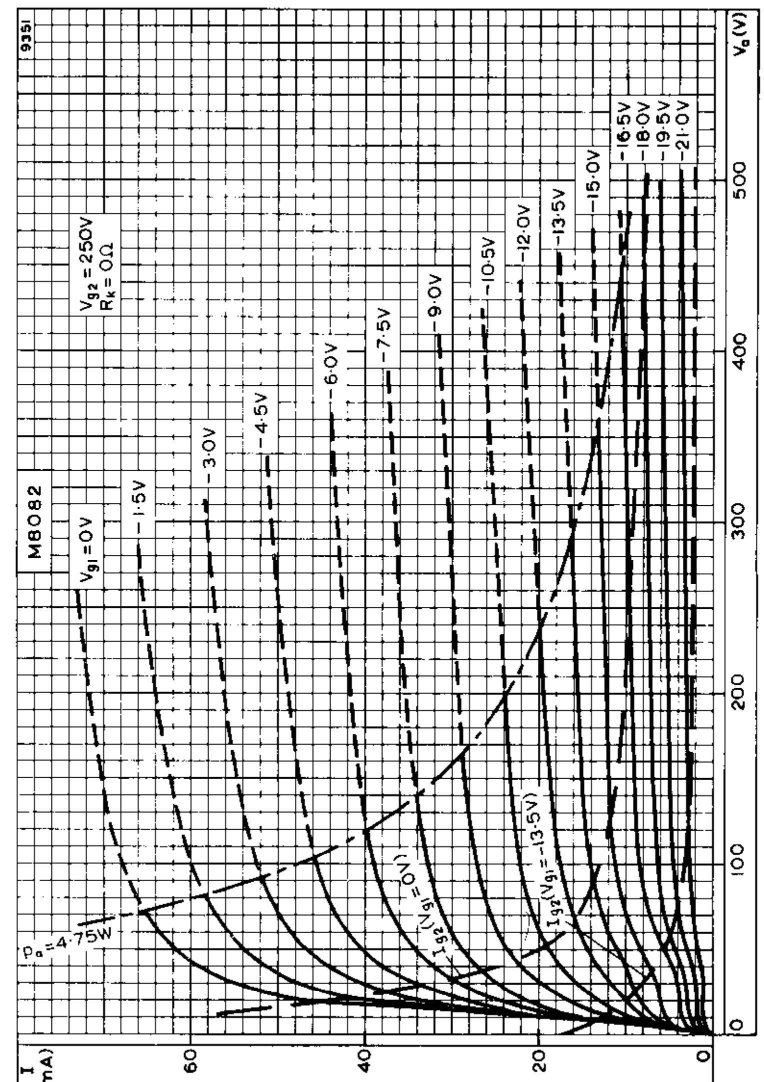
SPECIAL QUALITY OUTPUT PENTODE



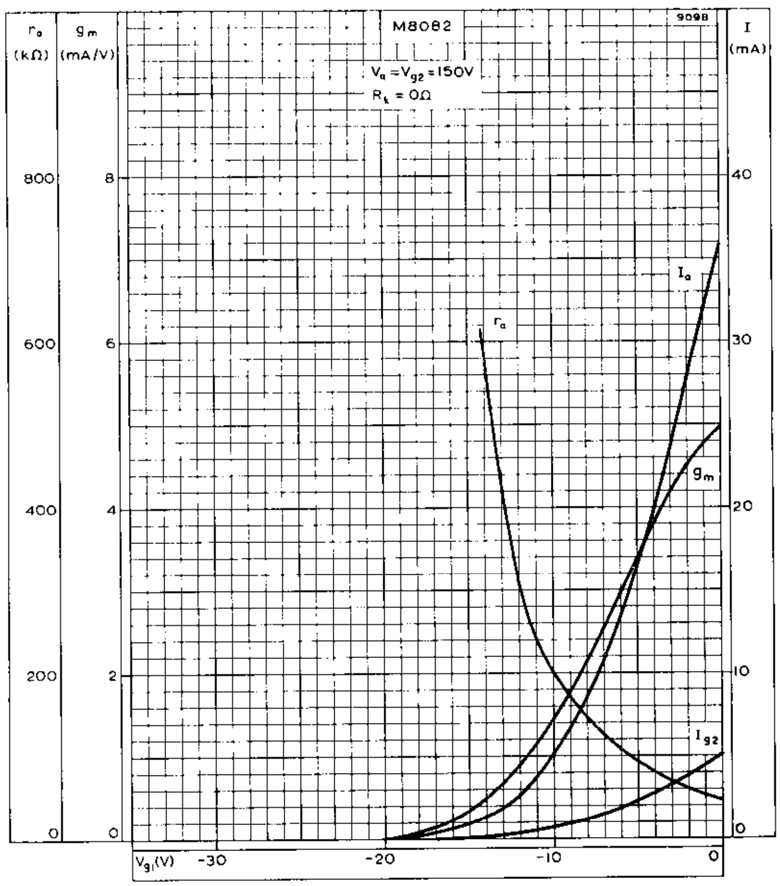
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 150V



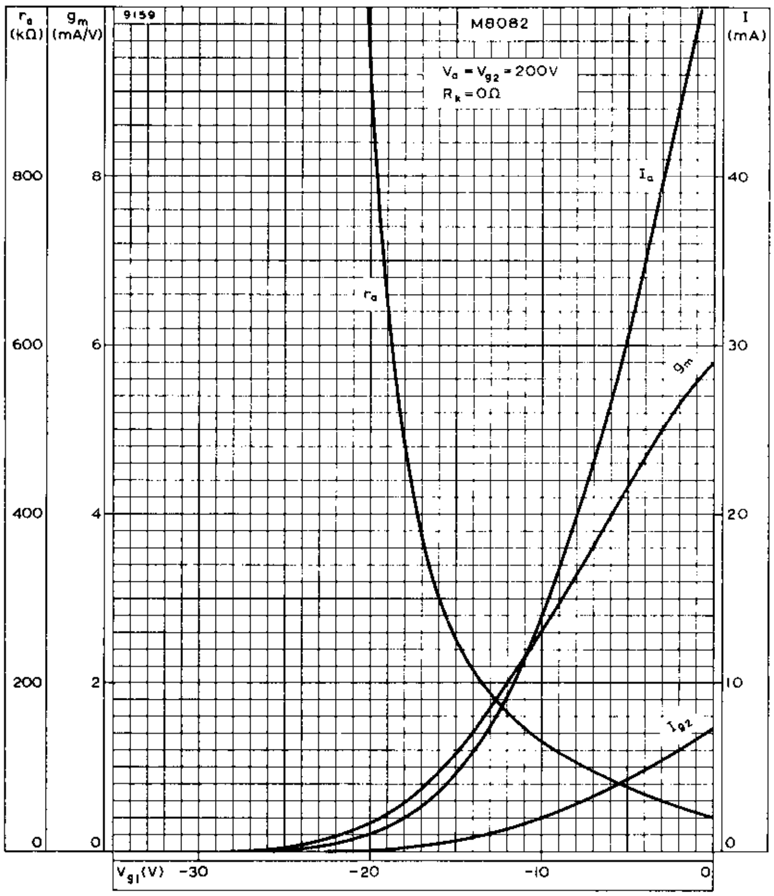
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 200V



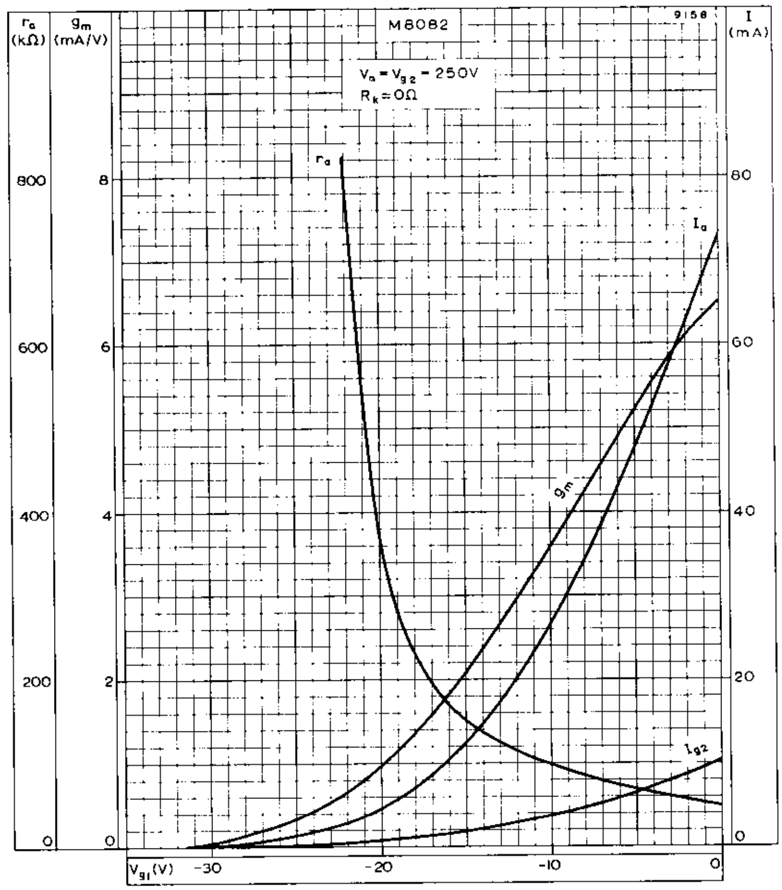
ANODE AND SCREEN-GRID CURRENTS PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER. V_{g2} = 250V



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



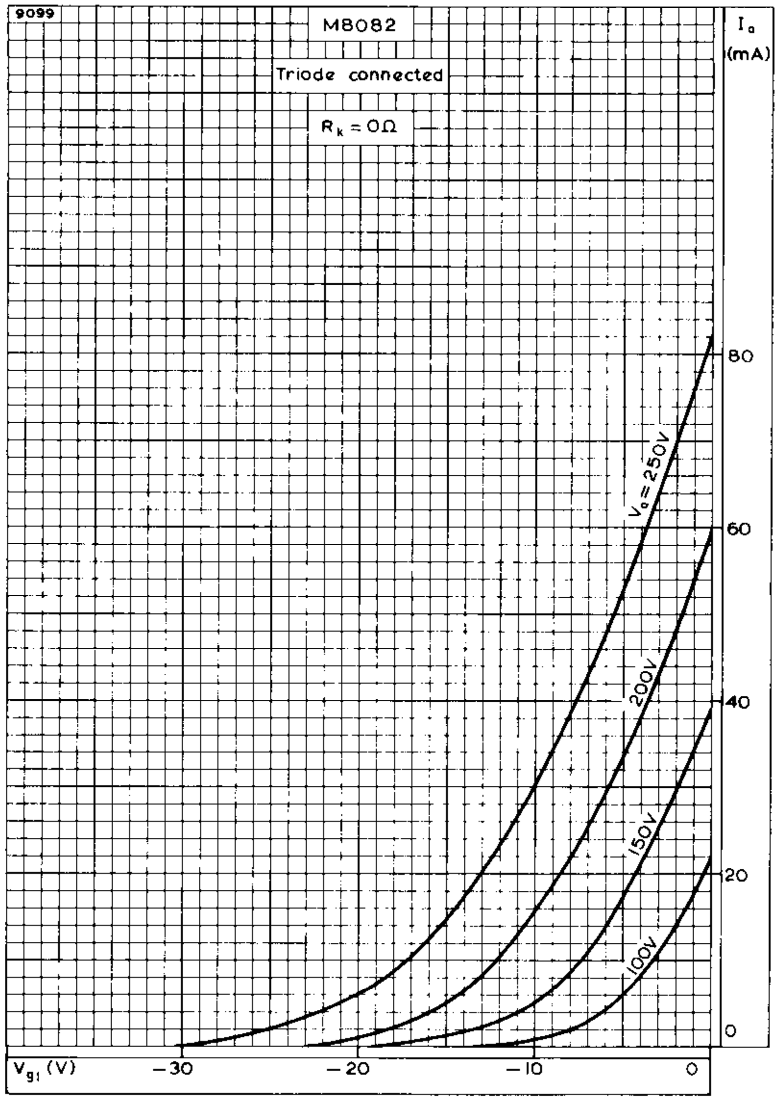
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
$V_a = V_{g2} = 200V$



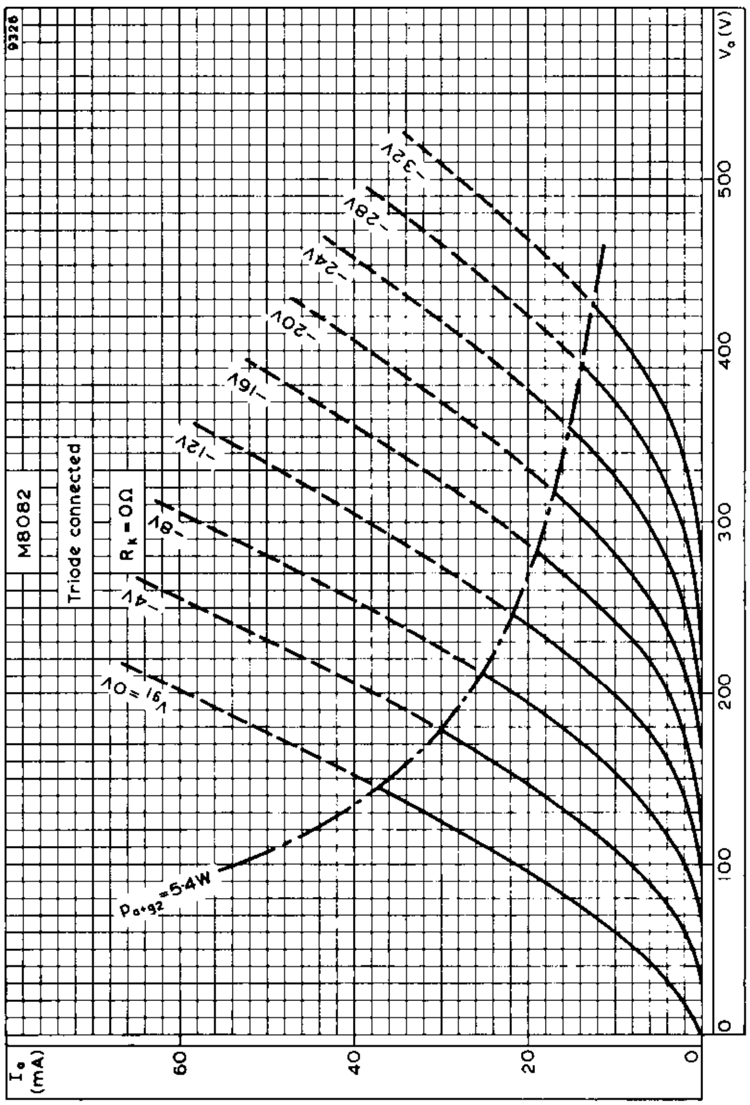
ANODE AND SCREEN-GRID CURRENTS, MUTUAL CONDUCTANCE AND ANODE IMPEDANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE. $V_a = V_{g2} = 250V$

M8082

SPECIAL QUALITY OUTPUT PENTODE



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



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

SPECIAL QUALITY HALF-WAVE RECTIFIER

M8091

Special quality half-wave rectifier primarily intended for operation at high altitudes in equipment where mechanical vibration and shocks are unavoidable.

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

HEATER

V_h[1]	6.3	V
I_h	1.15	A

MOUNTING POSITION

Any

LIMITING VALUES[4] (absolute ratings)

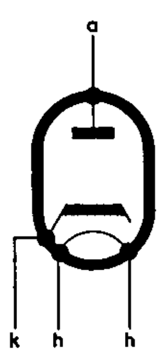
P.I.V. max.	2.0	kV
$i_{a(pk)}$ max.	900	mA
V_{h-k} max.	650	V
Maximum altitude for full P.I.V. rating	60,000	ft
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	220	°C

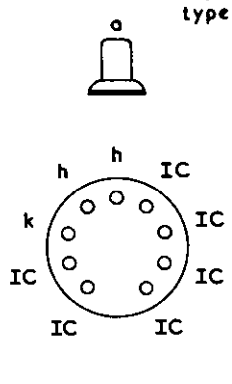
TYPICAL OPERATION OF TWO M8091 AS FULL-WAVE RECTIFIER

Capacitor input

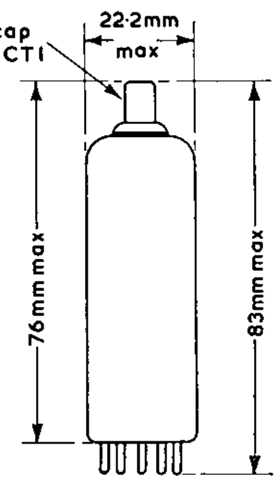
$V_{in(r.m.s.)}$	2 × 500	2 × 625	V
R_{lim} min. (per anode)	150	250	Ω
C max.	16	16	μF
I_{out} max.	300	250	mA

3367





B9A Base



TEST CONDITIONS (unless otherwise specified)

V_h (V)	$V_{in(r.m.s.)}$ (V)	R_{load} (kΩ)	C (μF)
6.3	625	5	8

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	
GROUP A					
Voltage breakdown	0.25	—	—	—	
GROUP B					
Heater current	0.65	—	0.9	1.4	A
Heater to cathode leakage current. $V_{h-k} = 330V$ (cathode positive)	0.65	—	—	150	μA
Anode voltage. $I_a = 150mA$	0.65	—	18	26	V
Output current	0.65	—	120	—	mA
Group quality level[10]	1.0	—	—	—	
GROUP C					
Output current. $V_{in(r.m.s.)} = 500V$, $R_{load} = 3k\Omega$	2.5	—	145	—	mA
†Hot switch	2.5	—	—	—	
†Hot switch. f = 1.5 to 2.4kc/s C reduced to suit frequency	6.5	—	—	—	

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

GROUP D

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

GROUP E

***Fatigue*[14]**

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

Post fatigue tests

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

***Shock*[15]**

No applied voltages, 500g.

Post shock tests

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

GROUP F

	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Min.	Max.	
Life[14]					
Running conditions. $V_{in(r.m.s.)} = 500V$, $R_{load} = 3k\Omega$ $V_{h-k} = V_{out} + 150V$ r.m.s., $C = 8\mu F$					
Stability life test end point					
Change in anode voltage after 1 hour. $I_a = 150mA$	1.0	—	—	10	%

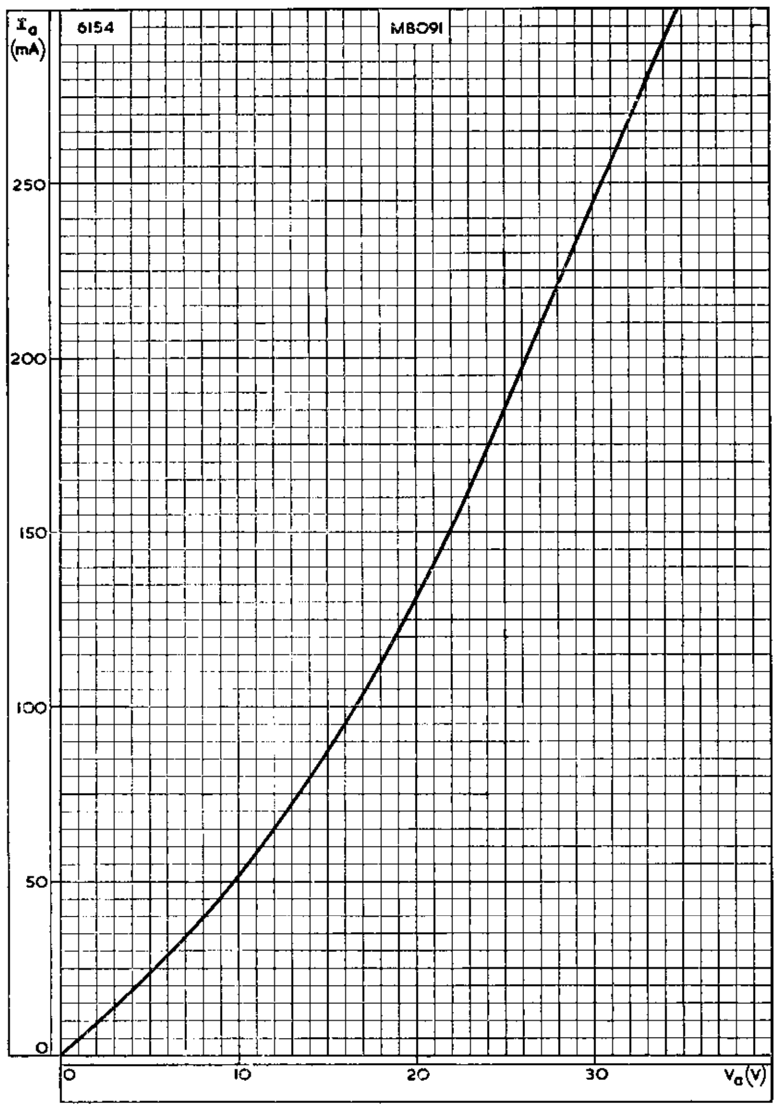
Intermittent life test

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

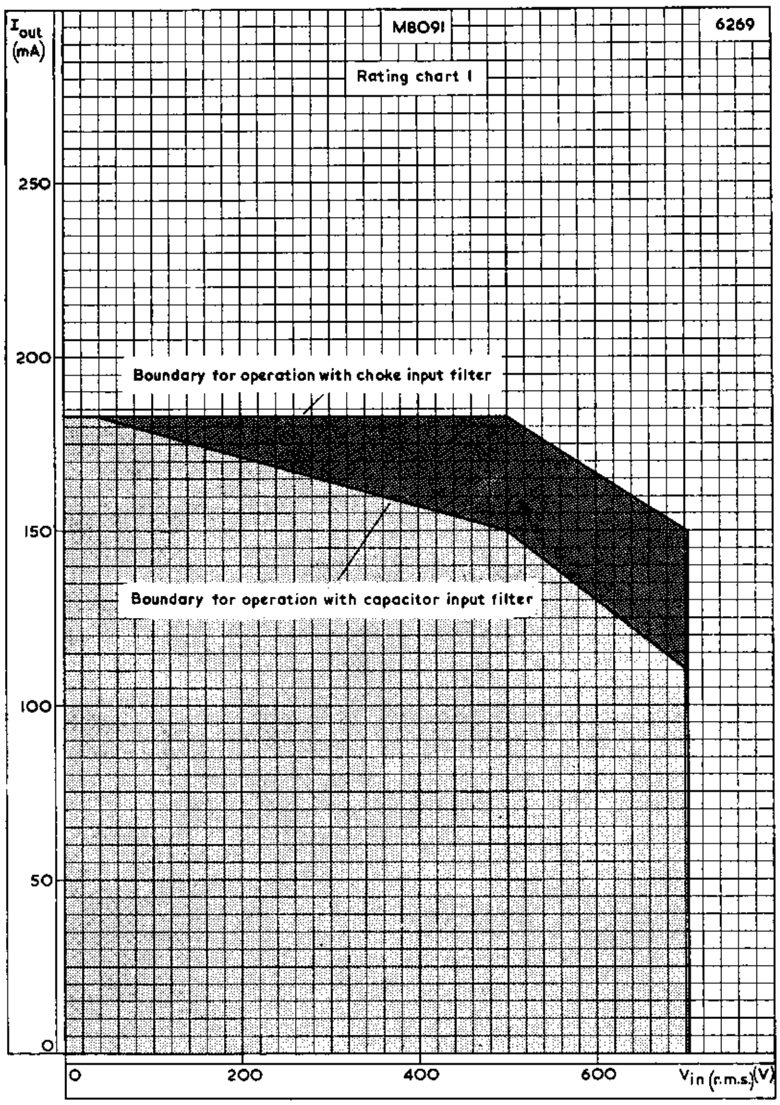
Intermittent life test end points		A.Q.L.[5] (%)	Min.	Max.	
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	0.9	1.4	A
Heater to cathode leakage current. $V_{h-k} = 300V$ (cathode positive)	500 hours	2.5	—	150	µA
	1000 hours	4.0	—	150	µA
Sub-group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

GROUP G

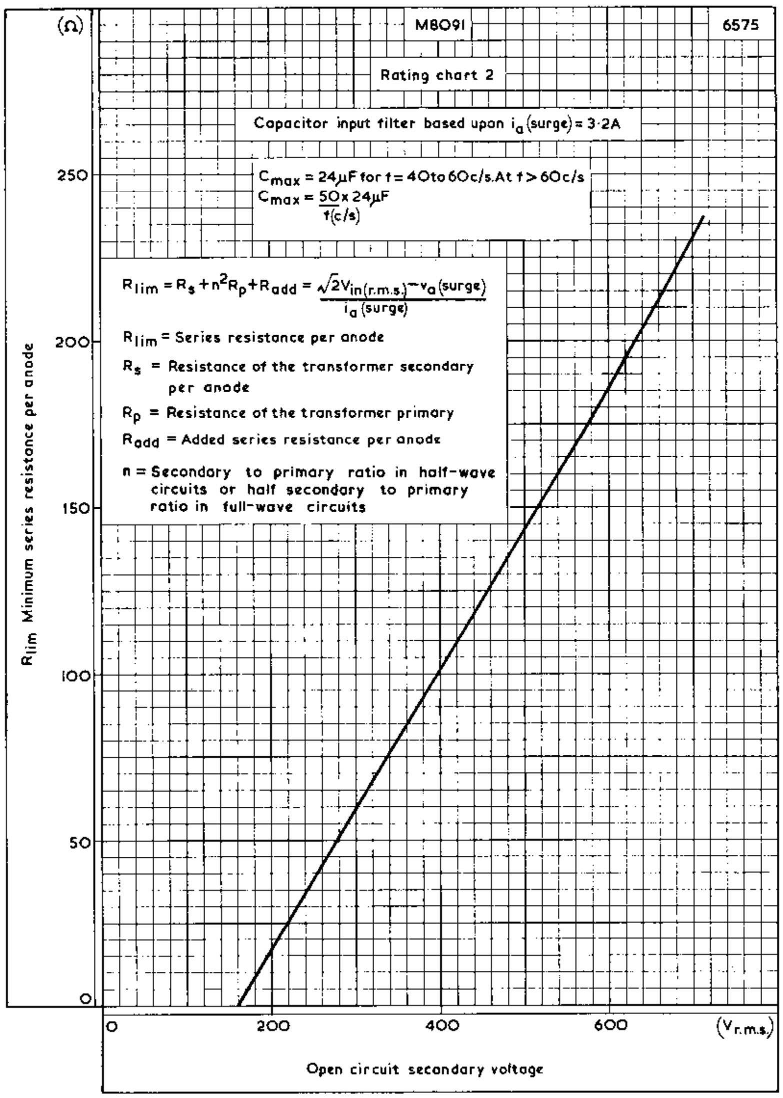
	A.Q.L. (%)	Min.	Max.
Valves are held for 28 days and retested for Inoperatives[16]	0.5	—	—



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE



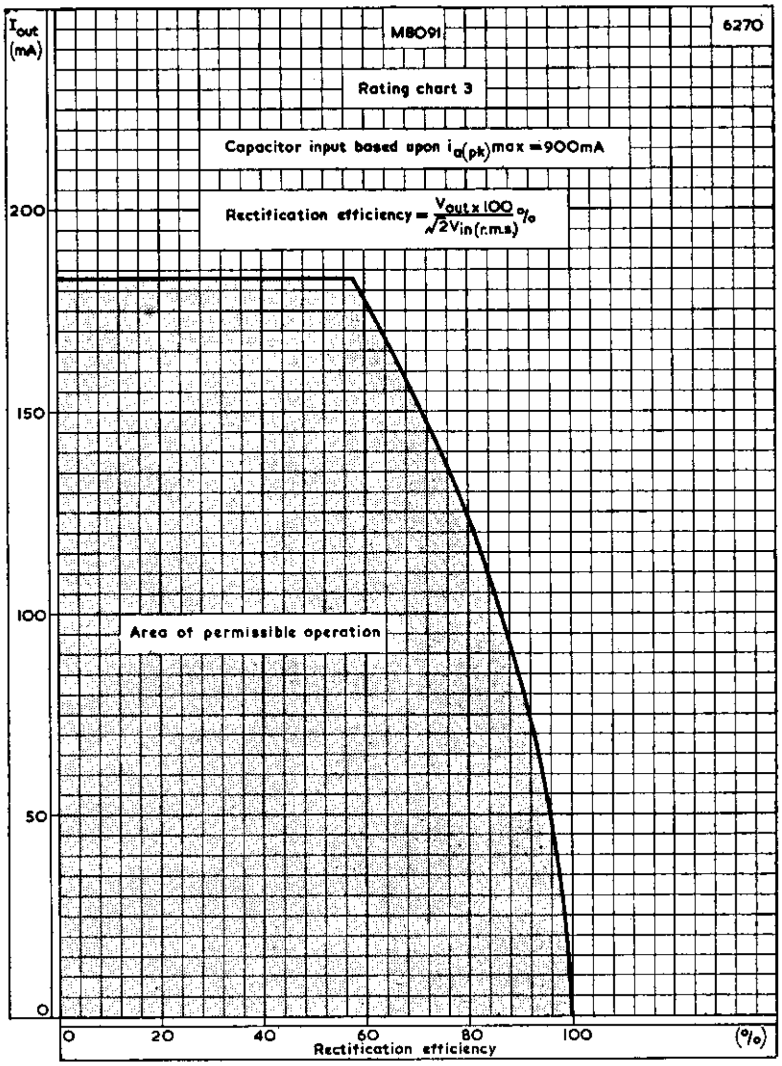
BOUNDARY OF OPERATION WITH CAPACITOR OR CHOKE INPUT FILTER



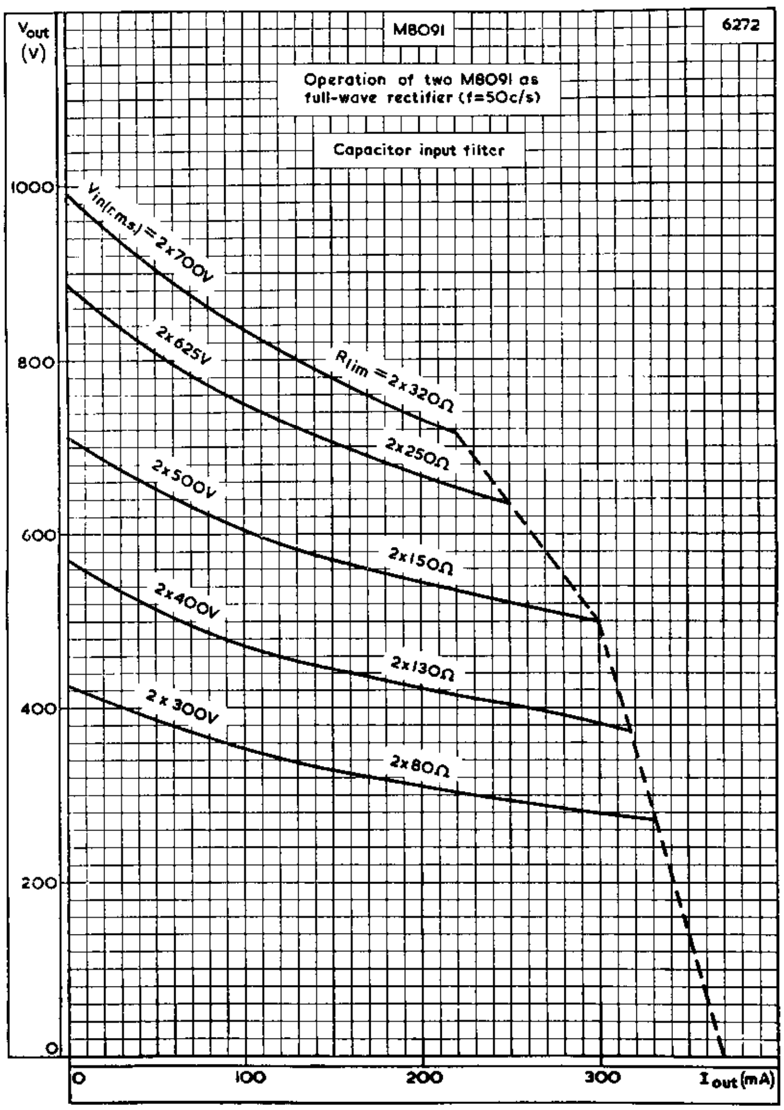
MINIMUM SERIES ANODE RESISTANCE PLOTTED AGAINST OPEN CIRCUIT SECONDARY VOLTAGE

M8091

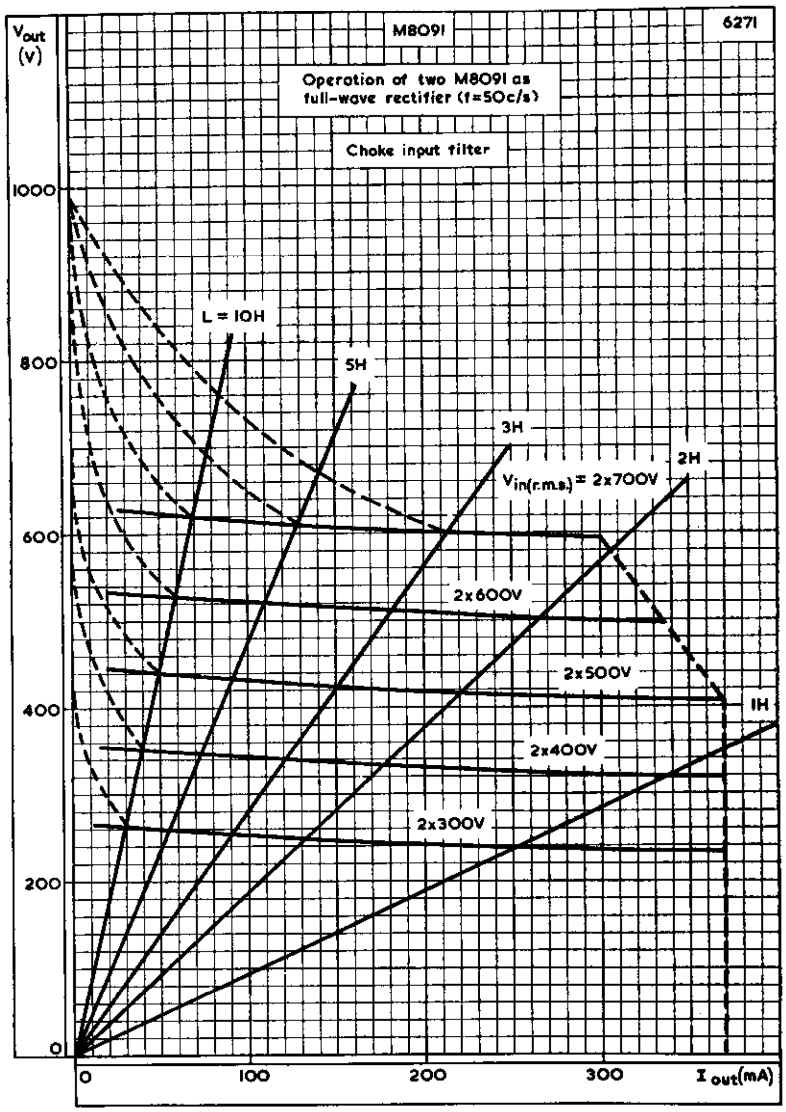
SPECIAL QUALITY HALF-WAVE RECTIFIER



OUTPUT CURRENT PLOTTED AGAINST RECTIFICATION EFFICIENCY



CAPACITOR INPUT FILTER REGULATION CURVES



CHOKE INPUT FILTER REGULATION CURVES

SPECIAL QUALITY DOUBLE DIODE

M8212

Special quality double diode with separate cathodes and internal screening between sections for use in equipment where mechanical vibrations and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

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

HEATER

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

V_h[1]	6.3	V
I_h	300	mA

CAPACITANCES[2] (measured with an external shield)

$c_{a'-k'+h+s+S}$	3.2	pF
$c_{a''-k''+h+s+S}$	3.2	pF
$c_{k'-a'+h+s+S}$	3.9	pF
$c_{k''-a''+h+s+S}$	3.9	pF
$c_{a'-a''}$	<26	mpF

LIMITING VALUES[4] (absolute ratings)[5] each section

P.I.V. max.	360	V
I_a max.	10	mA
$i_{a(pk)}$ max.	60	mA
$i_{a(surge)}$ max.	350	mA
V_{h-k} max.	360	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	165	°C

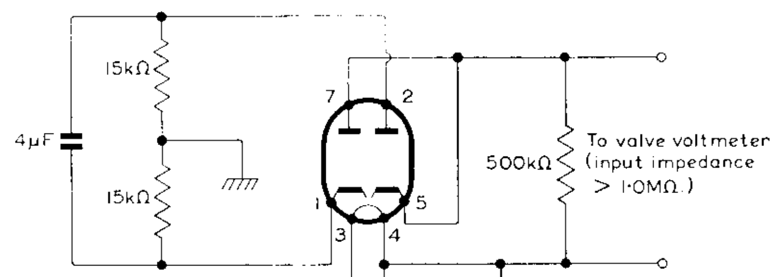
TEST CONDITIONS (unless otherwise specified)

V_h (V)	$V_{a(r.m.s.)}$ (V)	R_{load} (kΩ)	C (μF)
6.3	165	11	8.0

TESTS	*A.Q.L.*[5] (%)	*Individuals*[6] *Bogey*[9]	*Min.*	*Max.*	*Lot average*[7] *Min.*	*Max.*	*Lot standard deviation*[8] *Max.*	
GROUP A								
Insulation								
a-rest, screen-rest measured at −300V	0.25	—	100	—	—	—	—	MΩ
GROUP B								
Heater current	0.65	—	275	325	—	—	—	mA
Heater to cathode leakage current	0.65	—	—	—	—	—	—	
V_{h-k} = 100V (cathode negative)	—	—	—	5.0	—	—	—	μA
V_{h-k} = 100V (cathode positive)	—	—	—	5.0	—	—	—	μA
Output current	0.65	18	16	—	—	—	—	mA
Emission V_a = 10V	0.65	—	40	—	—	—	—	mA
Group quality level[10]	1.0	—	—	—	—	—	—	

GROUP C

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



4618

GROUP D

Glass strain test[11A]. No applied voltages	6.5	—	—	—	—	—	—	
Base strain test[12]. No applied voltages	6.5	—	—	—	—	—	—	
Capacitances (shielded). No applied voltages	6.5	—	—	—	—	—	—	
$c_{a'-a''}$	—	—	—	26	—	—	—	mpF
$c_{a'-k'+h+s+S}$	—	—	2.4	4.0	—	—	—	pF
$c_{a''-k''+h+s+S}$	—	—	2.4	4.0	—	—	—	pF
$c_{k'-a'+h+s+S}$	—	—	2.5	5.0	—	—	—	pF ←
$c_{k''-a''+h+s+S}$	—	—	2.5	5.0	—	—	—	pF ←

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP E								
***Fatigue*[14]**								
V_h = 6.9V, 1 minute on 3 minutes off. No other voltages applied, 5g min. peak acceleration, f = 170c/s for 33 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater to cathode leakage current. $V_{h-k} = \pm 100$V	2.5	—	—	15	—	—	—	μA
Output current	2.5	—	14	—	—	—	—	mA
***Shock*[15]**								
No applied voltages, 500g								
Post shock tests								
Heater to cathode leakage current. $V_{h-k} = \pm 100$V	2.5	—	—	15	—	—	—	μA
Output current	2.5	—	14	—	—	—	—	mA
Group quality level[10]	6.5	—	—	—	—	—	—	

GROUP F

Intermittent life test

The valve is connected in a full wave rectifier circuit with a load resistor of 11kΩ and a reservoir capacitor of 8μF. The supply impedance is adjusted so that the peak anode current is not less than 60mA for a nominal valve, the total output current being approximately 18mA.

The cathode to heater voltage is provided by the output voltage in series with 117Vr.m.s.

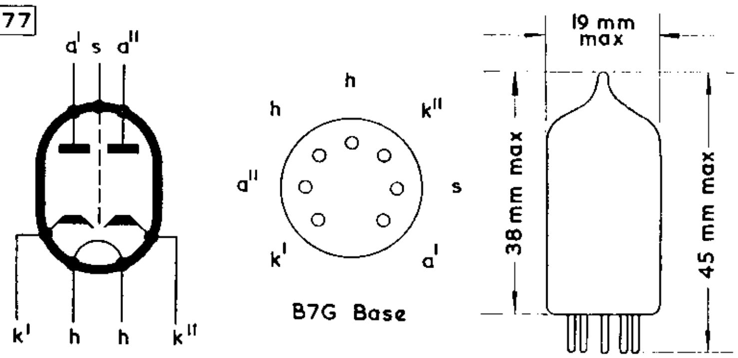
		A.Q.L.[5] (%)	Min.	Max.	
Intermittent life test end points					
Sub-group (a)					
Inoperatives[16]	500 hours	2.5	—	—	
	1000 hours	4.0	—	—	
Heater current	500 hours	2.5	275	325	mA
	1000 hours	4.0	275	325	mA
Heater to cathode leakage current. $V_{h-k} = \pm100V$	500 hours	2.5	—	10	μA
	1000 hours	4.0	—	10	μA
Emission $V_a = 10V$	500 hours	2.5	35	—	mA
	1000 hours	6.5	30	—	mA
Sub-group (b)					
Change in emission $V_h = 5.7V$, $V_a = 7.0V$	500 hours	4.0	—	20	%
Anode current $V_a = 0V$, $R_a = 40k\Omega$	500 hours	4.0	1.0	20	μA
Insulation as in group A	500 hours	4.0	50	—	MΩ
	1000 hours	6.5	50	—	MΩ
Group quality level[10]	500 hours	6.5	—	—	
	1000 hours	10	—	—	

GROUP G

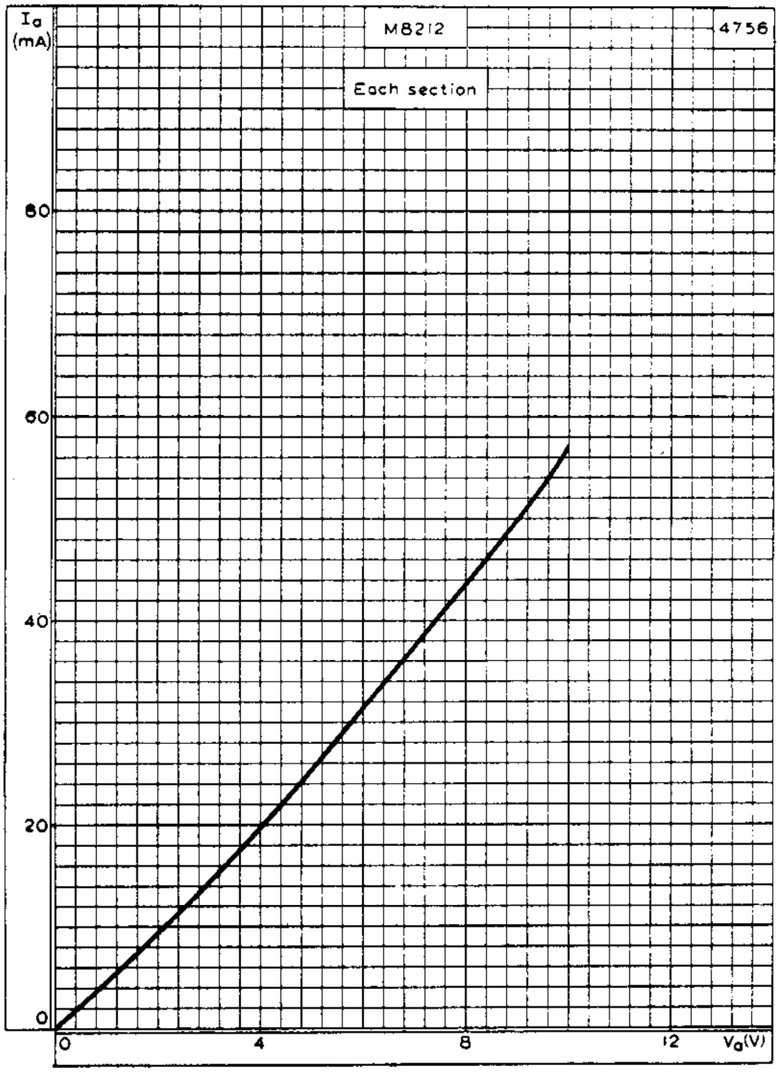
	A.Q.L. (%)	Min.	Max.
Valves are held for 28 days and retested for Inoperatives[16]	0.5	—	—

M8212 SPECIAL QUALITY DOUBLE DIODE

3577



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



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

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

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	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 $V_g = -15V$, $R_k = 0Ω$	0.65	—	—	60	—	—	—	μA
Mutual conductance	0.65	13.5	11.0	16.0	—	—	—	mA/V
	—	—	—	—	12.6	14.4	0.73	mA/V
Sub-group quality level[10]	1.0	—	—	—	—	—	—	
Inoperatives[16]	0.4	—	—	—	—	—	—	

GROUP B

Insulation								
a-rest measured at −300V	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.)

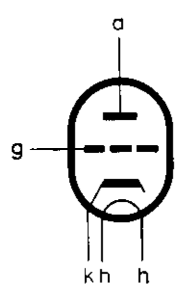
TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP C								
Fatigue[14]								
$V_h = 6.3V$. No other voltages applied. 2.5g minimum peak acceleration, fixed frequency. f = 25c/s min., 60c/s 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	6.5	—	—	20	—	—	—	%
Reverse grid current	6.5	—	—	1.0	—	—	—	μA
Microphonic noise as in Group B	6.5	—	—	300	—	—	—	mV (r.m.s.)
Shock[15]								
$V_{h-k} = 100V$ (cathode negative) $V_g = -1.5V$ d.c. $R_g = 100k\Omega$, 500g.								
Post Shock Tests								
Heater-cathode leakage current $V_{h-k} \pm 100V$	20	—	—	20	—	—	—	μA
Change in mutual conductance	20	—	—	20	—	—	—	%
Reverse grid current	20	—	—	1.0	—	—	—	μA
Microphonic noise as in Group B	20	—	—	300	—	—	—	mV (r.m.s.)
Base strain[12]. No applied voltages	—	—	—	—	—	—	—	
Glass strain[13A]. No applied voltages	2.5	—	—	—	—	—	—	

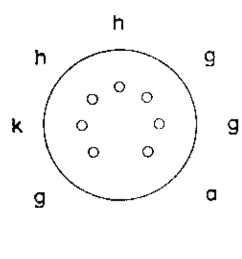
GROUP D

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

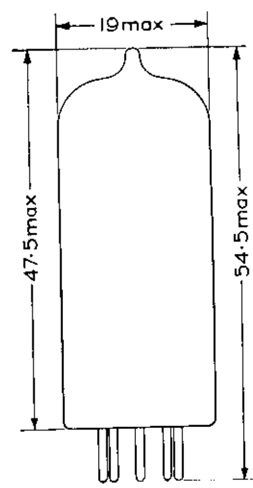
Heater cycling life end points								
Heater to cathode leakage								
$V_{h-k} \pm 100V$ d.c.	1.0	—	—	20	—	—	—	µA
Insulation as in Group B	2.5	—	30	—	—	—	—	MΩ
Stability life test[14]								
Running conditions, $V_{h-k} + 100V$ d.c. $R_g = 250\ k\Omega$								
$T_{ambient}$ = Room temperature.								
Stability life end point								
Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%
Survival rate life test[14]								
Running conditions. $V_{h-k} + 100V$ d.c. $R_g = 250k\Omega$								
$T_{ambient}$ = room temperature								
Survival rate end points (100 hours)								
Inoperatives[16]	0.65	—	—	—	—	—	—	
Mutual conductance	1.0	—	10	—	—	—	—	mA/V
Intermittent life test								
Running conditions								
$V_{h-k} + 100V$ d.c. $R_g = 250k\Omega$								
T_{bulb} min. = 120°C								
Intermittent life test end points (500 hours)								
Inoperatives[16]	2.5							
Heater current	2.5	—	370	460	—	—	—	mA
Reverse grid current	2.5	—	—	2.0	—	—	—	µA
Change in mutual conductance. $V_h = 5.7V$	4.0	—	—	15	—	—	—	%
Change in mutual conductance (individuals)	2.5	—	—	20	—	—	—	%
Heater to cathode leakage								
$V_{h-k} = \pm 100V$ d.c.	2.5	—	—	20	—	—	—	µA
Insulation as in Group B	2.5	—	100	—	—	—	—	MΩ
Average change in mutual conductance	—	—	—	10	—	—	—	%
Sub-group quality level[10]	10.0							

M8248 SPECIAL QUALITY U.H.F. TRIODE





B7G Base



All dimensions in mm

7824

TRIPLE DIODE TRIODE

PABC80

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

HEATER

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

I_h	300	mA
V_h	9.5	V

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

R.F. TRIODE

PC97

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

HEATER

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

I_h	300	mA
V_h	4.5	V

CAPACITANCES

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

CHARACTERISTICS

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

OPERATING CONDITIONS

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

PC97

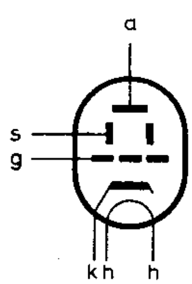
R.F. TRIODE

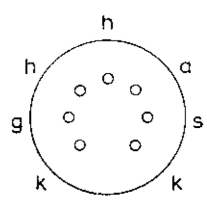
Condition	*5*	*6*	*7*	*8*	
V_b	200	200	200	200	V
R_a	5.6	5.6	6.8	6.8	kΩ
R_k	82	0	0	0	Ω
R_g	0	1.0	0.22	0.56	MΩ
R_{g-a}	—	—	22	22	MΩ
I_a	12	13	14	14	mA
g_m	14	15.5	16	16	mA/V
V_g for 100 : 1 reduction in g_m	−7.5	−7.3	−9.0	−12.5	V

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

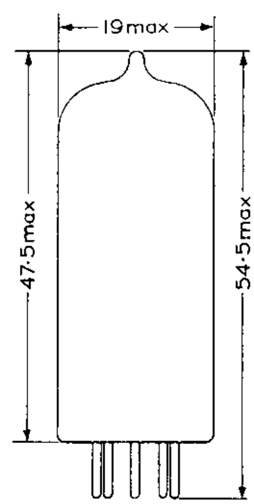
DESIGN CENTRE RATINGS

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





B7G Base



7438

All dimensions in mm

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.

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_a	180	V
I_a	12	mA
V_g	−1.5	V

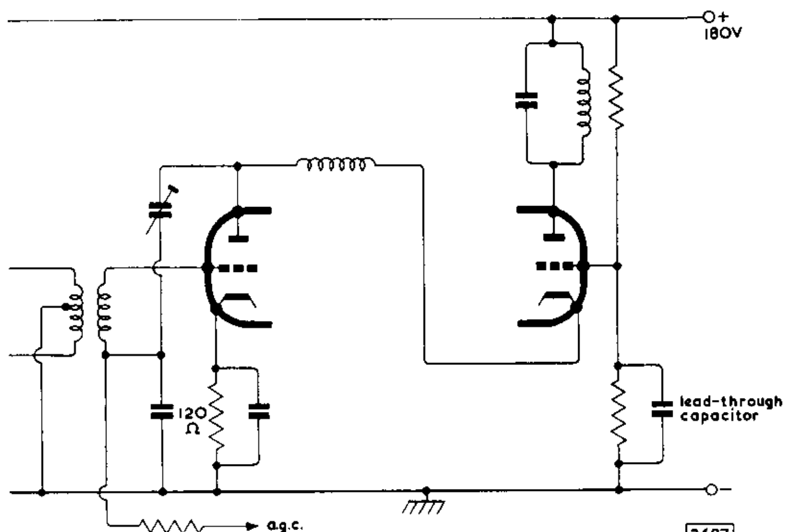


Fig.1

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

DOUBLE TRIODE

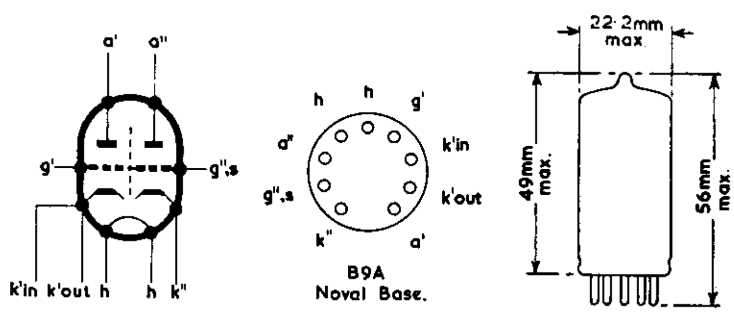
PCC84

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

LIMITING VALUES (each section unless otherwise specified)

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

*Max. d.c. component — 180V.



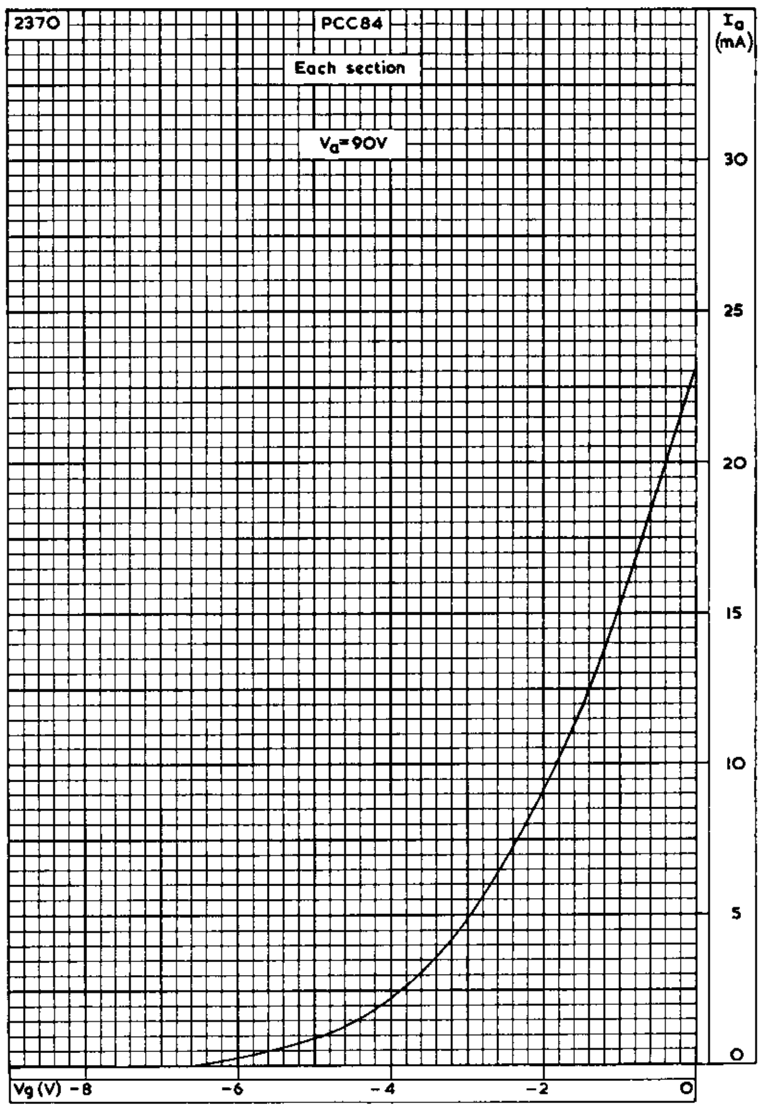
1390

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	70	V
V_{g2}	70	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	50	V
I_a	10.5	mA
V_g	−8.5	V
g_m	2.2	mA/V
r_a	7.7	kΩ
μ	17	

PCL83

TRIODE PENTODE

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve.

PENTODE SECTION AS FRAME OUTPUT VALVE

Circuit design

To allow for valve spread and deterioration during life the frame output circuit should be designed around the following values.

V_a	70	70	V
V_{g2}	170	200	V
$i_{a(pk)}$	54	64	mA

For an average new valve the following figures will apply.

V_a	70	70	V
V_{g2}	170	200	V
$i_{a(pk)}$	81	96	mA

PENTODE SECTION AS AUDIO OUTPUT VALVE

Single Valve Class 'A'

V_a	170	200	V
V_{g2}	170	200	V
V_{g1}	−9.5	−13	V
$I_{a(o)}$	30	27	mA
$I_{g2(o)}$	4.8	4.4	mA
R_a	5.5	7.5	kΩ
$V_{in(r.m.s.)}$	5.0	5.2	V
P_{out}	2.2	2.5	W
D_{tot}	10	10.5	%

Two Valves in Class 'AB' Push-Pull

V_a	170	200	V
V_{g2}	170	200	V
R_k	180	220	Ω
$I_{a(o)}$	2×24	2×25	mA
I_a (max. sig.)	2×27.5	2×29	mA
$I_{g2(o)}$	2×3.8	2×3.9	mA
I_{g2} (max. sig.)	2×6.25	2×8.5	mA
R_{a-a}	6.5	7.5	kΩ
$V_{in(g1-g1)}$ r.m.s.	17	23.5	V
P_{out}	5.0	7.2	W
D_{tot}	3.6	4.2	%

TRIODE SECTION AS A.F. VOLTAGE AMPLFIER

V_b (V)	R_a (kΩ)	I_a (mA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$)	R_{g1}* (kΩ)
170	100	1.07	2.7	14	21	330
200	100	1.17	3.3	13.5	26.5	330

$\frac{V_{out}}{V_{in}}$ measured with an input voltage of 100mV

V_{out} measured for a total harmonic distortion of 5%

*Grid resistor of following valve.

TRIODE PENTODE

PCL83

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve.

LIMITING VALUES

Pentode Section

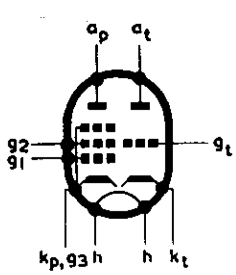
$V_{a(b)}$ max.	550	V
V_a max.	250	V
$+v_{a(pk)}$ max.	2.0	kV
$-v_{a(pk)}$ max.	500	V
p_a max.	5.4	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	1.2	W
p_{g2} max. (speech and music)	2.4	W
I_k max.	45	mA
R_{g1-k} max. (self bias)	500	kΩ
R_{g1-k} max. (fixed bias)	250	kΩ
R_{g1-k} max. (timebase operation)	2.2	MΩ
V_{h-k} max. (d.c. heater negative with respect to cathode or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max. (d.c. heater positive with respect to cathode)	150	V

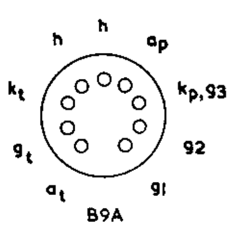
Triode Section

$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	3.5	W
I_k max.	20	mA
$*i_{k(pk)}$ max.	250	mA
$-v_{g1(pk)}$ max.	350	V
R_{g1-k} max.	1.0	MΩ
V_{h-k} max. (d.c. heater negative with respect to cathode or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max. (d.c. heater positive with respect to cathode)	150	V

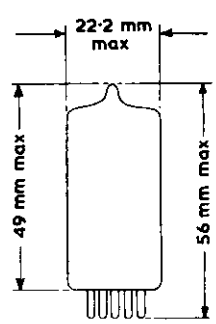
*Max. pulse duration 400μsec.

2224





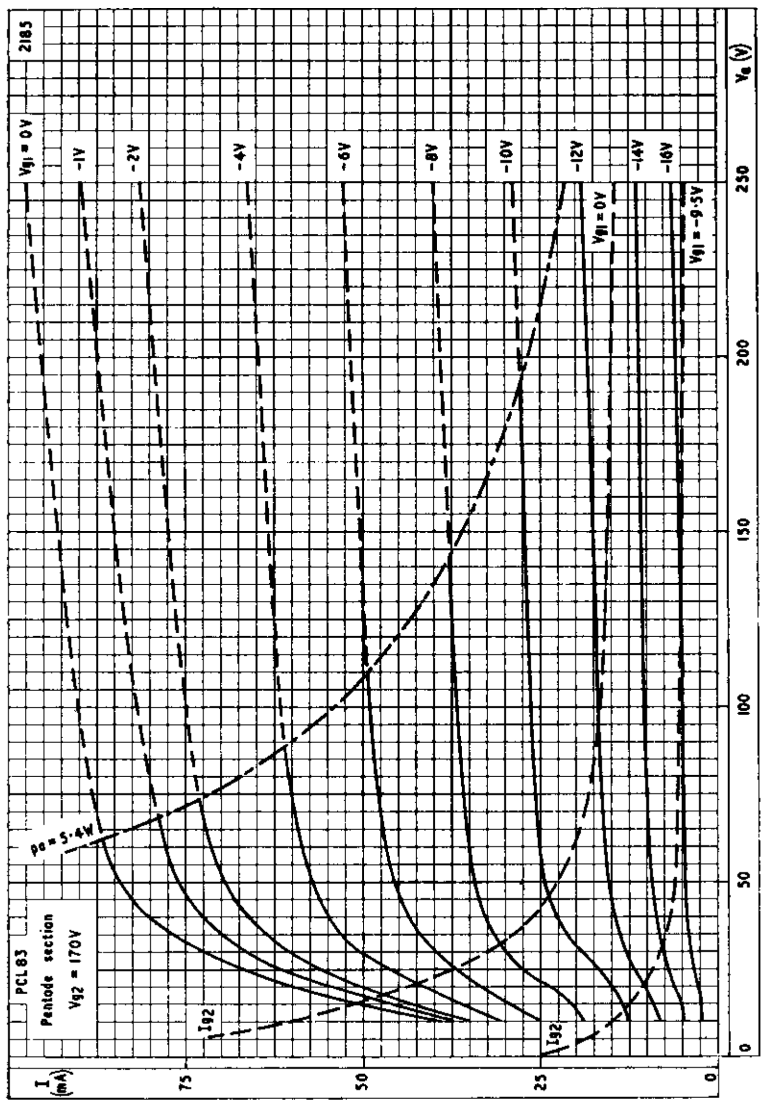
B9A
Noval Base



PCL83

TRIODE PENTODE

Combined triode and output pentode with separate cathodes for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve.



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

LINE OUTPUT PENTODE

PL81

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

HEATER

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

I_h	300	mA
V_h	21.5	V

CAPACITANCES

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

CHARACTERISTICS

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

OPERATION AS LINE OUTPUT PENTODE

Circuit Design

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

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

LIMITING VALUES

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

PL81

LINE OUTPUT PENTODE

Line output applications

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

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

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

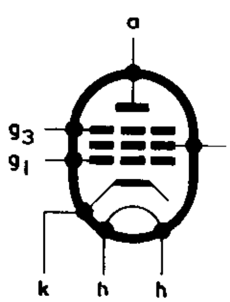
PEAK ANODE CURRENT NOMOGRAM

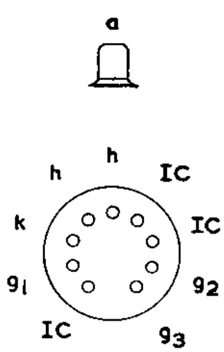
The nomogram shown on the following pages gives directly the recommended peak values of anode current, i_a(design), for a wide range of h.t. line potentials and screen-grid resistors.

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

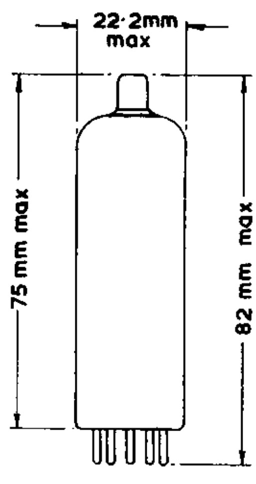
The use of the nomogram does not exempt the designer from checking that the valve is operating within its limiting values. During measurements of the operating conditions in a line timebase a valve whose characteristic is close to that of a nominal valve and a nominal screen-grid resistor should be used.

In receivers designed for a range of declared values of mains voltages, measurements should be made at the nominal declared value of mains voltage producing the lowest nominal h.t. voltage. The timebase should be synchronised and the raster adjusted to nominal scan. The beam current drawn from the e.h.t. supply should be adjusted to 300μA.





B9A Base



2710

OUTPUT PENTODE

PL82

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

HEATER

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

I_h	300	mA
V_h	16.5	V

CAPACITANCES

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

CHARACTERISTICS

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

OPERATING CONDITIONS AS AUDIO OUTPUT VALVE ←

V_a	170	200	V
V_{g2}	170	200	V
V_{g1}	−10.4	−13.9	V
R_a	3	4	kΩ
$I_{a(0)}$	53	45	mA
$I_{g2(0)}$	10	8.5	mA
$V_{in\ (r.m.s.)}$ (P_{out}=50 mW)	0.5	0.55	V
$V_{in\ (r.m.s.)}$ (D_{tot}=10%)	6.0	7.0	V
P_{out} (D_{tot}=10%)	4.0	4.2	W

PL82

OUTPUT PENTODE

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

OPERATION AS FRAME OUTPUT VALVE

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

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

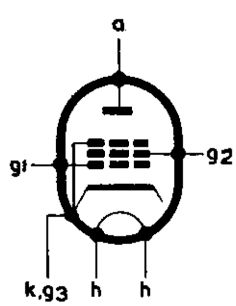
For an average new valve the following figures will apply :—

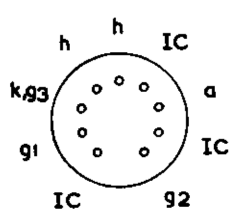
V_a	50	60	V
V_{g2}	170	200	V
V_{g1}	−1	−1	V
I_a	140	175	mA

LIMITING VALUES

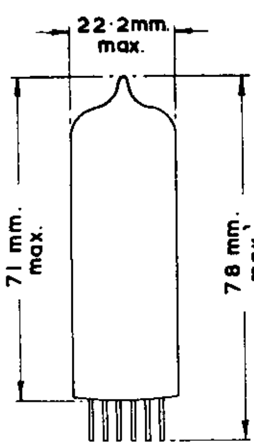
$V_{a(b)}$ max.	550	V
V_a max.	250	V
* $+v_{a\ (pk)}$ max.	2.5	kV
$-v_{a\ (pk)}$ max.	500	V
p_a max.	9	W
$V_{g2(b)}$ max.	550	V
V_{g2} max.	250	V
p_{g2} max.	2.5	W
I_k max.	75	mA
V_{g1} max. ($I_{g1}=+0.3\ \mu A$)	−1.3	V
R_{g1-k} max. (audio output valve)	1.0	MΩ
R_{g1-k} max. (frame output valve)	2.2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

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





B9A
Noval Base



558

HALF-WAVE RECTIFIER

PY33

Indirectly-heated half-wave rectifier with 300mA heater for use in television receivers with series connected heaters.

HEATER

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

I_h	300	mA
V_h	29	V

DESIGN CENTRE RATINGS

P.I.V. max.	700	V
$V_{a(r.m.s.)}$ max.	250	V
I_{out} max.	325	mA
$i_{a(pk)}$ max.	2.6	A
$i_{a(surge)}$ max.	9.5	A
C max.	200	μF
*$v_{h-k(pk)}$ max. (cathode positive)	625	V

*Max. d.c. component=275V. Max. a.c. component=$250V_{r.m.s.}$

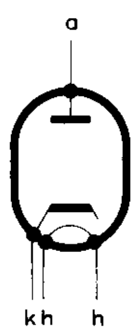
OPERATING CONDITIONS*

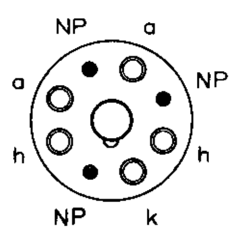
$V_{in(r.m.s.)}$	200	210	220	230	240	250	V
I_{out}	325	325	295	270	240	220	mA
C	200	200	200	200	200	200	μF
R_{lim} min.	15	17	19	21	23	25	Ω
V_{out}	209	219	234	249	264	280	V

*For television receivers, where a constant output voltage is required for different input voltages, the values of limiting resistor required can be obtained from the curves on pages C3 and C4.

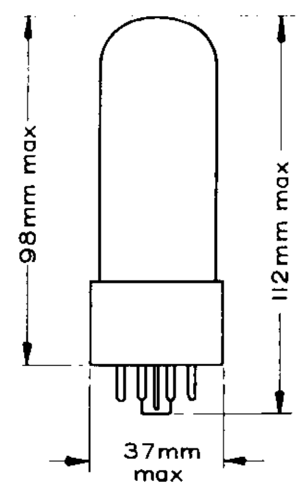
PY33

HALF-WAVE RECTIFIER





Octal Base



7575

HALF-WAVE RECTIFIER

PY82

indirectly heated half-wave rectifier with 300mA heater for use in 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
* $V_{h-k\ (pk)}$ max.	550	V
** C max.	60	μF

$V_{a(r.m.s.)}$ (V)	R_{lim} min. ($C=60\mu F$) (Ω)
250	100
240	80
230	60
220	40
210	30
200	30

* Max. 220V a.c. $_{(r.m.s.)}$ + Max. 250V d.c. (heater negative with respect to cathode.)

** This limit allows for normal capacitor tolerances up to +80%. When two PY82 are connected in parallel, C max.$=100\mu F$. In this case each anode must have the minimum sputter resistance (R_{lim}) specified above.

TYPICAL OPERATING CONDITIONS

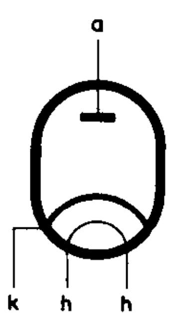
C	60	μF
I_{out}	180	mA
V_{out}	195	V

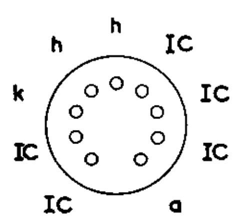
$V_{a\ (r.m.s.)}$ (V)	R_{lim} (Ω)
250	125
240	105
230	85
220	65
210	45
200	30

PY82

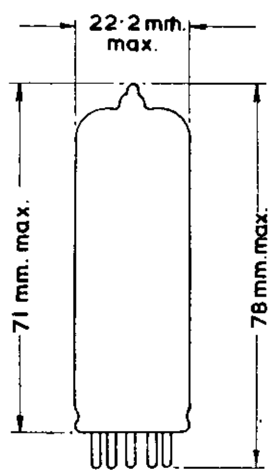
HALF-WAVE RECTIFIER

Indirectly heated half-wave rectifier with 300mA heater for use in receivers with series connected heaters.





B9A
Noval Base

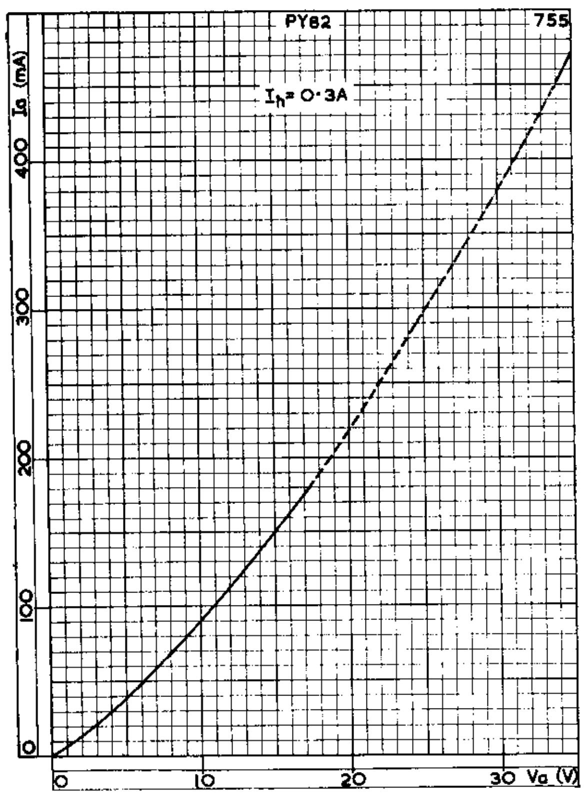


521

HALF-WAVE RECTIFIER

PY82

Indirectly heated half-wave rectifier with 300mA heater for use in receivers with series connected heaters.

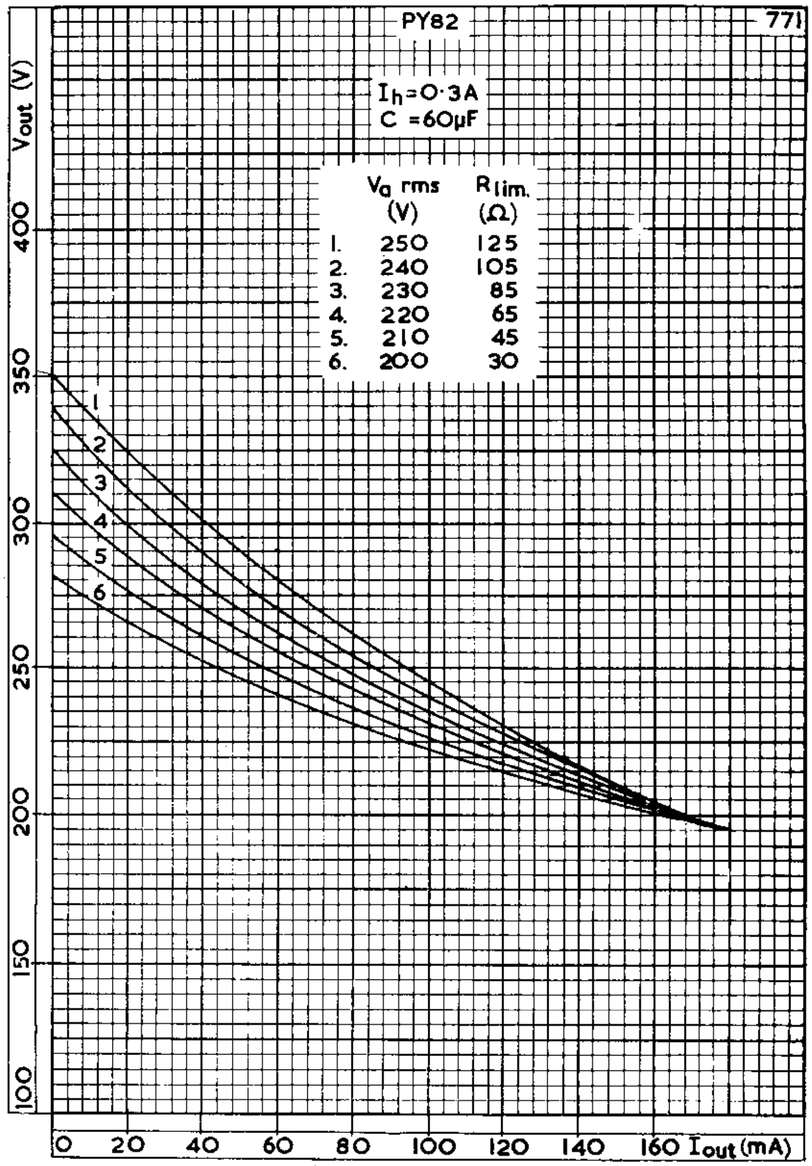


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

PY82

HALF-WAVE RECTIFIER

Indirectly heated half-wave rectifier with 300mA heater for use in receivers with series connected heaters.



REGULATION CURVE

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

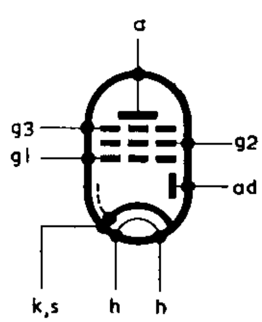
Pentode Section

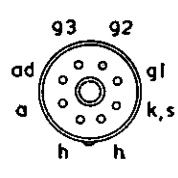
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	2	W
$V_{g2(b)}$ max.	550	V
$V_{g2}(I_a<2.5\text{ mA})$ max.	250	V
V_{g2} $(I_a=5.0\text{ mA})$ max.	125	V
p_{g2} max.	0.3	W
I_k max.	10	mA
V_{g1} $(I_{g1}=+0.3\mu A)$ max.	−1.3	V
R_{g1-k} max.	3.0	MΩ
*R_{g3-k} max.	3.0	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	150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

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

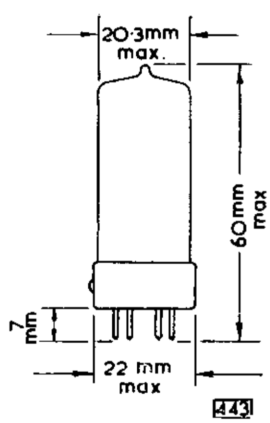
Diode Section

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

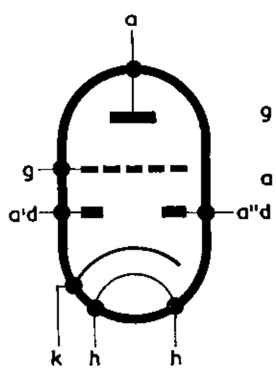
$c_{a'd-gt}$	<0.007	pF
$c_{a''d-gt}$	<0.03	pF
c_{ad-at}	<0.01	pF

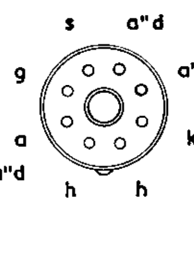
Triode section

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

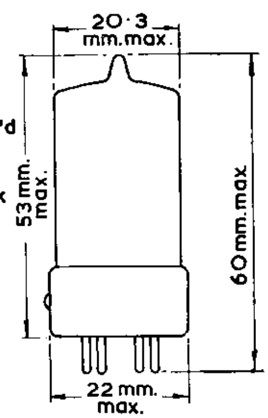
Diode sections

$c_{a'd-k}$	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

UBC81

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

HEATER

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

I_h	100	mA
V_h	14	V

MOUNTING POSITION

Any

CAPACITANCES

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

Triode section

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

Diode sections

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

CHARACTERISTICS

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

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

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

UBC81

DOUBLE DIODE TRIODE

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

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

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

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

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

LIMITING VALUES

Triode section

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

Diode sections (each section)

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

MICROPHONY

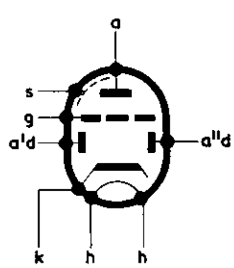
This valve can be used without special precautions against microphony in circuits in which the input voltage is >10mV (r.m.s.) for an output of 50mW from the output valve.

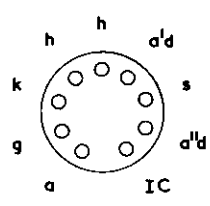
DOUBLE DIODE TRIODE

UBC81

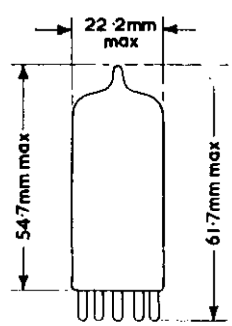
High gain triode for use as a.f. voltage amplifier, combined with twin diodes, for use in equipment with series connected heaters.

3684





B9A Base

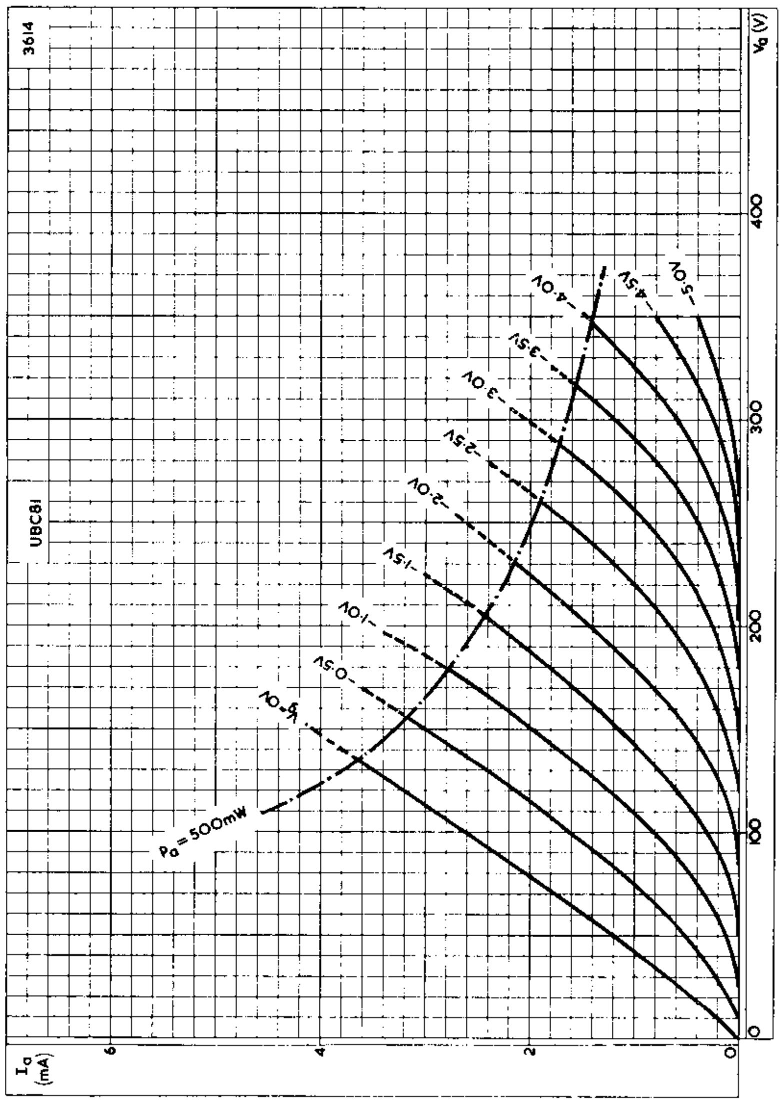


Pin 4 should be connected to the earthed side of the heater circuit

UBC81

DOUBLE DIODE TRIODE

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



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER

DOUBLE DIODE PENTODE

UBF80

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

HEATER

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

I_h	100	mA
V_h	17	V

MOUNTING POSITION

Any

CAPACITANCES

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

Pentode Section

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

Diode Sections

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

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

$V_a = V_b$	100	170	200	V
R_{g2}	47	47	68	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. ($I_a<2$mA)	250	V
V_{g2} max. ($I_a=5$mA)	125	V
p_{g2} max.	0.3	W
I_k max.	10	mA
V_{g1} max. ($I_{g1}=+0.3\ \mu$A)	-1.3	V
*R_{g1-k} max.	3	M Ω
R_{h-k} max.	20	k Ω
V_{h-k} max.	150	V

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

Diode Sections (each section)

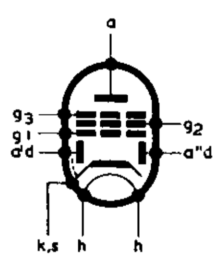
P.I.V.	350	V
I_{ad} max.	0.8	mA
$i_{ad(pk)}$ max.	5	mA
R_{h-k} max.	20	k Ω
V_{h-k} max.	150	V

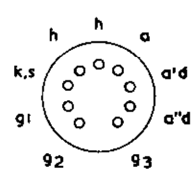
This valve can be used without special precautions against microphony if the input voltage, V_{in}, is not less than 25 mV for an output of 50 mW from the output valve.

DOUBLE DIODE PENTODE

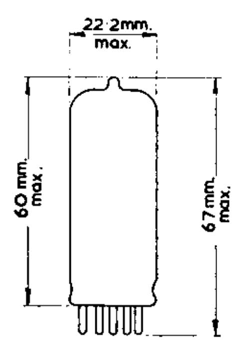
UBF80

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





B9A (Noval) BASE



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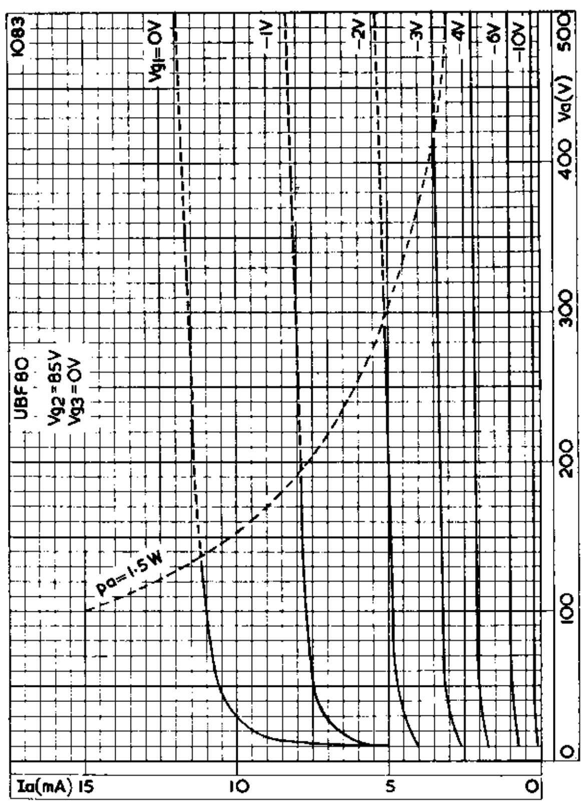
UBF80

DOUBLE DIODE PENTODE

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



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

TRIODE PENTODE

UCL83

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

HEATER

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

I_h	100	mA
V_h	38	V ←

MOUNTING POSITION

Any

CAPACITANCES (measured without an external shield)

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

Pentode section

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

Triode section

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

CHARACTERISTICS

Pentode section

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

Triode section

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

UCL83

TRIODE PENTODE

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

PENTODE SECTION AS AUDIO OUTPUT VALVE

Single valve class 'A'

V_a	170	200	V
V_{g2}	170	200	V
V_{g1}	−9.5	−13	V
$I_{a(o)}$	30	27	mA
$I_{g2(o)}$	5.0	4.4	mA
R_a	5.5	7.5	kΩ
$V_{in(r.m.s.)}$	5.0	5.2	V
P_{out}	2.2	2.5	W
D_{tot}	10	10.5	%

Two valves in class 'AB' push-pull

V_a	170	200	V
V_{g2}	170	200	V
R_k	180	220	Ω
$I_{a(o)}$	2×24	2×25	mA
I_a (max. sig.)	2×27.5	2×29	mA
$I_{g2(o)}$	2×3.8	2×3.9	mA
I_{g2} (max. sig.)	2×6.25	2×8.5	mA
R_{a-a}	6.5	7.5	kΩ
$V_{in(g1-g1)r.m.s.}$	17	23.5	V
P_{out}	5.0	7.2	W
D_{tot}	3.6	4.2	%

TRIODE SECTION AS A.F. VOLTAGE AMPLIFIER

V_b (V)	R_a (kΩ)	I_a (μA)	R_k (kΩ)	$\frac{V_{out}}{V_{in}}$	V_{out} ($V_{r.m.s.}$)	R_{g1}* (kΩ)
170	100	650	1.8	49	15.3	330
200	100	720	2.2	47	17.7	330

$\frac{V_{out}}{V_{in}}$ measured with an input of 100mV

V_{out} measured for a total harmonic distortion of 5%

*Grid resistor of following valve.

LIMITING VALUES

Pentode section

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

TRIODE PENTODE

UCL83

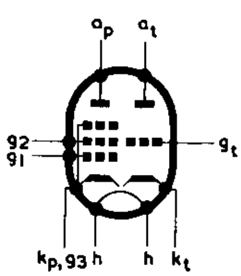
Combined triode and output pentode with separate cathodes and 100mA heater intended for use in audio frequency applications.

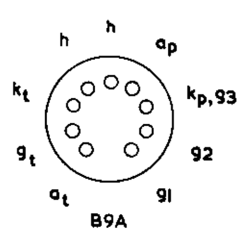
LIMITING VALUES

Triode Section

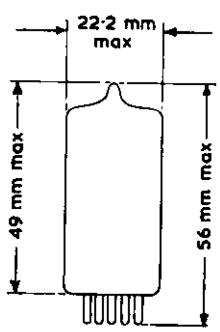
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	3.5	W
I_k max.	15	mA
R_{g1-k} max. (fixed bias)	1.0	MΩ
R_{g1-k}max (grid current biasing)	22	MΩ
V_{h-k} max. (d.c. cathode positive or a.c.$_{r.m.s.}$)	250	V
V_{h-k} max. (d.c. cathode negative)	100	V

2224





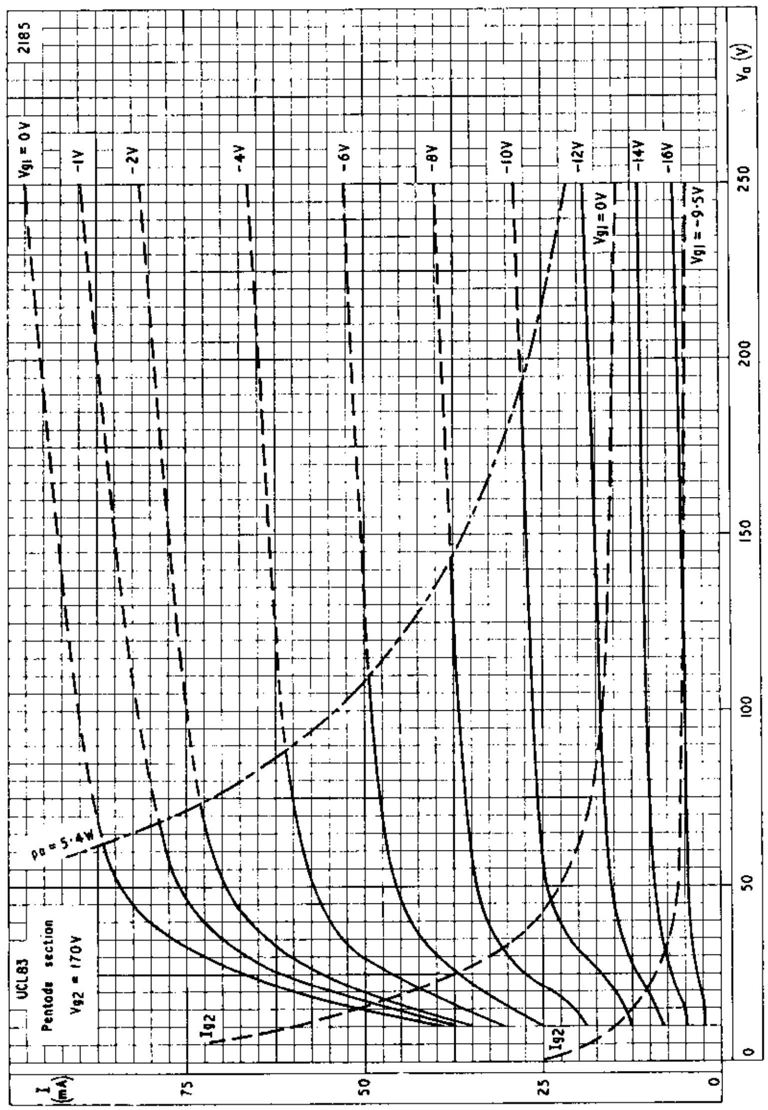
B9A
Noval Base



UCL83

TRIODE PENTODE

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



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

VARIABLE-MU R.F. PENTODE

UF41

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

HEATER

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

I_h	0.1	A
V_h	12.6	V

CAPACITANCES

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

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

$V_a = V_b$	100	170	200	V
R_{g2}	40	40	40	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

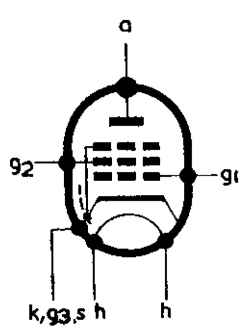
LIMITING VALUES

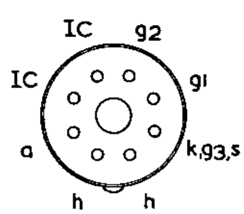
$V_{a(b)}$ max.	550	V
V_a max.	250	V
p_a max.	2	W
$V_{g2(b)}$ max.	550	V
V_{g2} max. ($I_a < 4$mA)	250	V
V_{g2} max. ($I_a = 7.2$mA)	150	V
p_{g2} max.	0.3	W
I_k max.	10	mA
V_{g1} max. ($I_{g1} = +0.3\mu$A)	−1.3	V
R_{g1-k} max.	3	MΩ
R_{h-k} max.	20	kΩ
V_{h-k} max.	150	V

UF41

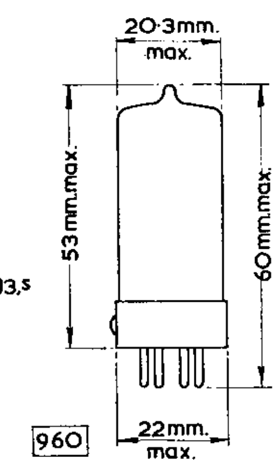
VARIABLE-MU R.F. PENTODE

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





B8A BASE



OUTPUT PENTODE

UL41

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

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

I_h	100	mA
V_h	45	V

CAPACITANCES

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

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)	550	500	540	mV

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	%

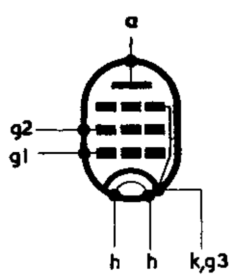
UL41

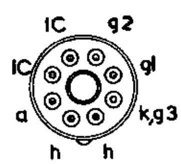
OUTPUT PENTODE

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

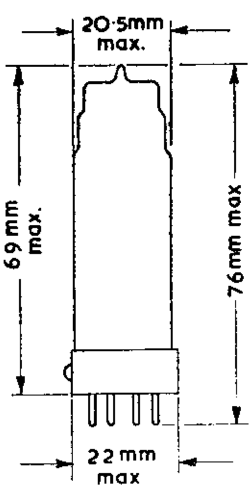
LIMITING VALUES

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





B8A BASE



610

UY41

HALF-WAVE RECTIFIER

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

HEATER

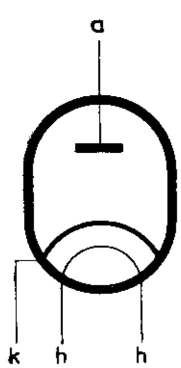
Suitable for series operation a.c. or d.c.

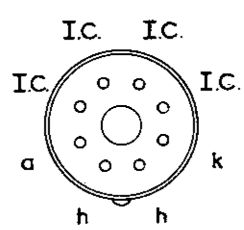
I_h	100	mA
V_h	31	V

LIMITING VALUES

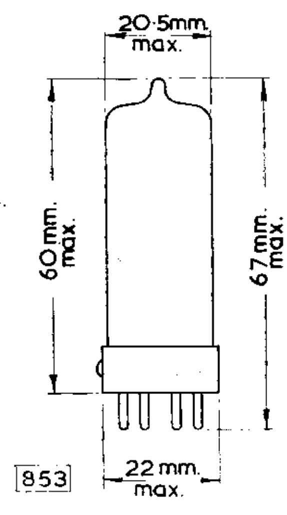
$V_{a(r.m.s.)}$ max.	250	V
I_{out} max.	100	mA
$v_{h-k\ (pk)}$ max.	550	V
C max.	50	μF

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





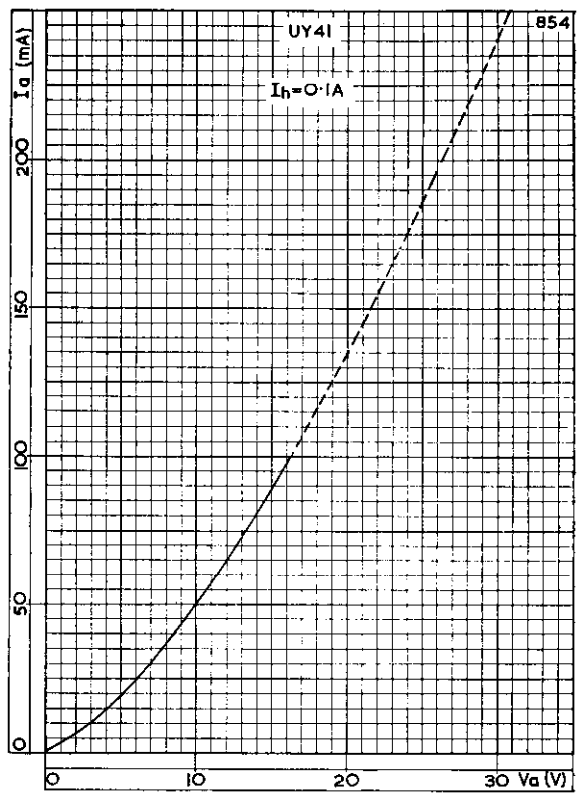
B8A BASE



UY41

HALF-WAVE RECTIFIER

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



ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

V.H.F. POWER PENTODE

YL1000

Directly heated v.h.f. power pentode for use as a power amplifier or frequency multiplier in portable and mobile equipment.

FILAMENT (parallel operation only)

V_f	1.1 (±15%)	V
I_f	880	mA
t_h max. (P_{out} = 70% of final value)	0.5	s

CAPACITANCES (unshielded)

c_{a-g1}	< 150	mpF
c_{in}	6.0	pF ←
c_{out}	3.5	pF ←
c_{g1-f}	1.5	pF

CHARACTERISTICS

V_a	120	V
V_{g2}	120	V
V_{g1}	−6.5	V
I_a	30	mA
I_{g2}	2.3	mA
g_m	4.3	mA/V
μ_{g1-g2}	7.0	

RATINGS (DESIGN CENTRE SYSTEM)

$V_{a(b)}$ max.	500	V
V_a max.	300	V
p_a max.	5.0	W
$V_{g2(b)}$ max.	500	V
V_{g2} max.	300	V
p_{g2} max.	1.0	W
V_{g1} max.	−100	V
$+v_{g1(pk)}$ max.	25	V
I_k max.	50	mA
R_{g1-f} max.	2.0	MΩ
T_{bulb} max.	200	°C
V_f max. (absolute)	1.27	V
V_f min. (absolute)	0.93	V

CLASS 'C' OPERATION F.M. TELEPHONY

Maximum recommended operating conditions

These conditions are based on reaching either the maximum electrode ratings or the point where load efficiency (η_{load}) begins to fall rapidly. The conditions for 175Mc/s were measured in a circuit with a parallel tuned output circuit. If a series tuned output circuit is used at this frequency with the same operating conditions, approx. 10% higher P_{load} figures are obtained.

CLASS 'C' OPERATION F.M. TELEPHONY AT f = 50Mc/s

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

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

Frequency trebler	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max. (mA)
	300	150	−100	29
	250	150	−100	35
	200	150	−100	32
	150	150	−100	28
	100	100	−100	20

CLASS 'C' OPERATION F.M. TELEPHONY AT f = 175Mc/s

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

Frequency doubler	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max. (mA)
	300	150	−90	26
	250	150	−90	32
	200	150	−90	38
	150	150	−90	32
	100	100	−90	20

Frequency trebler	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a max. (mA)
	250	150	−100	27
	200	150	−100	32
	150	150	−100	28
	100	100	−100	20

TYPICAL OPERATION CLASS 'C' OPERATION F.M. TELEPHONY

Amplifier at f = 50Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	$+V_{g1(pk)}$ (V)	P_{load} (W)	η_{load} (%)
300	150	−35	10	1.45	0.006	−4.5	1.68	56
			20	2.6	0.045	2.5	3.8	63.3
			30	3.0	0.45	9.0	6.1	67.8
			40	3.5	0.85	14.5	8.0	66.6
250	150	−35	10	1.62	0.008	−2.0	1.5	60
			20	3.1	0.08	3.5	3.3	65
			30	4.0	0.55	10	5.1	68
			40	5.0	0.95	17	6.7	67
200	150	−35	10	1.95	0.025	−1.5	1.3	65
			20	3.8	0.20	5.5	2.75	69
			30	5.0	0.75	12	4.1	68
			40	6.0	1.05	18	5.2	65
150	150	−35	10	2.6	0.038	−1.0	1.0	67
			20	4.3	0.24	6.0	2.05	68
			30	6.0	0.85	13.5	2.95	65.5
100	100	−23	10	2.1	0.09	1.5	0.6	60
			20	3.4	0.7	9.0	1.22	61
			25	4.5	1.2	13	1.45	57.6

Frequency doubler at f_{out} = 50Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	$+V_{g1(pk)}$ (V)	P_{load} (W)	η_{load} (%)
300	150	−90	10	1.38	0.015	0.5	1.58	52.7
			20	2.15	0.28	8.5	3.42	57
			30	2.6	0.73	15	5.15	57.2
			40	3.4	0.95	21	6.62	55.1
250	150	−90	10	1.6	0.024	1.2	1.36	54.4
			20	2.4	0.38	9.5	3.0	60
			30	3.2	0.80	15.5	4.45	59.3
			40	4.2	1.02	22	5.6	56
200	150	−90	10	2.05	0.04	2.0	1.16	58
			20	2.9	0.45	10	2.5	62.5
			30	3.6	0.85	16.5	3.5	58.3
150	150	−90	10	2.4	0.05	2.5	0.86	57.3
			20	3.8	0.56	11	1.8	60
			30	4.5	0.95	18	2.48	55.2
100	100	−60	10	1.95	0.26	6.0	0.53	53
			20	3.1	0.92	13	0.94	47

Frequency trebler at f_{out} = 50Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	$+v_{g1(pk)}$ (V)	P_{load} (W)	η_{load} (%)
300	150	−100	10	1.0	0.01	0.8	1.2	40
			20	1.75	0.26	9.5	2.6	43.3
250	150	−100	10	1.16	0.012	1.0	1.05	42
			20	1.9	0.3	10	2.24	44.8
			30	2.3	0.7	17	3.2	42.7
200	150	−100	10	1.4	0.015	1.3	0.9	45
			20	2.05	0.35	10.5	1.88	47
			30	2.45	0.72	17.5	2.7	45
150	150	−100	10	1.7	0.027	1.9	0.67	44.7
			20	2.35	0.39	11	1.44	48
100	100	−100	10	1.1	0.29	7.5	0.47	47
			20	2.2	1.02	17	0.8	40

Amplifier at f = 175Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	P_{load} (W)	η_{load} (%)
300	150	−35	15	0.9	0	0.98	21.7
			20	1.34	0	1.66	27.7
			25	1.56	0.01	2.48	33.1
			30	2.08	0.07	3.3	36.7
250	150	−35	15	1.0	0	0.91	24.3
			20	1.42	0	1.48	29.4
			25	1.96	0.01	2.17	34.7
			30	2.25	0.1	2.88	38.5
			35	2.42	0.2	3.6	41.1
200	150	−35	15	1.3	0	0.81	27
			20	1.96	0	1.37	32.5
			25	2.12	0.02	1.9	38
			30	2.4	0.11	2.5	41.7
			35	2.64	0.28	3.08	44
			40	3.0	0.5	3.69	46.1
150	150	−35	15	1.74	0	0.7	31.1
			20	2.14	0.01	1.14	38
			25	2.5	0.03	1.56	41.7
			30	2.9	0.12	2.0	44.5
			35	3.2	0.3	2.42	46.1
			40	3.5	0.55	2.82	47
100	100	−23	15	1.28	0.04	0.56	37.3
			20	1.5	0.22	0.89	44.5
			25	1.82	0.54	1.18	47.2

Frequency doubler at f_{out} = 175Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	P_{load} (W)	η_{load} (%)
300	150	−90	15	0.84	0	0.82	18.2
			20	1.1	0.12	1.46	24.3
			25	1.22	0.34	2.1	28
250	150	−90	15	0.98	0.02	0.8	21.3
			20	1.26	0.15	1.35	27
			25	1.4	0.4	1.88	30
			30	1.62	0.6	2.4	32
200	150	−90	15	1.2	0.04	0.73	24.3
			20	1.4	0.22	1.2	30
			25	1.6	0.42	1.7	34
			30	1.85	0.66	2.15	35.9
			35	2.0	0.8	2.55	36.5
150	150	−90	15	1.58	0.06	0.66	29.4
			20	1.76	0.26	1.04	34.7
			25	2.07	0.46	1.42	37.9
			30	2.25	0.72	1.78	39.5
			35	2.36	0.88	2.1	40
100	100	−60	15	1.0	0.38	0.54	36
			20	1.36	0.7	0.74	37

Frequency trebler f_{out} = 175Mc/s

V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)	I_{g2} (mA)	I_{g1} (mA)	P_{load} (W)	η_{load} (%)
250	150	−100	15	0.88	0.04	0.6	16
			20	1.12	0.18	0.95	19
			25	1.26	0.4	1.29	20.7
200	150	−100	15	1.02	0.05	0.55	18.3
			20	1.24	0.22	0.86	21.5
			25	1.42	0.42	1.15	23
			30	1.66	0.6	1.42	23.7
150	150	−100	15	1.26	0.07	0.49	21.8
			20	1.42	0.30	0.76	25.3
			25	1.64	0.44	0.99	26.4
100	100	−100	15	0.94	0.52	0.4	26.7
			20	1.5	0.84	0.5	25

CLASS 'C' A.M. TELEPHONY

Maximum carrier conditions for 100% modulation

Output tuned circuit

	Single valve operation Parallel	Parallel	Series	Push-pull operation		
f	50	175	175	50	175	Mc/s
V_a	250	200	200	250	200	V
V_{g2}	150	150	150	150	150	V
V_{g1}	−35	−35	−35	−35	−35	V
I_a	32	31	32	2×32	2×32	mA
I_{g2}	4.2	2.45	2.5	2×4.2	2×2.5	mA
I_{g1}	0.62	0.14	0.18	2×0.62	2×0.18	mA
P_{load}	5.4	2.65	3.05	12	6.2	W
η	67.5	42	47	75	48.5	%
For 100% modulation						
P_{mod}	4.2	3.2	3.3	8.4	6.4	W
$v_{g2}(pk)$	135	120	120	135	120	V

Maximum carrier conditions for anode and screen-grid modulation for various modulation depths. $f = 175$Mc/s

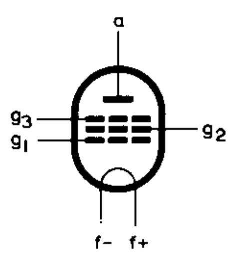
m (%)	V_a (V)	I_a (mA)	p_a (max.) (W)	p_{g2} (max.) (W)	P_{load}* (W)	Output tuned circuit
100	200	31	3.3	0.67	2.65	Parallel
	200	32	3.3	0.67	3.05	Series
	200	64	2×3.3	2×0.67	6.2	Push-Pull
75	220	34	3.9	0.78	3.2	Parallel
	220	35	3.9	0.78	3.65	Series
	220	70	2×3.9	2×0.78	7.4	Push-Pull
50	235	35	4.45	0.89	3.47	Parallel
	235	36	4.45	0.89	3.96	Series
	235	72	2×4.45	2×0.89	8.0	Push-Pull
25	245	37	4.85	0.97	3.82	Parallel
	245	38	4.85	0.97	4.37	Series
	245	76	2×4.85	0.97	8.8	Push-Pull
0	250	38	5.0	1.0	4.02	Parallel
	250	39	5.0	1.0	4.55	Series
	250	80	2×5.0	2×1.0	9.6	Push-Pull

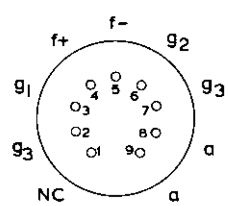
*Estimated value

These conditions may be varied for operation at lower frequencies. Operation at 100% modulation with $V_a > 250$V, $I_a > 32$mA is not permitted and the p_a max. and p_{g2} max. limits shown above must never be exceeded.

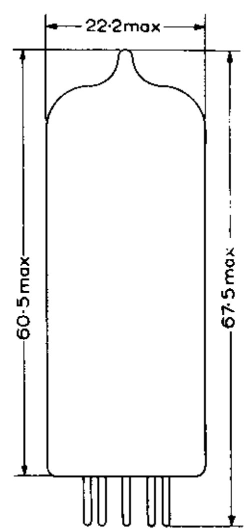
V.H.F. POWER PENTODE

YL1000



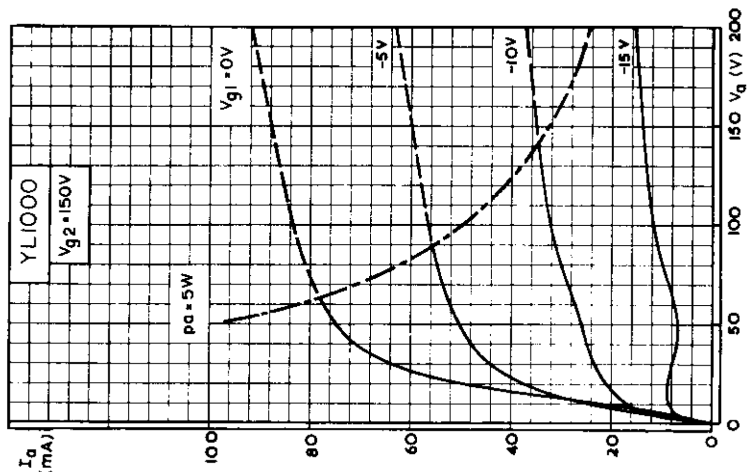


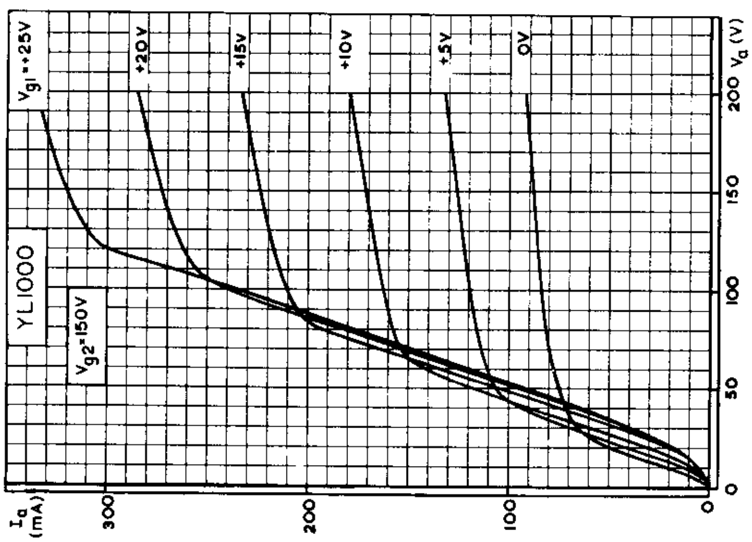
B9A Base



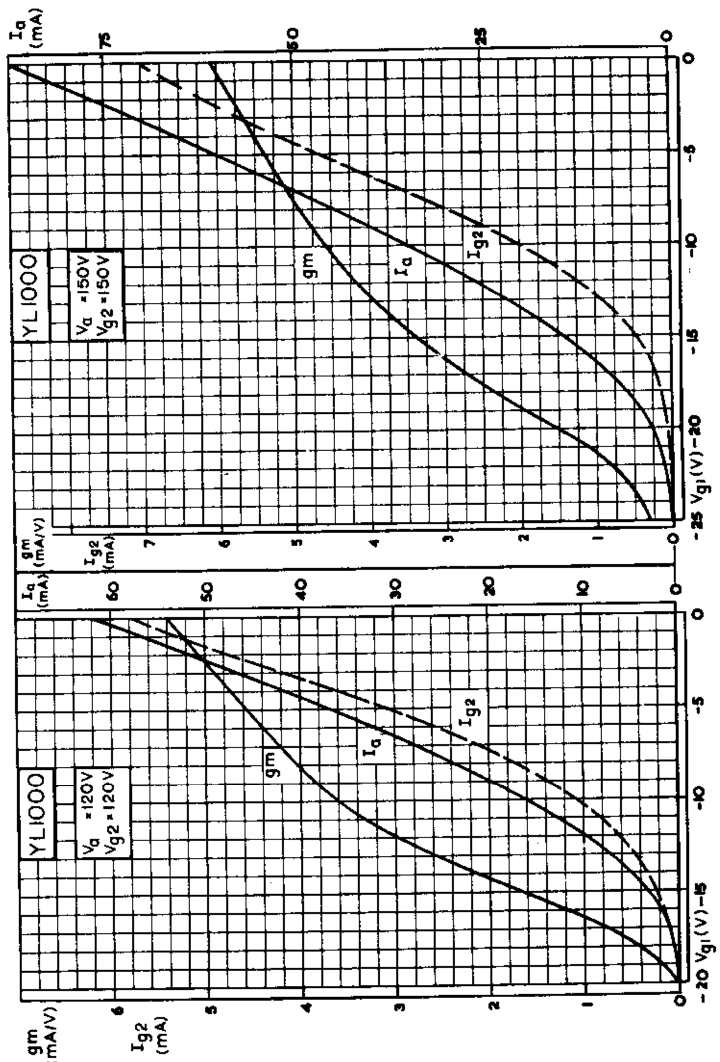
All dimensions in mm

B4662

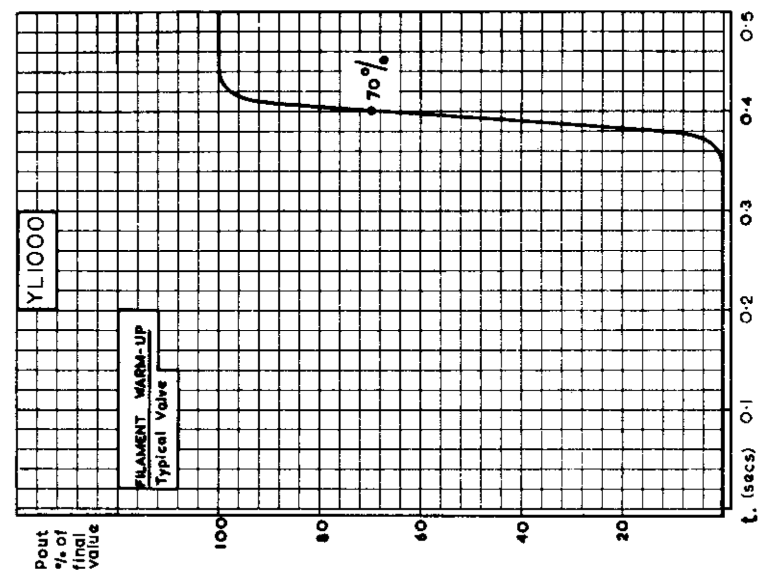


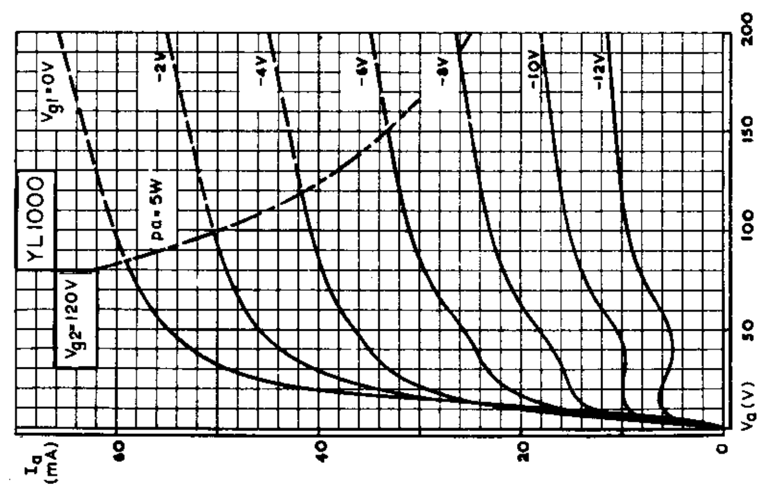


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER $V_{g2}=150V$



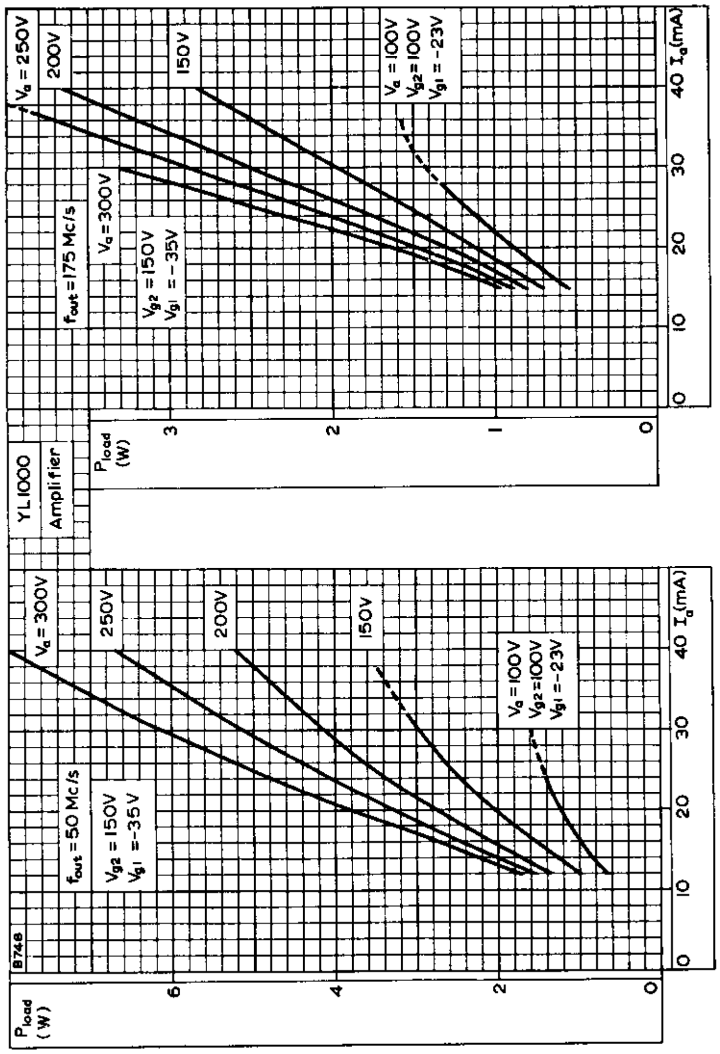
ANODE CURRENT, SCREEN-GRID CURRENT, AND MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE



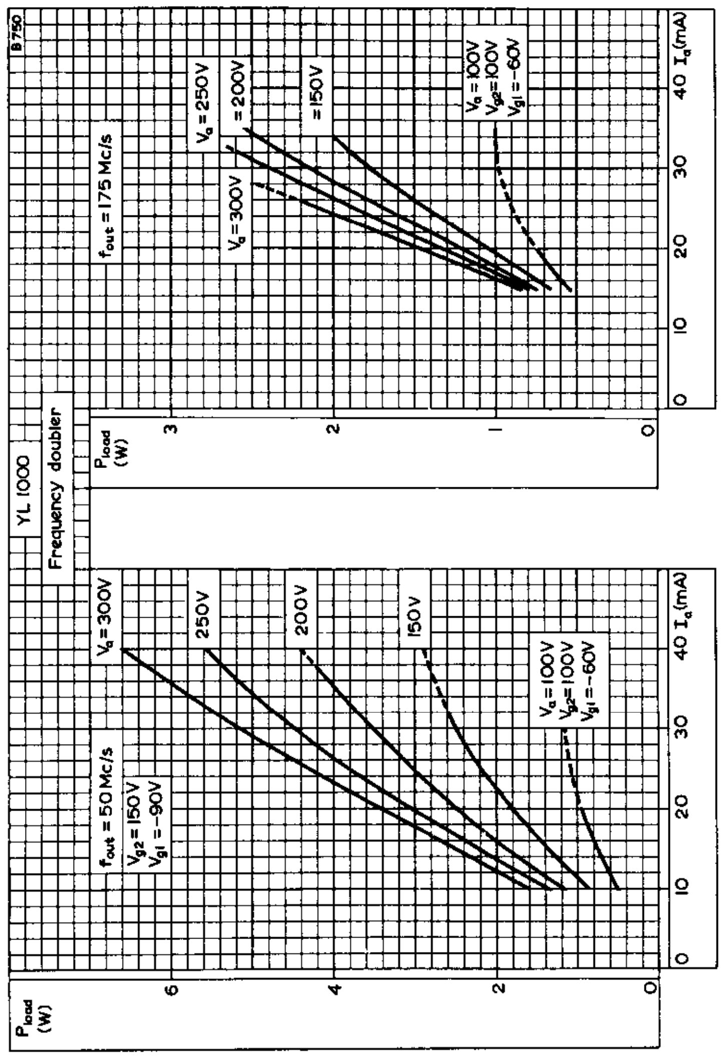


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH CONTROL-GRID VOLTAGE AS PARAMETER V_{g2}=120V

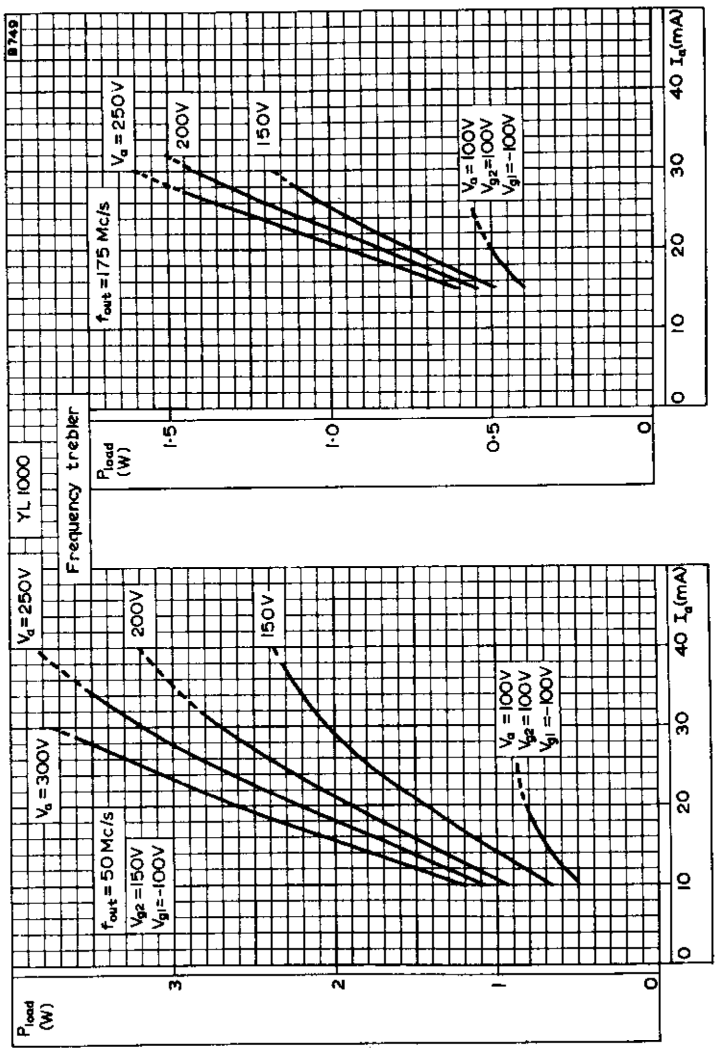
FILAMENT WARM-UP TIME



LOAD POWER AS AN AMPLIFIER PLOTTED AGAINST ANODE CURRENT FOR VARIOUS ANODE VOLTAGES



LOAD POWER AS A FREQUENCY DOUBLER PLOTTED AGAINST ANODE CURRENT FOR VARIOUS ANODE VOLTAGES



LOAD POWER AS A FREQUENCY TREBLER PLOTTED AGAINST ANODE CURRENT FOR VARIOUS ANODE VOLTAGES

DOUBLE DIODE

6AL5

Double diode with separate cathodes and internal screening between sections.

HEATER

Suitable for series or parallel operation, a.c. or d.c.

V_h	6.3	V
I_h	300	mA

MOUNTING POSITION

Any

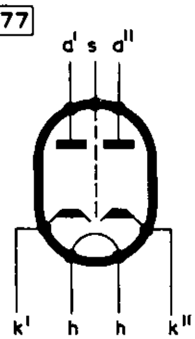
CAPACITANCES

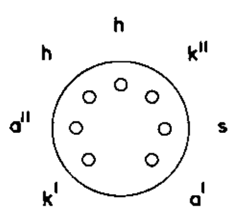
	Shielded	Unshielded	
$c_{a'-k'+h+s}$	3.1	2.5	pF
$c_{a''-k''+h+s}$	3.1	2.5	pF
$c_{k'-a'+h+s}$	3.9	3.4	pF
$c_{k''-a''+h+s}$	3.9	3.4	pF
$c_{a'-a''}$	<0.026	<0.068	pF

LIMITING VALUES (each section)

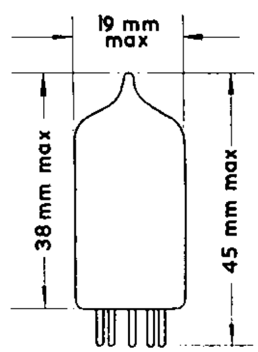
P.I.V. max.	330	V
I_a max.	9.0	mA
$i_{a(pk)}$ max.	54	mA
V_a max. ($I_a = +0.3\mu A$)	-1.3	V
$v_{h-k(pk)}$ max.	330	V

3577





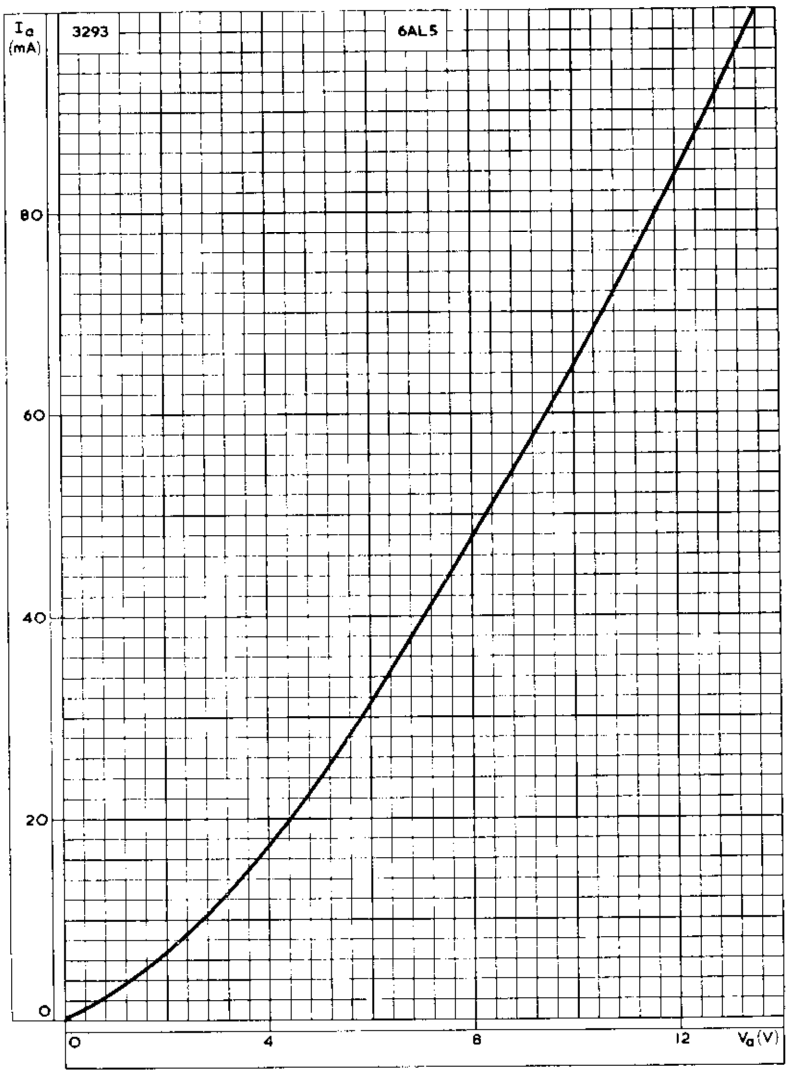
B7G Base



6AL5

DOUBLE DIODE

Double diode with separate cathodes and internal screening between sections.

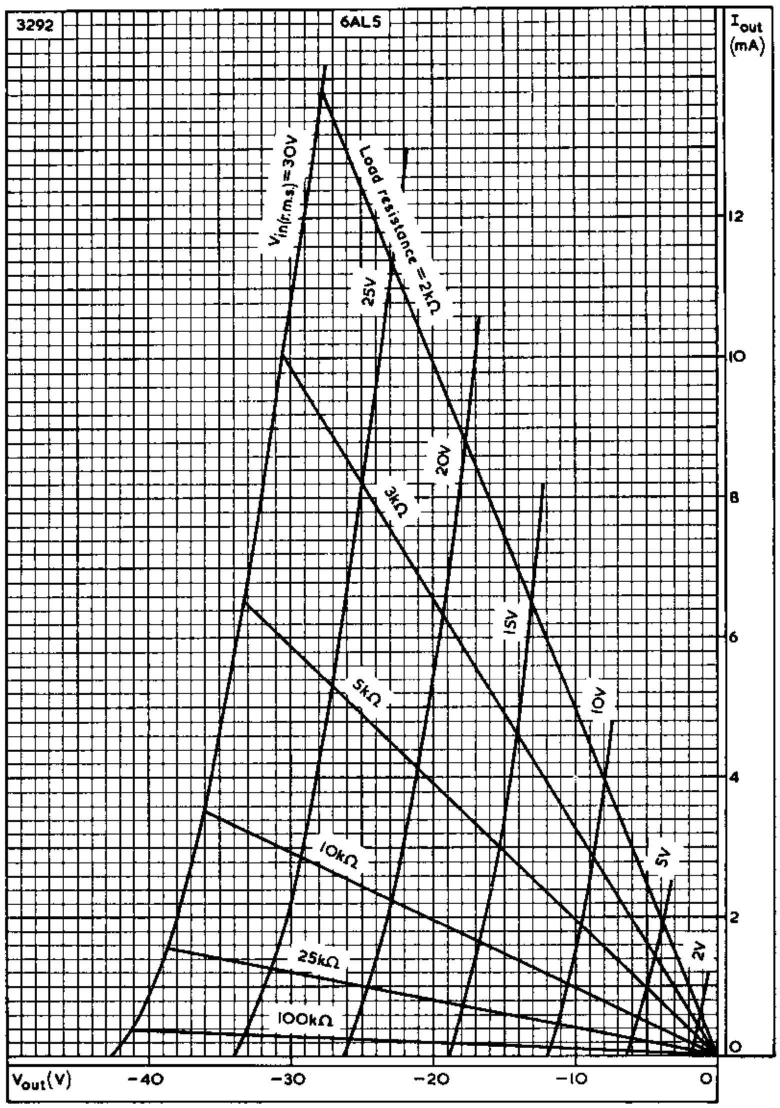


ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE

DOUBLE DIODE

Double diode with separate cathodes and internal screening between sections.

6AL5



OUTPUT CURRENT PLOTTED AGAINST OUTPUT VOLTAGE WITH INPUT VOLTAGE AS PARAMETER

SPECIAL QUALITY R.F. PENTODE

5636

Special quality subminiature r.f. pentode for use in equipment where high ambient temperatures, mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	150	mA

MOUNTING POSITION Any

Note—Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

CAPACITANCES[2] (measured with external shield)

c_{a-g1}	<20	mpF
c_{a-g3}	<1.1	pF
c_{g1-g3}	<150	mpF
$c_{in(g1)}$	4.0	pF
$c_{in(g3)}$	3.7	pF
c_{out}	3.4	pF

CHARACTERISTICS[3]

V_a	100	V
V_{g3}	0	V
V_{g2}	100	V
V_{g1}	−1.4	V
I_a	5.3	mA
I_{g2}	4.1	mA
$g_{m(g1-a)}$	3.2	mA/V
$g_{m(g3-a)}$	1.15	mA/V
μ_{g1-g2}	25	
R_k	0	Ω
V_{g1} (I_a <100μA)	−7.5	V
V_{g3} (I_a <100μA)	−8.0	V

LIMITING VALUES[4] (absolute ratings)

V_h max.	6.6	V
V_h min.	6.0	V
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	550	mW
$+V_{g3}$ max.	30	V
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_{g2} max.	450	mW
I_{g2} max.	7.0	mA
$+V_{g1}$ max.	0	V
$-V_{g1}$ max.	55	V
I_k max.	16	mA
V_{h-k} max.	200	V
R_{g1-k} max.	1.1	MΩ
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	220	°C

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.

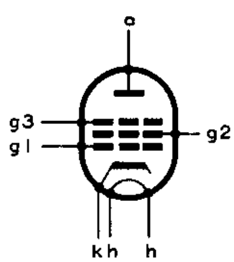
	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP C								
Lead fragility test[13B] 4 arcs	2.5	—	—	—	—	—	—	
Fatigue[14]								
$V_h = 6.3V$. No other voltages applied. 2.5g min. peak acceleration, fixed frequency f = 25c/s min. 60c/s max. for 32 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	6.5	—	—	20	—	—	—	µA
Change in mutual conductance	6.5	—	—	20	—	—	—	%
Microphonic noise as in group B	6.5	—	—	200	—	—	—	mV (r.m.s.)
Shock[15]								
$V_{h-k} = 100V$ (cathode negative), $R_{g1} = 100k\Omega$, 500g								
Post shock tests								
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	20	—	—	20	—	—	—	µA
Change in mutual conductance	20	—	—	20	—	—	—	%
Microphonic noise as in group B	20	—	—	200	—	—	—	mV (r.m.s.)
Glass strain test[11B]. No applied voltages	6.5	—	—	—	—	—	—	

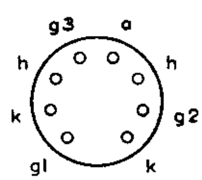
GROUP D

Heater cycling life test								
$V_h = 7.0V$ 1 minute on, 4 minutes off $V_{h-k} = 140V_{r.m.s.}$ (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
					A.Q.L.[5] (%)	*Min.*	*Max.*	
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)								
Inoperatives[16]					4.0	—	—	
Heater current					6.5	138	164	mA
Heater-to-cathode leakage current $V_{h-k} = \pm100V$					6.5	—	10	μA
Reverse grid current $R_{g1} = 1.0M\Omega$					4.0	0	0.9	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	—	—	

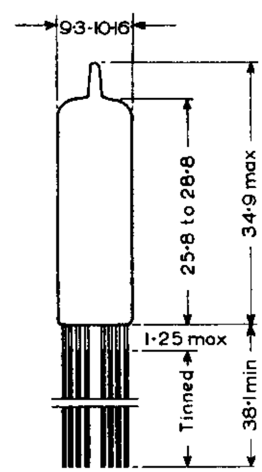
Mullard

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.

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)

$c_{a\text{-}g}$	1.3	pF
c_{in}	2.3	pF
c_{out}	800	mpF

CHARACTERISTICS[3]

V_a	100	V
V_g	−1.3	V
I_a	8.5	mA
g_m	5.8	mA/V
r_a	4.7	kΩ
μ	27	
R_k	0	Ω
$V_g(I_a < 100\mu A)$	−7.0	V

LIMITING VALUES[4] (absolute ratings)

V_h max.	6.6	V
V_h min.	6.0	V
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	900	mW
$+V_g$ max.	0	V ←
$-V_g$ max.	55	V
I_a max.	22	mA
I_g max.	5.5	mA
R_{g-k} max.	1.2	MΩ
V_{h-k} max.	200	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	220	°C

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_{a-e} (V)	V_{g-e} (V)	R_k (Ω)	C_k (μF)	V_{h-k} (V)
6.3	100	0	150	1000	0

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP A								
Heater current	0.65	150	140	160	—	—	—	mA
	—	—	—	—	144	156	4.2	mA
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	0.65	—	—	5.0	—	—	—	μA
Reverse grid current $R_g = 1.0M\Omega$, $V_{a-e} = 150V$, $R_k = 380\Omega$	0.65	—	0	0.4	—	—	—	μA
Anode current	0.65	8.5	6.0	11	—	—	—	mA
	—	—	—	—	7.5	9.5	1.1	mA
Anode current $V_g = -7.0V$, $R_k = 0\Omega$	0.65	—	—	100	—	—	—	μA
Mutual conductance	0.65	5.8	4.8	6.8	—	—	—	mA/V
	—	—	—	—	5.4	6.2	0.4	mA/V
Sub-group quality level[10]	1.0	—	—	—	—	—	—	
Inoperatives[16]	0.4	—	—	—	—	—	—	

GROUP B

Insulation								
a-rest, measured at −300V	2.5	—	100	—	—	—	—	MΩ
g-rest, measured at −100V	2.5	—	100	—	—	—	—	MΩ
Anode current $V_g = -4V$, $R_k = 0\Omega$	2.5	—	20	—	—	—	—	μA
Change in mutual conductance $V_h = 5.7V$	2.5	—	—	10	—	—	—	%
Reverse grid current $V_h = 7.5V$, $V_{g-e} = -7.0V$ $R_g = 1.0M\Omega$. Measured after 5 minutes 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.

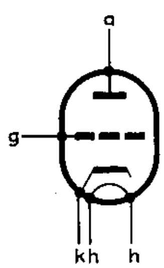
TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP C								
Lead fragility test[13B] 4 arcs	2.5	—	—	—	—	—	—	
Fatigue[14]								
$V_h = 6.3V$. No other voltages applied. 2.5g min. peak acceleration, 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 $V_{h-k} = \pm 100V$.	6.5	—	—	15	—	—	—	µA
Change in mutual conductance	6.5	—	—	15	—	—	—	%
Microphonic noise as in group B	6.5	—	—	100	—	—	—	mV
Shock[15]								
$V_{h-k} = 100V$ (cathode negative), $R_g = 100k\Omega$, 500g								
Post shock tests								
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	20	—	—	15	—	—	—	µA
Change in mutual conductance	20	—	—	15	—	—	—	%
Microphonic noise as in group B	20	—	—	100	—	—	—	mV
Glass strain test[11B]. No applied voltages	6.5	—	—	—	—	—	—	

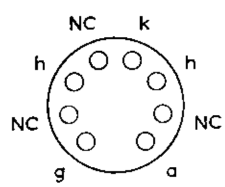
GROUP D

					A.Q.L.[5] (%)	Min.	Max.	
Heater cycling life test								
$V_h = 7.0V$. 1 minute on, 4 minutes off $V_{h-k} = 140V_{r.m.s.}$ (continuous). No other applied voltages	2.5	—	—	—	—	—	—	
Stability life test[14]								
Running conditions $R_g = 1.0M\Omega$, $V_{h-k} = 200V$ (cathode negative), $T_{ambient}$ = Room temperature								
Stability life test end points								
Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%
Survival rate life test[14]								
Running conditions $R_g = 1.0M\Omega$, $V_{h-k} = 200V$ (cathode negative), $T_{ambient}$ = Room temperature								
Survival rate life test end points (100 hours)								
Inoperatives[16]	0.65	—	—	—	—	—	—	
Mutual conductance	1.0	—	4.5	—	—	—	—	mA/V
Intermittent life test								
Running conditions, $Rg = 1.0M\Omega$, $V_{h-k} = 200V$ (cathode negative), T_{bulb} min. = 220°C								
Intermittent life test end points (500 hours)								
Inoperatives[16]					2.5	—	—	
Heater current					4.0	138	164	mA
Heater-to-cathode leakage current $V_{h-k} = \pm100V$					4.0	—	10	µA
Reverse grid current $R_g = 1.0M\Omega$					2.5	0	0.6	µA
Change in mutual conductance (individuals)					2.5	—	20	%
Change in mutual conductance $V_h = 5.7V$					4.0	—	15	%
Insulation as in group B					4.0	50	—	MΩ
Average change in mutual conductance					—	—	15	%
Sub-group quality level[10]					10	—	—	

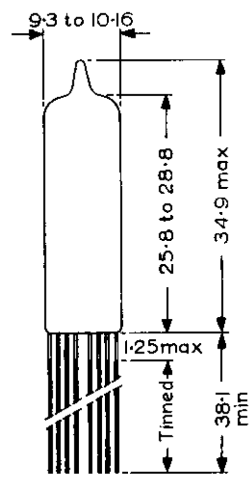
5718 SPECIAL QUALITY U.H.F. TRIODE

5604





B8D/F Base



All dimensions in mm

The base and bulb dimensions of this valve are in accordance with BS.448, Section B8D/F.

SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

5899

Special quality subminiature variable-mu r.f. pentode for use in equipment where high ambient temperatures, mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h [1]	6.3	V
I_h	150	mA

MOUNTING POSITION

Any

Note—Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

CAPACITANCES[2] (measured with an external shield)

c_{a-g1}	<15	mpF
c_{in}	4.3	pF
c_{out}	3.4	pF

CHARACTERISTICS[3]

V_a	100	V
V_{g2}	100	V
V_{g1}	−1.1	V
I_a	7.2	mA
I_{g2}	2.0	mA
g_m	4.5	mA/V
r_a	>175	kΩ
R_k	0	Ω
g_m ($V_{g1} = -15.5V$)	25	μA/V

LIMITING VALUES[4] (absolute ratings)

V_h max.	6.6	V
V_h min.	6.0	V
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	750	mW
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_{g2} max.	350	mW
$+V_{g1}$ max.	0	V←
$-V_{g1}$ max.	55	V
I_k max.	16.5	mA
R_{g1-k} max.	1.1	MΩ
V_{h-k} max.	200	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	220	°C

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_{a-e} (V)	V_{g2-e} (V)	V_{g1-e} (V)	R_k (Ω)	C_k (μF)
6.3	100	100	0	120	1000

TESTS	*A.Q.L.*[5] (%)	*Individuals*[6] *Bogey*[9]	*Individuals Min.*	*Individuals Max.*	*Lot average*[7] *Min.*	*Lot average Max.*	*Lot standard deviation*[8] *Max.*	
GROUP A								
Heater current	0.65	150	140	160	—	—	—	mA
	—	—	—	—	144	156	4.2	mA
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	0.65	—	—	5.0	—	—	—	μA
Reverse grid current $R_{g1} = 1.0M\Omega$	0.65	—	0	0.3	—	—	—	μA
Anode current	0.65	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.

	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP C								
Lead fragility test[13B] 4 arcs	2.5	—	—	—	—	—	—	
Fatigue[14]								
$V_h = 6.3V$. No other voltages applied. 2.5g min. peak acceleration, fixed frequency f = 25c/s min 60c/s max for 32 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	6.5	—	—	20	—	—	—	μA
Change in mutual conductance	6.5	—	—	20	—	—	—	%
Microphonic noise as in group B	6.5	—	—	200	—	—	—	mV (r.m.s.)
Shock[15]								
$V_{h-k} = 100V$ (cathode negative), $R_{g1} = 100k\Omega$, 500g								
Post shock tests								
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	20	—	—	20	—	—	—	μA
Change in mutual conductance	20	—	—	20	—	—	—	%
Microphonic noise as in group B	20	—	—	200	—	—	—	mV (r.m.s.)
Glass strain test[11B]. No applied voltages	6.5	—	—	—	—	—	—	

GROUP D

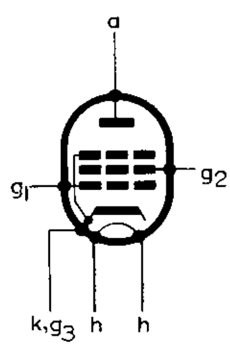
Heater cycling life test								
V_h = 7.0V, 1 minute on, 4 minutes off								
V_{h-k} = 140$V_{r.m.s.}$ (continuous). No other applied voltages	2.5	—	—	—	—	—	—	
Stability life test[14]								
Running conditions R_{g1} = 1.0MΩ								
V_{h-k} = 200V (cathode negative)								
$T_{ambient}$ = Room temperature								
Stability life test end points								
Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%
Survival rate life test[14]								
Running conditions R_{g1} = 1.0MΩ								
V_{h-k} = 200V (cathode negative)								
$T_{ambient}$ = Room temperature								
Survival rate life test end points (100 hours)								
Inoperatives[16]	0.65	—	—	—	—	—	—	
Mutual conductance	1.0	—	3.35	—	—	—	—	mA/V

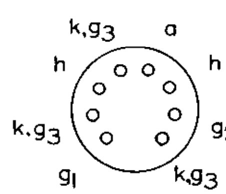
	A.Q.L.[5] (%)	Min.	Max.	
Intermittent life test				
Running conditions, R_{g1} = 1.0MΩ				
V_{h-k} = 200V, T_{bulb} min = 220°C				
Intermittent life test end points (500 hours)				
Inoperatives[16]	4.0	—	—	
Heater current	6.5	138	164	mA
Heater-to-cathode leakage current V_{h-k} = ±100V	6.5	—	10	μA
Reverse grid current R_{g1} = 1.0MΩ	4.0	0	0.8	μA
Change in mutual conductance (individuals)	4.0	—	20	%
Change in mutual conductance V_h = 5.7V	6.5	—	15	%
Insulation as in group B	6.5	50	—	MΩ
Average change in mutual conductance	—	—	15	%
Sub-group quality level[10]	10	—	—	

5899

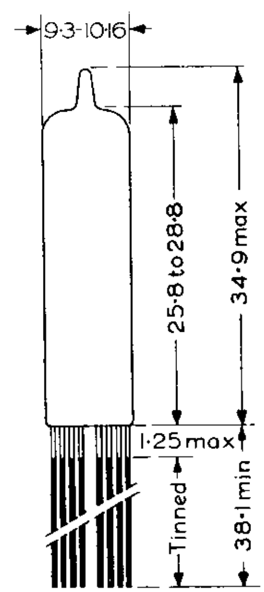
SPECIAL QUALITY VARIABLE-MU R.F. PENTODE

5494





B8D/F Base



All dimensions in mm

The bulb and base dimensions of this valve are in accordance with BS.448, Section B8D/F.

SPECIAL QUALITY OUTPUT PENTODE 5902

Special quality subminiature audio output pentode for use in equipment where high ambient temperatures, mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with the GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	450	mA

MOUNTING POSITION

Any

Note—Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

CAPACITANCES[2] (measured with an external shield)

c_{a-g1}	<200	mpF
c_{in}	6.5	pF
c_{out}	7.5	pF

CHARACTERISTICS[3]

V_a	100	V
V_{g2}	100	V
I_a	30	mA
I_{g2}	1.2	mA
g_m	4.2	mA/V
μ_{g1-g2}	6.0	←
r_a	>10	kΩ
V_{g1}	−8.3	V
R_k	0	Ω
V_{g1} (I_a <100μA)	−40	V

LIMITING VALUES[4] (absolute ratings)

V_h max.	6.6	V
V_h min.	6.0	V
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	3.7	W
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_{g2} max	400	mW
$+V_{g1}$ max.	0	V ←
$-V_{g1}$ max.	55	V
I_k max.	50	mA
R_{g1-k} max.	550	kΩ
V_{h-k} max.	200	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	220	°C

5902 SPECIAL QUALITY OUTPUT PENTODE

TEST CONDITIONS (unless otherwise specified)

V_h	V_{a-e}	V_{g2-e}	V_{g1-e}	R_k	C_k	V_{h-k}
(V)	(V)	(V)	(V)	(Ω)	(μF)	(V)
6.3	110	110	0	270	1000	0

TESTS	A.Q.L.[5]	Individuals[6]			Lot average[7]		Lot standard deviation[8]	
	(%)	Bogey[9]	Min.	Max.	Min.	Max.	Max.	
GROUP A								
Heater current	0.65	450	420	480	—	—	—	mA
	—	—	—	—	432	468	12.5	mA
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	0.65	—	—	15	—	—	—	μA
Reverse grid current $R_{g1} = 1.0M\Omega$	0.65	—	0	1.0	—	—	—	μA
Anode current	0.65	30	23	37	—	—	—	mA
	—	—	—	—	27	33	2.8	mA
Anode current $V_{g1} = -40V$, $R_k = 0\Omega$	0.65	—	—	100	—	—	—	μA
Power output $V_{in(r.m.s.)} = 6.4V$, $R_a = 3.0k\Omega$	0.65	—	750	—	—	—	—	mW
Sub-group quality level[10]	1.0	—	—	—	—	—	—	
Inoperatives[16]	0.4	—	—	—	—	—	—	

GROUP B

Insulation								
a-rest, measured at −300V	2.5	—	50	—	—	—	—	MΩ
g_1-rest, measured at −100V	2.5	—	50	—	—	—	—	MΩ
Change in power output $V_h = 5.7V$, $V_{in(r.m.s.)} = 6.4V$, $R_a = 3.0k\Omega$	2.5	—	—	15	—	—	—	%
Screen-grid current	2.5	—	0	4.0	—	—	—	mA
Mutual conductance	2.5	4.2	3.5	4.9	—	—	—	mA/V
	—	—	—	—	3.85	4.55	0.33	mA/V
Reverse grid current $V_h = 7.5V$, $V_{g1} = -40V$, $R_{g1} = 1.0M\Omega$, $R_k = 0\Omega$. Measured after 5 minutes preheat at $V_h = 7.5V$, $V_{a-e} = V_{g2-e} = 100V$, $R_k = 220\Omega$, $R_{g1} = 470k\Omega$	2.5	—	0	2.0	—	—	—	µA
†A.F. noise at anode, $V_{g2(b)} = 110V$, $V_{g1} = -8.7V$, $R_k = 0\Omega$, $R_{g1} = 500k\Omega$, $R_{g2} = 10k\Omega$, $R_a = 2.0k\Omega$, $C_{g2} = 4.0\mu F$	2.5	—	—	150	—	—	—	mV
Anode impedance	6.5	—	10	—	—	—	—	kΩ
Capacitances[2] (shielded). No applied voltages	6.5	—	—	—	—	—	—	
c_{in}	—	—	5.5	7.5	—	—	—	pF
c_{out}	—	—	6.5	8.5	—	—	—	pF
c_{a-g1}	—	—	—	200	—	—	—	mpF
Low pressure voltage breakdown Pressure = 55±5mm Hg. Voltage = $300V_{r.m.s.}$ No other applied voltages	6.5	—	—	—	—	—	—	
Microphonic noise at the anode at 50c/s, 15g min. peak acceleration, $R_a = 2.0k\Omega$	2.5	—	—	100	—	—	—	mV (r.m.s.)

†The valve is tapped with a specified hammer and the output observed on a meter of specified dynamic response.

TESTS	A.Q.L.[5] (%)	Individuals[6] Bogey[9]	Individuals[6] Min.	Individuals[6] Max.	Lot average[7] Min.	Lot average[7] Max.	Lot standard deviation[8] Max.	
GROUP C								
Lead fragility test[13B]. 4 arcs	2.5	—	—	—	—	—	—	
Fatigue[14]								
$V_h = 6.3V$. No other voltages applied. 2.5g min. peak acceleration, fixed frequency f = 25c/s min. 60c/s max. for 32 hours in each of 3 mutually perpendicular planes								
Post fatigue tests								
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	6.5	—	—	40	—	—	—	μA
Change in power output	6.5	—	—	20	—	—	—	%
Microphonic noise as in group B	6.5	—	—	300	—	—	—	mV (r.m.s.)
Shock[15]								
$V_{h-k} = 100V$ (cathode negative), $R_{g1} = 100k\Omega$, 500g								
Post shock tests								
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	20	—	—	40	—	—	—	μA
Change in power output	20	—	—	20	—	—	—	%
Microphonic noise as in group B	20	—	—	300	—	—	—	mV (r.m.s.)
Glass strain test[11B]. No applied voltages	6.5	—	—	—	—	—	—	

GROUP D

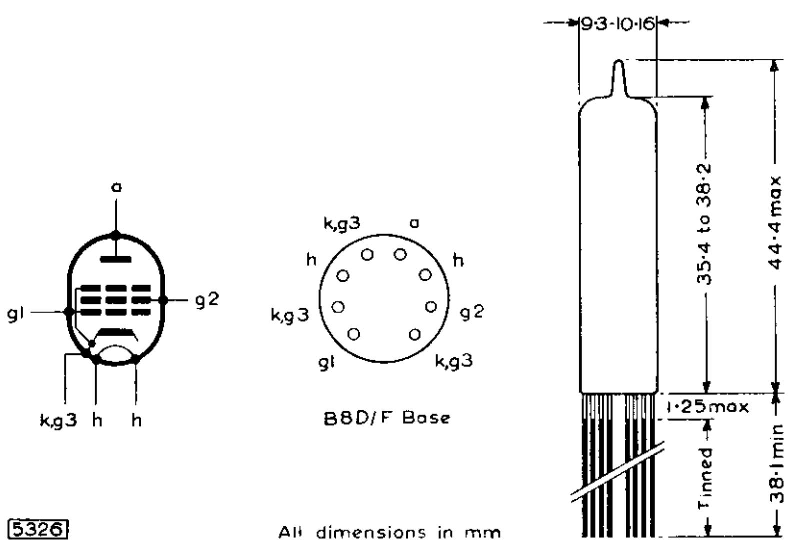
Heater cycling life test								
$V_h = 7.0V$, 1 minute on, 4 minutes off $V_{h-k} = 140V_{r.m.s.}$ (continuous). No other applied voltages	2.5	—	—	—	—	—	—	
Heater cycling life test end point								
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	—	—	—	40	—	—	—	µA
Stability life test[14]								
Running conditions $R_{g1} = 470k\Omega$, $R_k = 220\Omega$, $V_a = V_{g2} = 100V$, $V_{h-k} = 200V$ (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 $R_{g1} = 470k\Omega$, $R_k = 220\Omega$, $V_{h-k} = 200V$ (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, $R_{g1} = 470k\Omega$, $R_k = 220\Omega$, $V_a = V_{g2} = 100V$, $V_{h-k} = 200V$ (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 $R_{g1} = 1.0M\Omega$	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



The bulb and base dimensions of this valve are in accordance with BS448, Section B8D/F.

SPECIAL QUALITY R.F. PENTODE

6205

Special quality r.f. pentode for use in equipment where high ambient temperatures, mechanical vibration and shocks are unavoidable and where statistically controlled major electrical characteristics are required.

This data should be read in conjunction with GENERAL NOTES—SPECIAL QUALITY VALVES which precede this section of the handbook, and the index numbers are used to indicate where reference should be made to a specific note.

HEATER

V_h[1]	6.3	V
I_h	150	mA

MOUNTING POSITION — Any

Note – Direct soldered connections to the leads of this valve must be at least 5mm from the seal and any bending of the valve leads must be at least 1.5mm from the seal.

CAPACITANCES[2] (measured with external shield)

c_{a-g1}	<15	mpF
c_{in}	4.2	pF
c_{out}	3.4	pF

CHARACTERISTICS[3]

V_a	100	V
*V_{g3}	0	V
V_{g2}	100	V
V_{g1}	−1.5	V
I_a	7.5	mA
I_{g2}	2.4	mA
g_m	5.0	mA/V
r_a	>175	kΩ
R_k	0	Ω
V_{g1} (I_a <50μA)	−9.0	V

*The suppressor grid should not be used for control or gating purposes.

LIMITING VALUES[4] (absolute ratings)

V_h max.	6.6	V
V_h min.	6.0	V
$V_{a(b)}$ max.	330	V
V_a max.	165	V
p_a max.	800	mW
V_{g3} max.	22	V←
$V_{g2(b)}$ max.	310	V
V_{g2} max.	155	V
p_{g2} max.	350	mW
$+V_{g1}$ max.	0	V←
$-V_{g1}$ max.	55	V
I_k max.	16.5	mA
R_{g1-k} max.	1.1	MΩ
V_{h-k} max.	200	V
Maximum acceleration (continuous operation)	2.5	g
Maximum shock (short duration)	500	g
T_{bulb} max.	220	°C

TEST CONDITIONS (unless otherwise specified)

V_h (V)	V_{a-e} (V)	V_{g3-k} (V)	V_{g2-e} (V)	V_{g1-e} (V)	R_k (Ω)	C_k (μF)	V_{h-k} (V)
6.3	100	0	100	0	150	1000	0

TESTS	*A.Q.L.*[5] (%)	*Individuals*[6] *Bogey*[9]	*Individuals*[6] *Min.*	*Individuals*[6] *Max.*	*Lot average*[7] *Min.*	*Lot average*[7] *Max.*	*Lot standard deviation*[8] *Max.*	
GROUP A								
Heater current	0.65	150	140	160	—	—	—	mA
	—	—	—	—	144	156	4.2	mA
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	0.65	—	—	5.0	—	—	—	μA
Reverse grid current $R_{g1} = 1.0M\Omega$	0.65	—	0	0.3	—	—	—	μA
Anode current	0.65	7.5	5.5	9.5	—	—	—	mA
	—	—	—	—	6.7	8.3	0.8	mA
Anode current $V_{g1} = -9.0V$, $R_k = 0\Omega$	0.65	—	—	50	—	—	—	μA
Screen-grid current	0.65	—	1.5	3.3	—	—	—	mA
Mutual conductance	0.65	5.0	4.2	5.8	—	—	—	mA/V
	—	—	—	—	4.7	5.3	0.31	mA/V
Sub-group quality level[10]	1.0	—	—	—	—	—	—	
Inoperatives[16]	0.4	—	—	—	—	—	—	

GROUP B

Insulation								
a-rest, measured at −300V	2.5	—	100	—	—	—	—	MΩ
g_1-rest, measured at −100V	2.5	—	100	—	—	—	—	MΩ
Change in mutual conductance $V_h = 5.7V$	2.5	—	—	10	—	—	—	%
Reverse grid current $V_h = 7.5V$, $V_{g1} = -9.0V$, $R_{g1} = 1.0M\Omega$, $R_k = 0\Omega$. Measured after 5 minutes preheat under standard test conditions, except $V_h = 7.5V$, $R_{g1} = 1.0M\Omega$	2.5	—	0	0.5	—	—	—	µA
†A.F. noise at anode, $V_{g2-e} = 19V$, $R_{g1} = 100k\Omega$ $R_{g2} = 1.0k\Omega$, $R_a = 200k\Omega$	2.5	—	—	70	—	—	—	mV
Anode impedance	6.5	—	175	—	—	—	—	kΩ
Capacitances[2] (shielded) No applied voltages	6.5	—	—	—	—	—	—	
c_{in}	—	—	3.5	4.9	—	—	—	pF
c_{out}	—	—	2.9	3.9	—	—	—	pF
c_{a-g1}	—	—	—	15	—	—	—	mpF
Low pressure voltage breakdown Pressure = 55±5mmHg Voltage = $300V_{r.m.s.}$ 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 $V_{h-k} = \pm100V$	6.5	—	—	20	—	—	—	μA
Change in mutual conductance	6.5	—	—	20	—	—	—	%
Microphonic noise as in group B	6.5	—	—	200	—	—	—	mV (r.m.s.)
***Shock*[15]**								
V_{h-k} = 100V (cathode negative), R_{g1} = 100kΩ, 500g								
Post shock tests								
Heater-to-cathode leakage current $V_{h-k} = \pm100V$	20	—	—	20	—	—	—	μA
Change in mutual conductance	20	—	—	20	—	—	—	%
Microphonic noise as in group B	20	—	—	200	—	—	—	mV (r.m.s.)
Glass strain test[11B]. No applied voltages	6.5	—	—	—	—	—	—	

GROUP D

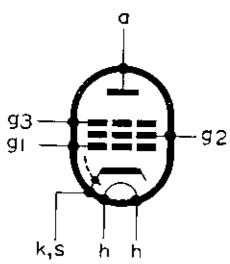
Heater cycling life test								
$V_h = 7.0V$ 1 minute on, 4 minutes off, 2000 switchings. $V_{h-k} = 140V_{r.m.s.}$ (continuous)								
No other applied voltages	2.5	—	—	—	—	—	—	
Stability life[14]								
Running conditions: $R_{g1} = 1.0M\Omega$, $V_{h-k} = 200V$ (cathode negative), $T_{ambient}$ = Room temperature								
Stability life end points								
Change in mutual conductance after 1 hour	1.0	—	—	10	—	—	—	%
Survival rate life test[14]								
Running conditions $R_{g1} = 1.0M\Omega$, $V_{h-k} = 200V$ (cathode negative), $T_{ambient}$ = Room temperature								
Survival rate life test end points (100 hours)								
Inoperatives[16]	0.65	—	—	—	—	—	—	
Mutual conductance	1.0	—	3.75	—	—	—	—	mA/V

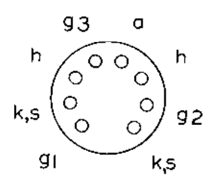
Intermittent life test

Running conditions: $R_{g1} = 1.0M\Omega$,
$V_{h-k} = 200V$ (cathode negative), T_{bulb} min. $= 220°C$

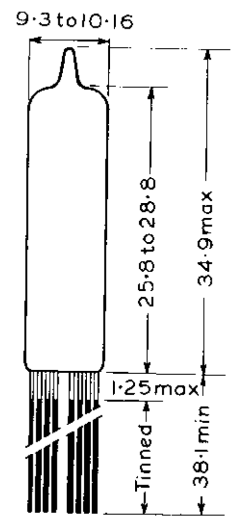
Intermittent life test end points (500 hours)	A.Q.L.[5] (%)	*Min.*	*Max.*	
Inoperatives[16]	2.5	—	—	
Heater current	4.0	138	164	mA
Heater-to-cathode leakage current $V_{h-k} = \pm 100V$	4.0	—	10	µA
Reverse grid current $R_{g1} = 1.0M\Omega$	2.5	0	0.8	µA
Change in mutual conductance (individuals)	2.5	—	20	%
Change in mutual conductance $V_h = 5.7V$	4.0	—	15	%
Insulation as in group B	4.0	50	—	MΩ
Average change in mutual conductance	—	—	15	%
Sub-group quality level[10]	10	—	—	

6205 SPECIAL QUALITY R.F. PENTODE





B8D/F Base



5544

All dimensions in mm

The bulb and base dimensions of this valve are in accordance with BS448, section B8D/F.

DOUBLE TRIODE 6080

A low-μ power double triode with separate cathodes intended for use as a series regulator valve in d.c. power supplies, in servo applications or as a booster triode.

HEATER

V_h	6.3	V
I_h	2.5	A

MOUNTING POSITION Any

CAPACITANCES (measured without an external shield)

$^*c_{a\text{-}g}$	8.6	pF
$^*c_{in}$	5.5	pF
$^*c_{out}$	2.5	pF
$^*c_{h\text{-}k}$	7.0	pF
$c_{a''\text{-}a'}$	2.2	pF
$c_{g''\text{-}g'}$	0.5	pF

*Each section

CHARACTERISTICS

		†	
V_b	-	135	V
V_a	100	-	V
I_a	100	125	mA
R_k	300	250	Ω
g_m	6.5	7.0	mA/V
r_a	300	280	Ω
μ	2.0	2.0	

†This condition represents operation at the absolute limit of anode current and dissipation.

CHARACTERISTIC RANGE VALUES FOR EQUIPMENT DESIGN

	Min.	Max.	
Heater Current at $V_h = 6.3V$	2.26	2.74	A
*Amplification factor at $V_b = 135V$, $R_k = 250\Omega$	1.4	2.6	

*Mutual Conductance			
at $V_b = 135V$, $R_k = 250\Omega$	5.8	8.2	mA/V
**Negative control grid current			
at $V_b = 135V$, $R_k = 250\Omega$, $R_{g1} = 1M\Omega$	-	4.0	μA
Anode current			
at $V_b = 135V$, $R_k = 250\Omega$	100	150	mA

Under these conditions the Absolute Maximum Ratings can be exceeded.

*Each section

**Two sections in parallel

SHOCK AND VIBRATION

The 6080 can withstand vibrations of 2.5g at 25c/s for 32 hours and is proof against impact accelerations of 450g.

LOW FREQUENCY VIBRATION PERFORMANCE

R.M.S. output voltage max.	200	mV

Two sections in parallel with $V_h = 6.3V$, $V_b = 135V$, $V_{g1} = -7V$, $R_a = 2k\Omega$ and vibrational acceleration of 2.5g at 25c/s.

RATINGS (ABSOLUTE MAXIMUM SYSTEM)(each section)

$V_{a(b)}$ max.	550	V
V_a max.	250	V
†P.I.V. max. (booster scanning service)	3.0	kV
†$-v_{g\ (pulse)}$ max. (booster scanning service)	2.3	kV
I_k max.	125	mA
p_a max.	13	W
R_{g-k} max. (cathode bias)	1.0	MΩ
*R_{g-k} max. (fixed bias)	100	kΩ
v_{h-k} (pk) max.	300	V
T_{bulb} max.	260	°C

†Max. pulse duration 15% of one cycle with a maximum duration of 10μs.

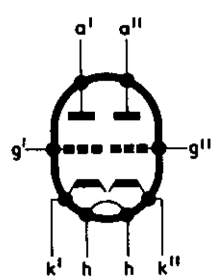
*With fixed bias the anode circuit should contain a protective resistance to provide a minimum drop of 15V d.c. at the normal operating conditions. When two or more sections are used in parallel at dissipations approaching the rated maximum, separate anode and cathode resistors must be used to assist load sharing.

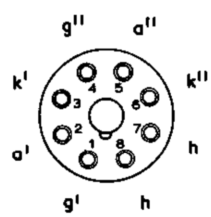
When combined fixed and cathode bias is used, the cathode bias portion should have a minimum value of 7.5V d.c. at the normal operating conditions and R_{g-k} max. = 100kΩ.

It is not recommended that fixed bias be used when the valve is used in a booster scanning circuit.

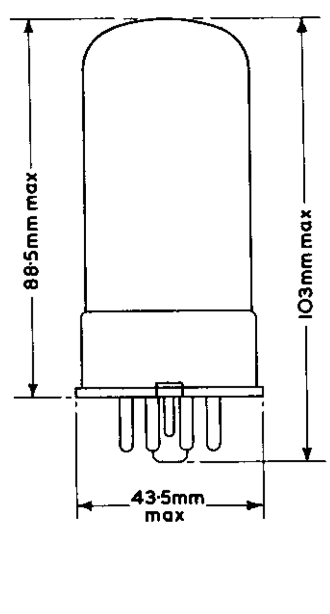
DOUBLE TRIODE 6080

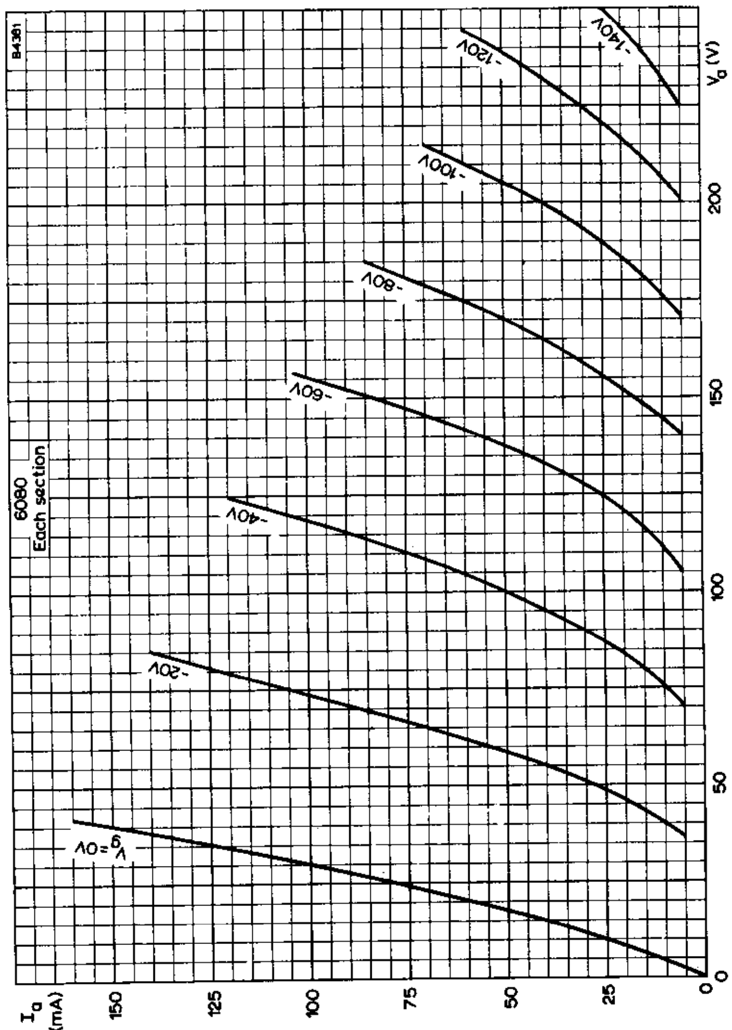
3761





Octal Base





ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH GRID VOLTAGE AS PARAMETER