MAZDA

VALVES & CATHODE RAY TUBES

VOL. 2

VALVES

Tech. Publications.

Handbook User

MAZDA Commercial Division

MAZDA

THORN-AEI Radio Valves & Tubes Ltd

MAZDA

DESIGN DATA HANDBOOK

U.K. EDITION

Volume 2

Valves

A Data Service is provided for this Handbook.
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MHA 5483

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SALES DEPARTMENT

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Title Card Issue 3

USE OF THIS HANDBOOK

Data sheets are filed in numerical/alphabetical order of the tube type numbers. Volume 1 contains colour and monochrome picture tubes. Volume 2 contains valves.

The CROSS REFERENCE INDEX covers all Volumes of the Handbook. The CONTENTS covers one particular Volume only, and is provided as a check against missing sheets.

DESIGN DATA SERVICE

New handbooks are supplied at an initial charge of £1 (Sterling) per Volume, which includes the Data Service up to the following June.

New and revised data sheets for this handbook are sent direct from Thorn Radio Valves and Tubes Ltd. to all registered handbook holders. This service is normally invoiced annually in advance, in July, for the coming " Data Year " to June.

The Annual Service Charge (£1 Sterling) is so small that it is not practicable to invoice it in two parts in cases where the " Data Year " does not coincide with the subscriber's "Accounting Year ".

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MAZDA DISTRIBUTION

Colour and Monochrome Picture Tubes and Valves for maintenance are available through Wholesale Stockists and Radio Retailers throughout the British Isles.

MAZDA Maintenance Sales Department,
Thorn Radio Valves & Tubes Ltd.,
Mollison Avenue, Brimsdown, Enfield,
Middlesex, EN3 7NS

Data Handbook

Contents - Volume 2

This Contents Sheet for the Mazda Data Handbook Volume 2 will be reissued periodically to allow Holders to check that their handbook contains all the latest sheets. Volume 2 contains data sheets for Valves which are classified into Current Equipment types recommended for use in new equipment and Maintenance types available for replacement purposes.

Volume 1 includes data sheets for Colour and Monochrome Picture Tubes which are each classified into Current Equipment and Maintenance types

Sheets are filed in numerical-alphabetical order of the individual type number and in cases where sheets are dual coded the Mazda number is given first and sheets are filed under this type number. Abridged data on older maintenance types follows the individual data sheets at the end of the Maintenance Valves section.

INTRODUCTORY SHEETS

Sheet Description	Issue	Pages
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Cross Reference Index	7	1 - 5

GENERAL SECTION – Guide Card

Sheet Description	Issue	Pages
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Operational Recommendations	2	1 - 5
Cross Modulation	2	1
Power Output Curves	2	1 - 2

CURRENT VALVES SECTION – Guide Card

Type	Issue	Pages
6C18	1	1 - 4
6F28	1	1 - 4
6F29	2	1 - 2
	1	3 - 6
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6F30	2	1 - 6
6L13	2	1 - 5
30C1	1	1 - 11
30C18	2	1 - 14
30FL2	1	1 - 8
30FL14	2	1 - 7
30P19	3	1 - 2
	2	3 - 9
30PL1	2	1 - 10
30PL12	1	1 - 6
DY86 } DY87 }	2	1
DY802	2	1 - 2
EC97	1	1
ECC81	1	1 - 3
ECC82	2	1 - 6
ECL86	2	1 - 11
PC97	2	1 - 8
PCL84	1	1 - 6
PCL86	2	1 - 9
PCL805 } PCL85 }	3	1 - 8
PFL200	2	1 - 21
PL36	1	1 - 2
PL504	3	1 - 8
PY81	1	1
PY88	1	1 - 2
PY800	1	1
U193	2	1 - 2

MAINTENANCE VALVES SECTION–Guide Card

Type	Issue	Pages
1M1	1	1 - 2
6/30L2	2	1 - 4
6BW7	1	1 - 2
6C12	2	1 - 10
6D2	1	1 - 2
	2	3 - 4
6F18	1	1 - 9
6F23	2	1 - 4
6F26	1	1 - 4
6FD12	1	1 - 8
6L12	2	1 - 5
6LD12	2	1 - 4
6P15	1	1 - 13
6PL12	1	1 - 6
10C14	2	1 - 10
10D2	1	1 - 4
10F18	1	1 - 10
10FD12	1	1 - 4
10L14	2	1 - 6
10LD13	1	1 - 6
10P18	1	1 - 6
10PL12	1	1 - 10
30C15	2	1 - 8
30C17	1	1 - 12
30F5	1	1 - 14
30FL1	2	1 - 8
30FL12	1	1 - 8
30L1	1	1 - 10
30L15	2	1 - 8
30L17	1	1 - 11
30P4	1	1 - 5
30P12	2	1 - 3
30P16	1	1 - 6
30P18	1	1 - 2
30PL13	2	1 - 7
30PL14	1	1 - 8
EBC90	1	1 - 2
EBF80	1	1
ECF80	1	1
ECF82	1	1
ECH84	1	1 - 6
ECL80	1	1
EF80	1	1 - 6
EF86	2	1 - 2
EH90	1	1 - 9
EM87	1	1 - 2
EY51	1	1
EY86 / EY87	2	1
EZ80	1	1 - 4
GY501	1	1 - 2
PC86	2	1 - 4
PC88	2	1 - 3
PC900	1	1 - 6
PCC85	1	1 - 4
PCC88	1	1 - 2
PCC89	1	1 - 2
PCC189	1	1 - 3
PCF82	1	1 - 2
PCF86	1	1 - 4
PCF200	1	1 - 4
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PCH200	1	1 - 4
PCL83	1	1
PD500	1	1 - 2
PL81	1	1 - 2
PL81A	1	1 - 6
PL83	1	1
PL500	3	1 - 3
PL508	1	1 - 4
PL509	1	1 - 4
PL802	1	1 - 4
PY33	1	1 - 4
PY83	1	1
PY500	1	1 - 2
U26	2	1 - 2
U191	1	1 - 3
U192	1	1 - 4
U381	1	1 - 4
UCL83	1	1
UF89	1	1
UU12	2	1 - 4
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Note: For Pro Electron and American Equivalents see Cross Reference Index following this Contents page.

USE OF THE CROSS REFERENCE INDEX

This index has two functions: -

(1) to locate data within the two volumes of this handbook,

(2) to give a complete equivalents cross reference between Pro Electron, American and Mazda type numbers.

Since the sheets in this handbook are filed in Mazda type order (where allocated), the cross reference index should be used to find the filing number when searching for data on types having Pro Electron and American type numbers.

Index	Hand-book Vol.	Filed under Type No.	Equivalent Types Pro Electron	American
1BQ2	2	DY802	DY802	1BQ2
1C1	2*	1C1	DK91	1R5
1F3	2*	1F3	DF91	1T4
1FD9	2*	1FD9	DAF91	1S5
1M1	2†	1M1	DM71	1N3
1N3	2†	1M1	DM71	1N3
1P1	2*	1P1	DL96	3C4
1P10	2*	1P10	DL92	3S4
1R5	2*	1C1	DK91	1R5
1S2	2	DY86/87	DY86	1S2
1S2A	2	DY86/87	DY87	1S2A
1S5	2*	1FD9	DAF91	1S5
1T4	2*	1F3	DF91	1T4
2J2	2†	U26	KY80	2J2
3BH2	2†	GY501	GY501	3BH2
3C4	2*	1P1	DL96	3C4
3S4	2*	1P10	DL92	3S4
4CM4	2†	PC86	PC86	4CM4
4DL4	2†	PC88	PC88	4DL4
4FY5	2	PC97	PC97	4FY5
4HA5	2†	PC900	PC900	4HA5
6/30L2	2†	6/30L2	ECC804	6GA8
6AB8	2†	ECL80	ECL80	6AB8
6AJ8	2†	6C12	ECH81	6AJ8
6AK8	2†	6LD12	EABC80	6AK8
6AL5	2†	6D2	EB91	6AL5
6AM6	2*	6F12	EF91	6AM6
6AQ8	2†	6L12	ECC85	6AQ8
6AT6	2†	EBC90	EBC90	6AT6
6BM8	2†	6PL12	ECL82	6BM8
6BQ5	2†	6P15	EL84	6BQ5
6BW7	2†	6BW7		6BW7
6BX6	2†	EF80	EF80	6BX6
6BY7	2†	6F26	EF85	6BY7
6C12	2†	6C12	ECH81	6AJ8
6C18	2	6C18	ECF805	6GV7
6CA4	2†	UU12	EZ81	6CA4
6CS6	2†	EH90	EH90	6CS6
6D2	2†	6D2	EB91	6AL5
6DC8	2†	6FD12	EBF89	6DC8
6EC7	2†	6F18		6EC7
6EH7	2	6F29	EF183	6EH7
6EJ7	2	6F30	EF184	6EJ7
6EL7	2†	6F23	EF812	6EL7
6F1	2*	6F1		
6F12	2*	6F12	EF91	6AM6
6F13	2*	6F13		
6F14	2*	6F14		
6F15	2*	6F15		
6F18	2†	6F18		6EC7
6F22	2†	EF86	EF86	6267
6F23	2†	6F23	EF812	6EL7
6F26	2†	6F26	EF85	6BY7
6F28	2	6F28	EE80	
6F29	2	6F29	EF183	6EH7
6F30	2	6F30	EF184	6EJ7
6FD12	2†	6FD12	EBF89	6DC8
6FY5	2	EC97	EC97	6FY5
6GA8	2†	6/30L2	ECC804	6GA8
6GV7	2	6C18	ECF805	6GV7

* Included in Abridged Data sheets.
† Maintenance type.

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Index	Hand-book Vol.	Filed under Type No.	Equivalent Types Pro Electron	American
6GW8	2	ECL86	ECL86	6GW8
6HU6	2†	EM87	EM87	6HU6
6JX8	2†	ECH84	ECH84	6JX8
6K25	2*	6K25		
6L12	2†	6L12	ECC85	6AQ8
6L13	2	6L13	ECC83	12AX7
6LD12	2†	6LD12	EABC80	6AK8
6N8	2†	EBF80	EBF80	6N8
6P15	2†	6P15	EL84	6BQ5
6PL12	2†	6PL12	ECL82	6BM8
6S2	2†	EY86/87	EY86	6S2
6S2A	2†	EY86/87	EY87	6S2A
6U8	2†	ECF82	ECF82	6U8
6V4	2†	EZ80	EZ80	6V4
6X2	2†	EY51	EY51	6X2
7AN7	2†	30L1	PCC84	7AN7
7DJ8	2†	PCC88	PCC88	7DJ8
7ED7	2†	30F5	PF818	7ED7
7EK7	2†	30L15	PCC805	7EK7
7ES8	2†	PCC189	PCC189	7ES8
7FC7	2†	PCC89	PCC89	7FC7
7GV7	2	30C18	PCF805	7GV7
8GJ7	2†	PCF801	PCF801	8GJ7
8HG8	2†	PCF86	PCF86	8HG8
8X9	2†	PCF200	PCF200	8X9
9A8	2	30C1	PCF80	9A8
9AQ8	2†	PCC85	PCC85	9AQ8
9ED4	2†	PD500	PD500	9ED4
9EN7	2†	30C15	PCF800	9EN7
9GB8	2†	30FL1	PCE800	9GB8
9JW8	2†	PCF802	PCF802	9JW8
9U8	2†	PCF82	PCF82	9U8
9V9	2†	PCH200	PCH200	9V9
10C2	2*	10C2		
10C14	2†	10C14	UCH81	19D8
10D2	2†	10D2		
10F9	2*	10F9		
10F18	2†	10F18		13EC7
10FD12	2†	10FD12	UBF89	19FL8
10L14	2†	10L14	UCC85	
10LD11	2*	10LD11		
10LD13	2†	10LD13	UBC81	
10P13	2*	10P13		
10P18	2†	10P18	UL84	45B5
10PL12	2†	10PL12	UCL82	50BM8
12AT7	2	ECC81	ECC81	12AT7
12AU7	2	ECC82	ECC82	12AU7
12AX7	2	6L13	ECC83	12AX7
12DT7	2	6L13	ECC83	12AX7
12FB5	2†	30P12	PL801	12FB5
13EC7	2†	10F18		13EC7
13GC8	2	30PL1	PCL801	13GC8
14GW8	2	PCL86	PCL86	14GW8
15A6	2†	PL83	PL83	15A6
15CW5	2†	30P18	PL84	15CW5
15DQ8	2	PCL84	PCL84	15DQ8
16A5	2†	30P16	PL82	16A5
16A8	2	30PL12	PCL82	16A8
16GK8	2†	30PL13	PCL800	16GK8
16LD6	2†	PL802	PL802	16LD6
17KW6	2†	PL508	PL508	17KW6
17Y9	2	PFL200	PFL200	17Y9
17Z3	2	PY81	PY81	17Z3
18GV8	2	PCL805	PCL85	18GV8
19CS4	2†	U191	PY301	19CS4
19D8	2†	10C14	UCH81	19D8
19FL8	2†	10FD12	UBF89	19FL8
19Y3	2†	U192	PY82	19Y3
20D1	2*	20D1		
20F2	2*	20F2		
20L1	2*	20L1		
20P3	2*	20P3		
20P4	2*	20P4	CL30	
20P5	2*	20P5		
21A6	2†	PL81	PL81	21A6
23DFP4	1†	CME2308	A59-15W	27DFP4
23DGP4	1†	CME2306	A59-13W	23DGP4
23DHP4	1†	CME2306	A59-13W	23DHP4
25E5	2	PL36	PL36	25E5
25GF6	2†	30P4		25GF6

* Included in Abridged Data sheets.
† Maintenance type.

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25UP22	1†	CTA2550	A63-11X	25UP22
27GB5	2†	PL500	PL500	27GB5
30AE3	2	PY88	PY88	30AE3
30C1	2	30C1	PCF80	9A8
30C15	2†	30C15	PCF800	9EN7
30C17	2†	30C17	PCF87	
30C18	2	30C18	PCF805	7GV7
30F5	2†	30F5	PF818	7ED7
30FL1	2†	30FL1	PCE800	9GB8
30FL2	2	30FL2	PCF812	
30FL12	2†	30FL12	PCE82	
30FL14	2	30FL14	PCF808	
30L1	2†	30L1	PCC84	7AN7
30L15	2†	30L15	PCC805	7EK7
30L17	2†	30L17	PCC806	
30P4	2†	30P4		25GF6
30P12	2†	30P12	PL801	12FB5
30P16	2†	30P16	PL82	16A5
30P18	2†	30P18	PL84	15CW5
30P19	2	30P19	PL302	
30PL1	2	30PL1	PCL801	13GC8
30PL12	2	30PL12	PCL82	16A8
30PL13	2†	30PL13	PCL800	16GK8
30PL14	2†	30PL14	PCL88	
38A3	2†	U381	UY85	38A3
42EC4	2†	PY500	PY500	42EC4
45B5	2†	10P18	UL84	45B5
50BM8	2†	10PL12	UCL82	50BM8
6267	2†	EF86	EF86	6267
A31-18W	1†	CME1201	A31-18W	
A31-120W	1	CME1220	A31-120W	
A31-181W	1	CME1202	A31-181W	
A38-160W	1	CME1520	A38-160W	
A40-11W	1†	CME1601	A40-11W	
A40-12W	1†	CME1602	A40-12W	
A44-120W	1	CME1713	A44-120W	
A47-13W	1†	CME1906	A47-13W	
A47-14W	1†	CME1908	A47-14W	
A47-17W	1†	CME1905	A47-17W	
A47-25W	1†	CME1907	A47-25W	
A47-28W	1†	CME1913	A47-28W	
A49-11X	1†	A49-11X	A49-11X	
A49-191X	1	A49-191X	A49-191X	
A50-12W	1	CME2013	A50-12W	
A50-120W	1	CME2013	A50-120W	
A51-110X	1	A51-110X	A51-110X	
A55-14X	1	A55-14X	A55-14X	
A56-120X	1	A56-120X	A56-120X	
A59-13W	1†	CME2306	A59-13W	23DGP4
				23DHP4
A59-15W	1†	CME2308	A59-15W	23DFP4
A59-16W	1†	CME2306	A59-16W	
A59-23W	1†	CME2313	A59-23W	
A59-25W	1†	CME2312	A59-25W	
A59-26W	1†	CME2313	A59-26W	
A61-120W	1	CME2413	A61-120W	
A63-11X	1†	CTA2550	A63-11X	25UP22
A63-200X	1	A63-200X	A63-200X	
A67-120X	1	A67-120X	A67-120X	
AW47-91	1†	CME1903	AW47-91	
AW59-90	1†	CME2302	AW59-90	
AW59-95	1†	CME2301	AW59-95	
CL30	2*	20P4	CL30	
CME1201	1†	CME1201	A31-18W	
CME1202	1	CME1202	A31-181W	
CME1220	1	CME1220	A31-120W	
CME1520	1	CME1520	A38-160W	
CME1601	1†	CME1601	A40-11W	
CME1602	1†	CME1602	A40-12W	
CME1702	1†	CME1702		
CME1703	1†	CME1703		
CME1705	1†	CME1705		
CME1713	1	CME1713	A44-120W	
CME1903	1†	CME1903	AW47-91	
CME1905	1†	CME1905	A47-17W	
CME1906	1†	CME1906	A47-13W	
CME1907	1†	CME1907	A47-25W	
CME1908	1†	CME1908	A47-14W	
CME1913	1†	CME1913	A47-28W	
CME2013	1	CME2013	A50-120W	

* Included in Abridged Data sheets.

† Maintenance type.

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CME2101	1†	CME2101		
CME2104	1†	CME2104		
CME2301	1†	CME2301	AW59-95	
CME2302	1†	CME2302	AW59-90	
CME2306	1†	CME2306	A59-13W	23DGP4 23DHP4
CME2308	1†	CME2308	A59-15W	23DFP4
CME2312	1†	CME2312	A59-25W	
CME2313	1†	CME2313	A59-23W	
CME2413	1	CME2413	A61-120W	
CRM121B	1*	CRM121B		
CRM141	1*	CRM141/142		
CRM142	1*	CRM141/142		
CRM151	1*	CRM151		
CRM152B	1*	CRM152B		
CRM153	1*	CRM153		
CRM171	1*	CRM171		
CRM172	1†	CRM172		
CRM173	1†	CRM173		
CRM211	1*	CRM211		
CRM212	1†	CRM212		
CTA2550	1†	CTA2550	A63-11X	25UP22
CY30	2*	U301	CY30	
DAF91	2*	1FD9	DAF91	1S5
DF91	2*	1F3	DF91	1T4
DK91	2*	1C1	DK91	1R5
DL92	2*	1P10	DL92	3S4
DL96	2*	1P1	DL96	3C4
DM71	2†	1M1	DM71	1N3
DY86	2	DY86/87	DY86	1S2
DY87	2	DY86/87	DY87	1S2A
DY802	2	DY802	DY802	1BQ2
EABC80	2†	6LD12	EABC80	6AK8
EB91	2†	6D2	EB91	6AL5
EBC90	2†	EBC90	EBC90	6AT6
EBF80	2†	EBF80	EBF80	6N8
EBF89	2†	6FD12	EBF89	6DC8
EC97	2	EC97	EC97	6FY5
ECC81	2	ECC81	ECC81	12AT7
ECC82	2	ECC82	ECC82	12AU7
ECC83	2	6L13	ECC83	12AX7
ECC85	2†	6L12	ECC85	6AQ8
ECC804	2†	6/30L2	ECC804	6GA8
ECF80	2†	ECF80	ECF80	
ECF82	2†	ECF82	ECF82	6U8
ECF805	2	6C18	ECF805	6GV7
ECH81	2†	6C12	ECH81	6AJ8
ECH84	2†	ECH84	ECH84	6JX8
ECL80	2†	ECL80	ECL80	6AB8
ECL82	2†	6PL12	ECL82	6BM8
ECL86	2	ECL86	ECL86	6GW8
EE80	2	6F28	EE80	
EF80	2†	EF80	EF80	6BX6
EF85	2†	6F26	EF85	6BY7
EF86	2†	EF86	EF86	6267
EF91	2*	6F12	EF91	6AM6
EF183	2	6F29	EF183	6EH7
EF184	2	6F30	EF184	6EJ7
EF812	2†	6F23	EF812	6EL7
EH90	2†	EH90	EH90	6CS6
EL84	2†	6P15	EL84	6BQ5
EM87	2†	EM87	EM87	6HU6
EY51	2†	EY51	EY51	6X2
EY86	2†	EY86/87	EY86	6S2
EY87	2†	EY86/87	EY87	6S2A
EZ80	2†	EZ80	EZ80	6V4
EZ81	2†	UU12	EZ81	6CA4
GY501	2†	GY501	GY501	3BH2
KY80	2†	U26	KY80	2J2
PC86	2†	PC86	PC86	4CM4
PC88	2†	PC88	PC88	4DL4
PC97	2	PC97	PC97	4FY5
PC900	2†	PC900	PC900	4HA5
PCC84	2†	30L1	PCC84	7AN7
PCC85	2†	PCC85	PCC85	9AQ8
PCC88	2†	PCC88	PCC88	7DJ8
PCC89	2†	PCC89	PCC89	7FC7
PCC189	2†	PCC189	PCC189	7ES8
PCC805	2†	30L15	PCC805	7EK7
PCC806	2†	30L17	PCC806	
PCE82	2†	30FL12	PCE82	

* Included in Abridged Data sheets.

† Maintenance type.

Index	Hand-book Vol.	Filed under Type No.	Equivalent Types Pro Electron	American
PCE800	2†	30FL1	PCE800	9GB8
PCF80	2	30C1	PCF80	9A8
PCF82	2†	PCF82	PCF82	9U8
PCF86	2†	PCF86	PCF86	8HG8
PCF87	2†	30C17	PCF87	
PCF200	2†	PCF200	PCF200	8X9
PCF800	2†	30C15	PCF800	9EN7
PCF801	2†	PCF801	PCF801	8GJ7
PCF802	2†	PCF802	PCF802	9JW8
PCF805	2	30C18	PCF805	7GV7
PCF806	2†	PCF806	PCF806	
PCF808	2	30FL14	PCF808	
PCF812	2	30FL2	PCF812	
PCH200	2†	PCH200	PCH200	9V9
PCL82	2	30PL12	PCL82	16A8
PCL83	2†	PCL83	PCL83	
PCL84	2	PCL84	PCL84	15DQ8
PCL85	2	PCL805	PCL85	18GV8
PCL86	2	PCL86	PCL86	14GW8
PCL88	2†	30PL14	PCL88	
PCL800	2†	30PL13	PCL800	16GK8
PCL801	2	30PL1	PCL801	13GC8
PCL805	2	PCL805	PCL805	
PD500	2†	PD500	PD500	9ED4
PF818	2†	30F5	PF818	7ED7
PFL200	2	PFL200	PFL200	17Y9
PL36	2	PL36	PL36	25E5
PL81	2†	PL81	PL81	21A6
PL81A	2†	PL81A	PL81A	
PL82	2†	30P16	PL82	16A5
PL83	2†	PL83	PL83	15A6
PL84	2†	30P18	PL84	15CW5
PL302	2	30P19	PL302	
PL500	2†	PL500	PL500	27GB5
PL504	2	PL504	PL504	
PL508	2†	PL508	PL508	17KW6
PL509	2†	PL509	PL509	
PL801	2†	30P12	PL801	12FB5
PL802	2†	PL802	PL802	16LD6
PY33	2†	PY33	PY33	
PY81	2	PY81	PY81	17Z3
PY82	2†	U192	PY82	19Y3
PY83	2†	PY83	PY83	
PY88	2	PY88	PY88	30AE3
PY301	2†	U191	PY301	19CS4
PY500	2†	PY500	PY500	42EC4
PY800	2	PY800	PY800	
PY801	2	U193	PY801	
U26	2†	U26	KY80	2J2
U191	2†	U191	PY301	19CS4
U192	2†	U192	PY82	19Y3
U193	2	U193	PY801	
U251	2*	U251		
U301	2*	U301	CY30	
U381	2†	U381	UY85	38A3
U404	2*	U404		
UBC81	2†	10LD13	UBC81	
UBF89	2†	10FD12	UBF89	19FL8
UCC85	2†	10L14	UCC85	
UCH81	2†	10C14	UCH81	19D8
UCL82	2†	10PL12	UCL82	50BM8
UCL83	2†	UCL83	UCL83	
UF89	2†	UF89	UF89	
UL84	2†	10P18	UL84	45B5
UU12	2†	UU12	EZ81	6CA4
UY85	2†	U381	UY85	38A3

* Included in Abridged Data sheets.
† Maintenance type.

Note: This information is supplied for the convenience of customers, but no guarantee is intended as regards the degree of equivalence of secondary parameters.

GENERAL INFORMATION

H 8.72 Printed in Great Britain

Guide Card

Nomenclature for

RADIO AND TELEVISION RECEIVING VALVES

Two type nomenclature systems are currently in use for Mazda Valves and, where applicable, both type numbers are given at the head of each sheet.
The Mazda type number is given first followed by the Pro-Electron type number, hence, types are filed according to the Mazda scheme.

MAZDA SYSTEM

SIGNAL VALVES

These have a three-symbol name comprising a number, a letter or letter sequence and a final number.

First number indicates heater or filament rating, i.e.

1	1·4 V (parallel or series)
6	6·3 V (parallel or series)
10	0·1 A (series)
20	0·2 A (series)
30	0·3 A (series)

Following letter or letter sequence indicates class of valve, i.e.

C	Frequency changer with special oscillator section
D	Signal diode(s)
F	Voltage amplifier tetrode or pentode
FD	Voltage amplifier tetrode or pentode with diode(s)
FL	Voltage amplifier tetrode or pentode with voltage amplifier triode
K	Small gas triode or tetrode
L	Voltage amplifier triode or double triode including oscillator triode
LD	Voltage amplifier triode with diode(s)
M	Tuning Indicator
P	Power amplifier valve, tetrode or pentode
PL	Power amplifier valve, tetrode or pentode with voltage amplifier triode

Final number distinguishes between different valves in the same class.

POWER RECTIFIER VALVES

These have a two-symbol name comprising one or two letters and a final number.

Letters indicate class of rectifier, i.e.

U	High vacuum half-wave
UU	High vacuum full-wave

Final numbers distinguish between different valves in the same class.

Half-wave rectifiers have the number chosen so that the number, excluding the final digit, corresponds to the approximate heater or filament voltage.

PRO-ELECTRON SYSTEM

The type nomenclature consists of two or more letters followed by a three-figure serial number. These symbols give information concerning the heater or filament rating, the principal uses of the valve and the type of base according to the following code:— ←

The first letter indicates the filament or heater rating, i.e.

Letter	*Filament or Heater Rating*	*Operation*
D	⩽1·4 V	Series or Parallel Supply
E	6·3 V	Series or Parallel Supply
G	Miscellaneous	←
H	0·15A	Series Supply
P	0·3 A	Series Supply
U	0·1 A	Series Supply
X	0·6 A	Series Supply

The following letters have formerly also been used A(4V), B(0·18A), C(0·2A), F(12·6V), K(2V), V(50mA) and Y(450mA). G was formerly exclusively used for indicating a 5V heater. ←

The second and subsequent letters indicate the construction and/or application of the valve, i.e.

A	Diode (excluding rectifier)
B	Double diode with common cathode (excluding rectifier) ←
C	Triode (excluding power output triode)
D	Power output triode
E	Tetrode (excluding power and output tetrode)
F	Pentode (excluding power output pentode)
L	Power output tetrode or power output pentode
H	Hexode or heptode (of the hexode type)
K	Octode or heptode (of the octode type)
M	Tuning indicator
Y	Half-wave rectifier
Z	Full-wave rectifier

Note: Two or three of the above letters may be combined as required and are placed in alphabetical order. ←

The first figure indicates the type of base, i.e.

1	Miscellaneous ←
2	Miniature 10 pin (JEDEC E10–61) B10B ←
3	International octal (I.E.C. 67–I–5a) ←
5	Magnoval (JEDEC E9–23) B9D and Novar (JEDEC E9–75)* ←
8	Noval (I.E.C. 67–I–12a) B9A ←
9	Miniature 7 pin (I.E.C. 67–I–10a) B7G ←

Note: The remaining first figures and the figure 5 have formerly been used for other base types, e.g. 6 and 7 for subminiature bases.

*Serial numbers for novar based valve types are from 520 upwards. ←

The remaining two figures are a serial number

Formerly one figure serial numbers have been used.

Note: The following classification is also used for tetrodes and pentodes (excluding power output types):—

Even number indicates a sharp cut-off characteristic.
Odd number indicates a variable-mu characteristic.

Indicates a change ←

GENERAL OPERATIONAL RECOMMENDATIONS

The following notes have been compiled to assist equipment designers in determining satisfactory operating conditions for the valves in their equipment. The recommendations below are based largely on the British Standard Code of Practice CP1005 : 1962 entitled "The Use of Electronic Valves", to which the user is referred for fuller information. The recommendations are necessarily of a general nature and should be interpreted accordingly. Where specific recommendations are published in the data relating to a particular valve, these should always be followed.

RATINGS

Ratings may be defined as values which establish either limiting capabilities or limiting conditions for an electron device. They are determined for specified values of environment and operation, and may be stated in any suitable terms. Limiting conditions may be either maxima or minima.

Ratings cannot be considered as barriers on one side of which satisfactory operation is obtained, while on the other side immediate failure will occur. The expectation of life decreases continuously as the maximum ratings are approached, particularly with respect to bulb temperature. Exceeding the rating accelerates this decline. With a few exceptions the more conservative the use of the valve with respect to limiting ratings, the greater is the life expectancy and reliability.

Unless otherwise stated, ratings given are in accordance with the design centre rating system. The absolute maximum rating system may be used in certain circumstances.

DESIGN CENTRE RATINGS

Design centre ratings are limiting values of operating and environmental conditions applicable to a bogey electron device of a specified type as defined by its published data, which should not be exceeded under normal conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device in average applications, taking responsibility for the effect of normal changes in operating condition due to rated supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of all electron devices in the equipment.

The equipment manufacturer should design so that initially no design-centre value for the intended service is exceeded with a bogey electron device in equipment operating at the stated normal supply voltage.

N.B.—A bogey electron device is an electron device whose characteristics have the published nominal values for the type. A bogey electron device for any particular application can be obtained by considering only those characteristics which are directly related to the application.

ABSOLUTE MAXIMUM RATINGS

Absolute maximum ratings are limiting values of operating and environmental conditions applicable to any electron device of a specified type as defined by its published data, which should not be exceeded under the worst probable conditions.

The device manufacturer chooses these values to provide acceptable serviceability of the device, taking no responsibility for the effect of equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the device under consideration and of all other electron devices in the equipment.

The equipment manufacturers should design so that initially and throughout life no absolute-maximum value for the intended service is exceeded with any device under the worst probable operating condition of supply voltage variation, equipment component variation, equipment control adjustment, load variations, signal variation, environmental conditions, and variations in characteristics of the device under consideration and of all other electron devices in the equipment.

HEATER AND FILAMENT SUPPLIES

Valves are designed to operate with a specified heater or filament voltage or current, and will give optimum life and performance when operated under the specified conditions. Deliberate over- or under-running of heaters or filaments to obtain apparently desirable characteristics is to be deprecated.

Valves operated in parallel from a transformer will give satisfactory operation if the voltages on the heaters or filaments are within $\pm$ 5 per cent of the rated value when the mains supply voltage is at its declared value, provided that the mains voltage does not deviate from this value by more than $\pm$ 10 per cent.

In the case of valve heaters connected in series with a controlling resistance, the current should be within $\pm$ 2½ per cent of the rated value at the declared mains supply voltage, and with valves having nominal heater voltage drop, provided that the mains voltage does not vary by more than $\pm$ 10 per cent from its nominal value.

Car radio valves are designed to give satisfactory performance over the range of voltages encountered in operation from a battery of lead-acid cells connected to a charger. The normal range of variation is from 1·8 to 2·5 volts per cell, with short-term fluctuations up to 2·7 volts per cell.

1·4 volt battery valves are designed for a mean voltage of 1·3 volts, which is the approximate mean voltage of a dry cell over its useful life. These valves will operate satisfactorily over the range 1·1 to 1·5 volts. If they are operated with their filaments connected in series, the anode and screen currents will return to the negative HT terminal through the filament chain, and in general the current in each filament will be different unless the appropriate filaments are shunted by a suitable resistor to by-pass the additional current. It is recommended that this practice be followed to equalise the voltage drops across the filaments.

Where variations of heater or filament supplies outside the recommended limits cannot be avoided, it will usually be necessary to apply reduced ratings to the valves.

HEATER TO CATHODE INSULATION

An unnecessarily high voltage between the heater and cathode should always be avoided.

The maximum value of heater to cathode voltage is normally quoted on individual data sheets and applies to that side of the heater where the heater to cathode voltage is greater.

The insulation resistance between heater and cathode should not be included in R.F. circuits where frequency stability or preservation of waveform is important or in A.F. circuits followed by high gain.

Transformer windings supplying heaters should not be left "floating". Where no D.C. connection between the winding and the cathode exists, a resistor of the order of 100 kΩ should be connected between the heater and the cathode.

A valve should not be rendered inoperative by opening the cathode circuit unless there is a resistor not exceeding 250 kΩ connected between heater and cathode.

CATHODE CIRCUIT

Valves should not be operated without a D.C. connection between cathode and each electrode.

Valves should not run for long periods with the cathode hot, but with no cathode emission, unless it is specified in the data that the valve is suitable for this class of service.

CONTROL-GRID CIRCUIT

The resistance between the control grid and cathode should be kept as low as possible, and published data should be consulted for limiting values. For most small receiving valves, unless otherwise specified, the resistance should not exceed 1 MΩ with auto-bias, and 0·5 MΩ with fixed bias. Certain types of small receiving valves, such as some R.F. amplifiers, may employ values up to 3·5 MΩ with auto-bias. In general the value used with receiving valves having anode dissipation in excess of 10 watts should not be greater than 0·5 MΩ with auto-bias, and 0·1 MΩ with fixed bias, unless otherwise specified. If the resistance is common to more than one control grid circuit its value should be reduced proportionately.

Valves should not be used in applications which result in appreciable grid current unless such conditions are specified in the published data.

When valves are operated at low values of grid bias, grid current will flow, damping the input circuit, unless the bias exceeds the contact potential, which will vary somewhat with individual samples and with life.

It is undesirable that grid bias should be provided solely by grid rectification, unless the circuit is designed so as to prevent damage to the valve in the event of loss of drive.

Valves having very high values of mutual conductance are sensitive to small variations of grid bias and auto-bias should be used in preference to fixed bias. The stability of D.C. operating conditions may be increased by using a positive bias on the grid, in conjunction with a suitably increased value of cathode bias resistor.

SCREEN-GRID CIRCUIT

The source resistance of the screen voltage supply should be kept as low as practicable, and for most applications a potential divider network, or other voltage source having good regulation, is preferred to a series resistor. This is particularly applicable to pentodes having aligned grids, and to unaligned tetrodes, where the screen current is subject to relatively wide variation with operating conditions and between individual valves. In the case of pentodes with unaligned grids the variation is smaller, and series resistors may be used.

Where variable grid bias is applied to control gain the use of a high impedance supply to the screen will result in the lengthening of the grid base.

At low anode voltages the screen current tends to increase greatly, and care is required to avoid exceeding the screen dissipation. The anode voltage should not be removed while the screen is energised.

SUPPRESSOR-GRID CIRCUIT

The suppressor grid should normally be connected to the cathode, although in certain applications connection to the negative end of the cathode bias resistor or to the A.G.C. line is permissible. If negative bias is applied to the suppressor, care is required to ensure that the screen dissipation is not exceeded. Unless the published data includes suppressor grid characteristics it is unwise to place any reliance on the uniformity of this parameter. Resistance in series with the suppressor grid should be avoided, unless conditions involving the use of such resistance are specified in the published data.

Valves should not be operated in conditions which result in appreciable suppressor grid current, unless such operation is indicated in the published data. Where pentodes are connected as triodes the suppressor grid should be connected to the cathode, unless otherwise specified.

MOUNTING AND VENTILATION

The mounting position of most modern indirectly heated valves is unrestricted but it is preferable that valves should be mounted vertically, with base downwards. If directly heated types are mounted horizontally, the plane of the filament should be vertical. Similarly for certain indirectly heated valves having a high mutual conductance, when mounted horizontally the plane of the major axis of the control grid should be vertical. If valves are to be subjected to continuous vibration means should be employed to damp out such vibration by the use of a cushioned valveholder mounting. Due attention should be paid to the effect of the mounting position on ventilation and cooling.

Care should be taken to avoid damaging the pins of glass based valves. If bending has occurred, the pins should be straightened in a pin-straightener before the valve is inserted in a socket. The connecting wires to valveholders having floating contacts should be as flexible as possible, and wiring jigs should be employed while the connections are being made.

Where valves are used with printed circuits the design of the sockets should be such as to ensure that after assembly the insertion and withdrawal forces are within the limits encountered with normal chassis mounting sockets. These limits are defined in British Standard BS448.

The use of spare socket contacts as wiring supports is not recommended, and on no account should any connection be made to pins marked I.C.

Flying lead valves are usually secured in position by the envelope. Any clamps used for this purpose should be of high thermal capacity and conductivity and should make intimate contact with the envelope over as large an area as possible. Well-designed clamps of this type may substantially improve the cooling of the valve with consequent increase of life expectancy and reliability. The leads of valves of this type should not be bent sharply close to the glass, and care is required in making soldered connections to avoid overheating the seals. In the case of miniature and sub-miniature types, the wire should not be soldered closer than 3 mm to the glass, and a thermal shunt between the point of soldering and the glass seal should be employed during the operation.

The presence of strong electromagnetic or electrostatic fields is liable to affect the performance of valves, which should be positioned or screened so as to avoid such effects.

Ventilation and layout of equipment should be such as to ensure a safe bulb temperature under all conditions. Unless otherwise specified the maximum temperature of the hottest part of the bulb under operating conditions should not exceed by more than 20°C the temperature which would be obtained if the valve were operated at its maximum rating in conditions of free air circulation at an ambient temperature of 20°C.

To allow free radiation of heat from a valve, surrounding surfaces should not be polished and should be as cool as possible. The inner and outer surfaces of screening cans should be matt blackened, and adequate ventilation holes should be provided at the top and bottom.

The use of screening cans which are not in thermal contact with the envelope may seriously interfere with the cooling of the valve, and the use of screening cans of high thermal capacity and conductivity in intimate thermal contact with the envelope is to be preferred, particularly with valves which tend to approach the limiting bulb temperature. The thermal capacity of screening cans is usually increased by the use of the chassis as a "heat sink", and careful consideration must be given to the question of cooling where no metallic chassis exists, as in the case of equipment using printed circuits.

Valves should not be mounted adjacent to components running at very high temperatures.

MICROPHONY

Small variations of electrode spacing cause corresponding variations in the output of the valve, and it is necessary to ensure that little or no vibration reaches the valve. Such vibrations may reach the valve by way of the valve socket, and it should be remembered that microphonic trouble may originate in the frequency changer or I.F. stages through audio microphonic modulation of signal or I.F. carrier.

In addition it is recommended that:

(*a*) The position of the valve in relation to the source of vibration should be so chosen that microphony effects will be at a minimum.

(*b*) The chassis should not be rigidly fixed to the cabinet containing the loudspeaker but should be mounted on rubber bushes. Alternatively the loudspeaker may be mechanically insulated from the chassis with rubber bushes.

(*c*) If trouble is experienced it may be reduced by the use of sprung holders for the valves which are followed by the largest degree of amplification.

HUM

For a minimum hum level in high gain amplifiers the earth connection to the heaters should be connected to the centre tap on the heater winding.

A small leakage current between the heater and cathode will set up a voltage across the cathode bias resistor which will feed a hum voltage into the grid circuit. If the heater is made positive with respect to the cathode this form of hum may be substantially reduced.

CROSS COUPLING

A certain amount of cross coupling may exist between the sections of multi-unit valves, and it should not be assumed that such valves will give satisfactory performance in applications other than those specified, even if the characteristics of the individual units are satisfactory for the proposed application.

NOTES ON CROSS-MODULATION CURVES

Introduction

Cross-modulation in a receiver is defined as: The modulating of a wanted signal by the modulation of an unwanted signal on a different carrier frequency, arising from the interaction of the radio frequency signals in non-linear circuits of the receiver preceding the detector.

Cross-modulation information is given in this handbook for valve types which are designed for A.G.C. operation.

Method of Measurement

Two signals are applied in series to the signal grid of the valve under test. One is the wanted signal, of amplitude V_w and frequency f_w, and the other is the unwanted, or interfering, signal, of amplitude V_u and frequency f_u sufficiently far removed from f_w to prevent any spurious responses at the frequency f_w (or the I.F. in the case of frequency-changers).

The valve under test is followed by an H.F. amplifier tunable to f_w (or the I.F.), then by a detector, and finally by an L.F. amplifier and L.F. a.c. voltmeter. The gain of the amplifiers is variable. The L.F. may also be reduced by a resistance attenuator.

(i) The wanted signal is modulated to a depth of m per cent and the gain of the following amplifiers adjusted to give an L.F. output voltage V, with an n : 1 attenuator in circuit.

Let amplification of valve under test + following stages (excluding attenuator)* = A.

$$\text{L.F. output } V = \frac{m\ V_w\ A}{100\ n}$$

(ii) Modulation to a depth of m per cent is now transferred from the wanted to the unwanted signal, and the n : 1 attenuator is removed while the gain A is kept constant. Unwanted signal level V_u is adjusted to give the same value of V as in (i), resulting in the wanted signal at the output of the valve under test being modulated to a depth of m_u per cent.

$$\text{Hence } V = \frac{m_u\ V_w\ A}{100}$$

$$\text{and since } V = \frac{m\ V_w\ A}{100\ n}$$

$$\text{then } \frac{m_u}{m} = \frac{1}{n} = K$$

K is known as the Cross-Modulation Factor.

Normally K = 0·01 (i.e. 1 per cent) is taken as the accepted tolerance level for cross-modulation and the handbook curves are drawn on this basis. In general, measurements are made with a wanted signal V_w = 0·1 V R.M.S. and modulation m = 30 per cent.

* "A" will be the product of the H.F. and L.F. amplifications and rectification efficiency.

NOTES ON POWER OUTPUT AND DISTORTION CURVES

Introduction

It is generally agreed that the distortion heard when listening to a sound reproducing system is due to spurious tones produced by intermodulation between two or more frequencies of the original sound, rather than harmonics of those frequencies. The intermodulation takes place at some point in the system where the input/output characteristic is non-linear.

If the system includes devices for which the non-linearity of the input/output characteristic varies with frequency, it is preferable to measure the non-linearity in terms of intermodulation products.

If, however, the characteristic of the device under consideration is independent of frequency over the audio range, the non-linearity may be described in terms of harmonic responses produced when a pure sine wave input is applied. Under these conditions, knowing the harmonic responses, it would be possible to calculate the intermodulation products, and vice versa.

Thermionic valves are devices which come into this category, and it is usual to measure their characteristics for non-linearity in terms of percentages of the harmonics produced.

The even harmonics describe the asymmetry of the device characteristic about its working point. The odd harmonics describe the non-linearity which would remain if the asymmetry were removed. In general, the minimum requirement would be to state the maximum percentage 2nd and 3rd harmonic produced over the power range.

Measurement and Presentation of Power Output and Distortion Data

Power output and distortion curves are plotted against anode load resistance for various values of grid input swing.

Unless otherwise stated, these curves are taken with fixed D.C. supply voltages the load resistance being by-passed to D.C. by means of a low resistance high inductance choke, so that the stated voltage is maintained at the anode. The bias arrangement, which is always stated, can be fixed control grid voltage or cathode self bias.

To facilitate selection of the best operating conditions, harmonic distortion contour lines for both 5 per cent and 7 per cent of 2nd and 3rd harmonic are inserted. These contours pass through the points on the power curves where constant percentages of harmonic distortion are encountered.

In order not to exceed the stated percentage harmonic, the grid input swing and anode load resistance must be so adjusted or controlled that the operating point remains within the boundaries of the appropriate harmonic contours.

Design Considerations

The amount of distortion which may be tolerated depends to some extent on the class of equipment which is being considered. For example, it would be uneconomic to design a battery portable to give, over its range of output power, the low level of distortion that would be expected from an expensive high fidelity mains equipment.

The average domestic mains receiver or television set employs a single tetrode or pentode output valve, and listening tests have shown that, from receivers of this class, the audible distortion produced on peaks is not excessive if the non-linearity of the characteristic is such that the measured 3rd harmonic does not exceed 5 per cent to 7 per cent at

maximum input swing. Generally speaking, for a given degree of audible distortion at a particular sound level, the asymmetry of the characteristic may be such that the measured 2nd harmonic is about twice the 3rd harmonic. However, for the single tetrode output stage, the shape of the harmonic versus power output characteristic is such that, whereas the percentage 3rd harmonic remains low over much of the power range and then rises steeply, the percentage 2nd harmonic remains fairly constant over much of the power range and may even fall before the peak power is reached. Since the percentage 2nd harmonic may remain near its maximum value at power levels well below the maximum, it is usual to adopt the same numerical value for percentage 2nd and percentage 3rd harmonic (not twice as much 2nd as 3rd) when selecting the load resistance and specifying the maximum power output.

The handbook curves show the power output which would be delivered into a resistive load connected across the primary of the output transformer (assumed loss-less). In practice, the loudspeaker load becomes reactive at the higher audio frequencies and the impedance rises. This can be largely compensated by the addition of a suitable series resistance capacitance circuit across the transformer primary. At the lower frequencies, the impedance again rises, up to the frequency of electro-mechanical resonance. Some compensation can be provided by a suitable choice of transformer primary inductance; but a more satisfactory method is to apply a suitable degree of negative feed-back taken from the high potential side of the speech coil.

It should be remembered that measurements made under fixed g_1 bias conditions may, for the same distortion, give 10 per cent to 15 per cent higher power than with cathode bias. In the latter case due to the cathode current increase with signal, the valve is biased further back, with consequent increase of 2nd harmonic distortion.

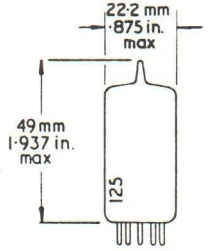
VALVES

CURRENT VALVES

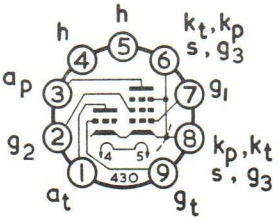
Current types recommended for inclusion in new equipment

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Guide Card



V.H.F. TRIODE PENTODE



†B9A Base

GENERAL

This triode and variable mu pentode valve combination, with the pentode of frame grid construction, is for use in television tuners. It is primarily intended to be used as a variable gain V.H.F. frequency changer with the triode as local oscillator but the pentode is also designed for use as a high gain controlled I.F. amplifier following a U.H.F. tuner.

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·35	A

RATINGS

		Pentode	Triode	
Maximum Anode Dissipation	$P_{a(max)}$	2	2	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	0·5	—	W
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	230	—	V
Maximum Heater to Cathode Voltage (D.C.)	$V_{h-k(max)}$	150	150	V
Maximum Cathode Current	$I_{k(max)}$	18	15	mA
Maximum Grid to Cathode Resistance (Fixed Bias)	$R_{g1-k(max)}$	250	500	kΩ

INTER-ELECTRODE CAPACITANCES

		*	‡	△	
Grid 1 to all	c_{g1-all}	6·7	7·1	8·2	pF
Anode Pentode to all	c_{ap-all}	2·7	3·1	4·2	pF
Grid 1 to Anode Pentode	c_{g1-ap}	·007	·008	·009	pF
Anode Triode to Earth	c_{at-E}	2·2	2·5	3·5	pF
Grid Triode to Earth	c_{gt-E}	2·4	2·7	3·7	pF
Anode Pentode to Grid Triode	c_{ap-gt}	·001	·003	·005	pF
Grid Triode to Anode Triode	c_{gt-at}	2·0	2·05	2·1	pF
Anode Pentode to Anode Triode	c_{ap-at}	·014	·027	·046	pF
Grid 1 to Grid Triode	c_{g1-gt}	·008	·018	·037	pF
Grid 1 to Anode Triode	c_{g1-at}	·002	·004	·006	pF

* In fully-shielded socket with can (I.E.C. Publication 100).
‡ With holder capacitance balanced out but with can. (Holder as below).
△ Total capacitance including B9A ceramic holder with skirt and screening can (Plessey holder type CP180024/3).
"Earth" denotes the electrodes of the other section and the remaining earthy potential electrodes of the section under measurement, heater and shields joined to cathode.

CHARACTERISTICS

		Pentode	Triode	
Anode Voltage	V_a	125	100	V
Screen Grid Voltage	V_{g2}	125	—	V
Control Grid Voltage	V_{g1}	−1·5	−3	V
Anode Current	I_a	10	14	mA
Screen Grid Current	I_{g2}	3·1	—	mA
Mutual Conductance	g_m	11	5·5	mA/V
Amplification Factor	μ	—	17	
Inner Amplification Factor	μ_{g1-g2}	50	—	

† Shield completely surrounds pentode.
Basing arranged to minimise pentode cathode lead inductance effects with the shorter lead to pin 8.

THORN RADIO VALVES AND TUBES LTD.

TYPICAL OPERATION AS FREQUENCY CHANGER AND I.F. AMPLIFIER

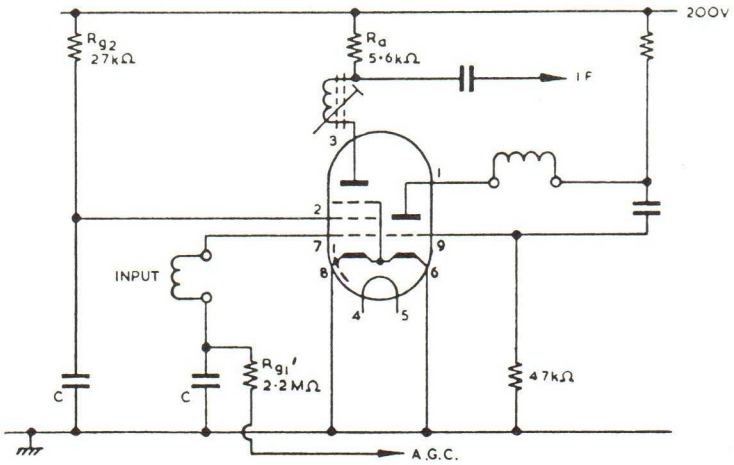
Grid current bias operation with A.G.C. Oscillator voltage injected into grid 1.

Pentode		F.C.	I.F.*	
Frequency	f	200	36	Mc/s
Supply Voltage	V_b	200	200	V
Anode Voltage (Decoupling Resistance, R_a=5·6kΩ) (approx)	V_a	155	125	V
Screen Grid Voltage (R_{g2}=27kΩ) (approx)	V_{g2}	135	92	V
Current through Grid 1 resistance $R_{g1'}$ ($R_{g1'}$=2·2MΩ)	I_{g1}	1·3	0·3	μA
Anode Current (approx)	I_a	7·8	13·2	mA
Screen Grid Current (approx)	I_{g2}	2·4	4·0	mA
D.C. Voltage on Pentode Control Grid at maximum gain		−3·0	—	V
Conversion Conductance at 1 Mc/s (V_b,R_a,R_{g1},R_{g2} as above)	g_c	4·7	—	mA/V
Grid Voltage for Conversion Conductance reduction 10 : 1	$V_{g1(gc/10)}$	−6·8	—	V
Mutual Conductance (V_b,R_a,R_{g1},R_{g2} as above)	g_m	—	15·2	mA/V
Grid Voltage for Mutual Conductance reduction 10 : 1	$V_{g1(gm/10)}$	—	−5·0	V
Grid Voltage for Mutual Conductance reduction 100 : 1	$V_{g1(gm/100)}$	—	−6·8	V
Valve Input Resistance (Anode short circuited)	r_{g1}	—	9	kΩ
Working Input Capacitance	$c_{in(w)}$	—	11†	pF
Change in Input Capacitance by biasing valve to cut-off	$\triangle c_{in(w)}$	—	2·8	pF

Triode			
Anode Voltage	V_a	77	V
Anode Current	I_a	7·8	mA
Rectified Grid Voltage (Grid Resistance=47kΩ)	Vg	6·5	V

* Supply voltage removed from triode.

† With holder capacitance balanced out but with can.



C = DECOUPLING CAPACITORS

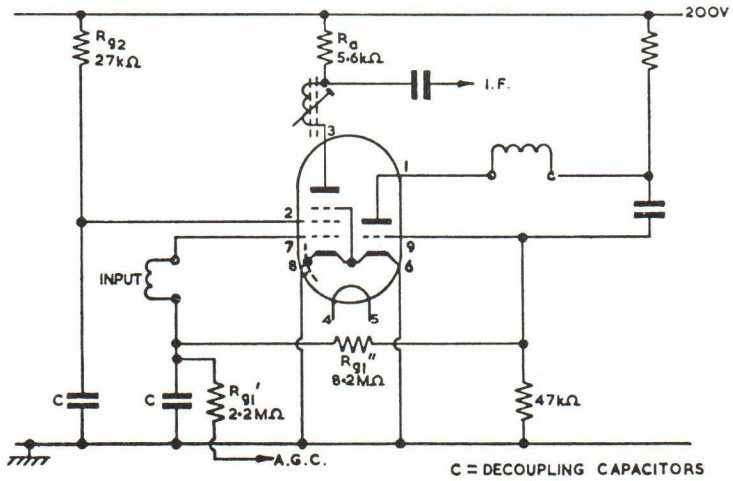
TYPICAL OPERATION AS FREQUENCY CHANGER AND I.F. AMPLIFIER

Partial grid current bias can be used for the frequency changer operation when a rectified voltage of greater than 8V d.c. is available from the triode grid resistor. This reduces the delay in the initial $V_{a.g.c.}/g_c$ characteristic. The heterodyne voltage is injected into grid 1.

Pentode		F.C.	I.F.*	
Frequency	f	200	36	Mc/s
Supply Voltage	V_b	200	200	V
Anode Voltage (Decoupling Resistance, R_a=5·6kΩ) approx	V_a	160	125	V
Screen Grid Voltage (R_{g2}=27kΩ) approx	V_{g2}	140	92	V
Current through resistance $R_{g1'}$ ($R_{g1'}$=2·2MΩ)		1·6	0·3	μA
Resistance to provide Bias from Triode Grid	$R_{g1''}$	8·2	8·2	MΩ
Anode Current (approx)	I_a	7·0	13·2	mA
Screen Grid Current (approx)	I_{g2}	2·2	4·0	mA
D.C. Voltage on Pentode Control Grid at maximum gain		−3·5	—	V
Conversion Conductance at 1 Mc/s (V_b,R_a,R_{g1},R_{g2} as above)	g_c	4·7	—	mA/V
Grid Voltage for Conversion Conductance reduction 10 : 1	$V_{g1(gc/10)}$	−5·8	—	V
Mutual Conductance (V_b,R_a,R_{g1},R_{g2} as above)	g_m	—	15·2	mA/V
Grid Voltage for Mutual Conductance reduction 10 : 1	$V_{g1(gm/10)}$	—	−6·2	V
Grid Voltage for Mutual Conductance reduction 100 : 1	$V_{g1(gm/100)}$	—	−8·5	V
Valve Input Resistance (Anode short circuited)	r_{g1}	—	9	kΩ
Working Input Capacitance	$c_{in(w)}$	—	11†	pF
Change in Input Capacitance by biasing valve to cut-off	$\triangle c_{in(w)}$	—	2·8	pF
Triode				
Anode Voltage	V_a	110		V
Anode Current	I_a	10·5		mA
Rectified Grid Voltage (Grid Resistance=47kΩ)	V_g	11		V

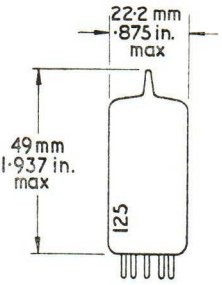
* Supply voltage removed from triode.

† With holder capacitance balanced out but with can.

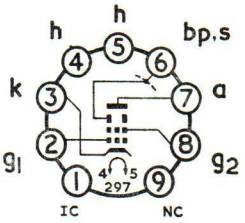


MOUNTING POSITION—Unrestricted

The characteristic curves for the 6C18 ECF805 are identical to those given for 30C18 PCF805.



HIGH SLOPE BEAM TETRODE



B9A Base

GENERAL

This valve is a high slope beam tetrode intended for use in the video output stages of A.C. or A.C./D.C. mains television receivers. The characteristics are identical to those of the tetrode section of the 30FL12.

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·3	A

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	2·5	W
Maximum Screen Grid Dissipation	$P_{g_2(max)}$	1·3	W
Maximum Anode Voltage	$V_{a(max)}$	250	V
Maximum Screen Grid Voltage	$V_{g_2(max)}$	250	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h\text{-}k(r.m.s.)max}$	150*	V

* Measured with respect to the higher potential heater pin.

INTER-ELECTRODE CAPACITANCES

		†	‡	§	
Grid 1 to Earth	c_{in}	8·1	8·5	9·6	pF
Anode to Earth	c_{out}	2·6	2·9	4·0	pF
Grid 1 to Anode	$c_{g_1\text{-}a}$	0·03	0·034	0·036	pF

† In fully shielded socket without can.
‡ With holder capacitance balanced out. (Holder as below.)
§ Total capacitance including B9A nylon phenolic holder without skirt or radial shield. (AEI holder type VH19/902.)
"Earth" denotes the remaining earthy potential electrodes, heater and shields joined to cathode.

CHARACTERISTICS

Anode Voltage	V_a	180	V
Screen Grid Voltage	V_{g_2}	180	V
Anode Current	I_a	10	mA
Mutual Conductance	g_m	12·5	mA/V

TYPICAL OPERATION—Video Amplifier

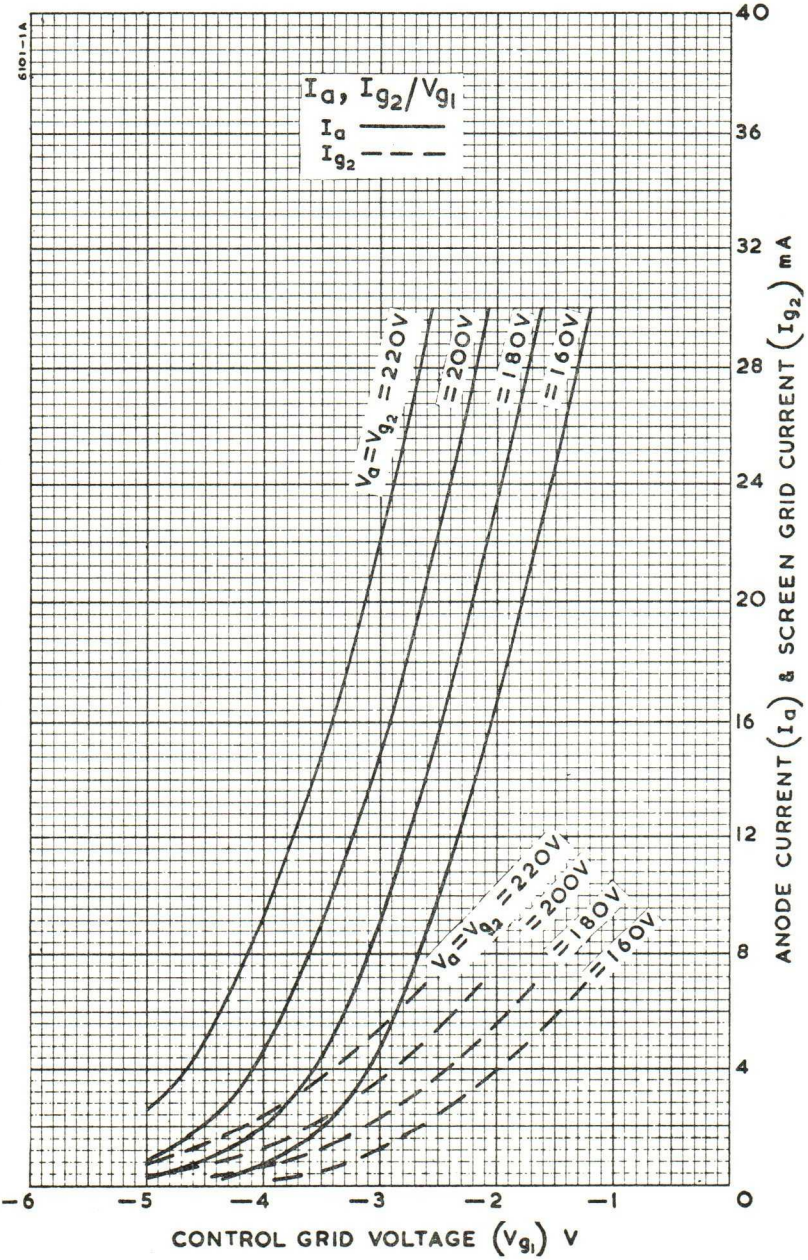
The stage should be designed to allow for valve spread and deterioration during life in addition to component variations. Values of peak anode current available for a new average valve and at the assumed end of life point for any valve are as follows:

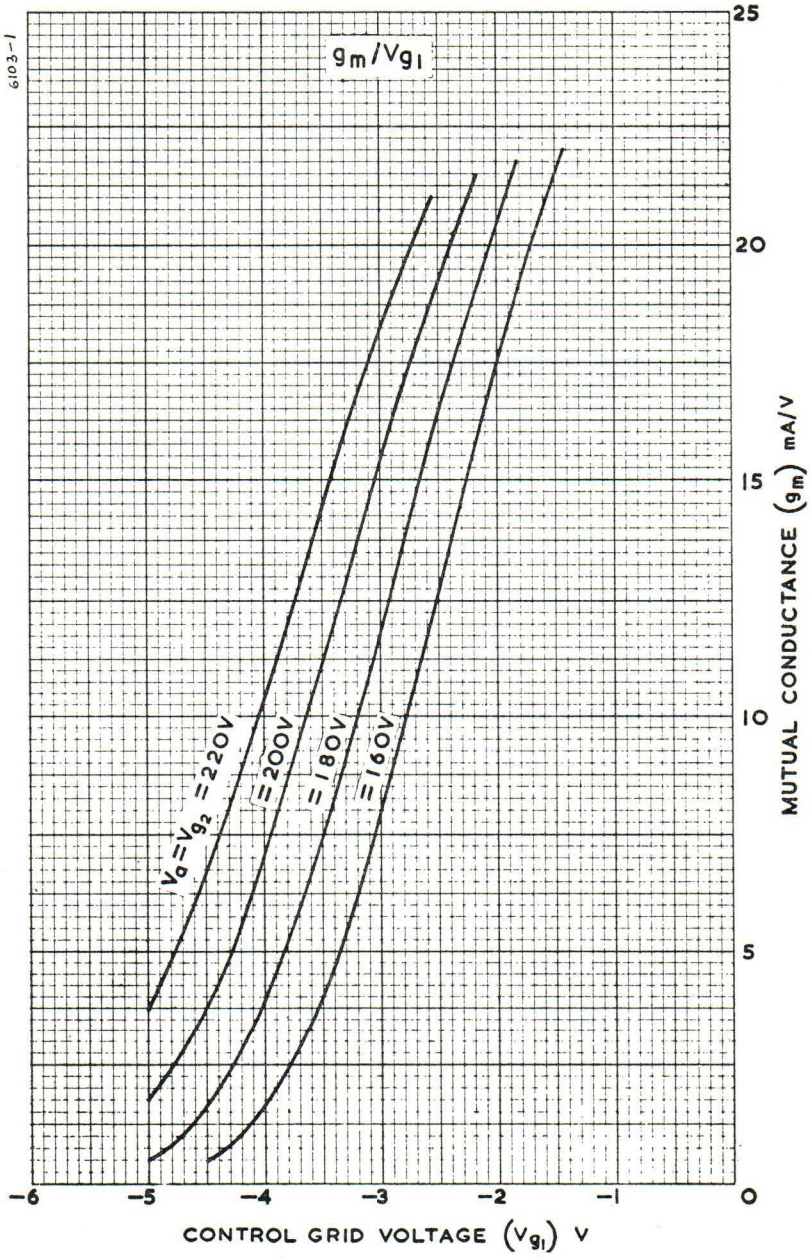
		ϕ	‖	
Anode Voltage	V_a	70	60	V
Screen Grid Voltage	V_{g_2}	180	180	V
Grid Bias Voltage	V_{g_1}	−1	−1	V
Anode Current	I_a	40	25	mA

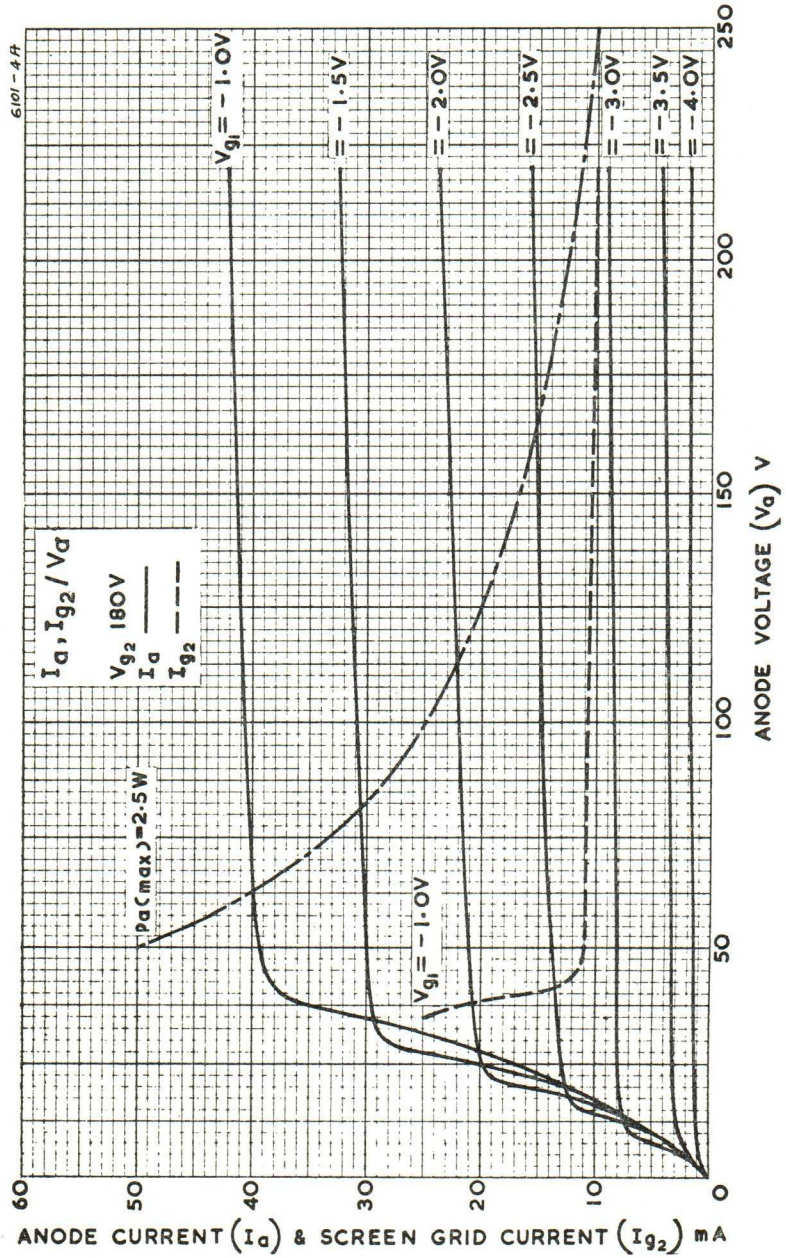
ϕ Average New Valve.
‖ Assumed End of Life Condition.

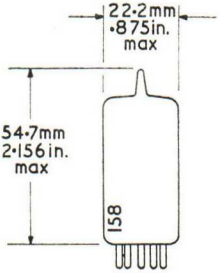
MOUNTING POSITION—Unrestricted

THORN—A E I RADIO VALVES & TUBES LTD.

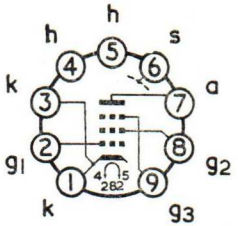

6101-1A
Ia, Ig2/Vg1
Ia
Ig2
Va=Vg2 =220V
=200V
=180V
=160V
Va=Vg2 =220V
=200V
=180V
=160V
40
36
32
28
24
20
16
12
8
4
0
ANODE CURRENT (Ia) & SCREEN GRID CURRENT (Ig2) mA
−6
−5
−4
−3
−2
−1
CONTROL GRID VOLTAGE (Vg1) V


6103-1
g_m/V_{g1}
$V_a=V_{g2}=220V$
$=200V$
$=180V$
$=160V$
25
20
15
10
5
0
MUTUAL CONDUCTANCE (g_m) mA/V
−6
−5
−4
−3
−2
−1
CONTROL GRID VOLTAGE (V_{g1}) V


6101-4A
$I_a, I_{g_2} / V_a$
V_{g_2} 180V
I_a
I_{g_2}
$V_{g_1} = -1.0V$
$= -1.5V$
$= -2.0V$
$= -2.5V$
$= -3.0V$
$= -3.5V$
$= -4.0V$
$P_{a(max)} = 2.5W$
$V_{g_1} = -1.0V$
ANODE VOLTAGE (V_a) V
250
200
150
100
50
0
60
50
40
30
20
10
0
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA



VARIABLE-MU R.F. PENTODE



B9A Base

GENERAL

This valve is a variable-mu frame grid R.F. pentode for use as an A.G.C. controlled, high gain I.F. amplifier in A.C. or A.C./D.C. television receivers.

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·3	A

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	2·5	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	0·65	W
Maximum Anode Voltage	$V_{a(max)}$	250	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	250	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h\text{-}k(r.m.s.)max}$	150	V
Maximum Control Grid to Cathode Resistance	$R_{g1\text{-}k(max)}$	1	MΩ

INTER-ELECTRODE CAPACITANCES

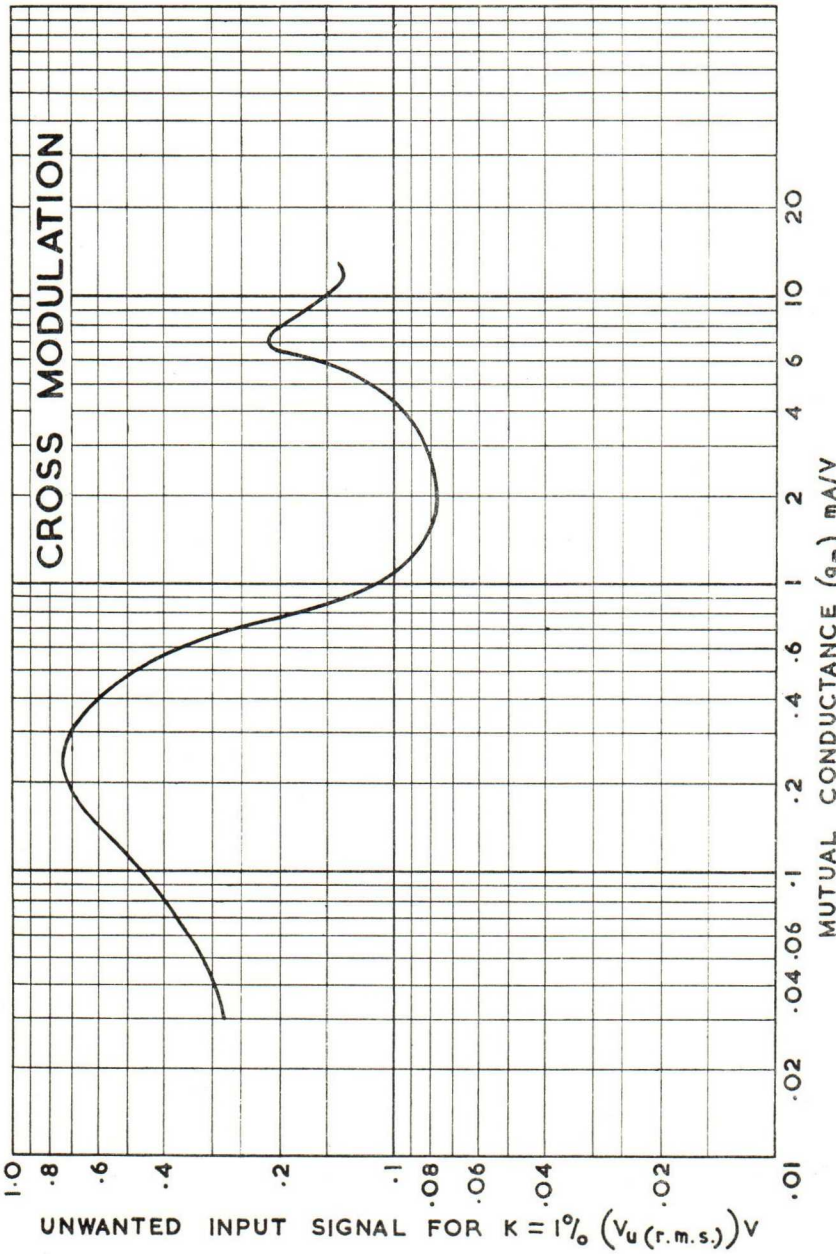
		*	†	‡	
Input	c_{in}	9·5	9·9	11·0	pF
Output	c_{out}	3·0	3·4	3·5	pF
Grid 1 to Anode	$c_{g1\text{-}a}$	<0·0055	<0·0065	<0·0075	pF
Grid 1 to Grid 2	$c_{g1\text{-}g2}$	2·8	2·8	2·8	pF

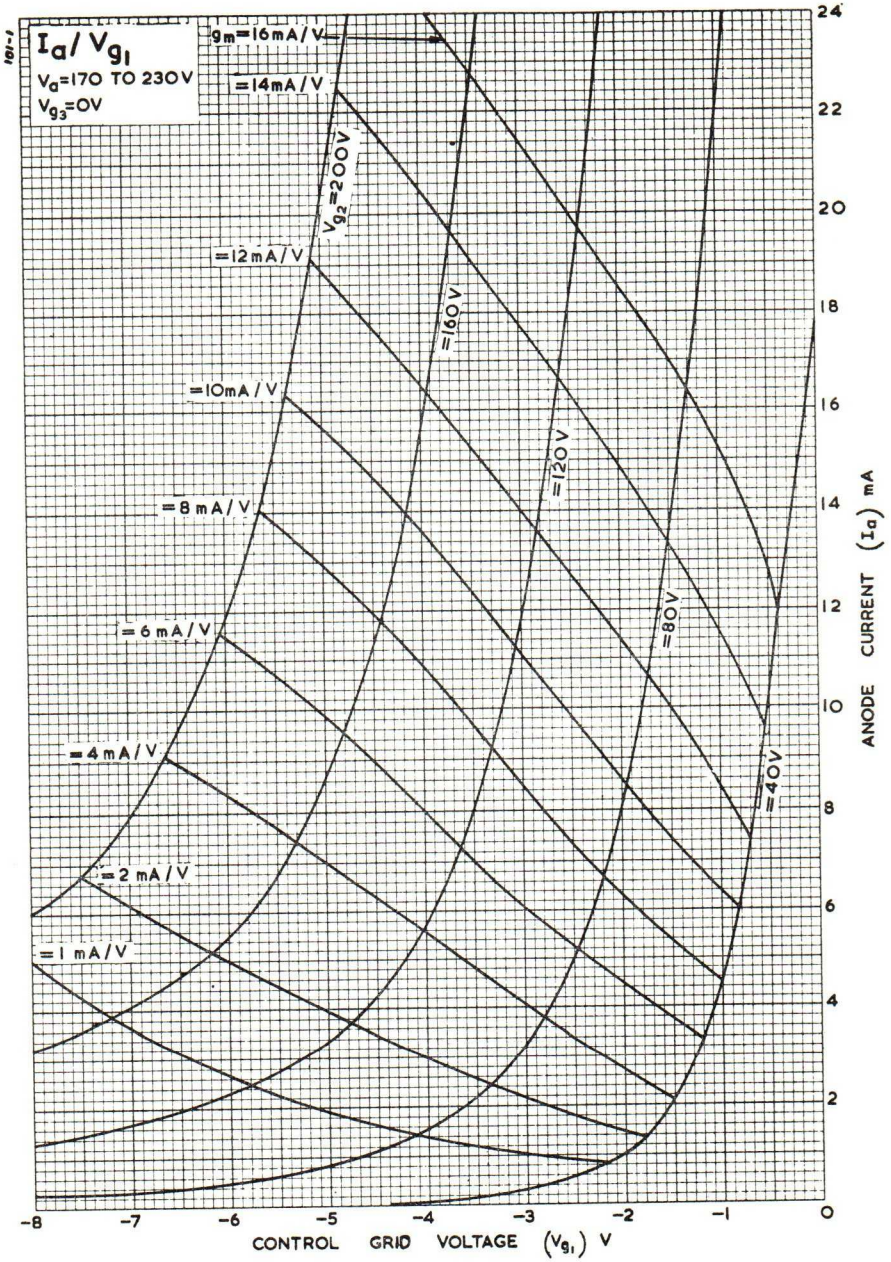
* In fully shielded socket without can.
† With holder capacitance balanced out. (Holder as below.)
‡ Total capacitance including B9A ceramic holder without skirt or radial shield. (Plessey holder type CP180900/1.)

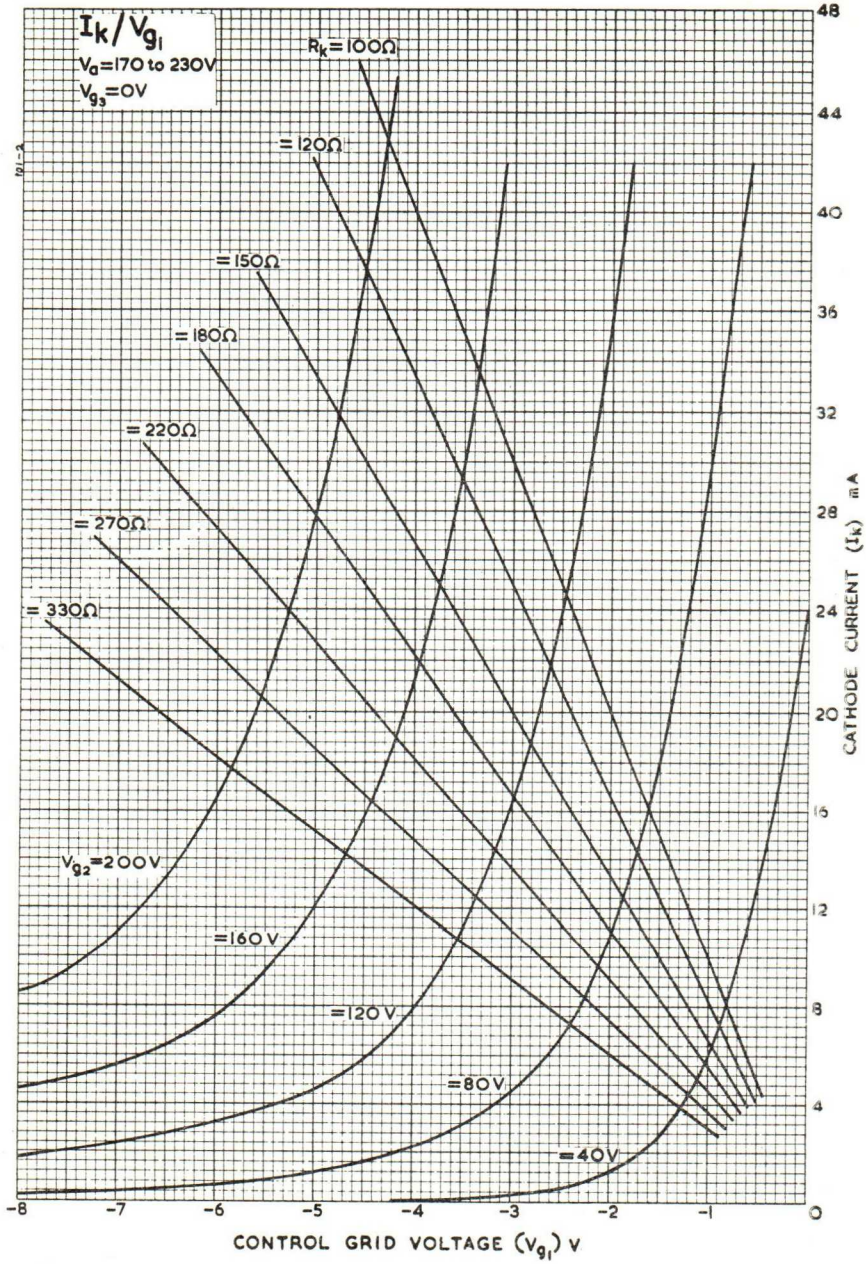
CHARACTERISTICS AND TYPICAL OPERATION

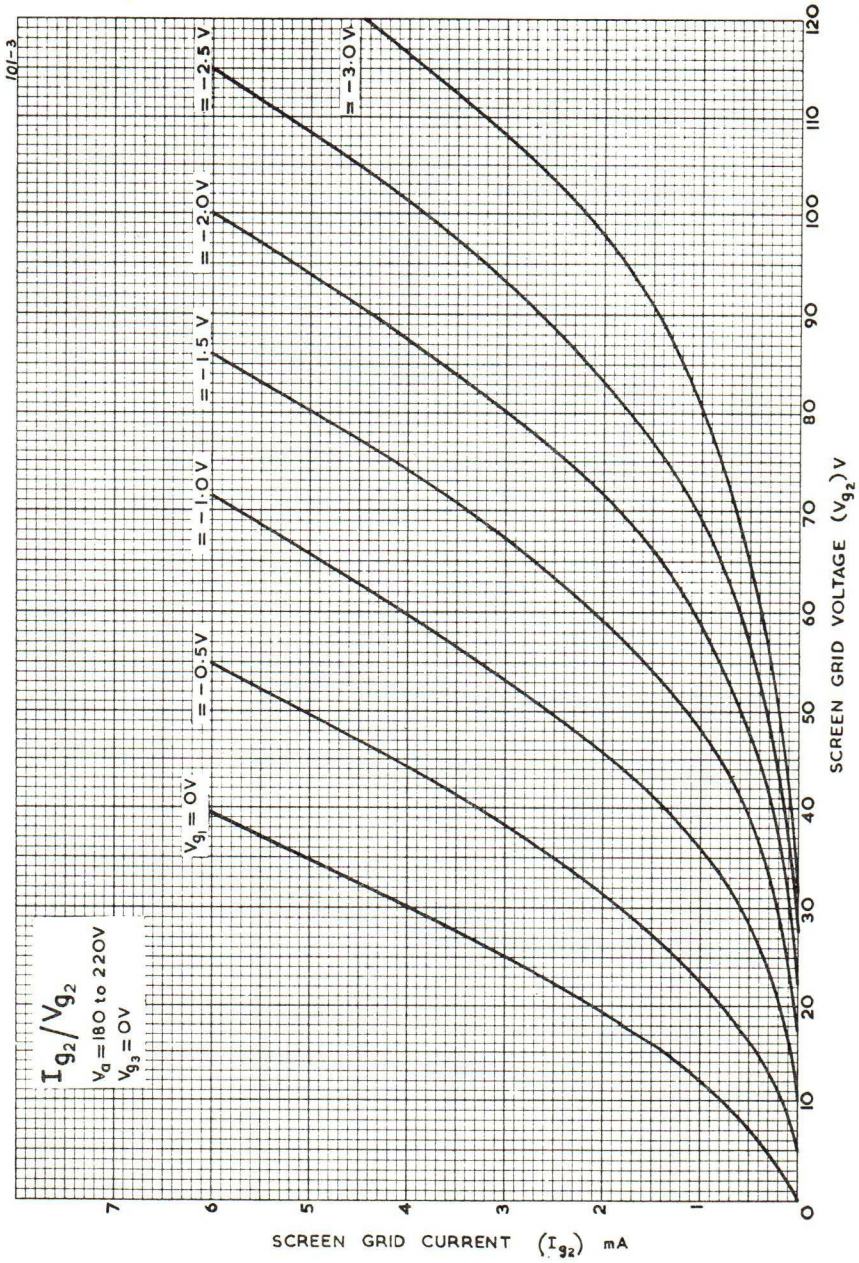
Supply Voltage	V_b	—	—	—	200	V
Anode Voltage	V_a	170	200	230	188	V
Screen Grid Voltage	V_{g2}	90	90	90	92	V
Screen Grid Resistance	R_{g2}	—	—	—	24	kΩ
Self Bias Resistance	R_k	—	—	—	120	Ω
Grid Bias Voltage	V_{g1}	−1·8	−2·0	−2·1	—	V
Anode Current	I_a	14	12	10·5	12	mA
Screen Grid Current	I_{g2}	5·3	4·5	3·6	4·5	mA
Mutual Conductance	g_m	14	12·5	10·6	12·5	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	350	500	650	—	kΩ
Valve Input Resistance at 40 Mc/s	r_{g1}	11·6	13	15·3	—	kΩ
Equivalent Grid Noise Resistance at 40 Mc/s	R_{eq}	—	490	—	—	Ω
Grid Voltage for $g_m/10$	$V_{g1}(g_m/10)$	—	—	—	−5·5	V
Grid Voltage for $g_m/100$	$V_{g1}(g_m/100)$	—	—	—	−19	V

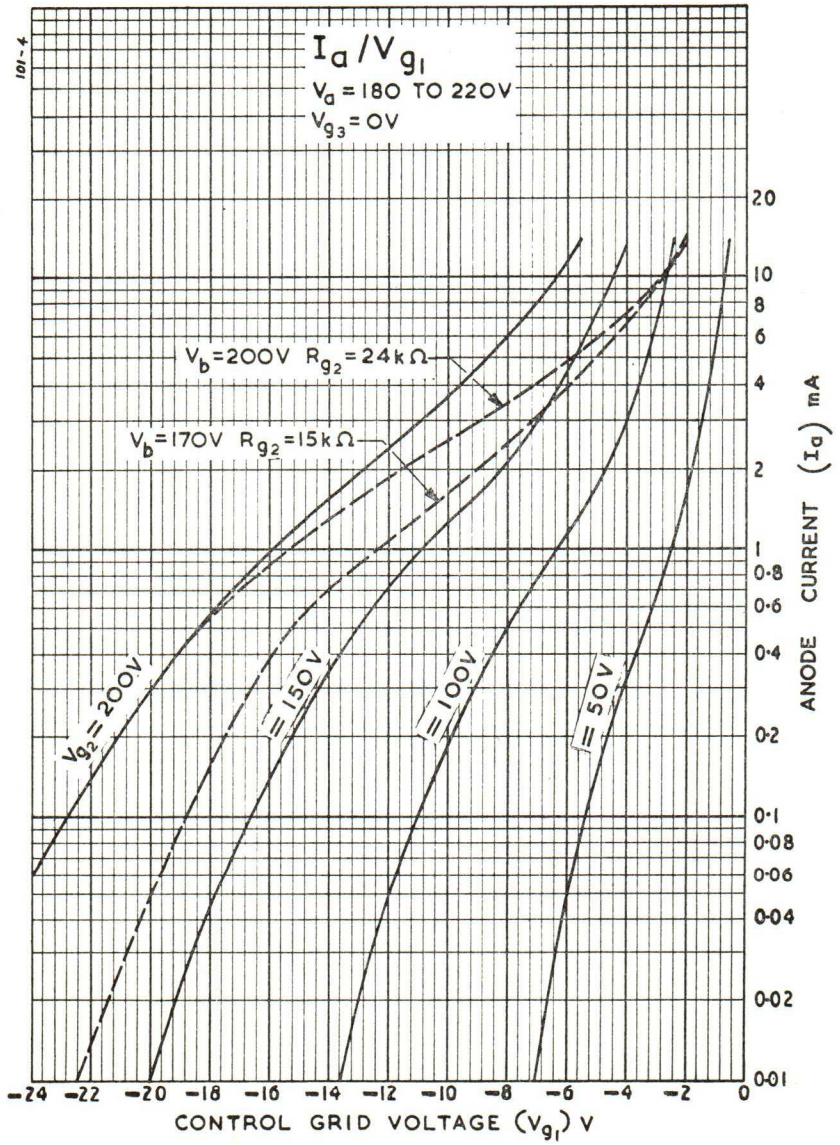
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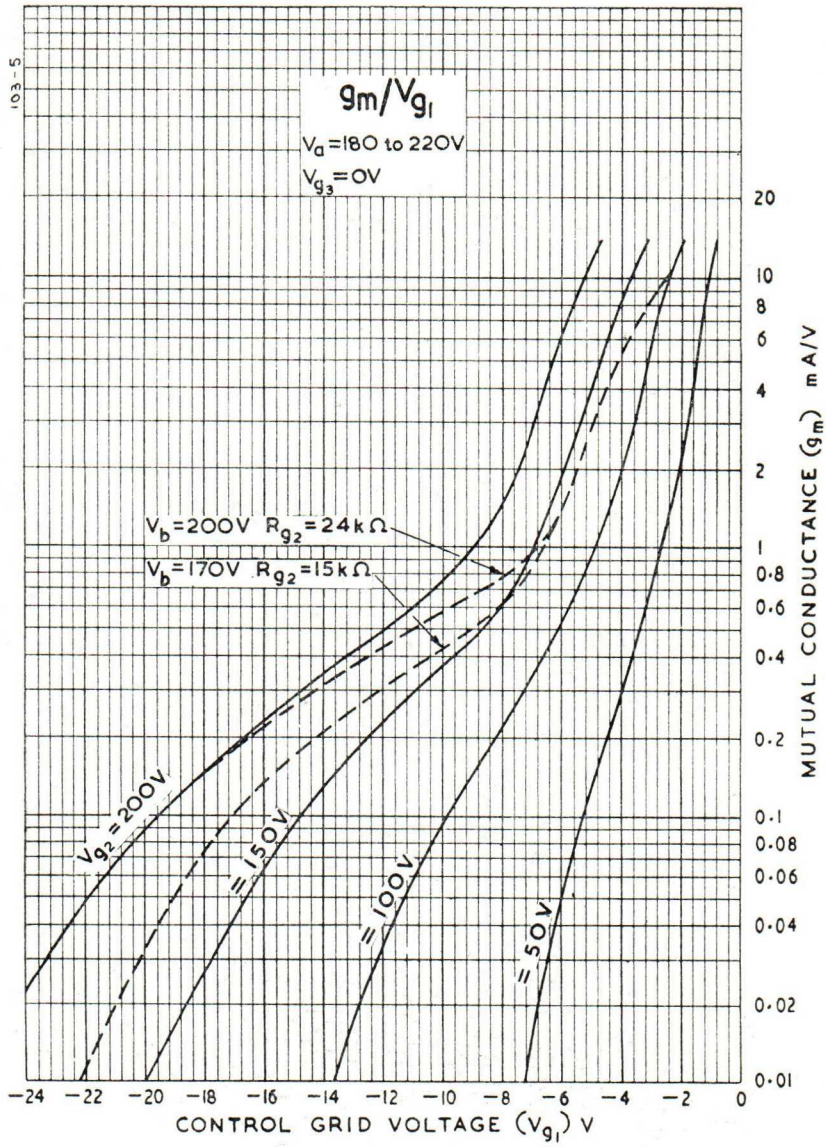

CROSS MODULATION
MUTUAL CONDUCTANCE (g_m) mA/V
20
10
6
4
2
1
.6
.4
.2
.1
.06
.04
.02
.01
1.0
.8
.6
.4
.2
.1
.08
.06
.04
.02
UNWANTED INPUT SIGNAL FOR K = 1% (V_u (r.m.s.)) V

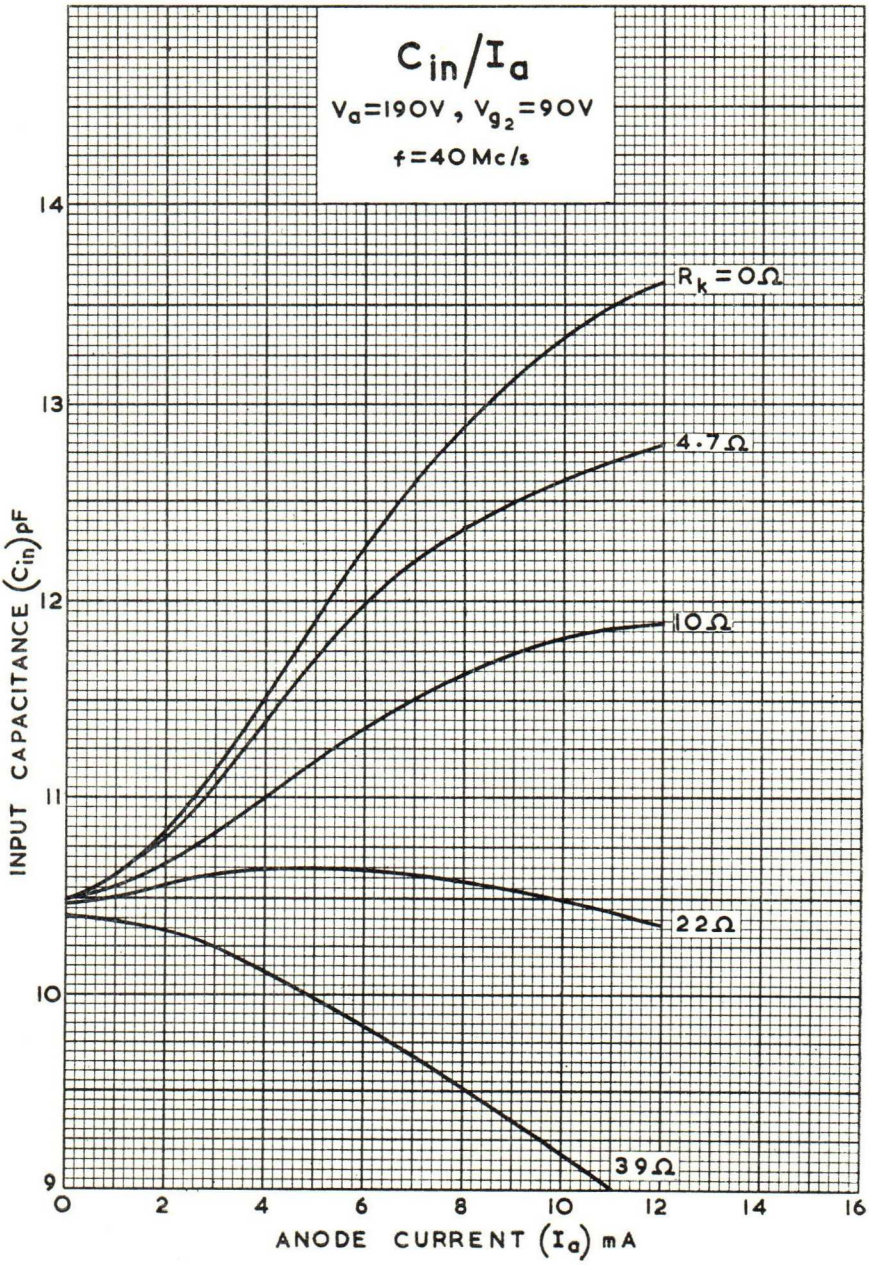

I_a / V_{g1}
V_a=170 TO 230V
V_{g3}=0V
g_m=16mA/V
=14mA/V
=12mA/V
=10mA/V
=8 mA/V
=6 mA/V
=4 mA/V
=2 mA/V
=1 mA/V
V_{g2}=200V
=160V
=120V
=80V
=40V
24
22
20
18
16
14
12
10
8
6
4
2
0
-8
-7
-6
-5
-4
-3
-2
-1
ANODE CURRENT (I_a) mA
CONTROL GRID VOLTAGE (V_{g1}) V

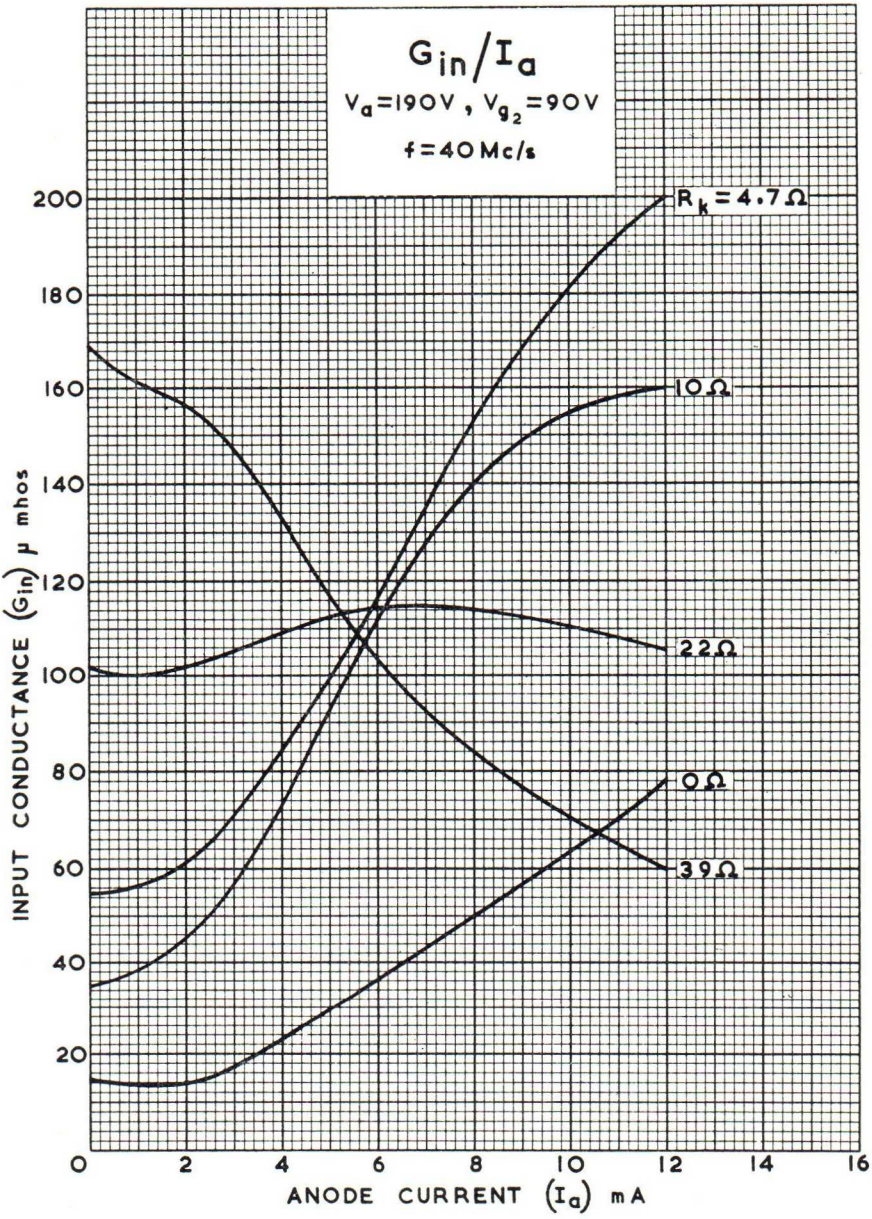

I_k / V_{g1}
V_a=170 to 230V
V_{g3}=0V
R_k=100Ω
=120Ω
=150Ω
=180Ω
=220Ω
=270Ω
=330Ω
V_{g2}=200V
=160V
=120V
=80V
=40V
CATHODE CURRENT (I_k) mA
CONTROL GRID VOLTAGE (V_{g1}) V
0
4
8
12
16
20
24
28
32
36
40
44
48
-8
-7
-6
-5
-4
-3
-2
-1

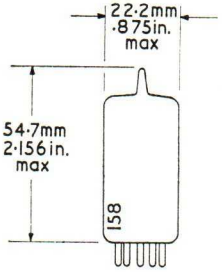

I_{g_2}/V_{g_2}
V_a = 180 to 220V
V_{g_3} = 0V
V_{g_1} = 0V
= −0·5V
= −1·0V
= −1·5V
= −2·0V
= −2·5V
= −3·0V
SCREEN GRID CURRENT (I_{g_2}) mA
SCREEN GRID VOLTAGE (V_{g_2}) V
0
1
2
3
4
5
6
7
10
20
30
40
50
60
70
80
90
100
110
120


101-4
I_a / V_{g1}
V_a = 180 TO 220V
V_{g3} = 0V
V_b=200V R_{g2}=24kΩ
V_b=170V R_{g2}=15kΩ
V_{g2}=200V
=150V
=100V
=50V
20
10
8
6
4
2
1
0·8
0·6
0·4
0·2
0·1
0·08
0·06
0·04
0·02
0·01
ANODE CURRENT (I_a) mA
−24 −22 −20 −18 −16 −14 −12 −10 −8 −6 −4 −2 0
CONTROL GRID VOLTAGE (V_{g1}) V

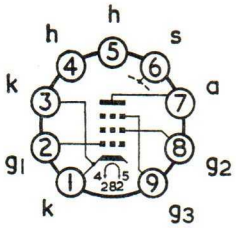

103-5
gm/Vg1
Va=180 to 220V
Vg3=0V
Vb=200V Rg2=24kΩ
Vb=170V Rg2=15kΩ
Vg2=200V
=150V
=100V
=50V
20
10
8
6
4
2
1
0·8
0·6
0·4
0·2
0·1
0·08
0·06
0·04
0·02
0·01
MUTUAL CONDUCTANCE (gm) mA/V
−24 −22 −20 −18 −16 −14 −12 −10 −8 −6 −4 −2 0
CONTROL GRID VOLTAGE (Vg1) V


C_{in}/I_a
V_a=190V , V_{g_2}=90V
f=40 Mc/s
R_k = 0Ω
4.7Ω
10Ω
22Ω
39Ω
INPUT CAPACITANCE (C_{in}) pF
ANODE CURRENT (I_a) mA
14
13
12
11
10
9
0
2
4
6
8
10
12
14
16


G_{in}/I_a
V_a=190V , V_{g_2}=90V
f=40Mc/s
R_k=4.7Ω
10Ω
22Ω
0Ω
39Ω
INPUT CONDUCTANCE (G_{in}) μ mhos
ANODE CURRENT (I_a) mA
0
2
4
6
8
10
12
14
16
20
40
60
80
100
120
140
160
180
200



HIGH SLOPE R.F. PENTODE



B9A Base

GENERAL

This valve is a sharp cut-off frame grid R.F. Pentode for use as an I.F. amplifier in A.C. or A.C./D.C. television receivers.

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·3	A

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	2·5	W
Maximum Screen Grid Dissipation	$P_{g_2(max)}$	0·9	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	250	V
Maximum Screen Grid Supply Voltage	$V_{g_2(b)max}$	550	V
Maximum Screen Grid Voltage	$V_{g_2(max)}$	250	V
Maximum Peak Negative Grid Voltage	$-v_{g_1(pk)max}$	50	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h\text{-}k(max)r.m.s.}$	150	V
Maximum Cathode Current	$I_{k(max)}$	25	mA
Maximum Control Grid to Cathode Resistance	$R_{g\text{-}k(max)}$	1·0	MΩ
Maximum Heater to Cathode Resistance	$R_{h\text{-}k(max)}$	20	kΩ
Maximum Bulb Temperature	$T_{bulb(max)}$	180	°C

INTER-ELECTRODE CAPACITANCES

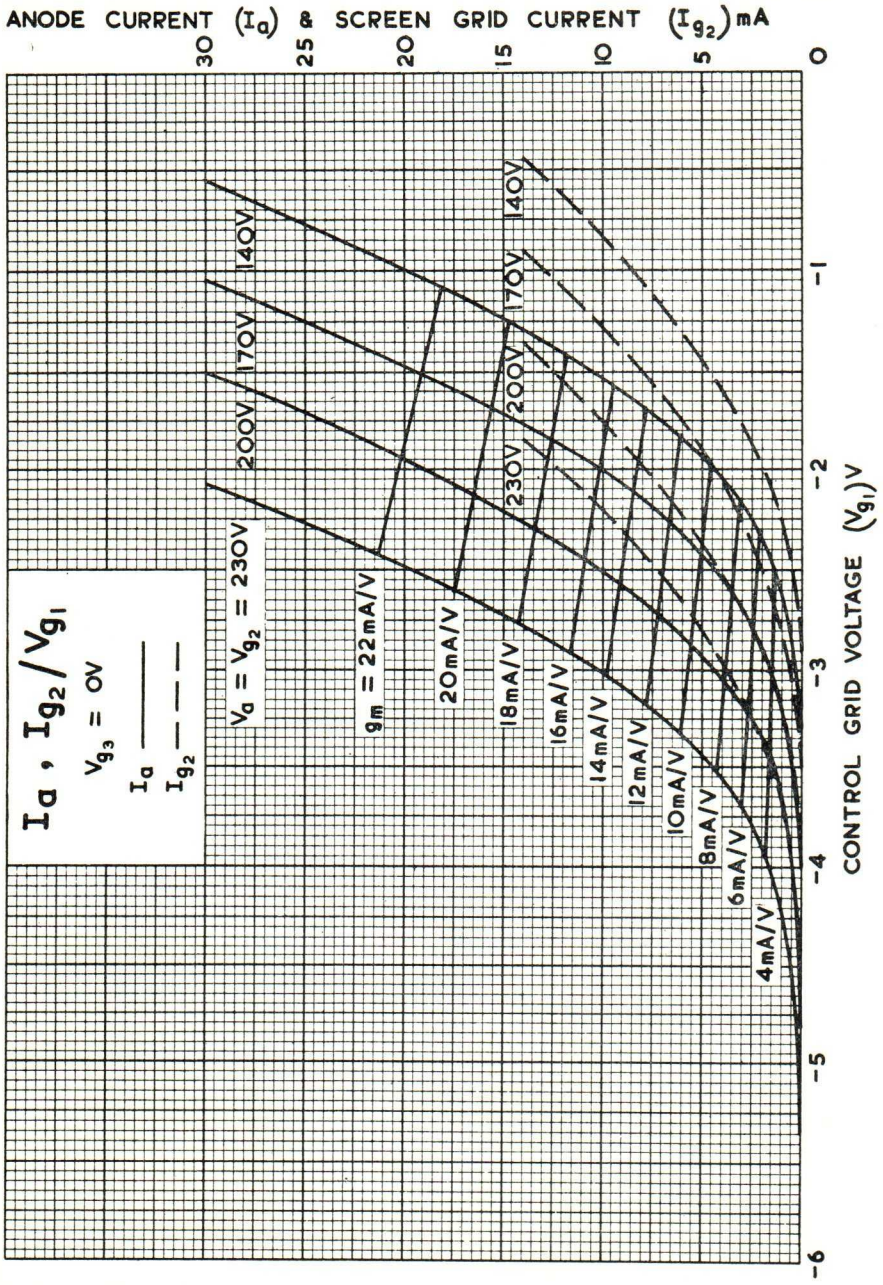
		*	†	‡	
Input	c_{in}	10	10·4	11·5	pF
Output	c_{out}	3·0	3·4	4·5	pF
Anode to Grid 1	$c_{a\text{-}g_1}$	<0·0055	<0·0065	<0·0075	pF
Grid 1 to Grid 2	$c_{g_1\text{-}g_2}$	2·8	2·8	2·8	pF

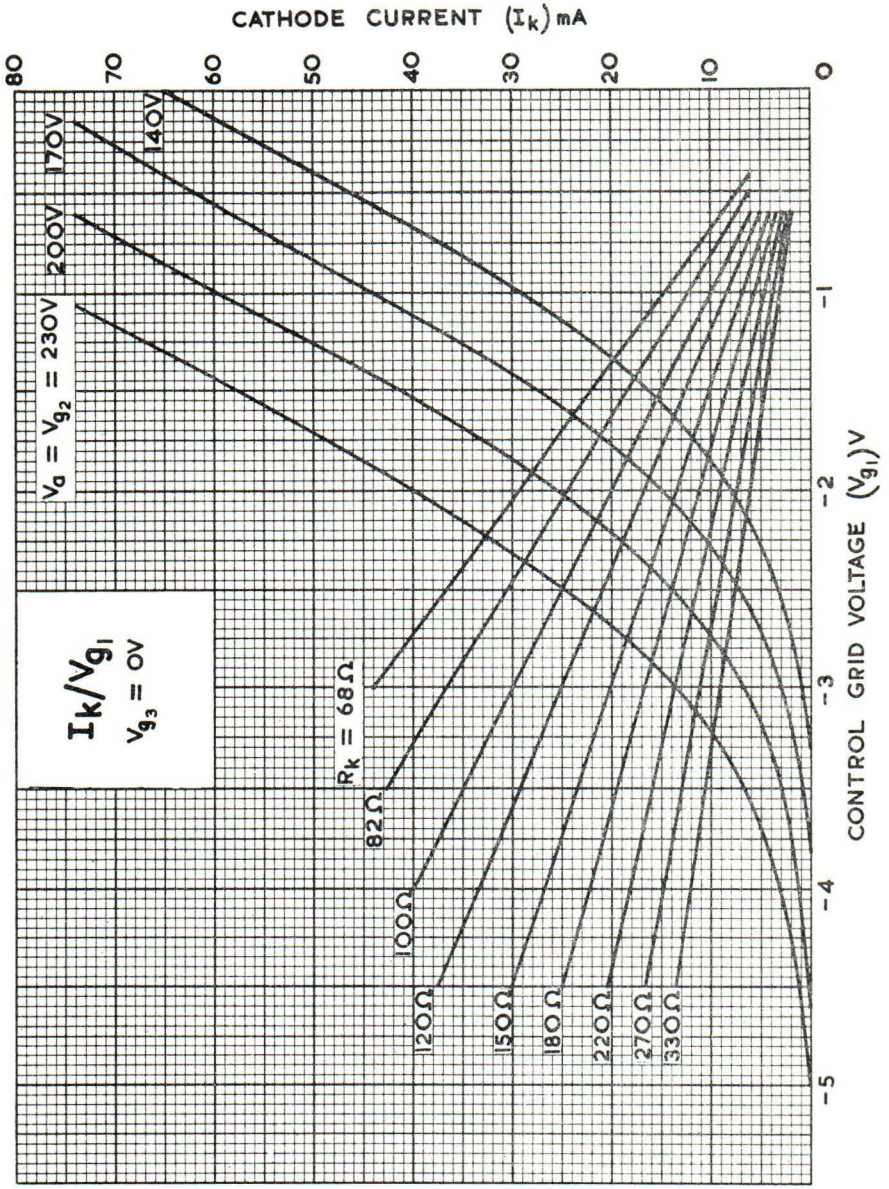
* In fully shielded socket without can (I.E.C. Publication 100).
† With holder capacitance balanced out (Holder as below).
‡ Total capacitance including B9A ceramic holder without skirt or radial shield (Plessey holder type CP180900/1).

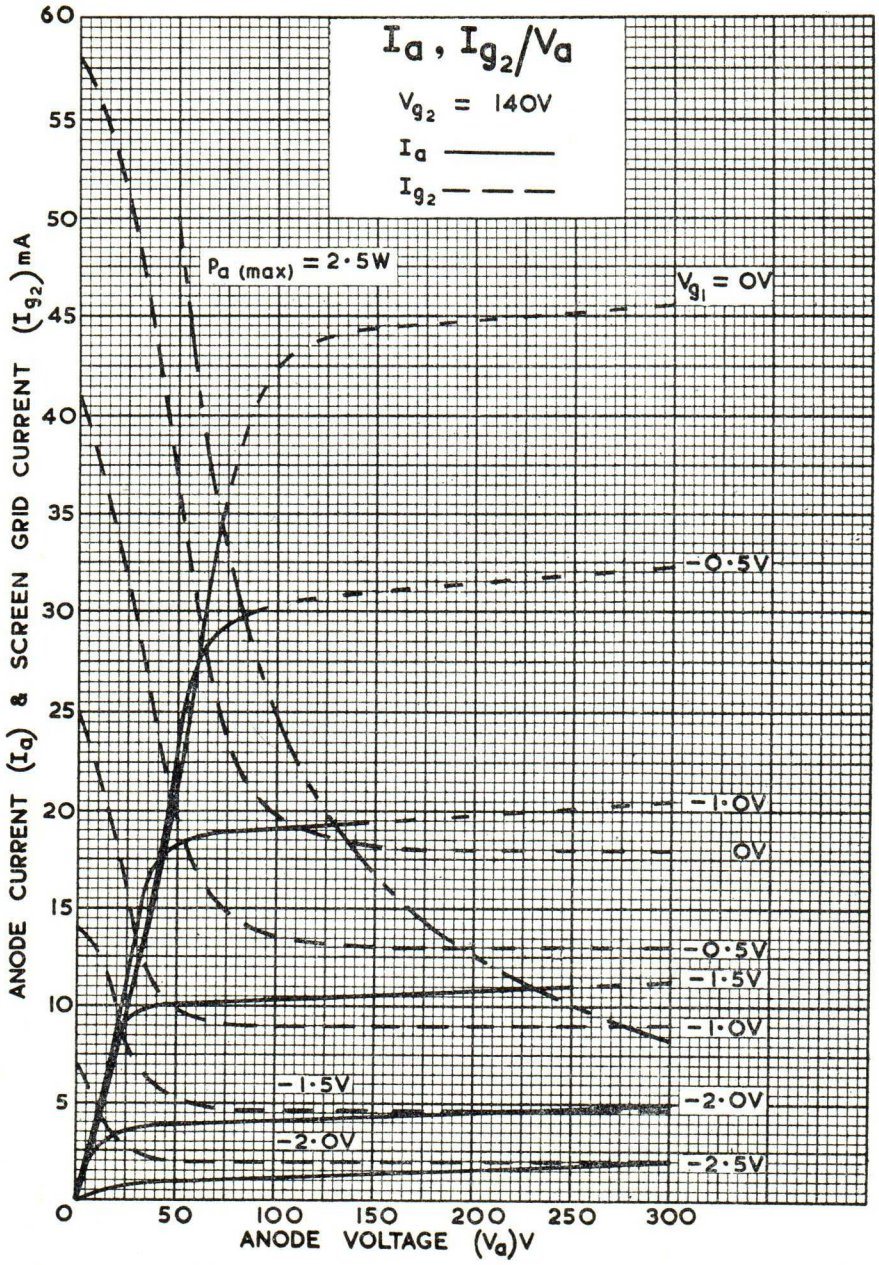
TYPICAL OPERATION

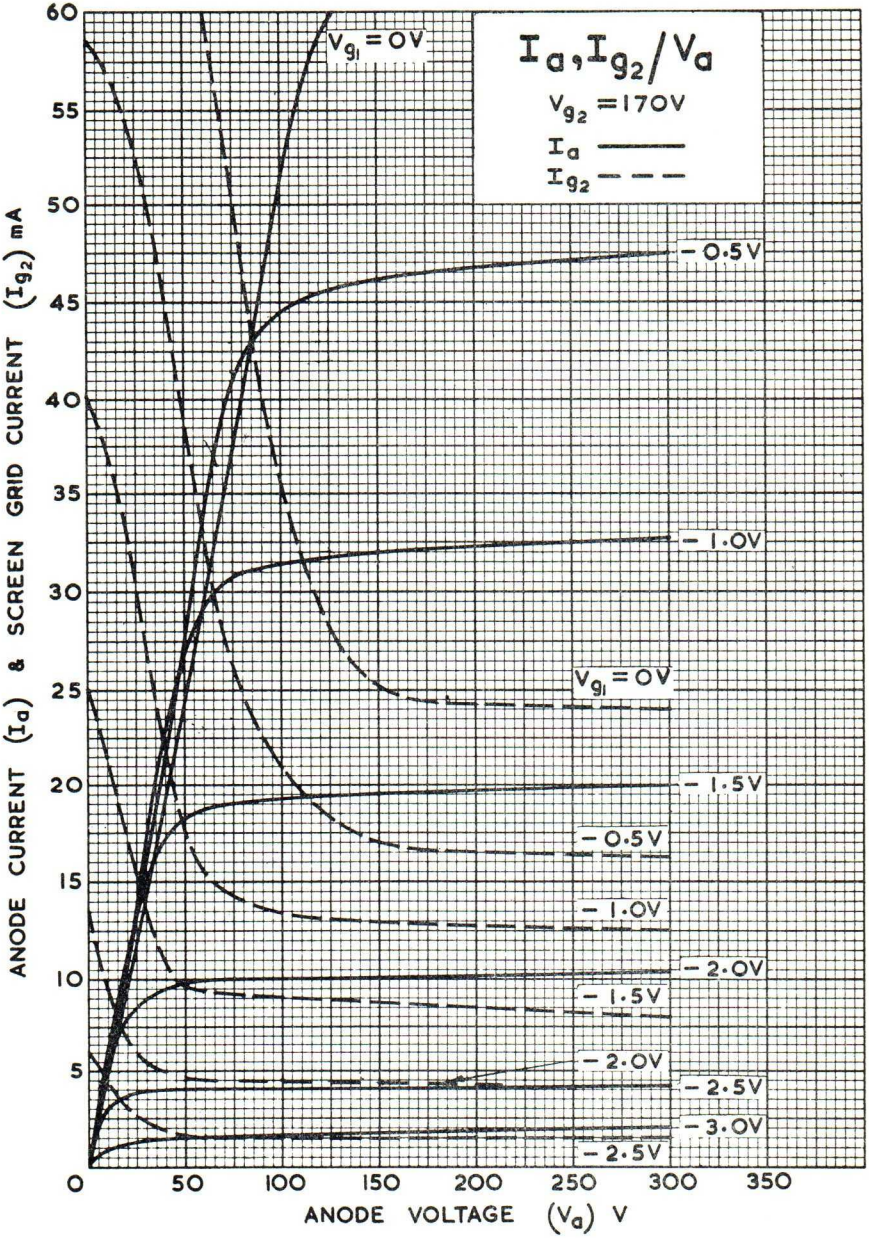
Anode Supply Voltage	$V_{a(b)}$	170	200	230	200	V
Screen Grid Supply Voltage	$V_{g_2(b)}$	170	200	230	200	V
Suppressor Grid Supply Voltage	$V_{g_3(b)}$	0	0	0	0	V
Control Grid Voltage	V_{g_1}	—	—	—	−2·5	V
Anode Current	I_a	10	10	10	10	mA
Screen Grid Current	I_{g_2}	4·1	4·1	4·1	4·1	mA
Screen Grid Resistance	R_{g_2}	0	7·5	15	—	kΩ
Cathode Bias Resistance	R_k	140	140	140	—	Ω
Mutual Conductance	g_m	15·6	15·6	15·6	15	mA/V
Inner Amplification Factor	$\mu_{g_1\text{-}g_2}$	—	—	—	60	
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	330	510	680	380	kΩ
Valve Input Resistance at 38 Mc/s	r_{g_1}	11	11	11	12	kΩ
Equivalent Grid Noise Resistance at 38 Mc/s	R_{eq}	300	300	300	330	Ω
Working Input Capacitance	$c_{in(w)}$	—	—	—	15*	pF

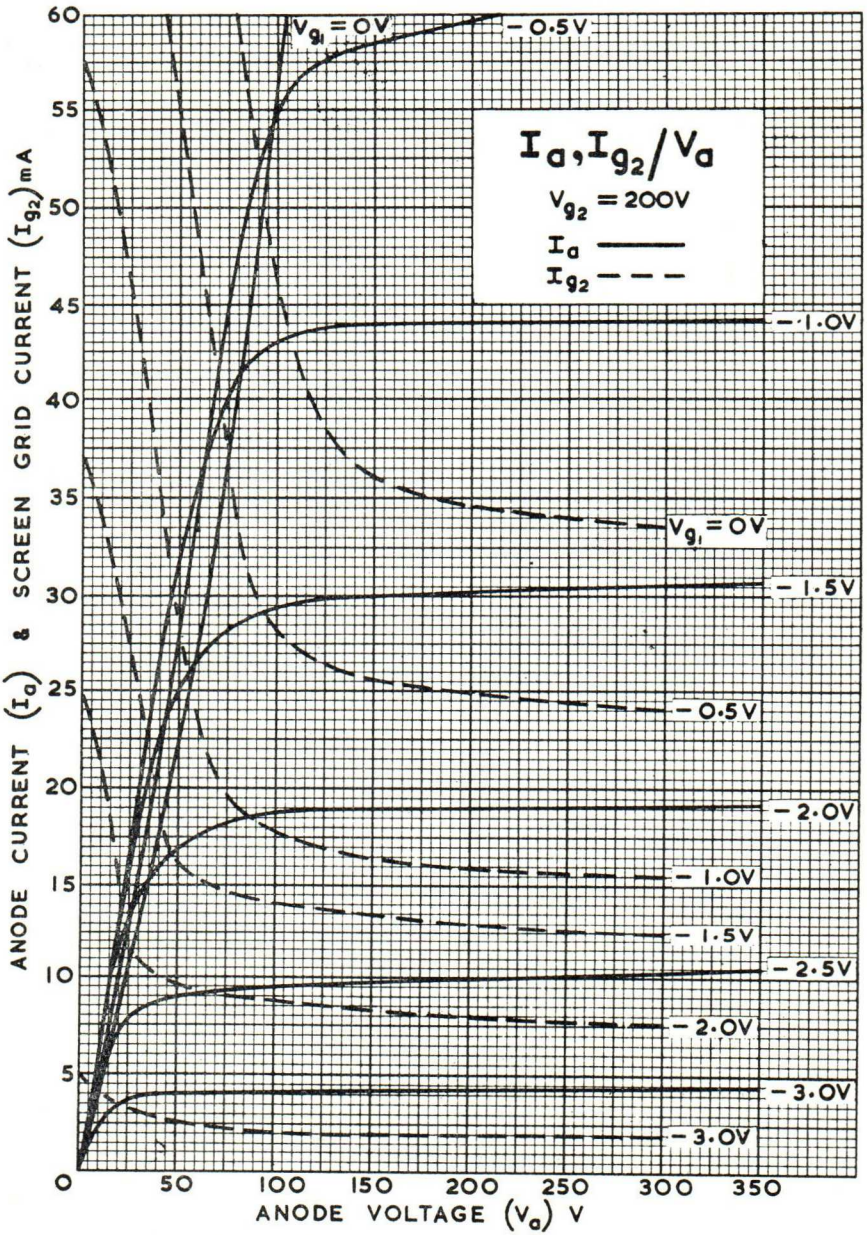
THORN—AEI RADIO VALVES & TUBES LTD.

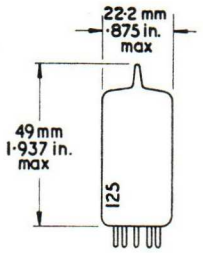

ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
30
25
20
15
10
5
0
-1
-2
-3
-4
-5
-6
CONTROL GRID VOLTAGE (V_{g_1}) V
I_a , I_{g_2} / V_{g_1}
V_{g_3} = 0V
I_a ———
I_{g_2} — — —
$V_a = V_{g_2}$ = 230V
200V
170V
140V
g_m = 22mA/V
20mA/V
18mA/V
16mA/V
14mA/V
12mA/V
10mA/V
8mA/V
6mA/V
4mA/V


CATHODE CURRENT (I_k) mA
80
70
60
50
40
30
20
10
0
$V_a = V_{g_2}$ = 230V
200V
170V
140V
I_k/V_{g_1}
V_{g_3} = 0V
R_k = 68Ω
82Ω
100Ω
120Ω
150Ω
180Ω
220Ω
270Ω
330Ω
-1
-2
-3
-4
-5
CONTROL GRID VOLTAGE (V_{g_1}) V

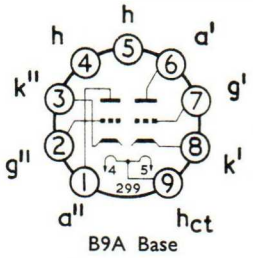

I_a , I_{g_2}/V_a
V_{g_2} = 140V
I_a
I_{g_2}
P_a (max) = 2·5W
V_{g_1} = 0V
-0·5V
-1·0V
0V
-0·5V
-1·5V
-1·0V
-1·5V
-2·0V
-2·0V
-2·5V
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
ANODE VOLTAGE (V_a) V
0
5
10
15
20
25
30
35
40
45
50
55
60
50
100
150
200
250
300


$I_a, I_{g_2} / V_a$
V_{g_2} = 170V
I_a
I_{g_2}
V_{g_1} = 0V
− 0·5V
− 1·0V
V_{g_1} = 0V
− 1·5V
− 0·5V
− 1·0V
− 2·0V
− 1·5V
− 2·0V
− 2·5V
− 3·0V
− 2·5V
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
0
5
10
15
20
25
30
35
40
45
50
55
60
50
100
150
200
250
300
350
ANODE VOLTAGE (V_a) V


$I_a, I_{g_2} / V_a$
$V_{g_2} = 200V$
I_a
I_{g_2}
$V_{g_1} = 0V$
-0.5V
-1.0V
$V_{g_1} = 0V$
-1.5V
-0.5V
-2.0V
-1.0V
-1.5V
-2.5V
-2.0V
-3.0V
-3.0V
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
ANODE VOLTAGE (V_a) V
0
5
10
15
20
25
30
35
40
45
50
55
60
50
100
150
200
250
300
350



HIGH μ DOUBLE TRIODE



B9A Base

GENERAL

This valve is primarily intended for use as a resistance coupled amplifier or phase inverter. The heater is centre tapped and the sections may be operated in series or in parallel on A.C. or A.C./D.C. mains.

Heater Voltage	V_h	6·3	or	12·6	V
Heater Current	I_h	0·3		0·15	A

RATINGS (Each Section)

Maximum Anode Dissipation	$P_{a(max)}$	1·0	W
Maximum Anode Voltage	$V_{a(max)}$	300	V
Maximum Heater to Cathode Voltage (D.C. or R.M.S.)	$V_{h\text{-}k(max)}$	180	V
Maximum Cathode Current	$I_{k(max)}$	8	mA
Maximum Grid to Cathode Resistance (Fixed Bias)	$R_{g\text{-}k(max)}$	1·0	MΩ

INTER-ELECTRODE CAPACITANCES

		*	†	‡	
Input′	c_{in}'	1·6	1·8	2·6	pF
Input″	c_{in}''	1·6	1·8	2·5	pF
Output′	c_{out}'	0·33	0·48	1·3	pF
Output″	c_{out}''	0·23	0·34	1·1	pF
Anode′ to Grid′	$c_a'\text{-}g'$	1·6	1·7	2·0	pF
Anode″ to Grid″	$c_a''\text{-}g''$	1·6	1·8	2·1	pF
Anode′ to Anode″	$c_a'\text{-}a''$	0·9	0·95	0·95	pF
Grid′ to Grid″	$c_g'\text{-}g''$	0·008	0·012	0·014	pF
Anode′ to Grid″	$c_a'\text{-}g''$	<0·1	<0·1	<0·15	pF
Anode″ to Grid′	$c_a''\text{-}g'$	<0·1	<0·1	<0·15	pF
Grid′ to Heater	$c_g'\text{-}h$	0·1	0·21	0·28	pF
Grid″ to Heater	$c_g''\text{-}h$	0·08	0·18	0·23	pF

* In fully shielded socket, without can (I.E.C. Publication 100).
† With holder capacitance balanced out (Holder as below).
‡ Total capacitance including unskirted nylon phenolic B9A holder (AEI type VH19/902).

CHARACTERISTICS (Each Section)

Anode Voltage	V_a	100	250	V
Anode Current	I_a	0·5	1·2	mA
Grid Voltage	V_g	–1·0	–2·0	V
Mutual Conductance	g_m	1·25	1·6	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	80	62·5	kΩ
Amplification Factor	μ	100	100	

When the two sections are used in cascade the section connected to pins 6, 7 and 8 should be used as the first stage for best hum performance. The heater voltage should be applied between pin 9 and pins 4 and 5 connected together and the centre tap of the heater transformer earthed.

MOUNTING POSITION—Unrestricted

THORN—AEI RADIO VALVES & TUBES LTD.

G. June, 1963

TYPICAL OPERATION

Conditions as resistance coupled A.F. Amplifier.

Cathode Self Bias†															
Supply Voltage	V_b	250	300	350	400	250	300	350	400	250	300	350	400		V
Anode Load Resistance	R_a	47	47	47	47	100	100	100	100	220	220	220	220		kΩ
Cathode Self Bias Resistance	R_k	2·2	1·5	1·2	1·0	3·3	2·2	1·8	1·5	4·7	3·9	2·7	2·2		kΩ
Grid Resistance of Following Valve		150	150	150	150	330	330	330	330	680	680	680	680		kΩ
Anode Current	I_a	0·9	1·3	1·7	2·2	0·6	0·88	1·1	1·4	0·38	0·5	0·7	0·88		mA
Voltage Amplification		36	40	42	43	50	55	57	59	62	65	69	71		
R.M.S. Output Voltage for 5% total distortion*		12·5	22	31	40·5	18·5	32·5	45	59	27	38·5	60	63§		V

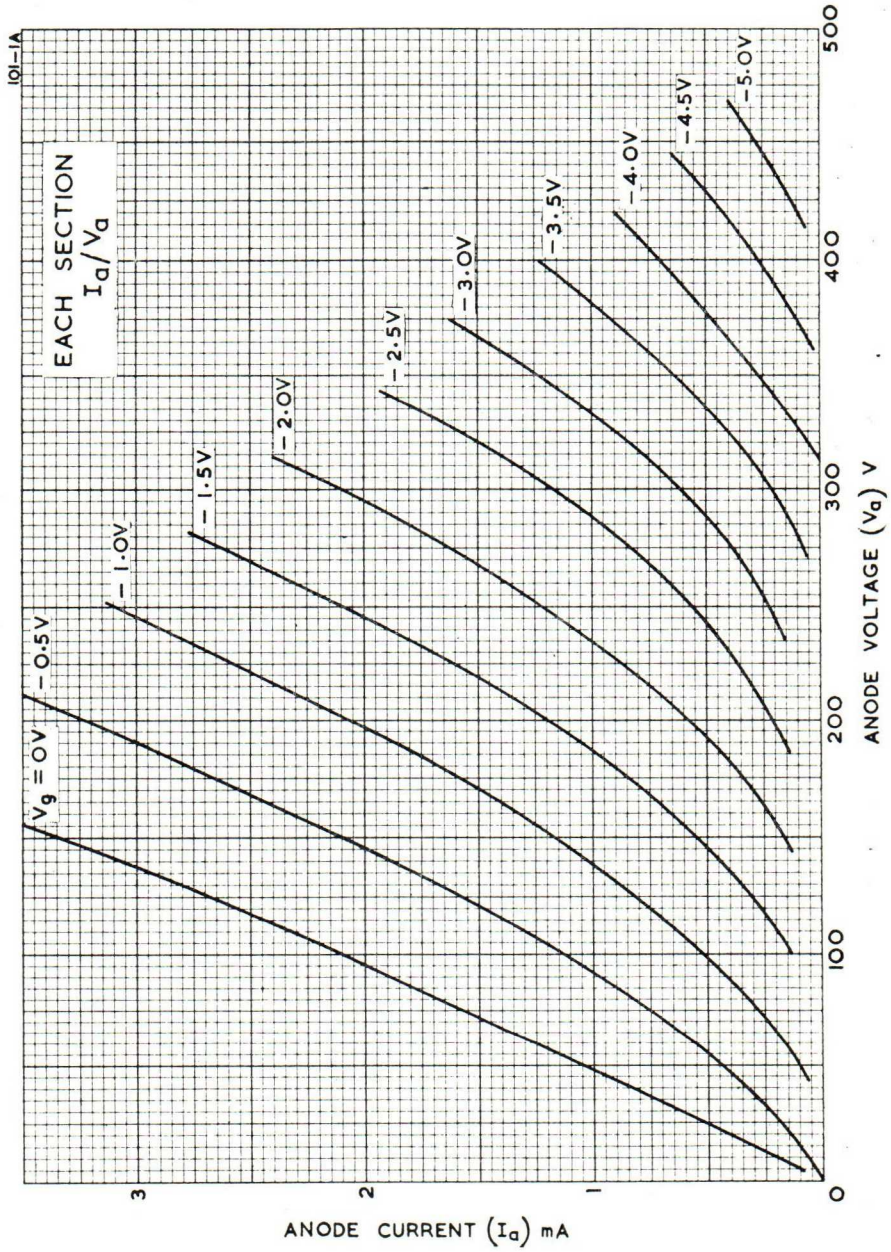
Grid Current Bias (R_g = 10 MΩ)																
Supply Voltage	V_b	200	250	300	350	400	200	250	300	350	400	200	250	300	350	400	V
Anode Load Resistance	R_a	47	47	47	47	47	100	100	100	100	100	220	220	220	220	220	kΩ
Grid Resistance of Following Valve		150	150	150	150	150	330	330	330	330	330	680	680	680	680	680	kΩ
Anode Current	I_a	1·2	1·7	2·2	2·8	3·5	0·8	1·1	1·4	1·7	2·1	0·4	0·6	0·8	1·0	1·2	mA
Signal source impedance Z_s = 0Ω																
Voltage Amplification for V_{in}(r.m.s.) = 100 mV		40	43	45	46	48	56	59	61	62	63	66	70	72	74	75	
R.M.S. Output Voltage for 5% total distortion		14	21	28	35	43	20	29	38	48	58	24	34	45	57	69	V
Signal source impedance Z_s = 220 kΩ																
Voltage Amplification for V_{in}(r.m.s.) = 100 mV		30	31	32	33	33	39	41	41	42	42	44	46	47	48	49	
R.M.S. Output Voltage for 5% total distortion‡		17	25	33	41	49	25	36	46	57	68	32	44	57	70	82	V

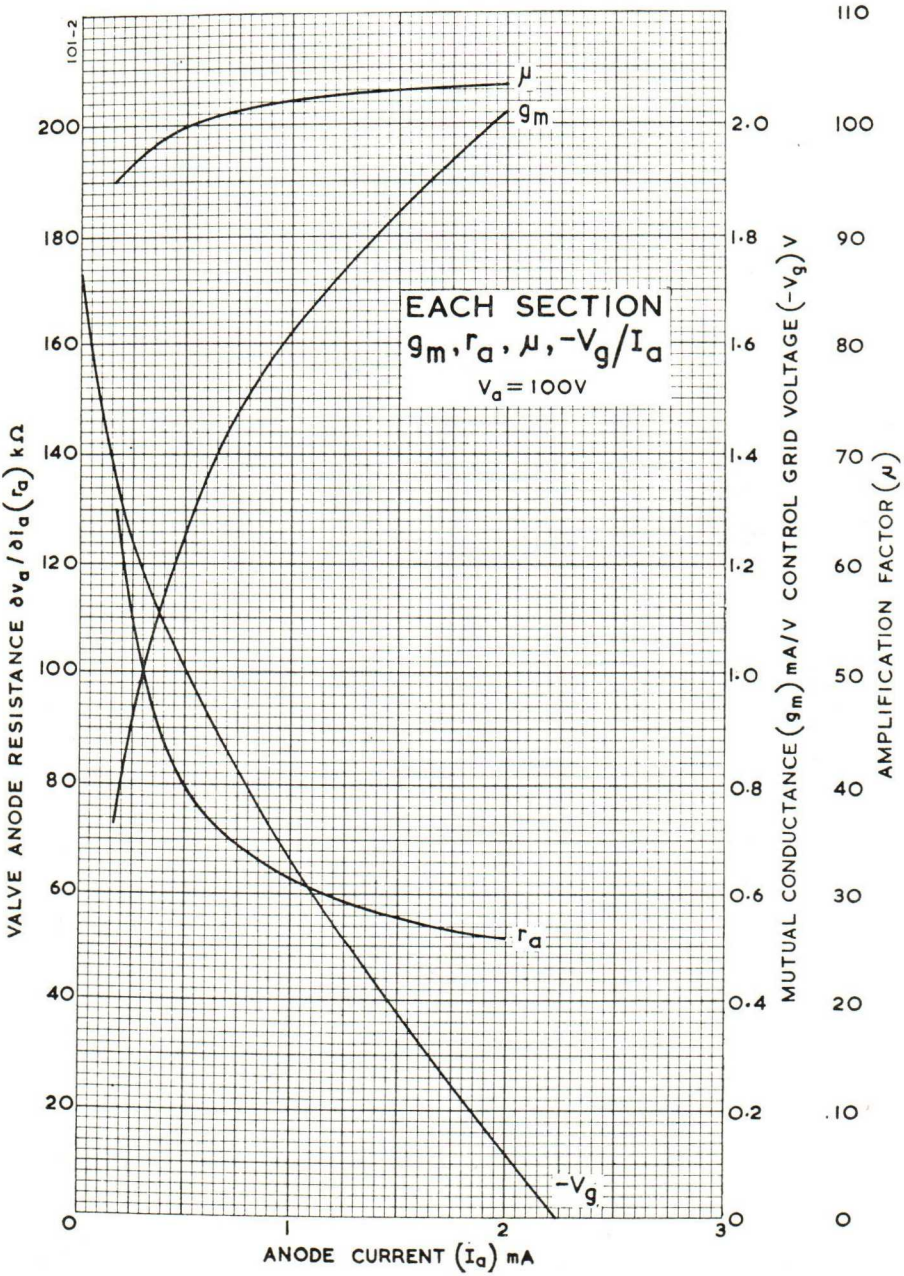
† At lower values of supply voltage grid current bias should be used.

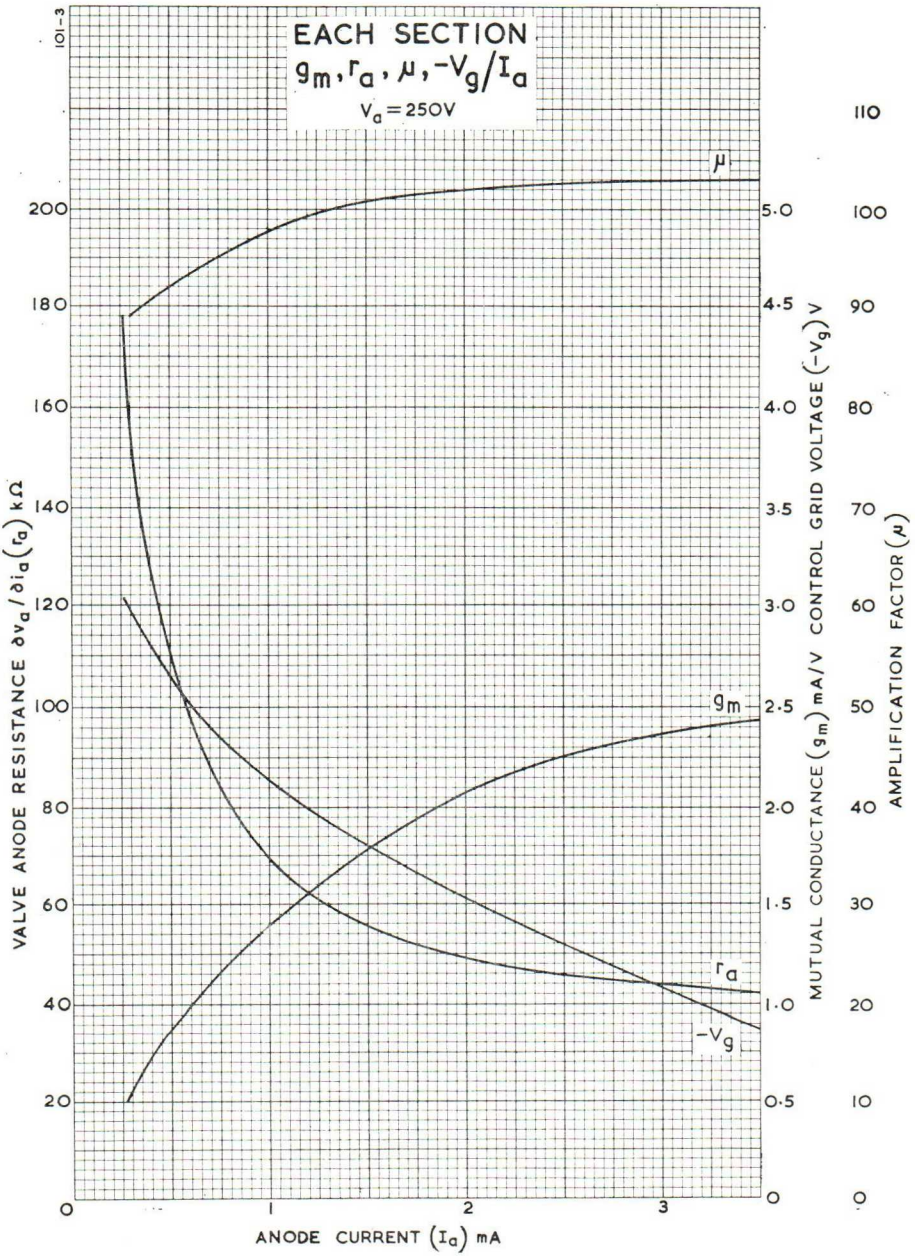
* At lower output voltages the distortion is approximately proportional to the output voltage.

§ For start of positive grid current. Total distortion = 3·7%.

‡ When operating this valve with grid current bias and a high source impedance, the second harmonic distortion rises to a peak at quite low levels of output (about 10 V r.m.s.) and then falls with increasing drive. The third harmonic then begins to rise, and D_{tot} finally reaches 5% at a much higher output level than with zero source impedance. The maximum value of this distortion peak varies inversely with the anode load, being about 5·5% with R_a = 47 kΩ, 4·5% with R_a = 100 kΩ and 4% with R_a = 220 kΩ.


101-1A
EACH SECTION
Ia/Va
Vg = 0V
-0.5V
-1.0V
-1.5V
-2.0V
-2.5V
-3.0V
-3.5V
-4.0V
-4.5V
-5.0V
0
100
200
300
400
500
ANODE VOLTAGE (Va) V
0
1
2
3
ANODE CURRENT (Ia) mA


101-2
EACH SECTION
$g_m, r_a, \mu, -V_g/I_a$
$V_a = 100V$
μ
g_m
r_a
$-V_g$
VALVE ANODE RESISTANCE $\delta v_a / \delta I_a (r_a)$ kΩ
MUTUAL CONDUCTANCE (g_m) mA/V
CONTROL GRID VOLTAGE ($-V_g$) V
AMPLIFICATION FACTOR (μ)
ANODE CURRENT (I_a) mA
0
20
40
60
80
100
120
140
160
180
200
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
10
20
30
40
50
60
70
80
90
100
110
1
2
3


EACH SECTION
$g_m, r_a, \mu, -V_g/I_a$
$V_a = 250V$
101-3
μ
g_m
r_a
$-V_g$
VALVE ANODE RESISTANCE $\delta v_a/\delta i_a (r_a)$ kΩ
MUTUAL CONDUCTANCE (g_m) mA/V
CONTROL GRID VOLTAGE $(-V_g)$ V
AMPLIFICATION FACTOR (μ)
ANODE CURRENT (I_a) mA
0
20
40
60
80
100
120
140
160
180
200
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
10
30
50
70
90
110
1
2
3

30C1/PCF80 ←

TRIODE PENTODE FREQUENCY CHANGER

GENERAL

The 30C1/PCF80 is a miniature based indirectly heated triode-pentode valve which has been designed for use as a frequency changer at V.H.F. It is suitable for use in AC/DC powered equipment having series connected heater chains. The two sections of the valve are provided with separate cathodes.

RATING

Heater Current (amps)	I_h	0·3
Heater Voltage (volts)	V_h	9·0

		Pentode	*Triode*
Maximum Anode Voltage (volts)	V_a (max)	250	250
Maximum Screen Voltage (volts)	V_{g_2} (max)	175	—
Mutual Conductance (mA/V)	g_m	6·2*	5·0†
Amplification Factor	μ		20
Maximum Anode Dissipation (watts)	P_a (max)	1·7	1·5
Maximum Screen Dissipation (watts)	P_{g_2} (max)	0·5	
Maximum Cathode Current (mA)	I_k (max)	14	14
Maximum Heater to Cathode Voltage (volts r.m.s.)	V_{h-k}	200 ‡‡	

* Taken at $V_a = 170$: $V_{g_2} = 170$: $I_a = 10mA$: $V_{g_1} = -2V$

† Taken at $V_a = 100$: $I_a = 14mA$

‡‡ Measured with respect to the higher potential heater pin.

Indicates a change ←

THORN — AEI RADIO VALVES & TUBES LTD.

30C1/PCF80 ←

TRIODE PENTODE FREQUENCY CHANGER

INTER-ELECTRODE CAPACITANCES (pF)

		‡	§
Grid 1 (Pentode)/All	$c_{g1(p)-all}$	6·1	7·35
Anode (Pentode)/All	$c_{a(p)-all}$	4·9	6·15
Grid 1 (Pentode)/Anode (Pentode)	$c_{g1(p)-a\,(p)}$	0·013	0·014
Grid (Triode)/Earth	$c_{in(t)}$	3·1	4·4
Grid (Triode)/Anode (Triode)	$c_{g(t)-a(t)}$	1·7	1·7
Anode (Triode)/Earth	$c_{out(t)}$	2·9	4·2
Grid (Triode)/Anode (Pentode)	$c_{g(t)-a\,(p)}$	0·007	0·01
Grid 1 (Pentode)/Anode (Triode)	$c_{g1(p)-a\,(t)}$	0·3	0·6
Anode (Pentode)/Anode (Triode)	$c_{a(p)-a\,(t)}$	0·023	0·023

‡ Inter-electrode capacitances taken with holder capacity balanced out, but with cylindrical screen can.

§ Total capacity including ceramic B9A holder with cylindrical screen, Carr Fastener type 76/804E/T.

" Earth " denotes electrodes of any second valve section and the remaining earthy potential electrodes of the section under measurement, heater and shields joined to cathode.

DIMENSIONS

Maximum Overall Length (mm)	56
Maximum Diameter (mm)	22·2
Maximum Seated Height (mm)	49
Approximate Nett Weight (ozs)	$\frac{1}{2}$
Approximate Packed Weight (ozs)	$\frac{3}{4}$

MOUNTING POSITION—Unrestricted

30C1/PCF80 ←

TRIODE PENTODE FREQUENCY CHANGER

TYPICAL OPERATION—As a frequency changer with oscillator volts applied to g_1.

Pentode Section		*	
Anode Voltage (volts)	V_a	170	180
Screen Voltage (volts)	V_{g_2}	145	165
Grid 1 Resistance for grid current bias (ohms)	R_{g_1}	33,000	33,000
Grid 1 Current (μA)	I_{g_1}	130	130
Conversion Conductance (mA/V)	g_c	2·0	2·1
Peak Heterodyne Voltage (volts)	$V_{het(pk)}$	5·0	5·0
Anode Current (approx) (mA)	I_a	6·8	7·7
Screen Current (approx) (mA)	I_{g_2}	2·0	2·4

* If the design of the tuner is such that it is possible for the 30C1/PCF80 to be left running without the triode section oscillating (e.g., by being switched to blank coil positions), the lower screen and anode voltage should be employed.

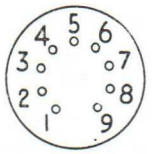
Triode Section		
Anode Voltage (volts)	V_a	120
Anode Current (average) (mA)	$I_{a(av)}$	6·0

Indicates a change ←

30C1/PCF80 ←

TRIODE PENTODE FREQUENCY CHANGER

BASE- Noval (B9A)



Viewed from Free End of Pins

CONNECTIONS

Pin 1	Triode Anode	a_t
Pin 2	Pentode Grid 1	g_1
Pin 3	Pentode Grid 2	g_2
Pin 4	Heater	h
Pin 5	Heater	h
Pin 6	Pentode Anode	a_p
Pin 7	Pentode Cathode Shield and Grid 3	k_{p,s,g_3}
Pin 8	Triode Cathode	k_t
Pin 9	Triode Grid	g_t

Indicates a change ←

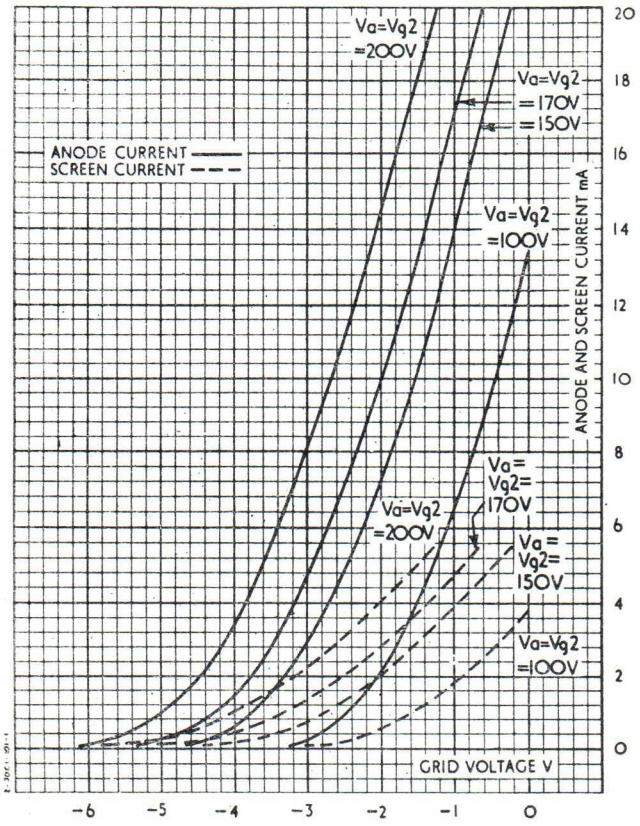
30C1/PCF80

TRIODE PENTODE FREQUENCY CHANGER

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES : I_a, I_{g2}/V_g

Pentode Section



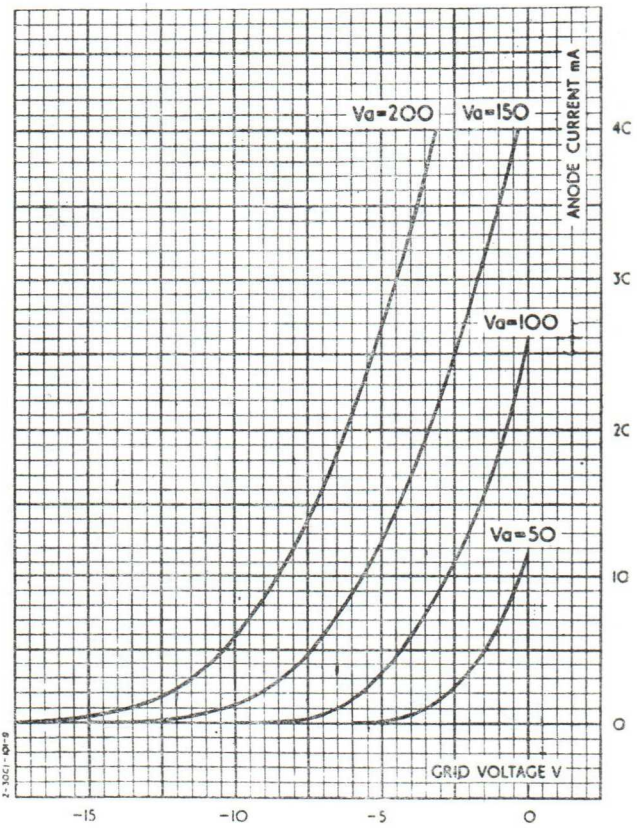
30C1/PCF80

TRIODE PENTODE FREQUENCY CHANGER

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES : I_a/V_g

Triode Section



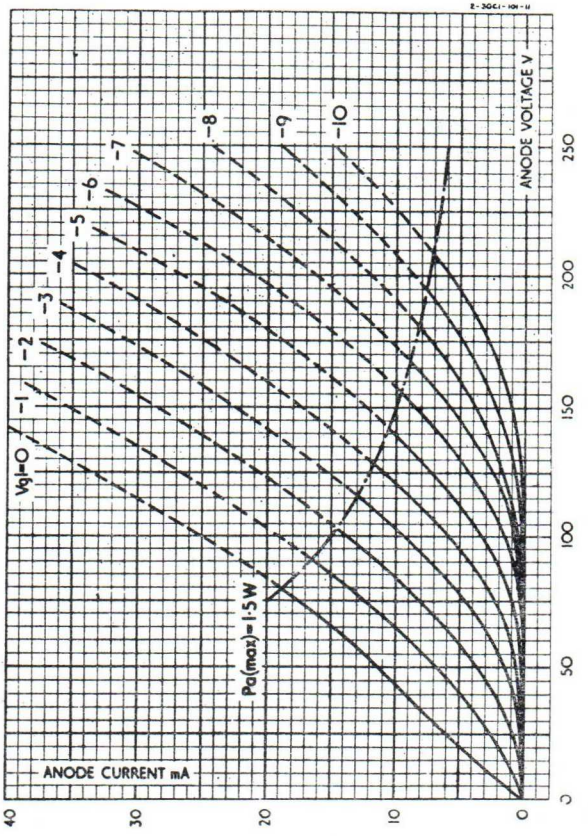
30C1/PCF80

TRIODE PENTODE FREQUENCY CHANGER

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES : I_a/V_a

Triode Section



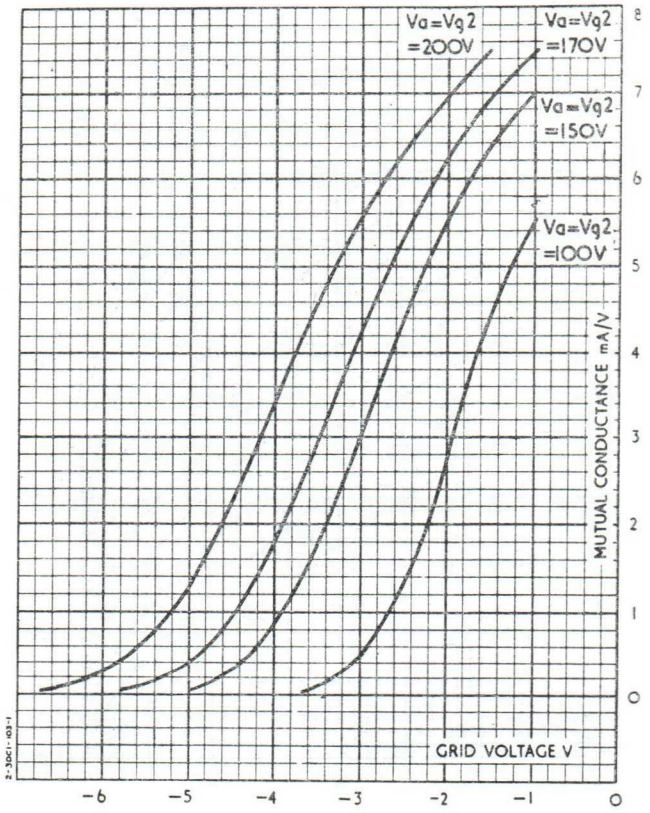
30C1/PCF80

TRIODE PENTODE FREQUENCY CHANGER

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES: g_m/V_g

Pentode Section



30C1/PCF80

TRIODE PENTODE FREQUENCY CHANGER

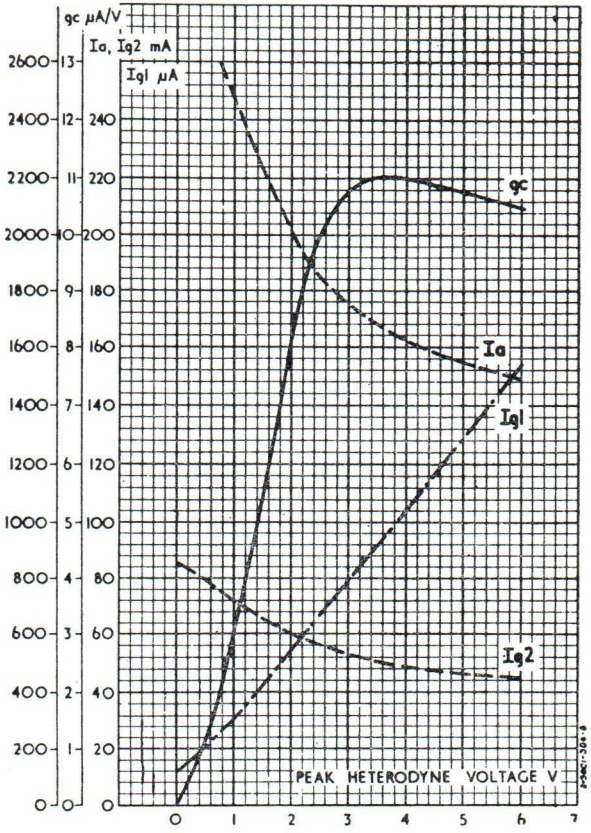
Indirectly heated—for series operation

TENTATIVE

CHARACTERISTIC CURVES: I_a, I_{g2}, I_{g1}, g_c/V_{het} (pk)

R2=2.2KΩ R3=15KΩ

See "Test Circuit"



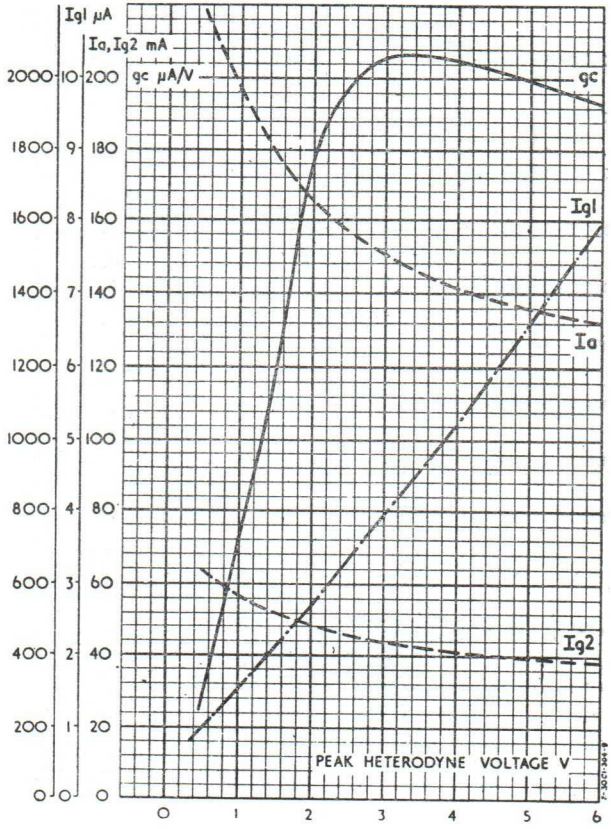
30C1/PCF80

TRIODE PENTODE FREQUENCY CHANGER

Indirectly heated—for series operation

TENTATIVE

CHARACTERISTIC CURVES: I_a, I_{g2}, I_{g1}, g_c/V_{het} (pk)
R2=4.7KΩ R3=27KΩ
See "Test Circuit"



30C1/PCF80

TRIODE PENTODE FREQUENCY CHANGER

Indirectly heated—for series operation

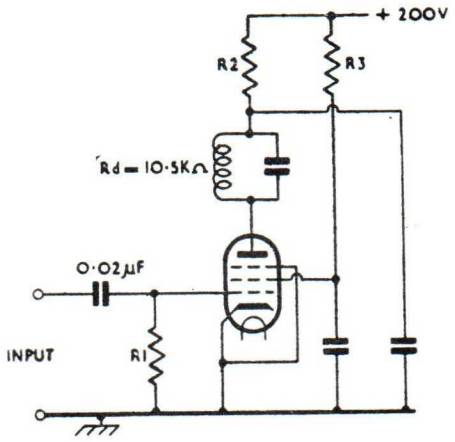
TENTATIVE

TEST CIRCUIT

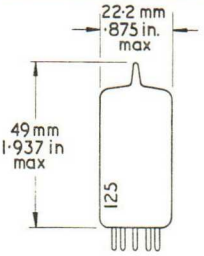
for

CHARACTERISTIC CURVES: I_a, I_{g2}, I_{g1}, $g_c/V_{het(pk)}$

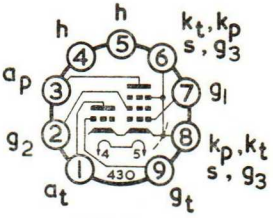
f = 1 Mc/s.



THORN — AEI RADIO VALVES & TUBES LTD.



V.H.F. TRIODE PENTODE



†B9A Base

GENERAL

This triode and variable mu pentode valve combination, with the pentode of frame grid construction, is for use in television tuners. It is primarily intended to be used as a variable gain V.H.F. frequency changer with the triode as local oscillator but the pentode is also designed for use as a high gain controlled I.F. amplifier following a U.H.F. tuner.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	7·4	V

RATINGS

		Pentode	Triode	
Maximum Anode Dissipation	$P_{a(max)}$	2	2	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	0·5	—	W
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	230	—	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h\text{-}k(r.m.s.)max}$	200	200	V
Maximum Cathode Current	$I_{k(max)}$	18	15	mA
Maximum Grid to Cathode Resistance (Fixed Bias)	$R_{g1\text{-}k(max)}$	250	500	kΩ

INTER-ELECTRODE CAPACITANCES

		*	‡	△	
Grid 1 to all	$c_{g1\text{-}all}$	6·7	7·1	8·2	pF
Anode Pentode to all	$c_{ap\text{-}all}$	2·7	3·1	4·2	pF
Grid 1 to Anode Pentode	$c_{g1\text{-}ap}$	·007	·008	·009	pF
Anode Triode to Earth	$c_{at\text{-}E}$	2·2	2·5	3·5	pF
Grid Triode to Earth	$c_{gt\text{-}E}$	2·4	2·7	3·7	pF
Anode Pentode to Grid Triode	$c_{ap\text{-}gt}$	·001	·003	·005	pF
Grid Triode to Anode Triode	$c_{gt\text{-}at}$	2·0	2·05	2·1	pF
Anode Pentode to Anode Triode	$c_{ap\text{-}at}$	·014	·027	·046	pF
Grid 1 to Grid Triode	$c_{g1\text{-}gt}$	·008	·018	·037	pF
Grid 1 to Anode Triode	$c_{g1\text{-}at}$	·002	·004	·006	pF

* In fully-shielded socket with can. (I.E.C. Publication 100.)
‡ With holder capacitance balanced out but with can. (Holder as below.)
△ Total capacitance including B9A ceramic holder with skirt and screening can (Plessey holder type CP180024/3).
"Earth" denotes the electrodes of the other section and the remaining earthy potential electrodes of the section under measurement, heater and shields joined to cathode.

CHARACTERISTICS

		Pentode	Triode	
Anode Voltage	V_a	125	100	V
Screen Grid Voltage	V_{g2}	125	—	V
Control Grid Voltage	V_{g1}	−1·5	−3	V
Anode Current	I_a	10	14	mA
Screen Grid Current	I_{g2}	3·1	—	mA
Mutual Conductance	g_m	11	5·5	mA/V
Amplification Factor	μ	—	17	
Inner Amplification Factor	$\mu_{g1\text{-}g2}$	50	—	

† Shield completely surrounds pentode.
Basing arranged to minimise pentode cathode lead inductance effects with the shorter lead to pin 8.

TYPICAL OPERATION AS FREQUENCY CHANGER AND I.F. AMPLIFIER

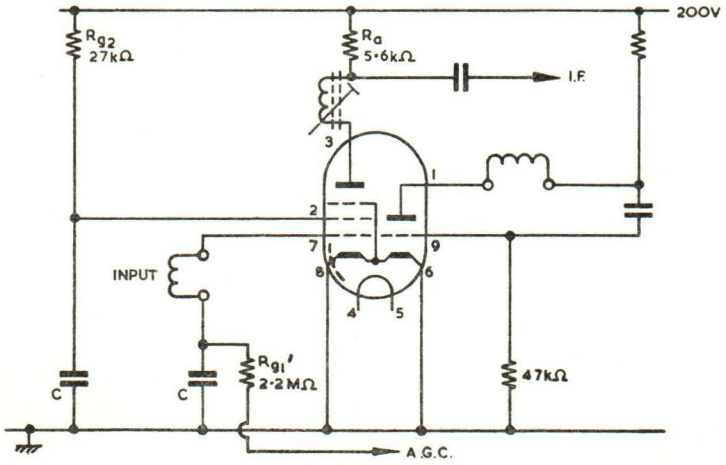
Grid current bias operation with A.G.C. Oscillator voltage injected into grid 1.

Pentode		F.C.	I.F.*	
Frequency	f	200	36	Mc/s
Supply Voltage	V_b	200	200	V
Anode Voltage (Decoupling Resistance, R_a=5·6kΩ) (approx)	V_a	155	125	V
Screen Grid Voltage (R_{g2}=27kΩ) (approx)	V_{g2}	135	92	V
Current through Grid 1 resistance $R_{g1'}$ ($R_{g1'}$=2·2MΩ)	I_{g1}	1·3	0·3	μA
Anode Current (approx)	I_a	7·8	13·2	mA
Screen Grid Current (approx)	I_{g2}	2·4	4·0	mA
D.C. Voltage on Pentode Control Grid at maximum gain		−3·0	—	V
Conversion Conductance at 1 Mc/s (V_b, R_a, R_{g1}, R_{g2} as above)	g_c	4·7	—	mA/V
Grid Voltage for Conversion Conductance reduction 10 : 1	$V_{g1(gc/10)}$	−6·8	—	V
Mutual Conductance (V_b,R_a,R_{g1},R_{g2} as above)	g_m	—	15·2	mA/V
Grid Voltage for Mutual Conductance reduction 10 : 1	$V_{g1(gm/10)}$	—	−5·0	V
Grid Voltage for Mutual Conductance reduction 100 : 1	$V_{g1(gm/100)}$	—	−6·8	V
Valve Input Resistance (Anode short circuited)	r_{g1}	—	9	kΩ
Working Input Capacitance	$c_{in(w)}$	—	11†	pF
Change in Input Capacitance by biasing valve to cut-off	$\triangle c_{in(w)}$	—	2·8	pF

Triode			
Anode Voltage	V_a	77	V
Anode Current	I_a	7·8	mA
Rectified Grid Voltage (Grid Resistance=47kΩ)	V_g	6·5	V

* Supply voltage removed from triode.

† With holder capacitance balanced out but with can.



C = DECOUPLING CAPACITORS

TYPICAL OPERATION AS FREQUENCY CHANGER AND I.F. AMPLIFIER

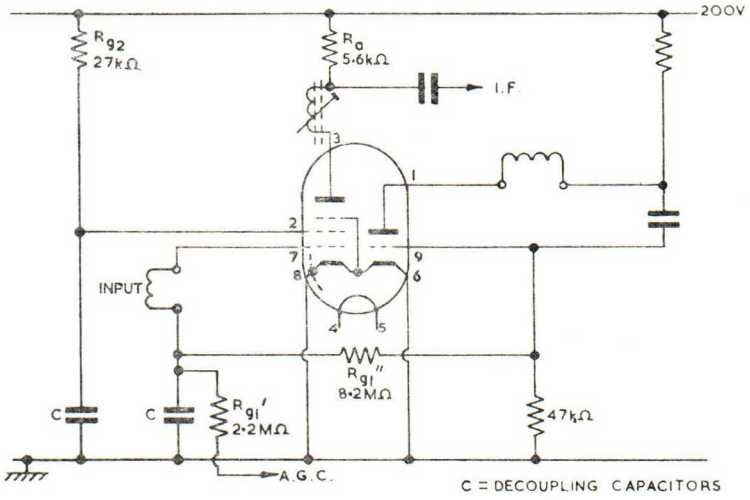
Partial grid current bias can be used for the frequency changer operation when a rectified voltage of greater than 8V d.c. is available from the triode grid resistor. This reduces the delay in the initial $V_{a.g.c.}/g_c$ characteristic as shown on page 12. The heterodyne voltage is injected into grid 1.

Pentode		F.C.	I.F.*	
Frequency	f	200	36	Mc/s
Supply Voltage	V_b	200	200	V
Anode Voltage (Decoupling Resistance, R_a=5·6kΩ) approx	V_a	160	125	V
Screen Grid Voltage (R_{g2}=27kΩ) approx	V_{g2}	140	92	V
Current through resistance $R_{g1'}$ ($R_{g1'}$=2·2MΩ)		1·6	0·3	μA
Resistance to provide Bias from Triode Grid	$R_{g1''}$	8·2	8·2	MΩ
Anode Current (approx)	I_a	7·0	13·2	mA
Screen Grid Current (approx)	I_{g2}	2·2	4·0	mA
D.C. Voltage on Pentode Control Grid at maximum gain		−3·5	—	V
Conversion Conductance at 1 Mc/s (V_b, R_a, R_{g1}, R_{g2} as above)	g_c	4·7	—	mA/V
Grid Voltage for Conversion Conductance reduction 10 : 1	$V_{g1(gc/10)}$	−5·8	—	V
Mutual Conductance (V_b, R_a, R_{g1}, R_{g2} as above)	g_m	—	15·2	mA/V
Grid Voltage for Mutual Conductance reduction 10 : 1	$V_{g1(gm/10)}$	—	−6·2	V
Grid Voltage for Mutual Conductance reduction 100 : 1	$V_{g1(gm/100)}$	—	−8·5	V
Valve Input Resistance (Anode short circuited)	r_{g1}	—	9	kΩ
Working Input Capacitance	$c_{in(w)}$	—	11†	pF
Change in Input Capacitance by biasing valve to cut-off	$\Delta c_{in(w)}$	—	2·8	pF

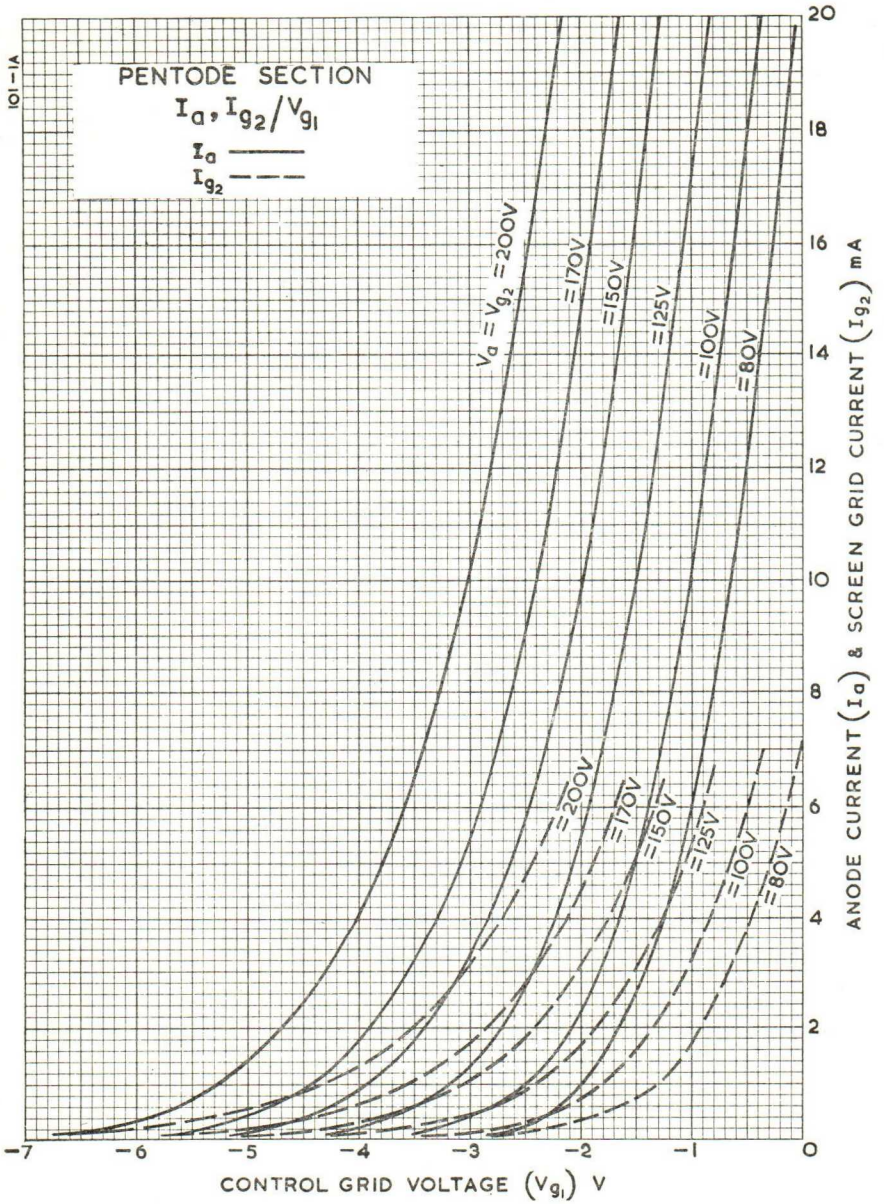
Triode			
Anode Voltage	V_a	110	V
Anode Current	I_a	10·5	mA
Rectified Grid Voltage (Grid Resistance=47kΩ)	V_g	11	V

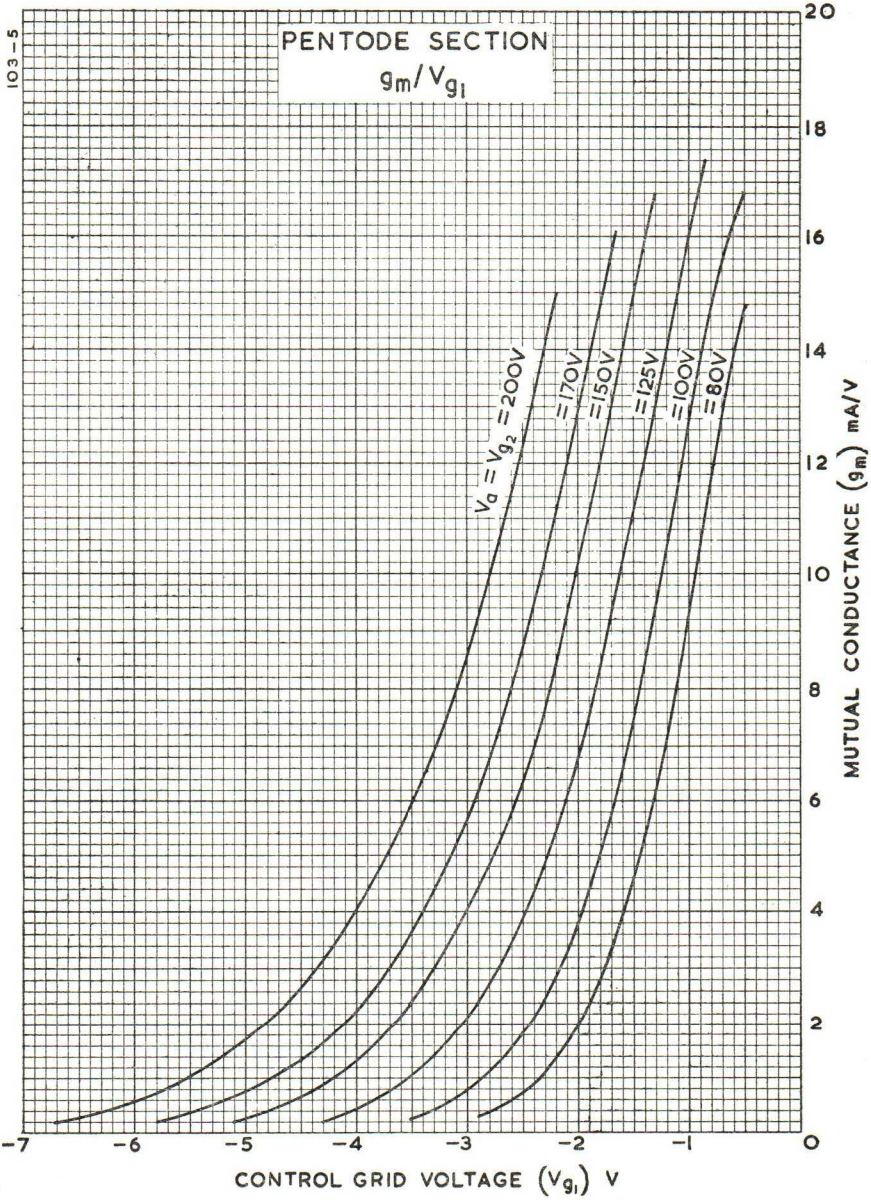
* Supply voltage removed from triode.

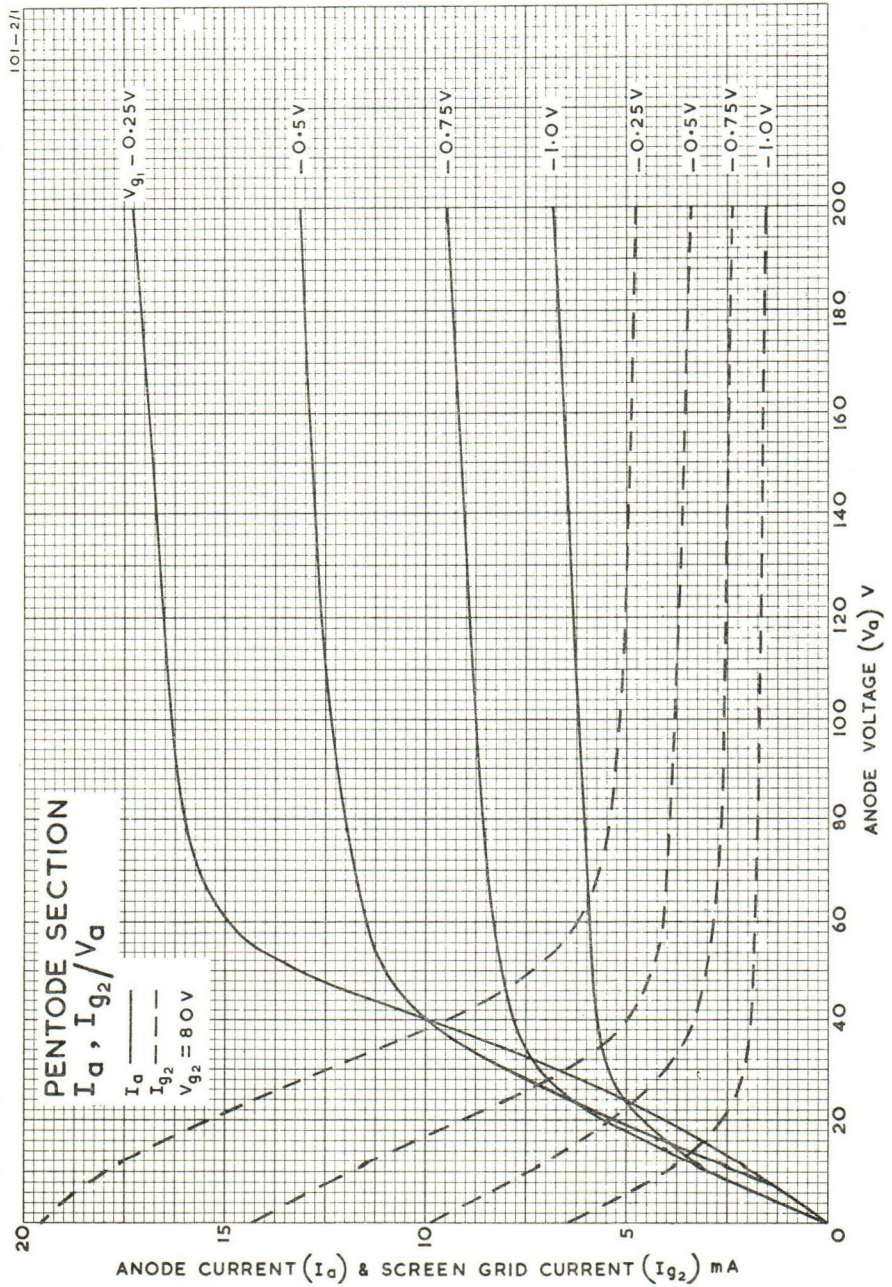
† With holder capacitance balanced out but with can.

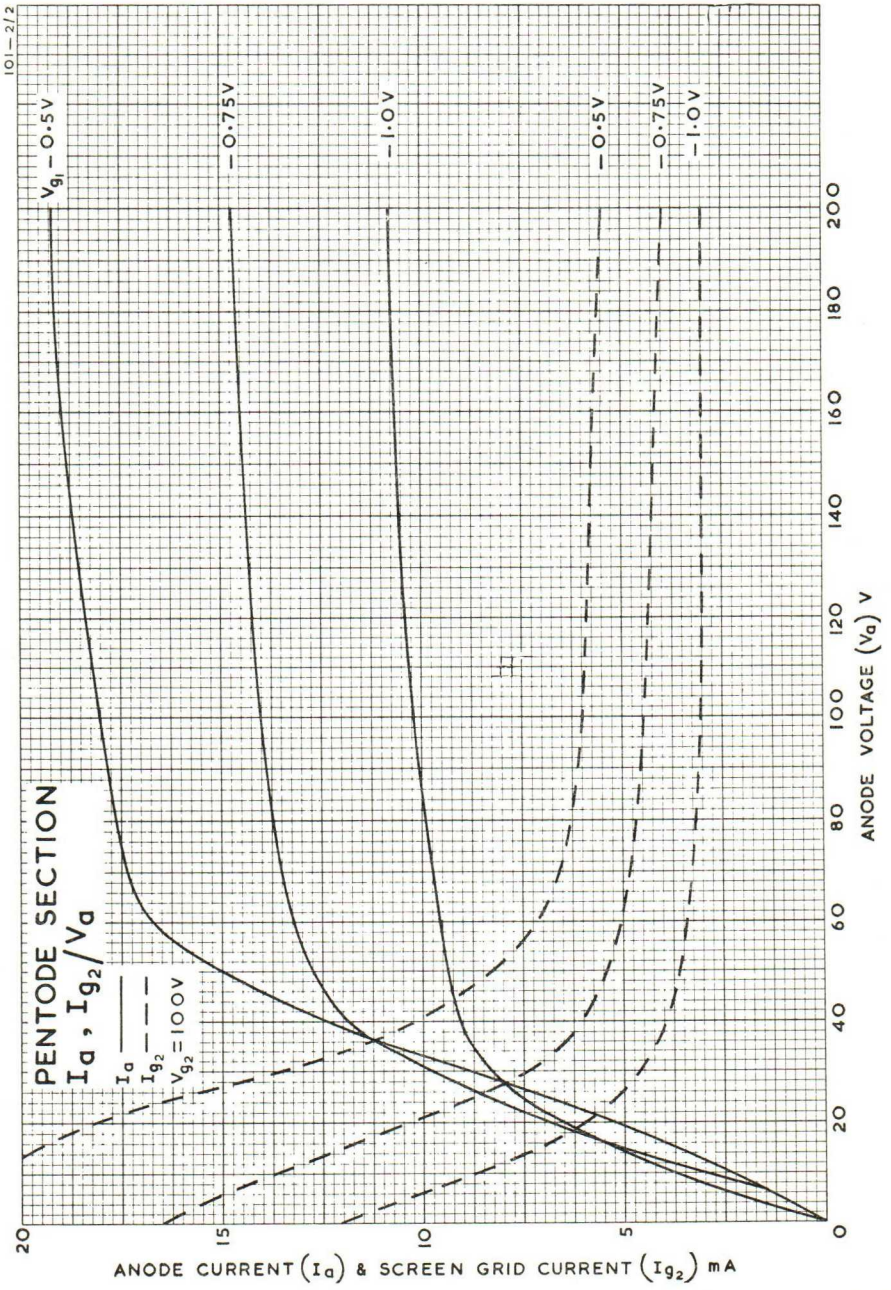


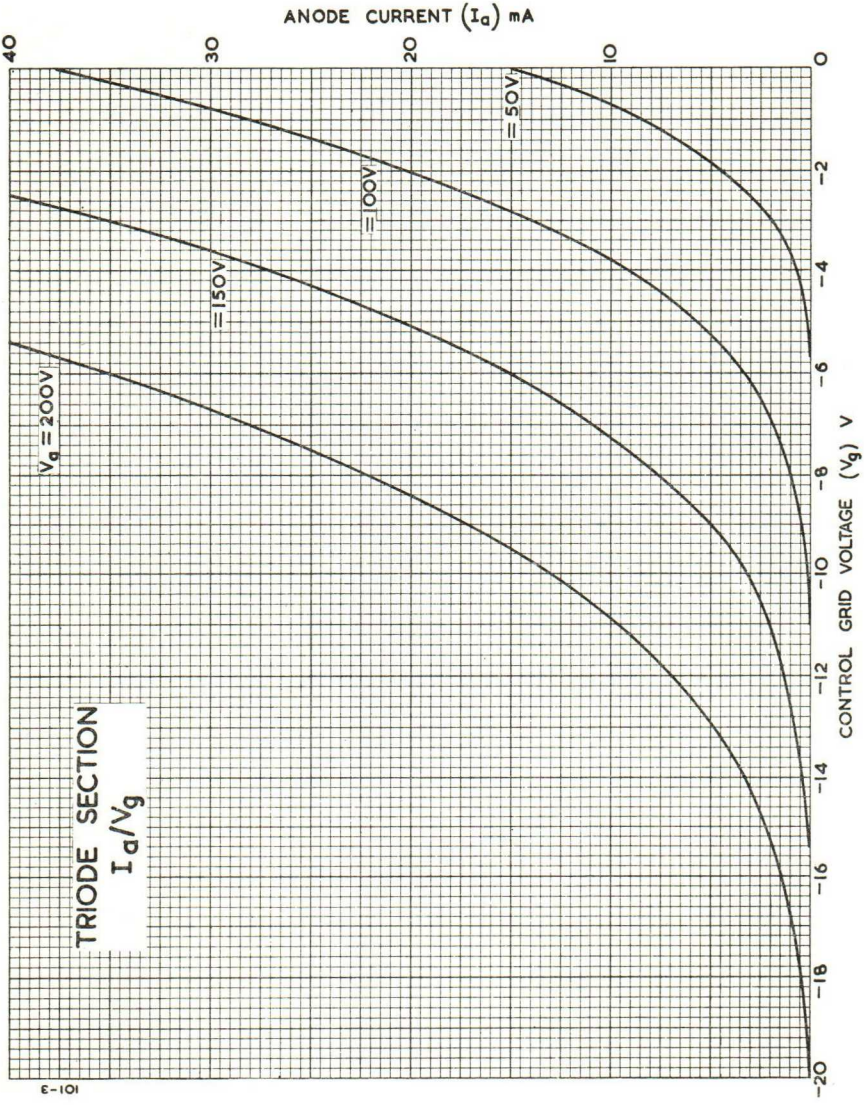
MOUNTING POSITION—Unrestricted

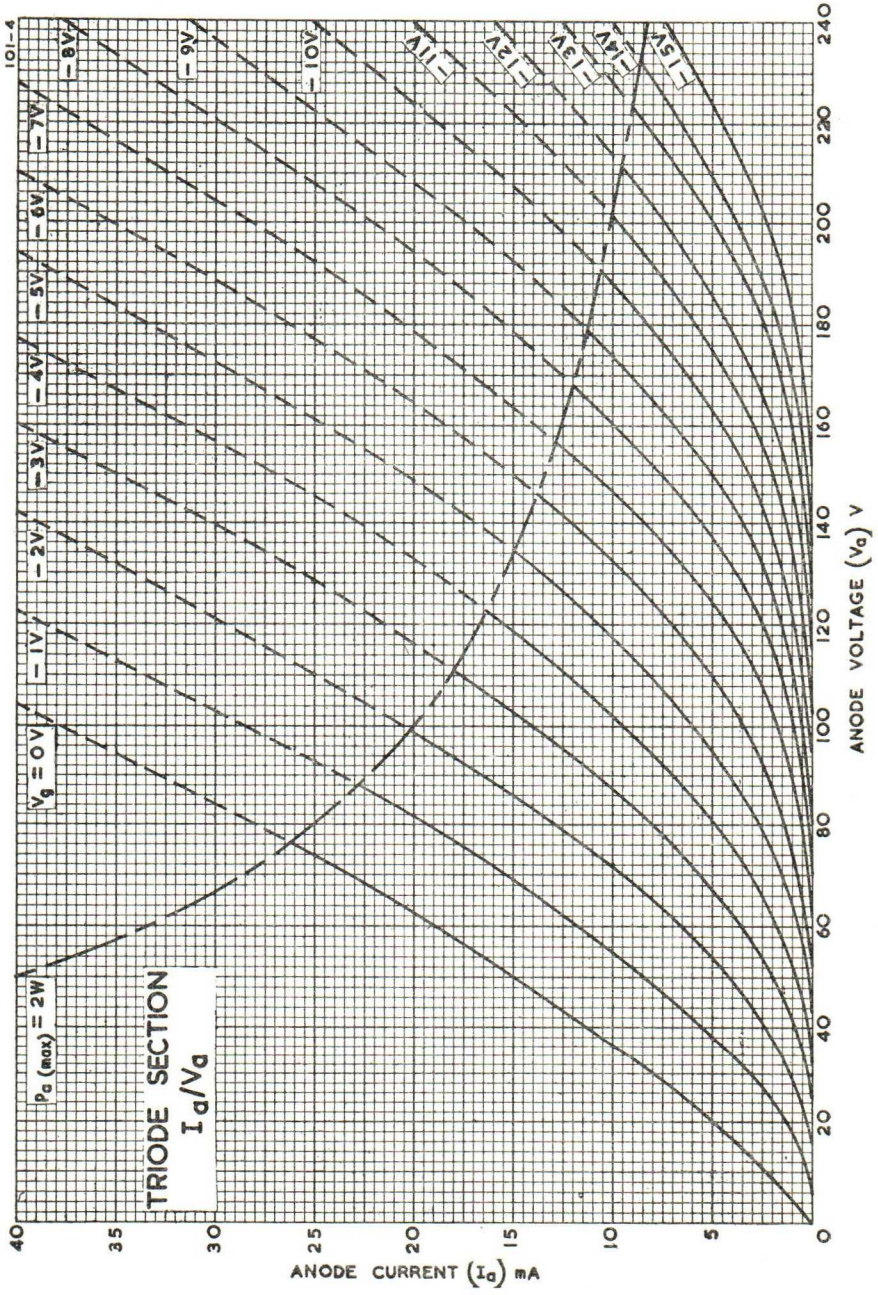

101-1A
PENTODE SECTION
$I_a, I_{g_2}/V_{g_1}$
I_a
I_{g_2}
$V_a = V_{g_2} = 200V$
$= 170V$
$= 150V$
$= 125V$
$= 100V$
$= 80V$
$= 200V$
$= 170V$
$= 150V$
$= 125V$
$= 100V$
$= 80V$
20
18
16
14
12
10
8
6
4
2
0
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
−7
−6
−5
−4
−3
−2
−1
0
CONTROL GRID VOLTAGE (V_{g_1}) V

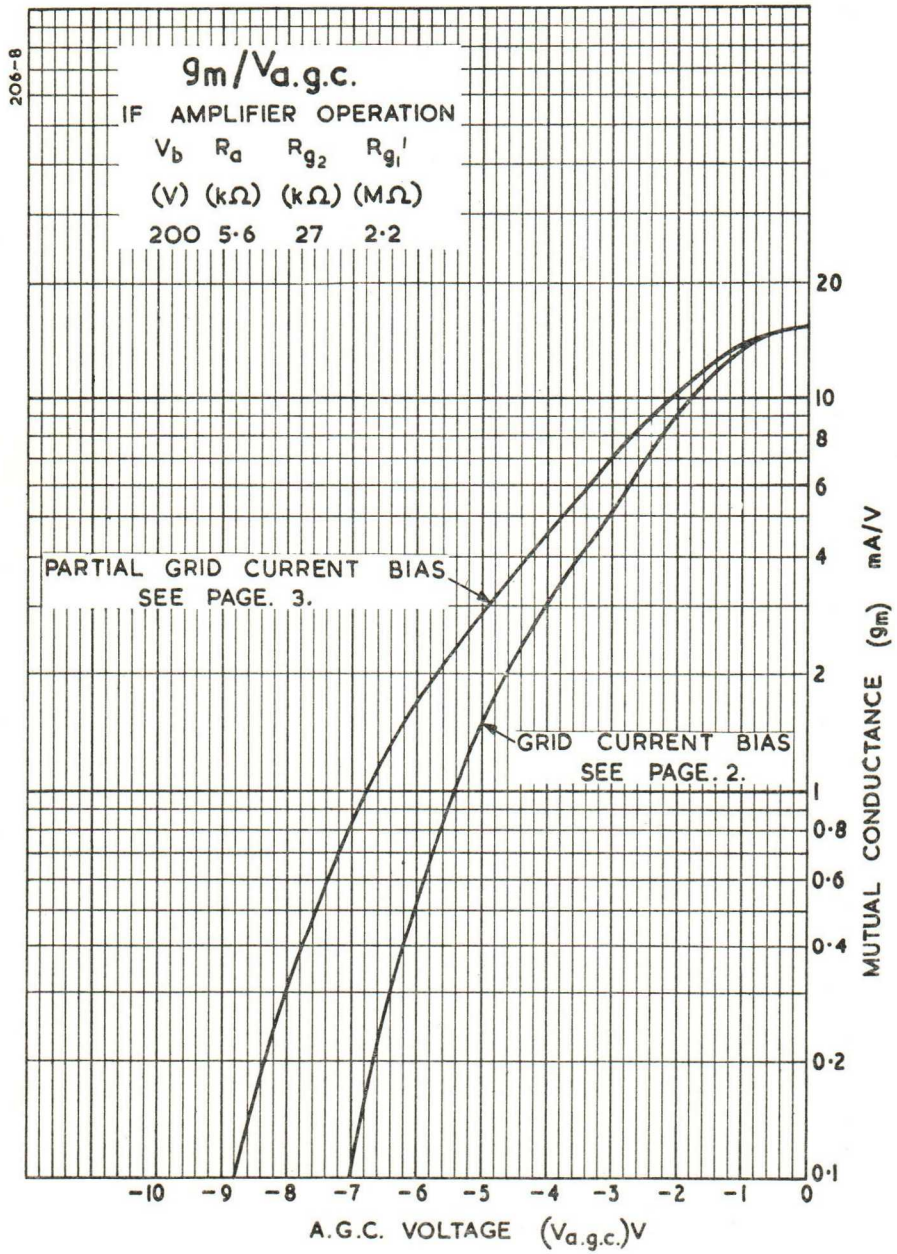

PENTODE SECTION
g_m/V_{g_1}
103-5
$V_a = V_{g_2} = 200V$
170V
150V
125V
100V
80V
MUTUAL CONDUCTANCE (g_m) mA/V
CONTROL GRID VOLTAGE (V_{g_1}) V
20
18
16
14
12
10
8
6
4
2
0
-7
-6
-5
-4
-3
-2
-1

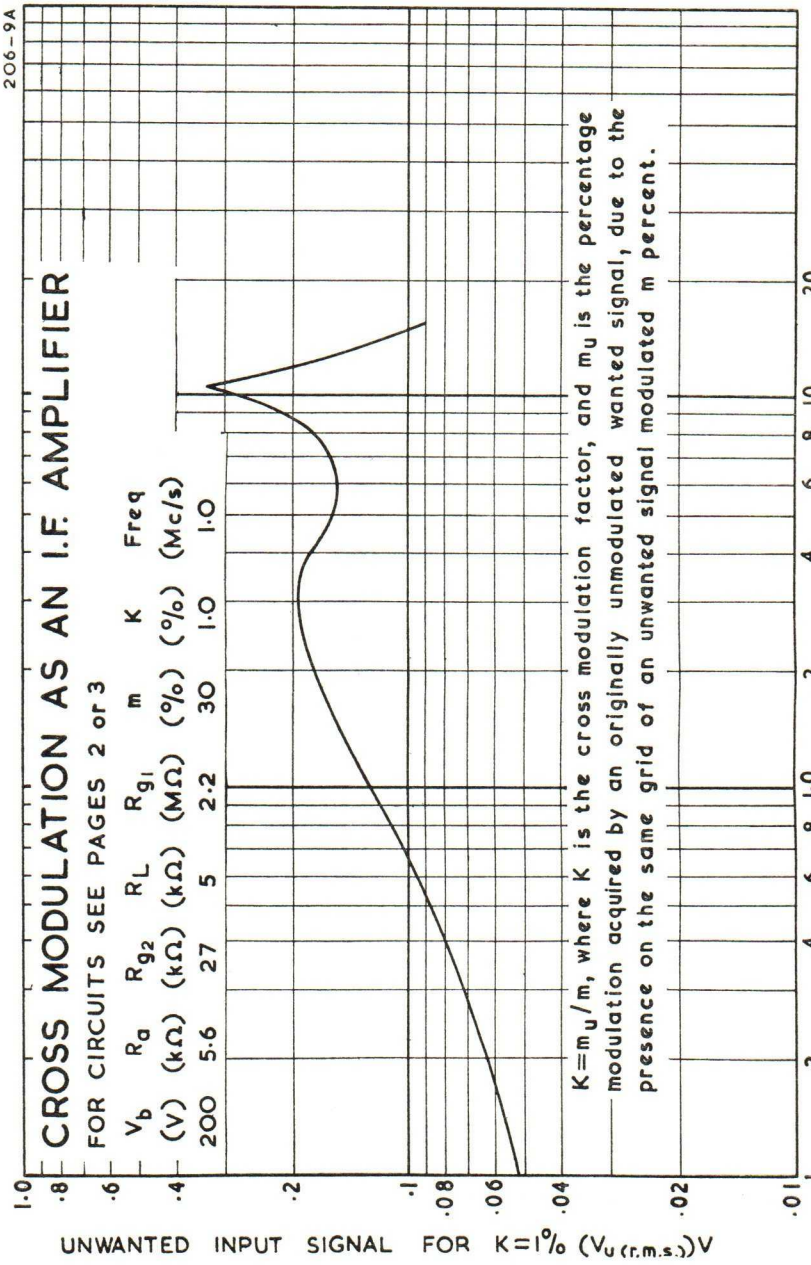

101-271
V_{g_1} -0·25V
-0·5V
-0·75V
-1·0V
-0·25V
-0·5V
-0·75V
-1·0V
PENTODE SECTION
I_a , I_{g_2}/V_a
I_a ——
I_{g_2} — — —
V_{g_2} = 80 V
ANODE VOLTAGE (V_a) V
0
20
40
60
80
100
120
140
160
180
200
20
15
10
5
0
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA

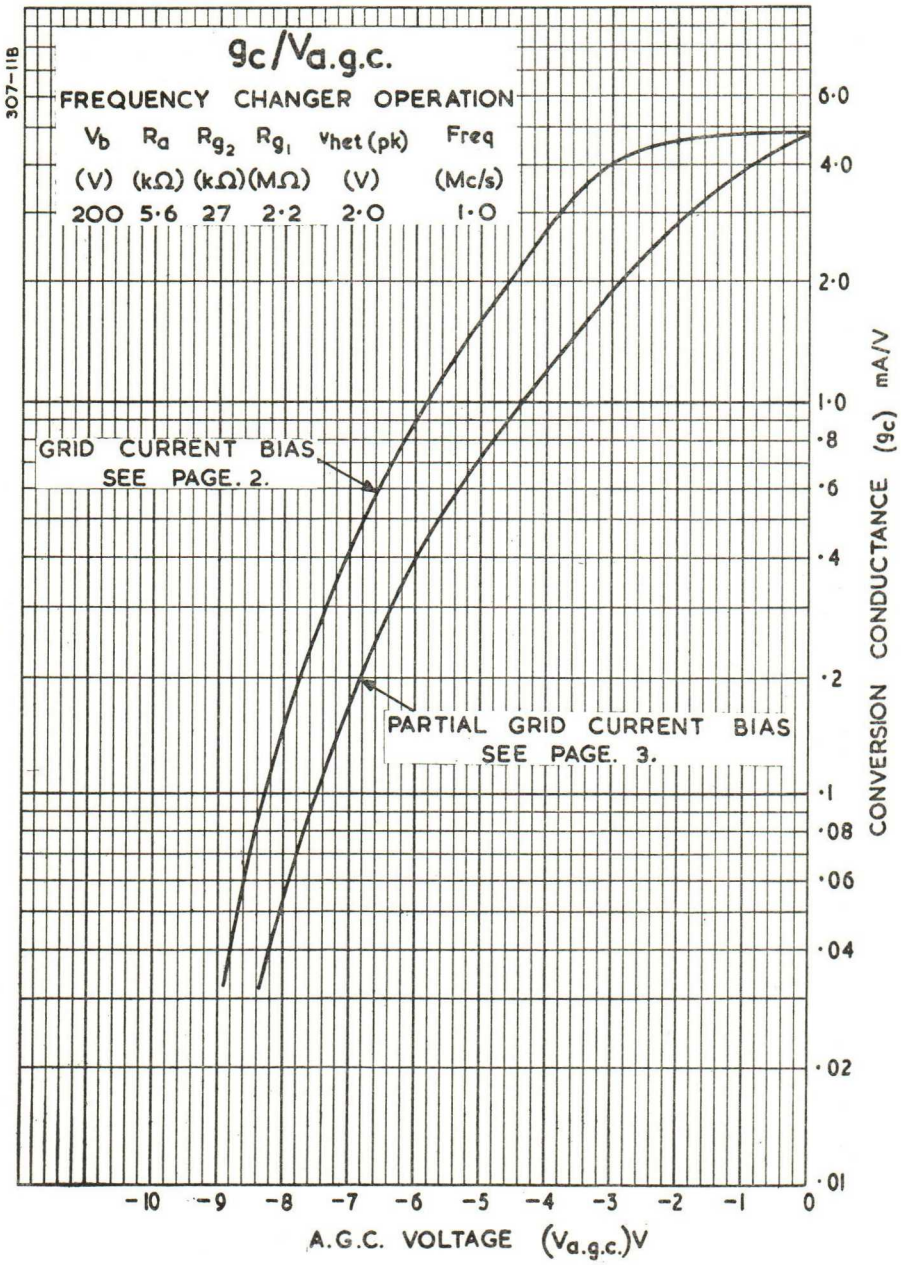

101—2/2
V_{g_1} — 0·5V
— 0·75V
— 1·0V
— 0·5V
— 0·75V
— 1·0V
PENTODE SECTION
I_a , I_{g_2}/V_a
I_a ——
I_{g_2} — — —
V_{g_2} = 100V
ANODE VOLTAGE (V_a) V
0 20 40 60 80 100 120 140 160 180 200
20 15 10 5
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA

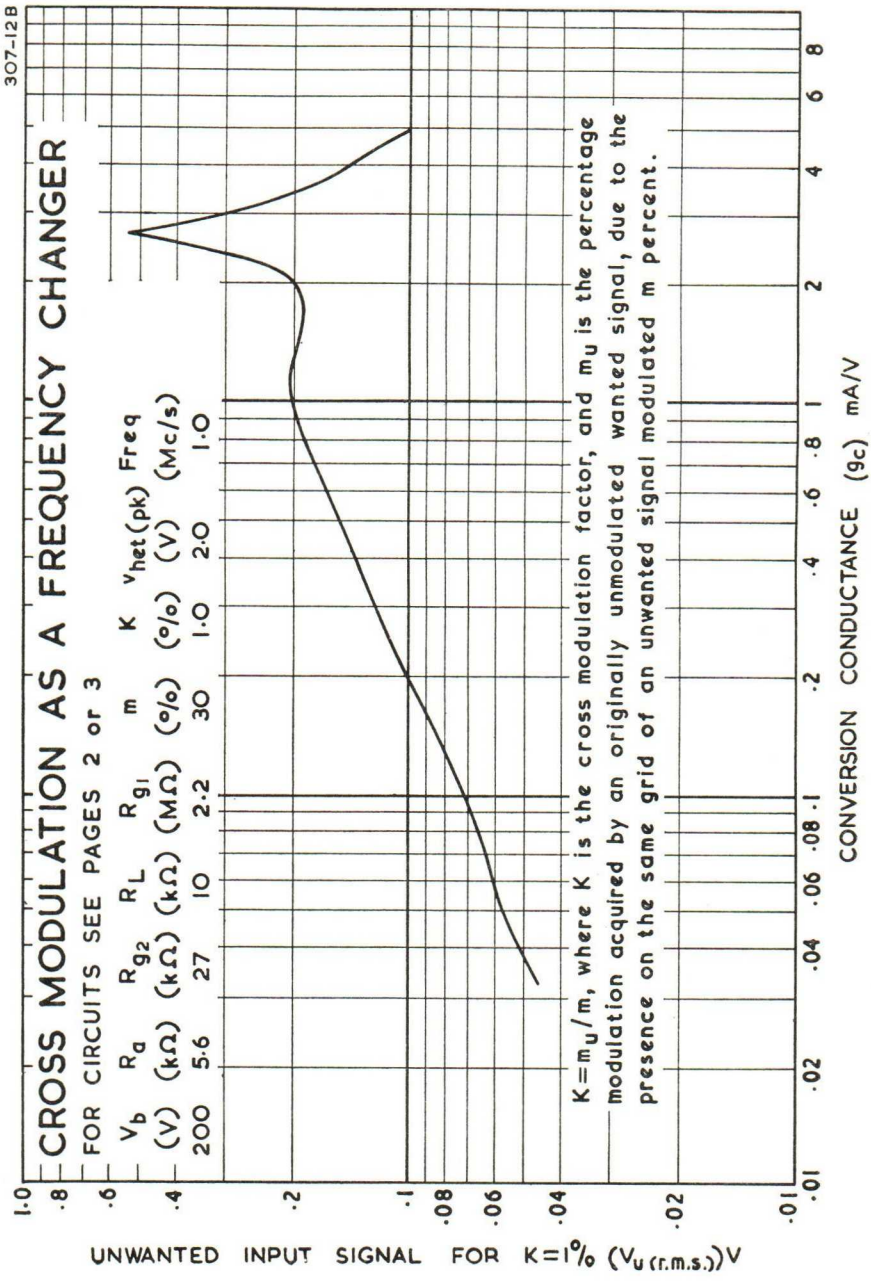

ANODE CURRENT (Ia) mA
40
30
20
10
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
CONTROL GRID VOLTAGE (Vg) V
Vg = 50V
Vg = 100V
Vg = 150V
Vg = 200V
TRIODE SECTION
Ia/Vg
E-101

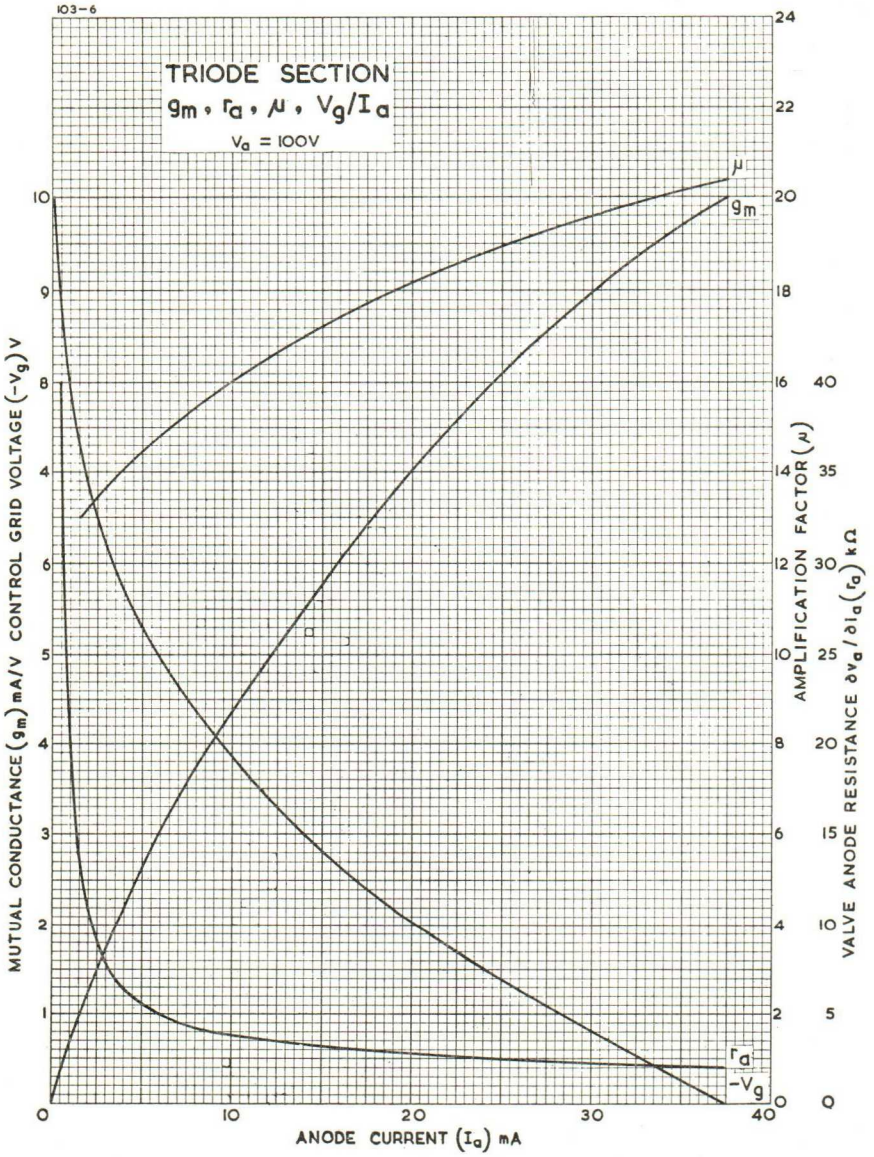

101-4
TRIODE SECTION
Ia/Va
Pa (max) = 2W
Vg = 0V
-1V
-2V
-3V
-4V
-5V
-6V
-7V
-8V
-9V
-10V
-11V
-12V
-13V
-14V
-15V
ANODE CURRENT (Ia) mA
ANODE VOLTAGE (Va) V
40
35
30
25
20
15
10
5
0
20
40
60
80
100
120
140
160
180
200
220
240

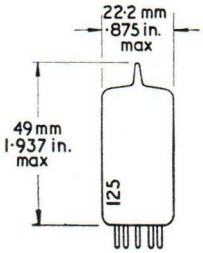

206-8
gm/Va.g.c.
IF AMPLIFIER OPERATION
Vb Ra Rg2 Rg1'
(V) (kΩ) (kΩ) (MΩ)
200 5·6 27 2·2
PARTIAL GRID CURRENT BIAS
SEE PAGE. 3.
GRID CURRENT BIAS
SEE PAGE. 2.
20
10
8
6
4
2
1
0·8
0·6
0·4
0·2
0·1
MUTUAL CONDUCTANCE (gm) mA/V
-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0
A.G.C. VOLTAGE (Va.g.c.)V


206-9A
CROSS MODULATION AS AN I.F. AMPLIFIER
FOR CIRCUITS SEE PAGES 2 or 3
Vb (V) 200
Ra (kΩ) 5.6
Rg2 (kΩ) 27
RL (kΩ) 5
Rg1 (MΩ) 2.2
m (%) 30
K (%) 1.0
Freq (Mc/s) 1.0
K=mu/m, where K is the cross modulation factor, and mu is the percentage modulation acquired by an originally unmodulated wanted signal, due to the presence on the same grid of an unwanted signal modulated m percent.
UNWANTED INPUT SIGNAL FOR K=1% (Vu (r.m.s.))V
MUTUAL CONDUCTANCE (gm) mA/V
1.0
.8
.6
.4
.2
.1
.08
.06
.04
.02
.01
.2
.4
.6
.8
1.0
2
4
6
8
10
20

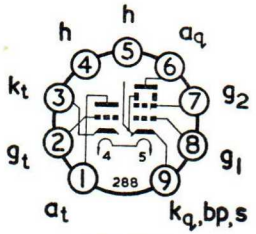

307-11B
gc/Va.g.c.
FREQUENCY CHANGER OPERATION
Vb Ra Rg2 Rg1 Vhet (pk) Freq
(V) (kΩ) (kΩ) (MΩ) (V) (Mc/s)
200 5·6 27 2·2 2·0 1·0
GRID CURRENT BIAS
SEE PAGE. 2.
PARTIAL GRID CURRENT BIAS
SEE PAGE. 3.
6·0
4·0
2·0
1·0
·8
·6
·4
·2
·1
·08
·06
·04
·02
·01
CONVERSION CONDUCTANCE (gc) mA/V
-10 -9 -8 -7 -6 -5 -4 -3 -2 -1 0
A.G.C. VOLTAGE (Va.g.c.)V


307-12B
CROSS MODULATION AS A FREQUENCY CHANGER
FOR CIRCUITS SEE PAGES 2 or 3
Vb (V) 200
Ra (kΩ) 5·6
Rg2 (kΩ) 27
RL (kΩ) 10
Rg1 (MΩ) 2·2
m (%) 30
K (%) 1·0
vhet(pk) (V) 2·0
Freq (Mc/s) 1·0
K=mu/m, where K is the cross modulation factor, and mu is the percentage modulation acquired by an originally unmodulated wanted signal, due to the presence on the same grid of an unwanted signal modulated m percent.
UNWANTED INPUT SIGNAL FOR K=1% (Vu (r.m.s.))V
CONVERSION CONDUCTANCE (gc) mA/V


103-6
TRIODE SECTION
gm , ra , μ , Vg/Ia
Va = 100V
μ
gm
ra
-Vg
MUTUAL CONDUCTANCE (gm) mA/V
CONTROL GRID VOLTAGE (-Vg) V
AMPLIFICATION FACTOR (μ)
VALVE ANODE RESISTANCE δva/δIa (ra) kΩ
ANODE CURRENT (Ia) mA
0
10
20
30
40
1
2
3
4
5
6
7
8
9
10
12
14
16
18
20
22
24
25
35



TRIODE BEAM TETRODE



B9A Base

GENERAL

This triode beam tetrode valve with separate cathodes is an improved 30FLI/PCE800 in which the construction and processing of the beam tetrode and triode have been optimised for use respectively as a sync. separator and line scan oscillator in TV receivers. The triode section has identical characteristics to the 6/30L2/ECC804.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	10·4	V

RATINGS

		Triode	Tetrode	
Maximum Anode Dissipation	$P_{a(max)}$	2·0	3·0	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	—	1·0	W
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	—	250	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h\text{-}k(r.m.s.)max}$	150*	150*	V

* Measured with respect to the higher potential heater pin.

INTER-ELECTRODE CAPACITANCES

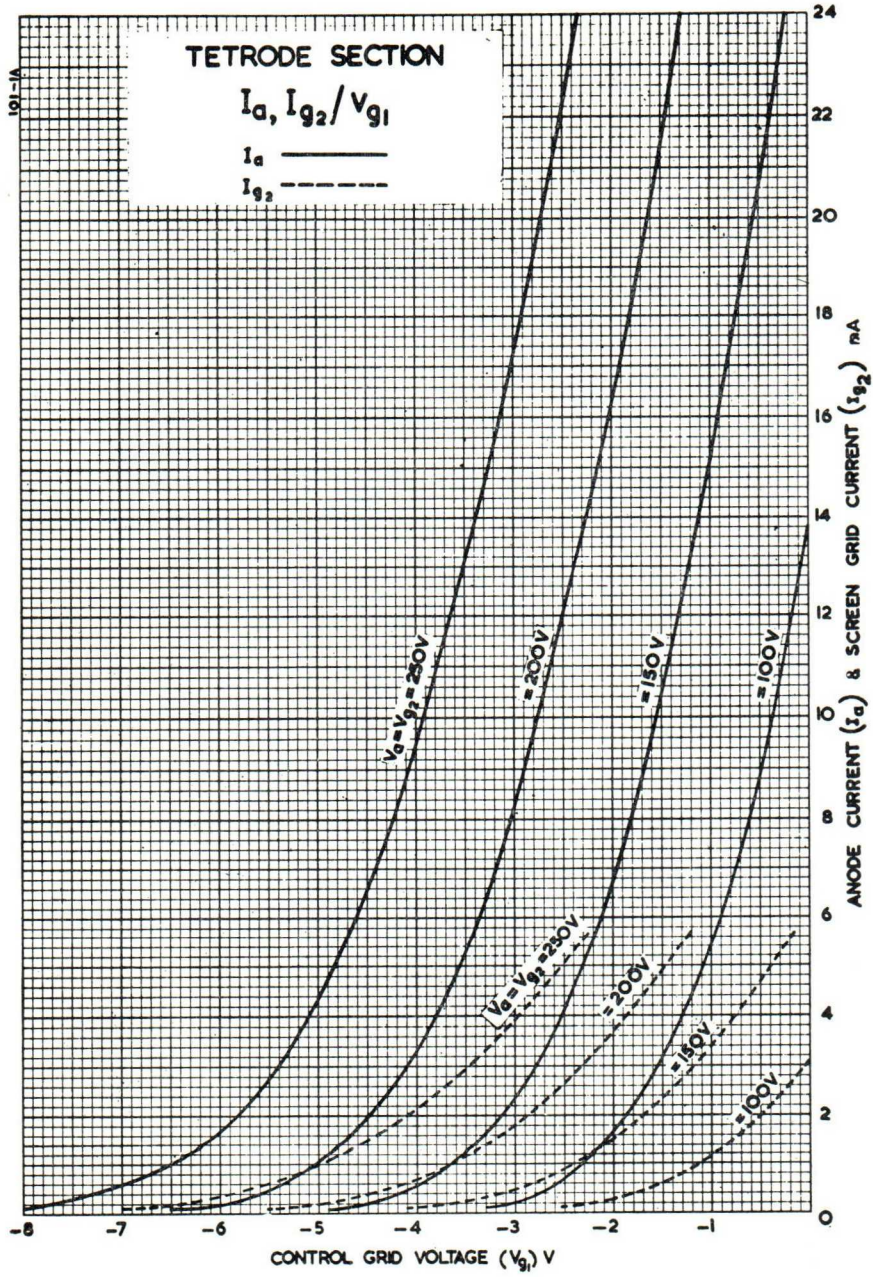
		†	§	‡	
Grid 1 to Earth	$c_{g1\text{-}E}$	7·8	8·0	9·1	pF
Anode Tetrode to Earth	$c_{aq\text{-}E}$	2·4	2·7	3·8	pF
Grid 1 to Anode Tetrode	$c_{g1\text{-}aq}$	0·033	0·047	0·075	pF
Grid Triode to Earth	$c_{gt\text{-}E}$	2·2	2·45	3·25	pF
Anode Triode to Earth	$c_{at\text{-}E}$	2·1	2·3	3·0	pF
Grid Triode to Anode Triode	$c_{gt\text{-}at}$	2·3	2·4	2·7	pF
Grid 1 to Anode Triode	$c_{g1\text{-}at}$	0·0065	0·016	0·03	pF
Grid Triode to Anode Tetrode	$c_{gt\text{-}aq}$	0·0073	0·012	0·015	pF
Anode Tetrode to Anode Triode	$c_{aq\text{-}at}$	0·035	0·043	0·046	pF
Grid 1 to Grid Triode	$c_{g1\text{-}gt}$	0·002	0·0055	0·0094	pF

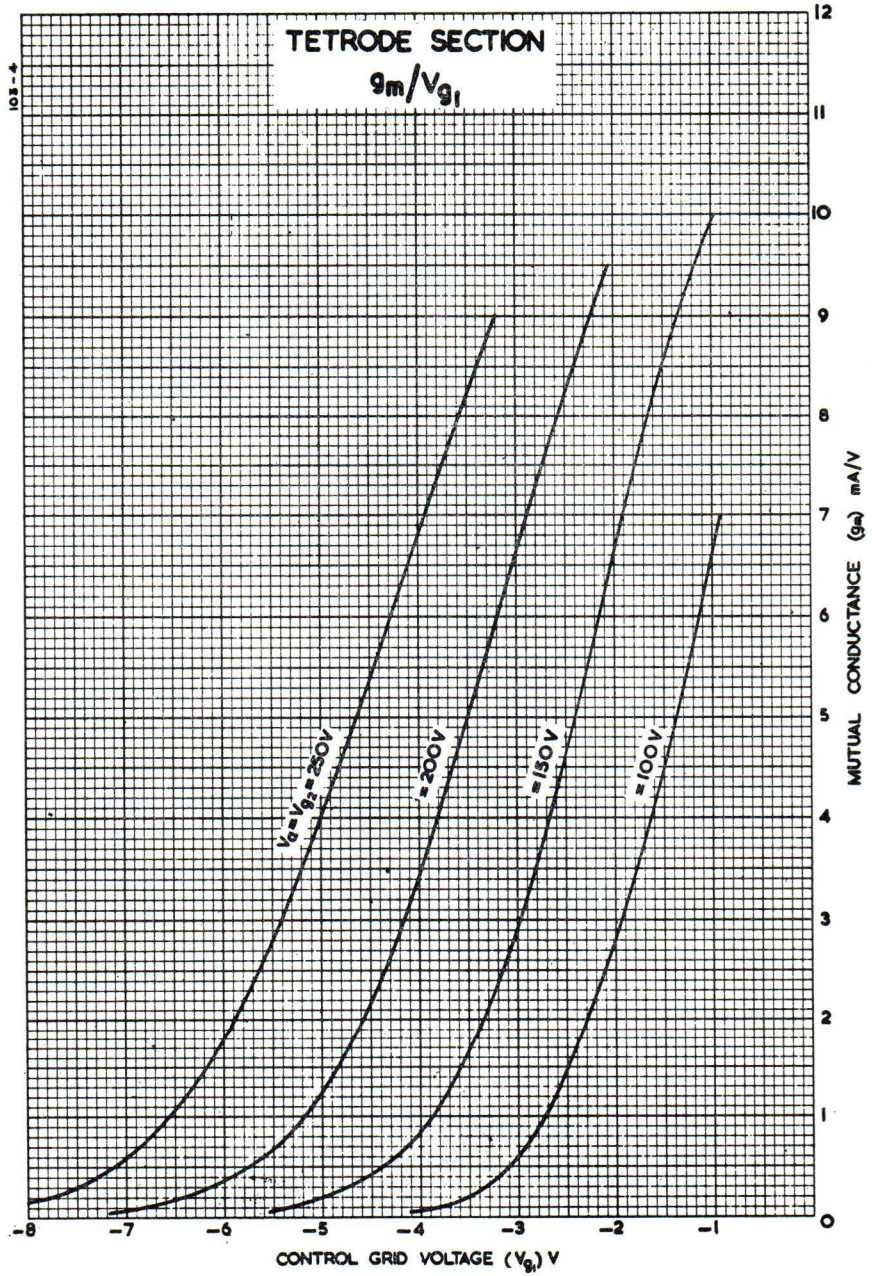
† In fully shielded socket without can.
§ With holder capacitance balanced out.
‡ Total capacity including B9A nylon phenolic holder without skirt or radial shield.
"Earth" denotes the electrodes of any second valve section and the remaining earthy potential electrodes of the section under measurement, heater and shields joined to cathode.

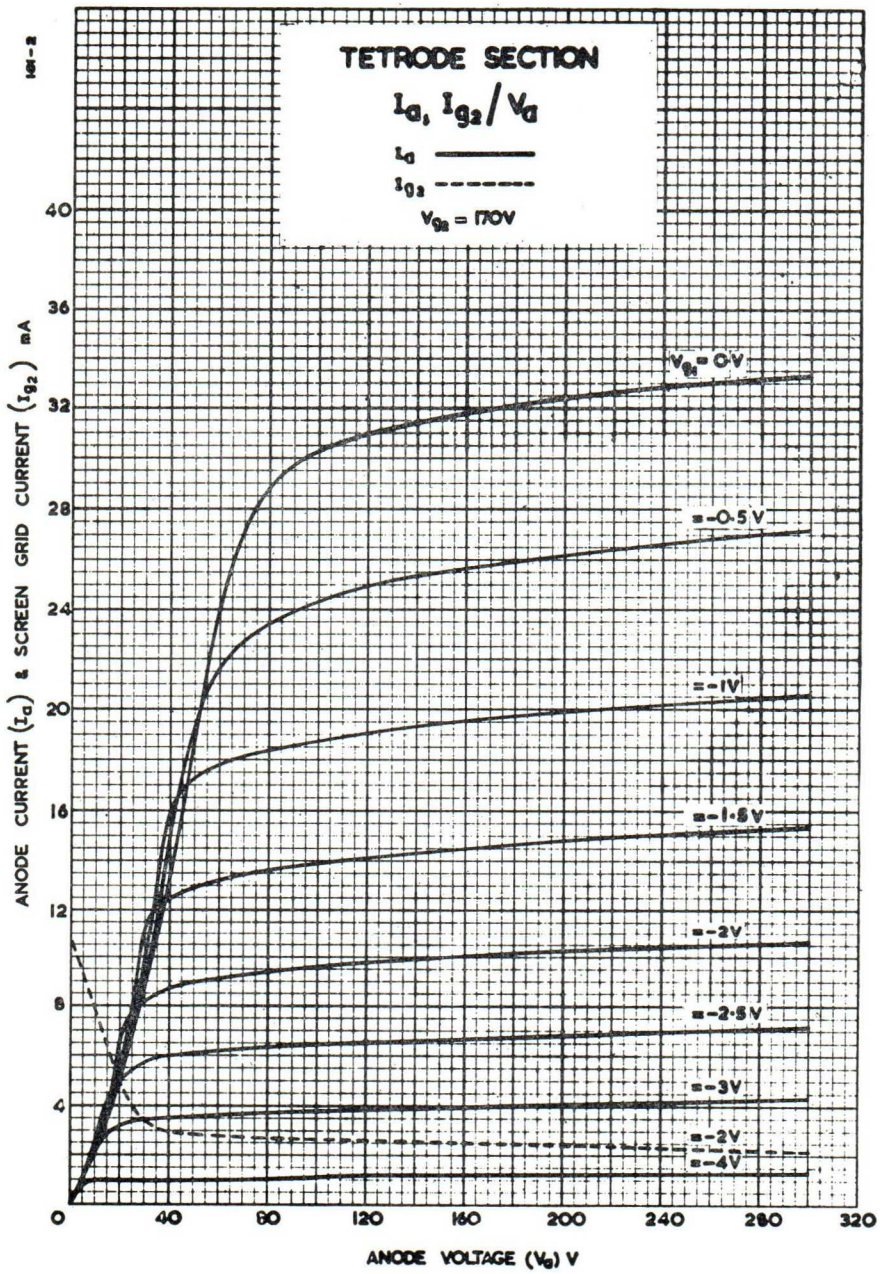
CHARACTERISTICS

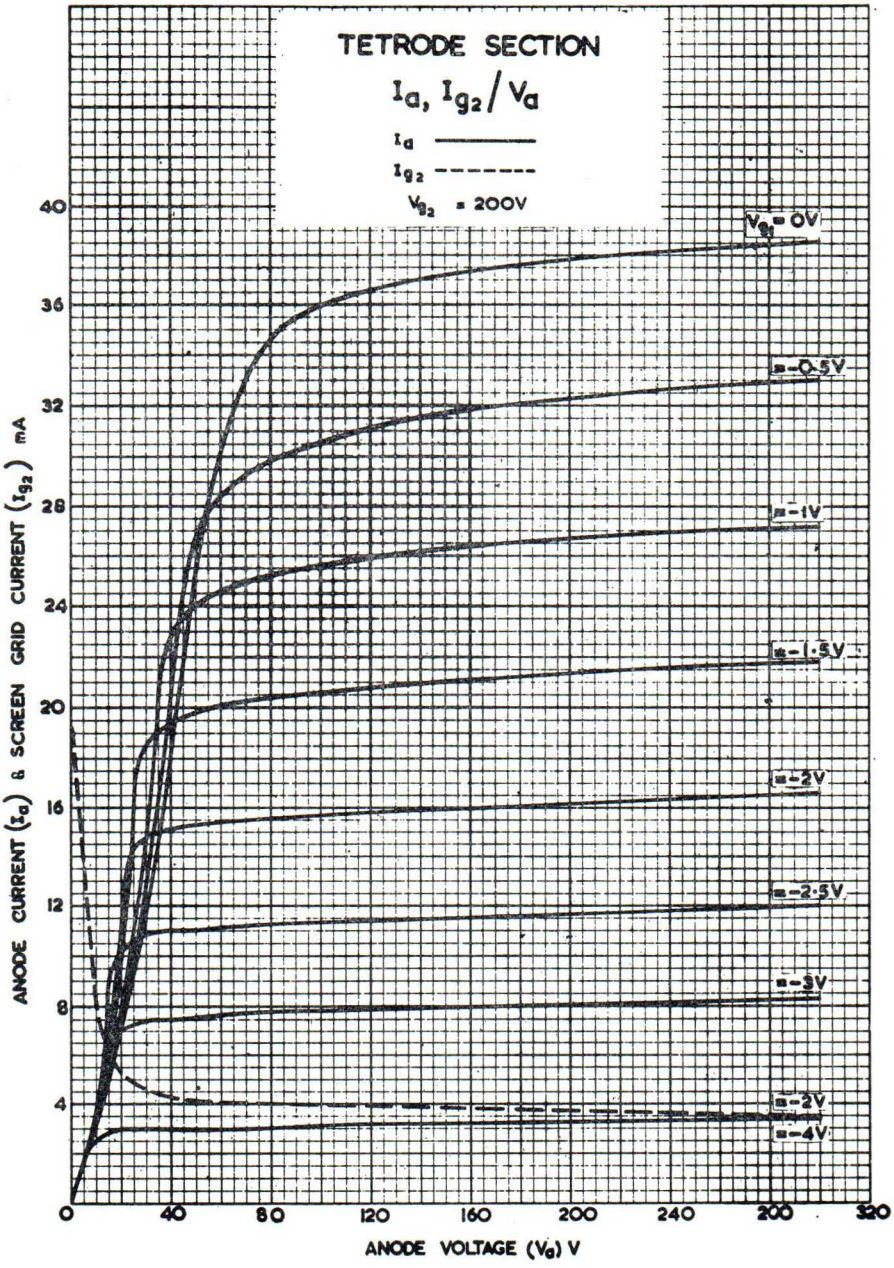
		Triode	Tetrode	
Anode Voltage	V_a	200	170	V
Screen Grid Voltage	V_{g2}	—	170	V
Control Grid Voltage	V_{g1}	−7·7	−2·0	V
Anode Current	I_a	10	10	mA
Screen Grid Current	I_{g2}	—	2·5	mA
Mutual Conductance	g_m	3·4	8·0	mA/V
Amplification Factor	μ	18	—	
Inner Amplification Factor	$\mu_{g1\text{-}g2}$	—	44	

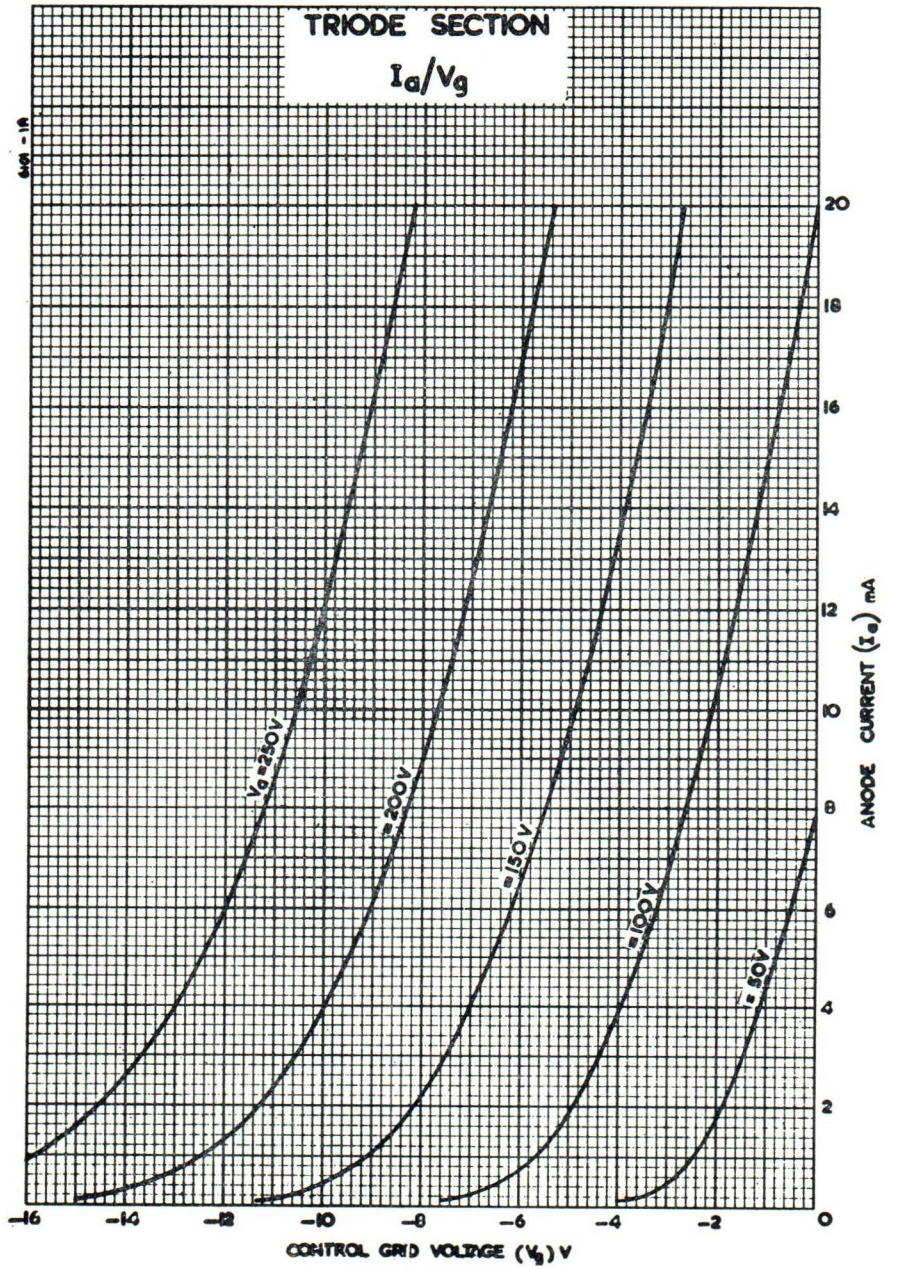
MOUNTING POSITION—Unrestricted.

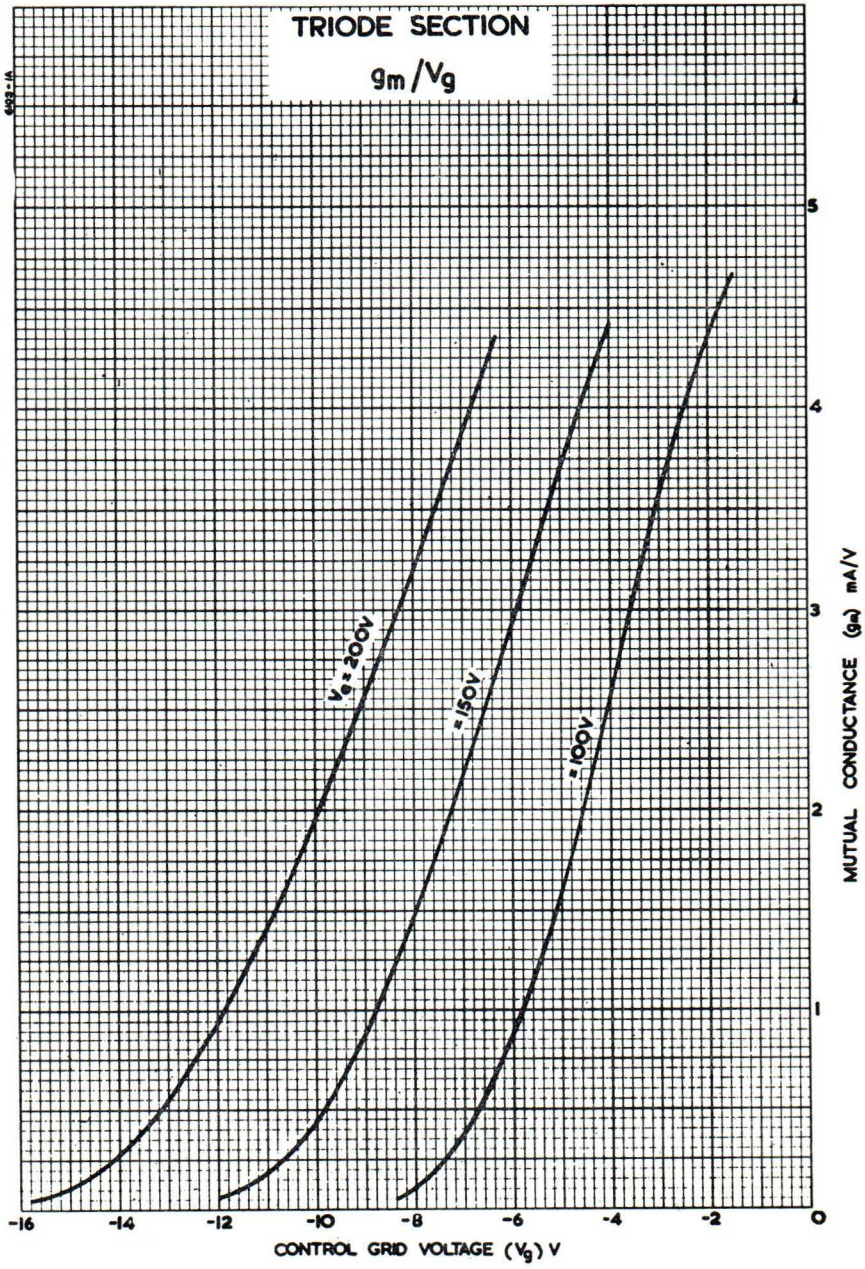

TETRODE SECTION
$I_a, I_{g_2} / V_{g1}$
I_a
I_{g_2}
191-1A
$V_a = V_{g_2} = 250V$
$= 200V$
$= 150V$
$= 100V$
$V_a = V_{g_2} = 250V$
$= 200V$
$= 150V$
$= 100V$
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
CONTROL GRID VOLTAGE (V_{g_1}) V
0
2
4
6
8
10
12
14
16
18
20
22
24
-8
-7
-6
-5
-4
-3
-2
-1


TETRODE SECTION
g_m/V_{g_1}
103-4
$V_a = V_{g_2} = 250V$
= 200V
= 150V
= 100V
MUTUAL CONDUCTANCE (g_m) mA/V
CONTROL GRID VOLTAGE (V_{g_1}) V
12
11
10
9
8
7
6
5
4
3
2
1
0
-8
-7
-6
-5
-4
-3
-2
-1


TETRODE SECTION
$I_a, I_{g_2} / V_a$
I_a
I_{g_2}
V_{g_2} = 170V
V_{g_1} = 0V
= -0.5V
= -1V
= -1.5V
= -2V
= -2.5V
= -3V
= -2V
= -4V
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
ANODE VOLTAGE (V_a) V
0
40
80
120
160
200
240
280
320
4
8
12
16
20
24
28
32
36
40

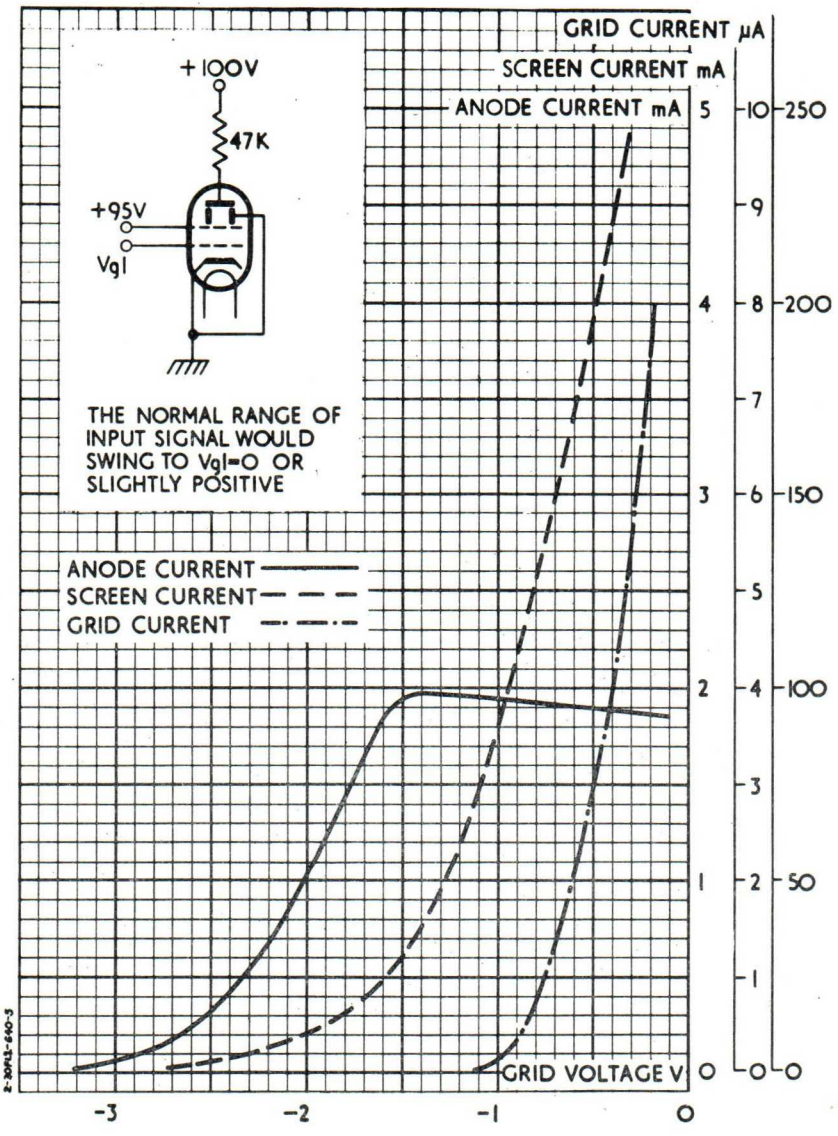

TETRODE SECTION
$I_a, I_{g_2} / V_a$
I_a
I_{g_2}
V_{g_2} = 200V
V_{g_1} = 0V
= -0.5V
= -1V
= -1.5V
= -2V
= -2.5V
= -3V
= -2V
= -4V
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
ANODE VOLTAGE (V_a) V
0
40
80
120
160
200
240
280
320
4
8
12
16
20
24
28
32
36
40

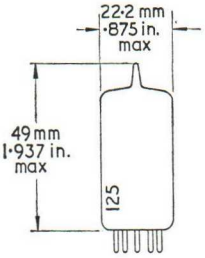

TRIODE SECTION
I_a/V_g
V_a = 250V
= 200V
= 150V
= 100V
= 50V
ANODE CURRENT (I_a) mA
0
2
4
6
8
10
12
14
16
18
20
−16
−14
−12
−10
−8
−6
−4
−2
CONTROL GRID VOLTAGE (V_g) V


TRIODE SECTION
gm/Vg
4093-1A
Va=200V
=150V
=100V
MUTUAL CONDUCTANCE (gm) mA/V
0
1
2
3
4
5
-16
-14
-12
-10
-8
-6
-4
-2
0
CONTROL GRID VOLTAGE (Vg) V

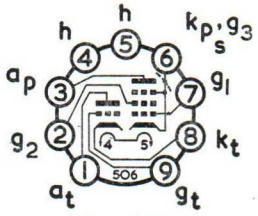
TETRODE SECTION

Used as limiter in a synchronising separator circuit.





TRIODE PENTODE



Base B9A

GENERAL

This triode pentode valve with separate cathodes is primarily intended for use in television receivers. The pentode has a high slope straight characteristic designed for use as an I.F. amplifier and is combined with a general purpose triode which may, for example, be used as a scanning oscillator. The shield connected to pin 6 completely surrounds the pentode thus minimising interaction between the sections.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	7·4	V

RATINGS

		Triode	Pentode	
Maximum Anode Dissipation	$P_{a(max)}$	2·0	2·0	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	—	0·7	W
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Screen Grid Voltage	$V_{g2(max}$	—	230	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h\text{-}k(r.m.s.)max}$	200	200	V
Maximum Cathode Current	$I_{k(max)}$	15	18	mA

INTER-ELECTRODE CAPACITANCES*

Grid 1 to Earth	$c_{g1\text{-}E}$	6·4	pF
Anode Pentode to Earth	$c_{ap\text{-}E}$	2·7	pF
Anode Pentode to Grid 1	$c_{ap\text{-}g1}$	0·008	pF
Anode Pentode to Grid 2	$c_{ap\text{-}g2}$	0·35	pF
Grid 1 to Grid 2	$c_{g1\text{-}g2}$	2·1	pF
Grid Triode to Earth	$c_{gt\text{-}E}$	2·4	pF
Anode Triode to Earth	$c_{at\text{-}E}$	1·6	pF
Anode Triode to Grid Triode	$c_{at\text{-}gt}$	2·1	pF
Anode Triode to Anode Pentode	$c_{at\text{-}ap}$	0·02	pF
Grid Triode to Grid 1	$c_{gt\text{-}g1}$	0·015	pF
Grid Triode to Anode Pentode	$c_{gt\text{-}ap}$	0·002	pF
Grid 1 to Anode Triode	$c_{g1\text{-}at}$	0·006	pF

"Earth" denotes the electrodes of the other section and the remaining earthy potential electrodes of the section under measurement, heater and shields joined to cathode.

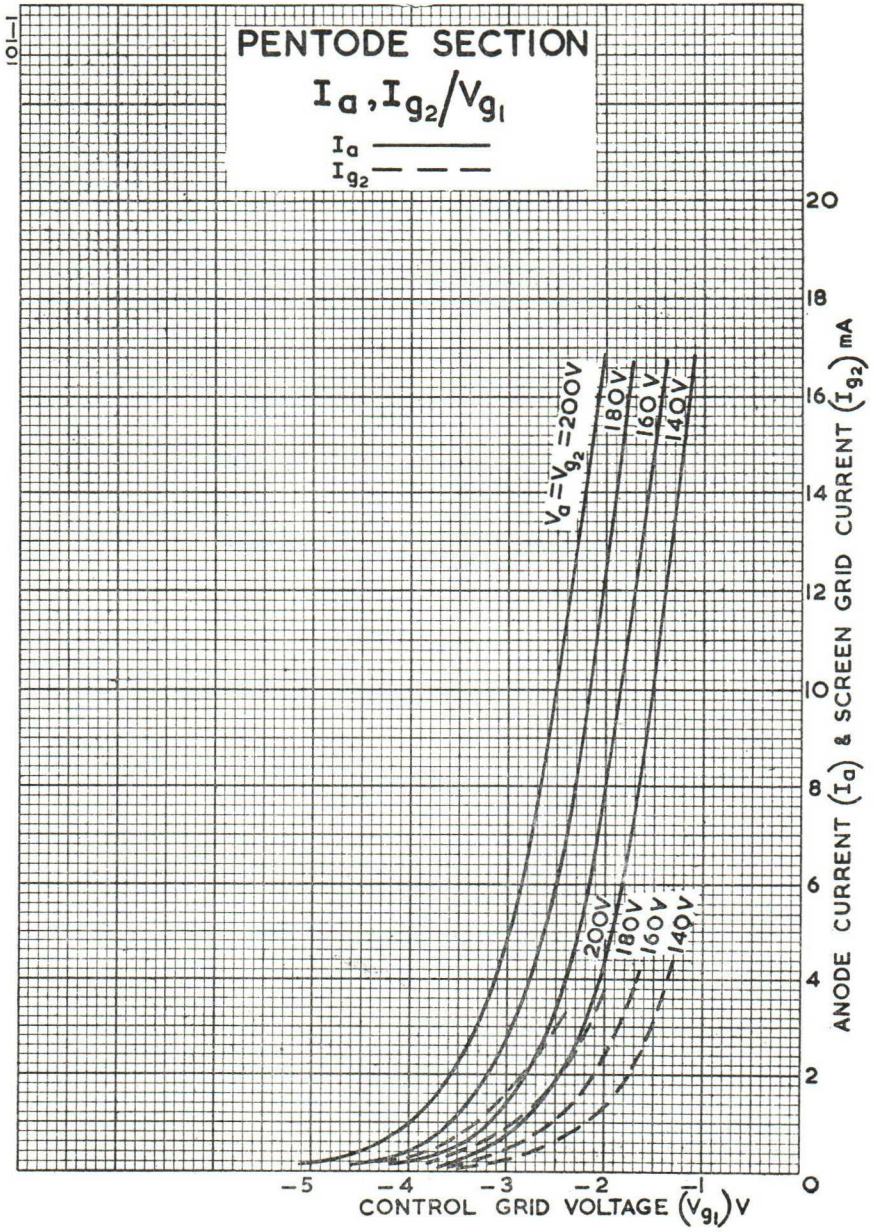
CHARACTERISTICS

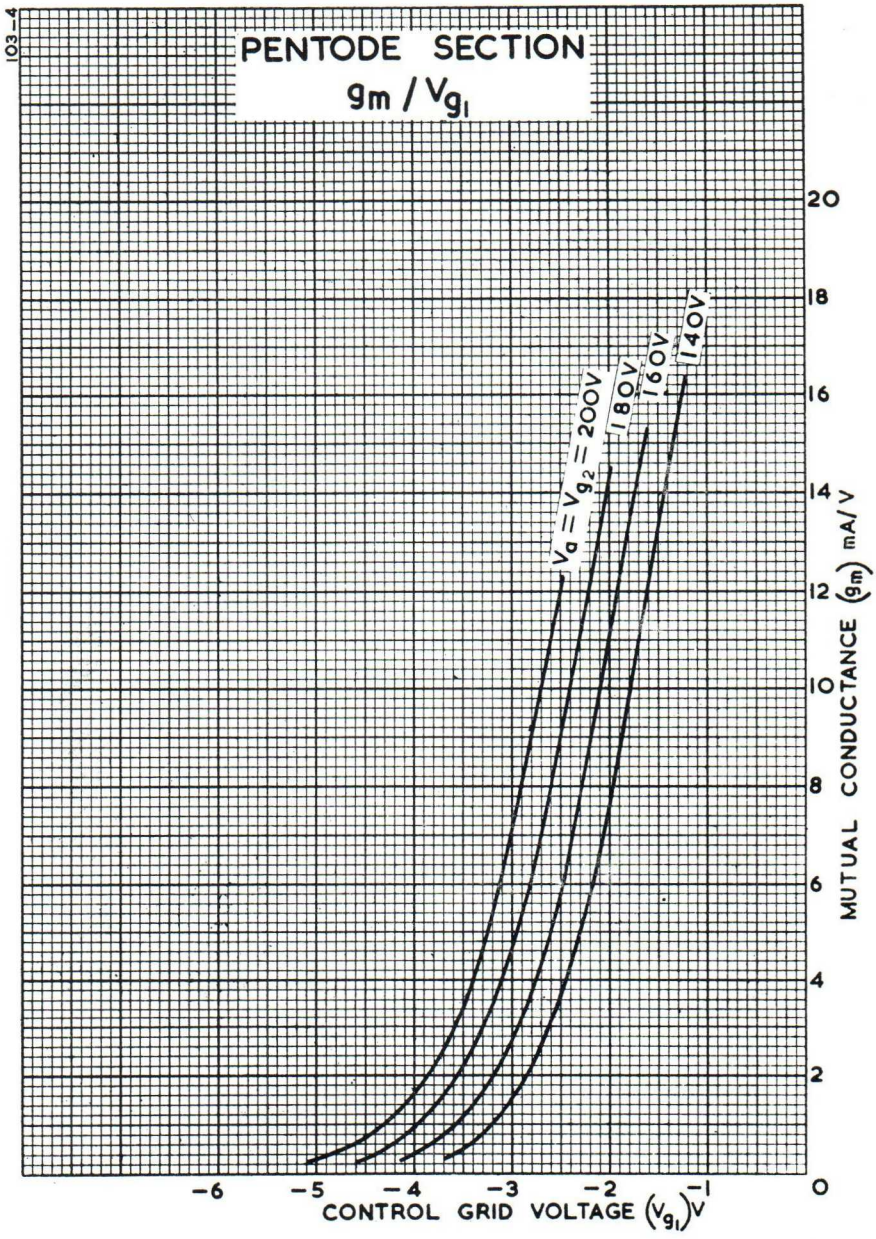
		Triode	Pentode	
Anode Voltage	V_a	100	160	V
Screen Grid Voltage	V_{g2}	—	160	V
Control Grid Voltage	V_{g1}	−3·0	−1·7	V
Anode Current	I_a	14	12	mA
Screen Grid Current	I_{g2}	—	4·0	mA
Mutual Conductance	g_m	5·5	14·5	mA/V
Anode Resistance ($\delta v_a/\delta i_a$)	r_a	3·1	—	kΩ
Amplification Factor	μ	17	—	
Inner Amplification Factor	$\mu_{g1\text{-}g2}$	—	60	
Working Input Capacitance	$c_{in(w)}$	—	10·6*	pF

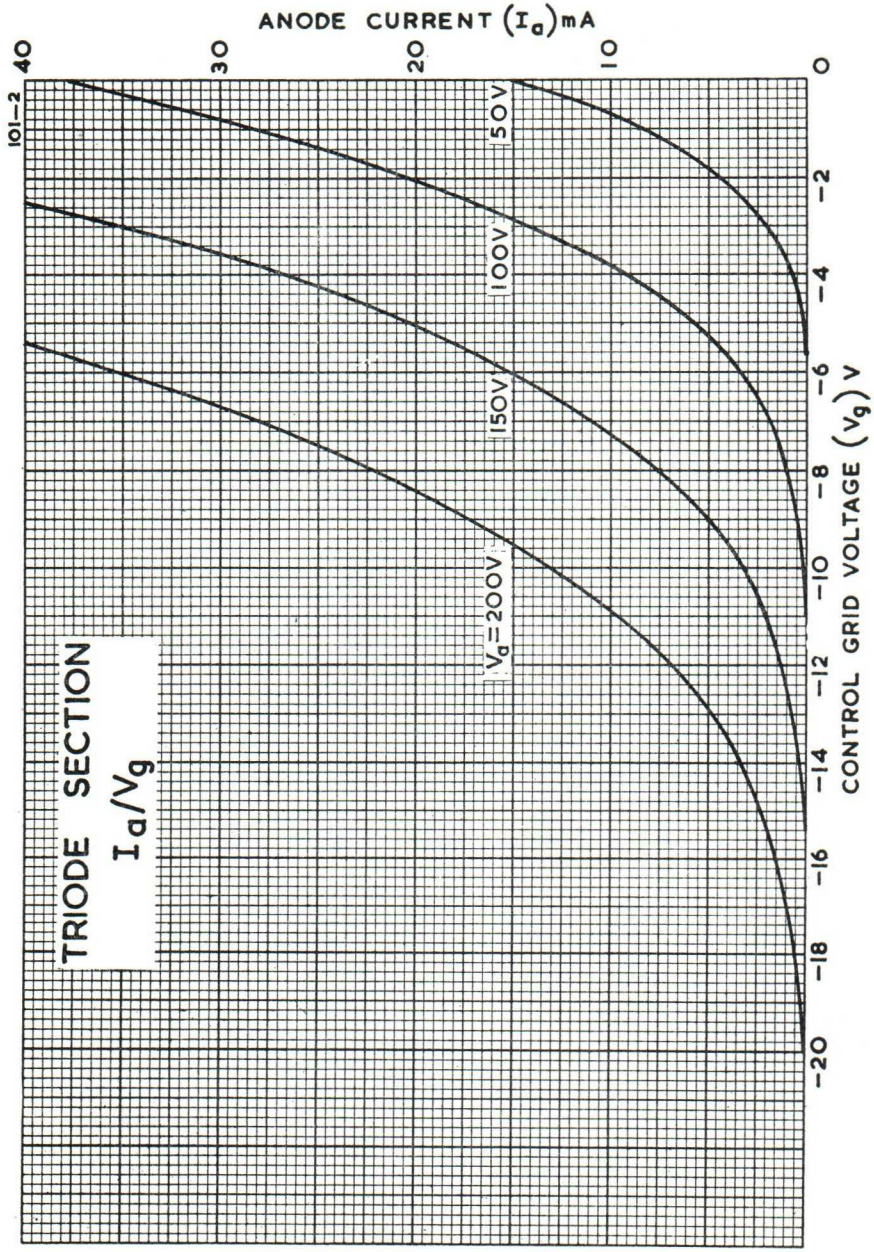
* In fully-shielded socket without can (I.E.C. Publication 100).

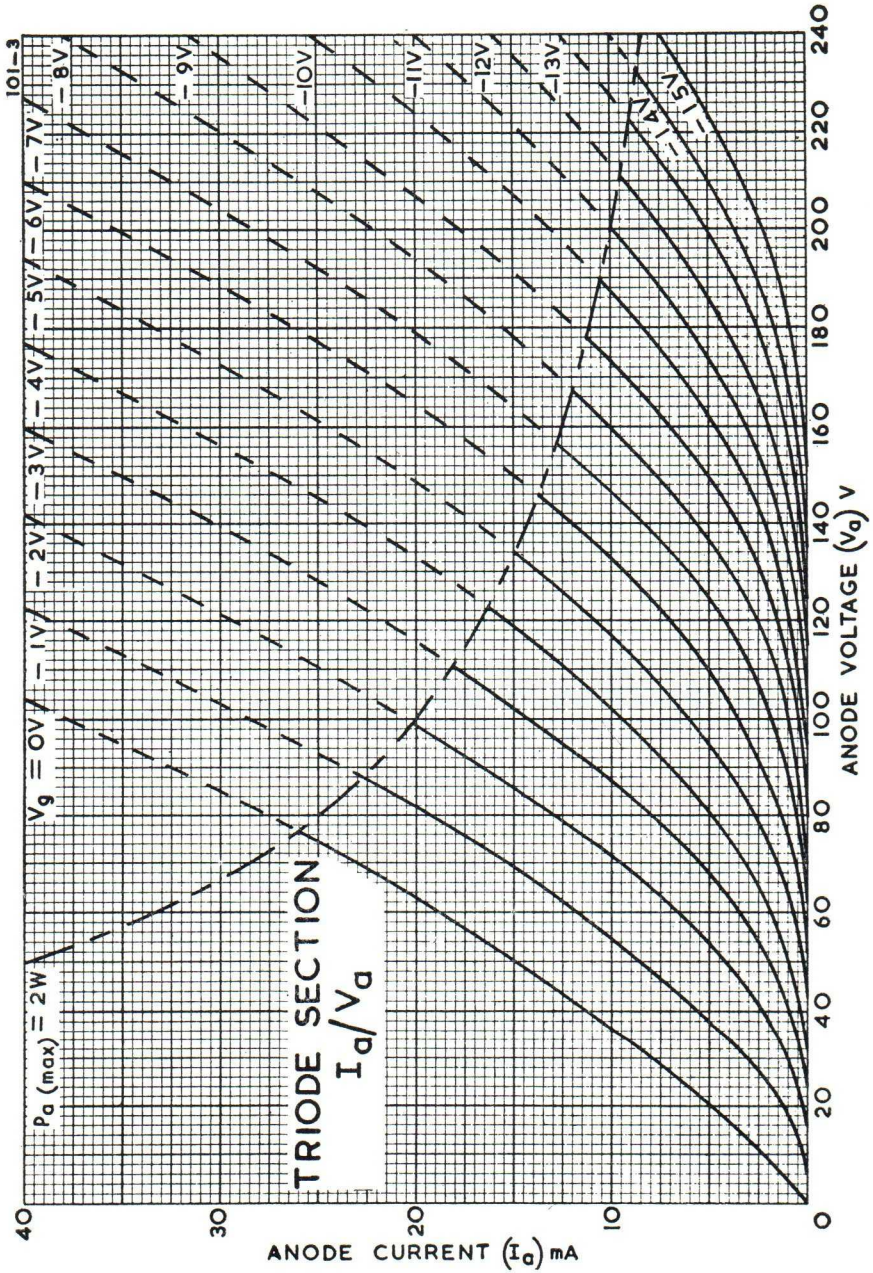
MOUNTING POSITION—Unrestricted.

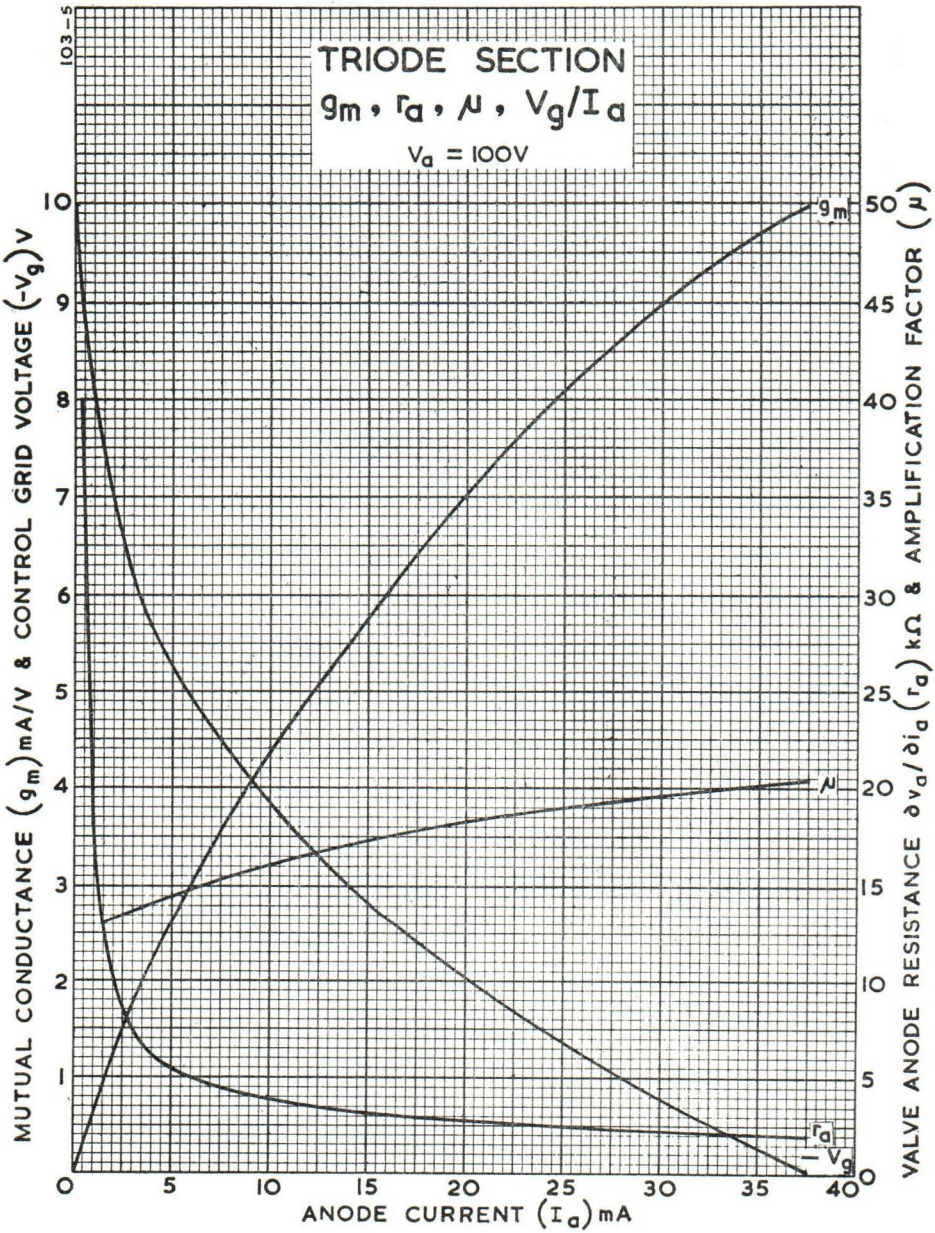
THORN — A E I RADIO VALVES & TUBES LTD.

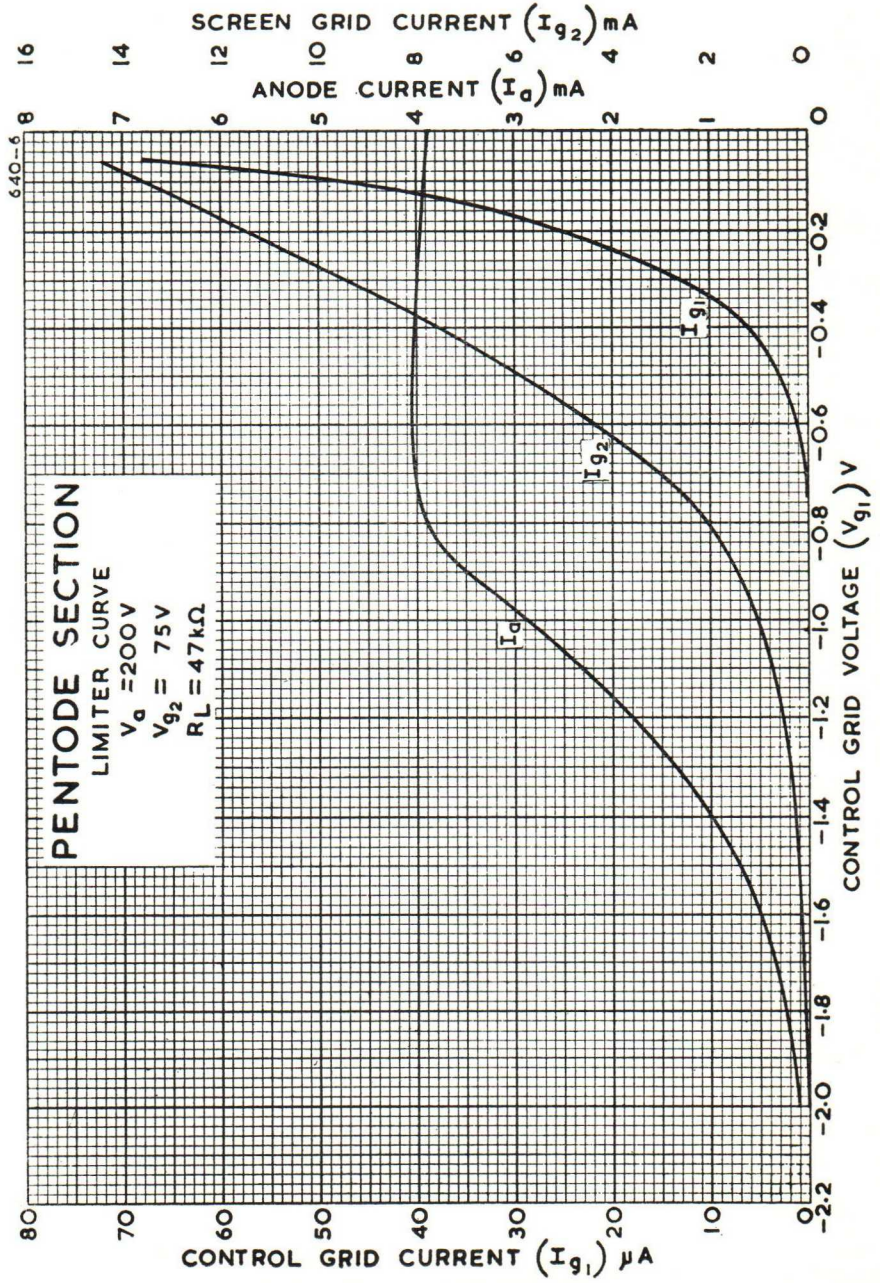

PENTODE SECTION
$I_a, I_{g_2}/V_{g_1}$
I_a
I_{g_2}
$V_a = V_{g_2} = 200V$
180V
160V
140V
200V
180V
160V
140V
20
18
16
14
12
10
8
6
4
2
0
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
−5
−4
−3
−2
−1
CONTROL GRID VOLTAGE (V_{g_1}) V

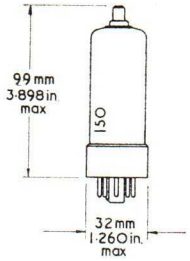

103-4
PENTODE SECTION
gm / Vg1
Va = Vg2 = 200V
180V
160V
140V
20
18
16
14
12
10
8
6
4
2
0
MUTUAL CONDUCTANCE (gm) mA/V
-6
-5
-4
-3
-2
-1
CONTROL GRID VOLTAGE (Vg1)V


ANODE CURRENT (I_a) mA
40
30
20
10
0
101-2
50V
100V
150V
V_a=200V
TRIODE SECTION
I_a/V_g
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
CONTROL GRID VOLTAGE (V_g) V

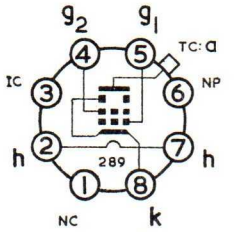

TRIODE SECTION
I_a/V_a
V_g = 0V, −1V, −2V, −3V, −4V, −5V, −6V, −7V, −8V, −9V, −10V, −11V, −12V, −13V, −14V, −15V
P_a (max) = 2W
101-3
ANODE CURRENT (I_a) mA
ANODE VOLTAGE (V_a) V
0
10
20
30
40
0
20
40
60
80
100
120
140
160
180
200
220
240


103-5
TRIODE SECTION
g_m, r_a, μ, V_g/I_a
V_a = 100V
MUTUAL CONDUCTANCE (g_m) mA/V & CONTROL GRID VOLTAGE ($-V_g$) V
VALVE ANODE RESISTANCE $\partial v_a/\partial i_a$ (r_a) kΩ & AMPLIFICATION FACTOR (μ)
ANODE CURRENT (I_a) mA
g_m
μ
r_a
$-V_g$
0
5
10
15
20
25
30
35
40
1
2
3
4
6
7
8
9
45
50


SCREEN GRID CURRENT (I_{g_2}) mA
ANODE CURRENT (I_a) mA
640-6
PENTODE SECTION
LIMITER CURVE
V_a = 200 V
V_{g_2} = 75 V
R_L = 47 kΩ
I_{g_1}
I_{g_2}
I_a
CONTROL GRID VOLTAGE (V_{g_1}) V
CONTROL GRID CURRENT (I_{g_1}) μA



LINE OUTPUT BEAM TETRODE



I.O. Base
CT1 Top cap

GENERAL

This valve is an output beam tetrode primarily intended for use in both stabilised and non-stabilised time base output stages of AC/DC, 405/625 line television receivers with series connected heaters.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	25	V

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	See rating chart	
Maximum Screen Grid Dissipation	$P_{g_2(max)}$	See rating chart	
Maximum Peak Anode Voltage (Pulse positive)	$v_{a(pk)max}$	7*†	kV
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	250	V
Maximum Peak Screen Grid Voltage (Pulse negative)	$v_{g_2(pk)max}$	2*	kV
Maximum Screen Grid Voltage	$V_{g_2(max)}$	250	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h\text{-}k(r.m.s.)max}$	200‡	V
Maximum Cathode Current	$I_{k(max)}$	200	mA
Maximum Grid to Cathode Resistance	$R_{g1\text{-}k(max)}$	3·3**	MΩ

* The pulse ratings are for television line scan where the applied voltage pulse does not exceed 22 per cent of one scanning cycle or 18 μs duration.

** For television line scan applications.

† 7 kV is a design centre rating, the absolute rating of 8·5 kV must not be exceeded.

‡ Measured with respect to the higher potential heater pin.

INTER-ELECTRODE CAPACITANCES

		§	ϕ	‖	
Grid 1 to Earth	c_{in}	18	18·5	20	pF
Anode to Earth	c_{out}	11	12	12	pF
Anode to Grid 1	$c_{a\text{-}g1}$	0·25	0·3	0·3	pF

§ In fully shielded socket without can.

ϕ With holder capacitance balanced out. (Holder as below.)

‖ Total capacitance including McMurdo amphenol international octal holder type B8/U. "Earth" denotes the remaining earthy potential electrodes, heater and shields joined to cathode.

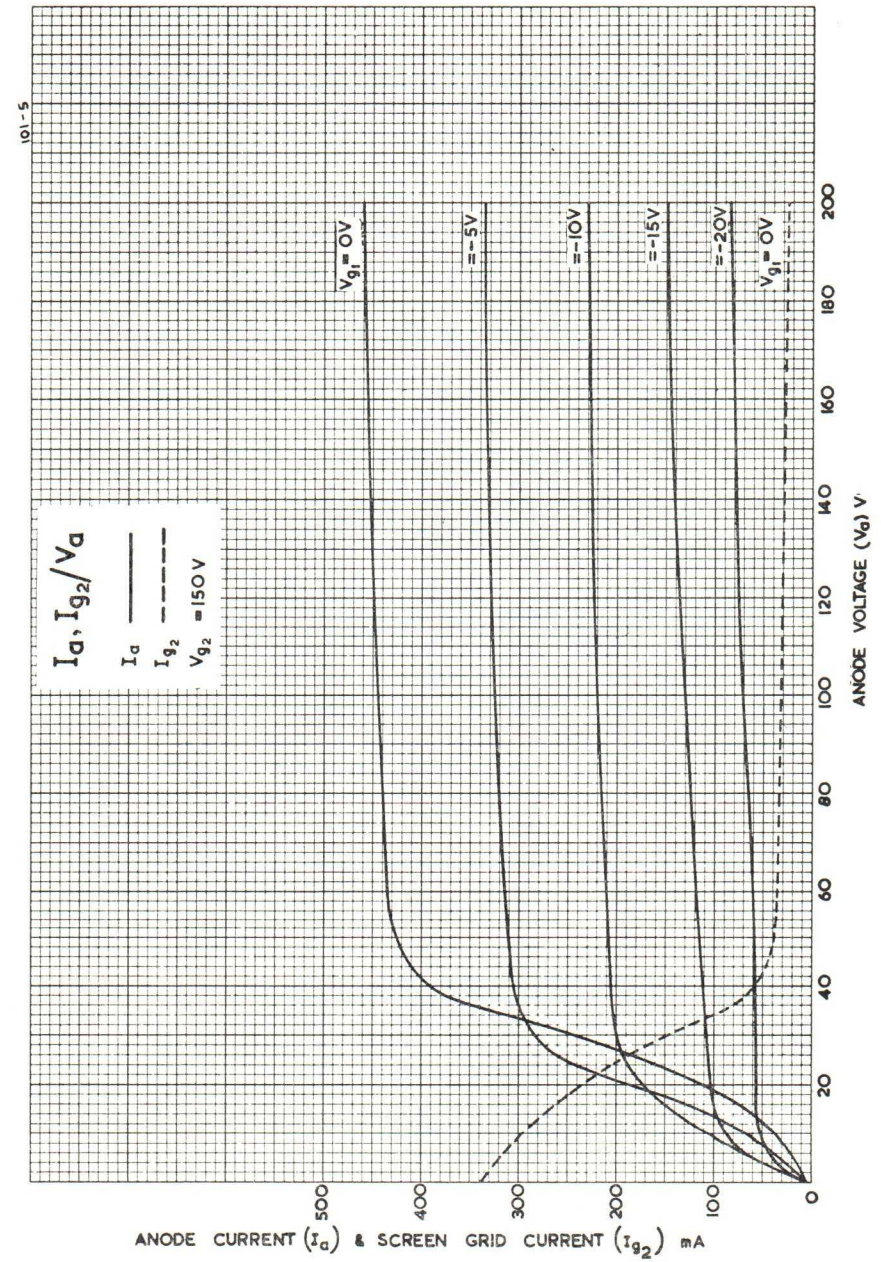
MOUNTING POSITION—Unrestricted

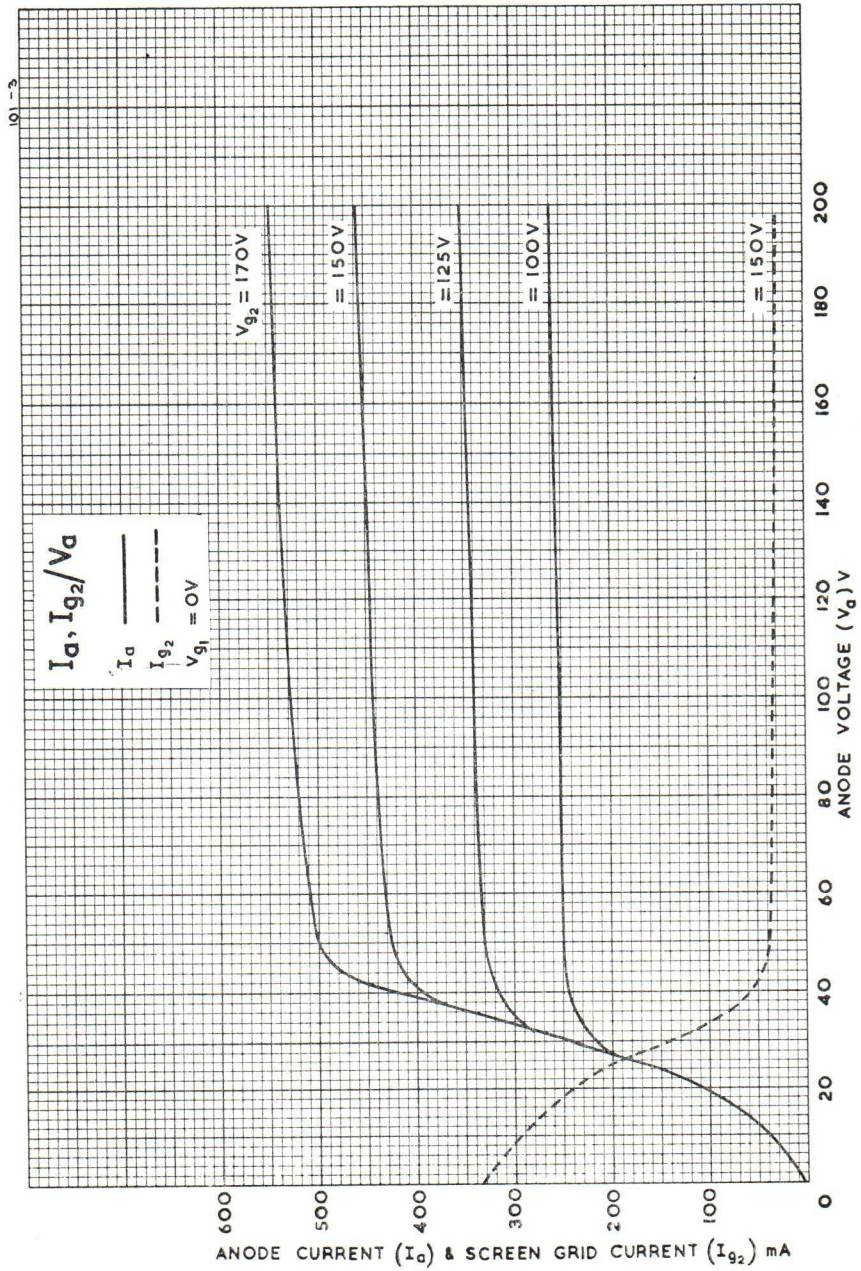
If mounted horizontally it is recommended that pins 4 and 8 should be in a vertical plane.

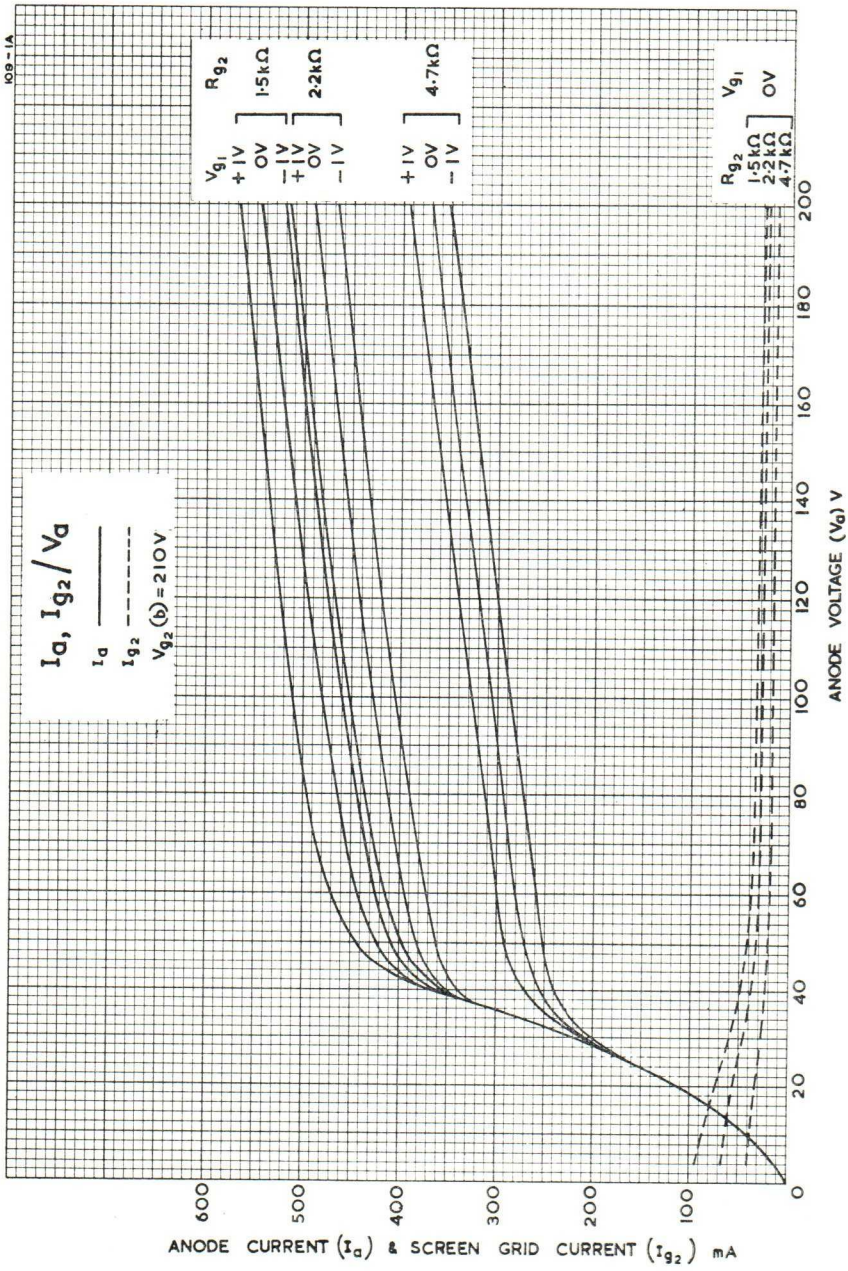
APPROXIMATE WEIGHT

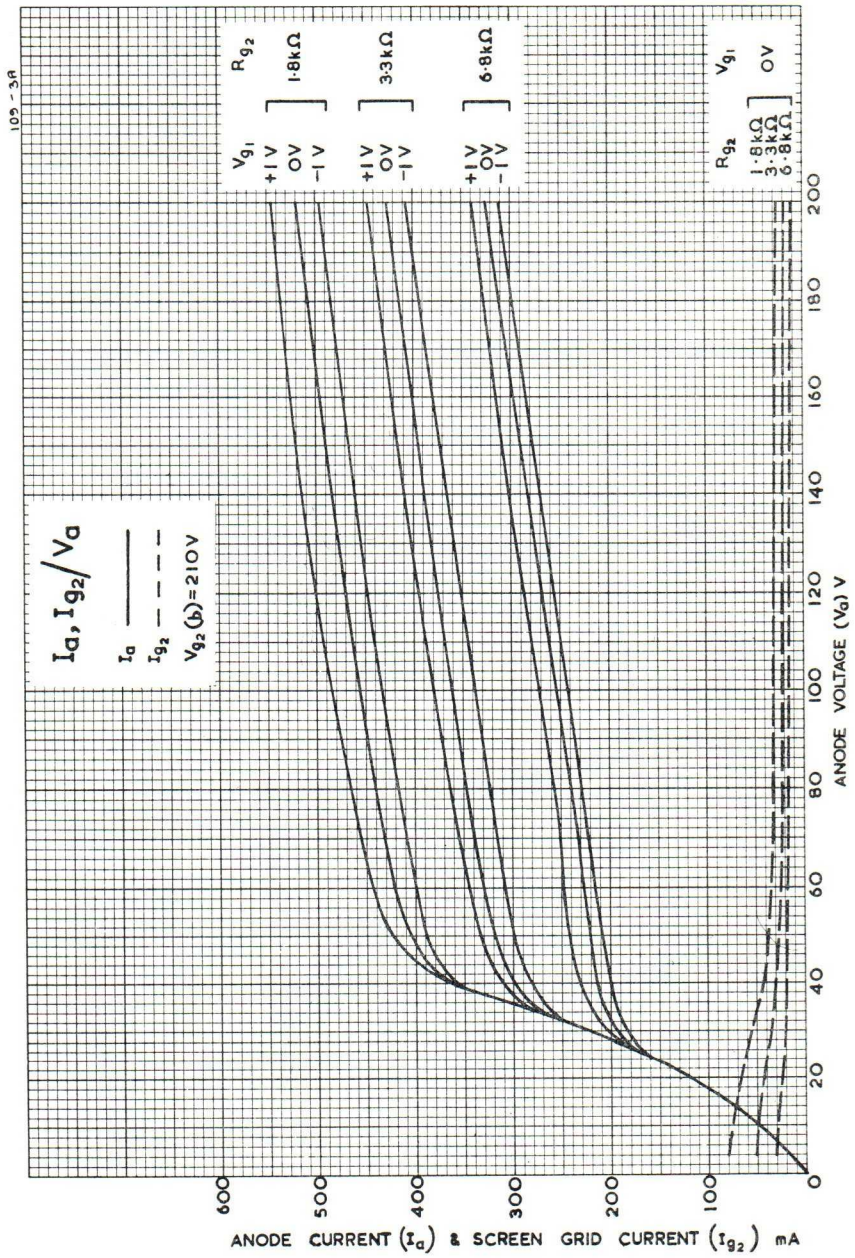
Net	1·5	oz
Packed	4	oz

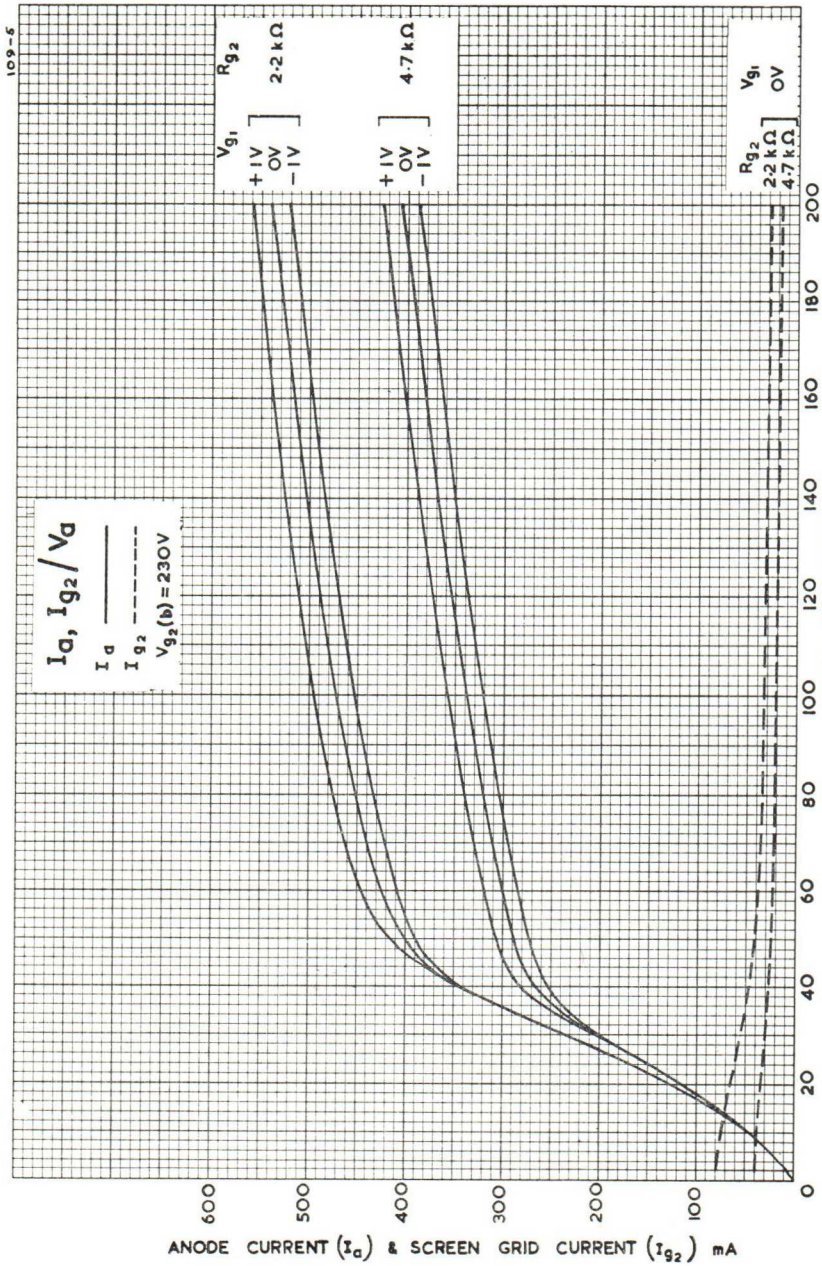
THORN—AEI RADIO VALVES & TUBES LTD.

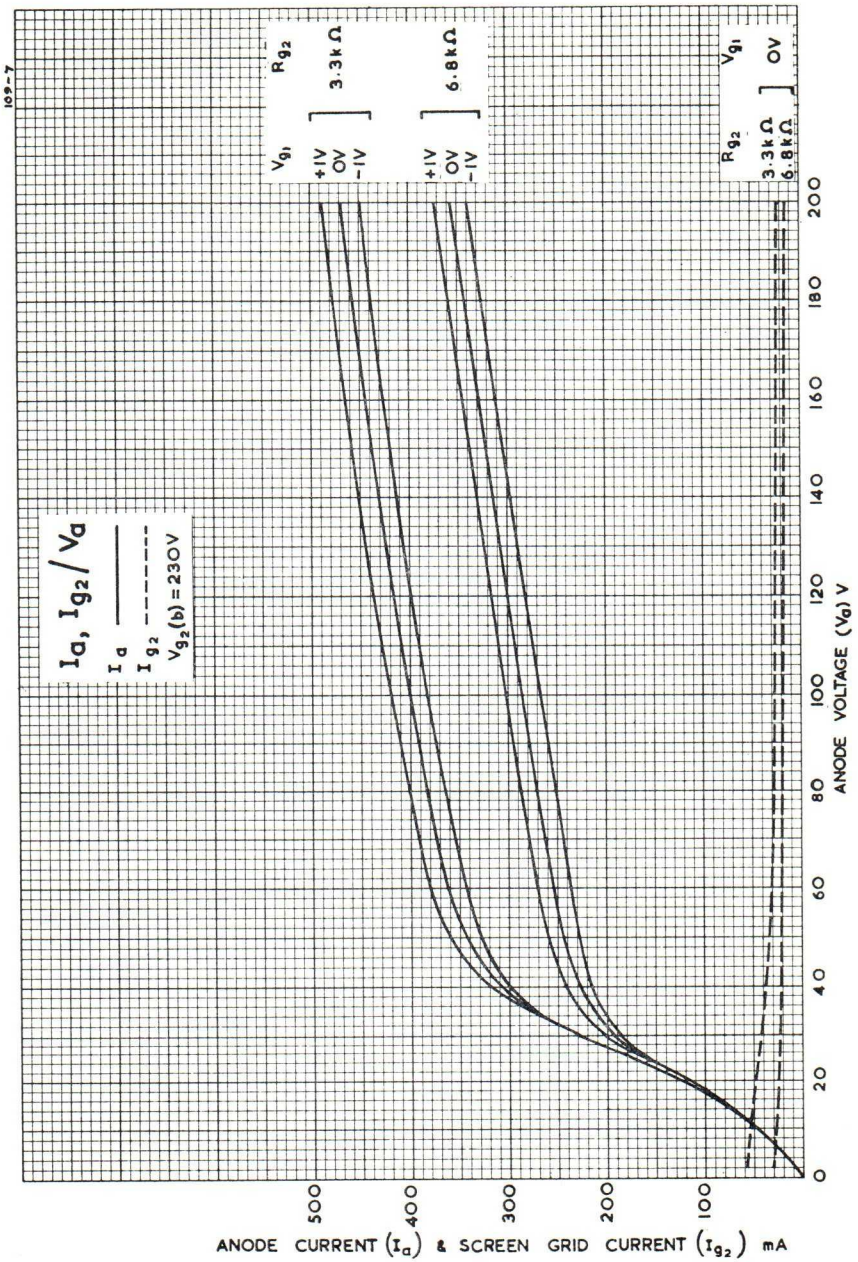

101-5
$I_a, I_{g_2}/V_a$
I_a
I_{g_2}
V_{g_2} = 150 V
V_{g_1} = 0V
= -5V
= -10V
= -15V
= -20V
V_{g_1} = 0V
ANODE VOLTAGE (V_a) V
0
20
40
60
80
100
120
140
160
180
200
100
200
300
400
500
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA

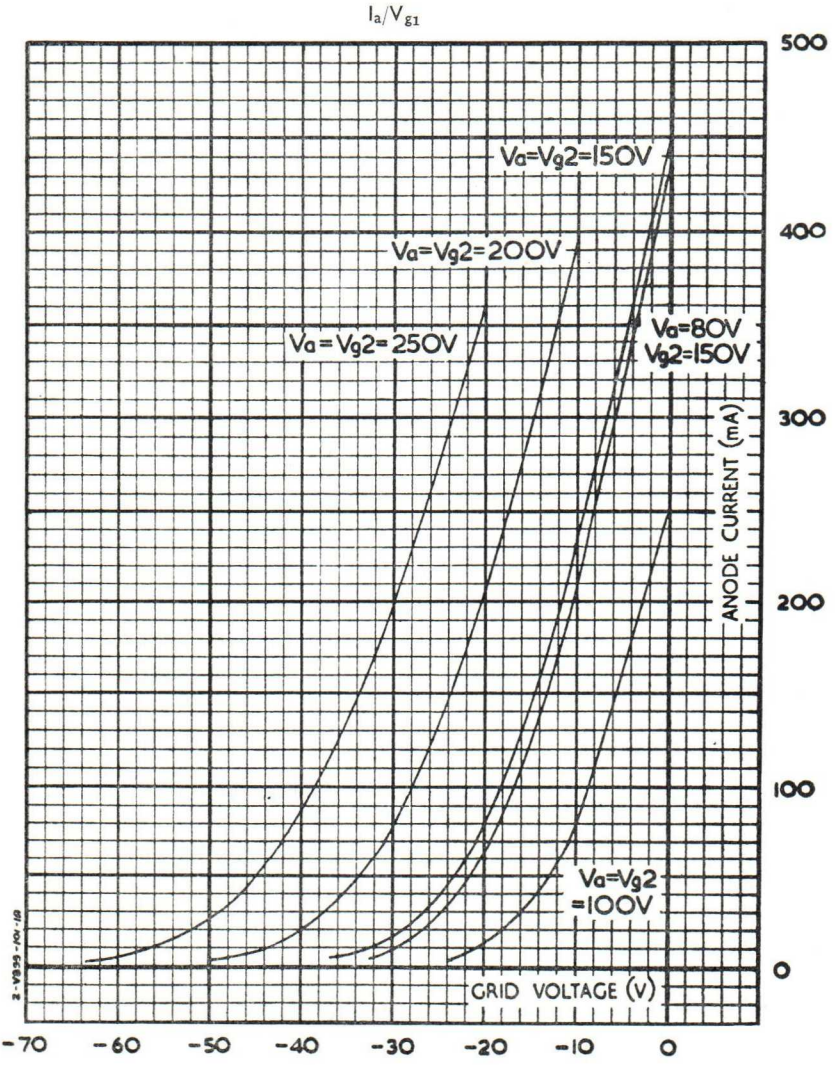

101-3
$I_a, I_{g_2}/V_a$
I_a
I_{g_2}
V_{g_1} = 0V
V_{g_2} = 170V
= 150V
=125V
= 100V
= 150V
ANODE VOLTAGE (V_a) V
0
20
40
60
80
100
120
140
160
180
200
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
600
500
400
300
200
100

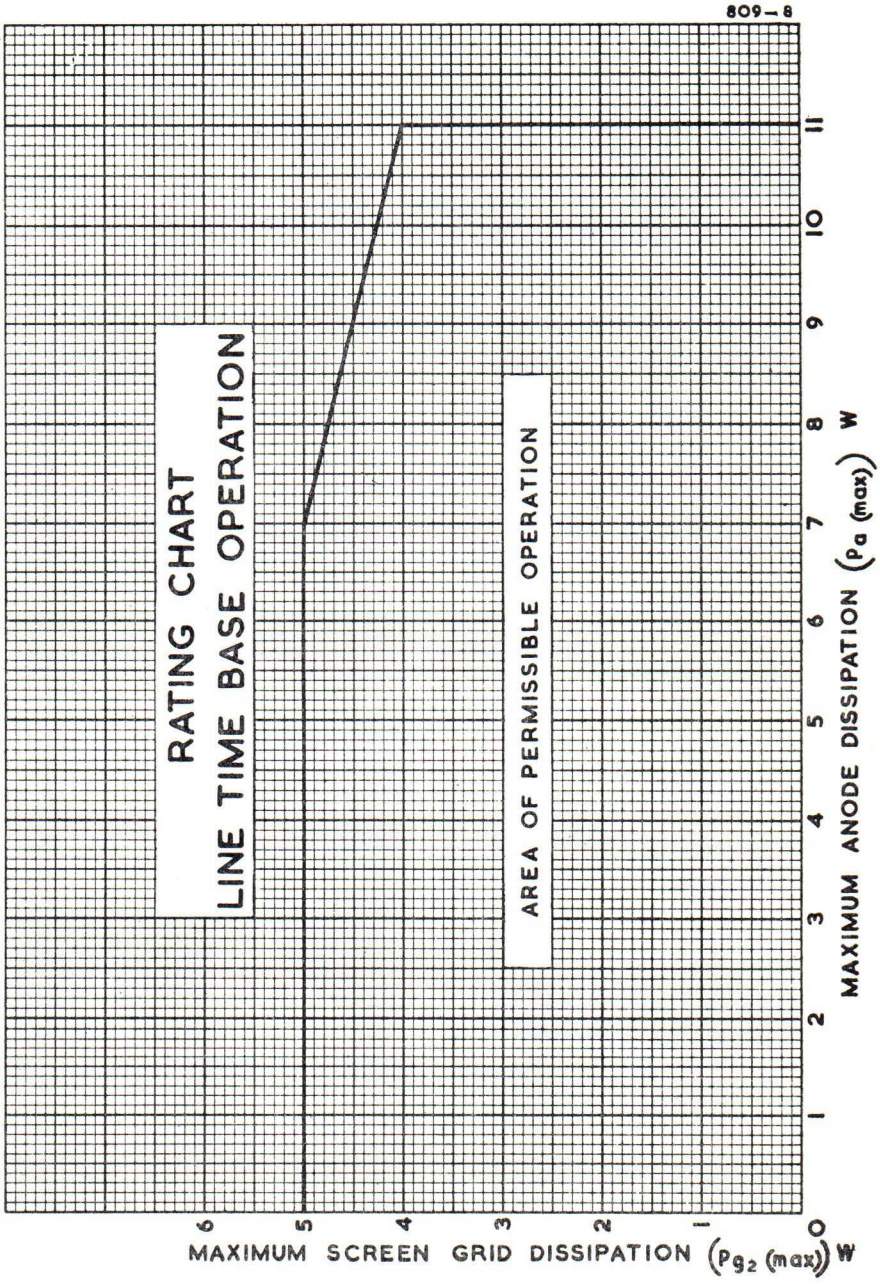

109-1A
$I_a, I_{g_2} / V_a$
I_a
I_{g_2}
$V_{g_2}(b) = 210$ V
R_{g_2}
1·5kΩ
2·2kΩ
4·7kΩ
V_{g_1}
+1V
0V
−1V
V_{g_1}
0V
R_{g_2}
1·5kΩ
2·2kΩ
4·7kΩ
ANODE VOLTAGE (V_a) V
0
20
40
60
80
100
120
140
160
180
200
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
600
500
400
300
200
100

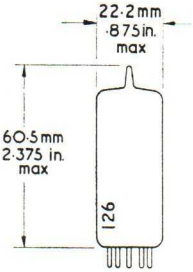

105-3A
R_{g_2}
1·8kΩ
3·3kΩ
6·8kΩ
V_{g_1}
+1V
0V
−1V
V_{g_1}
0V
R_{g_2}
1·8kΩ
3·3kΩ
6·8kΩ
$I_a, I_{g_2}/V_a$
I_a
I_{g_2}
$V_{g_2(b)}$=210V
ANODE VOLTAGE (V_a) V
0
20
40
60
80
100
120
140
160
180
200
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
600
500
400
300
200
100
0


109-6
$I_a, I_{g_2} / V_a$
I_a
I_{g_2}
$V_{g_2(b)} = 230V$
R_{g_2}
2·2 kΩ
4·7 kΩ
V_{g_1}
+1V
0V
−1V
V_{g_1}
0V
R_{g_2}
2·2 kΩ
4·7 kΩ
ANODE VOLTAGE (V_a) V
0
20
40
60
80
100
120
140
160
180
200
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
100
200
300
400
500
600

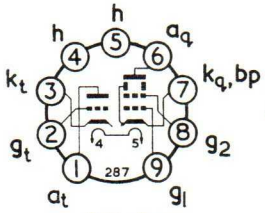

109-7
$I_a, I_{g_2} / V_a$
I_a
I_{g_2}
$V_{g_2}(b) = 230V$
R_{g_2}
3.3kΩ
6.8kΩ
V_{g_1}
+1V
0V
-1V
V_{g_1} 0V
R_{g_2} 3.3kΩ 6.8kΩ
0
20
40
60
80
100
120
140
160
180
200
ANODE VOLTAGE (V_a) V
500
400
300
200
100
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA


I_a/V_{g1}
500
400
300
200
100
0
ANODE CURRENT (mA)
Va=Vg2=150V
Va=Vg2=200V
Va=Vg2=250V
Va=80V
Vg2=150V
Va=Vg2
=100V
GRID VOLTAGE (V)
-70
-60
-50
-40
-30
-20
-10
0


809-8
RATING CHART
LINE TIME BASE OPERATION
AREA OF PERMISSIBLE OPERATION
MAXIMUM ANODE DISSIPATION (Pa (max)) W
0
1
2
3
4
5
6
7
8
9
10
11
MAXIMUM SCREEN GRID DISSIPATION (Pg2 (max)) W
6
5
4
3
2
1
0



TRIODE OUTPUT BEAM TETRODE



B9A Base

GENERAL

This triode output beam tetrode valve is intended principally for use in the audio amplifier or field deflection stages of AC/DC television receivers.
Each section has its own cathode.
The triode section is a general purpose one with identical characteristics to the 6/30L2.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	13	V

RATINGS

		Triode	Tetrode	
Maximum Anode Dissipation	$p_{a(max)}$	2*	5·5*	W
Maximum Screen Dissipation—Continuous		—	1·5	W
Maximum Screen Dissipation—Speech and Music		—	2·2	W
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Screen Grid Voltage	$V_{g_2(max)}$	—	250	V
Maximum Heater to Cathode Voltage (RMS)	$V_{h-k(rms)max}$		150†	V

The grid to cathode circuit resistance of the tetrode must not exceed 0·5 MΩ with cathode self bias when used at maximum dissipation ratings.

* The total anode dissipation of the two sections should not exceed 6W.

† Measured with respect to the higher potential heater pin.

INTER-ELECTRODE CAPACITANCES

		‡	§	
Grid 1 to Earth	c_{g_1-E}	9·8	11·0	pF
Anode Tetrode to Earth	c_{aq-E}	7·3	8·6	pF
Grid 1 to Anode Tetrode	c_{g_1-aq}	0·21	0·21	pF
Grid Triode to Earth	c_{gt-E}	2·6	3·7	pF
Anode Triode to Earth	c_{at-E}	2·0	3·0	pF
Grid Triode to Anode Triode	c_{gt-at}	2·4	2·7	pF
Grid 1 to Anode Triode	c_{g_1-at}	0·1	0·18	pF
Grid Triode to Anode Tetrode	c_{gt-aq}	0·093	0·093	pF
Anode Tetrode to Anode Triode	c_{aq-at}	1·0	1·0	pF
Grid Triode to Grid 1	c_{gt-g_1}	0·014	0·016	pF

‡ With holder capacity balanced out (holder as below).

§ Total capacity including ceramic B9A unskirted holder without radial shield (Carr Fastener holder type 77/076).

"Earth" denotes the electrodes of any second valve section and the remaining earthy potential electrodes of the section under measurement, heater and shields joined to cathode.

Indicates a change ←

THORN—AEI RADIO VALVES & TUBES LTD.

CHARACTERISTICS

		Triode	Tetrode	
Anode Voltage	V_a	200	170	V
Screen Grid Voltage	V_{g_2}	—	180	V
Anode Current	I_a	10	32	mA
Mutual Conductance	g_m	3·4	7·2	mA/V ←
Amplification Factor	μ	18	—	

CLASS A AUDIO OUTPUT TYPICAL OPERATION (Tetrode Section) ←

		Fixed Bias		Self Bias		
Anode Voltage (Anode to Earth)	V_a	170		180		V
Screen Voltage (Screen to Earth)	V_{g_2}	180		190		V
Anode Current (Quiescent)	$I_{a(o)}$	28		28		mA
Screen Current (Quiescent)	$I_{g_2(o)}$	6·5		6·5		mA
Grid Bias Applied	V_{g_1}	−9·6		—		V
Cathode Bias Resistance	R_k	—		270		Ω
Anode Load	R_a	6000§	5300†	7000§	6200†	Ω
Power Output	P_{out}	2·0§	2·35†	1·85§	2·2†	W
Input Swing	$V_{in(rms)}$	3·3§	3·9†	3·1§	3·8†	V

The above operating conditions are taken with constant anode and screen supply voltages.

§ For 5 per cent Third Harmonic and Second Harmonic not exceeding 5 per cent.

† For 7 per cent Third Harmonic and Second Harmonic not exceeding 7 per cent.

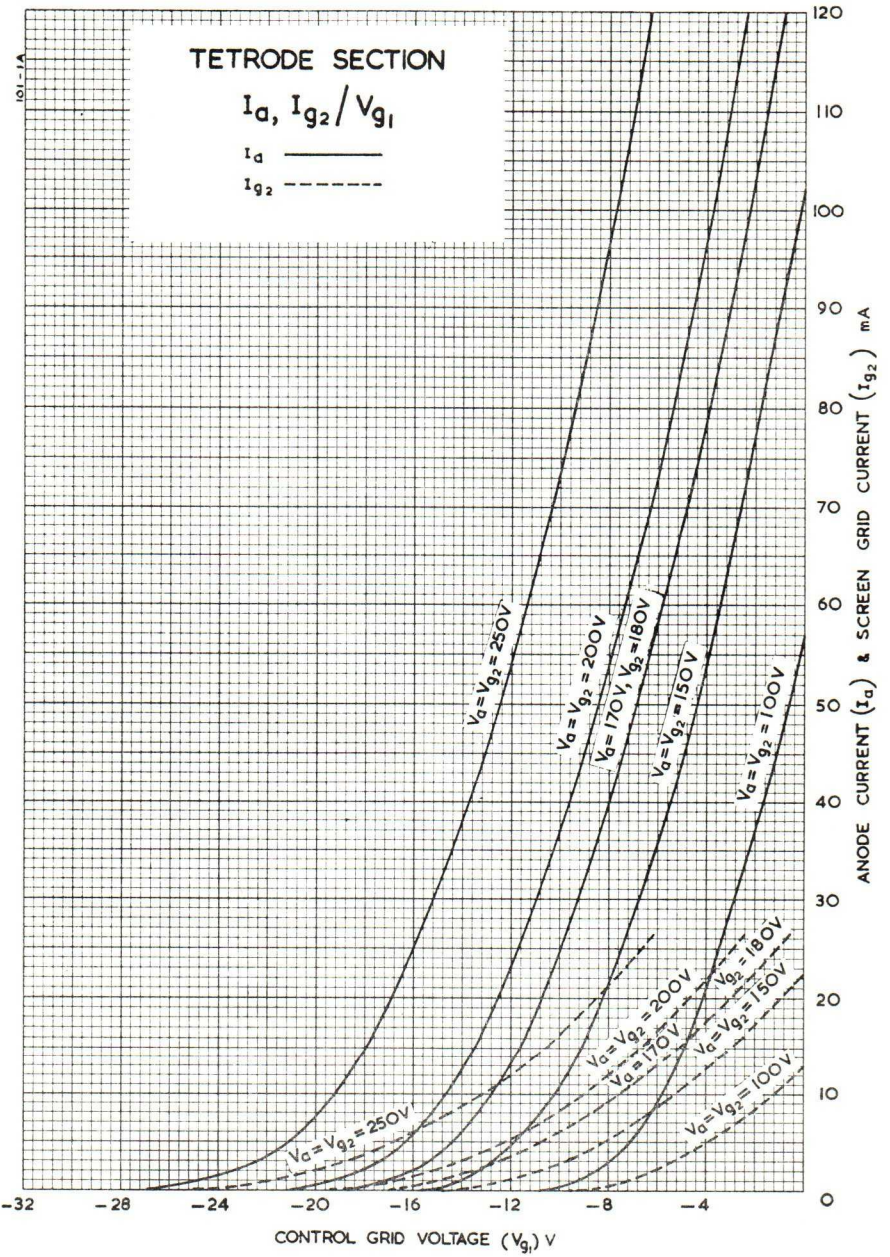
FIELD TIME BASE TYPICAL OPERATION (Tetrode Section)

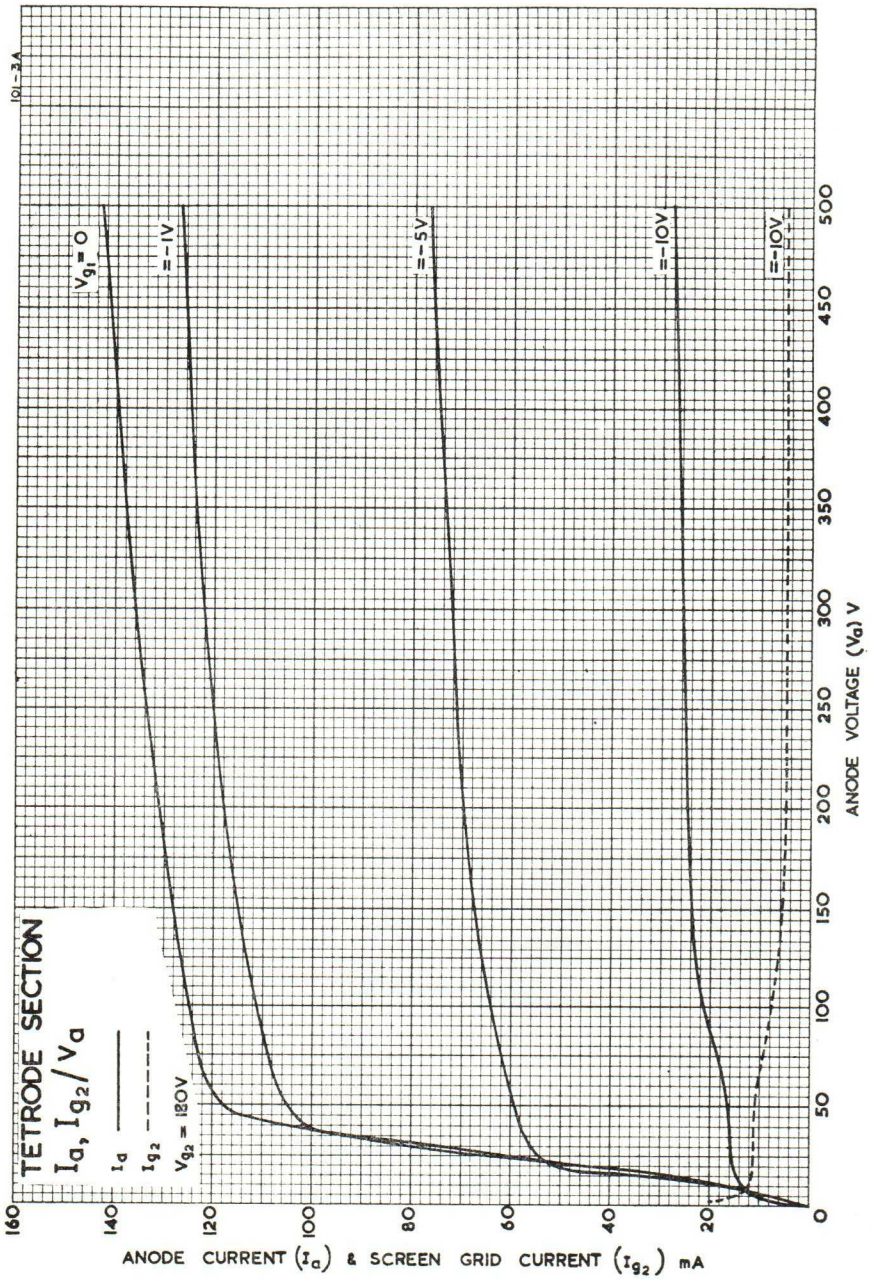
The output stage should be designed to allow for valve spread and deterioration during life in addition to component variation. Values of tetrode total peak anode current available for a new average valve and at assumed end of life point for any valve are as follows:

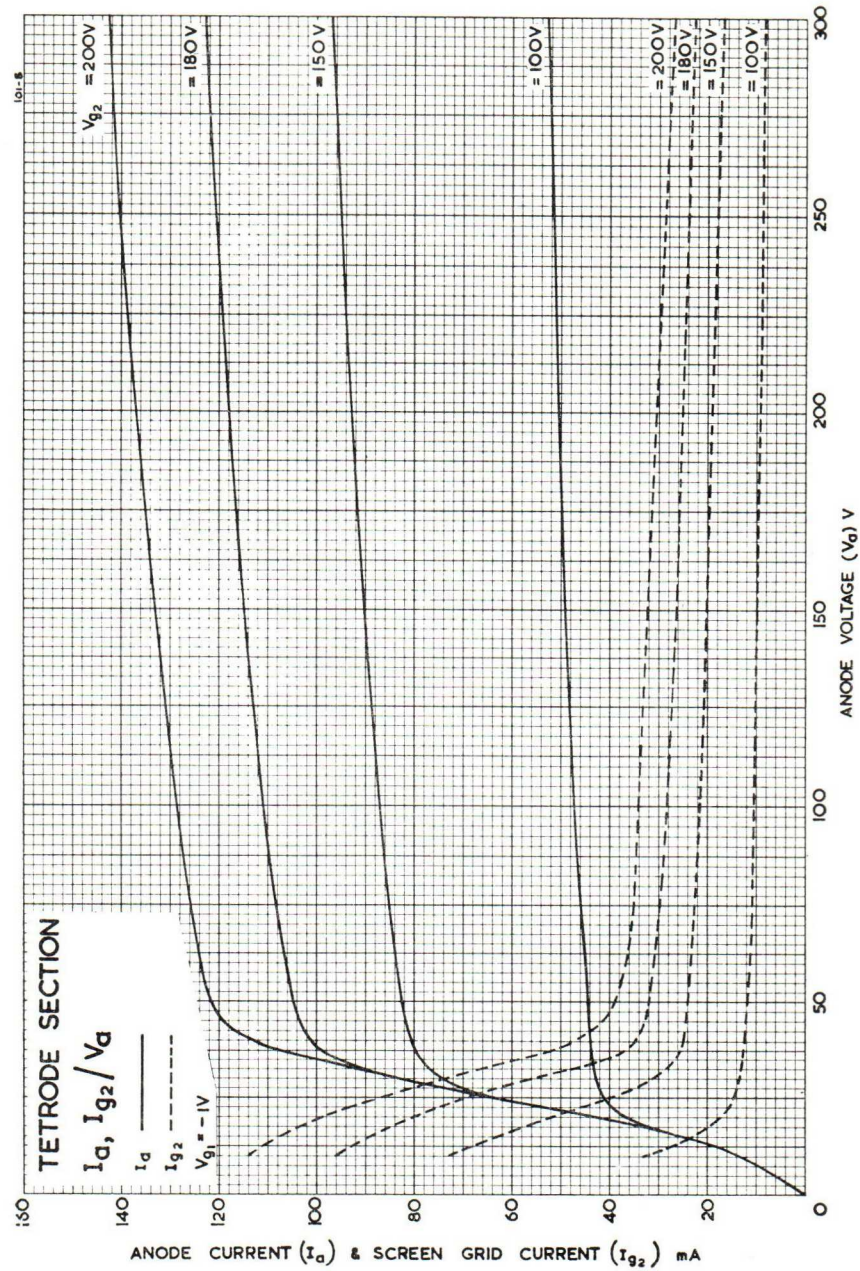
	V_a (V)	V_{g_2} (V)	V_{g_1} (V)	I_a (mA)	
Average New Valve	50	170	−1	95	←
Assumed End of Life Condition	50	170	−1	62	←
Average New Valve	50	180	−1	105	←
Assumed End of Life Condition	50	180	−1	68	←
Average New Valve	60	190	−1	115	←
Assumed End of Life Condition	60	190	−1	75	←

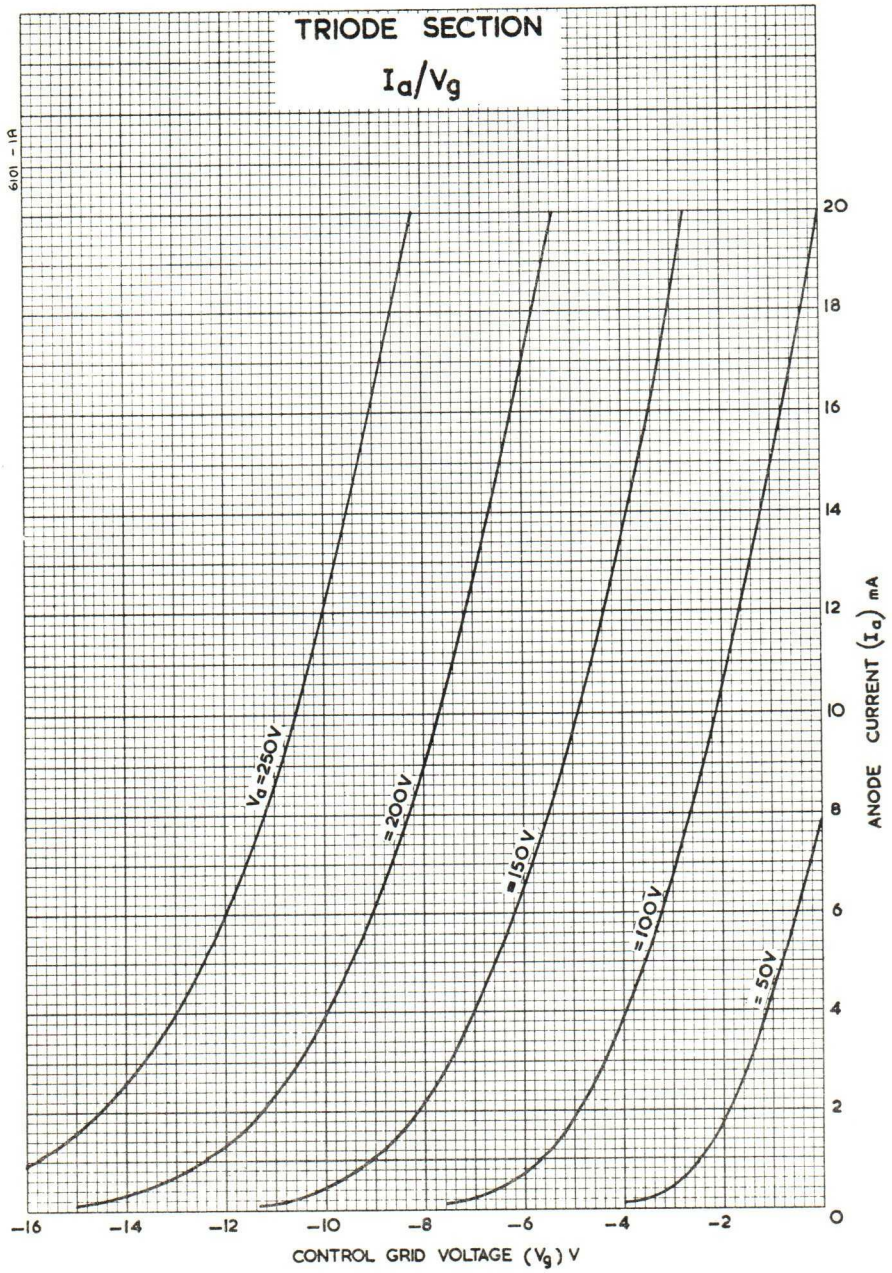
MOUNTING POSITION—Unrestricted

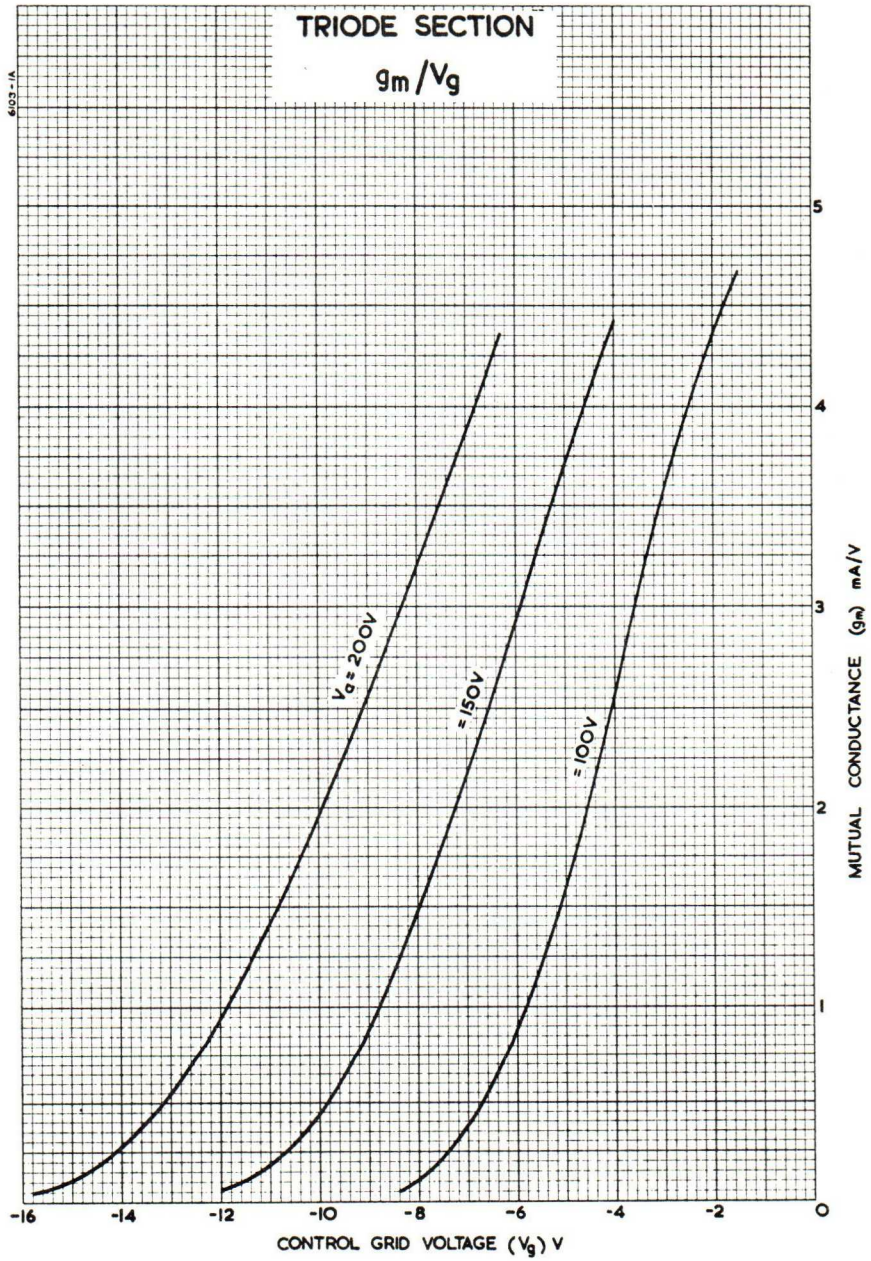
Indicates a change ←

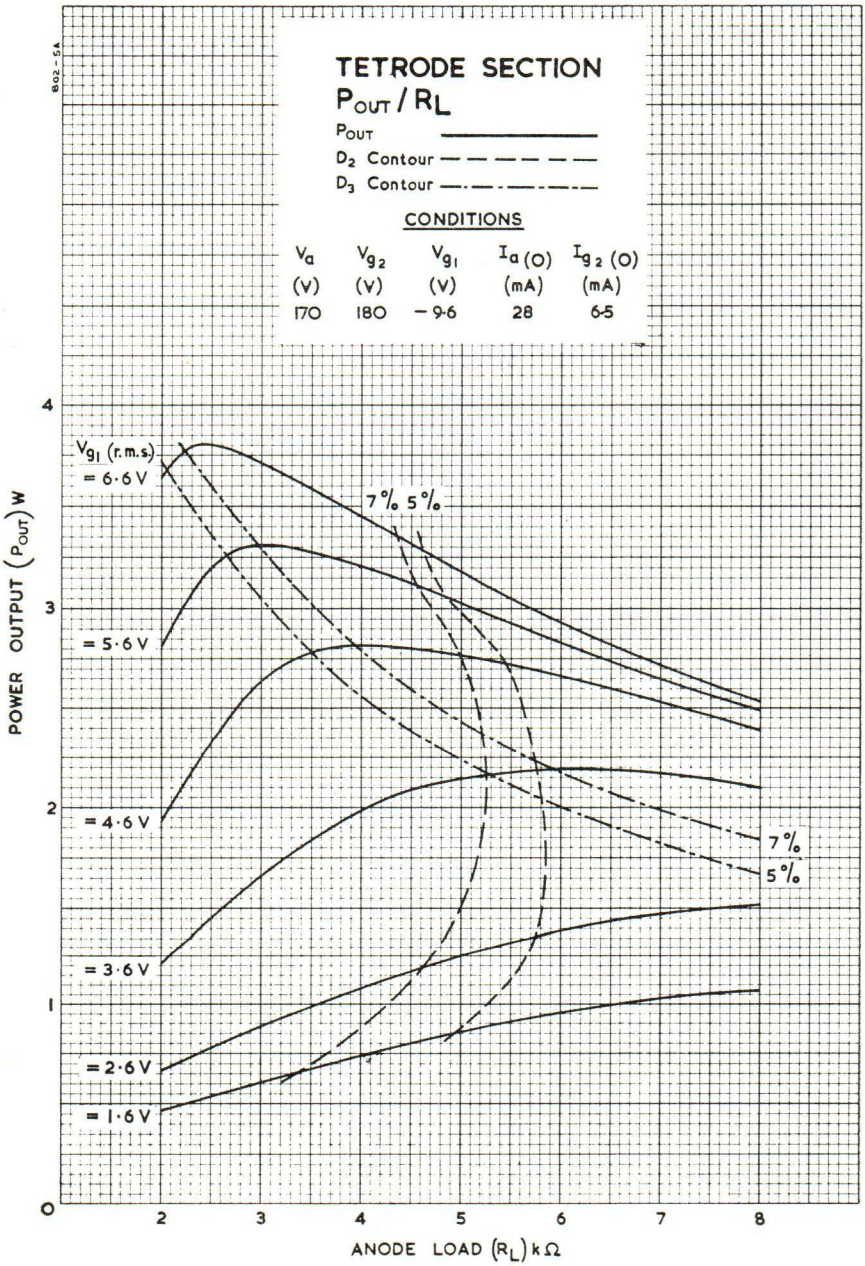

TETRODE SECTION
I_a, I_{g_2} / V_{g_1}
I_a
I_{g_2}
101-1A
$V_a = V_{g_2} = 250V$
$V_a = V_{g_2} = 200V$
$V_a = 170V$, $V_{g_2} = 180V$
$V_a = V_{g_2} = 150V$
$V_a = V_{g_2} = 100V$
$V_a = V_{g_2} = 250V$
$V_a = V_{g_2} = 200V$
$V_a = 170V$
$V_{g_2} = 180V$
$V_a = V_{g_2} = 150V$
$V_a = V_{g_2} = 100V$
120
110
100
90
80
70
60
50
40
30
20
10
0
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
−32
−28
−24
−20
−16
−12
−8
−4
CONTROL GRID VOLTAGE (V_{g_1}) V

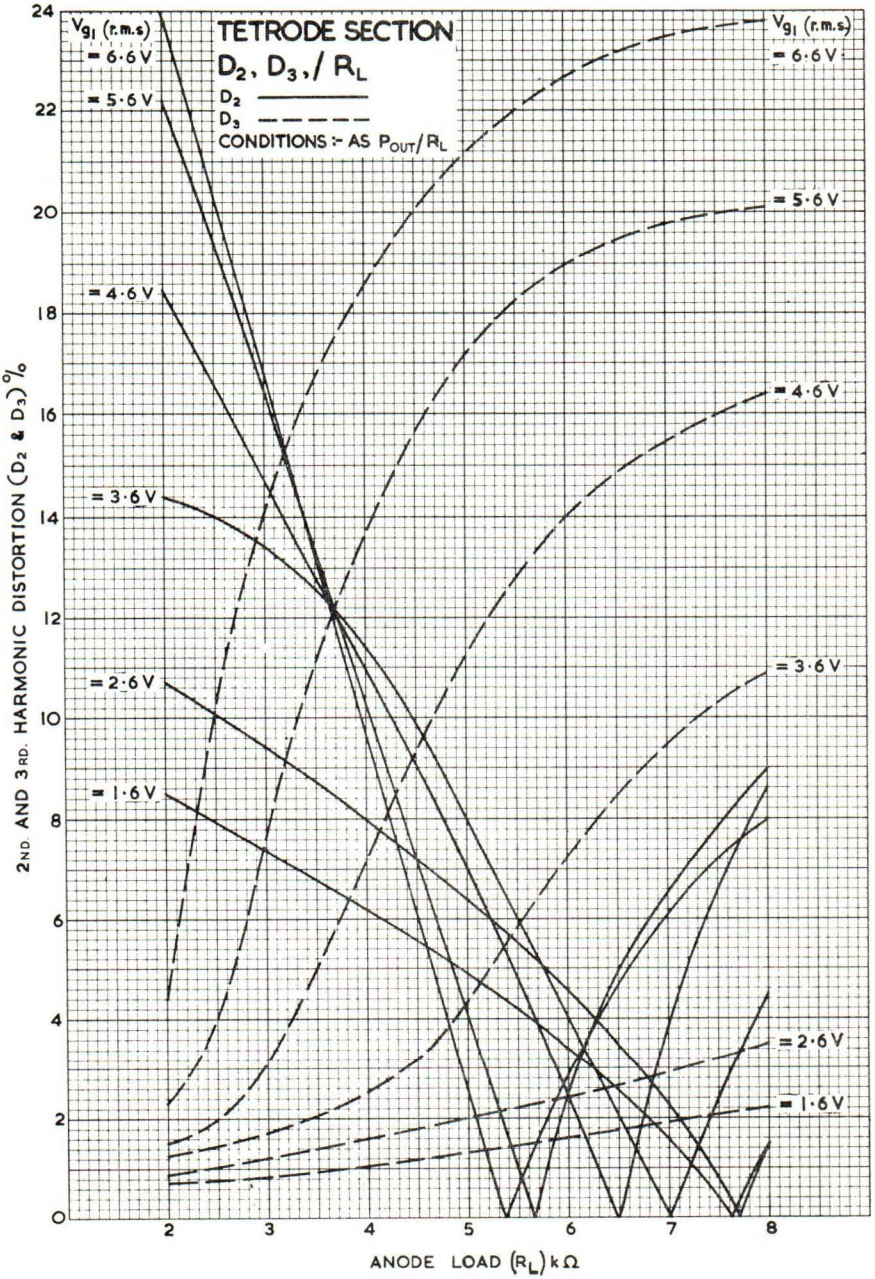

191-3A
TETRODE SECTION
$I_a, I_{g_2}/V_a$
I_a
I_{g_2}
V_{g_2} = 120V
V_{g_1} = 0
= -1V
= -5V
= -10V
= -10V
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
ANODE VOLTAGE (V_a) V
160
140
120
100
80
60
40
20
0
50
100
150
200
250
300
350
400
450
500

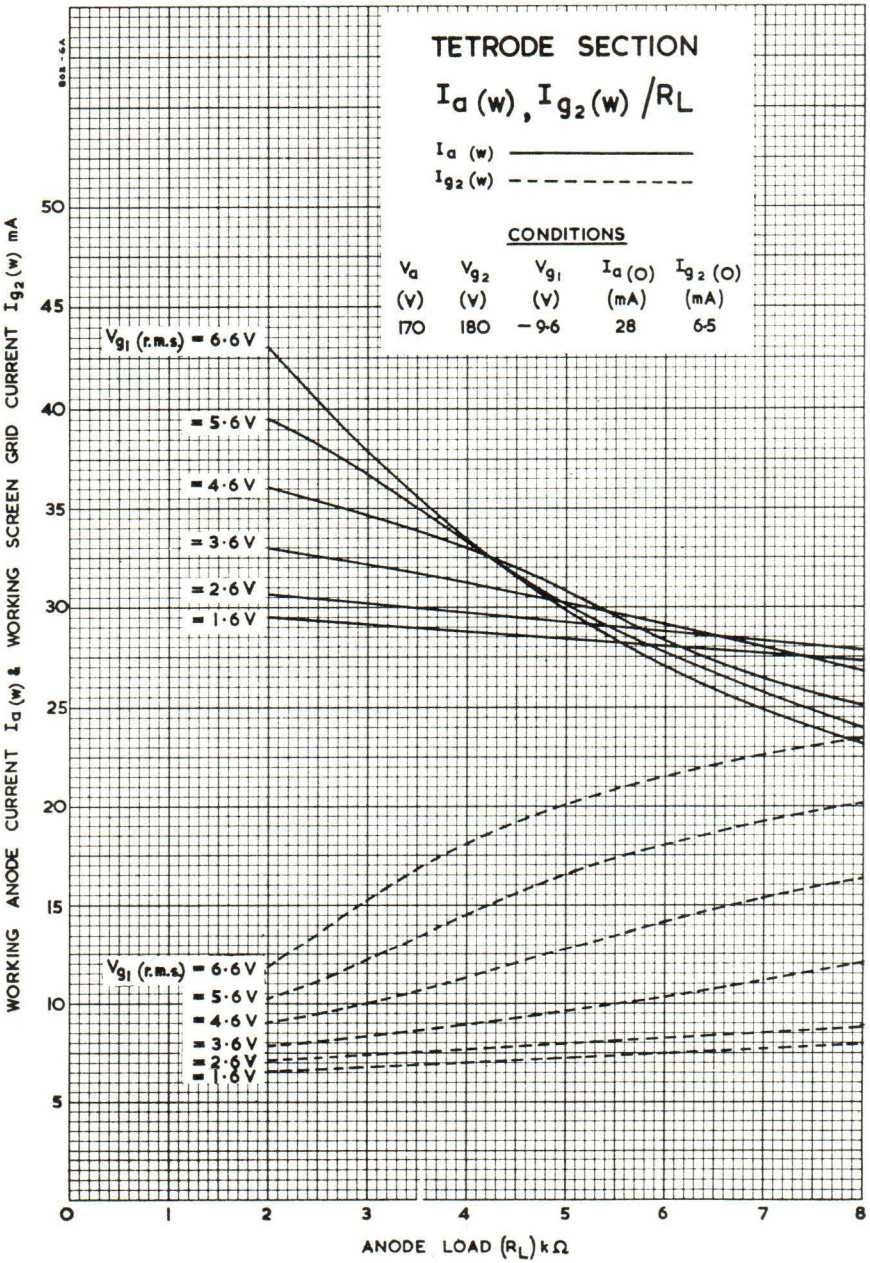

101-5
V_{g_2} = 200V
= 180V
= 150V
= 100V
= 200V
= 180V
= 150V
= 100V
TETRODE SECTION
$I_a, I_{g_2} / V_a$
I_a
I_{g_2}
V_{g_1} = -1V
160
140
120
100
80
60
40
20
0
50
100
150
200
250
300
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
ANODE VOLTAGE (V_a) V

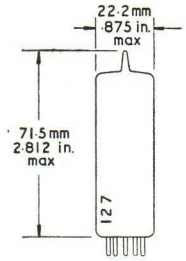

TRIODE SECTION
Ia/Vg
6101 - 1A
Va=250V
=200V
=150V
=100V
=50V
20
18
16
14
12
10
8
6
4
2
0
ANODE CURRENT (Ia) mA
-16
-14
-12
-10
-8
-6
-4
-2
CONTROL GRID VOLTAGE (Vg) V


TRIODE SECTION
gm/Vg
6103-1A
Vb = 200V
= 150V
= 100V
5
4
3
2
1
0
-16
-14
-12
-10
-8
-6
-4
-2
CONTROL GRID VOLTAGE (Vg) V
MUTUAL CONDUCTANCE (gm) mA/V

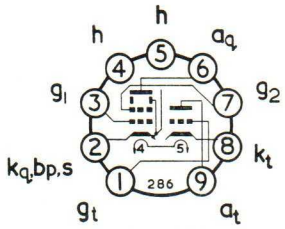

802-54
TETRODE SECTION
P_{OUT} / R_L
P_{OUT}
D_2 Contour
D_3 Contour
CONDITIONS
V_a (V) 170
V_{g2} (V) 180
V_{g1} (V) −9·6
I_a (O) (mA) 28
I_{g2} (O) (mA) 6·5
V_{g1} (r.m.s.) = 6·6 V
= 5·6 V
= 4·6 V
= 3·6 V
= 2·6 V
= 1·6 V
7% 5%
7%
5%
POWER OUTPUT (P_{OUT}) W
ANODE LOAD (R_L) kΩ
0
1
2
3
4
2
3
4
5
6
7
8


TETRODE SECTION
D2, D3, / RL
D2
D3
CONDITIONS :- AS POUT/RL
Vg1 (r.m.s) = 6·6 V
= 5·6 V
= 4·6 V
= 3·6 V
= 2·6 V
= 1·6 V
2ND AND 3RD. HARMONIC DISTORTION (D2 & D3) %
ANODE LOAD (RL) kΩ
0
2
4
6
8
10
12
14
16
18
20
22
24
2
3
4
5
6
7
8


TETRODE SECTION
I_a (w), I_{g_2} (w) /R_L
I_a (w)
I_{g_2} (w)
CONDITIONS
V_a (V) 170
V_{g_2} (V) 180
V_{g_1} (V) −9·6
I_a (O) (mA) 28
I_{g_2} (O) (mA) 6·5
V_{g_1} (r.m.s.) = 6·6 V
= 5·6 V
= 4·6 V
= 3·6 V
= 2·6 V
= 1·6 V
WORKING ANODE CURRENT I_a (w) & WORKING SCREEN GRID CURRENT I_{g_2} (w) mA
ANODE LOAD (R_L) kΩ
0
1
2
3
4
5
6
7
8
5
10
15
20
25
30
35
40
45
50



TRIODE OUTPUT BEAM TETRODE



Base B9A

GENERAL

This triode output beam tetrode is for use in television receivers with the triode as A.F. amplifier or time base oscillator and the tetrode as audio or field output valve.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	16	V

RATINGS

		Triode	Tetrode	
Maximum Anode Dissipation	$P_{a(max)}$			
For $V_a \leqslant 250V$		1·0	7·0	W
For $V_a > 250V$		—	5·0	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	—	1·8	W
For speech and music		—	3·2	W
Maximum Anode Supply Voltage ($I_a = 0$)	$V_{a(b)max}$	550	550	V
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Peak Anode Voltage	$v_{a(pk)max}$			
Pulse Positive		0·6†	2·5*	kV
Pulse Negative		—	500	V
Maximum Screen Grid Supply Voltage ($I_{g2} = 0$)	$V_{g2(b)max}$	—	550	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	—	250	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h\text{-}k(r.m.s.)max}$	200‡	200‡	V
Maximum Mean Cathode Current	$I_{k(av)max}$	15	50	mA
Maximum Resistance Grid 1 to Cathode	$R_{g1\text{-}k(max)}$			
Self Bias		3	2	MΩ
Fixed Bias		1	1	MΩ
Grid Current Bias		22	—	MΩ
Maximum Resistance Heater to Cathode	$R_{h\text{-}k(max)}$	20	20	kΩ

* Maximum pulse duration 4 per cent. of one cycle with a maximum of 800μs.

† Maximum pulse duration 200μs.

‡ Measured with respect to the higher potential heater pin.

THORN — A E I RADIO VALVES & TUBES LTD.

INTER-ELECTRODE CAPACITANCES

		§	¶	‖	
Tetrode Input	$C_{in(q)}$	9·3	9·6	10·7	pF
Tetrode Output	$C_{out(q)}$	9·0	9·3	10·4	pF
Tetrode Anode to Grid 1	C_{aq-g1}	0·35	0·37	0·38	pF
Triode Input	$C_{in(t)}$	3·0	3·2	4·1	pF
Triode Output	$C_{out(t)}$	4·3	4·5	5·4	pF
Grid Triode to Anode Triode	C_{gt-at}	4·2	4·3	4·4	pF
Anode Tetrode to Anode Triode	C_{aq-at}	0·15	0·18	0·19	pF
Grid 1 to Grid Triode	C_{g1-gt}	0·011	0·030	0·063	pF
Grid 1 to Anode Triode	C_{g1-at}	0·017	0·023	0·028	pF
Grid Triode to Anode Tetrode	C_{gt-aq}	0·014	0·020	0·022	pF
Grid Triode to Heater	C_{gt-h}	0·018	0·031	0·042	pF
Grid 1 to Heater	C_{g1-h}	0·24	0·38	0·71	pF

§ In fully shielded socket without can.

¶ With holder capacitance balanced out (Holder as below).

‖ Total inter-electrode capacitances including B9A nylon phenolic holder without skirt or radial shield (AEI holder type VH19/902).

CHARACTERISTICS

		Triode	Tetrode	
Anode Voltage	V_a	100	200	V
Screen Grid Voltage	V_{g2}	—	200	V
Anode Current	I_a	3·5	35	mA
Screen Grid Current	I_{g2}	—	7	mA
Control Grid Voltage	V_{g1}	0	−16	V
Mutual Conductance	g_m	2·5	6·4	mA/V
Amplification Factor	μ	70	—	
Inner Amplification Factor	μ_{g1-g2}	—	9·5	

TYPICAL OPERATION

Single Valve as Class A Audio Output

Anode Voltage	V_a	170	200	V
Screen Grid Voltage	V_{g2}	170	200	V
Grid Bias Voltage	V_g	−11·5	−16	V
Quiescent Anode Current	$I_{a(o)}$	41	35	mA
Quiescent Screen Grid Current	$I_{g2(o)}$	8	7	mA
Power Output for 10 per cent. total distortion	P_{out}	3·3	3·5	W
Anode Load Resistance	R_a	3·9	5.6	kΩ
Input Swing Voltage (R.M.S.)	$V_{in(r.m.s.)}$	6	6·6	V
Input Swing for 50mW output (R.M.S.)		0·59	0·6	V

Field Scanning

The field scan output stage should be designed to allow for valve spread and deterioration during life in addition to component variation. Values of total tetrode peak anode current available for a new average valve and at the assumed end of life point on any valve are as follows :—

		*	†	
Anode Voltage	V_a	50	50	V
Screen Grid Voltage	V_{g2}	170	170	V
Anode Current	I_a	135	85	mA

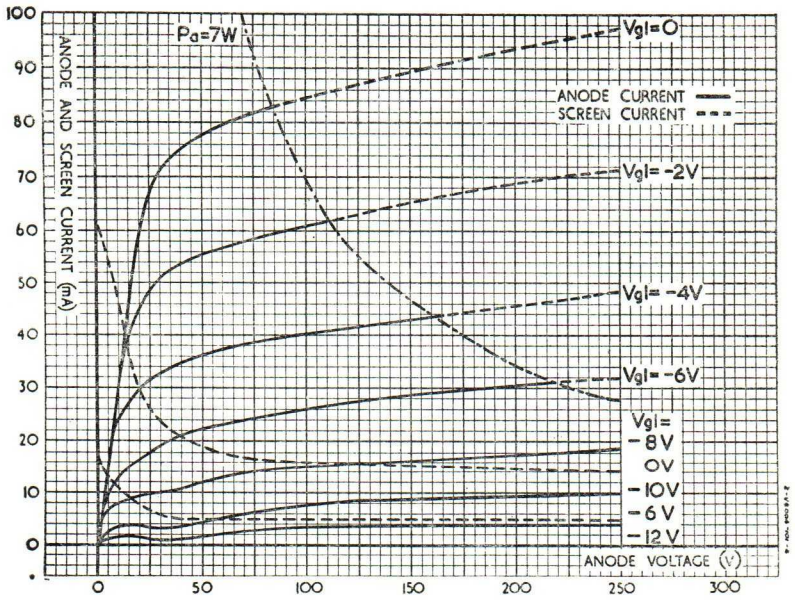
Where V_{g1} is adjusted so that $I_{g1} = +0{\cdot}3\mu A$.

* Average new valve.

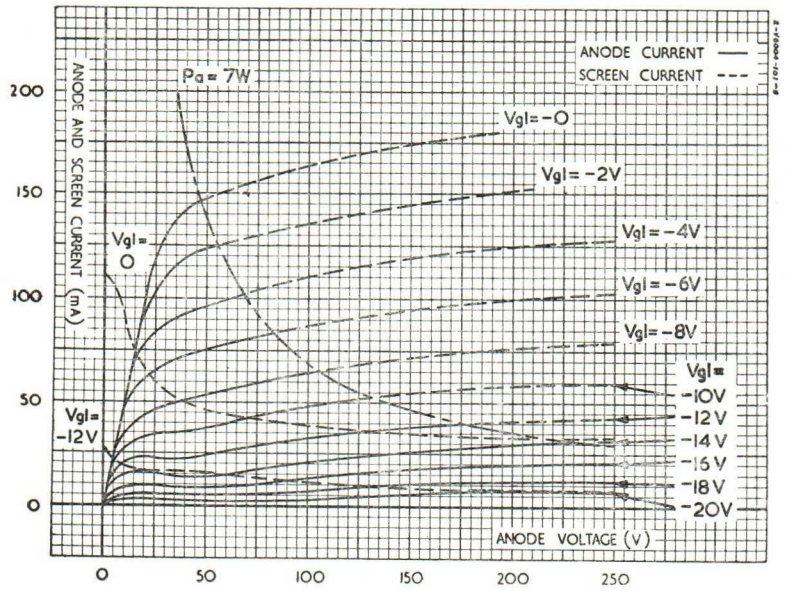
† Assumed end of life condition.

MOUNTING POSITION—Unrestricted

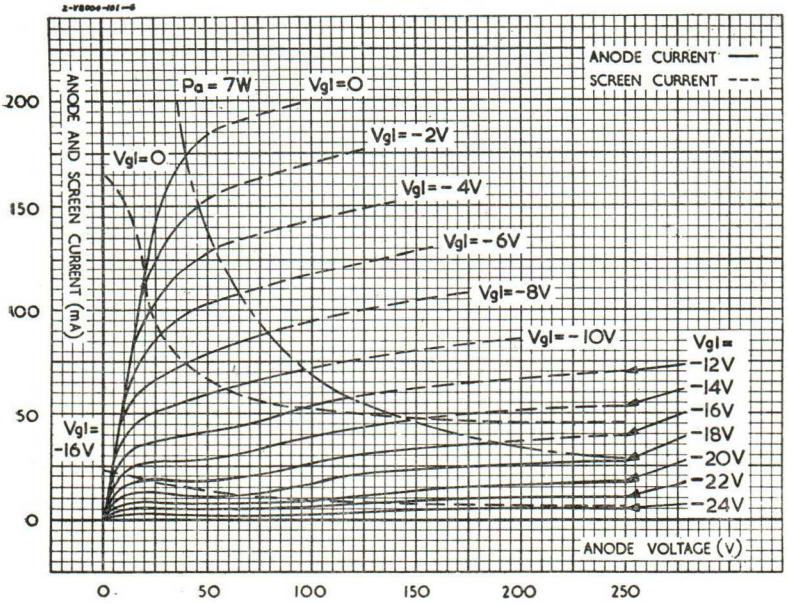
CHARACTERISTIC CURVES
$I_a, I_{g2}/V_a$ (V_{g2}=100V)
Tetrode Section



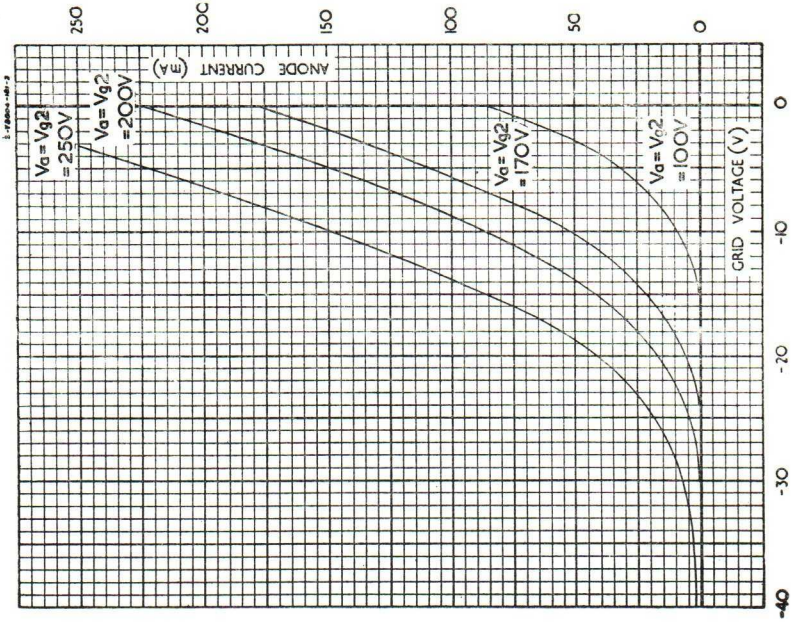
CHARACTERISTIC CURVES : $I_a, I_{g2}/V_a$ (V_{g2}=170V) — Tetrode Section



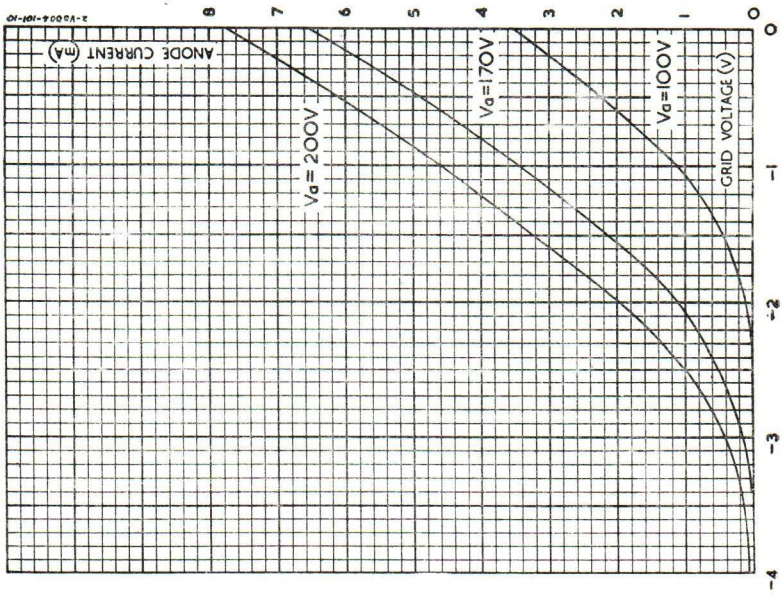
CHARACTERISTIC CURVES : $I_a, I_{g2}/V_a$ (V_{g2}=200V) — Tetrode Section



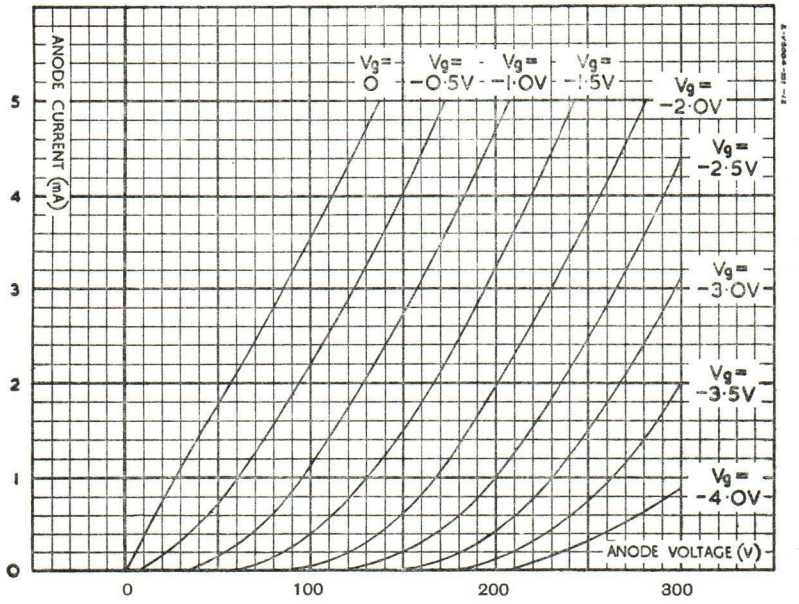
CHARACTERISTIC CURVES : I_a/V_{g1} — Tetrode Section



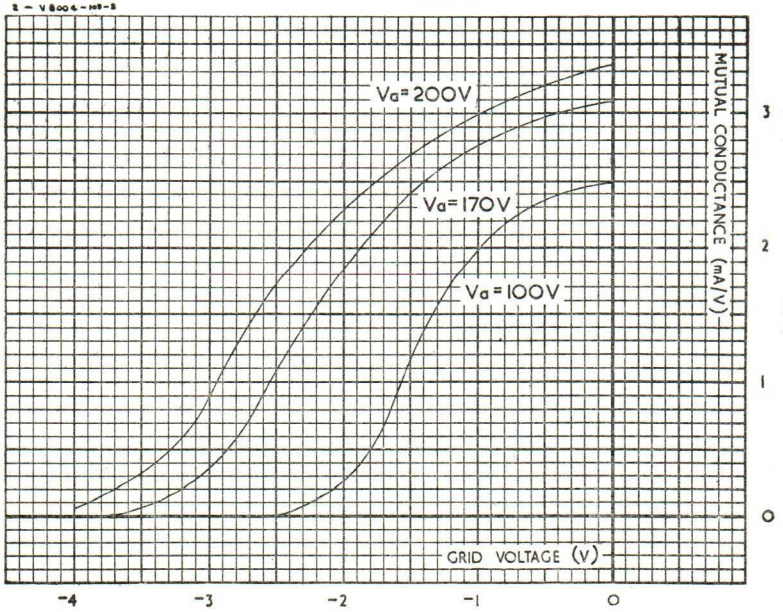
CHARACTERISTIC CURVES : I_a/V_g — Triode Section

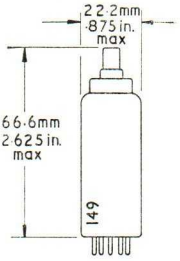


CHARACTERISTIC CURVES: I_a/V_a — Triode Section

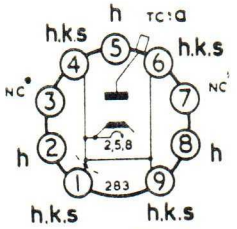


CHARACTERISTIC CURVES: g_m/V_g — Triode Section





HIGH VOLTAGE RECTIFIERS



B9A Base, CT1 Cap

GENERAL

These high voltage half-wave rectifiers are for use in television receivers employing line flyback EHT. The DY87 is electrically identical to the DY86 but has a chemically treated envelope which avoids flash-over under conditions of high humidity and low atmospheric pressure (45 cm.Hg.).

Heater Voltage	V_h	1·4	V
Heater Current	I_h	0·55	A

DESIGN CENTRE RATINGS

(The following ratings refer to normal television flyback EHT operation.)

Maximum Peak Inverse Voltage	$P.I.V_{max}$	22†	kV
Maximum Peak Anode Current	$i_{a(pk)max}$	40‡	mA
Maximum D.C. Anode Current	$I_{out(max)}$	0·5	mA

† The measured PIV must take into account the fact that during the scanning stroke, the anode of the EHT rectifier is at a potential negative with respect to chassis by an amount depending upon the transformer turns ratio. In addition, there is a damped leakage reactance oscillation assumed in the rating to have a peak to peak value not less than 10 per cent of the total PIV.

‡ Maximum duration 10 per cent of a line scanning cycle with a maximum of 10 μs.

INTER-ELECTRODE CAPACITANCE§

Anode to Heater, Cathode and Shield	$C_{a-h,k,s}$	1·55	pF

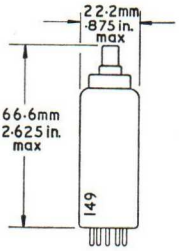
§ In fully shielded socket, without can (I.E.C. Publication 100).

Notes

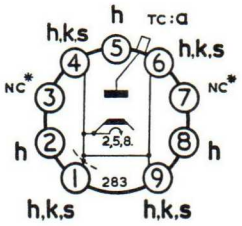
X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this valve whilst it is in use at a PIV in excess of 16 kV design centre.

Precautions must be taken to prevent corona discharge from the connections to this valve by ensuring that no sharp points or bends occur in the wiring and adequate spacing must be left between the valve and surrounding components.

* Pins 3 and 7 may be connected to points in the heater circuit only and must not be earthed. No low potential circuits should be connected to any base pins.



HIGH VOLTAGE RECTIFIER



B9A Base, CT1 Cap

GENERAL

This high voltage half-wave rectifier is for use in television receivers employing line flyback E.H.T.

Heater Voltage	V_h	1·4†	V
Heater Current	I_h	0·6	A

† Heater voltage tolerances: $I_{out} < 200\mu A$, ± 15%; $I_{out} > 200\mu A$, ± 7%.

DESIGN CENTRE RATINGS

(The following ratings refer to normal television flyback E.H.T. operation.)

Maximum Inverse Voltage	$V_{inv(max)}$	20‡	kV
Maximum Peak Inverse Voltage	P.I.V.max	25§	kV
Maximum Peak Inverse Voltage (Absolute maximum)	P.I.V.max	30§	kV
Maximum Peak Anode Current	$i_{a(pk)max}$	50	mA
Maximum D.C. Anode Current	$I_{out(max)}$	0·5‖	mA
Maximum Reservoir Capacitor	C_{max}	3000	pF

‡ D.C. component.

§ Maximum duration 22% of a line scanning cycle with a maximum of 18μs. The negative peak anode voltage due to ringing in the line output transformer must be taken into account.

‖ During short periods as in T.V. operation, $I_{out(max)} = 800\mu A$.

INTER-ELECTRODE CAPACITANCE¶

Anode to Heater, Cathode and Shield	$C_{a\text{-}h,k,s}$	1·0	pF

¶ In fully shielded socket, without can (I.E.C. Publication 100).

OPERATING CHARACTERISTICS

Output Current	I_{out}	200	μA
Output Voltage	V_{out}	20	kV

Notes

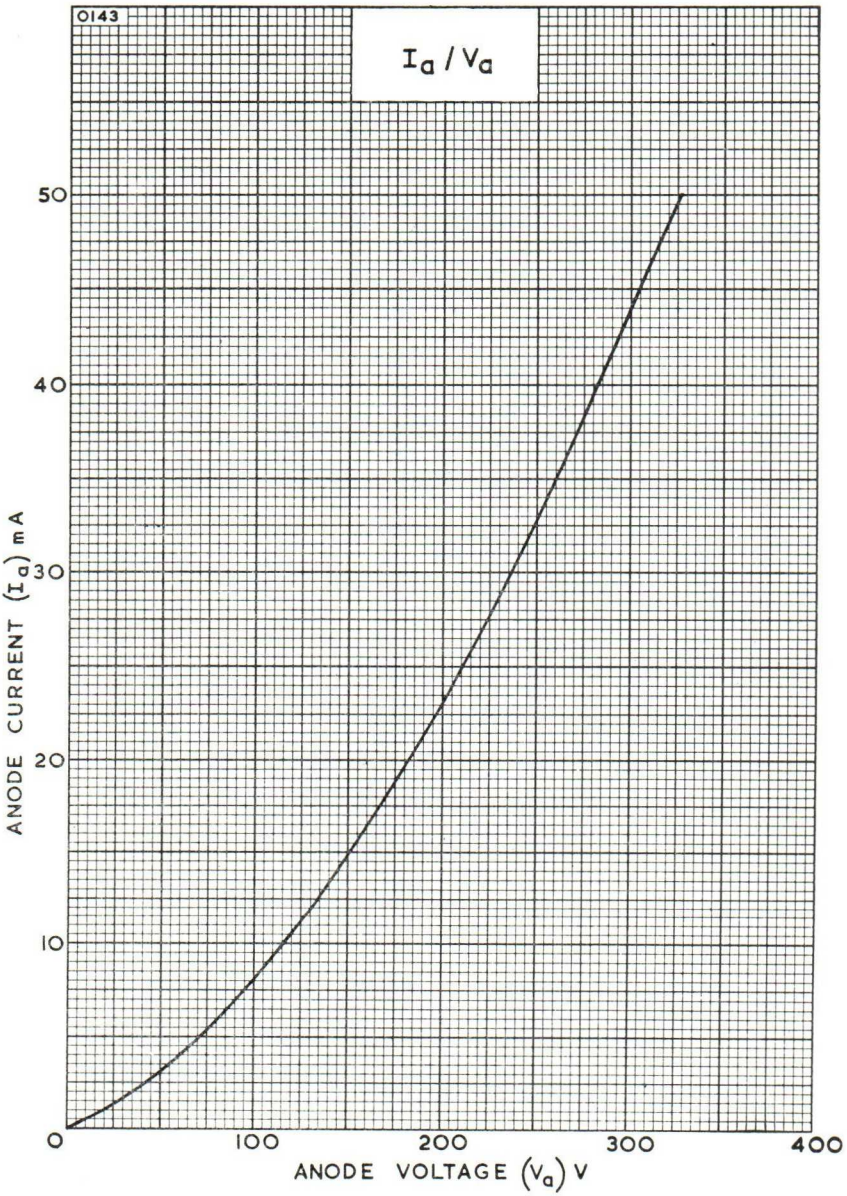
X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this valve whilst it is in use at a P.I.V. in excess of 16 kV design centre.

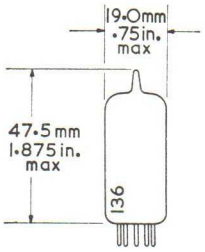
Precautions must be taken to prevent corona discharge from the connections to this valve by ensuring that no sharp points or bends occur in the wiring and adequate spacing must be left between the valve and surrounding components.

* Pins 3 and 7 may be connected to points in the heater circuit only and must not be earthed. No low potential circuits should be connected to any base pins.

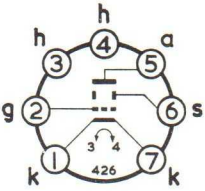
Pins 1, 4, 6 and 9 may be used for fixing an anti-corona shield.

THORN—AEI RADIO VALVES & TUBES LTD.


0143
I_a / V_a
50
40
30
20
10
0
ANODE CURRENT (I_a) mA
100
200
300
400
ANODE VOLTAGE (V_a) V



V.H.F. FRAME GRID TRIODE



B7G Base

GENERAL

This valve is a high slope, frame grid triode with low anode to grid capacitance for use as an R.F. amplifier in V.H.F. television tuners. The low anode to grid capacitance simplifies the problems of neutralising, and is achieved by specially shaped anodes and an internal shield.

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·215	A

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	2·2	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	200	V
Maximum Negative Grid Voltage	$-V_{g(max)}$	50	V
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$	100	V
Maximum Cathode Current	$I_{k(max)}$	20	mA
Maximum Grid to Cathode Resistance	$R_{g_1-k(max)}$	1·0	MΩ
Maximum Heater to Cathode Resistance	$R_{h-k(max)}$	20	kΩ

INTER-ELECTRODE CAPACITANCES

		Shielded	Unshielded	
Anode to Grid	c_{a-g}	0·48	0·5	pF
Grid to Cathode	c_{g-k}	3·2	3·2	pF
Anode to Cathode	c_{a-k}	0·21	0·25	pF
Grid to Cathode, Heater and Shield	$c_{g-k,h,s}$	5·0	5·0	pF
Anode to Cathode, Heater and Shield	$c_{a-k,h,s}$	4·2	3·3	pF
Grid to Heater	c_{g-h}	0·28	0·28	pF
Cathode to Heater	c_{k-h}	2·5	2·5	pF

CHARACTERISTICS

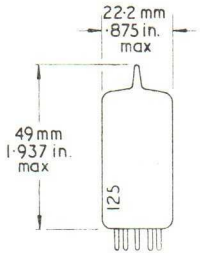
Anode Voltage	V_a	135	V
Grid Voltage	V_g	−1·0	V
Anode Current	I_a	11	mA
Amplification Factor	μ	65	
Mutual Conductance	g_m	13	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	5·0	kΩ
Grid Voltage for g_m reduction 20 : 1	$V_{g(gm/20)}$	−3·1	V
Grid Voltage for g_m reduction 100 : 1	$V_{g(gm/100)}$	−5·0	V
Grid Voltage for I_a = 100 μA	$V_{g(Ia=100\mu A)}$	−5·0	V

TYPICAL OPERATION

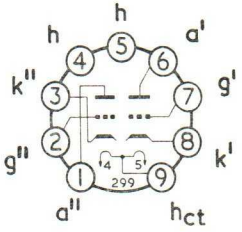
Supply Voltage	V_b	135	135	135	135	200	200	200	200	V
Anode Load Resistance	R_a	1·0	1·0	2·2	2·2	5·6	5·6	6·8	6·8	kΩ
Cathode Resistance	R_k	82	0	0	0	82	0	0	0	Ω
Grid Resistance	R_g	0	1·0	0·22	1·0	0	1·0	0·22	0·56	MΩ
Grid to Anode Resistance	R_{g-a}	—	—	22	22	—	—	22	22	MΩ
Anode Current	I_a	10·5	13	14	14	12	13	14	14	mA
Mutual Conductance	g_m	13	15·5	16	16	14	15·5	16	16	mA/V
Grid Voltage for g_m reduction 100 : 1		−5·0	−4·8	−6·0	−11	−7·5	−7·3	−9·0	−12·5	V

Characteristic curves are identical to those given for the PC97

THORN RADIO VALVES AND TUBES LTD.



DOUBLE TRIODE



B9A Base

GENERAL

The separate cathode connections and tapped heater features enable this valve to be used in a variety of applications.

Heater Voltage	V_h	6·3	or	12·6 V
Heater Current	I_h	0·3	or	0·15 A

RATINGS

Maximum Anode Dissipation (each section)	$P_{a(max)}$	2·5	W
Maximum Anode Voltage (I_a=0)	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	300	V
Maximum Cathode Current (each section)	$I_{k(max)}$	20	mA

INTER-ELECTRODE CAPACITANCES *

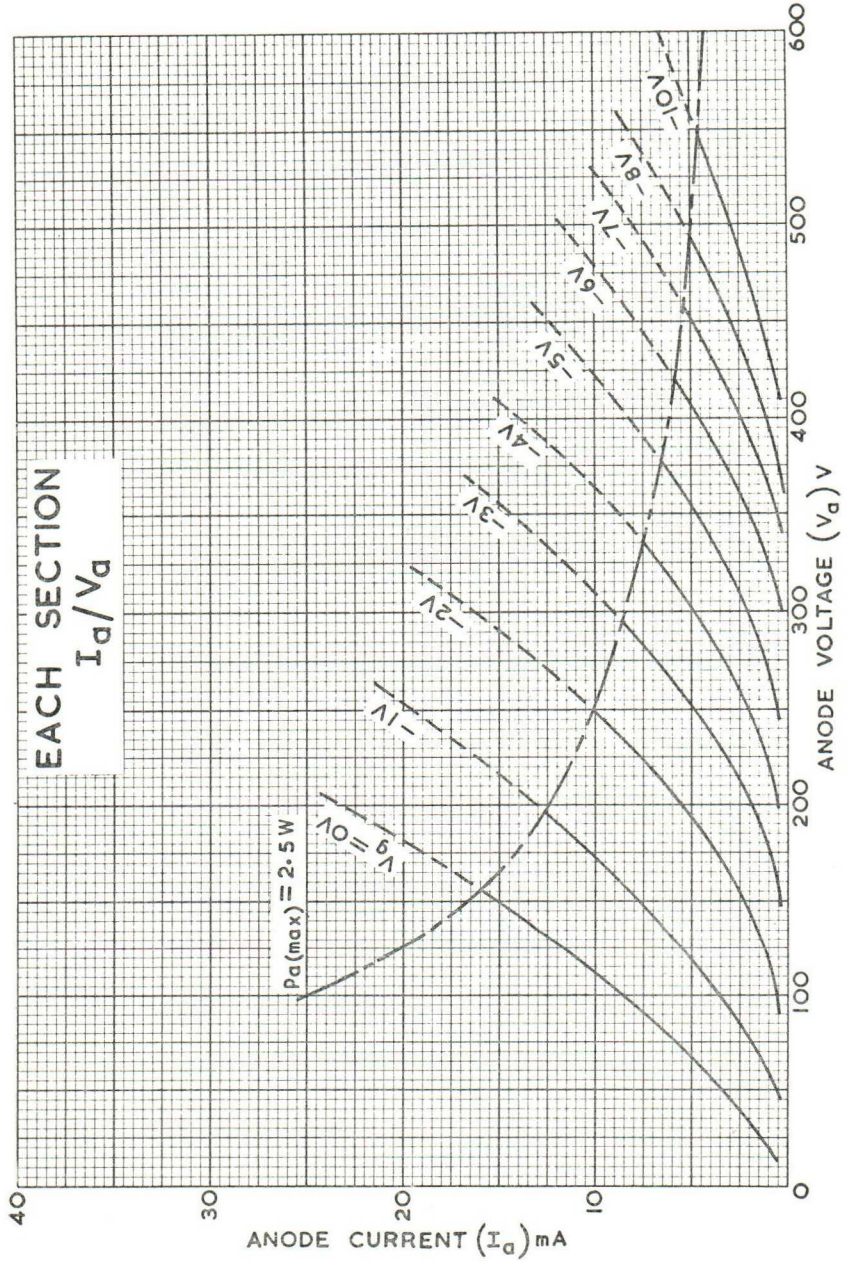
Input′	$c_{in'}$	2·5	pF
Input″	$c_{in''}$	2·5	pF
Output′	$c_{out'}$	0·4	pF
Output″	$c_{out''}$	0·4	pF
Anode′ to Grid′	$c_{a'-g'}$	1·5	pF
Anode″ to Grid″	$c_{a''-g''}$	1·5	pF
Cathode′ to Heater	$c_{k'-h}$	2·5	pF
Cathode″ to Heater	$c_{k''-h}$	2·5	pF
Grid′ to Grid″	$c_{g'-g''}$	<0·005	pF
Anode′ to Anode″	$c_{a'-a''}$	<0·4	pF

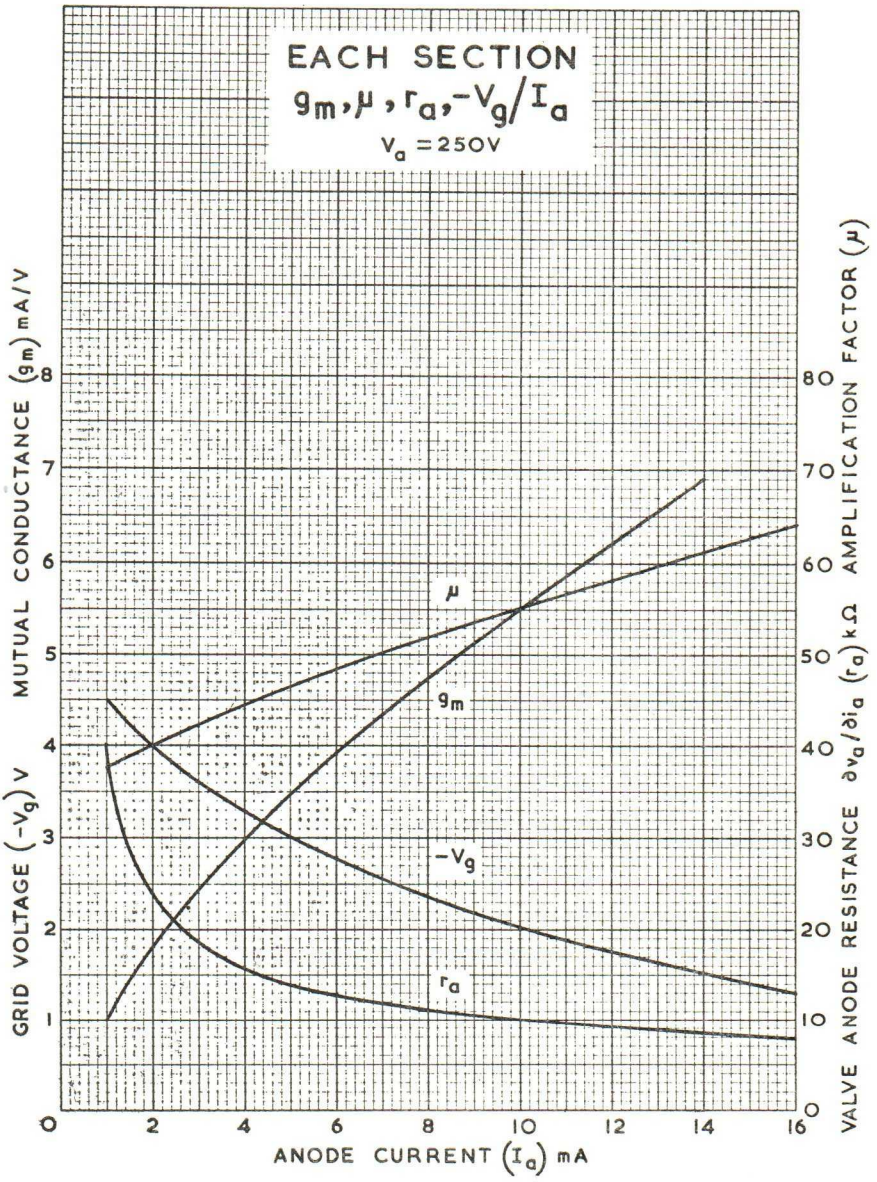
* Measured without an external shield.

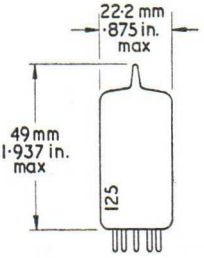
CHARACTERISTICS (Each Section—Class A)

Anode Voltage	V_a	100	180	250	V
Anode Current	I_a	3·7	11	10	mA
Grid Voltage	V_g	−1·0	−1·0	−2·0	V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	13·5	9·4	10	kΩ
Mutual Conductance	g_m	4·0	6·6	5·5	mA/V
Amplification Factor	μ	54	62	55	
Grid Voltage for Anode Current cut-off	V_g	−6·0	−8·0	−12	V

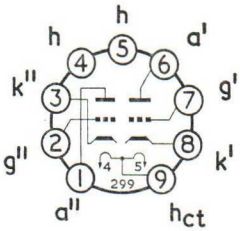
MOUNTING POSITION—Unrestricted


EACH SECTION
Ia/Va
Pa(max) = 2.5 W
-10V
-8V
-7V
-6V
-5V
-4V
-3V
-2V
-1V
0V
ANODE VOLTAGE (Va) V
ANODE CURRENT (Ia) mA
0
100
200
300
400
500
600
40
30
20
10


EACH SECTION
$g_m, \mu, r_a, -V_g/I_a$
$V_a = 250V$
GRID VOLTAGE $(-V_g)$ V
MUTUAL CONDUCTANCE (g_m) mA/V
VALVE ANODE RESISTANCE $\partial v_a/\partial i_a$ (r_a) kΩ
AMPLIFICATION FACTOR (μ)
ANODE CURRENT (I_a) mA
μ
g_m
$-V_g$
r_a
0
1
2
3
4
5
6
7
8
10
20
30
40
50
60
70
80
2
4
6
8
10
12
14
16



A.F. DOUBLE TRIODE



Base B9A

GENERAL

This general purpose double triode is intended for use as an amplifier or oscillator. Each triode unit has identical characteristics, the structures are separate and can be used for different functions or in cascade. The heater is centre tapped and the sections may be operated in series or in parallel on AC or AC/DC mains.

Heater Voltage	V_h	6·3	or	12·6 V
Heater Current	I_h	0·3	or	0·15 A

RATINGS (Each Section)

Maximum Anode Dissipation	$P_{a(max)}$	2·75	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	300	V
Maximum Negative Grid Voltage	$-V_{g(max)}$	150	V
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$	100	V
Maximum Peak Heater to Cathode Voltage	$V_{h-k(pk)max}$	200	V
Maximum Cathode Current	$I_{k(max)}$	20	mA
Maximum Average Grid Current	$I_{g(av)max}$	5·0	mA
Maximum Grid to Cathode Resistance	$R_{g-k(max)}$		
Fixed bias		0·25	MΩ
Self bias		1·0	MΩ

INTER-ELECTRODE CAPACITANCES

		*	
Input′	$c_{in'}$	1·6	pF
Input″	$c_{in''}$	1·6	pF
Output′	$c_{out'}$	0·5	pF
Output″	$c_{out''}$	0·35	pF
Grid′ to Anode′	$c_{g'-a'}$	1·5	pF
Grid″ to Anode″	$c_{g''-a''}$	1·5	pF

* Without external shield.

THORN — A E I RADIO VALVES & TUBES LTD.

CHARACTERISTICS (Each Section)

Anode Voltage	V_a	100	250	V
Anode Current	I_a	11·8	10·5	mA
Grid Voltage	V_g	0	−8·5	V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	6·25	7·7	kΩ
Mutual Conductance	g_m	3·1	2·2	mA/V
Amplification Factor	μ	19·5	17	

When the two sections are used in cascade the section connected to pins 6, 7 and 8 should be used as the first stage for best hum performance. The heater voltage should be applied between pin 9 and pins 4 and 5 connected together and the centre tap of the heater transformer earthed.

TYPICAL OPERATION AS RESISTANCE COUPLED AMPLIFIER

Anode Supply Voltage $V_{a(b)}$ = 100V

Anode Load Resistance	R_a	47	47	100	100	220	220	kΩ
Grid Resistance of following valve	$R_{g'}$	0·1	0·22	0·22	0·47	0·47	1·0	MΩ
Cathode Resistance	R_k	1·8	2·0	3·8	4·7	9·5	11·5	kΩ
Peak Output Voltage	$v_{out(pk)}$	11	14	15	18	20	24	V
Voltage Amplification	V_{out}/V_{in}	11	11	11	11	11	11	

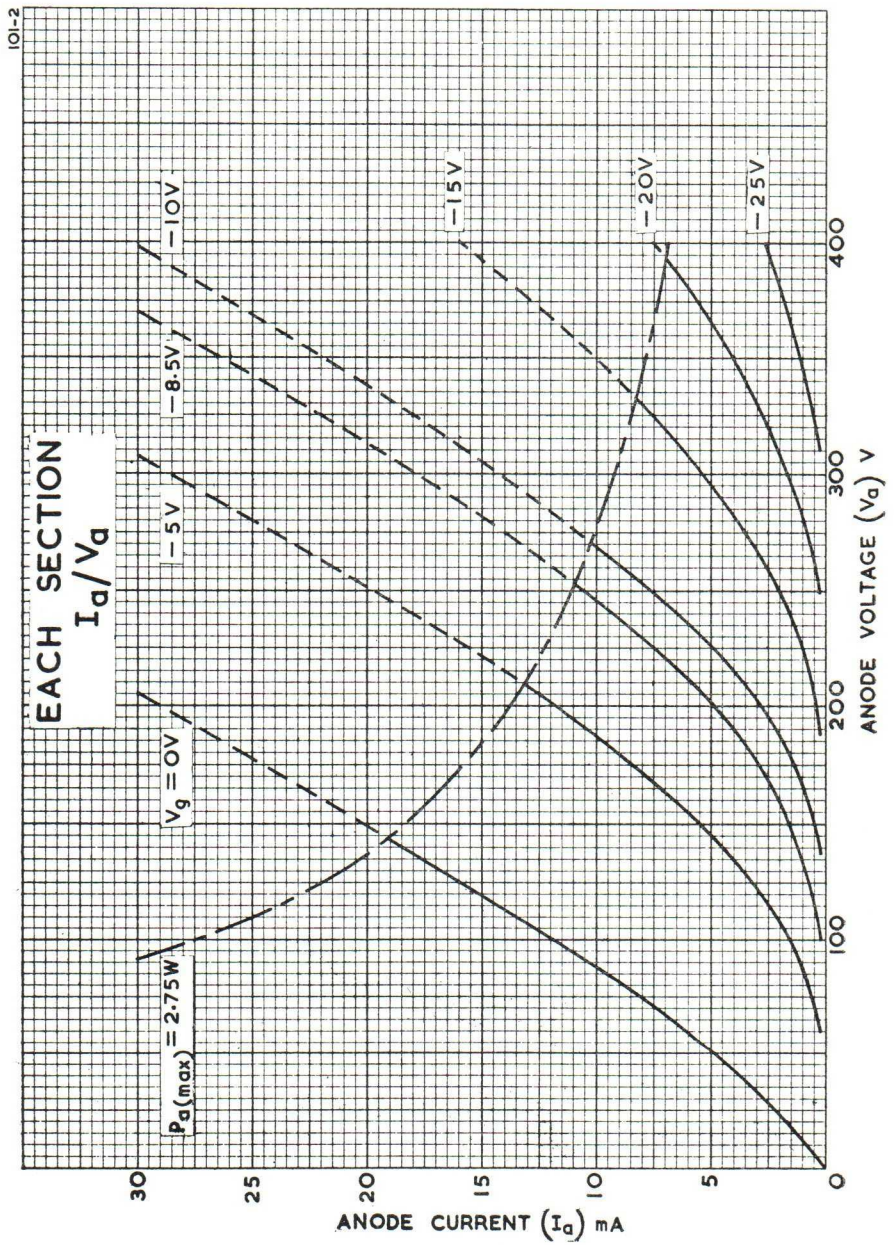
Anode Supply Voltage $V_{a(b)}$ = 200V

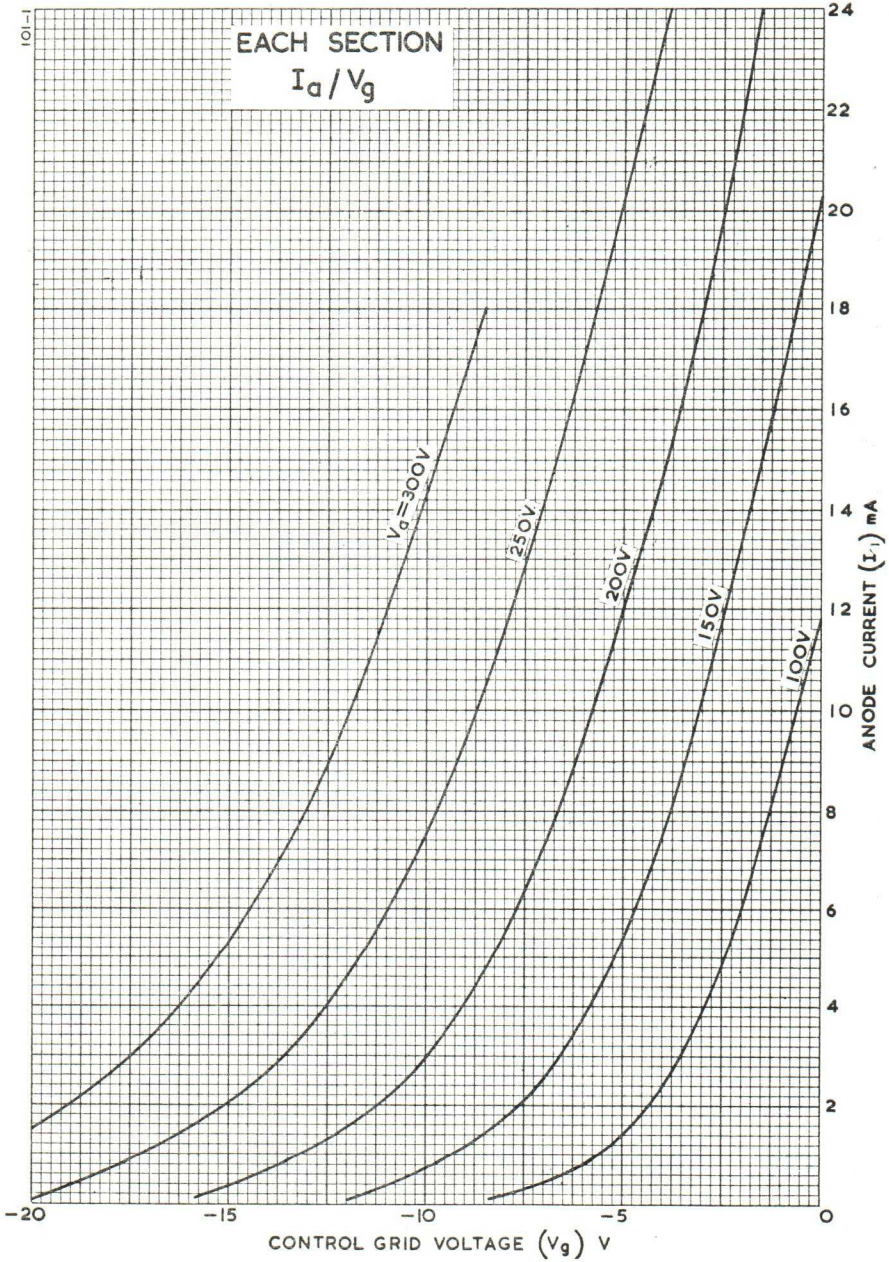
Anode Load Resistance	R_a	47	47	100	100	220	220	kΩ
Grid Resistance of following valve	$R_{g'}$	0·1	0·22	0·22	0·47	0·47	1·0	MΩ
Cathode Resistance	R_k	1·2	1·4	2·8	3·6	8·3	10	kΩ
Peak Output Voltage	$v_{out(pk)}$	26	29	33	40	44	54	V
Voltage Amplification	V_{out}/V_{in}	12	12	12	12	12	12	

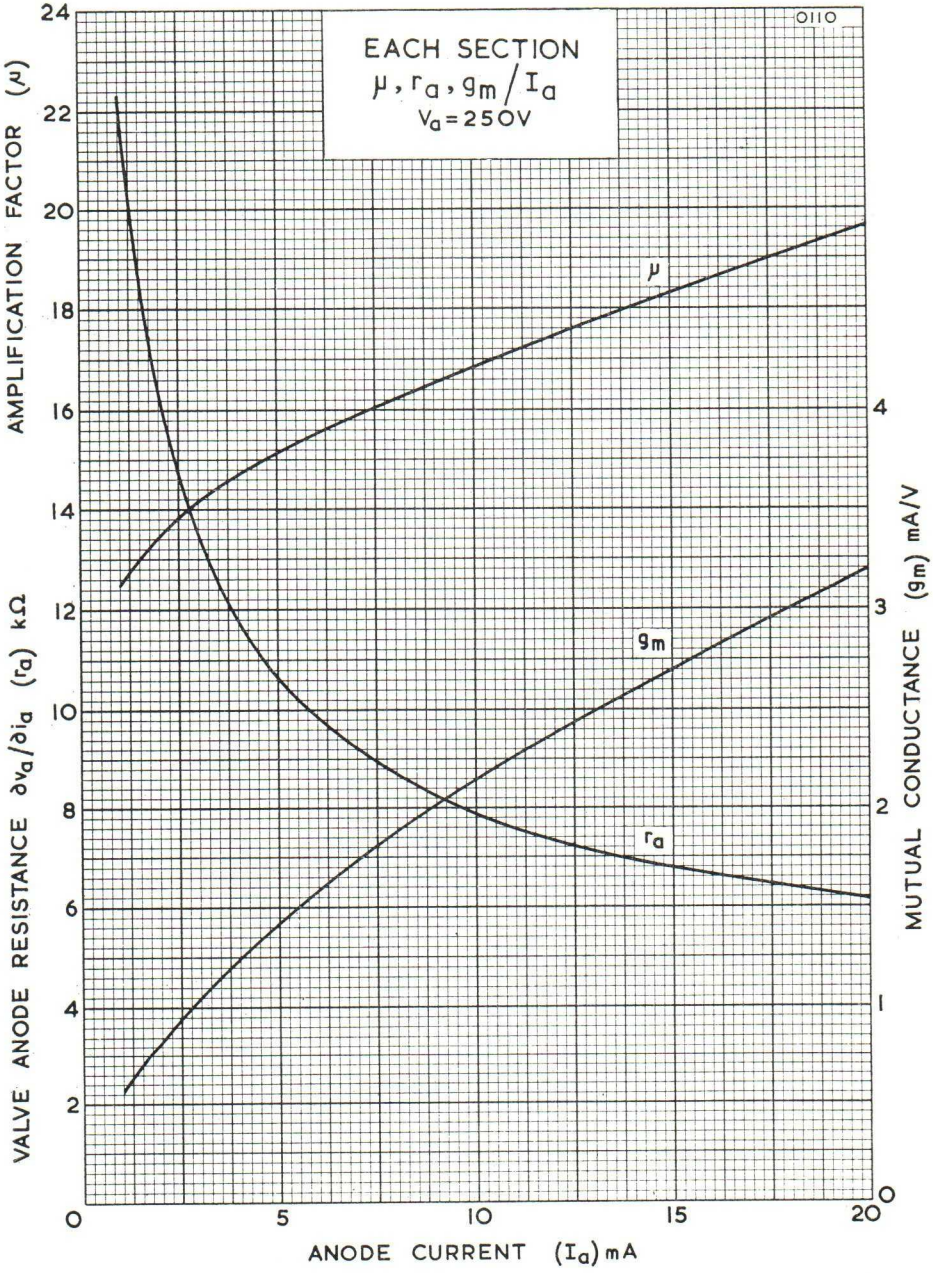
Anode Supply Voltage $V_{a(b)}$ = 300V

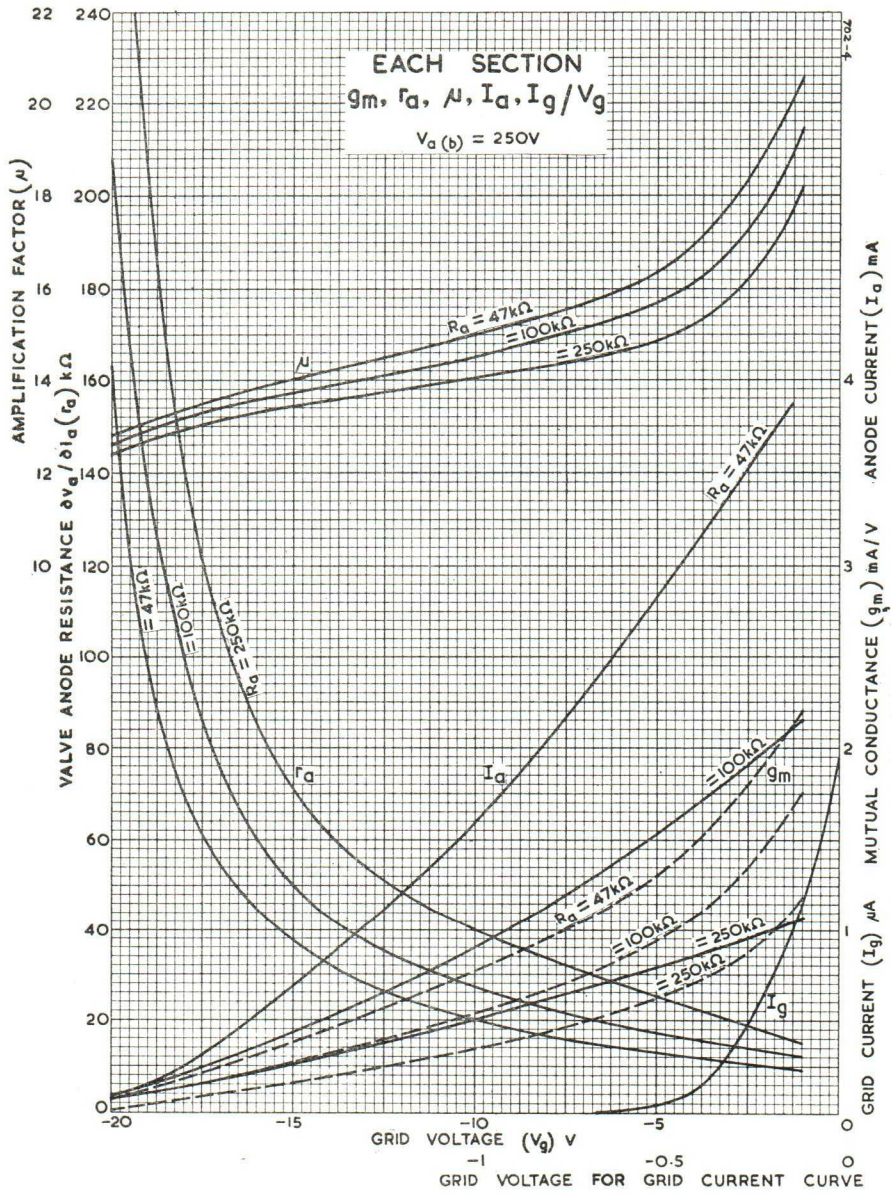
Anode Load Resistance	R_a	47	47	100	100	220	220	kΩ
Grid Resistance of following valve	$R_{g'}$	0·1	0·22	0·22	0·47	0·47	1·0	MΩ
Cathode Resistance	R_k	1·2	1·5	3·0	4·0	8·8	11	kΩ
Peak Output Voltage	$v_{out(pk)}$	52	68	68	80	82	92	V
Voltage Amplification	V_{out}/V_{in}	12	12	12	12	12	12	

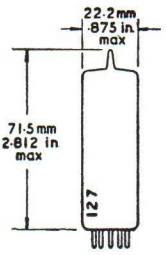
MOUNTING POSITION—Unrestricted


101-2
EACH SECTION
I_a/V_a
$V_g = 0V$
$-5V$
$-8.5V$
$-10V$
$-15V$
$-20V$
$-25V$
$P_{a(max)} = 2.75W$
ANODE CURRENT (I_a) mA
30
25
20
15
10
5
0
100
200
300
400
ANODE VOLTAGE (V_a) V

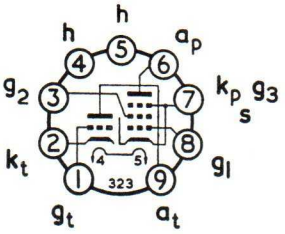

101-1
EACH SECTION
Ia / Vg
Va = 300V
250V
200V
150V
100V
24
22
20
18
16
14
12
10
8
6
4
2
0
ANODE CURRENT (Ia) mA
−20
−15
−10
−5
0
CONTROL GRID VOLTAGE (Vg) V


EACH SECTION
μ, ra, gm / Ia
Va = 250V
0110
μ
gm
ra
AMPLIFICATION FACTOR (μ)
VALVE ANODE RESISTANCE ∂va/∂ia (ra) kΩ
MUTUAL CONDUCTANCE (gm) mA/V
ANODE CURRENT (Ia) mA
0
2
4
6
8
10
12
14
16
18
20
22
24
0
1
2
3
4
0
5
10
15
20


EACH SECTION
gm, ra, μ, Ia, Ig/Vg
Va (b) = 250V
AMPLIFICATION FACTOR (μ)
VALVE ANODE RESISTANCE ∂va/∂ia (ra) kΩ
ANODE CURRENT (Ia) mA
MUTUAL CONDUCTANCE (gm) mA/V
GRID CURRENT (Ig) μA
GRID VOLTAGE (Vg) V
GRID VOLTAGE FOR GRID CURRENT CURVE
Ra = 47kΩ
= 100kΩ
= 250kΩ
μ
ra
Ia
gm
Ig



TRIODE
PENTODE



B9A Base

GENERAL

This high-μ triode and output pentode combination is for use in audio amplifier circuits.

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·66	A

RATINGS

		Triode	Pentode	
Maximum Anode Dissipation	$P_{a(max)}$	0·5	9·0	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	—	1·8	W
For speech and music		—	3·0	W
Maximum Anode Supply Voltage ($I_a = 0$)	$V_{a(b)max}$	550	550	V
Maximum Anode Voltage	$V_{a(max)}$	300	300	V
Maximum Screen Grid Supply Voltage ($I_{g_2} = 0$)	$V_{g2(b)max}$	—	550	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	—	300	V
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$	100	100	V
Maximum Cathode Current	$I_{k(max)}$	4·0	55	mA
Maximum Grid 1 to Cathode Resistance	$R_{g1-k(max)}$			
Fixed Bias		1·0	1·0	MΩ
Self Bias		2·0	—	MΩ
Grid Current Bias		22	—	MΩ
Maximum Heater to Cathode Resistance	$R_{h-k(max)}$	20*	20	kΩ

* When used as a phase inverter immediately preceding the output stage $R_{h-k(max)}$ may be 120kΩ.

INTER-ELECTRODE CAPACITANCES†

Pentode input	$C_{in(p)}$	10	pF
Grid 1 to Anode Pentode	C_{g1-ap}	<0·4	pF
Grid 1 to Heater	C_{g1-h}	<0·24	pF
Triode Input	$C_{in(t)}$	2·3	pF
Triode Output	$C_{out(t)}$	2·5	pF
Grid Triode to Anode Triode	C_{gt-at}	1·4	pF
Grid Triode to Heater	C_{gt-h}	<0·006	pF
Grid Triode to Grid 1	C_{gt-g1}	<0·02	pF
Grid Triode to Anode Pentode	C_{gt-ap}	<0·006	pF
Anode Triode to Anode Pentode	C_{at-ap}	<0·15	pF
Anode Triode to Grid 1	C_{at-g1}	<0·2	pF

† In fully shielded socket without can (I.E.C. Publication 100).

CHARACTERISTICS

		Triode	Pentode	
Anode Voltage	V_a	250	250	V
Screen Grid Voltage	V_{g_2}	—	250	V
Control Grid Voltage	V_{g_1}	−1·9	−7·0	V
Anode Current	I_a	1·2	36	mA
Screen Grid Current	I_{g_2}	—	6·0	mA
Mutual Conductance	g_m	1·6	10	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	62	48	kΩ
Amplification Factor	μ	100	—	
Inner Amplification Factor	$\mu_{g_1-g_2}$	—	21	

TYPICAL OPERATION

Pentode as Class A Audio Output Stage

Anode Voltage	V_a	250	250	V
Screen Grid Voltage	V_{g2}	250	250	V
Cathode Resistor	R_k	270	170	Ω
Anode Resistor	R_a	10	7·0	kΩ
Anode Current	I_a	27	37	mA
Screen Grid Current	I_{g2}	8·2	10	mA
Power Output	P_{out}	2·8	4·0	W
Total Distortion	D_{tot}	10	10	%
Input Voltage (R.M.S.)	$V_{in(r.m.s.)}$	2·7	3·2	V
Input Voltage (R.M.S.) for 50mW output		280	300	mV

Pentodes—Two Valves in Push-Pull (Cathode Bias)

Anode Supply Voltage	$V_{a(b)}$	250	300	V
Screen Supply Voltage	$V_{g2(b)}$	250	300	V
Cathode Resistor (per valve)	R_k	180	260	Ω
Anode to Anode Load Resistor	R_{a-a}	8·2	9·1	kΩ
Anode Current (Quiescent)	$I_{a(o)}$	2×32·5	2×31	mA
Anode Current (max. sig.)	$I_{a(max.\ sig.)}$	2×35·5	2×37	mA
Screen Grid Current (Quiescent)	$I_{g2(o)}$	2× 5·6	2× 5·5	mA
Screen Grid Current (max. sig.)	$I_{g2(max.\ sig.)}$	2× 8·9	2×10·6	mA
Power Output	P_{out}	10	13·6	W
Total Distortion	D_{tot}	5·0	4·0	%
Input Voltage (R.M.S.) Grid to Grid	$V_{in(g_1\text{-}g_1)r.m.s.}$	11	16·8	V
Input Voltage (R.M.S.) for 50mW output		480	520	mV

Triode as Resistance Coupled A.F. Amplifier

Cathode Self Bias*

Supply Voltage	V_b	200	250	250	300	V
Anode Load Resistance	R_a	220	220	220	220	kΩ
Cathode Self Bias Resistance	R_k	2·6	1·75	1·75	1·2	kΩ
Grid Resistance of Following Valve		0·68	0·68	10	10	MΩ
Anode Current	I_a	0·42	0·6	0·6	0·8	mA
Voltage Amplification		66	70	75	80	
R.M.S. Output Voltage		3·2	3·2	5·0	9·0	V
Total Harmonic Distortion	D_{tot}	0·6	0·4	0·4	0·4	%

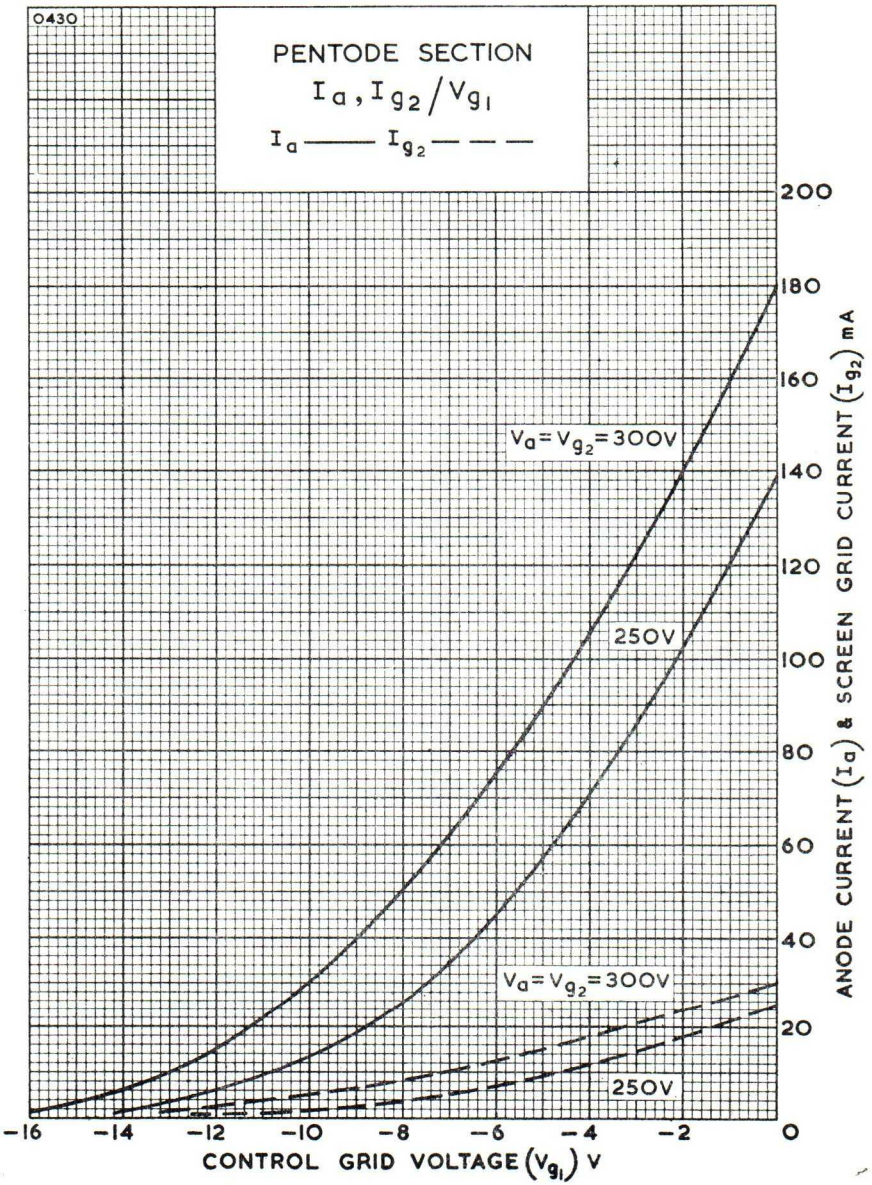
* At lower values of supply voltage grid current bias should be used.

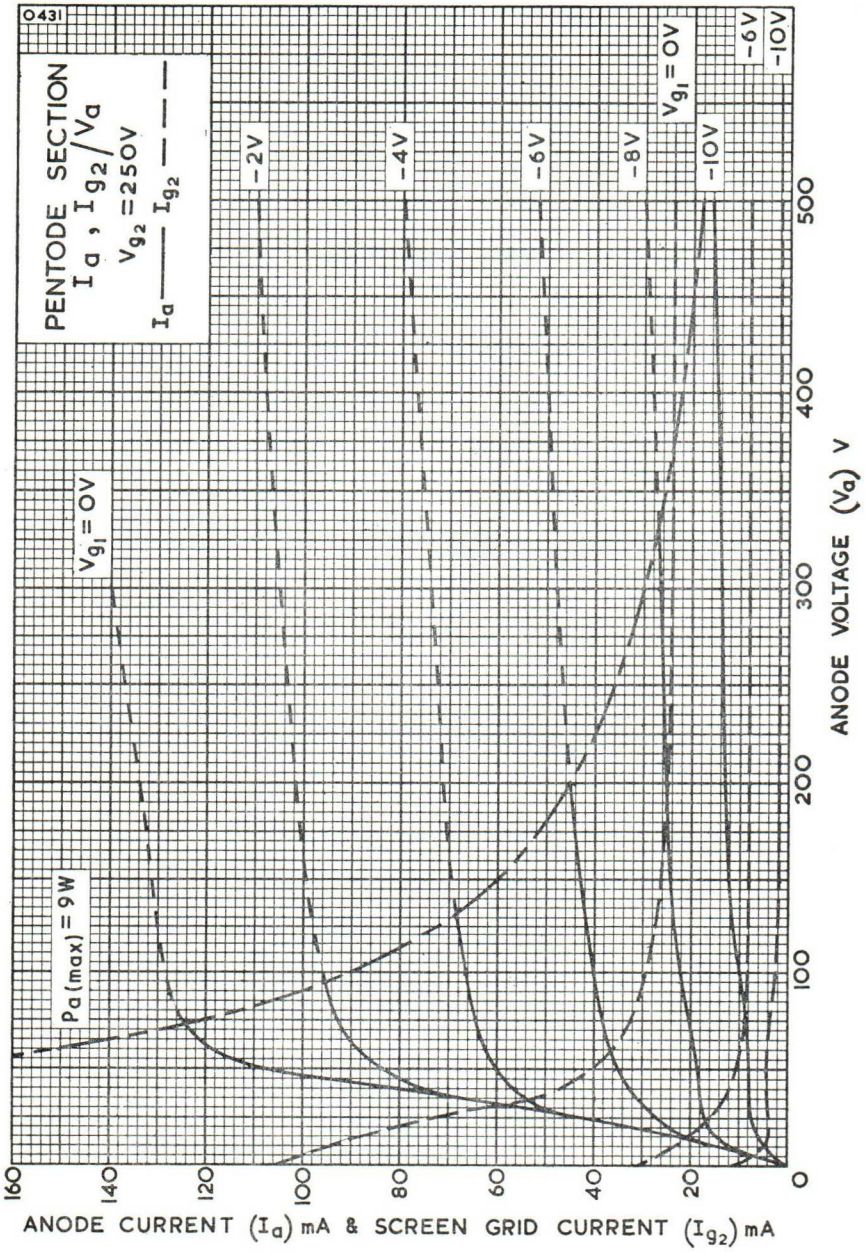
Grid Current Bias ($R_g = 10$ MΩ)

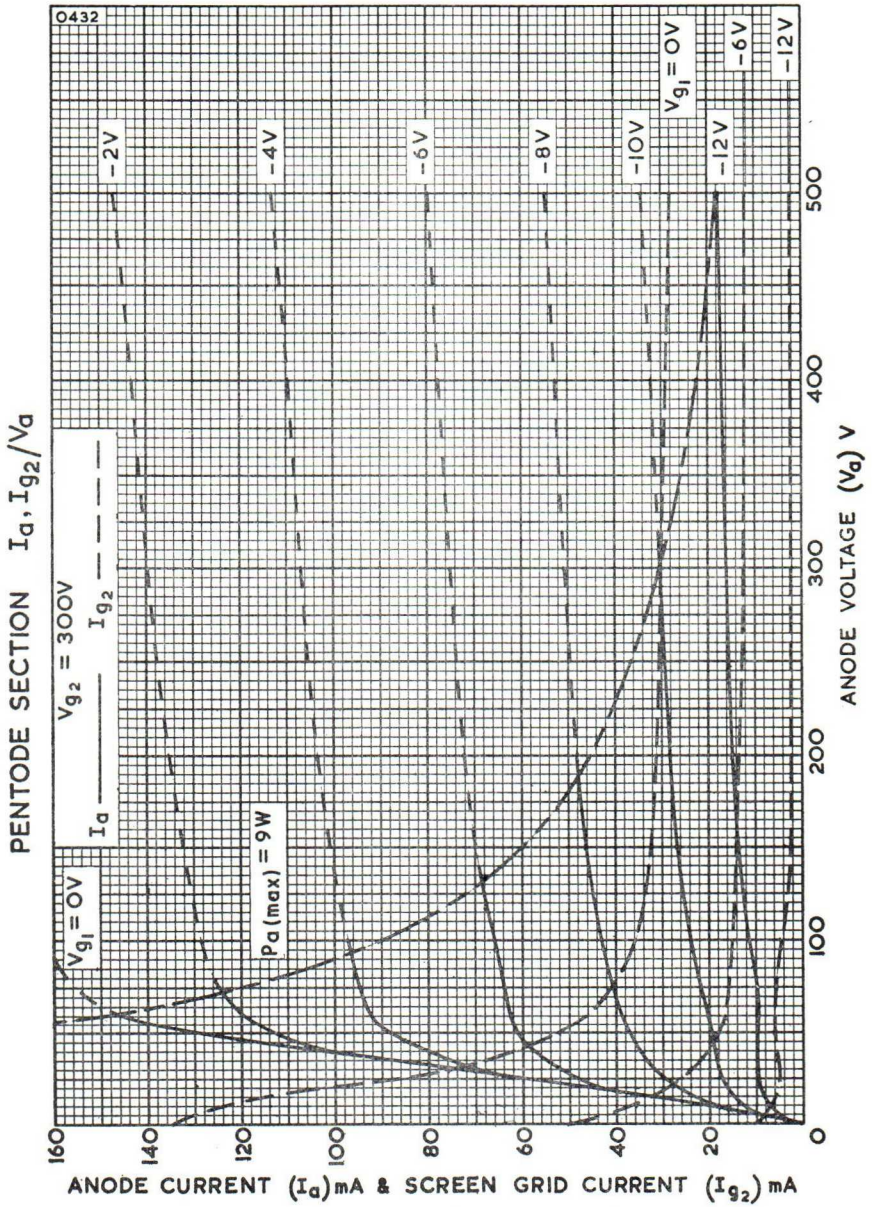
Supply Voltage	V_b	200	250	250	300	V
Anode Load Resistance	R_a	220	220	220	220	kΩ
Grid Resistance of Following Valve		0·68	0·68	10	10	MΩ
Anode Current	I_a	0·42	0·6	0·6	0·8	mA
Signal source impedance	Z_s	47	47	47	47	kΩ
Voltage amplification		66	70	75	80	
R.M.S. Output Voltage		3·2	3·2	5·0	9·0	V
Total Harmonic Distortion	D_{tot}	0·6	0·4	0·4	0·4	%

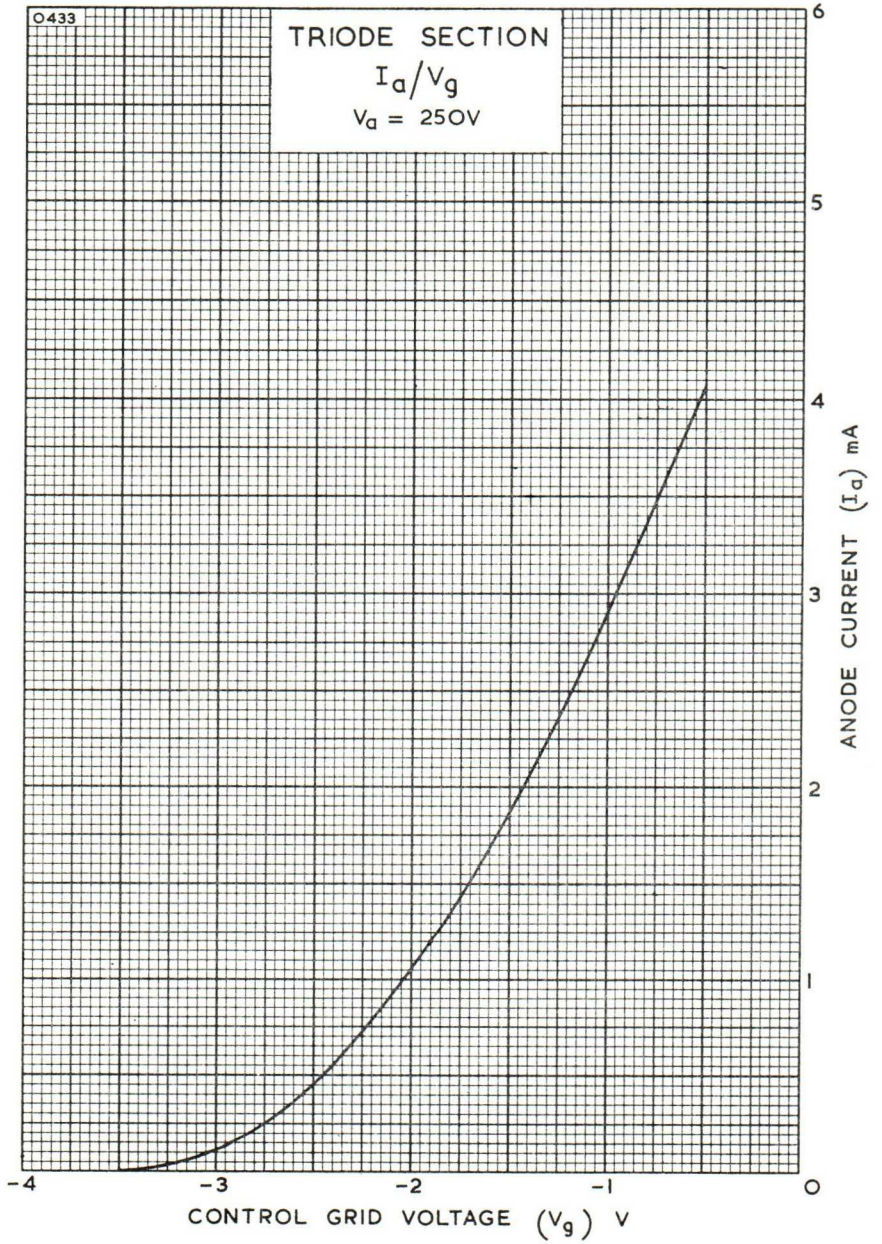
Note: Microphony. This valve may be used without special precautions against microphony in equipment where the input voltage is not less than 4 mV for an output of 50 mW.

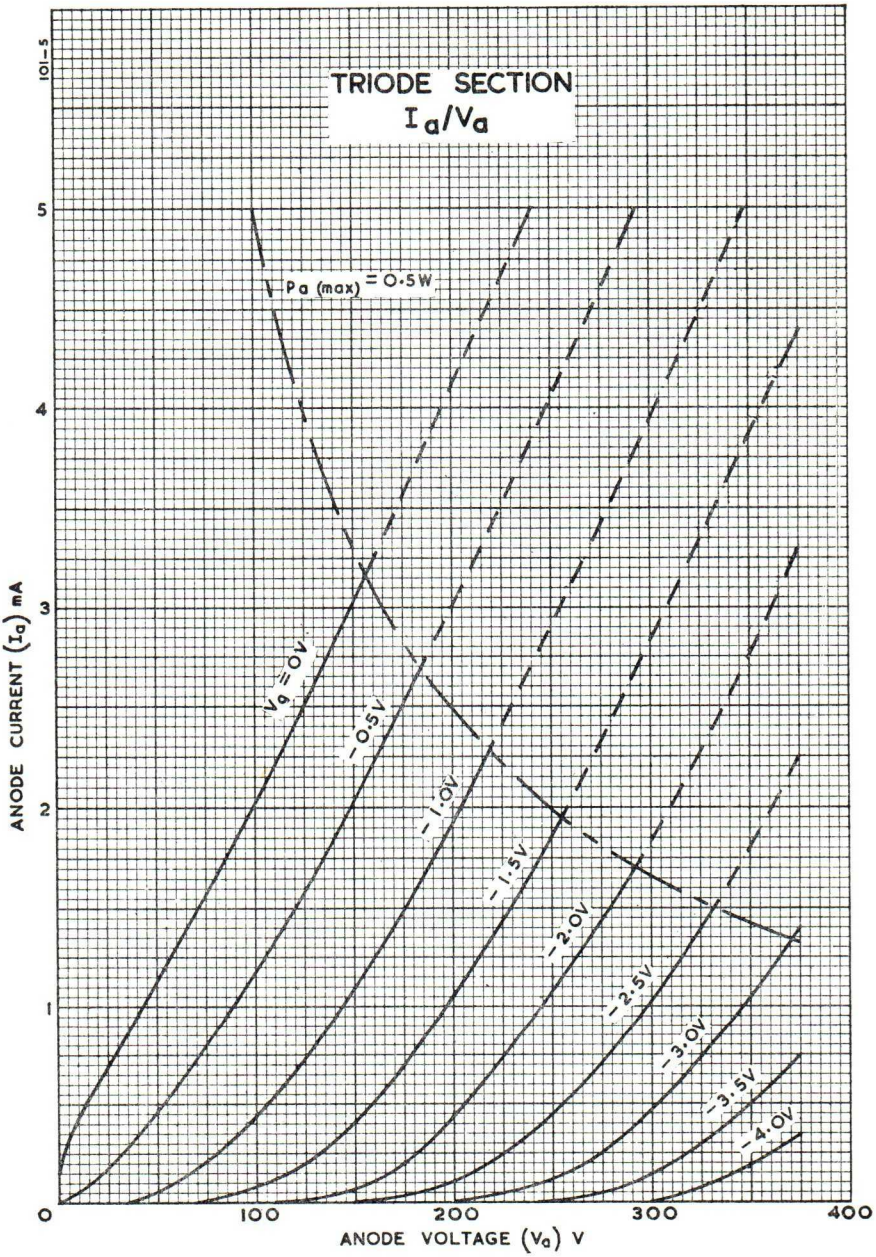
MOUNTING POSITION—Unrestricted

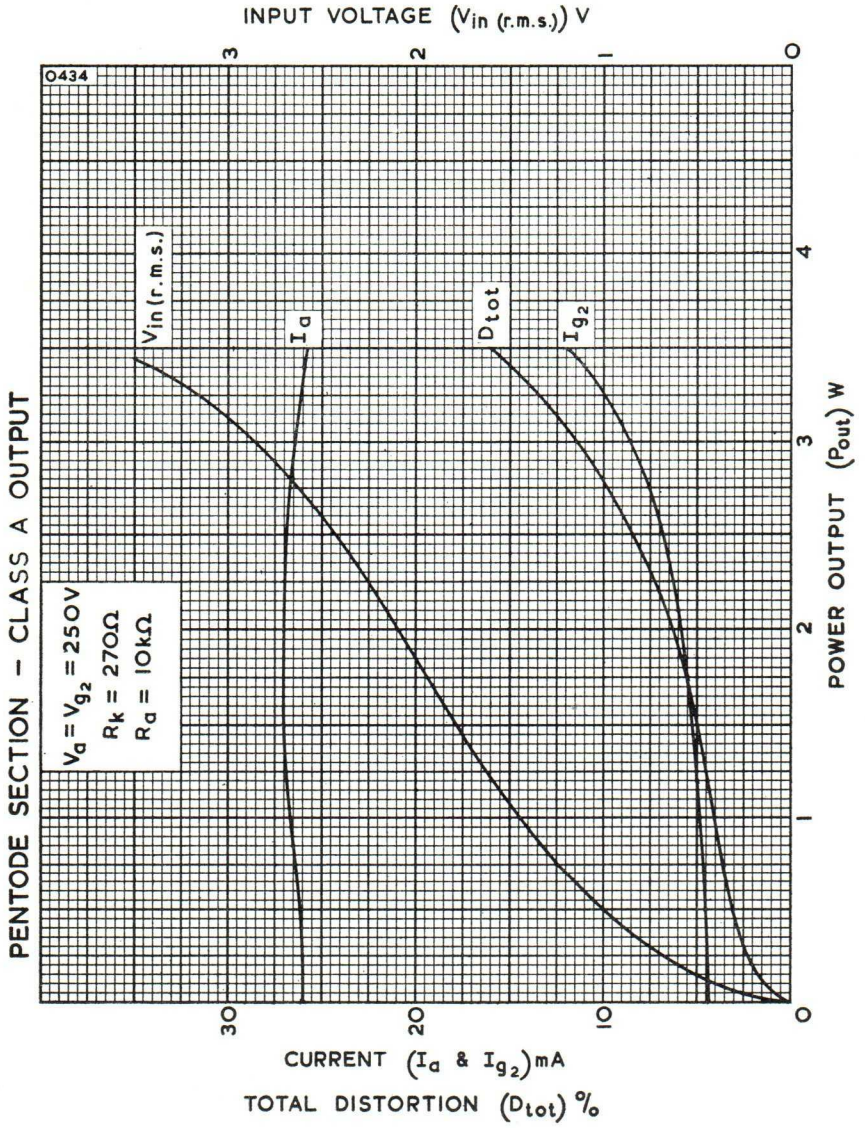

0430
PENTODE SECTION
$I_a, I_{g_2} / V_{g_1}$
I_a —— I_{g_2} — — —
$V_a = V_{g_2} = 300V$
250V
$V_a = V_{g_2} = 300V$
250V
200
180
160
140
120
100
80
60
40
20
0
−16
−14
−12
−10
−8
−6
−4
−2
CONTROL GRID VOLTAGE (V_{g_1}) V
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA

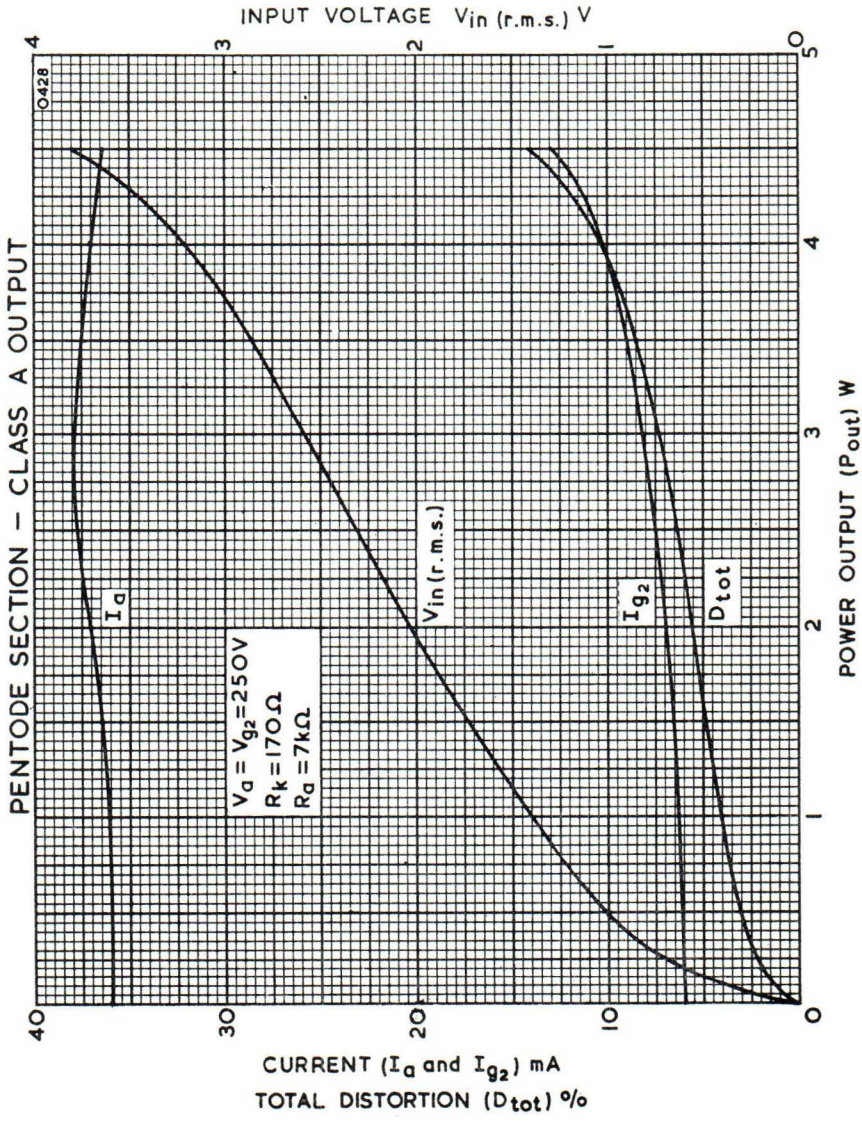

0431
PENTODE SECTION
Ia , Ig2 / Va
Vg2 = 250V
Ia —— Ig2 — — —
Vg1 = 0V
-2V
-4V
-6V
-8V
-10V
-6V
-10V
Pa (max) = 9W
ANODE VOLTAGE (Va) V
0
100
200
300
400
500
ANODE CURRENT (Ia) mA & SCREEN GRID CURRENT (Ig2) mA
160
140
120
100
80
60
40
20
0

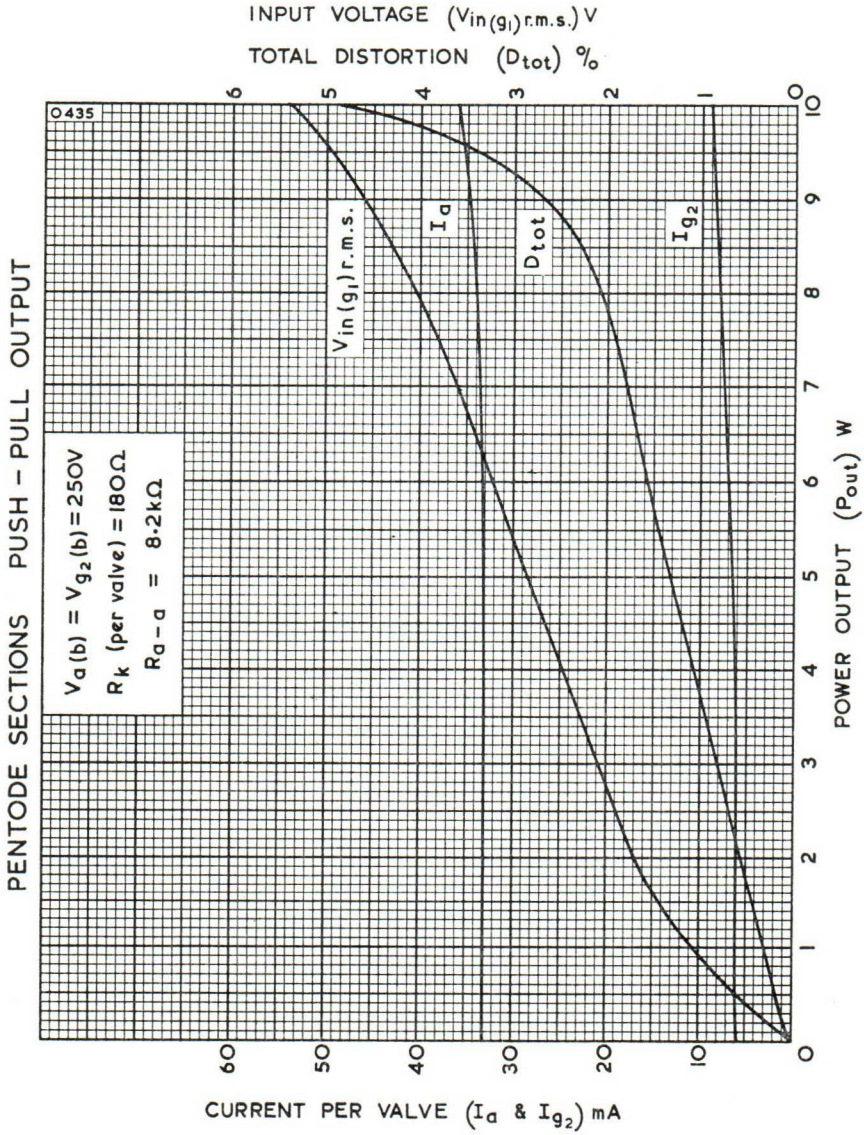

0432
PENTODE SECTION Ia, Ig2/Va
Vg2 = 300V
Ig2 ——— —
Ia ———
Vg1 = 0V
Pa(max) = 9W
-2V
-4V
-6V
-8V
-10V
-12V
Vg1 = 0V
-6V
-12V
ANODE VOLTAGE (Va) V
0
100
200
300
400
500
ANODE CURRENT (Ia) mA & SCREEN GRID CURRENT (Ig2) mA
160
140
120
100
80
60
40
20
0

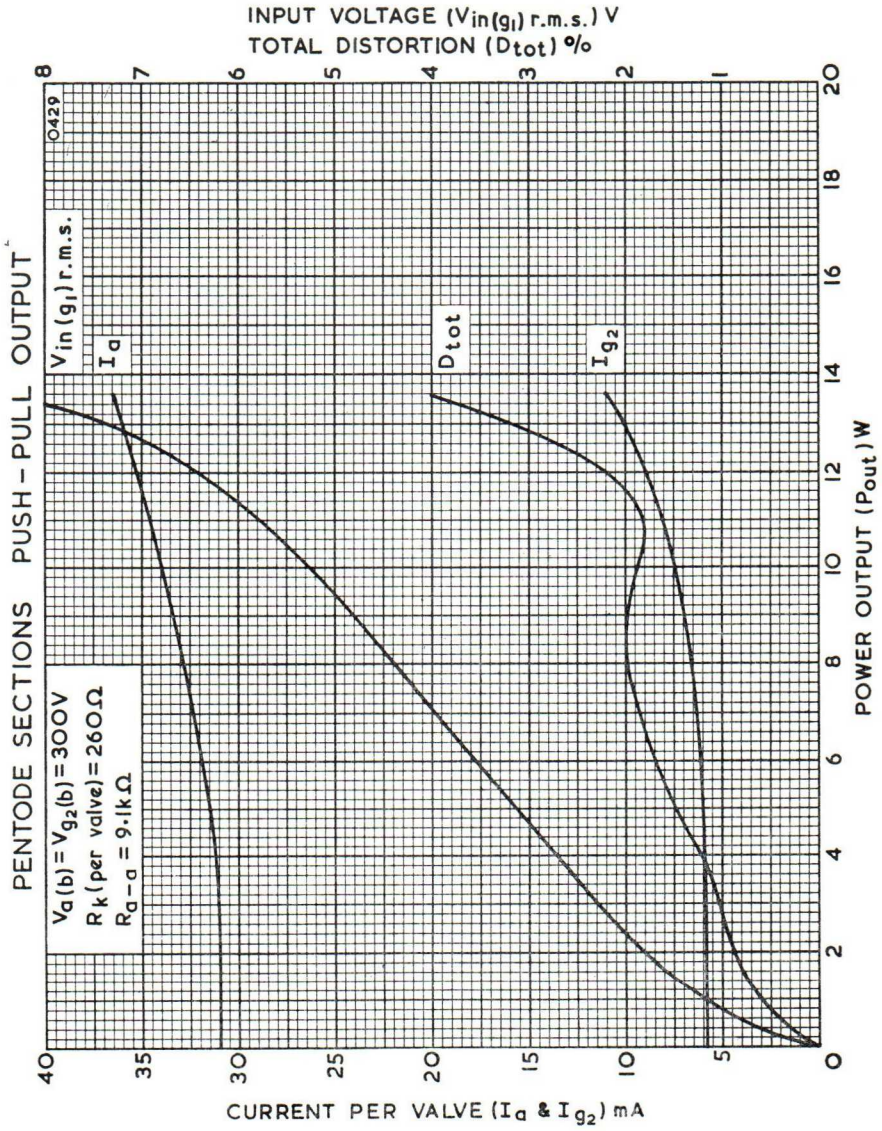

0433
TRIODE SECTION
I_a/V_g
V_a = 250V
6
5
4
3
2
1
0
ANODE CURRENT (I_a) mA
-4
-3
-2
-1
0
CONTROL GRID VOLTAGE (V_g) V

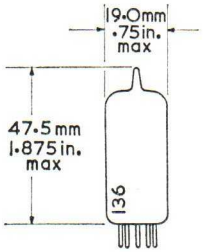

TRIODE SECTION
I_a/V_a
101-5
Pa (max) = 0·5W
V_g = 0V
-0·5V
-1·0V
-1·5V
-2·0V
-2·5V
-3·0V
-3·5V
-4·0V
ANODE CURRENT (I_a) mA
0
1
2
3
4
5
100
200
300
400
ANODE VOLTAGE (V_a) V


INPUT VOLTAGE (V_{in} (r.m.s.)) V
3
2
1
0
0434
V_{in} (r.m.s.)
I_a
D_{tot}
I_{g_2}
$V_a = V_{g_2} = 250V$
$R_k = 270\Omega$
$R_a = 10k\Omega$
PENTODE SECTION - CLASS A OUTPUT
POWER OUTPUT (P_{out}) W
4
3
2
1
0
30
20
10
0
CURRENT (I_a & I_{g_2}) mA
TOTAL DISTORTION (D_{tot}) %

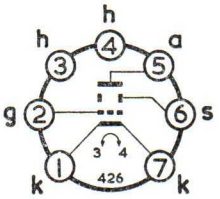

INPUT VOLTAGE V_{in} (r.m.s.) V
0428
PENTODE SECTION – CLASS A OUTPUT
I_a
$V_a = V_{g2} = 250V$
$R_k = 170\Omega$
$R_a = 7k\Omega$
V_{in} (r.m.s.)
I_{g_2}
D_{tot}
POWER OUTPUT (P_{out}) W
CURRENT (I_a and I_{g_2}) mA
TOTAL DISTORTION (D_{tot}) %


INPUT VOLTAGE ($V_{in(g_1)}$ r.m.s.) V
TOTAL DISTORTION (D_{tot}) %
0435
PENTODE SECTIONS PUSH – PULL OUTPUT
$V_{a(b)} = V_{g_2(b)} = 250V$
R_k (per valve) = 180Ω
R_{a-a} = 8·2kΩ
$V_{in(g_1)}$ r.m.s.
I_a
D_{tot}
I_{g_2}
POWER OUTPUT (P_{out}) W
CURRENT PER VALVE (I_a & I_{g_2}) mA


INPUT VOLTAGE ($V_{in(g_1)}$ r.m.s.) V
TOTAL DISTORTION (D_{tot}) %
0429
PENTODE SECTIONS PUSH-PULL OUTPUT
$V_{in(g_1)}$ r.m.s.
I_a
D_{tot}
I_{g_2}
$V_a(b) = V_{g_2}(b) = 300V$
R_k (per valve) = 260Ω
R_{a-a} = 9.1kΩ
POWER OUTPUT (P_{out}) W
CURRENT PER VALVE (I_a & I_{g_2}) mA



V.H.F. FRAME GRID TRIODE



B7G Base

GENERAL

This valve is a high slope, frame grid triode with low anode to grid capacitance for use as an R.F. amplifier in V.H.F. television tuners. The low anode to grid capacitance simplifies the problems of neutralising, and is achieved by specially shaped anodes and an internal shield.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	4·5	V

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	2·2	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	200	V
Maximum Negative Grid Voltage	$-V_{g(max)}$	50	V
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$	100	V
Maximum Cathode Current	$I_{k(max)}$	20	mA
Maximum Grid to Cathode Resistance	$R_{g1-k(max)}$	1·0	MΩ

INTER-ELECTRODE CAPACITANCES

		*	†	
Anode to Grid	c_{a-g}	0·48	0·5	pF
Grid to Cathode	c_{g-k}	3·2	3·2	pF
Anode to Cathode	c_{a-k}	0·21	0·25	pF
Grid to Cathode, Heater and Shield	$c_{g-k,h,s}$	5·0	5·0	pF
Anode to Cathode, Heater and Shield	$c_{a-k,h,s}$	4·2	3·3	pF
Grid to Heater	c_{g-h}	0·28	0·28	pF
Cathode to Heater	c_{k-h}	2·5	2·5	pF

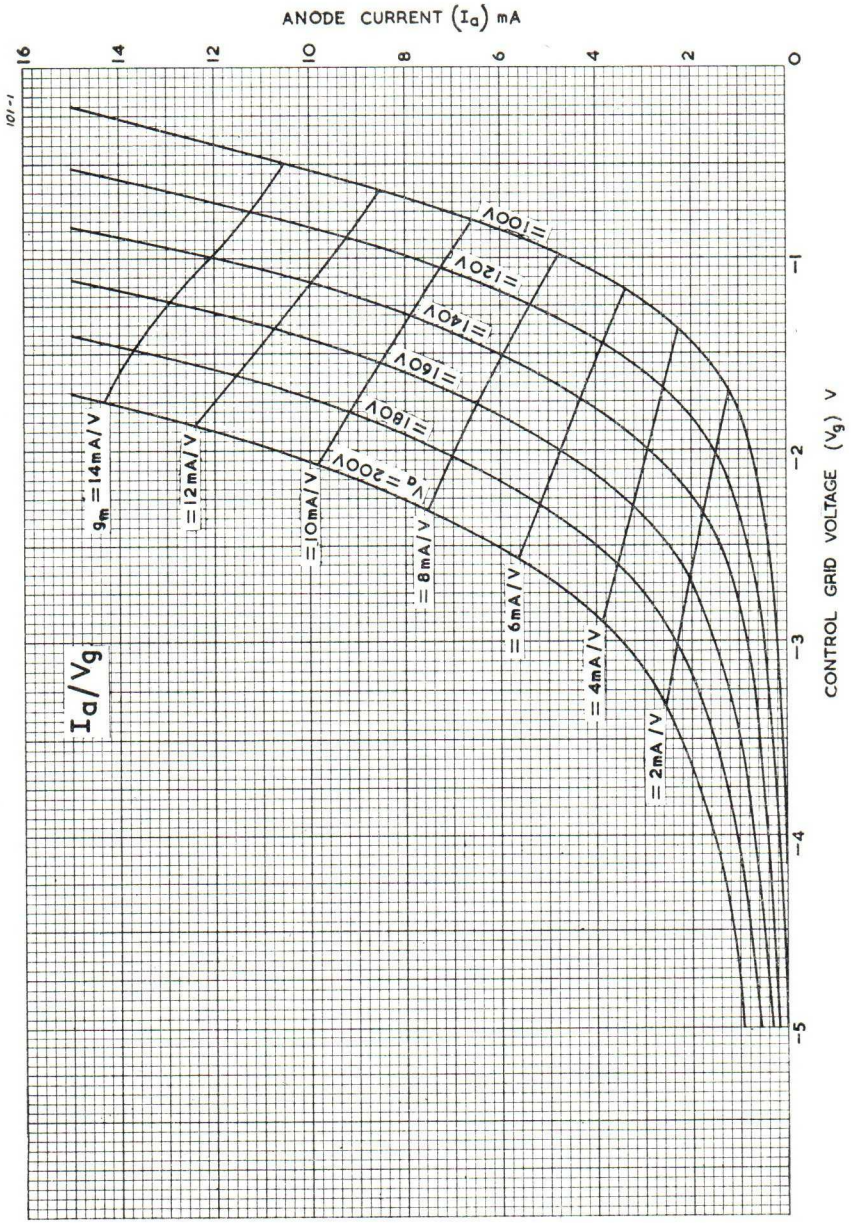
* With shield.
† Without shield.

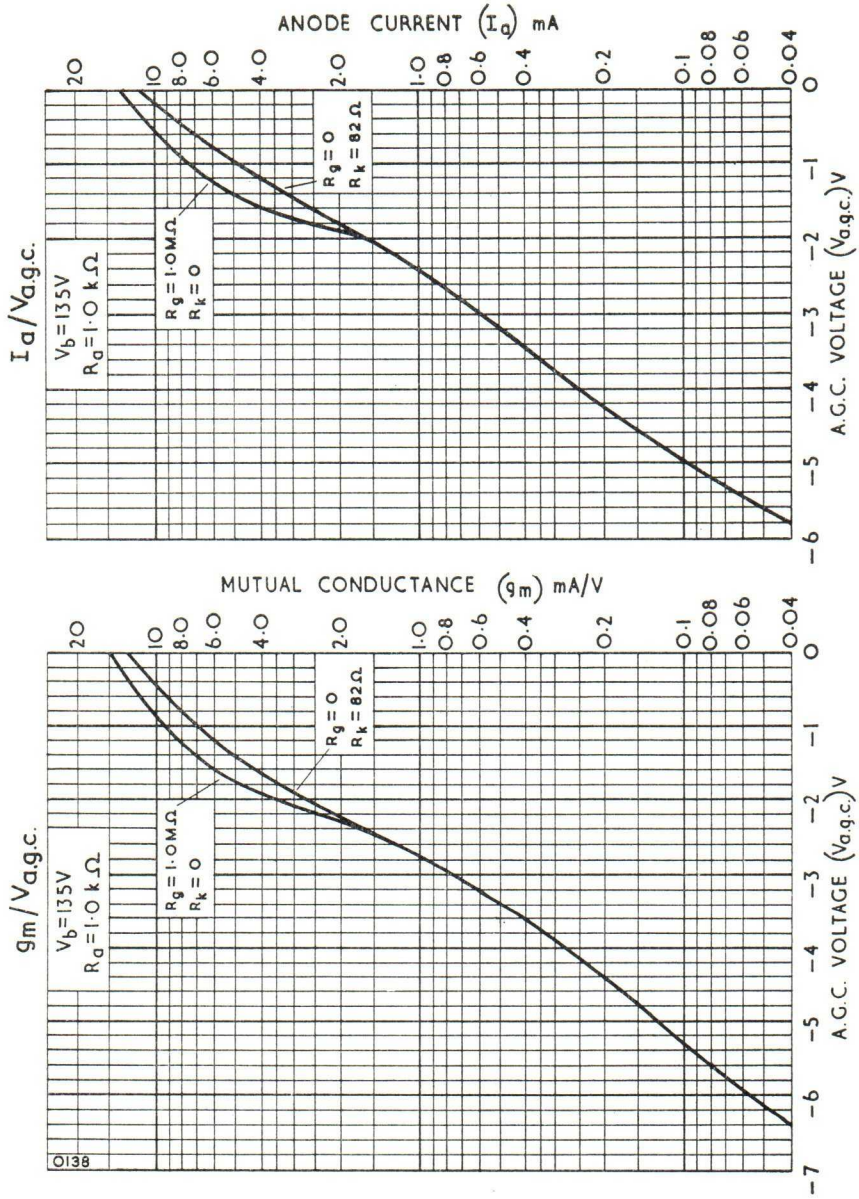
CHARACTERISTICS

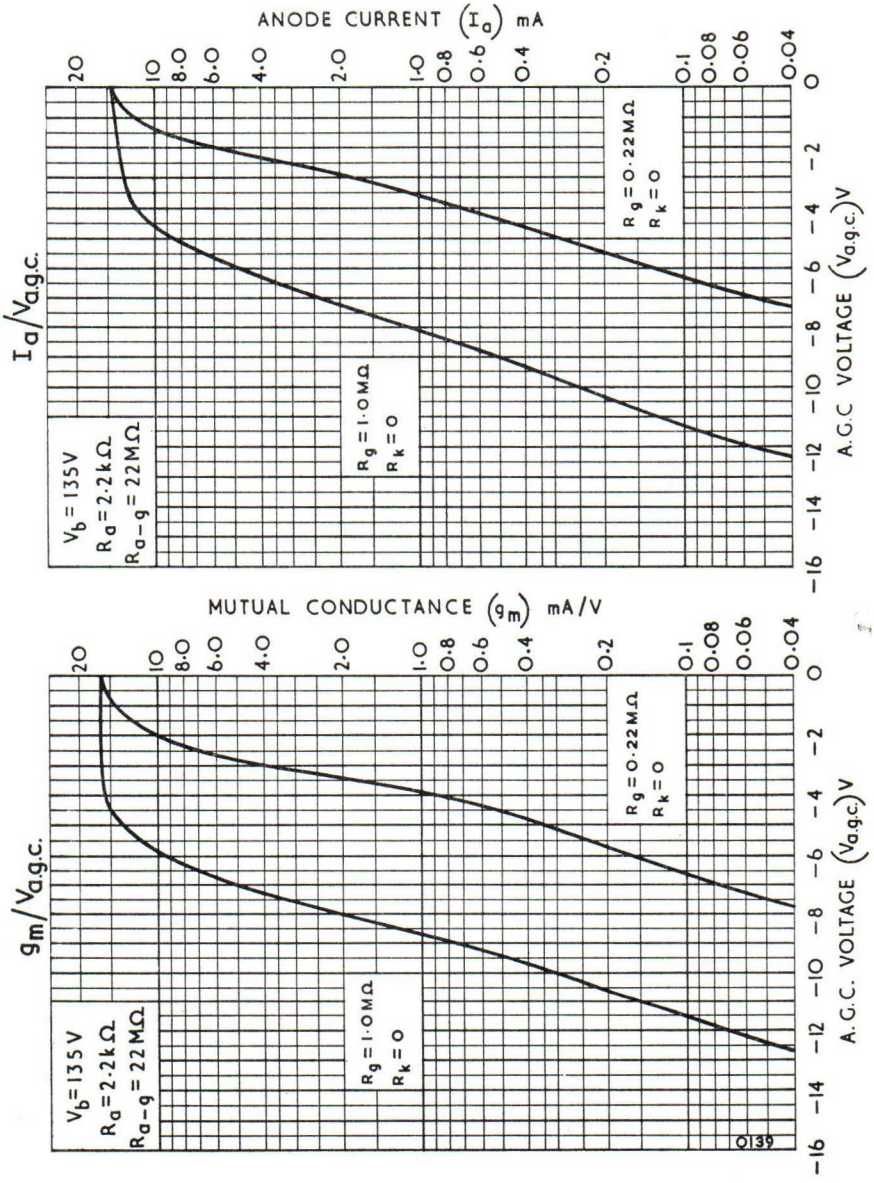
Anode Voltage	V_a	135	V
Grid Voltage	V_g	−1·0	V
Anode Current	I_a	11	mA
Amplification Factor	μ	65	
Mutual Conductance	g_m	13	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	5·0	kΩ
Grid Voltage for g_m reduction 20 : 1	$V_{g(gm/20)}$	−3·1	V
Grid Voltage for g_m reduction 100 : 1	$V_{g(gm/100)}$	−5·0	V
Grid Voltage for I_a = 100 μA	$V_{g(Ia\ =\ 100\ \mu a)}$	−5·0	V

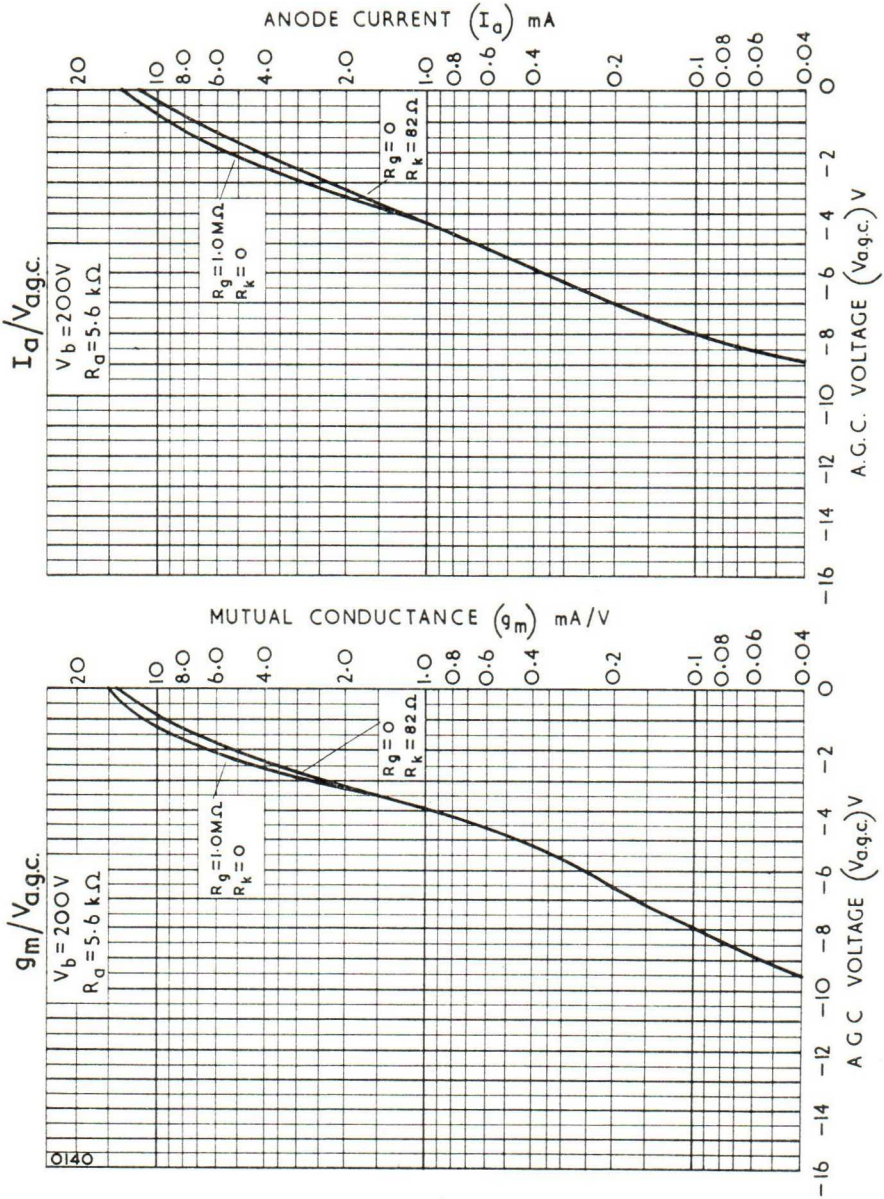
TYPICAL OPERATION

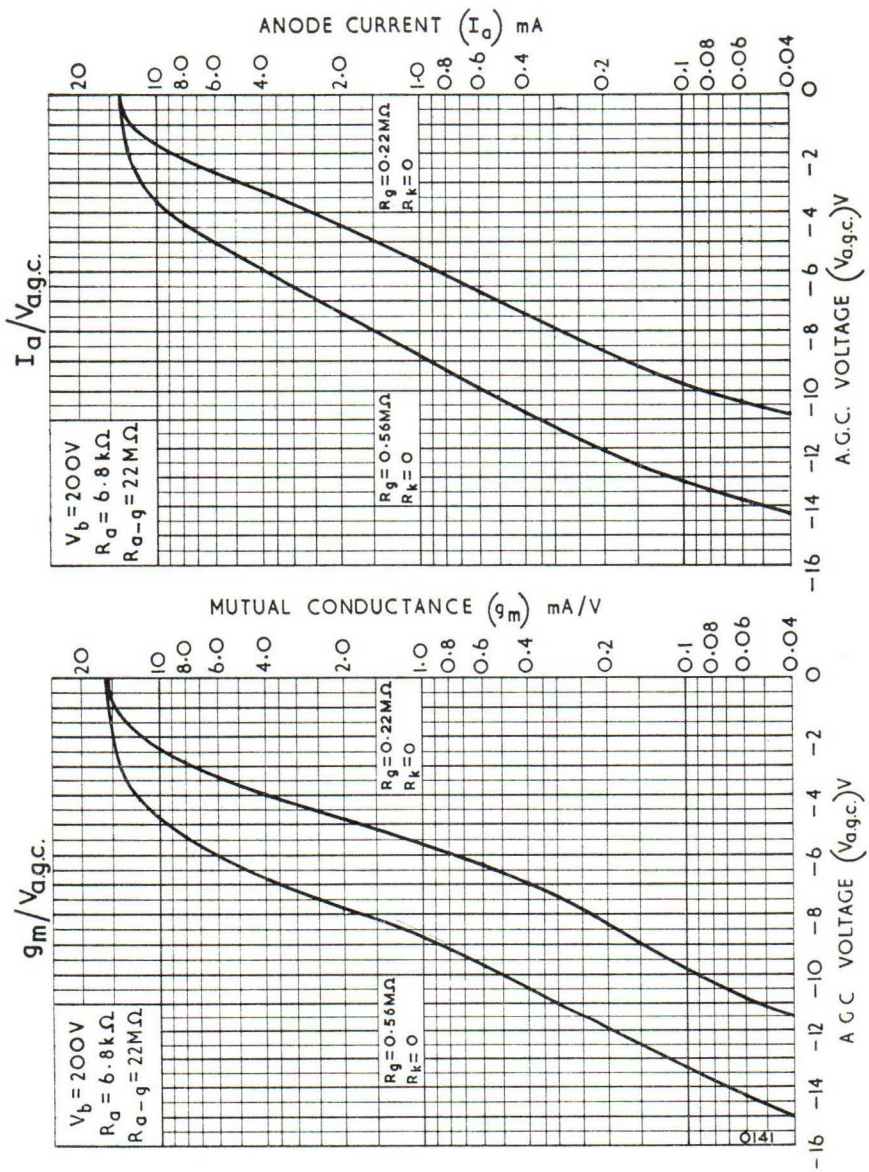
Supply Voltage	V_b	135	135	135	135	200	200	200	200	V
Anode Load Resistance	R_a	1·0	1·0	2·2	2·2	5·6	5·6	6·8	6·8	kΩ
Cathode Resistance	R_k	82	0	0	0	82	0	0	0	Ω
Grid Resistance	R_g	0	1·0	0·22	1·0	0	1·0	0·22	0·56	MΩ
Grid to Anode Resistance	R_{g-a}	—	—	22	22	—	—	22	22	MΩ
Anode Current	I_a	10·5	13	14	14	12	13	14	14	mA
Mutual Conductance	g_m	13	15·5	16	16	14	15·5	16	16	mA/V
Grid Voltage for g_m reduction 100 : 1		–5·0	–4·8	–6·0	–11	–7·5	–7·3	–9·0	–12·5	V

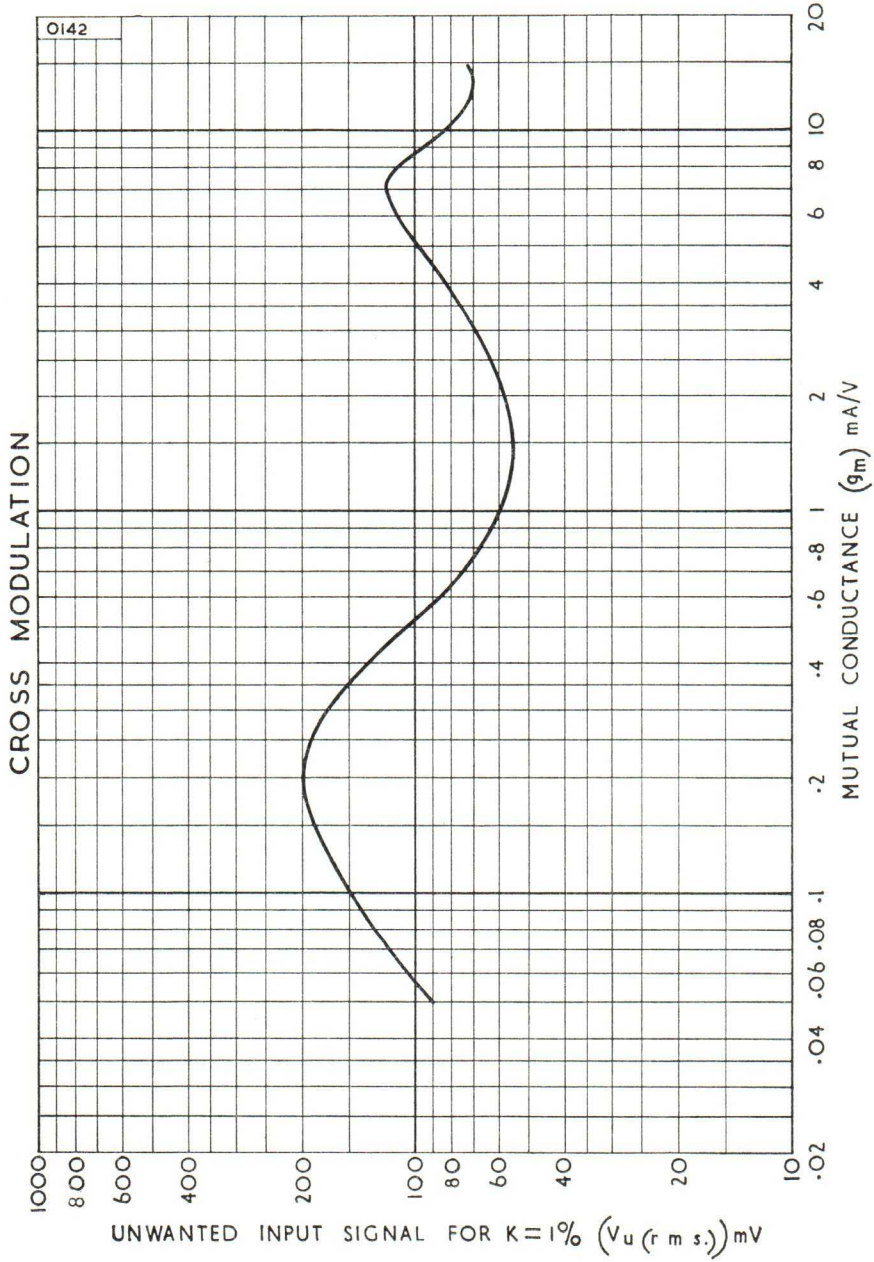

ANODE CURRENT (I_a) mA
16
14
12
10
8
6
4
2
0
CONTROL GRID VOLTAGE (V_g) V
-1
-2
-3
-4
-5
I_a/V_g
g_m = 14mA/V
= 12mA/V
= 10mA/V
= 8mA/V
= 6mA/V
= 4mA/V
= 2mA/V
V_a = 200V
= 180V
= 160V
= 140V
= 120V
= 100V

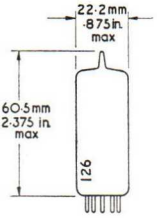

ANODE CURRENT (Ia) mA
20
10
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0
Ia/Vag.c.
Vb=135V
Ra=1·0 kΩ
Rg=1·0MΩ
Rk=0
Rg=0
Rk=82Ω
−1
−2
−3
−4
−5
−6
A.G.C. VOLTAGE (Vag.c.)V
MUTUAL CONDUCTANCE (gm) mA/V
gm/Vag.c.
Vb=135V
Ra=1·0 kΩ
Rg=1·0MΩ
Rk=0
Rg=0
Rk=82Ω
−7
A.G.C. VOLTAGE (Vag.c.)V
0138


ANODE CURRENT (Ia) mA
Ia/Vag.c.
Vb = 135V
Ra = 2·2kΩ
Ra-g = 22MΩ
Rg = 1·0MΩ
Rk = 0
Rg = 0·22MΩ
Rk = 0
A.G.C VOLTAGE (Vag.c.)V
MUTUAL CONDUCTANCE (gm) mA/V
gm/Vag.c.
Vb = 135V
Ra = 2·2kΩ
Ra-g = 22MΩ
Rg = 1·0MΩ
Rk = 0
Rg = 0·22MΩ
Rk = 0
A.G.C. VOLTAGE (Vag.c.)V
0139

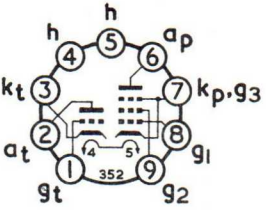

ANODE CURRENT (Ia) mA
20
10
8.0
6.0
4.0
2.0
1.0
0.8
0.6
0.4
0.2
0.1
0.08
0.06
0.04
0
Ia/Vag.c.
Vb=200V
Ra=5.6 kΩ
Rg=1.0MΩ
Rk=0
Rg=0
Rk=82Ω
-2
-4
-6
-8
-10
-12
-14
-16
A.G.C. VOLTAGE (Vag.c.) V
MUTUAL CONDUCTANCE (gm) mA/V
gm/Vag.c.
Vb=200V
Ra=5.6 kΩ
Rg=1.0MΩ
Rk=0
Rg=0
Rk=82Ω
A G C VOLTAGE (Vag.c.) V
0140


ANODE CURRENT (Ia) mA
Ia/Vag.c.
Vb=200V
Ra=6·8kΩ
Ra-g=22MΩ
Rg=0·56MΩ
Rk=0
Rg=0·22MΩ
Rk=0
A.G.C. VOLTAGE (Vag.c.)V
MUTUAL CONDUCTANCE (gm) mA/V
gm/Vag.c.
Vb=200V
Ra=6·8kΩ
Ra-g=22MΩ
Rg=0·56MΩ
Rk=0
Rg=0·22MΩ
Rk=0
A G C VOLTAGE (Vag.c.)V
0141


0142
CROSS MODULATION
MUTUAL CONDUCTANCE (g_m) mA/V
20
10
8
6
4
2
1
.8
.6
.4
.2
.1
.08
.06
.04
.02
1000
800
600
400
200
100
80
60
40
20
10
UNWANTED INPUT SIGNAL FOR K = 1% (V_u (r m s.)) mV



TRIODE PENTODE



B9A Base

GENERAL

This triode pentode valve with separate cathodes is primarily intended for use in the video output stage of television receivers. The triode may be used in a variety of ways such as sync. separator, A.G.C. and noise suppression circuits.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	15	V

RATINGS

		Triode	Pentode	
Maximum Anode Dissipation	$P_{a(max)}$	1	4	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	—	1·7	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	550	V
Maximum Anode Voltage	$V_{a(max)}$	250*	250	V
Maximum Screen Grid Supply Voltage	$V_{g2(b)max}$	—	550	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	—	250	V
Maximum Heater to Cathode Voltage (Heater Positive)	$V_{h-k(max)}$	150	200	V
Maximum Heater to Cathode Voltage (Heater Negative)	$V_{h-k(max)}$	350†	200	V
Maximum Cathode Current	$I_{k(max)}$	12‡	40	mA
Maximum Grid 1 to Cathode Resistance	$R_{g-k(max)}$			
Self Bias		3	2	MΩ
Fixed Bias		1	1	MΩ

* Maximum peak anode voltage (I_a <0·1mA) = 600V

† Maximum D.C. component = 200V

‡ Maximum peak cathode current = 160mA for maximum pulse duration = 800μs.

INTER-ELECTRODE CAPACITANCES

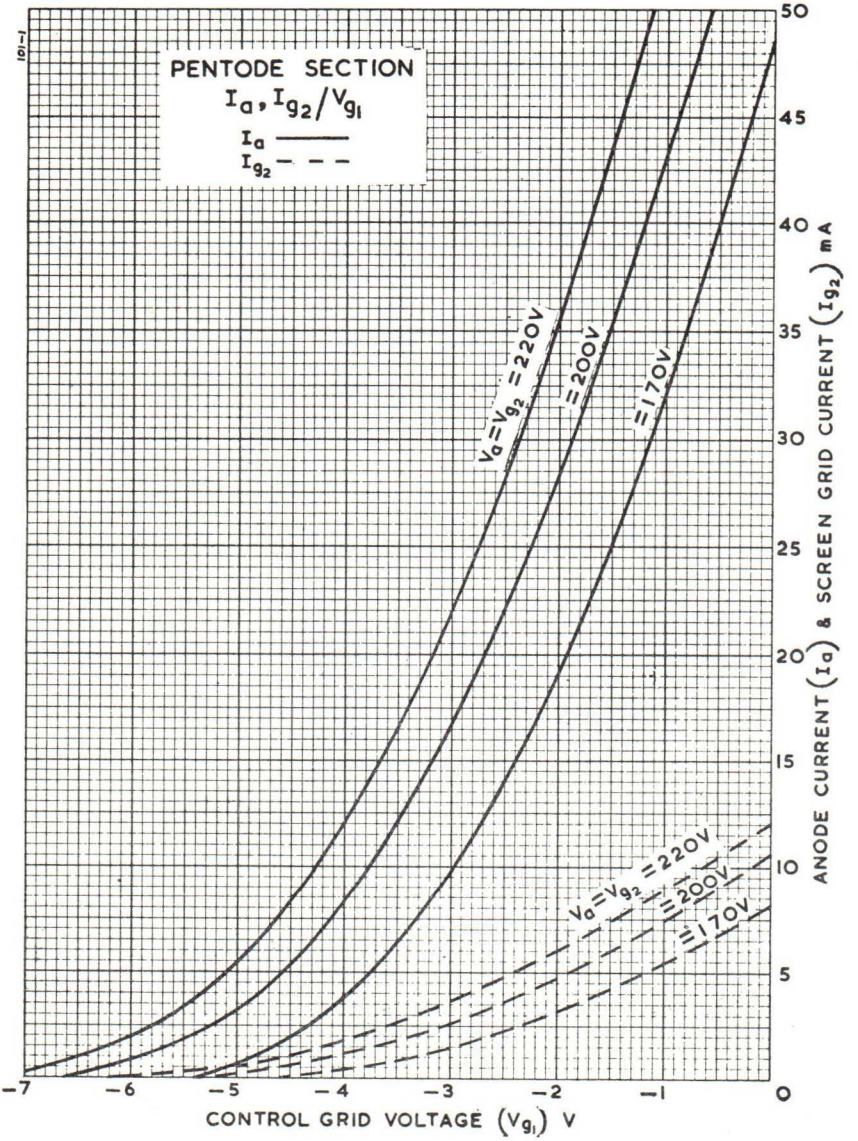
		§	
Pentode Input	$C_{in(p)}$	8·7	pF
Pentode Output	$C_{out(p)}$	4·2	pF
Grid 1 to Anode Pentode	C_{g1-ap}	<0·1	pF
Triode Input	$C_{in(t)}$	3·8	pF
Triode Output	$C_{out(t)}$	2·3	pF
Anode Triode to Grid Triode	C_{at-gt}	2·7	pF
Grid Triode to Grid 1	C_{gt-g1}	<0·01	pF
Anode Triode to Grid 1	C_{at-g1}	<0·01	pF
Grid Triode to Heater	C_{gt-h}	<0·1	pF

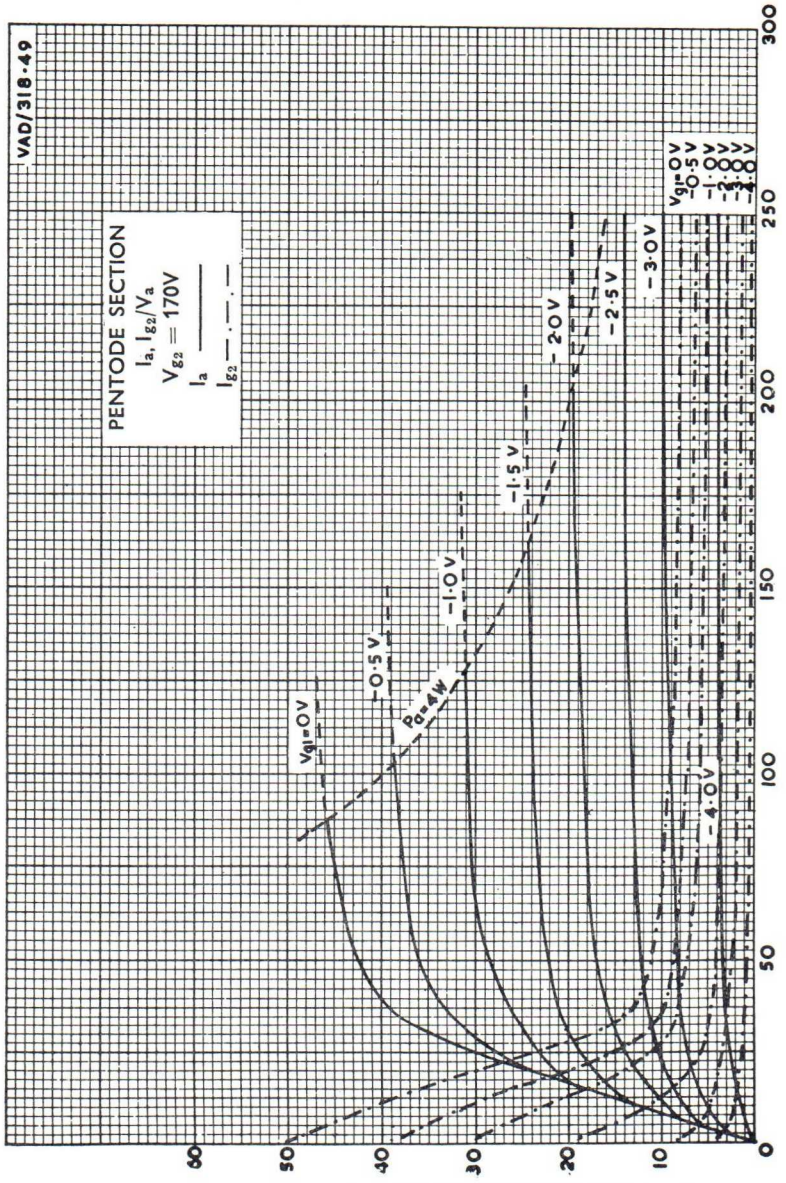
§ Inter-electrode capacitances in fully shielded socket without can.

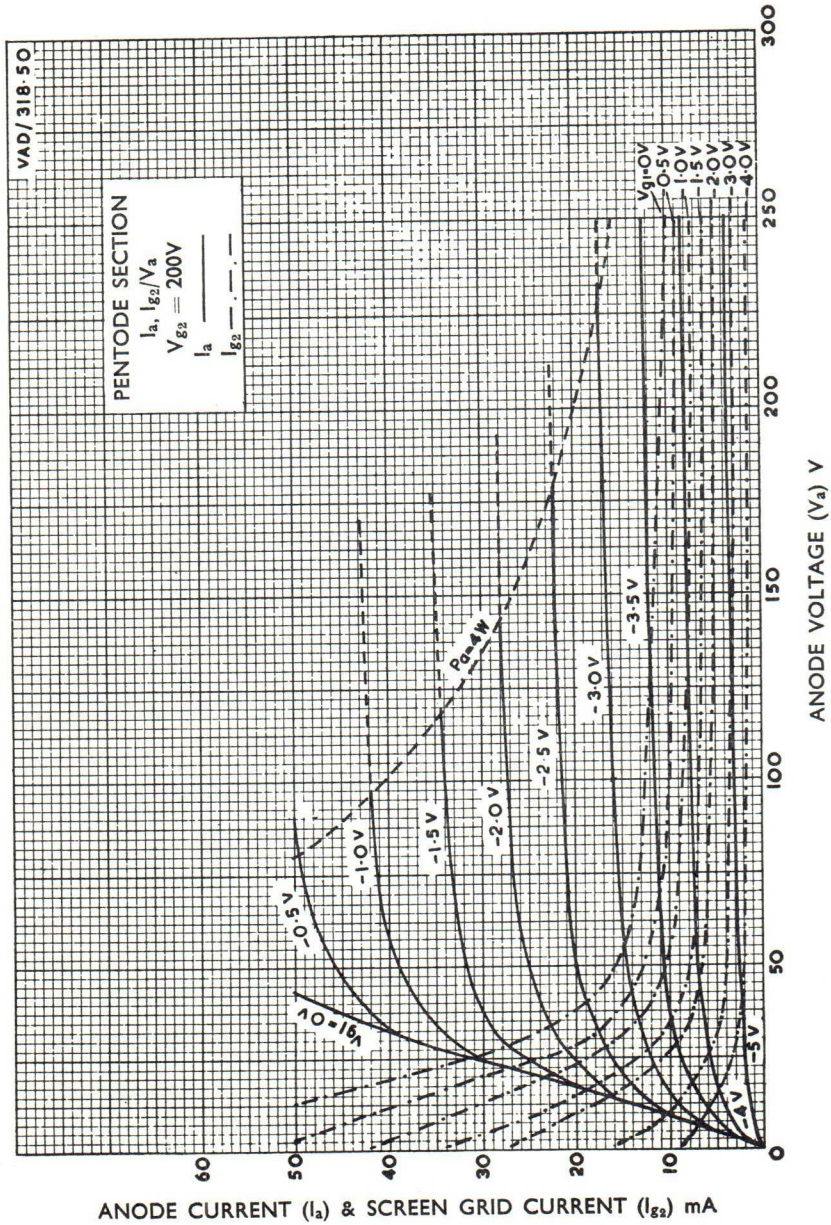
CHARACTERISTICS

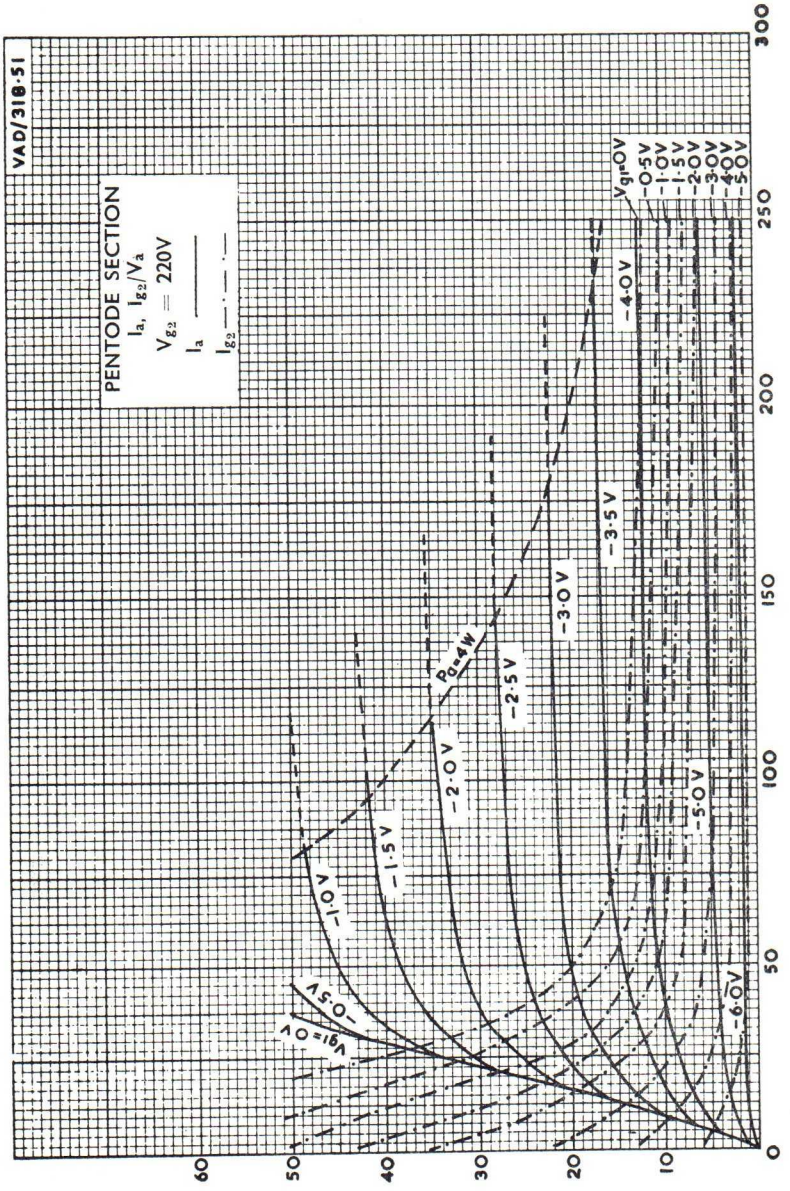
		Triode		Pentode		
Anode Voltage	V_a	200	170	200	220	V
Screen Grid Voltage	V_{g2}	—	170	200	220	V
Control Grid Voltage	V_{g1}	–1·7	–2·1	–2·9	–3·4	V
Anode Current	I_a	3	18	18	18	mA
Screen Grid Current	I_{g2}	—	3	3	3	mA
Mutual Conductance	g_m	4	11	10·4	10	mA/V
Amplification Factor	μ	65	—	—	—	
Inner Amplification Factor	μ_{g1-g2}	—	36	36	36	
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	16·2	100	130	150	kΩ

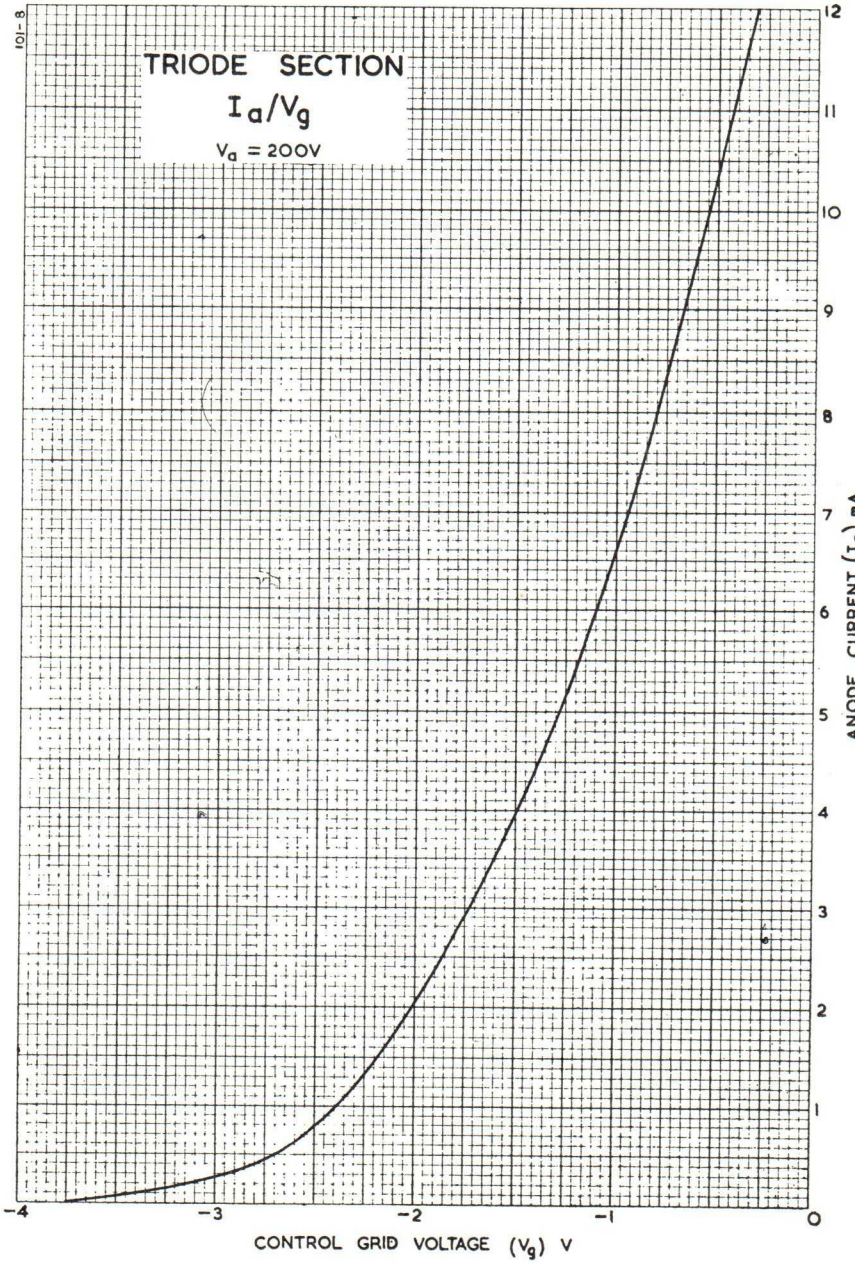
THORN—AEI RADIO VALVES & TUBES LTD.

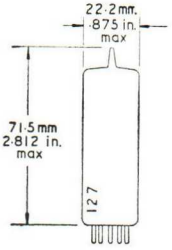

PENTODE SECTION
$I_a, I_{g_2}/V_{g_1}$
I_a ——
I_{g_2} – – –
$V_a = V_{g_2} = 220V$
$= 200V$
$= 170V$
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
CONTROL GRID VOLTAGE (V_{g_1}) V
50
45
40
35
30
25
20
15
10
5
0
−7
−6
−5
−4
−3
−2
−1


VAD/318·49
PENTODE SECTION
$I_a, I_{g2}/V_a$
$V_{g2} = 170V$
I_a ———
I_{g2} — · — · —
V_{g1}=0V
-0·5V
-1·0V
-1·5V
-2·0V
-2·5V
-3·0V
-4·0V
P_a=4W
300
250
200
150
100
50
0
60
50
40
30
20
10
ANODE VOLTAGE (V_a) V
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g2}) mA

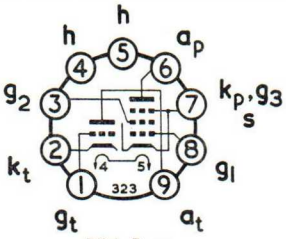

VAD/318·50
PENTODE SECTION
I_a, I_{g2}/V_a
V_{g2} = 200V
I_a
I_{g2}
V_{g1}=0V
-0·5V
-1·0V
-1·5V
-2·0V
-3·0V
-4·0V
-3·5V
-3·0V
-2·5V
-2·0V
-1·5V
-1·0V
-0·5V
0V
V_{g1}=+1V
Pg=4W
ANODE VOLTAGE (V_a) V
300
250
200
150
100
50
0
60
50
40
30
20
10
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g2}) mA


VAD/318·51
PENTODE SECTION
I_a, I_{g_2}/V_a
V_{g_2} = 220V
I_a ———
I_{g_2} — · — · —
V_{g1}=0V
-0·5V
-1·0V
-1·5V
-2·0V
-2·5V
-3·0V
-3·5V
-4·0V
-5·0V
-6·0V
P_a=4W
V_{g1}=0V
-0·5V
-1·0V
-1·5V
-2·0V
-3·0V
-4·0V
-5·0V
0
10
20
30
40
50
60
50
100
150
200
250
300
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
ANODE VOLTAGE (V_a) V


101-8
TRIODE SECTION
I_a/V_g
V_a = 200V
12
11
10
9
8
7
6
5
4
3
2
1
0
ANODE CURRENT (I_a) mA
−4
−3
−2
−1
CONTROL GRID VOLTAGE (V_g) V



TRIODE
PENTODE



B9A Base

GENERAL

This high-μ triode and output pentode is for use in the audio amplifier stage of television receivers.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	13·6	V

RATINGS

		Triode	Pentode	
Maximum Anode Dissipation	$P_{a(max)}$	0·5	9·0	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	—	1·8	W
For speech and music		—	3·0	W
Maximum Anode Supply Voltage ($I_a = 0$)	$V_{a(b)max}$	550	550	V
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Screen Grid Supply Voltage ($I_{g_2} = 0$)	$V_{g2(b)max}$	—	550	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	—	250	V
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$	100	100	V
Maximum Cathode Current	$I_{k(max)}$	4·0	55	mA
Maximum Grid 1 to Cathode Resistance	$R_{g1-k(max)}$			
Fixed Bias		1·0	1·0	MΩ
Self Bias		2·0	—	MΩ
Grid Current Bias		22	—	MΩ
Maximum Heater to Cathode Resistance	$R_{h-k(max)}$	20*	20	kΩ

* When used as a phase inverter immediately preceding the output stage $R_{h-k(max)}$ may be 120kΩ.

INTER-ELECTRODE CAPACITANCES†

Pentode Input	$c_{in(p)}$	10	pF
Grid 1 to Anode Pentode	c_{g1-ap}	<0·4	pF
Grid 1 to Heater	c_{g1-h}	<0·24	pF
Triode Input	$c_{in(t)}$	2·3	pF
Triode Output	$c_{out(t)}$	2·5	pF
Grid Triode to Anode Triode	c_{gt-at}	1·4	pF
Grid Triode to Heater	c_{gt-h}	<0·006	pF
Grid Triode to Grid 1	c_{gt-g1}	<0·02	pF
Grid Triode to Anode Pentode	c_{gt-ap}	<0·006	pF
Anode Triode to Anode Pentode	c_{at-ap}	<0·15	pF
Anode Triode to Grid 1	c_{at-g1}	<0·2	pF

† In fully shielded socket without can (I.E.C. Publication 100).

CHARACTERISTICS

		Triode	Pentode	
Anode Voltage	V_a	230	230	V
Screen Grid Voltage	V_{g_2}	—	230	V
Control Grid Voltage	V_{g_1}	−1·7	−5·7	V
Anode Current	I_a	1·2	39	mA
Screen Grid Current	I_{g_2}	—	6·5	mA
Mutual Conductance	g_m	1·6	10·5	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	62	45	kΩ
Amplification Factor	μ	100	—	
Inner Amplification Factor	$\mu_{g_1-g_2}$	—	21	

THORN—A E I RADIO VALVES & TUBES LTD.

TYPICAL OPERATION

Pentode as Class A Audio Output Stage

Anode Voltage	V_a	200	230	V
Screen Grid Voltage	V_{g2}	200	230	V
Cathode Resistor	R_k	115	125	Ω
Quiescent Anode Current	$I_{a(o)}$	35	39	mA
Quiescent Screen Grid Current	$I_{g2(o)}$	6·0	6·5	mA
Anode Load Resistor	R_a	5·6	5·1	kΩ
Input Voltage (R.M.S.)	$V_{in(r.m.s.)}$	3·2	3·6	V
Input Voltage (R.M.S.) for 50mW output		0·29	0·3	V
Power Output	P_{out}	3·1	4·1	W
Total Distortion	D_{tot}	10	10	%

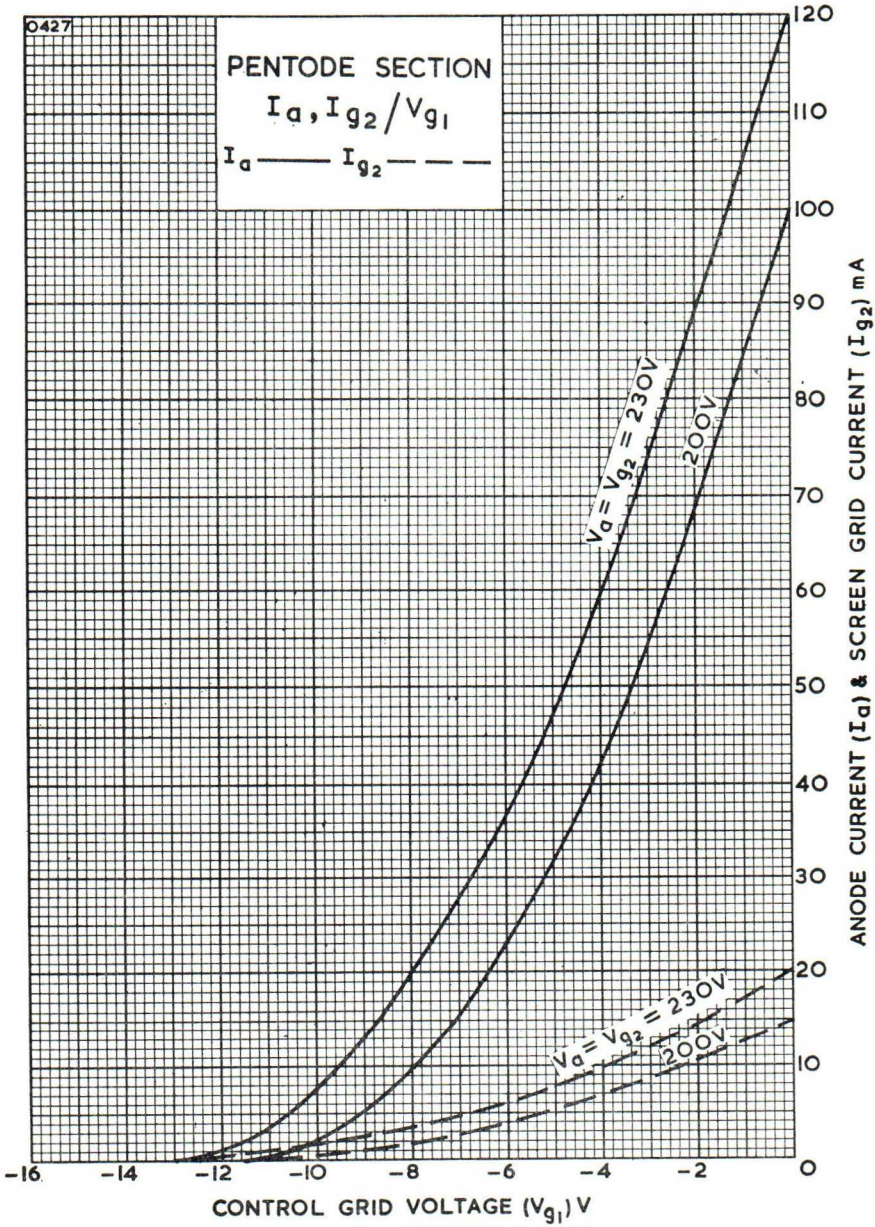
Triode as Resistance Coupled A.F. Amplifier

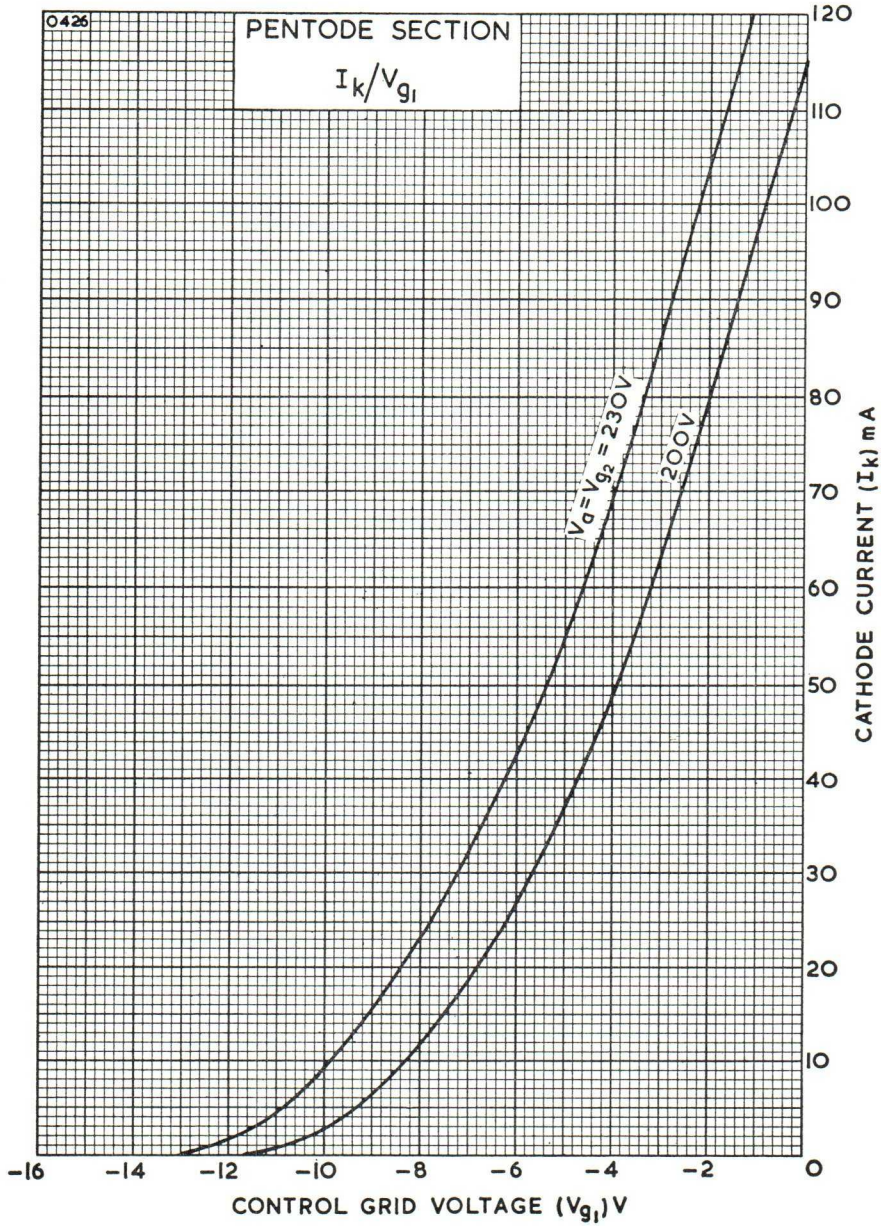
Grid Current Bias (R_g = 10MΩ)								
Supply Voltage	V_b	170	170	170	230	230	230	V
Anode Load Resistance	R_a	47	100	220	47	100	220	kΩ
Grid Resistance of Following Valve		150	330	680	150	330	680	kΩ
Anode Current	I_a	0·82	0·58	0·37	1·37	0·9	0·57	mA
Signal Source Impedance, Z_s = 0Ω								
Voltage Amplification for $V_{in(r.m.s.)}$ = 100mV		36	53	67	40	57	72	
R.M.S. Output Voltage for 5% total distortion		9	13	15	15	22	26	V
Signal Source Impedance, Z_s = 220kΩ								
Voltage Amplification for $V_{in(r.m.s.)}$ = 100mV		29	42	52	32	45	55	
R.M.S. Output Voltage for 5% total distortion*		11	16	21	18	26	33	V

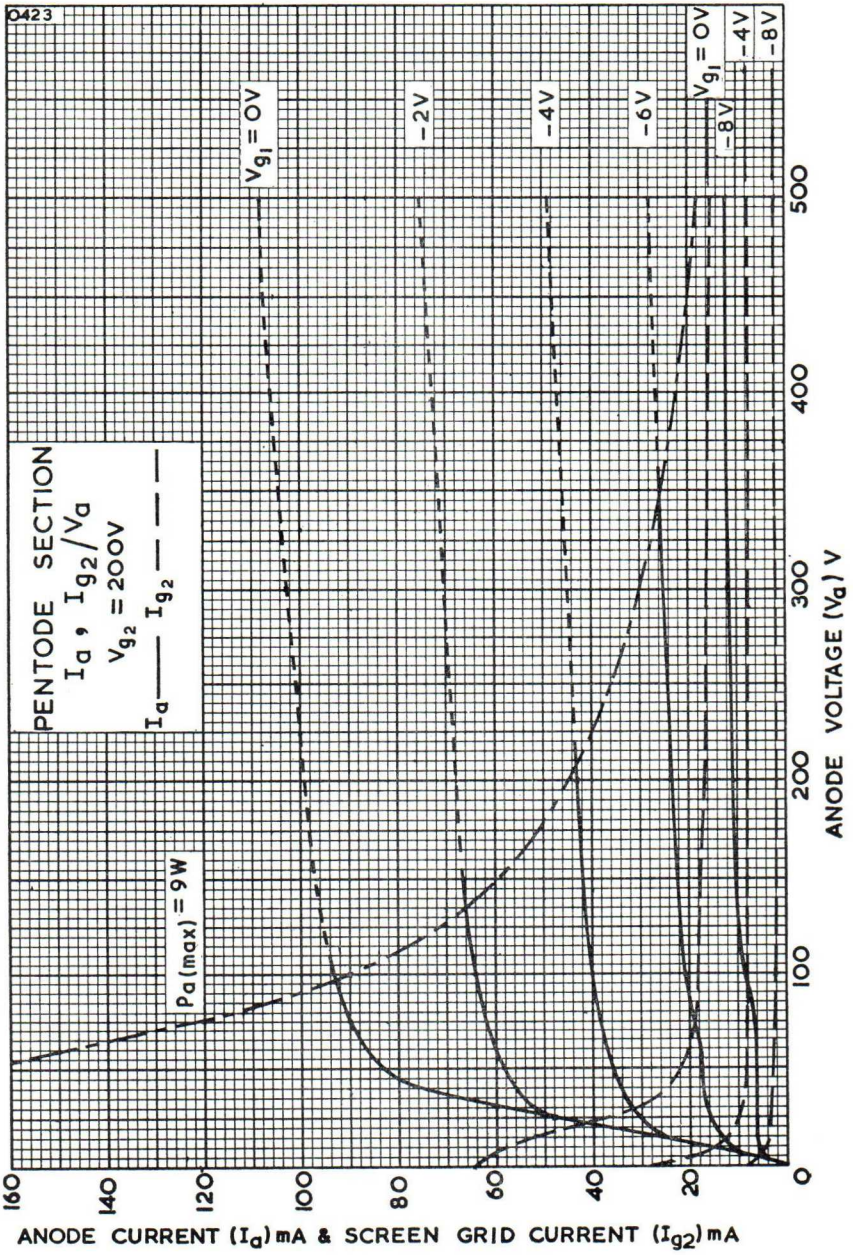
* When operating this valve with grid current bias and a high source impedance, the second harmonic distortion rises to a peak at quite low levels of output (about 10V r.m.s.) and then falls with increasing drive. The third harmonic then begins to rise, and D_{tot} finally reaches 5% at a much higher output level than with zero source impedance. The maximum value of this distortion peak varies inversely with the anode load, being about 5·5% with R_a = 47kΩ, 4·5% with R_a = 100kΩ and 4% with R_a = 220kΩ.

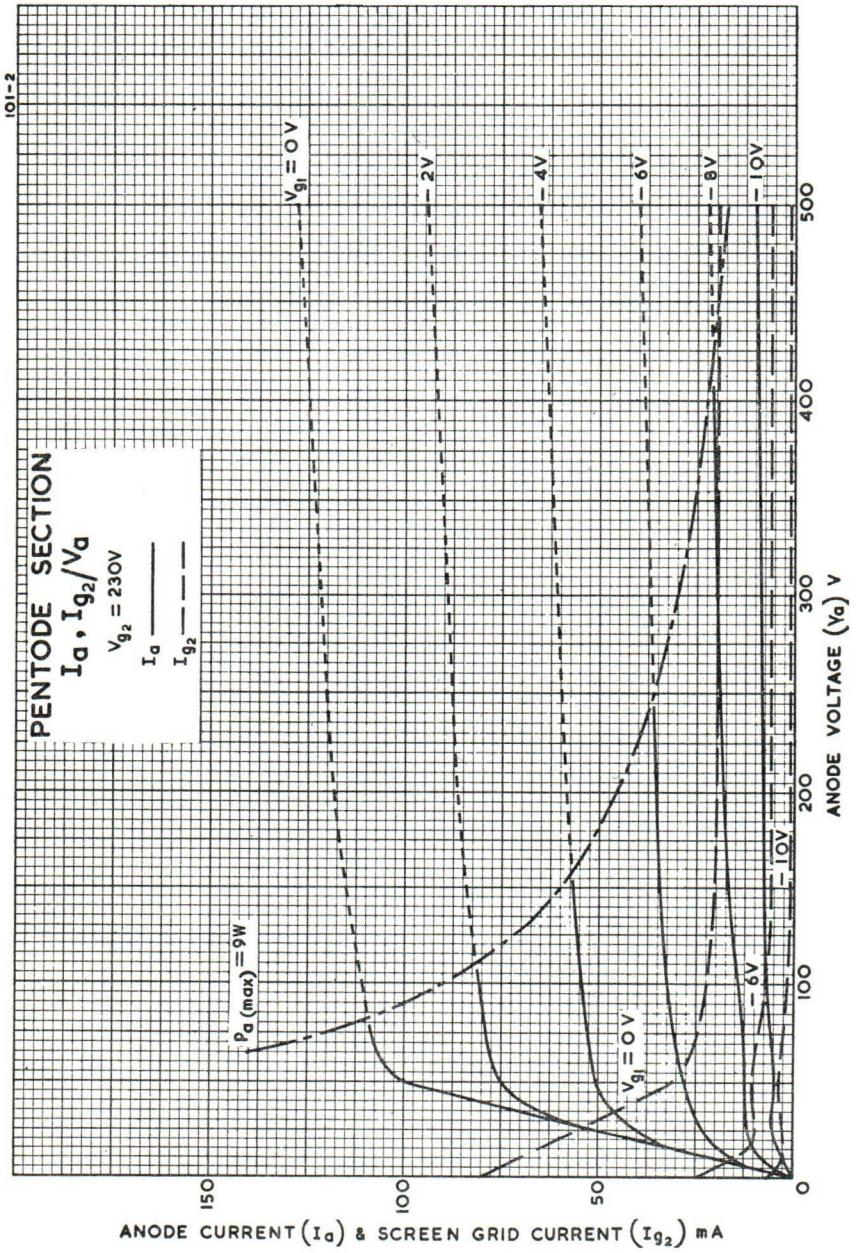
Note: Microphony. This valve may be used without special precautions against microphony in equipment where the input voltage is not less than 10mV for an output of 50 mW.

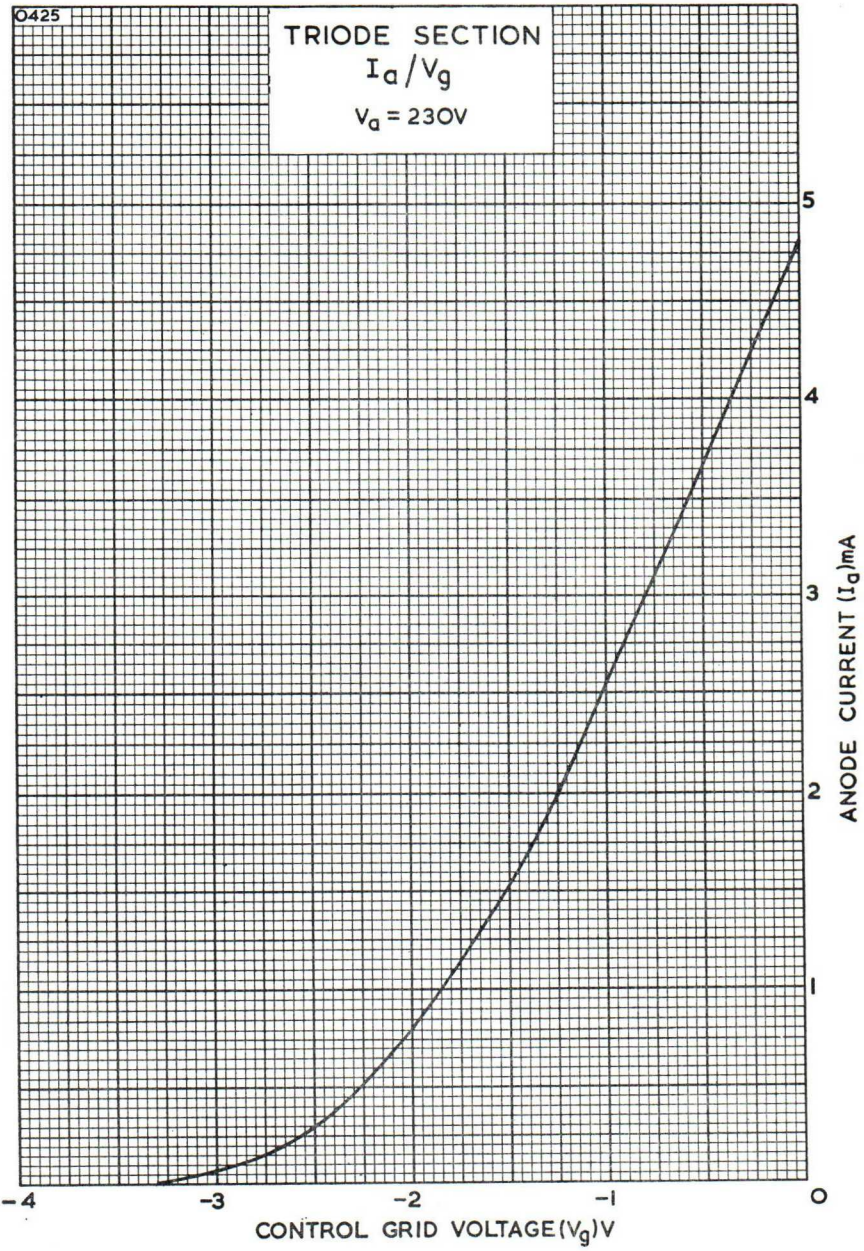
MOUNTING POSITION—Unrestricted.

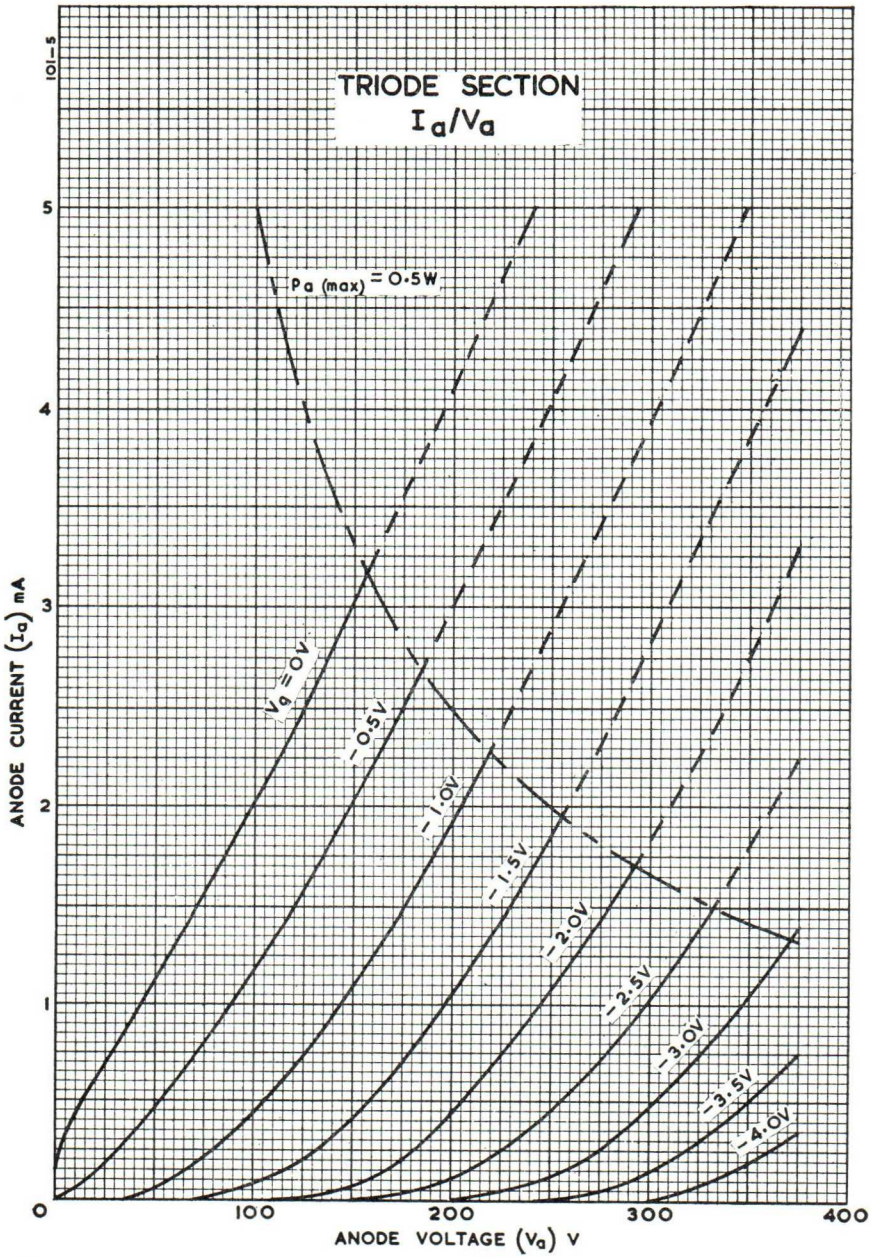

0427
PENTODE SECTION
$I_a, I_{g_2} / V_{g_1}$
I_a —— I_{g_2} — — —
$V_a = V_{g_2} = 230V$
200V
$V_a = V_{g_2} = 230V$
200V
120
110
100
90
80
70
60
50
40
30
20
10
0
-16
-14
-12
-10
-8
-6
-4
-2
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
CONTROL GRID VOLTAGE (V_{g_1}) V


0426
PENTODE SECTION
I_k/V_{g_1}
$V_a = V_{g_2} = 230V$
200V
CATHODE CURRENT (I_k) mA
120
110
100
90
80
70
60
50
40
30
20
10
0
−16
−14
−12
−10
−8
−6
−4
−2
CONTROL GRID VOLTAGE (V_{g_1}) V

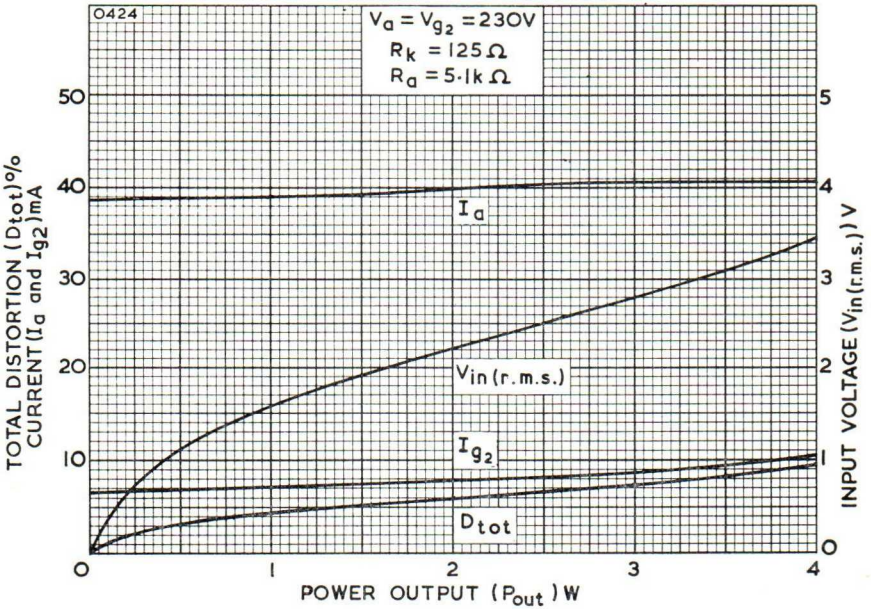

0423
PENTODE SECTION
Ia , Ig2 / Va
Vg2 = 200V
Ia —— Ig2 — — —
Vg1 = 0V
-2V
-4V
-6V
-8V
Vg1 = 0V
-4V
-8V
Pa (max) = 9W
160
140
120
100
80
60
40
20
0
100
200
300
400
500
ANODE VOLTAGE (Va) V
ANODE CURRENT (Ia) mA & SCREEN GRID CURRENT (Ig2) mA

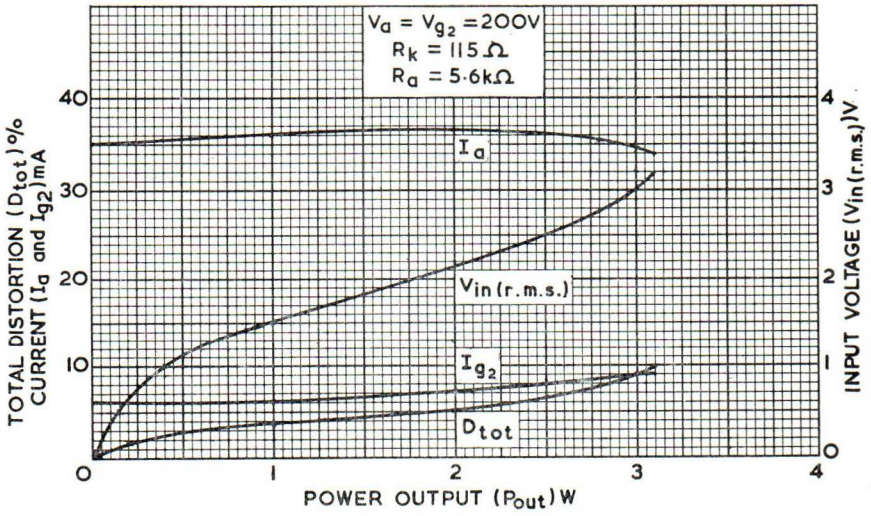

101-2
PENTODE SECTION
Ia, Ig2/Va
Vg2 = 230V
Ia
Ig2
Vg1 = 0 V
- 2V
- 4V
- 6V
- 8V
- 10V
- 10V
- 9V
Pa (max) = 9W
ANODE VOLTAGE (Va) V
500
400
300
200
100
0
150
100
50
ANODE CURRENT (Ia) & SCREEN GRID CURRENT (Ig2) mA

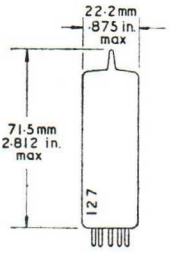

0425
TRIODE SECTION
I_a / V_g
V_a = 230V
5
4
3
2
1
0
ANODE CURRENT (I_a)mA
−4
−3
−2
−1
0
CONTROL GRID VOLTAGE (V_g)V


TRIODE SECTION
I_a/V_a
101-5
Pa (max) = 0·5W
V_g = 0V
-0·5V
-1·0V
-1·5V
-2·0V
-2·5V
-3·0V
-3·5V
-4·0V
ANODE CURRENT (I_a) mA
0
1
2
3
4
5
100
200
300
400
ANODE VOLTAGE (V_a) V

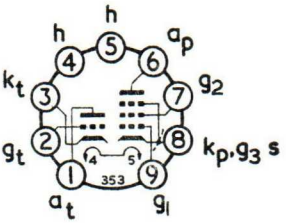
PENTODE SECTION — CLASS A OUTPUT







TRIODE FIELD OUTPUT PENTODES



B9A Base

GENERAL

Combined triode pentode with separate cathodes for use as a field oscillator and field output valve in television receivers. Data is applicable to both types.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	17·5	V

RATINGS

		Triode	Pentode	
Maximum Anode Dissipation	$p_{a(max)}$	0·5	8·0*	W
Maximum Screen Grid Dissipation	$p_{g2(max)}$	—	1·5†	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	550	V
Maximum Anode Voltage	$V_{a(max)}$	300	300	V
Maximum Peak Anode Voltage	$v_{a(pk)max}$	—	2·0‡	kV
Maximum Screen Grid Supply Voltage	$V_{g2(b)max}$	—	550	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	—	250	V
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$	200§	200	V
Maximum Cathode Current	$I_{k(max)}$	15	75	mA
Maximum Peak Cathode Current	$i_{k(pk)max}$	150‖	—	mA
Maximum Peak Cathode Current	$i_{k(pk)max}$	100¶	—	mA
Maximum Grid 1 to Cathode Resistance	$R_{g1-k(max)}$			
Fixed Bias		1·0	1·0	MΩ
Self Bias		3·3	2·2	MΩ

* For a nominal tube at the worst probable operating conditions and at normal picture height p_a should not exceed 10·5 W.

† For a nominal tube at the worst probable operating conditions and at normal picture height p_{g_2} should not exceed 2·0 W.

‡ Maximum pulse duration 5% of one cycle with a maximum of 1·0 ms.

§ During warming up the maximum d.c. component is 315 V, heater negative.

‖ Maximum pulse duration 2% of one cycle with a maximum of 400 μs.

¶ Maximum pulse duration 4% of one cycle with a maximum of 800 μs.

INTER-ELECTRODE CAPACITANCES

Anode Pentode to Grid Triode	c_{ap-gt}		<0·03	pF
Anode Triode to Grid 1	c_{at-g1}		<0·08	pF
		Triode	Pentode	
Anode to Grid 1	c_{a-g1}	—	<0·6	pF
Grid 1 to Heater	c_{g1-h}	<0·15	<0·2	pF

THORN RADIO VALVES AND TUBES LTD.

CHARACTERISTICS

Triode Section

Anode Voltage	V_a	100	100	V
Control Grid Voltage	V_g	−0·85	0	V
Anode Current	I_a	5·0	10·5	mA
Mutual Conductance	g_m	5·5	7·0	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	11	9·0	kΩ
Amplification Factor	μ	60	63	

Pentode Section—Field Output Application

Anode Voltage	V_a	50	65	V
Screen Grid Voltage	V_{g_2}	170	210	V
Control Grid Voltage	V_{g_1}	−1·0	−1·0	V
Peak Anode Current	$i_{a(pk)}$	200	285	mA
Peak Screen Grid Current	$i_{g2(pk)}$	35	45	mA

CIRCUIT DESIGN

Note.—The curves on page 7 can be used to derive the minimum I_a to be expected as a result of the spread of valve characteristics, valve deterioration during life and decrease of the mains voltage to 10% below the nominal value by decreasing by 40% the I_a values on the curve A–B at the V_{g_2} occurring at the decreased mains voltage.

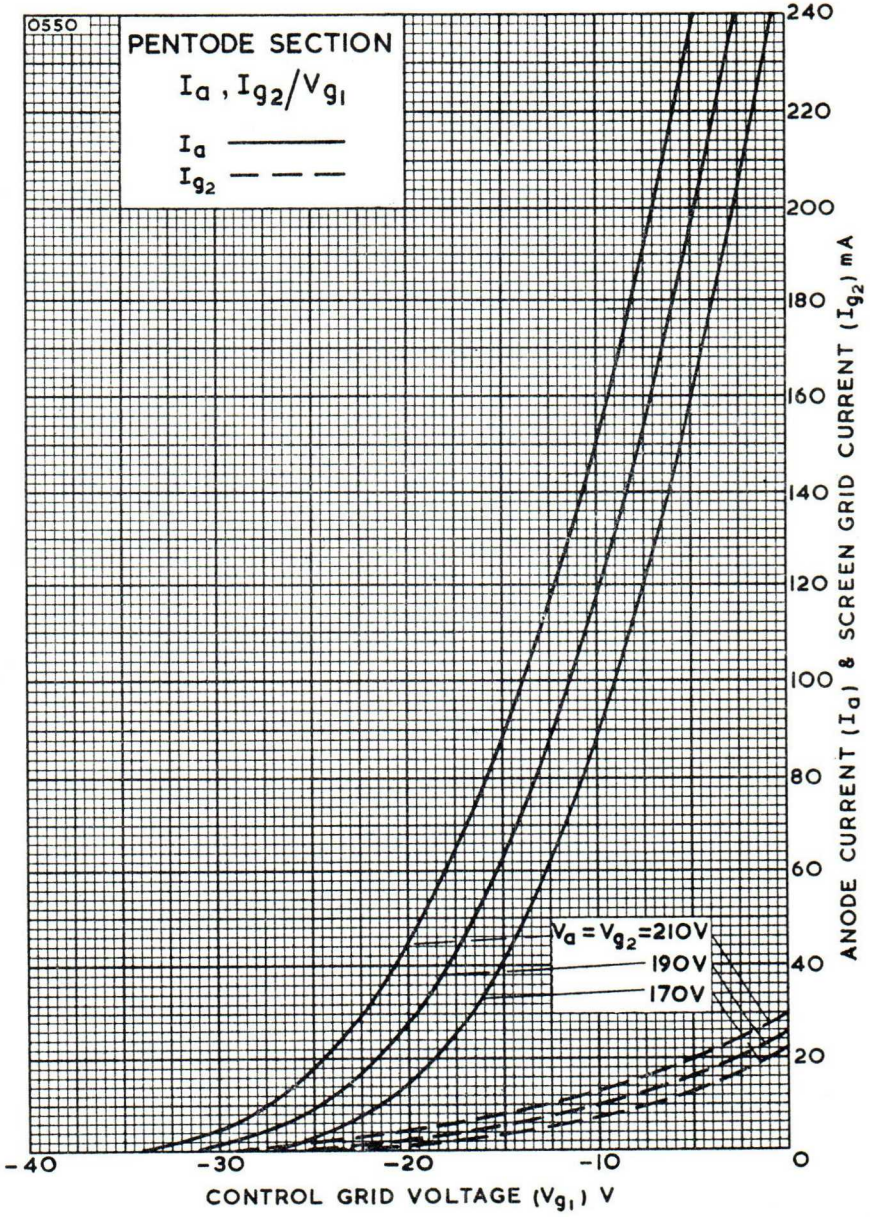
In order that the maximum permissible value of screen grid dissipation is not exceeded, the circuit should be designed in such a way that the anode voltage should never be lower than the value determined by curve A–B at the relevant V_{g_2} value.

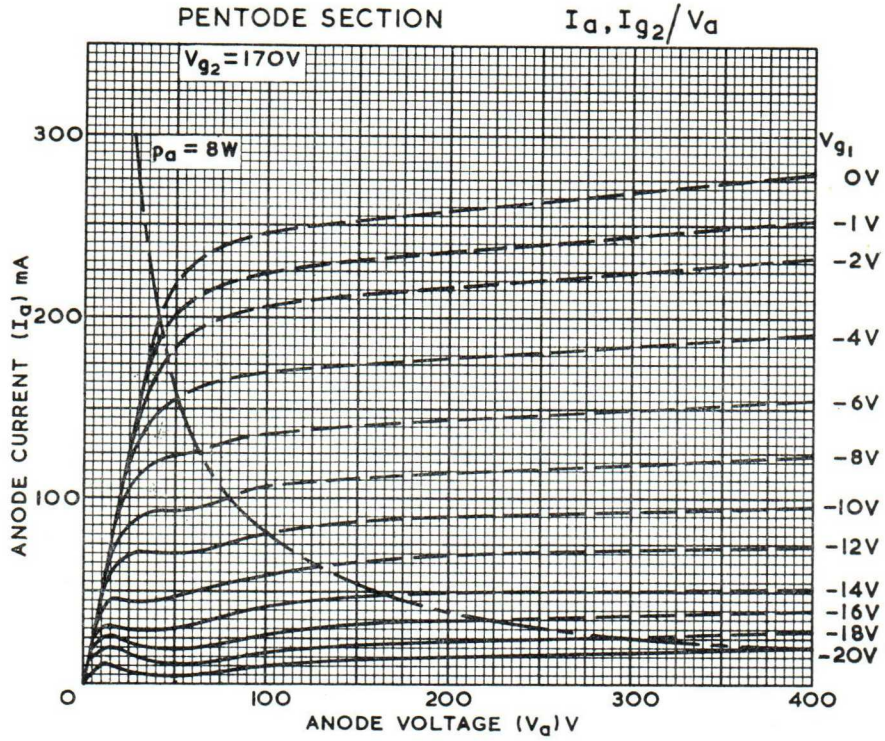
HUM

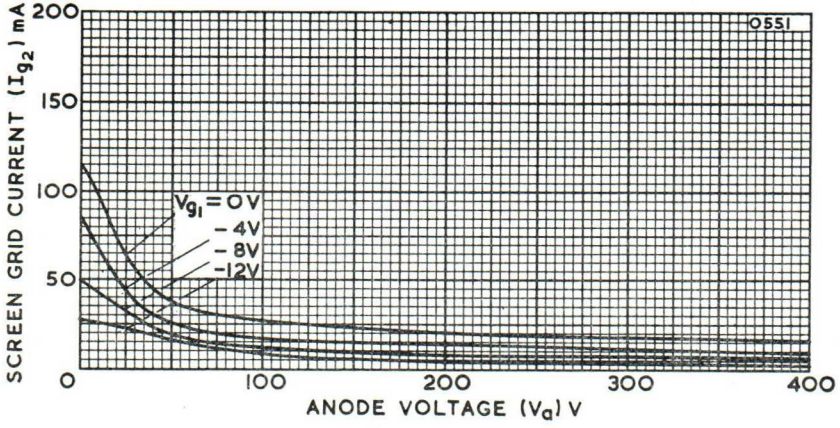
The equivalent pentode grid hum voltage without negative feedback is $\leqslant$ 10 mV when

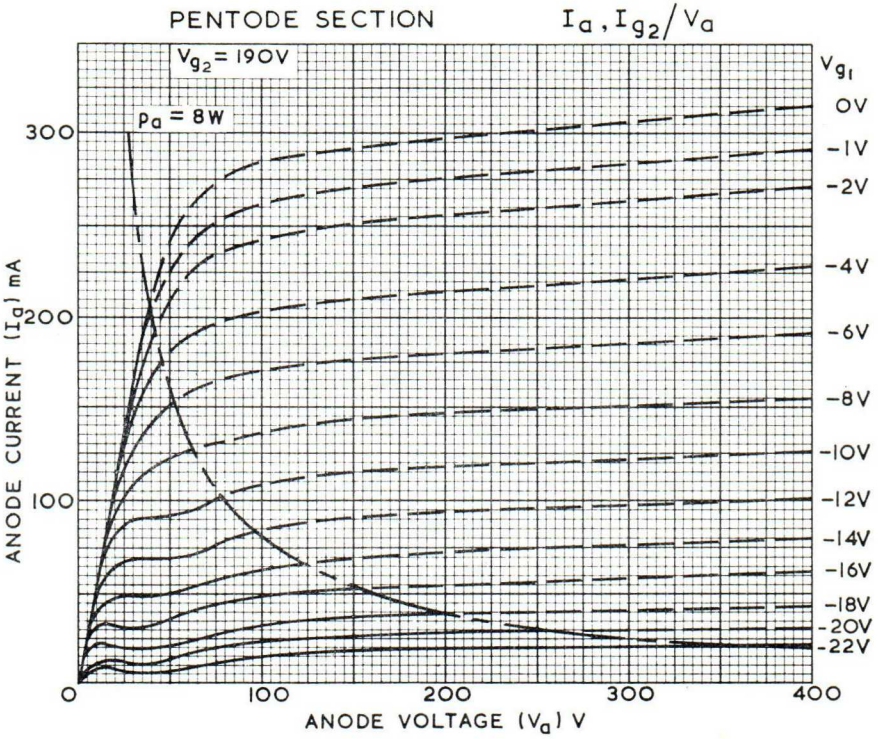
Z_{g_1} (f = 50 Hz)	$\leqslant$	500 kΩ
$C_{g_1\text{-}h}$	=	0·2 pF
$V_{h\text{-}k\ (r.m.s.)}$	=	150 V

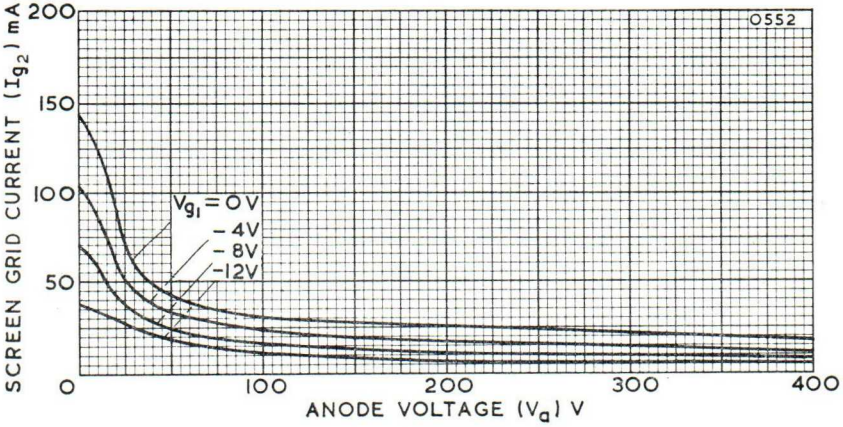
MOUNTING POSITION—Unrestricted

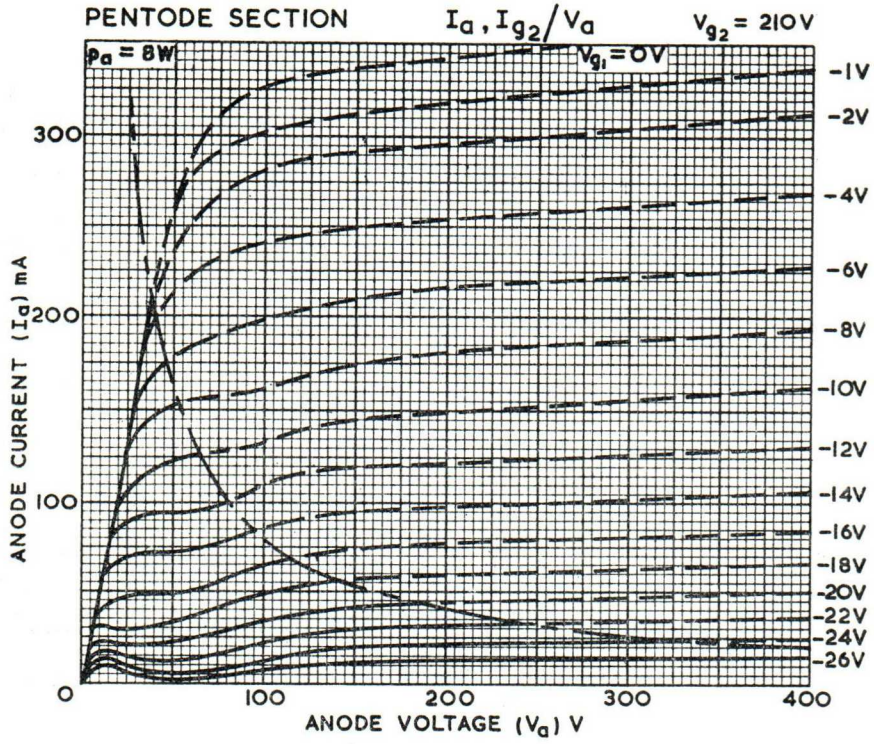

0550
PENTODE SECTION
I_a , I_{g_2}/V_{g_1}
I_a
I_{g_2}
$V_a = V_{g_2}$=210V
190V
170V
240
220
200
180
160
140
120
100
80
60
40
20
0
-40
-30
-20
-10
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
CONTROL GRID VOLTAGE (V_{g_1}) V

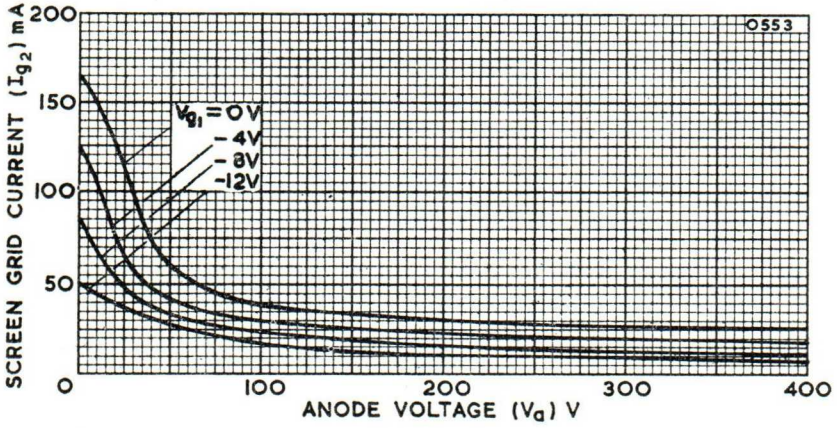

PENTODE SECTION
Ia, Ig2/Va
Vg2=170V
Pa = 8W
Vg1
0V
-1V
-2V
-4V
-6V
-8V
-10V
-12V
-14V
-16V
-18V
-20V
300
200
100
0
ANODE CURRENT (Ia) mA
100
200
300
400
ANODE VOLTAGE (Va) V

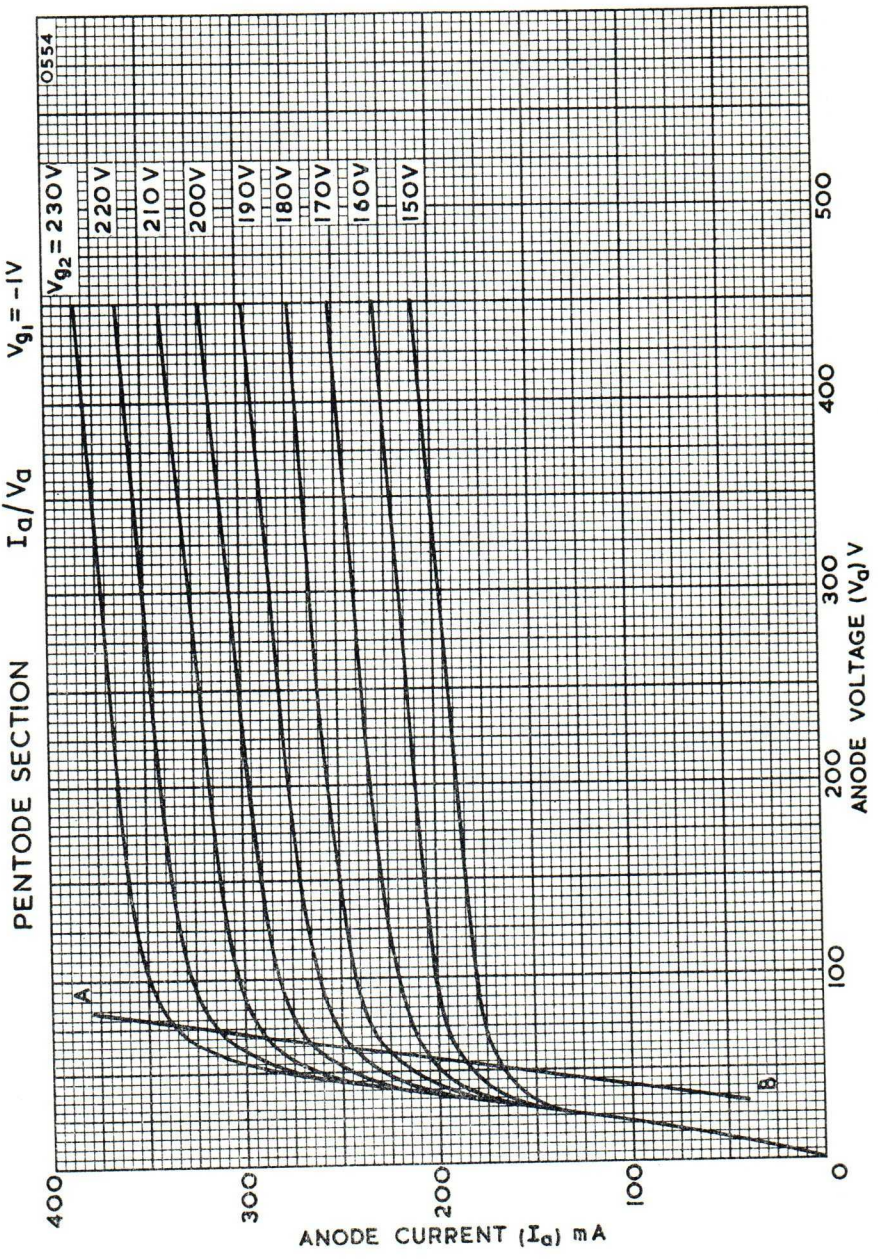

0551
200
150
100
50
0
SCREEN GRID CURRENT (Ig2) mA
Vg1 = 0V
-4V
-8V
-12V
100
200
300
400
ANODE VOLTAGE (Va) V

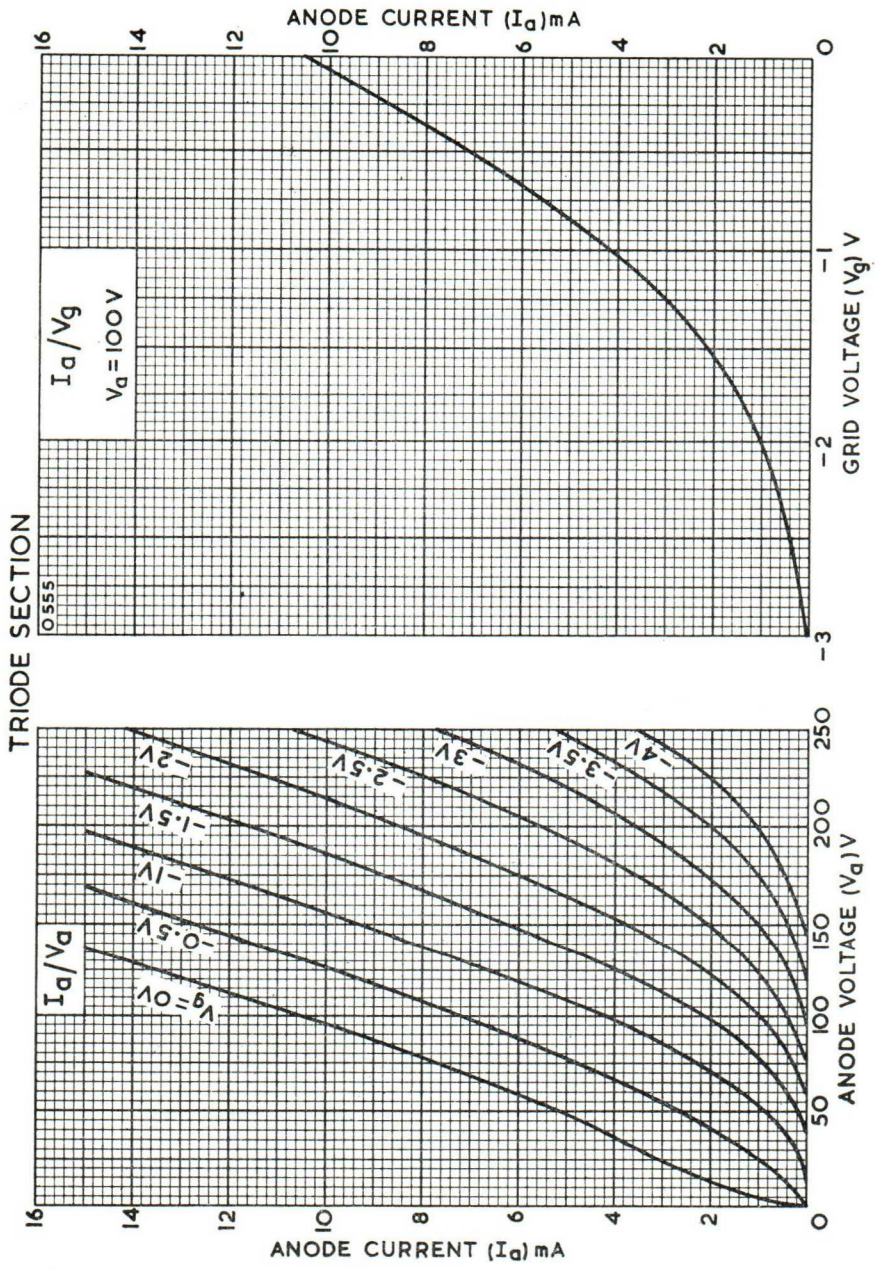

PENTODE SECTION
$I_a, I_{g_2} / V_a$
V_{g_2} = 190V
P_a = 8W
V_{g_1}
0V
-1V
-2V
-4V
-6V
-8V
-10V
-12V
-14V
-16V
-18V
-20V
-22V
ANODE CURRENT (I_a) mA
300
200
100
0
100
200
300
400
ANODE VOLTAGE (V_a) V

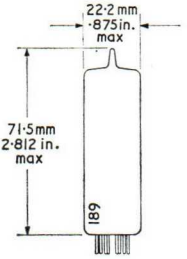

0552
SCREEN GRID CURRENT (I_{g_2}) mA
200
150
100
50
0
V_{g_1} = 0V
-4V
-8V
-12V
100
200
300
400
ANODE VOLTAGE (V_a) V


PENTODE SECTION
$I_a, I_{g_2}/V_a$
V_{g_2} = 210V
P_a = 8W
V_{g_1} = 0V
-1V
-2V
-4V
-6V
-8V
-10V
-12V
-14V
-16V
-18V
-20V
-22V
-24V
-26V
ANODE CURRENT (I_a) mA
0
100
200
300
400
ANODE VOLTAGE (V_a) V

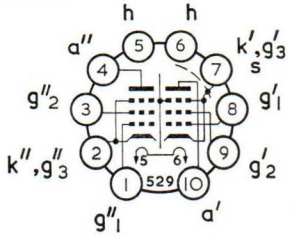

0553
V_{g_1} = 0V
-4V
-8V
-12V
SCREEN GRID CURRENT (I_{g_2}) mA
0
50
100
150
200
100
200
300
400
ANODE VOLTAGE (V_a) V


0554
PENTODE SECTION
I_a/V_a
$V_{g1} = -1V$
$V_{g2} = 230V$
220V
210V
200V
190V
180V
170V
160V
150V
A
B
400
300
200
100
0
ANODE CURRENT (I_a) mA
100
200
300
400
500
ANODE VOLTAGE (V_a) V


TRIODE SECTION
0555
I_a/V_g
V_a = 100 V
ANODE CURRENT (I_a) mA
GRID VOLTAGE (V_g) V
I_a/V_a
V_g = 0V
-0.5V
-1V
-1.5V
-2V
-2.5V
-3V
-3.5V
-4V
ANODE VOLTAGE (V_a) V
ANODE CURRENT (I_a) mA



DOUBLE PENTODE



B10B Base

GENERAL

This double pentode, is intended for use in television receivers with the 'L' section as a high gain video output stage and the 'F' section as a sync separator, A.G.C. amplifier or I.F. amplifier. Particular care has been taken in the design of the valve to reduce coupling between sections to a minimum. The 'L' section is on pins 7, 8, 9 and 10.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	17	V

RATINGS

		Output 'L' Section′	Amplifier 'F' Section″	
Maximum Anode Dissipation	$P_{a(max)}$	5·0	1·5	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	2·5	0·5	W
Intermittent rating, short duration		3·2	—	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	—	550	V
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Screen Grid Supply Voltage	$V_{g2(b)max}$	—	550	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	250	250	V
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$	200	200	V
Maximum Cathode Current	$I_{k(max)}$	60	15	mA
Intermittent rating, short duration		85	—	mA
Maximum Grid 1 to Cathode Resistance	$R_{g1-k(max)}$	1·0	1·0	MΩ

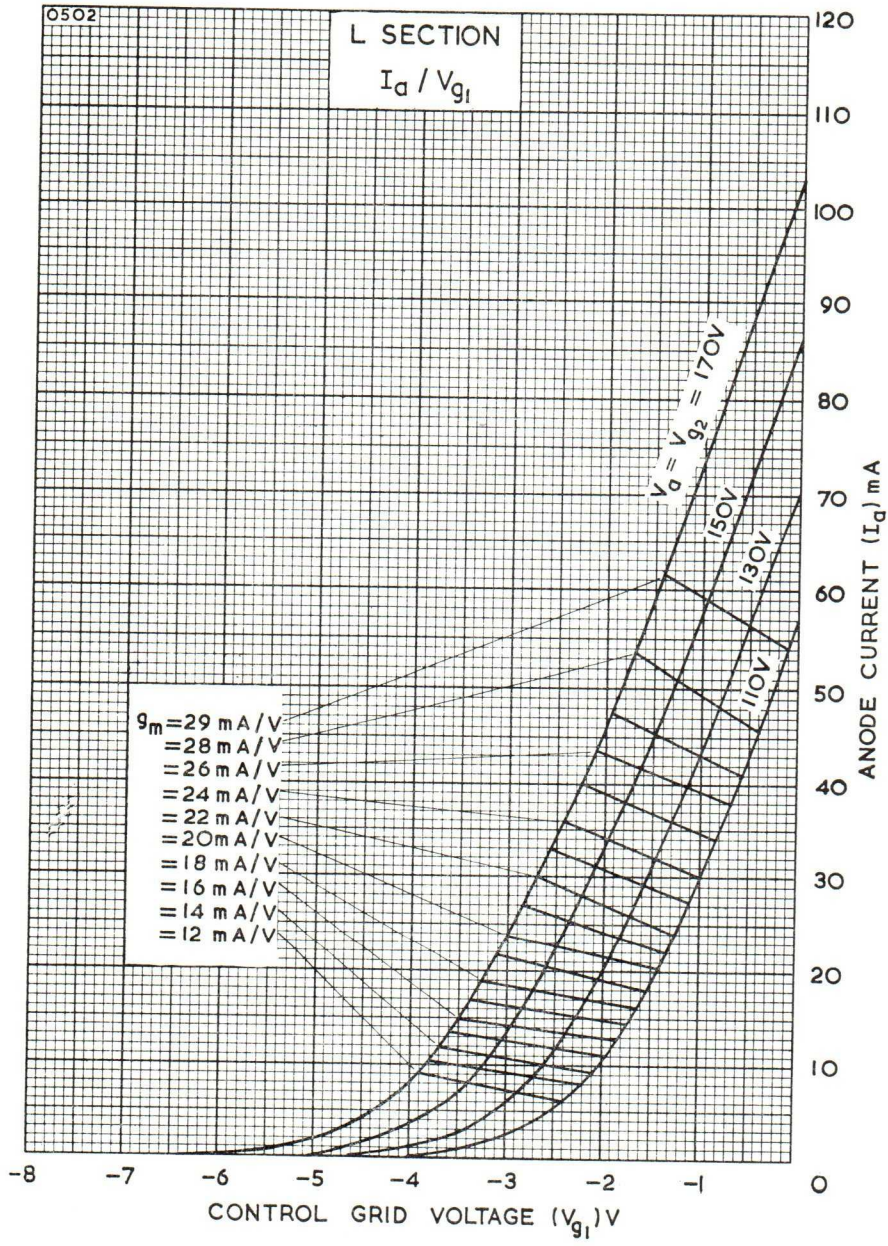
INTER-ELECTRODE CAPACITANCES*

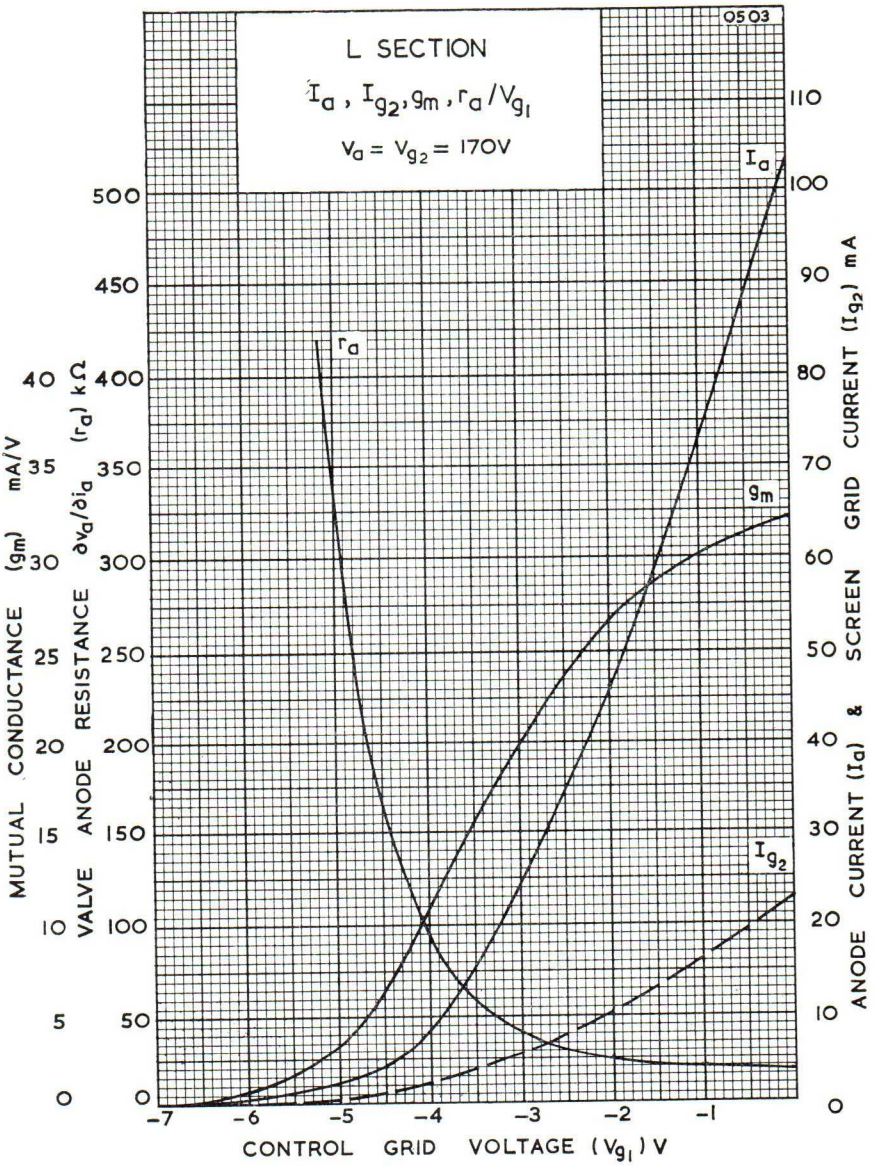
		Output 'L' Section′	Amplifier 'F' Section″	
Input	c_{in}	12·5	10·5	pF
Output	c_{out}	6·5	10·5	pF
Anode to Grid 1	c_{a-g1}	0·1	0·15	pF
Anode′ to Anode″	$c_{a'-a''}$		<0·15	pF
Grid′1 to Grid″1	$c_{g'1-g''1}$		<0·01	pF
Anode′ to Grid″1	$c_{a'-g''1}$		<0·10	pF
Grid′1 to Anode″	$c_{g'1-a''}$		<0·005	pF
Grid″1 to Heater	$c_{g''1-h}$		<0·15	pF

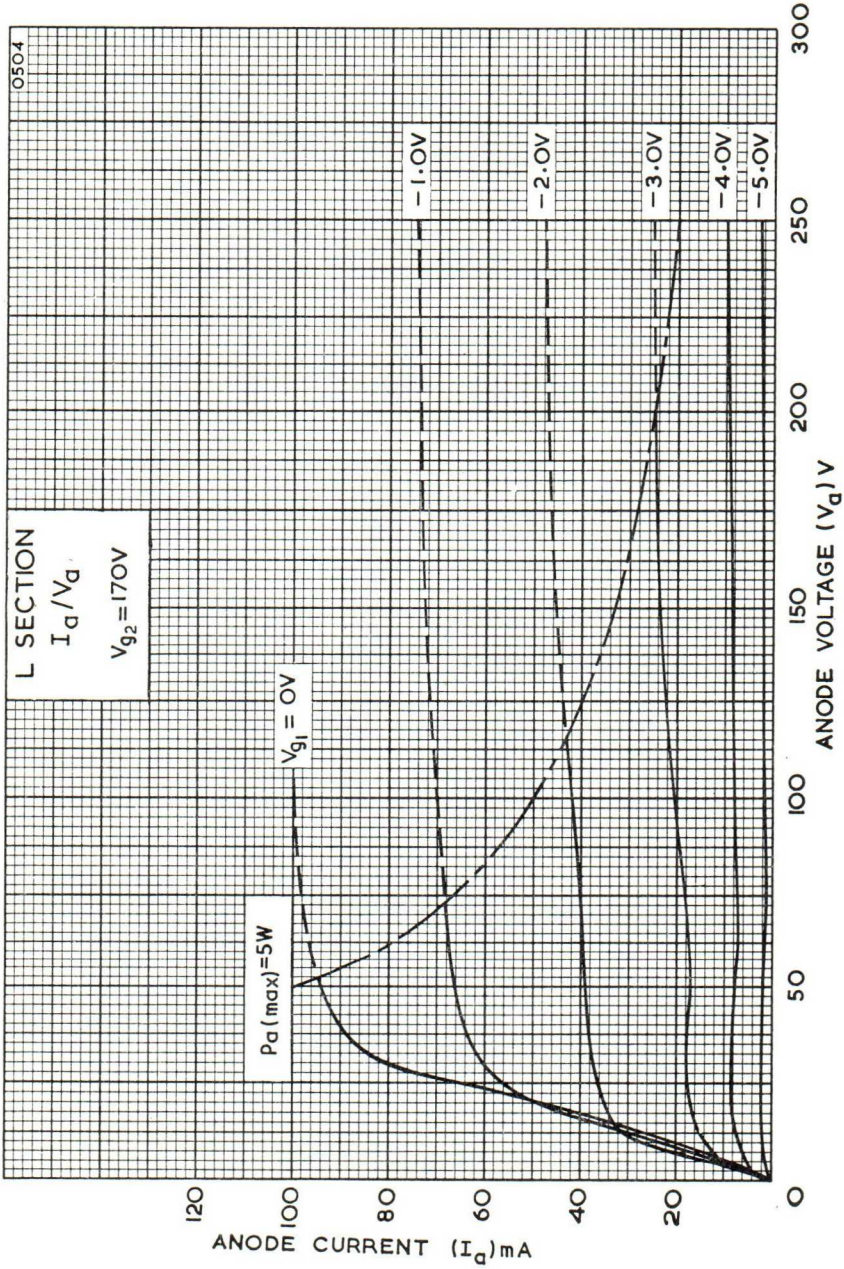
* Measured without an external shield.

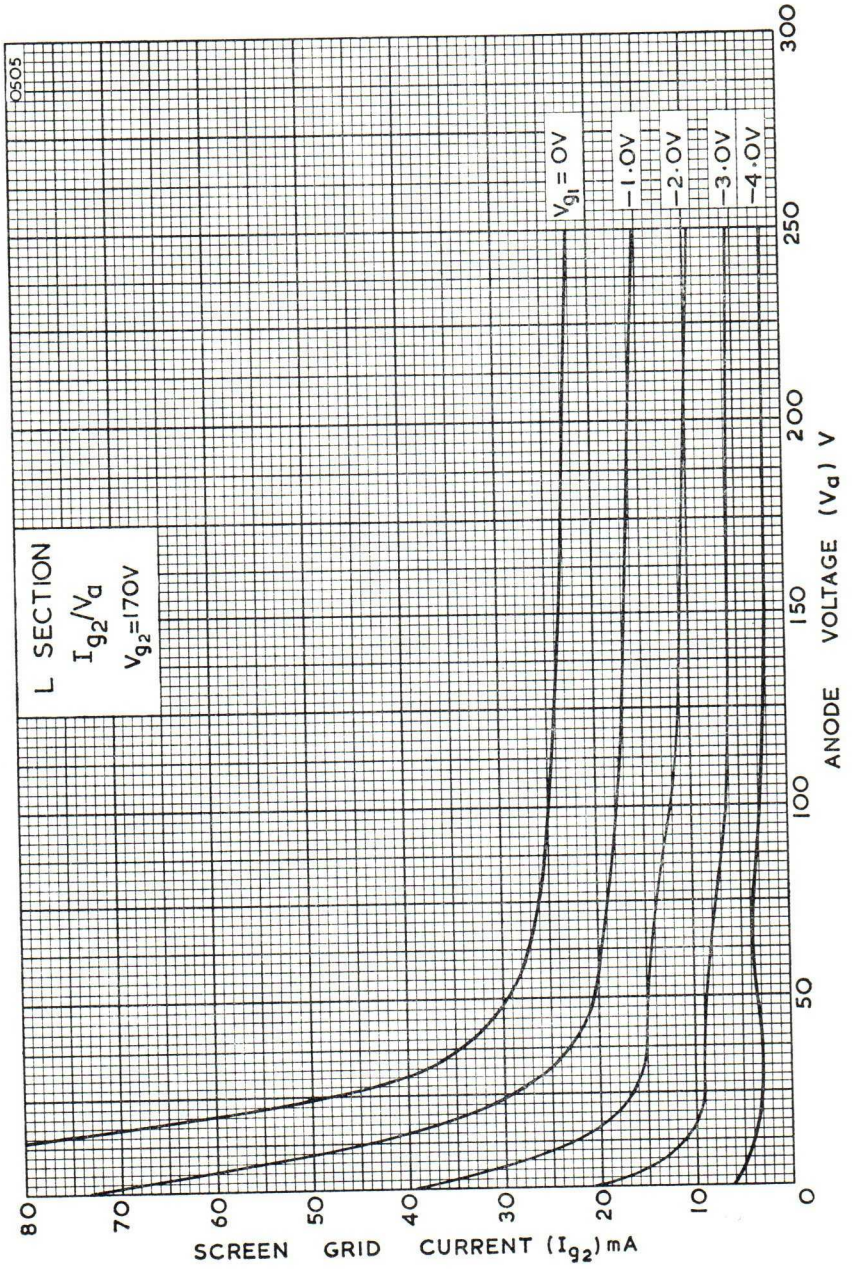
CHARACTERISTICS

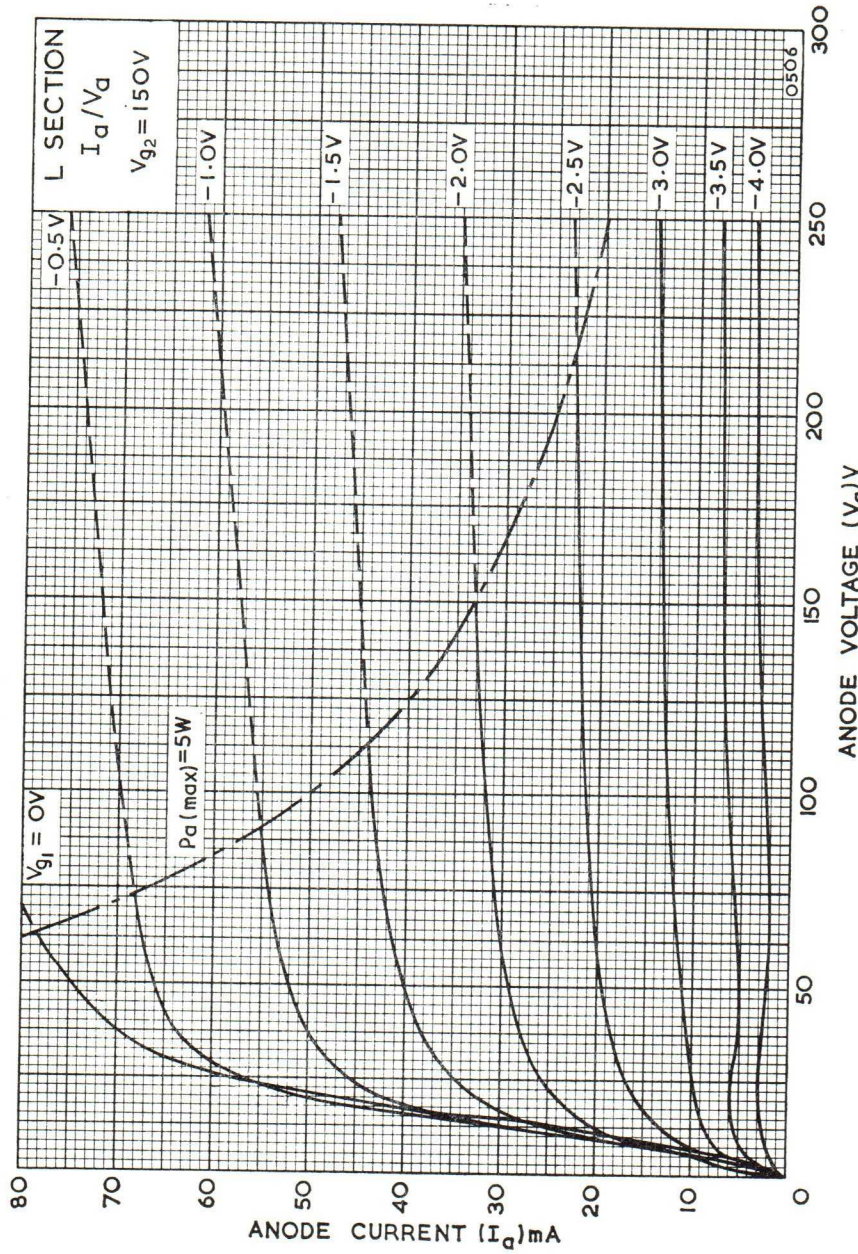
		Output 'L' Section′	Amplifier 'F' Section″		
Anode Voltage	V_a	170	150	50	V
Screen Grid Voltage	V_{g2}	170	150	75	V
Control Grid Voltage	V_{g1}	−2·7	−2·1	−0·65	V
Anode Current	I_a	30	10	5·0	mA
Screen Grid Current	I_{g2}	7·0	3·0	1·6	mA
Mutual Conductance	g_m	22	8·5	6·8	mA/V
Inner Amplification Factor	μ_{g1-g2}	38	38	34	
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	33	150	110	kΩ

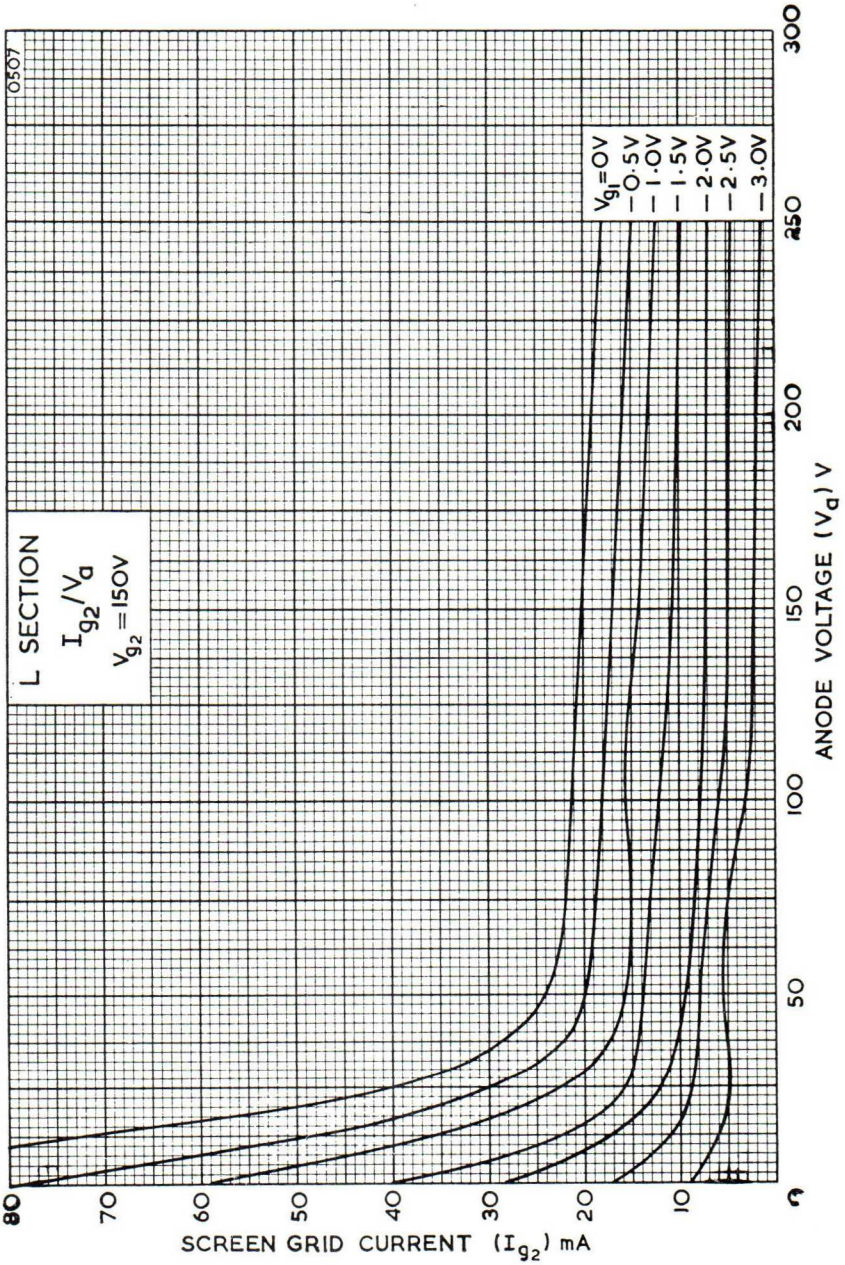

0502
L SECTION
I_a / V_{g1}
$V_a = V_{g2}$ = 170V
150V
130V
110V
g_m=29 mA/V
=28 mA/V
=26 mA/V
=24 mA/V
=22 mA/V
=20mA/V
=18 mA/V
=16 mA/V
=14 mA/V
=12 mA/V
120
110
100
90
80
70
60
50
40
30
20
10
0
ANODE CURRENT (I_a) mA
-8
-7
-6
-5
-4
-3
-2
-1
CONTROL GRID VOLTAGE (V_{g1}) V

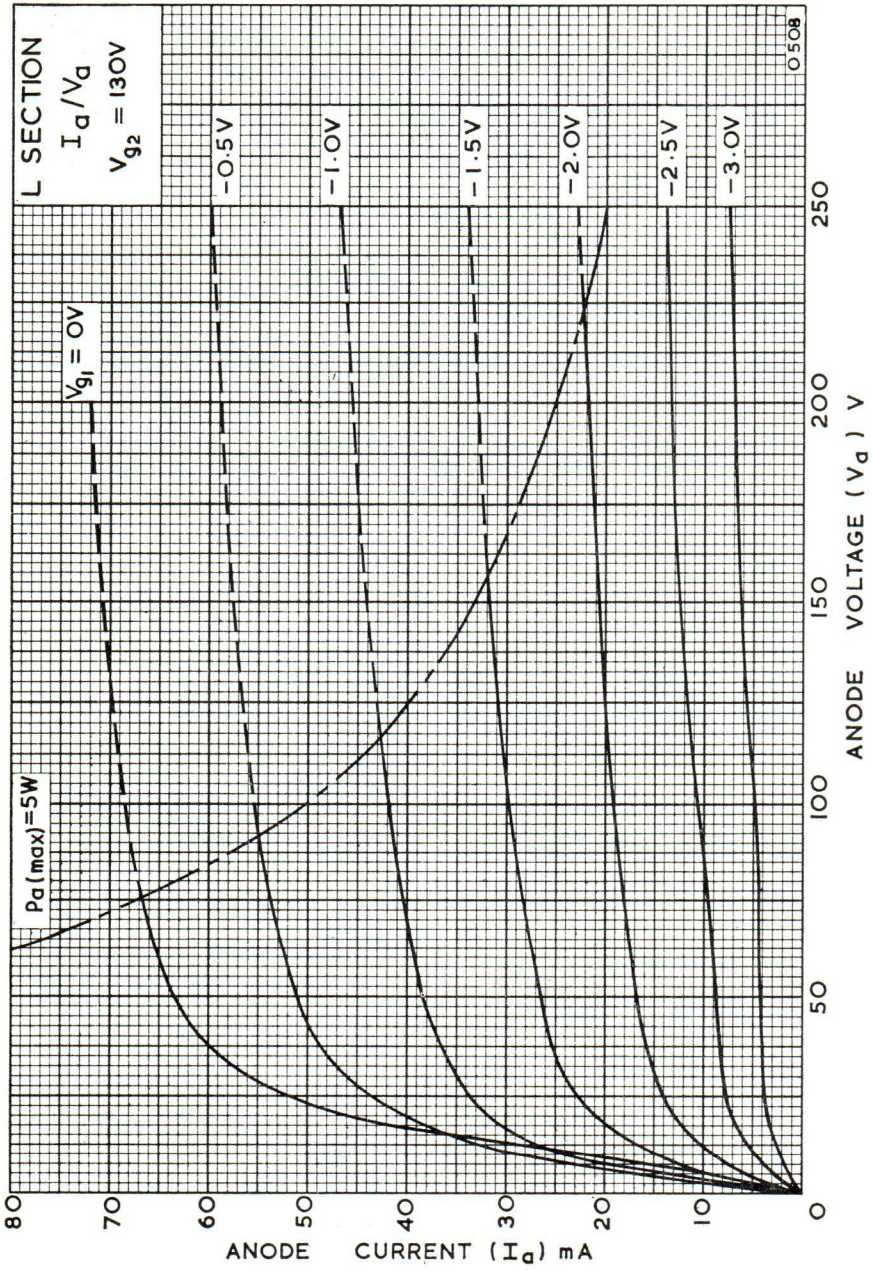

0503
L SECTION
I_a , I_{g2}, g_m , r_a / V_{g1}
$V_a = V_{g2} = 170V$
I_a
g_m
r_a
I_{g2}
MUTUAL CONDUCTANCE (g_m) mA/V
VALVE ANODE RESISTANCE $\partial v_a/\partial i_a$ (r_a) kΩ
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g2}) mA
CONTROL GRID VOLTAGE (V_{g1}) V
0 5 10 15 20 25 30 35 40
0 50 100 150 200 250 300 350 400 450 500
0 10 20 30 40 50 60 70 80 90 100 110
−7 −6 −5 −4 −3 −2 −1 0

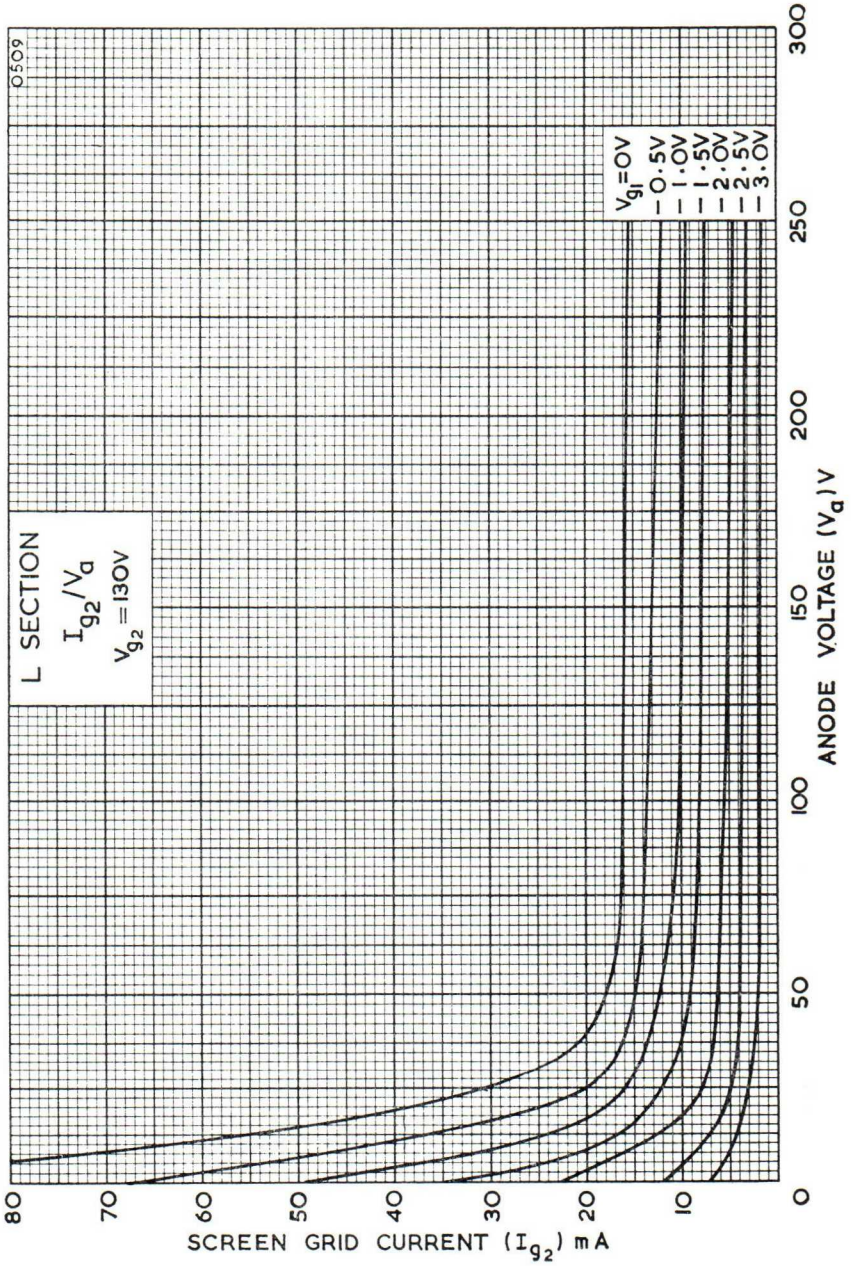

0504
L SECTION
I_a/V_a
V_{g2}=170V
V_{g1} = 0V
Pa(max)=5W
-1.0V
-2.0V
-3.0V
-4.0V
-5.0V
ANODE VOLTAGE (V_a) V
0
50
100
150
200
250
300
ANODE CURRENT (I_a) mA
120
100
80
60
40
20

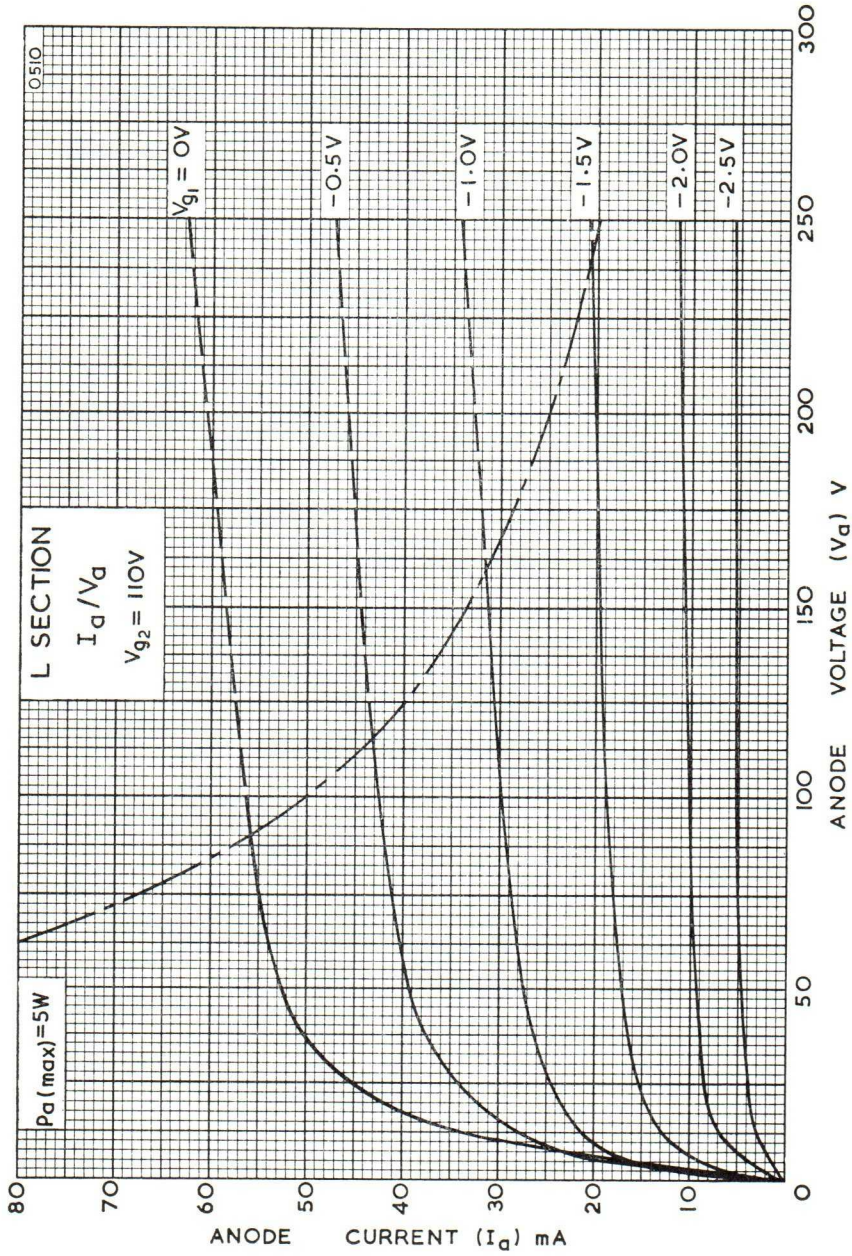

0505
L SECTION
I_{g2}/V_a
V_{g2}=170V
V_{g1} = 0V
-1·0V
-2·0V
-3·0V
-4·0V
ANODE VOLTAGE (V_a) V
0
50
100
150
200
250
300
SCREEN GRID CURRENT (I_{g2}) mA
80
70
60
50
40
30
20
10
0

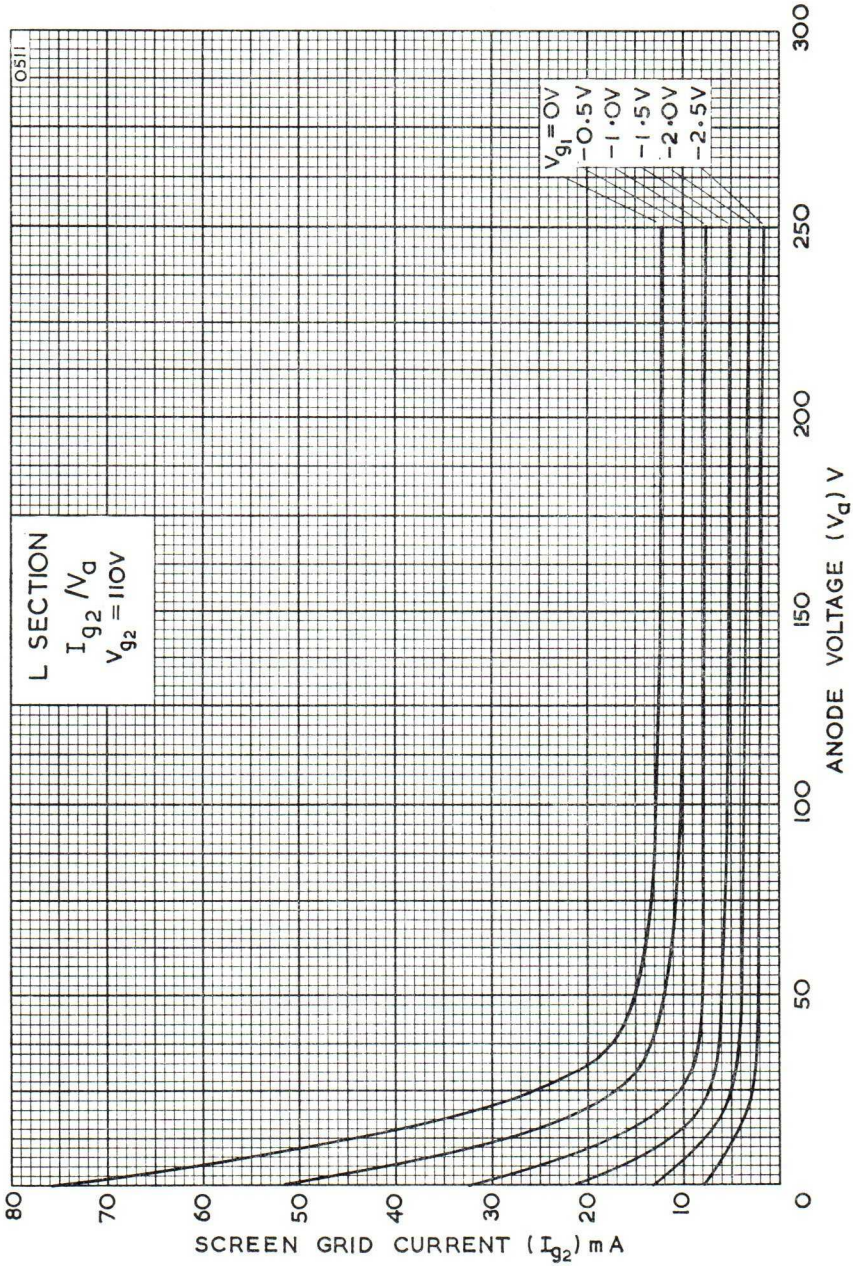

L SECTION
I_a/V_a
$V_{g2}=150V$
-0.5V
-1.0V
-1.5V
-2.0V
-2.5V
-3.0V
-3.5V
-4.0V
$V_{g1}=0V$
Pa(max)=5W
0506
ANODE VOLTAGE (V_a)V
ANODE CURRENT (I_a)mA
300
250
200
150
100
50
0
80
70
60
50
40
30
20
10


0507
L SECTION
I_{g_2}/V_a
V_{g_2} = 150V
V_{g_1}=0V
−0·5V
−1·0V
−1·5V
−2·0V
−2·5V
−3·0V
ANODE VOLTAGE (V_a) V
300
250
200
150
100
50
0
80
70
60
50
40
30
20
10
0
SCREEN GRID CURRENT (I_{g_2}) mA

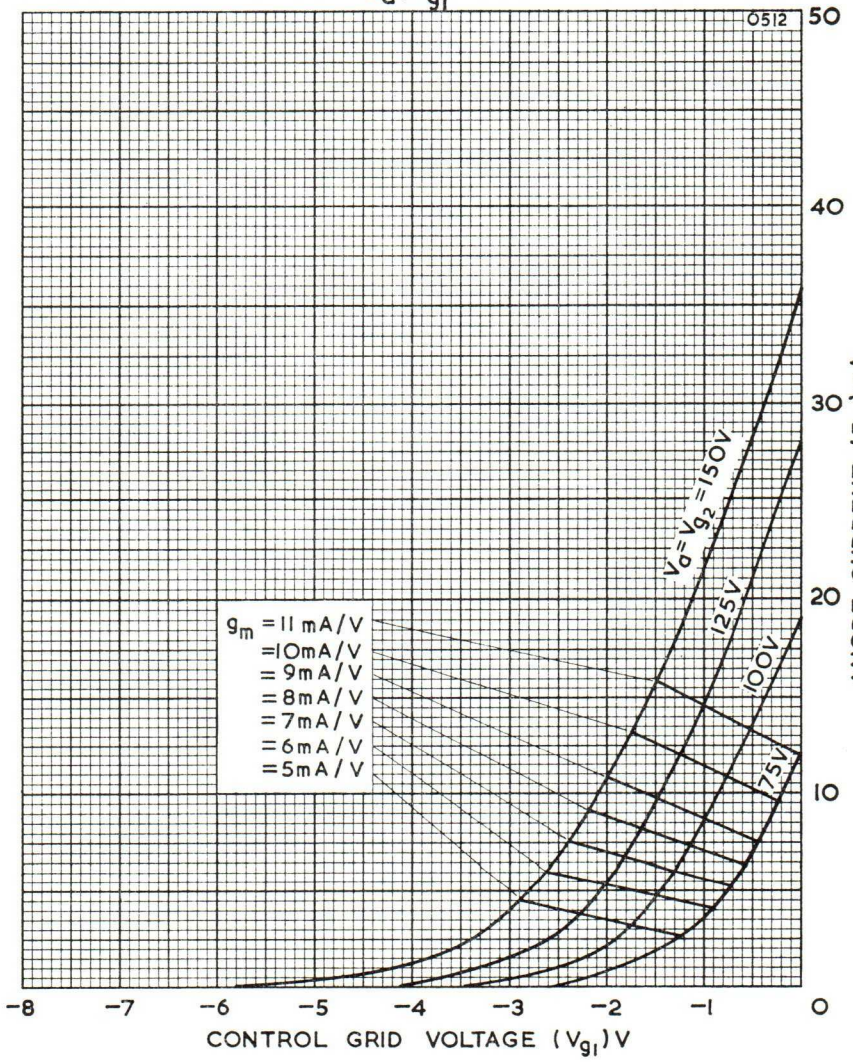

L SECTION
I_a/V_a
V_{g2} = 130V
V_{g1} = 0V
-0·5V
-1·0V
-1·5V
-2·0V
-2·5V
-3·0V
Pa(max)=5W
0508
ANODE VOLTAGE (V_a) V
0
50
100
150
200
250
ANODE CURRENT (I_a) mA
80
70
60
50
40
30
20
10
0


0509
L SECTION
I_{g_2}/V_a
V_{g_2} = 130V
V_{g_1}=0V
-0·5V
-1·0V
-1·5V
-2·0V
-2·5V
-3·0V
300
250
200
150
100
50
0
ANODE VOLTAGE (V_a) V
80
70
60
50
40
30
20
10
SCREEN GRID CURRENT (I_{g_2}) mA


0510
L SECTION
I_a / V_a
V_{g_2} = 110V
V_{g_1} = 0V
-0.5V
-1.0V
-1.5V
-2.0V
-2.5V
Pa (max)=5W
ANODE CURRENT (I_a) mA
ANODE VOLTAGE (V_a) V
80
70
60
50
40
30
20
10
0
50
100
150
200
250
300


0511
L SECTION
I_{g2} / V_a
V_{g2} = 110V
V_{g1} = 0V
-0.5V
-1.0V
-1.5V
-2.0V
-2.5V
ANODE VOLTAGE (V_a) V
0
50
100
150
200
250
300
SCREEN GRID CURRENT (I_{g2}) mA
80
70
60
50
40
30
20
10

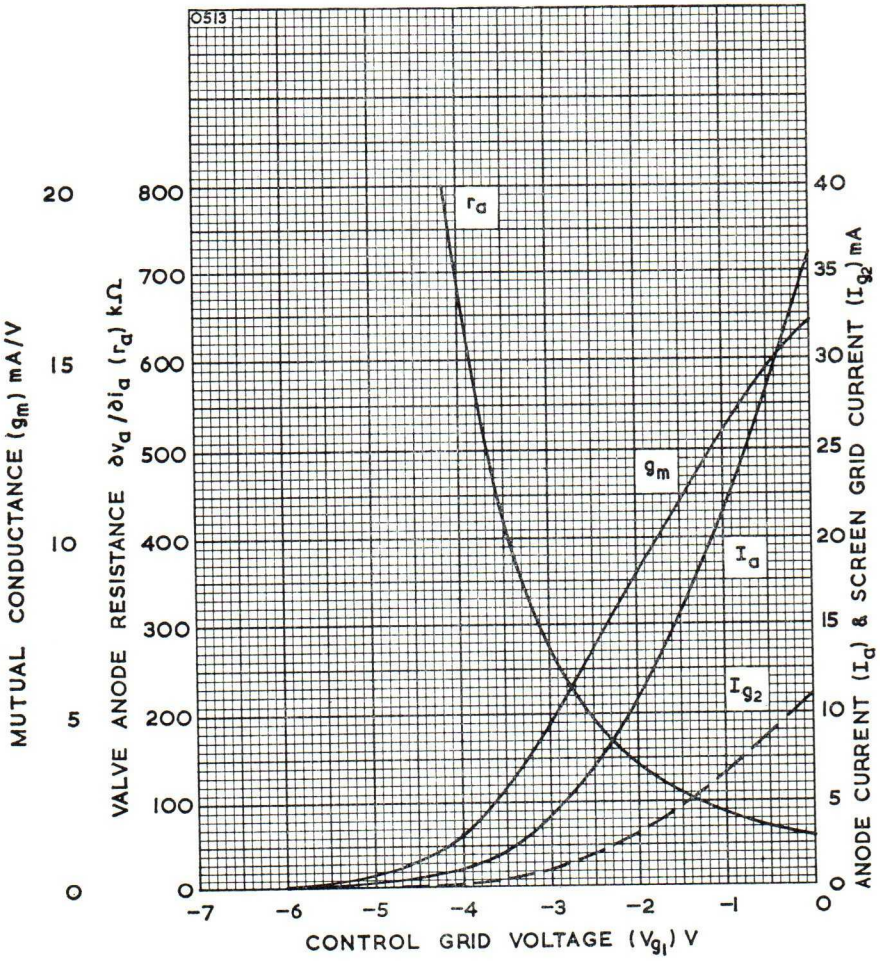
F SECTION
I_a / V_{g_1}

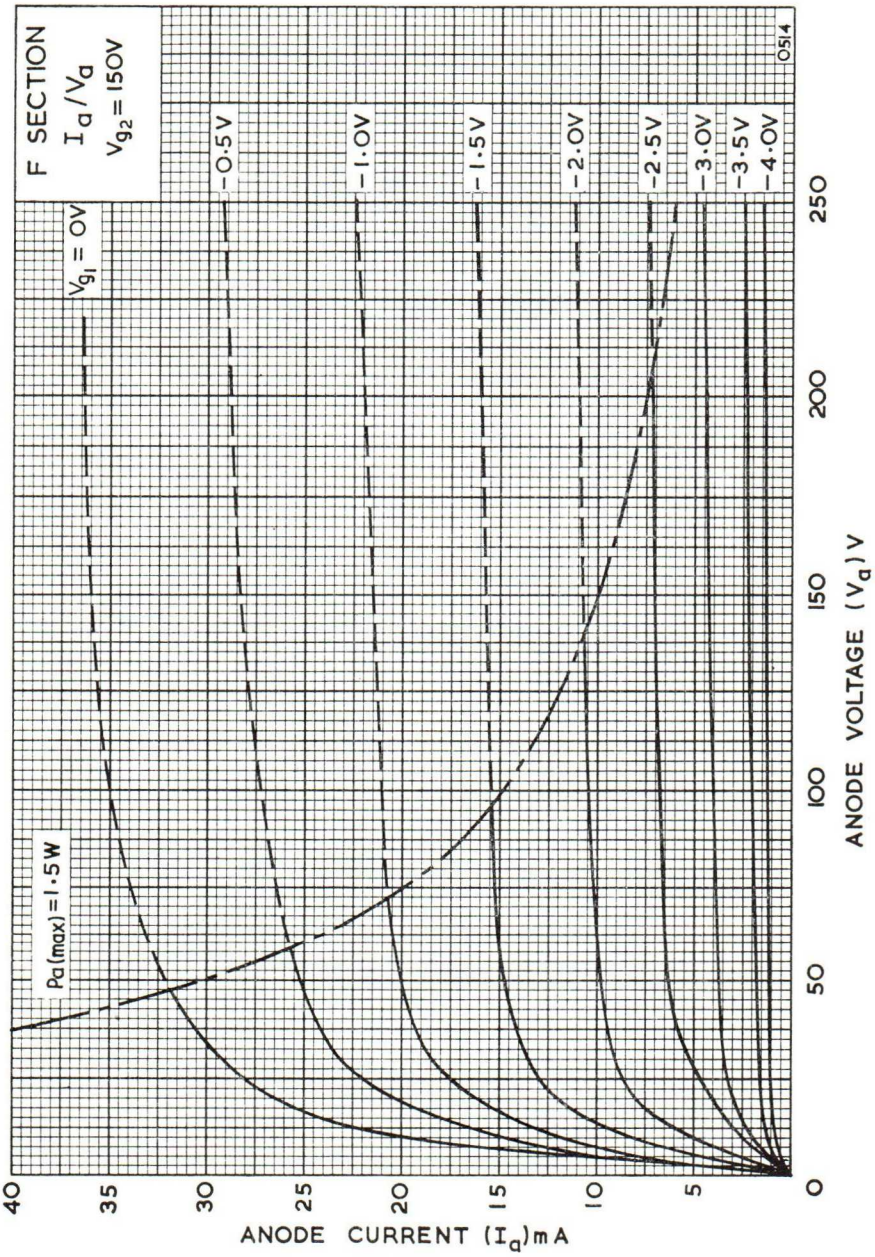


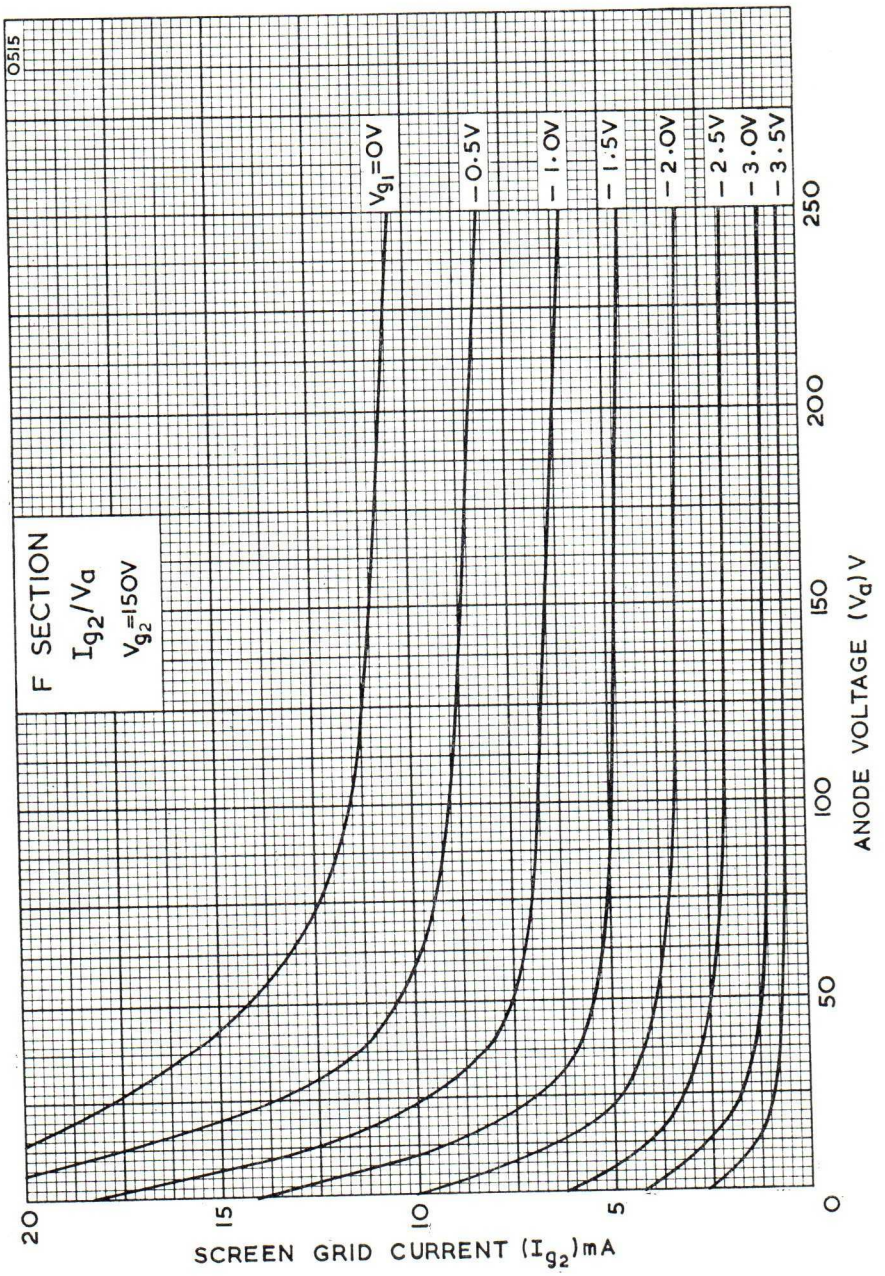
F SECTION

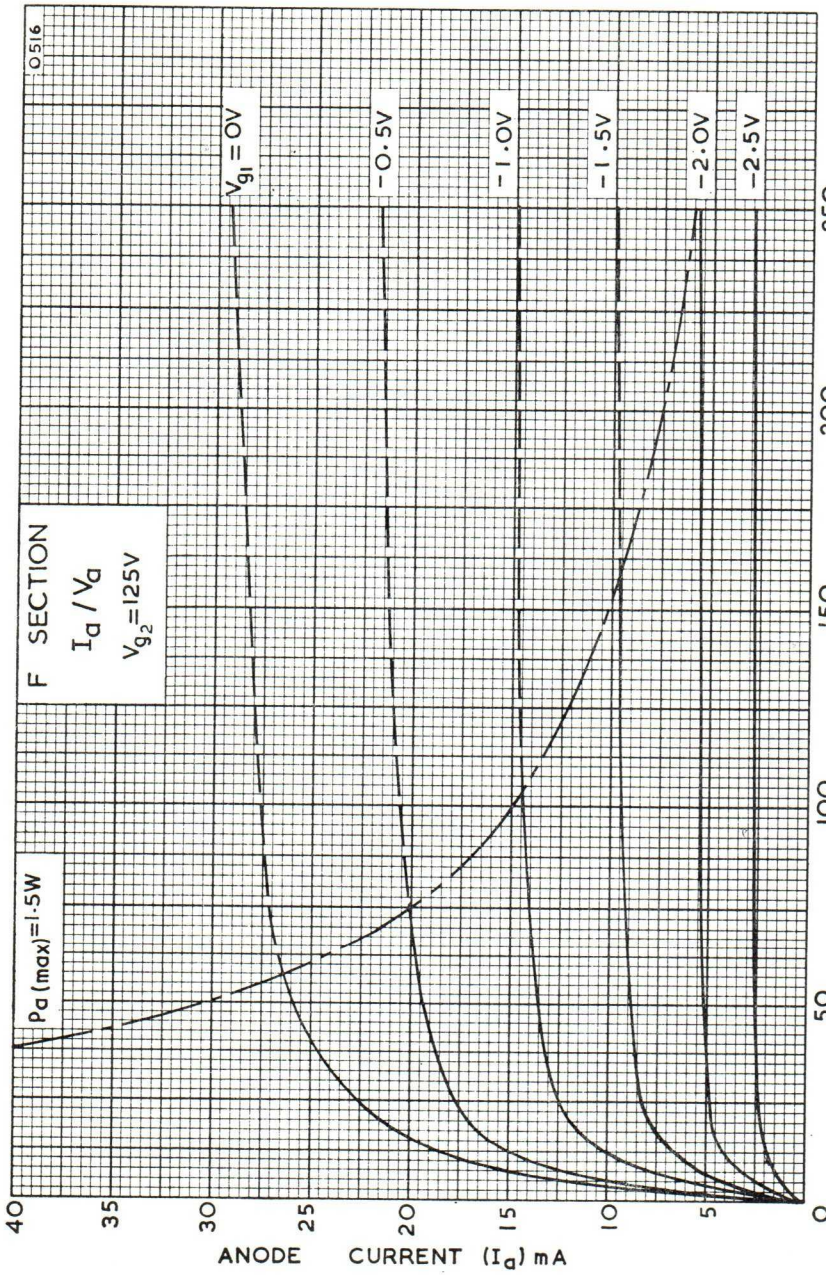
$I_a, I_{g_2}, r_a, g_m / V_{g_1}$

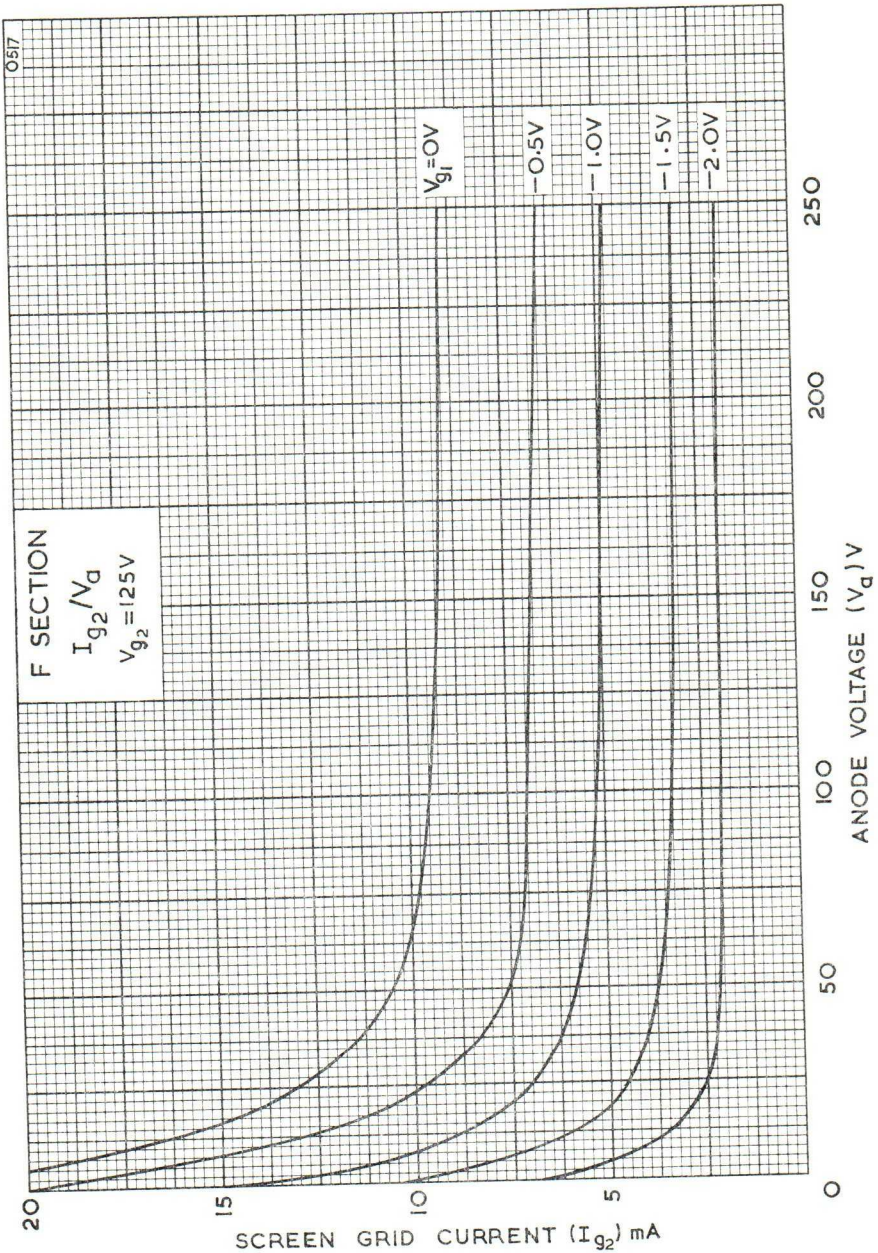
$V_a = V_{g_2} = 150V$

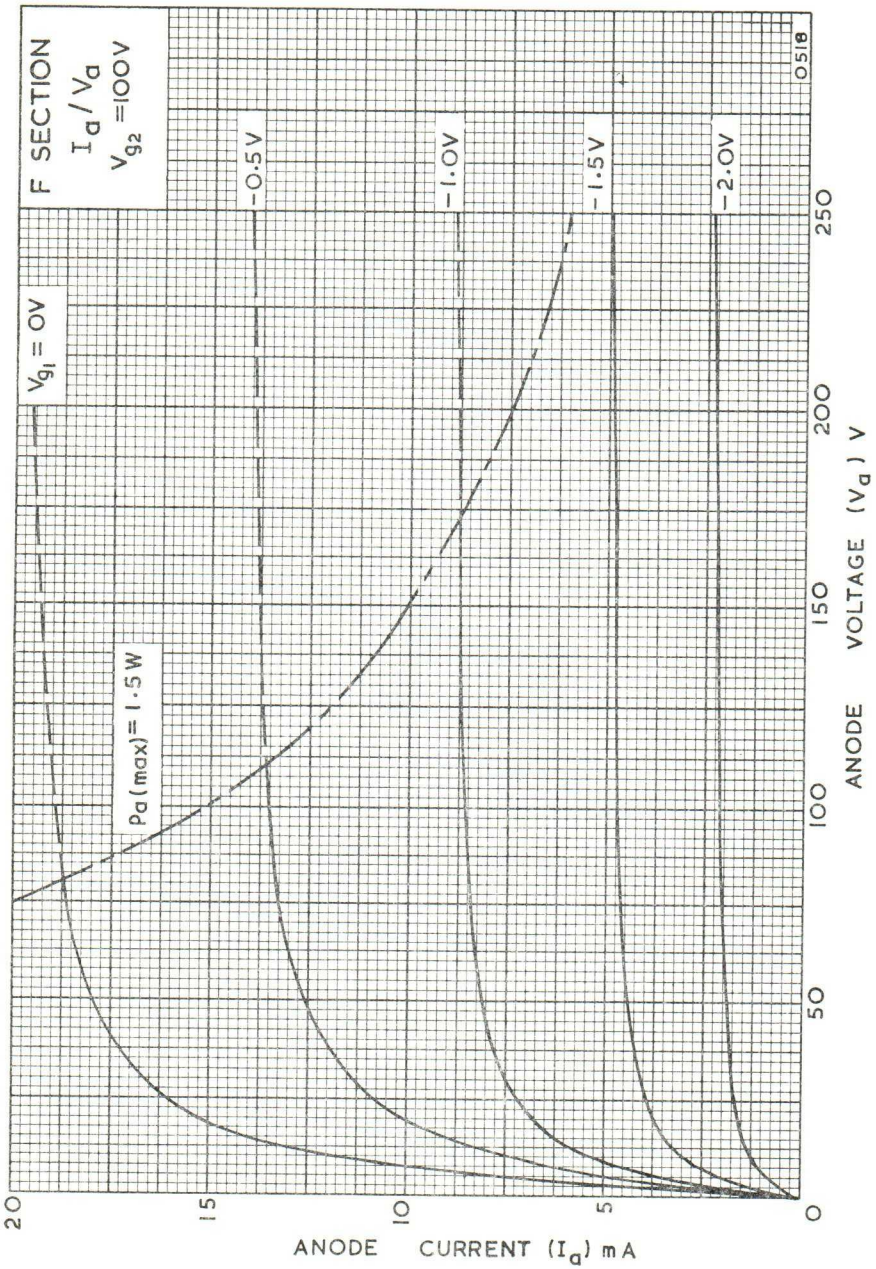


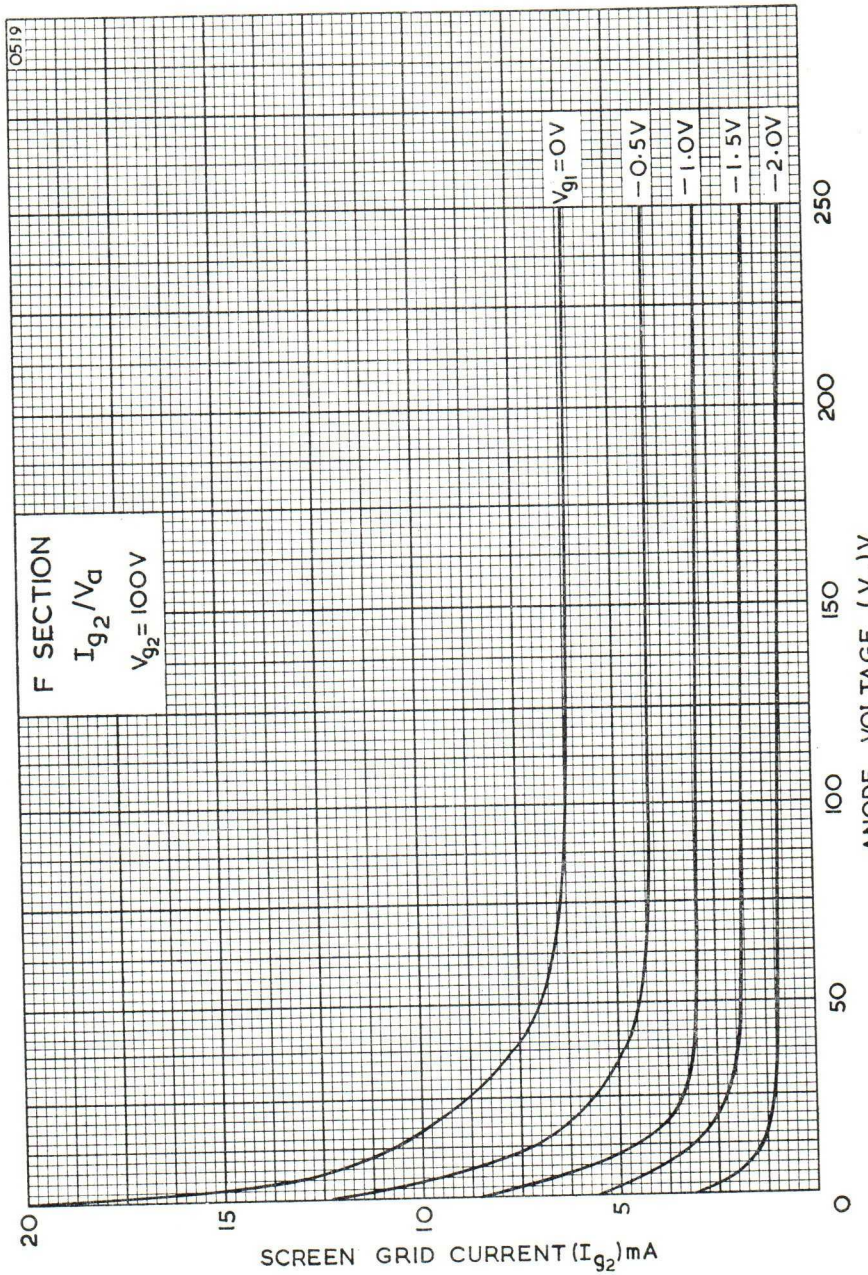

F SECTION
I_a / V_a
$V_{g2} = 150V$
$V_{g1} = 0V$
-0·5V
-1·0V
-1·5V
-2·0V
-2·5V
-3·0V
-3·5V
-4·0V
Pa(max) = 1·5W
0514
ANODE CURRENT (I_a) mA
ANODE VOLTAGE (V_a) V
40
35
30
25
20
15
10
5
0
50
100
150
200
250

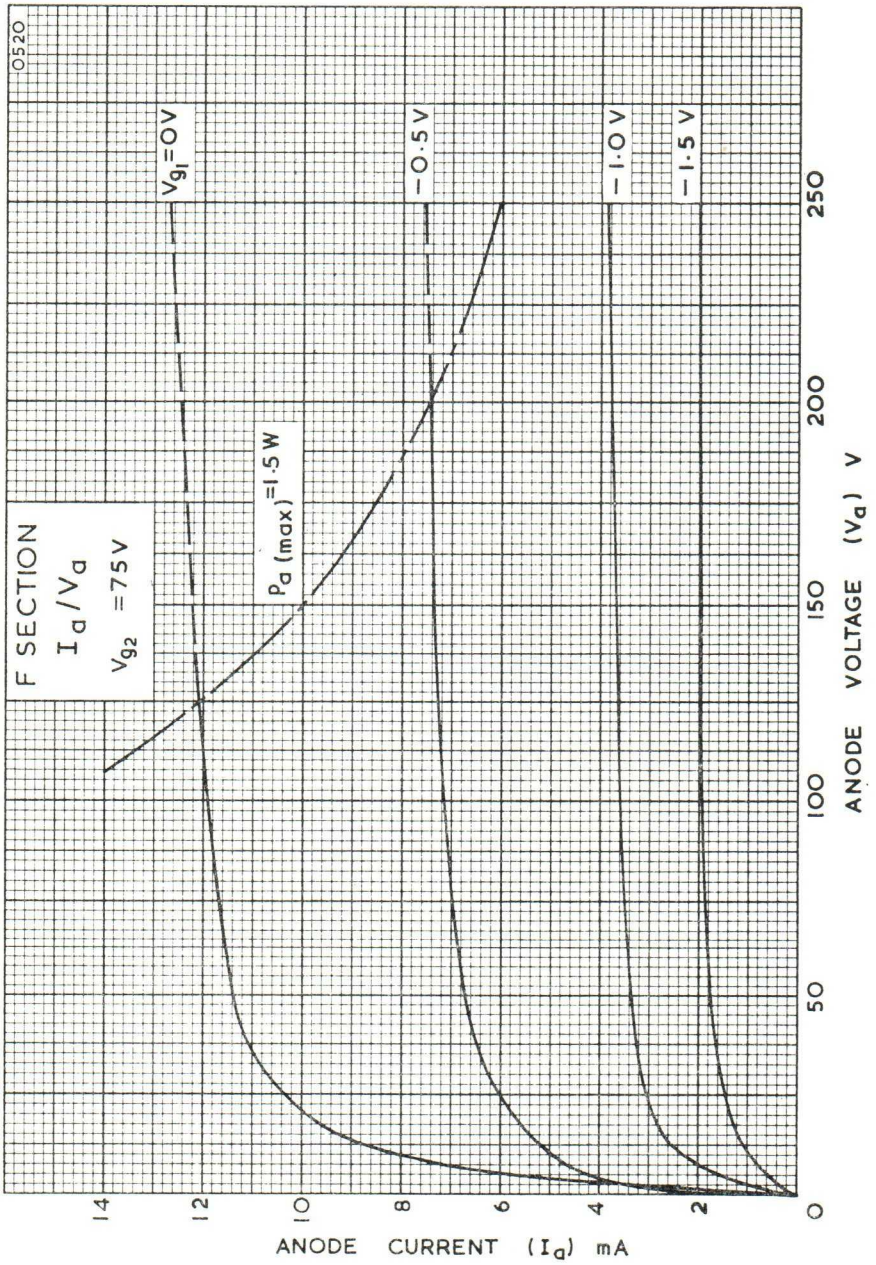

0515
F SECTION
I_{g2}/V_a
V_{g2}=150V
V_{g1}=0V
-0.5V
-1.0V
-1.5V
-2.0V
-2.5V
-3.0V
-3.5V
250
200
150
100
50
0
ANODE VOLTAGE (V_a) V
20
15
10
5
SCREEN GRID CURRENT (I_{g2}) mA

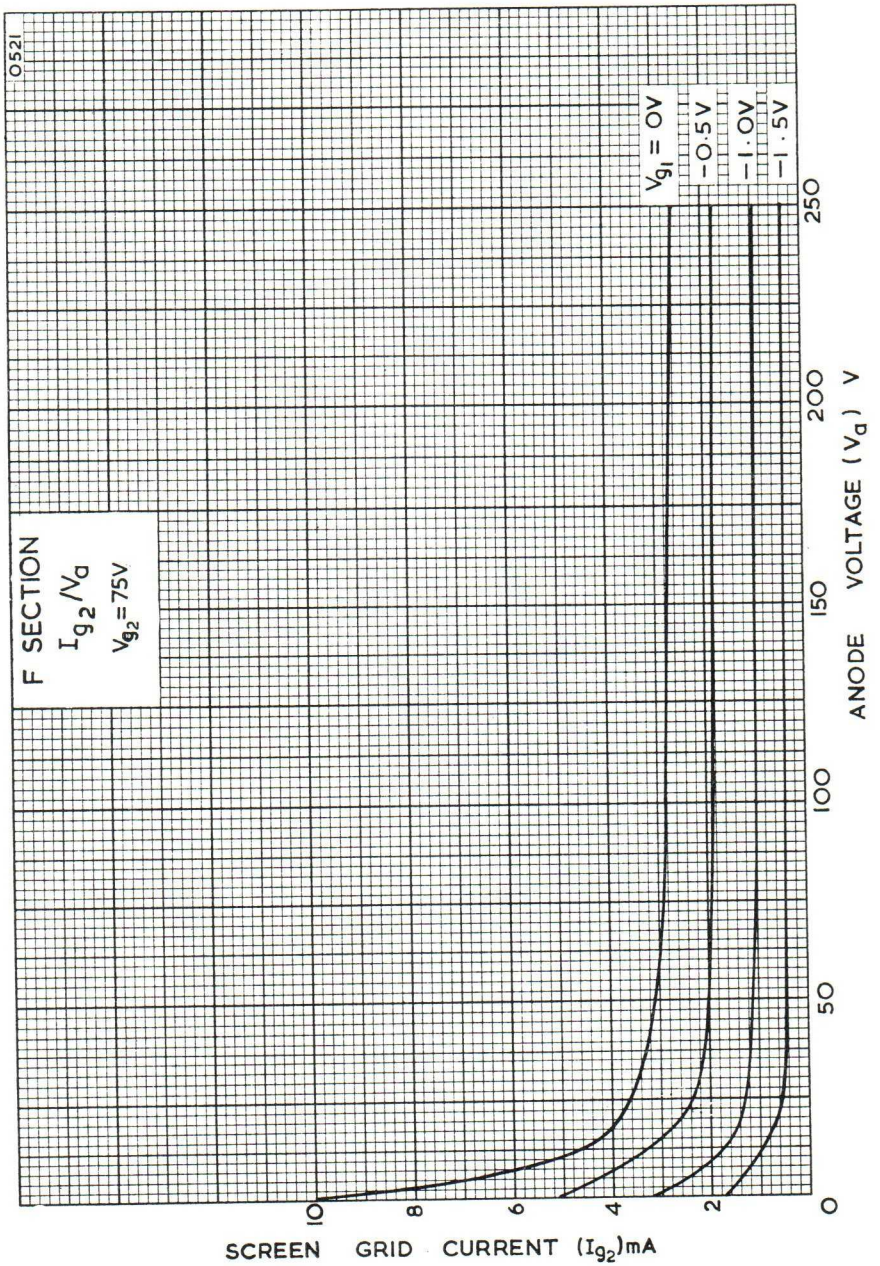

0516
F SECTION
I_a / V_a
V_{g_2}=125V
Pa (max)=1·5W
V_{g1} = 0V
-0·5V
-1·0V
-1·5V
-2·0V
-2·5V
ANODE CURRENT (I_a) mA
40
35
30
25
20
15
10
5
0
ANODE VOLTAGE (V_a) V
250
200
150
100
50

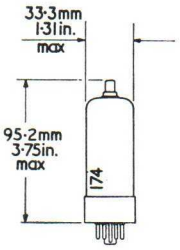

0517
F SECTION
I_{g_2}/V_a
V_{g_2}=125V
V_{g_1}=0V
-0.5V
-1.0V
-1.5V
-2.0V
250
200
150
100
50
0
ANODE VOLTAGE (V_a) V
20
15
10
5
SCREEN GRID CURRENT (I_{g_2}) mA


F SECTION
I_a / V_a
V_{g2} =100V
V_{g1} = 0V
-0.5V
-1.0V
-1.5V
-2.0V
Pa (max)= 1.5W
0518
ANODE VOLTAGE (V_a) V
0
50
100
150
200
250
ANODE CURRENT (I_a) mA
20
15
10
5
0

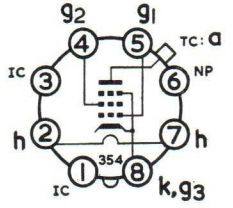

0519
F SECTION
I_{g_2}/V_a
V_{g_2}= 100 V
V_{g_1}=0V
-0·5V
-1·0V
-1·5V
-2·0V
20
15
10
5
0
50
100
150
200
250
SCREEN GRID CURRENT (I_{g_2}) mA
ANODE VOLTAGE (V_a) V


0520
F SECTION
I_a / V_a
V_{g2} = 75 V
V_{g1}=0V
−0.5V
−1.0V
−1.5V
P_a (max)=1.5W
ANODE VOLTAGE (V_a) V
0
50
100
150
200
250
ANODE CURRENT (I_a) mA
0
2
4
6
8
10
12
14


0521
F SECTION
I_{g_2}/V_a
V_{g_2}=75V
V_{g_1} = 0V
-0·5V
-1·0V
-1·5V
ANODE VOLTAGE (V_a) V
0
50
100
150
200
250
SCREEN GRID CURRENT (I_{g_2})mA
2
4
6
8
10



LINE OUTPUT PENTODE



I.O. Base, CT1 Top Cap

GENERAL

This valve is an output pentode intended for use as the line time base output valve in AC/DC television receivers having series connected heaters.

Heater Current	I_h	0·3 A
Heater Voltage	V_h	25 V

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	See rating chart	
Maximum Screen Grid Dissipation	$P_{g2(max)}$	See rating chart*	
Maximum Peak Anode Voltage,	$V_{a(pk)max}$		
Pulse Positive		7·0†	kV
Pulse Negative		1·5†	kV
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	250	V
Maximum Screen Grid Supply Voltage	$V_{g2(b)max}$	550	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	250	V
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$		
Cathode Positive		250	V
Cathode Negative		200	V
Maximum Cathode Current	$I_{k(max)}$	200	mA
Maximum Control Grid to Cathode Resistance	$R_{g1-k(max)}$	500	kΩ

* Maximum average screen dissipation is 7·0 watts during the period between the commencement of screen current flow and the instant when the anode current attains one half of its normal operating value.

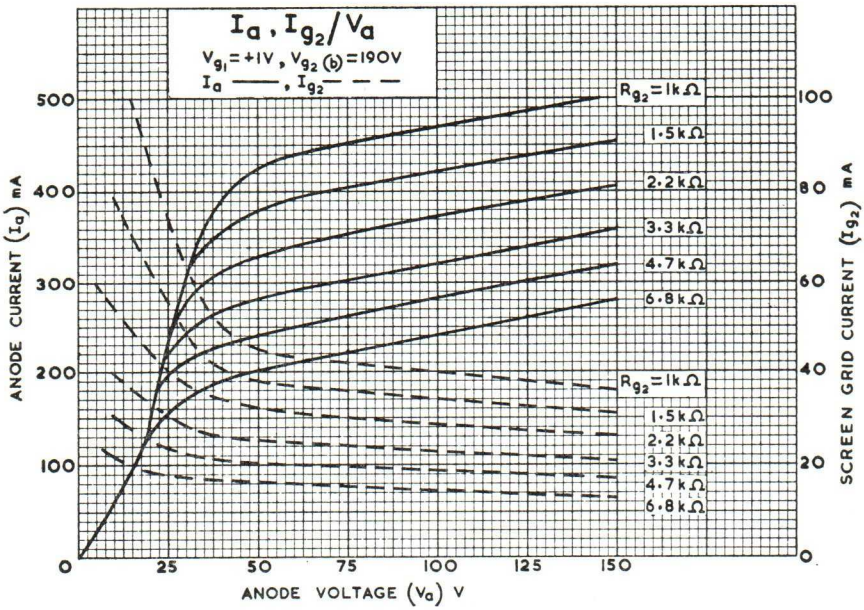
† Maximum duration 22 per cent of one cycle with a maximum duration of 18 μs.

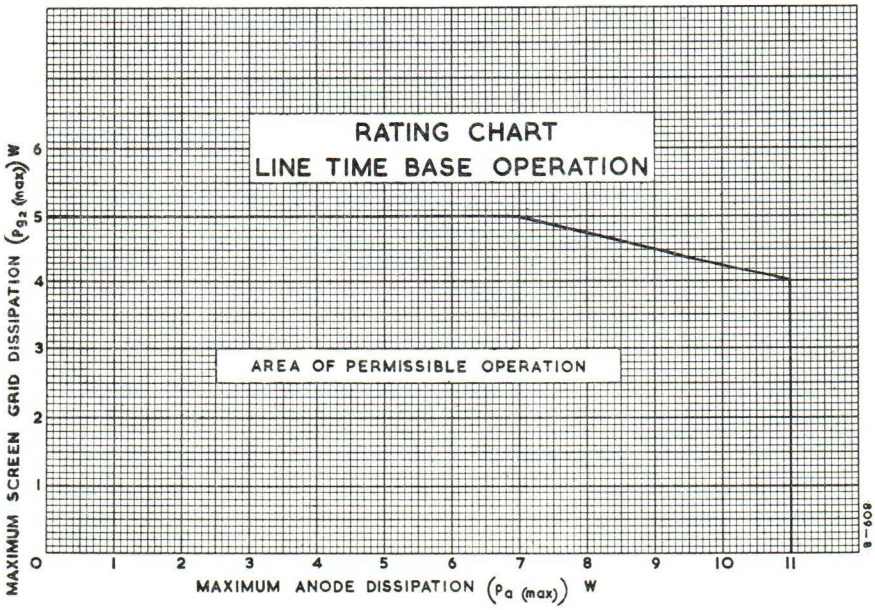
INTER-ELECTRODE CAPACITANCES

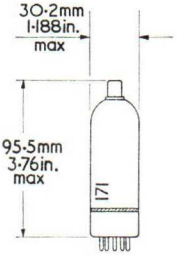
Input	C_{in}	17·5	pF
Output	C_{out}	8·0	pF
Anode to Control Grid	C_{a-g1}	<1·1	pF

CHARACTERISTICS

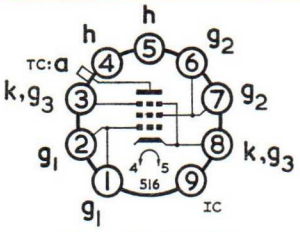
Anode Voltage	V_a	100	V
Screen Grid Voltage	V_{g2}	100	V
Control Grid Voltage	V_{g1}	−8·2	V
Anode Current	I_a	100	mA
Screen Grid Current	I_{g2}	7·0	mA
Mutual Conductance	g_m	14	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	5·0	kΩ
Inner Amplification Factor	μ_{g1-g2}	5·6	


I_a , I_{g_2}/V_a
V_{g_1} = +1V , V_{g_2} (b) = 190V
I_a ——— , I_{g_2} — — —
R_{g_2} = 1kΩ
1·5kΩ
2·2kΩ
3·3kΩ
4·7kΩ
6·8kΩ
ANODE CURRENT (I_a) mA
SCREEN GRID CURRENT (I_{g_2}) mA
ANODE VOLTAGE (V_a) V
0
25
50
75
100
125
150
100
200
300
400
500
20
40
60
80


RATING CHART
LINE TIME BASE OPERATION
AREA OF PERMISSIBLE OPERATION
MAXIMUM SCREEN GRID DISSIPATION (P_{g_2} (max)) W
MAXIMUM ANODE DISSIPATION (P_a (max)) W
0
1
2
3
4
5
6
7
8
9
10
11
8-608



LINE OUTPUT PENTODE



Base B9D, Cap CT1

GENERAL

This output pentode is primarily intended for use in the line timebase of television receivers.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	27	V

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	See Rating Chart	
Maximum Anode and Screen Grid Dissipation	$P_{(a+g2)max}$	See Rating Chart	
Maximum Screen Grid Dissipation	$P_{g2(max)}$	See Rating Chart	
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	250	V
Maximum Peak Anode Voltage	$V_{a(pk)max}$	7·0*	kV
Maximum Screen Grid Supply Voltage	$V_{g2(b)max}$	550	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	250	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h-k(r.m.s.)max}$	220†	V
Maximum Cathode Current	$I_{k(max)}$	250	mA
Maximum Control Grid to Cathode Resistance	$R_{g1-k(max)}$	500‡	kΩ

* Maximum pulse duration 22% of one cycle with a maximum of 22μs.

† Measured with respect to the high potential heater pin.

‡ In line timebase applications $R_{g1-k(max)}$ may be 2·2 MΩ.

INTER-ELECTRODE CAPACITANCES §

Input	C_{in}	22	pF
Output	C_{out}	9·0	pF
Anode to Grid 1	C_{a-g1}	<1·75	pF
Grid 1 to Heater	C_{g1-h}	<0·2	pF

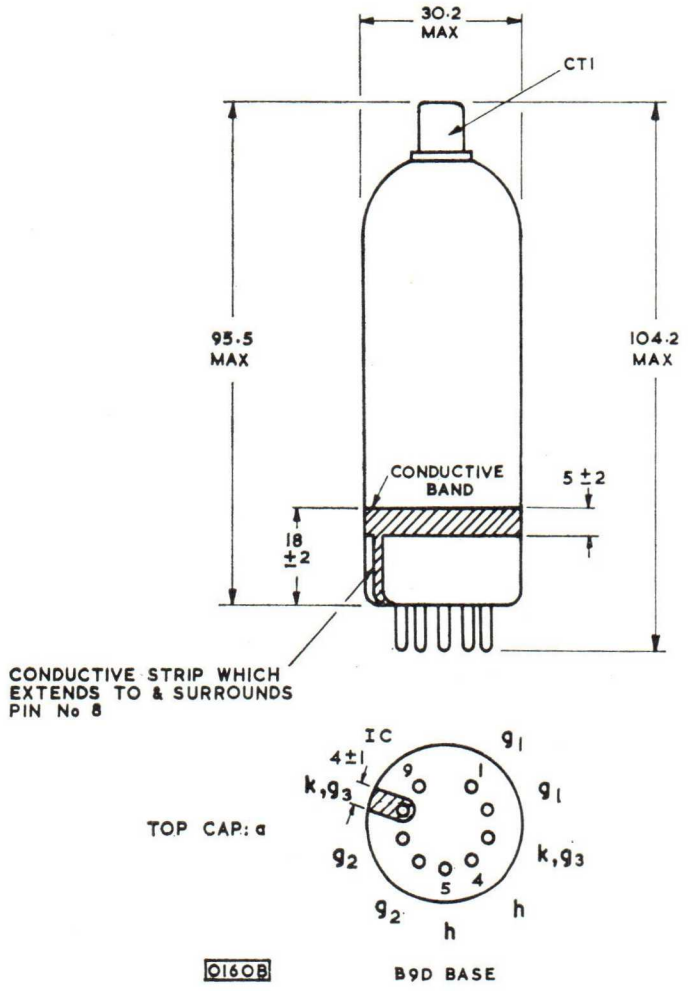
§ Measured without external shield.

CHARACTERISTICS

Anode Voltage	V_a	75	V
Screen Grid Voltage	V_{g2}	200	V
Control Grid Voltage	V_{g1}	–10	V
Anode Current	I_a	440	mA
Screen Grid Current	I_{g2}	30	mA

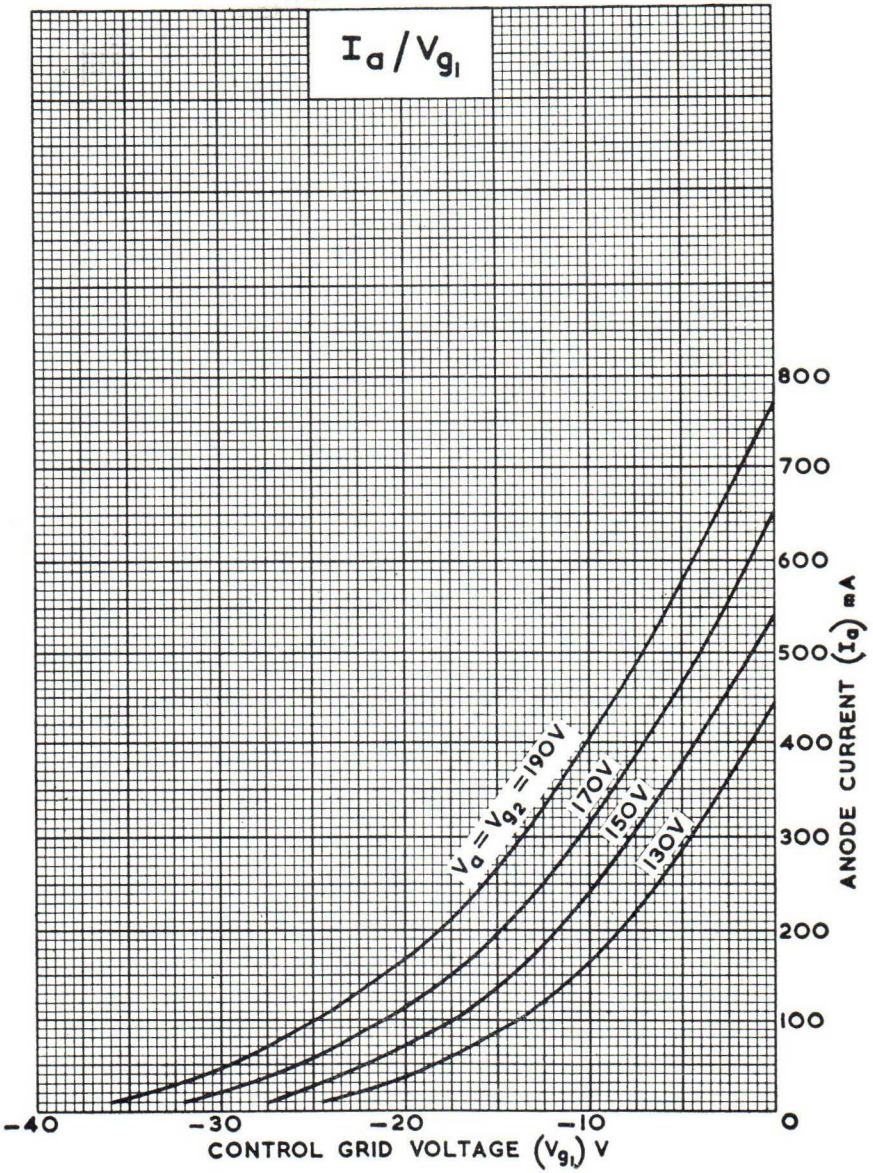
LINE OUTPUT VALVE CIRCUIT DESIGN

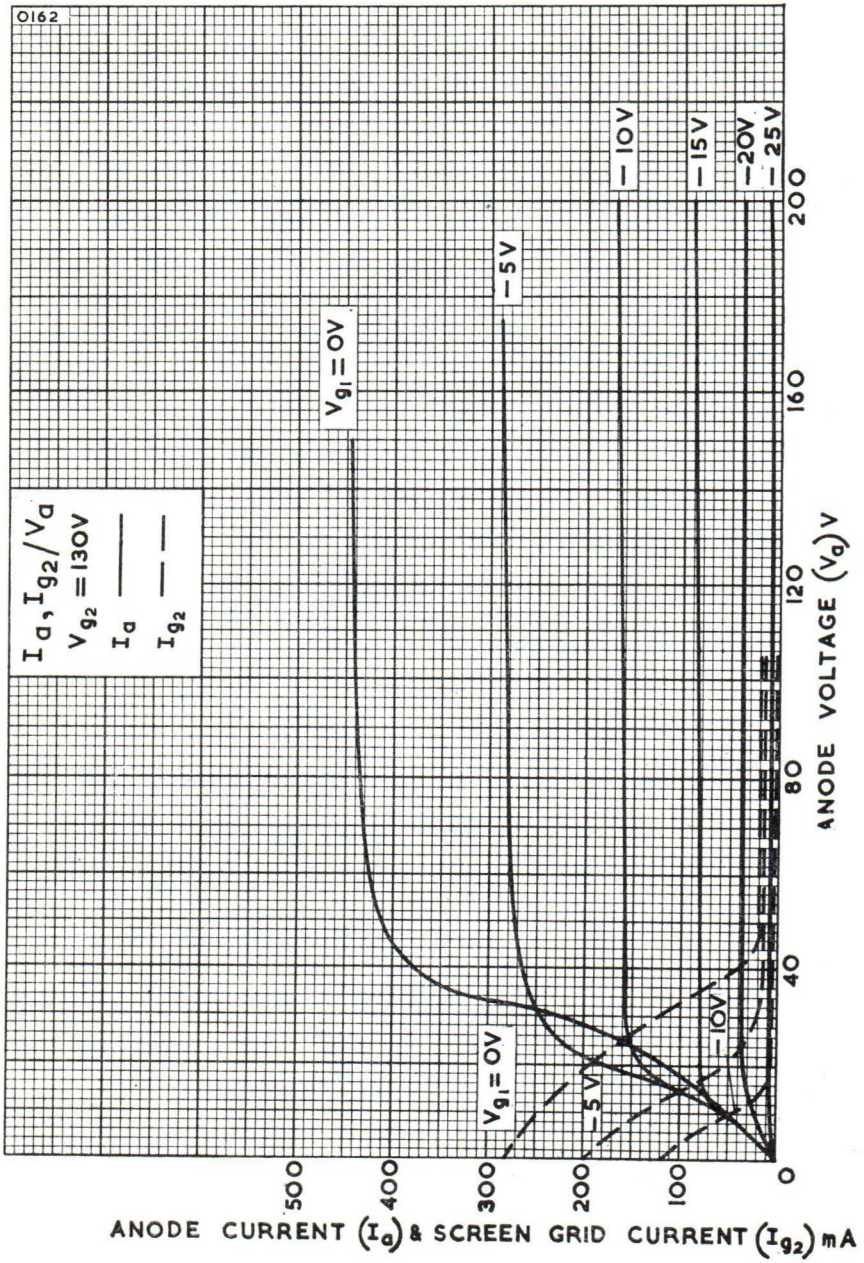
When calculating the peak anode current for circuit design purposes the knee should be taken as the reference point. Operation so that the anode potential of the output valve at the end of scan is above the knee of the anode characteristic is only recommended when an effective feedback stabilising circuit is employed.

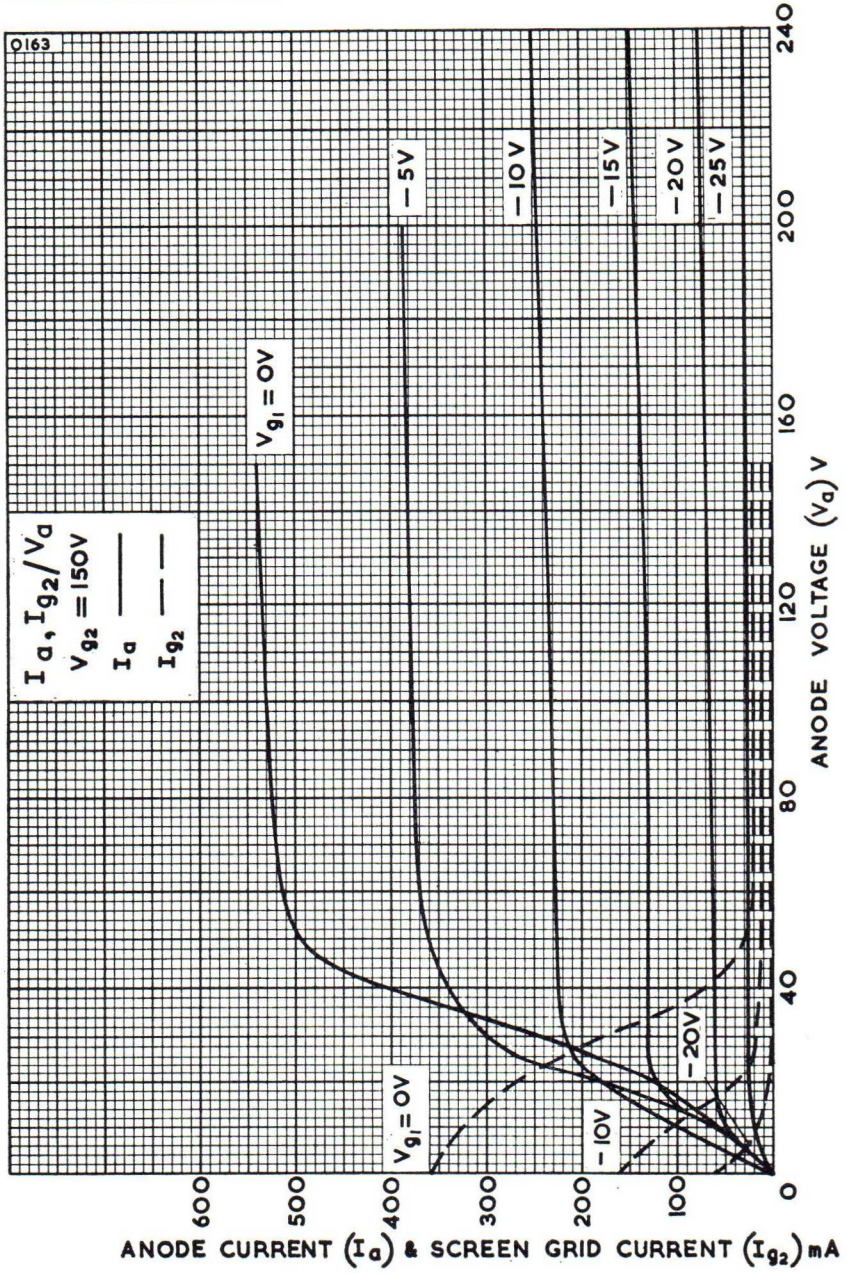


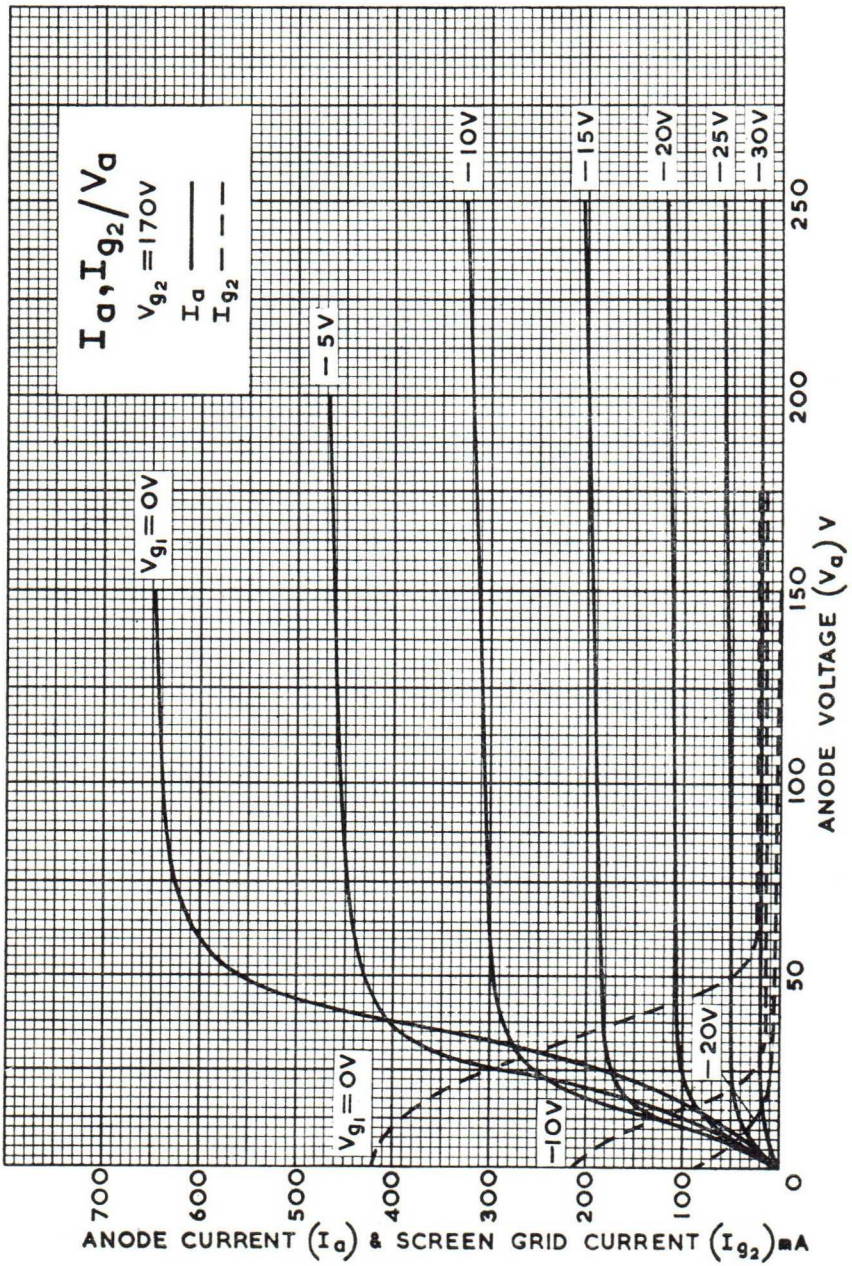
All dimensions in mm.

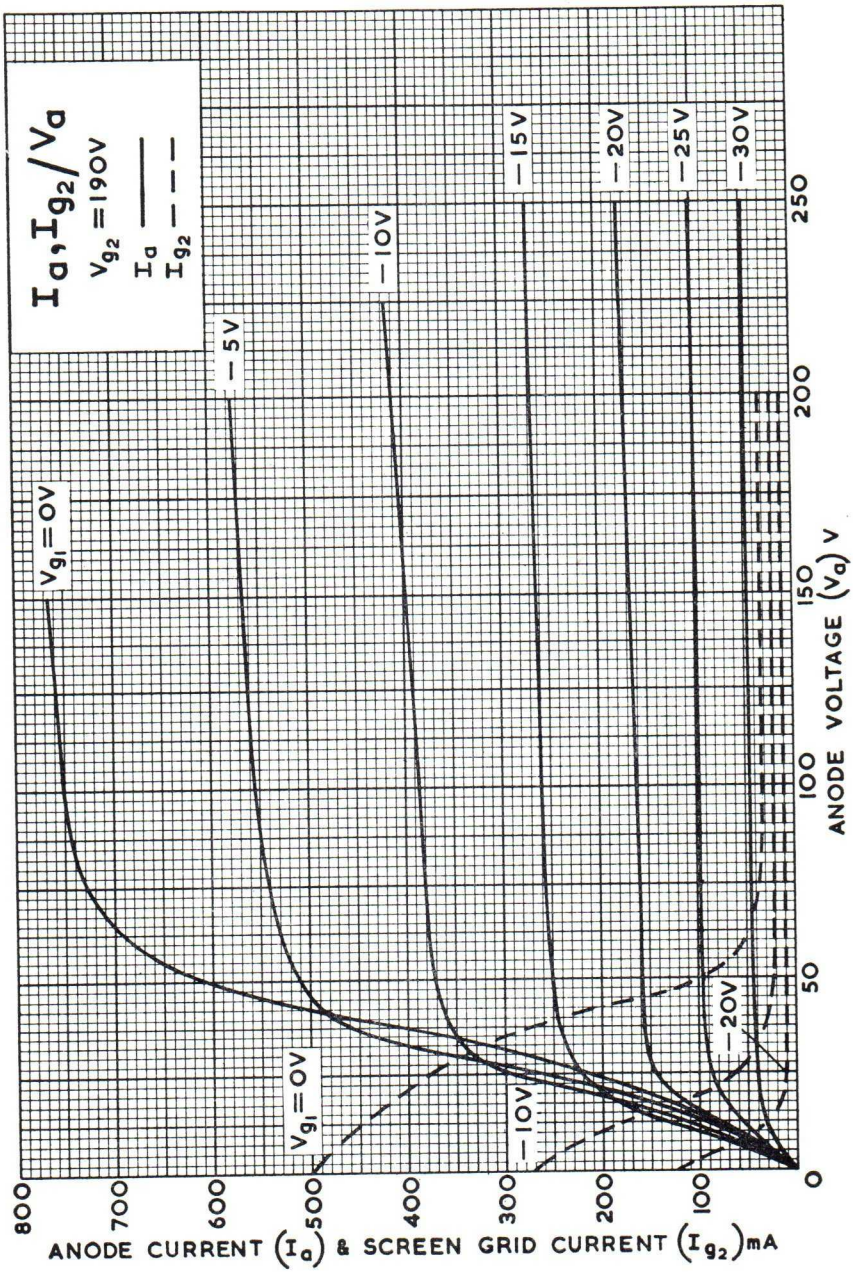
MOUNTING POSITION—Unrestricted

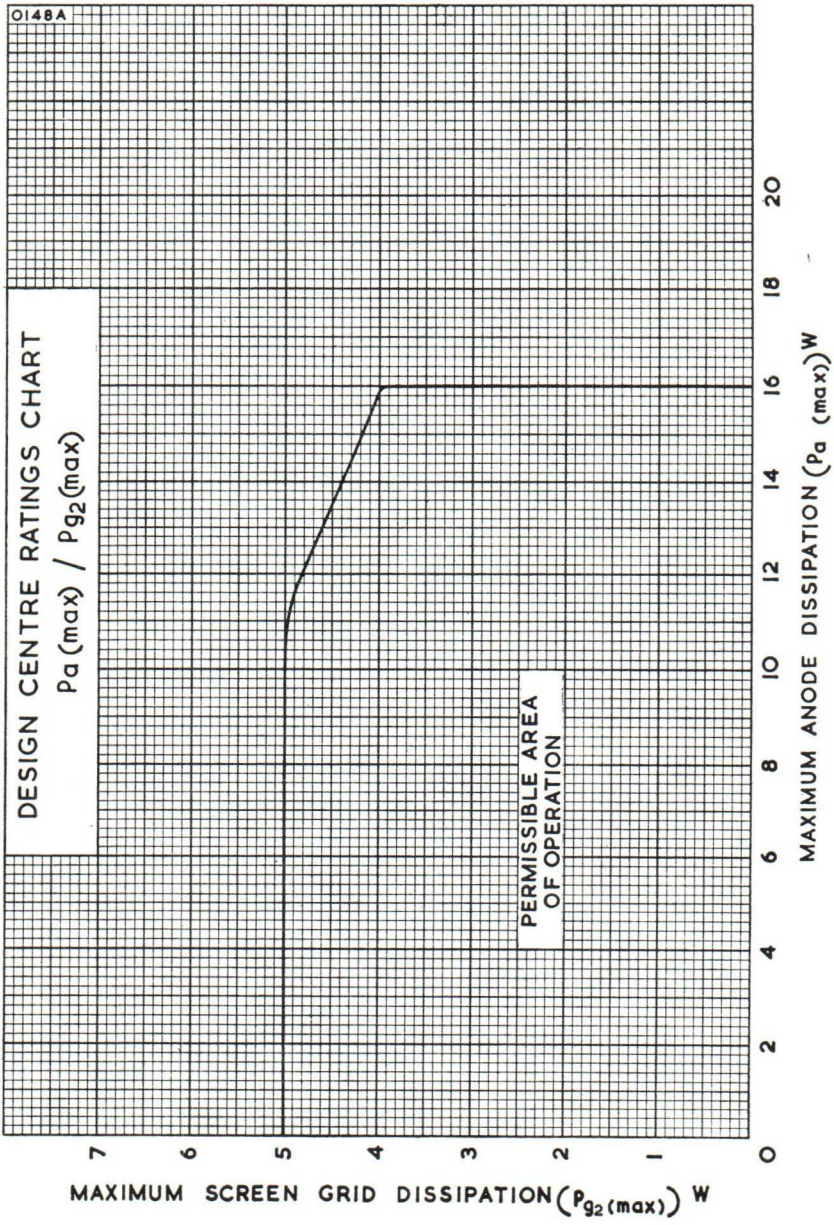

I_a / V_{g_1}
800
700
600
500
400
300
200
100
0
ANODE CURRENT (I_a) mA
$V_a = V_{g2}$ = 190V
170V
150V
130V
-40
-30
-20
-10
CONTROL GRID VOLTAGE (V_{g_1}) V


0162
$I_a, I_{g_2}/V_a$
V_{g_2} = 130V
I_a
I_{g_2}
V_{g_1} = 0V
-5V
-10V
-15V
-20V
-25V
V_{g_1} = 0V
-5V
-10V
0
40
80
120
160
200
ANODE VOLTAGE (V_a) V
0
100
200
300
400
500
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA


0163
$I_a, I_{g2}/V_a$
$V_{g2} = 150V$
I_a
I_{g2}
$V_{g1} = 0V$
$V_{g1} = 0V$
-5V
-10V
-15V
-20V
-25V
-10V
-20V
ANODE VOLTAGE (V_a) V
0
40
80
120
160
200
240
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g2}) mA
0
100
200
300
400
500
600

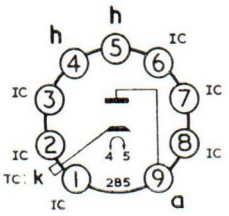

$I_a, I_{g_2}/V_a$
V_{g_2} = 170V
I_a ——
I_{g_2} – – –
−5V
−10V
−15V
−20V
−25V
−30V
V_{g_1} = 0V
V_{g_1} = 0V
−10V
−20V
0
50
100
150
200
250
ANODE VOLTAGE (V_a) V
0
100
200
300
400
500
600
700
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA


$I_a, I_{g_2}/V_a$
V_{g_2} = 190V
I_a ——
I_{g_2} – – –
V_{g_1} = 0V
– 5V
– 10V
– 15V
– 20V
– 25V
– 30V
V_{g_1} = 0V
– 10V
– 20V
800
700
600
500
400
300
200
100
0
250
200
150
100
50
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
ANODE VOLTAGE (V_a) V


0148A
DESIGN CENTRE RATINGS CHART
Pa (max) / Pg2(max)
PERMISSIBLE AREA OF OPERATION
MAXIMUM ANODE DISSIPATION (Pa (max)) W
0
2
4
6
8
10
12
14
16
18
20
MAXIMUM SCREEN GRID DISSIPATION (Pg2 (max)) W
7
6
5
4
3
2
1



EFFICIENCY DIODE



B9A Base

Heater Current	I_h	0·3	A
Heater Voltage	V_h	17	V

RATINGS

Maximum Peak Inverse Voltage	$P.I.V_{max}$	4·5*	kV
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$		
Heater Negative during Forward Stroke		800†	V
Heater Negative during Flyback		4·5*	kV
Maximum Heater to Anode Voltage during Flyback	$V_{h-a(max)}$		
Heater Positive		3·0*	kV
Maximum Peak Anode Current	$i_{a(pk)max}$	450*	mA
Maximum Mean Anode Current	$I_{a(av)max}$	150	mA

* Maximum pulse duration 22 per cent of one cycle with a maximum of 18 μs.

† This voltage may be made up of a maximum voltage of 220 V R.M.S. at the mains supply frequency and a D.C. component of not more than 600 V.

INTER-ELECTRODE CAPACITANCES‡

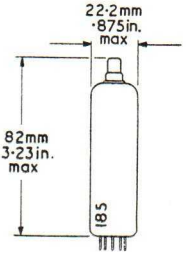
Anode to Cathode	C_{a-k}	6·4	pF
Heater to Cathode	C_{h-k}	3·6	pF

‡ Measured with no external shield.

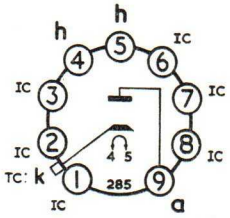
Note

The heating time of this valve is approximately twice that of other valves normally used in the series heater chain of television receivers and precautions may be necessary to ensure that the screen dissipation of the line output valve is not exceeded during the warm-up period.

THORN — A E I RADIO VALVES & TUBES LTD.



EFFICIENCY DIODE



B9A Base

GENERAL

This efficiency diode is intended for use in line timebase circuits of television receivers using 110° cathode ray tubes.

Heater Current	I_h	0·3 A
Heater Voltage	V_h	30 V

RATINGS

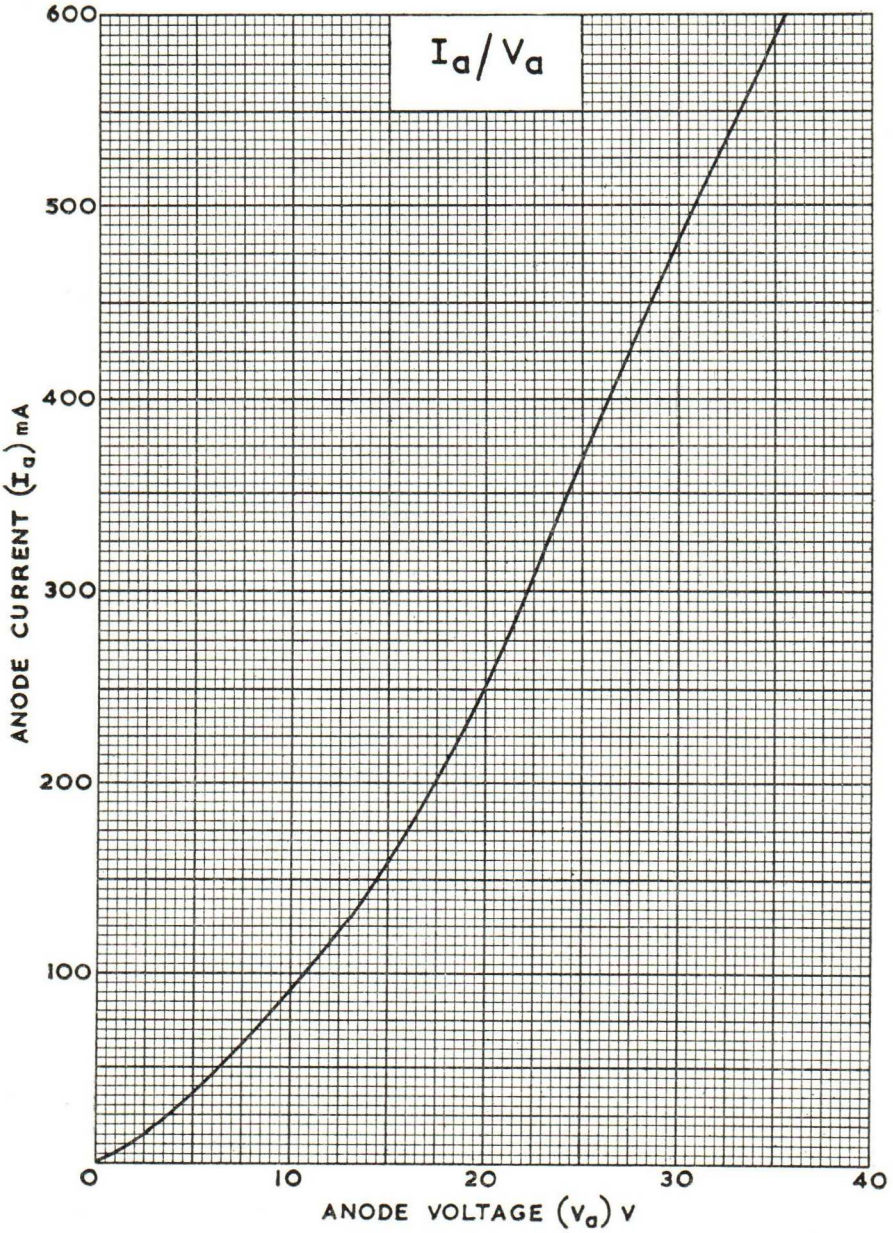
Maximum Peak Inverse Voltage	$P.I.V._{max}$	6·6*	kV
Maximum Peak Heater to Cathode Voltage Heater Negative	$V_{h-k(pk)max}$	6·6*	kV
Maximum Heater to Earth Voltage (r.m.s.)	$V_{h-e(r.m.s.)max}$	220	V
Maximum Mean Anode Current	$I_{a(av)max}$	220	mA
Maximum Peak Anode Current	$i_{a(pk)max}$	550	mA

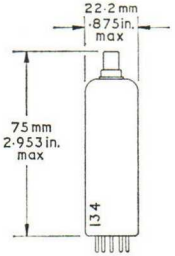
* Maximum pulse duration 22% of one cycle with a maximum of 18 μs.

INTER-ELECTRODE CAPACITANCES

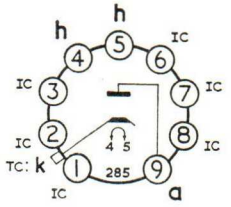
Anode to Cathode	C_{a-k}	8·6	pF
Heater to Cathode	C_{h-k}	2·0	pF

THORN—AEI RADIO VALVES & TUBES LTD.


I_a/V_a
600
500
400
300
200
100
0
10
20
30
40
ANODE CURRENT (I_a) mA
ANODE VOLTAGE (V_a) V



EFFICIENCY DIODE



B9A Base, CT1 Cap

GENERAL

This efficiency diode is designed for use in television receivers employing 110° cathode ray tubes.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	19	V

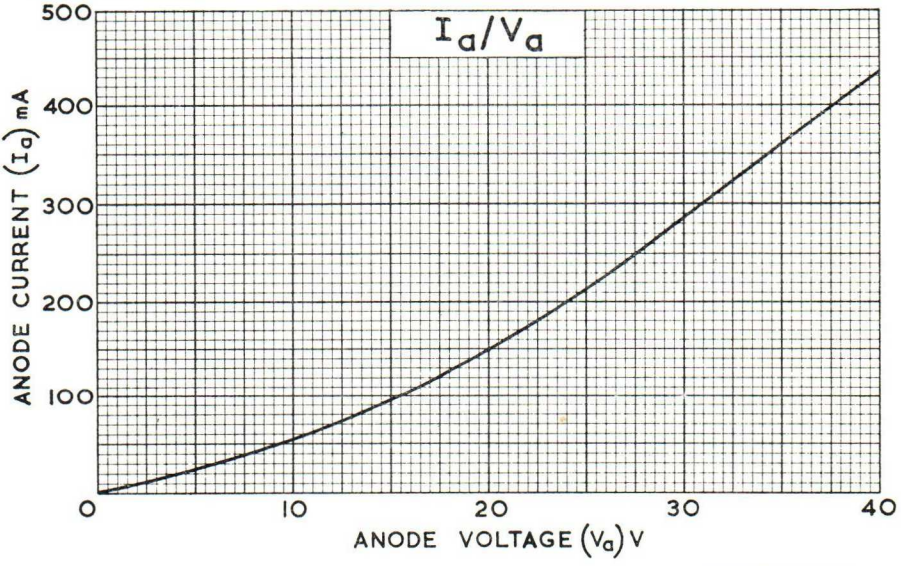
RATINGS

Maximum Peak Inverse Voltage	$P.I.V_{max}$	5·25*	kV
Maximum Peak Heater to Cathode Voltage Heater Negative	$v_{h-k(pk)max}$	5·75*	kV
Maximum Peak Anode Current	$i_{a(pk)max}$	350	mA
Maximum Mean Anode Current	$I_{a(av)max}$	150	mA

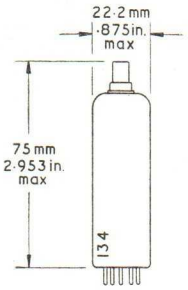
* Maximum pulse duration 22 per cent of one cycle with a maximum of 22 μs.

INTER-ELECTRODE CAPACITANCES

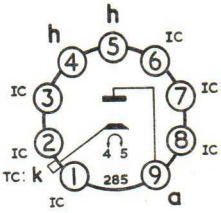
Anode to Cathode	c_{a-k}	4·7	pF
Heater to Cathode	c_{h-k}	1·9	pF



THORN—AEI RADIO VALVES & TUBES LTD.



EFFICIENCY DIODE



B9A Base
CT1 Top Cap

GENERAL

This valve is an Efficiency Diode designed for use in the line output stages of television receivers using 110° cathode ray tubes.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	19	V

RATINGS

Maximum Peak Inverse Voltage	$PIV_{(max)}$	5·5*	kV
Maximum Peak Heater to Cathode Voltage, Heater negative	$v_{h\text{-}k(pk)max}$	5·5*	kV
Maximum Mean Anode Current	$I_{a(av)max}$	175	mA ←
Maximum Peak Anode Current	$i_{a(pk)max}$	450	mA

* Rated for T.V. line scan where the duty cycle does not exceed 22% and the pulse duration does not exceed 18μs. ← ←

5·5 kV is a design centre rating, the absolute rating of 6·6 kV must not be exceeded.

INTER-ELECTRODE CAPACITANCES

		†	‡	§	
Anode to Heater and Cathode	$c_{a\text{-}k,h}$	6·5	7·8	10	pF
Cathode to Heater and Anode	$c_{k\text{-}a,h}$	7·7	8·0	8·0	pF

† In fully shielded socket, without can.

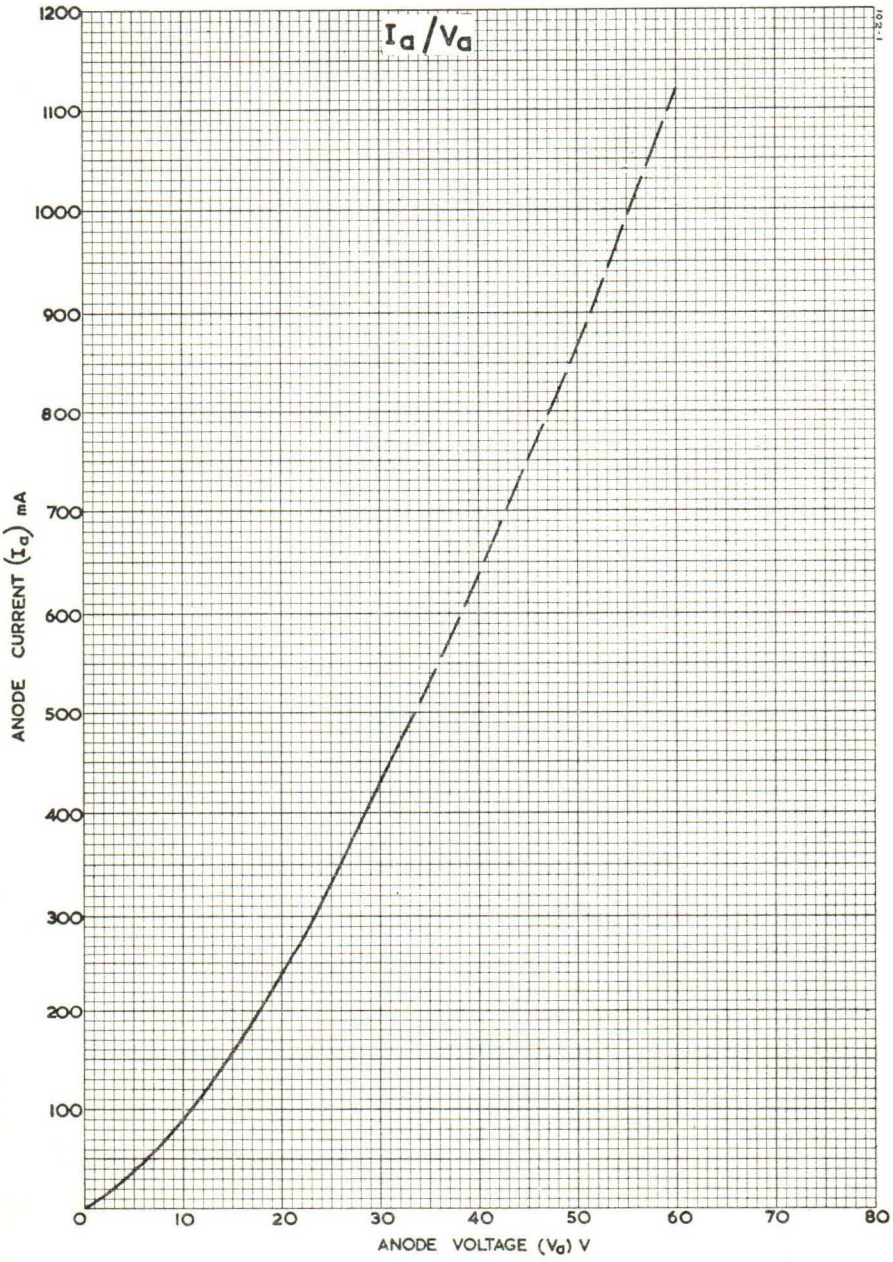
‡ With holder capacity balanced out.

§ Total capacity including B9A nylon phenolic holder without skirt or radial shield (AEI holder type VH19/902)

MOUNTING POSITION—Unrestricted.

Indicates a change ←

THORN — A E I RADIO VALVES & TUBES LTD.


I_a / V_a
102-1
ANODE CURRENT (I_a) mA
1200
1100
1000
900
800
700
600
500
400
300
200
100
0
10
20
30
40
50
60
70
80
ANODE VOLTAGE (V_a) V

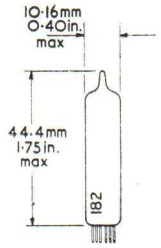
VALVES
FOR MAINTENANCE

Superseded types still available for maintenance purposes

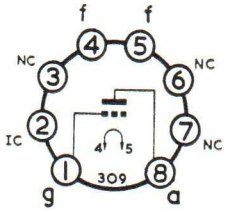
MAINTENANCE VALVES

H 8.72 Printed in Great Britain

Guide Card



TUNING INDICATOR



B8D Base

GENERAL

This directly heated subminiature tuning indicator is intended for use in mains or battery-operated receivers.

Filament Voltage	V_f	1·4	V
Filament Current	I_f	25	mA

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$		
$V_a \leqslant$ 90 V		25	mW
$V_a =$ 200 V		10	mW
Maximum Anode Voltage	$V_{a(max)}$	90*	V
Minimum Anode Voltage	$V_{a(min)}$	45	V
Maximum Cathode Current	$I_{k(max)}$	0·3	mA
Maximum Grid to Cathode Resistance	$R_{g-k(max)}$	10	MΩ

* For circuits without an anode series resistor.

TYPICAL OPERATION

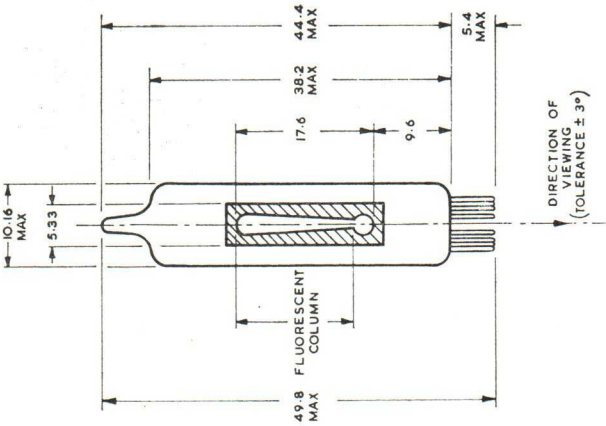
Battery Operation		Pin 5(f–) Earthed	Pin 4(f–) Earthed	
Anode Voltage	V_a	60	90	V
Anode Current at zero bias	$I_{a(V_g = 0)}$	120	250	μA
Grid Voltage for cut-off	$V_{g(cut\text{-}off)}$	−8·0	−13·5	V

Mains Operation

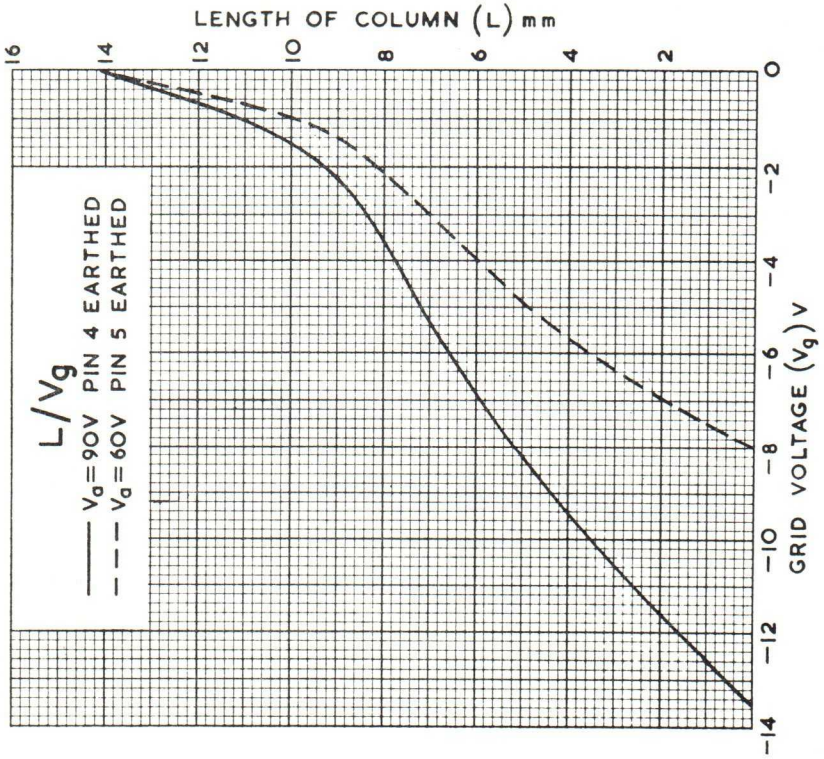
The filament, shunted by a suitable resistor, can be included in a series heater chain providing a current limiting device is used. Pin 5 should be earthed.

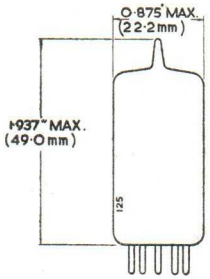
Supply Voltage	V_b	110	170	250	V
Anode Resistor	R_a	0·56	1·2	2·2	MΩ
Anode Current	I_a	90	90	90	μA
Grid Voltage for cut-off	$V_{g(cut\text{-}off)}$	−15	−23	−34	V

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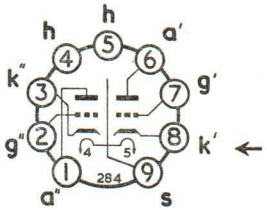


All dimensions in mm.





GENERAL PURPOSE TWIN TRIODE



B9A Base

GENERAL

This general purpose twin triode is intended for use in AC or AC/DC television receivers. The two triodes have identical characteristics.

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·3	A

RATINGS

Maximum Anode Dissipation (either section)	$P_{a(max)}$	2·0*	W
Maximum Total Anode Dissipation	$P_{a(tot)max}$	2·5*	W
Maximum Anode Voltage	$V_{a(max)}$	250	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h\text{-}k(r.m.s.)max}$	150†	V

* The permissible anode dissipation rating is a function of the grid to cathode resistance and circuit employed. For the values quoted, the grid to cathode resistance should not exceed 0·25MΩ with cathode self bias.

† Measured with respect to the higher potential heater pin.

INTER-ELECTRODE CAPACITANCES

		‡	§	
Grid′ to Earth	$c_{g'\text{-}E}$	2·5	3·5	pF
Grid″ to Earth	$c_{g''\text{-}E}$	2·4	3·5	pF
Anode′ to Earth	$c_{a'\text{-}E}$	2·1	3·2	pF
Anode″ to Earth	$c_{a''\text{-}E}$	2·0	2·9	pF
Anode′ to Grid′	$c_{a'\text{-}g'}$	2·5	2·8	pF
Anode″ to Grid″	$c_{a''\text{-}g''}$	2·5	2·8	pF
Anode′ to Anode″	$c_{a'\text{-}a''}$	0·038	0·038	pF
Grid′ to Grid″	$c_{g'\text{-}g''}$	0·006	0·0064	pF
Grid′ to Anode″	$c_{g'\text{-}a''}$	0·014	0·015	pF
Grid″ to Anode′	$c_{g''\text{-}a'}$	0·012	0·012	pF

‡ With holder capacity balanced out.

§ Total capacity including B9A ceramic holder (Carr Fastener holder type 77/076)

" Earth " denotes the electrodes of any second valve section and the remaining earthy potential electrodes of the section under measurement, heater and shields joined to cathode.

CHARACTERISTICS (Each section)

Anode Voltage	V_a	200	V
Anode Current	I_a	10	mA
Grid Voltage	V_g	–7·7	V
Mutual Conductance	gm	3·4	mA/V
Amplification Factor	μ	18	

MOUNTING POSITION—Unrestricted

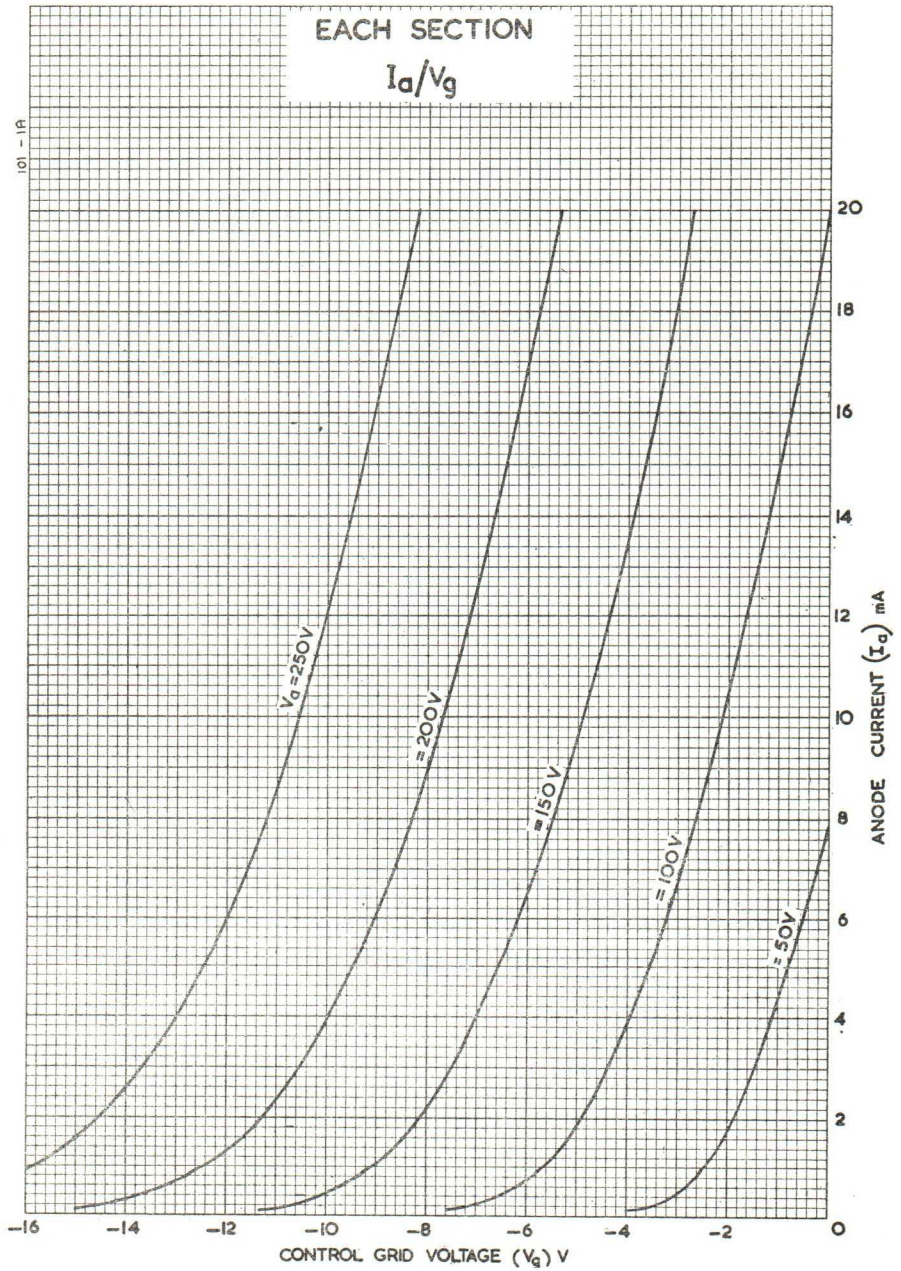
APPROXIMATE WEIGHT

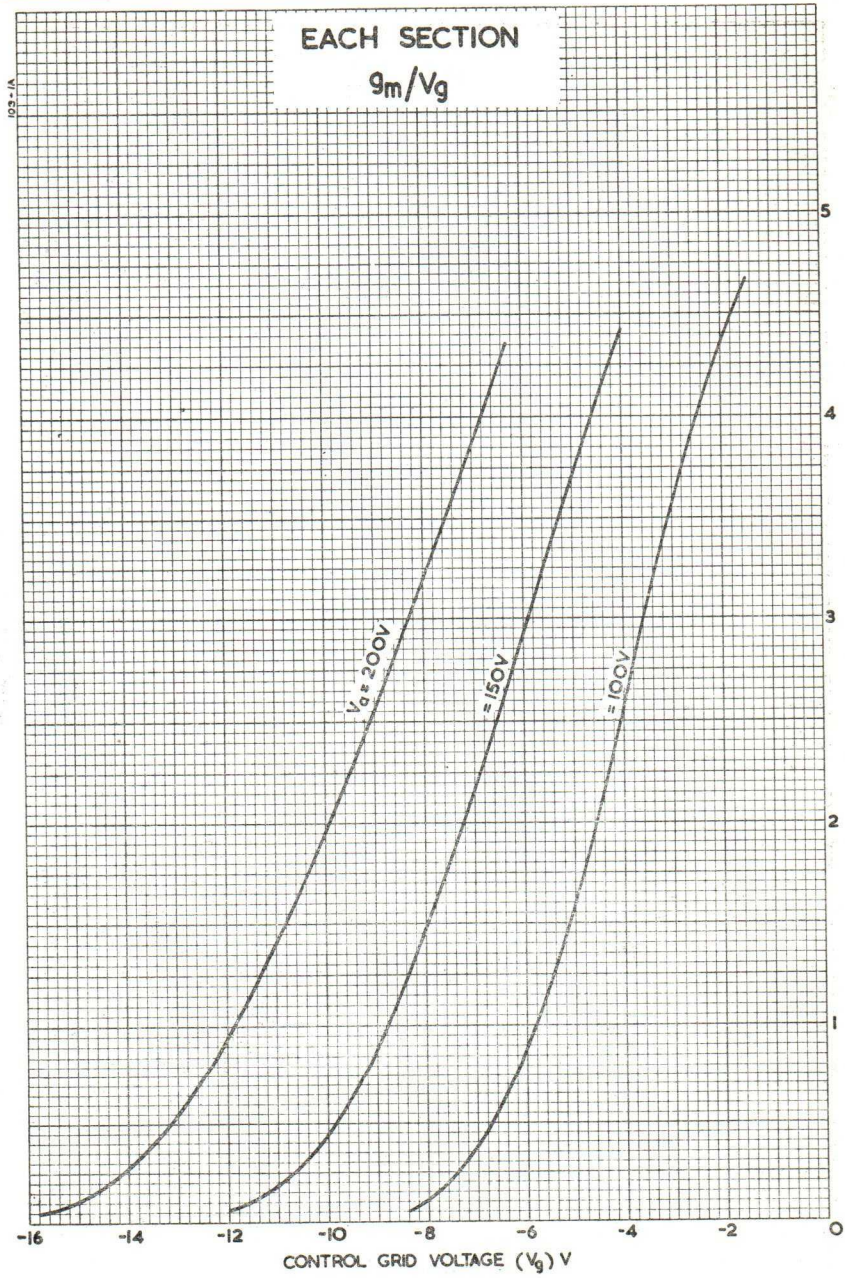
Net	0·5 oz
Packed	0·75 oz

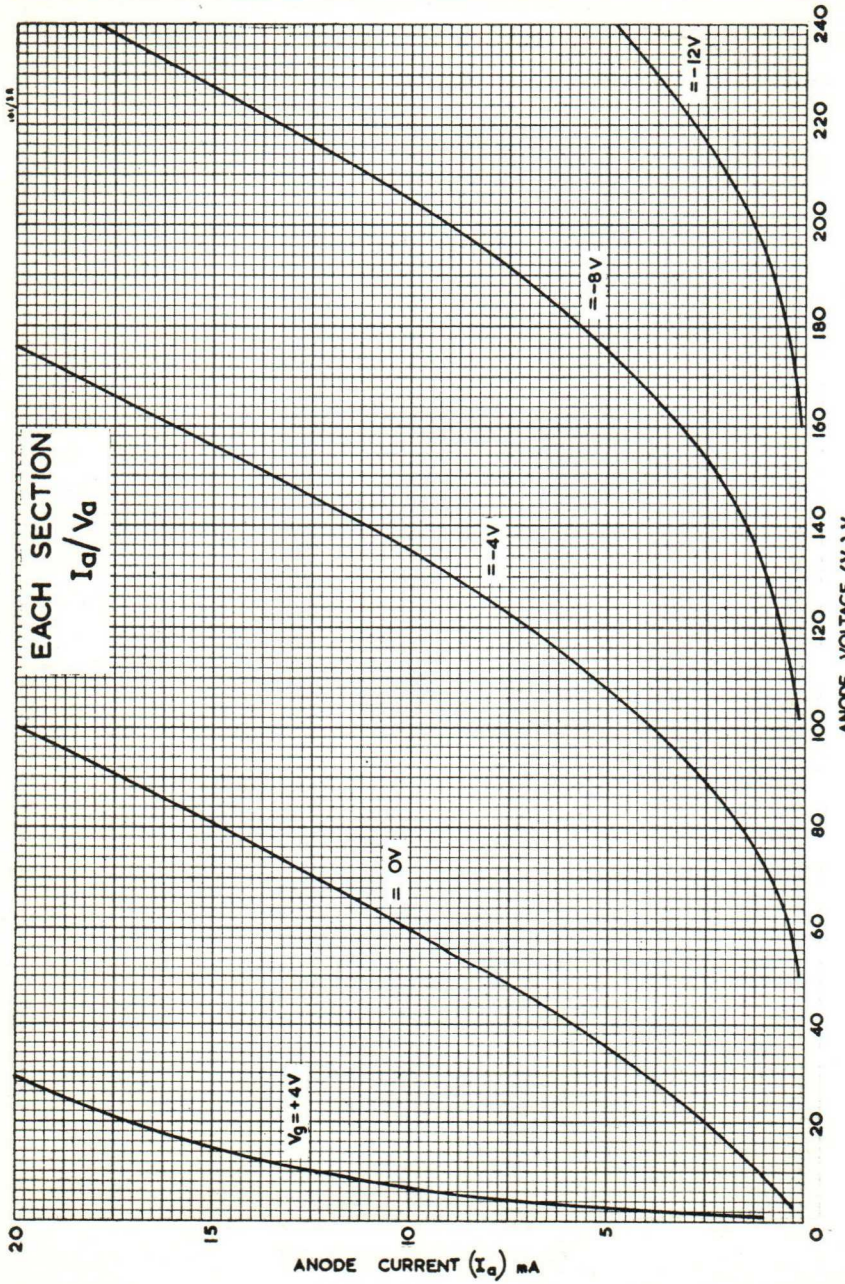
NOTE. The potential of the internal shield must not be positive to that of either cathode.

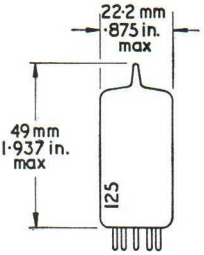
Indicates a change ←

THORN — A E I RADIO VALVES & TUBES LTD.

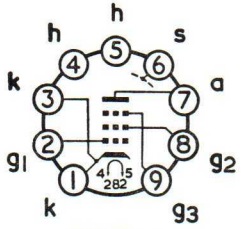

EACH SECTION
Ia/Vg
101 - 1A
Va = 250V
= 200V
= 150V
= 100V
= 50V
20
18
16
14
12
10
8
6
4
2
0
ANODE CURRENT (Ia) mA
-16
-14
-12
-10
-8
-6
-4
-2
0
CONTROL GRID VOLTAGE (Vg) V


EACH SECTION
g_m/V_g
103-1A
V_a = 200V
= 150V
= 100V
5
4
3
2
1
0
MUTUAL CONDUCTANCE (g_m) mA/V
-16
-14
-12
-10
-8
-6
-4
-2
CONTROL GRID VOLTAGE (V_g) V


EACH SECTION
Ia/Va
Vg=+4V
= 0V
= -4V
= -8V
= -12V
ANODE CURRENT (Ia) mA
ANODE VOLTAGE (Va) V
20
15
10
5
0
20
40
60
80
100
120
140
160
180
200
220
240



V.H.F. PENTODE



B9A Base

GENERAL

This pentode is suitable for use in the I.F. and video stages of television receivers.

Heater Voltage	V_h 6·3	V
Heater Current	I_h 0·3	A

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	2·75	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	1·2	W
Maximum Anode Voltage	$V_{a(max)}$	275	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	275	V
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$		
D.C. or Peak A.C.		150	V

INTER-ELECTRODE CAPACITANCES*

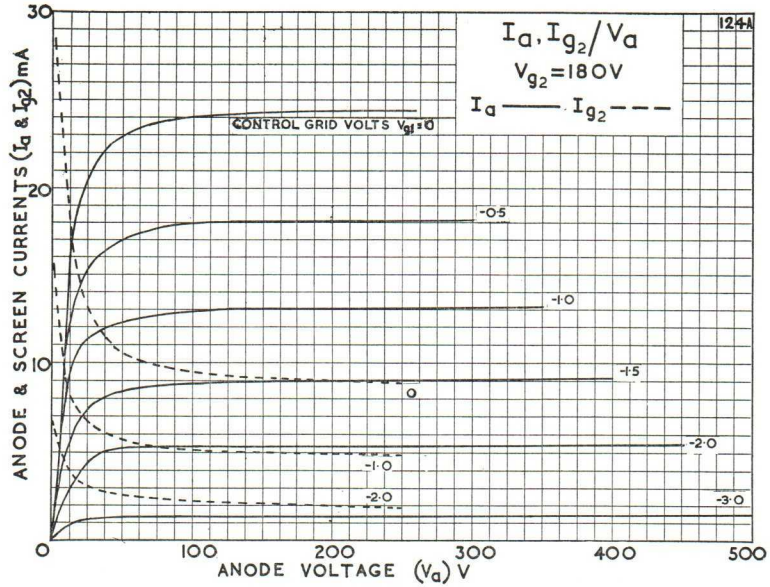
Input	c_{in}	9·5	pF
Output	c_{out}	3·5	pF
Control Grid to Anode	c_{g1-a}	<0·01	pF

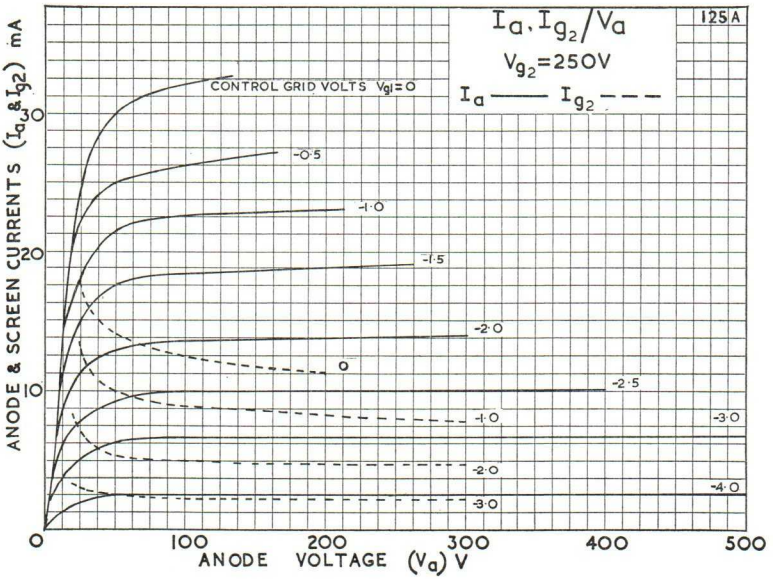
* Measured without an external shield.

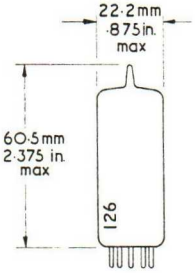
TYPICAL OPERATION (g_3 connected to Cathode)

Anode Voltage	V_a	180	250	V
Screen Grid Voltage	V_{g2}	180	250	V
Anode Current	I_a	9·5	9·5	mA
Screen Grid Current	I_{g2}	3·5	3·5	mA
Cathode Bias Resistance	R_k	100	180	Ω
Mutual Conductance	g_m	9·3	8·5	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	600	750	kΩ
Inner Amplification Factor	μ_{g1-g2}	70	70	
Input Impedance at 50 MHz		14	16	kΩ
Control Grid Voltage for $I_a = 0$	$V_{g1}(I_a = 0)$	−7·0	−8·0	V

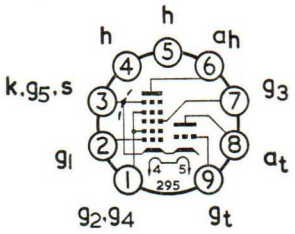
THORN—AEI RADIO VALVES & TUBES LTD.


$I_a, I_{g_2}/V_a$
V_{g_2}=180V
I_a —— I_{g_2} - - -
1244
CONTROL GRID VOLTS V_{g1}=0
-0·5
-1·0
-1·5
-2·0
-3·0
-1·0
-2·0
0
ANODE & SCREEN CURRENTS (I_a & I_{g2}) mA
ANODE VOLTAGE (V_a) V
0
100
200
300
400
500
10
20
30


$I_a, I_{g_2}/V_a$
V_{g_2}=250V
I_a —— I_{g_2} - - -
125A
CONTROL GRID VOLTS V_{g1}=0
-0·5
-1·0
-1·5
-2·0
-2·5
-3·0
-4·0
-1·0
-2·0
-3·0
0
ANODE & SCREEN CURRENTS (I_a & I_{g2}) mA
ANODE VOLTAGE (V_a) V
0
100
200
300
400
500
10
20
30



TRIODE HEPTODE FREQUENCY CHANGER



B9A Base

GENERAL

This triode heptode valve combination, with separate electrode structures, is for use in AM/FM broadcast radio AC mains receivers. The valve is intended to be used as a frequency changer for AM signals with the triode as local oscillator and the heptode switched to operate as an I.F. amplifier for FM signals.

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·3	A

RATINGS

		Triode	Heptode	
Maximum Anode Dissipation	$P_{a(max)}$	0·8	1·7	W
Maximum Screen Grids Dissipation	$P_{g2+g4(max)}$	—	1	W
Maximum Anode Voltage	$V_{a(max)}$	250	300	V
Maximum Screen Grids Voltage	$V_{g2+g4(max)}$	—	125	V
Maximum Screen Grids Voltage (I_a <1mA)		—	300	V
Maximum Heater to Cathode Voltage (D.C.)	$V_{h-k(max)}$	100*		V
Maximum Mean Cathode Current	$I_{k(av)max}$	6·5	12·5	mA

* Measured with respect to the higher potential heater pin.

INTER-ELECTRODE CAPACITANCES

		Triode	Heptode	
Output	C_{out}	2·1	7·9	pF
Input (g_1)	$C_{in(g1)}$	2·6	4·8	pF
Input (g_3)	$C_{in(g3)}$	—	6	pF
Grid 1 to Anode	C_{g1-a}	1	<0·006	pF
Grid 1 to Grid 3	C_{g1-g3}	—	<0·3	pF
Grid 1 to Grid 3, Grid Triode	$C_{g1-g3gt}$	<0·45		pF
Grid 1 to Grid Triode	C_{g1-gt}	<0·17		pF
Anode Heptode to Anode Triode	C_{ah-at}	0·2		pF

Inter-electrode capacitances measured with holder capacitances balanced out.

THORN—A E I RADIO VALVES & TUBES LTD.

CHARACTERISTICS

		Triode	Heptode	
Anode Voltage	V_a	100	250	V
Screen Grids Voltage	V_{g2+g4}	—	100	V
Grid 3 Voltage	V_{g3}	—	0	V
Control Grid Voltage	V_{g1}	−1	−2	V
Anode Current	I_a	10	6·5	mA
Mutual Conductance	g_m	3·2	2·4	mA/V
Amplification Factor	μ	19	—	
Inner Amplification Factor	$\mu_{g1-(g2+g4)}$	—	20	

TYPICAL OPERATION AS R.F. or I.F. AMPLIFIER

Heptode Section			
Supply Voltage	V_b	250	V
Anode Voltage	V_a	250	V
Screen Grids Resistance	R_{g2+g4}	39	kΩ
Screen Grids Voltage (Initial)	V_{g2+g4}	100	V
Grid 3 Voltage	V_{g3}	0	V
Control Grid Voltage	V_{g1}	−2	V
Anode Current (approximately)	I_a	6·5	mA
Screen Grids Current (approximately)	I_{g2+g4}	3·8	mA
Mutual Conductance	g_m	2·4	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	0·7	MΩ
Equivalent Grid Noise Resistance	R_{eq}	8·5	kΩ
Input Resistance at 100 Mc/s		2	kΩ
Grid 1 Voltage for 100 : 1 reduction of Mutual Conductance		−42	V

TYPICAL OPERATION AS A.M. FREQUENCY CHANGER

Heptode Section			
Supply Voltage	V_b	250	V
Anode Voltage	V_a	250	V
Screen Grids Resistance	R_{g2+g4}	22	kΩ
Screen Grids Voltage (Initial)	V_{g2+g4}	103	V
Control Grid Voltage	V_{g1}	−2	V
Anode Current (approximately)	I_a	3·25	mA
Screen Grids Current (approximately)	I_{g2+g4}	6·7	mA
Heptode Grid 3 and Triode Grid Current	I_{g3+gt}	200	μA
Heptode Grid 3 and Triode Grid Resistance	R_{g3+gt}	47	kΩ
Peak Heterodyne Voltage	$v_{(pk)het}$	12	V
Conversion Conductance	g_c	775	μA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	1	MΩ
Equivalent Grid Noise Resistance	R_{eq}	70	kΩ
Grid Voltage for 100 : 1 reduction of Conversion Conductance		−28·5	V
Triode			
Anode Voltage	V_a	100	V
Anode Current (Average)	$I_{a(av)}$	4·5	mA

MOUNTING POSITION—Unrestricted

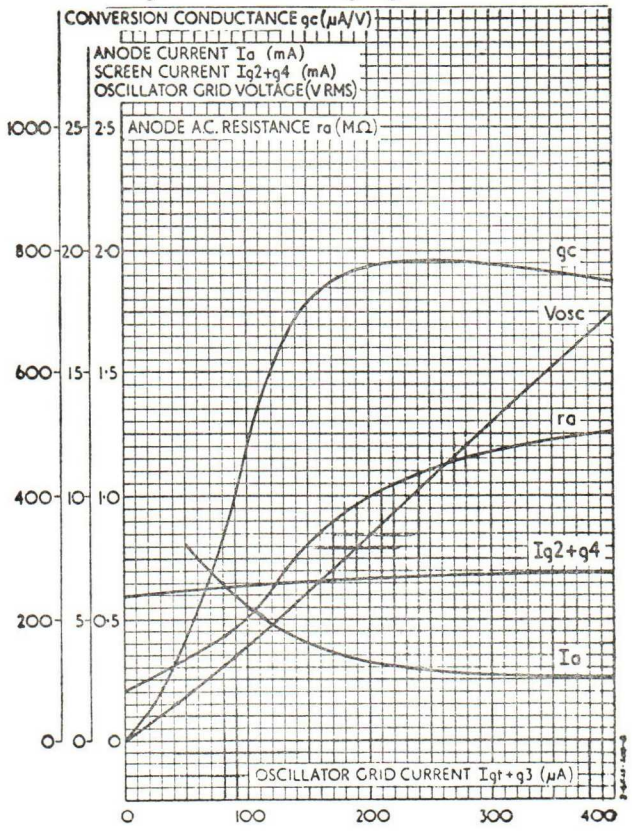
APPROXIMATE WEIGHT

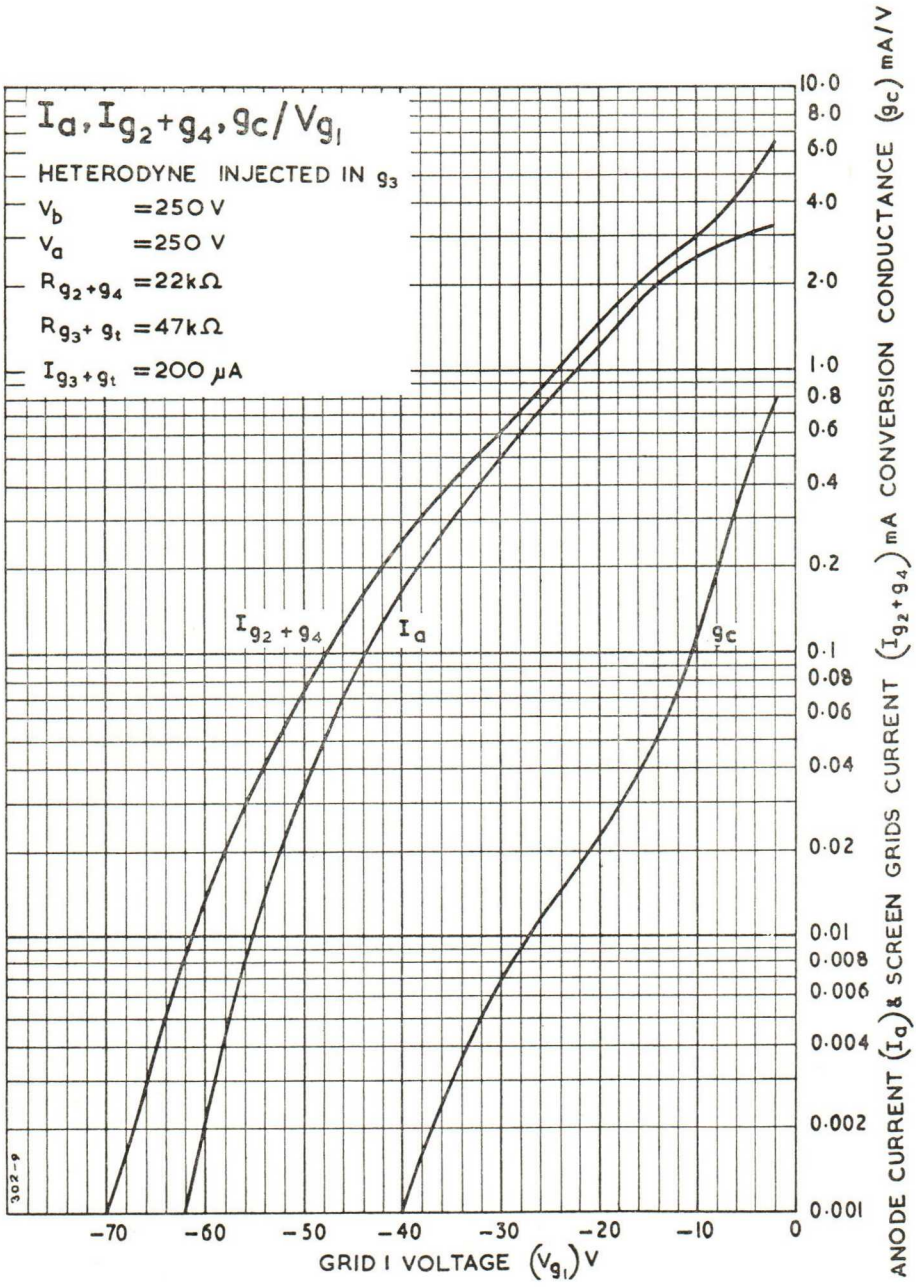
Net	0·5	oz
Packed	0·75	oz

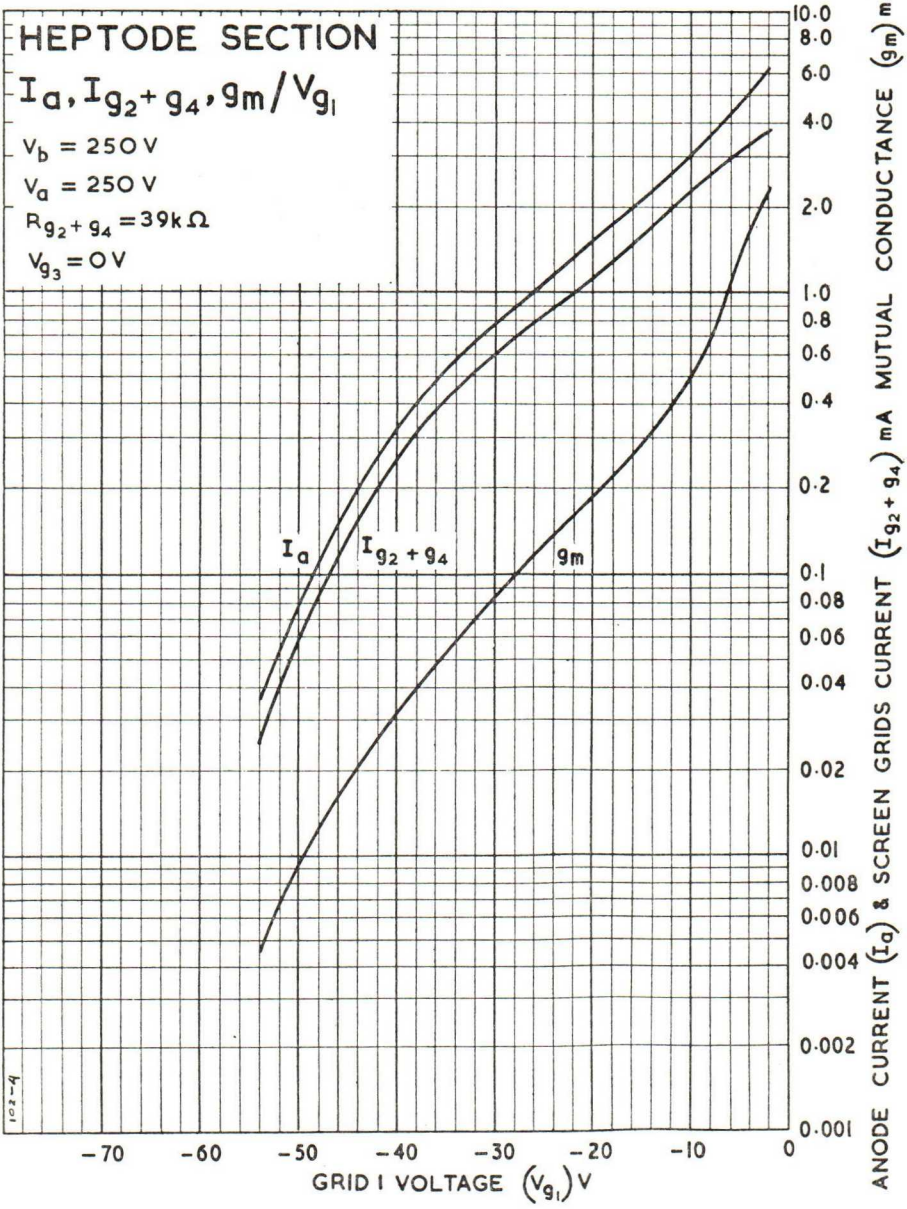
AVERAGE CHARACTERISTIC CURVES :
$I_a, I_{g2}, g_c, r_a, V_{osc}/I_{gt+g3}$

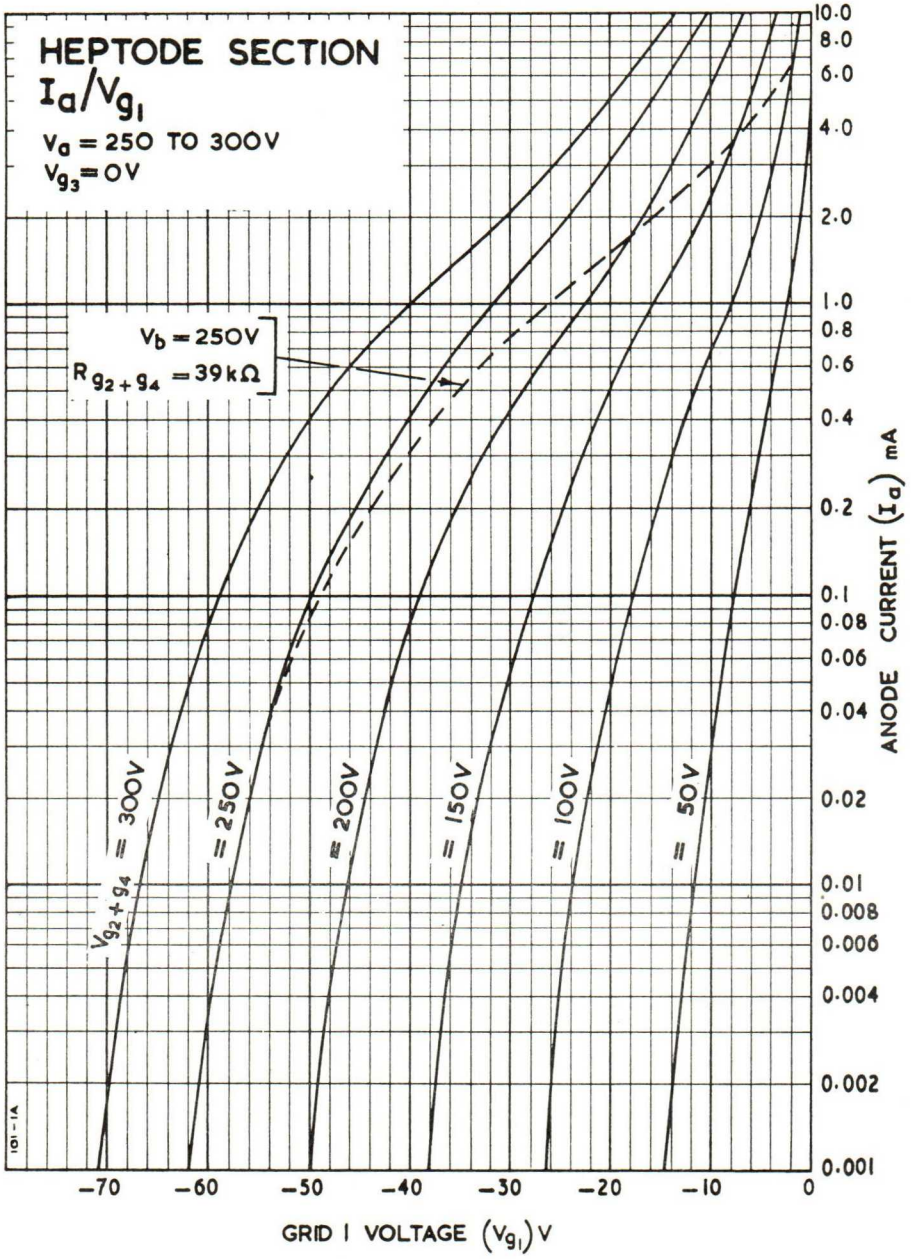
$V_a = 250V$ $R_{g2+g4} = 22k\Omega$

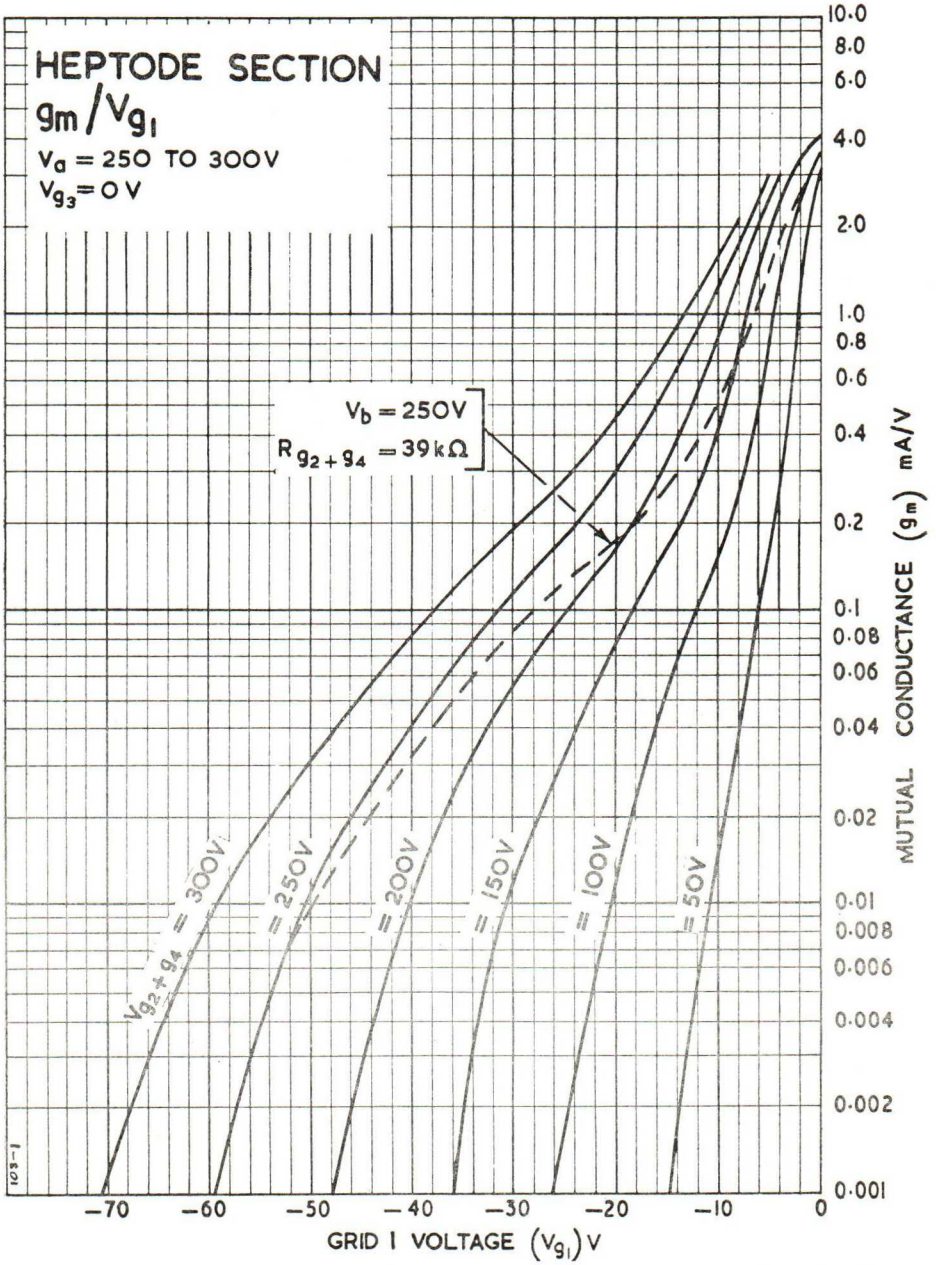
$V_{g1} = -2V$ $R_{gt+g3} = 47k\Omega$

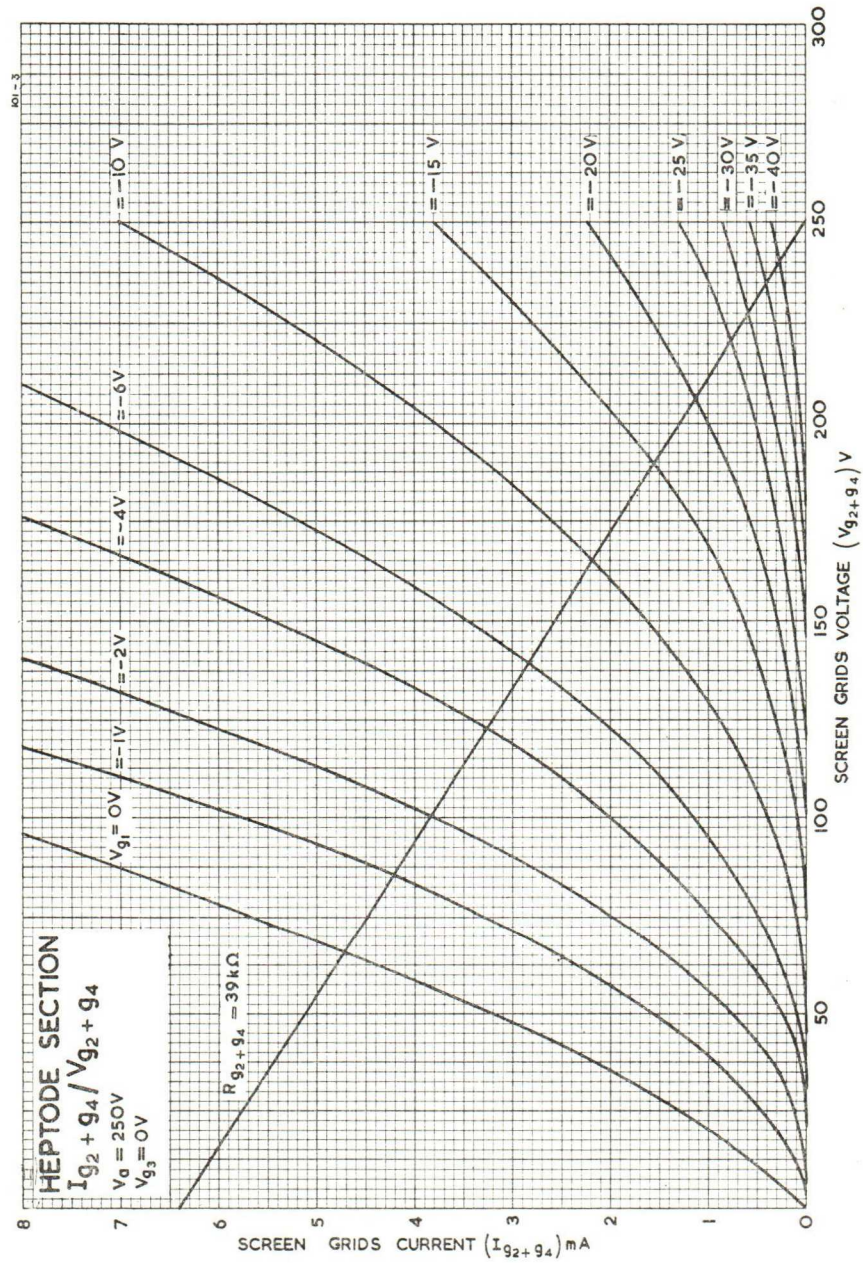


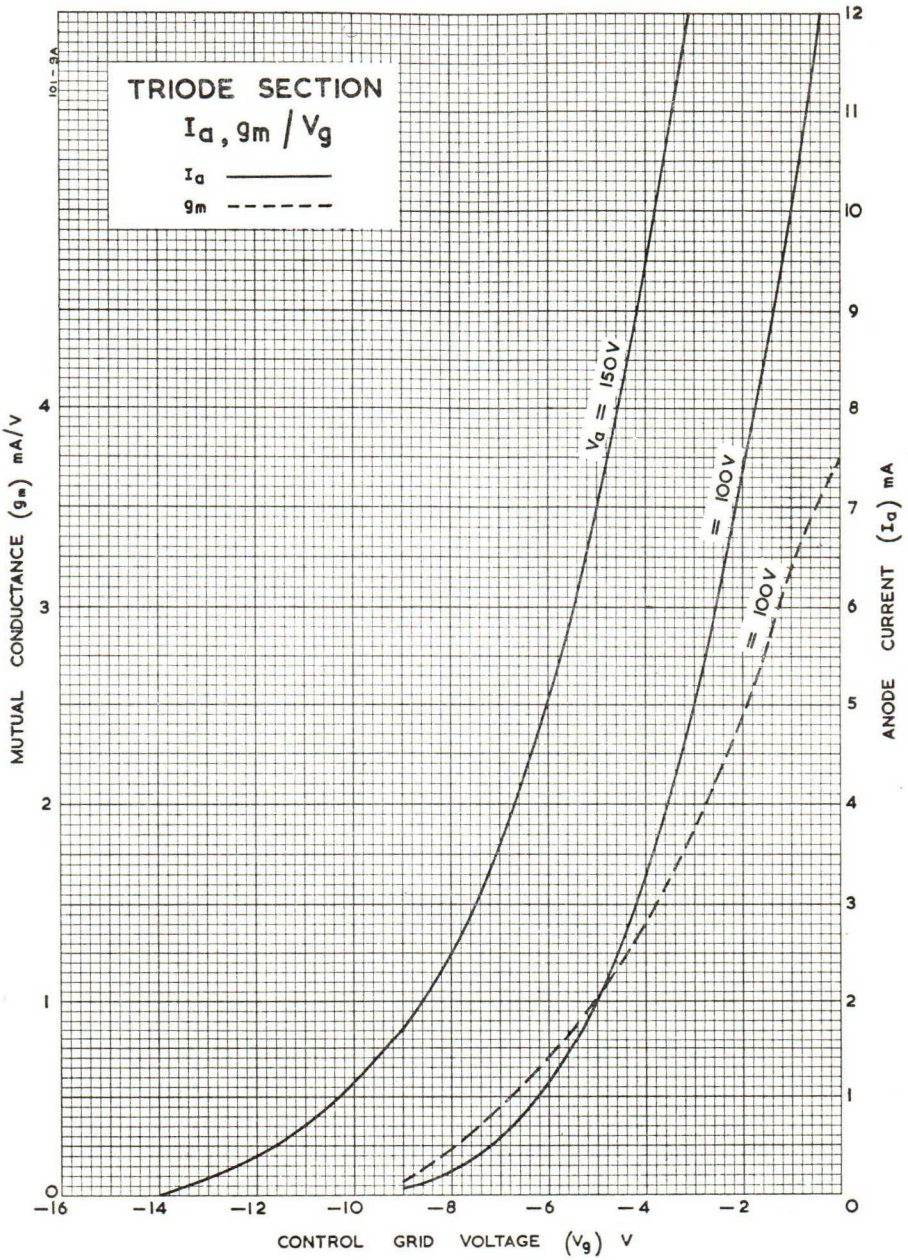

$I_a, I_{g_2+g_4}, g_c / V_{g_1}$
HETERODYNE INJECTED IN g_3
V_b =250 V
V_a =250 V
$R_{g_2+g_4}$ =22kΩ
$R_{g_3+g_t}$ =47kΩ
$I_{g_3+g_t}$ =200 μA
$I_{g_2+g_4}$
I_a
g_c
302-9
-70
-60
-50
-40
-30
-20
-10
0
GRID 1 VOLTAGE (V_{g_1}) V
10·0
8·0
6·0
4·0
2·0
1·0
0·8
0·6
0·4
0·2
0·1
0·08
0·06
0·04
0·02
0·01
0·008
0·006
0·004
0·002
0·001
ANODE CURRENT (I_a) & SCREEN GRIDS CURRENT $(I_{g_2+g_4})$ mA CONVERSION CONDUCTANCE (g_c) mA/V


HEPTODE SECTION
Ia, Ig2+g4, gm/Vg1
Vb = 250 V
Va = 250 V
Rg2+g4 = 39kΩ
Vg3 = 0 V
Ia
Ig2 + g4
gm
10·0
8·0
6·0
4·0
2·0
1·0
0·8
0·6
0·4
0·2
0·1
0·08
0·06
0·04
0·02
0·01
0·008
0·006
0·004
0·002
0·001
ANODE CURRENT (Ia) & SCREEN GRIDS CURRENT (Ig2+g4) mA MUTUAL CONDUCTANCE (gm) mA/V
−70
−60
−50
−40
−30
−20
−10
0
GRID 1 VOLTAGE (Vg1) V


HEPTODE SECTION
I_a/V_{g_1}
V_a = 250 TO 300V
V_{g_3} = 0V
V_b = 250V
$R_{g_2+g_4}$ = 39kΩ
$V_{g_2+g_4}$ = 300V
= 250V
= 200V
= 150V
= 100V
= 50V
10·0
8·0
6·0
4·0
2·0
1·0
0·8
0·6
0·4
0·2
0·1
0·08
0·06
0·04
0·02
0·01
0·008
0·006
0·004
0·002
0·001
ANODE CURRENT (I_a) mA
−70
−60
−50
−40
−30
−20
−10
0
GRID 1 VOLTAGE (V_{g_1}) V
101-1A

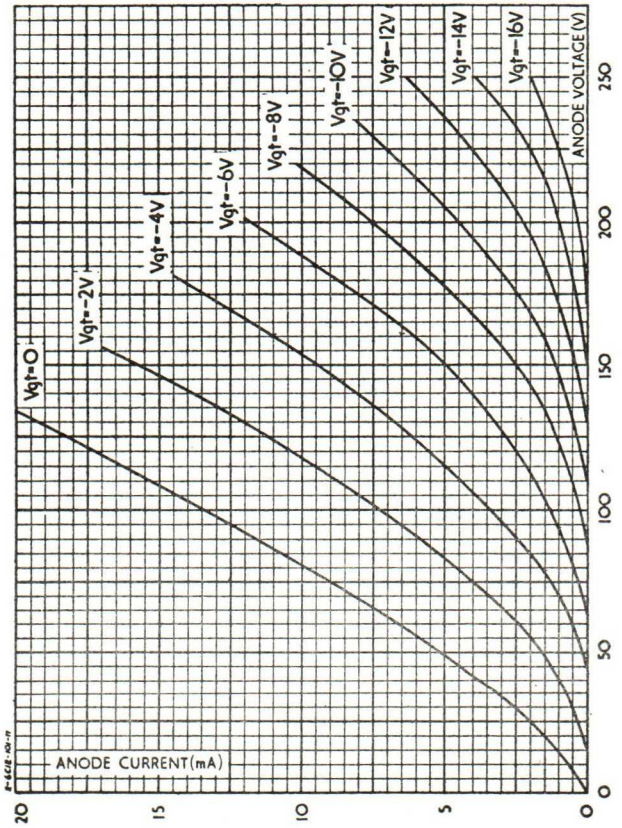

HEPTODE SECTION
gm/Vg1
Va = 250 TO 300V
Vg3 = 0V
Vb = 250V
Rg2+g4 = 39kΩ
Vg2+g4 = 300V
= 250V
= 200V
= 150V
= 100V
= 50V
10·0
8·0
6·0
4·0
2·0
1·0
0·8
0·6
0·4
0·2
0·1
0·08
0·06
0·04
0·02
0·01
0·008
0·006
0·004
0·002
0·001
MUTUAL CONDUCTANCE (gm) mA/V
−70
−60
−50
−40
−30
−20
−10
0
GRID 1 VOLTAGE (Vg1) V
1053-1


HEPTODE SECTION
$I_{g_2+g_4} / V_{g_2+g_4}$
$V_a = 250V$
$V_{g_3} = 0V$
$V_{g_1} = 0V$
$= -1V$
$= -2V$
$= -4V$
$= -6V$
$= -10V$
$= -15V$
$= -20V$
$= -25V$
$= -30V$
$= -35V$
$= -40V$
$R_{g_2+g_4} = 39k\Omega$
SCREEN GRIDS CURRENT $(I_{g_2+g_4})$ mA
SCREEN GRIDS VOLTAGE $(V_{g_2+g_4})$ V
0
1
2
3
4
5
6
7
8
50
100
150
200
250
300


TRIODE SECTION
Ia, gm / Vg
Ia
gm
191-3A
Va = 150V
= 100V
= 100V
MUTUAL CONDUCTANCE (gm) mA/V
ANODE CURRENT (Ia) mA
CONTROL GRID VOLTAGE (Vg) V
0
1
2
3
4
5
6
7
8
9
10
11
12
−16
−14
−12
−10
−8
−6
−4
−2
0

CHARACTERISTIC CURVES: I_a/V_a

Triode Section



6D2/EB91 ←

DOUBLE DIODE (Separate Cathodes)
Indirectly heated—for parallel operation

RATING

Heater Voltage (volts)	V_h	6.3
Heater Current (amps)	I_h	0.3
Maximum Mean Anode Current per Anode (mA)	$I_{a(av)max}$	9
Maximum Peak Anode Current per Anode (mA)	$I_{a(pk)max}$	50
Maximum Peak Inverse Anode Voltage (volts)	P.I.V.(max)	500
Maximum Potential Heater/Cathode (volts DC)	$V_{h-k(max)}$	300

INTER-ELECTRODE CAPACITANCES (pF)

		†	§
Anode 1/All	$c_{a'-all}$	3.4	4.5
Anode 1/Anode 2	$c_{a'-a''}$	0.018	0.021
Anode 1/Cathode 1	$c_{a'-k'}$	1.65	1.68
Anode 2/All	$c_{a''-all}$	3.4	4.5
Anode 2/Cathode 2	$c_{a''-k''}$	1.65	1.65
Cathode 1/All	$c_{k'-all}$	4.0	5.1
Cathode 1/Cathode 2	$c_{k'-k''}$	0.009	0.011
Cathode 2/All	$c_{k''-all}$	4.1	5.2
Cathode 2/Heater	$c_{k''-h}$	1.9	2.2
Cathode 1/Heater	$c_{k'-h}$	1.72	1.75

The hot heater to cathode capacity increases by 0.15 pF
The hot anode to cathode capacity increases by 0.1 pF.

† Inter-electrode capacitance with holder capacitance balanced out, but with earthed cylindrical screen.

§ Total capacitance including a B7G ceramic holder type 75/833 and cylindrical screen type 75/832. This holder has a shielding tag between Pins 1 and 7.

Indicates a change ←

THORN — AEI RADIO VALVES & TUBES LTD.

6D2/EB91 ←

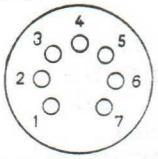
DOUBLE DIODE (Separate Cathodes)
Indirectly heated—for parallel operation

DIMENSIONS

Maximum Overall Length (mm)	54
Maximum Diameter (mm)	19
Maximum Seated Height (mm)	47.5
Approximate Nett Weight (ozs)	$\frac{1}{4}$
Approximate Packed Weight (ozs)	$\frac{1}{2}$

MOUNTING POSITION—Unrestricted.

BASE—B7G.

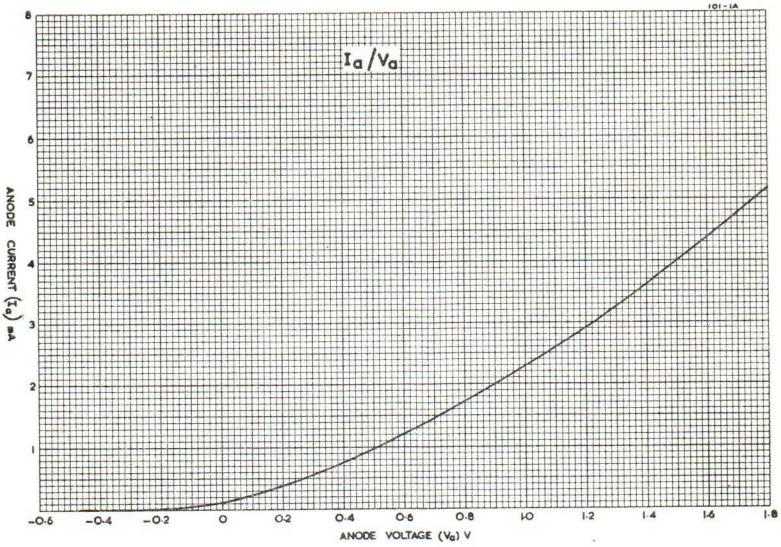


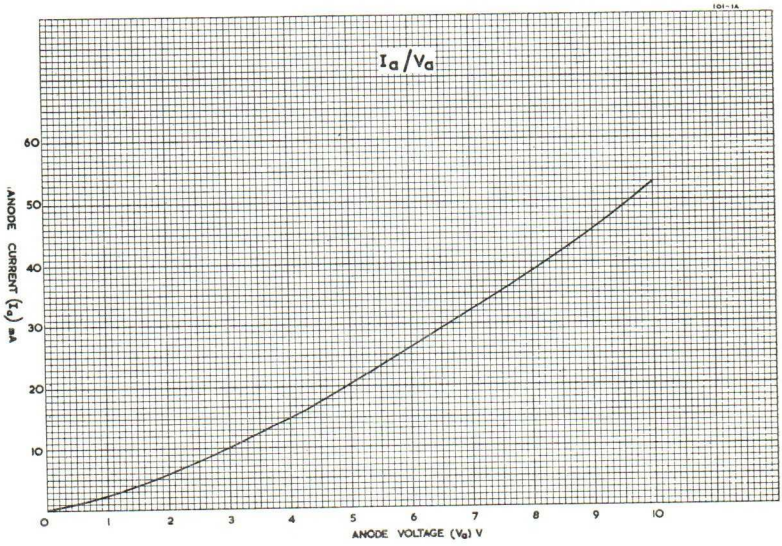
Viewed from free end of pins

CONNECTIONS

Pin 1	Cathode 1	k
Pin 2	Anode 2	a″
Pin 3	Heater	h
Pin 4	Heater	h
Pin 5	Cathode 2	k″
Pin 6	Internal Shield	s
Pin 7	Anode 1	a′

Indicates a change ←



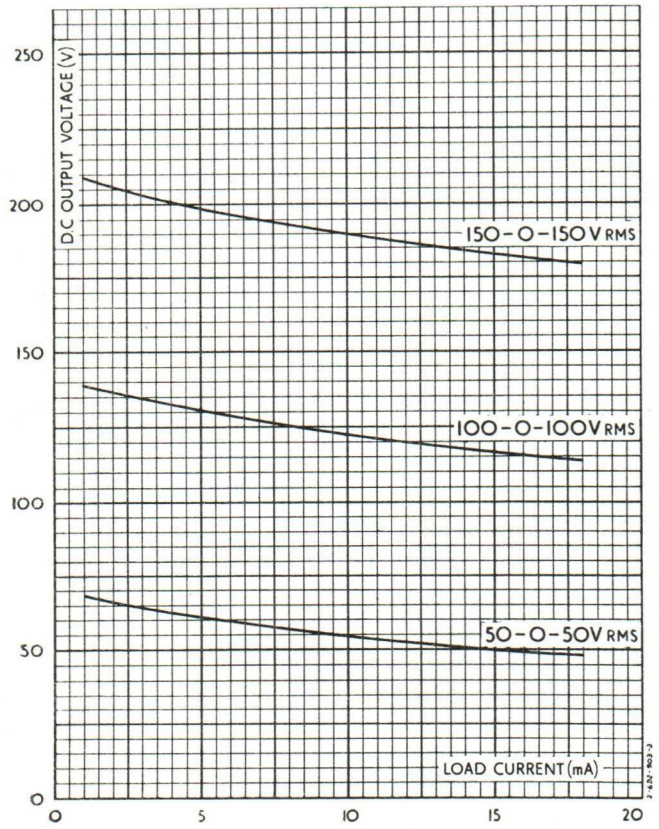


Indicates a change ←

AVERAGE CHARACTERISTIC CURVES : Regulation

(Full-Wave Rectification)

R_{lim} (each anode) = 300Ω C = 8μF f = 50 c/s



6F18

VARIABLE MU H.F. PENTODE

Indirectly heated—for parallel operation ←

GENERAL

The 6F18 is a variable-mu HF. Pentode intended for use in AM/FM Receivers.

RATING

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·2	A
Maximum Anode Voltage	$V_{a(max)}$	250	V
Maximum Screen Voltage	$V_{g2(max)}$	250	V
Maximum Anode Dissipation	$P_{a(max)}$	2·25	W
Maximum Screen Dissipation	$P_{g2(max)}$	0·5	W
Maximum Heater to Cathode Voltage (D.C.)	$V_{h-k(max)}$	150	V

INTER-ELECTRODE CAPACITANCES (pF)

		*	**	***	
Grid 1/Earth	c_{in}	5·0	5·2	6·2	←
Anode/Earth	c_{out}	4·3	4·5	4·5	←
Anode/Grid 1	c_{a-g1}	0·0019	0·0019	0·0031	←
Anode/Grid 1	c_{a-g1}	0·0017†	0·0017†	0·0029†	←
Anode/Grid 2	c_{a-g2}	0·12	0·23	0·41	←
Anode/Grid 3	c_{a-g3}	0·54	0·56	0·58	←
Grid 1/Grid 2	c_{g1-g2}	1·6	1·6	1·6	←
Grid 1/Grid 3	c_{g1-g3}	0·055	0·064	0·072	←

* Inter-electrode capacitances in fully shielded socket, without can.

** Inter-electrode capacitances with holder capacitance balanced out (using holder quoted below).

*** Total inter-electrode capacitances including B9A ceramic holder without skirt or radial shield (Plessey holder type CP180014/1). The total anode to grid capacitance (in can) may be reduced from 0·0029pF to 0·0019pF by the use of a close fitting vertical shield placed beneath the holder, between pins 1 and 9, 4 and 5.

† In can.

" Earth " denotes the remaining earthy potential electrodes, heater and shields connected to cathode.

Indicates a change ←

THORN — AEI RADIO VALVES & TUBES LTD.

6F18

VARIABLE MU H.F. PENTODE

Indirectly heated—for parallel operation ←

DIMENSIONS

Maximum Overall length	56·0 mm
Maximum Diameter	22·2 mm
Maximum Seated Height	49·0 mm
Approximate Nett Weight	½ ozs
Approximate Packed Weight	¾ ozs

MOUNTING POSITION—Unrestricted

TYPICAL OPERATION

Anode Voltage	V_a	175	175	V
Screen Voltage	V_{g2}	100	175	V
Grid Bias Voltage	V_{g1}	−1·3		V
Anode Current	I_a	12·0		mA
Screen Current	I_{g2}	3·5		mA
Mutual Conductance	g_m	4·4		mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	400		kΩ
Bias to give mutual conductance of 100 μA/V			−19·5	V
Input Capacity working (Hot)	$c_{in(w)}$	7·0**		pF ←
Input Capacity change to cut-off	Δc	1·5**		pF ←
Input Loss at 38 Mc/s, cathode pins strapped		21		kΩ ←

** Inter-electrode capacitances with holder capacitance balanced out (using Plessey holder type CP180014/1).

BULB—Clear

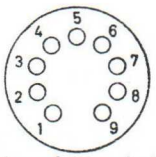
Indicates a change ←

6F18

VARIABLE MU H.F. PENTODE

Indirectly heated—for parallel operation ←

BASE—Noval (B9A)



View from free end of Pins

CONNECTIONS

Pin 1	Cathode	k
Pin 2	Control Grid	g1
Pin 3	Cathode	k
Pin 4	Heater	h
Pin 5	Heater	h
Pin 6	Internal Shield	s
Pin 7	Anode	a
Pin 8	Screen Grid	g2
Pin 9	Suppressor Grid	g3

NOTE

If only one cathode pin is required it is recommended that pin 3 be used.

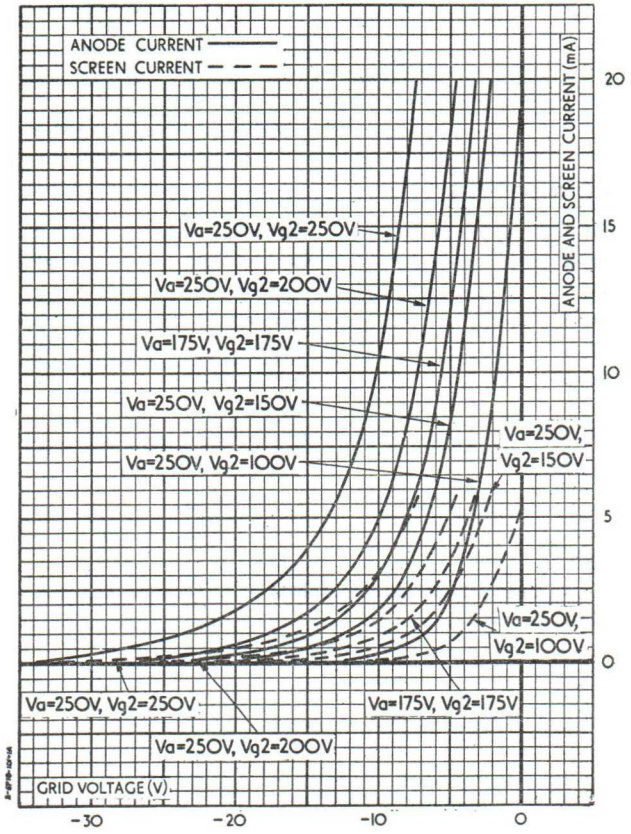
6F18

VARIABLE MU H.F. PENTODE

Indirectly heated—for parallel operation

←

AVERAGE CHARACTERISTIC CURVES : $I_a, I_{g2}/V_{g1}$



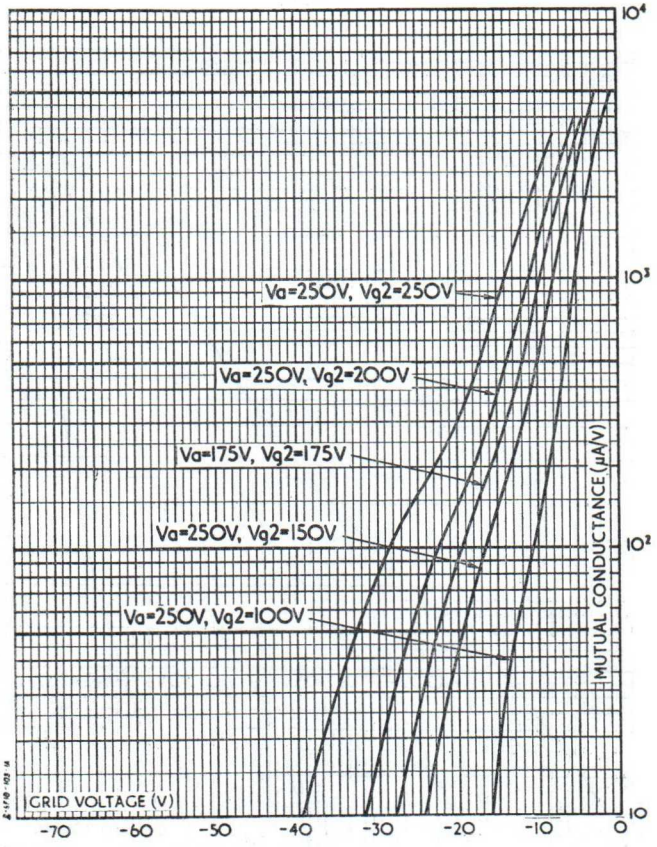
Indicates a change ←

6F18

VARIABLE MU H.F. PENTODE

Indirectly heated—for parallel operation ←

AVERAGE CHARACTERISTIC CURVES : g_m/V_{g1}



Indicates a change ←

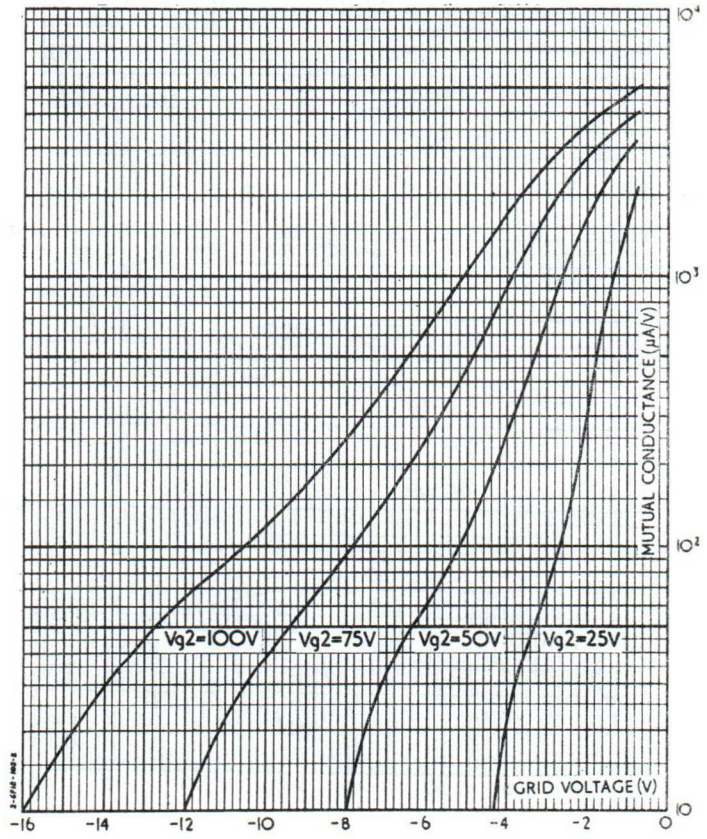
6F18

VARIABLE MU H.F. PENTODE

Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES : g_m/V_{g1}

$V_a = 175V$.

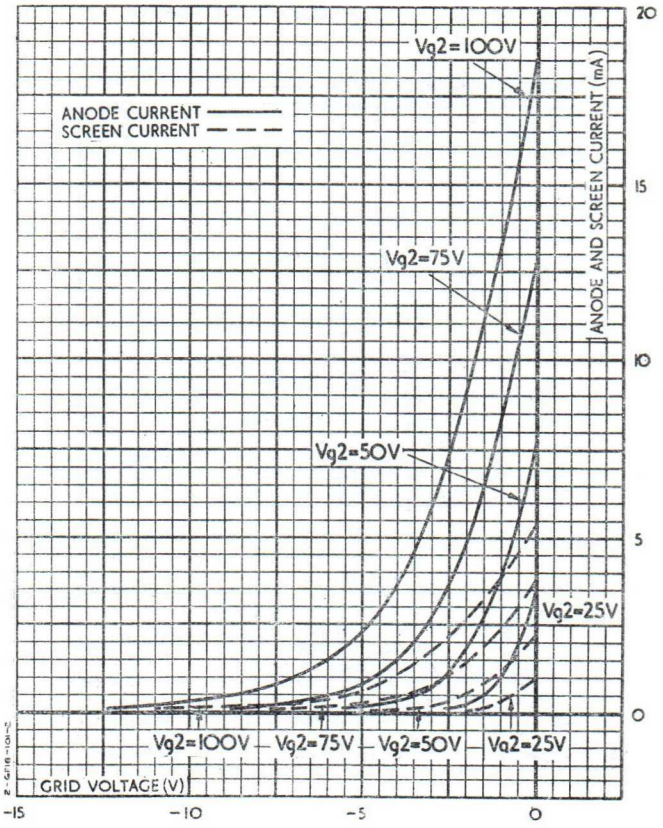


6F18

VARIABLE MU H.F. PENTODE

Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES : $I_a, I_{g2}/V_{g1}$
$V_a = 175V$.

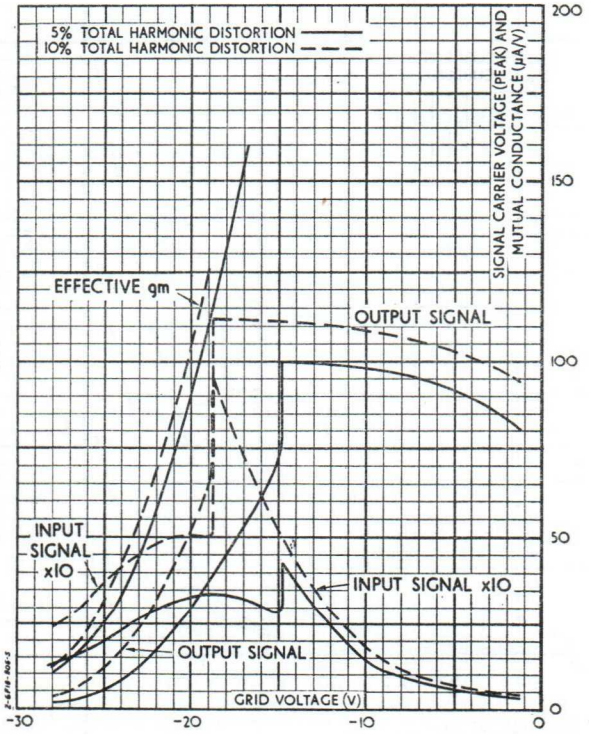


6F18

VARIABLE MU H.F. PENTODE

Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES : $V_{sig(pk)}$, g_m/V_{g1}
Initially : V_a=175V., V_{g2}=100V(Rising), I_a=12·0mA.,
I_{g2}=3·5mA., V_{g1}=−1·3V.,
R_{g2}=22kΩ, Z_L=100kΩ, Mod.=60%

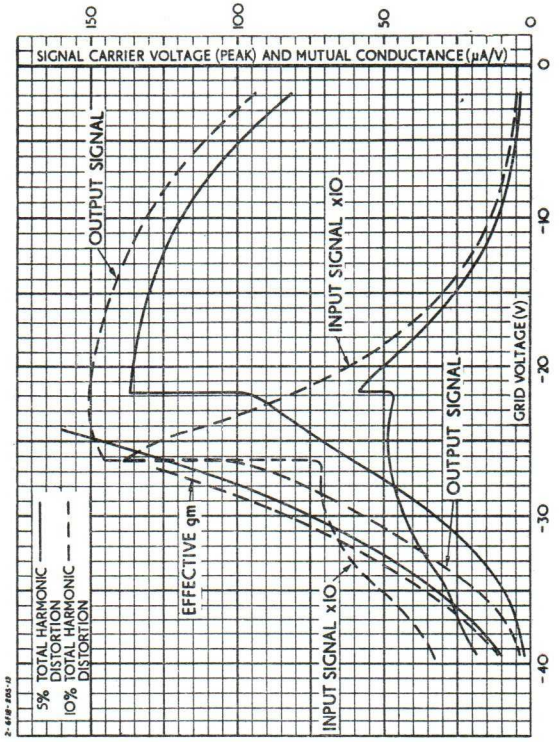


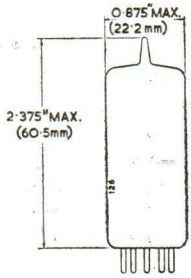
6F18

VARIABLE MU H.F. PENTODE

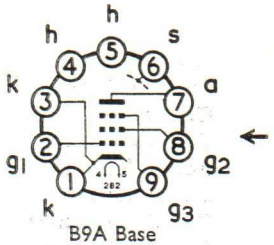
Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES : $V_{sig(pk)}$, g_m/V_{g1}
Initially : $V_{HT}=250V.$, $R_a=6{\cdot}8k\Omega$, $R_{g2}=39k\Omega$,
$I_a=12{\cdot}0mA.$, $I_{g2}=3{\cdot}5mA.$, $V_{g1}=-1{\cdot}85V$,
$Z_L=100k\Omega$, Mod.=60%





HIGH SLOPE SCREENED H.F. PENTODE



B9A Base

GENERAL

This valve is a straight high slope screened H.F. pentode intended for use in AC or AC/DC television receivers for I.F. amplification, video output and for synchronising pulse separation.

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·3	A

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	3*	W
Maximum Screen Dissipation	$P_{g2(max)}$	1*	W
Maximum Anode Voltage	$V_{a(max)}$	250	V
Maximum Screen Voltage	$V_{g2(max)}$	250	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h\text{-}k(r.m.s.)max}$	200†	V
Maximum Resistance Control Grid to Cathode		600‡	kΩ

* With grid to cathode resistance not exceeding 10kΩ.

† From cathode to higher potential heater pin.

‡ With maximum anode dissipation 2W, maximum screen dissipation 0·5W and assuming a common anode and screen decoupling resistance of not less than 2·2kΩ ± 10%.

INTER-ELECTRODE CAPACITANCES

		§	‖	**		
Grid 1 to Earth	c_{in}	8·3	8·6	9·6	pF	←
Anode to Earth	c_{out}	3·3	3·6	4·6	pF	←
Grid 1 to Anode	$c_{g1\text{-}a}$	0·0065	0·007	0·008	pF	←
Grid 1 to Grid 3	$c_{g1\text{-}g3}$	0·16	0·16	0·17	pF	←
Grid 1 to Grid 2	$c_{g1\text{-}g2}$	2·5	2·5	2·5	pF	←
Grid 2 to Anode	$c_{g2\text{-}a}$	0·16	0·24	0·42	pF	←
Grid 3 to Anode	$c_{g3\text{-}a}$	0·6	0·61	0·63	pF	←

§ In fully shielded socket, without can.

‖ With holder capacity balanced out.

** Total capacity including B9A ceramic holder without skirt or radial shield (Plessey holder type CP180014/1).

" Earth " denotes the remaining earthy potential electrodes, heater and shields joined to cathode.

Indicates a change ←

THORN — A E I RADIO VALVES & TUBES LTD.

TYPICAL OPERATION ←

Anode Voltage	V_a	170	V
Screen Voltage	V_{g2}	170	V
Cathode Self Bias Resistance	R_k	150	Ω
Grid Bias Voltage (Approx.)	V_{g1}	—1·9	V
Anode Current	I_a	10	mA
Screen Current	I_{g2}	2·6	mA
Mutual Conductance	g_m	9·2	mA/V
Inner Amplification Factor	$\mu_{g1\text{-}g2}$	60	
Input Loss at 38 Mc/s	$r_{g1\text{-}k(w)}$	12††	kΩ ←
Input Capacity Working	$c_{in(w)}$	11·5‡‡	pF ←
Change in Input Capacity produced by biassing valve to cut-off	$\triangle c_{in(w)}$	2·4§§	←
Equivalent Grid Noise Resistance	R_{eq}	670	Ω

†† With the two cathodes strapped and joined directly to earth.

‡‡ In fully shielded socket, without can at 38 Mc/s.

§§ Hot capacity at 38 Mc/s.

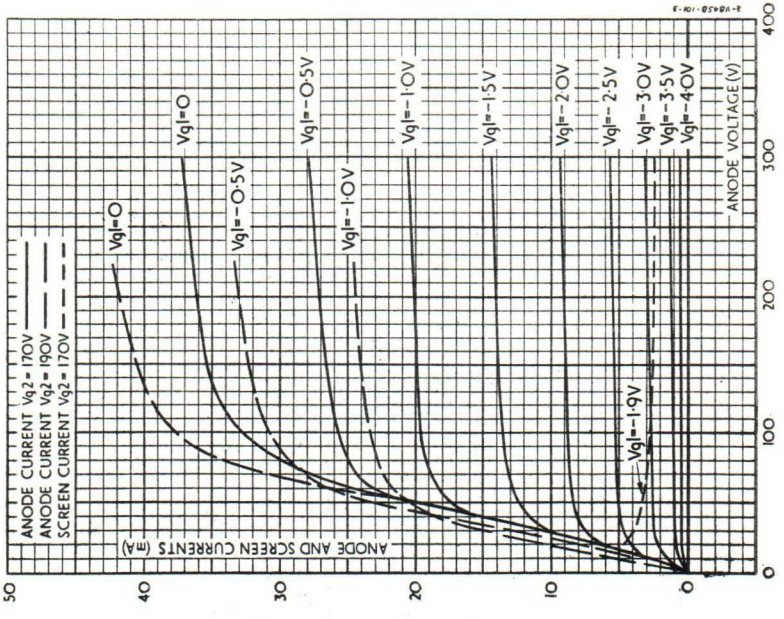
MOUNTING POSITION—Unrestricted.

APPROXIMATE WEIGHT

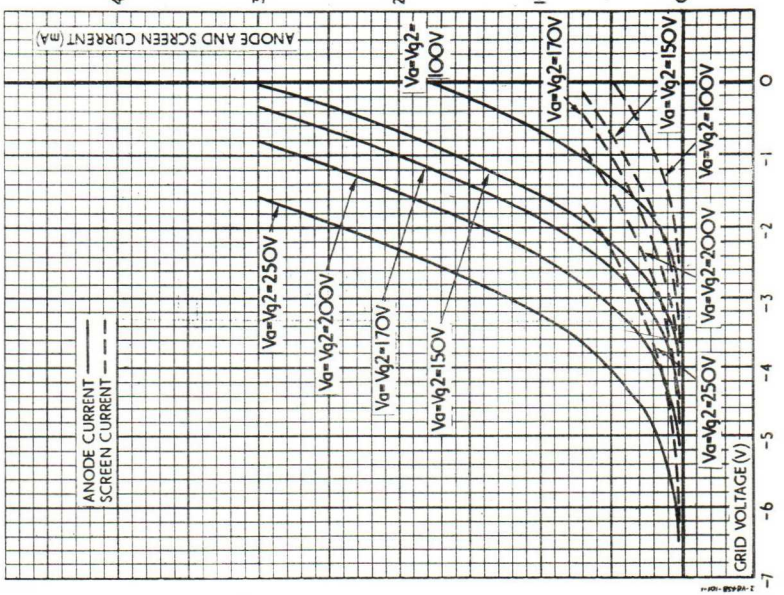
Net	0·5 oz
Packed	0·75 oz

Indicates a change ←

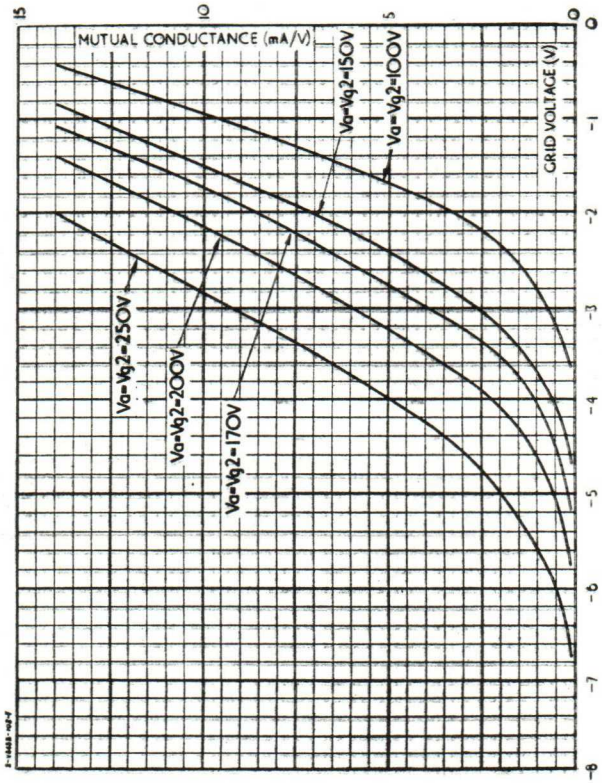
AVERAGE CHARACTERISTIC CURVES : $I_a, I_2/V_{ga}$



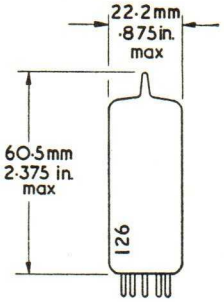
AVERAGE CHARACTERISTIC CURVES : $I_a, I_{g2}/V_{g1}$



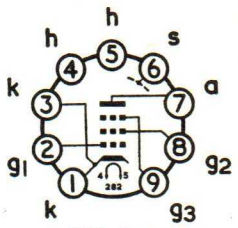
AVERAGE CHARACTERISTIC CURVES: g_m/V_{g1} ←



Indicates a change ←



VARIABLE-MU R.F. PENTODE



B9A Base

GENERAL

This valve is a variable-mu R.F. pentode primarily intended for use in A.C. or A.C./D.C. television receivers.

Heater Voltage	V_h	6·3 V
Heater Current	I_h	0·3 A

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	2·5	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	0·65	W
Maximum Anode Voltage	$V_{a(max)}$	300	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	300	V
Maximum Cathode Current	$I_{k(max)}$	15	mA
Maximum Heater to Cathode Voltage (DC)	$V_{h-k(max)}$	150*	V
Maximum Grid 1 to Cathode Resistance	$R_{g1-k(max)}$	3	MΩ
Maximum Heater to Cathode Resistance	$R_{h-k(max)}$	20	kΩ

* From cathode to higher potential heater pin.

INTER-ELECTRODE CAPACITANCES †

Grid to Earth	c_{in}	7·2	pF
Anode to Earth	c_{out}	3·7	pF
Grid 1 to Anode	c_{g1-a}	<·007	pF
Grid 1 to Heater	c_{g1-h}	<·15	pF

† Inter-electrode capacitance in fully shielded socket without can.

" Earth " denotes the remaining earthy potential electrodes, heater and shields joined to cathode.

TYPICAL OPERATION

Anode Voltage	V_a	250	250	V
Screen Grid Voltage	V_{g2}	100	250	V
Control Grid Voltage	V_{g1}	−2		V
Anode Current	I_a	10		mA
Screen Grid Current	I_{g2}	2·5		mA
Mutual Conductance	g_m	6		mA/V
Inner Amplification Factor	μ_{g1-g2}	25		
Anode Resistance ($\delta v_a/\delta i_a$)	r_a	0·5		MΩ
Grid Bias to give Mutual Conductance of 60 μA/V	V_{g1}		−35	V
Equivalent Grid Noise Resistance	R_{eq}	1·5		kΩ

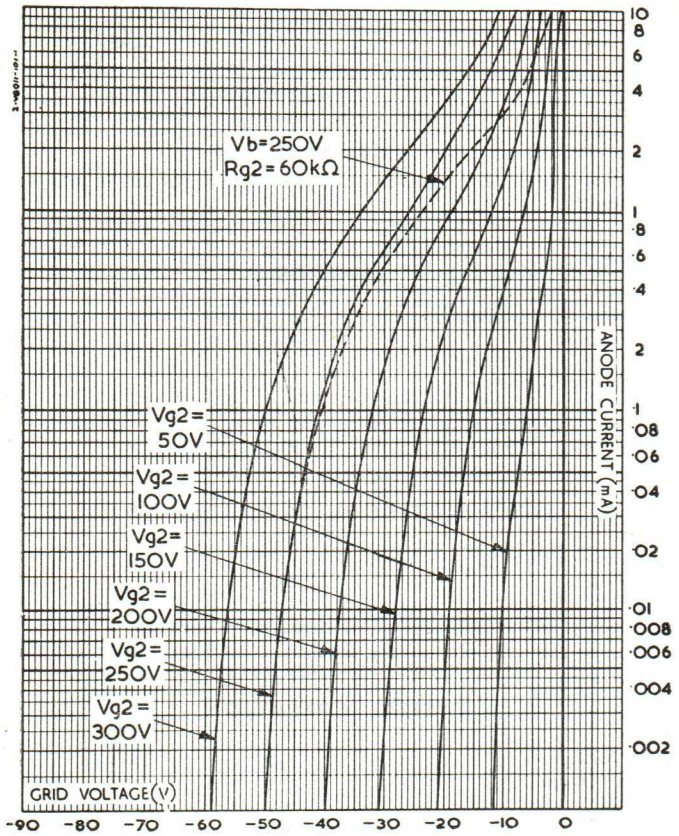
MOUNTING POSITION—Unrestricted.

APPROXIMATE WEIGHT

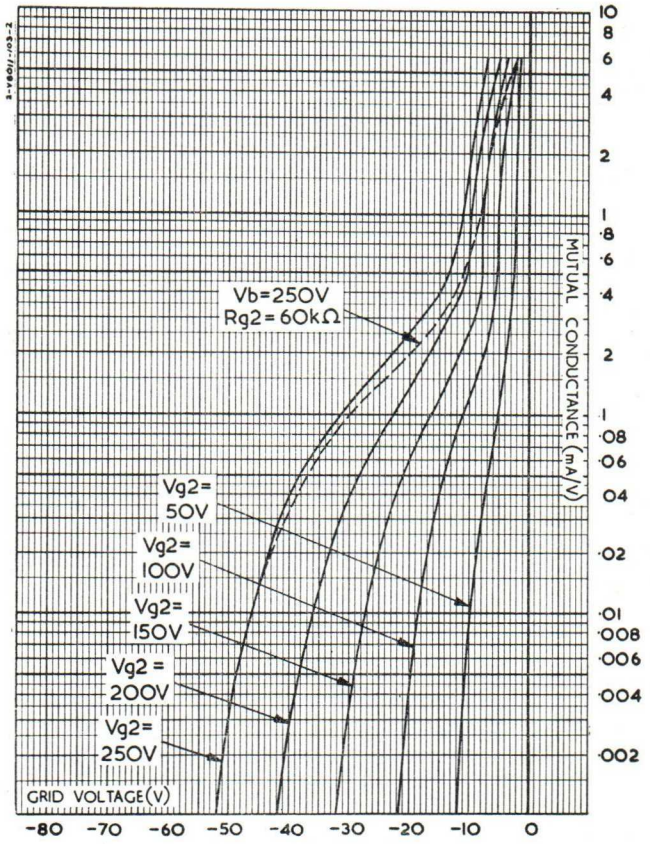
Net	0·5 oz
Packed	0·75 oz

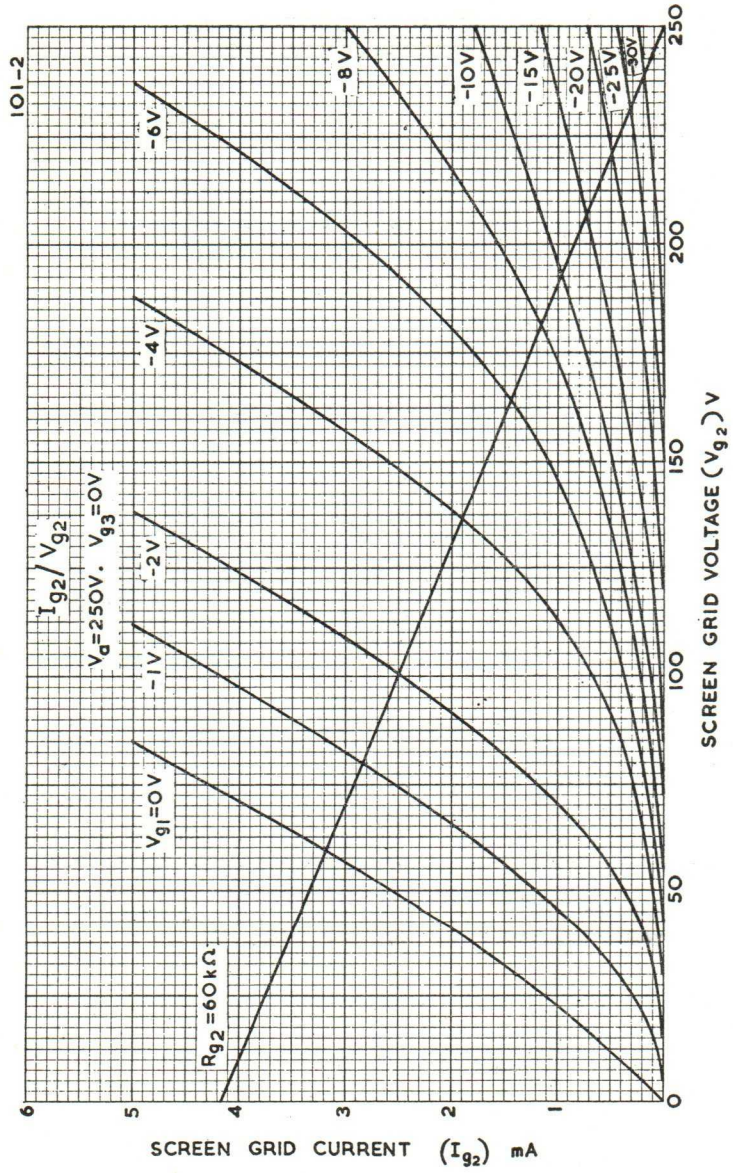
THORN — AEI RADIO VALVES & TUBES LTD.

CHARACTERISTIC CURVES : I_a/V_{g1}
(V_a=250V, V_{g3}=0V, V_h=6.3V)



CHARACTERISTIC CURVES : g_m/V_{g1}
(V_a=250V, V_{g3}=0V, V_h=6.3V)




101-2
-6V
-8V
-10V
-15V
-20V
-25V
-30V
-4V
-2V
-1V
V_{g1}=0V
R_{g2}=60kΩ
I_{g2}/V_{g2}
V_a=250V. V_{g3}=0V
250
200
150
100
50
0
SCREEN GRID VOLTAGE (V_{g2}) V
6
5
4
3
2
1
SCREEN GRID CURRENT (I_{g2}) mA

6FD12/EBF89

DOUBLE DIODE R.F. PENTODE

Indirectly heated—for parallel operation

←

GENERAL

The 6FD12/EBF89 is a miniature based indirectly heated Double Diode Variable-Mu RF Pentode with a single cathode. It is intended for use as an RF Amplifier or IF Amplifier-Detector in AC powered A.M. only receivers having parallel connected heater chains.

RATING

Heater Voltage	(volts)	V_h	6.3
Heater Current	(amps)	I_h	0.3
Pentode Section			
Maximum Anode Supply Voltage	(volts)	$V_{a(b)max}$	550
Maximum Anode Voltage	(volts)	$V_{a(max)}$	300
Maximum Screen Supply Voltage	(volts)	$V_{g2(b)max}$	550
Maximum Screen Voltage ($I_a < 4$ mA)	(volts)	$V_{g2(max)}$	300
Maximum Screen Voltage ($I_a > 8$ mA)	(volts)	$V_{g2(max)}$	125
Maximum Anode Dissipation	(watts)	$P_{a(max)}$	2.25
Maximum Screen Dissipation	(mW)	$P_{g2(max)}$	450
Maximum Cathode Current	(mA)	$I_{k(max)}$	16.5
Maximum Grid 1 Voltage	(volts)	$V_{g1(max)}$	—1.3
Maximum Grid 1-Cathode Resistance	(MΩ)	R_{g1-k}	3.0
Maximum Grid 1-Cathode Resistance (Grid Current biasing)	(MΩ)	R_{g1-k}	22
Maximum Grid 3-Cathode Resistance	(kΩ)	R_{g3-k}	10
Maximum Heater-Cathode Resistance	(kΩ)	R_{h-k}	20

Rating (continued overleaf).

Indicates a change ←

6FD12/EBF89

DOUBLE DIODE R.F. PENTODE

Indirectly heated—for parallel operation

←

Maximum Heater-Cathode Voltage	(volts)	V_{h-k}	100
Mutual Conductance	(mA/V)	g_m	3.8†
Anode Impedance	(MΩ)	r_a	1.0†
Inner Mu		μ_{g1-g2}	20†

† Measured at $V_a = 250$ V ; $V_{g2} = 100$ V ; $V_{g1} = -2.0$V.

Diode Section (each Diode)

Maximum Peak Inverse Voltage	(volts)	P.I.V.max	200
Maximum Mean Diode Current	(μA)	$I_{d(av)max}$	800
Maximum Peak Diode Current	(mA)	$I_{d(pk)max}$	5.0

INTER-ELECTRODE CAPACITANCES (pF)

Anode/All	c_{out}	5.2
Grid 1/All	c_{in}	5.0
Anode/Grid 1	c_{a-g1}	<0.0025
Anode/Diode 1	$c_{a-a'd}$	<0.025 ←
Anode/Diode 2	$c_{a-a''d}$	<0.15 ←
Grid 1/Diode 1	$c_{g1-a'd}$	<0.001 ←
Grid 1/Diode 2	$c_{g1-a''d}$	<0.0008 ←
Grid 1/Heater	c_{g1-h}	0.05
Diode 1/Cathode	$c_{a'd-k}$	2.5
Diode 2/Cathode	$c_{a''d-k}$	2.5
Diode 1/Heater	$c_{a'd-h}$	<0.015
Diode 2/Heater	$c_{a''d-h}$	<0.003
Diode 1/Diode 2	$c_{a'd-a''d}$	<0.25

Indicates a change ←

THORN — AEI RADIO VALVES & TUBES LTD.

6FD12/EBF89
DOUBLE DIODE R.F. PENTODE
Indirectly heated—for parallel operation ←

DIMENSIONS

Maximum Overall Length	(mm)	67.5
Maximum Diameter	(mm)	22.2
Maximum Seated Height	(mm)	60.5
Approximate Nett Weight	(ozs)	½
Approximate Packed Weight	(ozs)	¾

MOUNTING POSITION—Unrestricted

TYPICAL OPERATION

Anode Voltage	(volts)	V_a	200	200	250	250
Grid 2 Resistance	(kΩ)	R_{g2}	47	30	82	56
Grid 1 Voltage	(volts)	V_{g1}	—0.5‡	—1.5	—0.5‡	—2.0
Cathode Resistance	(ohms)	R_k	—	105	—	170
Anode Current	(mA)	I_a	9.5	11	8.0	9.0
Grid 2 Current	(mA)	I_{g2}	2.8	3.3	2.2	2.7
Mutual Conductance	(mA/V)	g_m	5.0	4.5	4.7	3.8
Mutual Conductance, V_{g1} = —20V.	(μA/V)	g_m	115	120	180	200
Anode Impedance	(MΩ)	r_a	0.6	0.6	0.8	1.0
Equivalent Noise Resistance	(kΩ)	R_{eq}	2.5	3.5	2.3	4.0

‡ Produced by Grid Current flow in grid resistor and diode current. If not acceptable the bias should be increased to —1.5 V. at Va=200V and —2V at Va=250V. ←

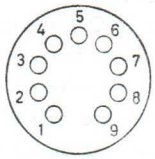
Indicates a change ←

THORN — AEI RADIO VALVES & TUBES LTD.

6FD12/EBF89
DOUBLE DIODE R.F. PENTODE
Indirectly heated—for parallel operation

←

BASE—Noval (B9A)



Viewed from free end of pins

CONNECTIONS

Pin 1	Grid 2	g_2
Pin 2	Grid 1	g_1
Pin 3	Cathode, Shield	k, s
Pin 4	Heater	h
Pin 5	Heater	h
Pin 6	Anode	a
Pin 7	Diode 2	a″ d
Pin 8	Diode 1	a′ d
Pin 9	Grid 3	g_3

Indicates a change ←

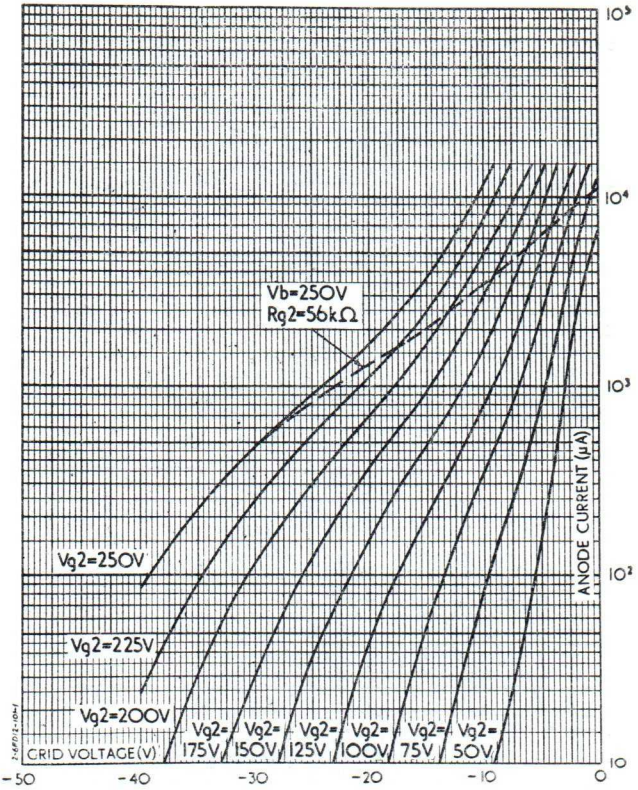
6FD12/EBF89

DOUBLE DIODE R.F. PENTODE

Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES : I_a/V_g

$V_a = 250V$



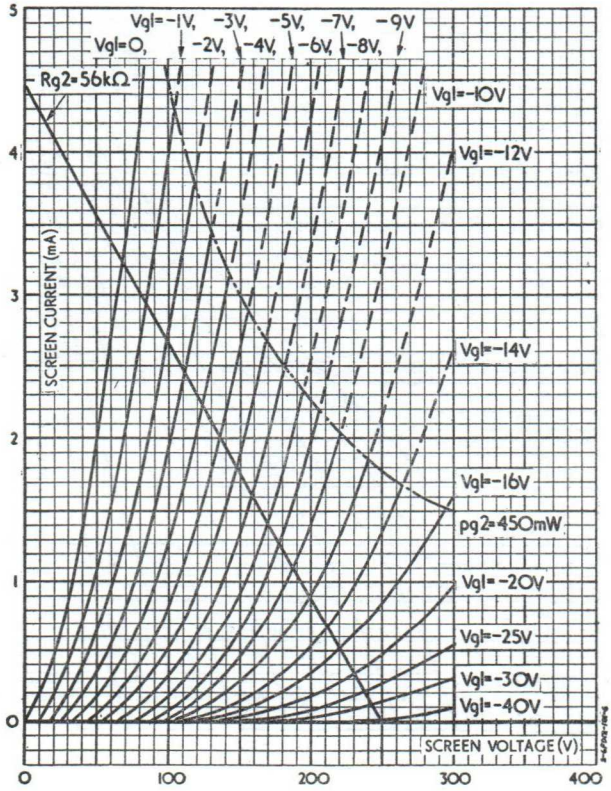
6FD12/EBF89

DOUBLE DIODE R.F. PENTODE

Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES: I_{g2}/V_{g2}

$V_a = 250V$



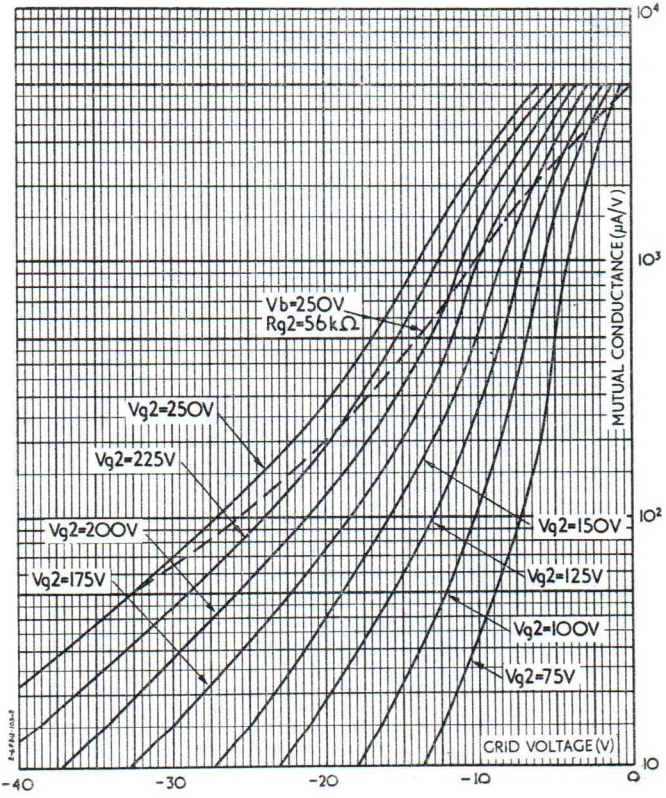
6FD12/EBF89

DOUBLE DIODE R.F. PENTODE

Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES: g_m/V_g

$V_a = 250V$



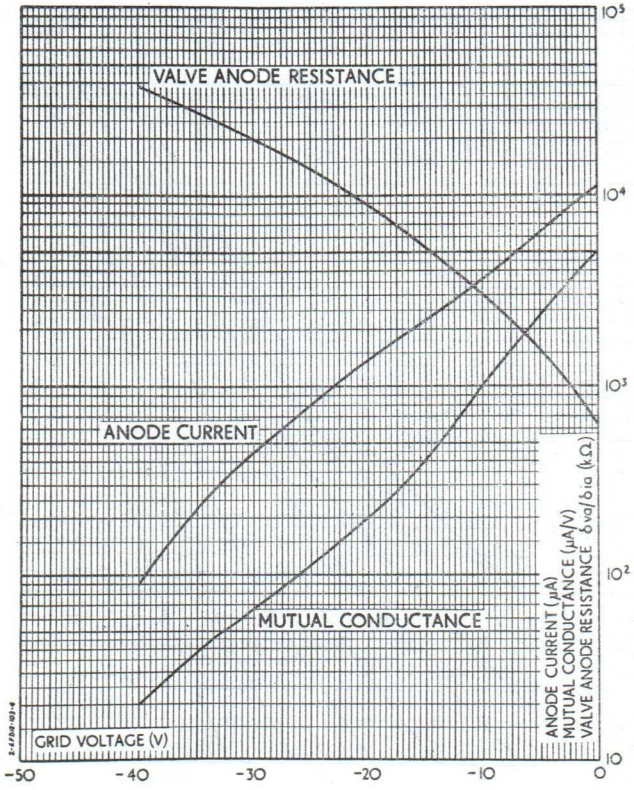
6FD12/EBF89

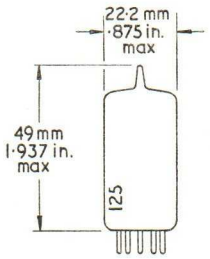
DOUBLE DIODE R.F. PENTODE

Indirectly heated—for parallel operation

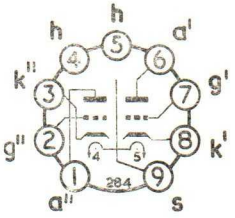
AVERAGE CHARACTERISTIC CURVES: I_a, g_m, r_a/V_g

$V_b = 250V$ $R_{g2} = 56k\Omega$





DOUBLE TRIODE



B9A Base

GENERAL

This valve is a double triode primarily intended for use as an R.F. amplifier and self-oscillating mixer in F.M. receivers.

Heater Voltage	V_h	6·3 V
Heater Current	I_h	0·435 A

RATINGS

Maximum Anode Dissipation (either section)	$P_{a(max)}$	2·5	W
Maximum Total Anode Dissipation	$P_{a(tot)max}$	4·5	W
Maximum Anode Voltage	$V_{a(max)}$	300	V
Maximum Heater to Cathode Voltage (D.C.)	$V_{h\text{-}k(max)}$	90	V
Maximum Cathode Current	$I_{k(max)}$	15	mA
Maximum Grid to Cathode Resistance	$R_{g\text{-}k(max)}$	1	MΩ

INTER-ELECTRODE CAPACITANCES

		*	‡	§	
Grid′ to Cathode′, Heater, Shield	$c_{g'\text{-}k',h,s}$	2·8	3·1	4·0	pF
Grid″ to Cathode″, Heater, Shield	$c_{g''\text{-}k'',h,s}$	2·8	3·2	4·0	pF
Anode′ to Cathode′, Heater, Shield	$c_{a'\text{-}k',h,s}$	1·2	1·6	2·5	pF
Anode′ to Cathode′, Heater, Shield†	$c_{a'\text{-}k',h,s}$	1·8	1·9	2·7	pF
Anode″ to Cathode″, Heater, Shield	$c_{a''\text{-}k'',h,s}$	1·15	1·6	2·4	pF
Anode″ to Cathode″, Heater, Shield †	$c_{a''\text{-}k'',h,s}$	1·8	2·0	2·7	pF
Anode′ to Grid′	$c_{a'\text{-}g'}$	1·5	1·6	1·8	pF
Anode″ to Grid″	$c_{a''\text{-}g''}$	1·5	1·6	1·6	pF
Anode′ to Anode″	$c_{a'\text{-}a''}$	0·028	0·032	0·033	pF
Anode′ to Anode″†	$c_{a'\text{-}a''}$	0·003	0·0067	0·0081	pF
Anode″ to Cathode′	$c_{a''\text{-}k'}$	0·006	0·014	0·02	pF

† Measured with can.

* In fully shielded socket. Without can, except where stated otherwise.

‡ With holder capacitance balanced out (holder as below).

§ Total capacitance including, where applicable, Plessey B9A ceramic type holders CP180900/1 (without can) or CP180024/3 (with can).

THORN — AEI RADIO VALVES & TUBES LTD.

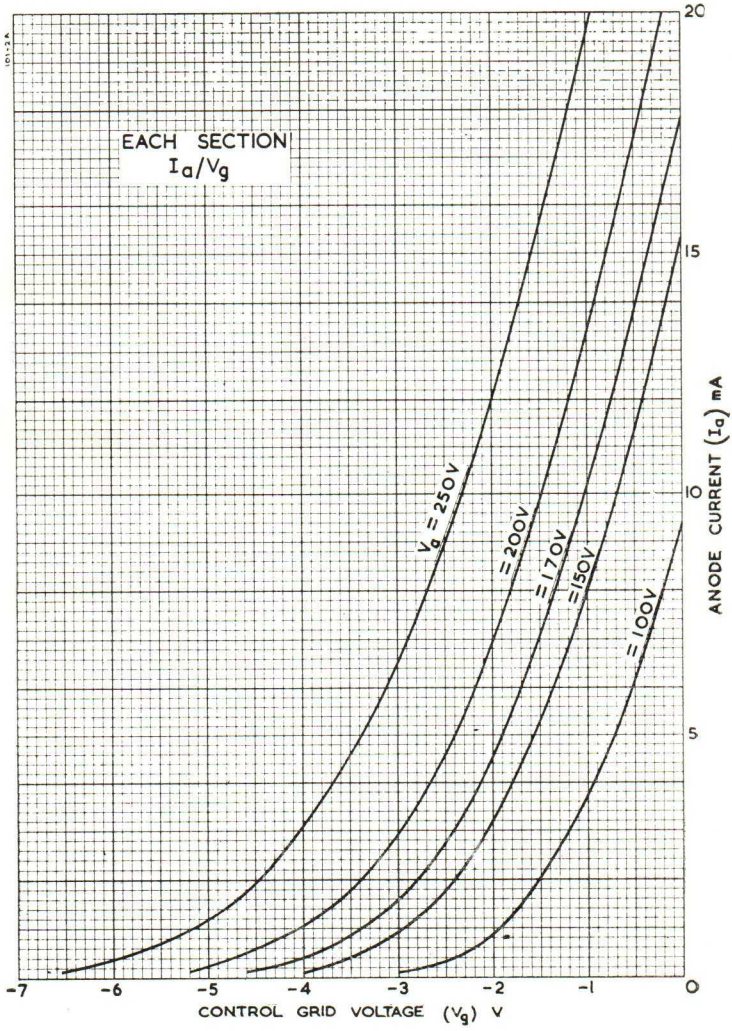
TYPICAL OPERATION AS R.F. AMPLIFIER

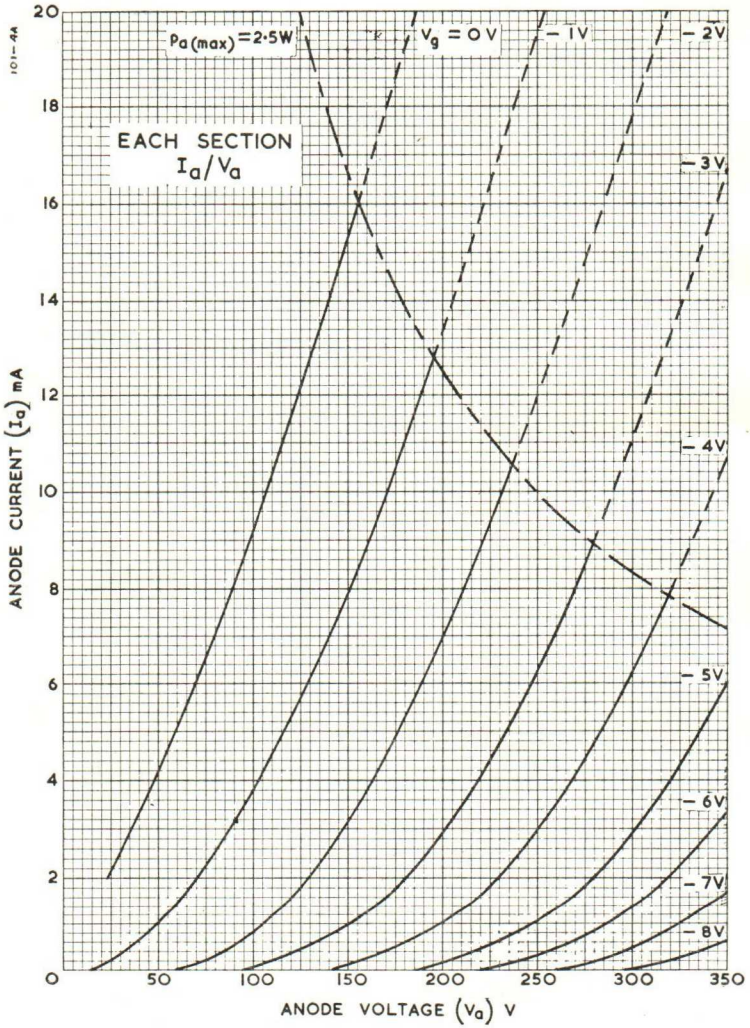
Supply Voltage	V_b	250	V
Anode Voltage	V_a	230	V
Anode Current	I_a	10	mA
Anode Load Resistance	R_a	1·8	kΩ
Grid Bias Voltage	V_g	—2	V
Mutual Conductance	g_m	6	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	9·7	kΩ
Amplification Factor	μ	58	
Input Loss at 100 Mc/s		6	kΩ
Equivalent Grid Noise Resistance	R_{eq}	500	Ω

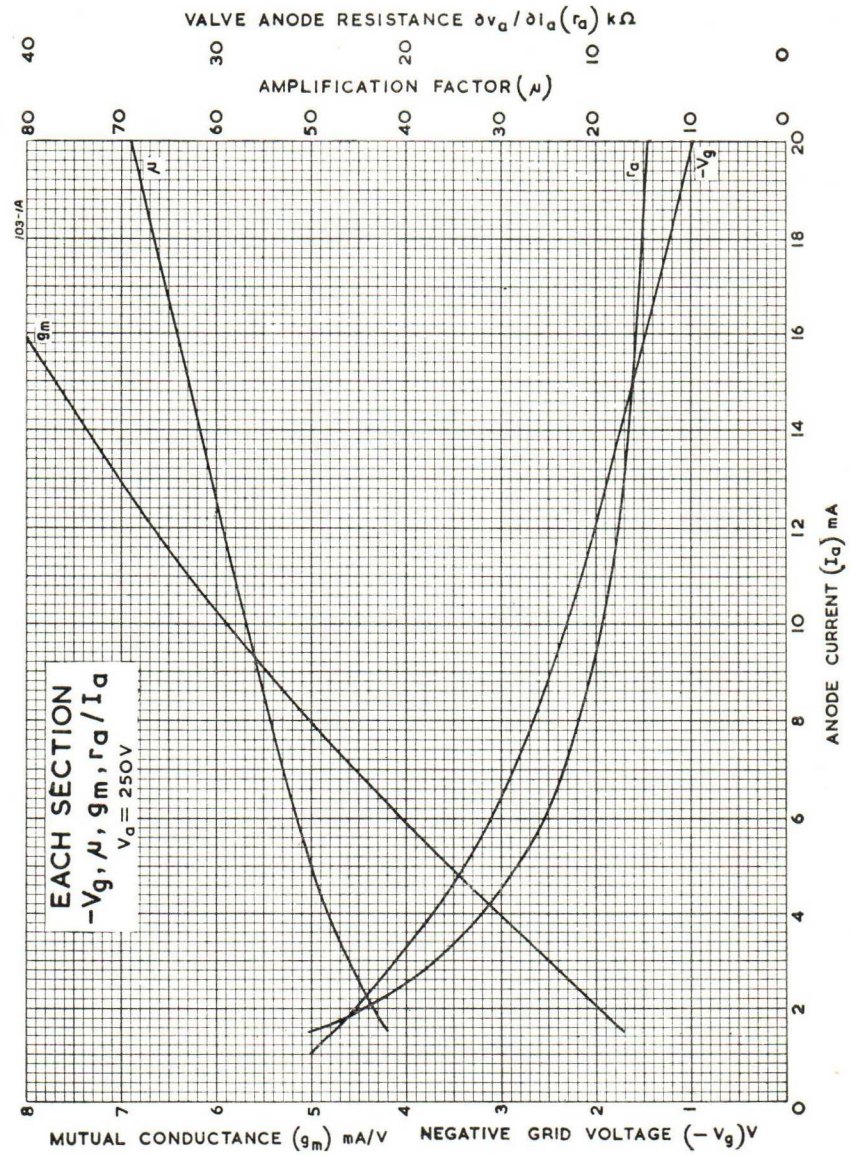
TYPICAL OPERATION AS SELF-OSCILLATING MIXER

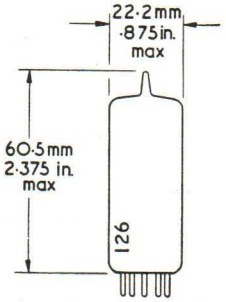
Supply Voltage	V_b	250	V
Anode Load Resistance	R_a	12	kΩ
Grid to Cathode Resistance	$R_{g\text{-}k}$	1	MΩ
Anode Current	I_a	5·2	mA
Peak Heterodyne Voltage	$v_{(pk)het}$	3·3	V
Conversion Conductance	g_c	2·3	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	22	kΩ

MOUNTING POSITION—Unrestricted.

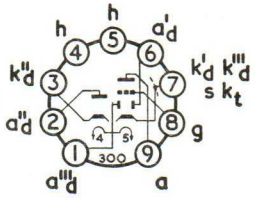

EACH SECTION
Ia/Vg
Vg = 250V
=200V
=170V
=150V
=100V
ANODE CURRENT (Ia) mA
CONTROL GRID VOLTAGE (Vg) V
20
15
10
5
0
-7
-6
-5
-4
-3
-2
-1


101-44
$P_{a(max)}$=2·5W
V_g = 0 V
– 1V
– 2V
– 3V
– 4V
– 5V
– 6V
– 7V
– 8V
EACH SECTION
I_a/V_a
ANODE CURRENT (I_a) mA
ANODE VOLTAGE (V_a) V
0
2
4
6
8
10
12
14
16
18
20
50
100
150
200
250
300
350


VALVE ANODE RESISTANCE ∂v_a / ∂i_a (r_a) kΩ
40
30
20
10
0
AMPLIFICATION FACTOR (μ)
80
70
60
50
40
30
20
10
0
103-1A
μ
gm
ra
-Vg
EACH SECTION
-Vg, μ, gm, ra / Ia
Va = 250V
20
18
16
14
12
10
8
6
4
2
0
ANODE CURRENT (Ia) mA
8
7
6
5
4
3
2
1
0
MUTUAL CONDUCTANCE (gm) mA/V
NEGATIVE GRID VOLTAGE (-Vg) V



TRIPLE DIODE TRIODE



B9A Base

GENERAL

This triple diode triode is intended for use in FM and AM/FM, AC mains receivers. The first diode is for AM detection with the second and third diodes designed for use as the FM ratio detector. The high μ triode is for audio amplification.

Heater Voltage	V_h	6·3 V
Heater Current	I_h	0·45 A

RATINGS

Maximum Triode Anode Dissipation	$P_{a(max)}$	1	W
Maximum Triode Anode Voltage	$V_{a(max)}$	300	V
Maximum Triode Heater to Cathode Voltage (d.c.)	$V_{h\text{-}kt(max)}$	150	V
Maximum Peak Inverse Voltage (All diodes)	$PIV_{(max)}$	350	V
Maximum Triode Cathode Current	$I_{kt(max)}$	5	mA
Maximum Anode Current. Diode 1	$I_{a'd(max)}$	1	mA
Maximum Anode Current. Diode 2	$I_{a''d(max)}$	10	mA
Maximum Anode Current. Diode 3	$I_{a'''d(max)}$	10	mA
Ratio Anode Resistance ($\delta v_a/\delta i_a$) Diode 2 to Diode 3		0·65 to 1·5	

INTER-ELECTRODE CAPACITANCES

		†	‡	§	
Grid to Earth	$c_{g\text{-}E}$	1·9	2·2	3·0	pF
Anode Triode to Earth	$c_{a\text{-}E}$	1·4	1·9	2·6	pF
Anode Triode to Grid	$c_{a\text{-}g}$	2·0	2·1	2·4	pF
Anode Triode to Anode Diode 1	$c_{a\text{-}a'd}$	0·08	0·09	0·10	pF
Anode Triode to Anode Diode 3	$c_{a\text{-}a'''d}$	0·05	0·11	0·22	pF
Anode Triode to Cathode Diode 2	$c_{a\text{-}k''d}$	0·006	0·011	0·016	pF
Grid to Anode Diode 1	$c_{g\text{-}a'd}$	0·06	0·07	0·10	pF
Grid to Anode Diode 3	$c_{g\text{-}a'''d}$	0·012	0·021	0·035	pF

Inter-electrode Capacitances (continued overleaf)

THORN — AEI RADIO VALVES & TUBES LTD.

		†	‡	§	
Grid to Cathode Diode 2	$c_{g\text{-}k''d}$	0·0025	0·0044	0·0066	pF
Cathode Diode 2 to All	$c_{k''d\text{-}all}$	4·9	5·3	6·4	pF
Anode Diode 3 to All	$c_{a'''d\text{-}all}$	5·1	5·6	6·6	pF
Anode Diode 1 to Heater, Cathodes Triode, Diode 1, Diode 3 and Shield	$c_{a'd\text{-}h,kt,k'd,k'''d,s}$	0·8	1·1	1·7	pF
Anode Diode 2 to Heater, Cathodes Diode 2, Triode, Diode 1, Diode 3 and Shield	$c_{a''d\text{-}h,k''d,kt,k'd,k'''d,s}$	4·8	5·0	5·4	pF

† In fully shielded socket without can.

‡With holder capacity balanced out (Holder as below).

§ Total capacity including B9A nylon phenolic holder without skirt or radial shield (AEI holder type VH19/902).

"Earth" denotes the electrodes of any second valve section and the remaining earthy potential electrodes of the section under measurement, heater and shields joined to cathode.

TRIODE CHARACTERISTICS

Anode Voltage	V_a	100	V
Anode Current	I_a	0·8	mA
Grid Voltage	V_g	–1	V
Amplification Factor	μ	70	
Mutual Conductance	g_m	1·45	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	48	kΩ

TYPICAL OPERATION AS RESISTANCE COUPLED AMPLIFIER

(Grid current bias)

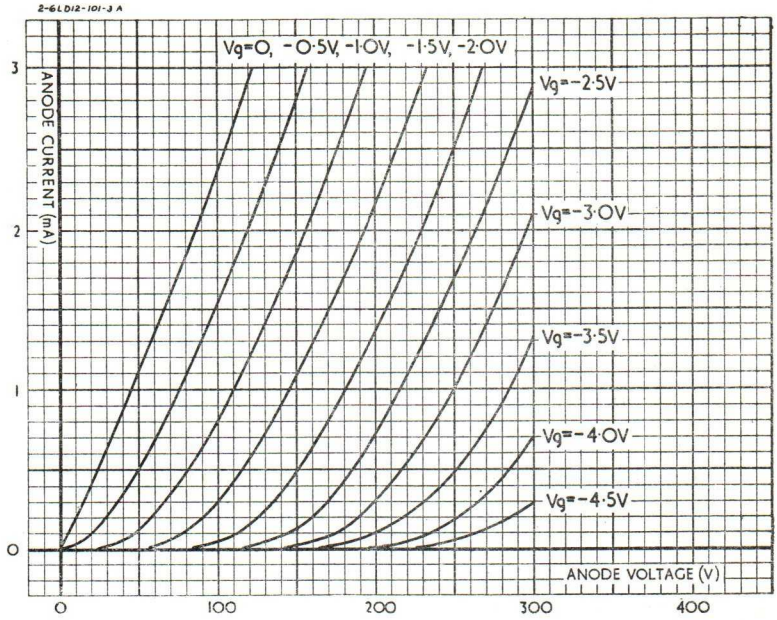
Supply Voltage	V_b	170	170	170	200	200	200	V
Anode Load Resistance	R_a	47	100	220	47	100	220	kΩ
Grid Resistor	R_g	10	10	10	10	10	10	MΩ
Anode Current	I_a	1·25	0·82	0·46	1·6	1·0	0·56	mA
Grid Resistor of Following Valve		150	330	680	150	330	680	kΩ
Voltage Amplification		32	42	51	34	44	53	
Total Distortion	D_{tot}							
for $V_{out\ (r.m.s.)}$=3V		0·6	0·5	0·4	0·5	0·4	0·3	%
for $V_{out\ (r.m.s.)}$=5V		1·1	0·8	0·5	0·9	0·6	0·4	%
for $V_{out\ (r.m.s.)}$=8V		2·0	1·3	1·1	1·5	1·0	0·9	%

MOUNTING POSITION—Unrestricted.

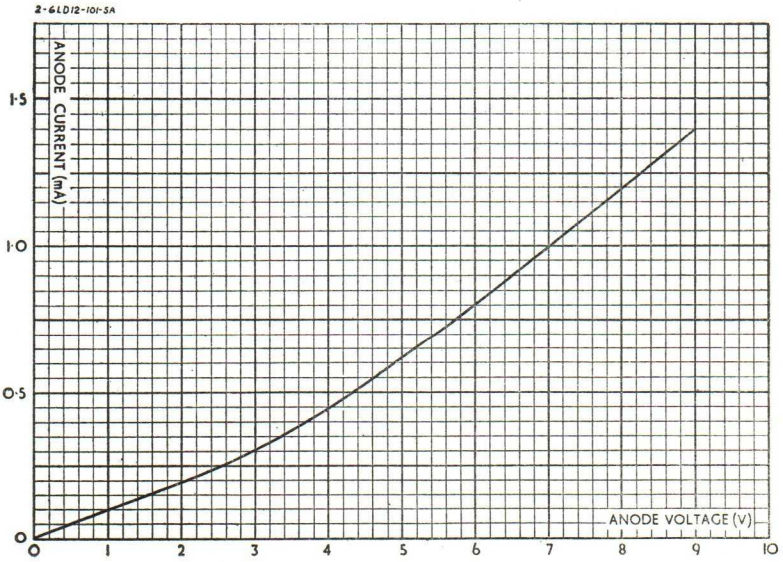
APPROXIMATE WEIGHT

Net	0·5 oz
Packed	0·75 oz

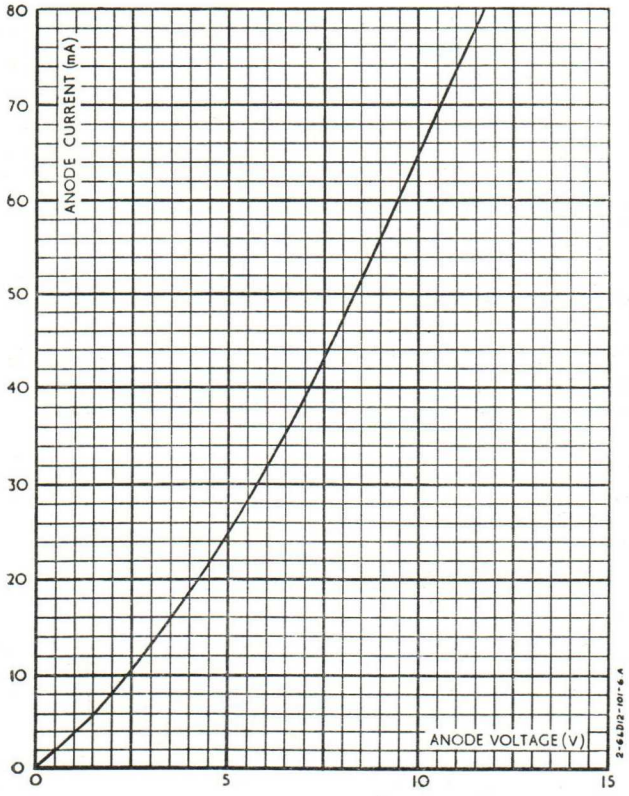
I_a/V_a : Triode Section



I_a/V_a : Diode Section 1



I_a/V_a : Diode Section 2 or 3



6P15/EL84

OUTPUT PENTODE

Indirectly heated—for parallel operation

←

GENERAL

The 6P15/EL84 is a miniature based indirectly heated output pentode having a maximum anode dissipation of 12 watts. It is intended for use in a.c. mains operated equipment having parallel connected heaters.

RATING

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·76	A
Maximum Anode Voltage	$V_{a(max)}$	300	V
Maximum Screen Voltage	$V_{g2(max)}$	300	V
Maximum Anode Dissipation	$P_{a(max)}$	12	W
Maximum Screen Dissipation (continuous)	$P_{g2(av)max}$	2§	W
Mutual Conductance	g_m	11·3*	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	38*	kΩ
Inner Mu	$\mu_{g1\text{-}g2}$	19*	
Maximum Mean Cathode Current	$I_{k(av)max}$	65	mA
Maximum Heater/Cathode Voltage d.c.	$V_{h\text{-}k(max)}$	100	V

* At $V_a = V_{g2} = 250V$. $I_a = 48$ mA. $V_{g1} = -7{\cdot}3V$.

§ On speech and music the permissible rating at max. signal is 4 watts.

INTER-ELECTRODE CAPACITANCES (pF) ←

		*	†	‡
Anode/Earth	c_{out}	5·7	6·8	7·9
Anode/Grid 1	$c_{a\text{-}g1}$	0·35	0·4	0·4
Grid 1/Earth	c_{in}	10·9	11·5	13·2
Heater/Grid 1	$c_{h\text{-}g1}$	0·1	0·15	0·15

" Earth " denotes all remaining earth potential electrodes including heater, shields and cathode.

† Inter-electrode capacity with holder balanced out.

‡ Total inter-electrode capacity including B9A nylon phenolic holder without skirt or radial shield (Clix Holder VH19/902).

* Inter electrode capacity in fully shielded jig, without can.

Indicates a change ←

THORN — AEI RADIO VALVES & TUBES LTD.

6P15/EL84

OUTPUT PENTODE

Indirectly heated—for parallel operation ←

DIMENSIONS

Maximum Overall Length	78 mm
Maximum Diameter	22·2 mm
Maximum Seated Height	71 mm
Approximate Net Weight	½ ozs
Approximate Packed Weight	¾ ozs

MOUNTING POSITION

Unrestricted but adequate ventilation should be provided.

TYPICAL OPERATION

Single Valve Class A Audio Amplifier. Fixed Bias. ←

Anode Supply Voltage	$V_{a(b)}$		250	V
Screen Voltage (screen to earth)	V_{g2}		250	V
Anode Current (quiescent)	$I_{a(o)}$		48	mA
Screen Current (quiescent)	$I_{g2(o)}$		5·5	mA
Grid Bias	V_{g1}		−7·3	V
Power Output	P_{out}	4·4†	5·4*	W
Anode Load	R_L	4,600†	4,000*	Ω
Input Swing (r.m.s.) (approx.)		3·5†	4·2*	V
Anode Current with Input Swing	I_a	50†	52*	mA
Screen Current with Input Swing	I_{g2}	8·9†	10·2*	mA
Input Swing for 50mW (r.m.s.)		0·25	0·34	V
Input Swing for 250mW (r.m.s.)		0·57	0·75	V

† For 5% third harmonic and second harmonic not exceeding 5%.

* For 7% third harmonic and second harmonic not exceeding 7%.

Taken with constant anode and screen supply voltages and no screen resistance. A voltage drop of 10 volts is assumed across the primary of the output transformer.

Indicates a change ←

THORN — AEI RADIO VALVES & TUBES LTD.

6P15/EL84

OUTPUT PENTODE

Indirectly heated—for parallel operation

←

TYPICAL OPERATION

Single Valve Class A Audio Amplifier. Self Bias.

Anode Supply Voltage	$V_{a(b)}$		257	V
Screen Voltage (screen to earth)	V_{g2}		257	V
Anode Current (quiescent)	$I_{a(o)}$		49·5	mA
Screen Current (quiescent)	$I_{g2(o)}$		5·7	mA
Cathode Bias Resistance	R_k		130	Ω
Power Output	P_{out}	4·1†	5·1*	W
Anode Load	R_L	4,600†	4,000*	Ω
Input Swing (approx) (r.m.s.)	$V_{in(r.m.s.)}$	3·4†	4·3*	V
Anode Current with Input Swing	I_a	49†	49*	mA
Screen Current with Input Swing	I_{g2}	8·5†	9·8*	mA
Input Swing for 50mW (r.m.s.)		0·25	0·34	V
Input Swing for 250mW (r.m.s.)		0·57	0·75	V

† For 5% third harmonic and second harmonic not exceeding 5%.

* For 7% third harmonic and second harmonic not exceeding 7%.

Taken with constant anode and screen supply voltages and no screen resistance. A voltage drop of 10 volts is assumed across the primary of the output transformer.

BULB—Clear

Indicates a change ←

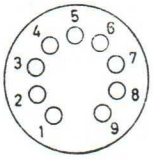
6P15/EL84

OUTPUT PENTODE

Indirectly heated—for parallel operation

←

BASE—Noval (B9A)



Viewed from Free End of Pins

CONNECTIONS

Pin 1	Internal Connection	IC
Pin 2	Control Grid	g1
Pin 3	Cathode, Suppressor Grid	k,g3
Pin 4	Heater	h
Pin 5	Heater	h
Pin 6	Internal Connection	IC
Pin 7	Anode	a
Pin 8	Internal Connection	IC
Pin 9	Screen Grid	g2

Indicates a change ←

6P15/EL84

OUTPUT PENTODE

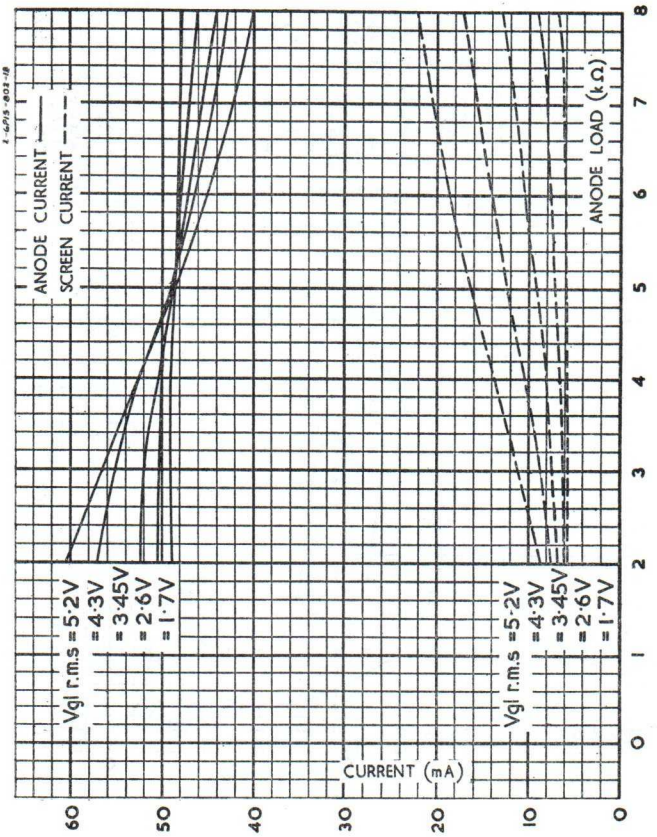
Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES

Working Anode and Screen Current

(fixed bias)

V_a (V)	V_{g2} (V)	$I_{a(o)}$ (mA)	$I_{g2(o)}$ (mA)	V_{g1} (V)
240	250	48	5·5	−7·3



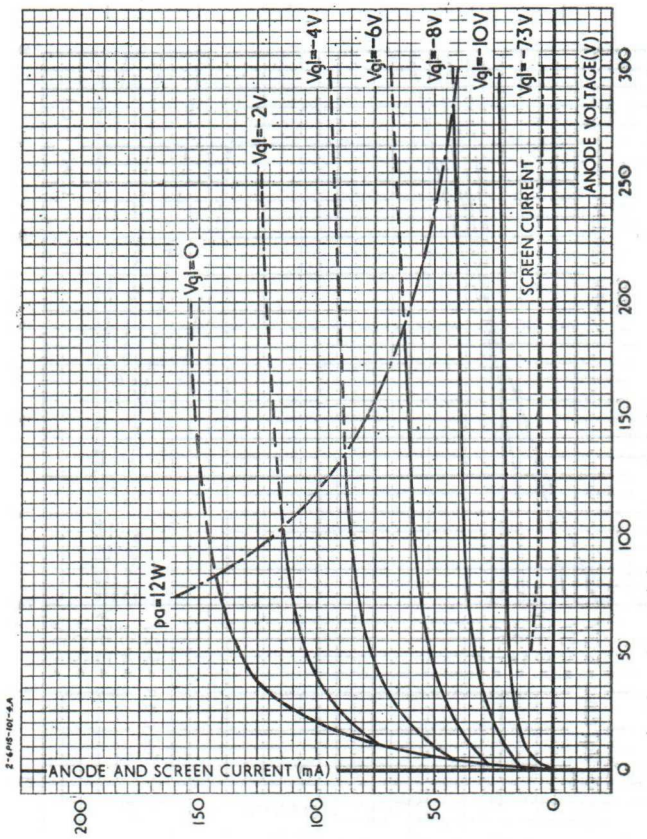
6P15/EL84

OUTPUT PENTODE

Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES : I_a, I_{g2}/V_a

(V_h=6·3V, V_{g2}=250V)



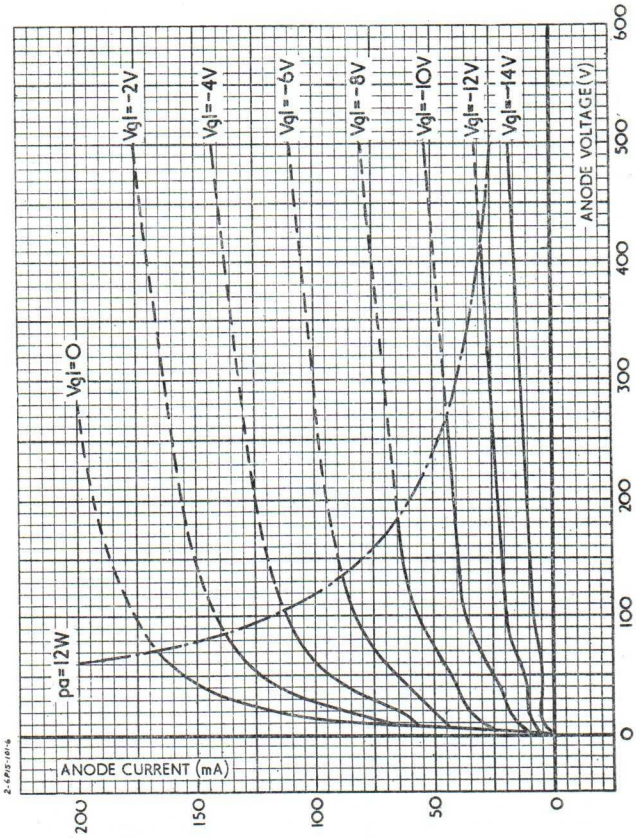
6P15/EL84

OUTPUT PENTODE

Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES : I_a/V_a

(V_{g2} = 300V)



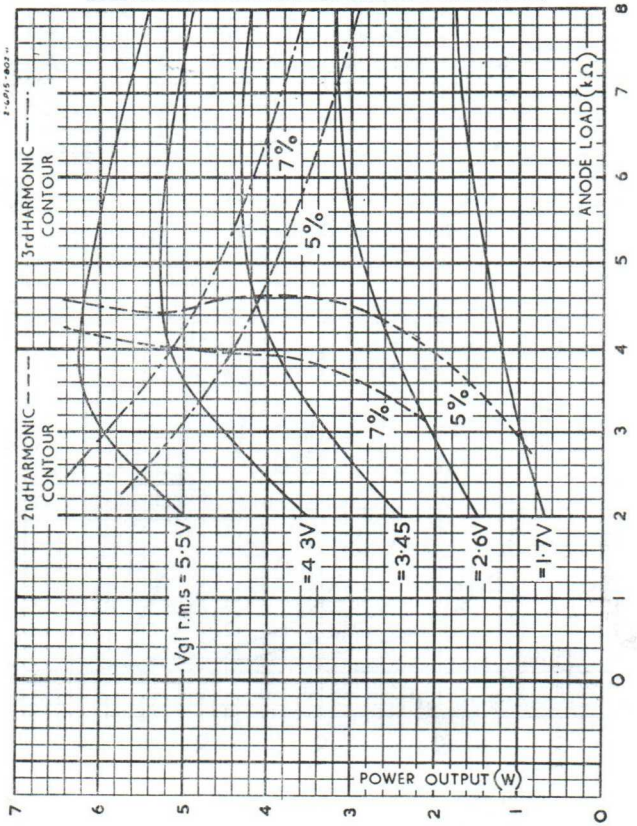
6P15/EL84

OUTPUT PENTODE

Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES :
Power Output and Harmonic Contours (Self bias)

V_{a}-E (V)	V_{g2}-E (V)	$I_{a(o)}$ (mA)	$I_{g2(o)}$ (mA)	R_k (Ω)
247	257	49·5	5·7	130
R_k bypassed by a condenser				



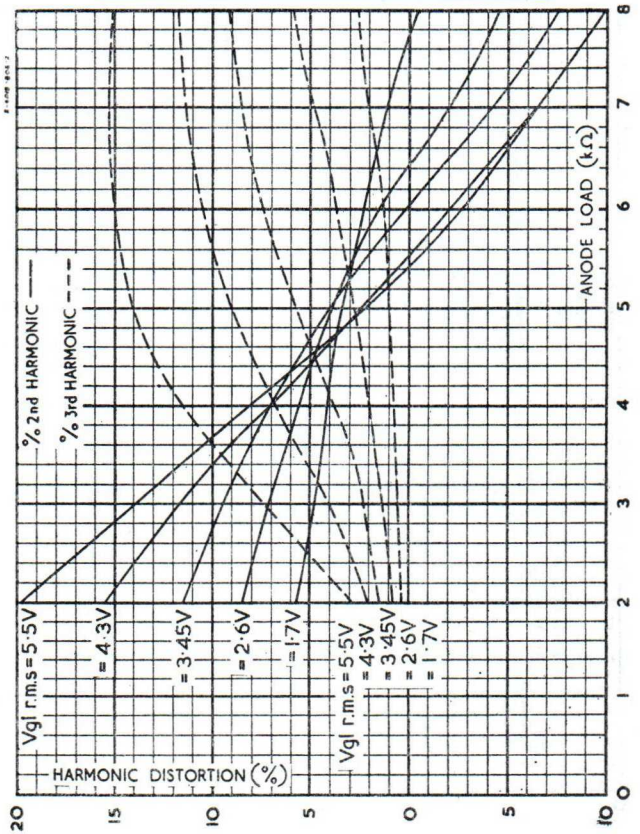
6P15/EL84

OUTPUT PENTODE

Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES:
Harmonic Distortion Curves (self bias)

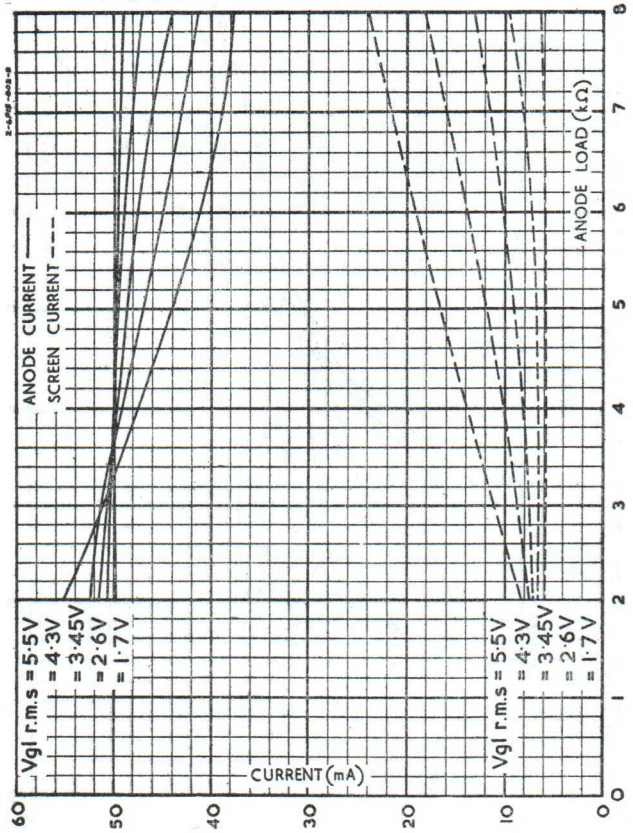
V_{a-E}	V_{g2-E}	$I_{a(o)}$	$I_{g2(o)}$	R_k
(V)	(V)	(mA)	(mA)	(Ω)
247	257	49·5	5·7	130
R_k bypassed by a condenser				



6P15/EL84
OUTPUT PENTODE
Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES
Working Anode and Screen Current (self bias)

V_{a-E}	V_{g2-E}	$I_{a(o)}$	$I_{g2(o)}$	R_k
(V)	(V)	(mA)	(mA)	(Ω)
247	257	49·5	5·7	130
R_k bypassed by a condenser				



6P15/EL84

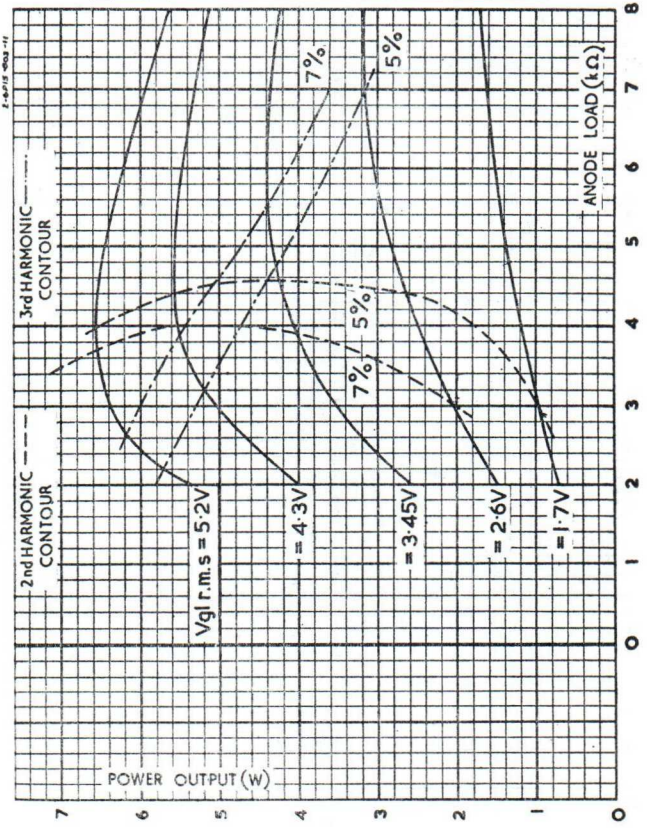
OUTPUT PENTODE

Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES:

Power Output and Harmonic Contours with Constant D.C. Supply Voltages (fixed bias)

V_a	V_{g2}	$I_{a(o)}$	$I_{g2(o)}$	V_{g1}
(V)	(V)	(mA)	(mA)	(V)
240	250	48	5·5	−7·3



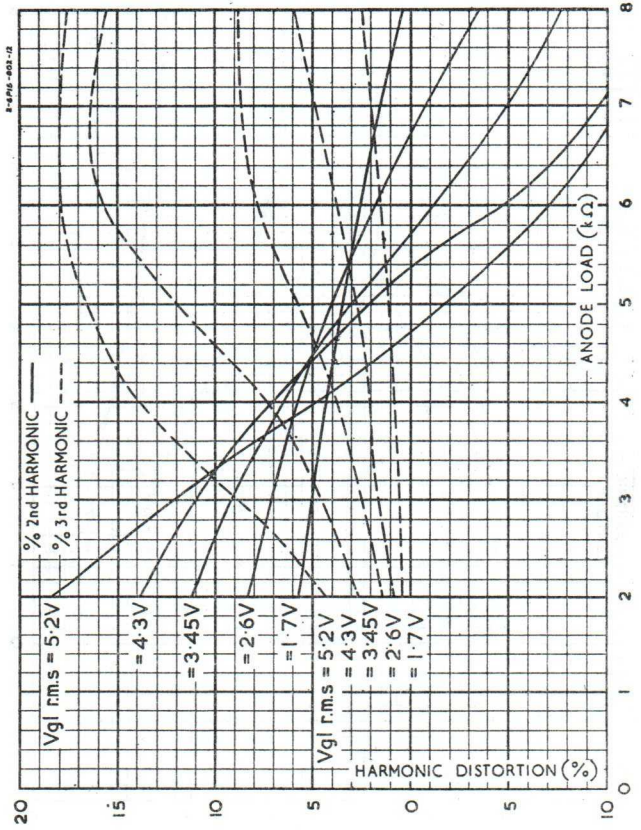
6P15/EL84

OUTPUT PENTODE

Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES:
Harmonic Distortion Curves
(fixed bias)

V_a	V_{g2}	$I_{a(o)}$	$I_{g2(o)}$	V_{g1}
(V)	(V)	(mA)	(mA)	(V)
240	250	48	5·5	−7·3

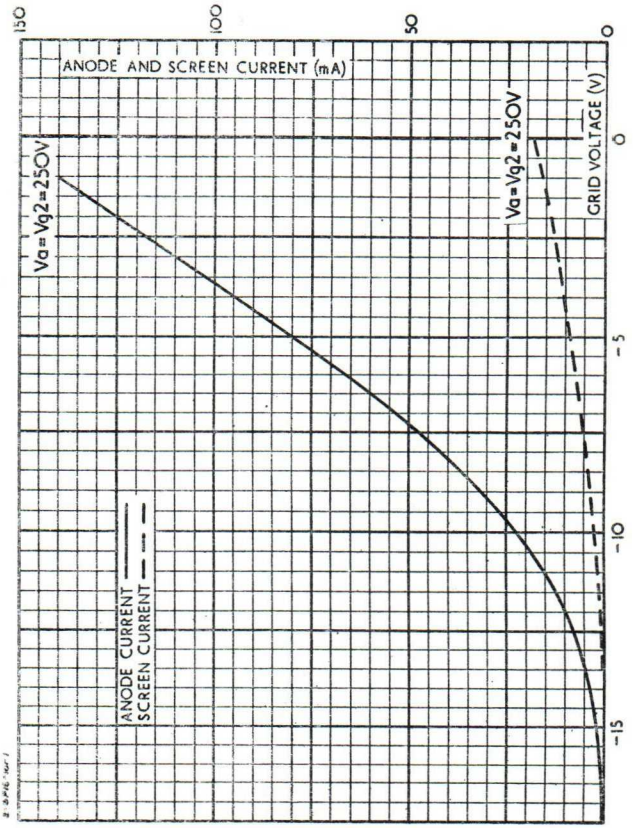


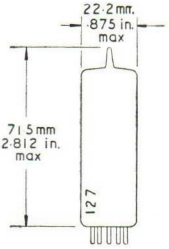
6P15/EL84

OUTPUT PENTODE

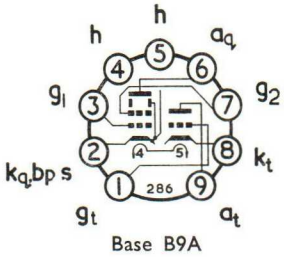
Indirectly heated—for parallel operation

AVERAGE CHARACTERISTIC CURVES : I_a, I_{g2}/V_{g1}





TRIODE OUTPUT BEAM TETRODE



Base B9A

GENERAL

This triode output beam tetrode is for use in television receivers with the triode as A.F. amplifier or time base oscillator and the tetrode as audio or field output valve.

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·78	A

RATINGS

		Triode	Tetrode	
Maximum Anode Dissipation	$P_{a(max)}$			
For $V_a \leqslant 250V$		1·0	7·0	W
For $V_a > 250V$		—	5·0	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	—	1·8	W
For speech and music		—	3·2	W
Maximum Anode Supply Voltage ($I_a=0$)	$V_{a(b)max}$	550	550	V
Maximum Anode Voltage	$V_{a(max)}$	300	300	V
Maximum Peak Anode Voltage	$V_{a(pk)max}$			
Pulse Positive		0·6*	2·5†	kV
Pulse Negative		—	500	V
Maximum Screen Grid Supply Voltage ($I_{g2}=0$)	$V_{g2(b)max}$	—	550	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	—	300	V
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$	100‡	100‡	V
Maximum Mean Cathode Current	$I_{k(av)max}$	15	50	mA
Maximum Resistance Grid 1 to Cathode	$R_{g1-k(max)}$			
Self Bias		3	2	MΩ
Fixed Bias		1	1	MΩ
Grid Current Bias		22	—	MΩ
Maximum Resistance Heater to Cathode	$R_{h-k(max)}$	20	20	kΩ

* Maximum pulse duration 200μs.
† Maximum pulse duration 4 per cent. of one cycle with a maximum of 800μs.
‡ Measured with respect to the higher potential heater pin.

THORN — A E I RADIO VALVES & TUBES LTD.

INTER-ELECTRODE CAPACITANCES

		§	¶	‖	
Tetrode Input	$c_{in(q)}$	9·3	9·6	10·7	pF
Tetrode Output	$c_{out(q)}$	9·0	9·3	10·4	pF
Tetrode Anode to Grid 1	c_{aq-g1}	0·35	0·37	0·38	pF
Triode Input	$c_{in(t)}$	3·0	3·2	4·1	pF
Triode Output	$c_{out(t)}$	4·3	4·5	5·4	pF
Grid Triode to Anode Triode	c_{gt-at}	4·2	4·3	4·4	pF
Anode Tetrode to Anode Triode	c_{aq-at}	0·15	0·18	0·19	pF
Grid 1 to Grid Triode	c_{g1-gt}	0·011	0·030	0·063	pF
Grid 1 to Anode Triode	c_{g1-at}	0·017	0·023	0·028	pF
Grid Triode to Anode Tetrode	c_{gt-aq}	0·014	0·020	0·022	pF
Grid Triode to Heater	c_{gt-h}	0·018	0·031	0·042	pF
Grid 1 to Heater	c_{g1-h}	0·24	0·38	0·71	pF

§ In fully-shielded socket without can.

¶ With holder capacitance balanced out (holder as below).

‖ Total inter-electrode capacitances including B9A nylon phenolic holder without skirt or radial shield (AEI holder type VH19/902).

CHARACTERISTICS

		Triode	Tetrode	
Anode Voltage	V_a	100	200	V
Screen Grid Voltage	V_{g2}	—	200	V
Anode Current	I_a	3·5	35	mA
Screen Grid Current	I_{g2}	—	7	mA
Control Grid Voltage	V_{g1}	0	−16	V
Mutual Conductance	g_m	2·5	6·4	mA/V
Amplification Factor	μ	70	—	
Inner Amplification Factor	μ_{g1-g2}	—	9·5	

TYPICAL OPERATION

Single Valve as Class A Audio Output

Anode Voltage	V_a	200	250	V
Screen Grid Voltage	V_{g2}	200	250	V
Undecoupled Screen Grid Resistor	R_{g2}	0	2·2	kΩ
Cathode Resistor	R_k	390	680	Ω
Grid Bias Voltage	V_{g1}	−16	−22·5	V
Quiescent Anode Current	$I_{a(o)}$	35	28	mA
Quiescent Screen Grid Current	$I_{g2(o)}$	7	5·5	mA
Power Output for 10 per cent. total distortion	P_{out}	3·5	3·4	W
Anode Load Resistance	R_a	5·6	9·0	kΩ
Input Swing Voltage (R.M.S.)	$V_{in(r.m.s.)}$	6·6	9·5	V
Input Swing for 50 mW output (R.M.S.)		0·6	0·78	V

Field Scanning

The field scan output stage should be designed to allow for valve spread and deterioration during life in addition to component variation. Values of total tetrode peak anode current available for a new average valve and at the assumed end of life point on any valve are as follows :—

		*	†	
Anode Voltage	V_a	50	50	V
Screen Grid Voltage	V_{g2}	170	170	V
Anode Current	I_a	135	85	mA

Where V_{g1} is adjusted so that $I_{g1} = +0{\cdot}3\mu A$.

* Average new valve.

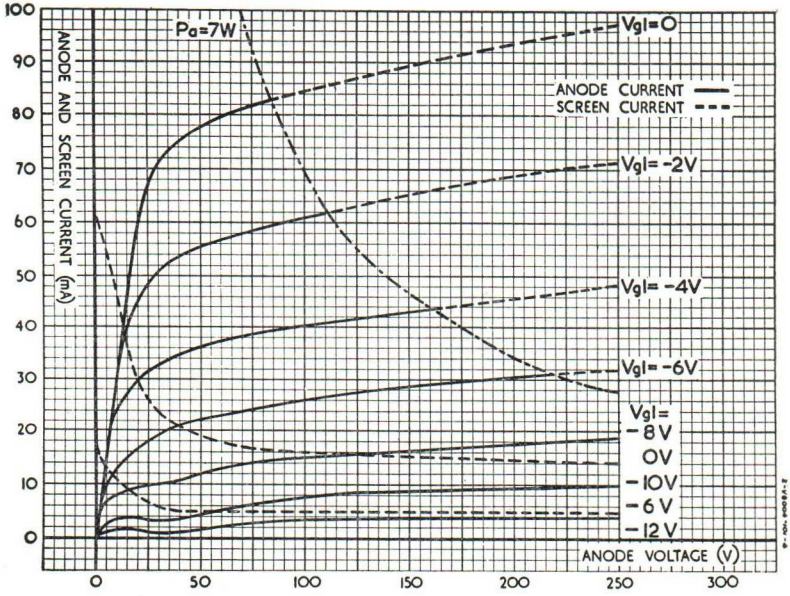
† Assumed end of life condition.

MOUNTING POSITION—Unrestricted

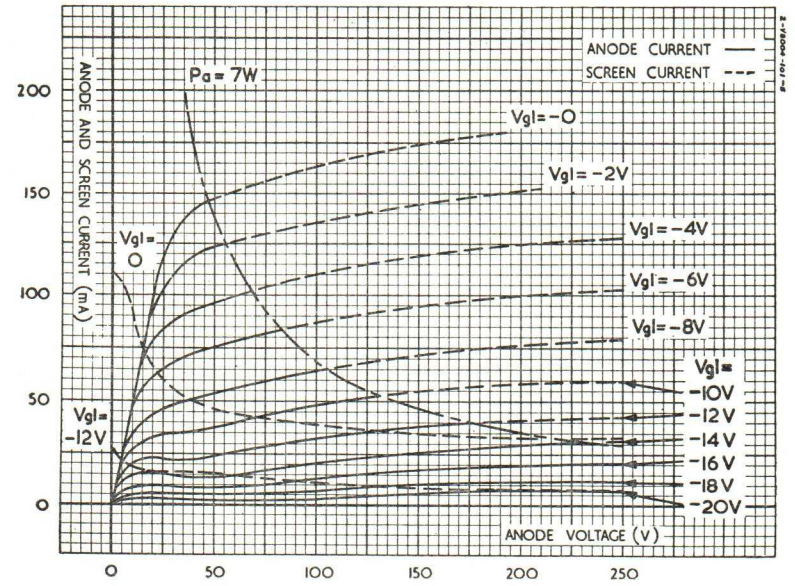
CHARACTERISTIC CURVES

$I_a, I_{g2}/V_a$ (V_{g2}=100V)

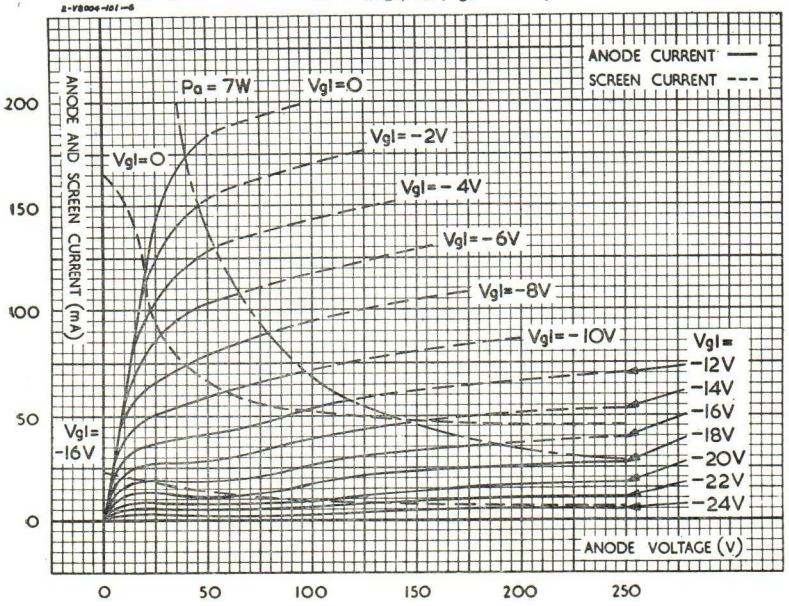
Tetrode Section



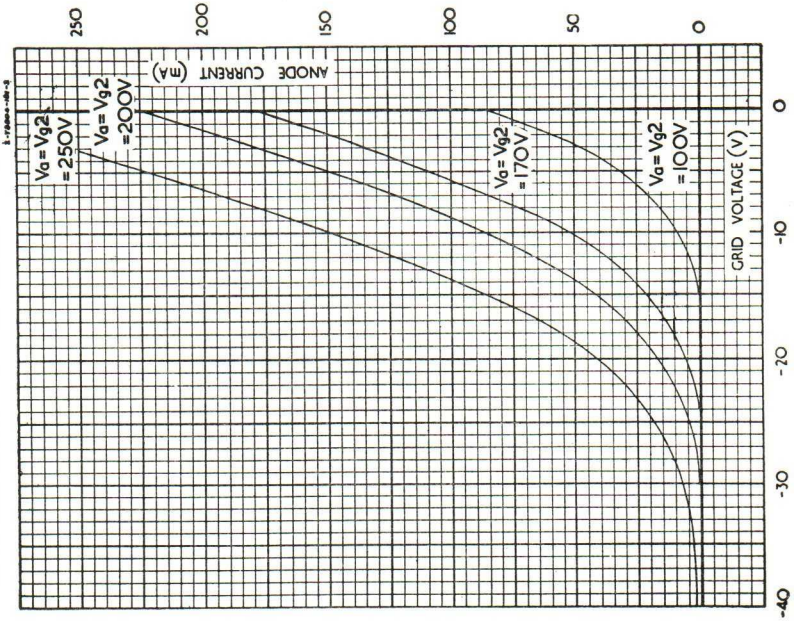
CHARACTERISTIC CURVES : $I_a, I_{g2}/V_a$ (V_{g2}=170V) — Tetrode Section



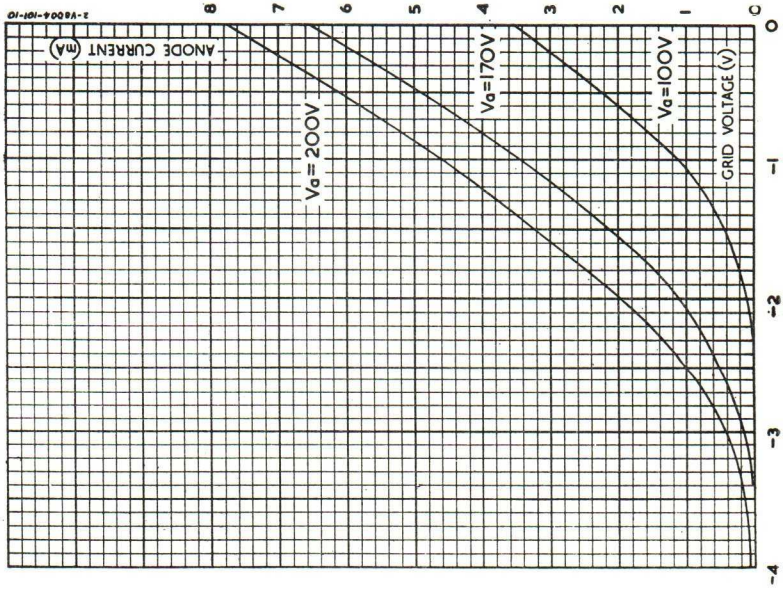
CHARACTERISTIC CURVES : $I_a, I_{g2}/V_a$ (V_{g2}=200V) — Tetrode Section



CHARACTERISTIC CURVES : I_a/V_{g1} — Tetrode Section



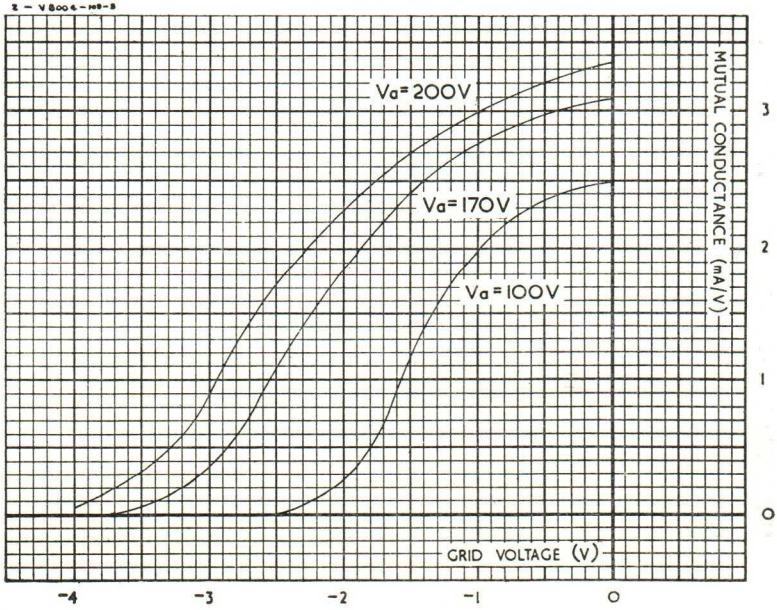
CHARACTERISTIC CURVES : I_a/V_g — Triode Section

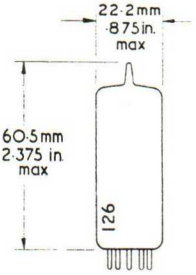


CHARACTERISTIC CURVES : I_a/V_a — Triode Section

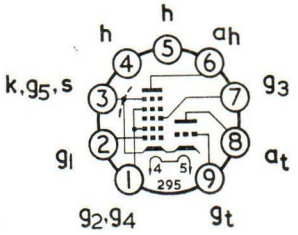


CHARACTERISTIC CURVES : g_m/V_g — Triode Section





TRIODE HEPTODE FREQUENCY CHANGER



B9A Base

GENERAL

This triode heptode valve combination, with separate electrode structures, is for use in AM/FM broadcast radio AC/DC receivers. The valve is intended to be used as a frequency changer for AM signals with the triode as local oscillator and the heptode switched to operate as an I.F. amplifier for FM signals.

Heater Current	I_h	0·1	A
Heater Voltage	V_h	19·0	V

RATINGS

		Triode	Heptode	
Maximum Anode Dissipation	$P_{a(max)}$	0·8	1·7	W
Maximum Screen Grids Dissipation	$P_{g2+g4(max)}$	—	1	W
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Screen Grids Voltage (I_a = 7·6mA)	$V_{g2+g4(max)}$	—	125	V
Maximum Screen Grids Voltage (I_a <1mA)		—	250	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h-k(r.m.s.)max}$	100*		V
Maximum Mean Cathode Current	$I_{k(av)max}$	6·5	12·5	mA

* Measured with respect to the higher potential heater pin.

INTER-ELECTRODE CAPACITANCES

		Triode	Heptode	
Output	C_{out}	2·1	7·9	pF
Input (g_1)	$C_{in(g1)}$	2·6	4·8	pF
Input (g_3)	$C_{in(g3)}$	—	6	pF
Grid 1 to Anode	C_{g1-a}	1	<0·006	pF
Grid 1 to Grid 3	C_{g1-g3}	—	<0·3	pF
Grid 1 to Grid 3, Grid Triode	$C_{g1-g3gt}$	<0·45		pF
Grid 1 to Grid Triode	C_{g1-gt}	<0·17		pF
Anode Heptode to Anode Triode	C_{ah-at}	0·2		pF

Inter-electrode capacitances measured with holder capacitances balanced out.

THORN—A E I RADIO VALVES & TUBES LTD.

CHARACTERISTICS

		Triode	Heptode	
Anode Voltage	V_a	100	170	V
Screen Grids Voltage	V_{g2+g4}	—	102	V
Grid 3 Voltage	V_{g3}	—	0	V
Control Grid Voltage	V_{g1}	−1	−2·2	V
Anode Current	I_a	10	6·2	mA
Mutual Conductance	g_m	3·2	2·3	mA/V
Amplification Factor	μ	19	—	
Inner Amplification Factor	$\mu_{g1-(g2+g4)}$	—	20	

TYPICAL OPERATION AS R.F. or I.F. AMPLIFIER

Heptode Section

Supply Voltage	V_b	170	V
Anode Voltage	V_a	170	V
Screen Grids Resistance	R_{g2+g4}	18	kΩ
Screen Grids Voltage (Initial)	V_{g2+g4}	102	V
Grid 3 Voltage	V_{g3}	0	V
Control Grid Voltage	V_{g1}	−2·2	V
Anode Current (approximately)	I_a	6·2	mA
Screen Grids Current (approximately)	I_{g2+g4}	3·8	mA
Mutual Conductance	g_m	2·3	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	0·6	MΩ
Equivalent Grid Noise Resistance	R_{eq}	8·8	kΩ
Grid 1 Voltage for 100 : 1 reduction of Mutual Conductance		−28	

TYPICAL OPERATION AS A.M. FREQUENCY CHANGER

Heptode Section

Supply Voltage	V_b	170	V
Anode Voltage	V_a	170	V
Screen Grids Resistance	R_{g2+g4}	10	kΩ
Screen Grids Voltage (Initial)	V_{g2+g4}	102	V
Control Grid Voltage	V_{g1}	−2·2	V
Anode Current (approximately)	I_a	3·2	mA
Screen Grids Current (approximately)	I_{g2+g4}	6·8	mA
Heptode Grid 3 and Triode Grid Current	I_{g3+gt}	200	μA
Heptode Grid 3 and Triode Grid Resistance	R_{g3+gt}	47	kΩ
Peak Heterodyne Voltage	$V_{(pk)het}$	12	V
Conversion Conductance	g_c	750	μA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	0·9	MΩ
Equivalent Grid Noise Resistance	R_{eq}	70	kΩ
Grid Voltage for 100 : 1 reduction of Conversion Conductance		−24	V

Triode

Anode Voltage	V_a	103	V
Anode Current (Average)	$I_{a(av)}$	4·5	mA

MOUNTING POSITION—Unrestricted

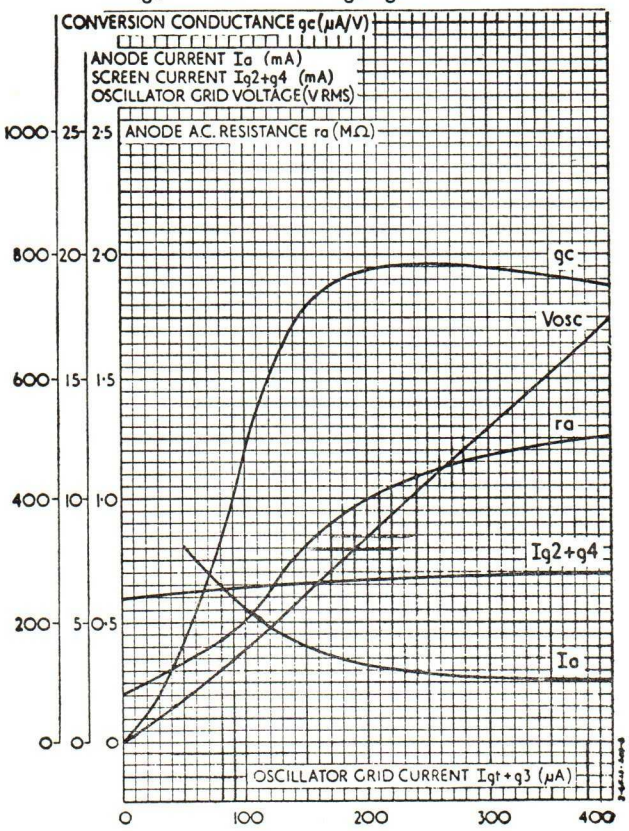
APPROXIMATE WEIGHT

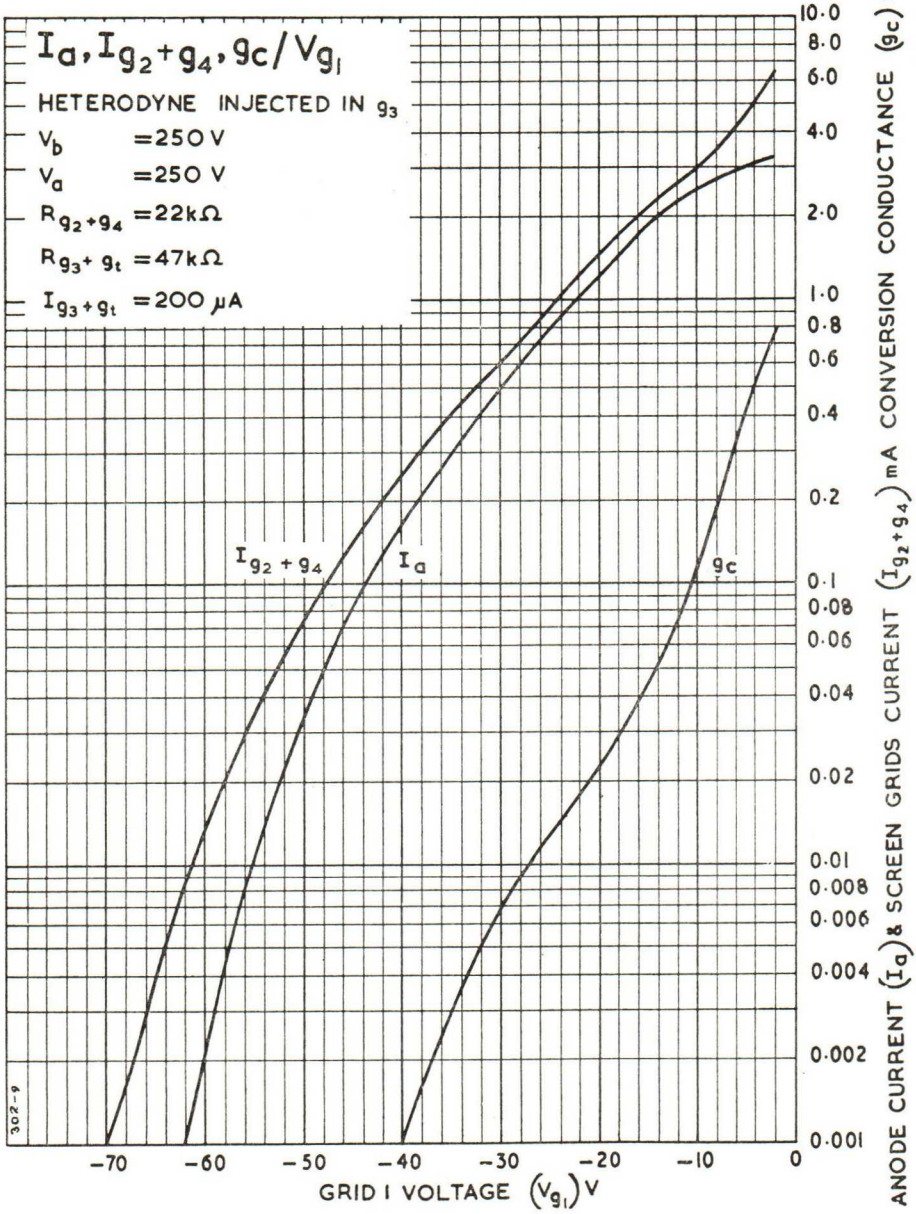
Net	0·5	oz
Packed	0·75	oz

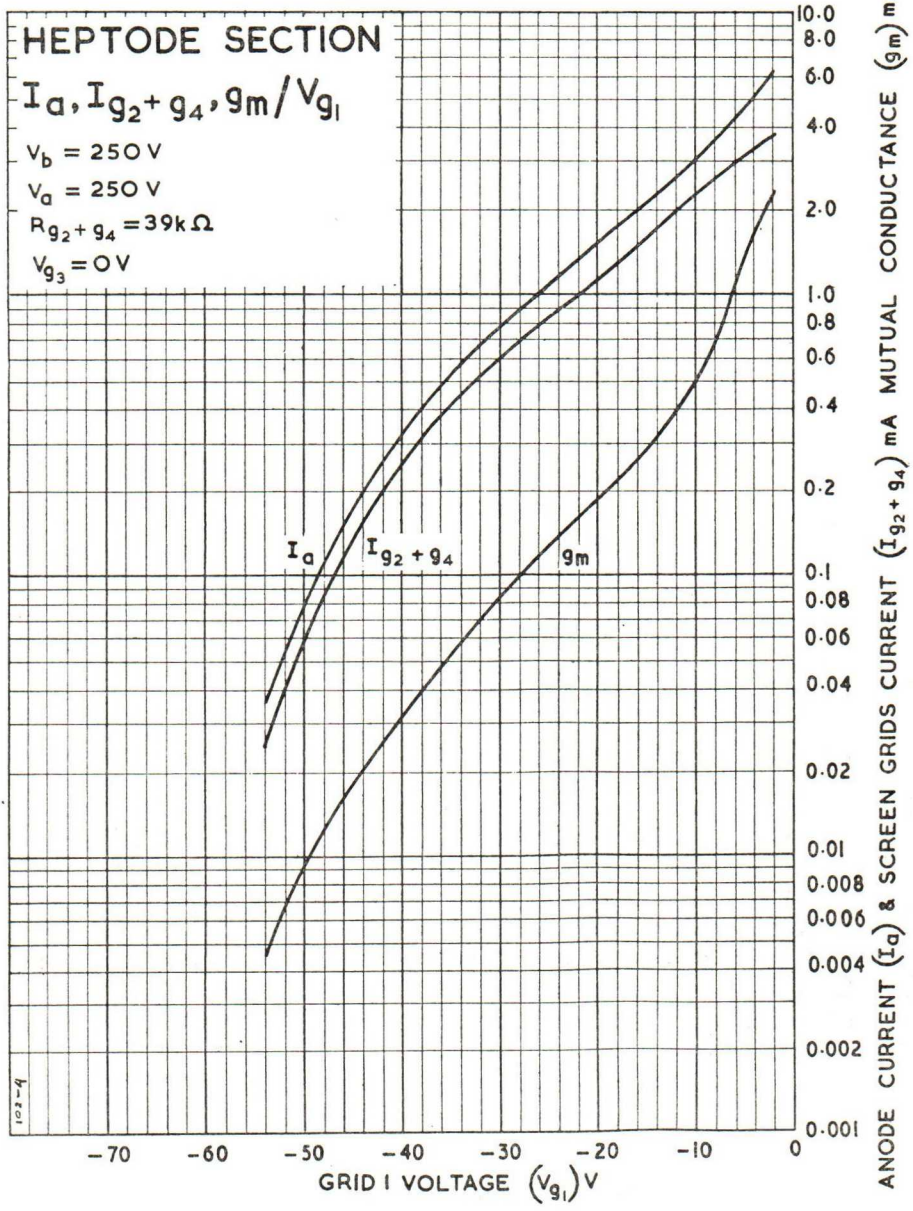
AVERAGE CHARACTERISTIC CURVES:
$I_a, I_{g2}, g_c, r_a, V_{osc}/I_{gt+g3}$

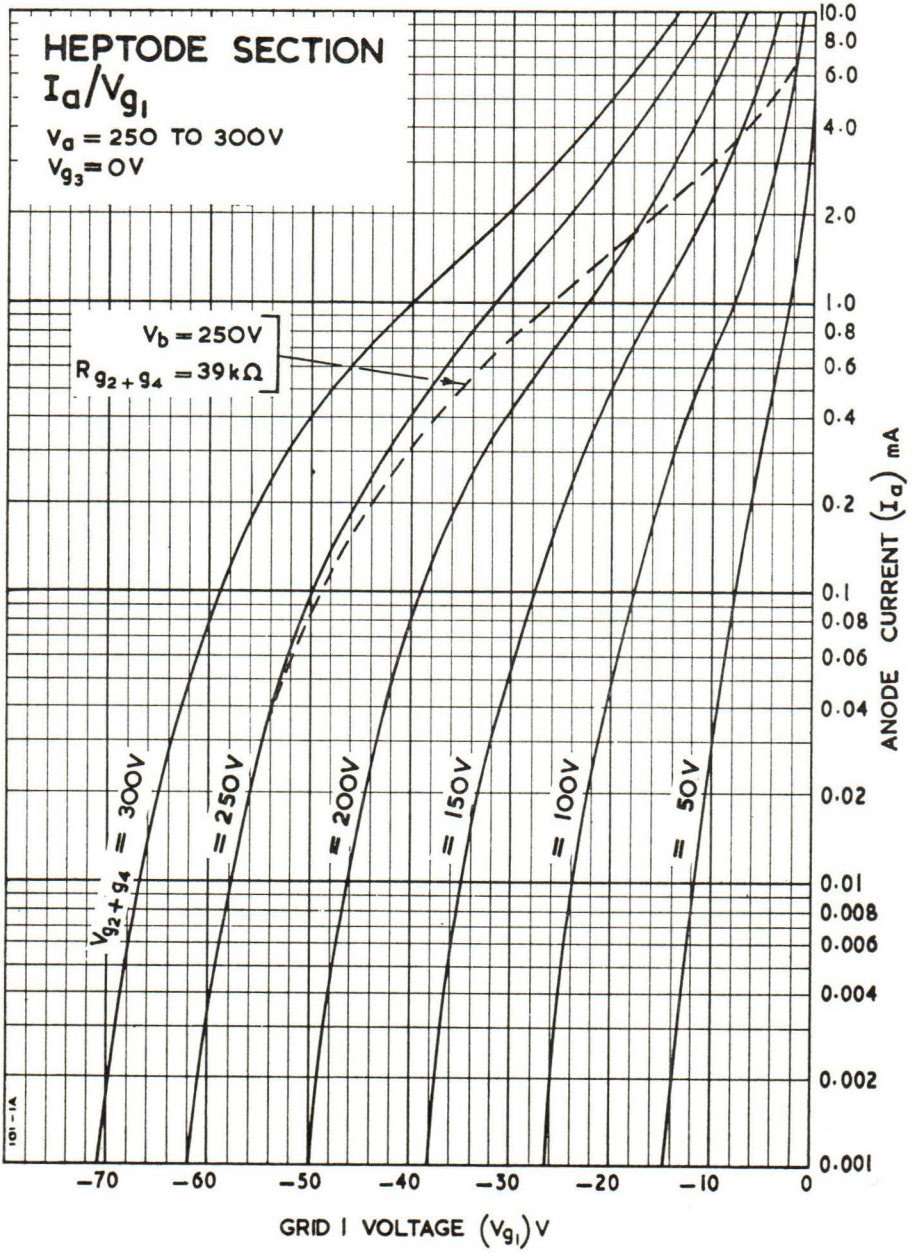
$V_a = 250V$ $R_{g2+g4} = 22k\Omega$

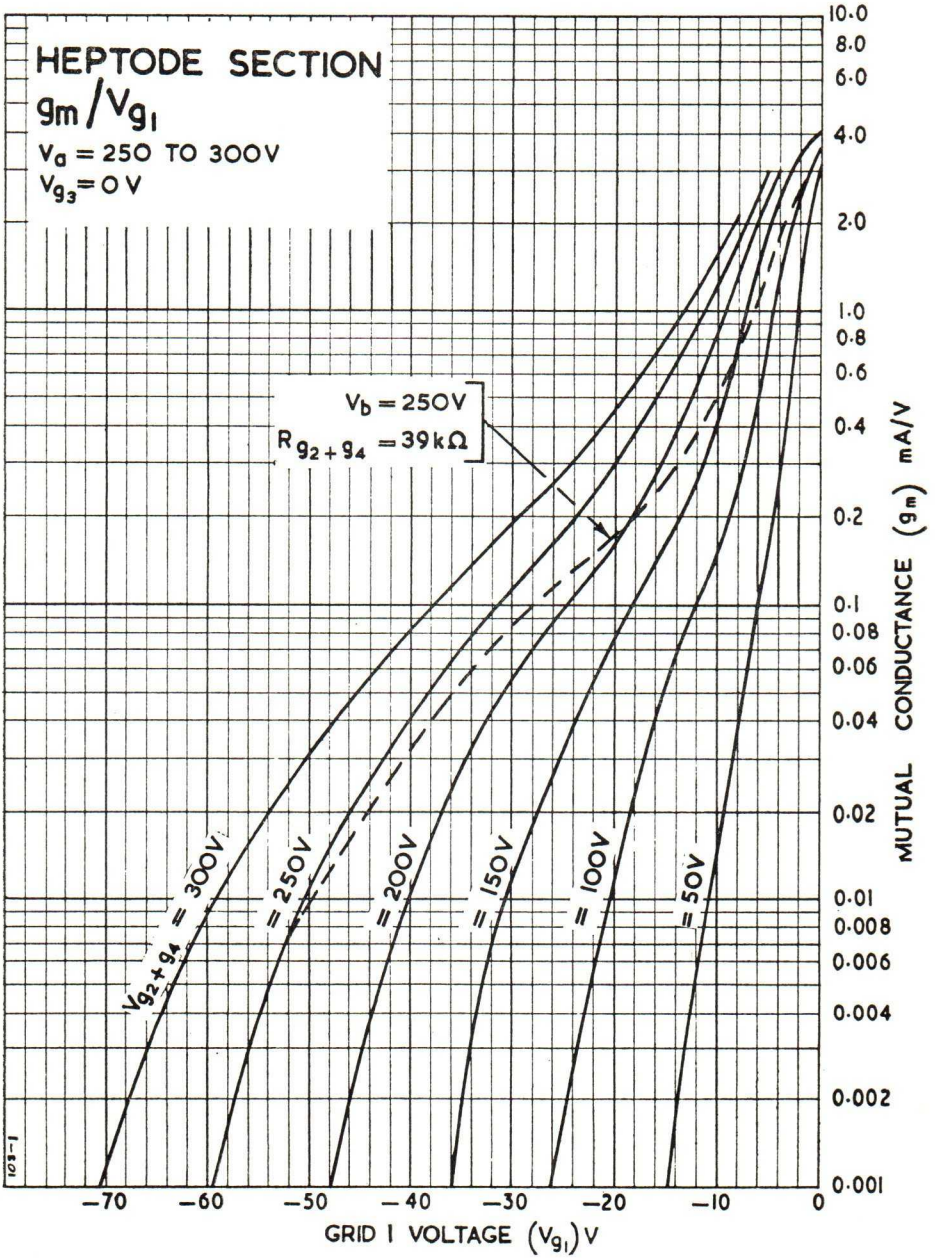
$V_{g1} = -2V$ $R_{gt+g3} = 47k\Omega$

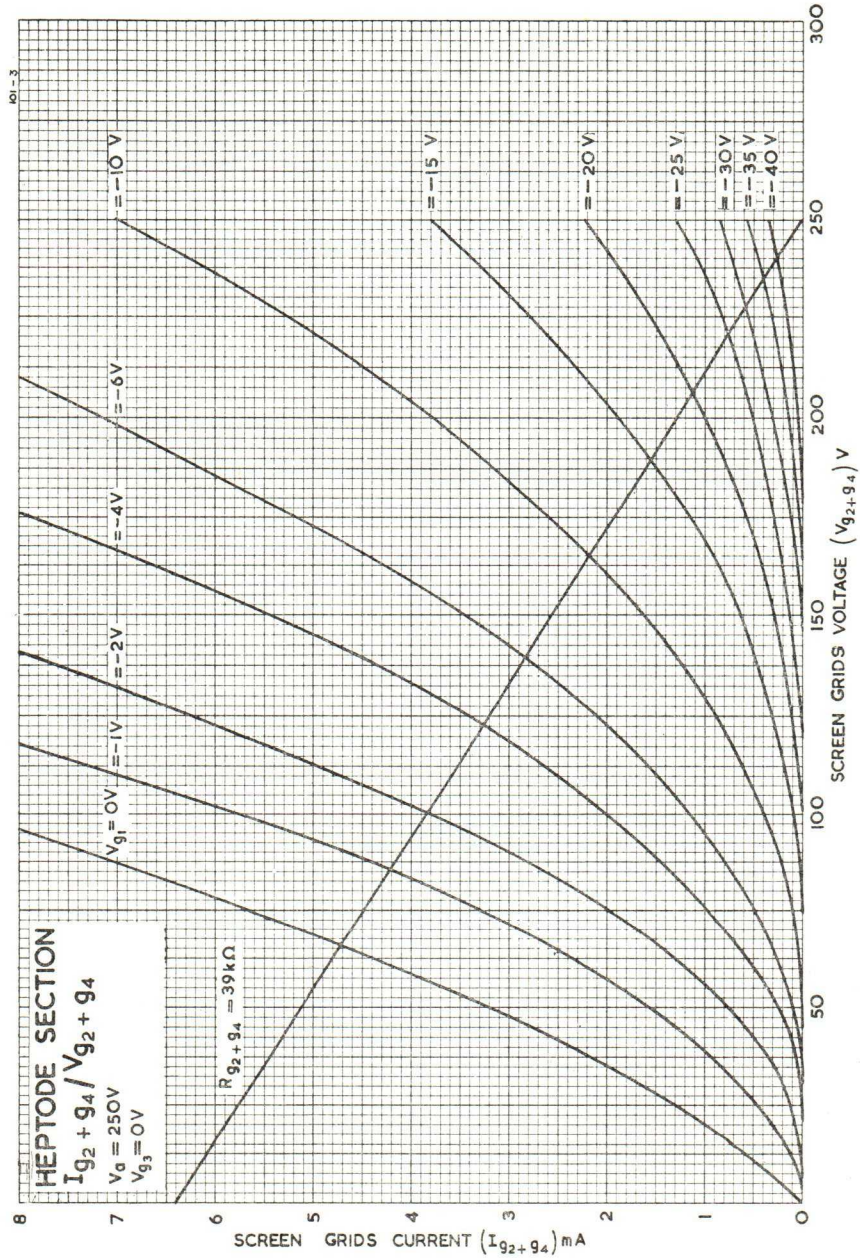


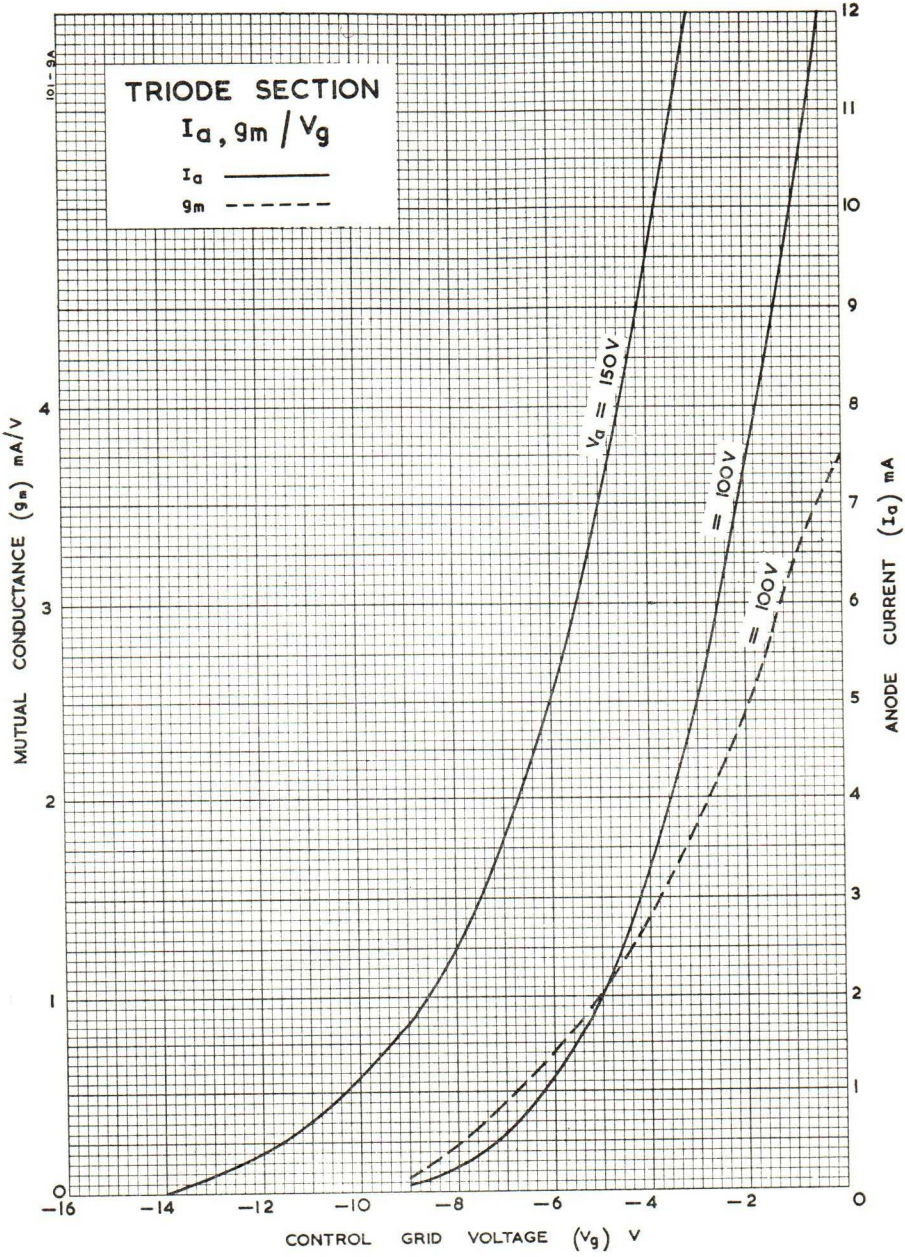

$I_a, I_{g_2+g_4}, g_c / V_{g_1}$
HETERODYNE INJECTED IN g_3
V_b =250 V
V_a =250 V
$R_{g_2+g_4}$ =22kΩ
$R_{g_3+g_t}$ =47kΩ
$I_{g_3+g_t}$ =200 μA
$I_{g_2+g_4}$
I_a
g_c
302-9
−70
−60
−50
−40
−30
−20
−10
0
GRID 1 VOLTAGE (V_{g_1}) V
10·0
8·0
6·0
4·0
2·0
1·0
0·8
0·6
0·4
0·2
0·1
0·08
0·06
0·04
0·02
0·01
0·008
0·006
0·004
0·002
0·001
ANODE CURRENT (I_a) & SCREEN GRIDS CURRENT $(I_{g_2+g_4})$ mA CONVERSION CONDUCTANCE (g_c) mA/V


HEPTODE SECTION
Ia, Ig2+g4, gm/Vg1
Vb = 250 V
Va = 250 V
Rg2+g4 = 39kΩ
Vg3 = 0 V
Ia
Ig2+g4
gm
10·0
8·0
6·0
4·0
2·0
1·0
0·8
0·6
0·4
0·2
0·1
0·08
0·06
0·04
0·02
0·01
0·008
0·006
0·004
0·002
0·001
ANODE CURRENT (Ia) & SCREEN GRIDS CURRENT (Ig2+g4) mA MUTUAL CONDUCTANCE (gm) mA/V
−70
−60
−50
−40
−30
−20
−10
0
GRID 1 VOLTAGE (Vg1) V


HEPTODE SECTION
I_a/V_{g_1}
V_a = 250 TO 300V
V_{g_3} = 0V
V_b = 250V
$R_{g_2+g_4}$ = 39kΩ
$V_{g_2+g_4}$ = 300V
= 250V
= 200V
= 150V
= 100V
= 50V
10·0
8·0
6·0
4·0
2·0
1·0
0·8
0·6
0·4
0·2
0·1
0·08
0·06
0·04
0·02
0·01
0·008
0·006
0·004
0·002
0·001
ANODE CURRENT (I_a) mA
−70
−60
−50
−40
−30
−20
−10
0
GRID 1 VOLTAGE (V_{g_1}) V
101-1A

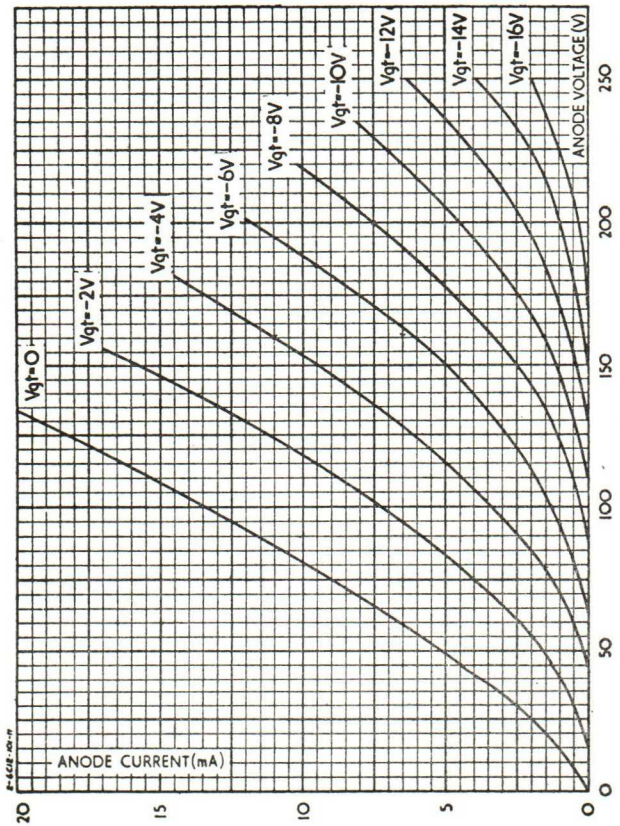

HEPTODE SECTION
gm / Vg1
Va = 250 TO 300V
Vg3 = 0 V
Vb = 250V
Rg2+g4 = 39kΩ
Vg2+g4 = 300V
= 250V
= 200V
= 150V
= 100V
= 50V
10·0
8·0
6·0
4·0
2·0
1·0
0·8
0·6
0·4
0·2
0·1
0·08
0·06
0·04
0·02
0·01
0·008
0·006
0·004
0·002
0·001
MUTUAL CONDUCTANCE (gm) mA/V
−70
−60
−50
−40
−30
−20
−10
0
GRID I VOLTAGE (Vg1) V
I-1501


HEPTODE SECTION
$I_{g_2+g_4}/V_{g_2+g_4}$
$V_a = 250V$
$V_{g_3} = 0V$
$R_{g_2+g_4} = 39k\Omega$
$V_{g_1} = 0V$
$= -1V$
$= -2V$
$= -4V$
$= -6V$
$= -10V$
$= -15V$
$= -20V$
$= -25V$
$= -30V$
$= -35V$
$= -40V$
SCREEN GRIDS CURRENT $(I_{g_2+g_4})$ mA
SCREEN GRIDS VOLTAGE $(V_{g_2+g_4})$ V
0
1
2
3
4
5
6
7
8
50
100
150
200
250
300


TRIODE SECTION
Ia, gm / Vg
Ia
gm
101-9A
Va = 150 V
= 100 V
= 100 V
MUTUAL CONDUCTANCE (gm) mA/V
ANODE CURRENT (Ia) mA
CONTROL GRID VOLTAGE (Vg) V
0
1
2
3
4
5
6
7
8
9
10
11
12
−16
−14
−12
−10
−8
−6
−4
−2
0

CHARACTERISTIC CURVES: I_a/V_a

Triode Section



10D2

DOUBLE DIODE (Separate Cathodes)
Indirectly heated—for series operation

RATING

Heater Voltage	V_h	19	V
Heater Current	I_h	0·1	A
Maximum Mean Anode Current per Anode	$I_{a(av)max}$	9	mA
Maximum Peak Anode Current per Anode	$I_{a(pk)max}$	50	mA
Maximum Peak Inverse Anode Voltage	P.I.V.(max)	500	V
Maximum Potential Heater/Cathode (d.c. + a.c. peak with heater –ve)	$V_{h-k(max)}$	150	V

INTER-ELECTRODE CAPACITANCES*(pF)

		§	†
Anode 1/All other Electrodes	$c_{a'-all}$	3·4	4·5
Anode 1/Anode 2	$c_{a'-a''}$	0·018	0·021
Anode 1/Cathode 1	$c_{a'-k'}$	1·65	1·68
Anode 2/All other Electrodes	$c_{a''-all}$	3·4	4·5
Anode 2/Cathode 2	$c_{a''-k''}$	1·65	1·65
Cathode 1/All other Electrodes	$c_{k'-all}$	4·0	5·1
Cathode 1/Cathode 2	$c_{k'-k''}$	0·009	0·011
Cathode 2/All other Electrodes	$c_{k''-all}$	4·1	5·2
Cathode 2/Heater	$c_{k''-h}$	2·5	2·8
Cathode 1/Heater	$c_{k'-h}$	2·27	2·3

* Measured with a closely fitting metal can connected to earth.

§ Inter-electrode capacitance with holder capacitance balanced out.

† Total capacitance including a Benjamin B7G ceramic holder Type 75/833 and cylindrical screen Type 75/832. This holder has a radial shield between pins 1 and 7.

DIMENSIONS

Maximum Overall Length	54	mm
Maximum Diameter	19	mm
Maximum Seated Height	47·5	mm
Approximate Net Weight	$\frac{1}{4}$	oz
Approximate Packed Weight	$\frac{1}{2}$	oz

MOUNTING POSITION—Unrestricted.

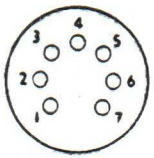
THORN — AEI RADIO VALVES & TUBES LTD.

10D2

DOUBLE DIODE (Separate Cathodes)
Indirectly heated—for series operation

BULB—Clear

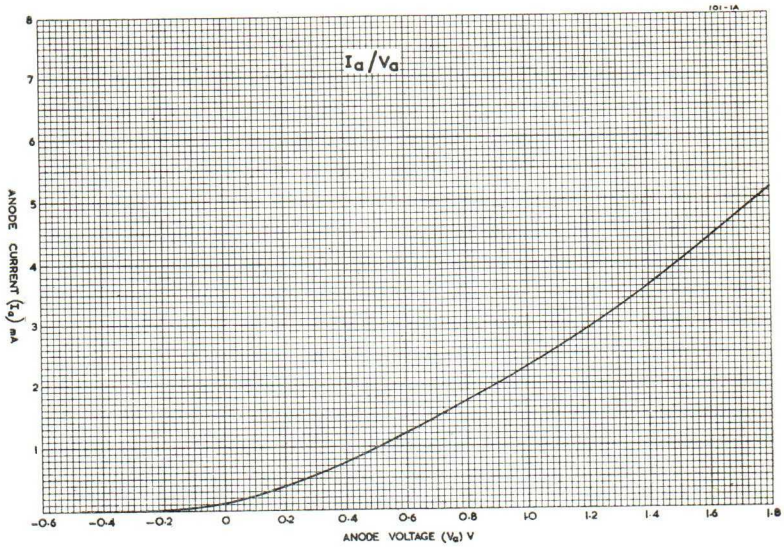
BASE—B7G

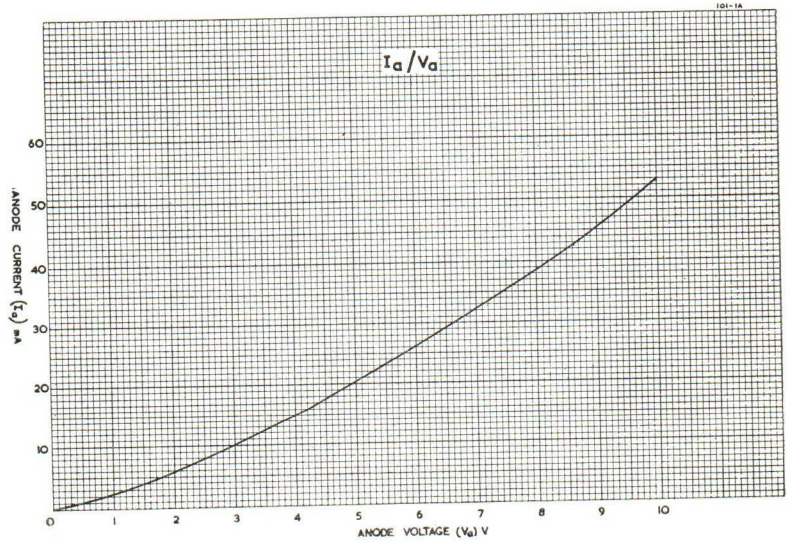


Viewed from free end of pins.

CONNECTIONS

Pin 1	Cathode 1	k′
Pin 2	Anode 2	a″
Pin 3	Heater	h
Pin 4	Heater	h
Pin 5	Cathode 2	k″
Pin 6	Internal Shield	s
Pin 7	Anode 1	a′



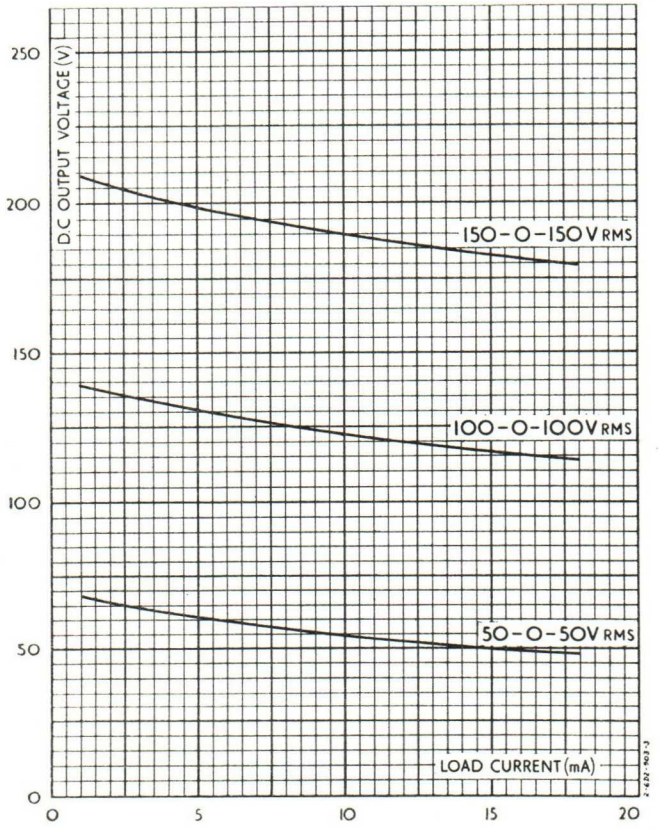


Indicates a change ←

AVERAGE CHARACTERISTIC CURVES : Regulation

(Full-Wave Rectification)

R_{lim} (each anode) = 300Ω C = 8μF f = 50 c/s



10F18

VARIABLE MU H.F. PENTODE

Indirectly heated—for series operation

GENERAL

The 10F18 is a variable mu H.F. Pentode intended for use in AM/FM Receivers having series fed heaters and is suitable for use on AC/DC Mains.

RATING

Heater Voltage	V_h	13·0	V
Heater Current	I_h	0·1	A
Maximum Anode Voltage	$V_{a(max)}$	250	V
Maximum Screen Voltage	$V_{g2(max)}$	250	V
Maximum Anode Dissipation	$P_{a(max)}$	2·25	W
Maximum Screen Dissipation	$P_{g2(max)}$	0·5	W
Maximum Heater to Cathode Voltage (r.m.s.)	$V_{h\text{-}k(r.m.s.)max}$	150	V

INTER-ELECTRODE CAPACITANCES (pF)

		*	**	***	
Grid/Earth	c_{in}	5·0	5·2	6·2	←
Anode/Earth	c_{out}	4·3	4·5	4·5	←
Anode/Grid 1	$c_{a\text{-}g1}$	0·0019	0·0019	0·0031	←
Anode/Grid 1	$c_{a\text{-}g1}$	0·0017†	0·0017†	0·0029†	←
Anode/Grid 2	$c_{a\text{-}g2}$	0·12	0·23	0·41	←
Anode/Grid 3	$c_{a\text{-}g3}$	0·54	0·56	0·58	←
Grid 1/Grid 2	$c_{g1\text{-}g2}$	1·6	1·6	1·6	←
Grid 1/Grid 3	$c_{g1\text{-}g3}$	0·055	0·064	0·072	←

* Inter-electrode capacitances in fully shielded socket, without can.

** Inter-electrode capacitances with holder capacitance balanced out (using holder quoted below).

*** Total inter-electrode capacitances including B9A ceramic holder without skirt or radial shield (Plessey holder type CP180014/1). The total anode to grid capacitance (in can) may be reduced from 0·0029pF to 0·0019pF by the use of a close fitting vertical shield placed beneath the holder ; between pins 1 and 9, 4 and 5.

† In can.

Earth denotes the remaining earthy potential electrodes, heater and shields connected to cathode.

Indicates a change ←

THORN — AEI RADIO VALVES & TUBES LTD.

10F18

VARIABLE MU H.F. PENTODE

Indirectly heated—for series operation

DIMENSIONS

Maximum Overall Length	56·0 mm
Maximum Diameter	22·2 mm
Maximum Seated Height	49·0 mm
Approximate Nett Weight	$\frac{1}{2}$ozs
Approximate Packed Weight	$\frac{3}{4}$ozs

MOUNTING POSITION—Unrestricted

TYPICAL OPERATION

Anode Voltage	V_a	175	175	V
Screen Voltage	V_{g2}	100	175	V
Grid Bias Voltage	V_{g1}	—1·3	•	V
Anode Current	I_a	12·0	·	mA
Screen Current	I_{g2}	3·5	·	mA
Mutual Conductance	g_m	4·4	•	mA/V
Grid Bias to give mutual conductance of 100 μA/V		·	—19·5	V
Anode Impedance	r_a	400		kΩ
Input Capacity Working (Hot)	C_{in}	7·0**	•	pF ←
Input Capacity Change at cut-off	ΔC	1·5**	·	pF ←
Input Loss at 38 Mc/s, cathode pins strapped		21	·	kΩ ←

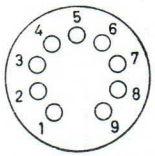
** Inter-electrode capacitances with holder capacitance balanced out (using Plessey holder type CP180014/1)

BULB—Clear

Indicates a change ←

10F18
VARIABLE MU H.F. PENTODE
Indirectly heated—for series operation

BASE—Noval (B9A)



Viewed from free end of pins

CONNECTIONS

Pin 1	Cathode	k
Pin 2	Control Grid	g1
Pin 3	Cathode	k
Pin 4	Heater	h
Pin 5	Heater	h
Pin 6	Internal Shield	s
Pin 7	Anode	a
Pin 8	Screen Grid	g2
Pin 9	Suppressor Grid	g3

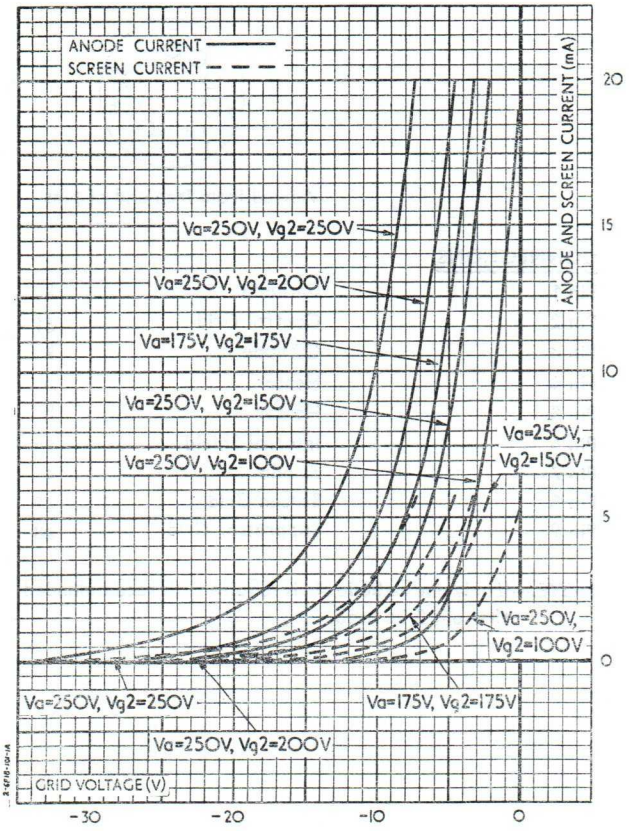
NOTE.—If only one cathode pin is required it is recommended that pin 3 be used.

10F18

VARIABLE MU H.F. PENTODE

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES : $I_a, I_{g2}/V_{g1}$



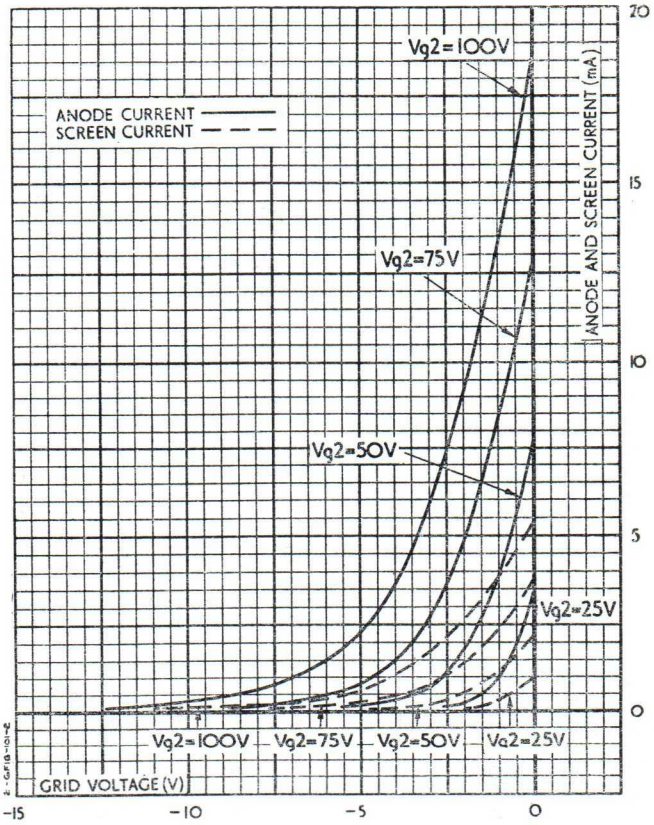
10F18

VARIABLE MU H.F. PENTODE

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES : $I_a, I_{g2}/V_{g1}$

V_a=175V.



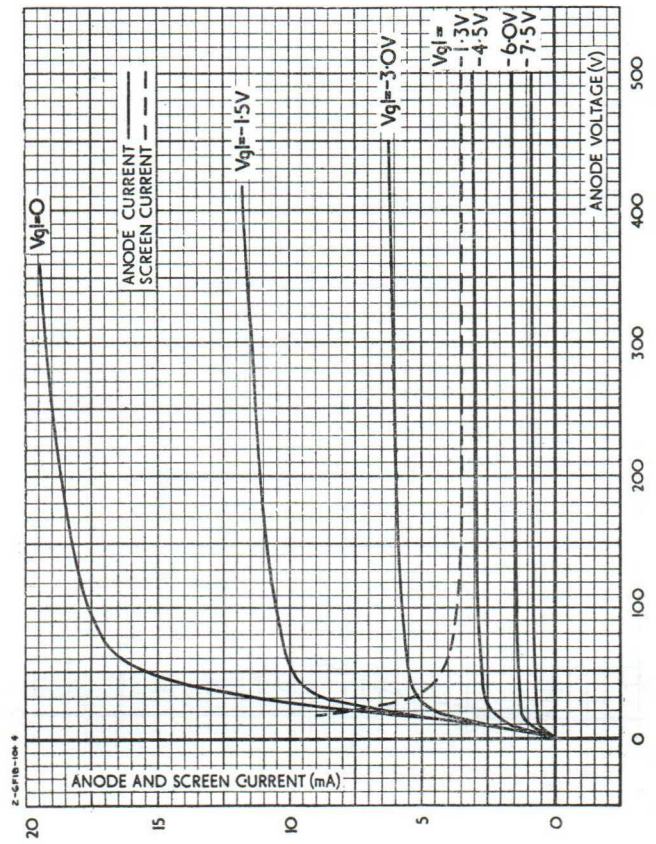
10F18

VARIABLE MU H.F. PENTODE

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES : $I_a, I_{g2}/V_a$

V_{g2}=100V.

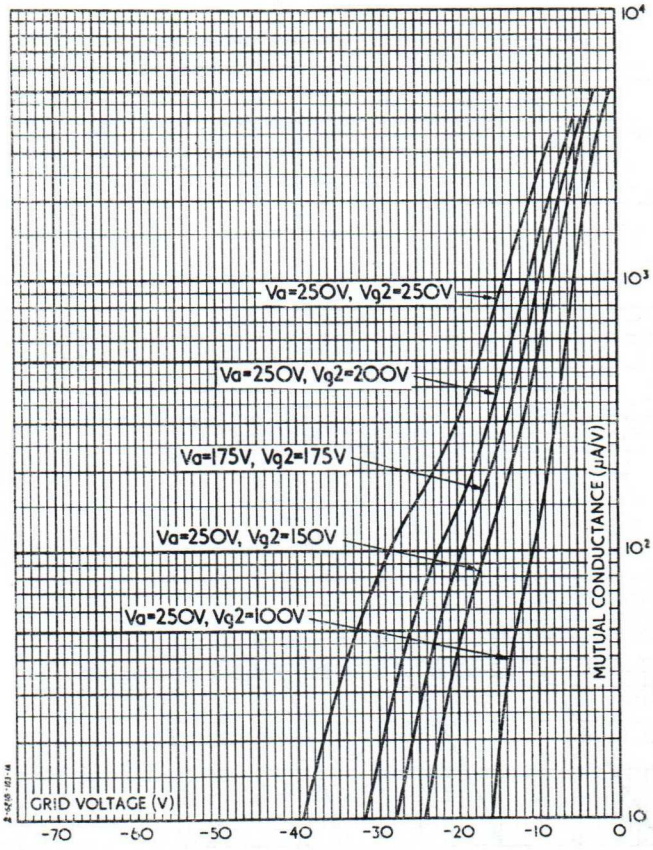


10F18

VARIABLE MU H.F. PENTODE

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES : g_m/V_g



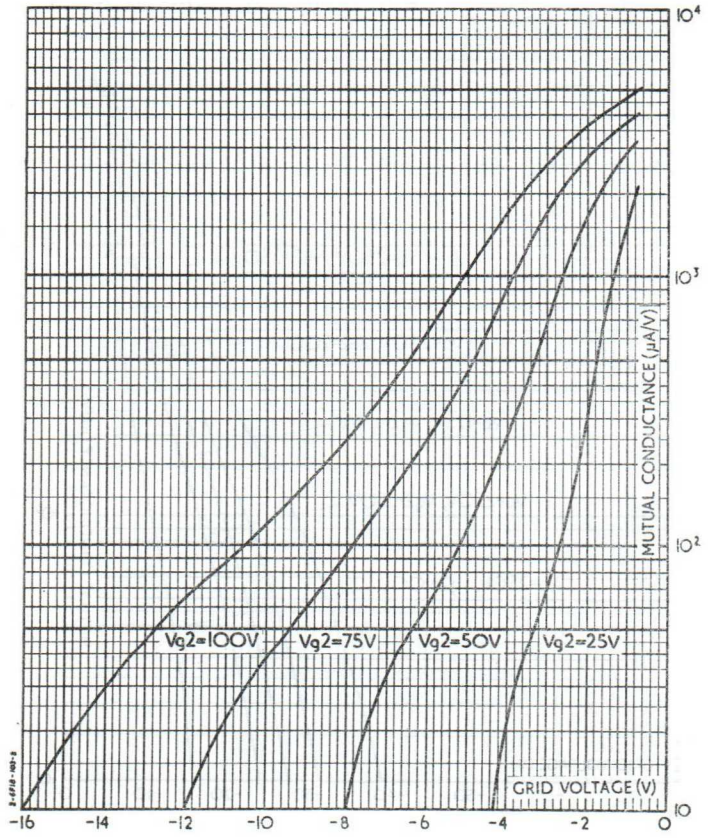
10F18

VARIABLE MU H.F. PENTODE

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES : g_m/V_g

V_a=175V.



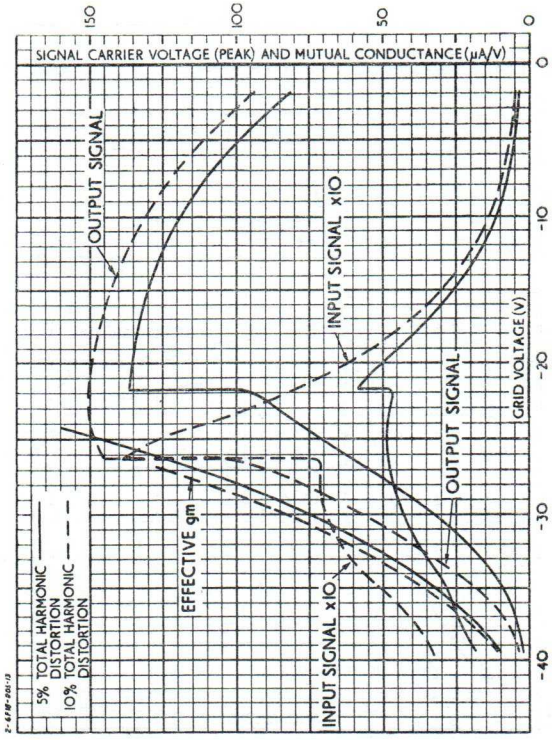
10F18

VARIABLE MU H.F. PENTODE

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES : $V_{sig(pk)}$, g_m/V_g

Initially : $V_{HT}=250V$, $R_a=6{\cdot}8k\Omega$, $R_{g2}=39k\Omega$, $I_a=12{\cdot}0mA$, $I_{g2}=3{\cdot}5mA$, $V_{g1}=-1{\cdot}85V$, $Z_L=100k\Omega$, Mod.=60%



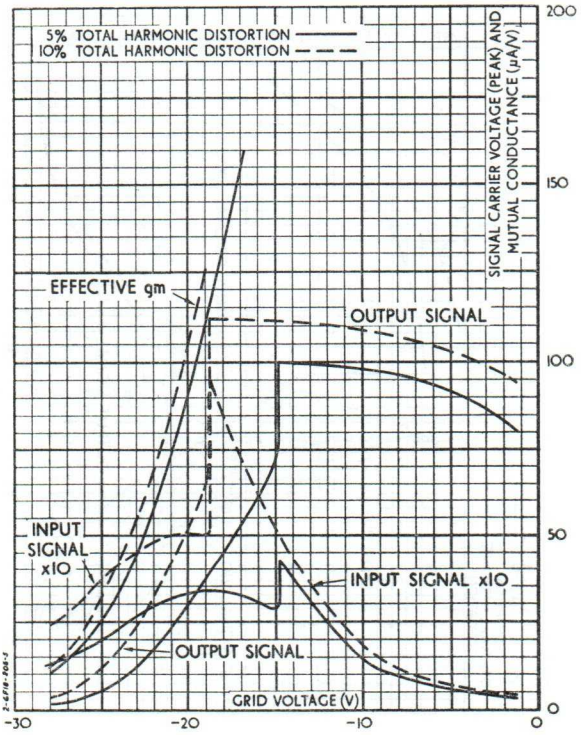
10F18

VARIABLE MU H.F. PENTODE

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES : $V_{sig(pk)}$, g_m/V_{gl}

Initially : V_a=175V, V_{g2}=100V(Rising), I_a=12·0mA, I_{g2}=3·5mA, V_{g1}=—1·3V, R_{g2}=22kΩ, Z_L=100kΩ, Mod.=60%



10FD12/UBF89
DOUBLE DIODE R.F. PENTODE
Indirectly heated—for series operation

GENERAL

The 10FD12/UBF89 is a miniature based indirectly heated Double Diode Variable-Mu RF Pentode with a single cathode. It is intended for use as an RF Amplifier or IF Amplifier Detector in AC/DC powered A.M. only receivers having series connected heater chains.

RATING

Heater Current	(amps)	I_h	0.1
Heater Voltage	(volts)	V_h	19.0
Pentode Section			
Maximum Anode Supply Voltage	(volts)	$V_{a(b)max}$	550
Maximum Anode Voltage	(volts)	$V_{a(max)}$	250
Maximum Screen Supply Voltage	(volts)	$V_{g2(b)max}$	550
Maximum Screen Voltage (I_a <4 mA)	(volts)	$V_{g2(max)}$	250
Maximum Screen Voltage (I_a> 8 mA)	(volts)	$V_{g2(max)}$	125
Maximum Anode Dissipation	(watts)	$P_{a(max)}$	2.25
Maximum Screen Dissipation	(mW)	$P_{g2(max)}$	450
Maximum Cathode Current	(mA)	$I_{k(max)}$	16.5
Maximum Grid 1 Voltage	(volts)	$V_{g1(max)}$	—1.3
Maximum Grid 1-Cathode Resistance	(MΩ)	$R_{g1\text{-}k(max)}$	3.0
Maximum Grid 1-Cathode Resistance (Grid Current biasing)	(MΩ)	$R_{g1\text{-}k(max)}$	22
Maximum Grid 3-Cathode Resistance	(kΩ)	$R_{g3\text{-}k(max)}$	10
Maximum Heater-Cathode Resistance	(kΩ)	$R_{h\text{-}k(max)}$	20

Rating (continued overleaf).

THORN — AEI RADIO VALVES & TUBES LTD.

10FD12/UBF89

DOUBLE DIODE R.F. PENTODE

Indirectly heated—for series operation

TENTATIVE

Maximum Heater-Cathode Voltage	(volts)	$V_{h\text{-}k(max)}$	100
Mutual Conductance	(mA/V)	g_m	4.5†
Anode Impedance	(kΩ)	r_a	600†
Inner Mu		$\mu_{g1\text{-}g2}$	20†

† Measured at $V_a = 200$ V ; $V_{g2} = 100$ V ; $V_{g1} = -1.5$ V.

Diode Section (each Diode)

Maximum Peak Inverse Voltage	(volts)	P.I.V.max	200
Maximum Mean Anode Current	(μA)	$I_{a(av)max}$	800
Maximum Peak Anode	(mA)	$I_{a(pk)max}$	5.0

INTER-ELECTRODE CAPACITANCES (pF)

Anode/All	c_{out}	5.2
Grid 1/All	c_{in}	5.0
Anode/Grid 1	$c_{a\text{-}g1}$	<0.0025
Anode/Diode 1	$c_{a\text{-}d'}$	<0.15
Anode/Diode 2	$c_{a\text{-}d''}$	<0.025
Grid 1/Diode 1	$c_{g1\text{-}d'}$	<0.0008
Grid 1/Diode 2	$c_{g1\text{-}d''}$	<0.001
Grid 1/Heater	$c_{g1\text{-}h}$	0.05
Diode 1/Cathode	$c_{d'\text{-}k}$	2.5
Diode 2/Cathode	$c_{d''\text{-}k}$	2.5
Diode 1/Heater	$c_{d'\text{-}h}$	<0.015
Diode 2/Heater	$c_{d''\text{-}h}$	<0.003
Diode 1/Diode 2	$c_{d'\text{-}d''}$	<0.25

10FD12/UBF89

DOUBLE DIODE R.F. PENTODE

Indirectly heated—for series operation

TENTATIVE

DIMENSIONS

Maximum Overall Length	(mm)	67.5
Maximum Diameter	(mm)	22.2
Maximum Seated Height	(mm)	60.5
Approximate Nett Weight	(ozs)	$\frac{1}{2}$
Approximate Packed Weight	(ozs)	$\frac{3}{4}$

MOUNTING POSITION—Unrestricted

TYPICAL OPERATION

Anode Voltage	(volts)	V_a	170	170	200	200
Grid 2 Resistance	(kΩ)	R_{g2}	27	21	47	30
Grid 1 Voltage	(volts)	V_{g1}	—0.5‡	—1.5	—0.5‡	—1.5
Cathode Resistance	(ohms)	R_k	—	105	—	105
Anode Current	(mA)	I_a	11.0	11.0	9.5	11.0
Grid 2 Current	(mA)	I_{g2}	3.4	3.4	2.8	3.3
Mutual Conductance	(mA/V)	g_m	5.0	4.5	5.0	4.5
Mutual Conductance, $V_{g1} = -20$ V.	(μA/V)	g_m	65	65	115	120
Anode Impedance	(kΩ)	r_a	450	450	600	600
Input Impedance	(kΩ)	R_{eq}	2.5	3.5	2.5	3.5

‡‡Produced by grid current flow in grid resistor and diode current. If not acceptable the bias should be increased to —1.5 V.

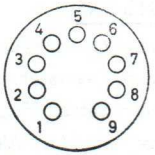
10FD12/UBF89

DOUBLE DIODE R.F. PENTODE

Indirectly heated—for series operation

TENTATIVE

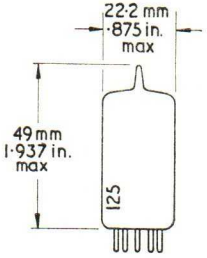
BASE—Noval (B9A)



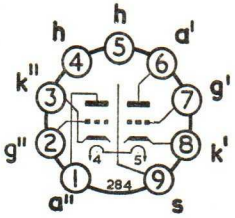
Viewed from free end of pins

CONNECTIONS

Pin 1	Grid 2	g2
Pin 2	Grid 1	g1
Pin 3	Cathode, Shield	k, s
Pin 4	Heater	h
Pin 5	Heater	h
Pin 6	Anode	a
Pin 7	Diode 1	a′d
Pin 8	Diode 2	a″d
Pin 9	Grid 3	g3



DOUBLE TRIODE



B9A Base

GENERAL

This valve is a double triode primarily intended for use as an R.F. amplifier and self-oscillating mixer in F.M. receivers.

Heater Current	I_h	0·1	A
Heater Voltage	V_h	26	V

RATINGS

Maximum Anode Voltage	$V_{a(max)}$	250	V
Maximum Anode Dissipation (either section)	$p_{a(max)}$	2·5	W
Maximum Total Anode Dissipation	$p_{a(tot)max}$	4·5	W
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h\text{-}k(max)r.m.s.}$	90	V
Maximum Cathode Current	$I_{k(max)}$	15	mA
Maximum Grid to Cathode Resistance	$R_{g\text{-}k(max)}$	1	MΩ

INTER-ELECTRODE CAPACITANCES

		*	†	‡	
Anode′ to Grid′	$c_{a'\text{-}g'}$	1·5	1·6	1·8	pF
Anode″ to Grid″	$c_{a''\text{-}g''}$	1·5	1·6	1·6	pF
Anode′ to Cathode′, Heater, Shield	$c_{a'\text{-}k',h,s}$	1·2	1·6	2·5	pF
§ Anode′ to Cathode′, Heater, Shield	$c_{a'\text{-}k',h,s}$	1·9	2·0	2·8	pF
Anode″ to Cathode″, Heater, Shield	$c_{a''\text{-}k'',h,s}$	1·2	1·6	2·4	pF
§ Anode″ to Cathode″, Heater, Shield	$c_{a''\text{-}k'',h,s}$	1·9	2·1	2·8	pF
Grid′ to Cathode′, Heater, Shield	$c_{g'\text{-}k',h,s}$	3·0	3·3	4·2	pF
Grid″ to Cathode″, Heater, Shield	$c_{g''\text{-}k'',h,s}$	3·0	3·4	4·2	pF
Anode′ to Anode″	$c_{a'\text{-}a''}$	·028	·032	·033	pF
§ Anode′ to Anode″	$c_{a'\text{-}a''}$	·003	·0067	·0081	pF
Anode″ to Cathode′	$c_{a''\text{-}k'}$	·006	·014	·02	pF

CHARACTERISTICS (Each Section)

Anode Voltage	V_a	170	200	V
Anode Current	I_a	10	10	mA
Grid Voltage	V_g	−1·5	−2·1	V
Mutual Conductance	g_m	6·2	5·8	mA/V
Amplification Factor	μ	50	48	
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	8·1	8·3	kΩ

NOTES

* Measured in fully-shielded socket. Without can, except where stated otherwise.
† Measured with holder capacitance balanced out. (Holders as below).
‡ Total capacitance including, where applicable, Plessey B9A ceramic type holders CP180900/1 (without can) or CP180024/3 (with can).
§ Measured with can.

THORN — A E I RADIO VALVES & TUBES LTD.

TYPICAL OPERATION AS R.F. AMPLIFIER

Supply Voltage	V_b	170	170	V
Anode Load Resistance	R_a	1·5	1·3	kΩ
Anode Voltage	V_a	155	160	V
Anode Current	I_a	8·7	6	mA
Grid Bias Voltage	V_g	−1·4	−2	V
Mutual Conductance	g_m	6	4·7	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	8·4	10·5	kΩ
Equivalent Grid Noise Resistance	R_{eq}	500	650	Ω
Input Loss at 100 Mc/s	r_g (100 Mc/s)	6	8	kΩ

TYPICAL OPERATION AS SELF-OSCILLATING MIXER ¶

Supply Voltage	V_b	170	200	V
Anode Load Resistance	R_a	4·7	8·2	kΩ
Grid to Cathode Resistance //	R_{g-k}	1	1	MΩ
Anode Current	I_a	4·8	5·2	mA
Peak Heterodyne Voltage	$V_{(pk)het}$	4	4	V
Conversion Conductance	g_c	2·2	2·3	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	16	15	kΩ

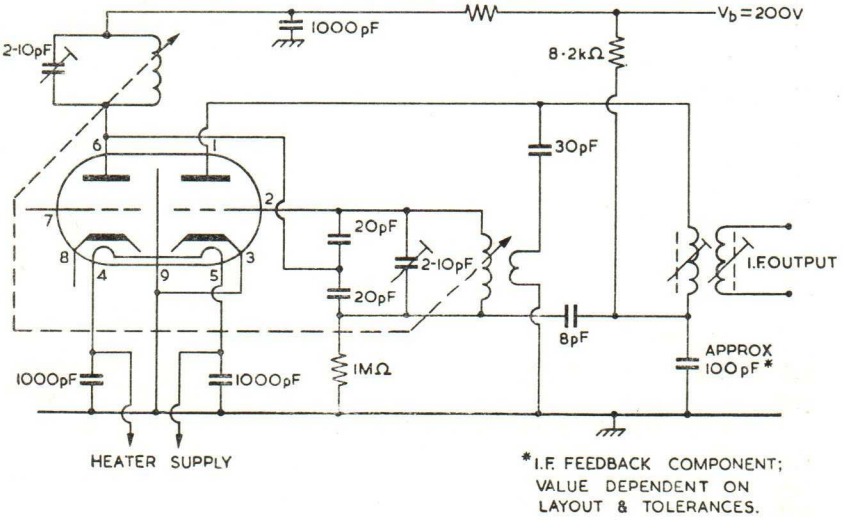
NOTES

The triode on pins 6, 7 and 8 should be used as the R.F. amplifier and that on pins 1, 2 and 3 as the self-oscillating mixer.

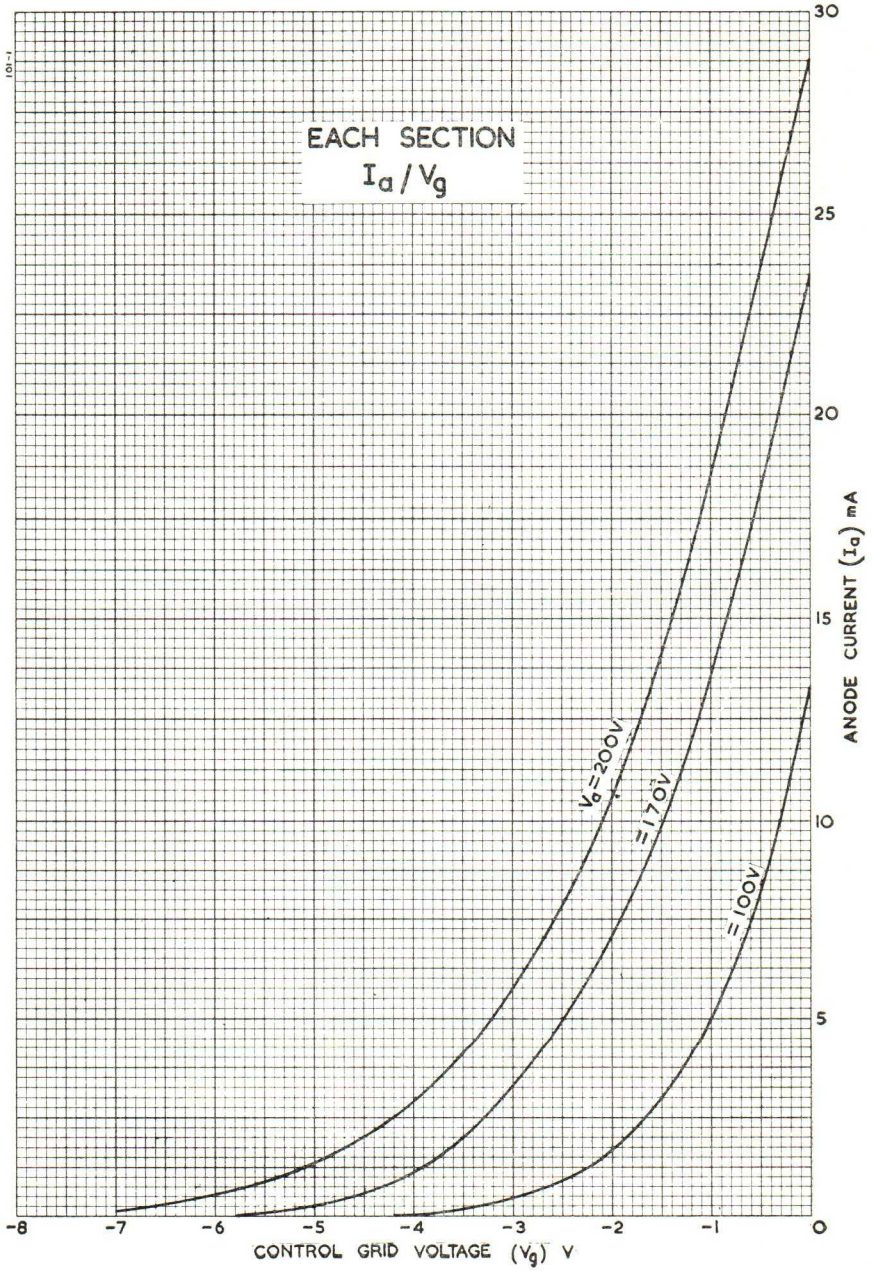
¶ For typical circuit as self-oscillating mixer see circuit below.

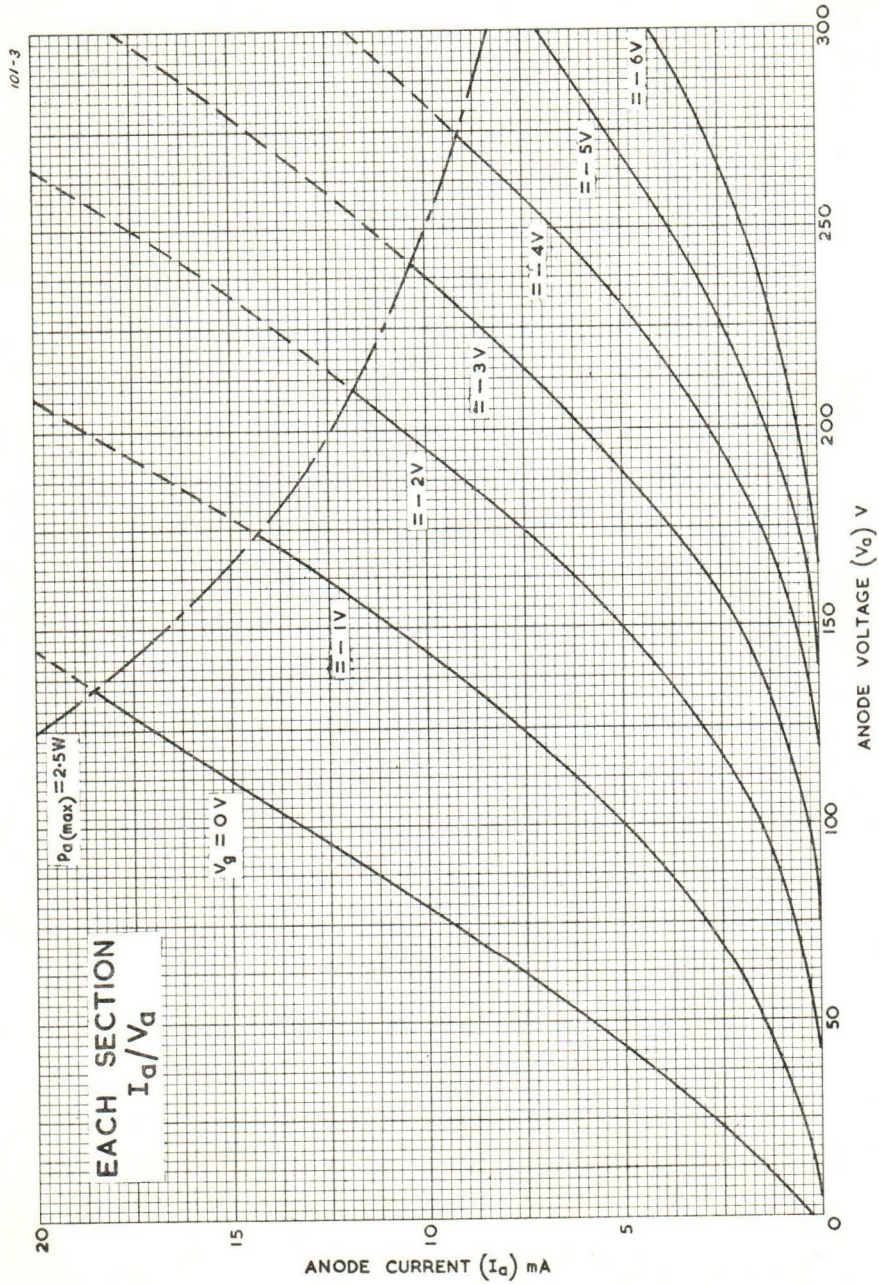
// I.F. feedback voltage tends to stabilise oscillator performance and permits this relatively high grid leak.

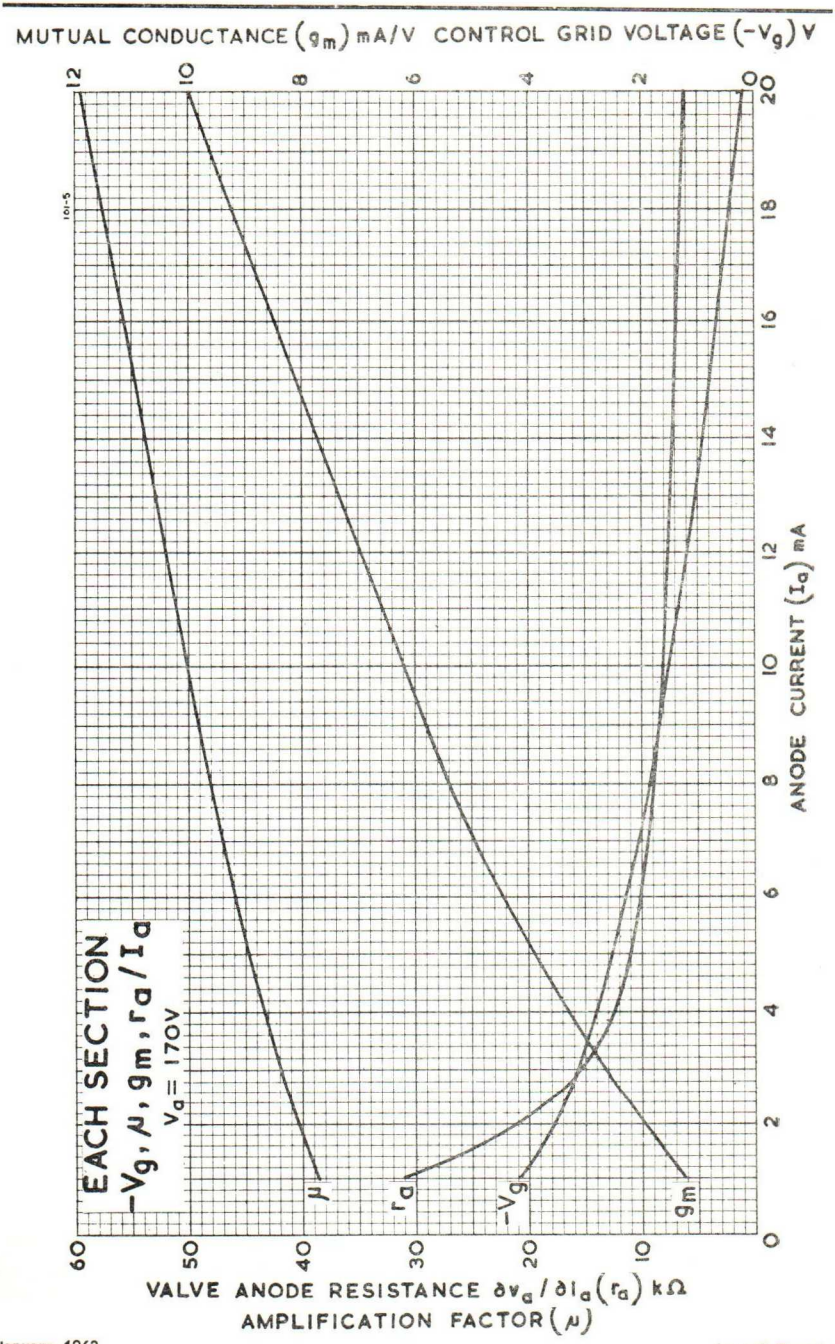
TYPICAL CIRCUIT AS SELF-OSCILLATING MIXER

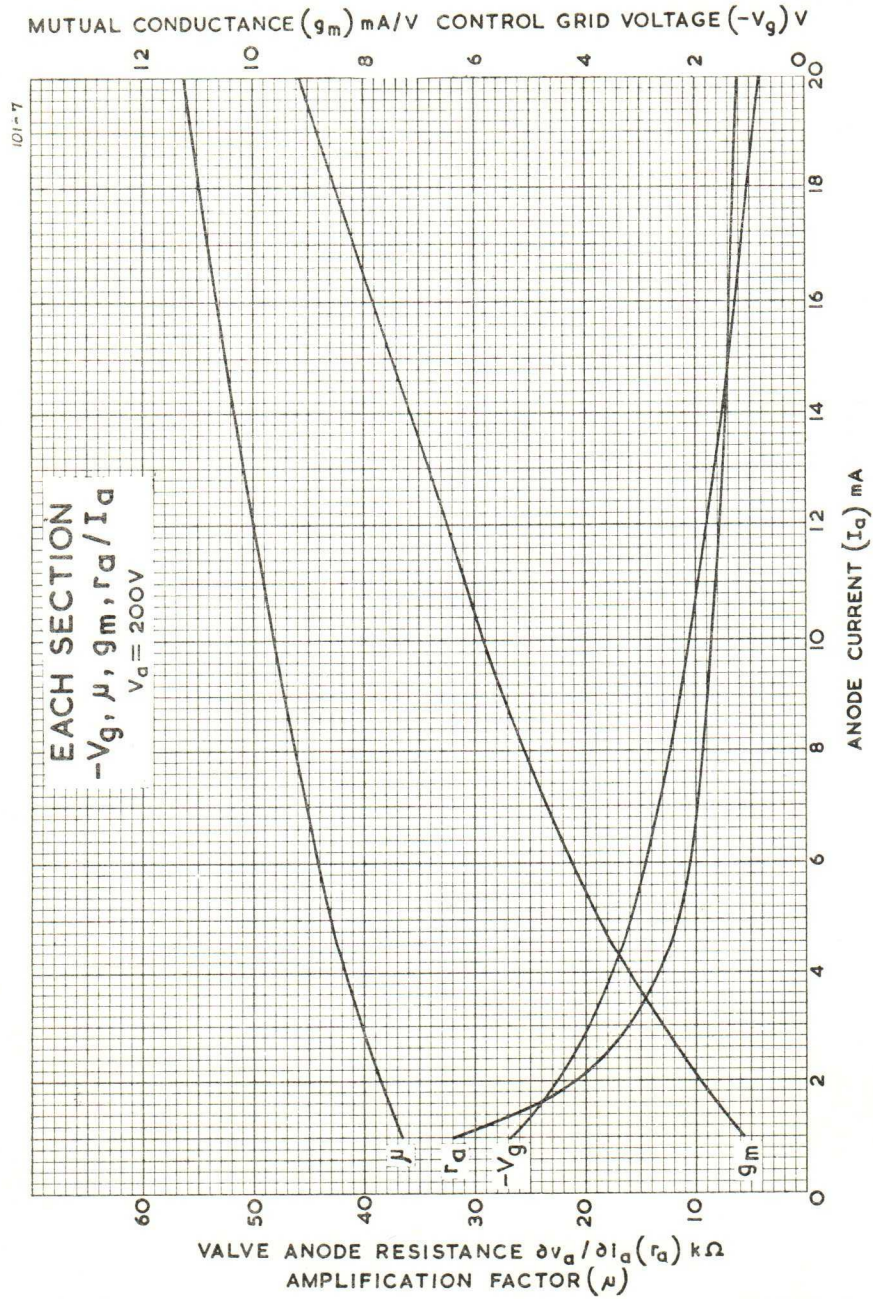


MOUNTING POSITION—Unrestricted


EACH SECTION
I_a / V_g
V_a=200V
=170V
=100V
ANODE CURRENT (I_a) mA
CONTROL GRID VOLTAGE (V_g) V
30
25
20
15
10
5
0
-8
-7
-6
-5
-4
-3
-2
-1


101-3
EACH SECTION
Ia/Va
Pa (max) = 2·5W
Vg = 0 V
= − 1V
= − 2V
= − 3V
= − 4V
= − 5V
= − 6V
ANODE CURRENT (Ia) mA
ANODE VOLTAGE (Va) V
0
50
100
150
200
250
300
5
10
15
20


MUTUAL CONDUCTANCE (gm) mA/V
CONTROL GRID VOLTAGE (-Vg) V
12
10
8
6
4
2
0
20
18
16
14
12
10
8
6
4
2
0
ANODE CURRENT (Ia) mA
101-5
EACH SECTION
-Vg, μ, gm, ra / Ia
Va = 170V
μ
ra
-Vg
gm
60
50
40
30
20
10
VALVE ANODE RESISTANCE δva / δia (ra) kΩ
AMPLIFICATION FACTOR (μ)


MUTUAL CONDUCTANCE (gm) mA/V
CONTROL GRID VOLTAGE (-Vg) V
12
10
8
6
4
2
0
20
18
16
14
12
10
8
6
4
2
0
ANODE CURRENT (Ia) mA
101-7
EACH SECTION
-Vg, μ, gm, ra / Ia
Va = 200V
μ
ra
-Vg
gm
60
50
40
30
20
10
VALVE ANODE RESISTANCE ∂va / ∂ia (ra) kΩ
AMPLIFICATION FACTOR (μ)

10LD13/UBC81 ←

DOUBLE DIODE TRIODE ←

GENERAL

The 10LD13/UBC81 is a miniature based, indirectly heated, Double Diode Triode. It is intended for use in AC/DC powered AM receivers having series connected heaters.

RATING

Heater Current	(amps)	I_h	0.1
Heater Voltage	(volts)	V_h	13.0
Maximum Anode Voltage (Triode)	(volts)	$V_{a(max)}$	250
Maximum Anode Dissipation (Triode)	(watts)	$P_{a(max)}$	1.0
Maximum Cathode Current	(mA)	$I_{k(max)}$	5.0
Amplification Factor		μ	75* ←
Mutual Conductance	(mA/V)	g_m	1.4*
Maximum Mean Diode Current	(mA)	$I_{ad(max)}$	0.8
Maximum Heater to Cathode Voltage	(volts r.m.s.)	$V_{h\text{-}k(max)}$	150†

* At V_a=100 V ; V_g = —0.7 V ; I_a = 0.8 mA ←

† Measured with respect to the higher potential heater pin.

INTER-ELECTRODE CAPACITANCES (pF) ←

		§	‡
Grid/Earth	c_{in}	2.3	3.1
Anode/Earth	c_{out}	2.4	3.2
Anode/Grid	$c_{a,g}$	1.9	2.1
Diode 1/Earth	$c_{a'd\text{-}E}$	1.8	2.8
Diode 2/Earth	$c_{a''d\text{-}E}$	1.9	2.8
Diode 1/Diode 2	$c_{a'd\text{-}a''d}$	0.29	0.31
Grid/Diode 1	$c_{g\text{-}a'd}$	0.0019	0.0033
Grid/Diode 2	$c_{g\text{-}a''d}$	0.0021	0.0040
Anode/Diode 1	$c_{a\text{-}a'd}$	0.0051	0.0065
Anode/Diode 2	$c_{a\text{-}a''d}$	0.018	0.027

Inter-electrode capacitances (continued overleaf)

10LD13/UBC81 ←
DOUBLE DIODE TRIODE ←

§ Inter-electrode capacities with holder capacity balanced out.

‡ Total inter-electrode capacity including a B9A ceramic holder without skirt or radial shield (Plessey holder type CP180014/1) ←

" Earth " denotes the electrodes of any second valve section and the remaining earthy potential electrodes of the section under measurement, heater and shield being joined to the cathode.

DIMENSIONS

Maximum Overall Length	(mm)	67.5
Maximum Diameter	(mm)	22.2
Maximum Seated Height	(mm)	60.5
Approximate Nett Weight	(ozs)	$\frac{1}{2}$
Approximate Packed Weight	(ozs)	$\frac{3}{4}$

MOUNTING POSITION—Unrestricted

Indicates a change ←

10LD13/UBC81
DOUBLE DIODE TRIODE

TYPICAL OPERATION—Resistance Coupled A.F. Amplifier (Cathode Self Bias)

Supply Voltage	(V)	$V_{a(b)}$	100	150	200	100	150	200
Anode Load Resistance	(kΩ)	R_a	100	100	100	220	220	220
Grid Resistance of following valve	(kΩ)	R_{g1}	330	330	330	680	680	680
Cathode Self Bias Resistance	(kΩ)	R_k	3.3	2.2	2.2	5.6	3.9	3.9
Anode Current	(mA)	I_a	0.27	0.48	0.63	0.16	0.27	0.37
Voltage Amplification			36.5	41.5	42	41.5	49	48.5
Output Voltage (rms) for 0.5μA Grid Current	(V_{rms})	V_{out}	6	13.5	25.5	6	14	28.5
Second Harmonic Distortion	(%)		4.5	4.5	6.5	4	4	5.5
Third Harmonic Distortion	(%)		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1

10LD13/UBC81
DOUBLE DIODE TRIODE

TYPICAL OPERATION—Resistance Coupled A.F. Amplifier (Grid Current Bias. Signal Source Impedance $Z_s = O\Omega$)*

Supply Voltage	(V)	$Va_{(b)}$	100	150	200	100	150	200
Anode Load Resistance	(kΩ)	R_a	100	100	100	220	220	220
Grid Resistance of following valve	(kΩ)	R_{g1}	330	330	330	680	680	680
Anode Current	(mA)	I_a	0.34	0.66	1.02	0.2	0.37	0.56
Voltage Amplification			39	44.5	48	44.5	51	54.5
Output for 2.5% Second Harmonic	(Vrms)	V_{out}	4	8.5	13	5.5	11.5	16.5
Third Harmonic at 2.5% Second	(%)		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Output for 5% Second Harmonic	(Vrms)	V_{out}	7	15	22.5	9	18	27.5

* The signal source impedance Z_s is coupled through a 0.05 μF capacitance with a 10MΩ grid resistance.

10LD13/UBC81

DOUBLE DIODE TRIODE

TYPICAL OPERATION—Resistance Coupled A.F. Amplifier (Grid Current Bias. Signal Source Impedance $Z_s = 200k\Omega$)*

Supply Voltage	(V)	$V_{a(b)}$	100	150	200	100	150	200
Anode Load Resistance	(kΩ)	R_a	100	100	100	220	220	220
Grid Resistance of following valve	(kΩ)	R_{g1}	330	330	330	680	680	680
Anode Current	(mA)	I_a	0.34	0.66	1.02	0.2	0.37	0.56
Voltage Amplification			32	36.5	39.5	36.5	42.5	44.5
Output for 2.5% Second Harmonic	(Vrms)	V_{out}	8.5	17.5	26	11	21.5	32
Third Harmonic at 2.5% Second	(%)		2.5	3	3	2.5	2.5	3

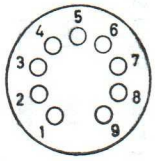
* The signal source impedance Z_s is coupled through a 0.05 μF capacitance with a 10 MΩ grid resistance.

10LD13/UBC81 ←

DOUBLE DIODE TRIODE

←

BASE—Noval (B9A)



Viewed from free end of pins

VALVE HOLDER—Ediswan Clix type VH599/901 series.

CONNECTIONS

Pin 1	Triode Anode	a
Pin 2	Control Grid	g
Pin 3	Cathode	k
Pin 4	Heater	h
Pin 5	Heater	h
Pin 6	Diode 1	a′d
Pin 7	Shield	s
Pin 8	Diode 2	a′′d
Pin 9	Internal Connection	IC

Diode Pin 8 should be used for detection.

Indicates a change ←

10P18

OUTPUT PENTODE

Indirectly heated—for series operation

GENERAL

The 10P18 is a miniature based Output Pentode having a maximum anode dissipation of 12 watts, It is intended for use in AC/DC mains powered audio output stages in equipment having series connected heater chains.

RATING

Heater Current	(amps)	I_h	0.1
Heater Voltage	(volts)	V_h	45.0
Maximum Anode Voltage	(volts)	$V_{a(max)}$	250
Maximum Screen Voltage	(volts)	$V_{g2(max)}$	200
Maximum Anode Dissipation	(watts)	$P_{a(max)}$	12
Maximum Screen Dissipation (continuous)	(watts)	$P_{g2(max)}$	1.75*
Mutual Conductance	(mA/V)	g_m	10.0†
Anode Impedance	(kΩ)	r_a	23†
Inner Amplification Factor		μ_{g1-g2}	8†
Maximum Mean Cathode Current	(mA)	$I_{k(mean)max}$	100
Maximum Heater to Cathode Voltage	(volts)	$V_{h-k(max)}$	200

* On speech and music the permissible rating at peak signal level is 6 watts.

† $V_a = V_{g2} = 170$ V ; $I_a = 70$ mA ; $V_{g1} = -12.5$v.

INTER-ELECTRODE CAPACITANCES (pF)

Grid 1/Earth	c_{in}	12.0
Anode/Earth	c_{out}	6.0
Anode/Grid 1	c_{a-g1}	0.5
Grid 1/Heater	c_{g1-h}	0.25

" Earth " denotes the remaining earthy potential electrodes, heater and shields connected to cathode.

THORN — AEI RADIO VALVES & TUBES LTD.

10P18

OUTPUT PENTODE

Indirectly heated—for series operation

TENTATIVE

DIMENSIONS

Maximum Overall Length	(mm)	78.5
Maximum Diameter	(mm)	22.2
Maximum Seated Height	(mm)	71.5
Approximate Nett Weight	(ozs)	$\frac{1}{2}$
Approximate Packed Weight	(ozs)	$\frac{3}{4}$

MOUNTING POSITION Unrestricted.

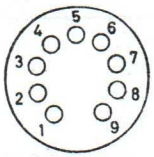
TYPICAL OPERATION Single Valve Class A Audio Amplifier

Anode Voltage	(volts)	V_a	160
Screen Voltage	(volts)	V_{g2}	170
Anode Current (Quiescent)	(mA)	I_a	70
Screen Current (Quiescent)	(mA)	I_{g2}	5
Grid Bias	(volts)	V_{g1}	—12.5
Power Output for 10% total Harmonic Distortion	(watts)	P_{out}	5.2
Anode Load	(ohms)	R_a	2,200
Input Swing for 10% total Harmonic Distortion (r.m.s.)	(volts)	$V_{in(rms)}$	7

These operating conditions are taken with fixed D.C. potentials.

BULB Clear

BASE Noval (B9A)



Viewed from free end of pins

10P18

OUTPUT PENTODE

Indirectly heated—for series operation

TENTATIVE

VALVE HOLDER

Ediswan Clix VH599/9, VH499/9, VH19/9 series

CONNECTIONS

Pin 1	Internal Connection	IC
Pin 2	Grid 1	g1
Pin 3	Cathode, Grid 3	k,g3
Pin 4	Heater	h
Pin 5	Heater	h
Pin 6	Internal Connection	IC
Pin 7	Anode	a
Pin 8	Internal Connection	IC
Pin 9	Grid 2	g2

"Internal connection" indicates that the pin is connected to an electrode for the purpose of improving mechanical rigidity. The connection may not always be made to the same electrode on a given valve type, and it is essential that the corresponding valve holder socket be left unconnected.

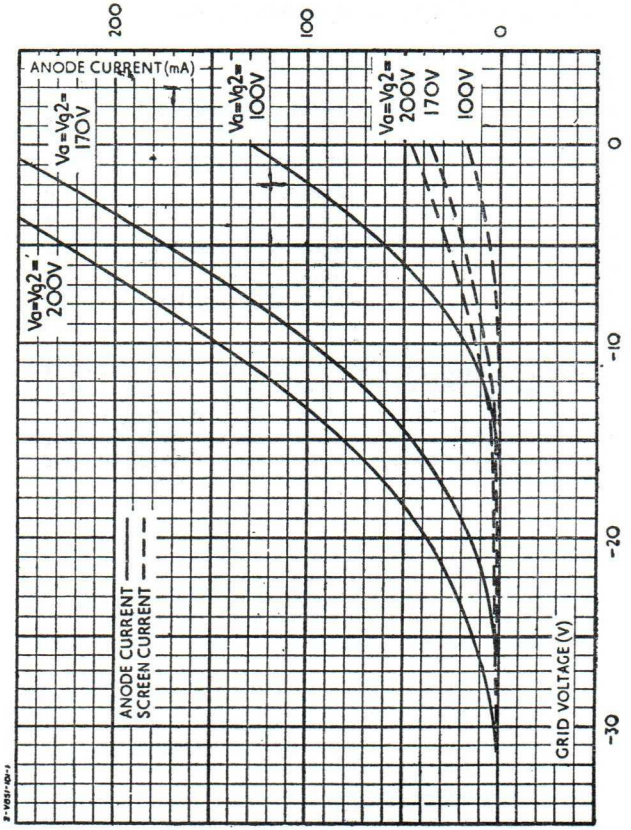
10P18

OUTPUT PENTODE

Indirectly heated—for series operation

TENTATIVE

CHARACTERISTIC CURVES: I_a, I_{g2}/V_{g1}



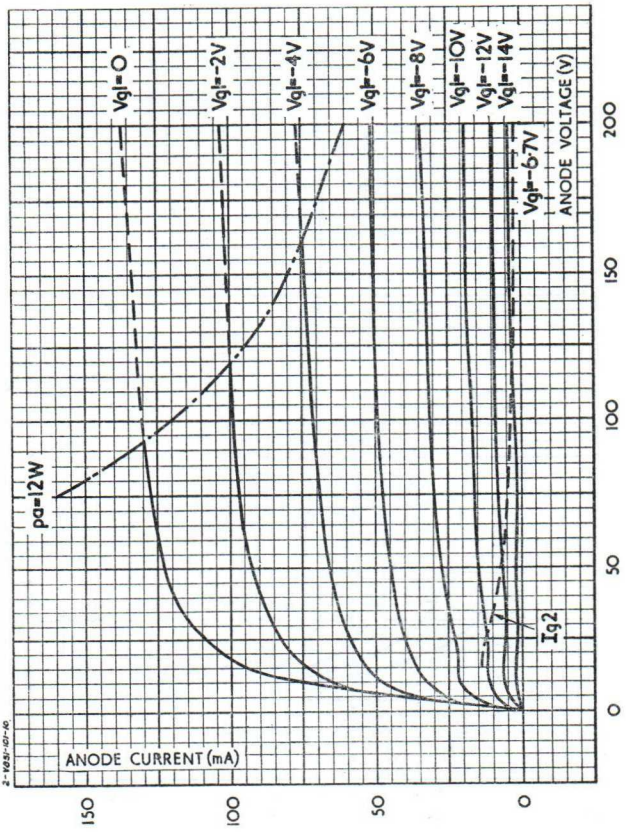
10P18/UL84

OUTPUT PENTODE

Indirectly heated—for series operation

CHARACTERISTIC CURVES: Ia,Ig2/Va

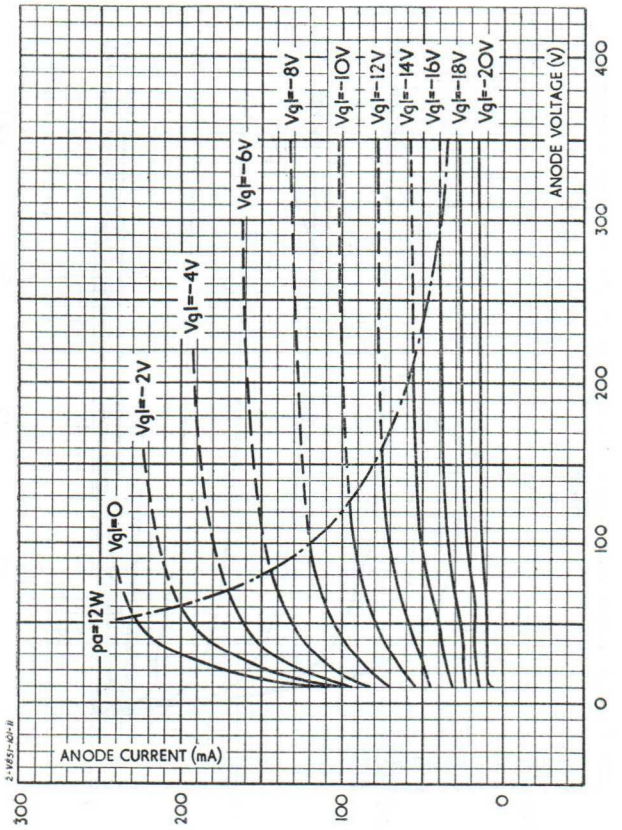
V_{g2}=100V



10P18/UL84
OUTPUT PENTODE
Indirectly heated—for series operation

TENTATIVE

CHARACTERISTIC CURVES: I_a/V_a
$V_{g2}=170V$



10PL12/UCL82

TRIODE BEAM TETRODE

GENERAL

The 10PL12/UCL82 is a miniature based Triode Beam Tetrode with separate cathodes. It is intended for use in the Audio Output stages of AC/DC mains powered receivers. The tetrode has a maximum anode dissipation of 7 watts and a single valve will give an output of 3.5 watts.

RATING

		Tetrode	*Triode*
Heater Current (amps)	I_h	0.1	
Heater Voltage (volts)	V_h	50	
Maximum Anode Voltage (volts)	$V_{a(max)}$	250	250
Maximum Screen Voltage (volts)	$V_{g2(max)}$	250	
Maximum Anode Dissipation (watts)	$P_{a(max)}$	7.0	1.0
Maximum Screen Dissipation (watts)	$P_{g2(max)}$	1.8*	
Maximum Mean Cathode Current (mA)	$I_{k(av)max}$	50	15
Mutual Conductance (mA/V)	g_m	6.4ϕ	2.5‡
Amplification Factor	μ	9.5ϕ	70‡
Maximum Heater/Cathode Voltage (rms) (volts)	$V_{h-k(max)}$	200§	200§
Maximum Grid 1/Cathode Resistance (Self Bias) (megohms)	$R_{g1-k(max)}$	2	3†
Maximum Grid 1/Cathode Resistance (Fixed Bias) (megohms)	$R_{g1-k(max)}$	1	1
Maximum Heater/Cathode Resistance (kilohms)	$R_{h-k(max)}$	20	20

Notes continued on next page.

THORN — AEI RADIO VALVES & TUBES LTD.

10PL12/UCL82
TRIODE BEAM TETRODE

NOTES

* For speech and music the permissible rating at maximum signal is 3.2 watts.

ϕ Measured at $V_a = V_{g2} = 200V$; $I_a = 35mA$; $I_{g2} = 7mA$; $V_{g1} = -16V$.

μ measured Grid 1 to Grid 2.

‡ Measured at $V_a = 100V$; $I_a = 3.5mA$; $V_g = 0V$.

§ Measured with respect to the higher potential heater pin.

† Maximum Grid 1/Cathode resistance (Grid Current Bias) 22 megohms.

INTER-ELECTRODE CAPACITANCES (pF)

Tetrode Grid 1/Earth	$c_{in(q)}$	9.3
Tetrode Anode/Earth	$c_{out(q)}$	8.0
Tetrode Grid 1/Tetrode Anode	$c_{g1\text{-}a(q)}$	<0.3
Triode Grid/Earth	$c_{g(t)\text{-}E}$	3.0
Triode Anode/Earth	$c_{a(t)\text{-}E}$	4.3
Triode Grid/Triode Anode	$c_{g(t)\text{-}a(t)}$	4.5
Triode Anode/Tetrode Anode	$c_{a(t)\text{-}a(q)}$	<0.25
Triode Grid/Tetrode Grid 1	$c_{g(t)\text{-}g1(q)}$	<0.025
Triode Anode/Tetrode Grid 1	$c_{a(t)\text{-}g1(q)}$	<0.02
Triode Grid/Tetrode Anode	$c_{g(t)\text{-}a(q)}$	<0.02

Measured in a fully shielded jig, without can.

DIMENSIONS

Maximum Overall Length	(mm)	78.5
Maximum Diameter	(mm)	22.2
Maximum Seated Height	(mm)	71.5
Approximate Nett Weight	(ozs)	$\frac{1}{2}$
Approximate Packed Weight	(ozs)	$\frac{10}{4}$

MOUNTING POSITION—Unrestricted

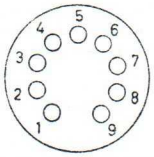
10PL12/UCL82

TRIODE BEAM TETRODE

TYPICAL OPERATION—Class A Audio Output

Anode Voltage (volts)	V_a	100	170	170
Screen Voltage (volts)	V_{g2}	100	170	170
Control Grid Voltage (volts)	V_{g1}	−6	−11.5	−16
Quiescent Anode Current(mA)	$I_{a(0)}$	26	41	35
Quiescent Screen Current (mA)	$I_{g2(0)}$	5	8	7
Power Output for 10% total distortion	P_{out}	1.05	3.3	3.5
Anode Load (kilohms)	R_a	3.9	3.9	5.6
Input Swing (r.m.s.) (volts)	V_{in}	3.8	6.0	6.6
Input Swing for 50mW output (r.m.s.) (volts)	V_{in}	0.65	0.59	0.6

BASE—Noval (B9A)



Viewed from free end of pins

CONNECTIONS

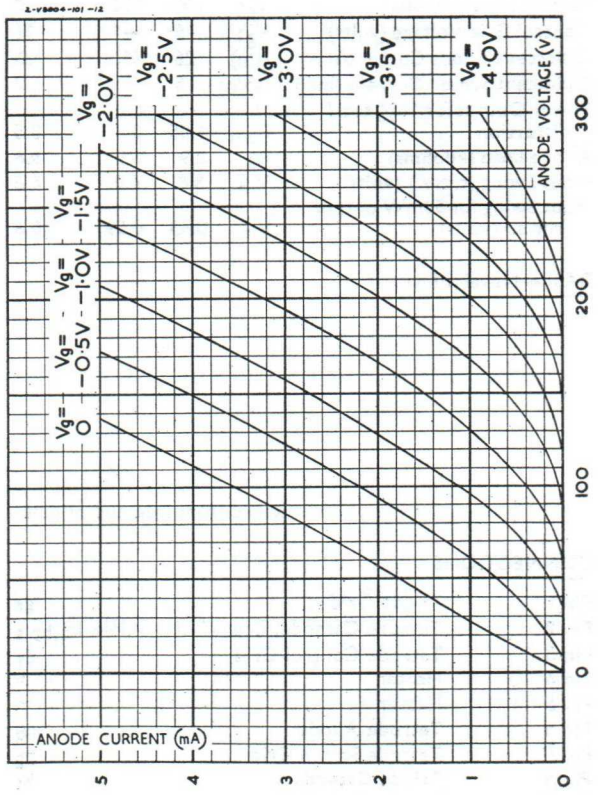
Pin 1	Triode Grid	g_t
Pin 2	Tetrode Cathode, Beam Plate, Shield	$k_{q,bp,s}$
Pin 3	Tetrode Control Grid	g_1
Pin 4	Heater	h
Pin 5	Heater	h
Pin 6	Tetrode Anode	a_q
Pin 7	Tetrode Screen Grid	g_2
Pin 8	Triode Cathode	k_t
Pin 9	Triode Anode	a_t

THORN — AEI RADIO VALVES & TUBES LTD.

10PL12/UCL82
TRIODE BEAM TETRODE

CHARACTERISTIC CURVES: I_a/V_a

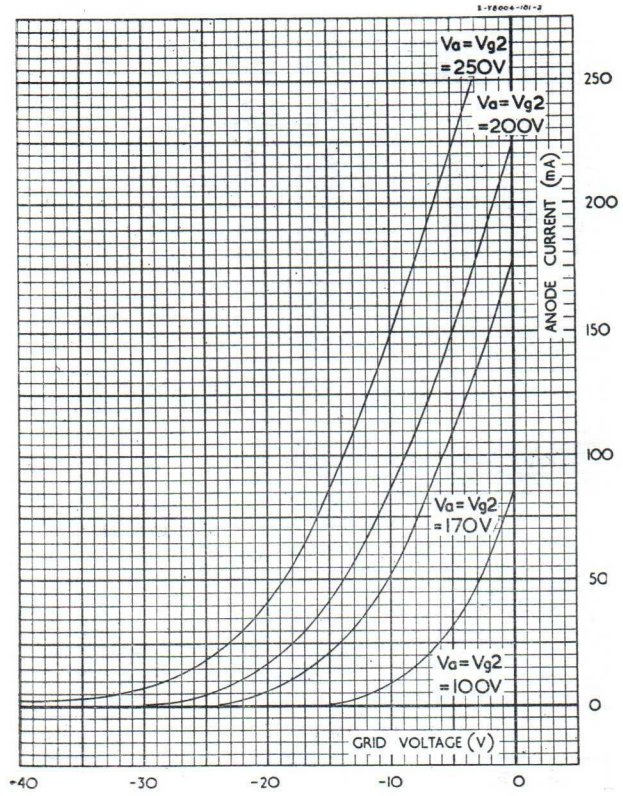
Triode Section



10PL12/UCL82
TRIODE BEAM TETRODE

TENTATIVE

CHARACTERISTIC CURVES: I_a/V_{g1}
Tetrode Section



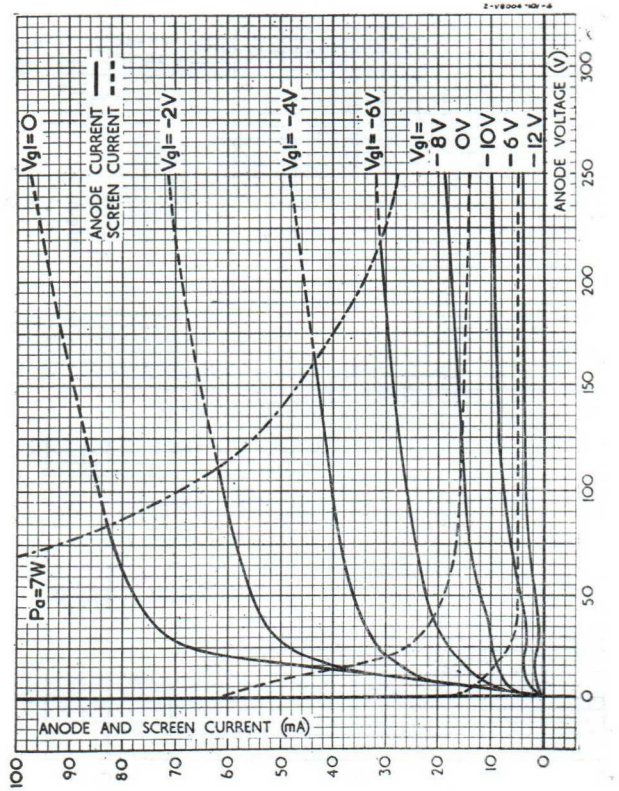
10PL12/UCL82

TRIODE BEAM TETRODE

TENTATIVE

CHARACTERISTIC CURVES: $I_a, I_{g2}/V_a$ ($V_{g2}=100V$)

Tetrode Section



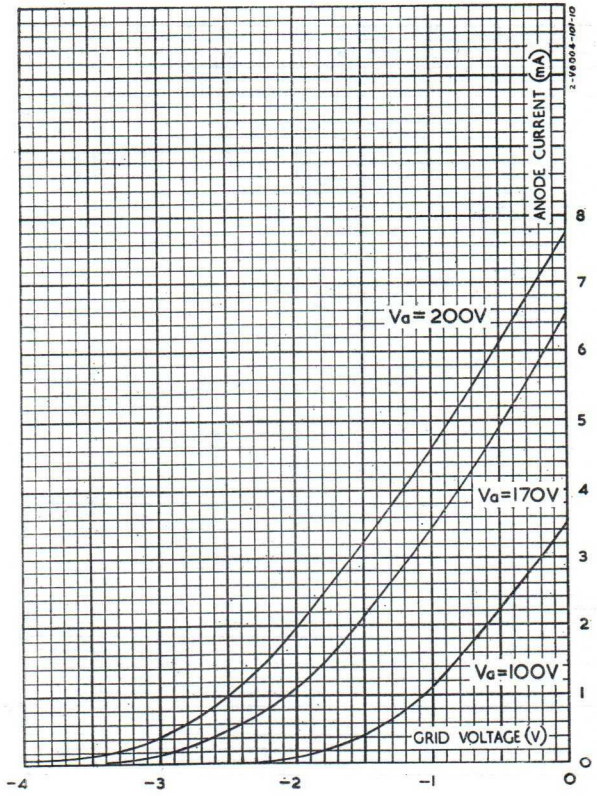
10PL12/UCL82

TRIODE BEAM TETRODE

TENTATIVE

CHARACTERISTIC CURVES: I_a/V_{g1}

Triode Section



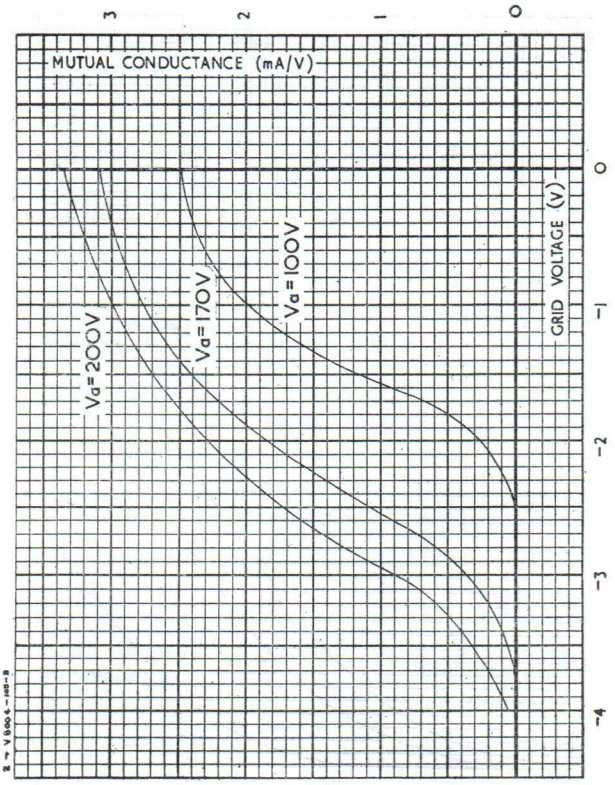
10PL12/UCL82

TRIODE BEAM TETRODE

TENTATIVE

CHARACTERISTIC CURVES: g_m/V_{g1}

Triode Section



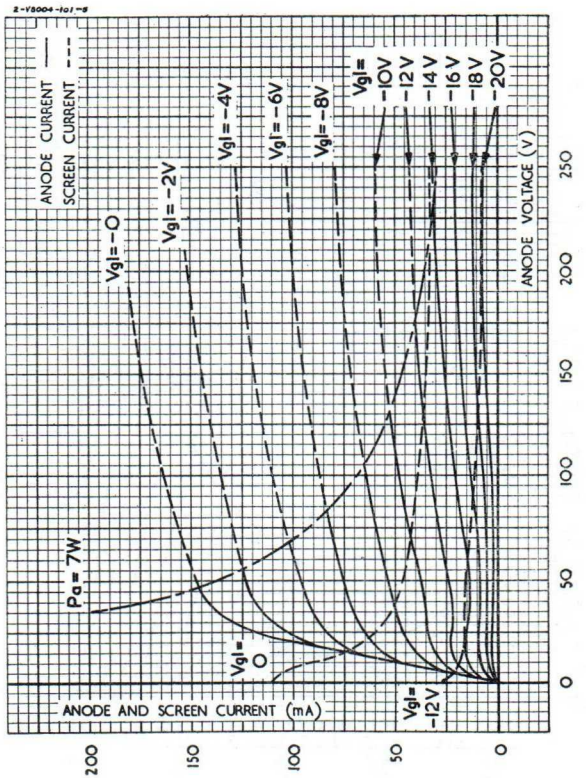
10PL12/UCL82

TRIODE BEAM TETRODE

TENTATIVE

CHARACTERISTIC CURVES: $I_a, I_{g2}/V_a$ ($V_{g2}=170V$)

Tetrode Section



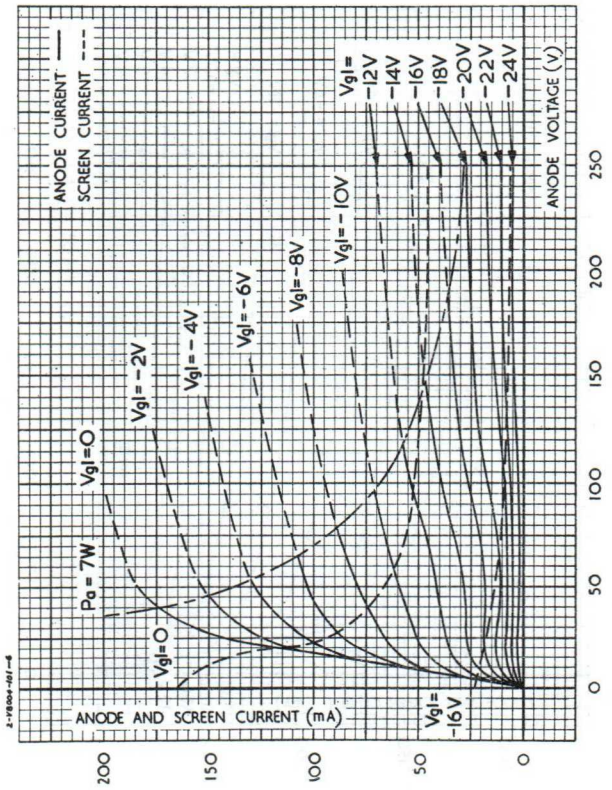
THORN — AEI RADIO VALVES & TUBES LTD.

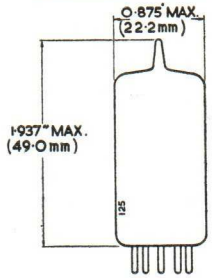
10PL12/UCL82

TRIODE BEAM TETRODE

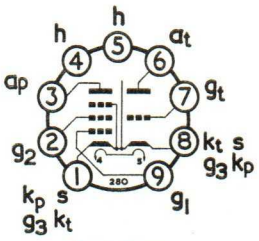
CHARACTERISTIC CURVES: $I_a, I_{g2}/V_a$ ($V_{g2}=200V$)

Tetrode Section





V.H.F. TRIODE PENTODE FREQUENCY CHANGER



B9A Base

GENERAL

This valve is a V.H.F. triode pentode frequency changer for use in AC/DC television receivers. In design, the internal layout is arranged to minimise cathode lead inductance and the basing has been selected to make the valve particularly suitable for use in printed circuits, but it can also be used with advantage in wired circuits. The triode is identical to that used in the 30C1/PCF80.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	9·0	V

RATINGS

		Triode	Pentode	
Maximum Anode Dissipation	$P_{a(max)}$	1·5	1·7	W
Maximum Screen Dissipation	$P_{g2(max)}$	—	0·5	W
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Screen Voltage	$V_{g2(max)}$	—	175	V
Maximum Heater to Cathode Voltage (RMS)	$V_{h-k(r.m.s.)max}$	200		V
Maximum Cathode Current	$I_{k(max)}$	15	14	mA ←

INTER-ELECTRODE CAPACITANCES

		*	†	‡	
Grid 1 to all	$c_{in(p)}$	6·6	6·8	7·7	pF ←
Anode Pentode to all	$c_{out(p)}$	4·6	4·9	5·9	pF ←
Anode Pentode to Grid 1	c_{ap-g1}	0·013	0·017	0·02	pF ←
Grid 1 to Grid 2	c_{g1-g2}	2·3	2·3	2·3	pF ←
Grid Triode to Earth	c_{gt-E}	2·8	3·0	3·8	pF ←
Anode Triode to Earth	c_{at-E}	2·7	2·9	3·7	pF ←
Anode Triode to Grid Triode	c_{at-gt}	1·6	1·7	1·8	pF ←
Anode Triode to Anode Pentode	c_{at-ap}	0·016	0·022	0·026	pF ←
Anode Pentode to Grid Triode	c_{ap-gt}	0·003	0·005	0·006	pF ←
Grid 1 to Grid Triode	c_{g1-gt}	0·012	0·02	0·04	pF ←
Grid 1 to Anode Triode	c_{g1-at}	0·006	0·01	0·015	pF ←

* In fully shielded socket, with cylindrical screening can.

† With holder capacity balanced out but with cylindrical screening can.

‡ Total capacity including B9A holder with cylindrical screen. (Plessey holder type CP180024/3).

" Earth " denotes the electrodes of any second valve section and the remaining earthy potential electrodes of the section under measurement, heater and shields joined to cathode.

Indicates a change ←

THORN — A E I RADIO VALVES & TUBES LTD.

CHARACTERISTICS

		Triode	Pentode	
Anode Voltage	V_a	100	170	V
Screen Voltage	V_{g2}	–	170	V
Anode Current	I_a	15	10	mA
Mutual Conductance	g_m	6	9	mA/V ←
Amplification Factor (Pentode g_1 to g_2)	μ	20	55	←

TYPICAL OPERATION

As frequency changer with oscillator voltage applied to grid 1

PENTODE			
Supply Voltage	V_b	200	V
Anode Voltage (Decoupling resistance=4·7kΩ)	V_a	164	V
Screen Voltage (Rg2=27kΩ)	V_{g2}	138	V
Grid 1 Resistance for Grid Current Bias	R_{g1}	100	kΩ
Grid 1 Current	I_{g1}	33	μA ←
Conversion Conductance	g_c	3·3	mA/V ←
Heterodyne Peak Voltage	$v_{het(pk)}$	3·7	V
Anode Current (Approximate)	I_a	7·6	mA ←
Screen Current (Approximate)	I_{g2}	2·3	mA
TRIODE			
Anode Voltage	V_a	120	V
Average Anode Current	$I_{a(av)}$	6	mA

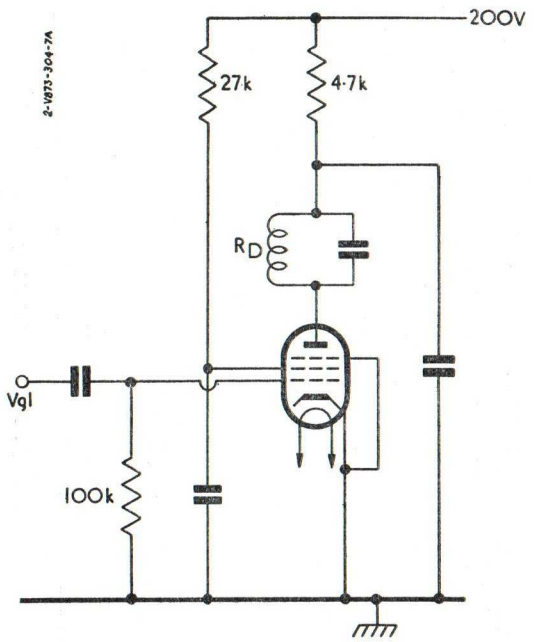
MOUNTING POSITION—Unrestricted.

APPROXIMATE WEIGHT

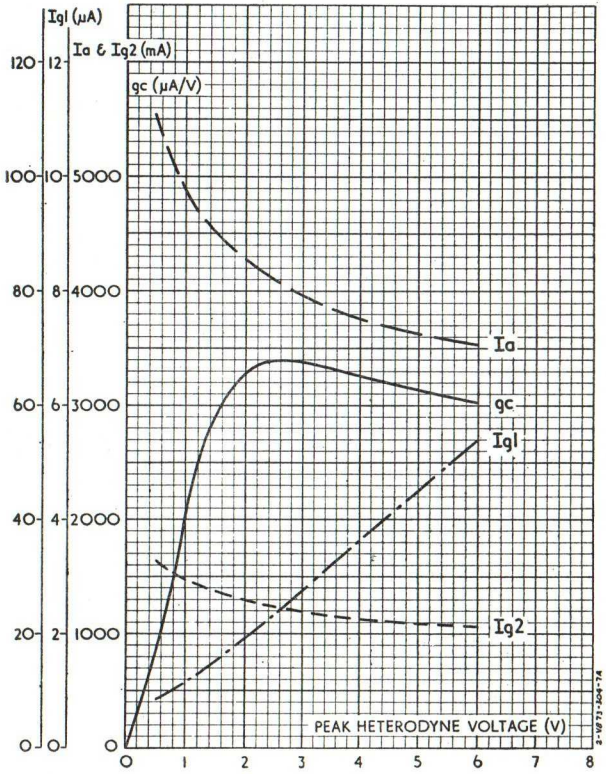
Net	0·5 oz
Packed	0·75 oz

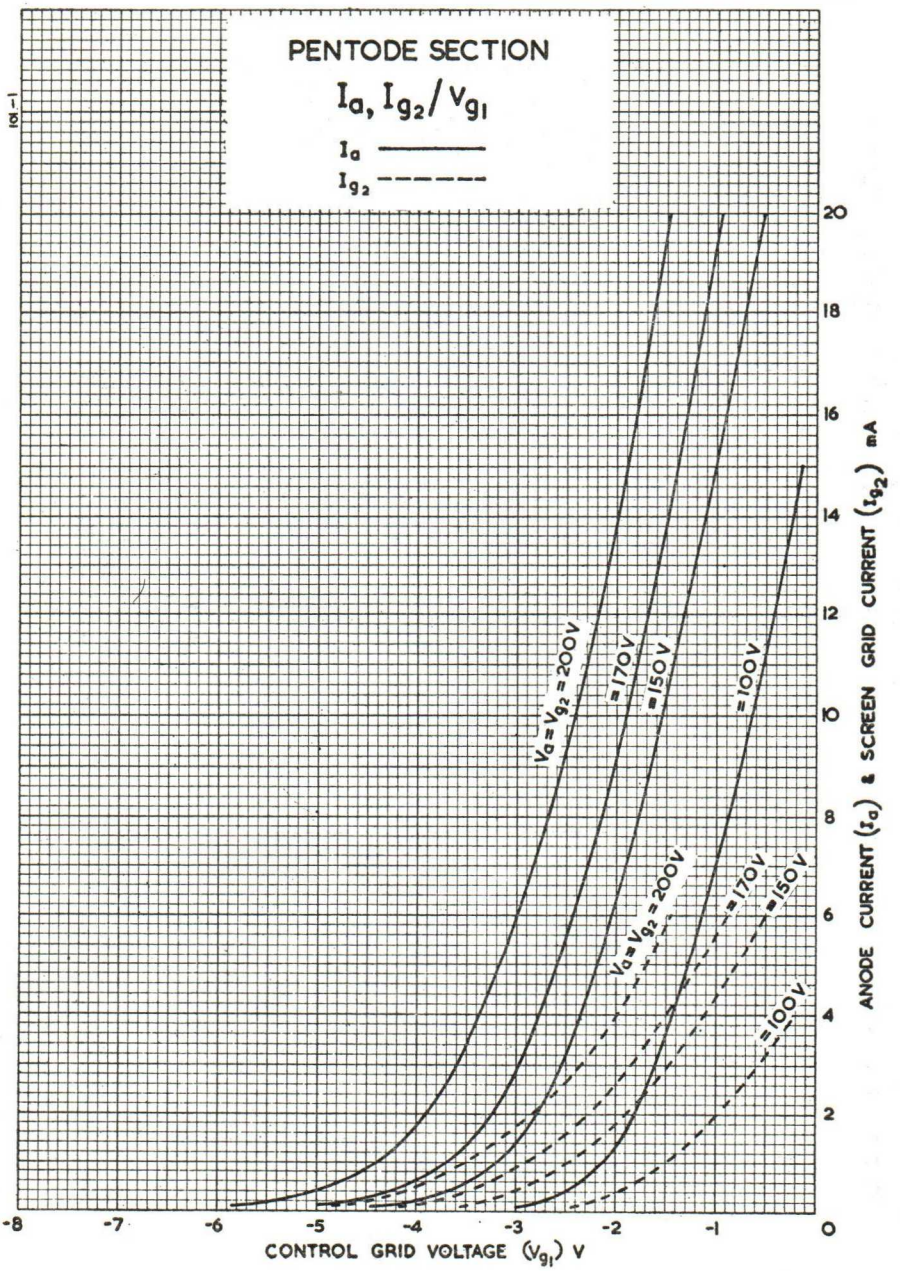
Indicates a change ←

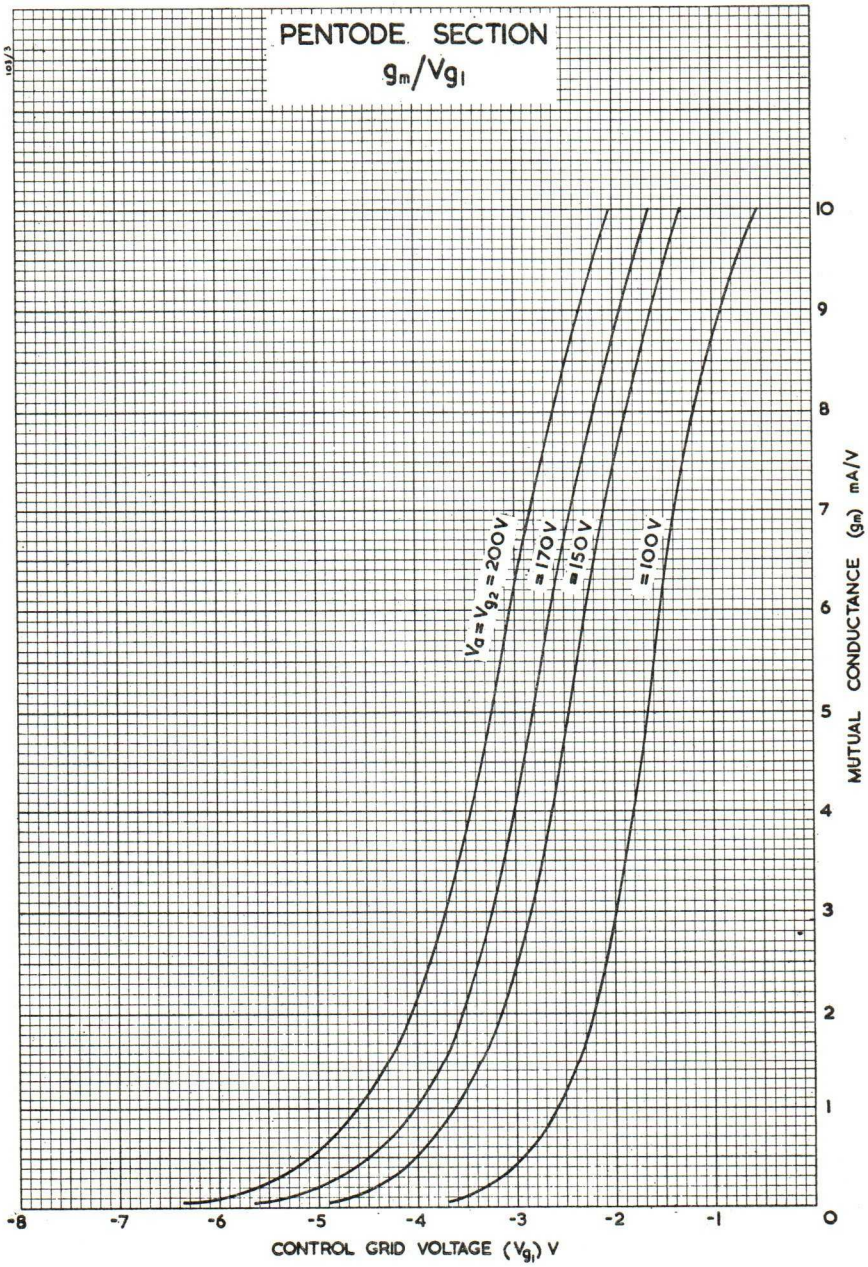
TEST CIRCUIT: Conversion Conductance

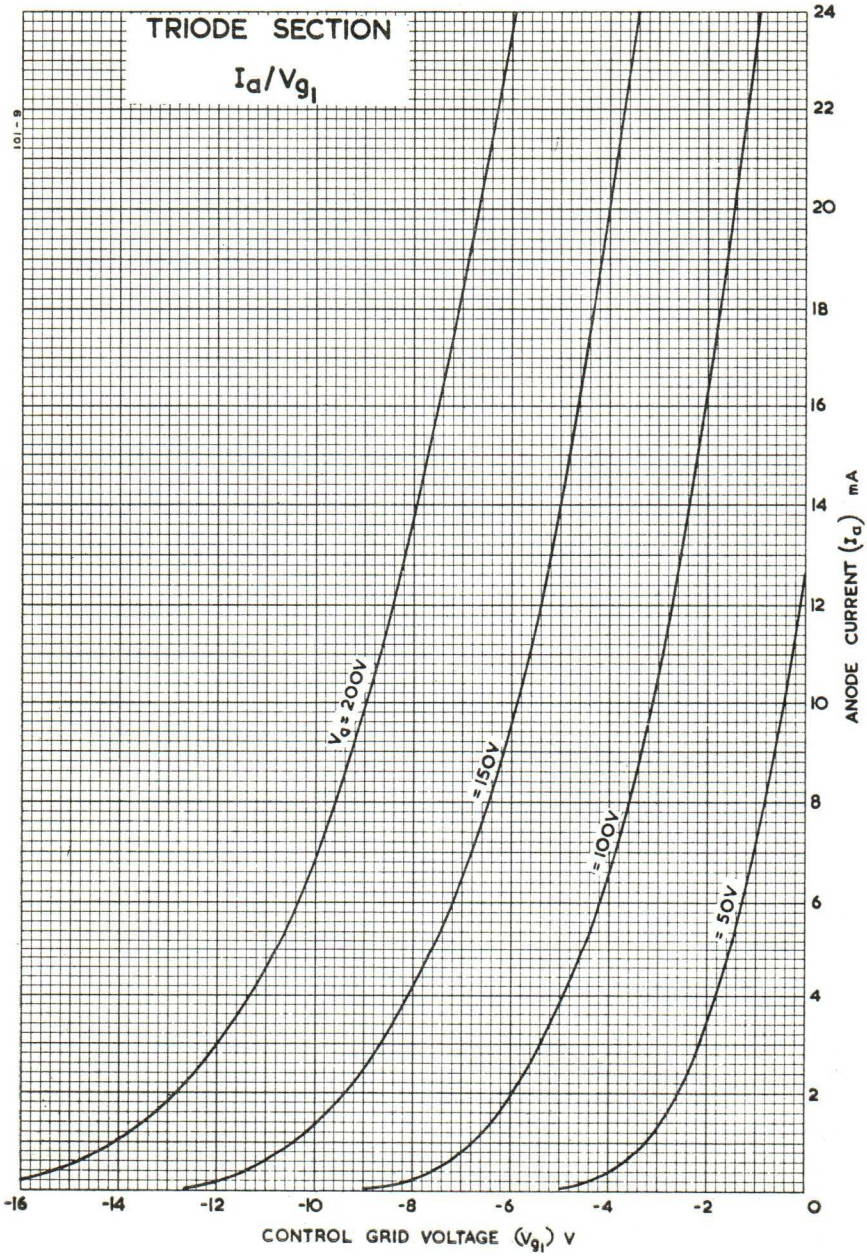


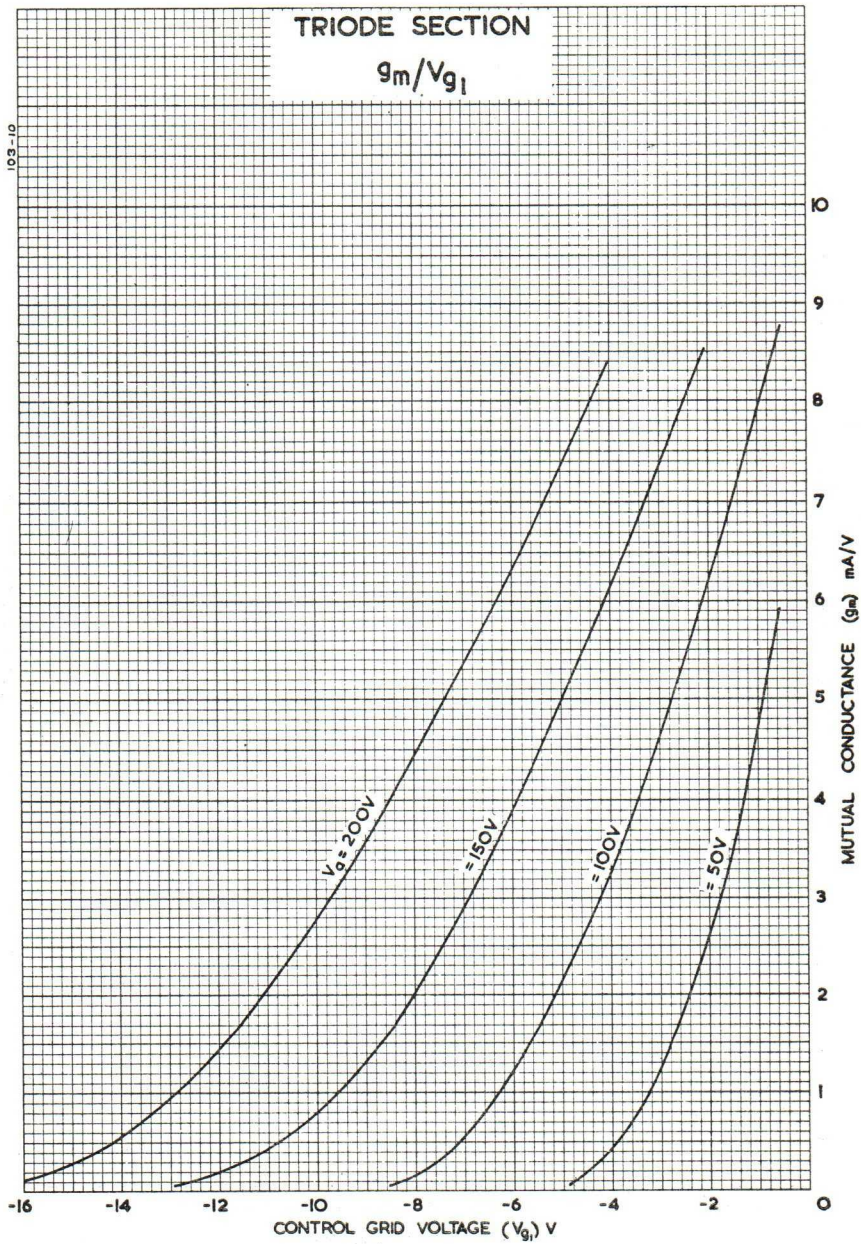
CHARACTERISTIC CURVES: Conversion Conductance

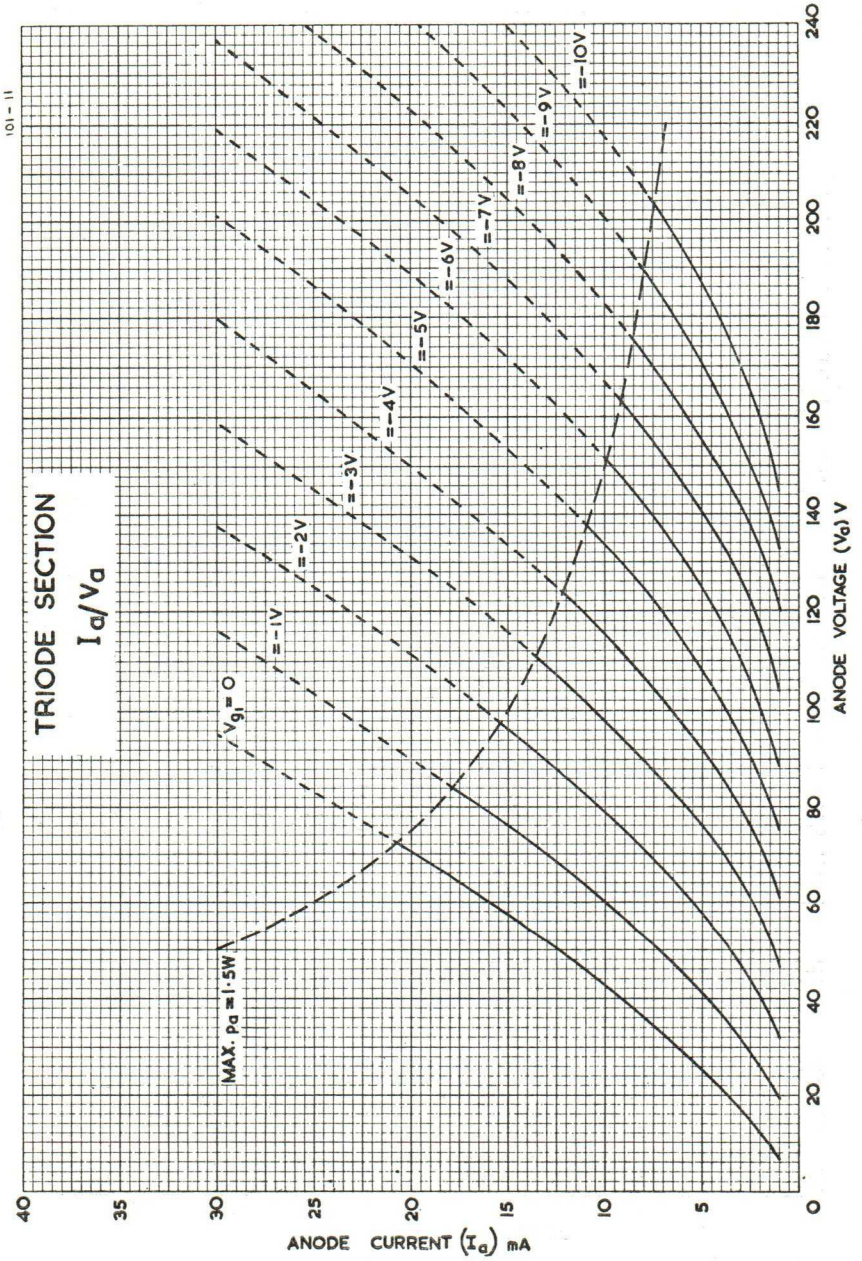


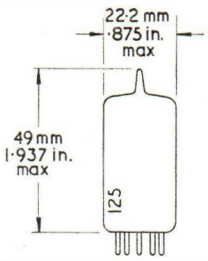

PENTODE SECTION
$I_a, I_{g_2} / V_{g_1}$
I_a
I_{g_2}
$V_a = V_{g_2} = 200V$
170V
150V
100V
$V_a = V_{g_2} = 200V$
170V
150V
100V
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
CONTROL GRID VOLTAGE (V_{g_1}) V
0
2
4
6
8
10
12
14
16
18
20
-1
-2
-3
-4
-5
-6
-7
-8


PENTODE SECTION
g_m/V_{g1}
101/3
$V_G = V_{g2}$ = 200 V
= 170 V
= 150 V
= 100 V
MUTUAL CONDUCTANCE (g_m) mA/V
0
1
2
3
4
5
6
7
8
9
10
-8
-7
-6
-5
-4
-3
-2
-1
CONTROL GRID VOLTAGE (V_{g1}) V

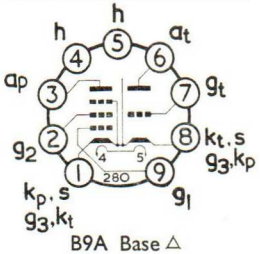

TRIODE SECTION
I_a/V_{g_1}
101-9
V_a = 200V
= 150V
= 100V
= 50V
ANODE CURRENT (I_a) mA
CONTROL GRID VOLTAGE (V_{g_1}) V
24
22
20
18
16
14
12
10
8
6
4
2
0
-16
-14
-12
-10
-8
-6
-4
-2


TRIODE SECTION
g_m/V_{g_1}
103-10
V_a = 200V
= 150V
= 100V
= 50V
-16
-14
-12
-10
-8
-6
-4
-2
0
CONTROL GRID VOLTAGE (V_{g_1}) V
1
2
3
4
5
6
7
8
9
10
MUTUAL CONDUCTANCE (g_m) mA/V


TRIODE SECTION
I_a/V_a
$V_{g_1}=0$
=-1V
=-2V
=-3V
=-4V
=-5V
=-6V
=-7V
=-8V
=-9V
=-10V
MAX. Pa=1·5W
ANODE CURRENT (I_a) mA
ANODE VOLTAGE (V_a) V
0
5
10
15
20
25
30
35
40
20
40
60
80
100
120
140
160
180
200
220
240



V.H.F. FREQUENCY CHANGER



GENERAL

This triode and variable mu pentode valve combination of frame grid construction is for use in television tuners. It is primarily intended to be used as a variable gain V.H.F. frequency changer with the triode as local oscillator but the pentode is also designed for use as a high gain controlled I.F. amplifier following a U.H.F. tuner.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	7·4	V

RATINGS

		Pentode	Triode	
Maximum Anode Dissipation	$P_{a(max)}$	2·0	2·0	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	0·5	—	W
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	230	—	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h\text{-}k(r.m.s.)max}$	200	200	V
Maximum Cathode Current	$I_{k(max)}$	18	18	mA
Maximum Grid to Cathode Resistance (Fixed Bias)	$R_{g1(max)}$	250	500	kΩ

INTER-ELECTRODE CAPACITANCES

		*	†	‡	
Grid 1 to all	$c_{g1\text{-}all}$	6·5	7·2	8·1	pF
Anode Pentode to all	$c_{ap\text{-}all}$	2·8	3·0	4·0	pF
Grid 1 to Anode Pentode	$c_{g1\text{-}ap}$	·008	·01	·012	pF
Anode Triode to Earth	$c_{at\text{-}E}$	2·1	2·2	3·0	pF
Grid Triode to Earth	$c_{gt\text{-}E}$	3·3	3·4	4·2	pF
Anode Pentode to Grid Triode	$c_{ap\text{-}gt}$	·0015	·0025	·004	pF
Grid Triode to Anode Triode	$c_{gt\text{-}at}$	1·9	2·0	2·2	pF
Anode Pentode to Anode Triode	$c_{ap\text{-}at}$	·009	·012	·015	pF
Grid 1 to Grid Triode	$c_{g1\text{-}gt}$	·008	·016	·035	pF
Grid 1 to Anode Triode	$c_{g1\text{-}at}$	·003	·0065	·011	pF

* In fully-shielded socket with can (I.E.C. Publication 100).
† With holder capacity balanced out but with cylindrical screen can (Holder as below).
‡ Total capacity including ceramic B9A holder with cylindrical screen (Plessey holder type CP180024/3).

CHARACTERISTICS

		Pentode	Triode	
Anode Voltage	V_a	125	100	V
Screen Grid Voltage	V_{g2}	125	—	V
Control Grid Voltage	V_{g1}	−1·5	−3·2	V
Anode Current	I_a	10	15	mA
Screen Grid Current	I_{g2}	3	—	mA
Mutual Conductance	g_m	11	8·5	mA/V
Amplification Factor	μ	—	20	
Inner Amplification Factor	$\mu_{g1\text{-}g2}$	45	—	

△ Shield completely surrounds pentode. The basing is arranged to minimise pentode cathode lead inductance effects with the shorter lead to pin 1.
The basing is identical to that of the 30C15/PCF800.

THORN — A E I RADIO VALVES & TUBES LTD.

TYPICAL OPERATION AS FREQUENCY CHANGER AND I.F. AMPLIFIER

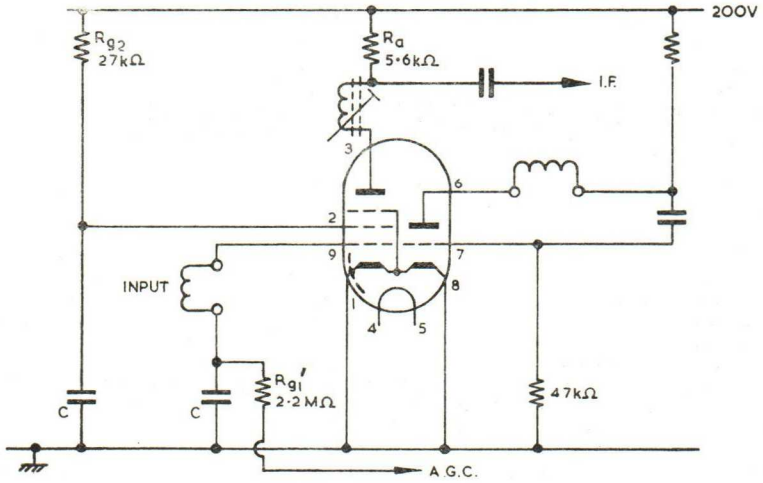
Grid current bias operation with A.G.C. Oscillator voltage injected into grid 1.

Pentode		F.C.	I.F.*	
Frequency	f	200	36	Mc/s
Supply Voltage	V_b	200	200	V
Anode Voltage (Decoupling Resistance, R_a=5·6k Ω) (approx.)	V_a	160	130	V
Screen Grid Voltage (R_{g2}=27k Ω) (approx.)	V_{g2}	150	100	V
Grid 1 Resistance	$R_{g1'}$	2·2	2·2	M Ω
Current through Grid 1 resistance	I_{g1}	1·3	0·3	μA
Anode Current (approx.)	I_a	7·3	12·5	mA
Screen Grid Current (approx.)	I_{g2}	1·8	3·7	mA
Conversion Conductance at 1 Mc/s (V_b,R_a,R_{g1},R_{g2} as above)	g_c	4·8	—	mA/V
Grid Voltage for Conversion Conductance reduction 10 : 1	$V_{g1(gc/10)}$	−6·5	—	V
Mutual Conductance (V_b,R_a,R_{g1},R_{g2} as above)	g_m	—	15	mA/V
Grid Voltage for Mutual Conductance reduction 10 : 1	$V_{g1(gm/10)}$	—	−4·8	V
Grid Voltage for Mutual Conductance reduction 100 : 1	$V_{g1(gm/100)}$	—	−6·6	V
Valve Input Resistance (Anode short circuited)	r_{g1}	—	11	k Ω
Working Input Capacitance	$c_{in(w)}$	—	11†	pF
Change in Input Capacitance by biasing valve to cut off	$\Delta c_{in(w)}$	—	2·7	pF

Triode			
Anode Voltage	V_a	60	V
Anode Current	I_a	7	mA
Rectified Grid Voltage (Grid Resistance = 47k Ω)	V_g	6	V

* Supply voltage removed from triode.

† With holder capacitance balanced out but with can.



C = DECOUPLING CAPACITORS

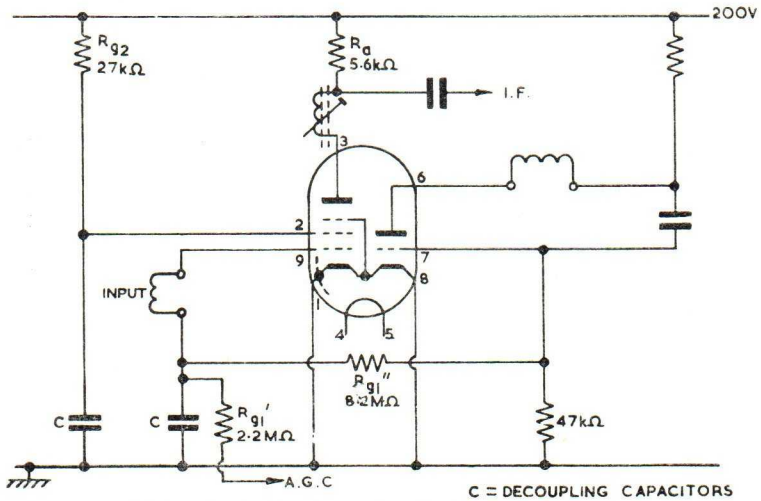
TYPICAL OPERATION AS FREQUENCY CHANGER AND I.F. AMPLIFIER

Partial grid current bias can be used for the frequency changer operation when a rectified voltage of greater than 8V d.c. is available from the triode grid resistor. This reduces the delay in the initial $V_{a.g.c.}/g_c$ characteristic as shown on page 10. The heterodyne voltage is injected into grid 1.

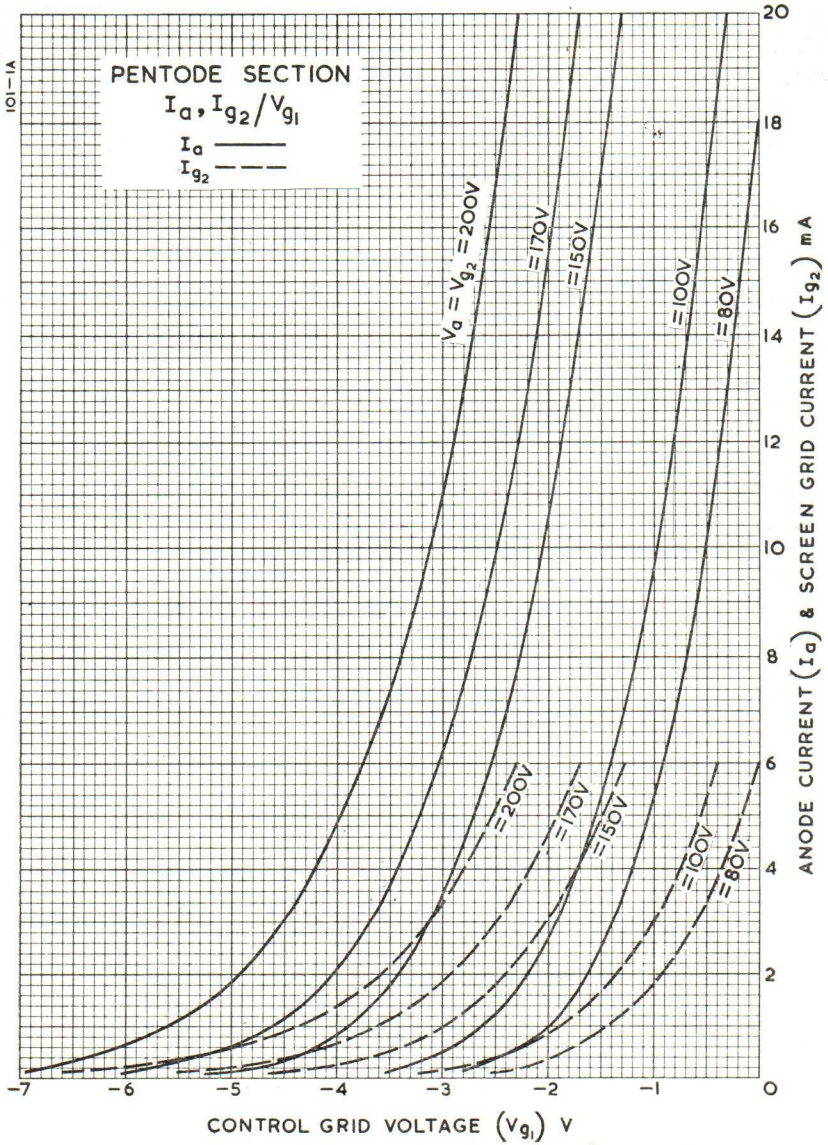
Pentode		F.C.	I.F.*	
Frequency	f	200	36	Mc/s
Supply Voltage	V_b	200	200	V
Anode Voltage (Decoupling Resistance, R_a=5·6k Ω) (approx.)	V_a	160	130	V
Screen Grid Voltage (R_{g2}=27k Ω) (approx.)	V_{g2}	150	100	V
Current through resistance $R_{g1'}$ ($R_{g1'}$=2·2M Ω)		1·8	0·3	μA
Resistance to provide bias from Triode Grid	$R_{g1''}$	8·2	8·2	M Ω
Anode Current (approx.)	I_a	7·3	12·5	mA
Screen Grid Current (approx.)	I_{g2}	1·8	3·7	mA
Conversion Conductance at 1 Mc/s (V_b,R_a,R_{g1},R_{g2} as above)	g_c	4·7	—	mA/V
Grid Voltage for Conversion Conductance reduction 10 : 1	$V_{g1(gc/10)}$	−5·4	—	V
Mutual Conductance (V_b,R_a,R_{g1},R_{g2} as above)	g_m	—	15	mA/V
Grid Voltage for Mutual Conductance reduction 10 : 1	$V_{g1(gm/10h)}$	—	−6	V
Grid Voltage for Mutual Conductance reduction 100 : 1	$V_{g1(gm/100)}$	—	−8·3	V
Valve Input Resistance (Anode short circuited)	r_{g1}	—	11	k Ω
Working Input Capacitance	$c_{in(w)}$	—	11†	pF
Change in Input Capacitance by biasing valve to cut off	$\triangle c_{in(w)}$	—	2·7	pF
Triode				
Anode Voltage	V_a	70		V
Anode Current	I_a	9		mA
Rectified Grid Voltage (Grid Resistance = 47k Ω)	V_g	11		V

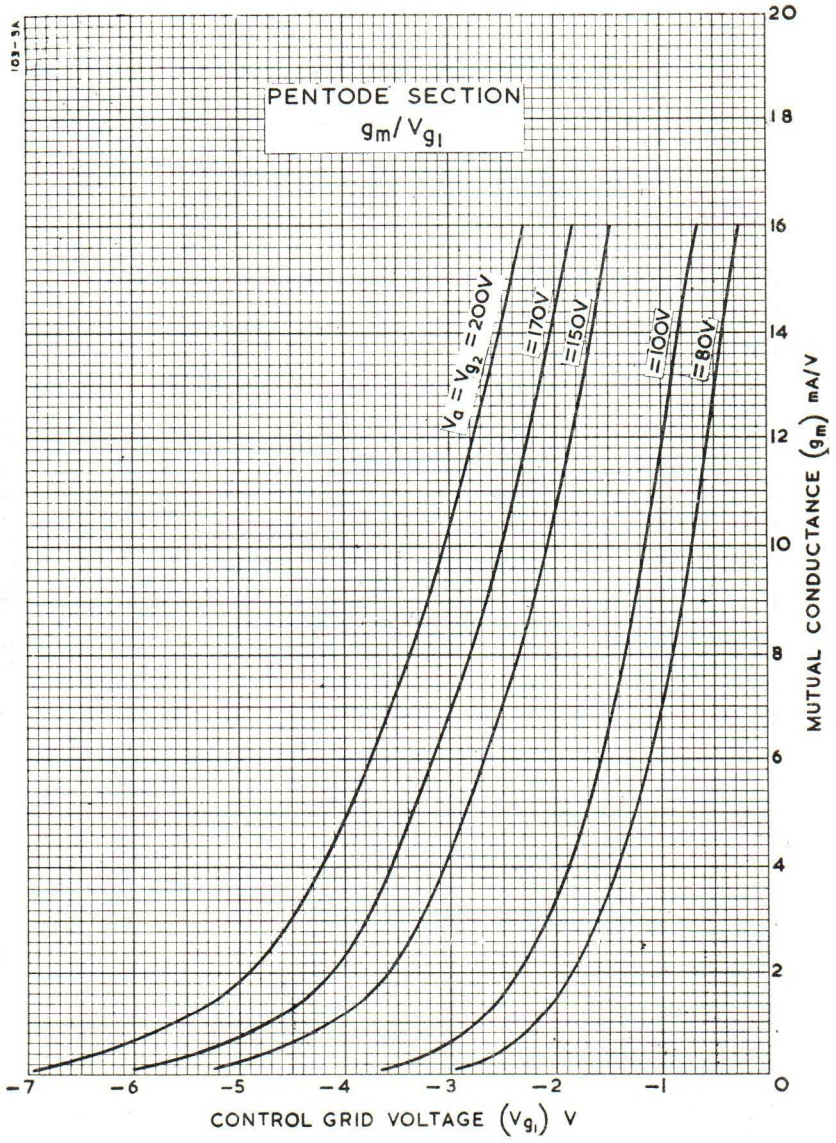
* Supply voltage removed from triode.

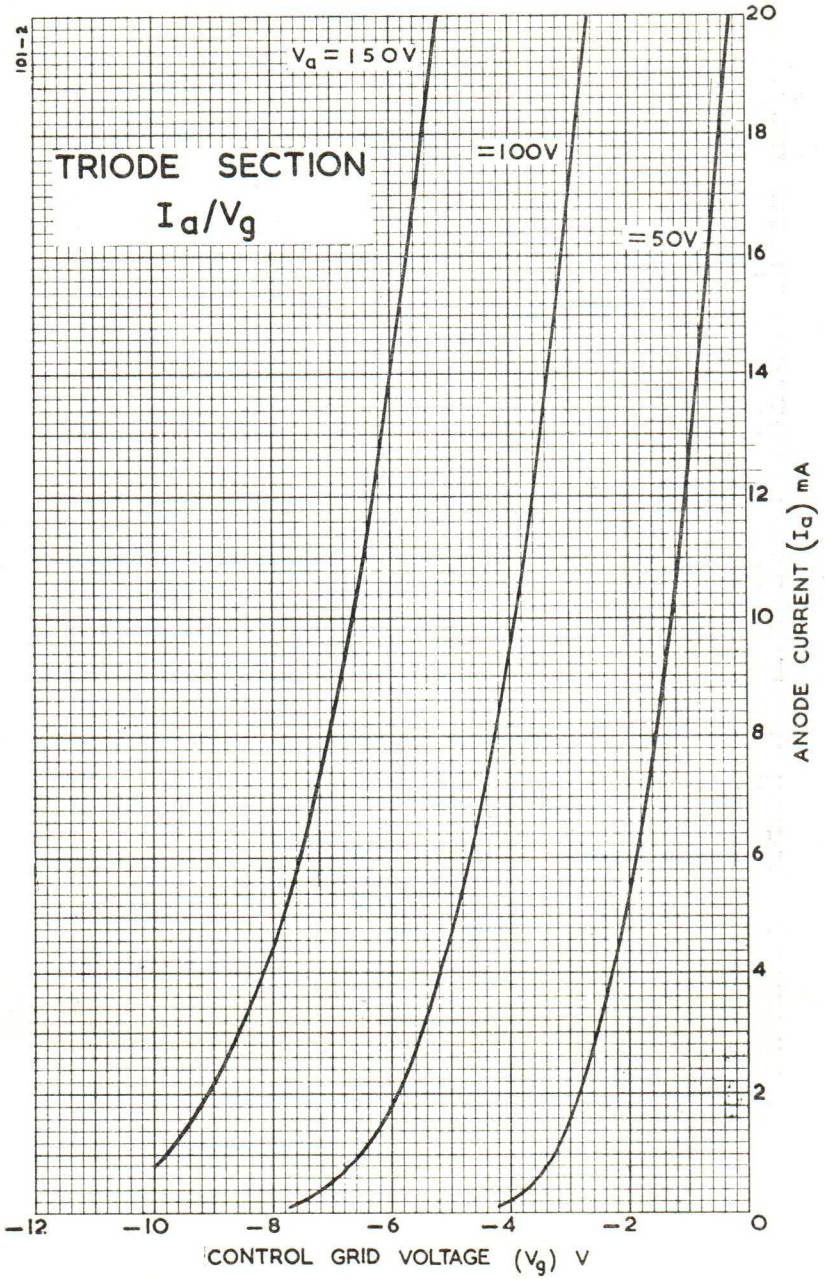
† With holder capacitance balanced out but with can.

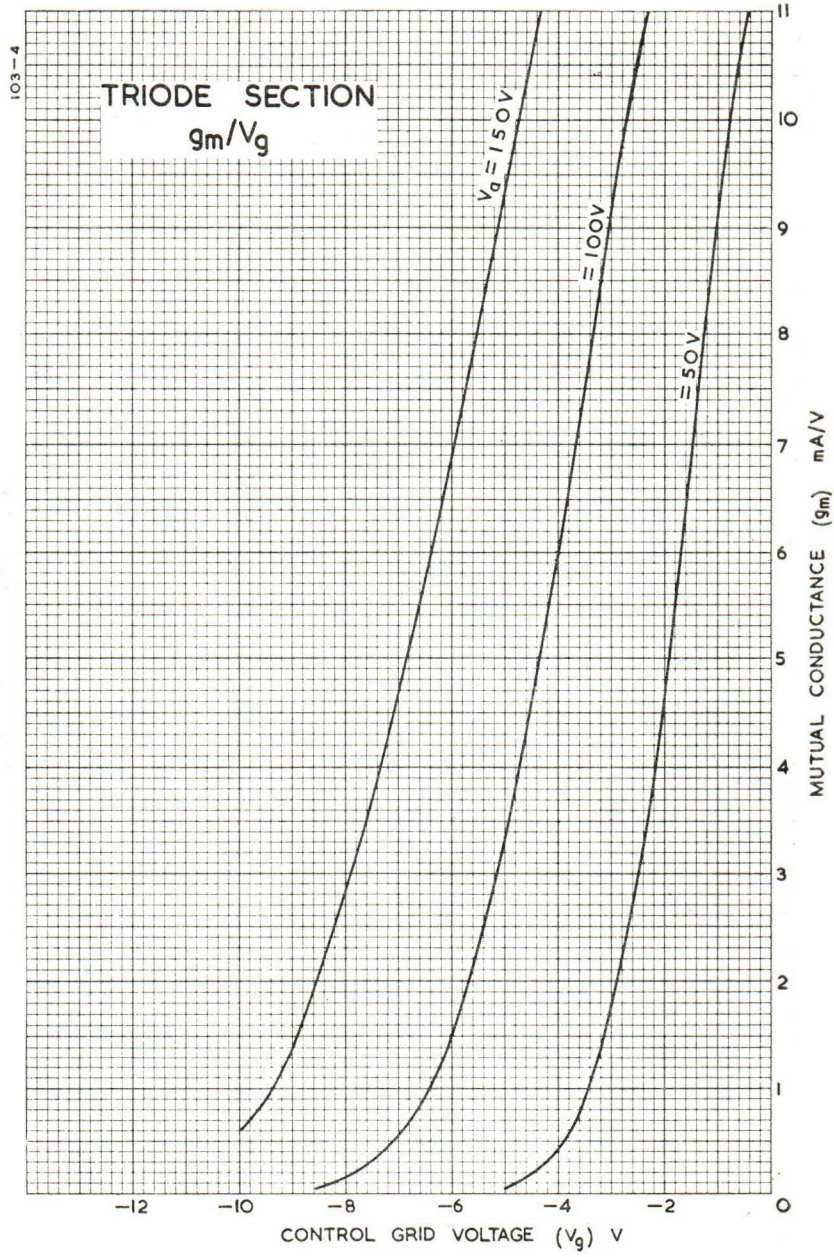


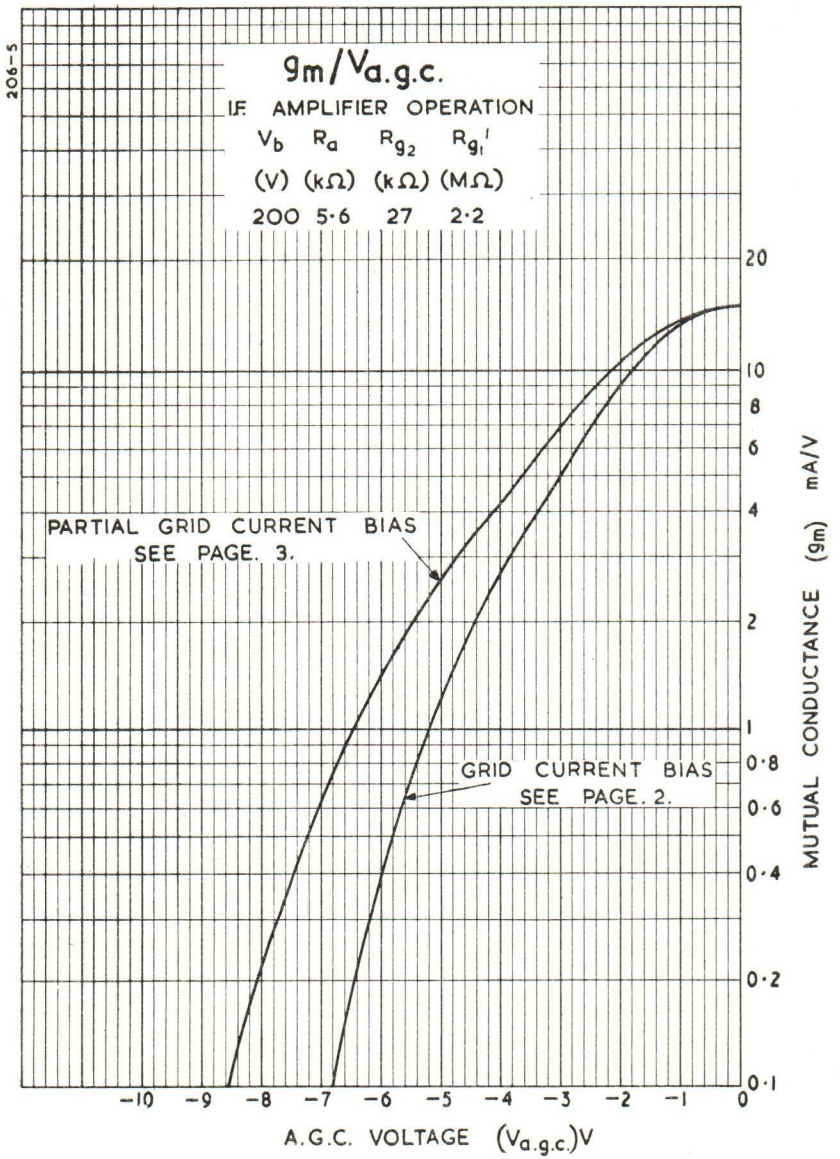
MOUNTING POSITION—Unrestricted

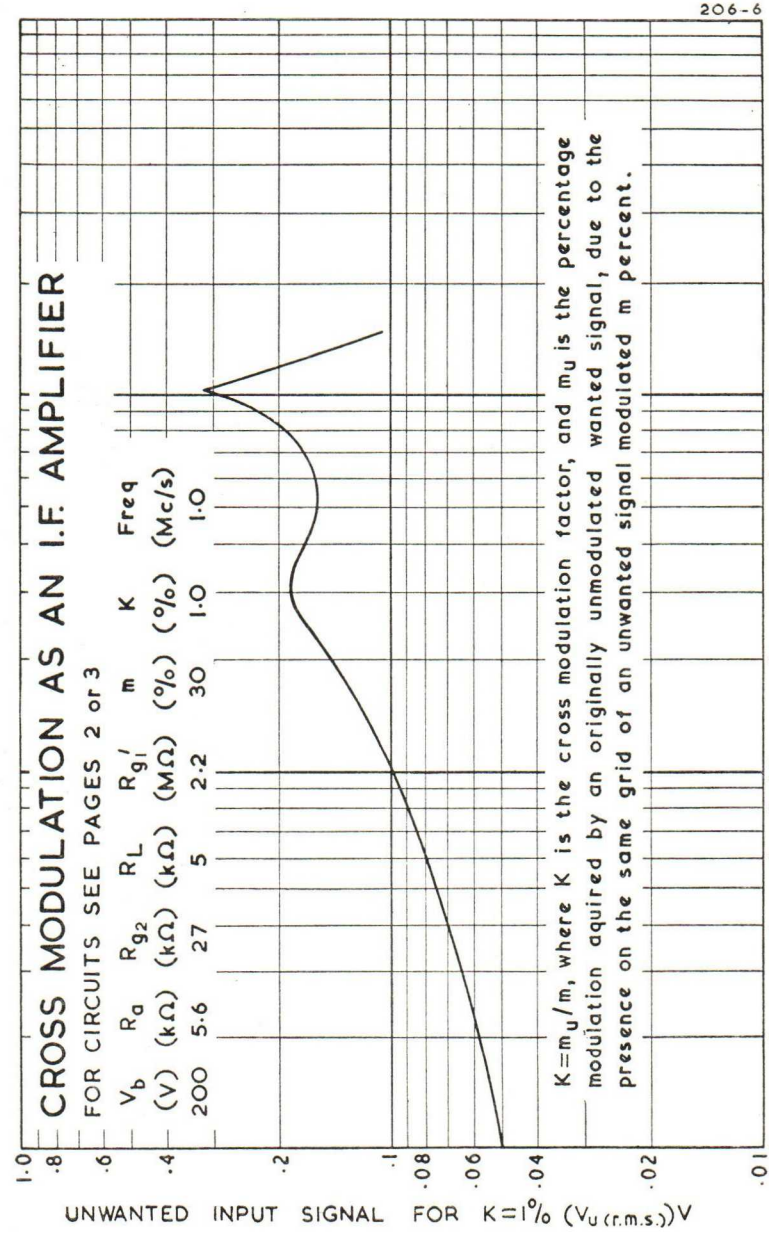

101-1A
PENTODE SECTION
$I_a, I_{g_2}/V_{g_1}$
I_a
I_{g_2}
$V_a = V_{g_2} = 200V$
$= 170V$
$= 150V$
$= 100V$
$= 80V$
$= 200V$
$= 170V$
$= 150V$
$= 100V$
$= 80V$
20
18
16
14
12
10
8
6
4
2
0
−7
−6
−5
−4
−3
−2
−1
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
CONTROL GRID VOLTAGE (V_{g_1}) V

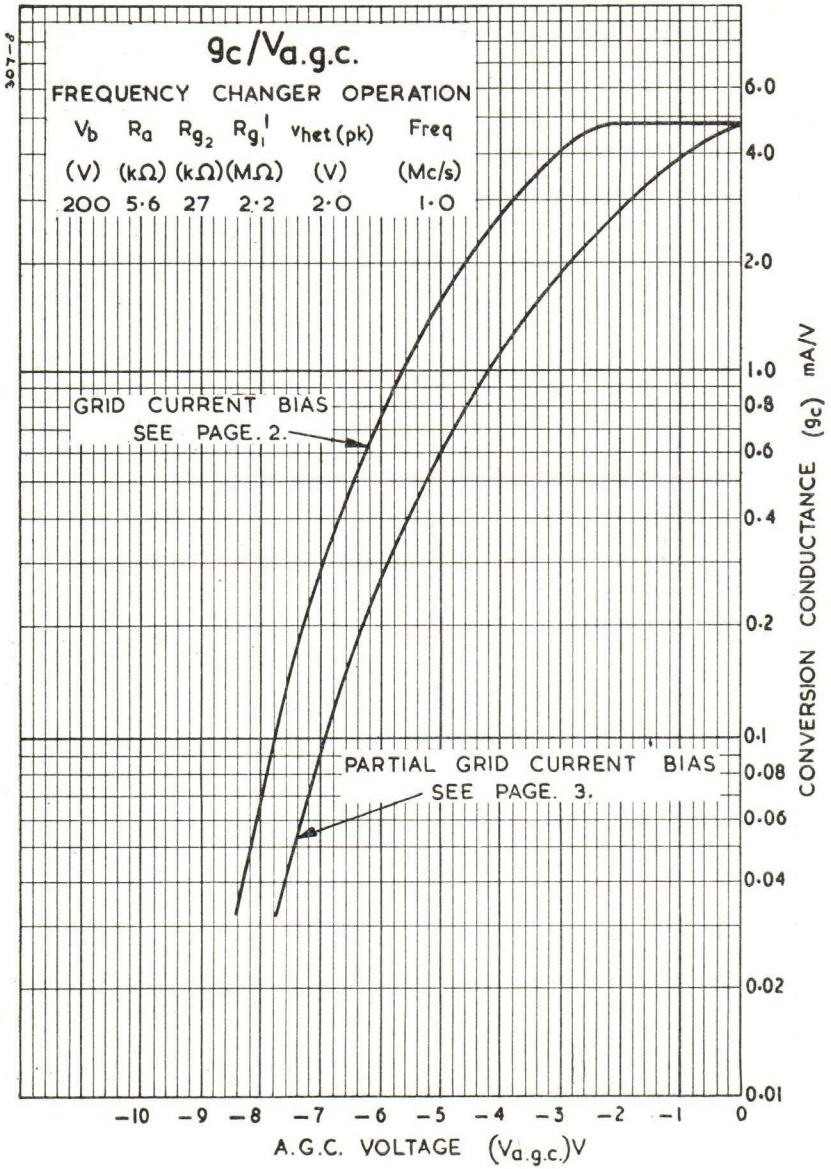

103-5A
PENTODE SECTION
g_m/V_{g1}
$V_a = V_{g2}$ = 200V
170V
150V
100V
80V
MUTUAL CONDUCTANCE (g_m) mA/V
20
18
16
14
12
10
8
6
4
2
0
−7
−6
−5
−4
−3
−2
−1
CONTROL GRID VOLTAGE (V_{g1}) V

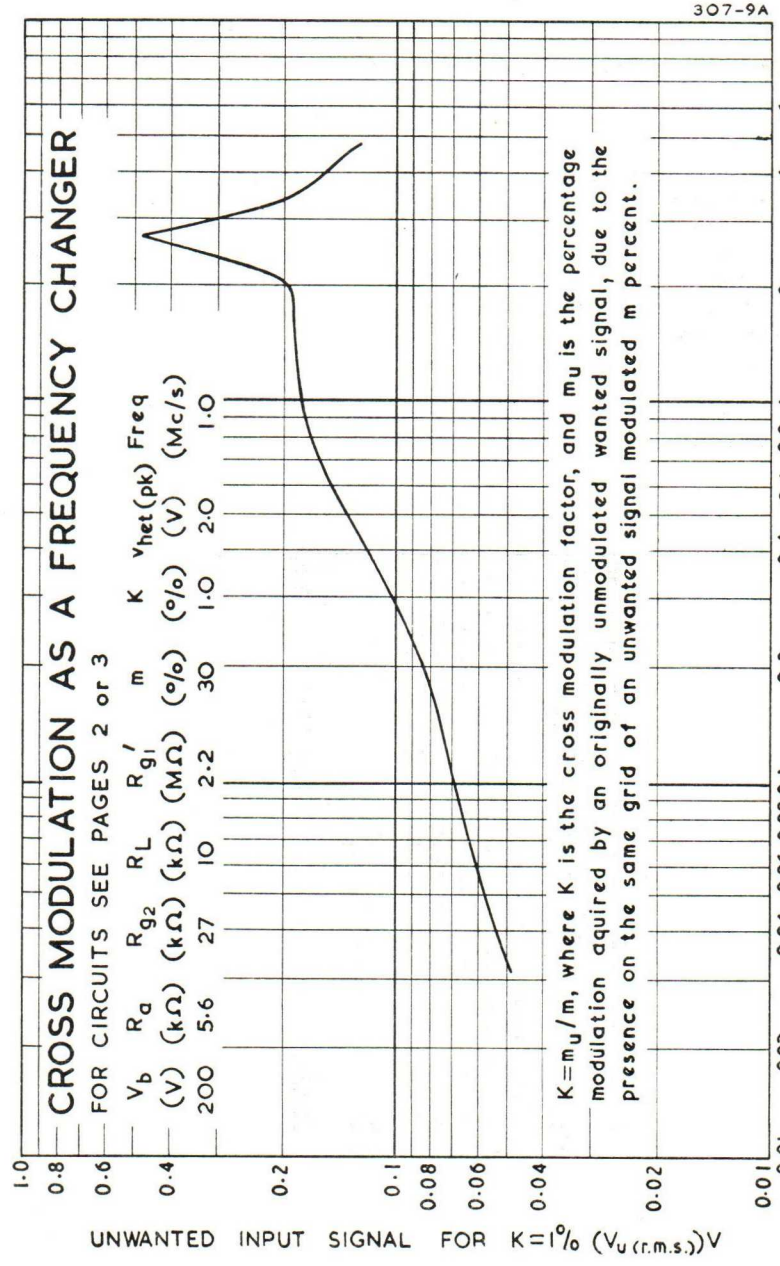

101-2
TRIODE SECTION
Ia/Vg
Va = 150V
=100V
=50V
20
18
16
14
12
10
8
6
4
2
0
ANODE CURRENT (Ia) mA
-12
-10
-8
-6
-4
-2
CONTROL GRID VOLTAGE (Vg) V


103-4
TRIODE SECTION
gm/Vg
Va = 150V
= 100V
= 50V
MUTUAL CONDUCTANCE (gm) mA/V
0
1
2
3
4
5
6
7
8
9
10
11
−12
−10
−8
−6
−4
−2
CONTROL GRID VOLTAGE (Vg) V


206-5
gm/Va.g.c.
I.F. AMPLIFIER OPERATION
Vb Ra Rg2 Rg1'
(V) (kΩ) (kΩ) (MΩ)
200 5·6 27 2·2
PARTIAL GRID CURRENT BIAS
SEE PAGE. 3.
GRID CURRENT BIAS
SEE PAGE. 2.
20
10
8
6
4
2
1
0·8
0·6
0·4
0·2
0·1
MUTUAL CONDUCTANCE (gm) mA/V
−10 −9 −8 −7 −6 −5 −4 −3 −2 −1 0
A.G.C. VOLTAGE (Va.g.c.)V


206-6
CROSS MODULATION AS AN I.F. AMPLIFIER
FOR CIRCUITS SEE PAGES 2 or 3
Vb (V) 200
Ra (kΩ) 5.6
Rg2 (kΩ) 27
RL (kΩ) 5
Rg1' (MΩ) 2.2
m (%) 30
K (%) 1.0
Freq (Mc/s) 1.0
K=mu/m, where K is the cross modulation factor, and mu is the percentage modulation aquired by an originally unmodulated wanted signal, due to the presence on the same grid of an unwanted signal modulated m percent.
UNWANTED INPUT SIGNAL FOR K=1% (Vu (r.m.s.))V
MUTUAL CONDUCTANCE (gm) mA/V
1.0
.8
.6
.4
.2
.1
.08
.06
.04
.02
.01
.2
.4
.6
.8
1.0
2
4
6
8
10
20


307-6
gc/Va.g.c.
FREQUENCY CHANGER OPERATION
Vb Ra Rg2 Rg1 vhet (pk) Freq
(V) (kΩ) (kΩ) (MΩ) (V) (Mc/s)
200 5·6 27 2·2 2·0 1·0
GRID CURRENT BIAS
SEE PAGE. 2.
PARTIAL GRID CURRENT BIAS
SEE PAGE. 3.
6·0
4·0
2·0
1·0
0·8
0·6
0·4
0·2
0·1
0·08
0·06
0·04
0·02
0·01
CONVERSION CONDUCTANCE (gc) mA/V
−10 −9 −8 −7 −6 −5 −4 −3 −2 −1 0
A.G.C. VOLTAGE (Va.g.c.)V


307-9A
CROSS MODULATION AS A FREQUENCY CHANGER
FOR CIRCUITS SEE PAGES 2 or 3
Vb (V) 200
Ra (kΩ) 5·6
Rg2 (kΩ) 27
RL (kΩ) 10
Rg1′ (MΩ) 2·2
m (%) 30
K (%) 1·0
vhet(pk) (V) 2·0
Freq (Mc/s) 1·0
K=mu/m, where K is the cross modulation factor, and mu is the percentage modulation aquired by an originally unmodulated wanted signal, due to the presence on the same grid of an unwanted signal modulated m percent.
UNWANTED INPUT SIGNAL FOR K=1% (Vu (r.m.s.))V
CONVERSION CONDUCTANCE (gc) mA/V
1·0
0·8
0·6
0·4
0·2
0·1
0·08
0·06
0·04
0·02
0·01
0·01
0·02
0·04
0·06
0·08
0·1
0·2
0·4
0·6
0·8
1
2
4
6

TYPICAL OPERATION AS FREQUENCY CHANGER AT 200Mc/s

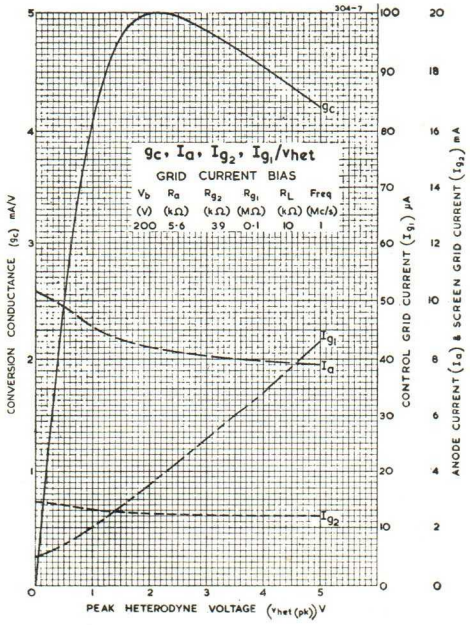
Grid current bias operation without A.G.C. Oscillator voltage injected into grid 1.

Pentode

Supply Voltage	Vb	200	V
Anode Voltage (Decoupling Resistance, R_a=5·6kΩ)	V_a	155	V
Screen Grid Voltage (R_{g2}=39kΩ)	V_{g2}	108	V
Grid 1 Resistance	R_{g1}	0·1	MΩ
Grid 1 Current	I_{g1}	24	μA
Anode Current (approx.)	I_a	8·1	mA
Screen Grid Current (approx.)	I_{g2}	2·4	mA
Conversion Conduction at 1 Mc/s ($V_{het(pk)}$=2·8V)	g_c	4·9	mA/V

Triode

Anode Voltage	V_a	100	V
Anode Current	I_a	5	mA



30F5

HIGH SLOPE SCREENED H.F. PENTODE

Indirectly heated—for series operation

GENERAL

The 30F5 is intended for use as a straight television pentode and is suitable for AC/DC series operation.

RATING

Heater Current (amps)	I_h	0·3
Heater Voltage (volts)	V_h	7·3
Maximum Anode Voltage (volts)	$V_{a(max)}$	250
Maximum Screen Voltage (volts)	$V_{g_2(max)}$	250
Maximum Anode Dissipation (watts)	$P_{a(max)}$	3§
Maximum Screen Dissipation (watts)	$P_{g_2(max)}$	1§
Maximum Heater to Cathode Voltage (volts) (r.m.s.)	$V_{h-k(max)}$	200†
Maximum Resistance Control Grid to Cathode (kΩ)	$R_{g-k(max)}$	600‡
Mutual Conductance (mA/V)	g_m	8.8*
Inner Amplification Factor	μ_{g_1,g_2}	55*

* At $V_a = V_{g_2} = 170$ volts. $V_{g_1} = -1{\cdot}9$

§ With a grid cathode resistance not exceeding 10,000 ohms

† From Cathode to higher potential heater pin

‡ With maximum anode dissipation 2 watts, maximum screen dissipation 0·5 watts and assuming a common anode and screen decoupling resistance of not less than 2,200 ohms ±10%

INTER-ELECTRODE CAPACITANCES (pF)

		‡	§
Grid/Earth	c_{in}	9·0	10·3
Anode/Earth	c_{out}	4·4	5·7
Anode/Grid	c_{g_1-a}	0·0073	0·0077

Inter-electrode Capacitances (*continued overleaf*)

THORN — AEI RADIO VALVES & TUBES LTD.

30F5

HIGH SLOPE SCREENED H.F. PENTODE

Indirectly heated—for series operation

" Earth " denotes the remaining earthy potential electrodes, shields and heater joined to cathode.

‡ Inter-electrode capacitances with holder capacitance balanced out.

§ Total inter-electrode capacity including B9A ceramic holder without skirt or radial shield (Carr Fastener holder type 77/076).

DIMENSIONS

Maximum Overall Length (mm)	67.5
Maximum Diameter (mm)	22.2
Maximum Seated Height (mm)	60.5
Approximate Nett Weight (ozs)	$\frac{1}{2}$
Approximate Packed Weight (ozs)	·1

MOUNTING POSITION—Unrestricted.

TYPICAL OPERATION

Anode Voltage (volts)	V_a	170
Screen Voltage (volts)	V_{g2}	170
Grid Bias Voltage (volts)	V_{g1}	—1·85
Anode Current (mA)	I_a	10
Screen Current (mA)	I_{g2}	2·6
Mutual Conductance (mA/V)	g_m	8·8
Input Loss at 45 Mc/s (ohms)	$r_{g1-k(w)}$	16,000*
Equivalent grid noise resistance (ohms)	R_{eq}	750

* With grid circuit ONLY returned to pin 3

THORN — AEI RADIO VALVES & TUBES LTD.

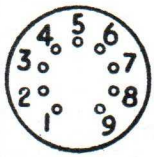
30F5

HIGH SLOPE SCREENED H.F. PENTODE

Indirectly heated—for series operation

BULB—Clear

BASE—Noval (B9A)



Viewed from Free End of Pins

CONNECTIONS

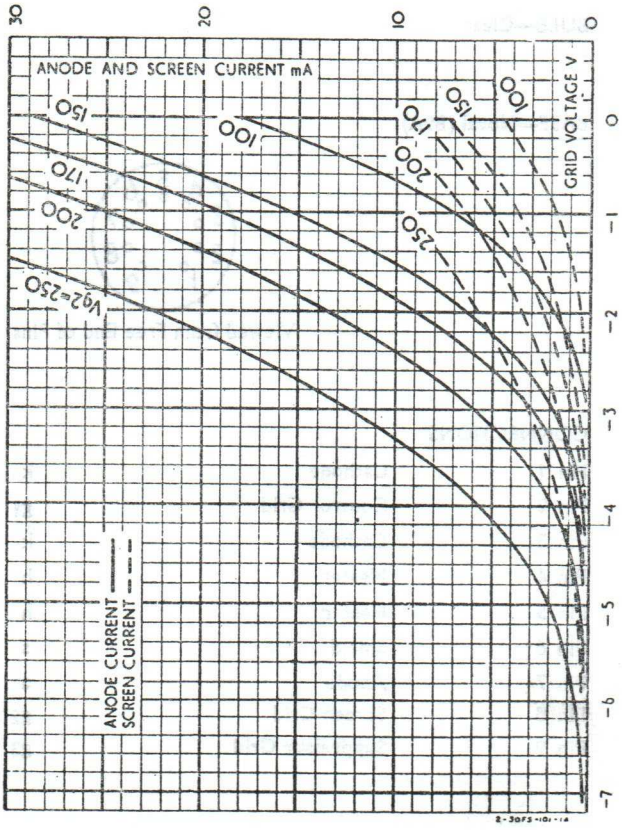
Pin 1	Cathode	k
Pin 2	Control Grid	g1
Pin 3	Cathode	k
Pin 4	Heater	h
Pin 5	Heater	h
Pin 6	Shield	s
Pin 7	Anode	a
Pin 8	Screen Grid	g2
Pin 9	Suppressor Grid	g3

30F5

HIGH SLOPE SCREENED H.F. PENTODE

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES: Ia, Ig2/Vg
Va=250V.



30F5

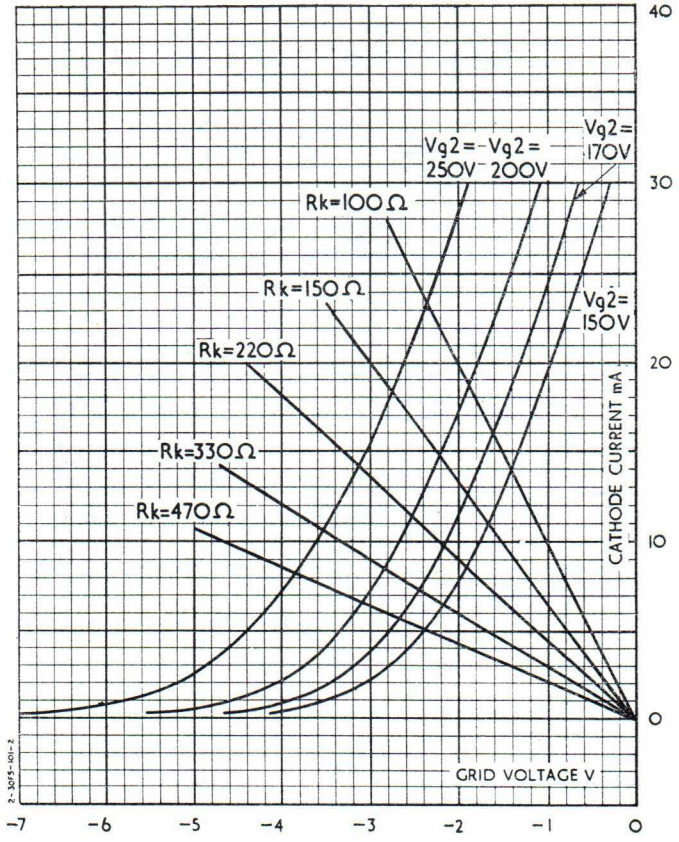
HIGH SLOPE SCREENED H.F. PENTODE

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES: I_k/V_g

Va=250V.

Screen to Anode Current Ratio=26% (approx.)

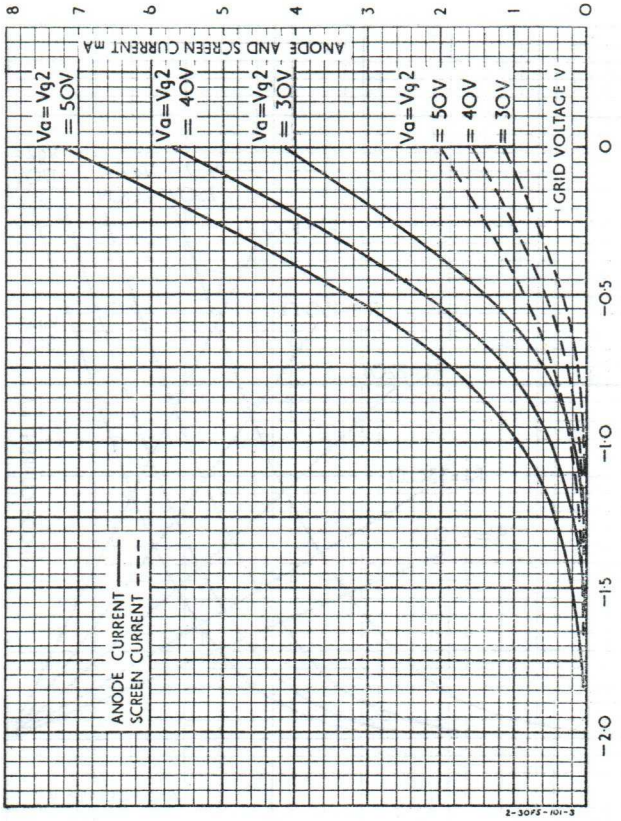


30F5

HIGH SLOPE SCREENED H.F. PENTODE

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES: Ia, Ig2/Vg

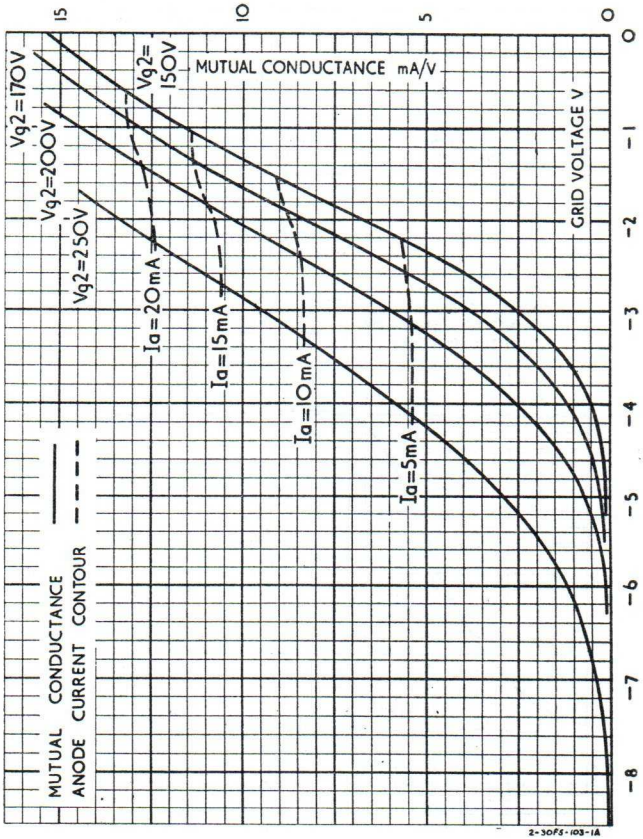


30F5

HIGH SLOPE SCREENED H.F. PENTODE

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES: gm/Vg
Va=250V.



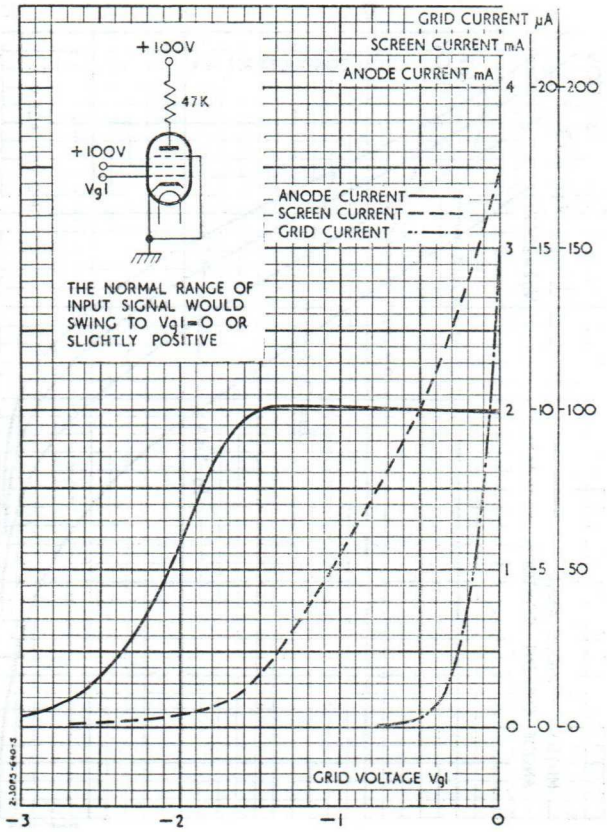
30F5

HIGH SLOPE SCREENED H.F. PENTODE

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES: Ia, Ig2, Ig1/Vg

Used as a limiter in a synchronising separator circuit.

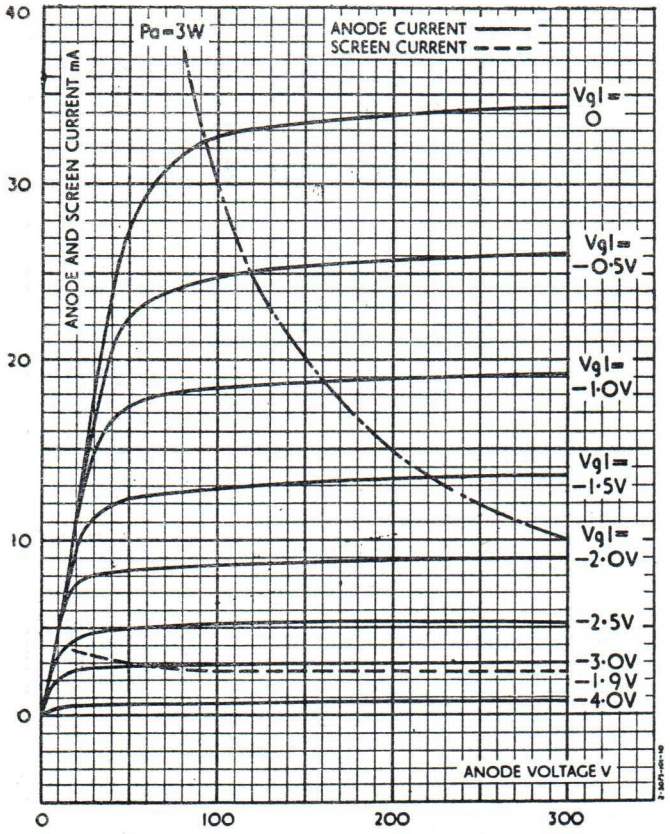


30F5

HIGH SLOPE SCREENED H.F. PENTODE

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES: Ia, Ig2/Va
Vg2=170V.

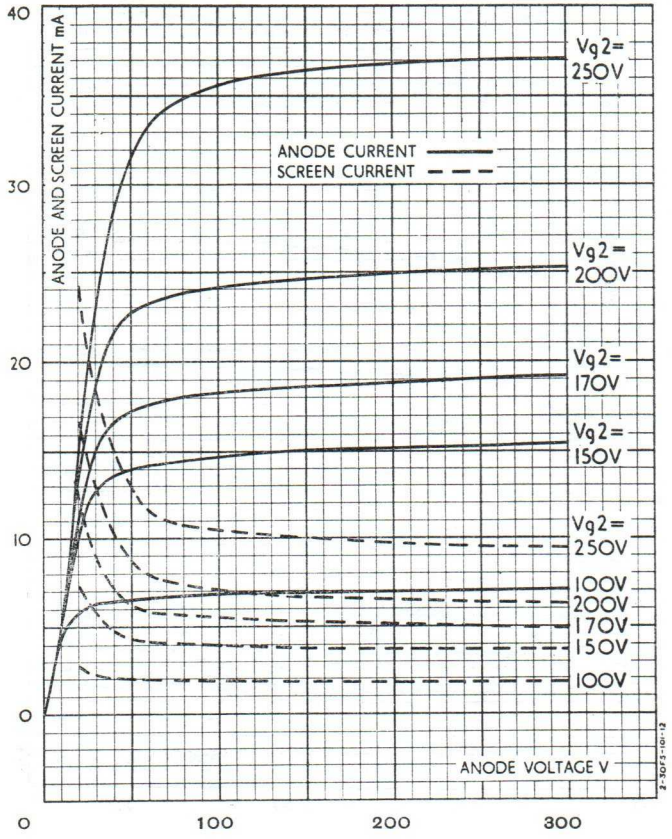


30F5

HIGH SLOPE SCREENED H.F. PENTODE

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES: Ia, Ig2/Va
$V_{g1} = -1{\cdot}0V$.



30F5

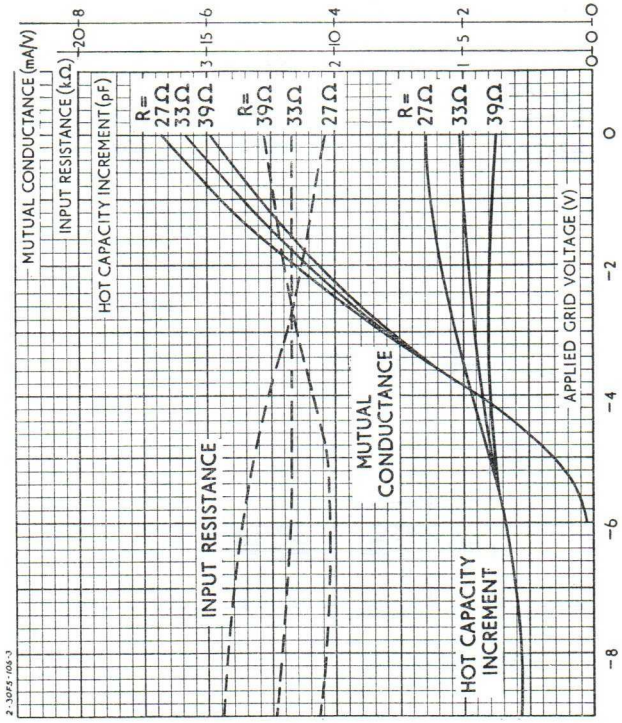
HIGH SLOPE SCREENED H.F. PENTODE

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES : $g_m, r_{in}, \delta c/V_g$

f = 38 Mc/s

See also "Test Circuit" overleaf



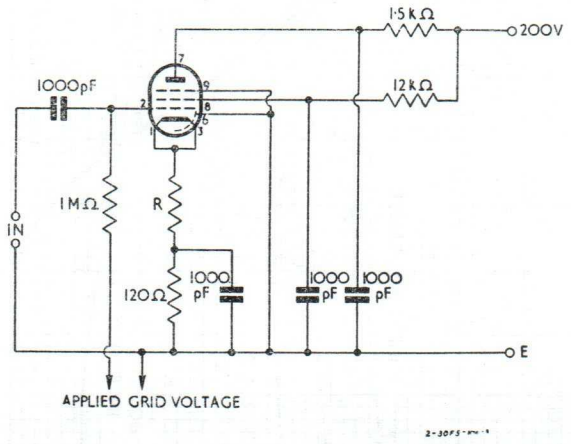
30F5

HIGH SLOPE SCREENED H.F. PENTODE

Indirectly heated—for series operation

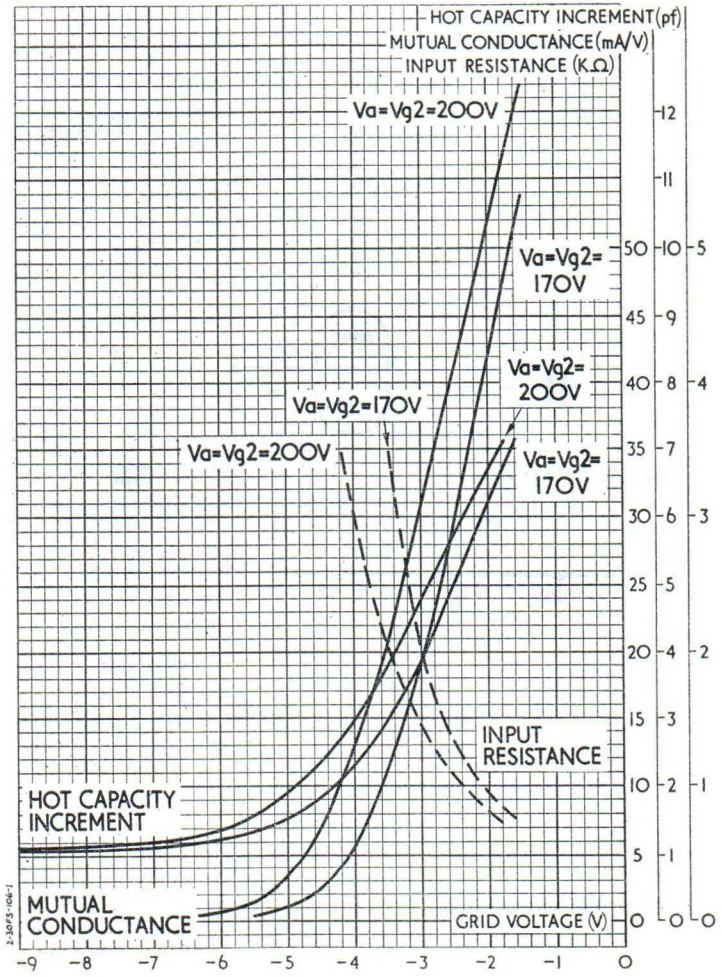
TEST CIRCUIT for
AVERAGE CHARACTERISTICS : g_m, r_{in}, $\delta c/V_g$
f = 38 Mc/s

R (Ω)	27	33	39
V_{g1} (Applied)	0	0	0
I_a (mA)	9.7	9.6	9.45
I_{g2} (mA)	2.75	2.72	2.69



AVERAGE CHARACTERISTIC CURVES: r_{in}, g_m $\delta c/V_g$
f = 38 Mc/s

See also "Test Circuit" overleaf.

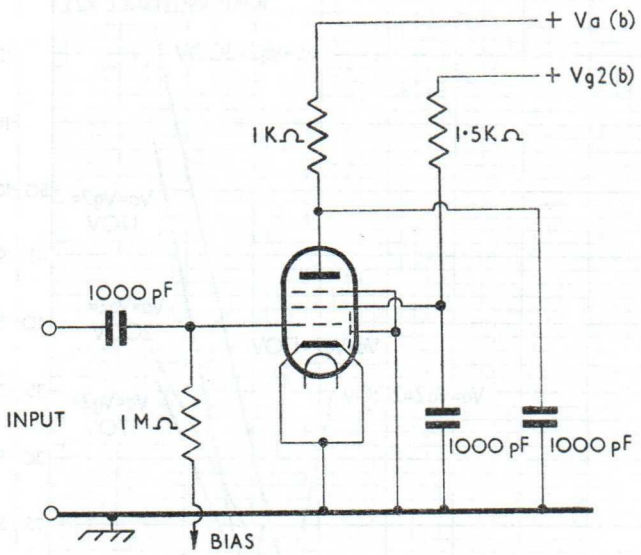


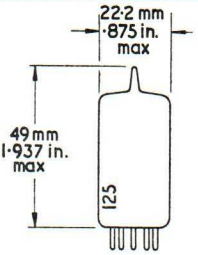
TEST CIRCUIT

for

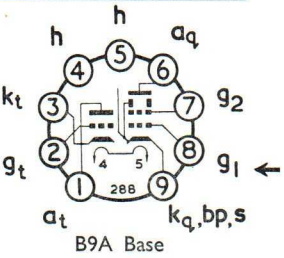
Average Characteristics r_{in}, g_m $\delta c/V_g$

f=38 Mc/s.





TRIODE BEAM TETRODE



B9A Base

GENERAL

This triode beam tetrode valve combination primarily intended for use in Video and Sync Separator stages of AC/DC television receivers, has a medium mu triode and a high slope beam tetrode with a shield between the two sections to reduce interaction. The triode section is a general purpose one with identical characteristics to the 6/30L2.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	9·4	V

RATINGS

		Triode	Tetrode	
Maximum Anode Dissipation	$P_{a(max)}$	2	3	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	—	1	W
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	—	250	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h\text{-}k(r.m.s.)max}$	150*	150*	V

* Measured with respect to the higher potential heater pin.

INTER-ELECTRODE CAPACITANCES

		†	§	‡	
Grid 1 to Earth	$C_{g1\text{-}E}$	7·8	8·0	9·1	pF
Anode Tetrode to Earth	$C_{aq\text{-}E}$	2·4	2·7	3·8	pF
Grid 1 to Anode Tetrode	$C_{g1\text{-}aq}$	0·033	0·047	0·075	pF
Grid Triode to Earth	$C_{gt\text{-}E}$	1·85	2·1	2·9	pF
Anode Triode to Earth	$C_{at\text{-}E}$	2·1	2·3	3·0	pF
Grid Triode to Anode Triode	$C_{gt\text{-}at}$	2·3	2·4	2·7	pF
Grid 1 to Anode Triode	$C_{g1\text{-}at}$	0·0065	0·016	0·03	pF
Grid Triode to Anode Tetrode	$C_{gt\text{-}aq}$	0·0073	0·012	0·015	pF
Anode Tetrode to Anode Triode	$C_{aq\text{-}at}$	0·035	0·043	0·046	pF
Grid 1 to Grid Triode	$C_{g1\text{-}gt}$	0·002	0·0055	0·0094	pF

† In fully shielded socket without can.

§ With holder capacitance balanced out (Holder as below).

‡ Total capacity including B9A nylon phenolic holder without skirt or radial shield (AEI holder type VH19/902).

"Earth" denotes the electrodes of any second value section and the remaining earthy potential electrodes of the section under measurement, heater and shields joined to cathode.

CHARACTERISTICS

		Triode	Tetrode	
Anode Voltage	V_a	200	170	V
Screen Grid Voltage	V_{g2}	—	170	V
Anode Current	I_a	10	10	mA
Mutual Conductance	g_m	3·4	8	mA/V
Amplification Factor (Tetrode g_1 to g_2)	μ	18	44	

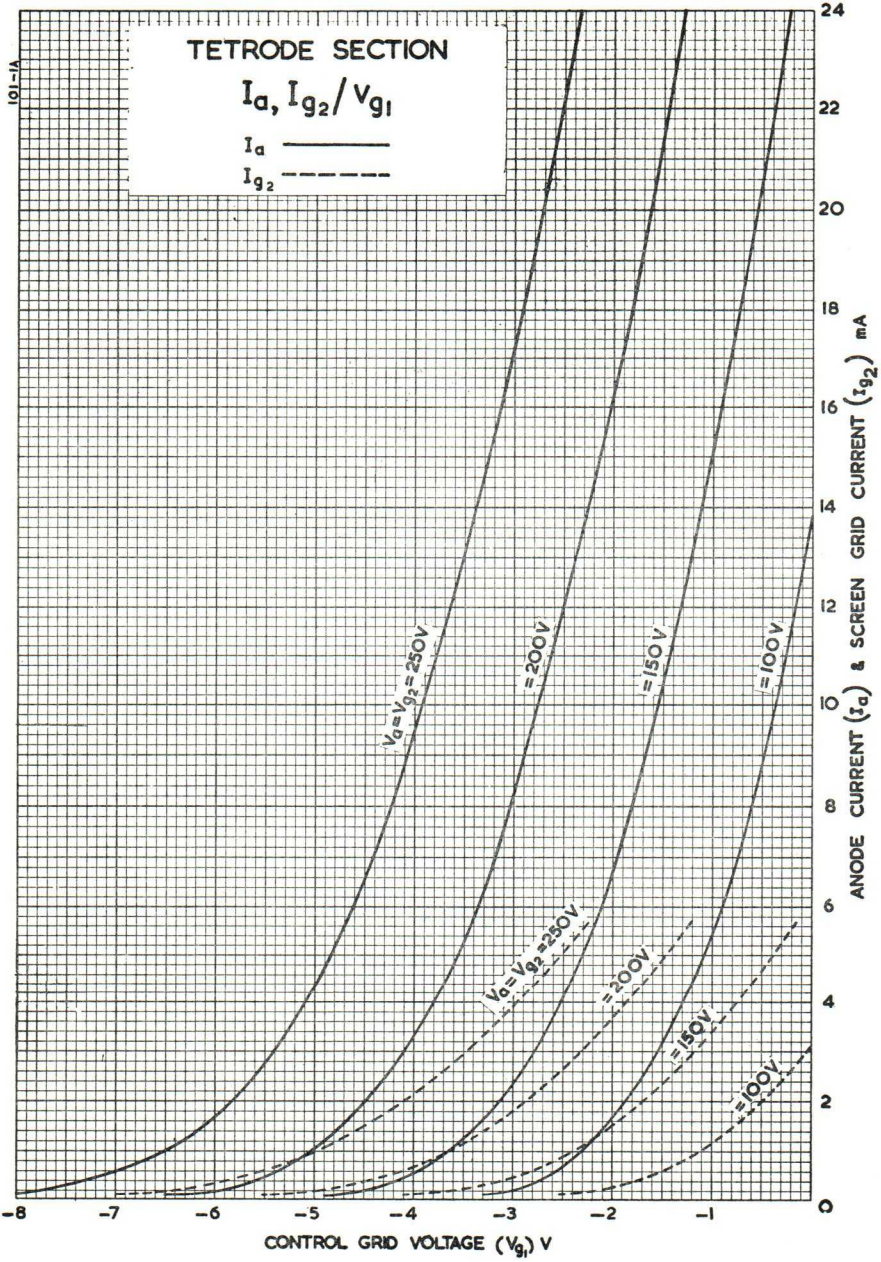
MOUNTING POSITION—Unrestricted.

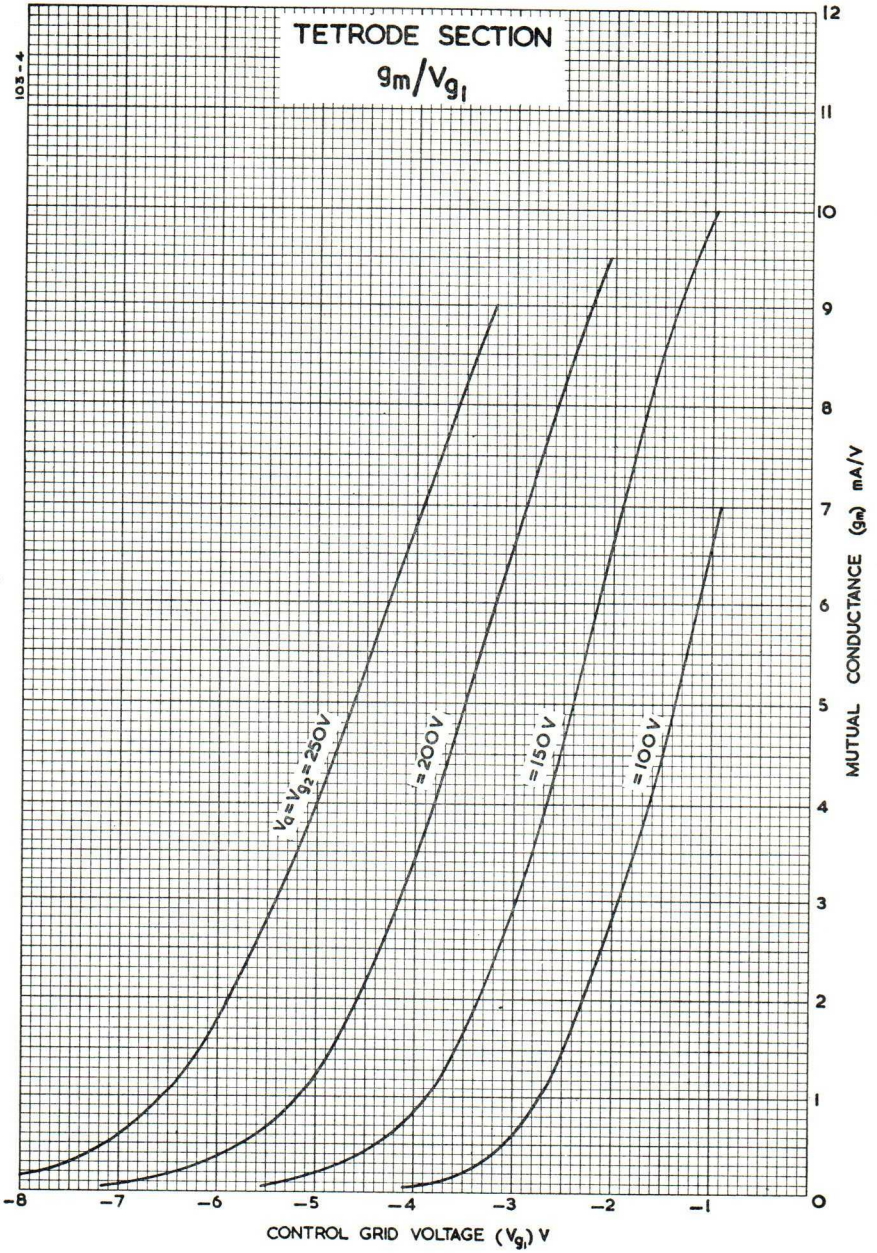
APPROXIMATE WEIGHT

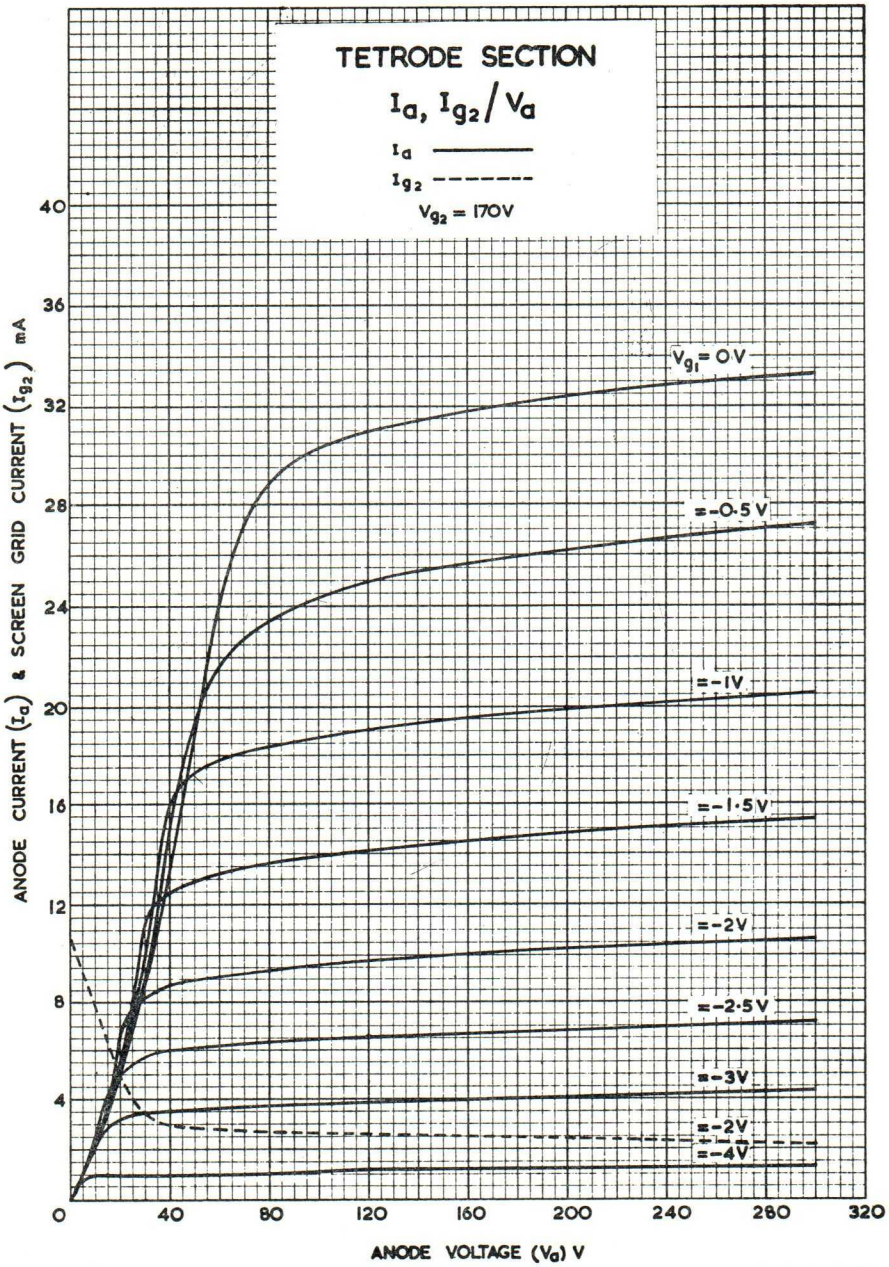
Net	0·5	oz
Packed	0·75	oz

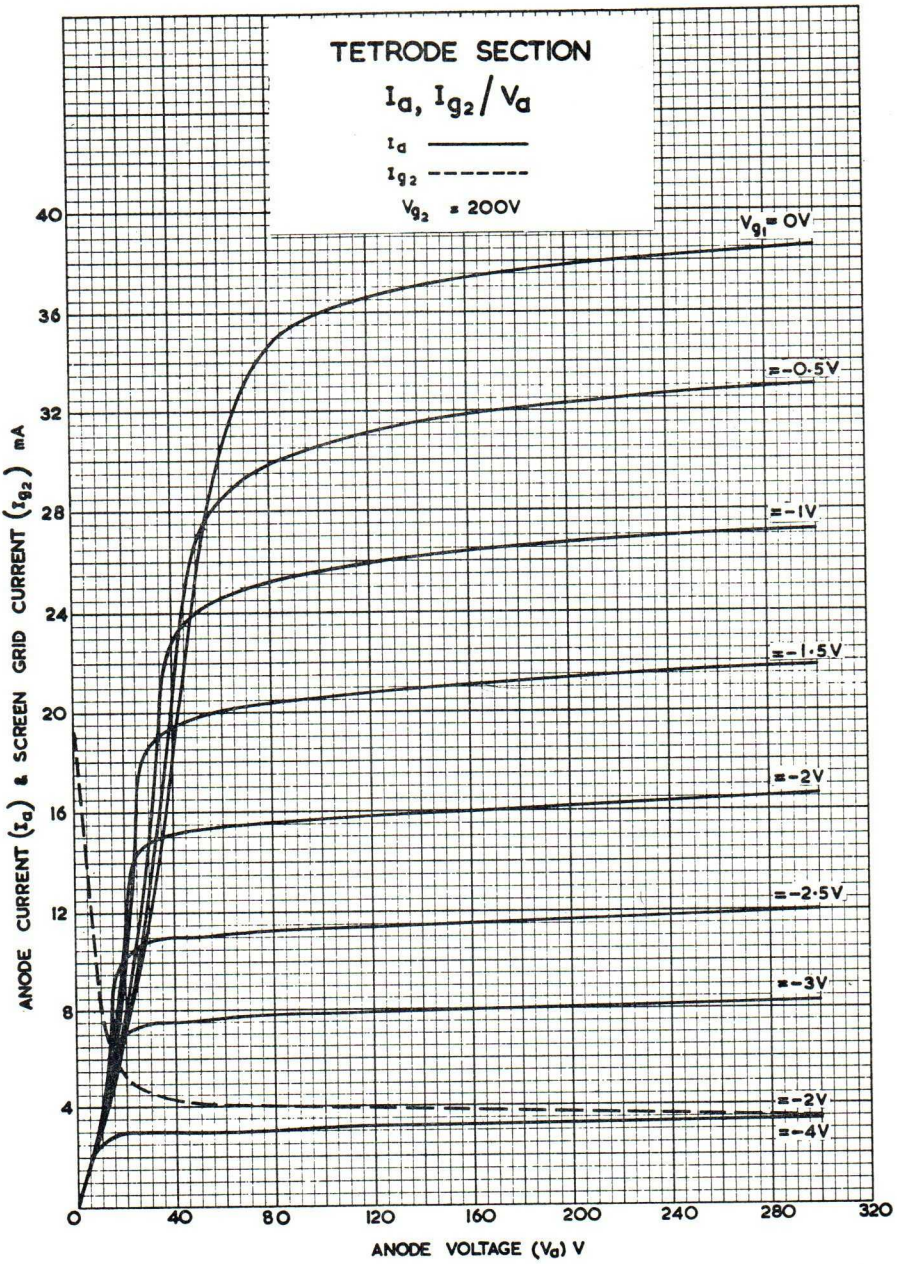
Indicates a change

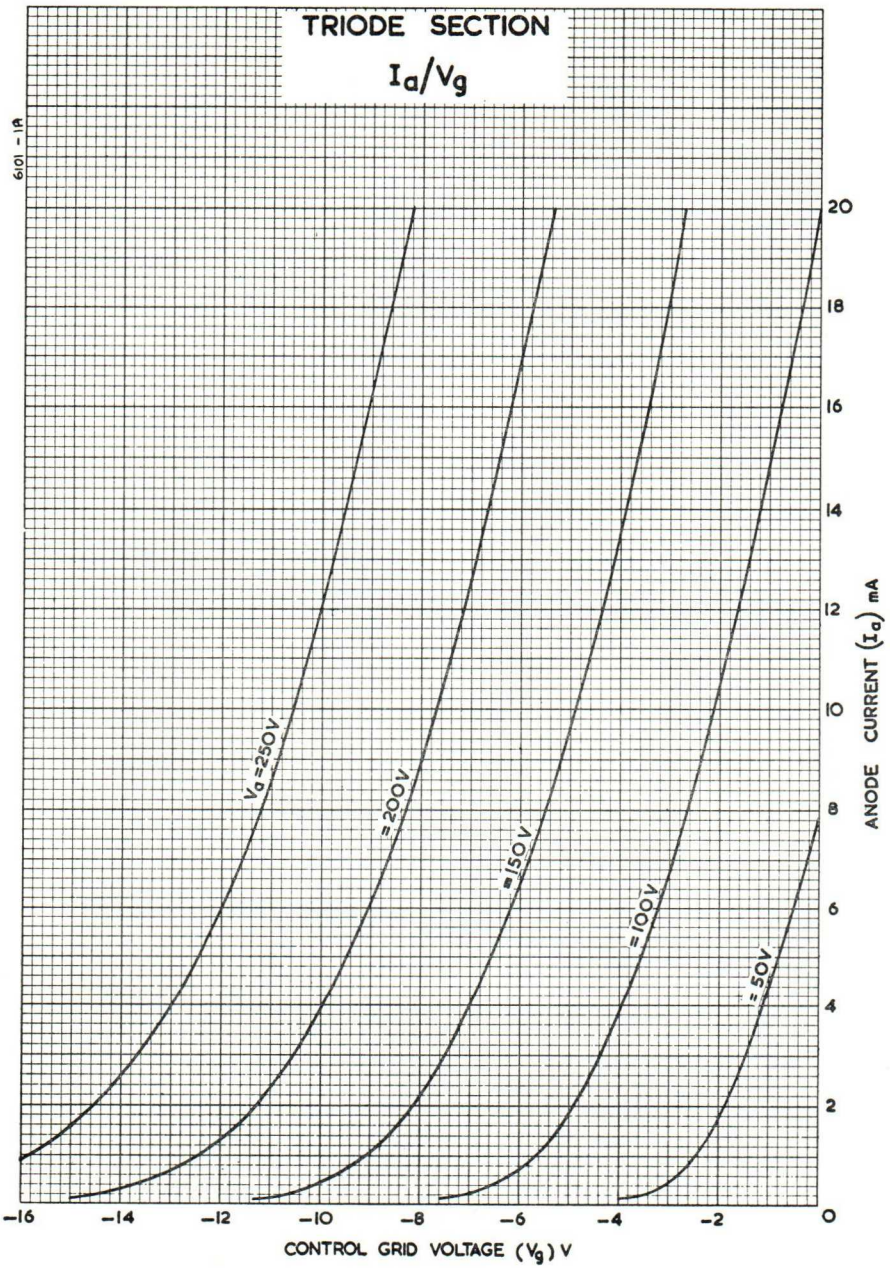
THORN—AEI RADIO VALVES & TUBES LTD.

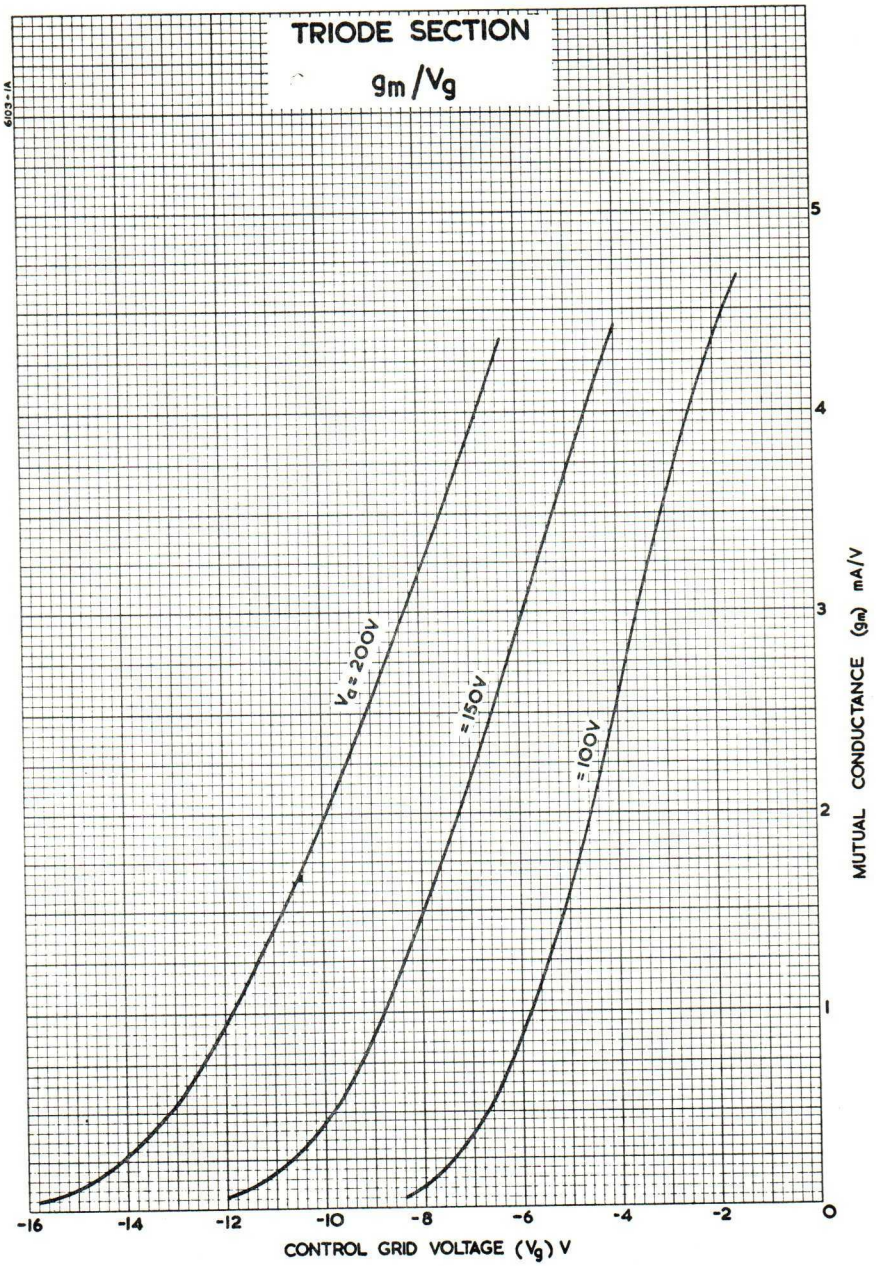

TETRODE SECTION
$I_a, I_{g_2} / V_{g_1}$
I_a
I_{g_2}
101-1A
$V_a = V_{g_2} = 250V$
200V
150V
100V
$V_a = V_{g_2} = 250V$
200V
150V
100V
24
22
20
18
16
14
12
10
8
6
4
2
0
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
-8
-7
-6
-5
-4
-3
-2
-1
CONTROL GRID VOLTAGE (V_{g_1}) V


TETRODE SECTION
g_m/V_{g_1}
103-4
$V_a = V_{g_2} = 250V$
= 200V
= 150V
= 100V
MUTUAL CONDUCTANCE (g_m) mA/V
CONTROL GRID VOLTAGE (V_{g_1}) V
12
11
10
9
8
7
6
5
4
3
2
1
0
−8
−7
−6
−5
−4
−3
−2
−1


TETRODE SECTION
I_a, I_{g_2} / V_a
I_a
I_{g_2}
V_{g_2} = 170V
V_{g_1} = 0V
= -0·5 V
= -1V
= -1·5V
= -2V
= -2·5V
= -3V
= -2V
= -4V
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280
320
ANODE VOLTAGE (V_a) V

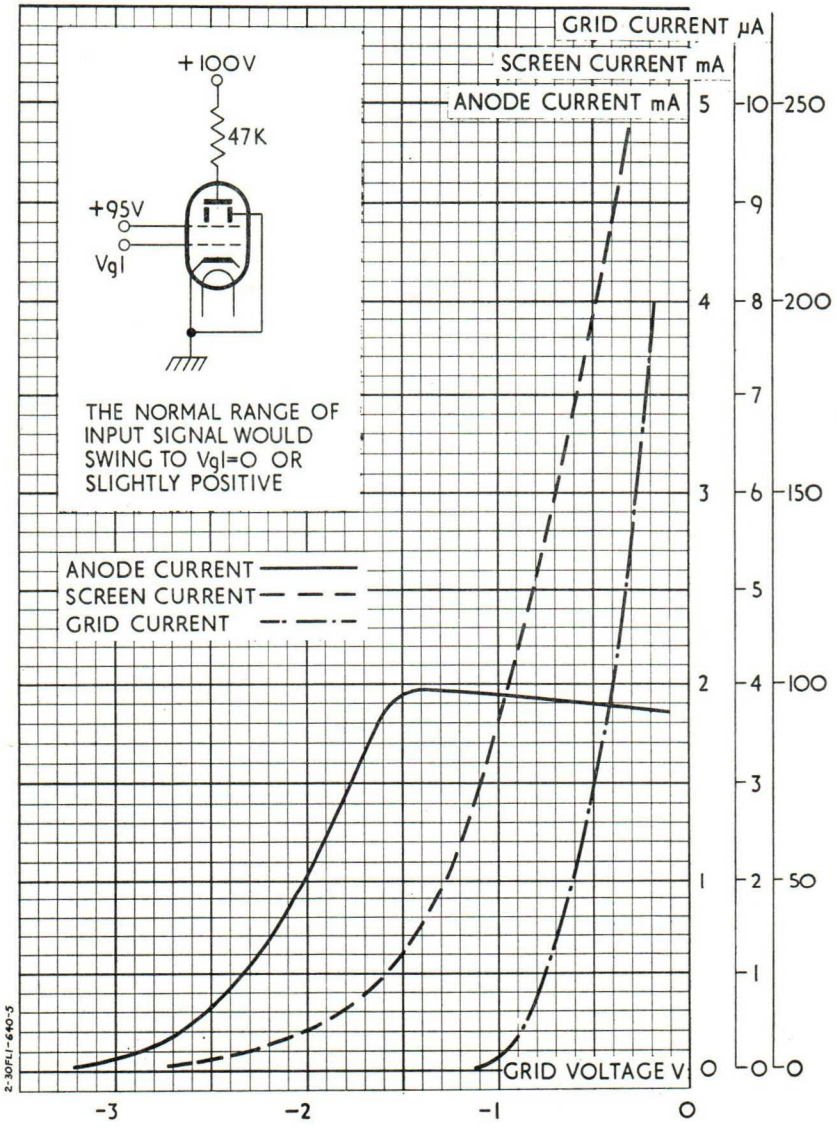

TETRODE SECTION
$I_a, I_{g_2} / V_a$
I_a
I_{g_2}
V_{g_2} = 200V
V_{g_1} = 0V
= -0·5V
= -1V
= -1·5V
= -2V
= -2·5V
= -3V
= -2V
= -4V
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
0
4
8
12
16
20
24
28
32
36
40
0
40
80
120
160
200
240
280
320
ANODE VOLTAGE (V_a) V

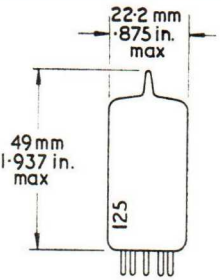

TRIODE SECTION
Ia/Vg
6101-1A
Va=250V
=200V
=150V
=100V
=50V
20
18
16
14
12
10
8
6
4
2
0
ANODE CURRENT (Ia) mA
-16
-14
-12
-10
-8
-6
-4
-2
CONTROL GRID VOLTAGE (Vg) V


TRIODE SECTION
gm/Vg
6103-1A
Va = 200V
= 150V
= 100V
-16
-14
-12
-10
-8
-6
-4
-2
0
1
2
3
4
5
CONTROL GRID VOLTAGE (Vg) V
MUTUAL CONDUCTANCE (gm) mA/V

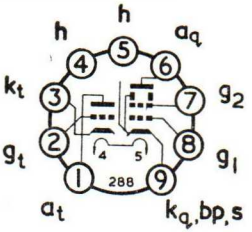
TETRODE SECTION

Used as limiter in a synchronising separator circuit.





TRIODE BEAM TETRODE



B9A Base

GENERAL

This valve is a triode beam tetrode intended for use in the video output stages of A.C./D.C. mains television receivers. The characteristics of the triode section are identical to those of the 6/30L2 triode.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	10	V

RATINGS

		Triode	Tetrode	
Maximum Anode Dissipation	$P_{a(max)}$	1·5	2·5	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	—	1·3	W
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	—	250	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h\text{-}k(r.m.s.)max}$	150*	150*	V

* Measured with respect to the higher potential heater pin.

INTER-ELECTRODE CAPACITANCES

		†	‡	§	
Grid 1 to Earth	$c_{g1\text{-}E}$	8·1	8·4	9·5	pF
Anode Tetrode to Earth	$c_{aq\text{-}E}$	2·7	3·0	4·1	pF
Grid 1 to Anode Tetrode	$c_{g1\text{-}aq}$	0·04	0·05	0·08	pF
Grid Triode to Earth	$c_{gt\text{-}E}$	2·2	2·4	3·2	pF
Anode Triode to Earth	$c_{at\text{-}E}$	1·9	2·1	2·8	pF
Grid Triode to Anode Triode	$c_{gt\text{-}at}$	2·4	2·5	2·8	pF
Anode Triode to Anode Tetrode	$c_{at\text{-}aq}$	0·012	0·017	0·019	pF
Grid Triode to Grid 1	$c_{gt\text{-}g1}$	0·004	0·007	0·011	pF
Anode Triode to Grid 1	$c_{at\text{-}g1}$	0·01	0·02	0·03	pF
Anode Tetrode to Grid Triode	$c_{aq\text{-}gt}$	0·004	0·007	0·01	pF

† In fully shielded socket without can.

‡ With holder capacitance balanced out. (Holder as below.)

§ Total capacitance including B9A nylon phenolic holder without skirt or radial shield. (AEI holder type VH19/902.)

"Earth" denotes the electrodes of any second valve section and the remaining earthy potential electrodes of the section under measurement, heater and shields joined to cathode.

THORN—A E I RADIO VALVES & TUBES LTD.

CHARACTERISTICS

		Triode	Tetrode	
Anode Voltage	V_a	150	180	V
Screen Grid Voltage	V_{g2}	—	180	V
Anode Current	I_a	10	10	mA
Mutual Conductance	g_m	3·7	12·5	mA/V
Amplification Factor	μ	18	—	

TYPICAL OPERATION—Video Amplifier

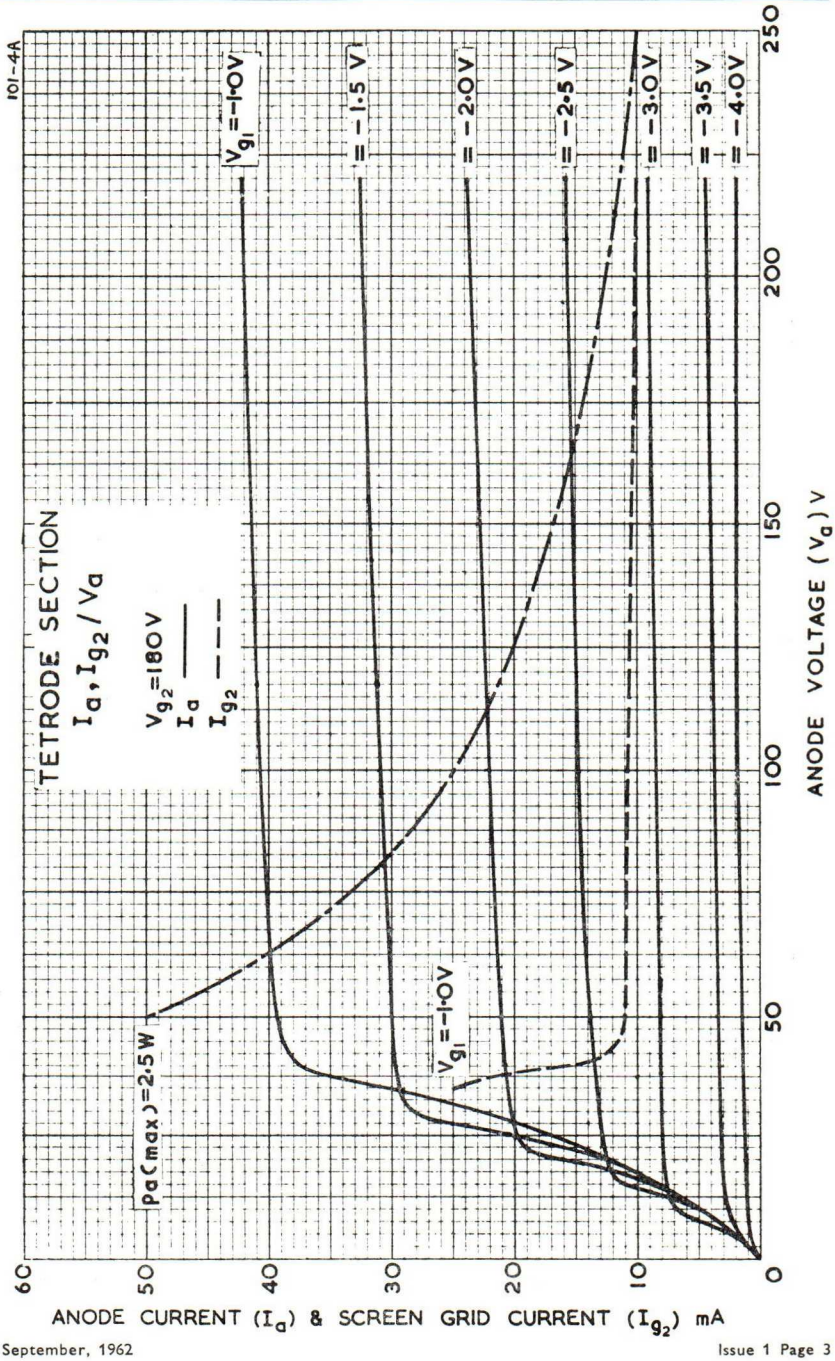
The stage should be designed to allow for valve spread and deterioration during life in addition to component variations. Values of peak anode current available for a new average valve and at the assumed end of life point for any valve are as follows:

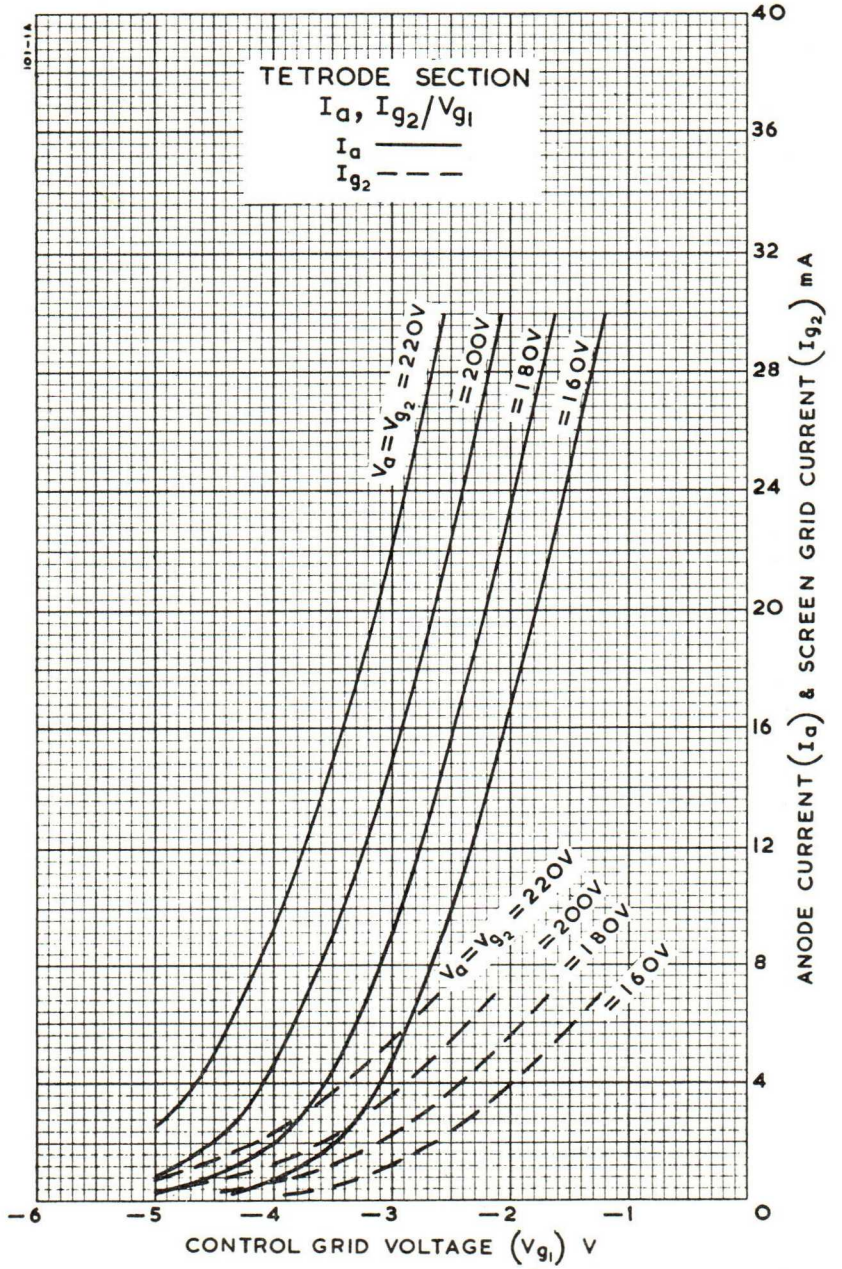
		ϕ	‖	
Anode Voltage	V_a	70	60	V
Screen Grid Voltage	V_{g2}	180	180	V
Grid Bias Voltage	V_{g1}	−1	−1	V
Anode Current	I_a	40	25	mA

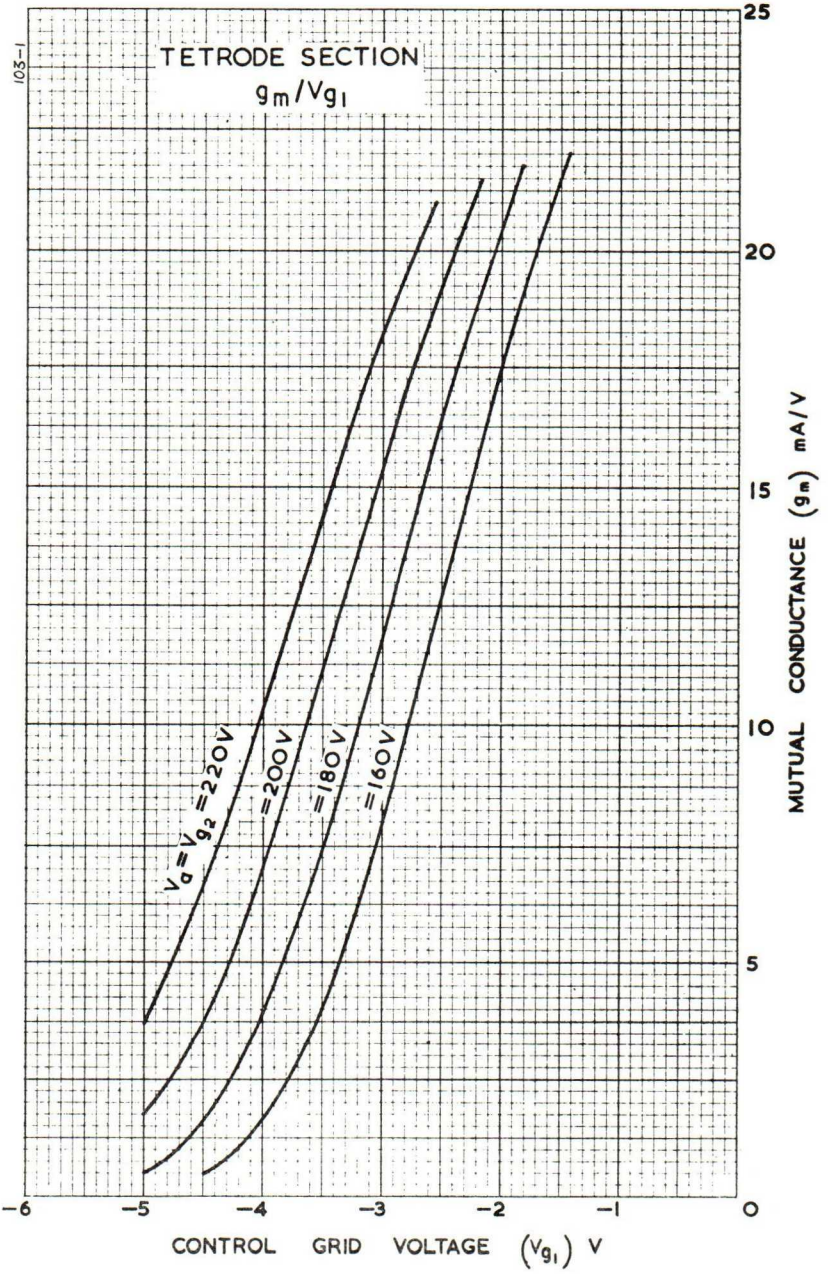
ϕ Average New Valve.

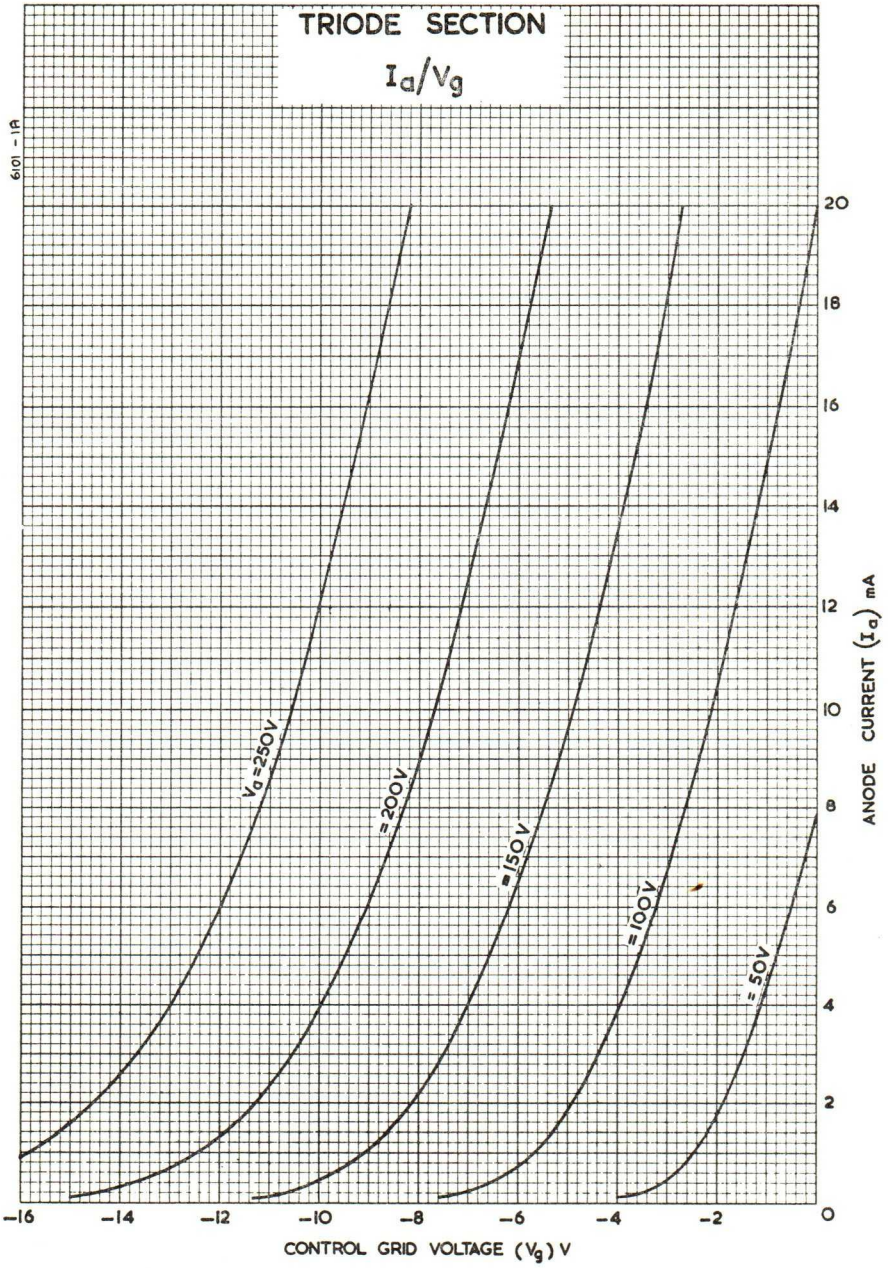
‖ Assumed End of Life Condition.

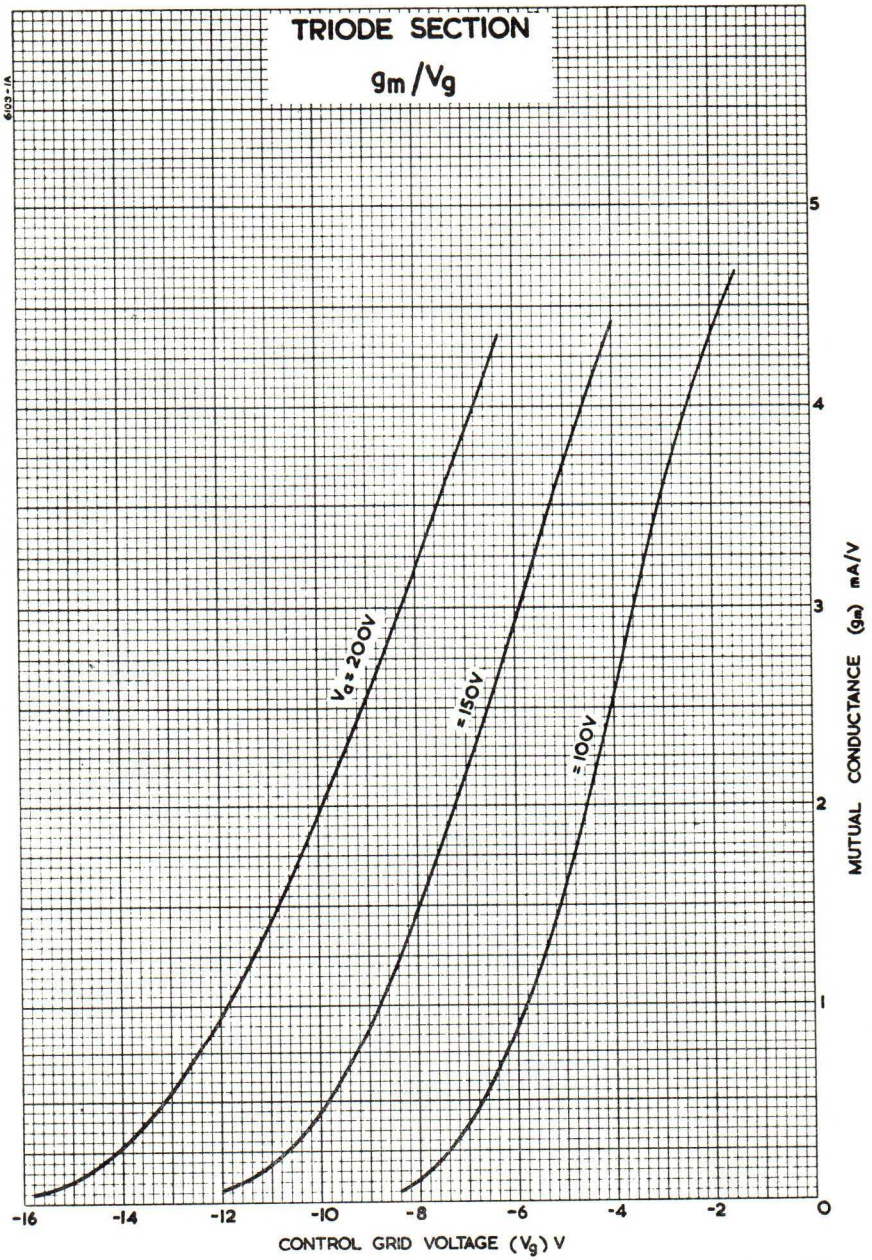
MOUNTING POSITION—Unrestricted

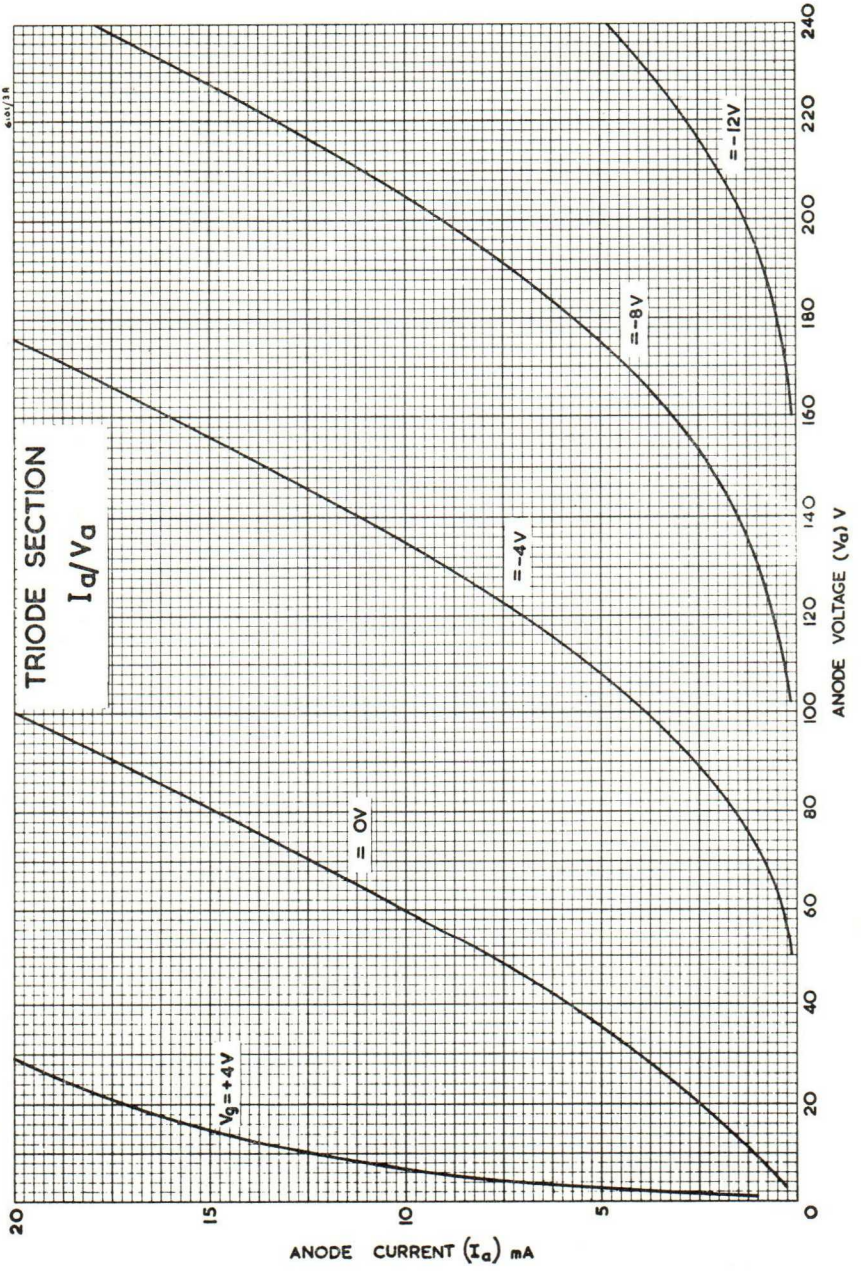

101-4A
TETRODE SECTION
$I_a, I_{g_2} / V_a$
V_{g_2}=180 V
I_a ——
I_{g_2} – – – –
V_{g_1}=-1·0V
=-1·5 V
=-2·0V
=-2·5 V
=-3·0V
=-3·5 V
=-4·0V
$P_{a(max)}$=2·5W
V_{g_1}=-1·0V
60
50
40
30
20
10
0
250
200
150
100
50
0
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
ANODE VOLTAGE (V_a) V


101-1A
TETRODE SECTION
I_a, I_{g_2}/V_{g_1}
I_a ——
I_{g_2} — — —
$V_a = V_{g_2}$ = 220V
= 200V
= 180V
= 160V
40
36
32
28
24
20
16
12
8
4
0
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
−6
−5
−4
−3
−2
−1
CONTROL GRID VOLTAGE (V_{g_1}) V


103-1
TETRODE SECTION
g_m/V_{g1}
$V_a = V_{g2} = 220V$
$= 200V$
$= 180V$
$= 160V$
25
20
15
10
5
0
MUTUAL CONDUCTANCE (g_m) mA/V
−6
−5
−4
−3
−2
−1
CONTROL GRID VOLTAGE (V_{g1}) V


TRIODE SECTION
I_a/V_g
6101 - 1A
20
18
16
14
12
10
8
6
4
2
0
ANODE CURRENT (I_a) mA
V_a = 250V
= 200V
= 150V
= 100V
= 50V
−16
−14
−12
−10
−8
−6
−4
−2
CONTROL GRID VOLTAGE (V_g) V


TRIODE SECTION
gm/Vg
6093-1A
Va = 200V
= 150V
= 100V
5
4
3
2
1
0
-16
-14
-12
-10
-8
-6
-4
-2
CONTROL GRID VOLTAGE (Vg) V
MUTUAL CONDUCTANCE (gm) mA/V


TRIODE SECTION
Ia/Va
Vg=+4V
= 0V
=-4V
=-8V
=-12V
ANODE CURRENT (Ia) mA
ANODE VOLTAGE (Va) V
20
15
10
5
0
20
40
60
80
100
120
140
160
180
200
220
240

30L1/PCC84 ←

CASCODE R.F. DOUBLE TRIODE

GENERAL

The 30L1/PCC84 is a miniature based indirectly heated double triode intended for use as cascode amplifier at V.H.F. in AC/DC powered equipment having series connected heater chains. The input is normally connected to the grid of triode 1, the output from this section being fed to the cathode of triode 2, which is operated as an earthed grid stage. This combination provides a low noise high gain amplifier, particularly suited to T.V. receivers operating in Band III.

RATING

Heater Current	(amps)	I_h	0·3
Heater Voltage	(volts)	V_h	7·0
Maximum Anode Voltage	(volts)	$V_{a(max)}$	250
Maximum Anode Dissipation (either section)	(watts)	$P_{a(max)}$	2·0
Maximum Cathode Current (per section)	(mA)	$I_{k(max)}$	18
Amplification Factor		μ	24*
Mutual Conductance	(mA/V)	g_m	6*
Anode Impedance	(ohms)	r_a	4,000*
Maximum Grid to Cathode Resistance (Section 1)	(ohms)	$R_{g'-k'(max)}$	500,000
Maximum Negative Grid Voltage	(volts)	$V_{g(max)}$	50
Maximum Grid to Cathode Resistance (Section 2)	(ohms)	$R_{g''-k''(max)}$	500,000†
Maximum Grid to Cathode Resistance (Section 2)	(ohms)	$R_{g''-k''(max)}$	22,000‡
Maximum Potential Heater to Cathode 1	(volts)	$V_{h-k'(max)}$	90
Maximum Potential Heater to Cathode 2 (with heater positive)	(volts)	$V_{h-k''(max)}$	90

Rating *(continued overleaf)*

Indicates a change ←

THORN — AEI RADIO VALVES & TUBES LTD.

30L1/PCC84 ←

CASCODE R.F. DOUBLE TRIODE

Maximum Potential Heater to Cathode 2 (with heater negative) (peak)	(volts)	$V_{h-k''(pk)\ max}$	250§

NOTES

† With potentiometer bias from H.T. Line.

‡ With grid current bias.

* Taken at V_a = 90v ; I_a = 12 mA

§ Maximum D.C. component = 180 volts.

INTER-ELECTRODE CAPACITANCES (pF)

		‖	¶
Anode 1/Grid 1	$c_{a'-g'}$	1·2	1·2
Grid 1/Cathode 1, Heater and Shields	$c_{g'-k',h,s}$	2·8	4·1
Anode 1/Cathode 1, Heater and Shields	$c_{a'-k',h,s}$	2·0	3·25
Anode 2/Cathode 1, Heater and Shields	$c_{a''-k',h,s}$	3·2	4·5
Cathode 2/Cathode 1, Heater and Shields	$c_{k''-k',h,s}$	5·0	6·3
Anode 2/Cathode 2	$c_{a''-k''}$	0·16	0·18
Grid 1/Anode 2	$c_{g'-a''}$	0·006	0·009
Anode 2/Anode 1	$c_{a''-a'}$	0·01	0·01

‖ Inter-electrode capacity with holder capacity balanced out but with cylindrical screening can.

¶ Total capacity including ceramic B9A holder with cylindrical screen. Carr Fastener holder type 76/804 E/T.
The symbol ' s ' indicates shields and earthy parts of the valve holder.

Indicates a change ←

30L1/PCC84 ←

CASCODE R.F. DOUBLE TRIODE

DIMENSIONS

Maximum Overall Length	(mm)	56
Maximum Diameter	(mm)	22·2
Maximum Seated Height	(mm)	49
Approximate Nett Weight	(ozs)	$\frac{1}{2}$
Approximate Packed Weight	(ozs)	$\frac{3}{4}$

MOUNTING POSITION—Unrestricted.

TYPICAL OPERATION—(As a cascode amplifier)

The input triode is connected as an earthed cathode stage and coupled directly to section 2 connected as an earthed grid stage. The valve sections are series fed, i.e., anode of section 1 connected directly to cathode of section 2.

			*Circuit** I	*Circuit** II
H.T. Supply Voltage	(volts)	V_b	200	200
Anode decoupling resistor, Section 2	(ohms)	$R_{a''}$	2,200	3,900
Anode current	(mA)	$I_{a'} = I_{a''}$	12·5	12·5
Grid bias voltage, section 1 (supplied by cathode resistor)	(volts)	V_g	—1·5	—1·5
Combined mutual conductance ($\delta i_a/\delta v_{g'}$)	(mA/V)		5·8	5·7
Approx. A.G.C. Volts to give combined mutual conductance of 100μ A/V	(volts)	$V_{g'}$	—7·4	—14
Self bias resistor, section 1	(ohms)	$R_{k'}$	120	120
Input Capacity, working †	(pF)	$C_{in\ (w)}$	4·56	4·56
Change in input capacity by biassing valve to cut-off	(pF)	$\triangle C_{in\ (w)}$	1·27	1·27

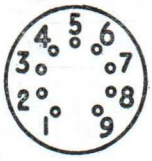
† Inter-electrode capacity with holder capacity balanced out but with cylindrical screening can.

* See Typical 30L1/PCC84 Cascode Bias Circuits.

30L1/PCC84 ←

CASCODE R.F. DOUBLE TRIODE

BASE—Noval (B9A)



Viewed from Free End of Pins

CONNECTIONS

Pin 1	Cathode 2	k''
Pin 2	Grid 2, Shield	g'',s
Pin 3	Anode 2	a''
Pin 4	Heater	h
Pin 5	Heater	h
Pin 6	Grid 1	g'
Pin 7	Cathode 1, input	k'_{in}
Pin 8	Cathode 1, output	k'_{out}
Pin 9	Anode 1	a'

Indicates a change ←

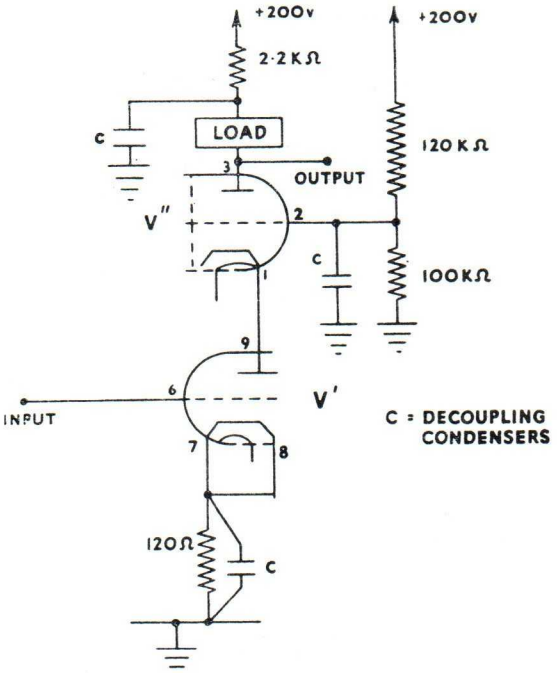
30L1/PCC84 ←

CASCODE R.F. DOUBLE TRIODE

TYPICAL 30L1/PCC84 CASCODE BIAS CIRCUITS

Circuit 1

Valve Section 2, Potentiometer Bias arrangement.



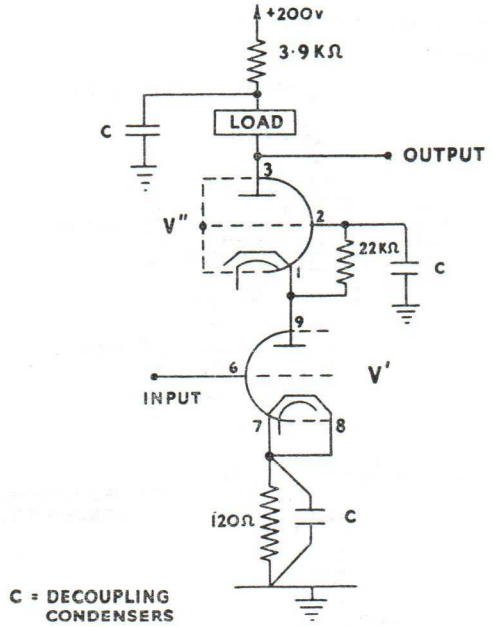
Indicates a change ←

30L1/PCC84 ←

CASCODE R.F. DOUBLE TRIODE

Circuit 2

Valve Section 2, Grid Current Bias arrangement.



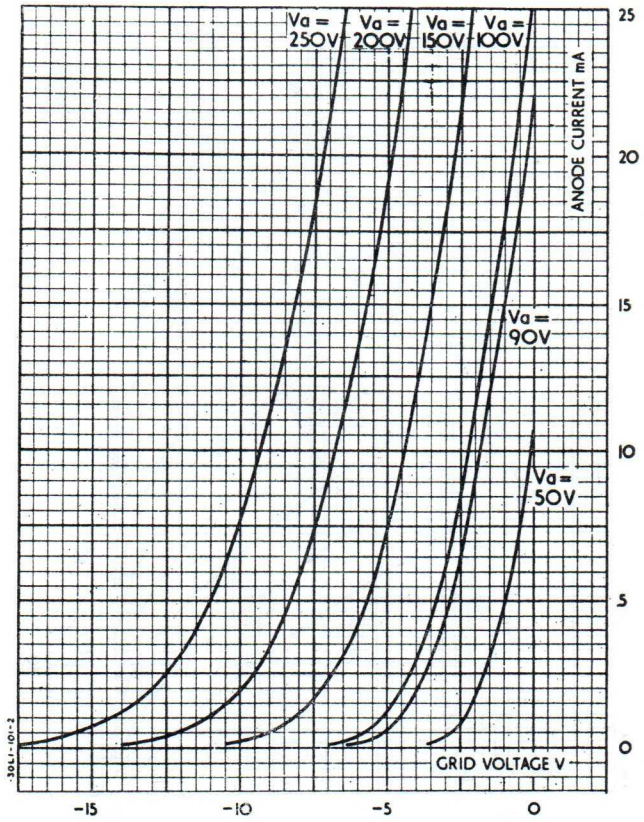
NOTE: Application of bias to section 1 in the Potentiometer Bias arrangement effectively controls both triodes giving this combination a shorter grid base than the Grid Current Bias arrangement.

30L1/PCC84

CASCODE R.F. DOUBLE TRIODE

AVERAGE CHARACTERISTIC CURVES : I_a/V_g

Each Section

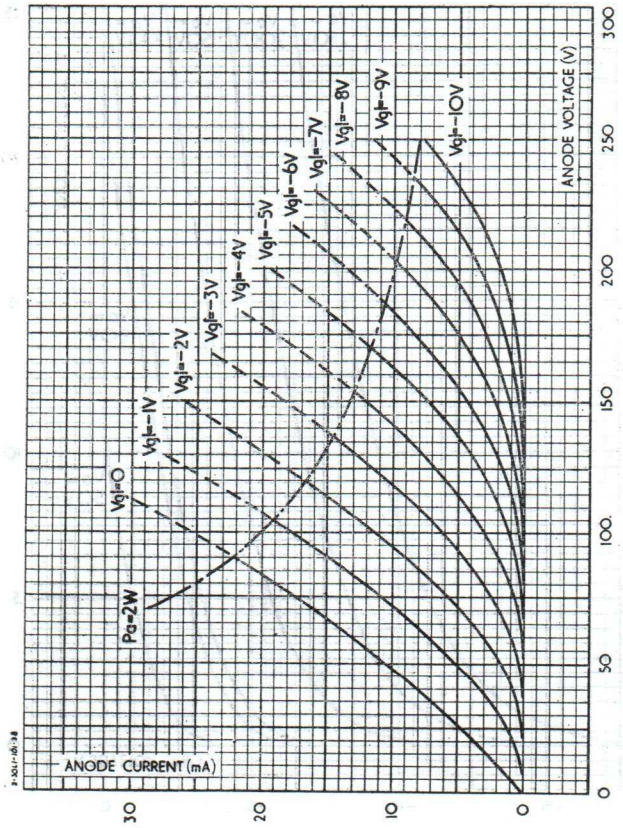


THORN — AEI RADIO VALVES & TUBES LTD.

30L1/PCC84 ←

CASCODE R.F. DOUBLE TRIODE

AVERAGE CHARACTERISTIC CURVES : I_a/V_a
Each Section



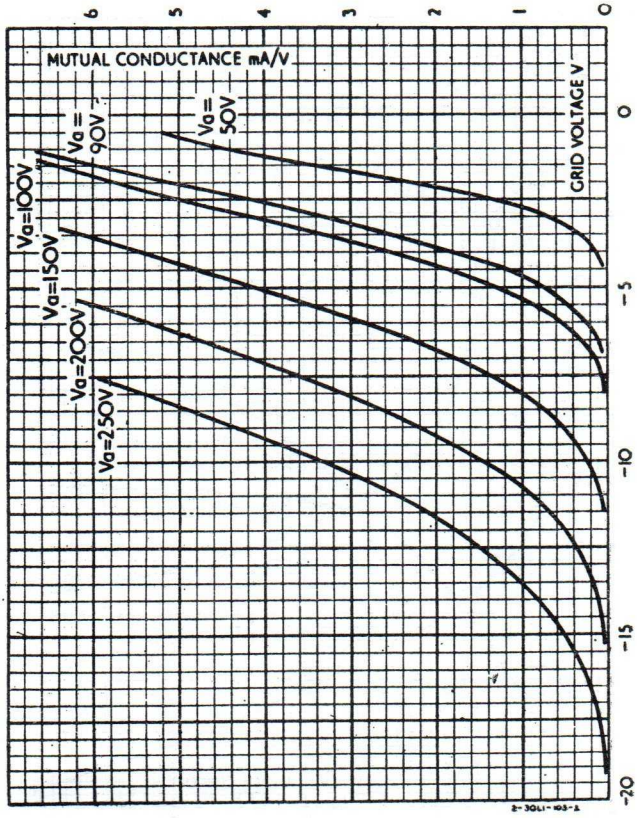
30L1/PCC84

CASCODE R.F. DOUBLE TRIODE

Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES: g_m/V_g

Each Section



30L1/PCC84

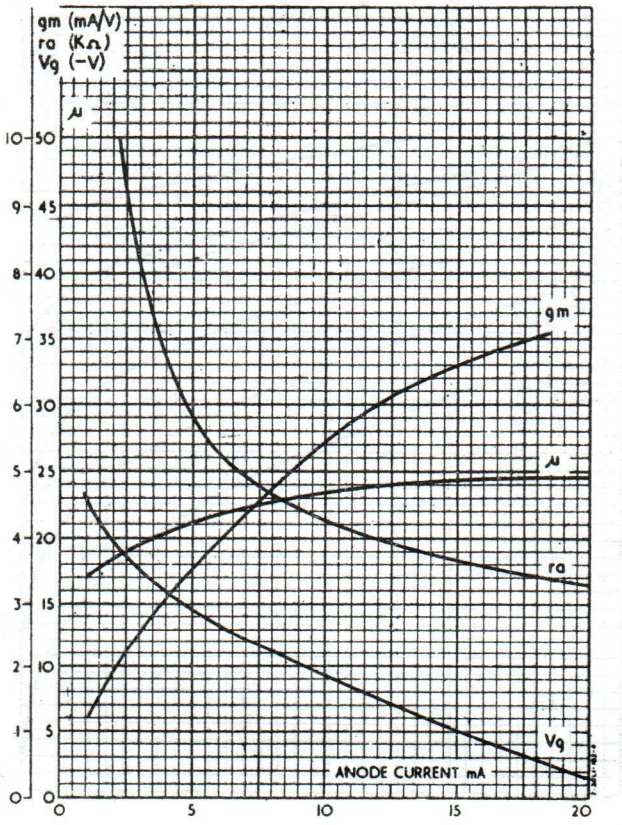
CASCODE R.F. DOUBLE TRIODE

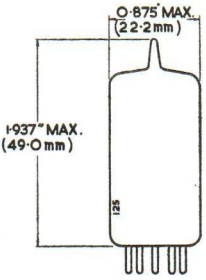
Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES : g_m, μ, r_a, V_g/I_a

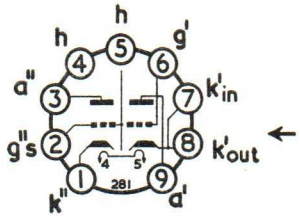
Each Section

Anode Voltage=90v.





R.F. CASCODE DOUBLE TRIODE



B9A Base

GENERAL

This is an R.F. Double Triode on a B9A base having separate cathodes and shielded sections for use as a Cascode R.F. Amplifier in AC/DC television receivers.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	7	V

RATINGS

Maximum Anode Dissipation (either section)	$P_{a(max)}$	2	W	
Maximum Anode Voltage	$V_{a(max)}$	250	V	
Maximum Grid Voltage (Negative)	$V_{g(max)}$	−50	V	
Maximum Heater to Cathode Voltage (Section 1)	$V_{h\text{-}k'(max)}$	90*	V	←
Maximum Heater to Cathode Voltage (Heater positive) Section 2	$V_{h\text{-}k''(max)}$	90*	V	←
Maximum Peak Heater to Cathode Voltage (Heater negative) Section 2		250*†	V	←
Maximum Cathode Current per section	$I_{k(max)}$	16	mA	
Maximum Grid to Cathode Resistance (Section 1)	$R_{g'\text{-}k'(max)}$	500	kΩ	
Maximum Grid to Cathode Resistance (Section 2)		22‡	kΩ	
Maximum Effective Grid to Earth Resistance (Section 2)		150§	kΩ	

* Measured with respect to the higher potential heater pin

† Maximum DC component=180V.

‡ Grid current bias.

§ With potentiometer bias from H.T. line

INTER-ELECTRODE CAPACITANCES ←

		ϕ	††	**	
Grid′ to Cathode′, Heater, Shield	$c_{g'\text{-}k'}$, h,s	3·0	3·3	4·3	pF
Anode″ to Grid″, Shield, Heater, Cathode′	$c_{a''\text{-}g''}$,s,h,k′	3·3	3·6	4·6	pF
Anode′ to Cathode′, Heater, Shield	$c_{a'\text{-}k'}$,h,s	1·7	1·9	2·9	pF
Cathode″ to Grid″, Shield, Heater, Cathode′	$c_{k''\text{-}g''}$, s,h,k′	5·3	5·6	6·4	pF
Anode′ to Grid′	$c_{a'\text{-}g'}$	1·5	1·5	1·5	pF
Anode″ to Cathode″	$c_{a''\text{-}k''}$	0·17	0·19	0·21	pF
Anode′ to Anode″	$c_{a'\text{-}a''}$	0·007	0·011	0·013	pF
Grid′ to Anode″	$c_{g'\text{-}a''}$	0·0035	0·0065	0·010	pF

ϕ In fully shielded socket, with cylindrical screening can.

†† With holder capacity balance out but with cylindrical screening can.

** Total capacity including B9A holder with cylindrical screening can. (Plessey holder type CP180024/3)

Indicates a change ←

THORN — A E I RADIO VALVES & TUBES LTD.

CHARACTERISTICS (Each section)

Anode Voltage	V_a	90	V
Anode Current	I_a	15	mA
Grid Voltage	V_g	−1·2	V
Mutual Conductance	gm	9	mA/V
Amplification Factor	μ	27	←

TYPICAL CASCODE OPERATION

		Circuit ††	Circuit ‡‡	
H.T. Supply Voltage	V_b	200	200	V
Anode Decoupling Resistor, Section 2		2·2	3·3	kΩ
Anode Current	I_a	15·3	14·8	mA
Grid Bias Voltage, Section 1 (Supplied by Cathode Resistor)		−1·53	−1·2	V
Self Bias Resistor, Section 1	R_k'	100	82	Ω
Combined Mutual Conductance ($\Delta i_a/\Delta v_{g1}$)		8·5	8·6	mA/V
Approximate A.G.C. Voltage to give Combined Mutual Conductance of 0·1 mA/V		−7	−12	V
Input Capacitance (Working)	$c_{in(w)}$	5·2*	5·2*	pF ←
Change in Input Capacitance by biassing valve to cut off	$\Delta c_{in(w)}$	1·2	1·2	pF
Input Resistance at 50 Mc/s (Anode short circuit)		28		kΩ ←
Input Resistance at 200 Mc/s (Anode short circuit)		1·1		kΩ ←

†† With potentiometer bias from the HT line for valve section 2.

‡‡ With grid current bias for valve section 2.

* With holder capacitance balanced out but with cylindrical screening can.

MOUNTING POSITION—Unrestricted.

APPROXIMATE WEIGHT

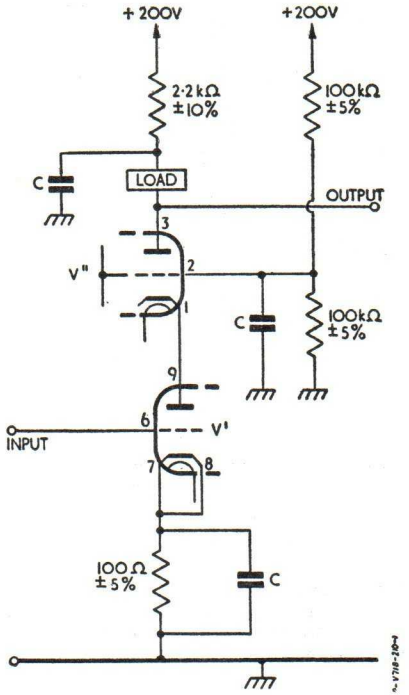
Net	0·5 oz
Packed	0·75 oz

Indicates a change ←

TYPICAL CASCODE BIAS CIRCUITS

Circuit 1

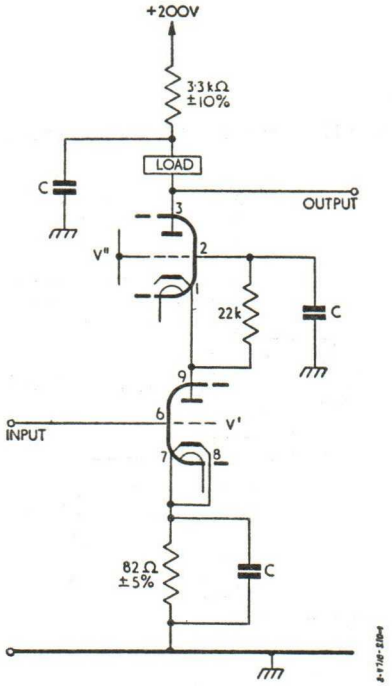
Valve section 2, Potentiometer Bias arrangement.



C = DECOUPLING CONDENSERS

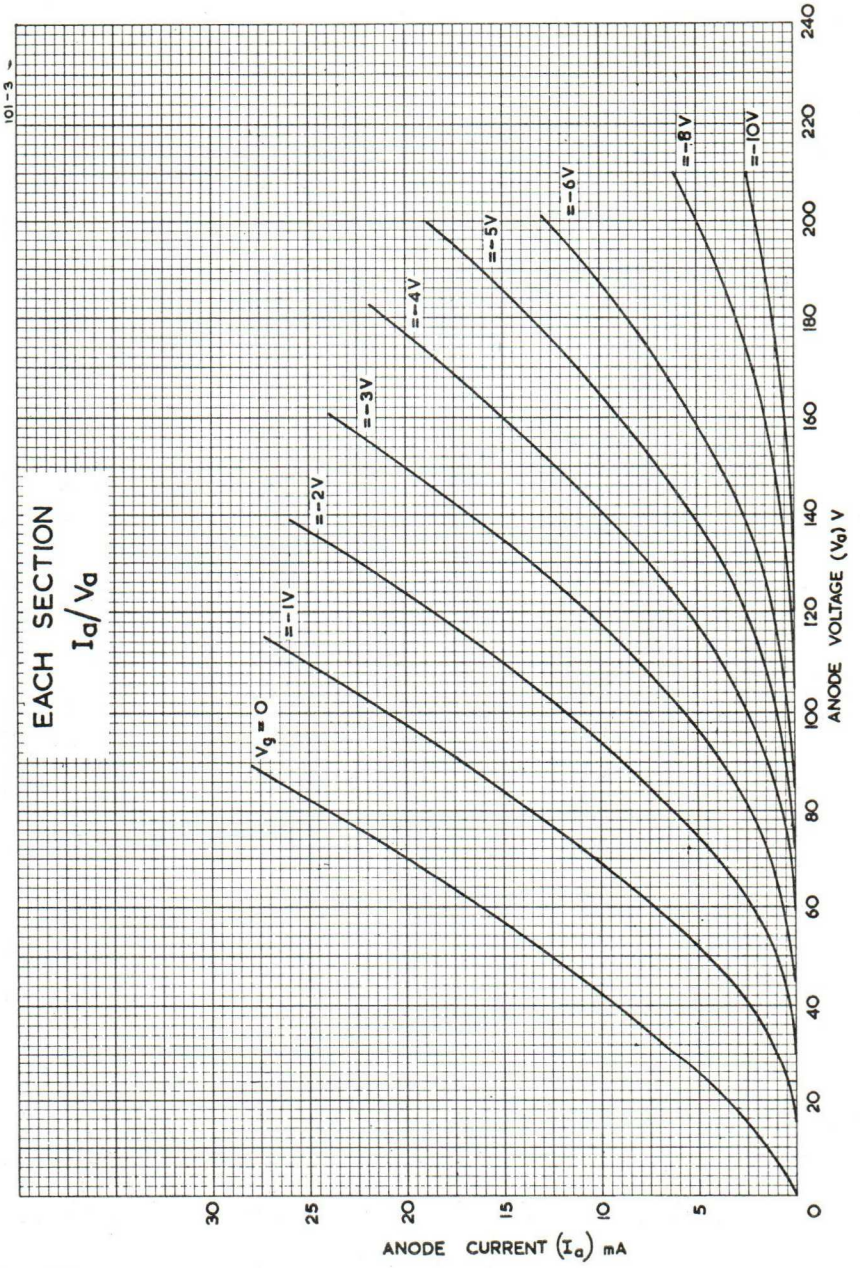
Circuit 2

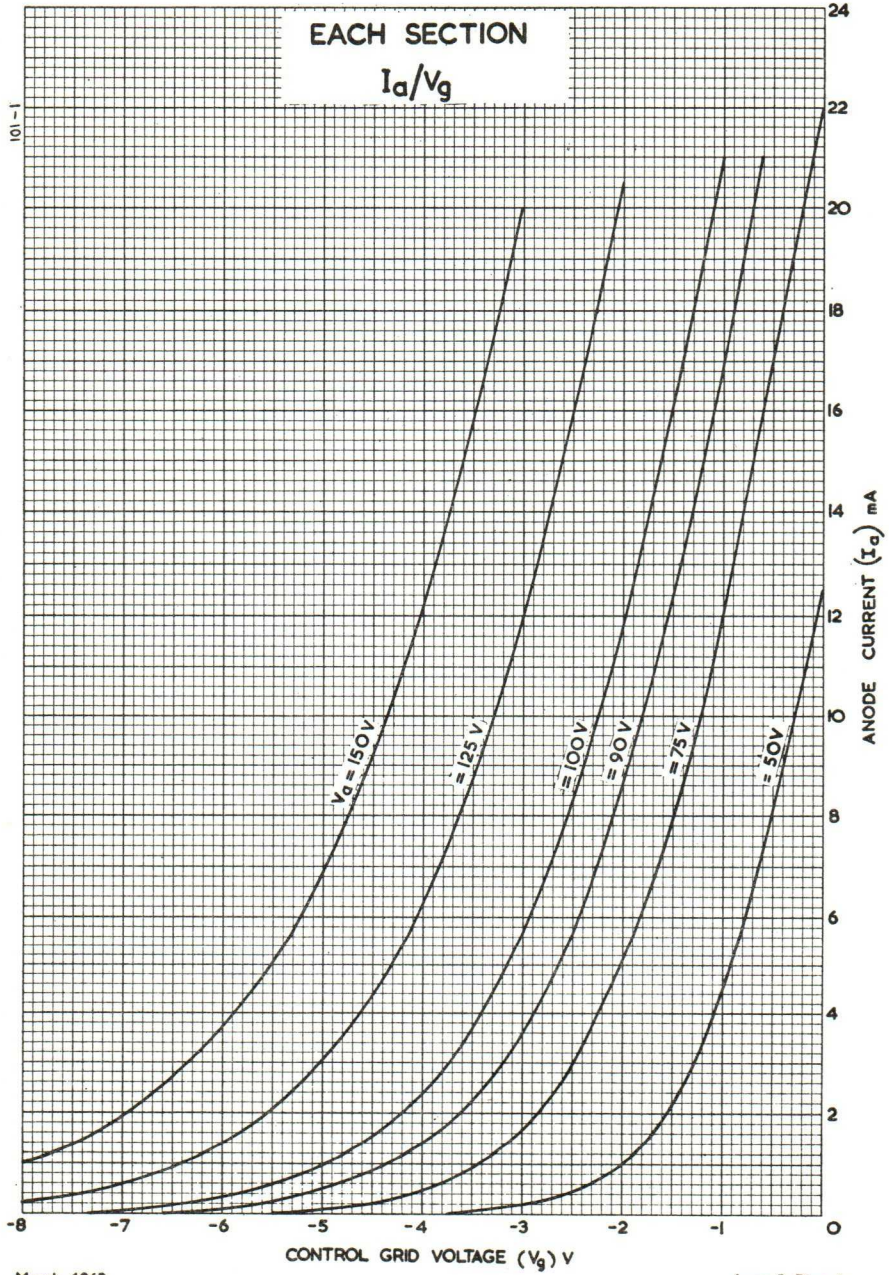
Valve section 2, Grid Current Bias arrangement.

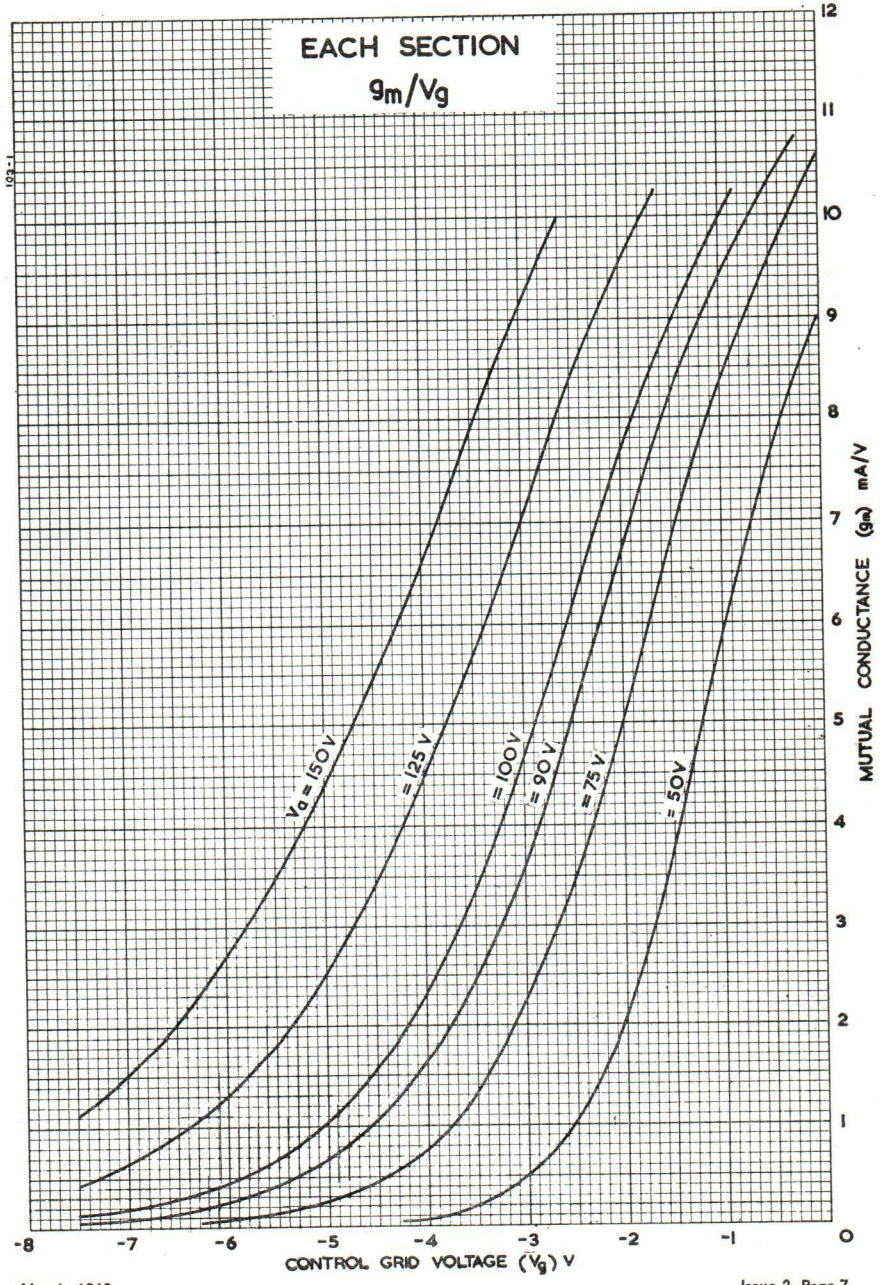


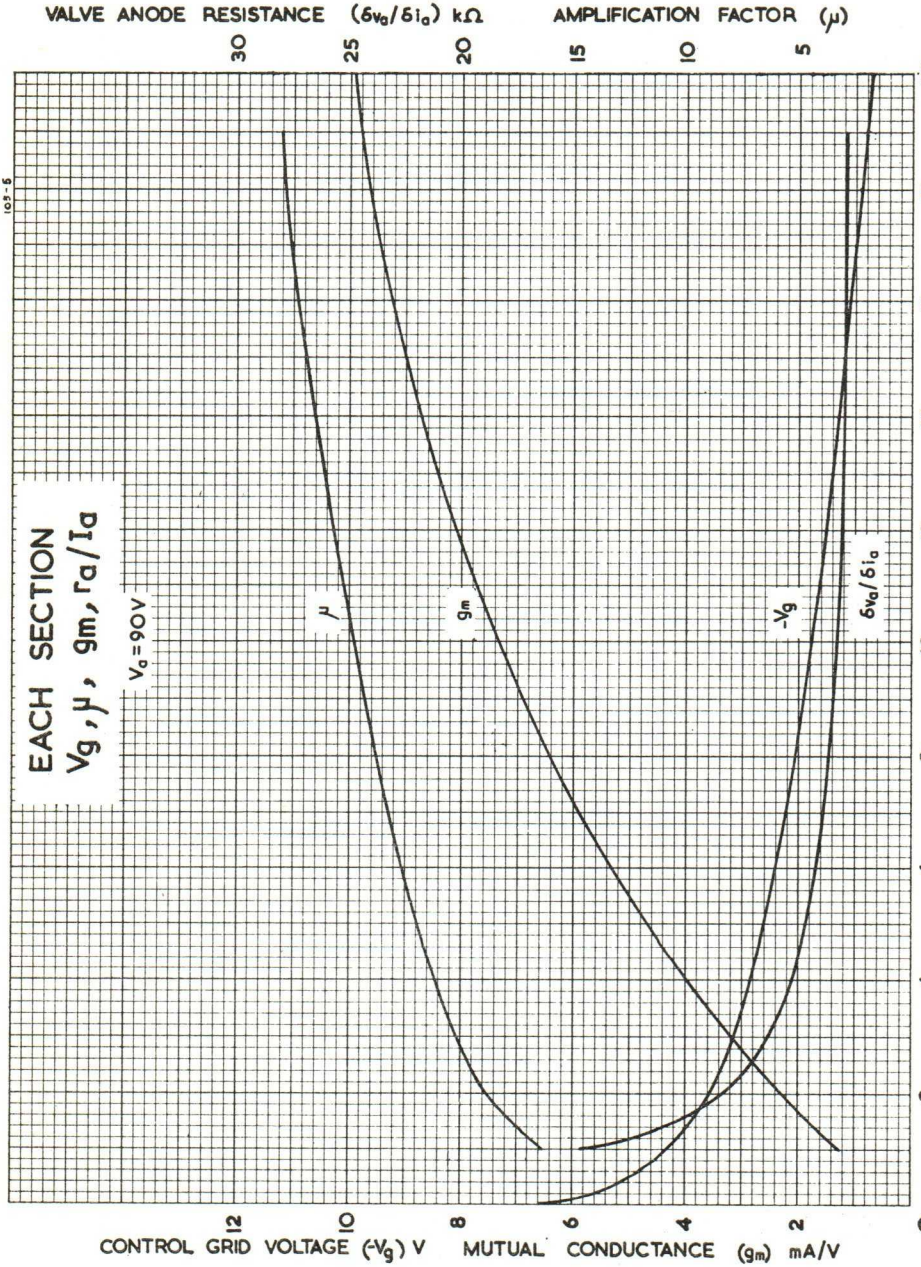
C=DECOUPLING CONDENSERS

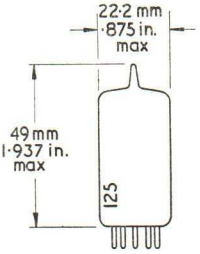
NOTE : Application of bias to section 1 in the Potentiometer Bias arrangement effectively controls both triodes giving this combination a shorter grid base than the Grid Current Bias arrangement.


101-3
EACH SECTION
Ia/Va
Vg = 0
=-1V
=-2V
=-3V
=-4V
=-5V
=-6V
=-8V
=-10V
ANODE CURRENT (Ia) mA
30
25
20
15
10
5
0
ANODE VOLTAGE (Va) V
240
220
200
180
160
140
120
100
80
60
40
20
0

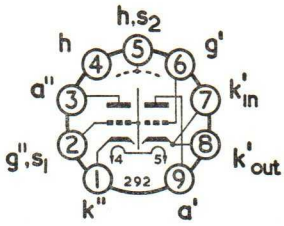

EACH SECTION
Ia/Vg
101-1
Va = 150 V
= 125 V
= 100 V
= 90 V
= 75 V
= 50 V
ANODE CURRENT (Ia) mA
CONTROL GRID VOLTAGE (Vg) V
24
22
20
18
16
14
12
10
8
6
4
2
0
-8
-7
-6
-5
-4
-3
-2
-1


EACH SECTION
g_m/V_g
193-1
V_a = 150 V
= 125 V
= 100 V
= 90 V
= 75 V
= 50 V
MUTUAL CONDUCTANCE (g_m) mA/V
0
1
2
3
4
5
6
7
8
9
10
11
12
-8
-7
-6
-5
-4
-3
-2
-1
CONTROL GRID VOLTAGE (V_g) V


VALVE ANODE RESISTANCE (δVa/δia) kΩ
AMPLIFICATION FACTOR (μ)
30
25
20
15
10
5
EACH SECTION
Vg, μ, gm, ra/Ia
Va = 90V
μ
gm
-Vg
δVa/δia
ANODE CURRENT (Ia) mA
20
18
16
14
12
10
8
6
4
2
0
12
10
8
6
4
2
CONTROL GRID VOLTAGE (-Vg) V
MUTUAL CONDUCTANCE (gm) mA/V



V.H.F. CASCODE DOUBLE TRIODE



B9A Base

GENERAL

This valve is a variable-mu double triode for use as a cascode R.F. amplifier in V.H.F. television tuners. Frame grids are used giving high gain and low noise while good stability has been achieved by careful arrangement of internal shielding and connections.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	7·2	V

RATINGS

Maximum Anode Dissipation (Either section)	$P_{a(max)}$	1·6	W
Maximum Anode Voltage (Each section)	$V_{a(max)}$	150	V
Maximum Negative Grid Voltage (Each section)	$V_{g(max)}$	50	V
Maximum Heater to Cathode′ Voltage	$V_{h\text{-}k'(max)}$	90*	V
Maximum Heater to Cathode″ Voltage (Heater Positive)	$V_{h\text{-}k''(max)}$	90*	V
Maximum Peak Heater to Cathode″ Voltage (Heater Negative)	$V_{h\text{-}k''(pk)max}$	250*†	V
Maximum Cathode Current (Each section)	$I_{k(max)}$	18	mA
Maximum Grid′ to Cathode′ Resistance	$R_{g'\text{-}k'(max)}$	1	MΩ
Maximum Effective Grid″ to Earth Resistance	$R_{g''\text{-}E(max)}$	150‡	kΩ
Maximum Grid″ to Cathode″ Resistance	$R_{g'\text{-}k''(max)}$	22¶	kΩ

INTER-ELECTRODE CAPACITANCES

		//	**	††	
Grid′ to Cathode′, Heater, Shields, Grid″	$C_{g'\text{-}k',h,s,g''}$	4·1	4·5	5·5	pF
Anode″ to Grid″, Shields, Heater, Cathode′	$C_{a''\text{-}g'',s,h\,k'}$	3·3	3·8	4·8	pF
Anode′ to Cathode′, Heater, Shields, Grid″	$C_{a'\text{-}k',h,s,g''}$	1·8	2·0	2·9	pF
Cathode″ to Grid″, Shields, Heater, Cathode′	$C_{k''\text{-}g'',s,h,k'}$	6·3	6·7	7·5	pF
Anode′ to Grid′	$C_{a'\text{-}g'}$	1·6	1·6	1·6	pF
Anode″ to Cathode″	$C_{a''\text{-}k''}$	·17	·18	·2	pF
Anode′ to Anode″	$C_{a'\text{-}a''}$	·0025	·0065	·0085	pF
Grid′ to Anode″	$C_{g'\text{-}a''}$	·003	·0095	·013	pF

NOTES

* Measured with respect to the higher potential heater pin.
† Maximum D.C. component=180V.
‡ With potentiometer bias from H.T. line.
¶ Grid current bias.
// In fully-shielded socket with cylindrical screen can (I.E.C. Publication 100).
** With holder capacitance balanced out but with cylindrical can (Holder as below).
†† Total capacitance including ceramic B9A holder with cylindrical screen (Plessey holder type CP.180024/3).

THORN — A E I RADIO VALVES & TUBES LTD.

CHARACTERISTICS

		Section 1	Section 2	
Anode Voltage	V_a	75	75	V
Anode Current	I_a	15	15	mA
Amplification Factor (approx)	μ	40	40	
Mutual Conductance	g_m	16·5	16·5	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	2·4	2·4	kΩ
Input Resistance at 50 Mc/s	$r_{in'(50\ Mc/s)}$	10·5‡‡		kΩ
Input Capacitance at 50 Mc/s (Working)	$c_{in'(w)50\ Mc/s.}$	7·9**		pF
Change of Input Capacitance produced by biasing valve to cut-off	$\triangle c_{in'(w)}$	2·4		pF

TYPICAL CASCODE OPERATION

Cathode Bias. See circuit 1 on page 3

Supply Voltage	$V_{a(b)}$	200	V
Anode″ Decoupling Resistor		820	Ω
Anode Current	I_a	14·8	mA
Combined Mutual Conductance ($\triangle i_a/\triangle v_{g'}$)	g_m	14·5	mA/V
Bias Voltage to give combined Mutual Conductance 100 : 1 reduction (approx)		−8·0	V
Cathode′ Self Bias Resistor	$R_{k'}$	82	Ω

Grid Current Bias. See circuit 2 on page 3

Supply Voltage	$V_{a(b)}$	200	V
Anode″ Decoupling Resistor		3·9	kΩ
Grid′ Current Bias Resistor	$R_{g'}$	560	kΩ
Anode Current	I_a	15·8	mA
Combined Mutual Conductance ($\triangle i_a/\triangle v_{g'}$)	g_m	18·3	mA/V
Bias Voltage to give combined Mutual Conductance 100 : 1 reduction (approx)		−8·2	V

Grid Current Bias with Delay. See circuit 3 on page 4

Supply Voltage	$V_{a(b)}$	200	V
Anode″ Decoupling Resistor		3·9	kΩ
Grid′ Current Bias Resistor	$R_{g'}$	560	kΩ
Anode Current	I_a	15	mA
Combined Mutual Conductance ($\triangle i_a/\triangle v_{g'}$)	g_m	19	mA/V
Bias Voltage to give combined Mutual Conductance 100 : 1 reduction (approx)		−11·5	V

NOTES

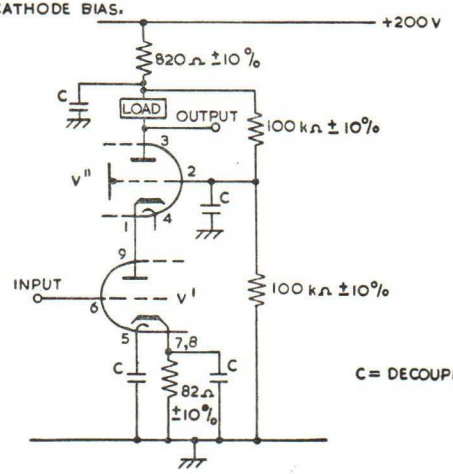
In operation pin 5 must be decoupled to earth (Ch-E> 500pF).

** With holder capacitance balanced out but with cylindrical screen can (Ceramic B9A holder).

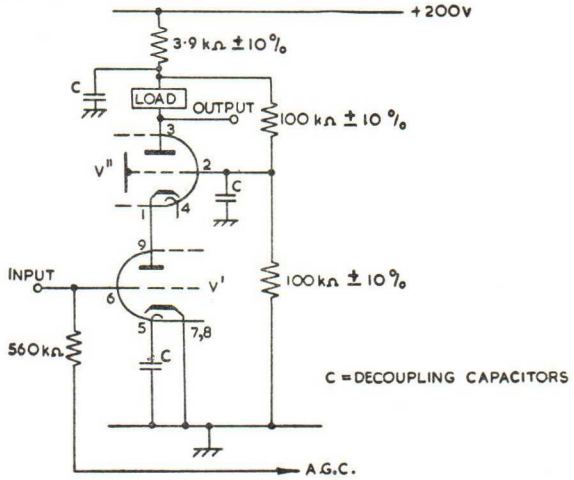
‡‡ Cathode pins 7 and 8 strapped. Anode short circuited (see Page 11).

MOUNTING POSITION—Unrestricted

CIRCUIT 1
VALVE SECTION I CATHODE BIAS.

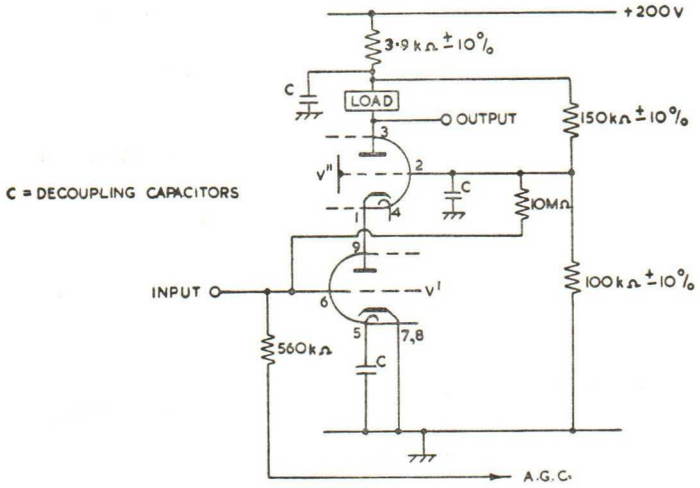


CIRCUIT 2
VALVE SECTION I GRID CURRENT BIAS

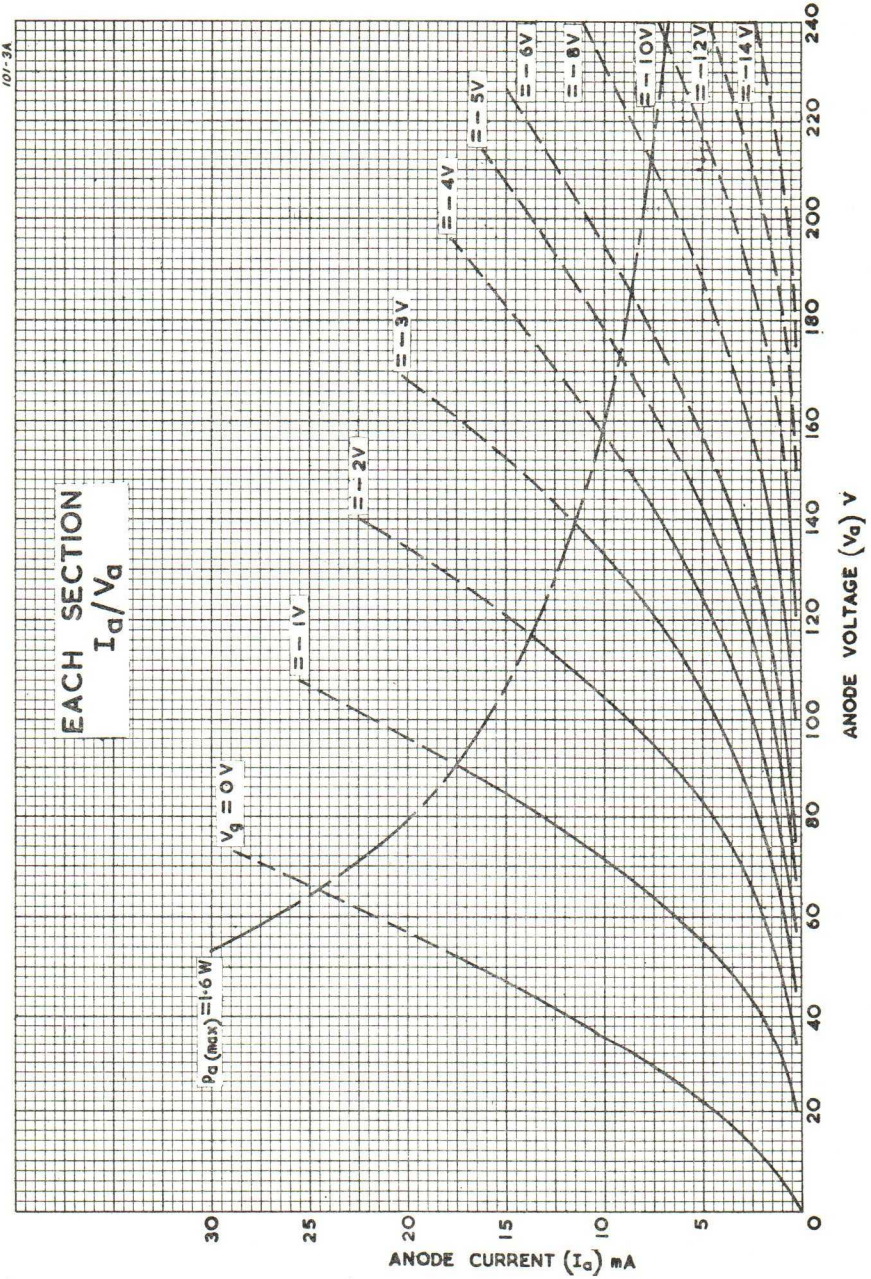


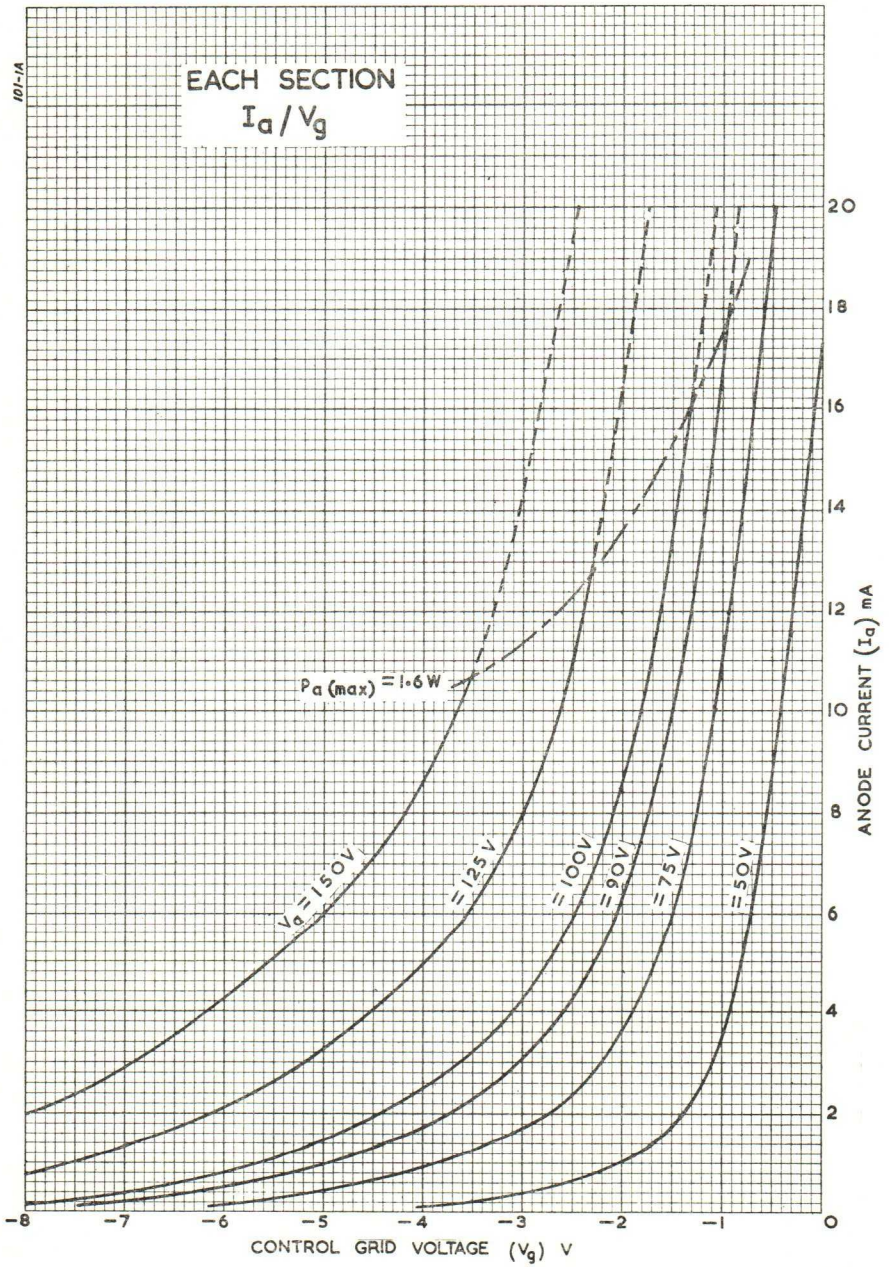
CIRCUIT 3

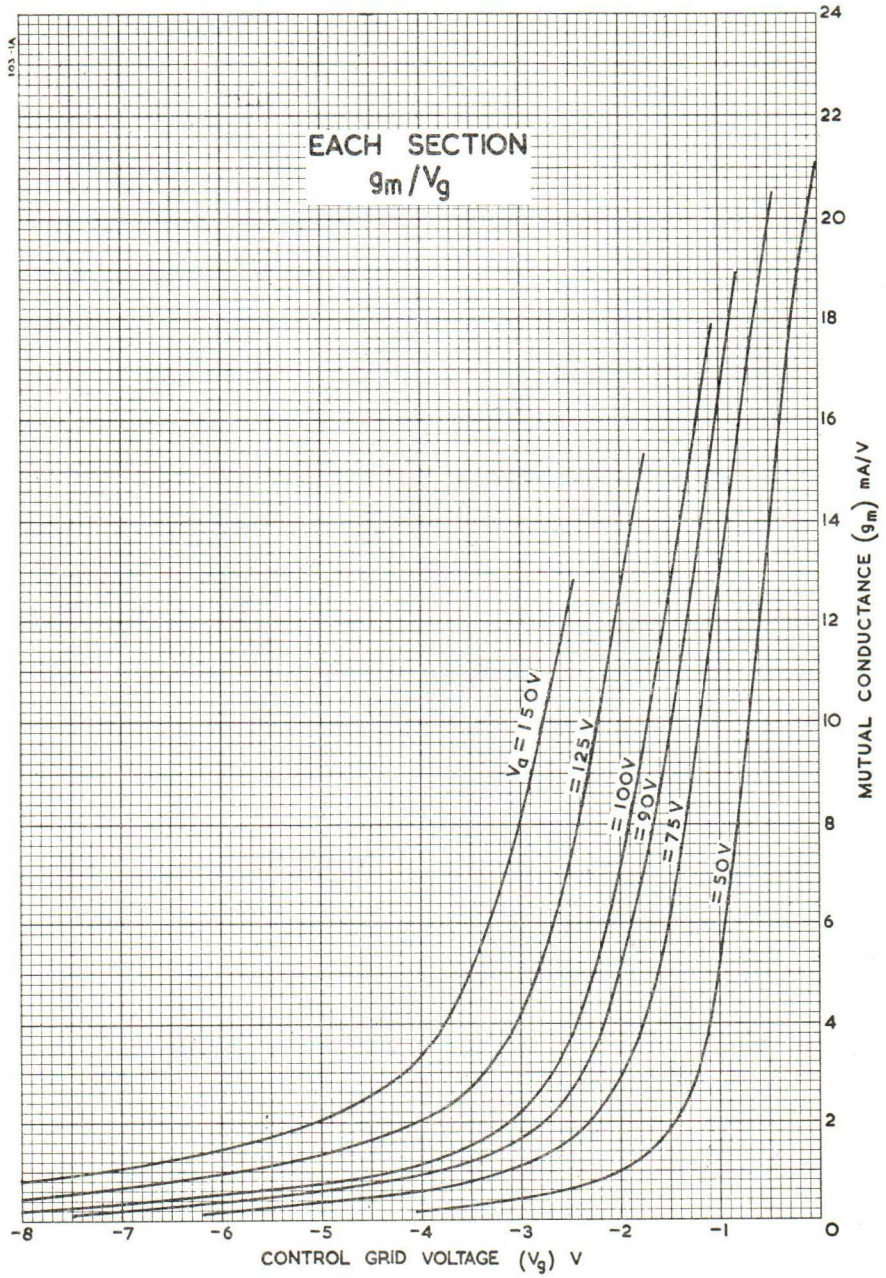
VALVE SECTION I GRID CURRENT BIAS, WITH DELAY

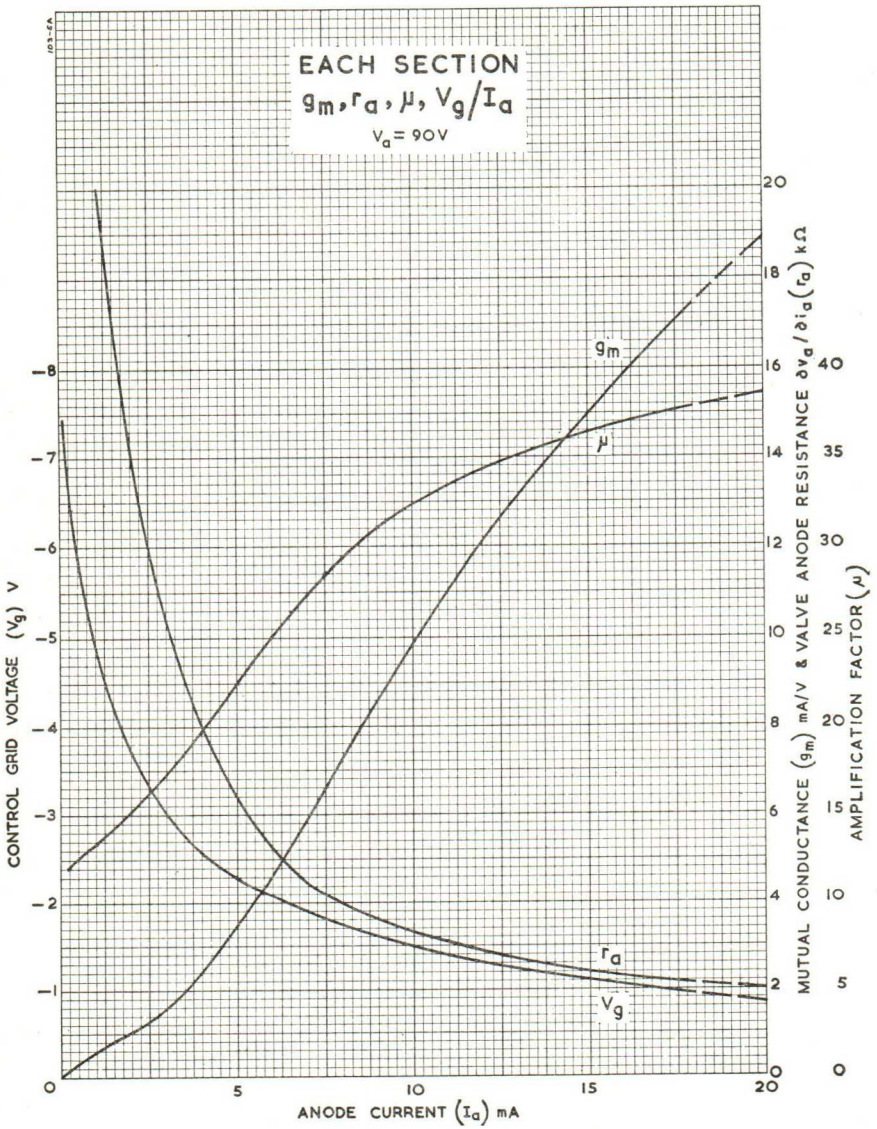


C = DECOUPLING CAPACITORS


101-3A
EACH SECTION
Ia/Va
Vg = 0V
= -1V
= -2V
= -3V
= -4V
= -5V
= -6V
= -8V
= -10V
= -12V
= -14V
Pa (max) = 1·6 W
ANODE CURRENT (Ia) mA
30
25
20
15
10
5
0
ANODE VOLTAGE (Va) V
240
220
200
180
160
140
120
100
80
60
40
20


EACH SECTION
Ia / Vg
VI-101
Pa (max) = 1·6 W
Va = 150 V
= 125 V
= 100 V
= 90 V
= 75 V
= 50 V
20
18
16
14
12
10
8
6
4
2
0
ANODE CURRENT (Ia) mA
−8
−7
−6
−5
−4
−3
−2
−1
CONTROL GRID VOLTAGE (Vg) V


EACH SECTION
gm / Vg
Va = 150V
125 V
100V
90V
75V
50V
MUTUAL CONDUCTANCE (gm) mA/V
CONTROL GRID VOLTAGE (Vg) V
24
22
20
18
16
14
12
10
8
6
4
2
0
-8
-7
-6
-5
-4
-3
-2
-1


EACH SECTION
$g_m, r_a, \mu, V_g/I_a$
V_a = 90V
CONTROL GRID VOLTAGE (V_g) V
ANODE CURRENT (I_a) mA
MUTUAL CONDUCTANCE (g_m) mA/V & VALVE ANODE RESISTANCE $\delta v_a/\delta i_a$ (r_a) kΩ
AMPLIFICATION FACTOR (μ)
g_m
μ
r_a
V_g
0
5
10
15
20
-1
-2
-3
-4
-5
-6
-7
-8
2
4
6
8
10
12
14
16
18
20
25
30
35
40

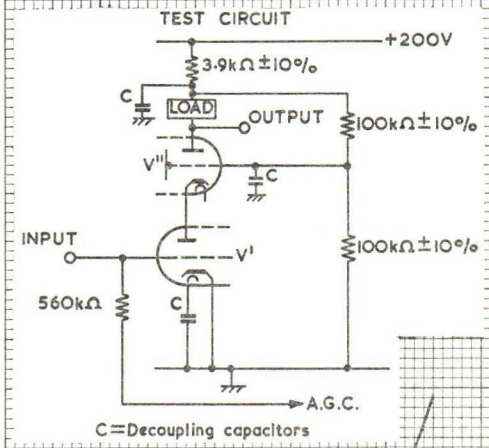
206-2A

CROSS MODULATION

GRID CURRENT BIAS OPERATION.

R_L	m	K
5kΩ	30%	1%

Where $K=\frac{m_u}{m}$ = cross modulation factor, m_u is the percentage modulation acquired by an originally unmodulated wanted signal, due to the presence on the same grid of an unwanted signal modulated m percent.



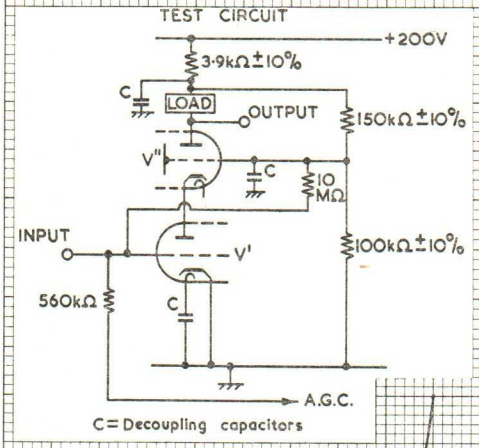
206-3A

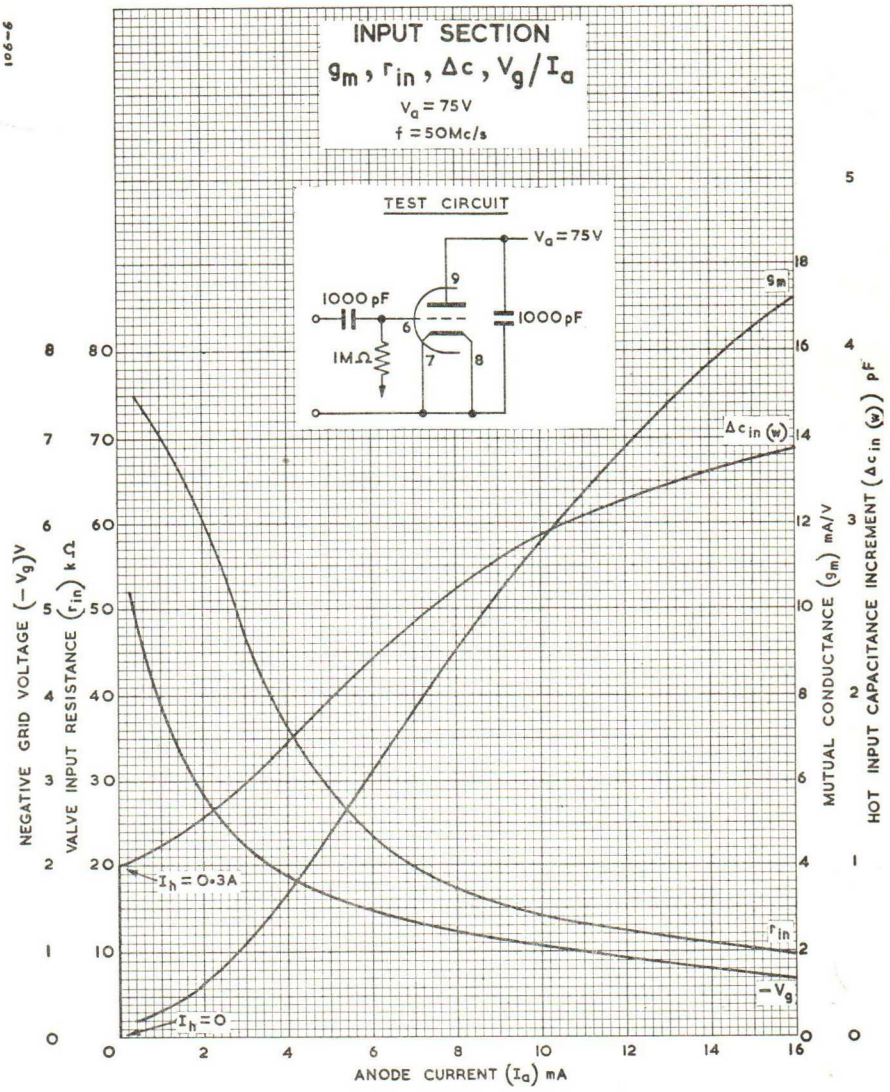
CROSS MODULATION

GRID CURRENT BIAS OPERATION WITH DELAY

R_L	m	K
5kΩ	30%	1%

Where $K=\frac{m_u}{m}$ = cross modulation factor, m_u is the percentage modulation acquired by an originally unmodulated wanted signal, due to the presence on the same grid of an unwanted signal modulated m percent.




106-6
INPUT SECTION
g_m, r_{in}, Δc, V_g/I_a
V_a = 75V
f = 50Mc/s
TEST CIRCUIT
V_a = 75V
1000 pF
1000 pF
1MΩ
9
6
7
8
g_m
Δc_{in} (w)
r_{in}
$-V_g$
I_h = 0·3A
I_h = 0
NEGATIVE GRID VOLTAGE $(-V_g)$V
VALVE INPUT RESISTANCE (r_{in}) kΩ
MUTUAL CONDUCTANCE (g_m) mA/V
HOT INPUT CAPACITANCE INCREMENT $(\Delta c_{in}$ (w)) pF
ANODE CURRENT (I_a) mA

30P4

TELEVISION BEAM POWER AMPLIFIER
Indirectly heated—for AC/DC series operation

GENERAL

The 30P4 is primarily intended for use in the Magnetic Scanning Line Output Stage of A.C./D.C. Television Receivers with series connected heaters.

RATING

			Note
Heater Current (amps)	I_h	0·3	
Heater Voltage (volts)	V_h	25	
Maximum Anode Voltage (volts)	$V_{a(max)}$	400	(a)
Maximum Screen Voltage (volts)	$V_{g2(max)}$	250	
Maximum Cathode Current (mA)	$I_{k(max)}$	160	
Maximum Screen Dissipation (watts)	$P_{g2(max)}$	4·0	
Maximum Anode Dissipation (watts)	$P_{a\ (max)}$	10·0	
Maximum Peak Anode Voltage (Pulse positive) (volts)	$V_{a\ (pk)\ max}$	6,000	(c)
Maximum Heater to Cathode (volts) (R.M.S.)	$V_{h-k\ (max)}$	200	(b)
Maximum Grid to Cathode Circuit Resistance (Megohms)	$R_{g1-k\ (max)}$	1·0	
Maximum Peak Screen Voltage (Pulse negative) (volts)	$V_{g2\ (pk)\ max}$	2,000	

Rating (*continued overleaf*)

THORN — AEI RADIO VALVES & TUBES LTD.

30P4

TELEVISION BEAM POWER AMPLIFIER

Indirectly heated—for AC/DC series operation

NOTES

(a) V_a may be increased to 550v. where a "recovered Voltage" of more than 200 volts is available.

(b) Heater Cathode voltage is measured with respect to the higher potential heater pin.

(c) Rated for Television Line Scan where the duty cycle does not exceed 15% and the pulse duration does not exceed 15 microseconds.

The maximum rating of 6 kV is a design centre rating The absolute rating of 7·5 kV maximum must not be exceeded.

INTER-ELECTRODE CAPACITANCES (pF)

Control Grid to Earth	c_{in}	20·0
Anode to Earth	c_{out}	10·0
Anode to Control Grid	c_{a-g1}	0·3

"Earth" denotes the remaining earthy potential electrodes, heater and shields connected to cathode.

DIMENSIONS

Maximum Overall Length (mm)	113
Maximum Diameter (mm)	32
Maximum Seated Height (mm)	99
Approximate Nett Weight (ozs)	1½
Approximate Packed Weight (ozs)	4

MOUNTING POSITION

If mounted horizontally it is recommended that pins 4 and 8 should be in a vertical plane.

THORN — AEI RADIO VALVES & TUBES LTD.

30P4

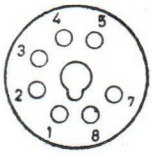
TELEVISION BEAM POWER AMPLIFIER

Indirectly heated—for AC/DC series operation

BULB—Clear

TOP CAP—CT1

BASE—International Octal (I07)



Viewed from free end of Pins.

CONNECTIONS

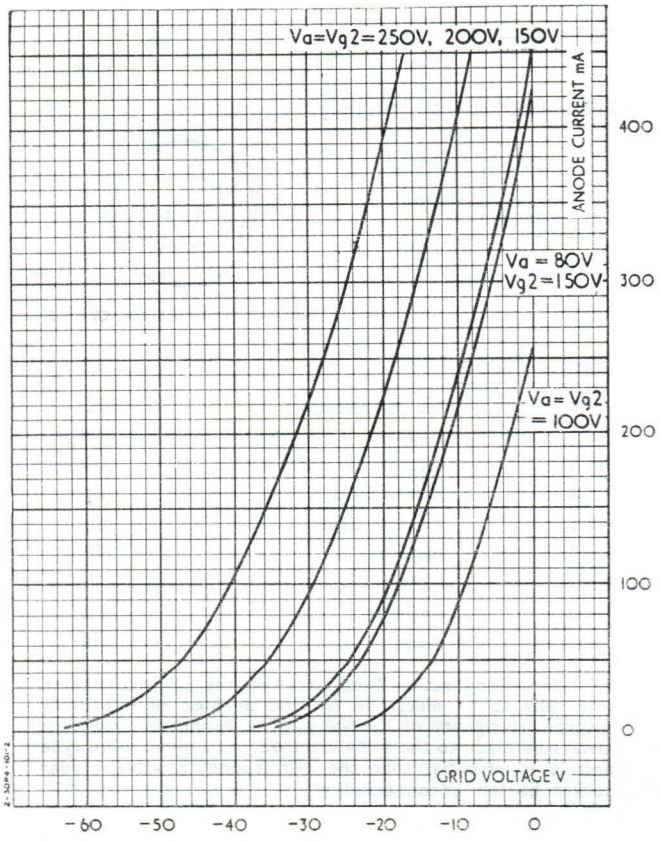
Pin 1	No connection	NC
Pin 2	Heater	h
Pin 3	Internal Connection†	IC
Pin 4	Screen Grid	g_2
Pin 5	Control Grid	g_1
Pin 6	No Pin	NP
Pin 7	Heater	h
Pin 8	Cathode	k
Top Cap	Anode	a

† " Internal connection " indicates that the pin is connected internally to an electrode for the purpose of improving mechanical rigidity of the valve. The connection may not always be made to the same electrode on a given valve type and it is essential that the corresponding valve holder socket be left unconnected.

30P4

TELEVISION BEAM POWER AMPLIFIER
Indirectly heated—for AC/DC series operation

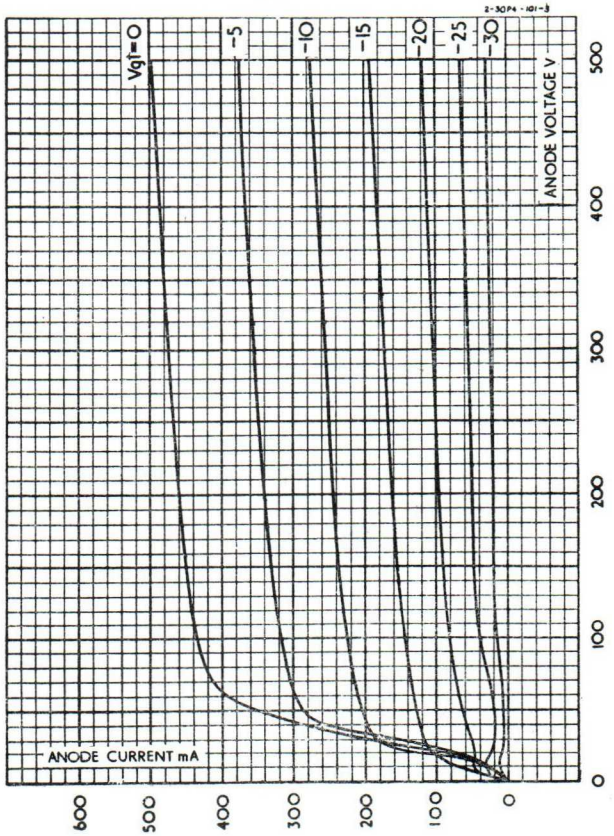
AVERAGE CHARACTERISTIC CURVES: I_a/V_g



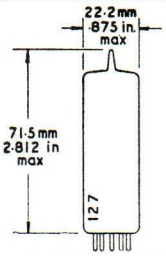
30P4

TELEVISION BEAM POWER AMPLIFIER
Indirectly heated—for AC/DC series operation

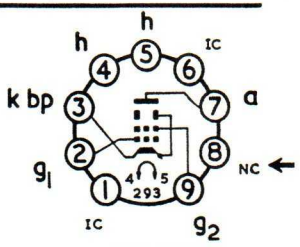
AVERAGE CHARACTERISTIC CURVES: I_a/V_a
$V_{g2}=150V$



THORN — AEI RADIO VALVES & TUBES LTD.



OUTPUT TETRODE



B9A Base

GENERAL

This valve has been designed for use in the output stage of Audio Amplifiers or Field Time Bases and has a heater which is suitable for AC/DC operation.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	12·6	V

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	6	W
Maximum Screen Grid Dissipation—Continuous		1·8	W
Maximum Screen Grid Dissipation—Speech and Music		2·7	W
Maximum Anode Voltage	$V_{a(max)}$	250	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	250	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h\text{-}k(r.m.s.)max}$	150*	V
Maximum Cathode Current	$I_{k(max)}$	50	mA

The grid to cathode circuit resistance must not exceed 0·5 MΩ with cathode self bias.
* Measured with respect to the higher potential heater pin.

CHARACTERISTICS

Anode Voltage	V_a	170	V
Screen Grid Voltage	V_{g2}	180	V
Control Grid Voltage	V_{g1}	−9·4	V
Anode Current	I_a	35	mA
Screen Grid Current	I_{g2}	8·8	mA
Mutual Conductance	g_m	7·9	mA/V
Inner Amplification Factor	$\mu_{g1\text{-}g2}$	13	

CLASS A AUDIO OUTPUT TYPICAL OPERATION

Anode Voltage	V_a	170	V
Screen Voltage	V_{g2}	180	V
Anode Current (Quiescent)	$I_{a(o)}$	31	mA
Screen Current (Quiescent)	$I_{g2(o)}$	7·3	mA
Grid Bias Applied	V_{g1}	−10·3	V
Anode Load	R_a	5†	kΩ
Power Output	P_{out}	2·25†	W
Input Swing Voltage (R.M.S.)	$V_{in(r.m.s.)}$	3·9†	V

The above operating conditions are taken with constant anode and screen supply voltages.
† For 5% Third Harmonic and Second Harmonic not exceeding 5%.

FIELD TIME BASE OPERATION

The field output stage should be designed to allow for valve spread and deterioration during life in addition to component variation.
Values for total peak anode current available for a new average valve and at the assumed end of life point on any valve are as follows:

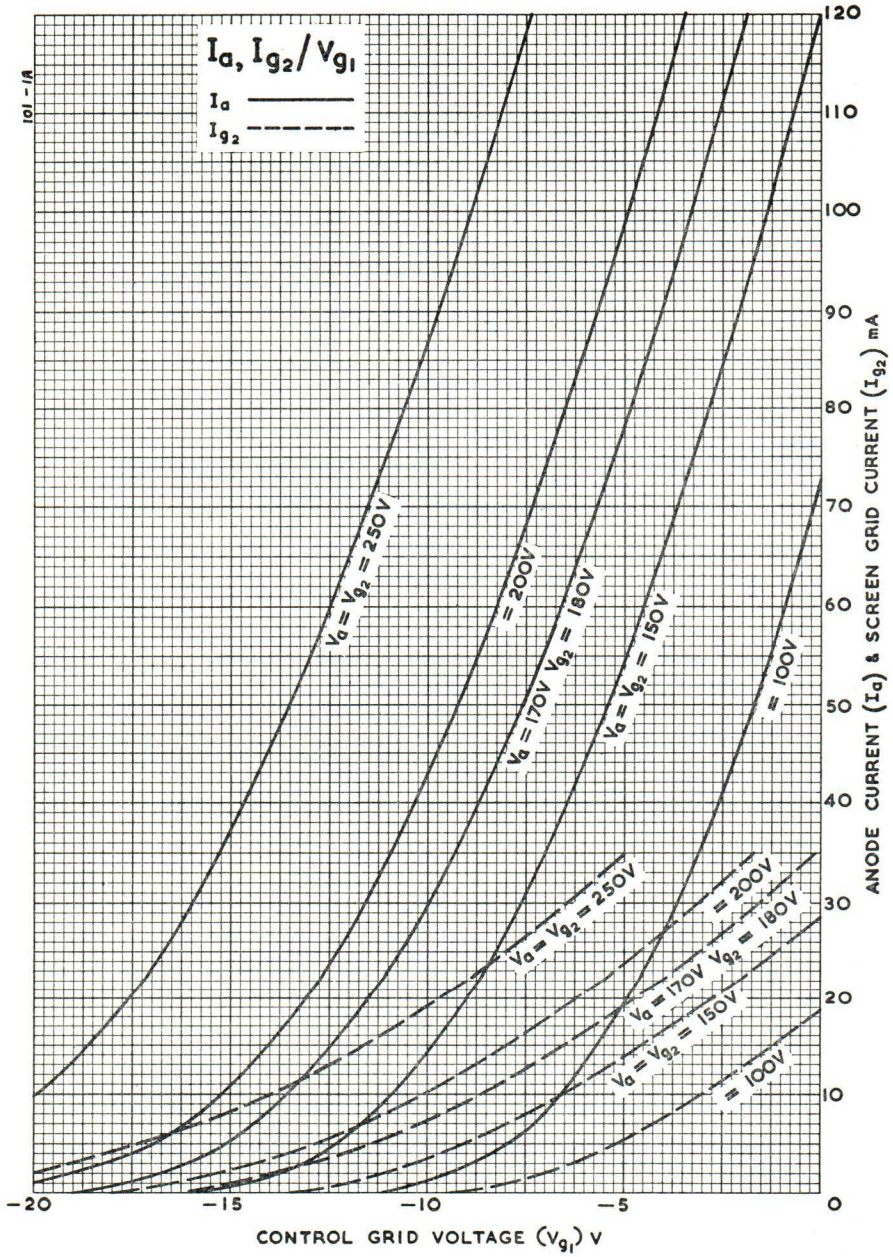
	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)
Average New Valve	50	180	−1	120
Assumed End of Life Condition	50	180	−1	78

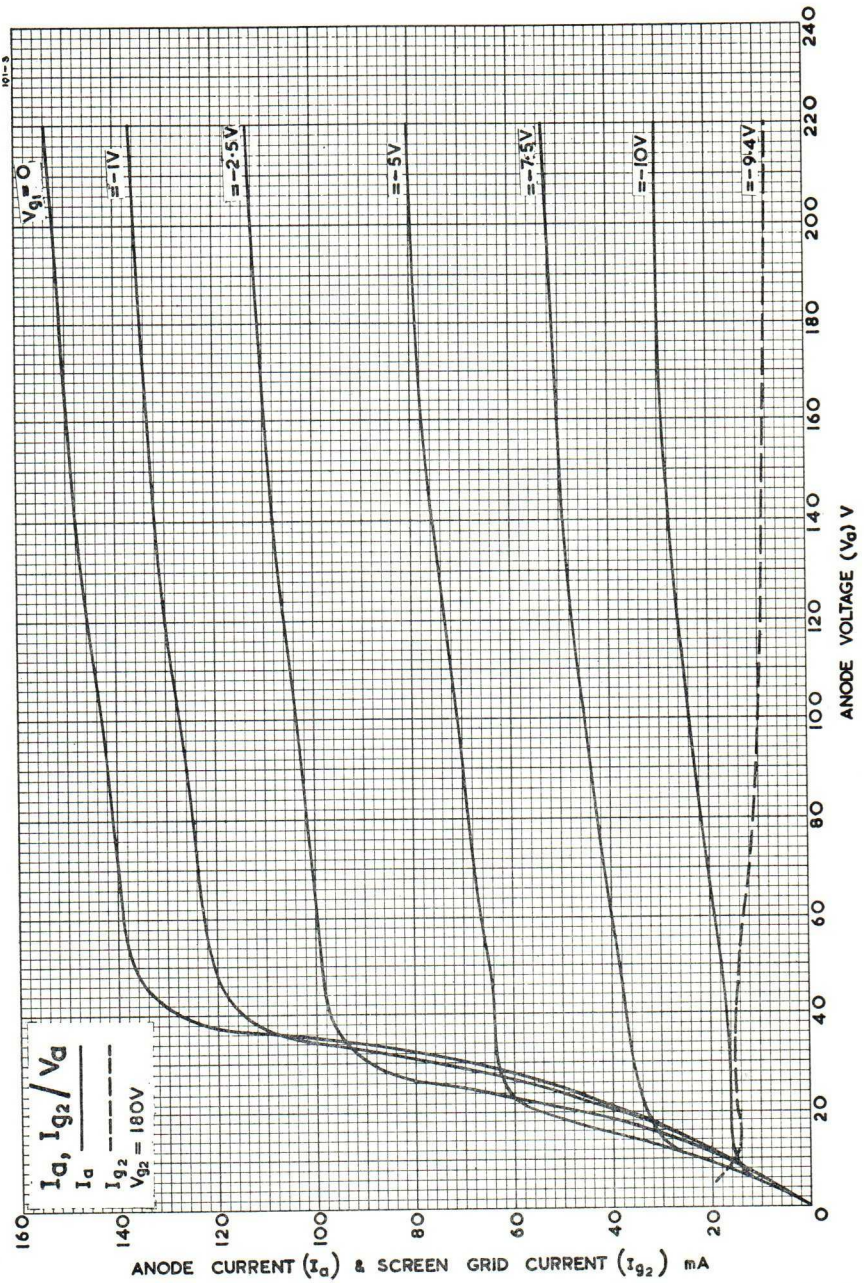
MOUNTING POSITION—Unrestricted.

APPROXIMATE WEIGHT

Net	0·5	oz
Packed	1·25	oz

THORN—AEI RADIO VALVES & TUBES LTD.


$I_a, I_{g_2} / V_{g_1}$
I_a
I_{g_2}
101 - 1A
$V_a = V_{g_2} = 250V$
$= 200V$
$V_a = 170V$ $V_{g_2} = 180V$
$V_a = V_{g_2} = 150V$
$= 100V$
$V_a = V_{g_2} = 250V$
$= 200V$
$V_a = 170V$ $V_{g_2} = 180V$
$V_a = V_{g_2} = 150V$
$= 100V$
120
110
100
90
80
70
60
50
40
30
20
10
0
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
−20
−15
−10
−5
CONTROL GRID VOLTAGE (V_{g_1}) V


101-3
V_{g1} = 0
= -1V
= -2·5V
= -5V
= -7·5V
= -10V
= -9·4V
$I_a, I_{g2} / V_a$
I_a
I_{g2}
V_{g2} = 180V
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g2}) mA
ANODE VOLTAGE (V_a) V
160
140
120
100
80
60
40
20
0
20
40
60
80
100
120
140
160
180
200
220
240

30P16/PL82 ←

OUTPUT PENTODE

TENTATIVE

GENERAL

The 30P16/PL82 is a miniature based indirectly heated output pentode having a maximum anode dissipation of 9 watts. It is intended for use as an Audio or Frame Time-Base Output Valve in AC/DC Television Receivers having series connected heater chains.

RATING

Heater Current (amps)	I_h	0·3
Heater Voltage (volts)	V_h	16·5
Maximum Anode Voltage (volts)	$V_{a(max)}$	250
Maximum Screen Voltage (volts)	$V_{g_2(max)}$	250
Maximum Anode Dissipation (watts)	P_a	9
Maximum Screen Dissipation (watts)	P_{g_2}	2·5
Mutual Conductance (mA/V)	g_m	9*
Anode Impedance (ohms)	r_a	20,000*
Inner Amplification Factor (μg_1-g_2)		10*
Maximum Mean Cathode Current (mA)	$I_{k\cdot av\cdot(max)}$	75
Maximum Heater to Cathode Voltage (volts)	$V_{h-k(max)}$	200†

* Taken at $Va = Vg_2 = 170$ volts. $Ia = 53$ mA. $Vg_1 = -10{\cdot}4$ volts

† Measured with respect to the higher potential heater pin.

INTER-ELECTRODE CAPACITANCES (pF)

Anode/Earth	c_{out}	6·2
Anode/Control Grid	c_{a,g_1}	1·0
Grid/Earth	c_{in}	11·0

"Earth" denotes all remaining earth potential electrodes including heater, shields and cathode.

30P16/PL82 ←

OUTPUT PENTODE

TENTATIVE

DIMENSIONS

Maximum Overall Length (mm)	78·5
Maximum Diameter (mm)	22·2
Maximum Seated Height (mm)	71·5
Approximate Nett Weight (ozs)	½
Approximate Packed Weight (ozs)	¾

MOUNTING POSITION—Unrestricted but adequate ventilation should be provided.

TYPICAL OPERATION—Audio Output (Class A)

Anode Voltage (volts)	V_a	200	170
Screen Voltage (volts)	V_{g_2}	200	170
Anode Current (mA) (Quiescent)	$I_{a(o)}$	45	53
Screen Current (mA) (Quiescent)	$I_{g_2(o)}$	8.5	10
Grid Bias (volts) (approx)	V_{g_1}	—14.4	—10·4
Power Output (watts)	P_{out}	4.2‡	4‡
Anode Load (ohms)	R_a	4,000	3,000
Input Swing (volts r.m.s.)	$V_{in\ (rms)}$	7‡	6‡
Input Swing for 50 mW output (volts r.m.s.)	$V_{in\ (rms)}$	0.55	0·5

‡ For 10% total harmonic distortion.

TYPICAL OPERATION—Frame Time-Base

The frame output stage should be designed to allow for valve spread and deterioration during life in addition to component variation. Values of total peak anode current available for a new average valve and at assumed end-of-life point for any valve are as follows:—

	Va	Vg_2	Vg_1	I_a(mA)
Average new valve	50	170	—1	140
Assumed end-of-life condition	50	170	—1	90

Indicates a change ←

30P16/PL82 ←

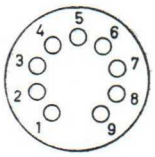
OUTPUT PENTODE

Indirectly heated—for series operation

TENTATIVE

BULB—Clear

BASE—Noval (B9A)



Viewed from Free end of Pins

VALVE HOLDER—Ediswan Clix VH599/9 series.

CONNECTIONS

Pin 1	Internal Connection	IC
Pin 2	Control Grid	g1
Pin 3	Cathode, Suppressor Grid	k,g3
Pin 4	Heater	h
Pin 5	Heater	h
Pin 6	Internal Connection	IC
Pin 7	Anode	a
Pin 8	Internal Connection	IC
Pin 9	Screen Grid	g2

Indicates a change ←

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30P16/PL82

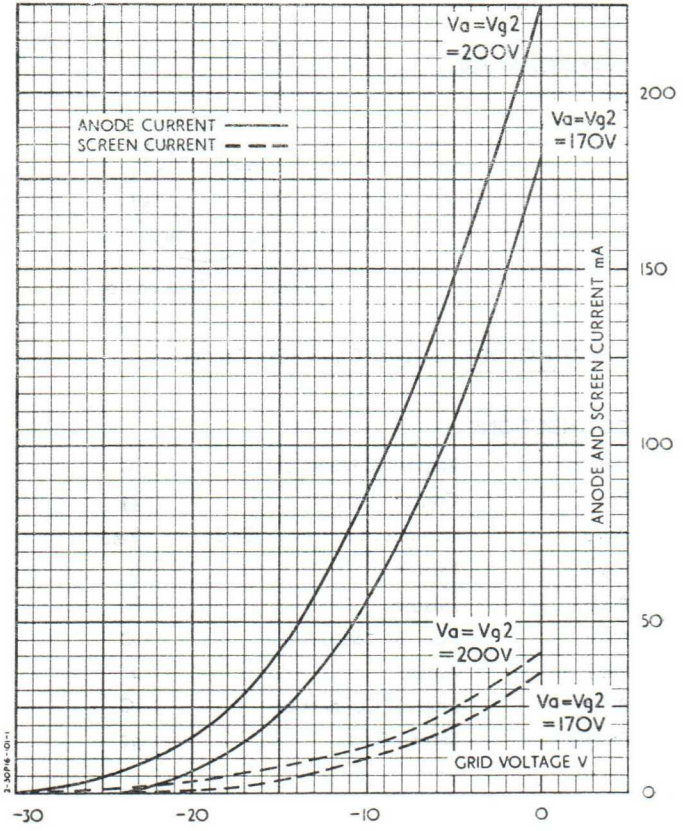
OUTPUT PENTODE

Indirectly heated—for series operation

TENTATIVE

CHARACTERISTIC CURVES : I_a, I_{g2}/V_{g1}

Heater Current = 0·3 amps



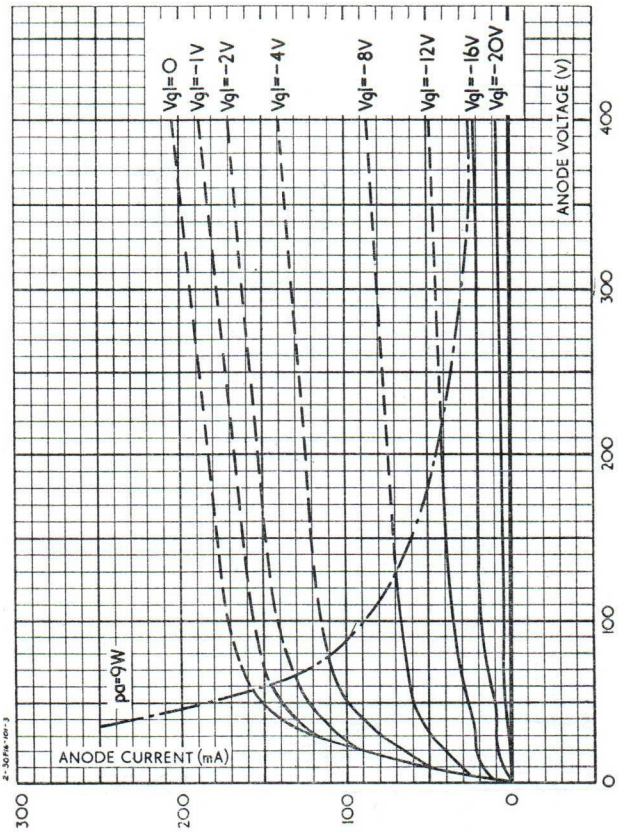
30P16/PL82

OUTPUT PENTODE

Indirectly heated—for series operation

CHARACTERISTIC CURVES : I_a/V_a

$V_{g2}=170V$



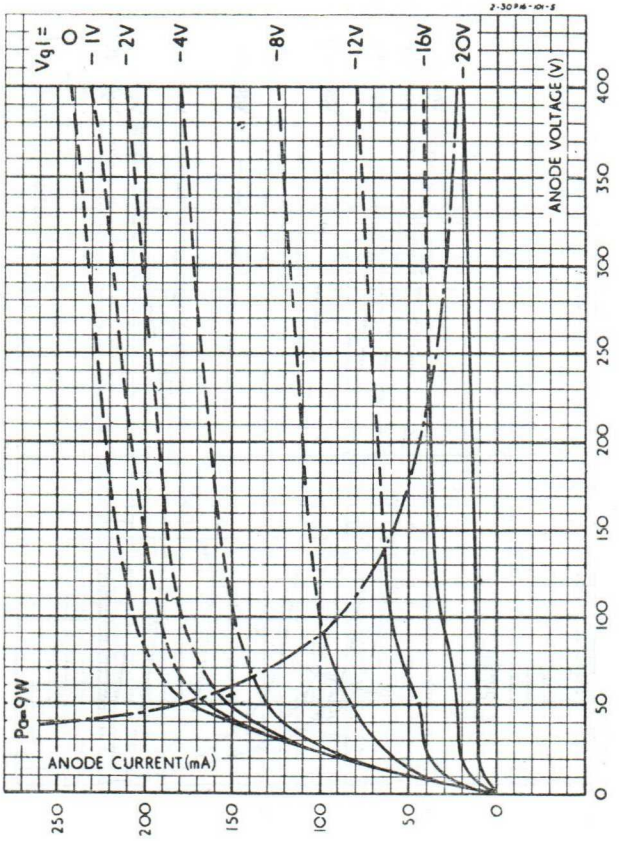
30P16/PL82

OUTPUT PENTODE

Indirectly heated—for series operation

CHARACTERISTIC CURVES : I_a/V_a

$V_{g2}=200V$



30P18/PL84

OUTPUT PENTODE

TENTATIVE

GENERAL

The 30P18/PL84 is an indirectly heated miniature based Output Pentode having a maximum anode dissipation of 12 watts. It is intended for use as the Frame Output stage in AC/DC mains powered television receivers with series connected heater chains.

RATING

Heater Current (amps)	I_h	0.3
Heater Voltage (volts)	V_h	15
Maximum Anode Voltage (volts)	$V_{a(max)}$	250*
Maximum Screen Voltage (volts)	$V_{g2(max)}$	200
Maximum Anode Dissipation (watts)	$P_{a(max)}$	12
Maximum Screen Dissipation (watts)	$P_{g2(max)}$	1.75
Maximum Heater to Cathode Voltage (volts D.C.)	$V_{h\text{-}k(max)}$	200
Mutual Conductance (mA/V)	g_m	10†
Anode Impedance (ohms)	r_a	23000†
Inner Amplification Factor	$\mu_{g1\text{-}g2}$	8†
Maximum Mean Cathode Current (mA)	$I_{k(av)max}$	100
Maximum Grid 1 to Cathode Resistance (Self Bias) (Megohms)	$R_{g1\text{-}k(max)}$	1

* Maximum Peak Anode Voltage (Pulse Positive) 2kV.
Maximum Peak Anode Voltage (Pulse Negative) 500V.
Maximum pulse duration 4% of one cycle with a maximum of 800 μ secs.

† Measured at $V_a=V_{g2}=170V$; $I_a=70mA$; $I_{g2}=5mA$ $V_{g1}=-12.5V$.

INTER-ELECTRODE CAPACITANCES (pF)

Grid 1/Earth	$c_{g1\text{-}E}$	11.8
Anode/Earth	$c_{a\text{-}E}$	6.0
Anode/Grid 1	$c_{a\text{-}g1}$	<0.6
Grid 1/Heater	$c_{g1\text{-}h}$	<0.25

THORN — AEI RADIO VALVES & TUBES LTD.

30P18/PL84
OUTPUT PENTODE

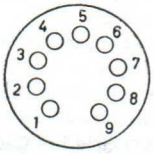
TENTATIVE

DIMENSIONS

Maximum Overall Length	(mm)	78.5
Maximum Diameter	(mm)	22.2
Maximum Seated Height	(mm)	71.5
Approximate Nett Weight	(ozs)	$\frac{1}{2}$
Approximate Packed Weight	(ozs)	$\frac{3}{4}$

MOUNTING POSITION—Unrestricted

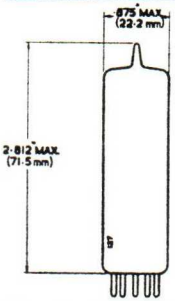
BASE—Noval (B9A)



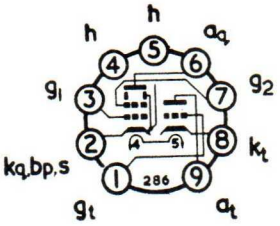
Viewed from free end of pins

CONNECTIONS

Pin 1	Internal Connection	IC
Pin 2	Control Grid	g1
Pin 3	Cathode, Suppressor Grid	k_1g3
Pin 4	Heater	h
Pin 5	Heater	h
Pin 6	Internal Connection	IC
Pin 7	Anode	a
Pin 8	Internal Connection	IC
Pin 9	Screen Grid	g2



TRIODE OUTPUT BEAM TETRODE



B9A Base

GENERAL

This triode output beam tetrode valve is intended principally for use in field deflection circuits of AC/DC television receivers using 110° cathode ray tubes.
Each section has its own cathode.
The triode section is a general purpose one with identical characteristics to the 6/30L2.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	16	V

RATINGS

		Triode	Tetrode	
Maximum Anode Dissipation	$p_{a(max)}$	1	7	W
Maximum Screen Dissipation	$p_{g_2(max)}$	—	2·4	W
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Peak Anode Voltage (Pulse positive)		—	2*	kV
Maximum Peak Anode Voltage (Pulse negative)		—	500*	V
Maximum Screen Grid Voltage	$V_{g_2(max)}$	—	250	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h\text{-}k(r.m.s.)max}$	150†	150†	V
Maximum Mean Cathode Current	$I_{k(av)max}$	—	75	mA
Maximum Resistance Grid 1 to Cathode (Self bias)		—	2	MΩ
Maximum Resistance Grid 1 to Cathode (Fixed bias)		—	1	MΩ

* Maximum pulse duration 4% of one cycle with a maximum of 800 μs.

† Measured with respect to the higher potential heater pin.

INTER-ELECTRODE CAPACITANCES ←

		‡	§	‖	
Grid 1 to Earth	$c_{g1\text{-}E}$	10·0	10·4	11·5	pF
Anode Tetrode to Earth	$c_{aq\text{-}E}$	9·5	10·3	11·4	pF
Grid 1 to Anode Tetrode	$c_{g1\text{-}aq}$	0·36	0·36	0·37	pF
Grid Triode to Earth	$c_{gt\text{-}E}$	2·1	2·4	3·3	pF
Anode Triode to Earth	$c_{at\text{-}E}$	1·9	2·3	3·3	pF
Grid Triode to Anode Triode	$c_{gt\text{-}at}$	2·3	2·3	2·4	pF
Grid 1 to Anode Triode	$c_{g1\text{-}at}$	0·007	0·014	0·019	pF
Grid Triode to Anode Tetrode	$c_{gt\text{-}aq}$	0·017	0·022	0·024	pF
Anode Tetrode to Anode Triode	$c_{aq\text{-}at}$	0·075	0·085	0·095	pF

‡ In fully shielded socket without can.

§ With holder capacity balanced out (Holder as below).

‖ Total capacity including B9A nylon phenolic holder without skirt or radial shield (AEI "Clix" holder type VH19/902).

"Earth" denotes the electrodes of any second valve section and the remaining earthy potential electrodes of the section under measurement, heater and shields joined to cathode.

Indicates a change ←

THORN—AEI RADIO VALVES & TUBES LTD.

CHARACTERISTICS

		Triode	Tetrode	
Anode Voltage	V_a	100	170	V
Screen Grid Voltage	V_{g2}	—	170	V
Anode Current	I_a	10	45	mA
Screen Current	I_{g2}	—	8·7	mA
Mutual Conductance	g_m	4·3	7·5	mA/V ←
Amplification Factor (Tetrode g_1 to g_2)	μ	18	8·3	←

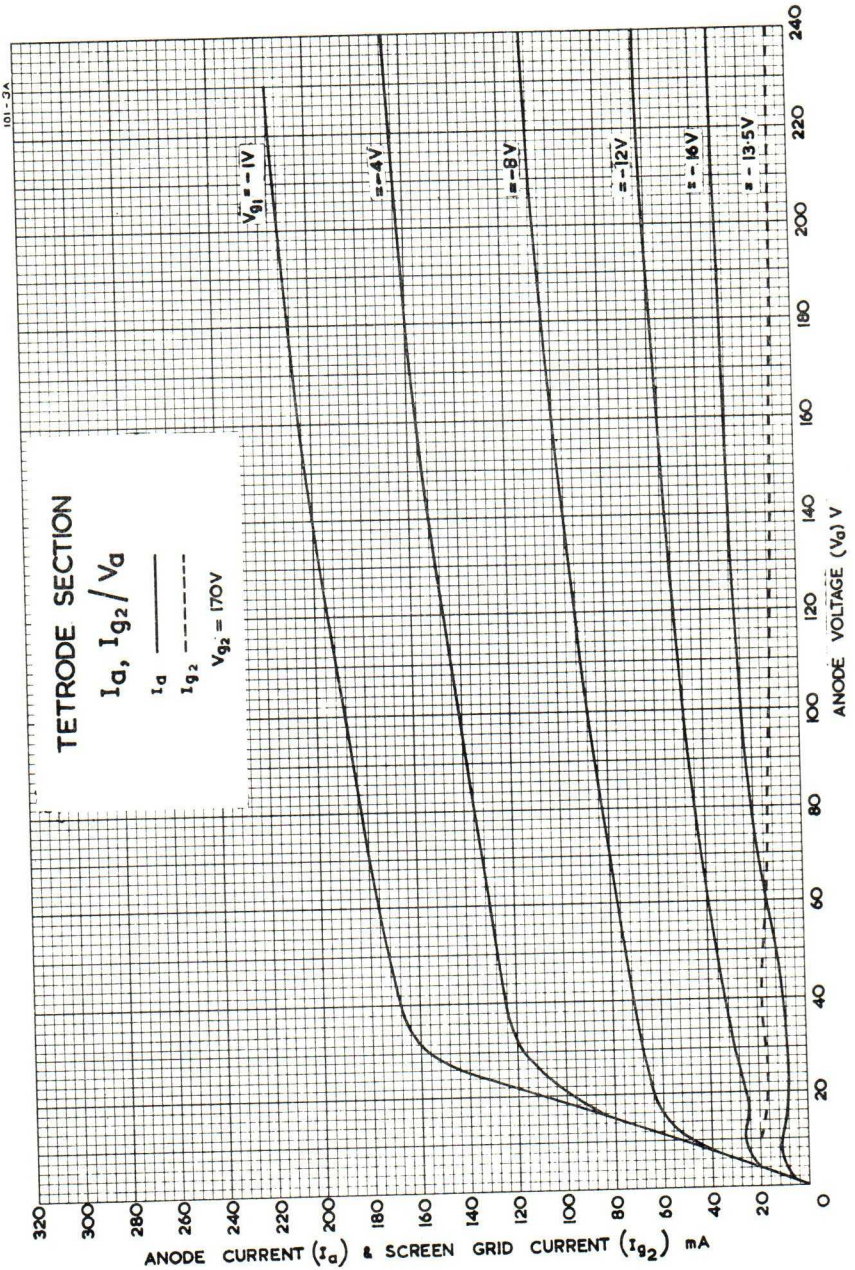
FIELD TIME BASE TYPICAL OPERATION

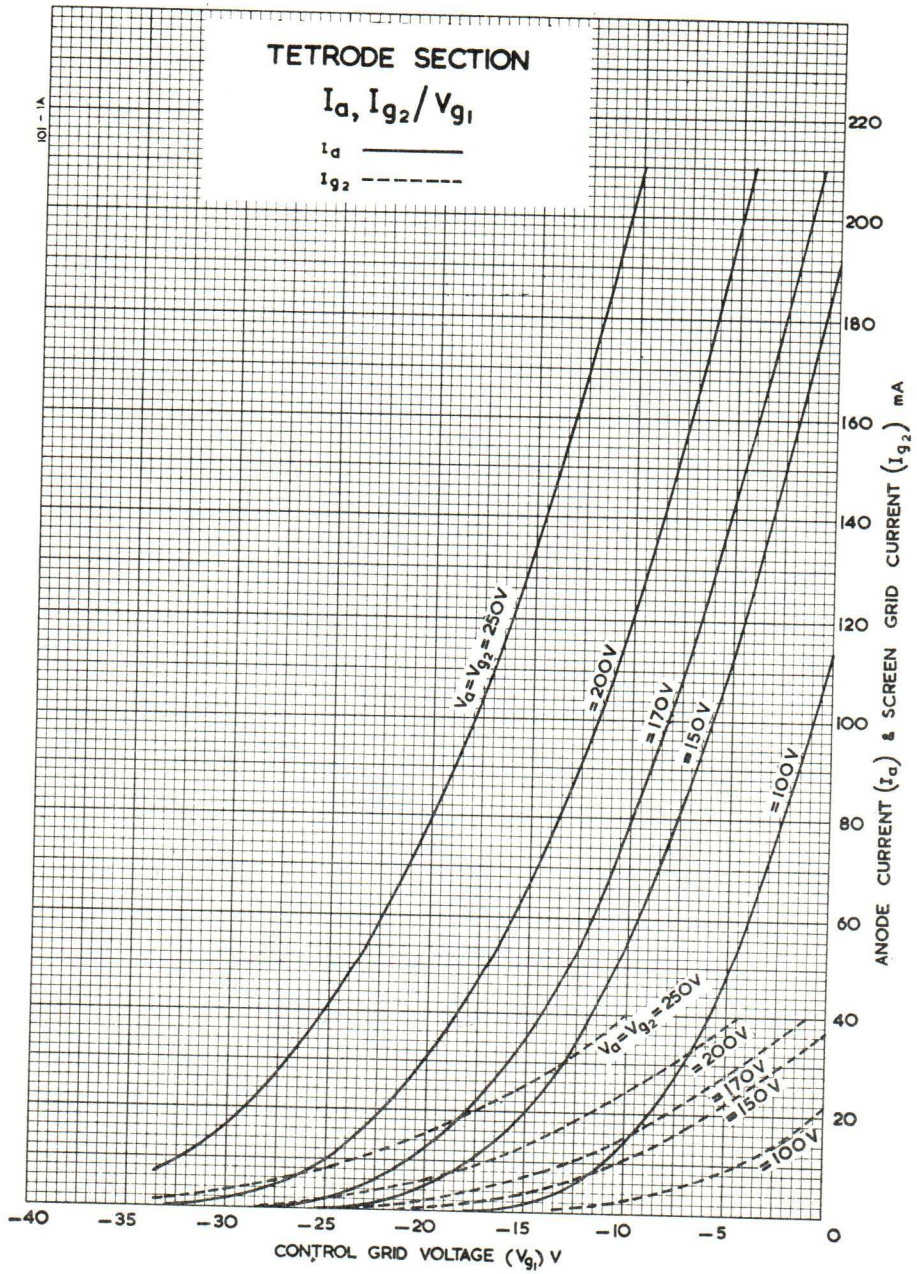
The output stage should be designed to allow for valve spread and deterioration during life in addition to component variation. Values of total peak anode current available for a new average valve and at assumed end of life point for any valve are as follows:

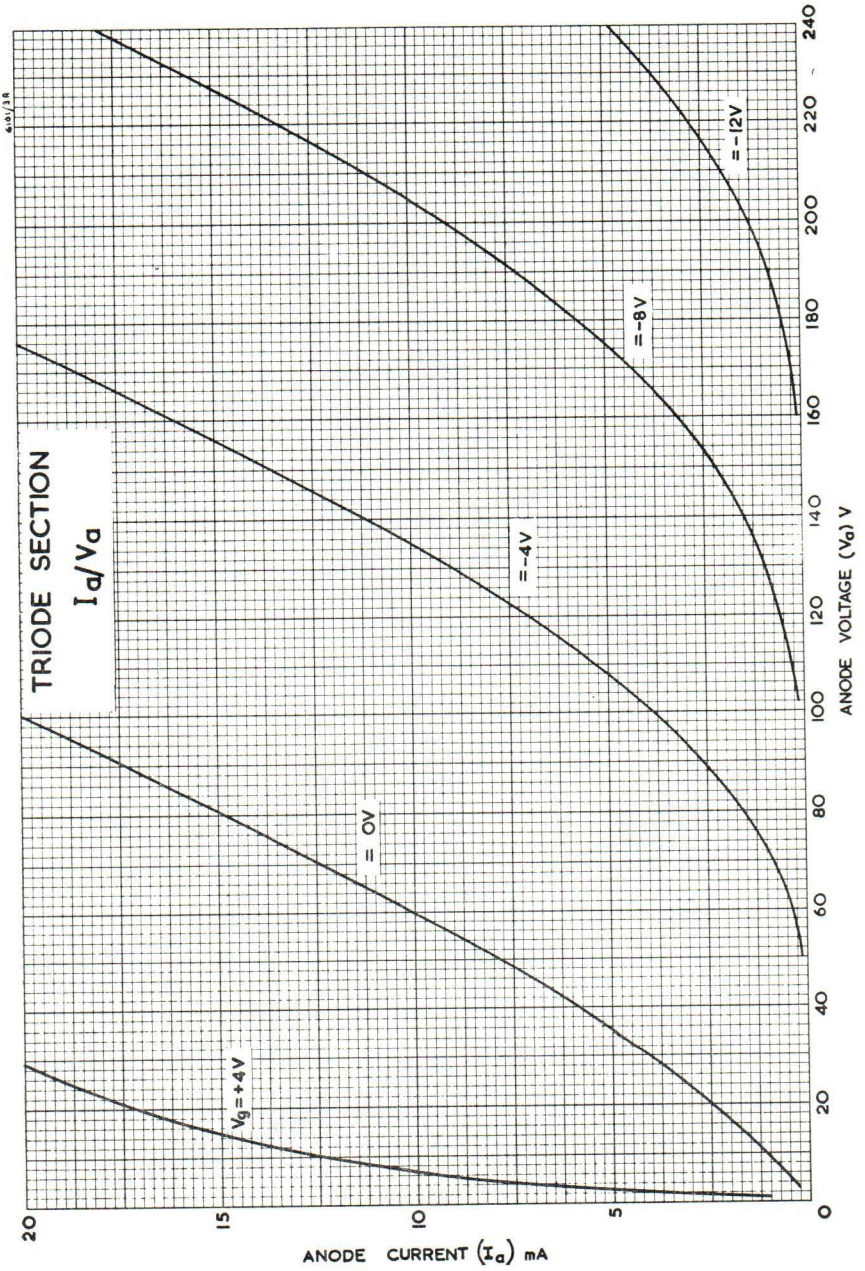
	V_a (V)	V_{g2} (V)	V_{g1} (V)	I_a (mA)
Average New Valve	55	170	−1	175
Assumed End of Life Condition	50	170	−1	110

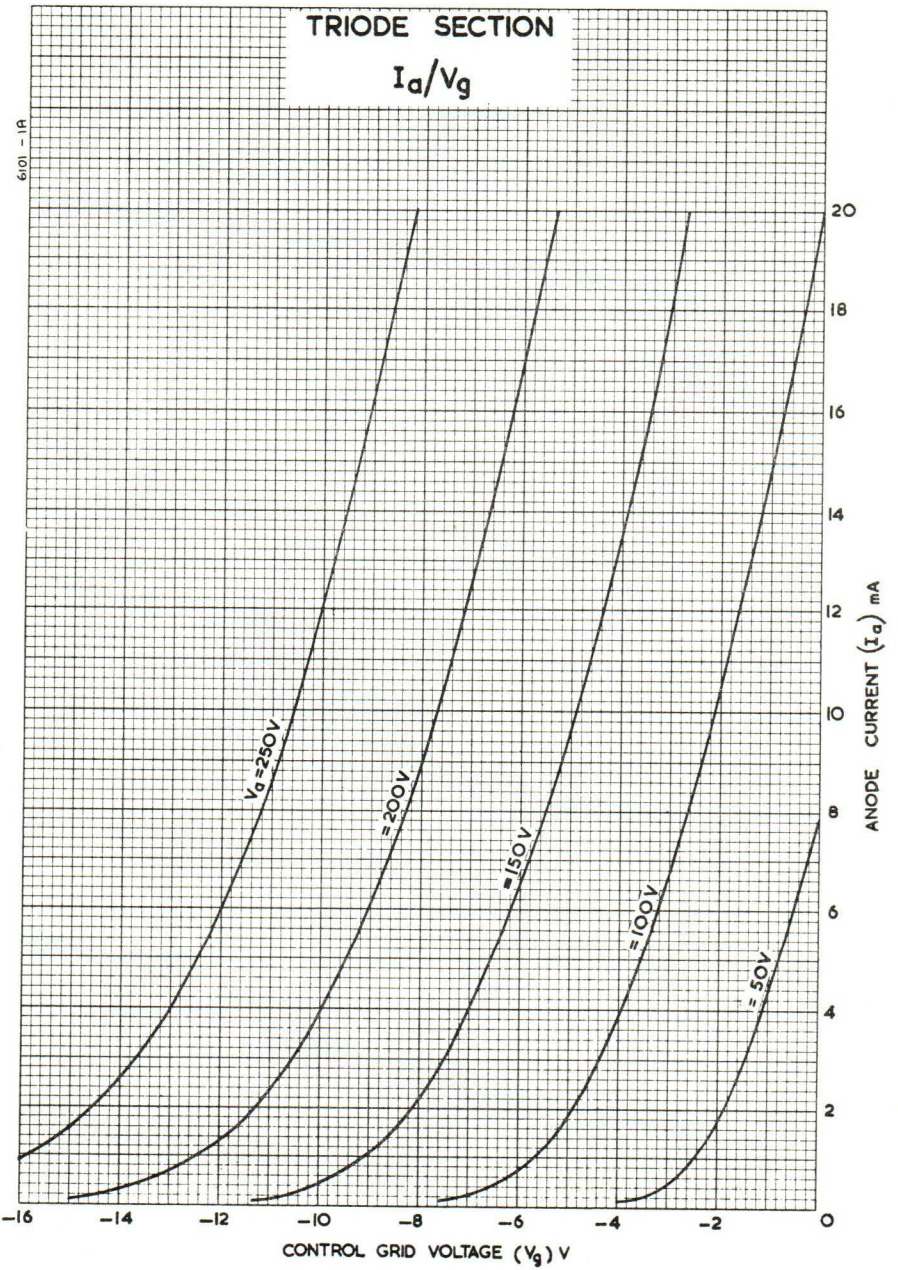
MOUNTING POSITION—Unrestricted

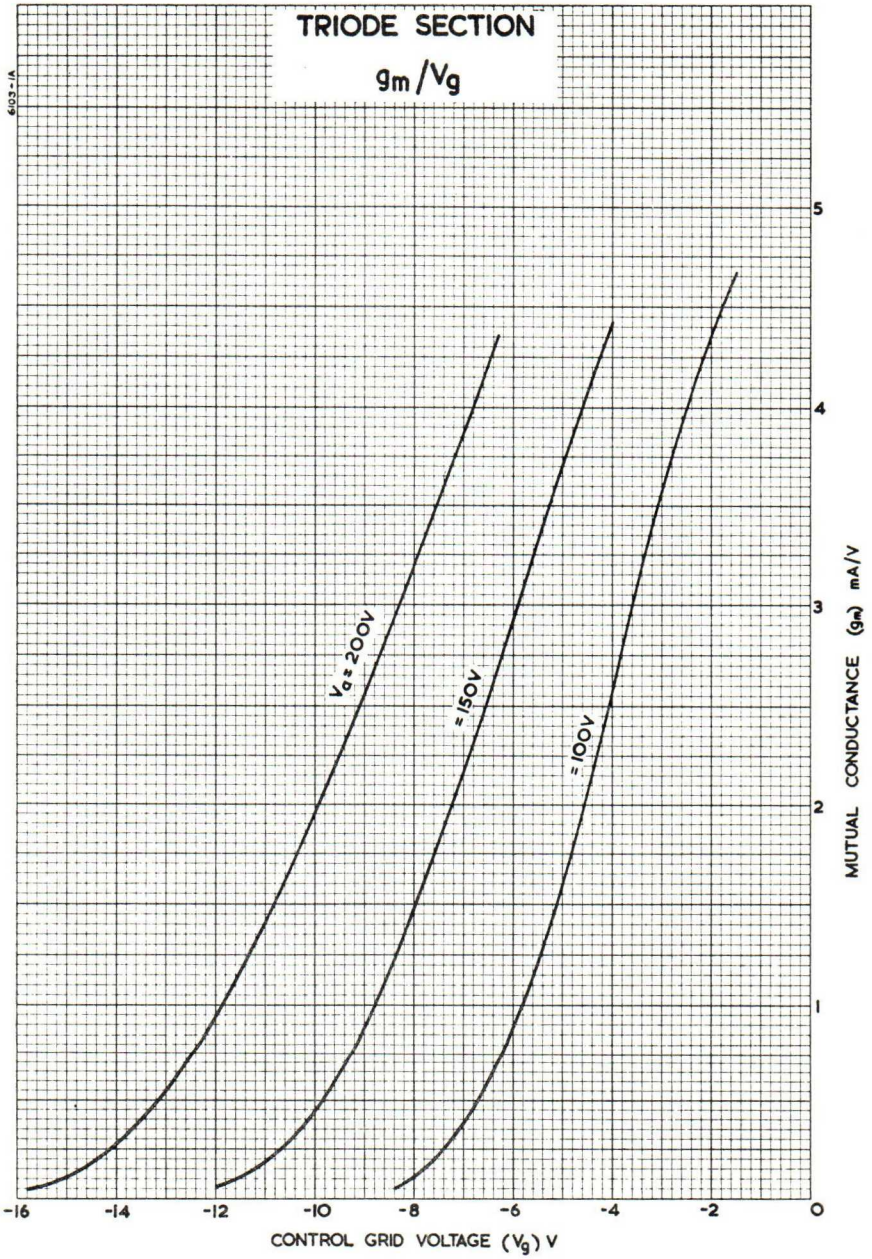
Indicates a change ←

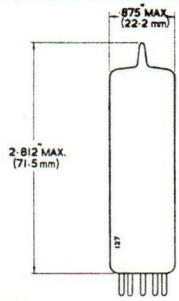

101-2A
TETRODE SECTION
$I_a, I_{g_2} / V_a$
I_a
I_{g_2}
$V_{g_2} = 170V$
$V_{g_1} = -1V$
= -4V
= -8V
= -12V
= -16V
= -13·5V
ANODE VOLTAGE (V_a) V
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320


TETRODE SECTION
$I_a, I_{g_2} / V_{g_1}$
I_a ——
I_{g_2} - - - - - -
101 - 1A
$V_a = V_{g_2} = 250V$
200V
170V
150V
100V
$V_a = V_{g_2} = 250V$
200V
170V
150V
100V
220
200
180
160
140
120
100
80
60
40
20
0
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
−40
−35
−30
−25
−20
−15
−10
−5
0
CONTROL GRID VOLTAGE (V_{g_1}) V

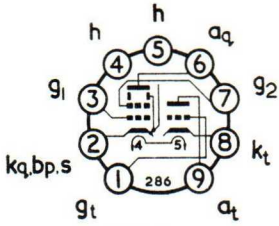

TRIODE SECTION
Ia/Va
Vg = +4V
= 0V
= -4V
= -8V
= -12V
ANODE CURRENT (Ia) mA
ANODE VOLTAGE (Va) V
0
20
40
60
80
100
120
140
160
180
200
220
240
5
10
15
20


TRIODE SECTION
Ia/Vg
6101-1A
Va=250V
=200V
=150V
=100V
=50V
20
18
16
14
12
10
8
6
4
2
0
ANODE CURRENT (Ia) mA
-16
-14
-12
-10
-8
-6
-4
-2
0
CONTROL GRID VOLTAGE (Vg) V


TRIODE SECTION
gm/Vg
6103-1A
Va = 200V
= 150V
= 100V
-16
-14
-12
-10
-8
-6
-4
-2
0
1
2
3
4
5
CONTROL GRID VOLTAGE (Vg) V
MUTUAL CONDUCTANCE (gm) mA/V



TRIODE OUTPUT BEAM TETRODE



B9A Base

GENERAL

This triode output beam tetrode valve is intended principally for use in field deflection circuits of AC/DC television receivers using 110° cathode ray tubes.
Each section has its own cathode.
The triode section is a general purpose one with identical characteristics to the 6/30L2.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	16	V

RATINGS

		Triode	Tetrode	
Maximum Anode Dissipation	$P_{a(max)}$	1	8	W
Maximum Screen Dissipation	$P_{g_2(max)}$	—	2	W
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Peak Anode Voltage (Pulse positive)		—	2*	kV
Maximum Peak Anode Voltage (Pulse negative)		—	500*	V
Maximum Screen Grid Voltage	$V_{g_2(max)}$	—	250	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h\text{-}k(r.m.s.)max}$	150†	150†	V
Maximum Mean Cathode Current	$I_{k(av)max}$	—	75	mA
Maximum Resistance Grid 1 to Cathode (Self bias)		—	2	MΩ
Maximum Resistance Grid 1 to Cathode (Fixed bias)		—	1	MΩ

* Maximum pulse duration 5% of one cycle with a maximum of 1 ms.

† Measured with respect to the higher potential heater pin.

INTER-ELECTRODE CAPACITANCES ←

		‡	§	‖	
Grid 1 to Earth	$c_{g_1\text{-}E}$	10·5	10·9	12·0	pF
Anode Tetrode to Earth	$c_{aq\text{-}E}$	9·5	10·3	11·4	pF
Grid 1 to Anode Tetrode	$c_{g_1\text{-}aq}$	0·32	0·32	0·33	pF
Grid Triode to Earth	$c_{gt\text{-}E}$	2·1	2·5	3·4	pF
Anode Triode to Earth	$c_{at\text{-}E}$	1·8	2·3	3·2	pF
Grid Triode to Anode Triode	$c_{gt\text{-}at}$	2·3	2·3	2·4	pF
Grid 1 to Anode Triode	$c_{g_1\text{-}at}$	0·009	0·015	0·02	pF
Grid Triode to Anode Tetrode	$c_{gt\text{-}aq}$	0·019	0·024	0·026	pF
Anode Tetrode to Anode Triode	$c_{aq\text{-}at}$	0·078	0·09	0·098	pF

‡ In fully shielded socket without can.

§ With holder capacity balanced out (Holder as below).

‖ Total capacity including B9A nylon phenolic holder without skirt or radial shield (AEI "Clix" holder type VH19/902).

"Earth" denotes the electrodes of any second valve section and the remaining earthy potential electrodes of the section under measurement, heater and shields joined to cathode.

Indicates a change ←

THORN—AEI RADIO VALVES & TUBES LTD.

CHARACTERISTICS

		Triode	Tetrode	
Anode Voltage	V_a	100	170	V
Screen Grid Voltage	V_{g_2}	—	170	V
Anode Current	I_a	10	50	mA
Mutual Conductance	g_m	4·3	7·3	mA/V ←
Amplification Factor (Tetrode g_1 to g_2)	μ	18	7·5	←

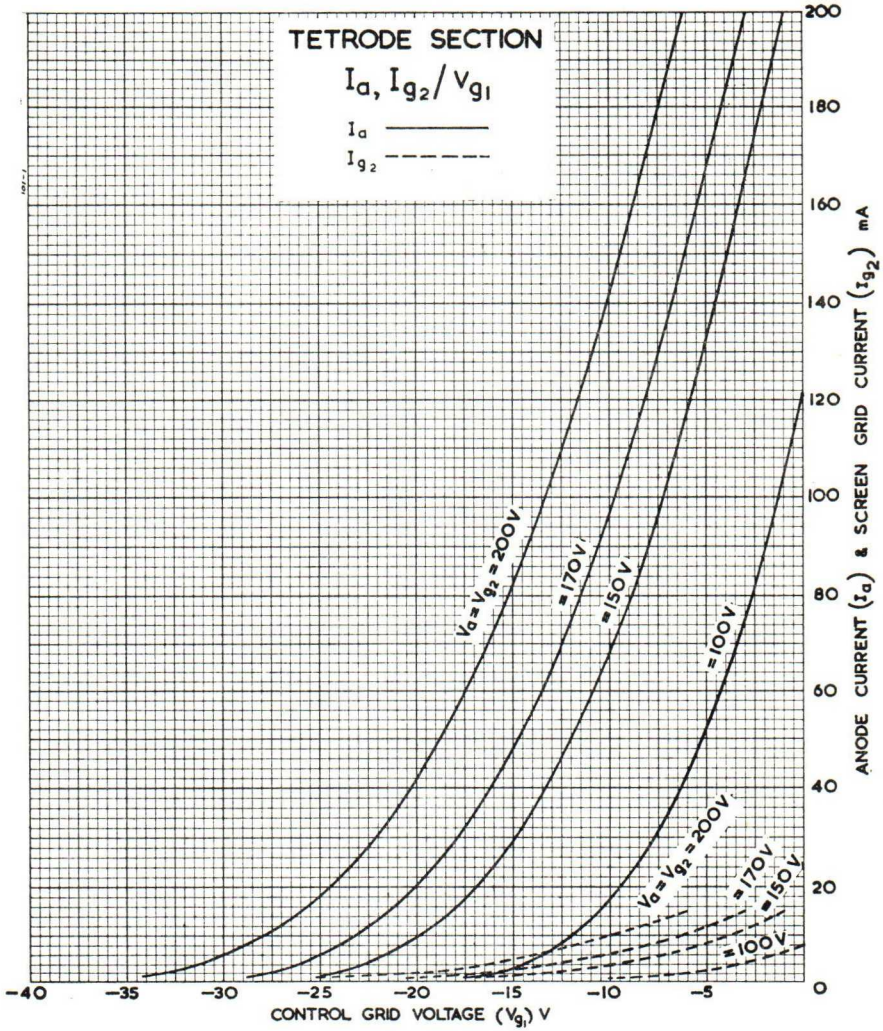
FIELD TIME BASE TYPICAL OPERATION

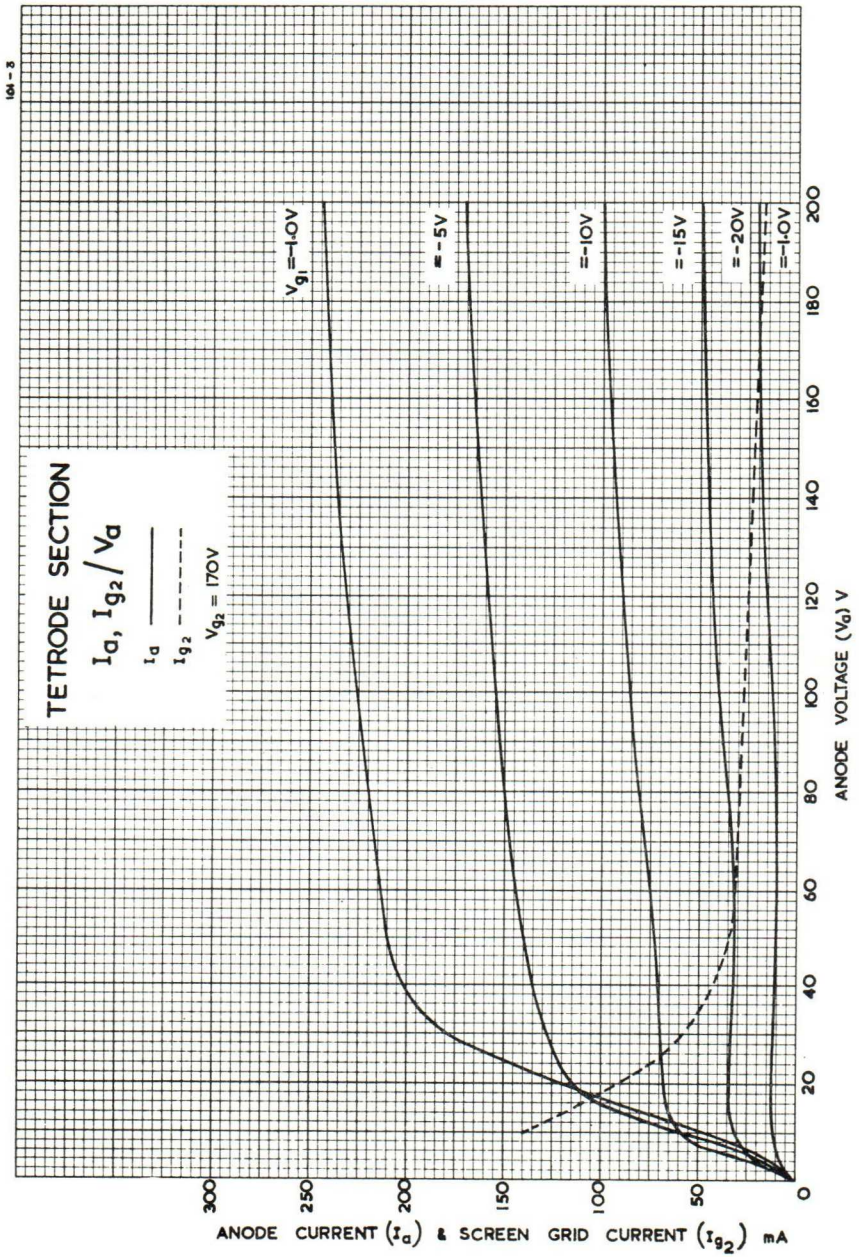
The output stage should be designed to allow for valve spread and deterioration during life in addition to component variation. Values of total peak anode current available for a new average valve and at assumed end of life point for any valve are as follows:

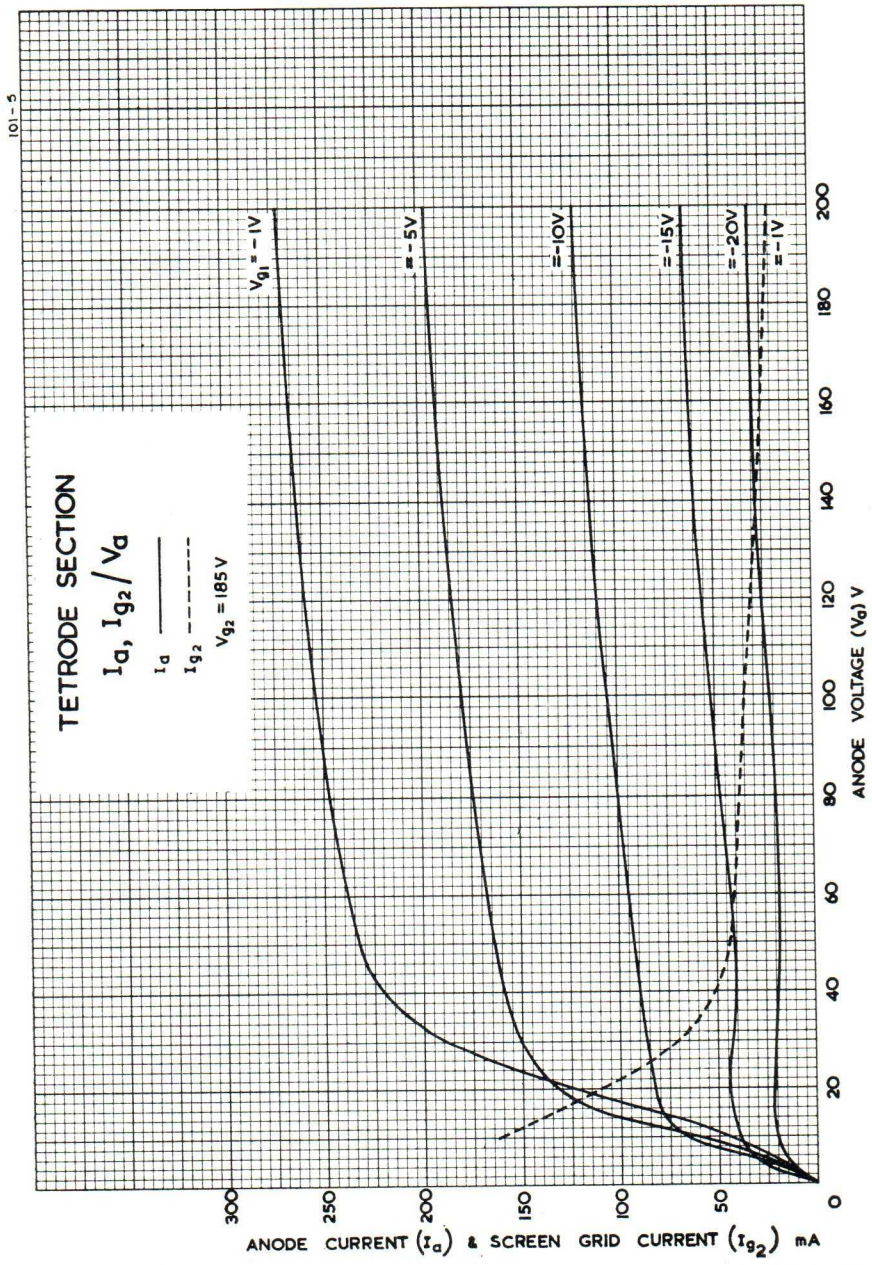
	V_a (V)	V_{g_2} (V)	V_{g_1} (V)	I_a (mA)
Average New Valve	55	170	−1	210
Assumed End of Life Condition	50	170	−1	135
Average New Valve	55	185	−1	235
Assumed End of Life Condition	50	185	−1	151

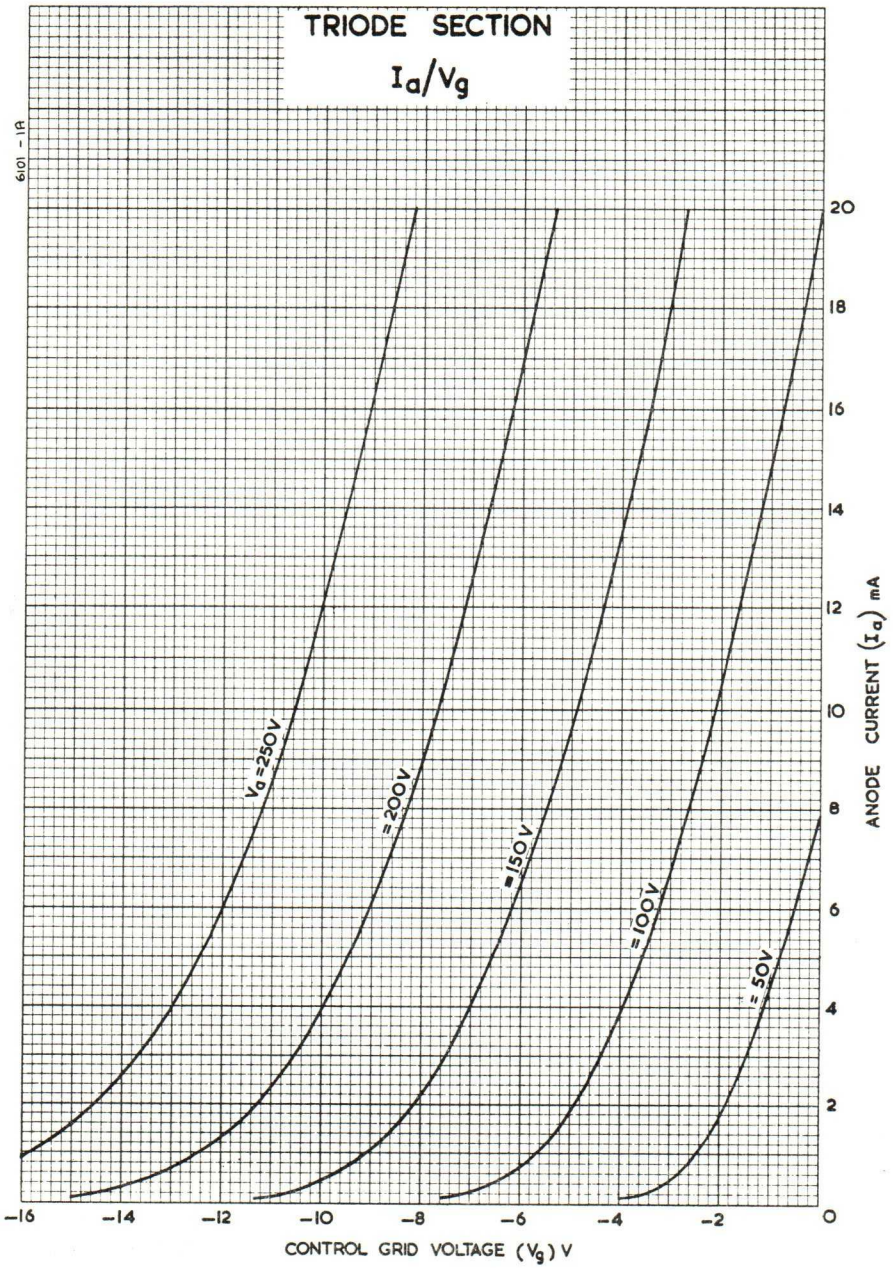
MOUNTING POSITION—Unrestricted

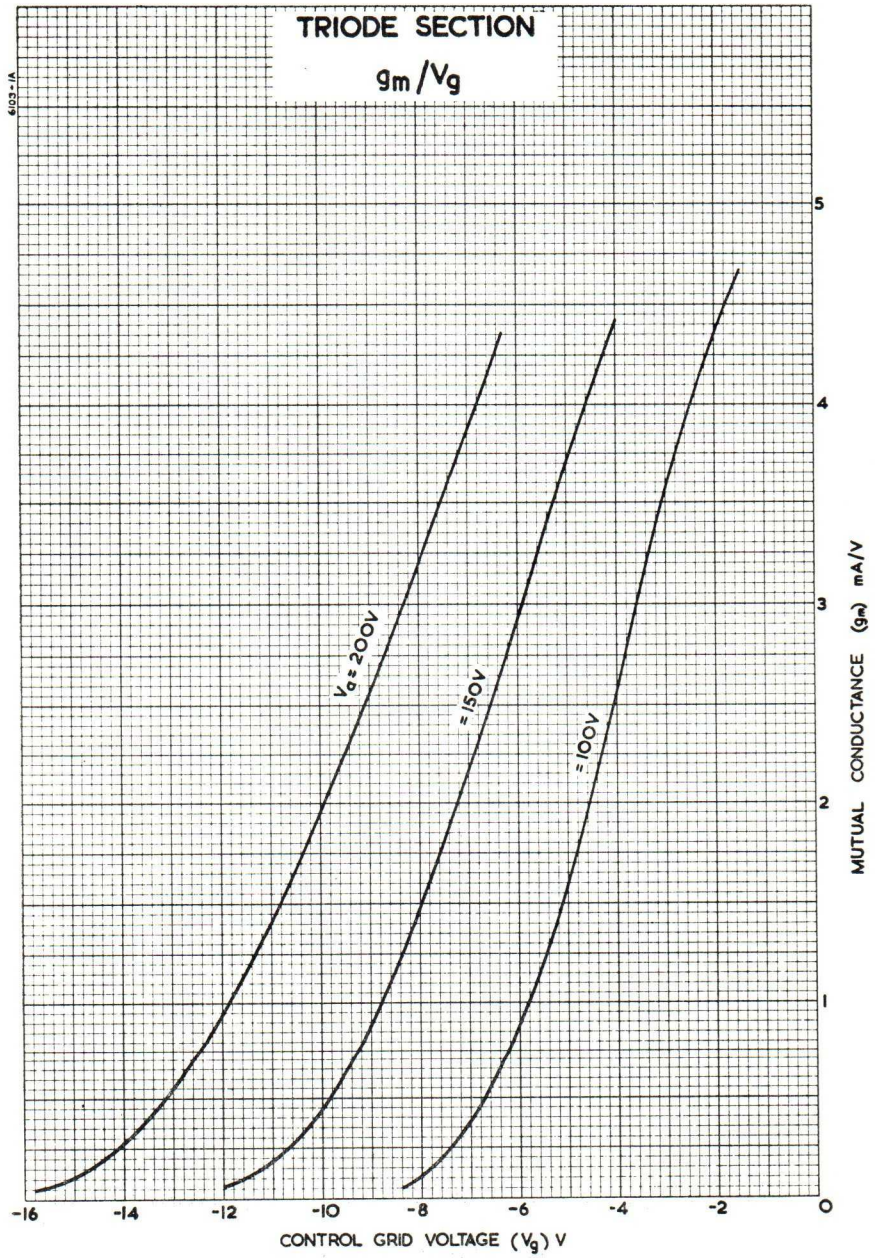
Indicates a change ←

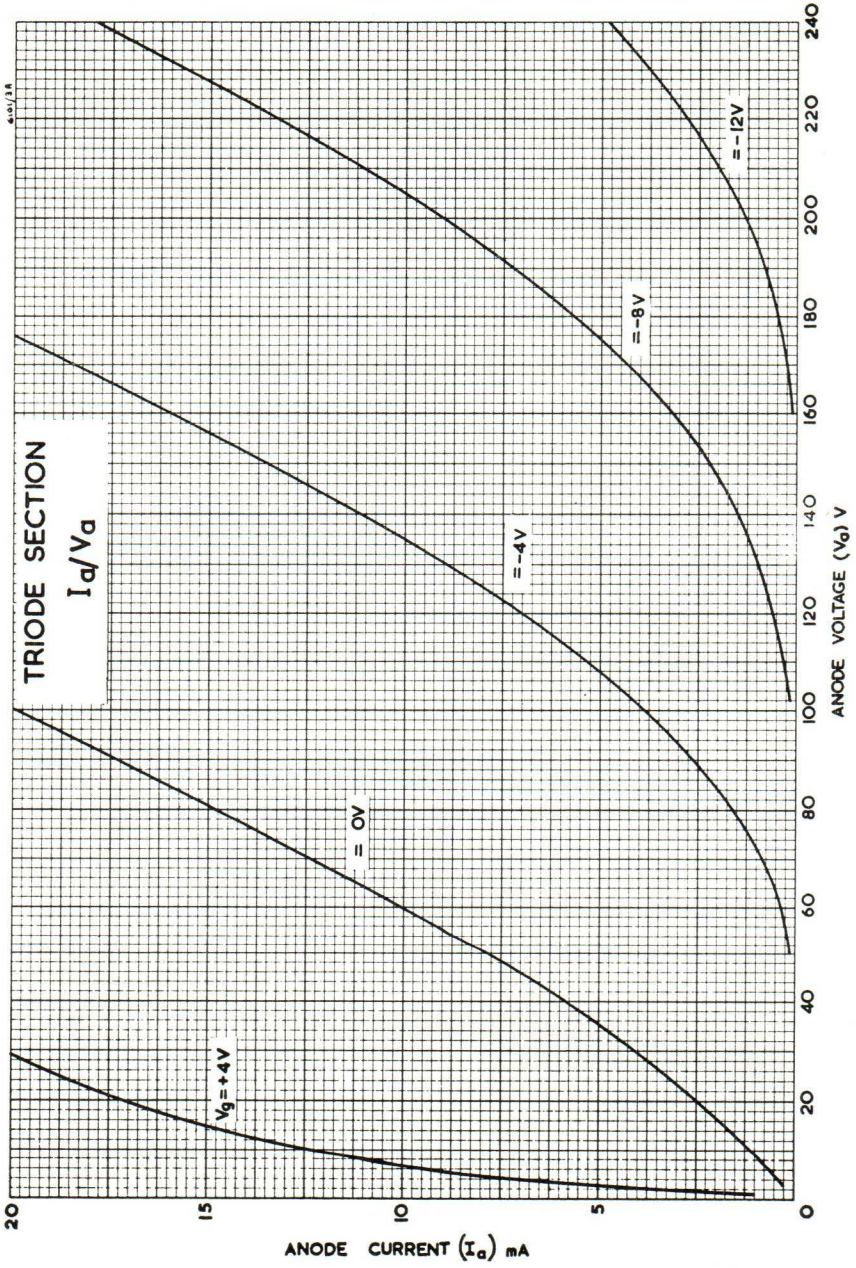

TETRODE SECTION
$I_a, I_{g_2} / V_{g_1}$
I_a
I_{g_2}
$V_a = V_{g_2} = 200V$
= 170V
= 150V
= 100V
$V_a = V_{g_2} = 200V$
= 170V
= 150V
= 100V
200
180
160
140
120
100
80
60
40
20
0
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
−40
−35
−30
−25
−20
−15
−10
−5
CONTROL GRID VOLTAGE (V_{g_1}) V

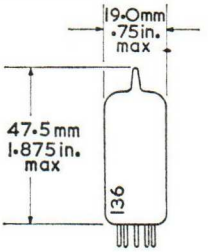

TETRODE SECTION
$I_a, I_{g_2} / V_a$
I_a
I_{g_2}
V_{g_2} = 170V
V_{g_1} = -1.0V
= -5V
= -10V
= -15V
= -20V
= -1.0V
ANODE VOLTAGE (V_a) V
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA


101-5
TETRODE SECTION
$I_a, I_{g_2} / V_a$
I_a
I_{g_2}
$V_{g_2} = 185$ V
$V_{g_1} = -1$V
$= -5$V
$= -10$V
$= -15$V
$= -20$V
$= -1$V
ANODE VOLTAGE (V_a) V
0 20 40 60 80 100 120 140 160 180 200
300 250 200 150 100 50 0
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA

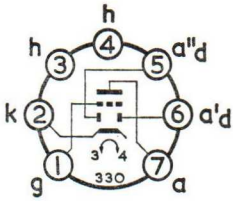

TRIODE SECTION
Ia/Vg
6101 - 1A
Vg=250V
=200V
=150V
=100V
=50V
20
18
16
14
12
10
8
6
4
2
0
ANODE CURRENT (Ia) mA
-16
-14
-12
-10
-8
-6
-4
-2
CONTROL GRID VOLTAGE (Vg) V


TRIODE SECTION
gm/Vg
6103-1A
Vg = 200V
= 150V
= 100V
5
4
3
2
1
0
-16
-14
-12
-10
-8
-6
-4
-2
CONTROL GRID VOLTAGE (Vg) V
MUTUAL CONDUCTANCE (gm) mA/V


TRIODE SECTION
I_a/V_a
V_g=+4V
= 0V
=-4V
=-8V
=-12V
ANODE CURRENT (I_a) mA
ANODE VOLTAGE (V_a) V
20
15
10
5
0
20
40
60
80
100
120
140
160
180
200
220
240



DOUBLE DIODE A.F. TRIODE



B7G Base

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·3	A

RATINGS

Maximum Triode Anode Voltage	$V_{a(max)}$	300	V
Maximum Diode Anode Current	$I_{a(d)max}$	1·0	mA

INTER-ELECTRODE CAPACITANCES*

Grid to Cathode	c_{g-k}	2·3	pF
Anode to Cathode	c_{a-k}	1·1	pF
Grid to Anode	c_{g-a}	2·1	pF
Anode" Diode to Grid	$c_{a"d-g}$	<0·025	pF

* Measured without an external shield.

OPERATING CHARACTERISTICS

Anode Voltage	V_a	250	V
Grid Voltage	V_g	−3·0	V
Anode Current	I_a	1·0	mA
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	58	kΩ
Mutual Conductance	g_m	1·2	mA/V
Amplification Factor	μ	70	

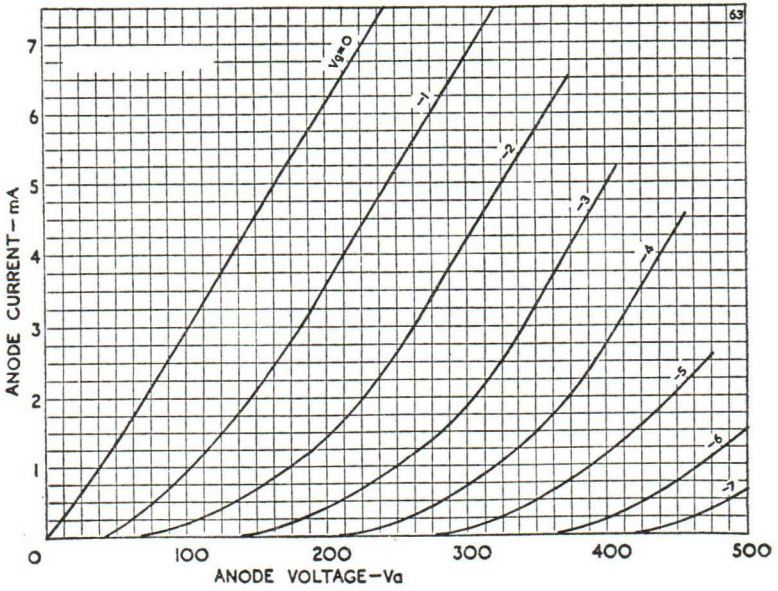
TYPICAL OPERATION—As a resistance coupled amplifier

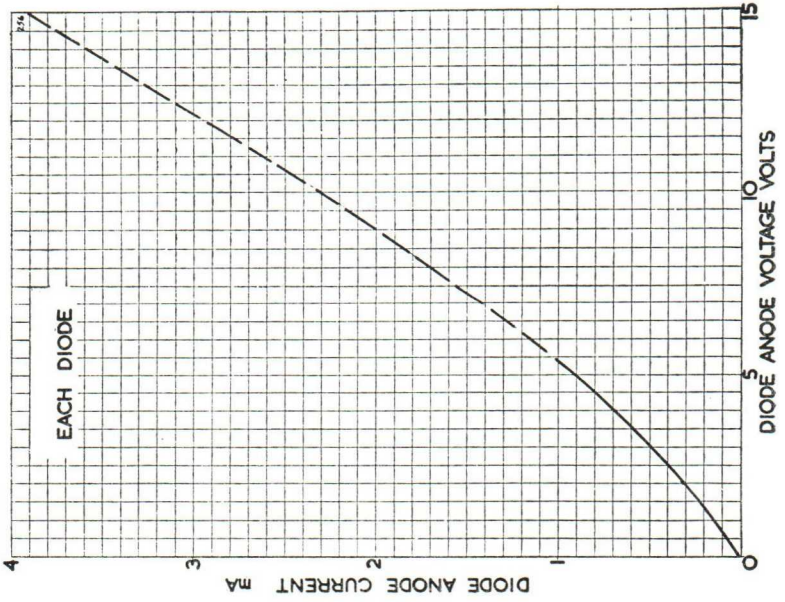
Anode Supply Voltage	$V_{a(b)}$	100	250	250	V
Anode Load Resistor	R_L	500	250	250	kΩ
Grid Resistor	R_g	1·0	1·0	1·0	MΩ
Cathode Bias Resistor	R_k	9·0	3·0	0	kΩ
Peak Output Voltage	$v_{out(pk)}$	16	43	40	V
Stage Gain†		33	42	42	
Harmonic Distortion†	D	2·0	1·0	5·0	%

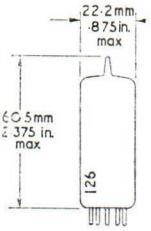
† For $v_{out(pk)}$ = 12 V.

Type EBC90 is a commercial equivalent to the CV452.

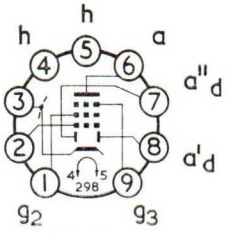
THORN—AEI RADIO VALVES & TUBES LTD.


63
ANODE CURRENT – mA
ANODE VOLTAGE – Va
Vg=0
-1
-2
-3
-4
-5
-6
-7
0
100
200
300
400
500
1
2
3
4
5
6
7


EACH DIODE
DIODE ANODE CURRENT mA
DIODE ANODE VOLTAGE VOLTS
0
1
2
3
4
5
10
15



DOUBLE DIODE VARIABLE-MU H.F. PENTODE



B9A Base

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·3	A

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	1·5	W
Maximum Screen Grid Dissipation	$P_{g_2(max)}$	0·3	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	500	V
Maximum Anode Voltage	$V_{a(max)}$	300	V
Maximum Screen Grid Supply Voltage	$V_{g_2(b)max}$	500	V
Maximum Screen Grid Voltage	$V_{g_2(max)}$	300	V
Maximum Heater to Cathode Voltage	$V_{h\text{-}k(max)}$	100	V
Maximum Cathode Current	$I_{k(max)}$	10	mA
Maximum Diode Anode Current	$I_{a(d)max}$	0·8	mA

INTER-ELECTRODE CAPACITANCES*

Pentode Input	$C_{in(p)}$	4·2	pF
Pentode Output	$C_{out(p)}$	4·9	pF
Control Grid to Pentode Anode	$C_{g_1\text{-}ap}$	<0·0025	pF
Anode′ Diode to Cathode	$C_{a'd\text{-}k}$	2·2	pF
Anode″ Diode to Cathode	$C_{a''d\text{-}k}$	2·35	pF
Anode′ Diode to Control Grid	$C_{a'd\text{-}g_1}$	<0·0008	pF
Anode″ Diode to Control Grid	$C_{a''d\text{-}g_1}$	<0·001	pF

* Measured without an external shield.

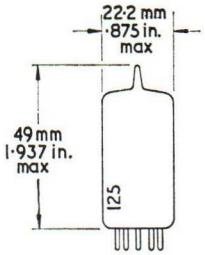
CHARACTERISTICS

Anode Voltage	V_a	250	V
Screen Grid Voltage	V_{g_2}	85	V
Control Grid Voltage	V_{g_1}	−2·0	V
Anode Current	I_a	5·0	mA
Screen Grid Current	I_{g_2}	1·75	mA
Mutual Conductance	g_m	2·2	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	1·5	MΩ
Inner Amplification Factor	$\mu_{g_1\text{-}g_2}$	18	

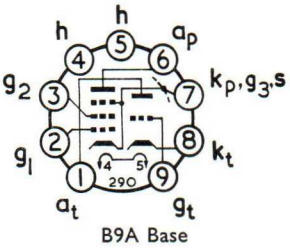
TYPICAL OPERATION—As a Resistance Coupled A.F. Amplifier

Anode Supply Voltage	$V_{a(b)}$	250	250	250	250	V
Screen Grid Supply Voltage	$V_{g_2(b)}$	250	250	250	250	V
Anode Resistor	R_a	220	100	220	100	kΩ
Series Screen Grid Resistor	R_{g_2}	680	270	680	270	kΩ
Control Grid Resistor	R_{g_1}	1·0	1·0	10	10	MΩ
Control Grid Resistor of following stage		680	330	680	330	kΩ
Cathode Bias Resistor	R_k	1200	560	0	0	Ω
Stage Gain		150	100	185	125	

THORN — AEI RADIO VALVES & TUBES LTD.



V.H.F.
TRIODE PENTODE



B9A Base

GENERAL

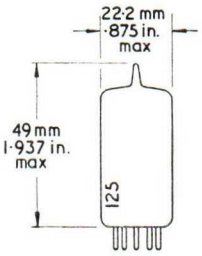
This triode pentode is intended for use as a frequency changer in television receivers up to 220 MHz.

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·43	A

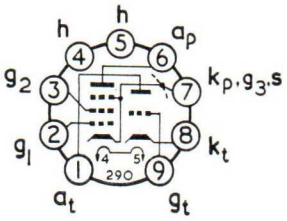
RATINGS

		Triode	Pentode	
Maximum Heater to Cathode Voltage	$V_{h\text{-}k(max)}$			
Heater Positive		100	100	V
Heater Negative		150	150	V

For all other data and curves please see 30C1/PCF80.



TRIODE PENTODE V.H.F. FREQUENCY CHANGER



B9A Base

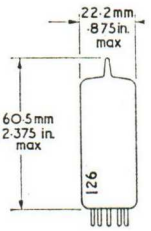
GENERAL

This triode pentode is intended for use as a frequency changer in V.H.F. television receivers.

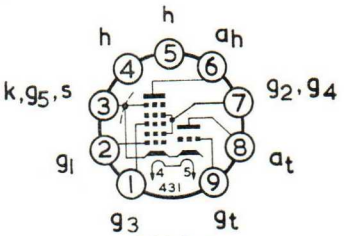
Heater Voltage	V_h	6·3	V (Nominal)
Heater Current	I_h	0·45	A

For all other data and curves please see PCF82.

THORN—AEI RADIO VALVES & TUBES LTD.



TRIODE
HEPTODE



B9A Base

GENERAL

This triode heptode is intended for use as a noise cancelled synchronising pulse separator and time base oscillator.

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·3	A

RATINGS

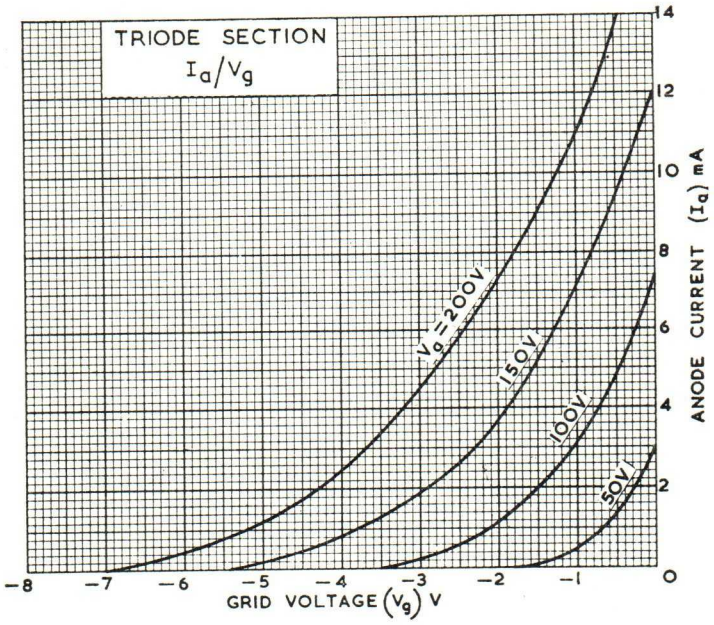
		Triode	Heptode	
Maximum Anode Dissipation	$P_{a(max)}$	1·3	1·7	W
Maximum Screen Grids Dissipation	$P_{g_2+g_4(max)}$	—	0·8	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	550	V
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Screen Grids Supply Voltage	$V_{g_2+g_4(b)max}$	—	550	V
Maximum Screen Grids Voltage	$V_{g_2+g_4(max)}$	—	250	V
Minimum Screen Grids Voltage	$V_{g_2+g_4(min)}$	—	10	V
Maximum Peak Negative Control Grid Voltage	$-V_{g_1(pk)max}$	200	150	V
Maximum Peak Negative Grid 3 Voltage	$-V_{g_3(pk)max}$	—	150	V
Maximum Cathode Current	$I_{k(max)}$	10	12·5	mA
Maximum Control Grid to Cathode Resistance	$R_{g_1\text{-}k(max)}$	3·0	3·0	MΩ
Maximum Grid 3 to Cathode Resistance	$R_{g_3\text{-}k(max)}$	—	3·0	MΩ
Maximum Heater to Cathode Voltage	$V_{h\text{-}k(max)}$	—	100	V

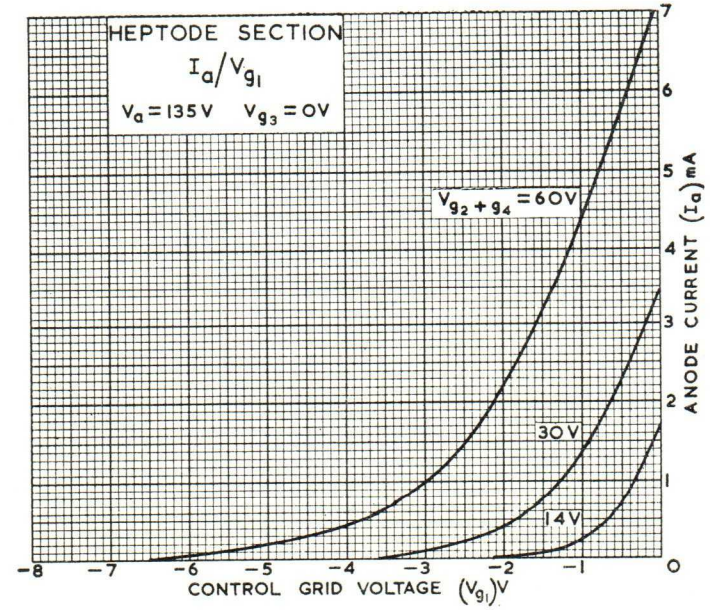
INTER-ELECTRODE CAPACITANCES

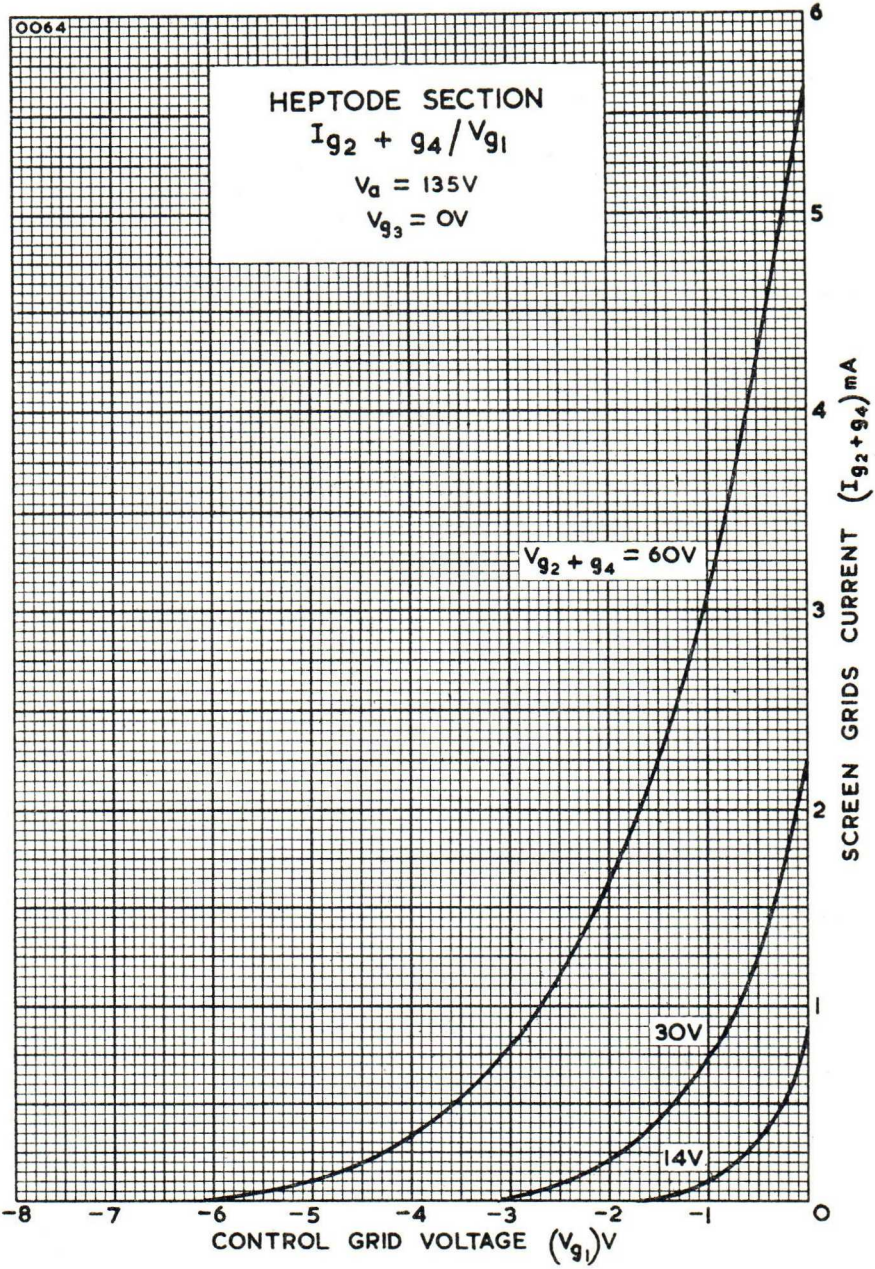
Anode Heptode to Anode Triode	$c_{ah\text{-}at}$	<0·25	pF
Anode Heptode to Grid Triode	$c_{ah\text{-}gt}$	<0·09	pF
Grid 1 to Anode Triode	$c_{g_1\text{-}at}$	<0·08	pF
Grid 1 to Grid Triode	$c_{g_1\text{-}gt}$	<0·10	pF
Grid 3 to Anode Triode	$c_{g_3\text{-}at}$	<0·13	pF
Anode Heptode to Grid 1	$c_{ah\text{-}g_1}$	<0·009	pF
Triode Input	$c_{in(t)}$	3·0	pF
Anode Triode to Grid Triode	$c_{at\text{-}gt}$	1·1	pF

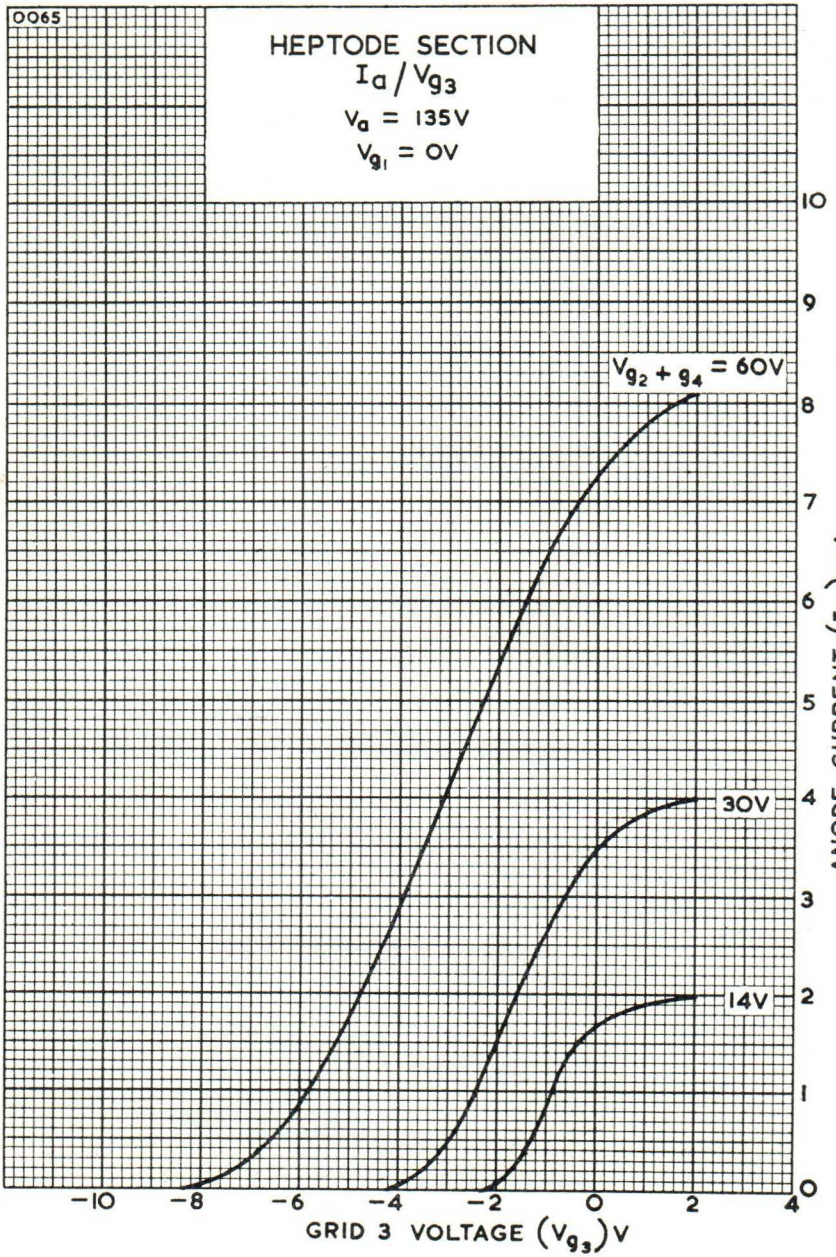
CHARACTERISTICS

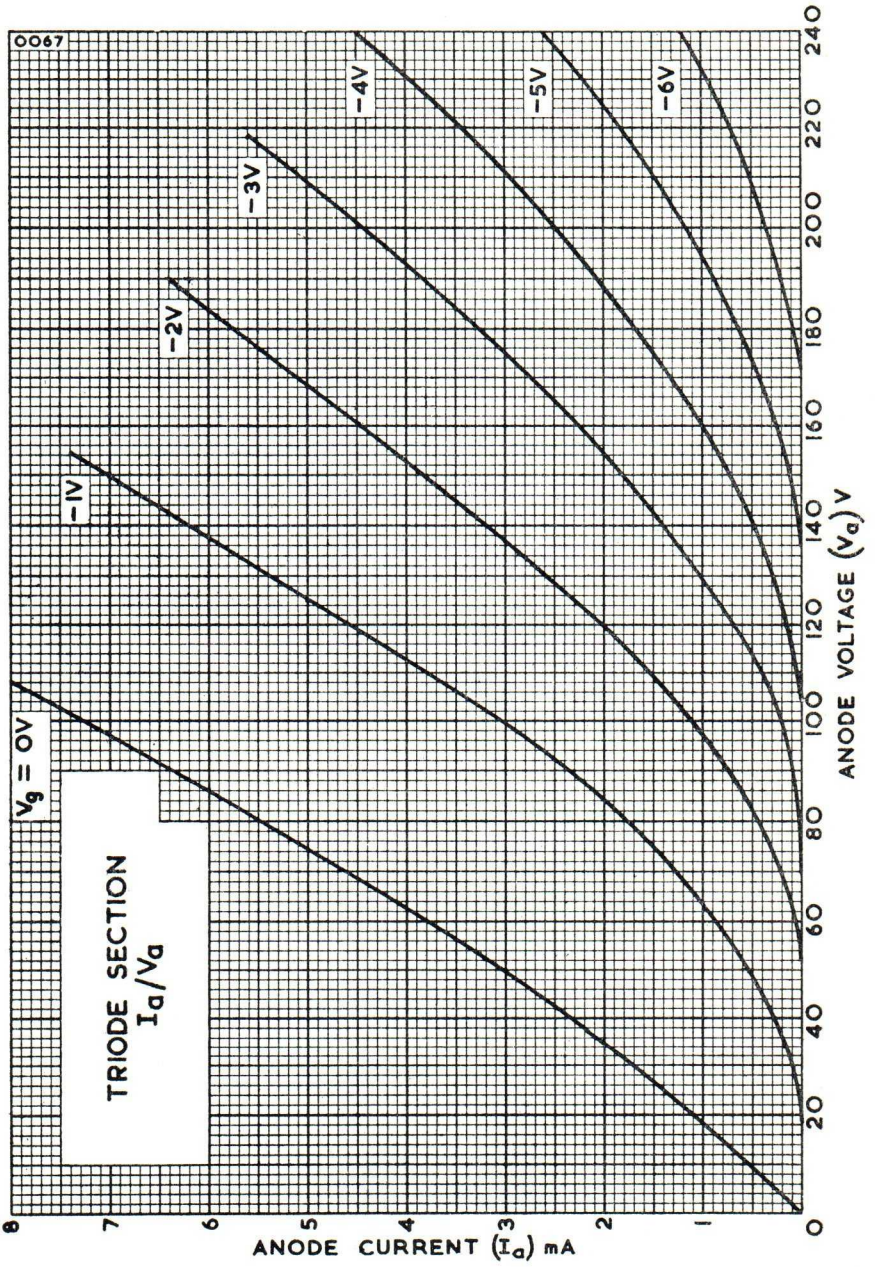
		Triode	Heptode	
Anode Voltage	V_a	50	135	V
Screen Grids Voltage	$V_{g_2+g_4}$	—	14	V
Grid 3 Voltage	V_{g_3}	—	0	V
Control Grid Voltage	V_{g_1}	0	0	V
Anode Current	I_a	3·0	1·7	mA
Screen Grids Current	$I_{g_2+g_4}$	—	0·9	mA
Mutual Conductance	g_m	3·7	2·2	mA/V
Amplification Factor	μ	50	—	
Grid 3 Voltage for $I_a = 20\ \mu A$	V_{g_3}	—	−2·0	V
Control Grid Voltage for $I_a = 20\ \mu A$	V_{g_1}	—	−1·9	V
Anode Current ($V_a = 200$ V, $V_g = -11$ V)	I_a	<100	—	μA
Maximum Negative Grid 3 Voltage ($I_{g_3} = +0{\cdot}3\mu A$)		—	1·3	V
Maximum Negative Grid 1 Voltage ($I_{g_1} = +0{\cdot}3\mu A$)		1·3	1·3	V

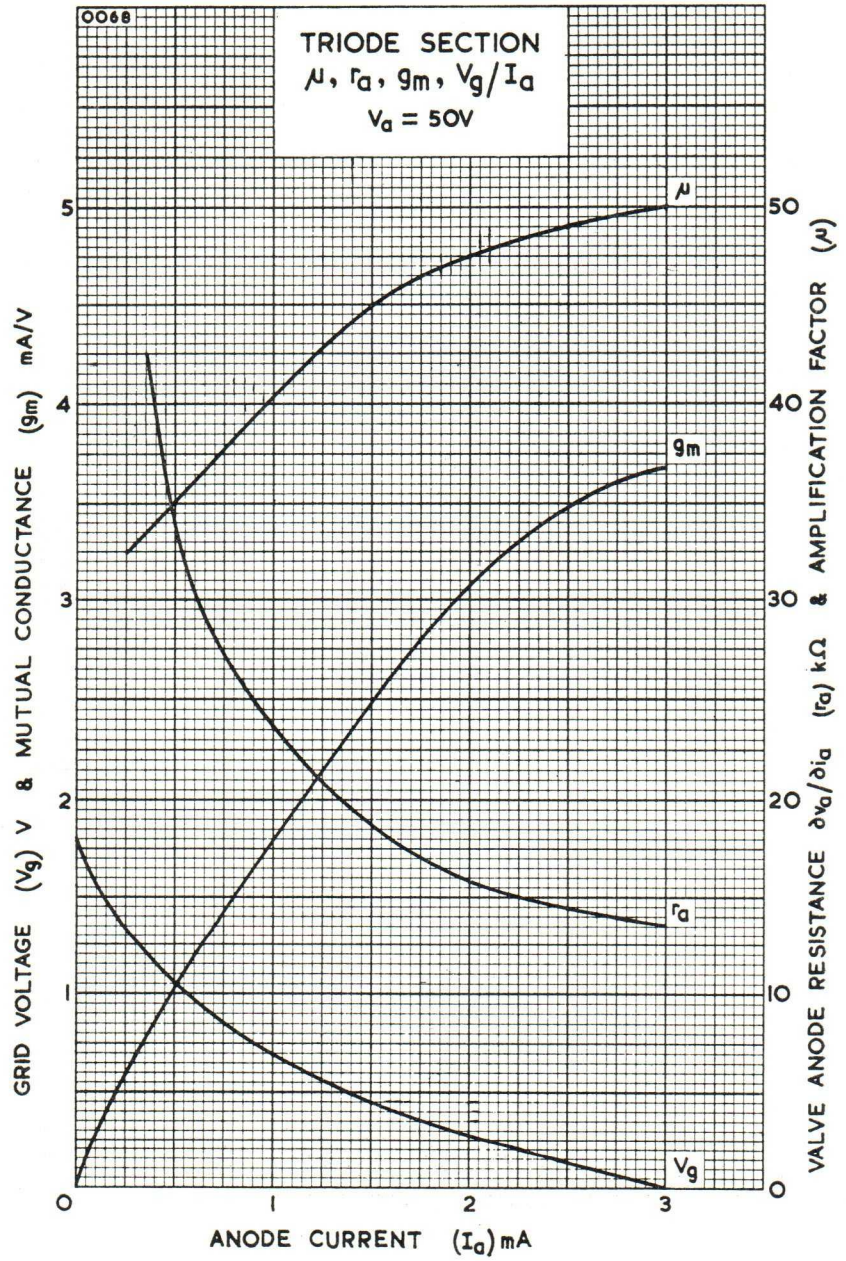

TRIODE SECTION
I_a/V_g
$V_g = 200V$
150V
100V
50V
ANODE CURRENT (I_a) mA
GRID VOLTAGE (V_g) V
14
12
10
8
6
4
2
0
−8
−7
−6
−5
−4
−3
−2
−1

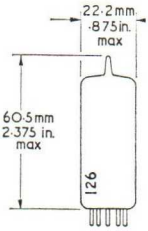

HEPTODE SECTION
I_a/V_{g_1}
$V_a = 135V$ $V_{g_3} = 0V$
$V_{g_2+g_4} = 60V$
30V
14V
ANODE CURRENT (I_a) mA
CONTROL GRID VOLTAGE (V_{g_1}) V
7
6
5
4
3
2
1
0
−8
−7
−6
−5
−4
−3
−2
−1


0064
HEPTODE SECTION
$I_{g2} + g_4 / V_{g1}$
V_a = 135V
V_{g3} = 0V
$V_{g2} + g_4$ = 60V
30V
14V
SCREEN GRIDS CURRENT (I_{g2+g4}) mA
0
1
2
3
4
5
6
−8 −7 −6 −5 −4 −3 −2 −1 0
CONTROL GRID VOLTAGE (V_{g1})V

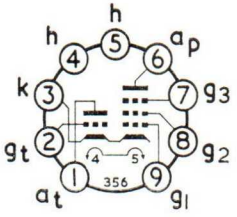

0065
HEPTODE SECTION
I_a / V_{g3}
V_a = 135V
V_{g1} = 0V
V_{g2+g4} = 60V
30V
14V
ANODE CURRENT (I_a) mA
GRID 3 VOLTAGE (V_{g3}) V
10
9
8
7
6
5
4
3
2
1
0
−10
−8
−6
−4
−2
0
2
4


0067
−4V
−5V
−6V
−3V
−2V
−1V
V_g = 0V
TRIODE SECTION
I_a/V_a
ANODE VOLTAGE (V_a) V
ANODE CURRENT (I_a) mA
0
20
40
60
80
100
120
140
160
180
200
220
240
8
7
6
5
4
3
2
1


0068
TRIODE SECTION
μ, ra, gm, Vg/Ia
Va = 50V
μ
gm
ra
Vg
GRID VOLTAGE (Vg) V & MUTUAL CONDUCTANCE (gm) mA/V
VALVE ANODE RESISTANCE ∂va/∂ia (ra) kΩ & AMPLIFICATION FACTOR (μ)
ANODE CURRENT (Ia) mA
0
1
2
3
4
5
10
20
30
40
50



A.F. TRIODE PENTODE



B9A Base

GENERAL

This triode pentode is for use in the field time base and audio circuits of television receivers.

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·3	A

RATINGS

		Triode	Pentode	
Maximum Anode Dissipation	$P_{a(max)}$	1·0	3·5	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	—	1·2	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	550	V
Maximum Peak Anode Voltage	$v_{a(pk)max}$	—	1·2*	kV
Maximum Anode Voltage	$V_{a(max)}$	200	400	V
Maximum Screen Grid Supply Voltage	$V_{g2(b)max}$	—	550	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	—	250	V
Maximum Cathode Current	$I_{k(max)}$	8·0	25	mA
Maximum Peak Cathode Current	$i_{k(pk)max}$	200*	350*	mA
Maximum Grid Resistance	$R_{g(max)}$			
I_{kp} = 12 mA, Field Output Stage		3·0	2·2	MΩ
I_{kp} = 20 mA, Audio Output Stage		—	1·0	MΩ
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$	150		V
Maximum Heater to Cathode Resistance	$R_{h-k(max)}$	20		kΩ

* Maximum pulse duration 10 per cent of one cycle, with a maximum of 2 ms.

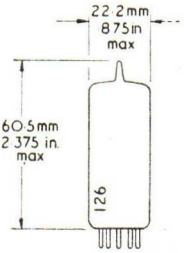
INTER-ELECTRODE CAPACITANCES

		Triode	Pentode	
Anode to Grid	c_{a-g}	0·9	<0·2	pF
Control Grid to Heater	c_{g1-h}	<0·05	<0·25	pF
Triode Grid to Pentode Anode	c_{gt-ap}	<0·12		pF
Triode Anode to Pentode Anode	c_{at-ap}	<1·2		pF
Triode Grid to Pentode Grid 1	c_{gt-g1}	<0·2		pF
Triode Anode to Pentode Grid 1	c_{at-g1}	<0·2		pF
Heater to Cathode	c_{h-k}	3·7		pF
Pentode Input	$c_{in(p)}$	4·5		pF
Pentode Output	$c_{out(p)}$	5·0		pF
Triode Grid to Cathode	c_{gt-k}	2·0		pF
Triode Anode to Cathode	c_{at-k}	0·3		pF

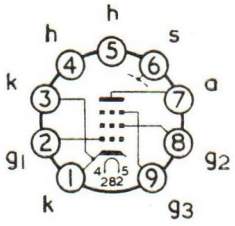
CHARACTERISTICS

		Triode	Pentode		
Anode Voltage	V_a	100	170	200	V
Screen Grid Voltage	V_{g2}	—	170	200	V
Control Grid Voltage	V_{g1}	−2·3	−6·7	−8·0	V
Anode Current	I_a	4·0	15	17·5	mA
Screen Grid Current	I_{g2}	—	2·8	3·3	mA
Mutual Conductance	g_m	1·4	3·2	3·3	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	12·5	150	150	kΩ
Amplification Factor	μ	17·5	—	—	
Inner Amplification Factor	μ_{g1-g2}	—	14	14	

THORN — AEI RADIO VALVES & TUBES LTD.



R.F. PENTODE



B9A Base

GENERAL

This valve is a high slope Pentode for R.F. or I.F. Amplification in television receivers. It is also suitable for use as a video output and synchronising pulse separator.

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·3	A

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	2·5	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	0·7	W
Maximum Anode Voltage	$V_{a(max)}$	300	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	300	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h-k(r.m.s)max}$	150	V
Maximum Cathode Current	$I_{k(max)}$	15	mA
Maximum Resistance Control Grid to Cathode	$R_{g1-k(max)}$		
Fixed Bias		0·5	MΩ
Self Bias		1	MΩ

INTER-ELECTRODE CAPACITANCES

		*	
Input	c_{in}	7·5	pF
Output	c_{out}	3·3	pF
Grid 1 to Anode	c_{g1-a}	<0·007	pF
Grid 1 to Grid 2	c_{g1-g2}	2·6	pF
Grid 2 to all	c_{g2-all}	5·4	pF
Anode to Cathode	c_{a-k}	<0·01	pF
Grid 1 to Heater	c_{g1-h}	<0·15	pF

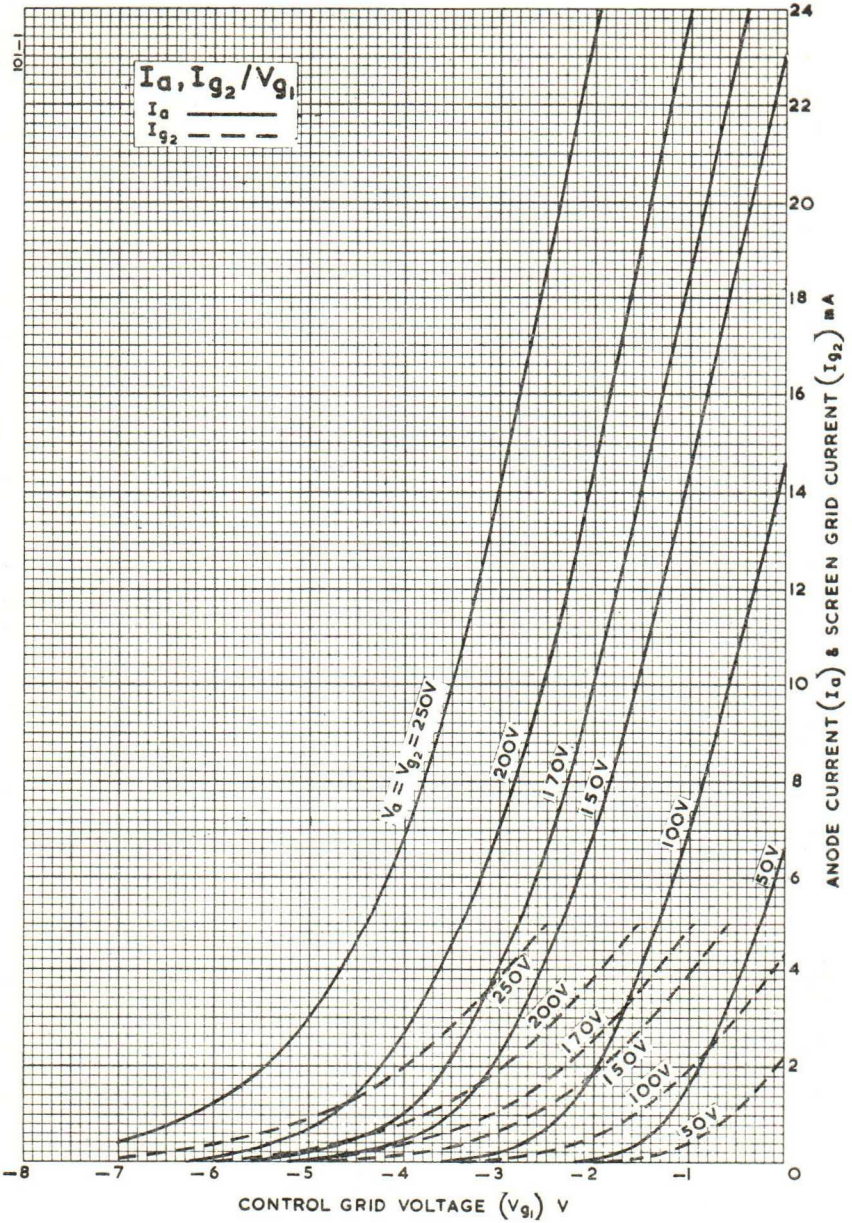
* In fully-shielded socket without can (I.E.C. Publication 100).

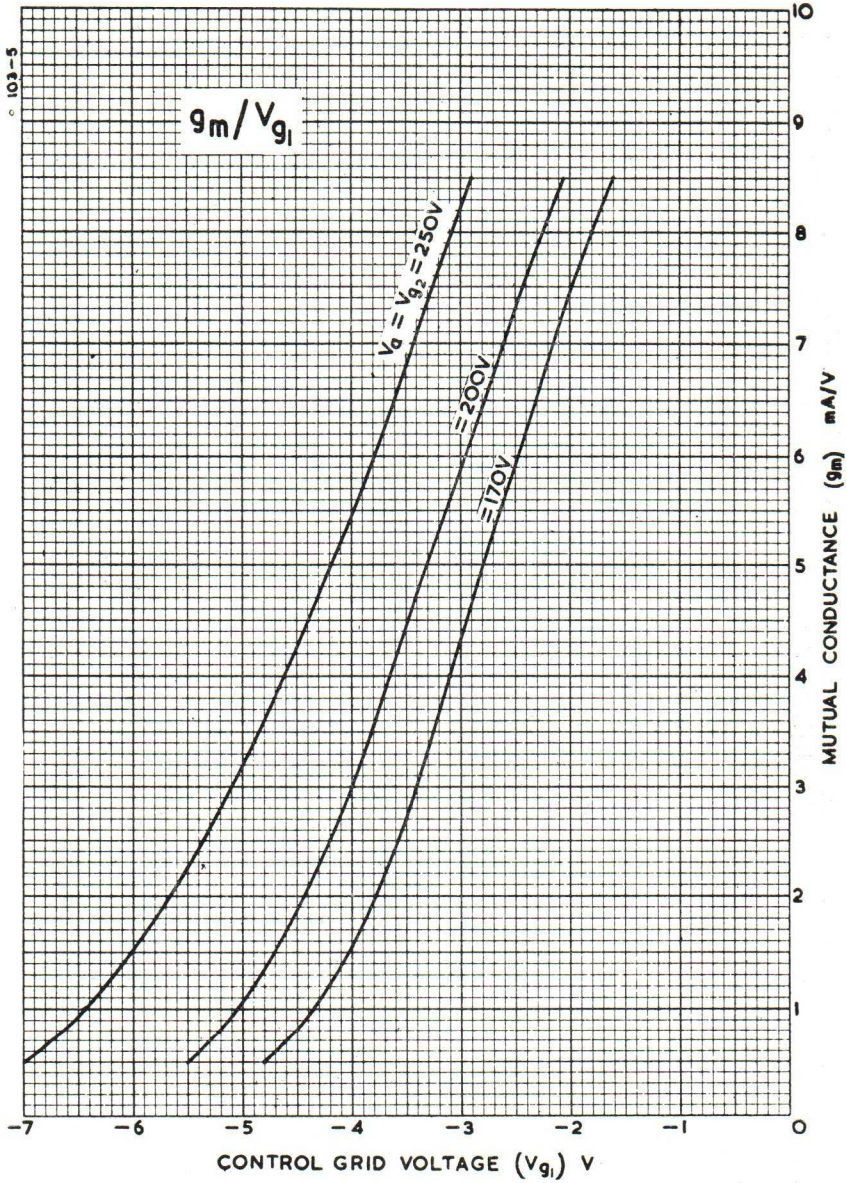
CHARACTERISTICS

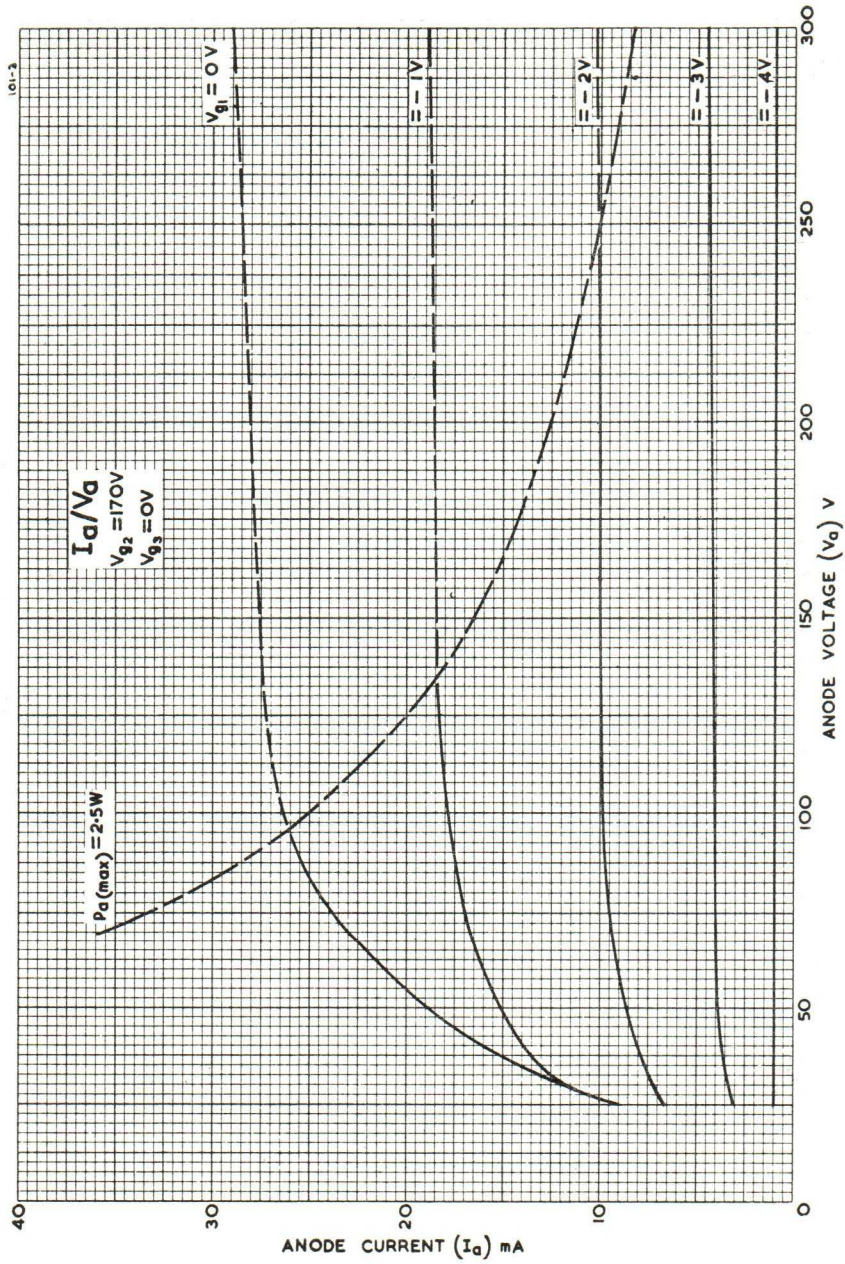
Anode Voltage	V_a	170	200	250	V
Screen Grid Voltage	V_{g2}	170	200	250	V
Anode Current	I_a	10	10	10	mA
Screen Grid Current	I_{g2}	2·5	2·6	2·8	mA
Mutual Conductance	g_m	7·4	7·1	6·8	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	0·5	0·55	0·65	MΩ
Inner Amplification Factor	μ_{g1-g2}	50	50	50	
Input Resistance at 50 Mc/s	$r_{in(50Mc/s)}$	10	12	15	kΩ

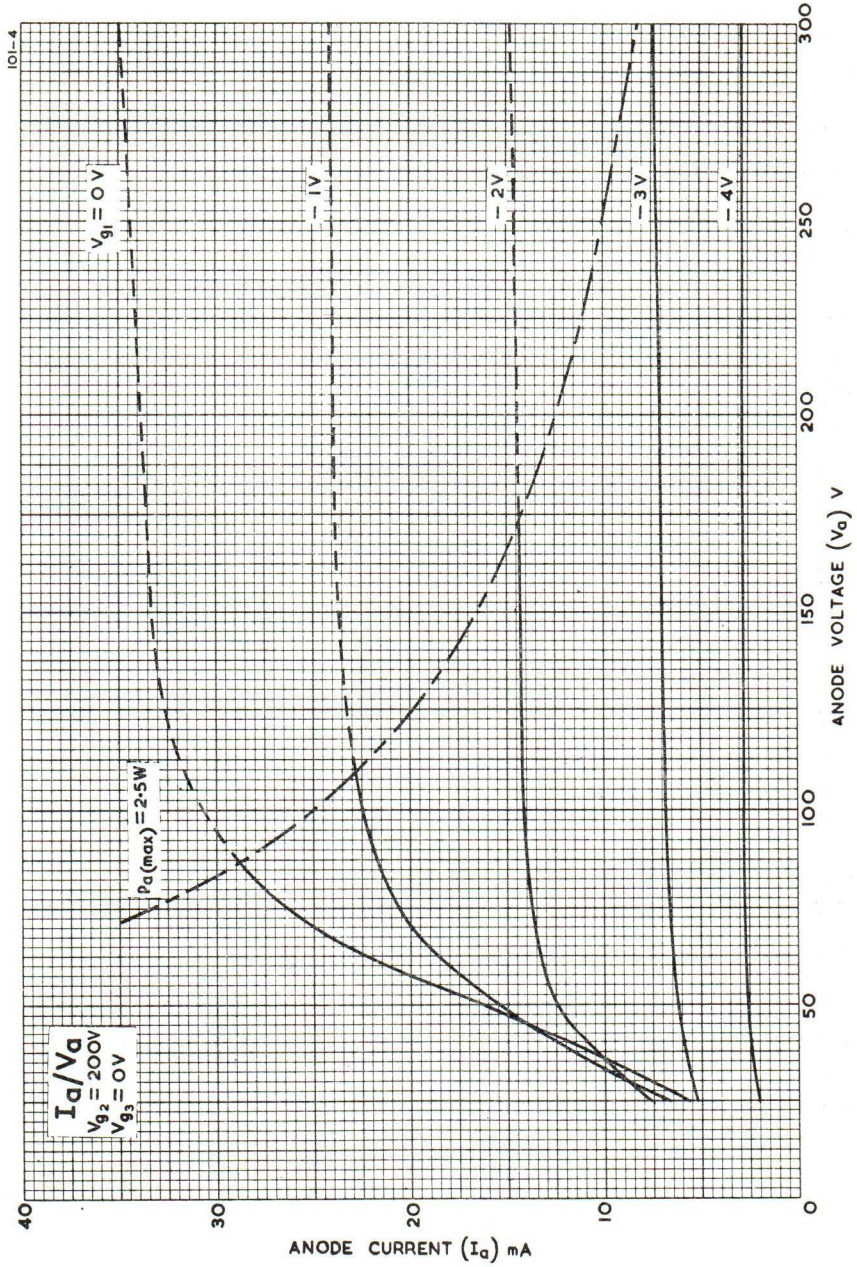
MOUNTING POSITION—Unrestricted

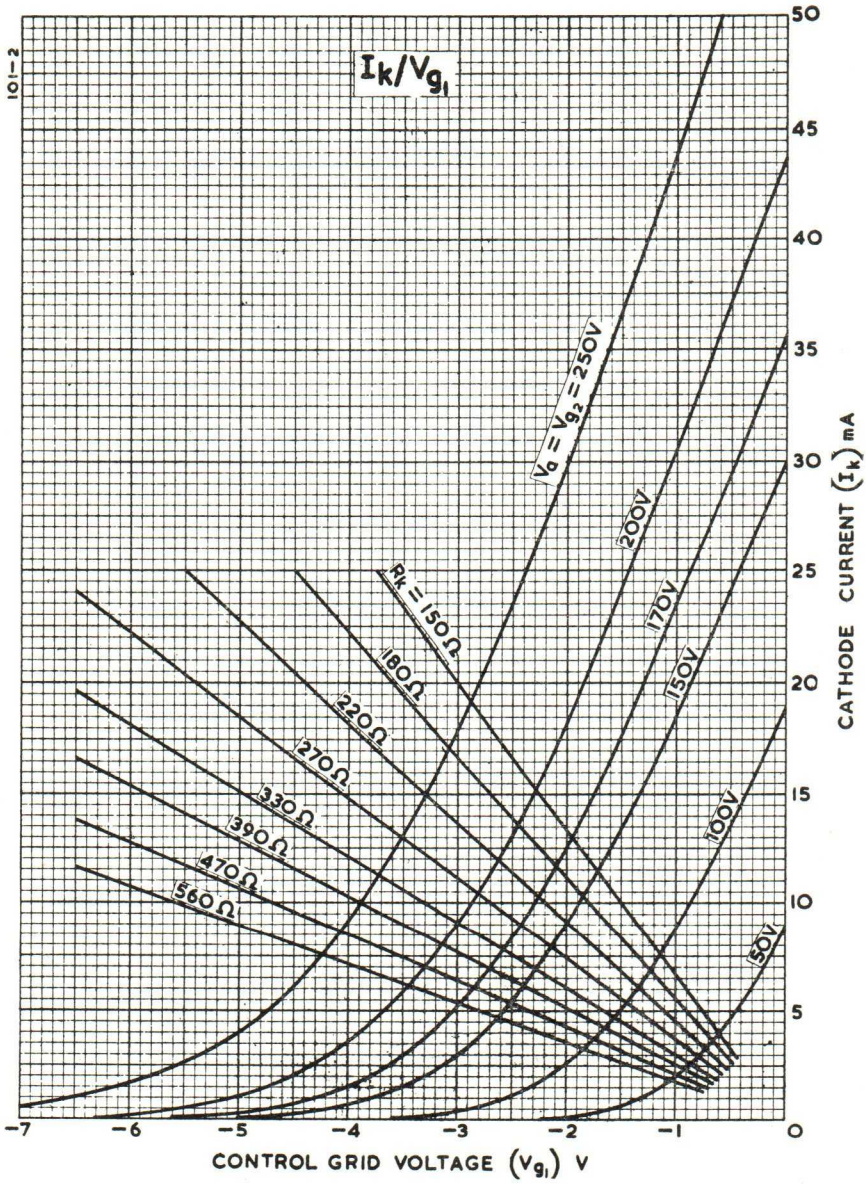
THORN — A E I RADIO VALVES & TUBES LTD.

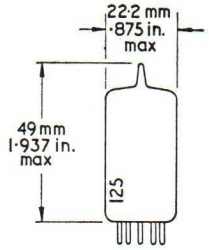

$I_a, I_{g_2}/V_{g_1}$
I_a
I_{g_2}
$V_a = V_{g_2} = 250V$
200V
170V
150V
100V
50V
250V
200V
170V
150V
100V
50V
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
CONTROL GRID VOLTAGE (V_{g_1}) V
24
22
20
18
16
14
12
10
8
6
4
2
0
−8
−7
−6
−5
−4
−3
−2
−1


103-5
g_m / V_{g_1}
$V_a = V_{g_2} = 250V$
$= 200V$
$= 170V$
MUTUAL CONDUCTANCE (g_m) mA/V
CONTROL GRID VOLTAGE (V_{g_1}) V
10
9
8
7
6
5
4
3
2
1
0
−7
−6
−5
−4
−3
−2
−1

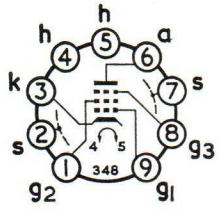

101-3
I_a/V_a
V_{g_2} =170V
V_{g_3} =0V
V_{g_1} = 0 V
= − 1V
= − 2V
= − 3V
= − 4V
P_a(max) = 2·5W
ANODE CURRENT (I_a) mA
ANODE VOLTAGE (V_a) V
40
30
20
10
0
50
100
150
200
250
300


101-4
$V_{g1} = 0$ V
− 1V
− 2V
− 3V
− 4V
$P_{a(max)} = 2{\cdot}5$W
Ia/Va
$V_{g2} = 200$V
$V_{g3} = 0$V
300
250
200
150
100
50
0
ANODE VOLTAGE (V_a) V
40
30
20
10
0
ANODE CURRENT (I_a) mA


101-2
I_k/V_{g_1}
$V_a = V_{g_2} = 250V$
200V
175V
150V
100V
50V
R_k = 150Ω
180Ω
220Ω
270Ω
330Ω
390Ω
470Ω
560Ω
50
45
40
35
30
25
20
15
10
5
0
−7
−6
−5
−4
−3
−2
−1
CATHODE CURRENT (I_k) mA
CONTROL GRID VOLTAGE (V_{g_1}) V



LOW NOISE PENTODE



B9A Base

GENERAL

This low noise pentode is particularly suitable for use in the early stages of high gain audio amplifiers, microphone pre-amplifiers and tape recorders.

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·2	A

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	1·0	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	0·2	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	300	V
Maximum Screen Grid Supply Voltage	$V_{g2(b)max}$	550	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	200	V
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$		
Heater Negative		100	V
Heater Positive		50	V
Maximum Cathode Current	$I_{k(max)}$	6·0	mA
Maximum Control Grid to Cathode Resistance	$R_{g1-k(max)}$		
$p_a > 200$ mW		3·0	MΩ
$p_a < 200$ mW		10	MΩ

INTER-ELECTRODE CAPACITANCES*

Input	c_{in}	3·8	pF
Output	c_{out}	5·1	pF
Anode to Grid 1	c_{a-g1}	<0·05	pF
Grid 1 to Heater	c_{g1-h}	<0·0025	pF

* Measured without an external shield.

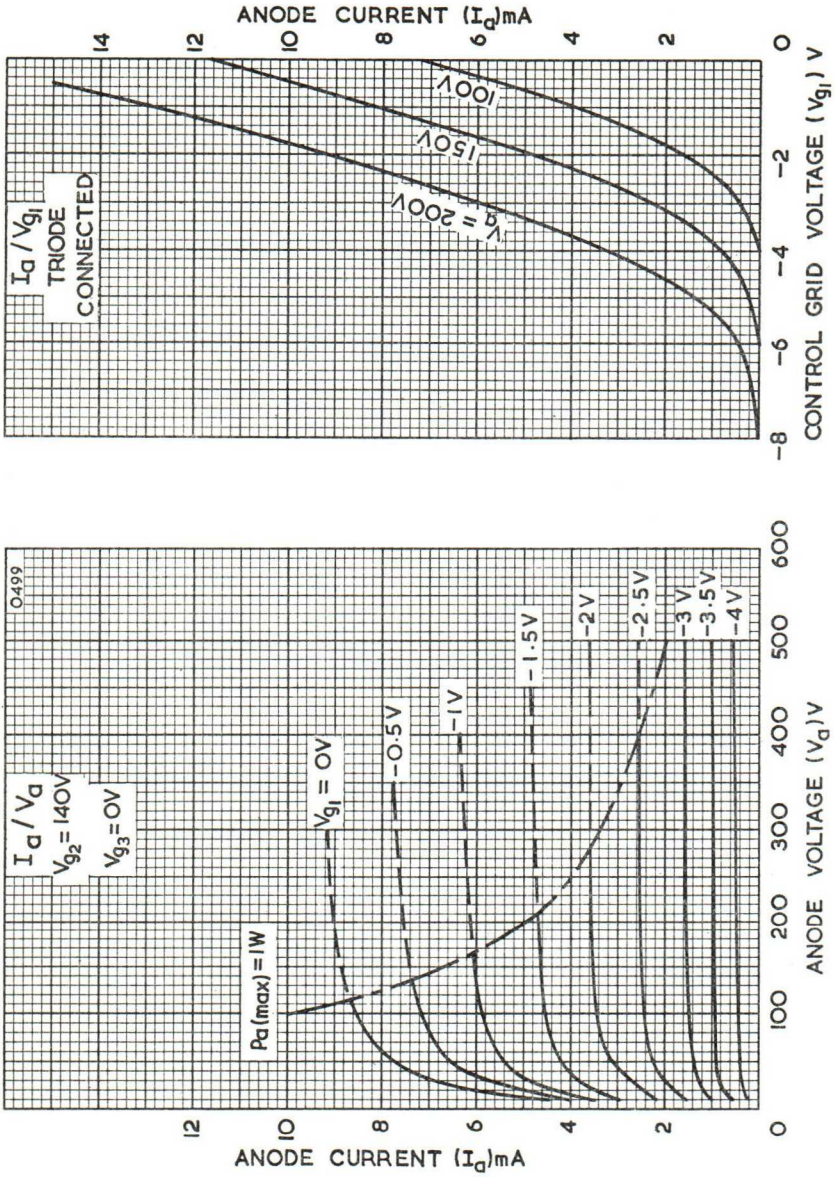
CHARACTERISTICS

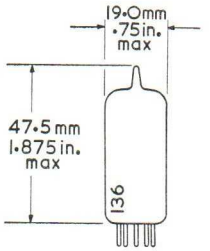
Anode Voltage	V_a	250	V
Screen Grid Voltage	V_{g2}	140	V
Control Grid Voltage	V_{g1}	−2·2	V
Anode Current	I_a	3·0	mA
Screen Grid Current	I_{g2}	0·6	mA
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	2·5	MΩ
Mutual Conductance	g_m	2·2	mA/V
Inner Amplification Factor	μ_{g1-g2}	38	

TYPICAL OPERATION—As an R.C. coupled A.F. Amplifier

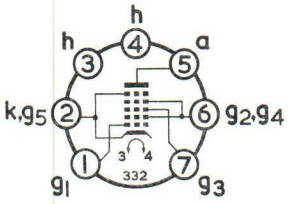
Anode Supply Voltage	$V_{a(b)}$	200	250	300	400	V
Screen Grid Supply Voltage	$V_{g2(b)}$	200	250	300	400	V
Anode Load Resistance	R_a	220	220	220	220	kΩ
Series Screen Grid Resistance	R_{g2}	1·0	1·0	1·0	1·0	MΩ
Cathode Bias Resistance	R_k	2·2	2·2	2·2	2·2	kΩ
Grid Resistor of following stage		680	680	680	680	kΩ
R.M.S. Output Voltage at $D_{tot} = 5\%$	$V_{out(r.m.s.)}$	35	44	53	72	V
Voltage Gain		173	185	194	210	
Cathode Current	I_k	0·75	0·9	1·1	1·45	mA

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ANODE CURRENT (I_a)mA
14
12
10
8
6
4
2
0
I_a / V_{g1}
TRIODE CONNECTED
100V
150V
V_a = 200V
−8
−6
−4
−2
0
CONTROL GRID VOLTAGE (V_{g1}) V
0499
I_a / V_a
V_{g2} = 140V
V_{g3} = 0V
P_a(max) = 1W
V_{g1} = 0V
−0·5V
−1V
−1·5V
−2V
−2·5V
−3V
−3·5V
−4V
0
100
200
300
400
500
600
ANODE VOLTAGE (V_a) V
12
10
8
6
4
2
ANODE CURRENT (I_a)mA



DUAL CONTROL HEPTODE



Base B7G

GENERAL

This valve is a dual control heptode intended for use in television receivers.

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·3	A

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	1·0	W
Maximum Screen Grids Dissipation	$P_{g2+g4(max)}$	1·0	W
Maximum Anode Voltage	$V_{a(max)}$	300	V
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	V
Maximum Screen Grids Voltage	$V_{g2+g4(max)}$	100	V
Maximum Screen Grids Supply Voltage	$V_{g2+g4(b)max}$	300	V
Maximum Cathode Current	$I_{k(max)}$	14	mA
Maximum Control Grid to Cathode Resistance	$R_{g1\text{-}k(max)}$	470	kΩ
Maximum Grid 3 to Cathode Resistance	$R_{g3\text{-}k(max)}$	2·2	MΩ
For $V_{g2+g4} \leqslant 30V$		5·0	MΩ
Maximum Heater to Cathode Voltage,	$V_{h\text{-}k(max)}$		
Cathode Positive		200	V
Cathode Negative		100	V

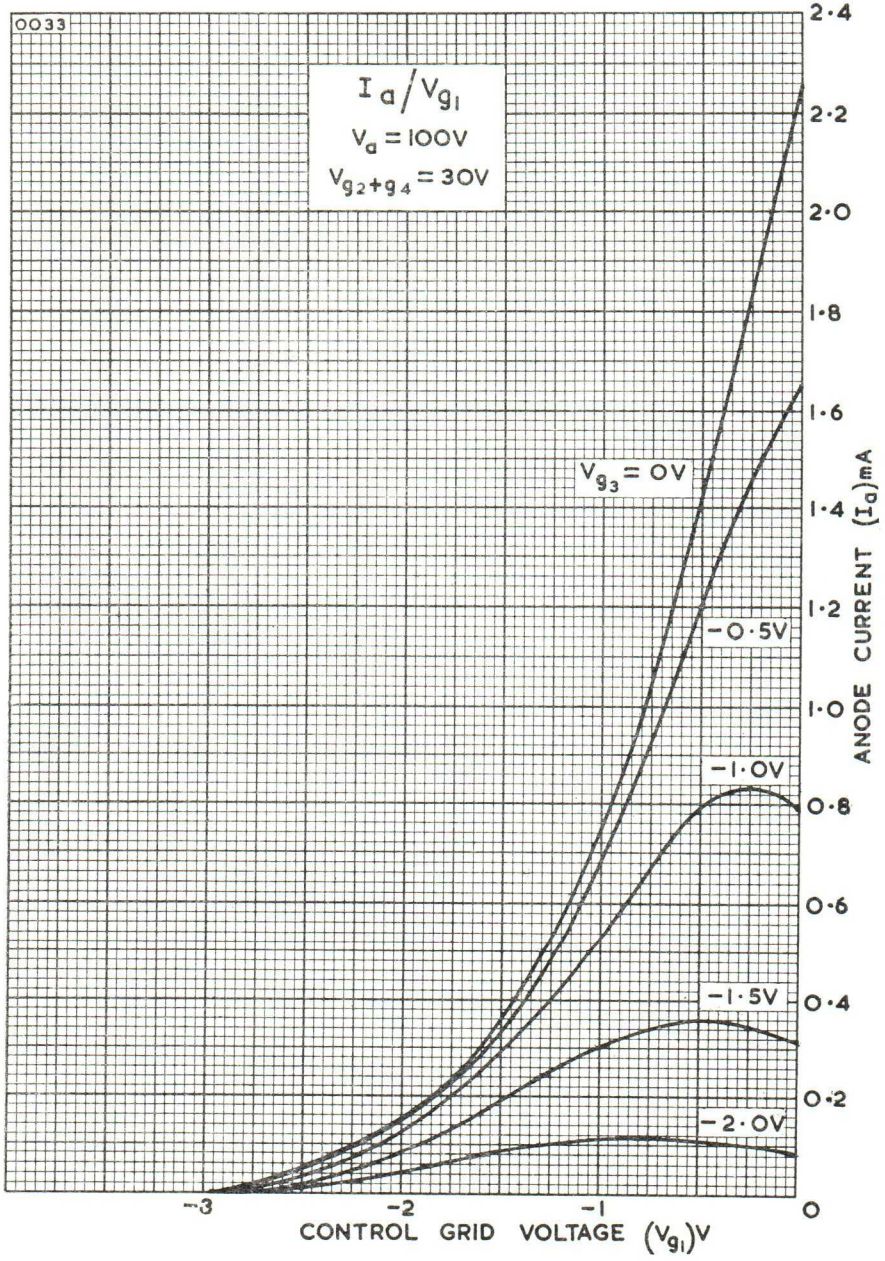
INTER-ELECTRODE CAPACITANCES

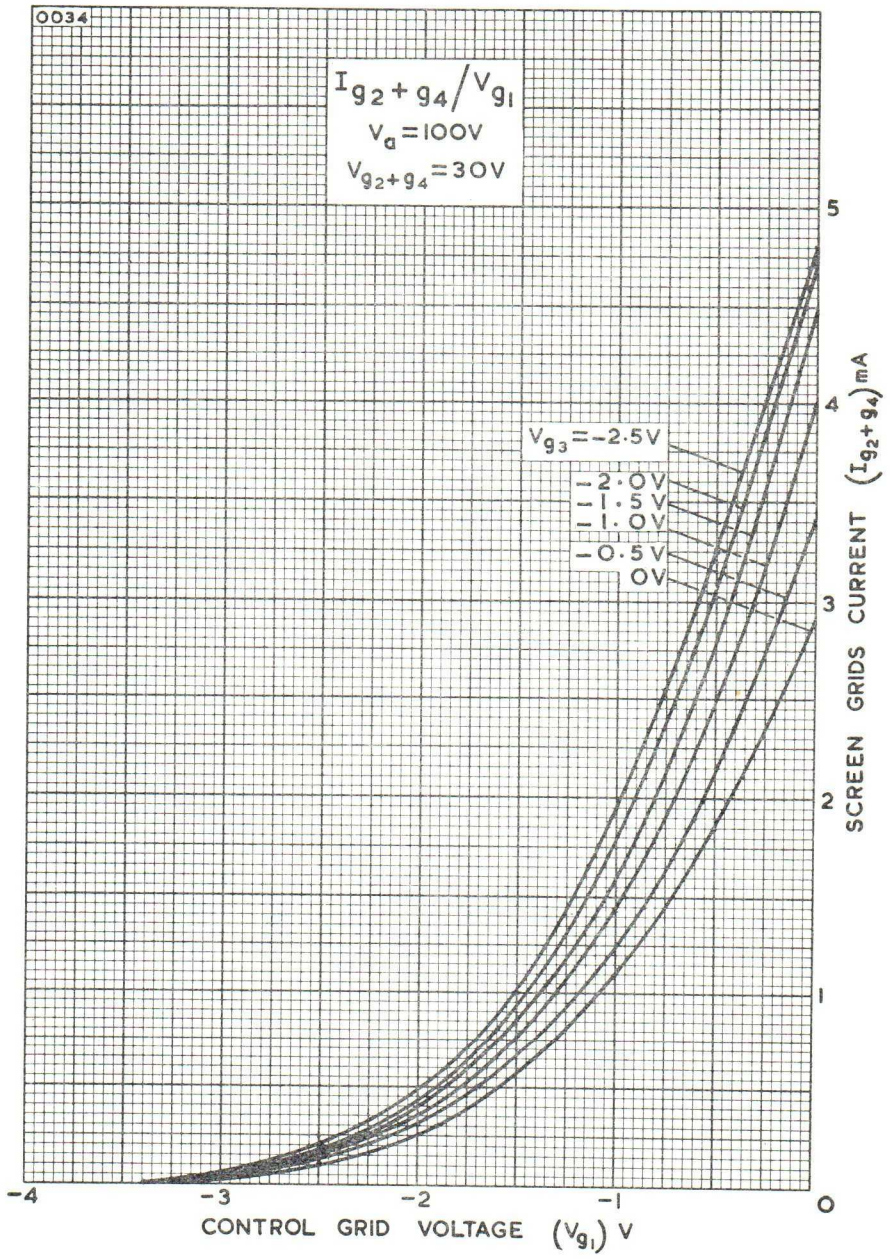
Anode to Grid 1	$C_{a\text{-}g1}$	<0·07	pF
Anode to Grid 3	$C_{a\text{-}g3}$	<0·36	pF
Grid 1 Input	$C_{in(g1)}$	5·5	pF
Grid 3 Input	$C_{in(g3)}$	7·0	pF
Output	C_{out}	7·5	pF
Grid 1 to Grid 3	$C_{g1\text{-}g3}$	<0·22	pF

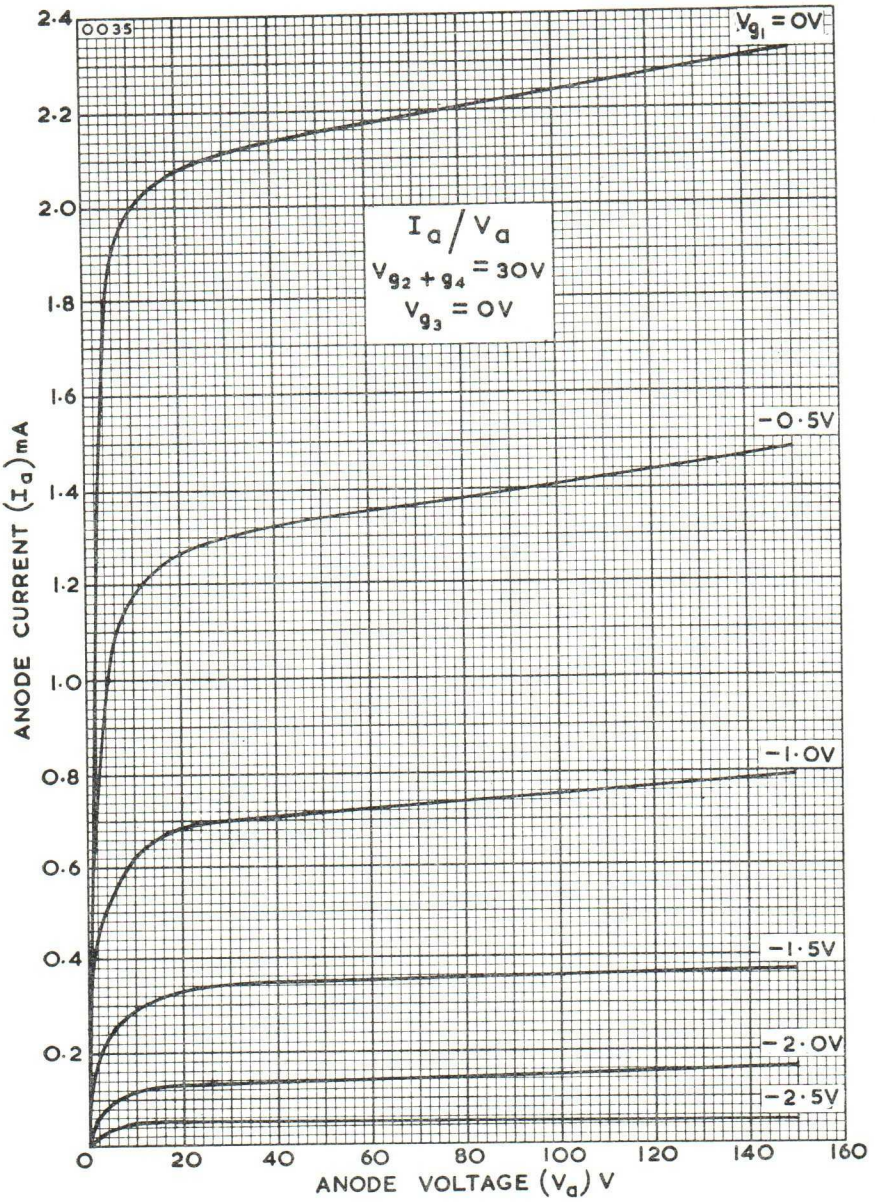
CHARACTERISTICS

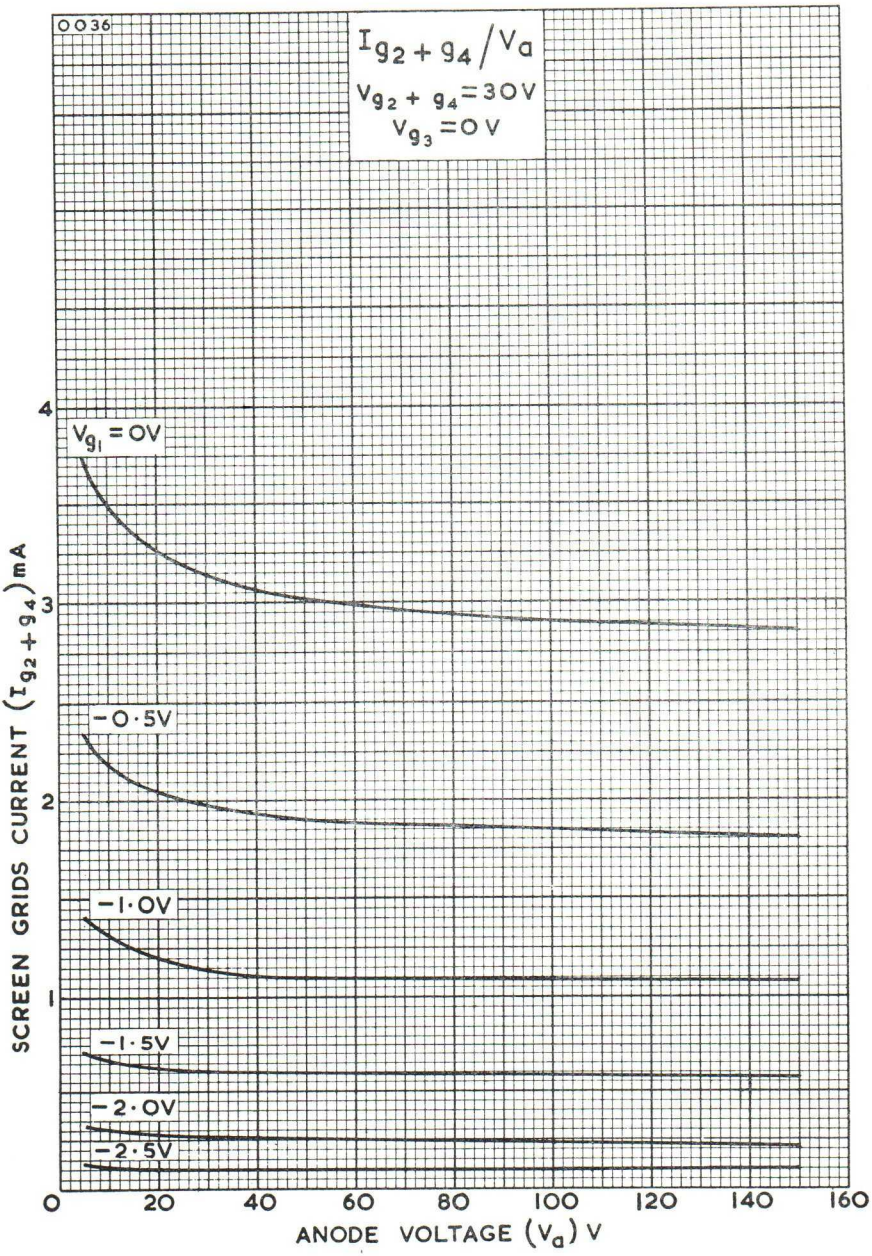
Anode Voltage	V_a	10	100	100	V
Screen Grids Voltage	V_{g2+g4}	30	30	30	V
Control Grid Voltage	V_{g1}	0	0	−1·0	V
Grid 3 Voltage	V_{g3}	0	−1·0	0	V
Anode Current	I_a	2·0	0·8	0·75	mA
Screen Grids Current	I_{g2+g4}	3·5	4·0	1·1	mA
Mutual Conductance (Control Grid to Anode)	$g_{m(g1\text{-}a)}$	—	—	1·2	mA/V
Mutual Conductance (Grid 3 to Anode)	$g_{m(g3\text{-}a)}$	—	1·55	—	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	—	400	900	kΩ
Control Grid Voltage (I_a=50μA)	V_{g1}	—	—	−2·5	V
Grid 3 Voltage (I_a=50μA)	V_{g3}	—	−2·2	—	V

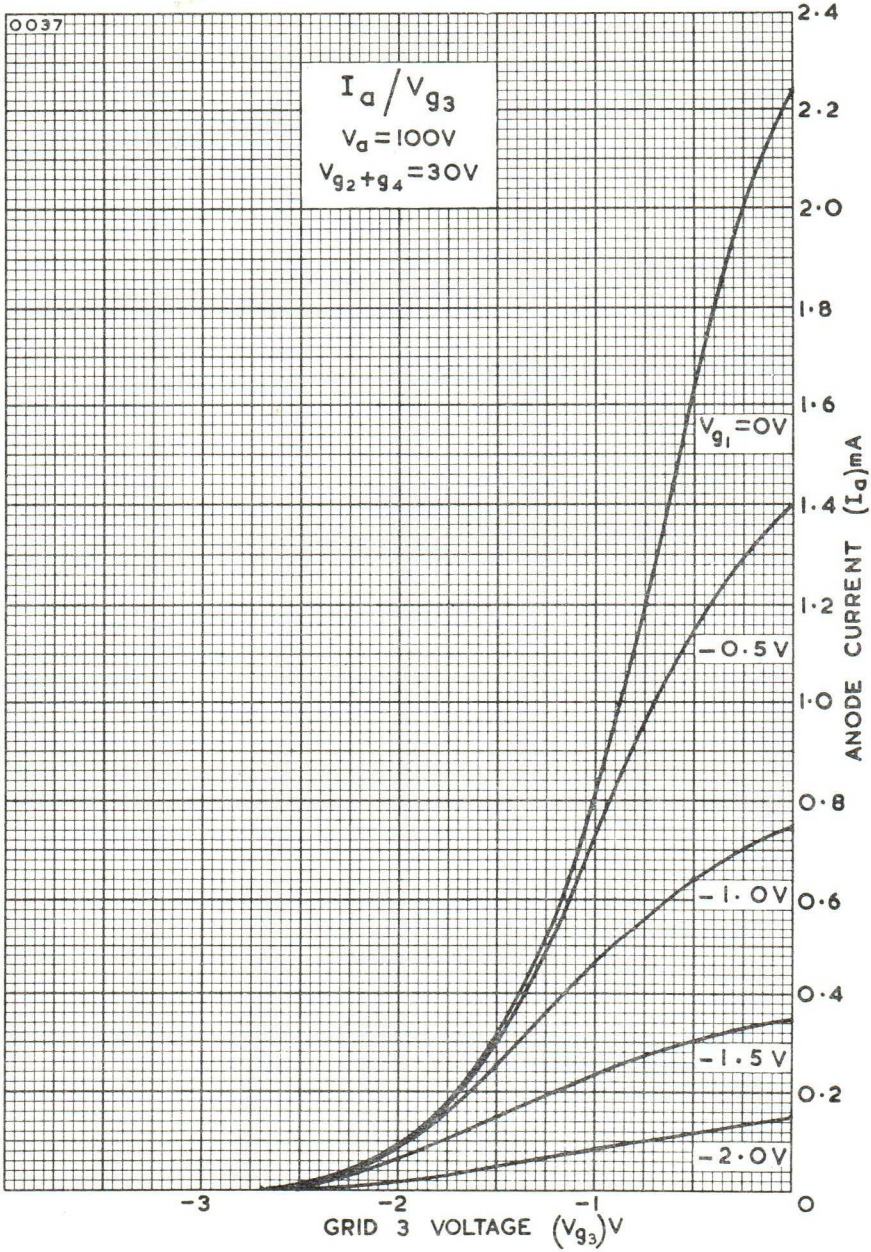
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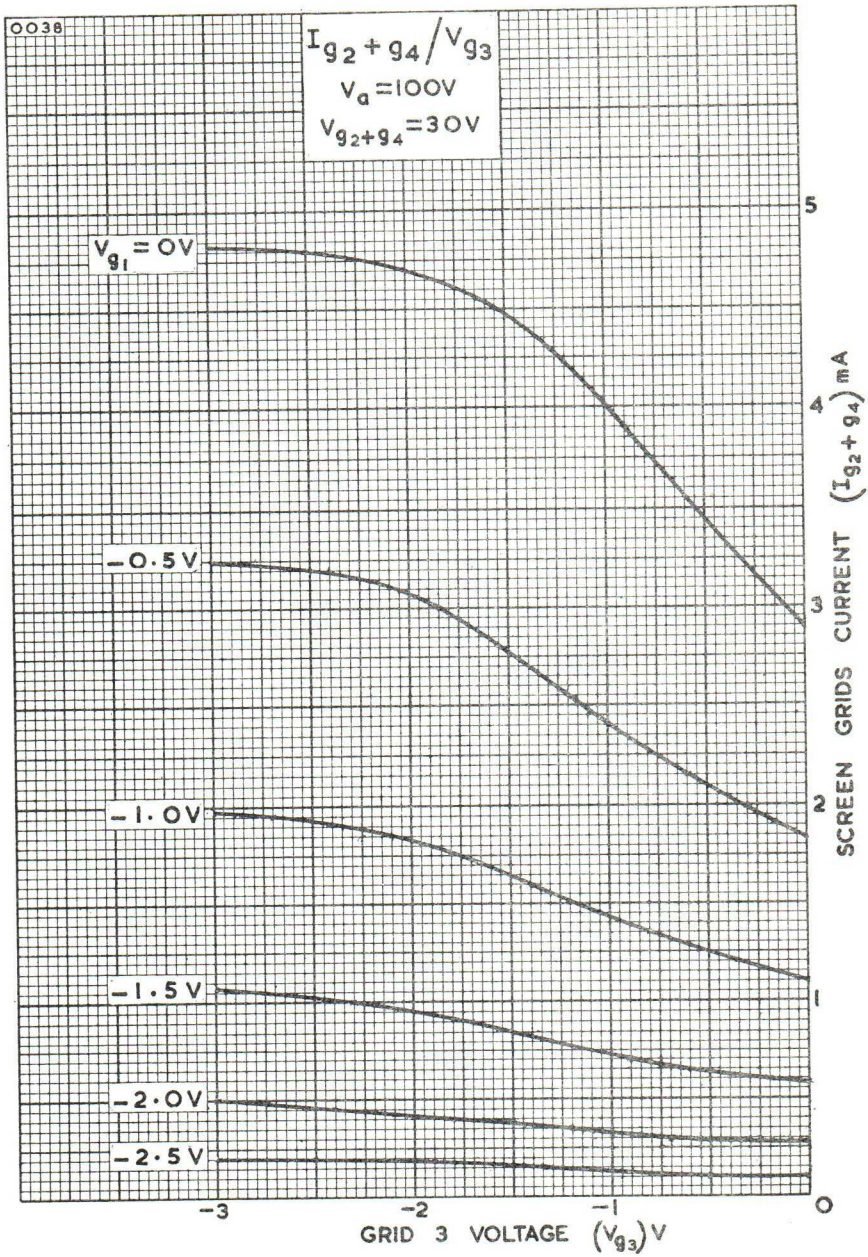

0033
I_a/V_{g1}
$V_a = 100V$
$V_{g2+g4} = 30V$
$V_{g3} = 0V$
−0·5V
−1·0V
−1·5V
−2·0V
2·4
2·2
2·0
1·8
1·6
1·4
1·2
1·0
0·8
0·6
0·4
0·2
0
ANODE CURRENT (I_a)mA
−3
−2
−1
0
CONTROL GRID VOLTAGE (V_{g1})V

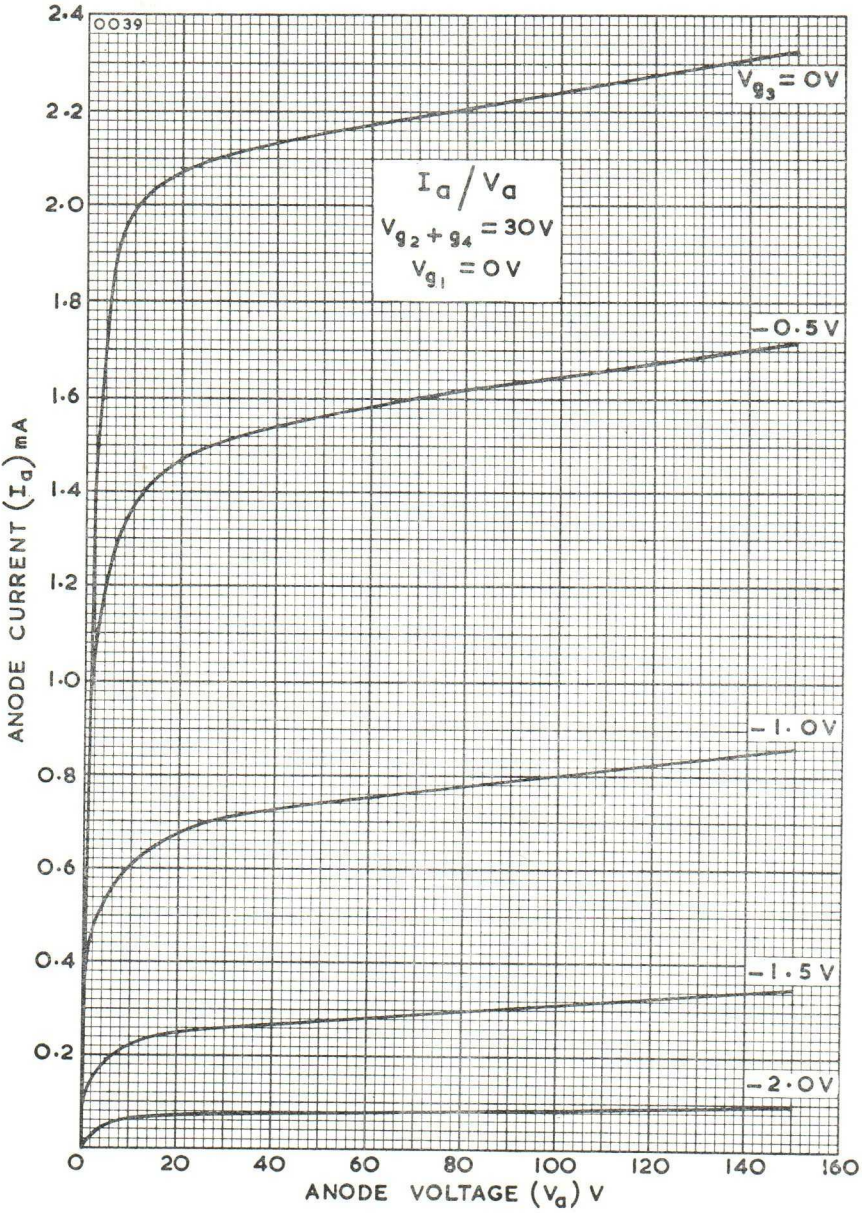

0034
I_{g2+g4}/V_{g1}
V_a = 100V
V_{g2+g4} = 30V
V_{g3} = −2·5V
−2·0V
−1·5V
−1·0V
−0·5V
0V
SCREEN GRIDS CURRENT (I_{g2+g4}) mA
0
1
2
3
4
5
−4
−3
−2
−1
CONTROL GRID VOLTAGE (V_{g1}) V

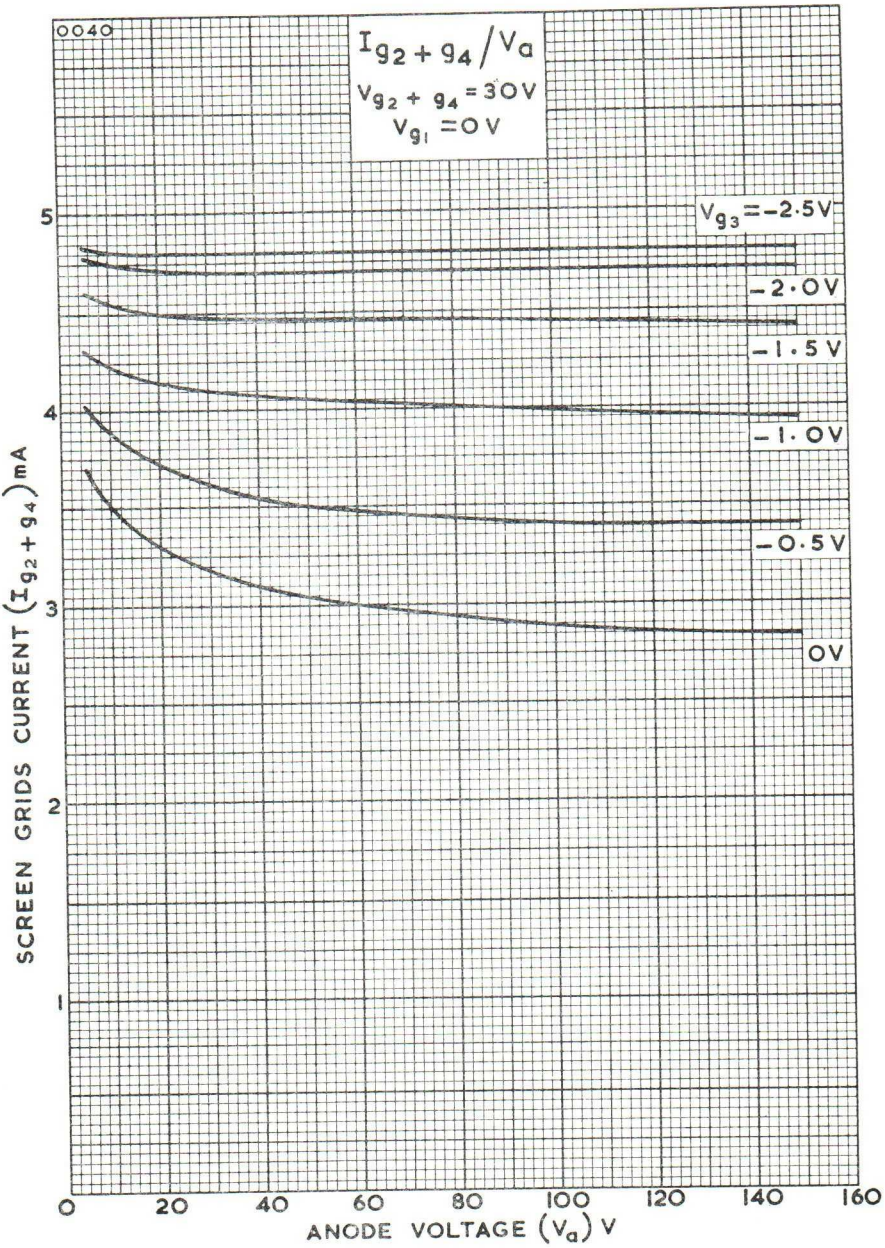

0035
V_{g_1} = 0V
I_a / V_a
$V_{g_2+g_4}$ = 30V
V_{g_3} = 0V
−0·5V
−1·0V
−1·5V
−2·0V
−2·5V
ANODE CURRENT (I_a) mA
2·4
2·2
2·0
1·8
1·6
1·4
1·2
1·0
0·8
0·6
0·4
0·2
0
20
40
60
80
100
120
140
160
ANODE VOLTAGE (V_a) V

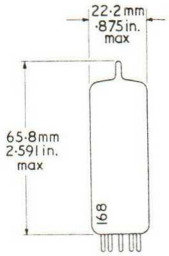

0036
$I_{g_2+g_4}/V_a$
$V_{g_2+g_4}=30V$
$V_{g_3}=0V$
$V_{g_1}=0V$
−0·5V
−1·0V
−1·5V
−2·0V
−2·5V
SCREEN GRIDS CURRENT ($I_{g_2+g_4}$) mA
ANODE VOLTAGE (V_a) V
0
1
2
3
4
20
40
60
80
100
120
140
160


0037
I_a / V_{g3}
$V_a = 100V$
$V_{g2+g4} = 30V$
$V_{g1} = 0V$
$-0.5V$
$-1.0V$
$-1.5V$
$-2.0V$
2·4
2·2
2·0
1·8
1·6
1·4
1·2
1·0
0·8
0·6
0·4
0·2
0
ANODE CURRENT (I_a)mA
−3
−2
−1
0
GRID 3 VOLTAGE (V_{g3})V

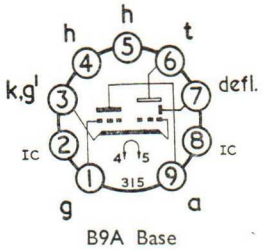

0038
$I_{g_2+g_4}/V_{g_3}$
V_a=100V
$V_{g_2+g_4}$=30V
V_{g_1}=0V
−0·5V
−1·0V
−1·5V
−2·0V
−2·5V
5
4
3
2
1
0
SCREEN GRIDS CURRENT $(I_{g_2+g_4})$ mA
−3
−2
−1
GRID 3 VOLTAGE (V_{g_3}) V


0039
I_a / V_a
$V_{g_2+g_4} = 30V$
$V_{g_1} = 0V$
$V_{g_3} = 0V$
−0·5V
−1·0V
−1·5V
−2·0V
ANODE CURRENT (I_a) mA
2·4
2·2
2·0
1·8
1·6
1·4
1·2
1·0
0·8
0·6
0·4
0·2
0
20
40
60
80
100
120
140
160
ANODE VOLTAGE (V_a) V


0040
I_{g2+g4}/V_a
V_{g2+g4} = 30V
V_{g1} = 0V
V_{g3} = −2·5V
−2·0V
−1·5V
−1·0V
−0·5V
0V
SCREEN GRIDS CURRENT (I_{g2+g4}) mA
ANODE VOLTAGE (V_a) V
0
20
40
60
80
100
120
140
160
1
2
3
4
5



TUNING INDICATOR



B9A Base

GENERAL

This tuning indicator has a short grid-base and is suitable for use in tape recorders.

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·3	A

RATINGS

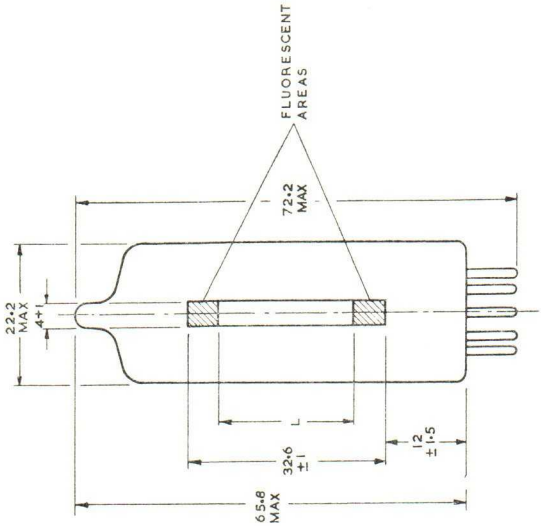
Maximum Anode Dissipation	$P_{a(max)}$	0·6	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	300	V
Maximum Deflector Supply Voltage	$V_{def(b)max}$	550	V
Maximum Deflector Voltage	$V_{def(max)}$	300	V
Maximum Target Supply Voltage	$V_{t(b)max}$	550	V
Maximum Target Voltage	$V_{t(max)}$	300	V
Minimum Target Voltage	$V_{t(min)}$	170	V
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$	250	V
Maximum Cathode Current	$I_{k(max)}$	5·0	mA
Maximum Grid to Cathode Resistance	$R_{g-k(max)}$	3·0	MΩ
Maximum Heater to Cathode Resistance	$R_{h-k(max)}$	100	kΩ
Maximum Bulb Temperature	$T_{bulb(max)}$	120	°C

TYPICAL OPERATION (Deflector connected to Anode)

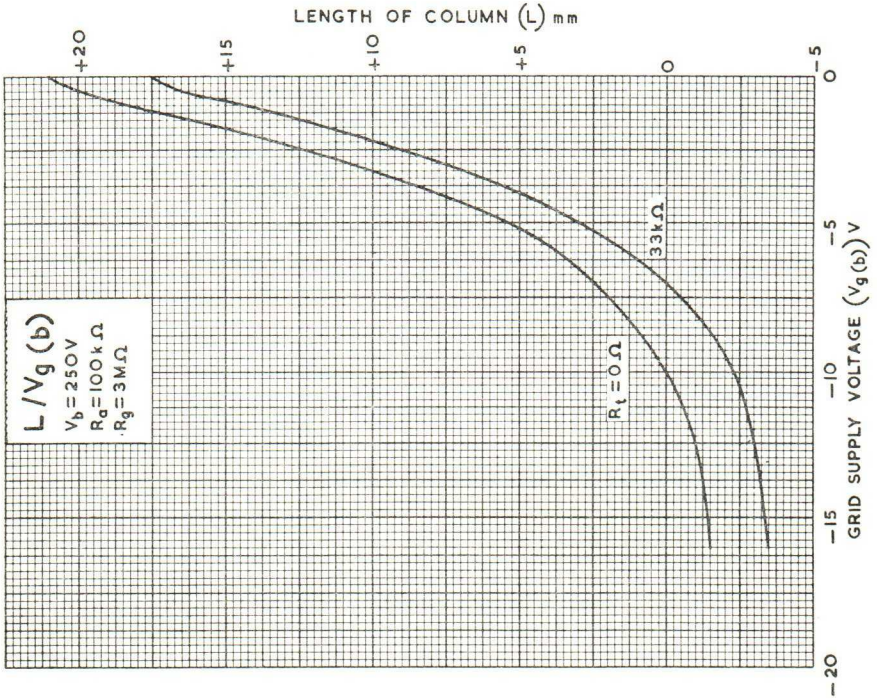
Supply Voltage	V_b		250		V
Target Voltage	V_t		250		V
Anode Resistance	R_a		100		kΩ
Grid to Cathode Resistance	R_{g-k}		3·0		MΩ
Grid Supply Voltage	$V_{g(b)}$	0	−10	−15	V
Anode Current	I_a	2·0	0·5	0·2	mA
Target Current	I_t	1·0	1·8	2·0	mA
Length of column	L	21	0	−1·5*	mm

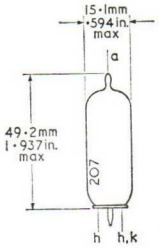
* This is a 1·5 mm overlap which can be utilised to indicate overloading.

THORN — AEI RADIO VALVES & TUBES LTD.



All dimensions in mm.



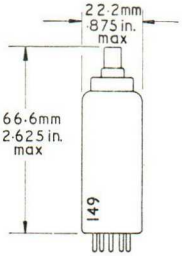


E.H.T. RECTIFIER

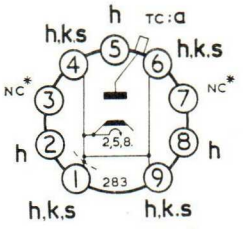
Heater Voltage	V_h 6·3	V ± 10%
Heater Current	I_h 0·09	A

RATINGS

Sinusoidal Input (10 to 500 kHz)			
Maximum Peak Inverse Voltage	$P.I.V_{max}$	17	kV
Maximum Rectified Current	$I_{out(max)}$	3·0	mA
Maximum Reservoir Capacitor	C_{max}	0·01	μF
Pulse Input			
Maximum Peak Inverse Voltage	$P.I.V_{max}$	17	kV
Maximum Rectified Current	$I_{out(max)}$	0·35	mA
Maximum Reservoir Capacitor	C_{max}	0·005	μF



HIGH VOLTAGE RECTIFIERS



B9A Base, CT1 Cap

GENERAL

These high voltage half-wave rectifiers are for use in television receivers employing line flyback EHT. The EY87 is electrically identical to the EY86 but has a chemically treated envelope which avoids flash-over under conditions of high humidity and low atmospheric pressure (45 cm. Hg.).

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·09	A

DESIGN CENTRE RATINGS

(The following ratings refer to normal television flyback EHT operation.)

Maximum Peak Inverse Voltage	$P.I.V_{max}$	22†	kV
Maximum Peak Anode Current	$i_{a(pk)max}$	40‡	mA
Maximum D.C. Anode Current	$I_{out(max)}$	0·8	mA

† The measured PIV must take into account the fact that during the scanning stroke, the anode of the EHT rectifier is at a potential negative with respect to chassis by an amount depending upon the transformer turns ratio. In addition, there is a damped leakage reactance oscillation assumed in the rating to have a peak to peak value not less than 10 per cent of the total PIV.

‡ Maximum duration 10 per cent of a line scanning cycle with a maximum of 10 μs.

INTER-ELECTRODE CAPACITANCE §

Anode to Heater, Cathode and Shield	$c_{a-k,h,s}$	1·7	pF

§ In fully shielded socket, without can (I.E.C. Publication 100).

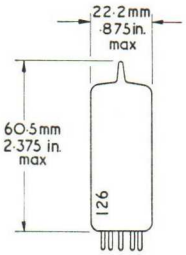
Notes

X-ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this valve whilst it is in use at a PIV in excess of 16 kV design centre.

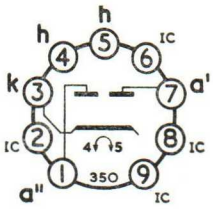
Precautions must be taken to prevent corona discharge from the connections to this valve by ensuring that no sharp points or bends occur in the wiring and adequate spacing must be left between the valve and surrounding components.

* Pins 3 and 7 may be connected to points in the heater circuit only and must not be earthed. No low potential circuits should be connected to any base pins.

THORN—AEI RADIO VALVES & TUBES LTD.



FULL-WAVE RECTIFIER



Base B9A

GENERAL

Heater Voltage	V_h	6·3	V
Heater Current	I_h	0·6	A

RATINGS

Maximum Peak Inverse Voltage	PIV_{max}	980	V
Maximum Peak Current (each Anode)	$i_{a(pk)max}$	270	mA
Maximum D.C. Output Current	$I_{out(max)}$	See Rating Chart 1	
Maximum Anode Supply Voltage	$V_{a(r.m.s.)max}$	See Rating Chart 1	
Maximum Peak Heater to Cathode Voltage (Heater Negative)	$v_{h-k(max)}$	500	V
Maximum Reservoir Capacitor	C_{max}	50	μF

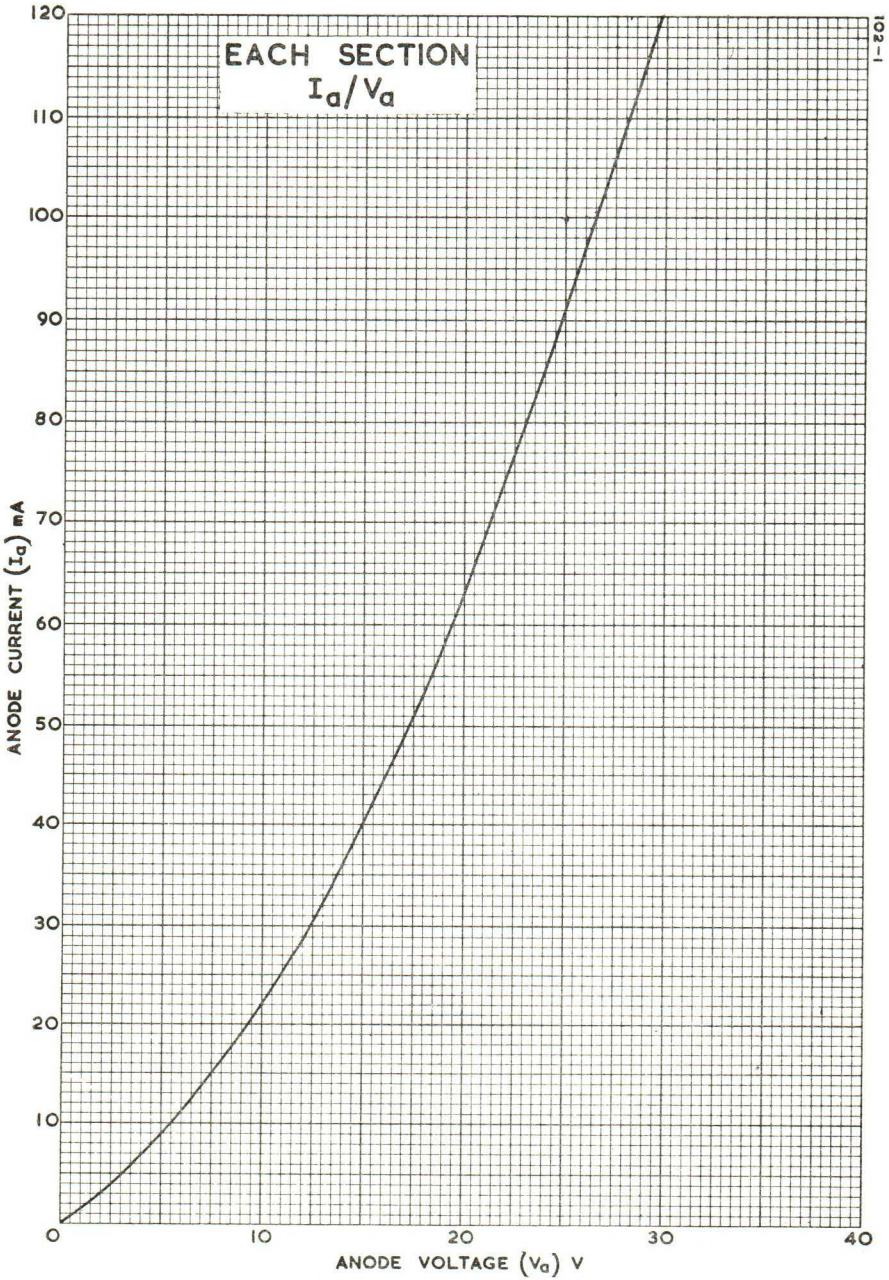
TYPICAL OPERATION AS A FULL-WAVE RECTIFIER

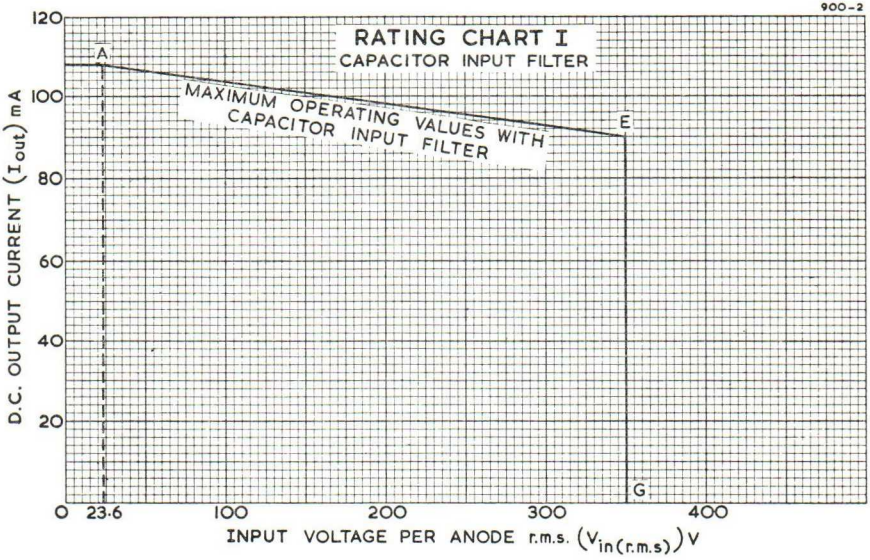
Capacitor Input

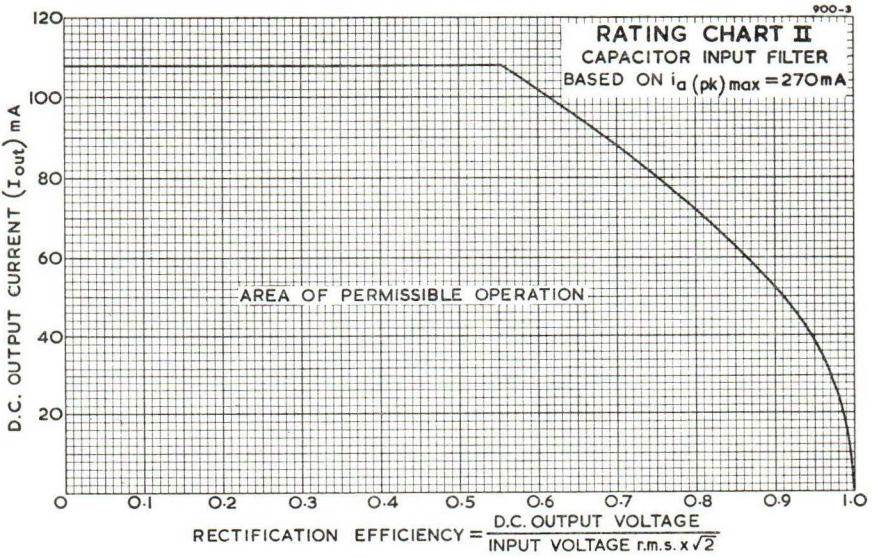
Input Voltage per Anode (r.m.s.)	$V_{in(r.m.s.)}$	250	275	300	350	V
D.C. Output Current	I_{out}	90	90	90	90	mA
D.C. Output Voltage	V_{out}	265	285	310	360	V
Minimum Limiting Resistance each Anode	$R_{lim(min)}$ per anode	125	175	215	300	Ω
Reservoir Capacitor	C	50	50	50	50	μF

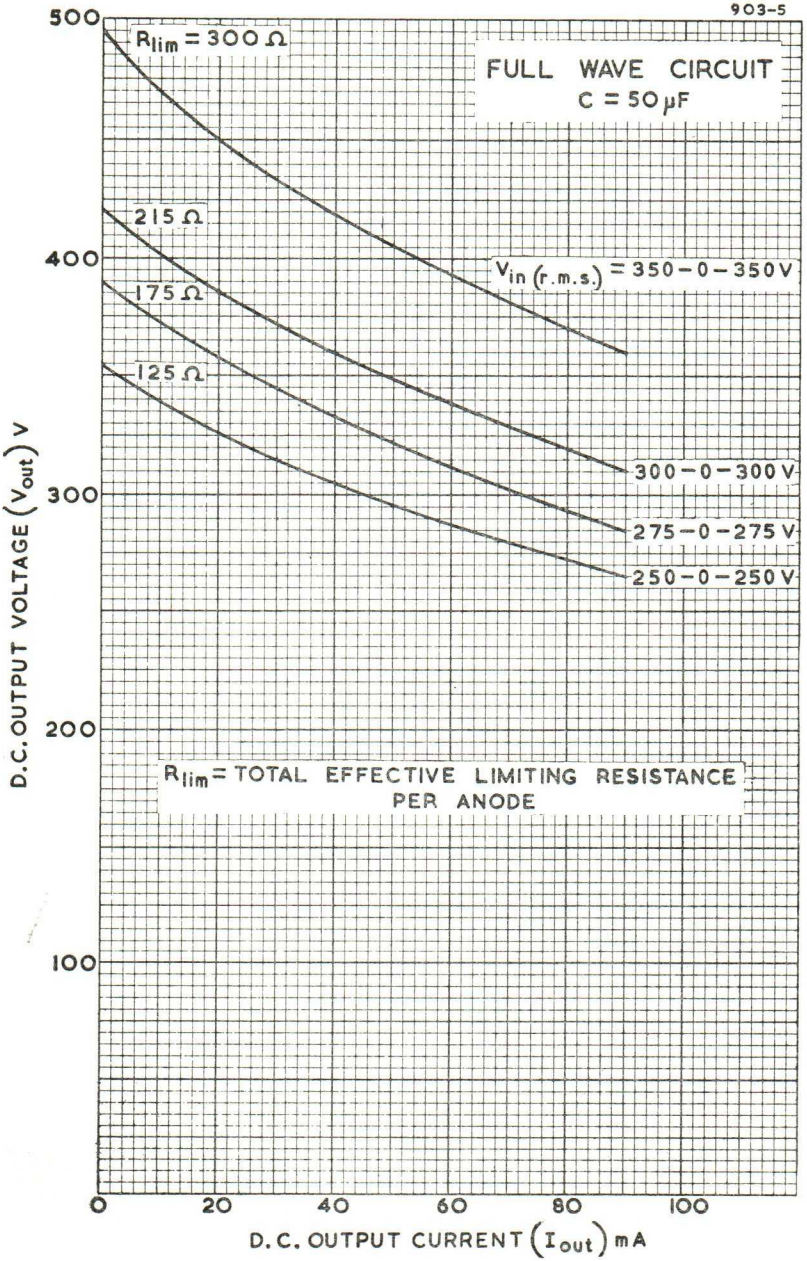
MOUNTING POSITION—Unrestricted.

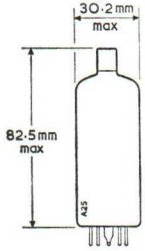
THORN — A E I RADIO VALVES & TUBES LTD.


EACH SECTION
I_a/V_a
102-1
ANODE CURRENT (I_a) mA
120
110
100
90
80
70
60
50
40
30
20
10
0
10
20
30
40
ANODE VOLTAGE (V_a) V

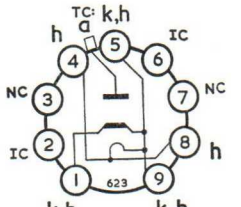

900-2
RATING CHART I
CAPACITOR INPUT FILTER
MAXIMUM OPERATING VALUES WITH CAPACITOR INPUT FILTER
A
E
G
D.C. OUTPUT CURRENT (Iout) mA
120
100
80
60
40
20
0
23·6
100
200
300
400
INPUT VOLTAGE PER ANODE r.m.s. (Vin(r.m.s.)) V


900-3
RATING CHART II
CAPACITOR INPUT FILTER
BASED ON ia (pk) max = 270mA
AREA OF PERMISSIBLE OPERATION
D.C. OUTPUT CURRENT (Iout) mA
120
100
80
60
40
20
0
0·1
0·2
0·3
0·4
0·5
0·6
0·7
0·8
0·9
1·0
RECTIFICATION EFFICIENCY = D.C. OUTPUT VOLTAGE / INPUT VOLTAGE r.m.s. x √2


903-5
R_{lim} = 300 Ω
215 Ω
175 Ω
125 Ω
FULL WAVE CIRCUIT
C = 50 μF
V_{in} (r.m.s.) = 350-0-350 V
300-0-300 V
275-0-275 V
250-0-250 V
R_{lim} = TOTAL EFFECTIVE LIMITING RESISTANCE PER ANODE
D.C. OUTPUT VOLTAGE (V_{out}) V
500
400
300
200
100
0
20
40
60
80
100
D.C. OUTPUT CURRENT (I_{out}) mA



E.H.T. RECTIFIER



B9D Base with centre stem
CT2 Cap

GENERAL

This e.h.t. half-wave rectifier is for use in colour television receivers. It has a chemically treated envelope to avoid flash-over under conditions of high humidity and low atmospheric pressure (45 cm Hg).

Heater Voltage	V_h	3·15*	V
Heater Current	I_h	0·4	A

* The nominal heater voltage value applies to operation with the average beam current to be expected in practice. Heater voltage variations up to maximum ±15% are permitted for a nominal valve under the worst probable conditions.

ABSOLUTE RATINGS

Maximum Peak Inverse Voltage	$P.I.V._{max}$	35†	kV
Maximum Output Voltage	$V_{out(max)}$	27·5	kV
Maximum Anode Current	$I_{a(out)max}$	1·7‡	mA

† The negative peak due to ringing in the line output transformer should be taken into account. Maximum pulse duration 22% of one cycle with a maximum of 18μs.
‡ Design centre rating.

INTER-ELECTRODE CAPACITANCE

Anode to Heater and Cathode	$c_{a\text{-}h,\,k}$	1·2	pF

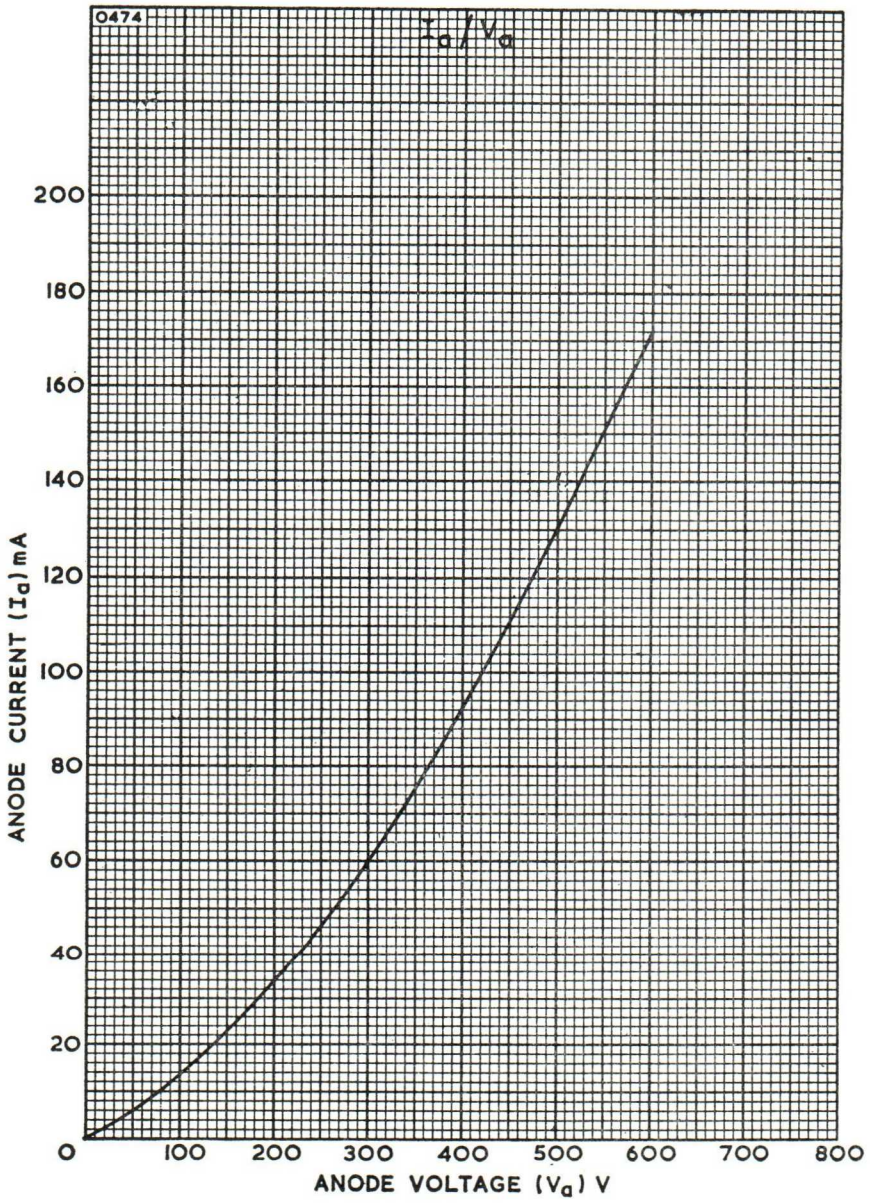
TYPICAL OPERATION

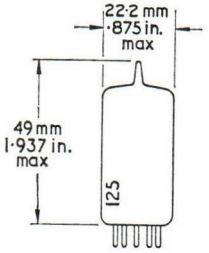
Output Voltage	V_{out}	25	kV
Anode Current	$I_{a(out)}$	1·5	mA

Notes

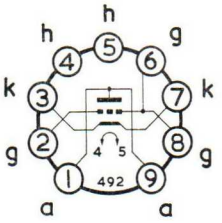
X-ray shielding may be required to give protection against excessive radiation.
Pins 1, 5 and 9 may be used to connect an anti-corona ring.
Circuit elements having the same potential as the heater, e.g. series resistor, may be connected to pins 3 and 7. These pins must not be earthed.

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0474
I_a / V_a
200
180
160
140
120
100
80
60
40
20
0
ANODE CURRENT (I_a) mA
100
200
300
400
500
600
700
800
ANODE VOLTAGE (V_a) V



U.H.F. TRIODE



B9A Base

GENERAL

This frame grid triode is for use as a grounded grid U.H.F. oscillator and mixer for bands IV and V.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	3·8	V

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	2·2	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	220	V
Maximum Negative Grid Voltage	$-V_{g(max)}$	50	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h-k(r.m.s.)max}$	90	V
Maximum Cathode Current	$I_{k(max)}$	20	mA
Maximum Grid to Cathode Resistance	$R_{g-k(max)}$	1·0	MΩ

INTER-ELECTRODE CAPACITANCES

		*	†	
Anode to Grid	c_{a-g}	2·2		pF
Anode to Cathode	c_{a-k}	0·24		pF
Grid to Cathode	c_{g-k}	3·5		pF
Grid to Heater	c_{g-h}	0·3		pF
Cathode to Grid, Heater	$c_{k-g,h}$	6·3		pF
Grid to Cathode, Heater	$c_{g-k,h}$	3·8		pF
Anode to Cathode, Heater	$c_{a-k,h}$	0·35		pF
Anode to Grid, Heater	$c_{a-g,h}$	2·3		pF
Anode to Grid, Shield	$c_{a-g,s}$		3·3	pF
Cathode, Heater to Grid, Shield	$c_{k,h-g,s}$		4·1	pF
Anode to Cathode, Heater	$c_{a-k,h}$		0·3	pF

* In fully shielded socket without can (I.E.C. Publication 100).
† In fully shielded socket with can (I.E.C. Publication 100).

CHARACTERISTICS

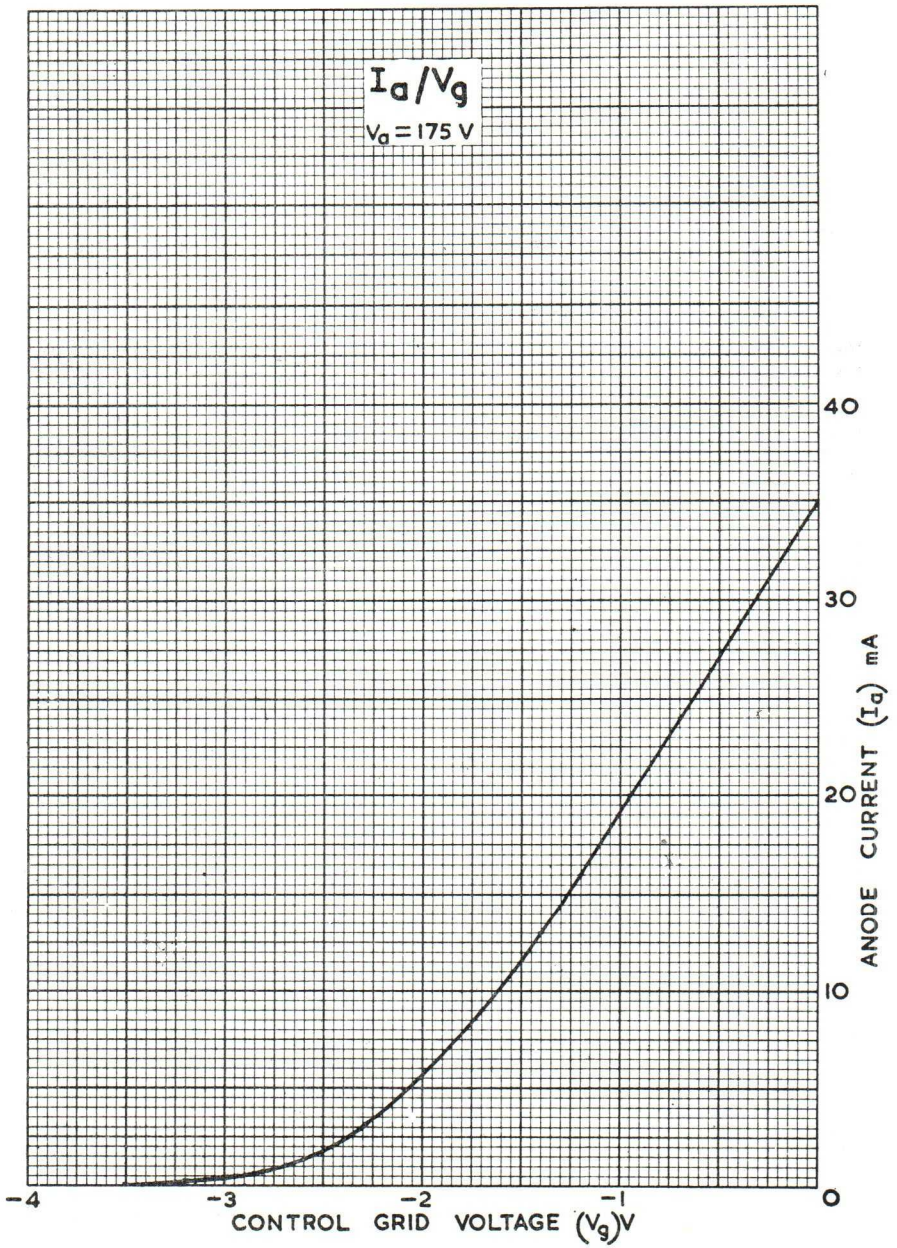
Anode Voltage	V_a	175	V
Grid Voltage	V_g	−1·5	V
Anode Current	I_a	12	mA
Mutual Conductance	g_m	14	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	4·85	kΩ
Amplification Factor	μ	68	
Equivalent Grid Noise Resistance	R_{eq}	230	Ω

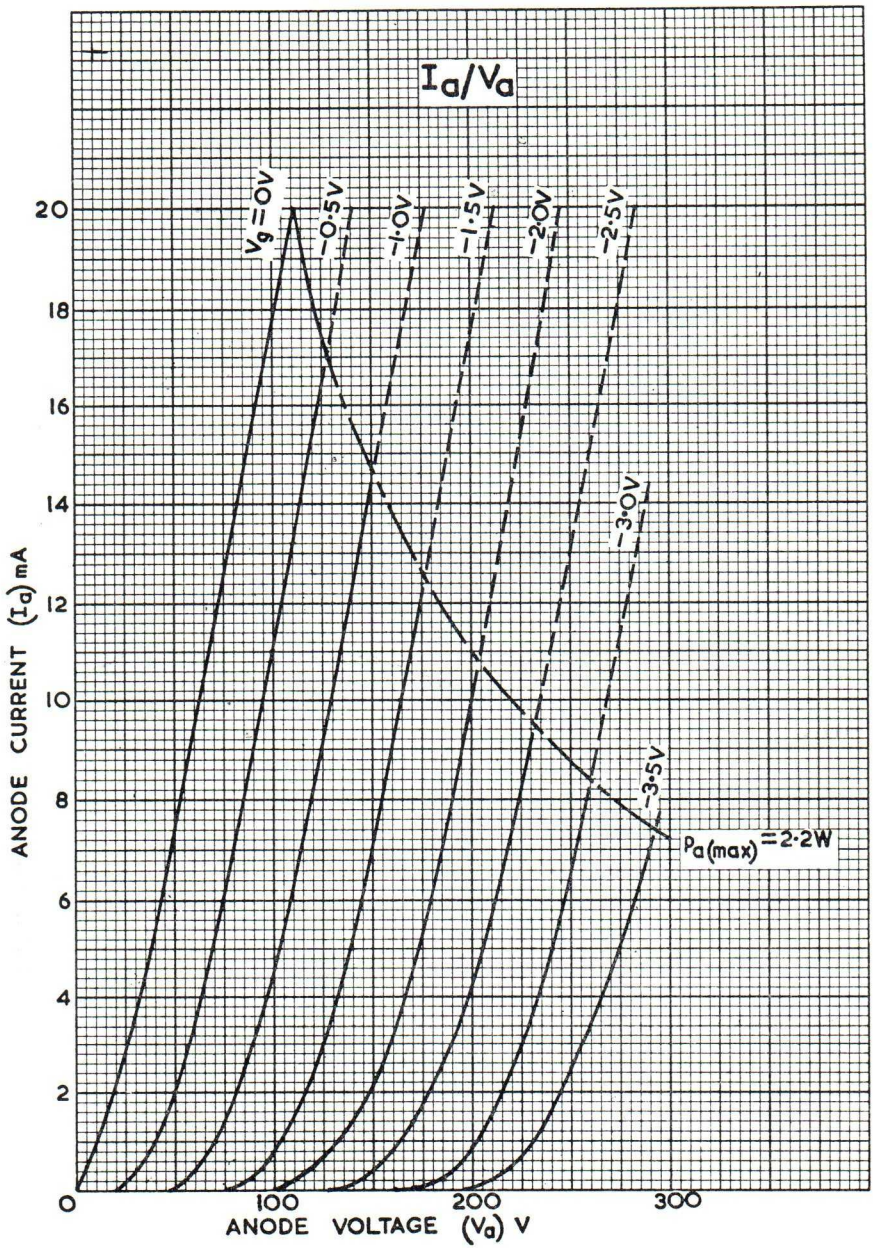
TYPICAL OPERATION—As a Self-Oscillating Mixer

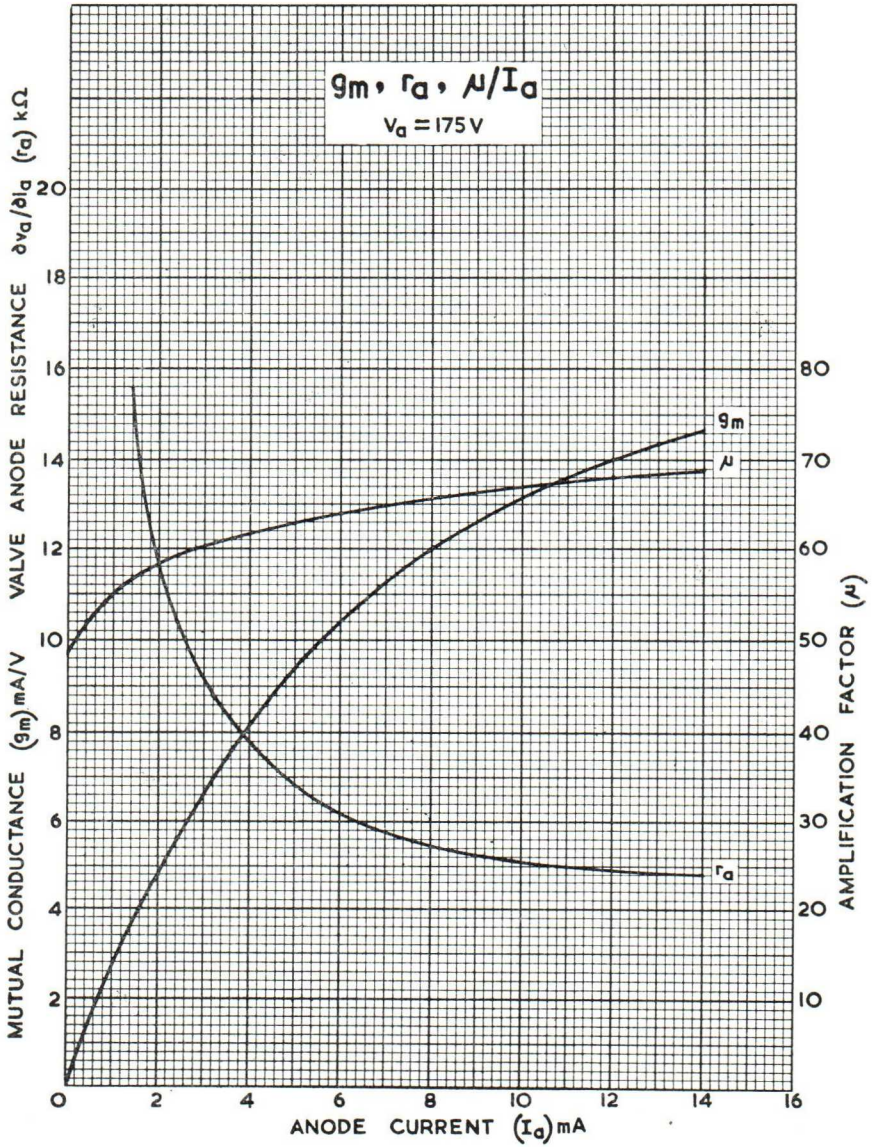
		‡	§	
Anode Supply Voltage	$V_{a(b)}$	220	220	V
Anode Resistance	R_a	5·6	5·6	kΩ
Grid Resistance	R_g	—	47	kΩ
Cathode Bias Resistance	R_k	220	—	Ω
Anode Current	I_a	12	12	mA
Grid Current	I_g	—	50	μA
Conversion Conductance	g_c	5·5	5·5	mA/V

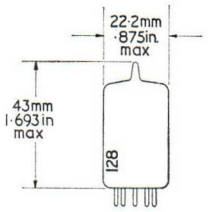
‡ Cathode self bias § Grid current bias

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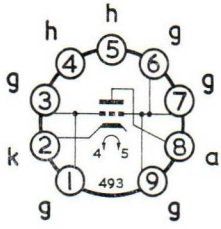

Ia/Vg
Va = 175 V
40
30
20
10
0
ANODE CURRENT (Ia) mA
−4
−3
−2
−1
CONTROL GRID VOLTAGE (Vg)V


Ia/Va
Vg=0V
-0·5V
-1·0V
-1·5V
-2·0V
-2·5V
-3·0V
-3·5V
Pa(max)=2·2W
ANODE CURRENT (Ia) mA
0
2
4
6
8
10
12
14
16
18
20
100
200
300
ANODE VOLTAGE (Va) V


gm, ra, μ/Ia
Va = 175 V
MUTUAL CONDUCTANCE (gm) mA/V
VALVE ANODE RESISTANCE δVa/δIa (ra) kΩ
AMPLIFICATION FACTOR (μ)
ANODE CURRENT (Ia) mA
gm
μ
ra
0
2
4
6
8
10
12
14
16
18
20
30
40
50
60
70
80



U.H.F. TRIODE



B9A Base

GENERAL

This frame grid triode is for use as a grounded grid U.H.F. Amplifier for bands IV and V.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	3·8	V

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	2·0	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	175	V
Maximum Negative Grid Voltage	$-V_{g(max)}$	50	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h-k(r.m.s.)max}$	70	V
Maximum Cathode Current	$I_{k(max)}$	13	mA
Maximum Grid to Cathode Resistance	$R_{g-k(max)}$	1·0	MΩ

INTER-ELECTRODE CAPACITANCES

		*	†	
Anode to Grid	c_{a-g}	1·2		pF
Anode to Grid, Shield	$c_{a-g,s}$		1·7	pF
Cathode, Heater to Grid, Shield	$c_{k,h-g,s}$		3·8	pF
Anode to Cathode, Heater	$c_{a-k,h}$		0·055	pF

* In fully shielded socket without can (I.E.C. Publication 100).
† In fully shielded socket with can (I.E.C. Publication 100).

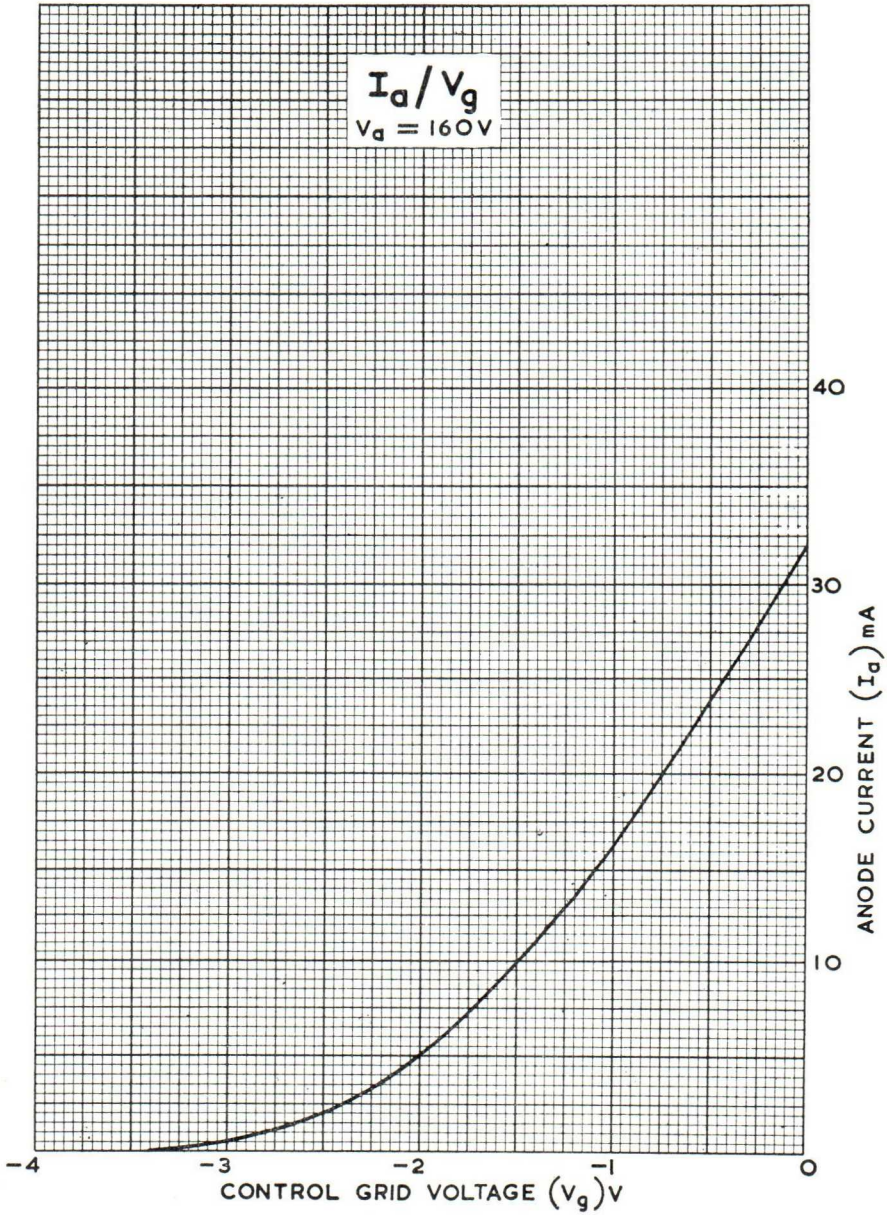
CHARACTERISTICS

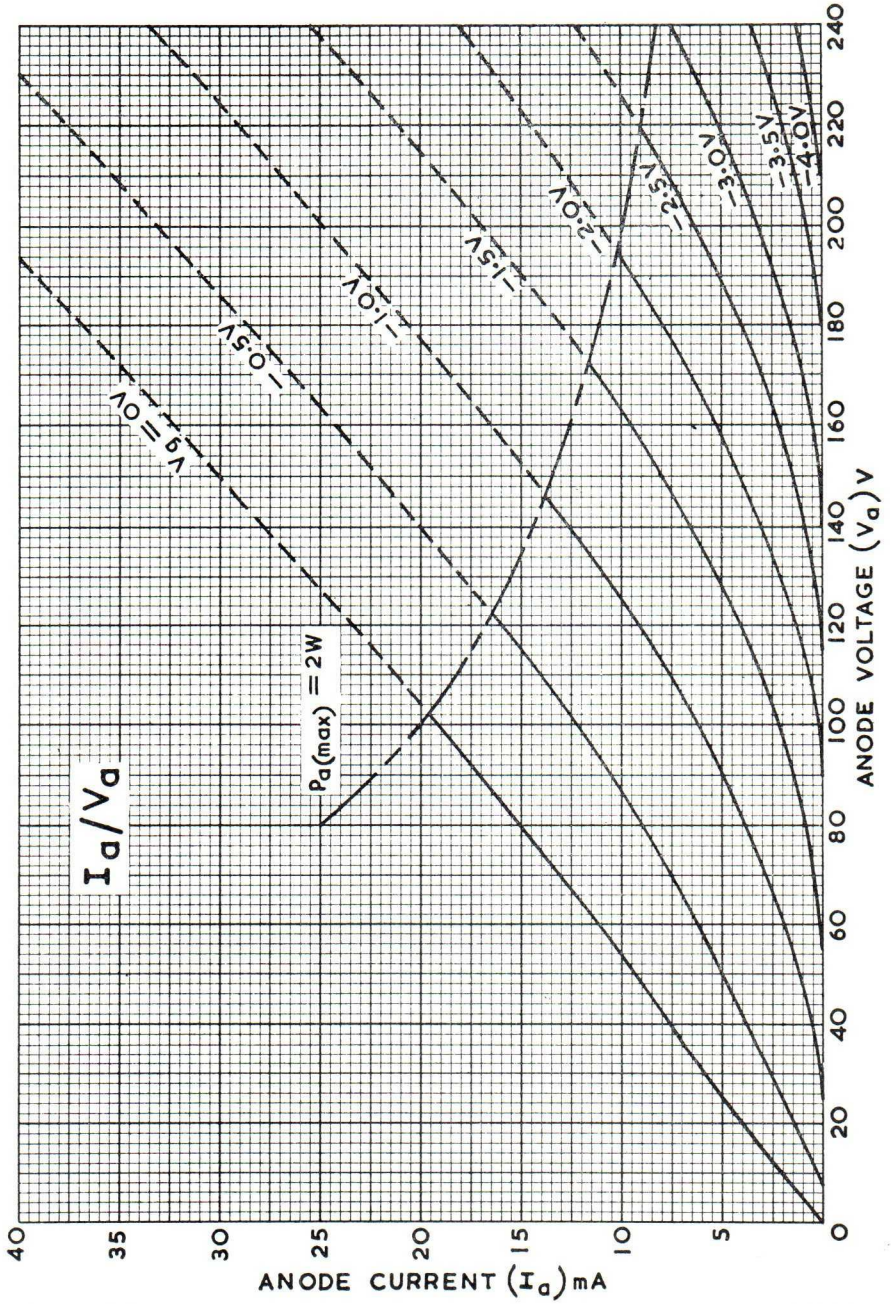
Anode Voltage	V_a	160	V
Grid Voltage	V_g	−1·25	V
Anode Current	I_a	12·5	mA
Mutual Conductance	g_m	13·5	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	4·8	kΩ
Amplification Factor	μ	65	
Equivalent Grid Noise Resistance	R_{eq}	240	Ω

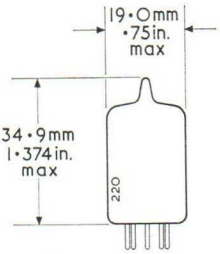
TYPICAL OPERATION

Anode Voltage	V_a	160	V
Cathode Resistance	R_k	100	Ω
Anode Current	I_a	12·5	mA
Mutual Conductance	g_m	13·5	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	4·8	kΩ
Amplification Factor	μ	65	
Noise Factor		10	dB

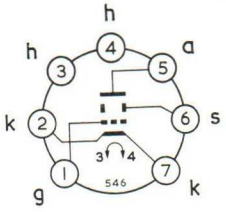
THORN—AEI RADIO VALVES & TUBES LTD.


I_a / V_g
$V_a = 160V$
40
30
20
10
ANODE CURRENT (I_a) mA
−4
−3
−2
−1
0
CONTROL GRID VOLTAGE (V_g) V


I_a/V_a
$P_{a(max)} = 2W$
$V_g = 0V$
$-0.5V$
$-1.0V$
$-1.5V$
$-2.0V$
$-2.5V$
$-3.0V$
$-3.5V$
$-4.0V$
ANODE CURRENT (I_a) mA
ANODE VOLTAGE (V_a) V
40 35 30 25 20 15 10 5 0
0 20 40 60 80 100 120 140 160 180 200 220 240



R.F. TRIODE



B7G Base

GENERAL

This triode, having low anode to grid capacitance, is for use as an R.F. amplifier in V.H.F. television receivers.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	3·9	V

DESIGN CENTRE RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	2·2	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	200	V
Maximum Negative Grid Voltage	$-V_{g(max)}$	50	V
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$	100*	V
Maximum Cathode Current	$I_{k(max)}$	20	mA
Maximum Grid to Cathode Resistance	$R_{g-k(max)}$	1·0†	MΩ

* To fulfil modulation hum requirement, V_{h-k} should not exceed 55Vr.m.s.
† In a.g.c. circuits $R_{g\ k(max)}$ may be 3·0 MΩ.

INTER-ELECTRODE CAPACITANCES (Shielded)

Anode to Grid	c_{a-g}	0·35	pF
Grid to Cathode	c_{g-k}	3·3	pF
Anode to Cathode	c_{a-k}	0·08	pF
Grid to Cathode, Heater and Shield	$c_{g-k,h,s}$	4·5	pF
Anode to Cathode, Heater and Shield	$c_{a-k,h,s}$	3·0	pF
Grid to Heater	c_{g-h}	<0.07	pF
Cathode to Heater	c_{k-h}	2·3	pF

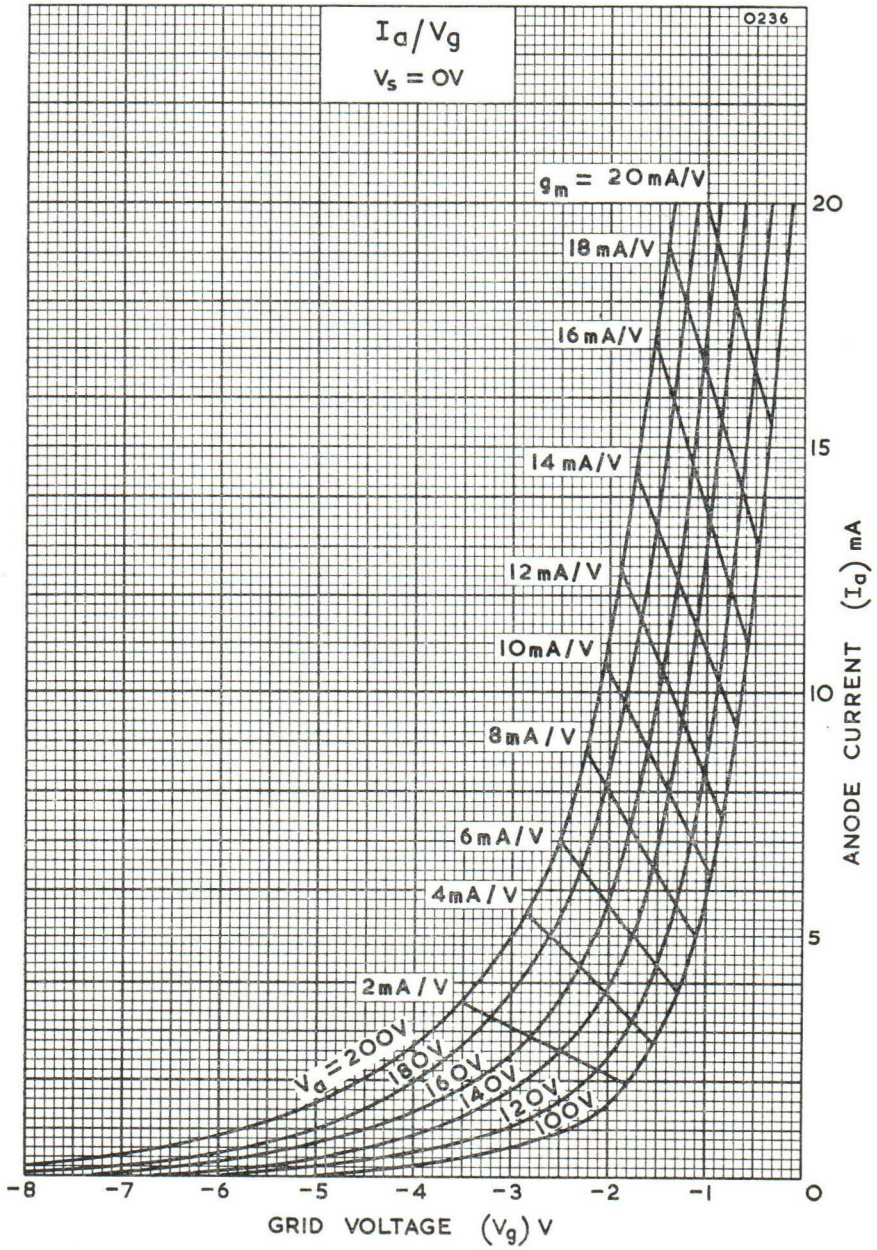
CHARACTERISTICS

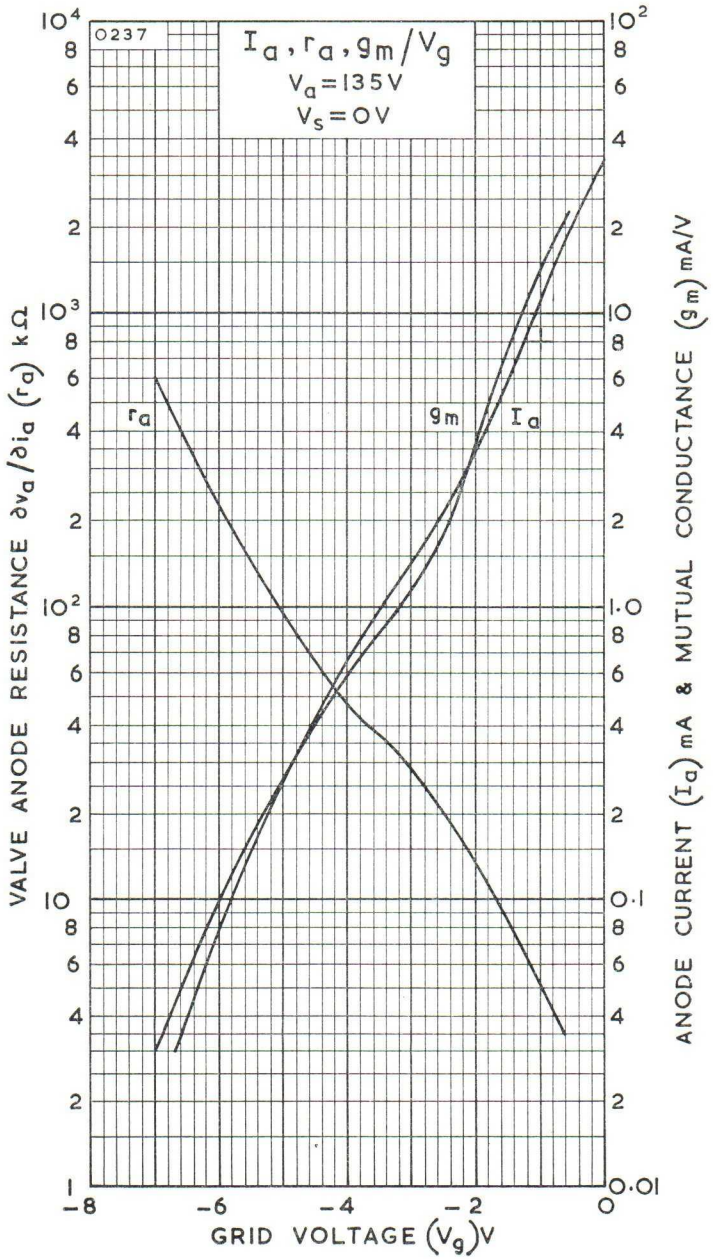
Anode Voltage	V_a	135	V
Shield Voltage	V_s	0	V
Grid Voltage	V_g	–1·0	V
Anode Current	I_a	11·5	mA
Mutual Conductance	g_m	14·5	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	5·25	kΩ
Amplification Factor	μ	76	

TYPICAL OPERATION

Supply Voltage	V_b	135	200	200	V
Anode Load Resistance	R_a	1·5	5·6	5·6	kΩ
Shield Voltage	V_s	0	0	0	V
Cathode Resistance	R_k	0	0	87	Ω
Anode Current	I_a	16·5	16·5	11·5	mA
Grid Current	I_g	20	20	0	μA
Mutual Conductance	g_m	20	20	14·5	mA/V
Amplification Factor	μ	84	84	76	
Grid Voltage for gm reduction 10 : 1	$V_{g(gm/10)}$	–2·3	–3·2	–3·8	V
Grid Voltage for gm reduction 100 : 1	$V_{g(gm/100)}$	–5·3	–7·7	–8·3	V

THORN — A E I RADIO VALVES & TUBES LTD.


Ia/Vg
Vs = OV
0236
gm = 20mA/V
18mA/V
16mA/V
14mA/V
12mA/V
10mA/V
8mA/V
6mA/V
4mA/V
2mA/V
Va = 200V
180V
160V
140V
120V
100V
20
15
10
5
0
ANODE CURRENT (Ia) mA
-8
-7
-6
-5
-4
-3
-2
-1
GRID VOLTAGE (Vg) V


0237
$I_a, r_a, g_m / V_g$
$V_a = 135V$
$V_s = 0V$
r_a
g_m
I_a
VALVE ANODE RESISTANCE $\partial v_a / \partial i_a$ (r_a) kΩ
ANODE CURRENT (I_a) mA & MUTUAL CONDUCTANCE (g_m) mA/V
GRID VOLTAGE (V_g)V
10^4 8 6 4 2 10^3 8 6 4 2 10^2 8 6 4 2 10 8 6 4 2 1
10^2 8 6 4 2 10 8 6 4 2 1·0 8 6 4 2 0·1 8 6 4 2 0·01
−8 −6 −4 −2 0

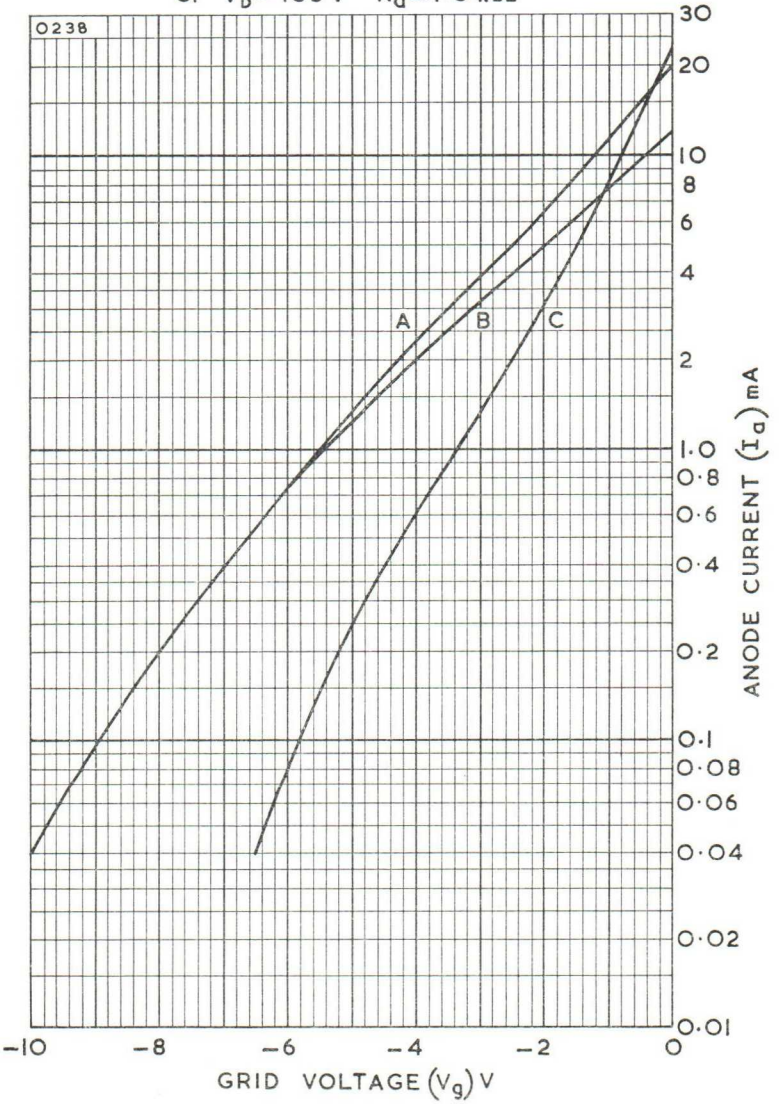
I_a / V_g

$V_s = 0$

A. $V_b = 200V$ $R_a = 5{\cdot}6k\Omega$

B. $V_b = 200V$ $R_a = 5{\cdot}6k\Omega$ $R_k = 87\Omega$

C. $V_b = 135V$ $R_a = 1{\cdot}5\,k\Omega$



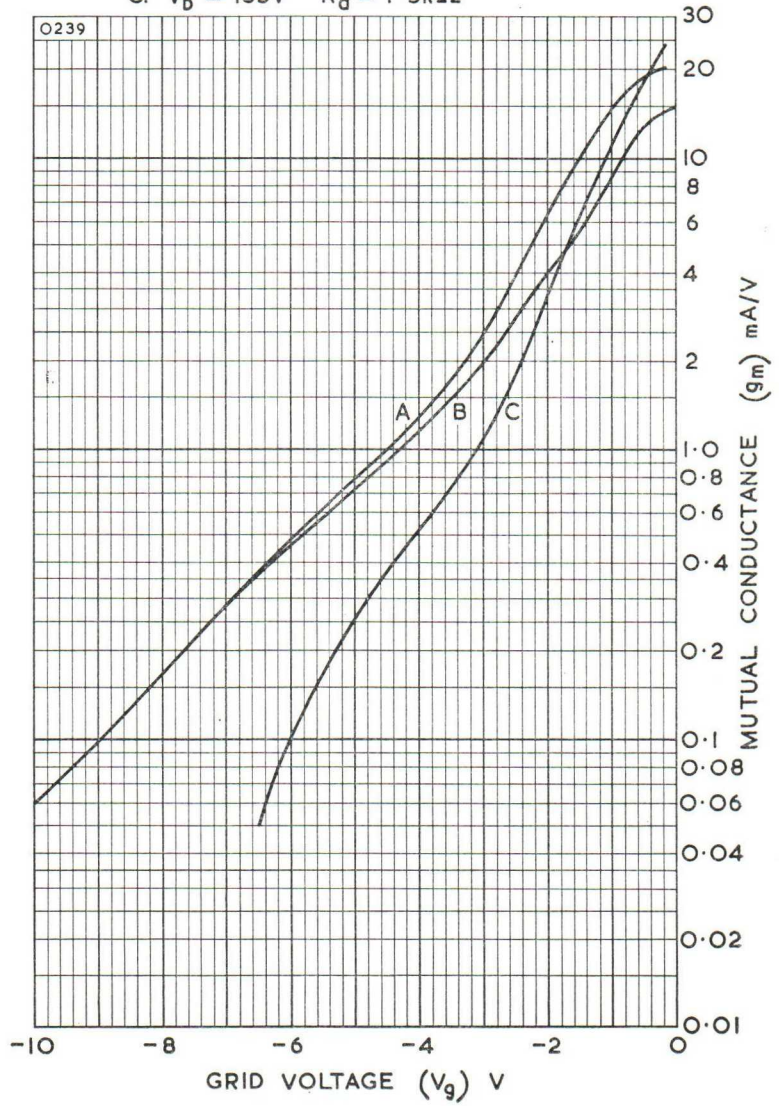
g_m / V_g

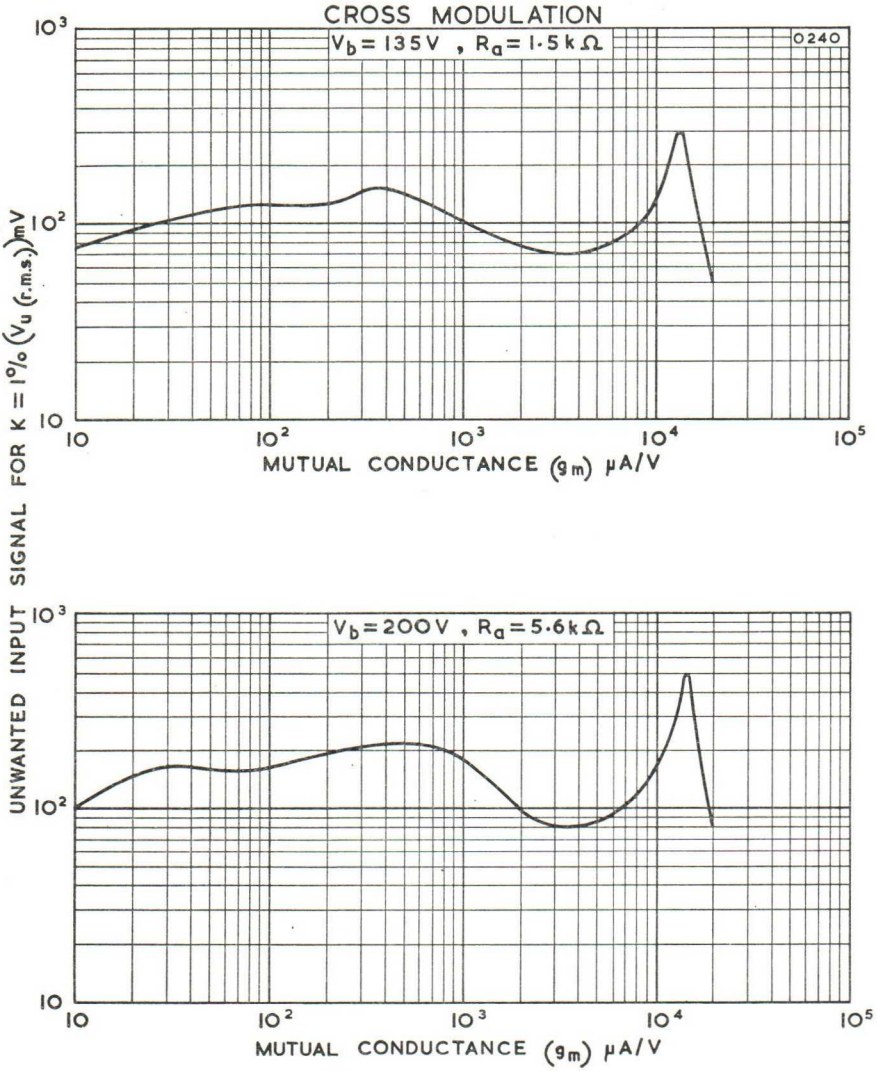
$V_s = 0$

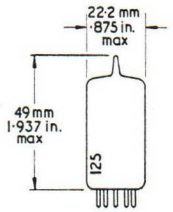
A. $V_b = 200V$ $R_a = 5{\cdot}6k\Omega$

B. $V_b = 200V$ $R_a = 5{\cdot}6k\Omega$ $R_k = 87\Omega$

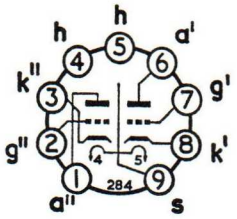
C. $V_b = 135V$ $R_a = 1{\cdot}5k\Omega$




CROSS MODULATION
V_b = 135V , R_a = 1·5kΩ
0240
10^3
10^2
10
10
10^2
10^3
10^4
10^5
MUTUAL CONDUCTANCE (g_m) μA/V
UNWANTED INPUT SIGNAL FOR K = 1% (V_u (r.m.s.)) mV
V_b = 200V , R_a = 5·6kΩ
10^3
10^2
10
10
10^2
10^3
10^4
10^5
MUTUAL CONDUCTANCE (g_m) μA/V



R.F. DOUBLE TRIODE



B9A Base

GENERAL

This double triode is primarily designed for use in television receivers as an oscillator and mixer at frequencies up to 200 MHz.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	9·0	V

DESIGN CENTRE RATINGS (Each Section)

Maximum Anode Dissipation	$P_{a(max)}$	2·5	W
Maximum Total Anode Dissipation	$P_{a(tot)max}$	4·5	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	250	V
Maximum Negative Grid Voltage	$-V_{g(max)}$	100	V
Maximum Heater to Cathode Voltage*	$V_{h-k(max)}$	90	V
Maximum Cathode Current	$I_{k(max)}$	15	mA
Maximum Grid to Cathode Resistance	$R_{g-k(max)}$	1·0	MΩ
Maximum Heater to Cathode Resistance	$R_{h-k(max)}$	20	kΩ

* When operating as an oscillator no r.f. voltage should be applied between heater and cathode.

INTER-ELECTRODE CAPACITANCES

Anode to Grid (each section)	c_{a-g}	1·5	pF
Grid to Cathode, Heater, Shield (each section)	$c_{g-k+h+s}$	3·1	pF
Anode to Cathode (each section)	c_{a-k}	0·18	pF
Anode to Cathode, Heater, Shield (each section)	$c_{a-k+h+s}$		
Unshielded		1·2	pF
Shielded		1·8	pF
Anode′ to Anode″	$c_{a'-a''}$		
Unshielded		<0·04	pF
Shielded		<0·008	pF
Grid′ to Grid″	$c_{g'-g''}$	<0·003	pF
Anode′ to Grid″	$c_{a'-g''}$	<0·008	pF
Anode″ to Grid′	$c_{a''-g'}$	<0·008	pF
Anode′ to Cathode″	$c_{a'-k''}$	<0·008	pF
Anode″ to Cathode′	$c_{a''-k'}$	<0·008	pF
Grid′ to Cathode″	$c_{g'-k''}$	<0·003	pF
Grid″ to Cathode′	$c_{g''-k'}$	<0·003	pF

THORN RADIO VALVES AND TUBES LTD.

TYPICAL CHARACTERISTICS (Each Section)

Anode Voltage	V_a	100	170	200	V
Grid Voltage	V_g	−1·2*	−1·75	−2·4	V
Anode Current	I_a	4·5	10	10	mA
Mutual Conductance	g_m	4·8	6·7	6·0	mA/V
Amplification Factor	μ	46	48	46	
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	9·6	7·1	7·7	kΩ

* Grid current may occur, if this is not permissible use a condition with $V_g = -1{\cdot}5$ V.

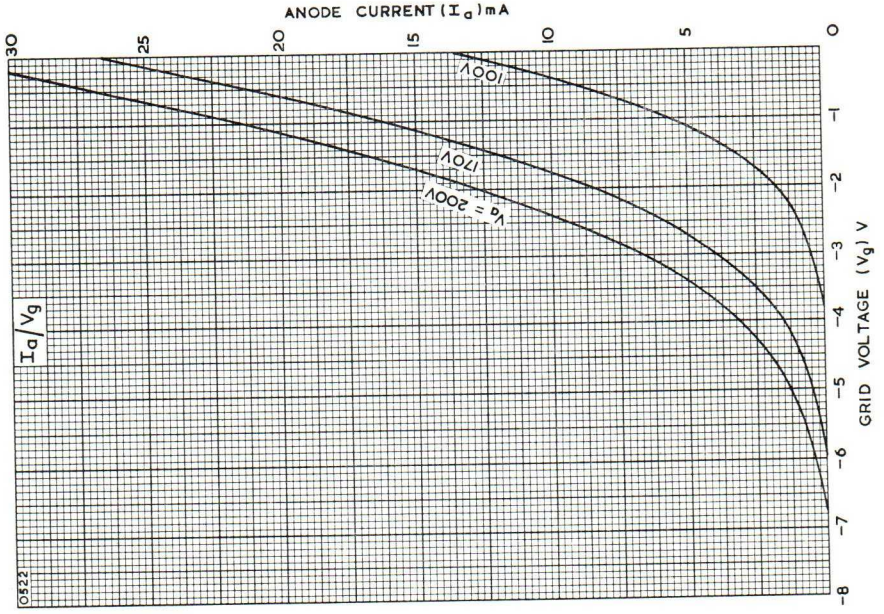
TYPICAL OPERATION

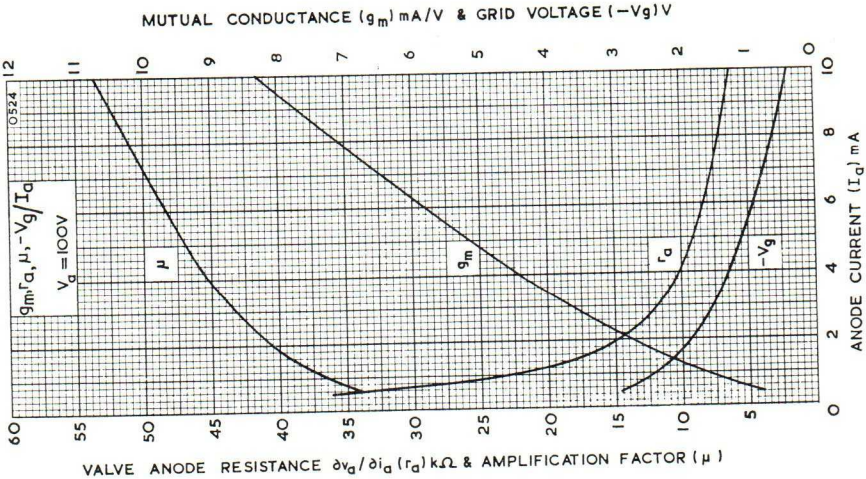
As Self-oscillating Additive Mixer

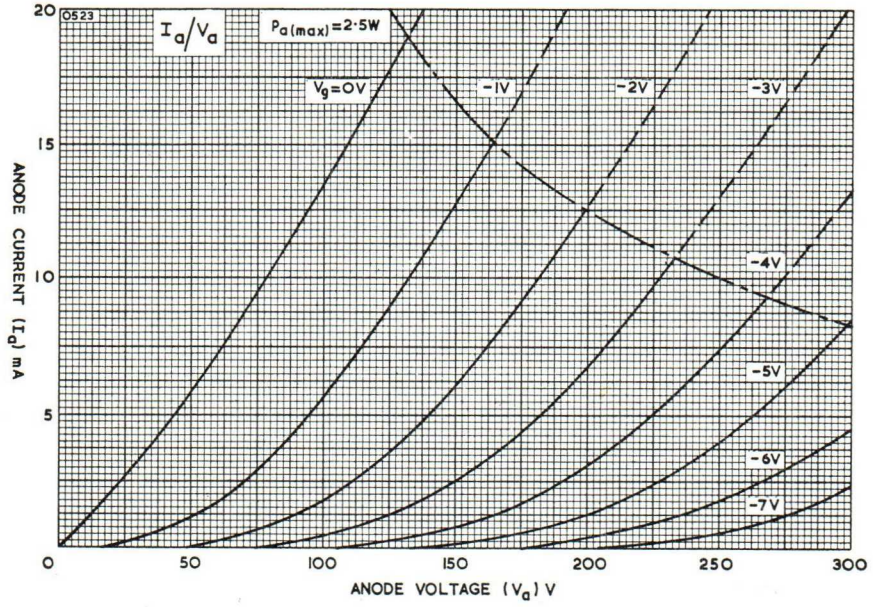
Anode Supply Voltage	$V_{a(b)}$	100	170	200	V
Anode Load Resistance	R_a	4·7	4·7	8·2	kΩ
Grid Resistance	R_g	1·0	1·0	1·0	MΩ
Oscillator Voltage	$V_{osc(r.m.s.)}$	1·8	2·8	2·8	V
Anode Current	I_a	2·7	5·5	6·0	mA
Conversion Conductance	g_c	2·2	2·8	2·9	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	19	15	14	kΩ
Input Resistance (f = 100 MHz)	R_{in}	—	15	—	kΩ

As Oscillator in Television Receivers

Anode Supply Voltage	$V_{a(b)}$	180	V
Anode Load Resistance	R_a	4·4	kΩ
Grid Resistance	R_g	22	kΩ
Oscillator Voltage	$V_{osc(r.m.s.)}$	9·0	V
Anode Current	I_a	7·4	mA
Anode Dissipation	p_a	1·2	W

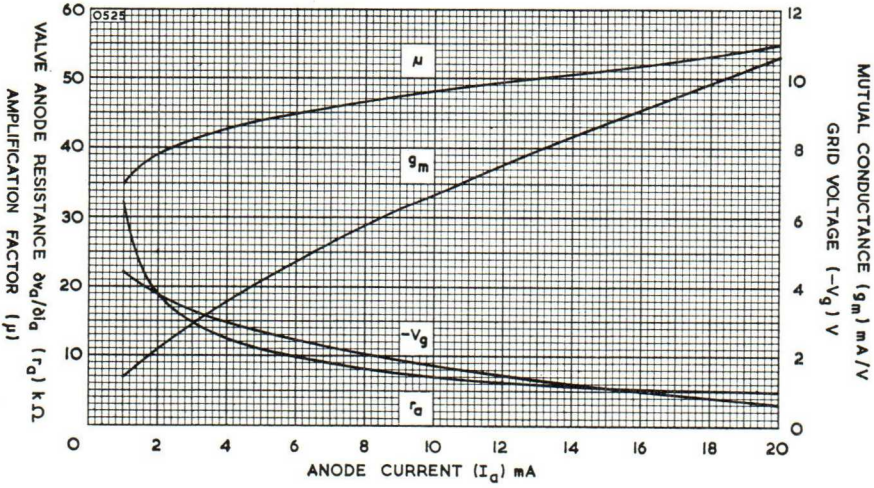

ANODE CURRENT (I_a) mA
30
25
20
15
10
5
0
V_a = 100V
V_a = 170V
V_a = 200V
I_a/V_g
0522
-1
-2
-3
-4
-5
-6
-7
-8
GRID VOLTAGE (V_g) V

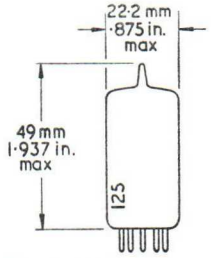

MUTUAL CONDUCTANCE (g_m) mA/V & GRID VOLTAGE (−Vg) V
12
11
10
9
8
7
6
5
4
3
2
1
0
0524
$g_m r_a, \mu, -V_g/I_a$
V_a = 100V
μ
g_m
r_a
$-V_g$
60
55
50
45
40
35
30
25
20
15
10
5
0
10
8
6
4
2
0
ANODE CURRENT (I_a) mA
VALVE ANODE RESISTANCE $\partial v_a / \partial i_a$ (r_a) kΩ & AMPLIFICATION FACTOR (μ)



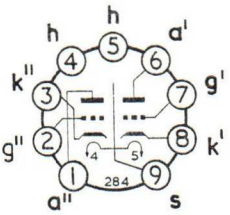
$g_m, r_a, \mu, -V_g/I_a$

V_a = 170V





HIGH SLOPE DOUBLE TRIODE



B9A Base

GENERAL

This high slope, low noise double triode is intended for use as a cascode R.F. amplifier in V.H.F. television tuners.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	7·6	V

RATINGS—Each Section

Maximum Anode Dissipation	$p_{a(max)}$	1·8	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	130	V
Maximum Negative Grid Voltage	$-V_{g(max)}$	50	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h\text{-}k'(r.m.s.)max}$	80	V
Maximum Heater to Cathode″ Voltage, Heater Negative	$V_{h\text{-}k''(max)}$	180*	V
Maximum Cathode Current	$I_{k(max)}$	25	mA
Maximum Grid to Cathode Resistance	$R_{g\text{-}k(max)}$	1·0	MΩ
Maximum Heater to Cathode Resistance	$R_{h\text{-}k(max)}$	20	kΩ

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 output section (a″, g″, k″). With grid current biasing for the grounded cathode input section (a′, g′, k′), the anode voltage across this section should not be more than 75V in the non-controlled condition.

*Maximum D.C. component 130V.

INTER-ELECTRODE CAPACITANCES

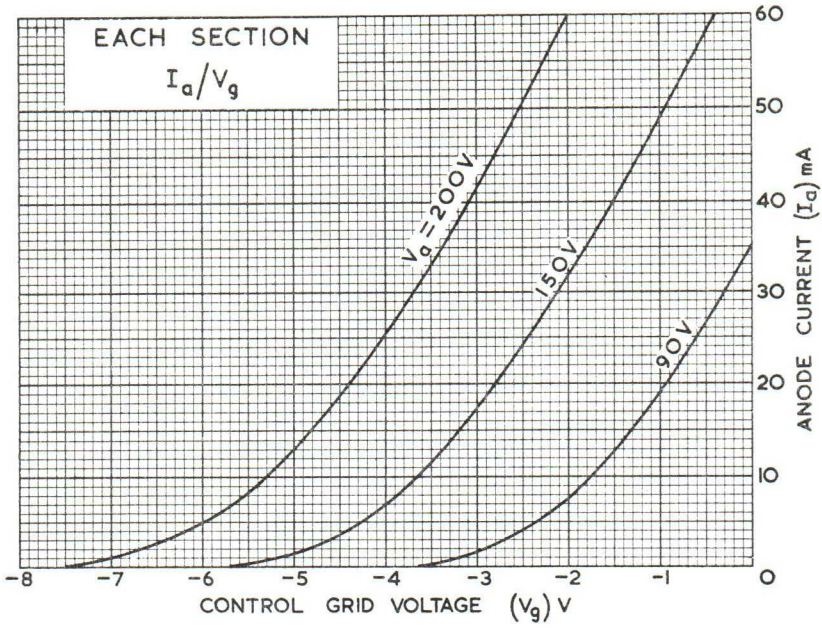
		†	‡	
Grid′to Cathode′, Heater and Shield	$c_{g'\text{-}k',h,s}$	3·3	3·3	pF
Anode′to Cathode′, Heater and Shield	$c_{a'\text{-}k',h,s}$	1·8	2·5	pF
Anode′to Grid′	$c_{a'\text{-}g'}$	1·4	1·4	pF
Grid′ to Heater	$c_{g'\text{-}h}$	0·13	0·13	pF
Cathode″ to Grid″, Heater and Shield	$c_{k''\text{-}g'',h,s}$	6·0	6·0	pF
Anode″ to Grid″, Heater and Shield	$c_{a''\text{-}g'',h,s}$	2·8	3·7	pF
Anode″ to Cathode″	$c_{a''\text{-}k''}$	0·18	0·16	pF
Anode″ to Grid″	$c_{a''\text{-}g''}$	1·4	1·4	pF
Cathode″ to Heater	$c_{k''\text{-}h}$	2·7	2·7	pF
Anode′ to Anode″	$c_{a'\text{-}a''}$	<0·045	<0·015	pF
Grid′ to Anode″	$c_{g'\text{-}a''}$	<0·005	<0·005	pF

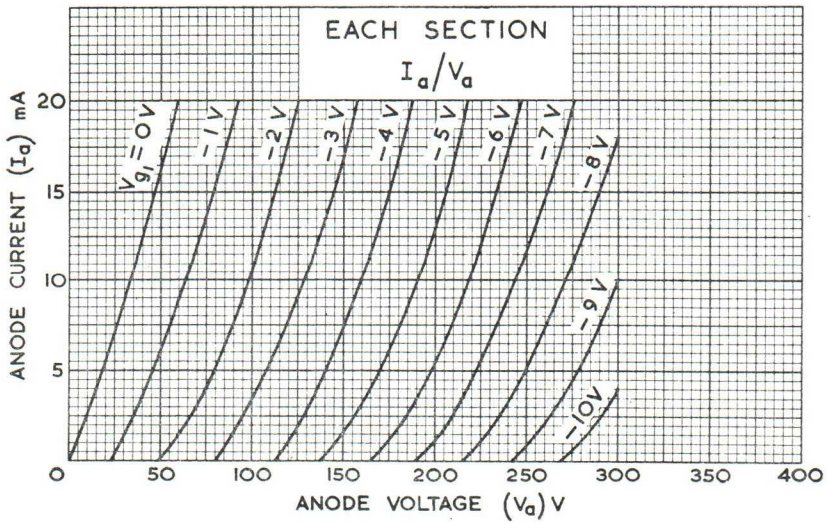
† Measured without an external shield.
‡ Measured with an external shield.

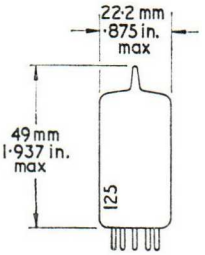
CHARACTERISTICS—Each Section

Anode Voltage	V_a	90	V
Grid Voltage	V_g	–1·3	V
Anode Current	I_a	15	mA
Mutual Conductance	g_m	12·5	mA/V
Amplification Factor	μ	33	
Equivalent Noise Resistance	R_{eq}	300	Ω

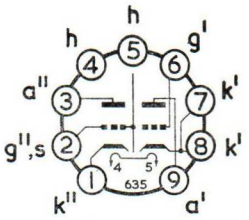
MOUNTING POSITION—Unrestricted


EACH SECTION
I_a/V_g
V_a = 200 V
150 V
90 V
60
50
40
30
20
10
0
ANODE CURRENT (I_a) mA
−8
−7
−6
−5
−4
−3
−2
−1
CONTROL GRID VOLTAGE (V_g) V


EACH SECTION
I_a/V_a
V_{g_1} = 0 V
−1 V
−2 V
−3 V
−4 V
−5 V
−6 V
−7 V
−8 V
−9 V
−10 V
ANODE CURRENT (I_a) mA
20
15
10
5
0
50
100
150
200
250
300
350
400
ANODE VOLTAGE (V_a) V



V.H.F. DOUBLE TRIODE



B9A Base

GENERAL

This variable-mu frame grid double triode is intended for use as a cascode R.F. amplifier at frequencies up to 220 MHz.

Heater Current	I_h	0·3 A
Heater Voltage	V_h	7·5 V

RATINGS—Each Section

Maximum Anode Dissipation	$P_{a(max)}$	1·8	W
Maximum Anode Voltage	$V_{a(max)}$	130	V
Maximum Negative Grid Voltage	$-V_{g(max)}$	50	V
Maximum Heater to Cathode″ Voltage Heater Negative	$V_{h\text{-}k''(max)}$	200	V
Maximum Cathode Current	$I_{k(max)}$	18	mA
Maximum Grid′ to Cathode′ Resistance	$R_{g'\text{-}k'(max)}$	1·0	MΩ
Maximum Grid″ to Cathode″ Resistance	$R_{g''\text{-}k''(max)}$	500	kΩ
Maximum Heater to Cathode Resistance	$R_{h\text{-}k(max)}$	20	kΩ

To fulfil hum requirements, $V_{h\text{-}k'(r.m.s.)}$ must be less than 50 V.

INTER-ELECTRODE CAPACITANCES*

Grid′ to Cathode′, Heater, Grid″, Shield	$c_{g'\text{-}k',h,g'',s}$	3·8	pF
Anode′ to Cathode′, Heater, Grid″, Shield	$c_{a'\text{-}k',h,g'',s}$	2·5	pF
Anode″ to Grid″, Heater, Shield	$c_{a''\text{-}g'',h,s}$	4·5	pF
Cathode″ to Grid″, Heater, Shield	$c_{k''\text{-}g'',h,s}$	6·3	pF
Anode′ to Grid′	$c_{a'\text{-}g'}$	1·9	pF
Grid′ to Heater	$c_{g'\text{-}h}$	<0·3	pF
Anode′ to Anode″	$c_{a'\text{-}a''}$	<0·015	pF
Grid′ to Anode″	$c_{g'\text{-}a''}$	<0·005	pF
Anode″ to Grid″	$c_{a''\text{-}g''}$	4·1	pF
Anode″ to Cathode″	$c_{a''\text{-}k''}$	<0·2	pF
Cathode″ to Heater	$c_{k''\text{-}h}$	2·9	pF

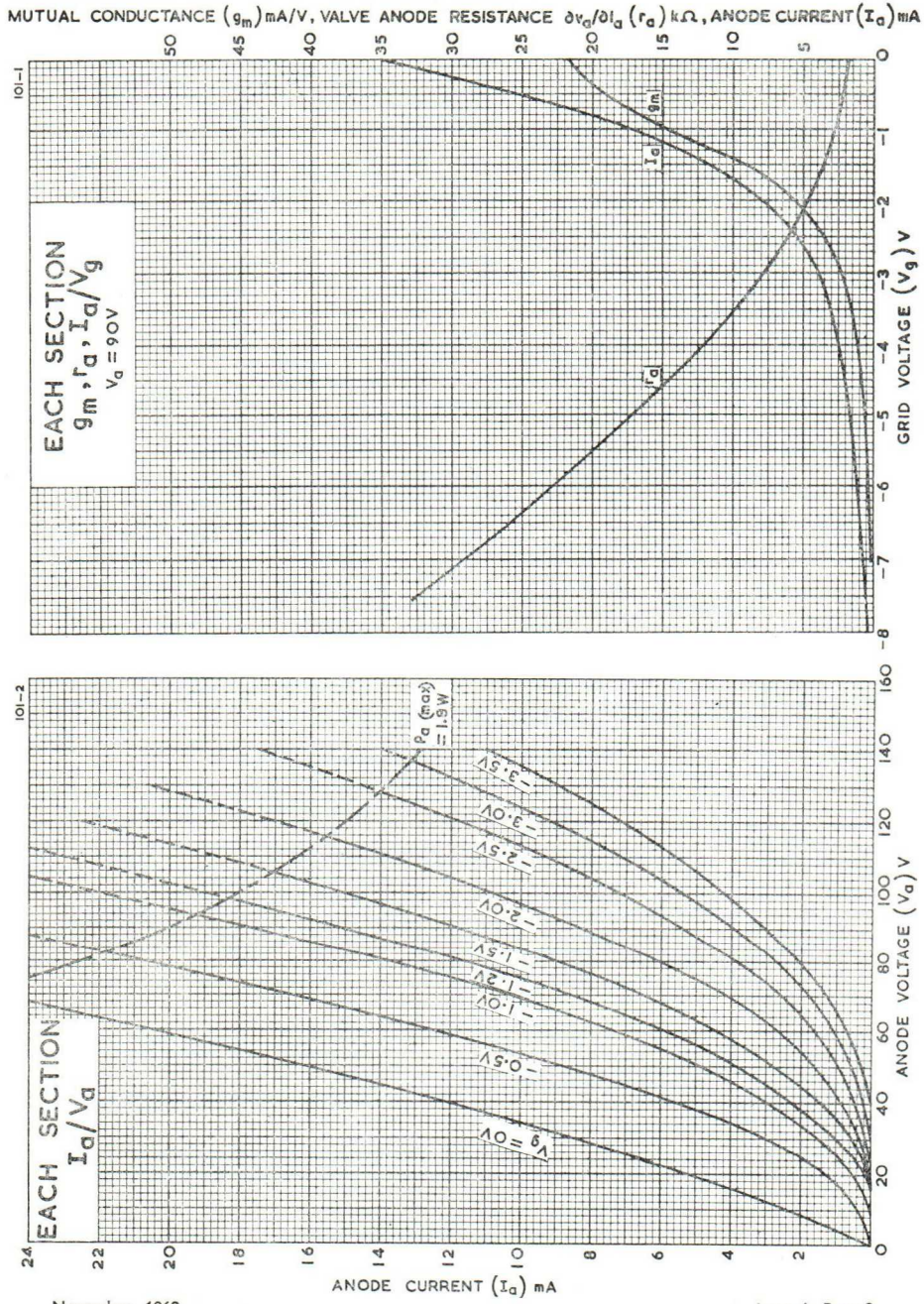
* Measured with an external shield.

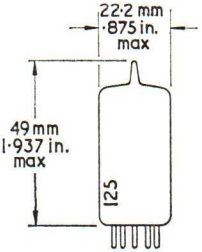
CHARACTERISTICS—Each Section

Anode Voltage	V_a	90	V
Grid Voltage	V_g	−1·2	V
Anode Current	I_a	15	mA
Mutual Conductance	g_m	12·3	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	2·9	kΩ
Amplification Factor	μ	36	

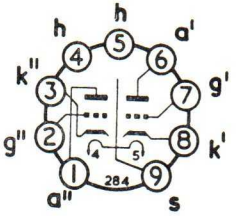
NOTE.—The triode on pins 6, 7, 8 and 9 should have the grounded cathode connection and that on pins 1, 2 and 3 should have the grounded grid connection. It is recommended that pins 7 and 8 be strapped.

THORN—A E I RADIO VALVES & TUBES LTD.


MUTUAL CONDUCTANCE (g_m) mA/V, VALVE ANODE RESISTANCE $\partial v_a/\partial I_a$ (r_a) kΩ, ANODE CURRENT (I_a) mA
101-1
EACH SECTION
g_m, r_a, I_a/V_g
V_a = 90V
g_m
I_a
r_a
GRID VOLTAGE (V_g) V
101-2
EACH SECTION
I_a/V_a
P_a (max) = 1.9W
V_g = 0V
-0.5V
-1.0V
-1.2V
-1.5V
-2.0V
-2.5V
-3.0V
-3.5V
ANODE VOLTAGE (V_a) V
ANODE CURRENT (I_a) mA



V.H.F.
HIGH SLOPE
DOUBLE TRIODE



B9A Base

GENERAL

This variable-mu, low noise, high slope frame grid double triode is intended for use as a V.H.F. cascode amplifier.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	7·6	V

RATINGS—Each Section

Maximum Anode Dissipation	$P_{a(max)}$	1·8	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	130	V
Maximum Negative Grid Voltage	$-V_{g(max)}$	50	V
Maximum Heater to Cathode′ Voltage	$V_{h\text{-}k'(max)}$	80	V
Maximum Heater to Cathode″ Voltage Heater Negative	$V_{h\text{-}k''(max)}$	180	V
Maximum Cathode Current	$I_{k(max)}$	22	mA
Maximum Grid′ to Cathode′ Resistance	$R_{g'\text{-}k'(max)}$	1·0	MΩ
Maximum Grid″ to Cathode″ Resistance	$R_{g''\text{-}k''(max)}$	500	kΩ
Maximum Heater to Cathode Resistance	$R_{h\text{-}k(max)}$	20	kΩ

INTER-ELECTRODE CAPACITANCES

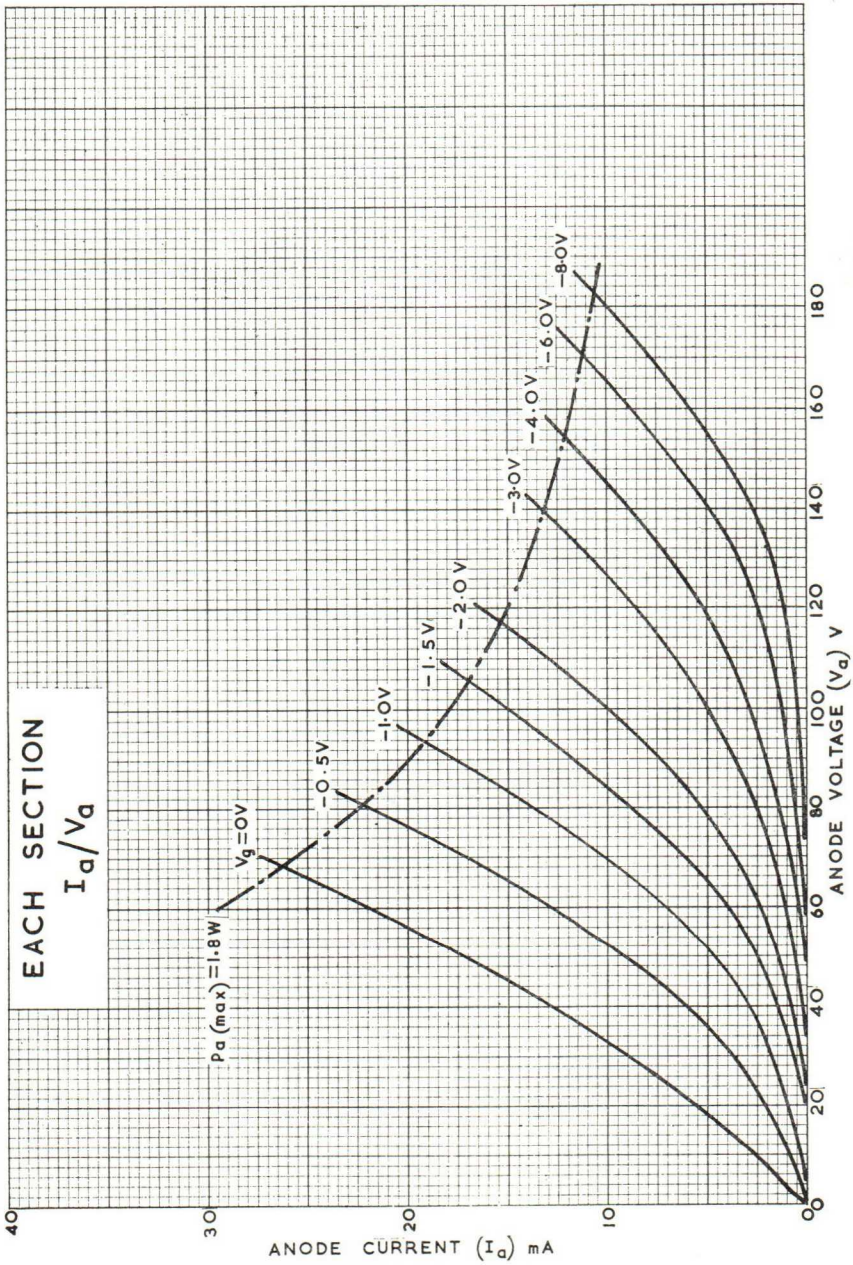
		Shielded	Unshielded	
Anode′ to Anode″	$c_{a'\text{-}a''}$	<0·015	<0·045	pF
Grid′ to Anode″	$c_{g'\text{-}a''}$	<0·004	<0·004	pF
Anode′ to Grid′	$c_{a'\text{-}g'}$	1·9	1·9	pF
Grid′ to Cathode′, Heater and Shield	$c_{g'\text{-}k',h,s}$	3·5	3·5	pF
Anode′ to Cathode′, Heater and Shield	$c_{a'\text{-}k',h,s}$	2·3	1·7	pF
Grid′ to Heater	$c_{g'\text{-}h}$	<0·28	<0·28	pF
Anode″ to Grid″	$c_{a''\text{-}g''}$	1·9	1·9	pF
Cathode″ to Grid″, Heater and Shield	$c_{k''\text{-}g'',h,s}$	6·0	6·0	pF
Anode″ to Grid″, Heater and Shield	$c_{a''\text{-}g'',h,s}$	4·0	3·4	pF
Cathode″ to Heater	$c_{k''\text{-}h}$	3·0	3·0	pF
Anode″ to Cathode″	$c_{a''\text{-}k''}$	0·17	0·18	pF

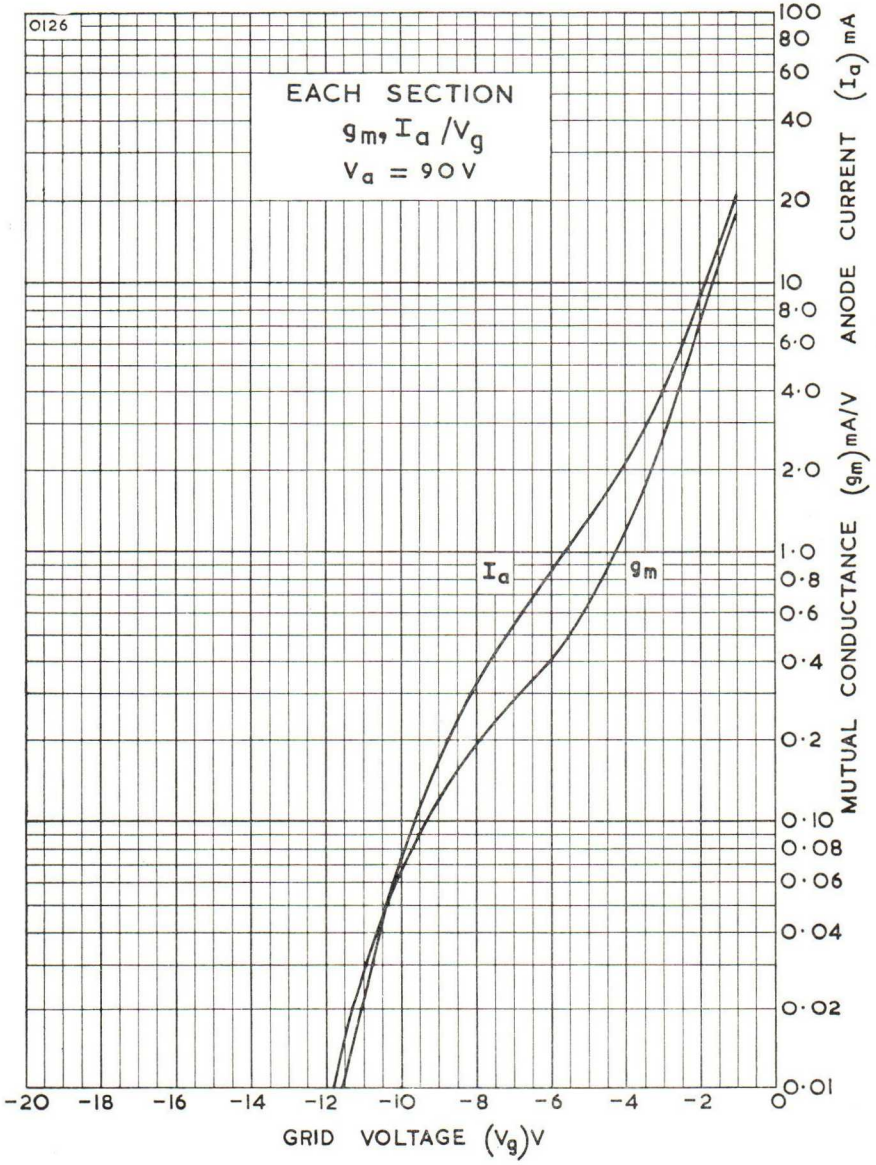
CHARACTERISTICS—Each Section

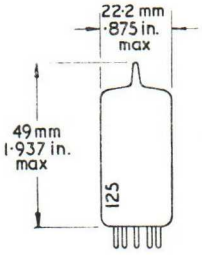
Anode Voltage	V_a	90	V
Grid Voltage	V_g	−1·4	V
Anode Current	I_a	15	mA
Mutual Conductance	g_m	12·5	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	2·5	kΩ
Amplification Factor	μ	34	
Grid Voltage for $g_m/20$	$V_{g(gm/20)}$	−5·0	V
Grid Voltage for $g_m/100$	$V_{g(gm/100)}$	−9·0	V

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

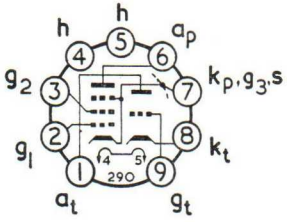
THORN—AEI RADIO VALVES & TUBES LTD.


EACH SECTION
I_a/V_a
P_a (max) = 1.8W
V_g=0V
-0.5V
-1.0V
-1.5V
-2.0V
-3.0V
-4.0V
-6.0V
-8.0V
ANODE CURRENT (I_a) mA
ANODE VOLTAGE (V_a) V
0
10
20
30
40
0
20
40
60
80
100
120
140
160
180


0126
EACH SECTION
$g_m, I_a / V_g$
$V_a = 90V$
I_a
g_m
100
80
60
40
20
10
8·0
6·0
4·0
2·0
1·0
0·8
0·6
0·4
0·2
0·10
0·08
0·06
0·04
0·02
0·01
ANODE CURRENT (I_a) mA
MUTUAL CONDUCTANCE (g_m) mA/V
−20 −18 −16 −14 −12 −10 −8 −6 −4 −2 0
GRID VOLTAGE (V_g) V



TRIODE PENTODE V.H.F. FREQUENCY CHANGER



B9A Base

GENERAL

This triode pentode is intended for use as a frequency changer in television receivers.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	9·5	V (nominal)

RATINGS

		Pentode	Triode	
Maximum Anode Dissipation	$p_{a(max)}$	2·8	2·7	W
Maximum Screen Grid Dissipation	$p_{g2(max)}$	0·5	—	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	550	V
Maximum Anode Voltage	$V_{a(max)}$	300	300	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	300	—	V
Maximum Positive D.C. Control Grid Voltage	$V_{g1(max)}$	0	0	V
Maximum Cathode Current	$I_{k(max)}$	20	20	mA
Maximum Grid Resistance	$R_{g(max)}$	1·0	1·0	MΩ
Maximum Heater to Cathode Voltage	$V_{h\text{-}k(max)}$			
Heater Negative			220	V
Heater Positive			90	V

INTER-ELECTRODE CAPACITANCES—With External Shield

Grid 1 to Anode Pentode	$c_{g1\text{-}ap}$	0·006	pF
Pentode Input	$c_{in(p)}$	5·0	pF
Pentode Output	$c_{out(p)}$	3·5	pF
Triode Grid to Triode Anode	$c_{gt\text{-}at}$	1·8	pF
Triode Grid to Cathode	$c_{gt\text{-}k}$	2·5	pF
Triode Anode to Cathode	$c_{at\text{-}k}$	1·0	pF
Cathode to Heater (each section) approximately	$c_{k\text{-}h}$	3·0	pF

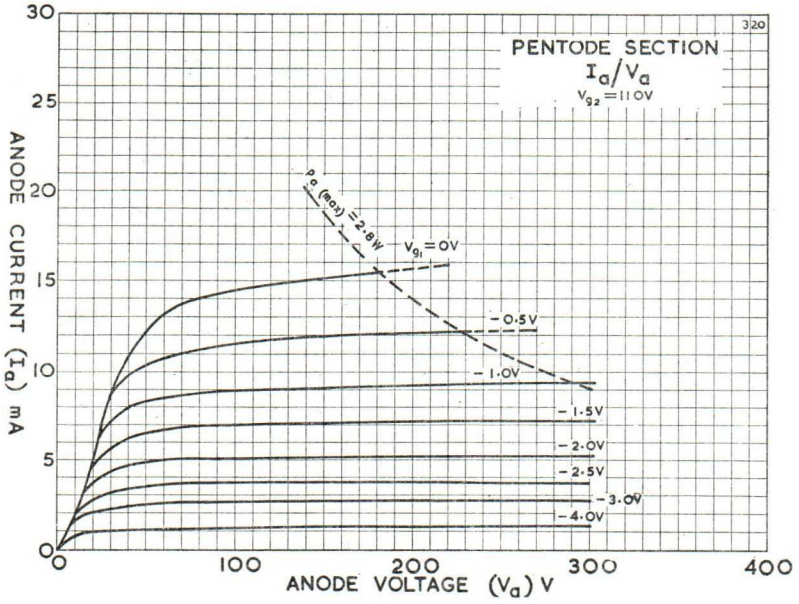
CHARACTERISTICS

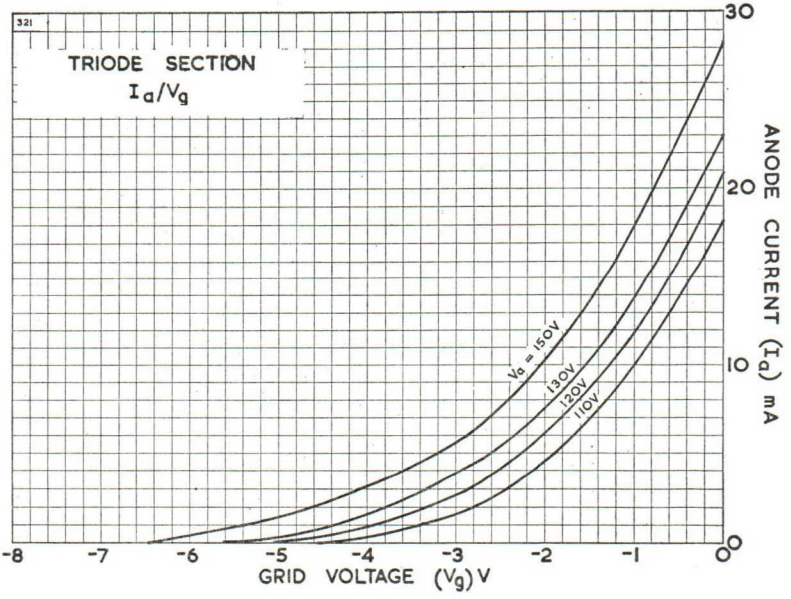
		Pentode	Triode	
Anode Voltage	V_a	250	150	V
Screen Grid Voltage	V_{g2}	110	—	V
Anode Current	I_a	10	18	mA
Screen Grid Current	I_{g2}	3·5	—	mA
Cathode Bias Resistance	R_k	68	56	Ω
Mutual Conductance	g_m	5·2	8·5	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$) approximately	r_a	400	5·0	kΩ
Amplification Factor	μ	—	40	
Control Grid Voltage for $I_a = 10\ \mu A$	$V_{g1(Ia=10\mu A)}$	−10	−12	V

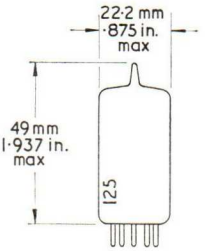
TYPICAL OPERATION—As a Mixer

			Pentode		Triode	
Anode Voltage	V_a	170	170	100		V
Screen Grid Voltage	V_{g2}	110	170	—		V
Anode Current	I_a	5·5	6·6	7·0		mA
Screen Grid Current	I_{g2}	2·0	2·5	—		mA
Cathode Bias Resistance	R_k	0	680	0		Ω
Grid Leak Resistor	R_g	270	100	27		kΩ
Peak Heterodyne Voltage	$v_{het(pk)}$	3·0	5·0	—		V
Conversion Conductance	g_c	1·6	1·65	—		mA/V

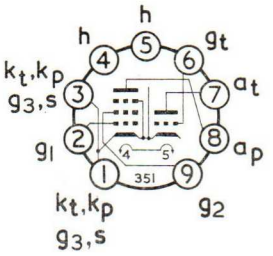
THORN—AEI RADIO VALVES & TUBES LTD.


320
PENTODE SECTION
I_a/V_a
$V_{g2}=110V$
P_a (max) = 2.8W
$V_{g1}=0V$
-0·5V
-1·0V
-1·5V
-2·0V
-2·5V
-3·0V
-4·0V
ANODE CURRENT (I_a) mA
ANODE VOLTAGE (V_a) V
0
5
10
15
20
25
30
100
200
300
400


321
TRIODE SECTION
I_a/V_g
V_a = 150V
130V
120V
110V
ANODE CURRENT (I_a) mA
GRID VOLTAGE (V_g) V
0
10
20
30
-8
-7
-6
-5
-4
-3
-2
-1
0



V.H.F. TRIODE PENTODE



B9A Base

GENERAL

This triode pentode is designed for use as a V.H.F. frequency changer. It has high conversion conductance and input impedance at 200 Mc/s.

Heater Current	I_h	0·3 A
Heater Voltage	V_h	8·0 V

RATINGS

		Pentode	Triode	
Maximum Anode Dissipation	$P_{a(max)}$	2·0	1·5	W
Maximum Screen Grid Dissipation	$P_{g_2(max)}$	0·5	—	W
Maximum Anode Voltage	$V_{a(max)}$	250	125	V
Maximum Screen Grid Voltage	$V_{g_2(max)}$	150	—	V
Maximum Heater to Cathode Voltage	$V_{h\text{-}k(max)}$	—	100*	V
Maximum Cathode Current	$I_{k(max)}$	18	15	mA
Maximum Grid to Cathode Resistance	$R_{g_1\text{-}k(max)}$	250	500	kΩ

* To fulfil hum requirements on A.M. sound, it will be necessary for $V_{h\text{-}k}$ to be less than 50 V r.m.s. For intercarrier receivers $V_{h\text{-}k}$ should not exceed 75 V r.m.s.

INTER-ELECTRODE CAPACITANCES†

Input Pentode	$c_{in(p)}$	5·8	pF
Output Pentode	$c_{out(p)}$	3·5	pF
Grid 1 to Anode Pentode	$c_{g_1\text{-}ap}$	0·012	pF
Grid 1 to Grid 2	$c_{g_1\text{-}g_2}$	1·7	pF
Grid Triode to Anode Triode	$c_{gt\text{-}at}$	2·0	pF
Grid Triode to Cathode and Heater	$c_{gt\text{-}k,h}$	2·4	pF
Anode Triode to Cathode and Heater	$c_{at\text{-}k,h}$	1·1	pF
Anode Pentode to Anode Triode	$c_{ap\text{-}at}$	0·125	pF
Anode Pentode to Grid Triode	$c_{ap\text{-}gt}$	0·014	pF
Grid 1 to Anode Triode	$c_{g_1\text{-}at}$	<0·01	pF
Grid 1 to Grid Triode	$c_{g_1\text{-}gt}$	<0·01	pF

† Measured without an external shield.

CHARACTERISTICS

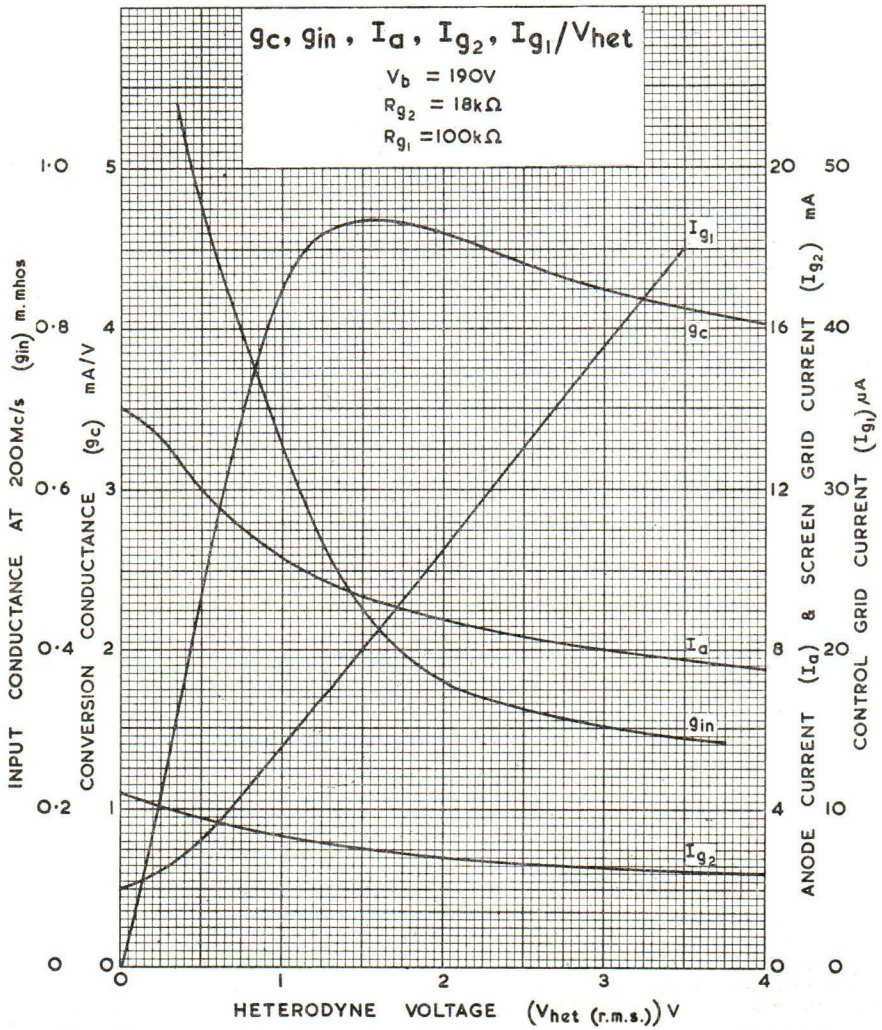
		Pentode	Triode	
Anode Voltage	V_a	170	100	V
Screen Grid Voltage	V_{g_2}	150	—	V
Control Grid Voltage	V_{g_1}	−1·2	−3·0	V
Anode Current	I_a	10	14	mA
Screen Grid Current	I_{g_2}	3·3	—	mA
Mutual Conductance	g_m	12	5·7	mA/V
Amplification Factor	μ	—	17	
Inner Amplification Factor	$\mu_{g_1\text{-}g_2}$	70	—	
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	>350	—	kΩ
Equivalent Grid Noise Resistance	R_{eq}	1·0	—	kΩ

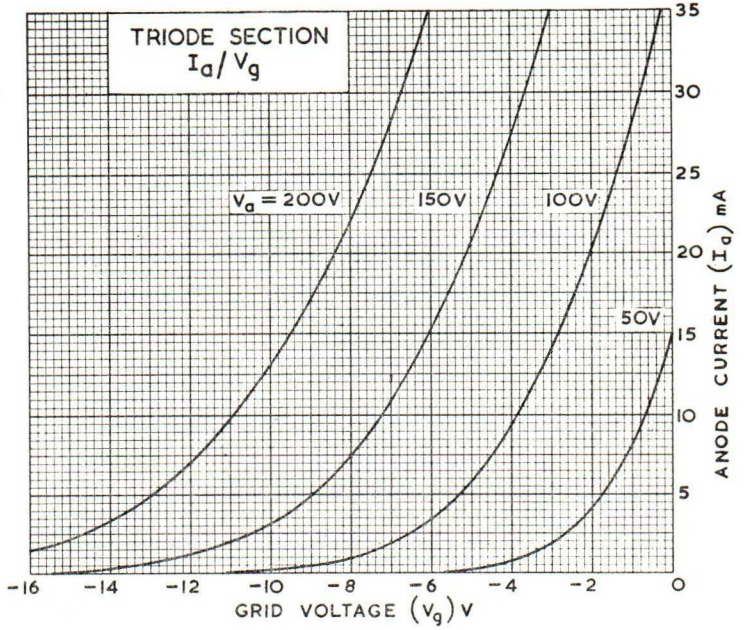
THORN—AEI RADIO VALVES & TUBES LTD.

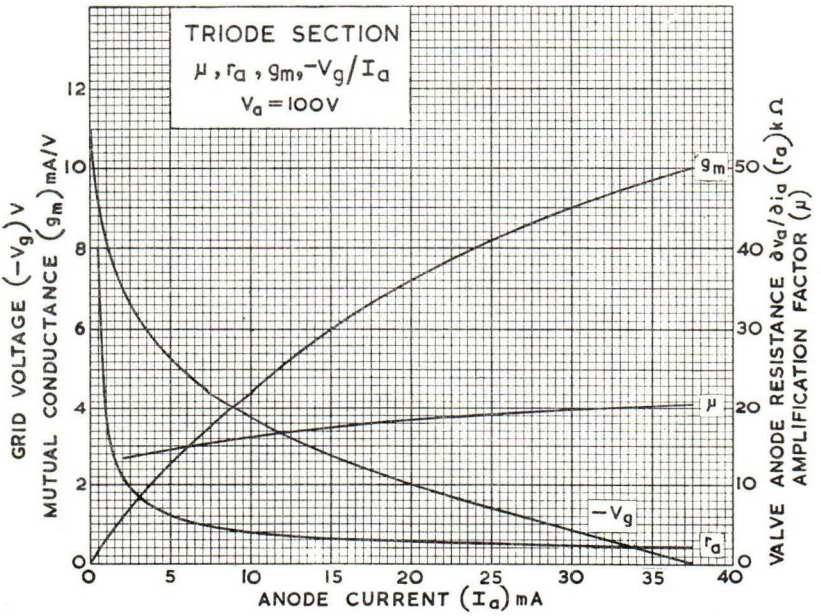
TYPICAL OPERATION—As a Frequency Changer

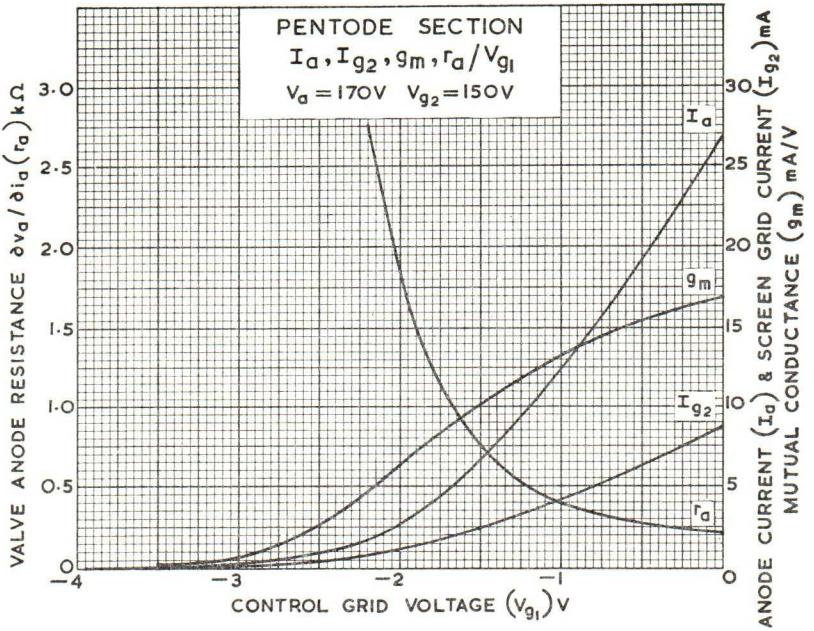
Anode Voltage	V_a	190	V
Screen Supply Voltage (R_{g_2} = 18kΩ)	$V_{g_{2(b)}}$	190	V
Control Grid Resistance	R_{g_1}	100	kΩ
Heterodyne Voltage (R.M.S.)	$V_{het(r.m.s.)}$	2·3	V
Anode Current	I_a	8·5	mA
Screen Grid Current	I_{g_2}	2·7	mA
Conversion Conductance	g_c	4·5	mA/V

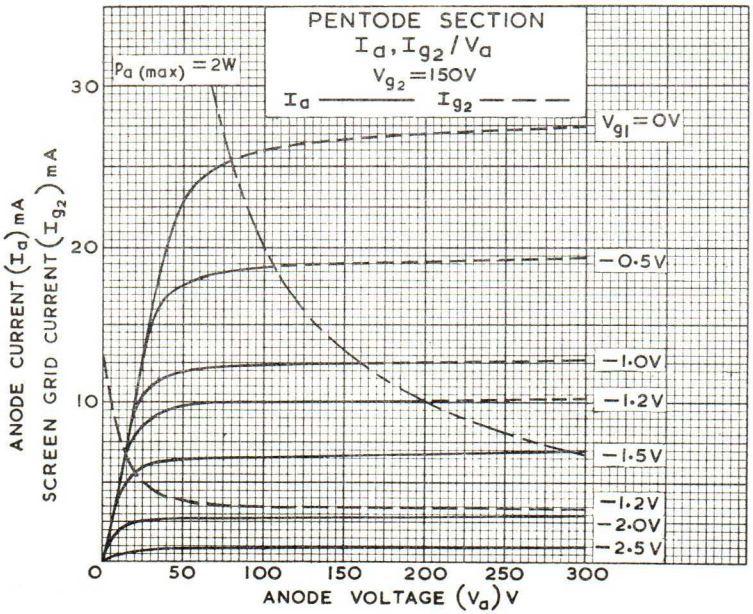
MOUNTING POSITION:—Unrestricted

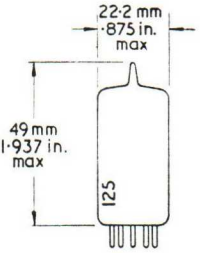



TRIODE SECTION
I_a / V_g
$V_a = 200V$
150V
100V
50V
ANODE CURRENT (I_a) mA
GRID VOLTAGE (V_g) V
35
30
25
20
15
10
5
0
−16
−14
−12
−10
−8
−6
−4
−2

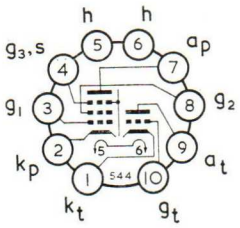

TRIODE SECTION
$\mu, r_a, g_m, -V_g / I_a$
$V_a = 100V$
GRID VOLTAGE $(-V_g)$ V
MUTUAL CONDUCTANCE (g_m) mA/V
VALVE ANODE RESISTANCE $\partial v_a / \partial i_a$ (r_a) kΩ
AMPLIFICATION FACTOR (μ)
ANODE CURRENT (I_a) mA
g_m
μ
$-V_g$
r_a
12
10
8
6
4
2
0
50
40
30
20
10
0
5
10
15
20
25
30
35
40


PENTODE SECTION
$I_a, I_{g_2}, g_m, r_a / V_{g_1}$
$V_a = 170V$ $V_{g_2} = 150V$
VALVE ANODE RESISTANCE $\delta v_a / \delta i_a$ (r_a) kΩ
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
MUTUAL CONDUCTANCE (g_m) mA/V
I_a
g_m
I_{g_2}
r_a
CONTROL GRID VOLTAGE (V_{g_1}) V


PENTODE SECTION
$I_a, I_{g_2} / V_a$
$V_{g_2} = 150V$
I_a ——— I_{g_2} — — —
P_a (max) = 2W
$V_{g_1} = 0V$
−0·5V
−1·0V
−1·2V
−1·5V
−1·2V
−2·0V
−2·5V
ANODE CURRENT (I_a) mA
SCREEN GRID CURRENT (I_{g_2}) mA
ANODE VOLTAGE (V_a) V



TRIODE PENTODE



B10B Base

GENERAL

This triode pentode is intended for use in television receivers with the triode as a limiter, noise detector, a.g.c. amplifier, sync. separator or pulse amplifier and the pentode as a sound or video i.f. amplifier.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	8·5	V

DESIGN CENTRE RATINGS

		Triode	Pentode	
Maximum Anode Dissipation	$P_{a(max)}$	1·5	2·1	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	—	0·75	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	550	V
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Peak Anode Voltage (I_a <0·1 mA)	$v_{a(pk)max}$	600*	—	V
Maximum Screen Grid Supply Voltage	$V_{g2(b)max}$	—	550	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	—	250	V
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$			
Heater positive		150	150	V
Heater negative		350†	150	V
Maximum Cathode Current	$I_{k(max)}$	18	20	mA
Maximum Control Grid Resistance	$R_{g1(max)}$	1·0	1·0	MΩ

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

† Comprising d.c. maximum of 200V and 150V r.m.s.

INTER-ELECTRODE CAPACITANCES

Triode Input	$c_{in(t)}$	2·1	pF
Triode Output	$c_{out(t)}$	3·0	pF
Triode Anode to Triode Grid	c_{at-gt}	2·2	pF
Pentode Input	$c_{in(p)}$	6·0	pF
Pentode Output	$c_{out(p)}$	3·3	pF
Pentode Anode to Grid 1	c_{ap-g1}	0·0056	pF
Pentode Anode to Grid 1	c_{ap-g1}	<0·008	pF
Pentode Grid 1 to Grid 2	c_{g1-g2}	1·7	pF
Pentode Grid 1 to Cathode	c_{g1-kp}	3·7	pF
Pentode Anode to Triode Anode	c_{ap-at}	<0·015	pF
Pentode Grid 1 to Triode Anode	c_{g1-at}	<0·0012	pF
Pentode Grid 1 to Triode Grid	c_{g1-gt}	<0·0015	pF

THORN RADIO VALVES AND TUBES LTD.

CHARACTERISTICS

		Triode	Pentode	
Anode Voltage	V_a	170	160	V
Suppressor Grid Voltage	V_{g3}	—	0	V
Screen Grid Voltage	V_{g2}	—	135	V
Control Grid Voltage	V_{g1}	−1·0	−1·7	V
Anode Current	I_a	8·5	13	mA
Screen Grid Current	I_{g2}	—	5·3	mA
Mutual Conductance	g_m	5·2	14	mA/V
Inner Amplification Factor	μ_{g1-g2}	—	53	
Amplification Factor	μ	57	—	

TYPICAL OPERATION

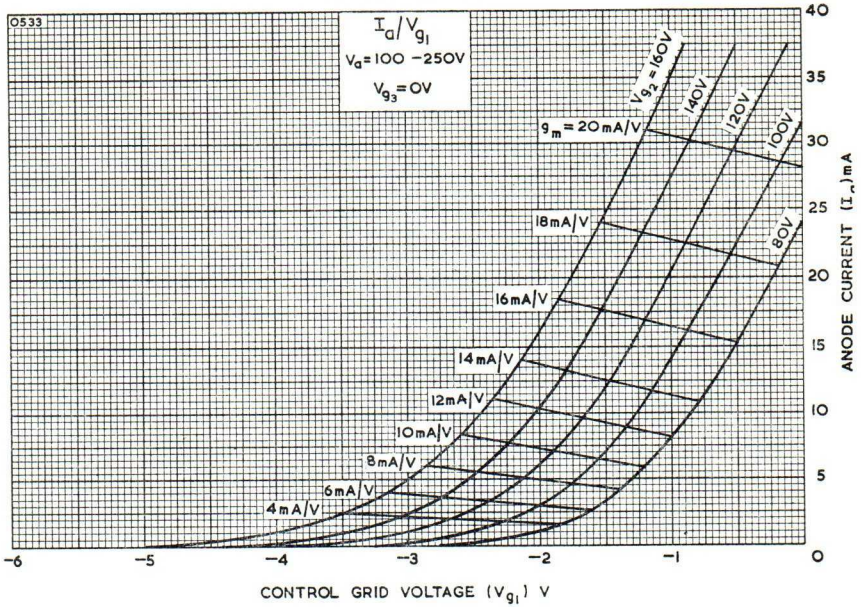
Pentode as Sound or Video I.F. Amplifier (g_3 earthed)

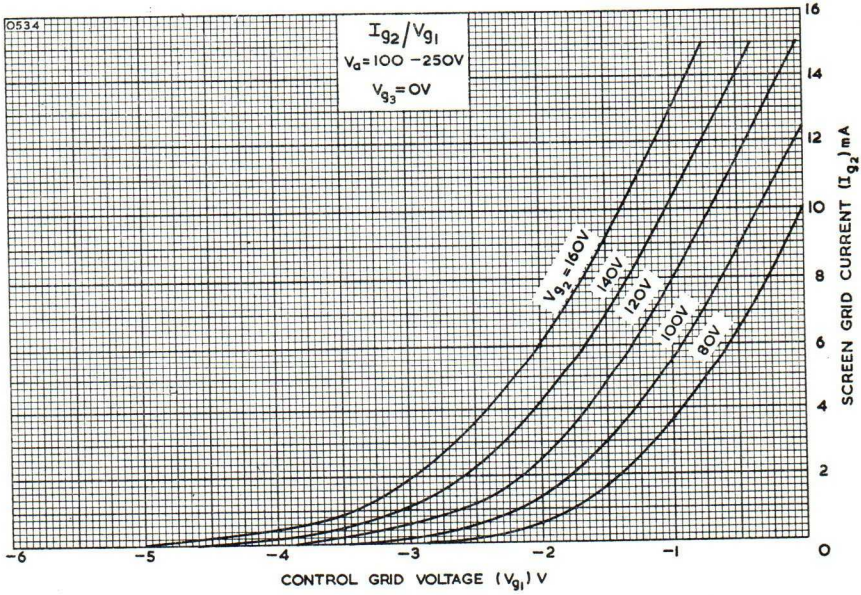
Supply Voltage	V_b	210	230	V
Anode Load Resistance	R_a	3·9	5·6	kΩ
Screen Grid Resistance	R_{g2}	15	22	kΩ
Cathode Bias Resistance	R_k	91	83	Ω
Anode Current	I_a	13	12·5	mA
Screen Grid Current	I_{g2}	5·3	5·1	mA
Mutual Conductance	g_m	14	14	mA/V
Input Resistance at 40 MHz	R_{in}	6·6	6·6	kΩ

Triode as Sync. Separator

Anode Supply Voltage	$V_{a(b)}$	130 to 150	V
Anode Load Resistance	R_a	33	kΩ
Anode Current	I_a	>2·0	mA
Grid Current	I_g	1·0	μA

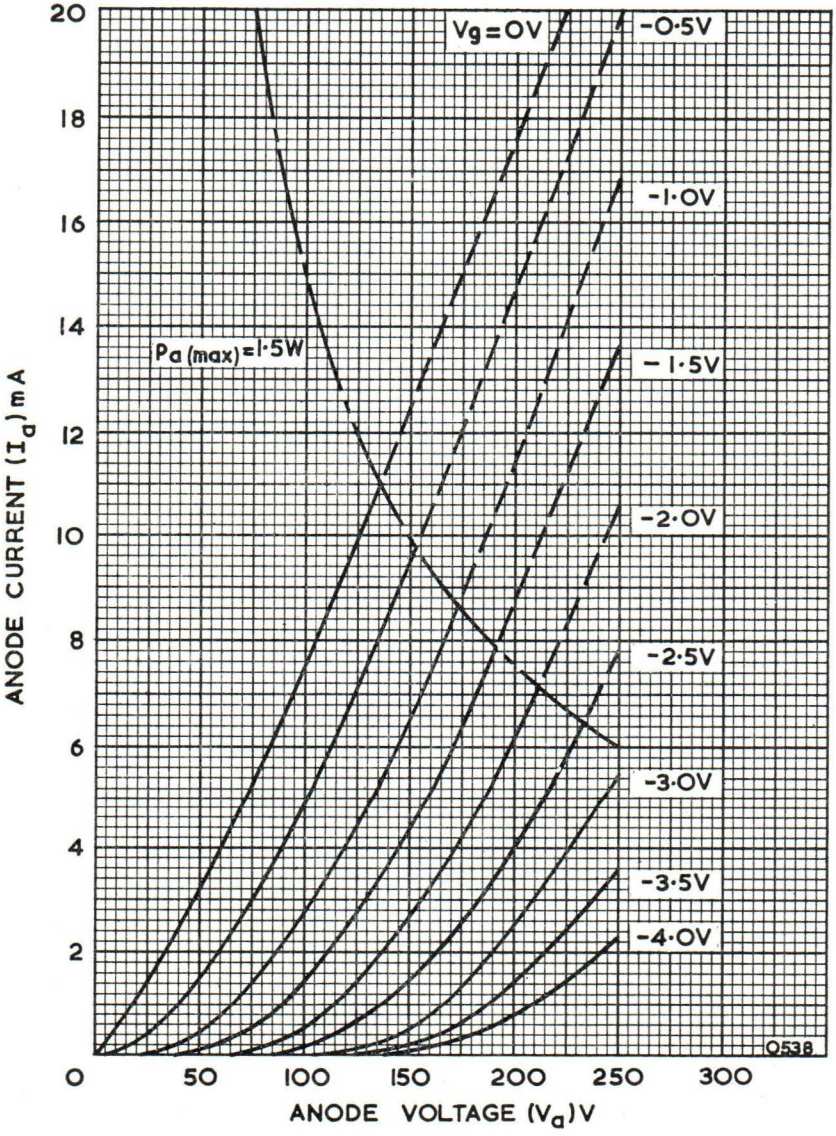
PENTODE SECTION

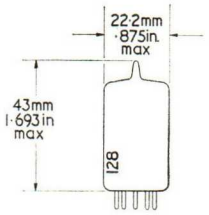




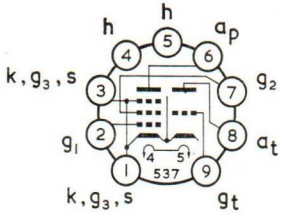
TRIODE SECTION

I_a/V_a





V.H.F. TRIODE PENTODE



B9A Base

GENERAL

This combined triode and variable-mu, frame grid pentode is for use as a frequency changer and I.F. amplifier at frequencies up to 200 Mc/s in television receivers.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	8·5	V

RATINGS

		Triode	Pentode	
Maximum Anode Dissipation	$p_{a(max)}$	1·5	2·0	W
Maximum Screen Grid Dissipation (V_{g_1}=0 V)	$p_{g_2(max)}$	—	0·45†	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	550	V
Maximum Anode Voltage	$V_{a(max)}$	125	250	V
Maximum Screen Grid Supply Voltage	$V_{g_2(b)max}$	—	550	V
Maximum Screen Grid Voltage	$V_{g_2(max)}$	—	250	V
Maximum Heater to Cathode Voltage	$V_{h\text{-}k(max)}$	100*	100*	V
Maximum Negative Control Grid Voltage	$-V_{g_1(max)}$	50	50	V
Maximum Cathode Current	$I_{k(max)}$	20	18	mA
Maximum Grid to Cathode Resistance	$R_{g\text{-}k(max)}$	0·5	1·0	MΩ

* To fulfil hum requirements on A.M. sound it will be necessary for $V_{h\text{-}k}$ to be less than 50 V r.m.s.

† For V_{g_1} equal to or more negative than 5·2 V then $p_{g_2(max)}$ = 0·2 W.

INTER-ELECTRODE CAPACITANCES (Shielded)

Pentode Input	$c_{in(p)}$	6·2	pF
Pentode Output	$c_{out(p)}$	3·7	pF
Pentode Anode to Grid 1	$c_{ap\text{-}g_1}$	0·009	pF
Pentode Anode to Grid 1	$c_{ap\text{-}g_1}$	<0·012	pF
Grid 1 to Grid 2	$c_{g_1\text{-}g_2}$	1·6	pF
Triode Input	$c_{in(t)}$	3·3	pF
Triode Output	$c_{out(t)}$	1·7	pF
Anode Triode to Grid Triode	$c_{at\text{-}gt}$	1·8	pF
Anode Pentode to Anode Triode	$c_{ap\text{-}at}$	<0·025	pF
Anode Pentode to Grid Triode	$c_{ap\text{-}gt}$	<0·010	pF
Grid 1 to Anode Triode	$c_{g_1\text{-}at}$	<0·010	pF
Grid 1 to Grid Triode	$c_{g_1\text{-}gt}$	<0·010	pF

CHARACTERISTICS

		Triode	Pentode	
Anode Voltage	V_a	100	170	V
Screen Grid Voltage	V_{g_2}	—	120	V
Control Grid Voltage	V_{g_1}	−3·0	−1·4	V
Anode Current	I_a	15	10	mA
Screen Grid Current	I_{g_2}	—	3·0	mA
Mutual Conductance	g_m	9·0	11	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	2·2	>350	kΩ
Inner Amplification Factor	$\mu_{g_1\text{-}g_2}$	—	55	
Amplification Factor	μ	20	—	
Equivalent Grid Noise Resistance	R_{eq}	—	1·5	kΩ

THORN—AEI RADIO VALVES & TUBES LTD.

TYPICAL OPERATION

Pentode as Frequency Changer

Anode Supply Voltage	$V_{a(b)}$	200	200	V
Screen Grid Supply Voltage	$V_{g2(b)}$	200	200	V
Anode Load Resistance	R_a	2·7	4·7	kΩ
Screen Grid Resistance	R_{g2}	27	27	kΩ
Control Grid Resistance	R_{g1}	0·1	1·0	MΩ
Anode Current	I_a	10	9·3	mA
Screen Grid Current	I_{g2}	3·0	2·9	mA
Control Grid Current	I_{g1}	8·0	2·3	μA
Control Grid Supply Voltage	$V_{g1(b)}$	−1·4	0	V
R.M.S. Heterodyne Voltage	$V_{het(r.m.s.)}$	1·6	1·6	V
Conversion Conductance	g_c	5·0	4·7	mA/V

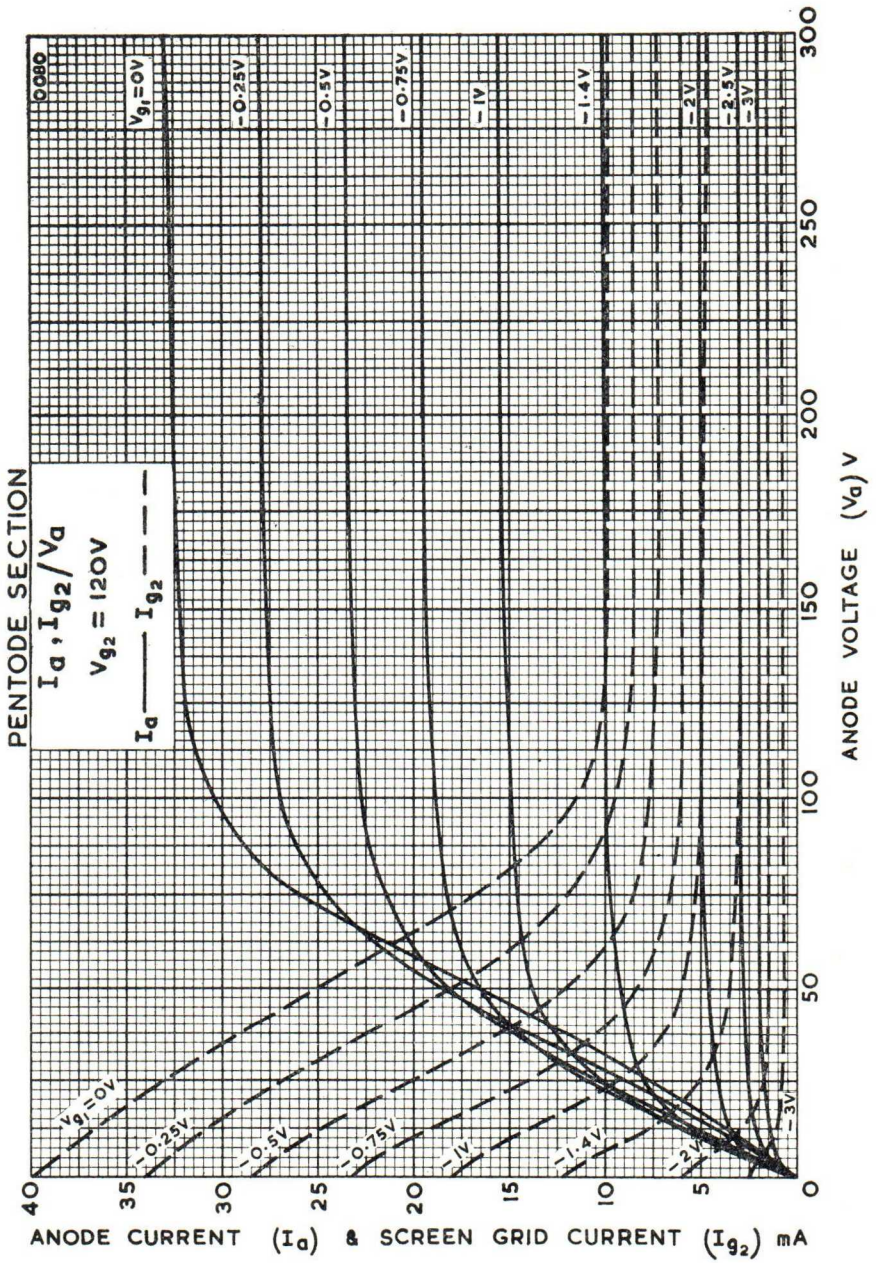
Pentode as I.F. Amplifier

Anode Supply Voltage	$V_{a(b)}$	200	200	V
Screen Grid Supply Voltage	$V_{g2(b)}$	200	200	V
Anode Load Resistance	R_a	2·7	4·7	kΩ
Screen Grid Resistance	R_{g2}	27	27	kΩ
Control Grid Resistance	R_{g1}	0·1	1·0	MΩ
Anode Current	I_a	10	13	mA
Screen Grid Current	I_{g2}	3·0	3·9	mA
Control Grid Supply Voltage	$V_{g1(b)}$	−1·4	0	V
Mutual Conductance	g_m	11	14·5	mA/V
Control Grid Voltage for g_m = 0·11 mA/V	V_{g1}	−12	—	V
Input Resistance at 50 Mc/s	R_{in}	10	10	kΩ

Triode as Oscillator

Anode Supply Voltage	$V_{a(b)}$	200	200	V
Anode Load Resistance	R_a	8·2	12	kΩ
Grid Resistance	R_g	10	10	kΩ
R.M.S. Heterodyne Voltage	$V_{het(r.m.s.)}$	4·5	3·3	V
Anode Current	I_a	16	12	mA
Mutual Conductance	g_m	3·7	3·7	mA/V

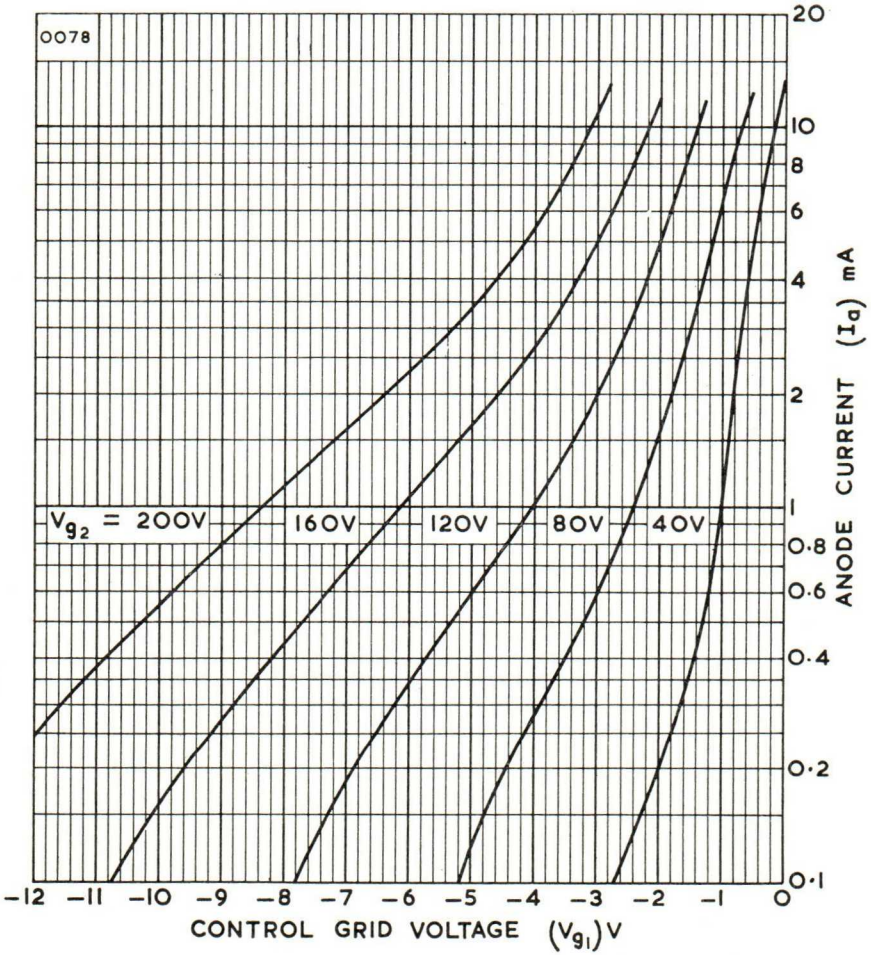
MOUNTING POSITION—Unrestricted


PENTODE SECTION
Ia, Ig2/Va
Vg2 = 120V
Ia ——— Ig2 - - - -
Vg1=0V
-0·25V
-0·5V
-0·75V
-1V
-1·4V
-2V
-2·5V
-3V
ANODE VOLTAGE (Va) V
300
250
200
150
100
50
0
ANODE CURRENT (Ia) & SCREEN GRID CURRENT (Ig2) mA
40
35
30
25
20
15
10
5
0

PENTODE SECTION

I_a / V_{g1}

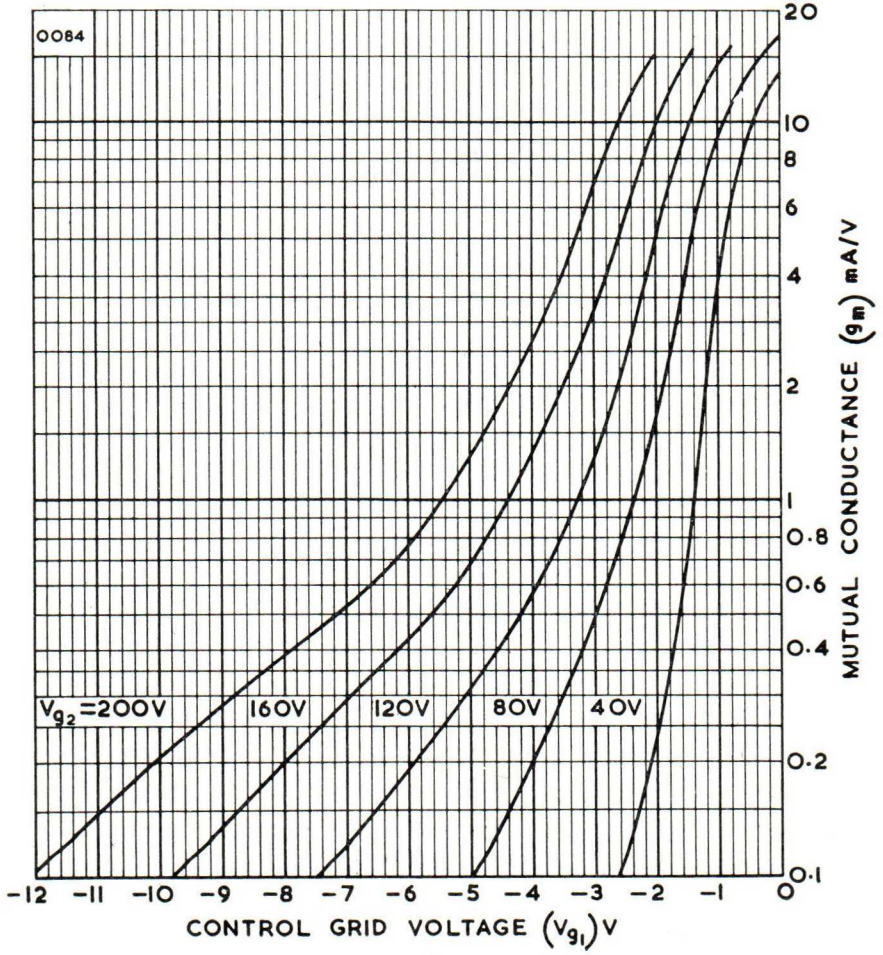
V_a = 170V



PENTODE SECTION

g_m / V_{g_1}

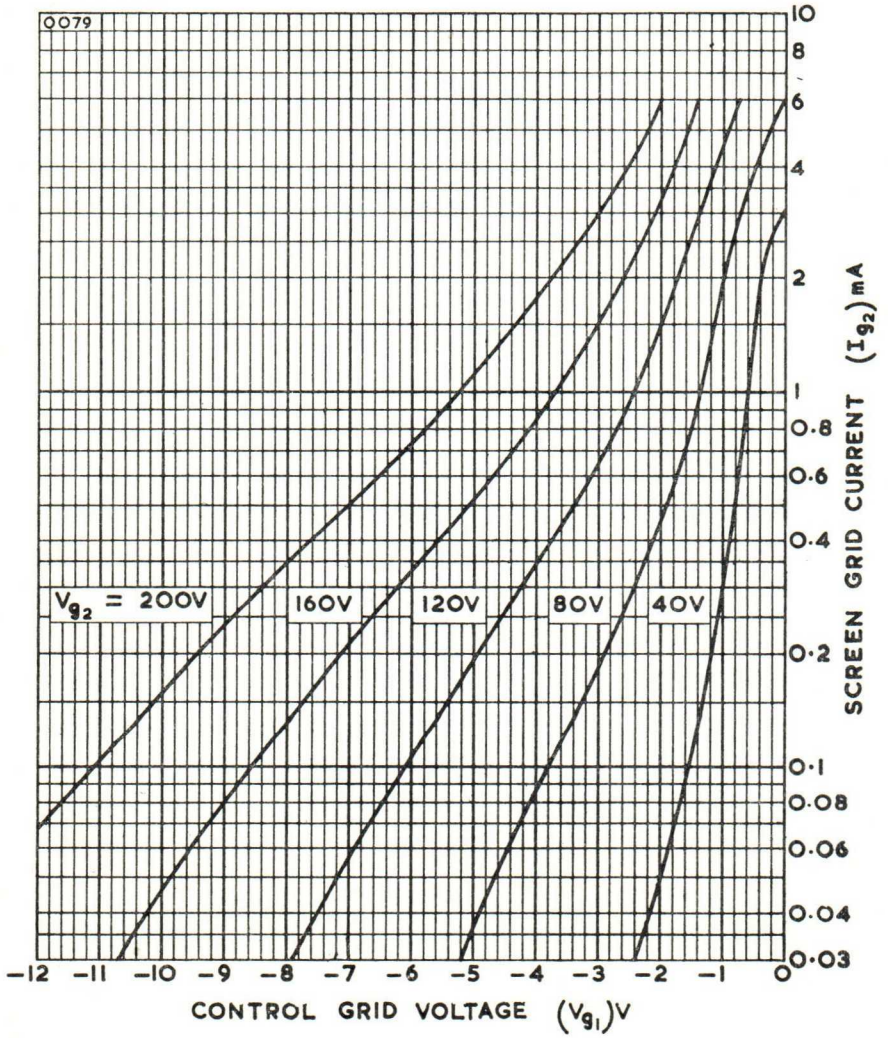
$V_a = 170V$

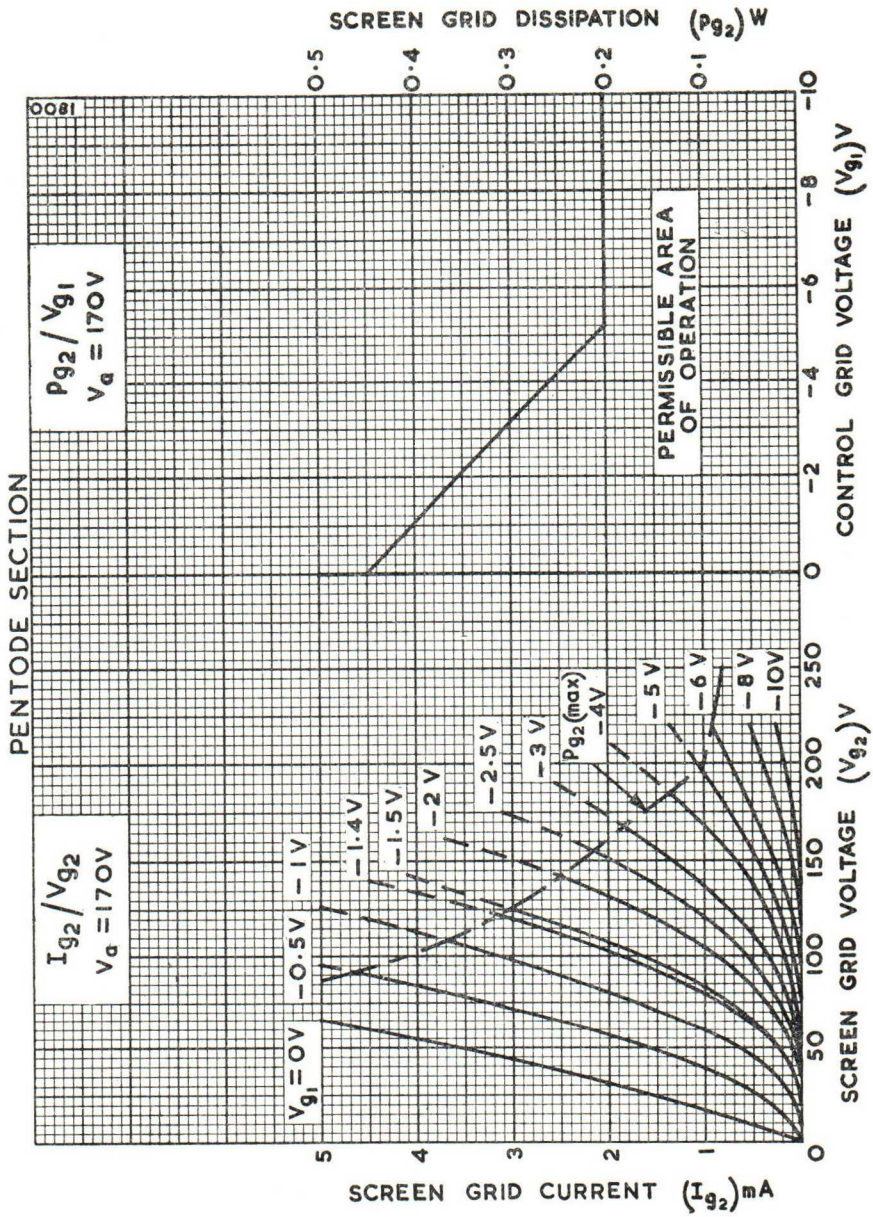


PENTODE SECTION

I_{g2} / V_{g1}

V_a = 170V




SCREEN GRID DISSIPATION (P_{g_2}) W
0·5
0·4
0·3
0·2
0·1
0081
P_{g_2}/V_{g_1}
V_a = 170V
PERMISSIBLE AREA OF OPERATION
CONTROL GRID VOLTAGE (V_{g_1}) V
-10
-8
-6
-4
-2
0
PENTODE SECTION
I_{g_2}/V_{g_2}
V_a = 170V
V_{g_1} = 0V
-0·5V
-1V
-1·4V
-1·5V
-2V
-2·5V
-3V
P_{g_2}(max)
-4V
-5V
-6V
-8V
-10V
SCREEN GRID VOLTAGE (V_{g_2}) V
0
50
100
150
200
250
SCREEN GRID CURRENT (I_{g_2}) mA
5
4
3
2
1
0

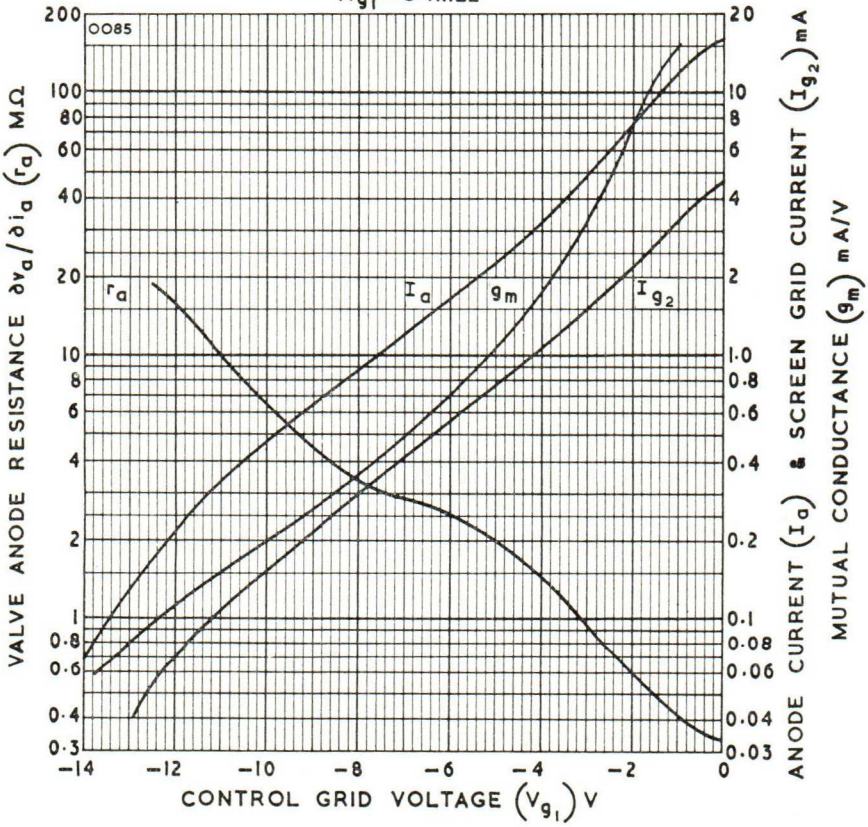
PENTODE SECTION

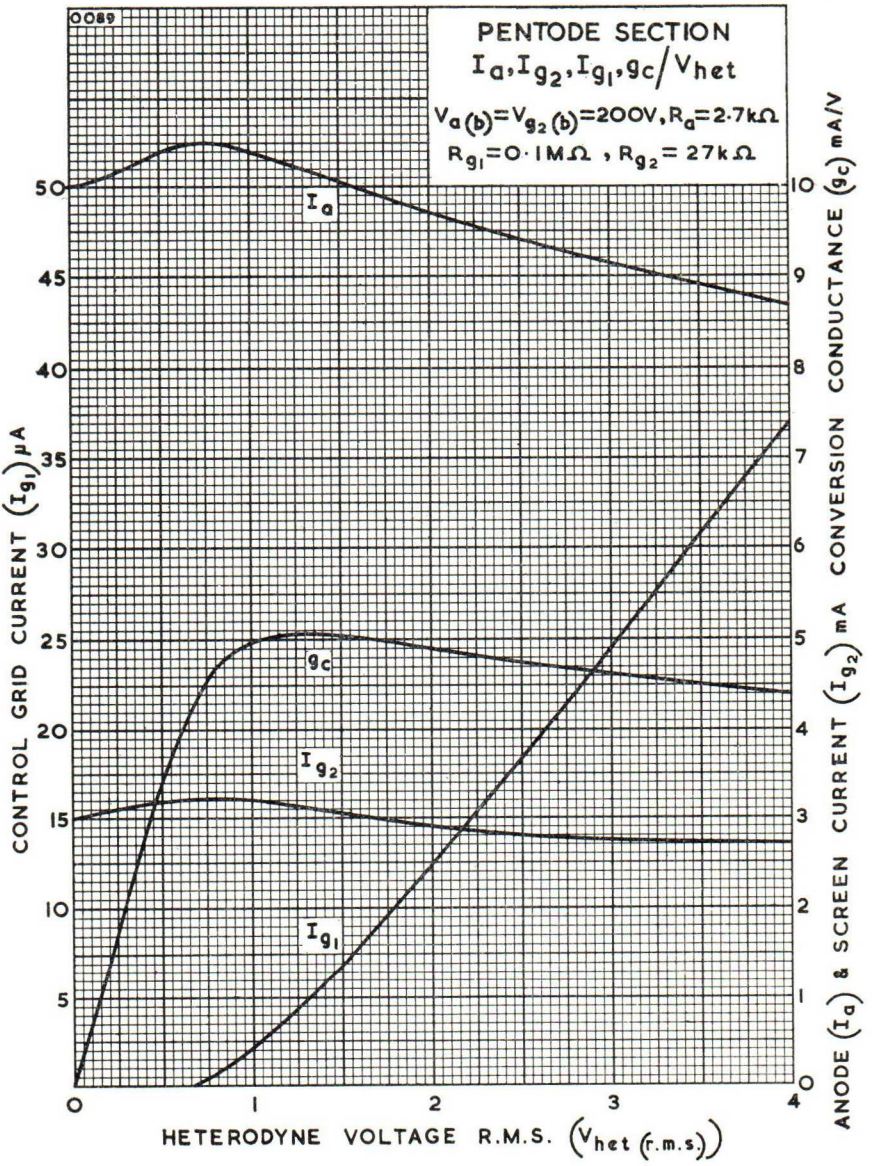
r_a, g_m, I_a, I_{g_2}/V_{g_1}

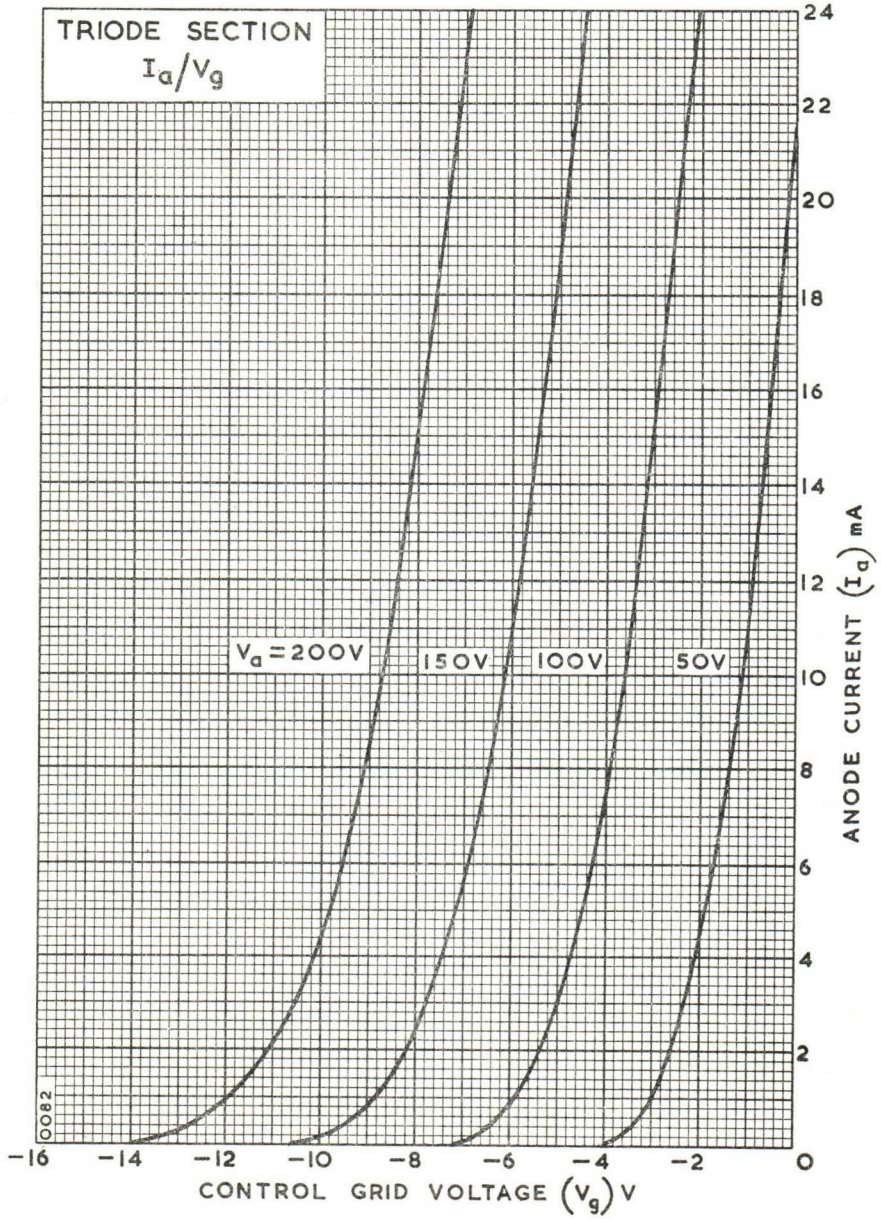
$V_a(b) = 200V$ $R_a = 2.7k\Omega$

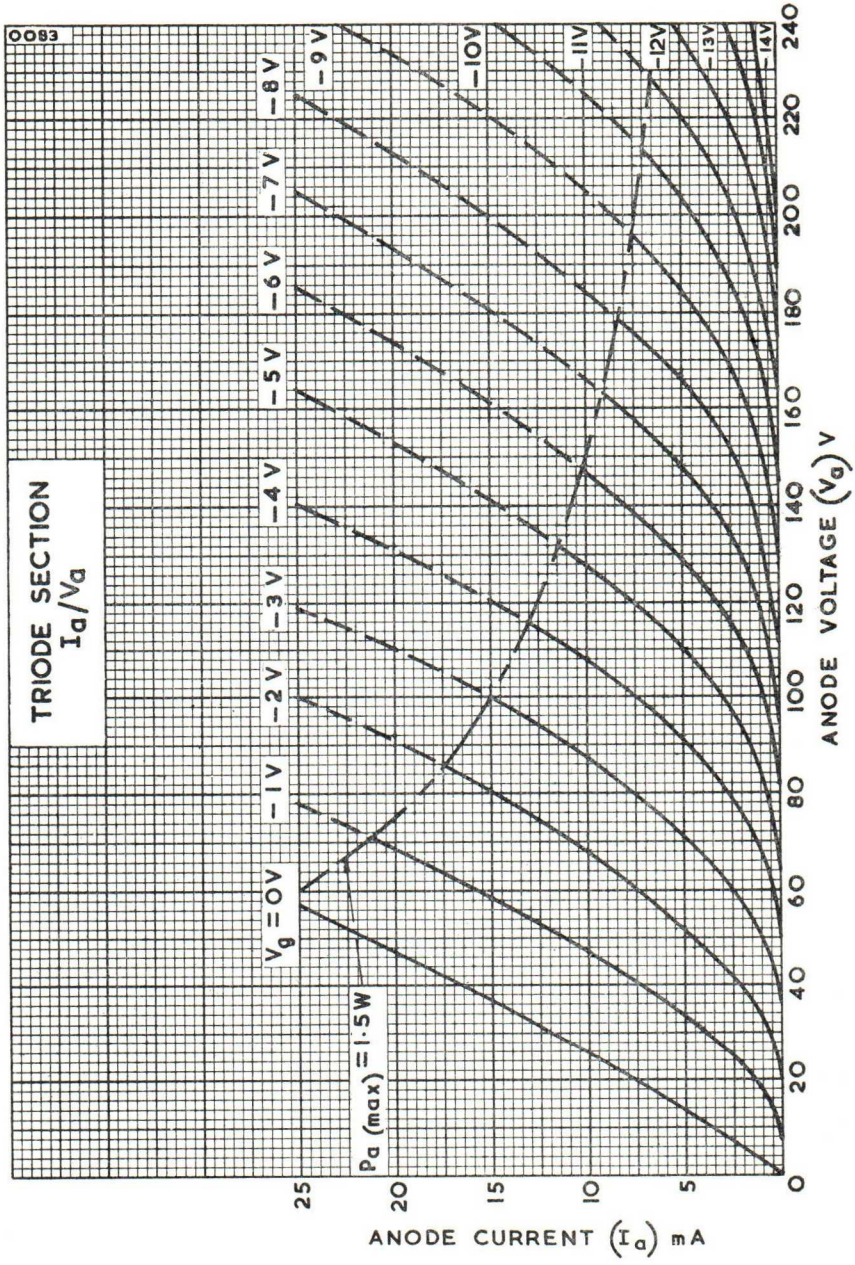
$V_{g_2}(b) = 200V$ $R_{g_2} = 27k\Omega$

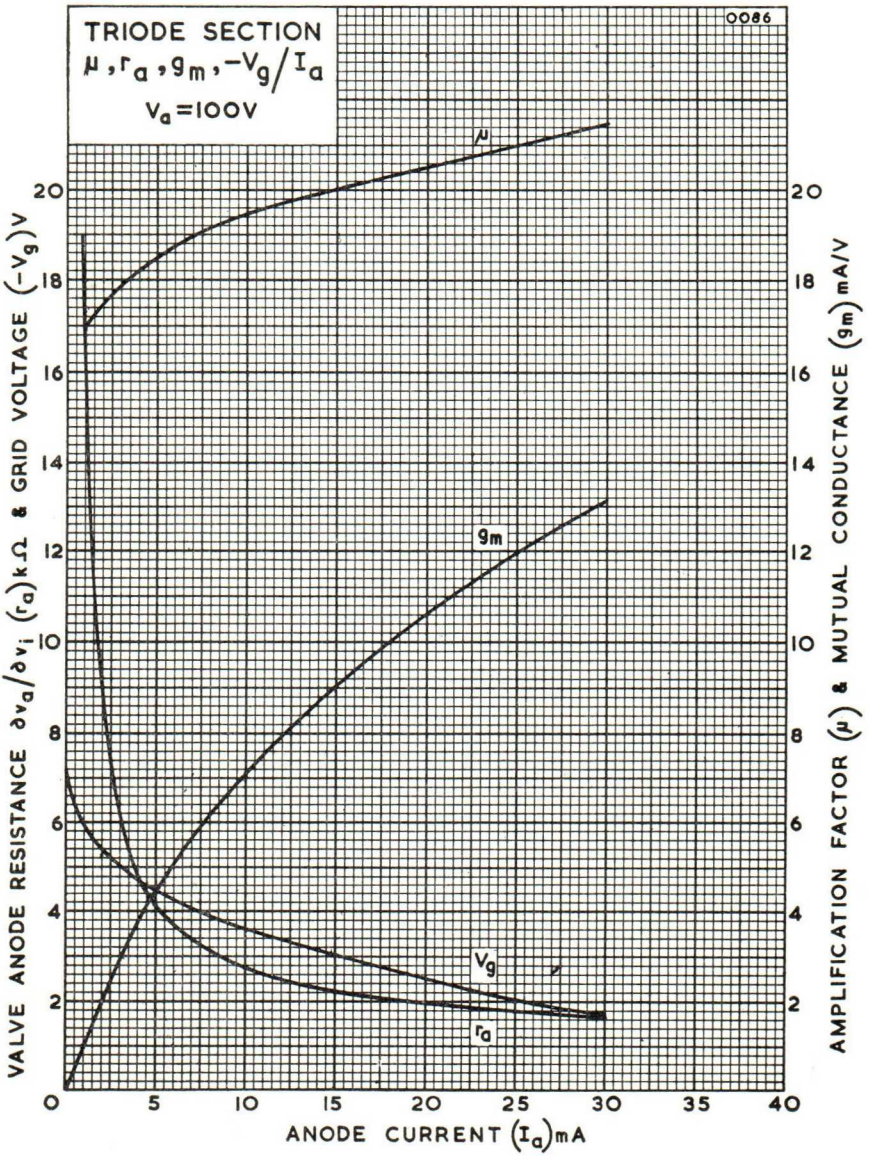
$R_{g_1} = 0.1M\Omega$

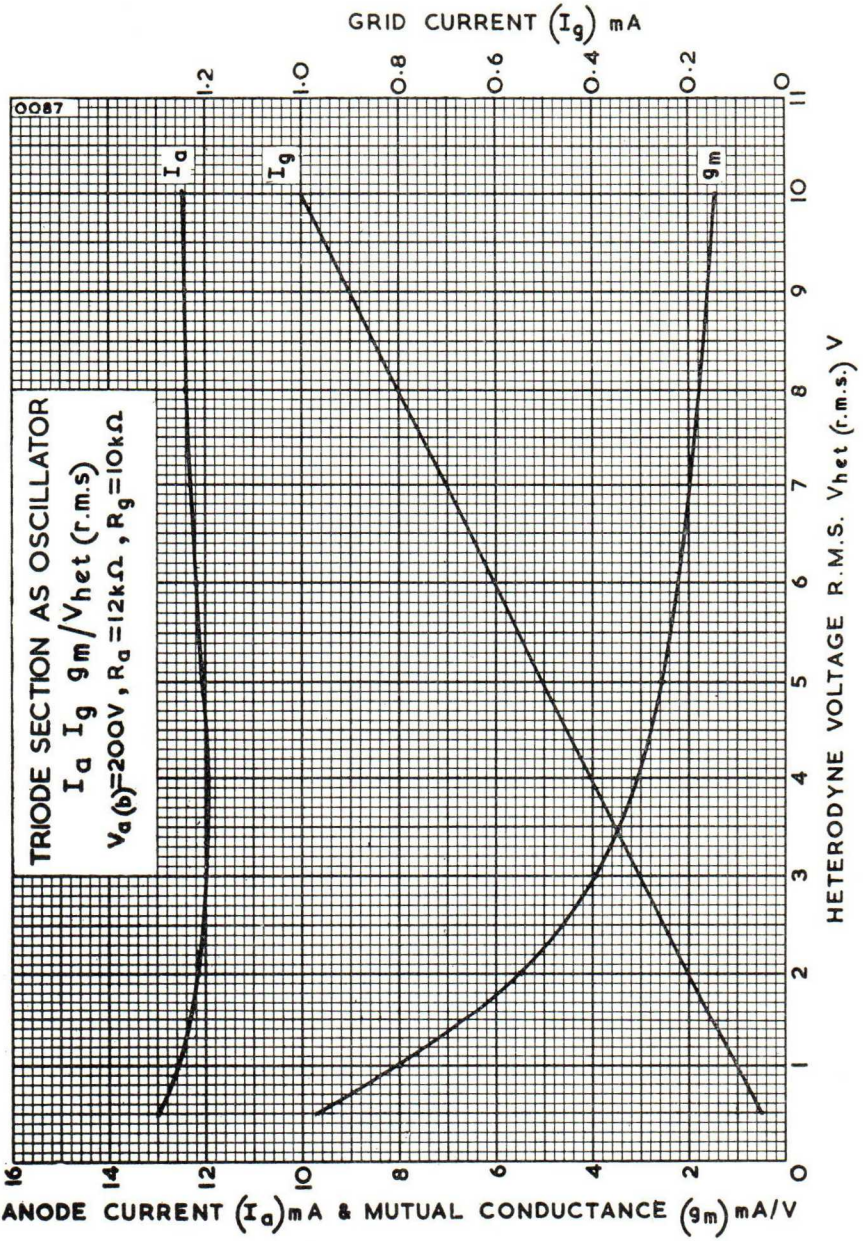


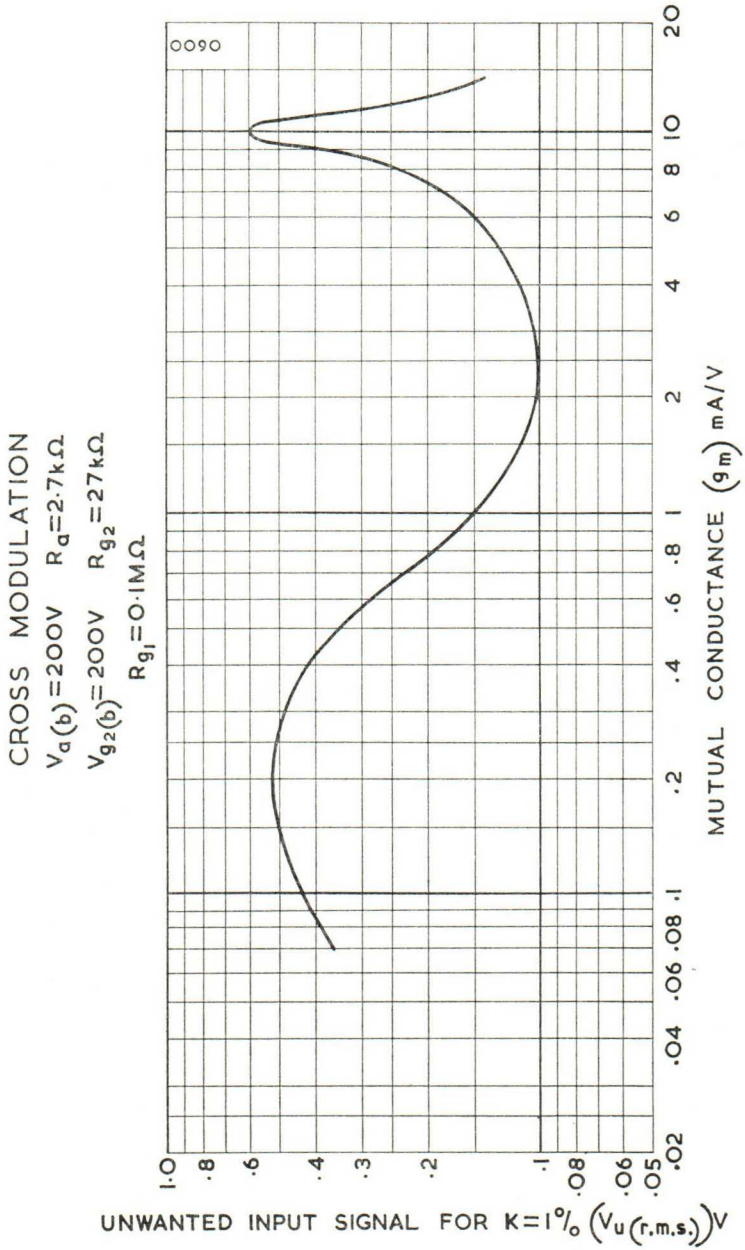

0089
PENTODE SECTION
$I_a, I_{g_2}, I_{g_1}, g_c / V_{het}$
$V_{a(b)} = V_{g_2(b)} = 200V, R_a = 2.7k\Omega$
$R_{g_1} = 0{\cdot}1M\Omega$, $R_{g_2} = 27k\Omega$
I_a
g_c
I_{g_2}
I_{g_1}
CONTROL GRID CURRENT (I_{g_1}) µA
ANODE (I_a) & SCREEN CURRENT (I_{g_2}) mA
CONVERSION CONDUCTANCE (g_c) mA/V
HETERODYNE VOLTAGE R.M.S. $(V_{het\ (r.m.s.)})$
0
5
10
15
20
25
30
35
40
45
50
1
2
3
4
6
7
8
9

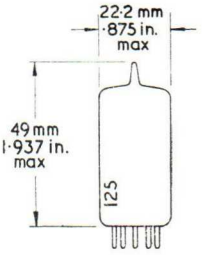

TRIODE SECTION
I_a/V_g
V_a = 200V
150V
100V
50V
0082
24
22
20
18
16
14
12
10
8
6
4
2
0
ANODE CURRENT (I_a) mA
−16
−14
−12
−10
−8
−6
−4
−2
0
CONTROL GRID VOLTAGE (V_g) V


0083
TRIODE SECTION
Ia/Va
Vg = 0V
-1V
-2V
-3V
-4V
-5V
-6V
-7V
-8V
-9V
-10V
-11V
-12V
-13V
-14V
Pa (max) = 1·5W
ANODE CURRENT (Ia) mA
25
20
15
10
5
0
ANODE VOLTAGE (Va) V
0
20
40
60
80
100
120
140
160
180
200
220
240

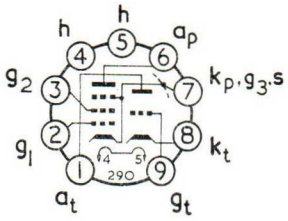

TRIODE SECTION
μ, r_a, g_m, $-V_g/I_a$
V_a=100V
0086
μ
g_m
V_g
r_a
VALVE ANODE RESISTANCE $\partial v_a/\partial v_i$ (r_a) kΩ & GRID VOLTAGE $(-V_g)$ V
AMPLIFICATION FACTOR (μ) & MUTUAL CONDUCTANCE (g_m) mA/V
ANODE CURRENT (I_a) mA
0
5
10
15
20
25
30
35
40
2
4
6
8
10
12
14
16
18
20


GRID CURRENT (Ig) mA
1.2
1.0
0.8
0.6
0.4
0.2
0
0087
Ia
Ig
gm
TRIODE SECTION AS OSCILLATOR
Ia Ig gm/Vhet (r.m.s)
Va(b)=200V, Ra=12kΩ, Rg=10kΩ
HETERODYNE VOLTAGE R.M.S. Vhet (r.m.s.) V
11
10
9
8
7
6
5
4
3
2
1
0
16
14
12
10
8
6
4
2
0
ANODE CURRENT (Ia) mA & MUTUAL CONDUCTANCE (gm) mA/V


CROSS MODULATION
$V_a(b)$=200V R_a=2·7kΩ
$V_{g2}(b)$=200V R_{g2}=27kΩ
R_{g1}=0·1MΩ
0090
MUTUAL CONDUCTANCE (g_m) mA/V
20 10 8 6 4 2 1 .8 .6 .4 .2 .1 .08 .06 .04 .02
1·0 .8 .6 .4 .3 .2 .1 .08 .06 .05 .02
UNWANTED INPUT SIGNAL FOR K=1% ($V_{u(r.m.s.)}$)V



TIME BASE TRIODE PENTODE



B9A Base

GENERAL

This triode pentode is for use in line oscillator circuits with the pentode section as an oscillator and the triode section as a reactance valve.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	9·0	V

DESIGN CENTRE RATINGS

		Triode	Pentode	
Maximum Anode Dissipation	$p_{a(max)}$	1·4	1·2	W
Maximum Screen Grid Dissipation	$p_{g2(max)}$	—	0·8	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	550	V
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Screen Grid Supply Voltage	$V_{g2(b)max}$	—	550	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	—	250	V
Maximum Heater to Cathode Voltage	$V_{h\text{-}k(max)}$	100†	100†	V
Maximum Cathode Current	$I_{k(max)}$	10	15	mA
Maximum Peak Cathode Current	$i_{k(pk)max}$	—	50*	mA
Maximum Grid to Cathode Resistance Fixed Bias	$R_{g\text{-}k(max)}$	3·0	0·56	MΩ

* Maximum Duty Factor 30 per cent, maximum pulse duration 30 μs.
† To avoid hum interference the A.C. component should not exceed 65 V at $Z_{g(max)}$ = 50 kΩ (f=50 c/s)

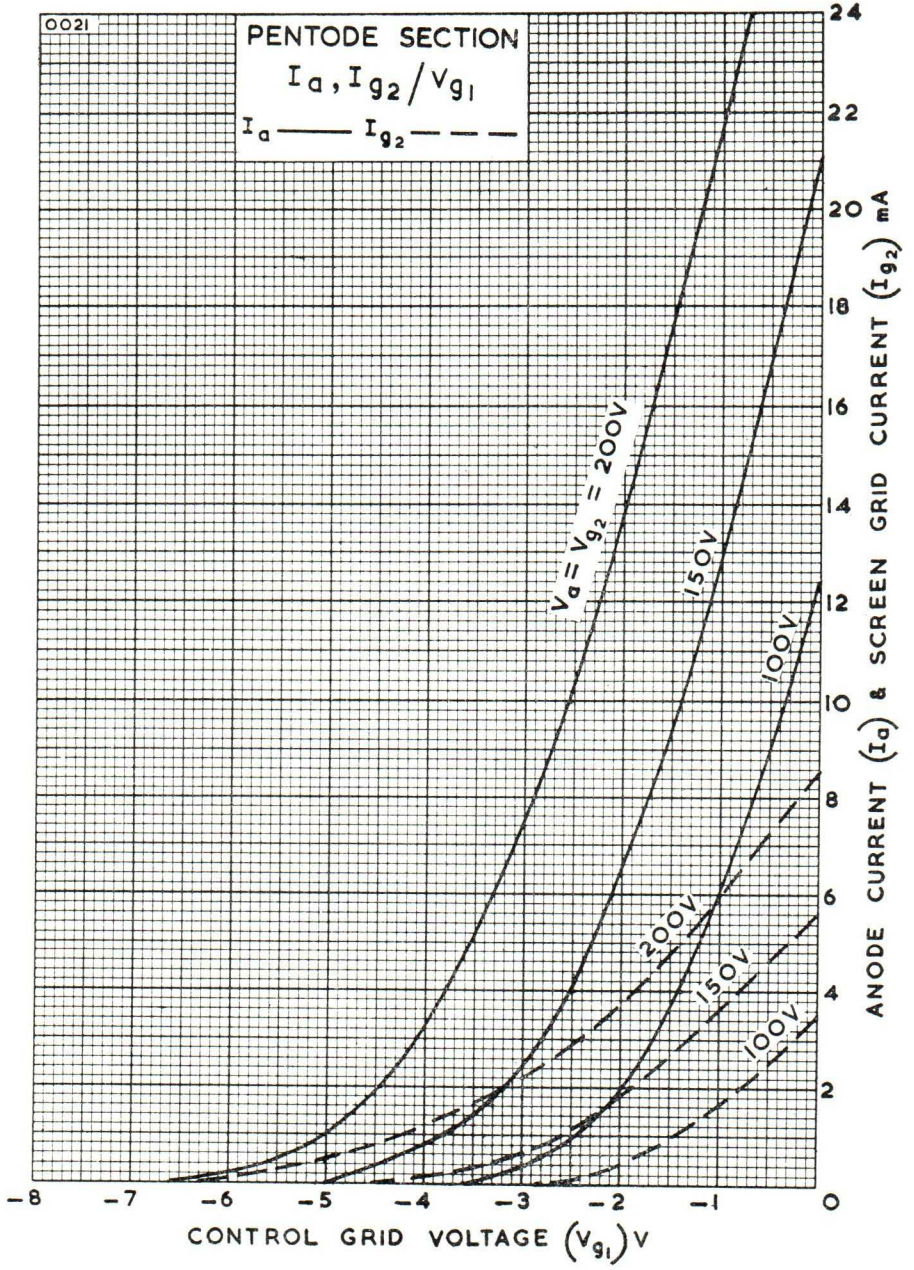
INTER-ELECTRODE CAPACITANCES

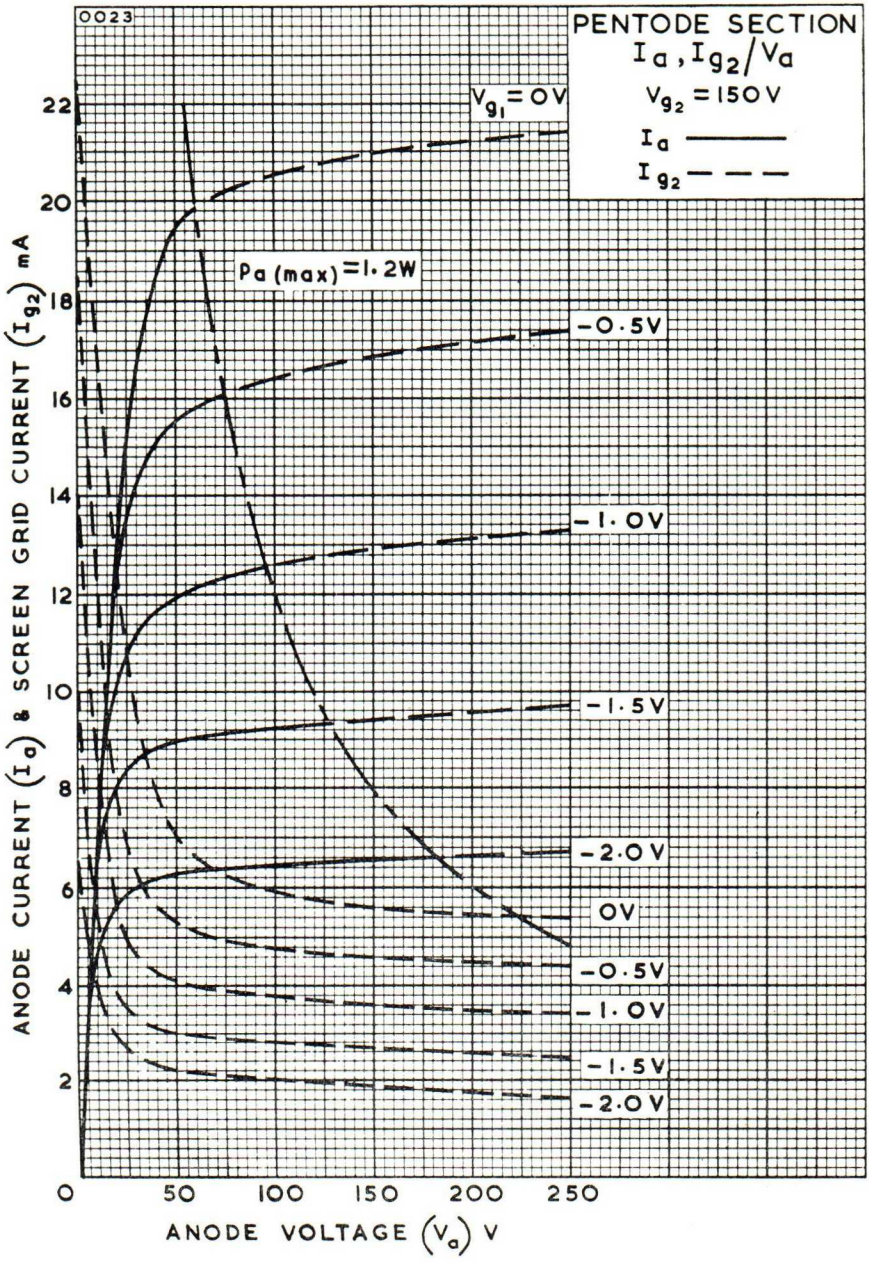
		Triode	Pentode	
Input	c_{in}	2·4	5·4	pF
Anode to Grid 1	$c_{a\text{-}g_1}$	1·5	0·06	pF
Grid 1 to Heater	$c_{g_1\text{-}h}$	<0·1	<0·1	pF

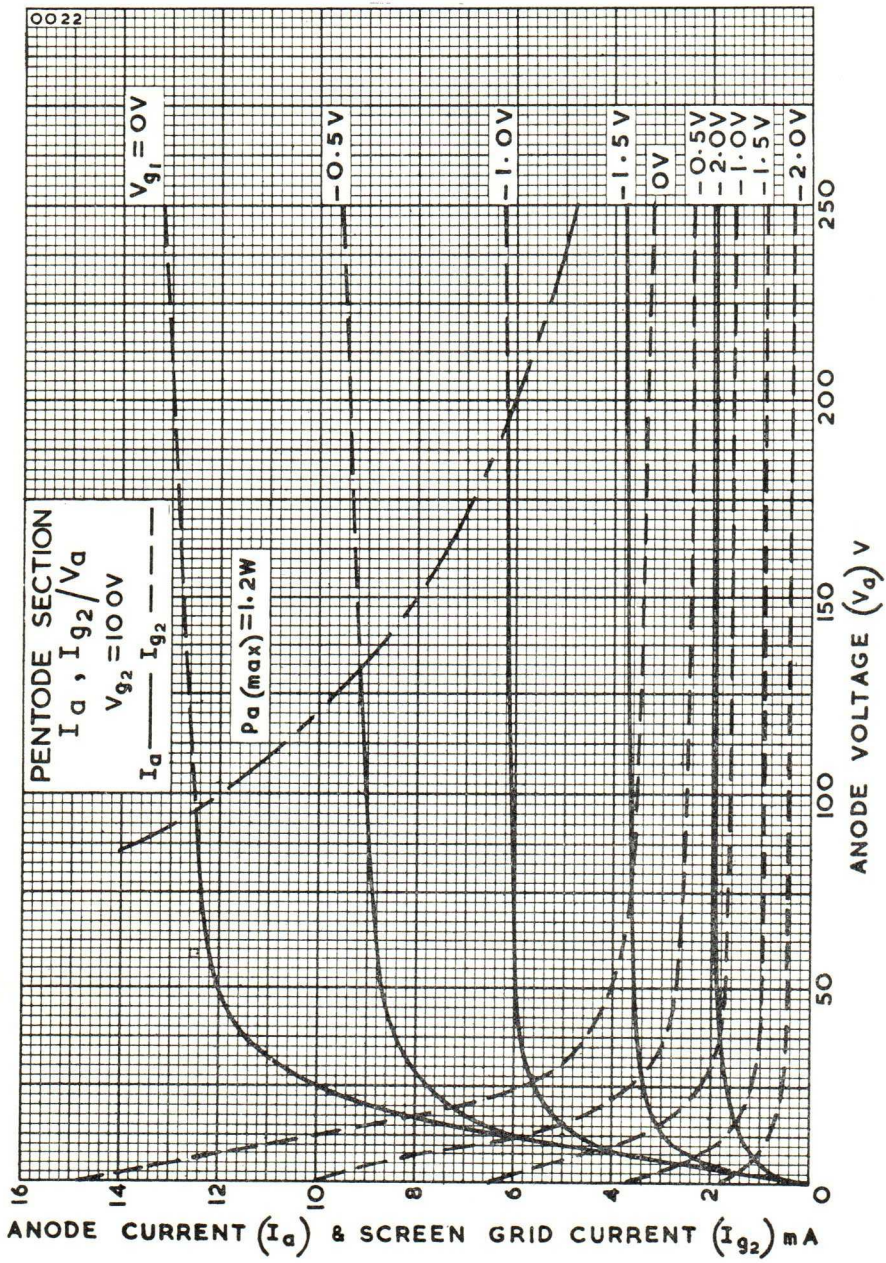
CHARACTERISTICS

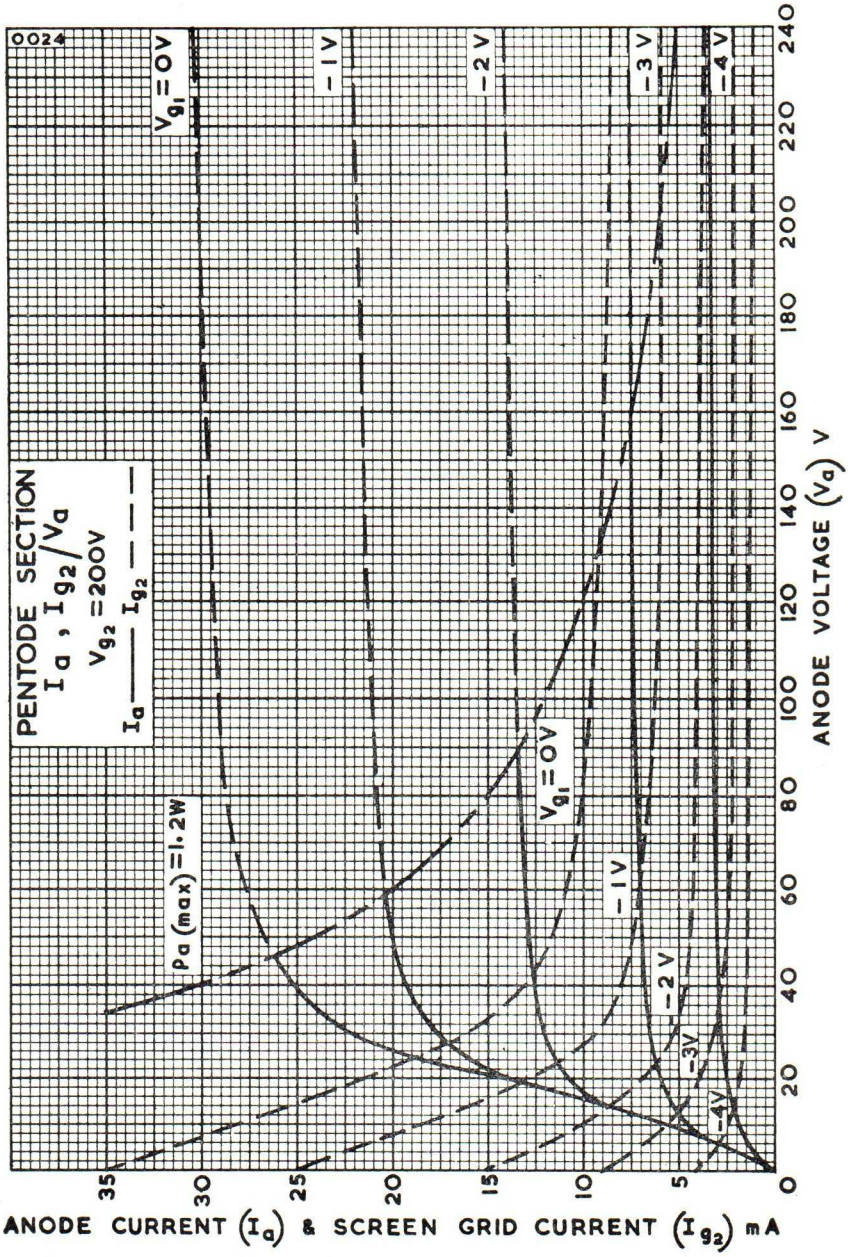
		Triode	Pentode	
Anode Voltage	V_a	200	100	V
Screen Grid Voltage	V_{g_2}	—	100	V
Control Grid Voltage	V_{g_1}	−2·0	−1·0	V
Anode Current	I_a	3·5	6·0	mA
Screen Grid Current	I_{g_2}	—	1·7	mA
Mutual Conductance	g_m	3·5	5·5	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	20	400	kΩ
Amplification Factor	μ	70	—	
Inner Amplification Factor	$\mu_{g_1\text{-}g_2}$	—	47	
Anode Current at V_{g_1} = 0 V		—	12·5	mA
Screen Grid Current at V_{g_1} = 0 V		—	3·5	mA
Anode Current at I_g = + 10 μA, V_a = 200 V		10	—	mA
Negative Grid Voltage at V_a = V_{g_2} = 200 V, I_a = 10 μA		—	<16	V
Negative Grid Voltage at I_g = + 0·3 μA		<1·3	<1·3	V

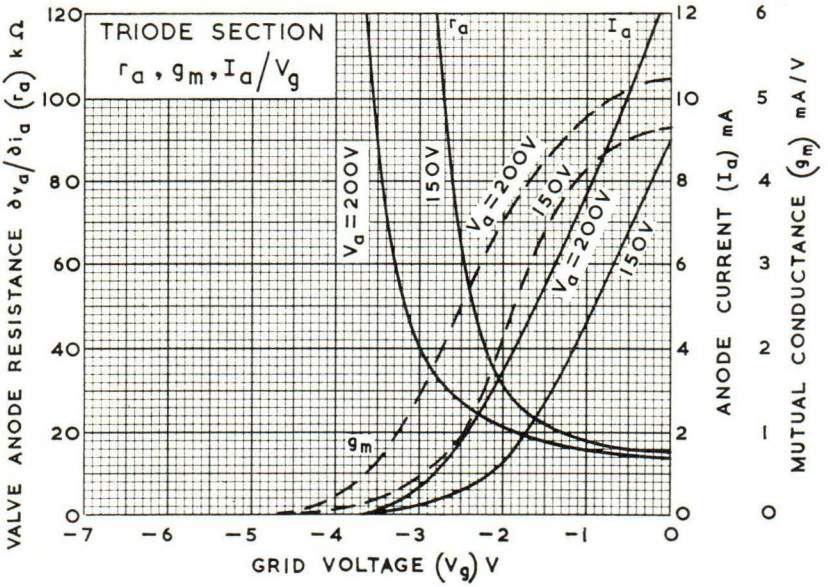
THORN—AEI RADIO VALVES & TUBES LTD.

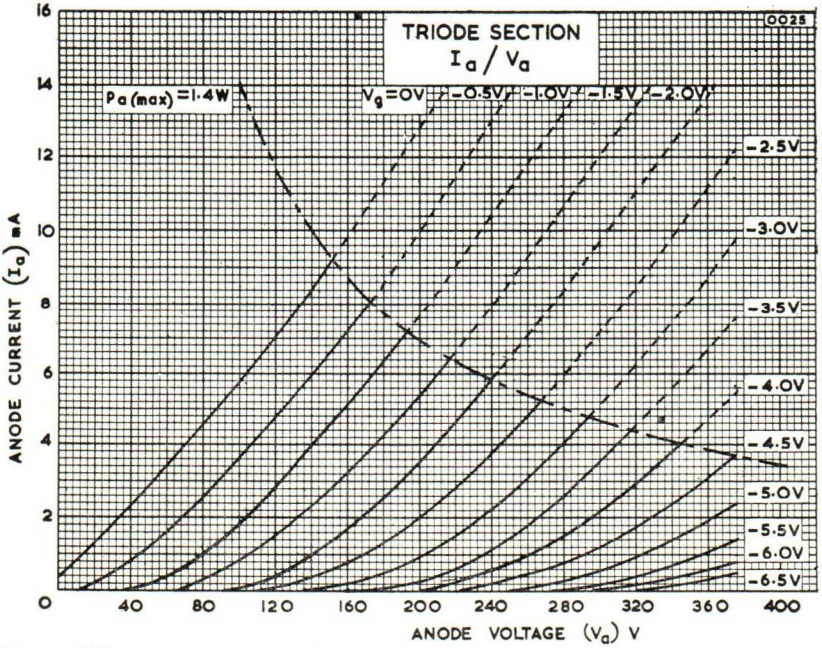

0021
PENTODE SECTION
$I_a, I_{g_2} / V_{g_1}$
I_a —— I_{g_2} — — —
$V_a = V_{g_2} = 200V$
150V
100V
200V
150V
100V
24
22
20
18
16
14
12
10
8
6
4
2
0
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
−8 −7 −6 −5 −4 −3 −2 −1 0
CONTROL GRID VOLTAGE (V_{g_1}) V

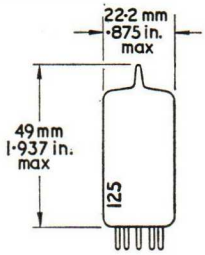

0023
PENTODE SECTION
$I_a, I_{g_2}/V_a$
$V_{g_2} = 150V$
I_a
I_{g_2}
$V_{g_1} = 0V$
$P_a (max) = 1.2W$
-0.5V
-1.0V
-1.5V
-2.0V
0V
-0.5V
-1.0V
-1.5V
-2.0V
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
0
2
4
6
8
10
12
14
16
18
20
22
50
100
150
200
250
ANODE VOLTAGE (V_a) V


0022
PENTODE SECTION
Ia , Ig2 / Va
Vg2 = 100V
Ia ——— Ig2 — — —
Pa (max) = 1.2W
Vg1 = 0V
-0.5V
-1.0V
-1.5V
0V
-0.5V
-2.0V
-1.0V
-1.5V
-2.0V
250
200
150
100
50
0
ANODE VOLTAGE (Va) V
16
14
12
10
8
6
4
2
0
ANODE CURRENT (Ia) & SCREEN GRID CURRENT (Ig2) mA

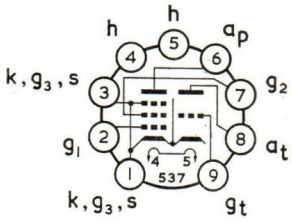

0024
PENTODE SECTION
Ia , Ig2 / Va
Vg2 = 200V
Ia ——— Ig2 — — —
Vg1 = 0V
-1 V
-2 V
-3 V
-4 V
Pa (max) = 1.2W
Vg1 = 0V
-1V
-2 V
-3V
-4V
ANODE VOLTAGE (Va) V
0
20
40
60
80
100
120
140
160
180
200
220
240
35
30
25
20
15
10
5
ANODE CURRENT (Ia) & SCREEN GRID CURRENT (Ig2) mA


TRIODE SECTION
r_a, g_m, I_a/V_g
r_a
I_a
V_a = 200V
150V
V_a = 200V
150V
V_a = 200V
150V
g_m
VALVE ANODE RESISTANCE $\delta v_a/\delta i_a$ (r_a) kΩ
ANODE CURRENT (I_a) mA
MUTUAL CONDUCTANCE (g_m) mA/V
GRID VOLTAGE (V_g) V
120
100
80
60
40
20
0
12
10
8
6
4
2
0
6
5
4
3
2
1
0
−7
−6
−5
−4
−3
−2
−1
0


TRIODE SECTION
I_a / V_a
0025
P_a (max) = 1·4W
V_g = 0V
−0·5V
−1·0V
−1·5V
−2·0V
−2·5V
−3·0V
−3·5V
−4·0V
−4·5V
−5·0V
−5·5V
−6·0V
−6·5V
ANODE CURRENT (I_a) mA
ANODE VOLTAGE (V_a) V
16
14
12
10
8
6
4
2
0
40
80
120
160
200
240
280
320
360
400



V.H.F. TRIODE PENTODE



B9A Base

GENERAL

This combined triode and high slope frame grid pentode is for use as a frequency changer at frequencies up to 220 Mc/s in television tuners.

Heater Current	I_h	0·3 A
Heater Voltage	V_h	8·0 V

RATINGS

		Pentode	Triode	
Maximum Anode Dissipation	$P_{a(max)}$	2·0	1·5	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	0·5	—	W
Maximum Anode Voltage	$V_{a(max)}$	250	125	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	150	—	V
Maximum Heater to Cathode Voltage	$V_{h\text{-}k(max)}$	100*	100*	V
Maximum Cathode Current	$I_{k(max)}$	18	15	mA
Maximum Grid to Cathode Resistance	$R_{g1\text{-}k(max)}$	250	500	kΩ

* To fulfil hum requirements on A.M. sound, it will be necessary for $V_{h\text{-}k}$ to be less than 50 V r.m.s.

INTER-ELECTRODE CAPACITANCES†

Input Pentode	$C_{in(p)}$	6·0	pF
Output Pentode	$C_{out(p)}$	3·3	pF
Grid 1 to Anode Pentode	$C_{g1\text{-}ap}$	0·012	pF
Grid 1 to Grid 2	$C_{g1\text{-}g2}$	1·6	pF
Grid Triode to Anode Triode	$C_{gt\text{-}at}$	2·0	pF
Grid Triode to Cathode and Heater	$C_{gt\text{-}k,h}$	2·2	pF
Anode Triode to Cathode and Heater	$C_{at\text{-}k,h}$	1·2	pF
Anode Pentode to Anode Triode	$C_{ap\text{-}at}$	<0·03	pF
Anode Pentode to Grid Triode	$C_{ap\text{-}gt}$	<0·01	pF
Grid 1 to Anode Triode	$C_{g1\text{-}at}$	<0·01	pF
Grid 1 to Grid Triode	$C_{g1\text{-}gt}$	<0·01	pF

† Measured without an external shield

CHARACTERISTICS

		Pentode	Triode	
Anode Voltage	V_a	170	100	V
Screen Grid Voltage	V_{g2}	150	—	V
Control Grid Voltage	V_{g1}	−1·2	−3·0	V
Anode Current	I_a	10	14	mA
Screen Grid Current	I_{g2}	3·3	—	mA
Mutual Conductance	g_m	12	5·5	mA/V
Amplification Factor	μ	—	17	
Inner Amplification Factor	$\mu_{g1\text{-}g2}$	70	—	
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	>350	—	kΩ
Equivalent Grid Noise Resistance	R_{eq}	1·0	—	kΩ

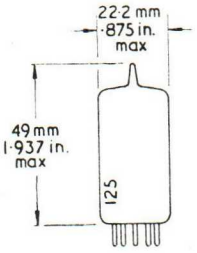
THORN—AEI RADIO VALVES & TUBES LTD.

TYPICAL OPERATION—As a Frequency Changer

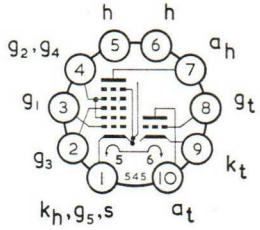
Anode Voltage	V_a	190	V
Screen Supply Voltage (R_{g_2} = 18kΩ)	$V_{g2(b)}$	190	V
Control Grid Resistance	R_{g1}	100	kΩ
Heterodyne Voltage (R.M.S.)	$V_{het(r.m.s.)}$	2·3	V
Anode Current	I_a	8·5	mA
Screen Grid Current	I_{g_2}	2·7	mA
Conversion Conductance	g_c	4·5	mA/V

MOUNTING POSITION:—Unrestricted

For characteristic curves see PCF86



TRIODE
HEPTODE



GENERAL

This triode heptode is intended for use with the triode as a pulse amplifier and the heptode as a noise gated sync. separator.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	8·5	V

DESIGN CENTRE RATINGS

		Triode	Heptode	
Maximum Anode Dissipation	$P_{a(max)}$	1·5	0·5	W
Maximum Screen Grids Dissipation	$P_{g2+g4(max)}$	—	0·5	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	550	V
Maximum Anode Voltage	$V_{a(max)}$	250	100	V
Maximum Screen Grids Supply Voltage	$V_{g2+g4(b)max}$	—	550	V
Maximum Screen Grids Voltage	$V_{g2+g4(max)}$	—	50	V
Minimum Screen Grids Voltage	$V_{g2+g4(min)}$	—	6·0*	V
Maximum Peak Negative Control Grid Voltage	$-V_{g1(pk)max}$	200	100	V
Maximum Peak Negative Grid 3 Voltage	$-V_{g3(pk)max}$	—	150	V
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$	170†	100	V
Maximum Cathode Current	$I_{k(max)}$	20	8·0	mA
Maximum Control Grid to Cathode Resistance	$R_{g1-k(max)}$			
Fixed Bias		2·0	3·0	MΩ
Cathode Bias		3·0	—	MΩ
Maximum Grid 3 to Cathode Resistance	$R_{g3-k(max)}$	—	3·0	MΩ

* Under design maximum conditions.

† Heater negative. Comprises d.c. maximum of 70V and 100$V_{r.m.s.}$

INTER-ELECTRODE CAPACITANCES

		Triode	Heptode	
Input	C_{in}	3·3	4·4	pF
Output	C_{out}	1·7	5·4	pF
Anode to Grid 1	C_{a-g1}	1·8	<0·1	pF
Anode to Grid 3	C_{a-g3}	—	<0·25	pF
Grid 1 to Grid 3	C_{g1-g3}	—	0·3	pF
Heptode Anode to Triode Anode	C_{ah-at}	<0·15		pF
Grid 1 to Triode Anode	C_{g1-at}	<0·01		pF
Grid 1 to Triode Grid	C_{g1-gt}	<0·005		pF
Grid 3 to Triode Grid	C_{g3-gt}	<0·02		pF

THORN RADIO VALVES AND TUBES LTD.

CHARACTERISTICS

Triode Section

Anode Voltage	V_a	100	200	V
Grid Voltage	V_g	−1·0	−7·0 (<11)	V
Anode Current	I_a	9·0	0·1	mA
Mutual Conductance	gm	8·8	—	mA/V
Amplification Factor	μ	50	—	

Heptode Section

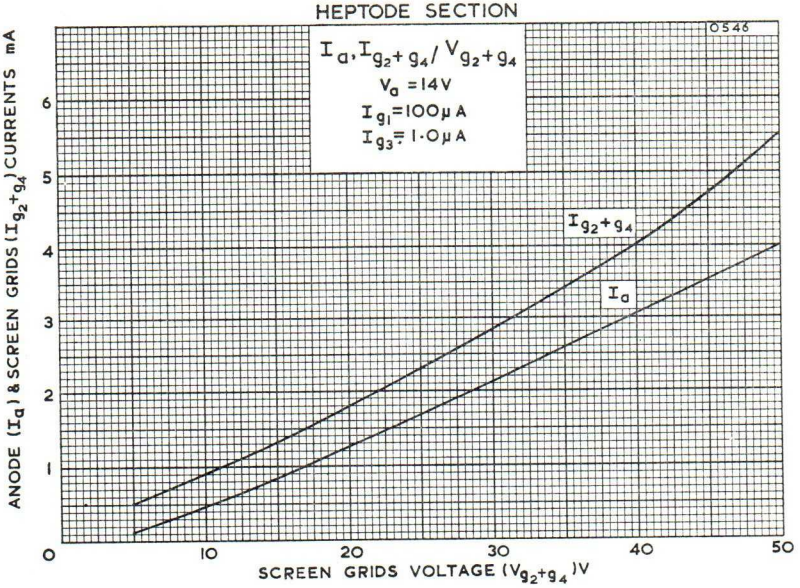
Anode Voltage	V_a	14	14	14	V
Screen Grids Voltage	V_{g2+g4}	14	14	14	V
Grid 3 Voltage	V_{g3}	0	0	−1·8 (<2·2)	V
Control Grid Voltage	V_{g1}	0	−1·8	0	V
Anode Current	I_a	1500	20	20	μA
Screen Grids Current	I_{g2+g4}	1300	—	—	μA

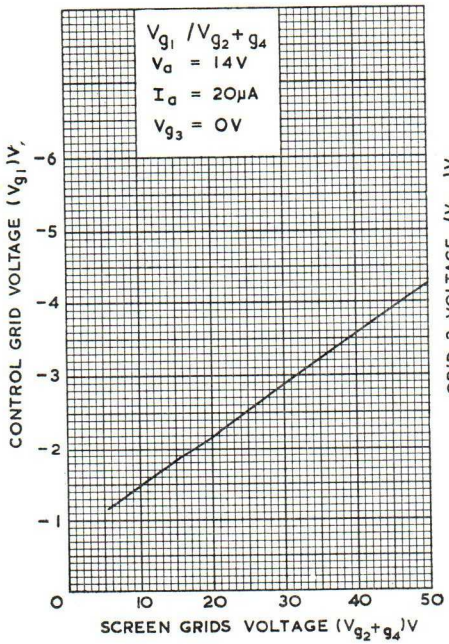
TYPICAL OPERATION

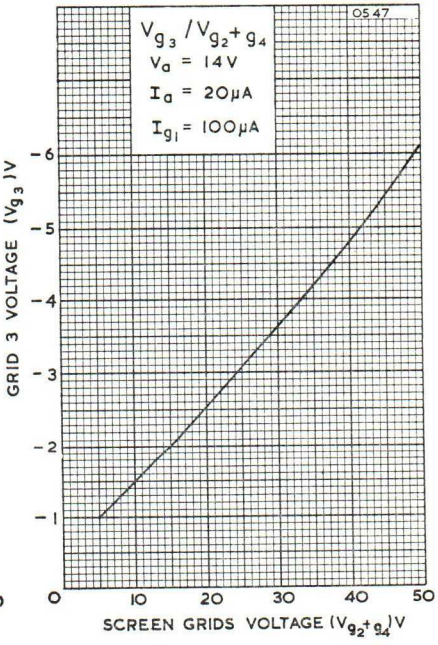
Heptode as Sync. Separator

Anode Voltage	V_a	14	1·0	14	14	V
Screen Grids Voltage	V_{g2+g4}	14	14	14	14	V
Grid 3 Voltage	V_{g3}	—	—	+25	−1·9 (<2·3)	V
Control Grid Voltage	V_{g1}	—	—	−2·0	—	V
Anode Current	I_a	750	>300	20	20	μA
Grid 3 Current	I_{g3}	1·0	1·0	—	—	μA
Control Grid Current	I_{g1}	100	100	—	100	μA

HEPTODE SECTION

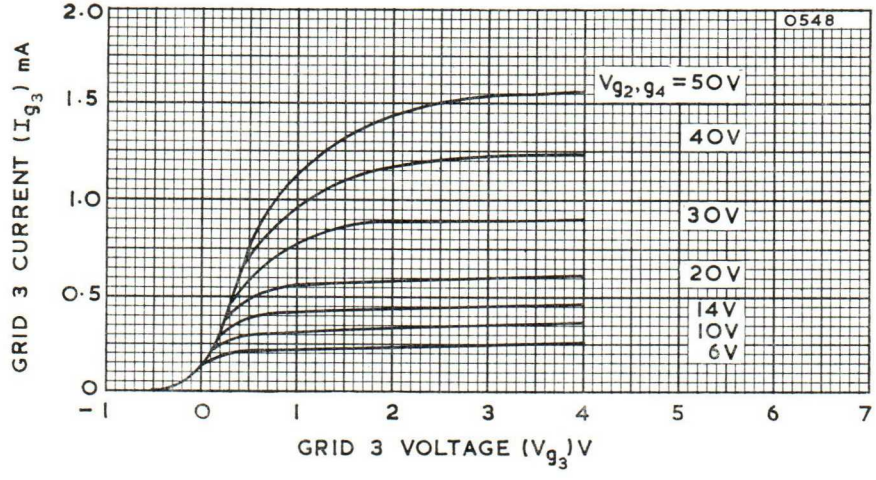




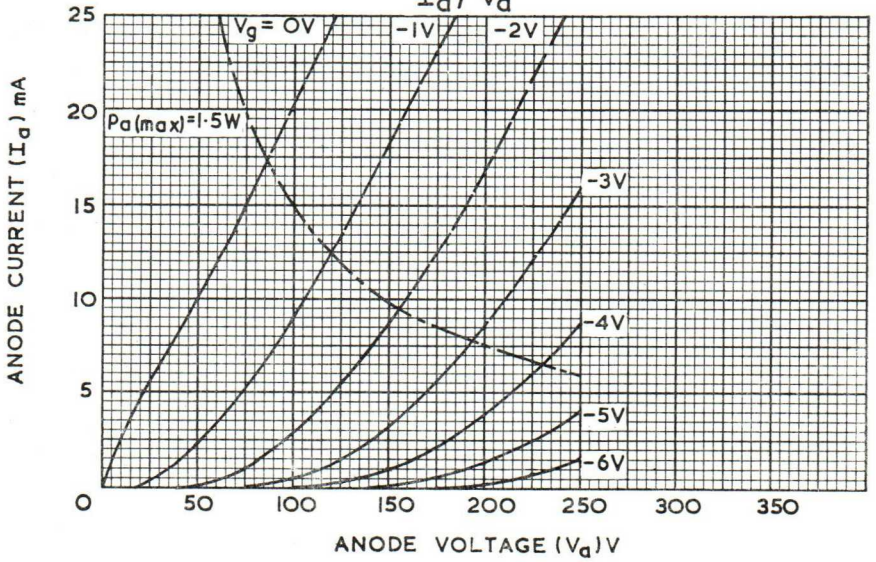


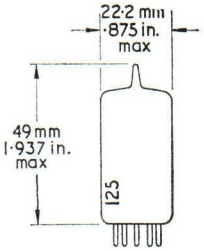
HEPTODE SECTION
I_{g_3} / V_{g_3}

V_a = 14V I_{g_1} = 100μA

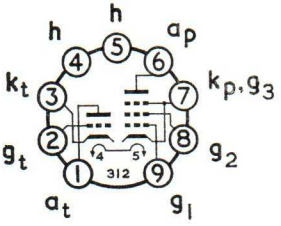


TRIODE SECTION
I_a / V_a





TIME BASE TRIODE PENTODE



B9A Base

GENERAL

This triode pentode is for use in television receivers with the triode as a frame blocking oscillator and the pentode as a frame output valve.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	12·6	V

RATINGS

		Triode	Pentode	
Maximum Anode Dissipation	$P_{a(max)}$	3·5	5·4	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	—	1·2	W
Speech and Music		—	2·4	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	550	V
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Peak Positive Anode Voltage	$v_{a(pk)max}$	—	2·0	kV
Maximum Screen Grid Supply Voltage	$V_{g2(b)max}$	—	550	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	—	250	V
Maximum Heater to Cathode Voltage	$V_{h\text{-}k(max)}$			
Heater Positive		100	100	V
Maximum Cathode Current	$I_{k(max)}$	15	45	mA
Maximum Control Grid to Cathode Resistance	$R_{g1\text{-}k(max)}$			
Self Bias		—	500	kΩ
Fixed Bias		1·0	0·25	MΩ
Grid Current Bias		22	—	MΩ

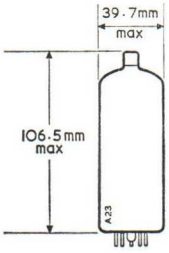
INTER-ELECTRODE CAPACITANCES

		Triode	Pentode	
Input	c_{in}	2·3	5·7	pF
Output	c_{out}	0·32	4·7	pF
Anode to Control Grid	$c_{a\text{-}g1}$	1·6	<0·2	pF
Control Grid to Heater	$c_{g1\text{-}h}$	—	0·4	pF

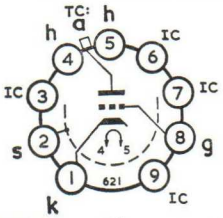
OPERATING CHARACTERISTICS

		Triode	Pentode	
Anode Voltage	V_a	250	170	V
Screen Grid Voltage	V_{g2}	—	170	V
Control Grid Voltage	V_{g1}	−8·5	−9·5	V
Anode Current	I_a	10·5	30	mA
Screen Grid Current	I_{g2}	—	5·0	mA
Mutual Conductance	g_m	2·2	5·5	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	7·7	53	kΩ
Amplification Factor	μ	17	—	
Inner Amplification Factor	$\mu_{g1\text{-}g2}$	—	10	

THORN—AEI RADIO VALVES & TUBES LTD.



SHUNT STABILISER TRIODE



B9D Base with centre stem
CT2 Cap

GENERAL

This high voltage triode is for use as a shunt stabiliser in colour television receivers having series connected heaters (a.c. or d.c.).

Heater Current	I_h	0·3	A
Heater Voltage	V_h	7·3	V

DESIGN CENTRE RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	30*	W
Maximum Anode Voltage	$V_{a(max)}$	25†	kV
Maximum Negative Grid Voltage	$-V_{g(max)}$	150‡	V
Maximum Heater to Cathode Voltage	$V_{h\text{-}k(max)}$		
Heater Negative		400V$_{d.c.}$ + 250V$_{a.c.}$	
Heater Positive		250	V
Maximum Shield to Cathode Voltage	$V_{s\text{-}k(max)}$		
Shield Positive		0	V
Shield Negative		400§	V
Maximum Anode Current	$I_{a(max)}$	1·6	mA
Maximum Grid to Cathode Resistance	$R_{g\text{-}k(max)}$	5·0	MΩ
Maximum Anode Seal Temperature (absolute)	$T_{anode\ seal}$	200	°C

* The absolute rating of 40W is permissible only during short periods—in total up to a maximum of 10% of the operation time of the valve.

† The absolute rating is 27·5kV. If due to a circuit failure the anode current becomes 0mA the anode voltage should never exceed 45kV (absolute).

‡ During equipment warm-up period and for brief intervals during equipment adjustment only, this voltage may increase to 440V max.

§ The shield connected to pin 2 is provided in order to shield grid and cathode from the high anode voltage. It should be connected directly to earth with a minimum lead inductance. A.C. potential between the shield and cathode can modulate the anode current; the maximum sensitivity is 2·5μA/V.

MOUNTING

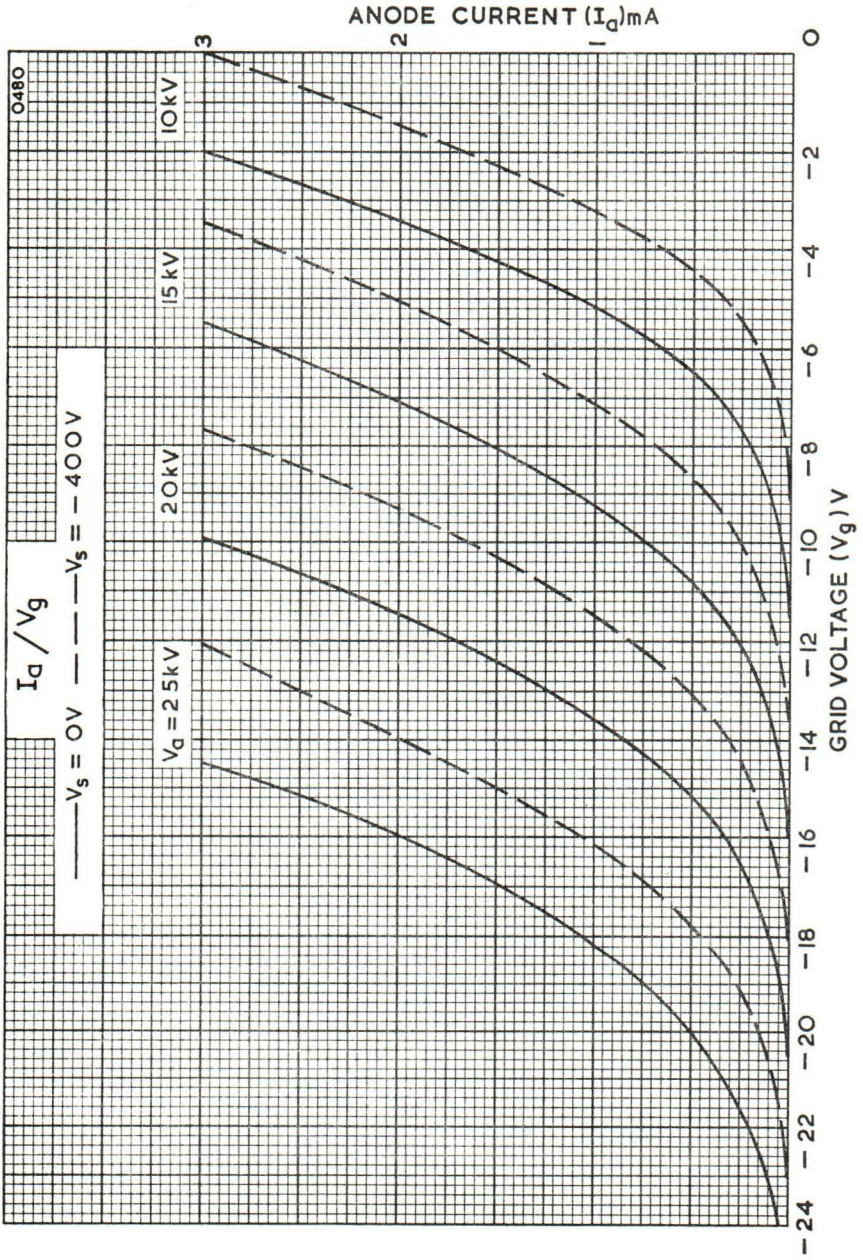
Additional supporting of the valve at the top is required. To prevent corona effects any metal screening applied around the valve should be at least 5 cm from the nearest point of the bulb. Adequate ventilation should be provided.

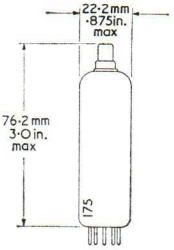
CHARACTERISTICS

Anode Voltage	V_a	25	kV
Shield Voltage	V_s	0	V
Negative Grid Voltage at I_a = 1·5mA	$-V_g$	7 to 30	V
Maximum Negative Grid Voltage at I_a = 0·1mA	$-V_{g(max)}$	40	V
Maximum Grid Voltage change between I_a = 0·1mA and I_a = 1·5mA	$\Delta V_{g(max)}$	10	V

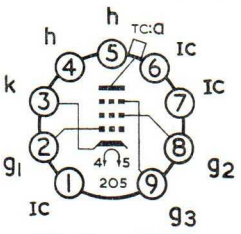
X-RAYS

X-ray shielding may be required to give protection against excessive radiation.


ANODE CURRENT (I_a)mA
3
2
1
0
GRID VOLTAGE (V_g) V
0
−2
−4
−6
−8
−10
−12
−14
−16
−18
−20
−22
−24
0480
10kV
15kV
20kV
V_a = 25kV
I_a / V_g
V_s = 0V
V_s = −400V



LINE OUTPUT PENTODE



B9A Base, CT1 Cap

GENERAL

This valve is a line output pentode designed for use as the line time base output valve in AC/DC television receivers having series connected heaters.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	21·5	V

DESIGN CENTRE RATINGS

Maximum Anode Dissipation	$P_{a(max)}$		
For $P_{g_2} \leqslant 2{\cdot}0$W		7·5	W
For $P_{g_2} = 4{\cdot}5$W		5·0	W
Maximum Anode and Screen Grid Dissipation	$P_{a+g_2(max)}$	See Rating Chart	
Maximum Screen Grid Dissipation	$P_{g_2(max)}$		
For $P_a \leqslant 5{\cdot}0$W		4·5	W
For $P_a = 7{\cdot}5$W		2·0	W
Maximum Anode Supply Voltage ($I_a=0$)	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	250	V
Maximum Peak Anode Voltage, Pulse Positive	$v_{a(pk)max}$	7·0*	kV
Maximum Screen Grid Supply Voltage	$V_{g_2(b)max}$	550	V
Maximum Screen Grid Voltage	$V_{g_2(max)}$	250	V
Maximum Heater to Cathode Voltage	$V_{h\text{-}k(max)}$	200	V
Maximum Cathode Current	$I_{k(max)}$	180	mA
Maximum Control Grid to Cathode Resistance	$R_{g_1\text{-}k(max)}$	0·5†	MΩ

* Maximum pulse duration 22 per cent of one cycle, with a maximum of 18 μs.
† For television line scan applications $R_{g_1\text{-}k(max)}$ may be 3·3 MΩ.

INTER-ELECTRODE CAPACITANCES§

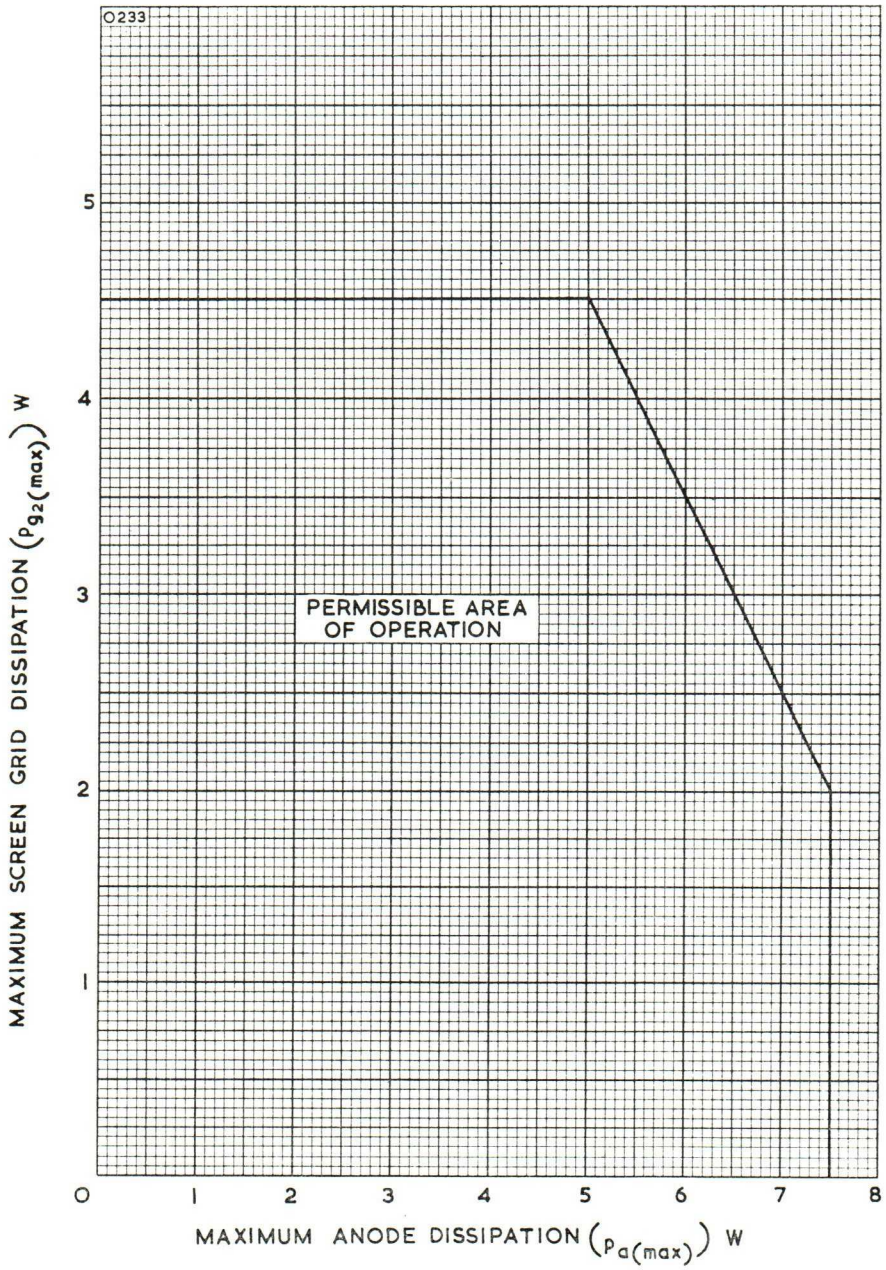
Input	C_{in}	14·7	pF
Output	C_{out}	6·0	pF
Anode to Grid 1	$C_{a\text{-}g_1}$	<0·8	pF
Grid 1 to Heater	$C_{g_1\text{-}h}$	<0·2	pF
Anode to Cathode	$C_{a\text{-}k}$	<0·1	pF

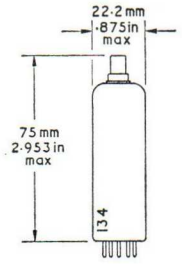
§ Measured without an external shield.

CHARACTERISTICS

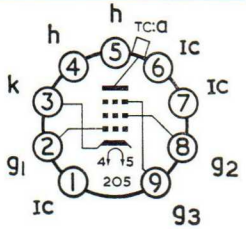
Anode Voltage	V_a	170	V
Screen Grid Voltage	V_{g_2}	170	V
Control Grid Voltage	V_{g_1}	–22	V
Anode Current	I_a	45	mA
Screen Grid Current	I_{g_2}	2·9	mA
Mutual Conductance	g_m	6·2	mA/V
Inner Amplification Factor	$\mu_{g_1\text{-}g_2}$	5·3	
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	10	kΩ

THORN—A E I RADIO VALVES & TUBES LTD.


O233
PERMISSIBLE AREA OF OPERATION
MAXIMUM SCREEN GRID DISSIPATION ($P_{g_2(max)}$) W
MAXIMUM ANODE DISSIPATION ($P_{a(max)}$) W
0
1
2
3
4
5
6
7
8



LINE OUTPUT PENTODE



B9A Base, CT1 Cap

GENERAL

This output pentode is primarily intended for use in the line timebase of AC/DC portable television receivers.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	21·5	V

DESIGN CENTRE RATINGS

Maximum Anode Dissipation	$P_{a(max)}$		
For $p_{g_2} \leqslant 2{\cdot}0W$		7·5	W
For $p_{g_2} = 4{\cdot}5W$		5·0	W
Maximum Anode and Screen Grid Dissipation	$P_{(a+g_2)max}$	See Rating Chart	
Maximum Screen Grid Dissipation	$P_{g_2(max)}$		
For $p_a \leqslant 5{\cdot}0W$		4·5	W
For $p_a = 7{\cdot}5W$		2·0	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	650	V
Maximum Anode Voltage	$V_{a(max)}$	250	V
Maximum Peak Anode Voltage	$v_{a(pk)max}$	7·0*	kV
Maximum Screen Grid Supply Voltage	$V_{g2(b)max}$	550	V
Maximum Screen Grid Voltage	$V_{g_2(max)}$	250	V
Maximum Peak Control Grid Voltage	$v_{g1(pk)max}$	1·0	kV
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$	200	V
Maximum Cathode Current	$I_{k(max)}$	180	mA
Maximum Control Grid to Cathode Resistance	$R_{g1-k(max)}$	500†	kΩ
Maximum Heater to Cathode Resistance	$R_{h-k(max)}$	20	kΩ
Maximum Bulb Temperature	$T_{bulb(max)}$	240	°C

* Maximum pulse duration 22 per cent of one cycle, with a maximum of 18 μs.

† In line timebase applications $R_{g1-k(max)}$ may be 2·2 MΩ.

INTER-ELECTRODE CAPACITANCES§

Input	c_{in}	14	pF
Output	c_{out}	6·0	pF
Anode to Grid 1	c_{a-g_1}	<0·8	pF
Grid 1 to Heater	c_{g_1-h}	<0·2	pF
Anode to Cathode	c_{a-k}	<0·1	pF

§ Measured without an external shield.

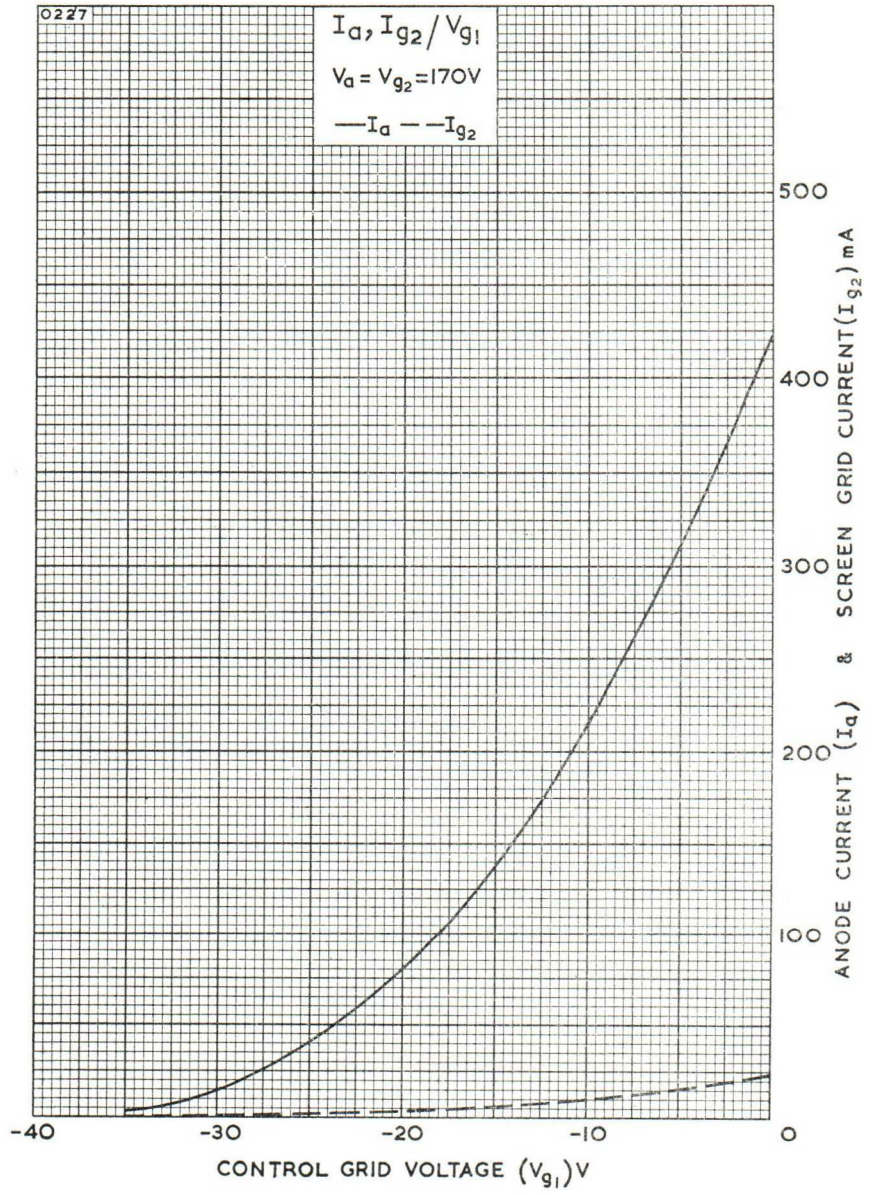
CHARACTERISTICS

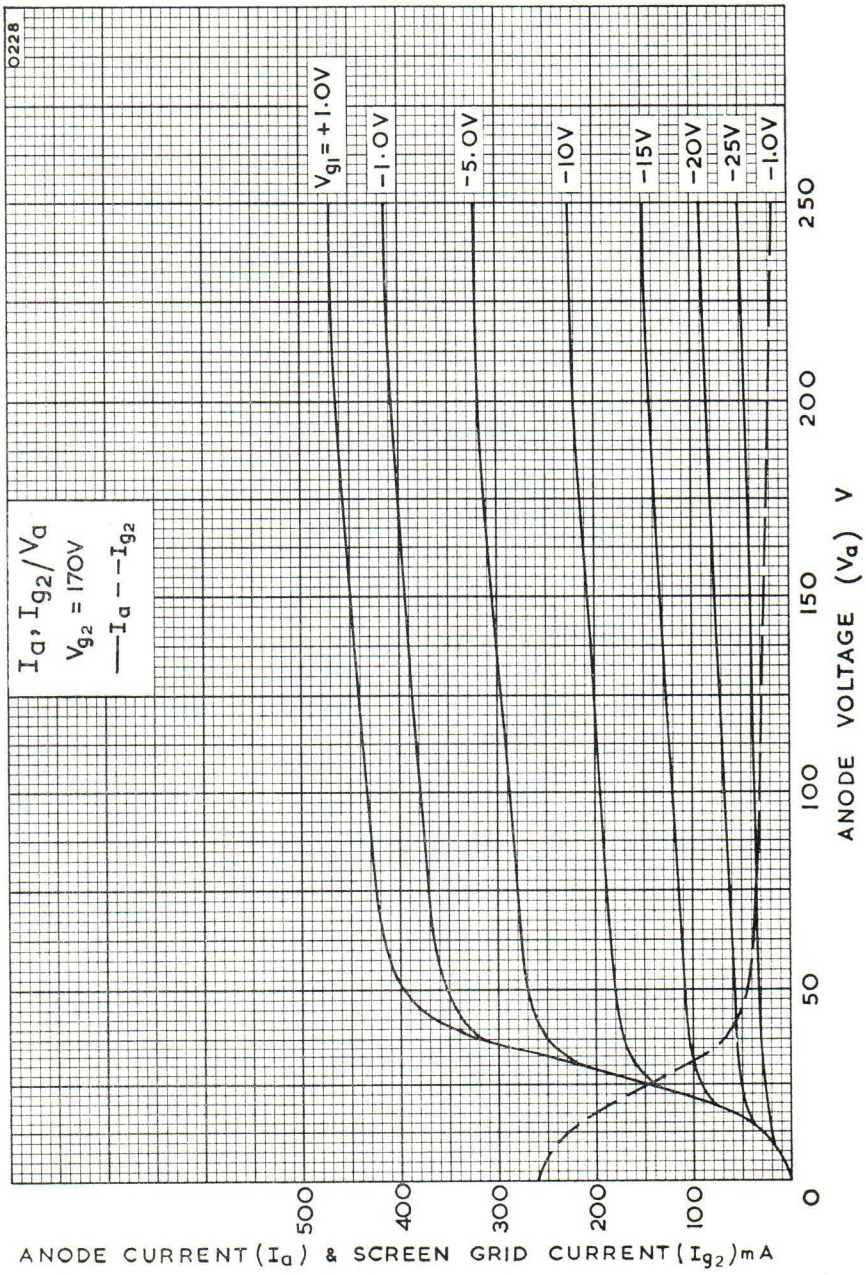
Anode Voltage	V_a	170	V
Screen Grid Voltage	V_{g_2}	170	V
Control Grid Voltage	V_{g_1}	−24·5	V
Anode Current	I_a	45	mA
Screen Grid Current	I_{g_2}	2·2	mA
Mutual Conductance	g_m	6·0	mA/V
Inner Amplification Factor	$\mu_{g_1-g_2}$	4·9	
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	11·5	kΩ

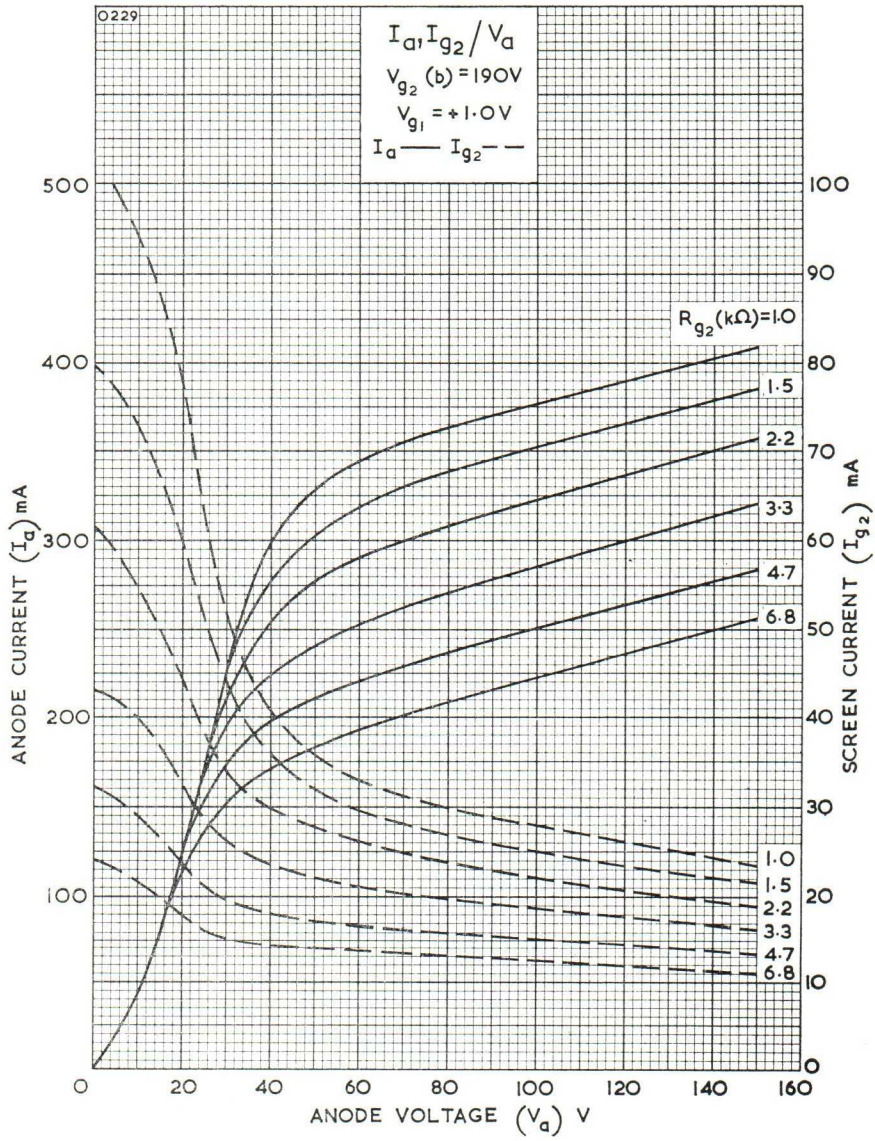
LINE OUTPUT VALVE CIRCUIT DESIGN

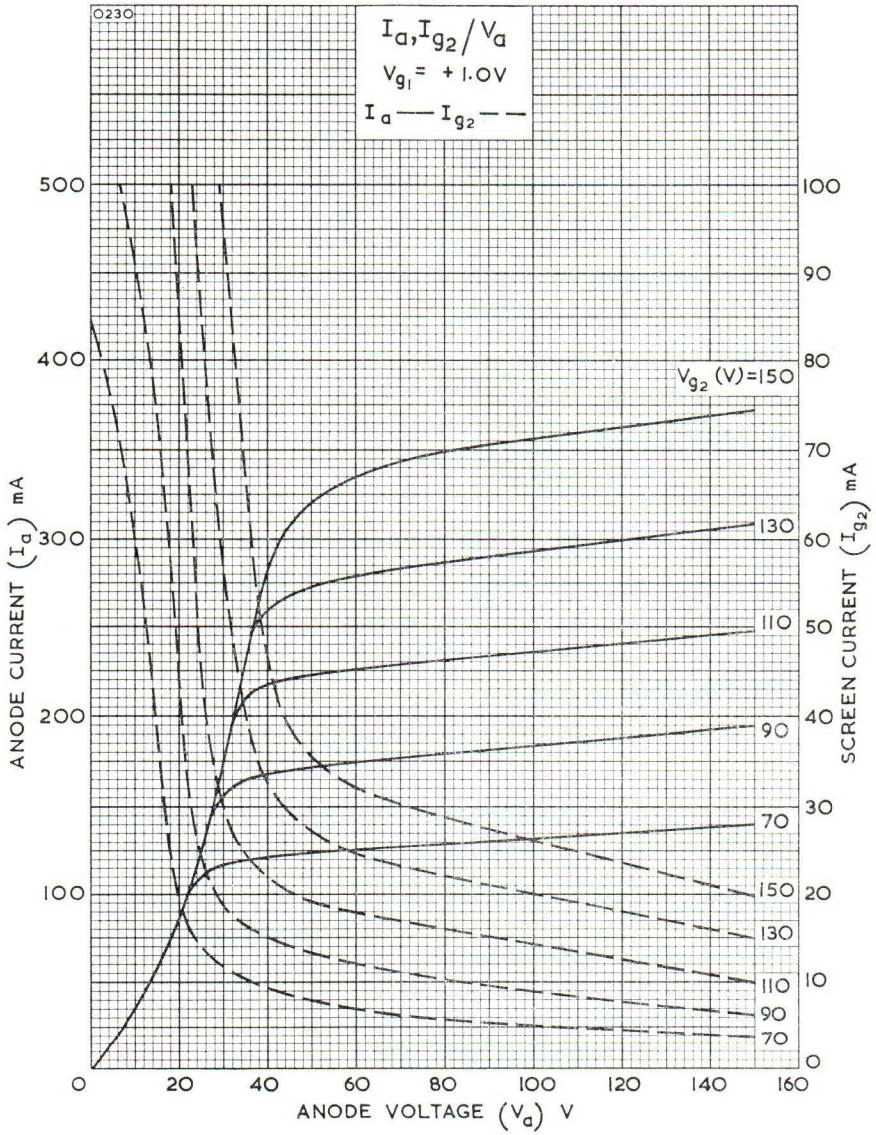
It is recommended that the valve be operated so that the anode potential at the end of the scan is above the knee of the anode characteristic. An effective feedback stabilising circuit should be employed.

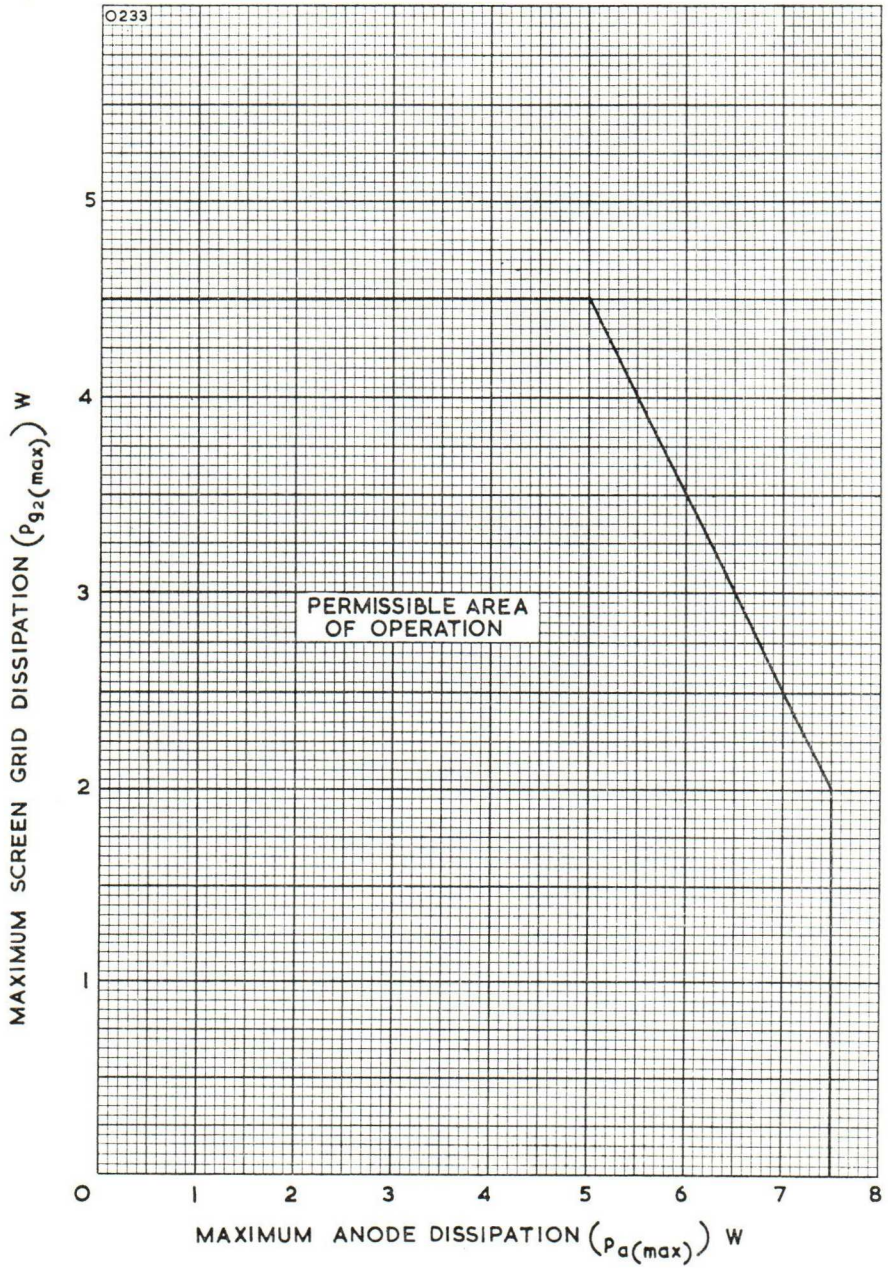
THORN—A E I RADIO VALVES & TUBES LTD.

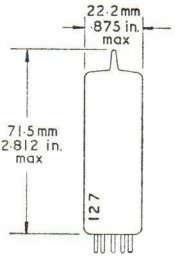

0227
$I_a, I_{g2} / V_{g1}$
$V_a = V_{g2} = 170V$
—I_a – –I_{g2}
500
400
300
200
100
0
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g2}) mA
-40
-30
-20
-10
CONTROL GRID VOLTAGE (V_{g1}) V


0228
I_a, I_{g2}/V_a
V_{g2} = 170V
——I_a – – I_{g2}
V_{g1} = +1.0V
-1.0V
-5.0V
-10V
-15V
-20V
-25V
-1.0V
0
50
100
150
200
250
ANODE VOLTAGE (V_a) V
500
400
300
200
100
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g2}) mA

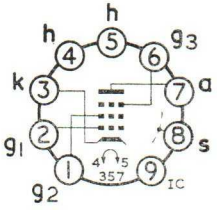

0229
$I_a, I_{g_2} / V_a$
V_{g_2} (b) = 190V
V_{g_1} = +1·0V
I_a —— I_{g_2} – –
R_{g_2}(kΩ)=1·0
1·5
2·2
3·3
4·7
6·8
1·0
1·5
2·2
3·3
4·7
6·8
ANODE CURRENT (I_a) mA
SCREEN CURRENT (I_{g_2}) mA
ANODE VOLTAGE (V_a) V
0
20
40
60
80
100
120
140
160
100
200
300
400
500
10
20
30
40
50
60
70
80
90
100


0230
$I_a, I_{g_2} / V_a$
V_{g_1} = +1.0V
I_a —— I_{g_2} – –
V_{g_2} (V)=150
130
110
90
70
150
130
110
90
70
ANODE CURRENT (I_a) mA
SCREEN CURRENT (I_{g_2}) mA
ANODE VOLTAGE (V_a) V
0
20
40
60
80
100
120
140
160
100
200
300
400
500
10
20
30
40
50
60
70
80
90
100


O233
PERMISSIBLE AREA OF OPERATION
MAXIMUM SCREEN GRID DISSIPATION ($P_{g2(max)}$) W
MAXIMUM ANODE DISSIPATION ($P_{a(max)}$) W
0
1
2
3
4
5
6
7
8



VIDEO OUTPUT PENTODE



B9A Base

GENERAL

This video output pentode is particularly suitable for use in projection television receivers or with high definition television systems.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	15	V

RATINGS

Maximum Anode Dissipation	$p_{a(max)}$	9·0	W
Maximum Screen Grid Dissipation	$p_{g2(max)}$	2·0	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	250	V
Maximum Screen Grid Supply Voltage	$V_{g2(b)max}$	550	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	250	V
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$	150	V
Maximum Cathode Current	$I_{k(max)}$	70	mA
Maximum Control Grid to Cathode Resistance	$R_{g1-k(max)}$		
Self Bias		1·0	MΩ
Fixed Bias		500	kΩ
Maximum Heater to Cathode Resistance	$R_{h-k(max)}$	20	kΩ

INTER-ELECTRODE CAPACITANCES

Input	c_{in}	10·4	pF
Output	c_{out}	6·6	pF
Anode to Control Grid	c_{a-g1}	<0·06	pF
Control Grid to Heater	c_{g1-h}	<0·15	pF

CHARACTERISTICS

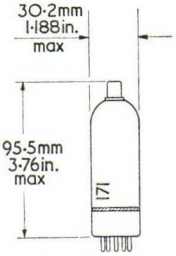
Anode Voltage	V_a	170	200	V
Screen Grid Voltage	V_{g2}	170	200	V
Control Grid Voltage	V_{g1}	−2·3	−3·5	V
Anode Current	I_a	36	36	mA
Screen Grid Current	I_{g2}	5·0	5·0	mA
Mutual Conductance	g_m	10	10	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	100	100	kΩ
Inner Amplification Factor	μ_{g1-g2}	24	24	

TYPICAL OPERATION

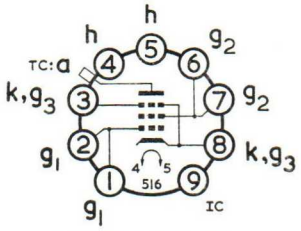
(Driving a cathode ray tube with cathode injection)

Supply Voltage	V_b	170	V
Screen Grid Voltage	V_{g2}	170	V
Control Grid Voltage	V_{g1}	−6·7	V
Anode Current	I_a	4·0	mA
Screen Grid Current	I_{g2}	0·25	mA
Anode Load Resistance	R_a	2·2	kΩ
Peak Output Voltage	$v_{out(pk)}$	>70	V

THORN—AEI RADIO VALVES & TUBES LTD.



LINE OUTPUT PENTODE



Base B9D, Cap CT1

GENERAL

This output pentode is primarily intended for use in the line timebase of television receivers.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	27	V

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$		
$P_{g2} \leqslant 4{\cdot}0W$		12	W
$P_{g2} = 5{\cdot}0W$		8·0	W
Maximum Anode and Screen Grid Dissipation	$P_{(a+g2)max}$	See Rating Chart	
Maximum Screen Grid Dissipation	$P_{g2(max)}$		
$P_a \leqslant 8{\cdot}0W$		5·0	W
$P_a = 12W$		4·0	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	250	V
Maximum Peak Anode Voltage	$v_{a(pk)max}$	7·0*	kV
Maximum Screen Grid Supply Voltage	$V_{g2(b)max}$	550	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	250	V
Maximum Heater to Cathode Voltage (R.M.S.)	$V_{h\text{-}k(r.m.s.)max}$	220†	V
Maximum Cathode Current	$I_{k(max)}$	250	mA
Maximum Control Grid to Cathode Resistance	$R_{g1\text{-}k(max)}$	500‡	kΩ

* Maximum pulse duration 22% of one cycle with a maximum of 22 μs.

† Measured with respect to the high potential heater pin.

‡ In line timebase applications $R_{g1\text{-}k(max)}$ may be 2·2MΩ.

INTER-ELECTRODE CAPACITANCES §

Input	c_{in}	22	pF
Output	c_{out}	9·0	pF
Anode to Grid 1	$c_{a\text{-}g1}$	<1·75	pF
Grid 1 to Heater	$c_{g1\text{-}h}$	<0·2	pF

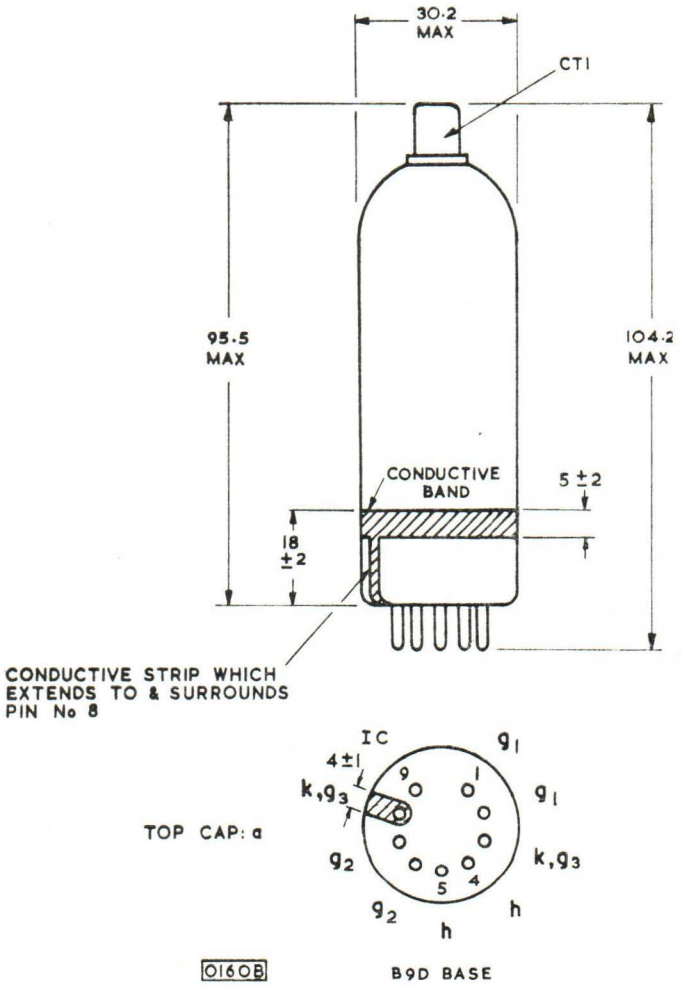
§ Measured without external shield.

CHARACTERISTICS

Anode Voltage	V_a	75	V
Screen Grid Voltage	V_{g2}	200	V
Control Grid Voltage	V_{g1}	–10	V
Anode Current	I_a	440	mA
Screen Grid Current	I_{g2}	30	mA

LINE OUTPUT VALVE CIRCUIT DESIGN

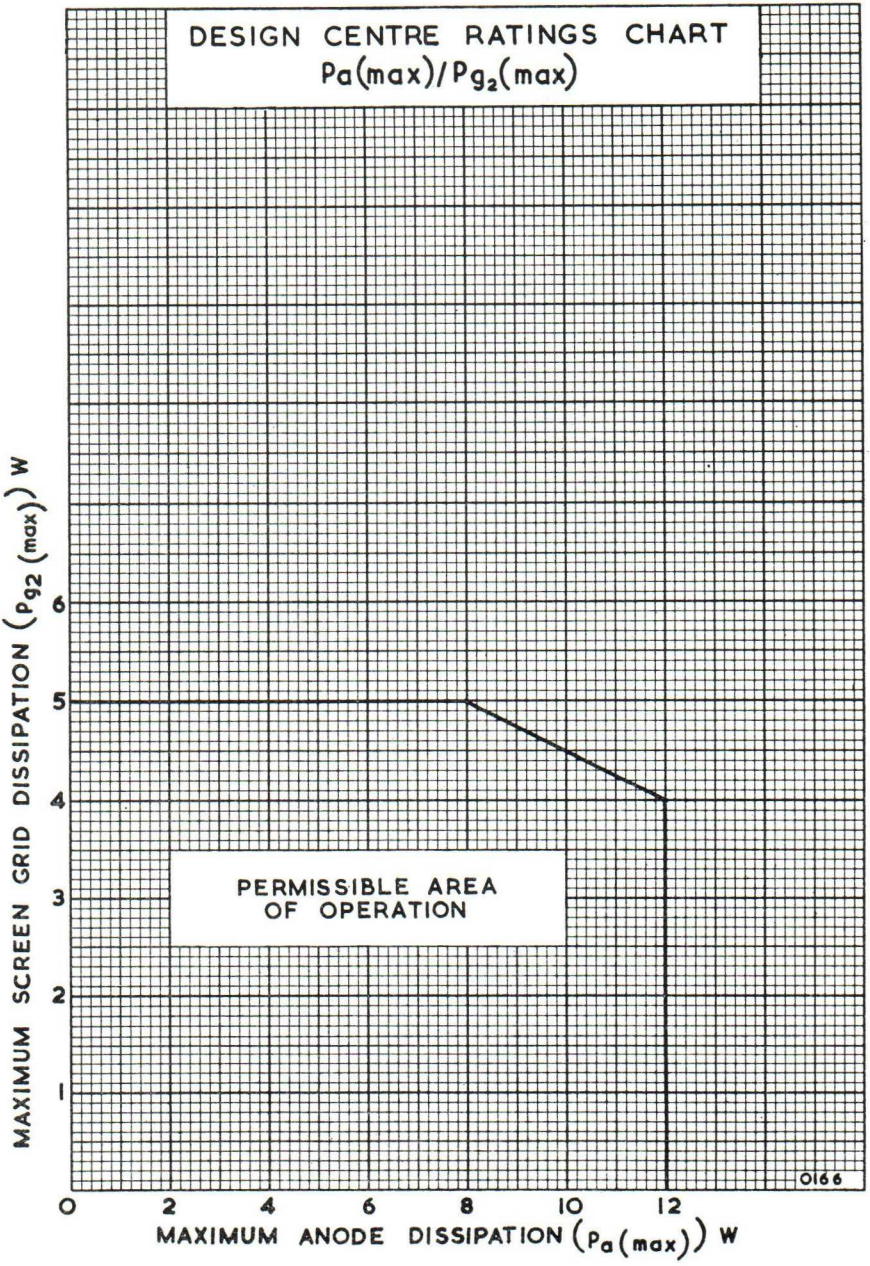
When calculating the peak anode current for circuit design purposes the knee should be taken as the reference point. Operation so that the anode potential of the output valve at the end of scan is above the knee of the anode characteristic is only recommended when an effective feedback stabilising circuit is employed.

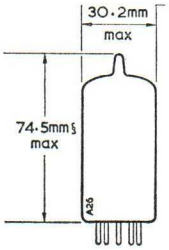


All dimensions in mm.

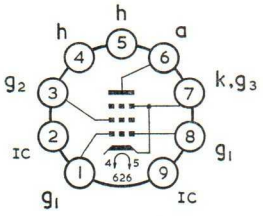
MOUNTING POSITION—Unrestricted.

Characteristic curves are as the PL504.


DESIGN CENTRE RATINGS CHART
Pa(max)/Pg2(max)
PERMISSIBLE AREA OF OPERATION
MAXIMUM SCREEN GRID DISSIPATION (Pg2 (max)) W
1
2
3
4
5
6
0
2
4
6
8
10
12
MAXIMUM ANODE DISSIPATION (Pa(max)) W
0166



FIELD OUTPUT PENTODE



B9D Base §

GENERAL

This pentode is for use as a field output amplifier in colour television receivers having series connected heaters (a.c. or d.c.).

Heater Current	I_h	0·3	A
Heater Voltage	V_h	17	V

DESIGN CENTRE RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	12	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	3·0*	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	700	V
Maximum Anode Voltage	$V_{a(max)}$	400	V
Maximum Peak Anode Voltage	$v_{a(pk)max}$	2·5†	kV
Maximum Screen Grid Supply Voltage	$V_{g2(b)max}$	700	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	275	V
Maximum Heater to Cathode Voltage	$V_{h-k(max)}$	220	V
Maximum Cathode Current	$I_{k(max)}$	100	mA
Maximum Grid 1 to Cathode Resistance	$R_{g1-k(max)}$		
Fixed Bias		1·0	MΩ
Self Bias		2·2	MΩ

All voltages referred to cathode.

* The Design Maximum rating is 4·0W max.

† Maximum pulse duration 5% of one cycle with a maximum of 1 ms.

INTER-ELECTRODE CAPACITANCES

Anode to Grid 1	c_{a-g1}	<1·6	pF
Grid 1 to Heater	c_{g1-h}	<0·2	pF

CHARACTERISTICS ‡

Anode Voltage	V_a	50	190	V
Screen Grid Voltage	V_{g2}	190	190	V
Control Grid Voltage	V_{g1}	−1·0	−17	V
Anode Current	I_a	320	60	mA
Screen Grid Current	I_{g2}	approx. 60	5·0	mA
Mutual Conductance	g_m	—	9·0	mA/V
Inner Amplification Factor	μ_{g1-g2}	—	8·0	

‡ Measured under pulse conditions.

§ Some valves have the pumping stem in the base and for such valves the maximum seated height is 71·4 mm.

THORN RADIO VALVES AND TUBES LTD.

CIRCUIT DESIGN

Note: The curves on page 4 can be used to derive the minimum I_a to be expected as a result of the spread of the valve characteristics, valve deterioration during life and decrease of the mains voltages to 10% below the nominal value by decreasing by 40% the I_a values on the curve A–B at the V_{g_2} occurring at the decreased mains voltage.

In order that the maximum permissible value of screen grid dissipation is not exceeded, the circuit should be designed in such a way that the anode voltage should never be lower than the value determined by curve A–B at the relevant V_{g_2} value.

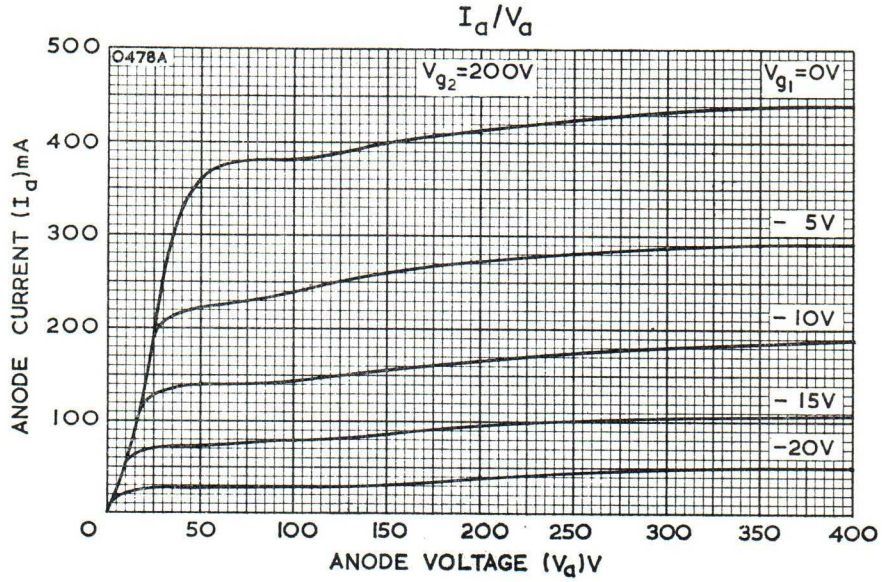
TYPICAL OPERATION

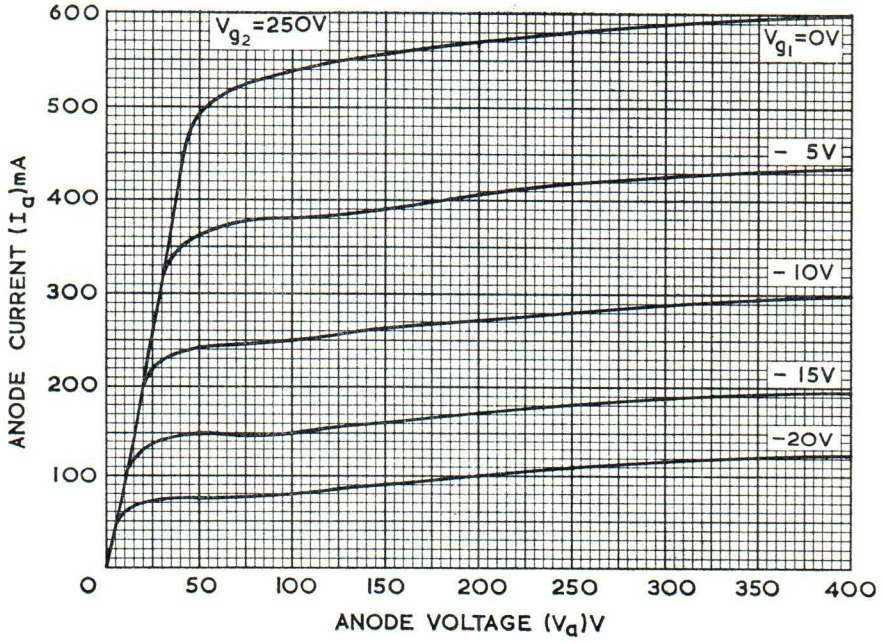
(End of scan values)

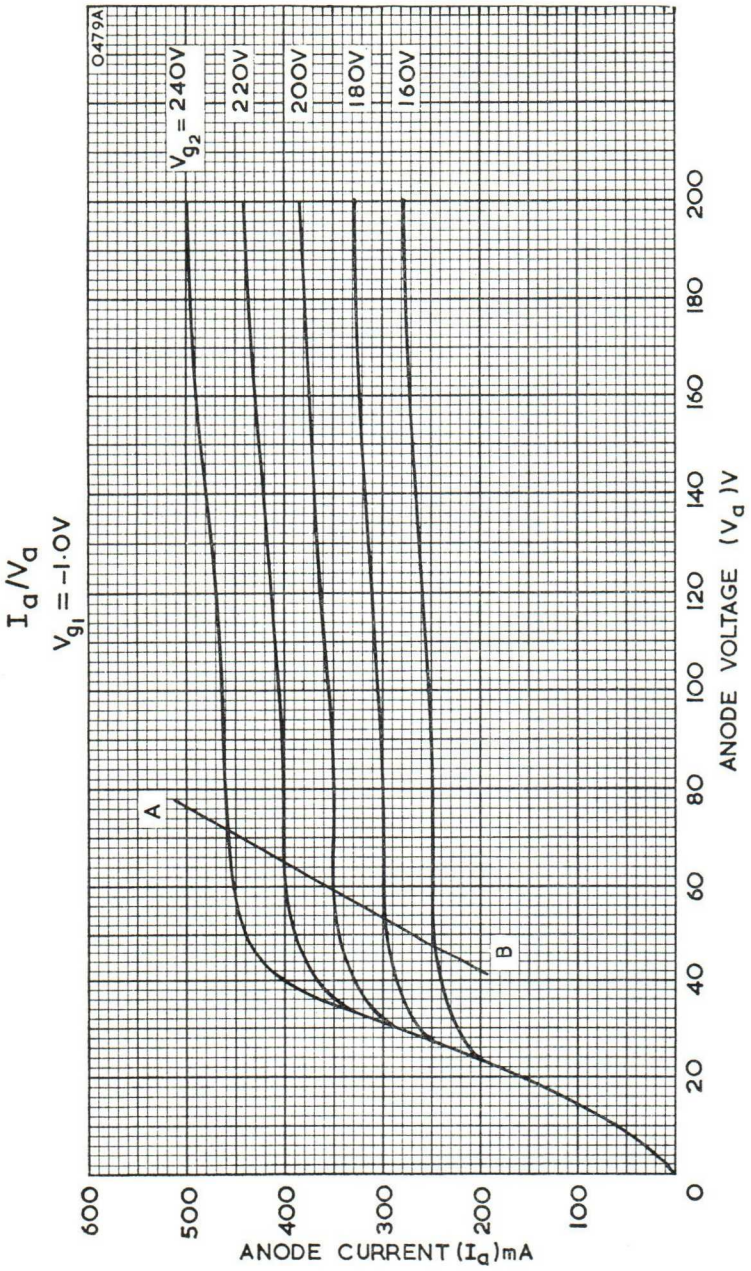
Anode Voltage	V_a	70	V
Screen Grid Voltage	V_{g_2}	200	V
Control Grid Voltage	V_{g_1}	−5·0	V
Peak Anode Current	$i_{a(pk)}$	230	mA

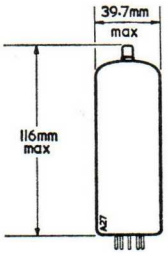
MICROPHONY

The maximum peak acceleration to which the valve may be subjected under the most unfavourable conditions is 1·5g at frequencies <600Hz and 0·2g at frequencies >600Hz. The equivalent interference voltage at the control grid voltage will then be <25mV.

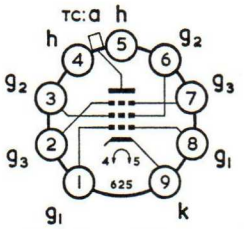

I_a/V_a
0478A
V_{g_2}=200V
V_{g_1}=0V
- 5V
- 10V
- 15V
-20V
ANODE CURRENT (I_a)mA
ANODE VOLTAGE (V_a)V
0
50
100
150
200
250
300
350
400
100
200
300
400
500


V_{g_2}=250V
V_{g_1}=0V
- 5V
- 10V
- 15V
-20V
ANODE CURRENT (I_a)mA
ANODE VOLTAGE (V_a)V
0
50
100
150
200
250
300
350
400
100
200
300
400
500
600


0479A
I_a/V_a
$V_{g_1} = -1.0V$
$V_{g_2} = 240V$
220V
200V
180V
160V
A
B
ANODE CURRENT (I_a)mA
600
500
400
300
200
100
0
20
40
60
80
100
120
140
160
180
200
ANODE VOLTAGE (V_a)V



LINE OUTPUT PENTODE



B9D Base, CT1 Cap

GENERAL

This output pentode is for use in the line deflection circuits of colour television receivers having series connected heaters (a.c. or d.c.).

Heater Current	I_h	0·3	A
Heater Voltage	V_h	40	V

RATINGS

		†		*	
Maximum Anode Dissipation	$p_{a(max)}$	40		30	W
Maximum Anode and Screen Grid Dissipation (Triode connected)	$p_{(a+g_2)max}$	42		31	W
Maximum Screen Grid Dissipation	$p_{g_2(max)}$	9·0		7·0‡	W
Maximum Anode Supply Voltage (Valve cold)	$V_{a(b)max}$	—		700	V
Maximum Peak Anode Voltage	$v_{a(pk)max}$	8·0§		7·0§	kV
Maximum Suppressor Grid Voltage	$V_{g3(max)}$	—		50	V
Maximum Screen Grid Supply Voltage (Valve cold)	$V_{g_2(b)max}$	—		700	V
Maximum Screen Grid Voltage	$V_{g_2(max)}$	—		275	V
Maximum Negative Peak Control Grid Voltage	$-v_{g_1(pk)max}$	550§		—	V
Maximum Heater to Cathode Voltage	$V_{h\text{-}k(max)}$	—		250	V
Maximum Cathode Current	$I_{k(max)}$	—		0·5	A
Maximum Peak Cathode Current	$i_{k(pk)max}$	—		1·2	A
Maximum Control Grid Resistance	$R_{g_1(max)}$				
Fixed Bias		—		0·5¶	MΩ
Stabilised Line Timebases		—		2·2¶	MΩ
Maximum Suppressor Grid Resistance	$R_{g3(max)}$	—		10‖	kΩ
Maximum Bulb Temperature (Absolute)	$T_{bulb(max)}$	—	300	—	°C

* Design centre ratings.

† Design maximum ratings. These limits should not be exceeded with a nominal tube under the worst probable operating conditions at a normal picture width.

‡ To prevent an excessive value of p_{g_2} the graph on page 3 should be used to obtain the minimum R_{g_2} values.

§ Maximum pulse duration is 22% of one cycle with a maximum of 18 μs.

¶ The circuit design has to be such that negative control grid currents up to 5 μA do not have any detrimental effect upon valve adjustment or circuit performance. Care should be taken that with 5 μA grid current the limiting values for I_k, p_a and p_{g_2} are not exceeded.

‖ With $R_{g3} \leqslant 10$ kΩ, capacitive decoupling of g3 is not required.

THORN RADIO VALVES AND TUBES LTD.

INTER-ELECTRODE CAPACITANCES

Anode to Grid 1	$c_{a\text{-}g_1}$	2·5	pF
Anode to Grid 1	$c_{a\text{-}g_1}$	<3·0	pF
Grid 1 to Heater	$c_{g_1\text{-}h}$	<0·2	pF

DYNAMIC CHARACTERISTICS

(Measured under pulse conditions)

Anode Voltage	V_a	160	50	V
Suppressor Grid Voltage	V_{g_3}	0	0	V
Screen Grid Voltage	V_{g_2}	160	175	V
Control Grid Voltage	V_{g_1}	0	−10	V
Anode Current	I_a	1·4	0·8	A
Screen Grid Current	I_{g_2}	45	70	mA

TYPICAL OPERATING CONDITIONS

The diagram on page 4 indicates values of $V_{a(min)}$, $-V_{g_1}$ and V_{g_2} corresponding to $i_{a(pk)}$ at the end of scan. Higher values of V_{g_2} may be used provided maximum screen grid dissipation and the minimum screen grid resistor are considered. This will require a larger $-V_{g_1}$. The screen grid resistor should be determined by measurement on valves with average characteristics.

V_{g_2} and $-V_{g_1}$ apply for nominal mains voltage but safety factors have been taken into consideration for component spread, valve spread and decrease of the valve characteristics during life.

To ensure operation above the knee at mains voltage below nominal value, the value of $V_{a(min)}$ shown on the diagram must be increased by the amount the supply voltage may fall.

Typical example using diagram

Peak anode current	$i_{a(pk)}$	800	mA
Screen grid voltage	V_{g_2}	175	V
Grid 1 voltage	V_{g_1}	−10	V
Minimum anode voltage for low mains voltage	$V_{a(min)}$	54	V
Supply Voltage	V_b	240	V
Supply voltage variation (due to low limit mains)	$\triangle V_b$	24	V
Hence minimum anode voltage for nominal mains voltage (54 + 24)		78	V

Minimum cut-off voltage during flyback

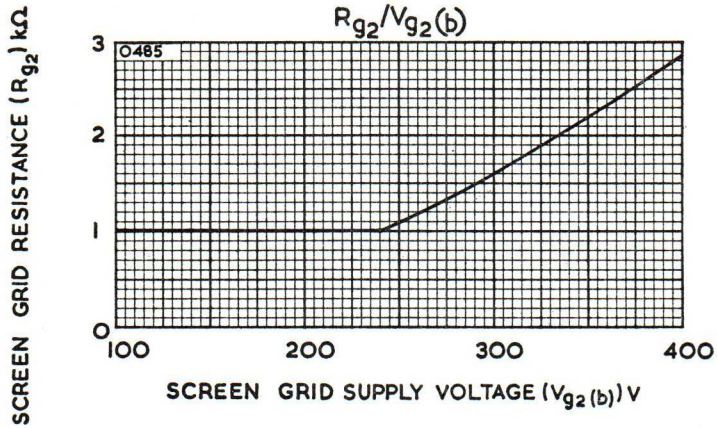
Peak anode voltage	$v_{a(pk)}$		7·0		kV
Grid 1 impedance at line frequency	Z_{g_1}		1·0		kΩ
Screen grid voltage	V_{g_2}	150	200	250	V
Minimum cut-off voltage during flyback	$V_{g_1(min)}$	−175	−195	−215	V

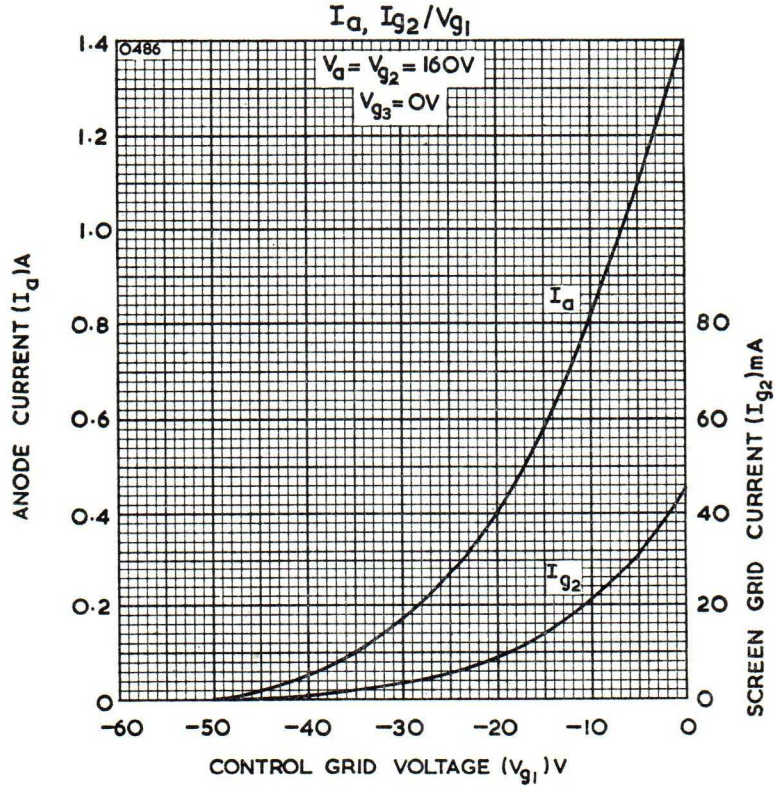
Note

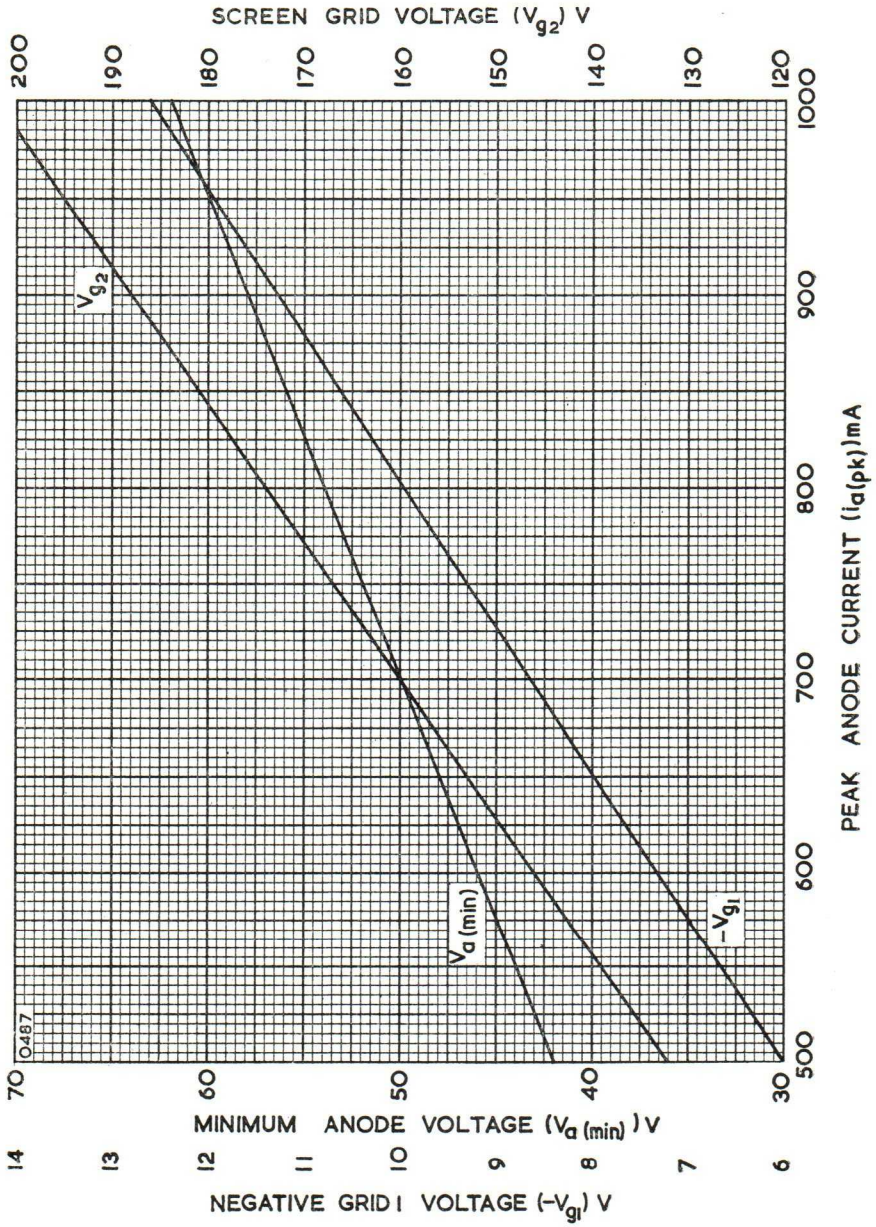
When optimum suppression of Barkhausen oscillations and/or snivets is required g_3 may be connected to a positive voltage of approximately 20V.

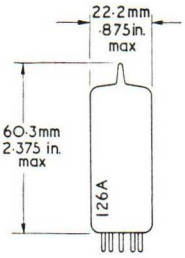
Hum. At Z_{g_1} = 200 kΩ (f = 50 Hz), $V_{h\text{-}k}$ = 220 $V_{r.m.s.}$ and without wiring and socket capacitances, the equivalent grid hum voltage is less than 5 mV.

Mounting. This valve requires additional support at the top.

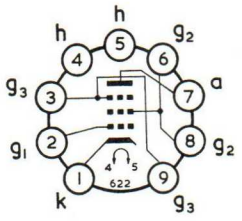

$R_{g2}/V_{g2(b)}$
0485
SCREEN GRID RESISTANCE (R_{g2}) kΩ
3
2
1
0
100
200
300
400
SCREEN GRID SUPPLY VOLTAGE ($V_{g2(b)}$) V


$I_a, I_{g2}/V_{g1}$
0486
$V_a = V_{g2} = 160V$
$V_{g3} = 0V$
ANODE CURRENT (I_a) A
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0
I_a
I_{g2}
80
60
40
20
0
SCREEN GRID CURRENT (I_{g2}) mA
−60
−50
−40
−30
−20
−10
0
CONTROL GRID VOLTAGE (V_{g1}) V


SCREEN GRID VOLTAGE (V_{g2}) V
200
190
180
170
160
150
140
130
120
1000
900
800
700
600
500
PEAK ANODE CURRENT ($i_{a(pk)}$) mA
V_{g2}
$V_{a\ (min)}$
$-V_{g1}$
0487
70
60
50
40
30
MINIMUM ANODE VOLTAGE ($V_{a\ (min)}$) V
14
13
12
11
10
9
8
7
6
NEGATIVE GRID I VOLTAGE ($-V_{g1}$) V



VIDEO OUTPUT PENTODE



B9A Base

GENERAL

This pentode is for use as a luminance output valve in colour television receivers having series connected heaters (a.c. or d.c.).

Heater Current	I_h	0·3	A
Heater Voltage	V_h	16	V

DESIGN CENTRE RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	6·0	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	2·5*	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	400†	V
Maximum Anode Voltage	$V_{a(max)}$	300	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	300†	V
Maximum Heater to Cathode Voltage	$V_{h\text{-}k(max)}$	200	V
Maximum Cathode Current	$I_{k(max)}$	100	mA
Maximum Control Grid Resistance	$R_{g1(max)}$	0·1‡	MΩ

* Design maximum rating including no signal condition is 3·0 W.

† With valve cold $V_{a(b)max} = V_{g2(b)max} = 550$ V.

‡ With $R_k \geqslant 39\Omega$, $R_{g1(max)} = 0{\cdot}5$ MΩ.

INTER-ELECTRODE CAPACITANCES

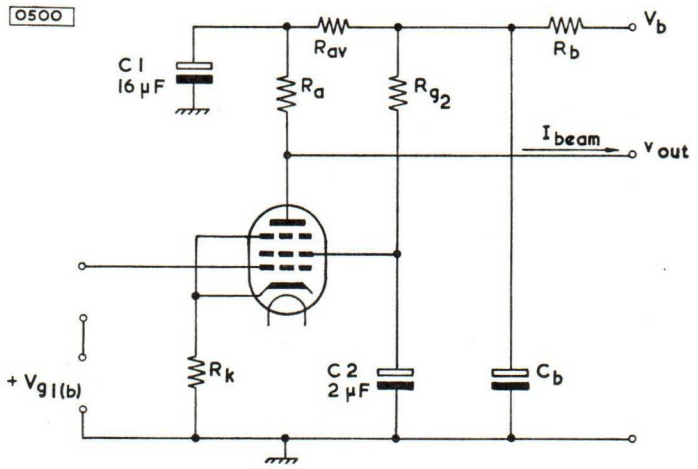
Input	C_{in}	20	pF
Output	C_{out}	4·0	pF
Anode to Grid 1	$C_{a\text{-}g1}$	0·075	pF
Maximum Anode to Grid 1	$C_{a\text{-}g1(max)}$	0·1	pF

CHARACTERISTICS

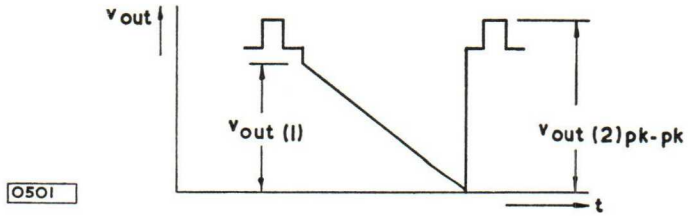
Anode Voltage	V_a	170	V
Suppressor Grid Voltage	V_{g3}	0	V
Screen Grid Voltage	V_{g2}	170	V
Cathode Resistor (decoupled)	R_k	36	Ω
Anode Current	I_a	30	mA
Screen Grid Current	I_{g2}	6·5	mA
Mutual Conductance	g_m	40	mA/V
Inner Amplification Factor	$\mu_{g1\text{-}g2}$	70	

THORN RADIO VALVES AND TUBES LTD.

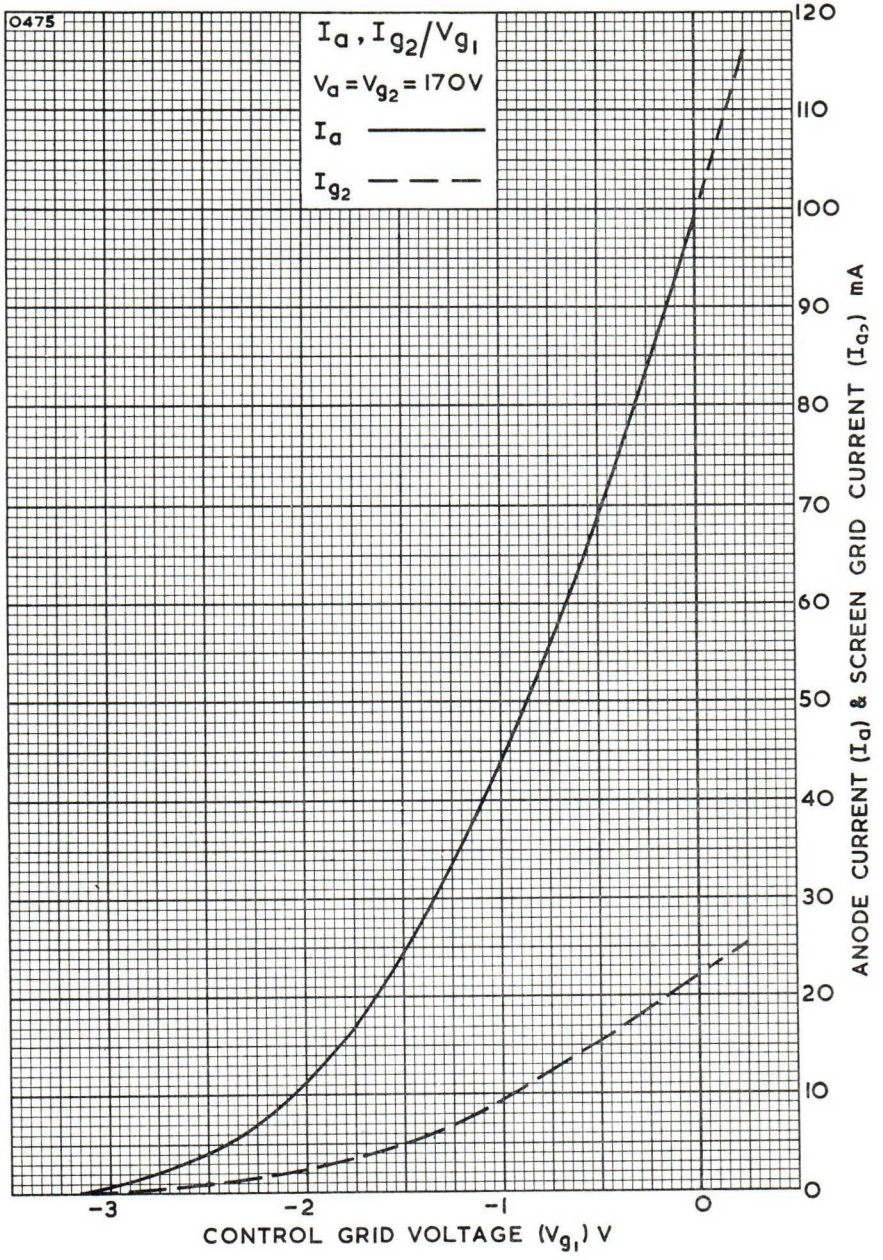
OPERATING CONDITIONS—Negative Modulation

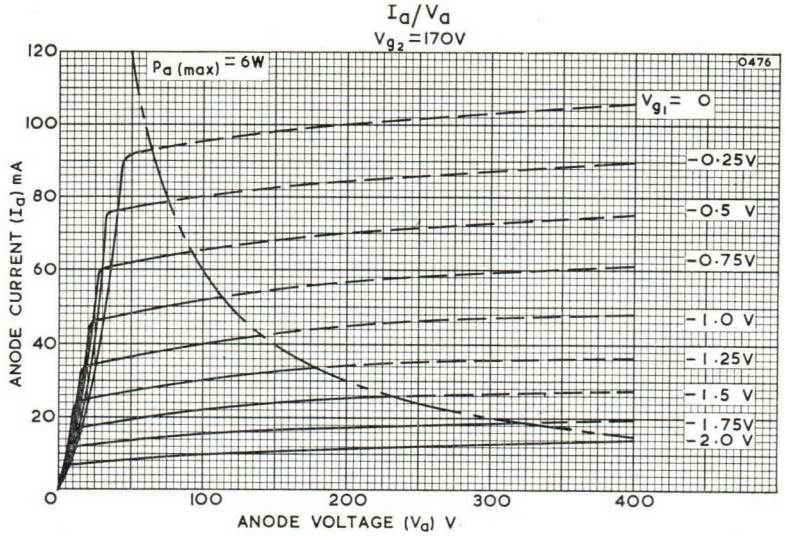


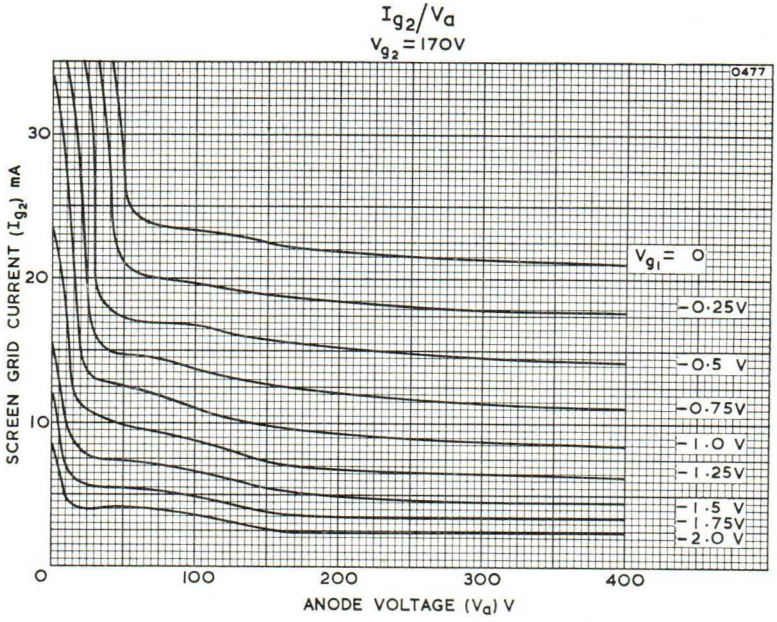
Supply Voltage	V_b	250	V
Supply Resistor	R_b	330	Ω
Average Decoupling Resistor	R_{av}	560	Ω
Anode Load Resistor	R_a	2·7	kΩ
Screen Grid Resistor	R_{g_2}	5·6	kΩ
Cathode Resistor (no bypass capacitor)	R_k	39	Ω
Control Grid Supply Voltage	$V_{g1(b)}$	+4·0	V

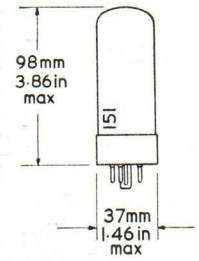


Output Voltage 1	$V_{out(1)}$	100	V
Output Voltage 2 (peak to peak)	$V_{out(2)pk\text{-}pk}$	⩾140	V
Video Linearity		⩾0·8	
Input Voltage (peak to peak)	$V_{in(pk\text{-}pk)}$	approx. 5·0	V
Maximum beam current	$I_{beam(max)}$	7·0	mA

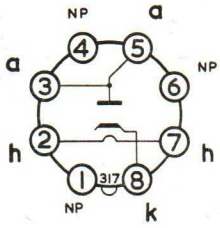

0475
$I_a, I_{g_2}/V_{g_1}$
$V_a = V_{g_2} = 170V$
I_a
I_{g_2}
120
110
100
90
80
70
60
50
40
30
20
10
0
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
-3
-2
-1
0
CONTROL GRID VOLTAGE (V_{g_1}) V


I_a/V_a
V_{g_2} = 170V
P_a (max) = 6W
0476
V_{g_1} = 0
-0·25V
-0·5 V
-0·75V
-1·0 V
-1·25V
-1·5 V
-1·75V
-2·0 V
ANODE CURRENT (I_a) mA
ANODE VOLTAGE (V_a) V
0
20
40
60
80
100
120
100
200
300
400


I_{g_2}/V_a
V_{g_2} = 170V
0477
V_{g_1} = 0
-0·25V
-0·5 V
-0·75V
-1·0 V
-1·25V
-1·5 V
-1·75V
-2·0 V
SCREEN GRID CURRENT (I_{g_2}) mA
ANODE VOLTAGE (V_a) V
0
10
20
30
100
200
300
400



HALF-WAVE RECTIFIER



Base 105‡

GENERAL

This indirectly heated half-wave rectifier is for use in television receivers employing series connected 0·3A heaters.

Heater Current	I_h	0·3	A
Heater Voltage	V_h	29·0	V

RATINGS

Maximum Peak Inverse Voltage	PIV_{max}	700	V
Maximum Anode Voltage (R.M.S.)	$V_{a(r.m.s.)max}$	250	V
Maximum Mean Anode Current	$I_{a(av)max}$	325	mA
Maximum Peak Anode Current	$i_{a(pk)max}$	2·6	A
Maximum Surge Anode Current	$i_{a(surge)max}$	9·5	A
Maximum Reservoir Capacitor	C_{max}	200	μF
Maximum Peak Heater to Cathode Voltage Heater Negative	$v_{h-k(pk)max}$	625*	V

* Measured with respect to the higher potential heater pin.
Maximum D.C. component = 275V, Maximum A.C. component = 250V r.m.s.

TYPICAL OPERATION†

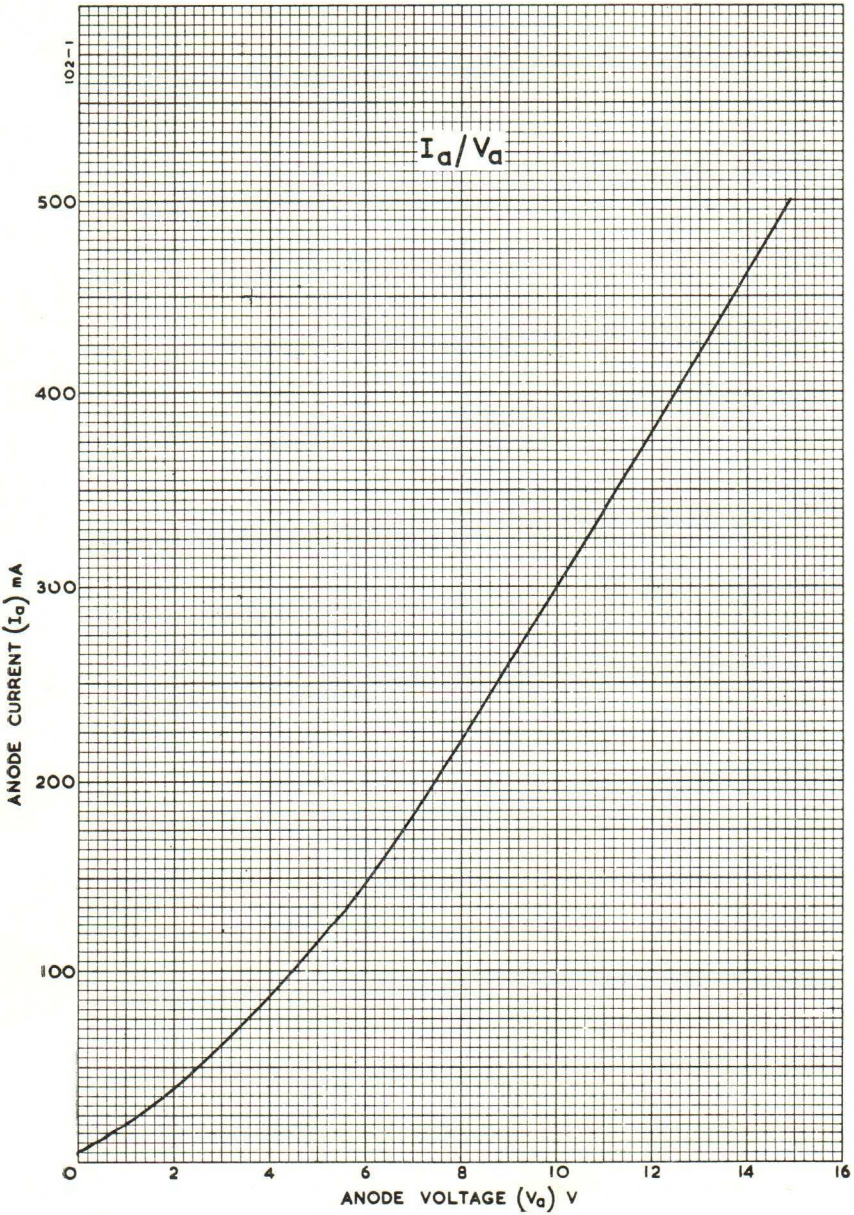
Input Anode Voltage (R.M.S.)	$V_{in(r.m.s.)}$	200	210	220	230	240	250	V
Output Current	I_{out}	325	325	295	270	240	220	mA
Reservoir Capacitor	C	200	200	200	200	200	200	μF
Minimum Surge limiting resistance	$R_{lim(min)}$	15	17	19	21	23	25	Ω
Output Voltage	V_{out}	209	219	234	249	264	280	V

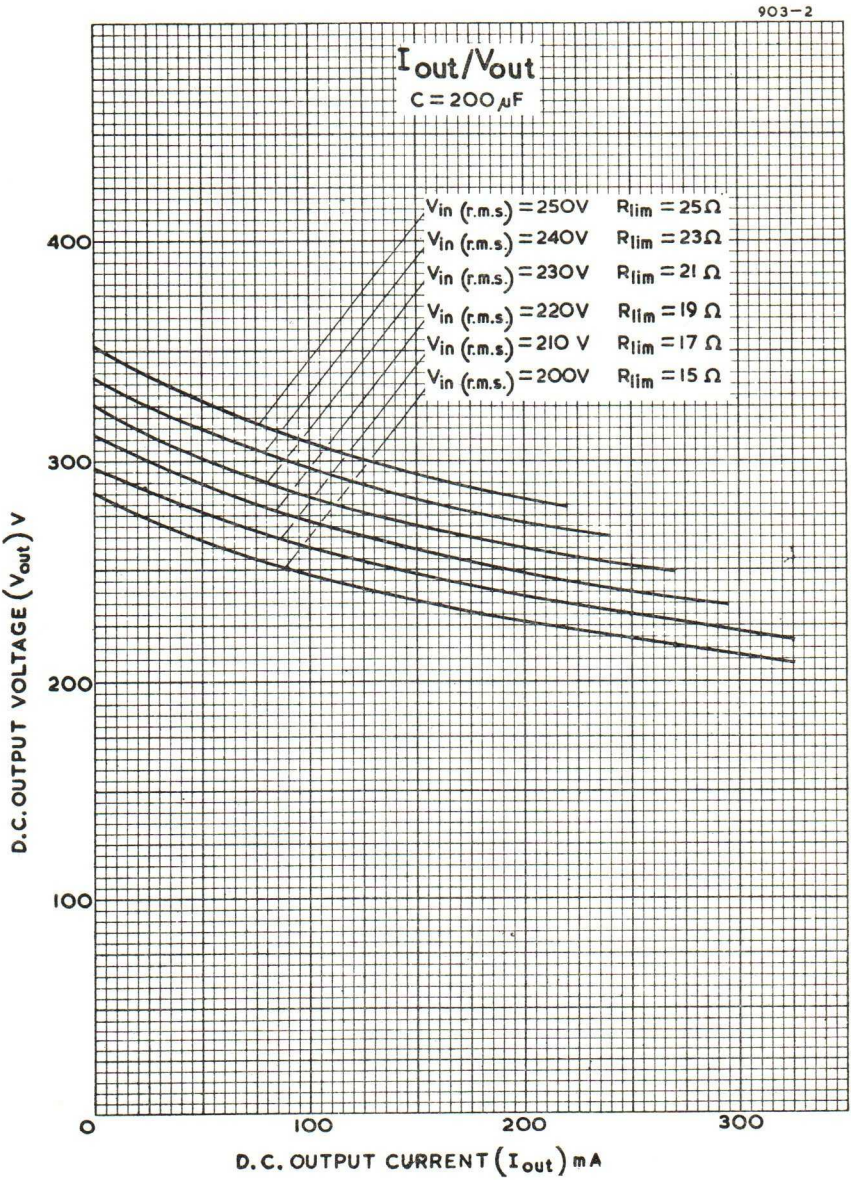
† For television receiver conditions see curves.

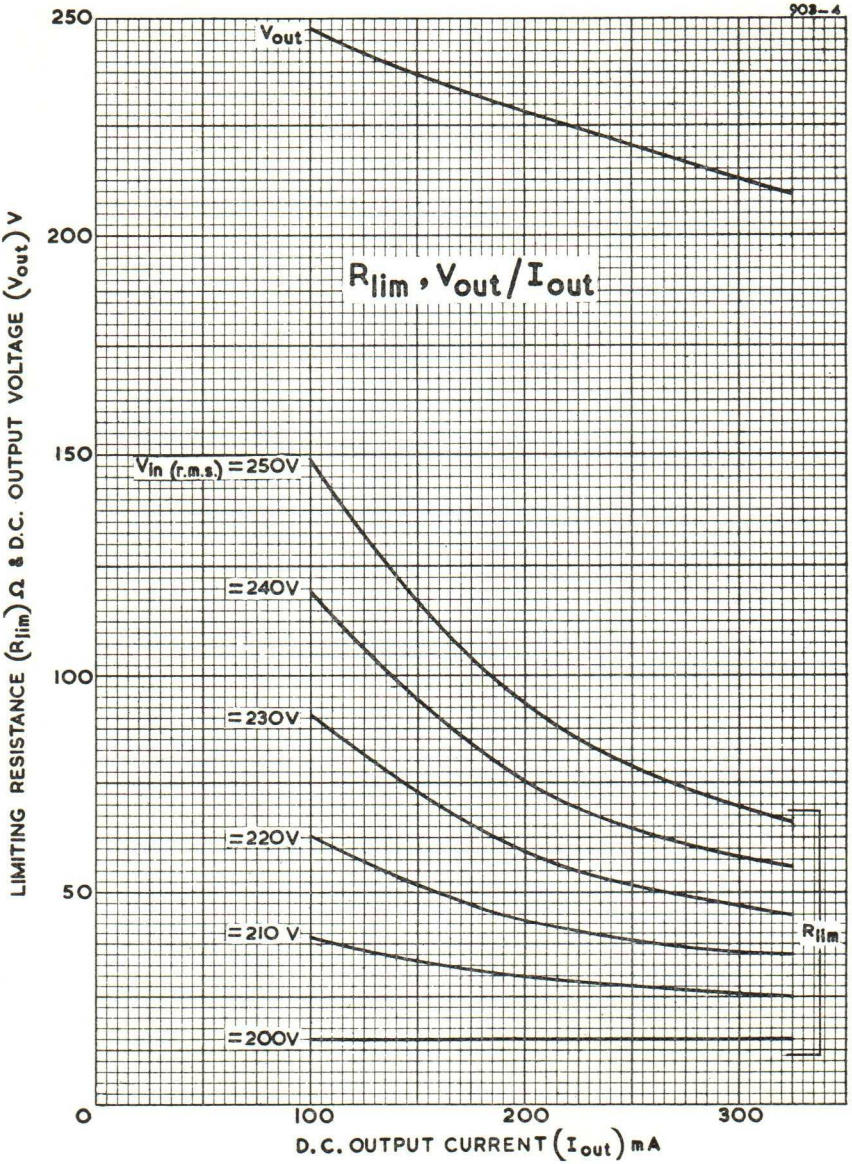
MOUNTING POSITION—Unrestricted.

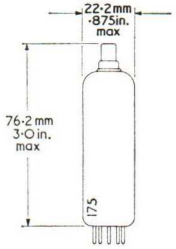
‡ Some PY33 valves may have an 107 base having pins 1 and 6 : NC.

THORN — A E I RADIO VALVES & TUBES LTD.

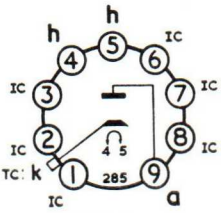

102-1
I_a/V_a
500
400
300
200
100
0
2
4
6
8
10
12
14
16
ANODE CURRENT (I_a) mA
ANODE VOLTAGE (V_a) V


903-2
Iout/Vout
C = 200 μF
Vin (r.m.s.) = 250V Rlim = 25Ω
Vin (r.m.s.) = 240V Rlim = 23Ω
Vin (r.m.s.) = 230V Rlim = 21 Ω
Vin (r.m.s.) = 220V Rlim = 19 Ω
Vin (r.m.s.) = 210 V Rlim = 17 Ω
Vin (r.m.s.) = 200V Rlim = 15 Ω
400
300
200
100
0
100
200
300
D.C. OUTPUT VOLTAGE (Vout) V
D.C. OUTPUT CURRENT (Iout) mA


903-4
250
200
150
100
50
0
100
200
300
V_{out}
R_{lim} , V_{out}/I_{out}
$V_{in\ (r.m.s.)}$ = 250V
= 240V
= 230V
= 220V
= 210 V
= 200V
R_{lim}
LIMITING RESISTANCE (R_{lim}) Ω & D.C. OUTPUT VOLTAGE (V_{out}) V
D.C. OUTPUT CURRENT (I_{out}) mA



EFFICIENCY DIODE



B9A Base

Heater Current	I_h	0·3	A
Heater Voltage	V_h	20	V (nominal)

RATINGS

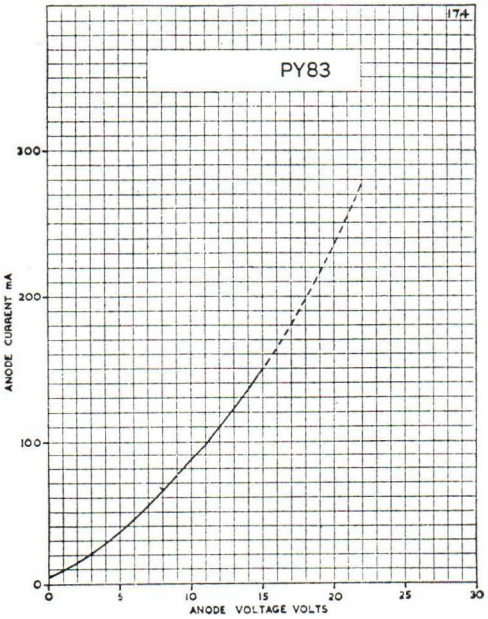
Maximum Peak Inverse Voltage	$P.I.V_{max}$	5·0*	kV
Maximum Heater to Cathode Voltage during flyback Heater Negative	$V_{h-k(max)}$	5·0*	kV
Maximum Peak Anode Current	$i_{a(pk)max}$	500	mA
Maximum Mean Anode Current	$I_{a(av)max}$	175	mA

* Maximum pulse duration 15 per cent of one cycle with a maximum of 15 μs.

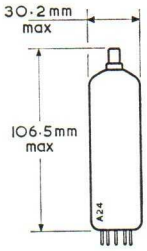
INTER-ELECTRODE CAPACITANCES†

Anode to Cathode	C_{a-k}	6·2	pF
Heater to Cathode	C_{h-k}	2·1	pF

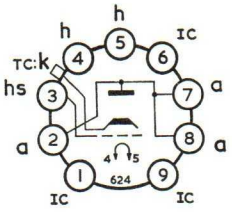
† Measured without an external shield.



THORN — AEI RADIO VALVES & TUBES LTD.



EFFICIENCY DIODE



B9D Base, CT1 Cap

GENERAL

This efficiency diode is for use in the timebase circuits of colour television receivers having series connected heaters (a.c. or d.c.).

Heater Current	I_h	0·3	A
Heater Voltage	V_h	42	V

During operation the minimum resistance between any heater pin and any mains terminal for the heater chain should be 100Ω. The hot heater resistances of the other valves in the chain can serve for this resistance.

DESIGN CENTRE RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	11	W
Maximum Peak Inverse Voltage	P.I.V.max	5·6*†	kV
Maximum Peak Heater to Cathode Voltage Heater Negative	$V_{h\text{-}k(pk)max}$	6·3*	kV
Maximum Anode Current	$I_{a(max)}$	440	mA
Maximum Peak Anode Current	$i_{a(pk)max}$	800	mA

* Maximum pulse duration 22% of one cycle with a maximum of 18μs.
† Absolute maximum rating is 7·0kV.

INTER-ELECTRODE CAPACITANCES

Anode to Cathode	$C_{a\text{-}k}$	13	pF
Heater to Cathode	$C_{h\text{-}k}$	3·7	pF

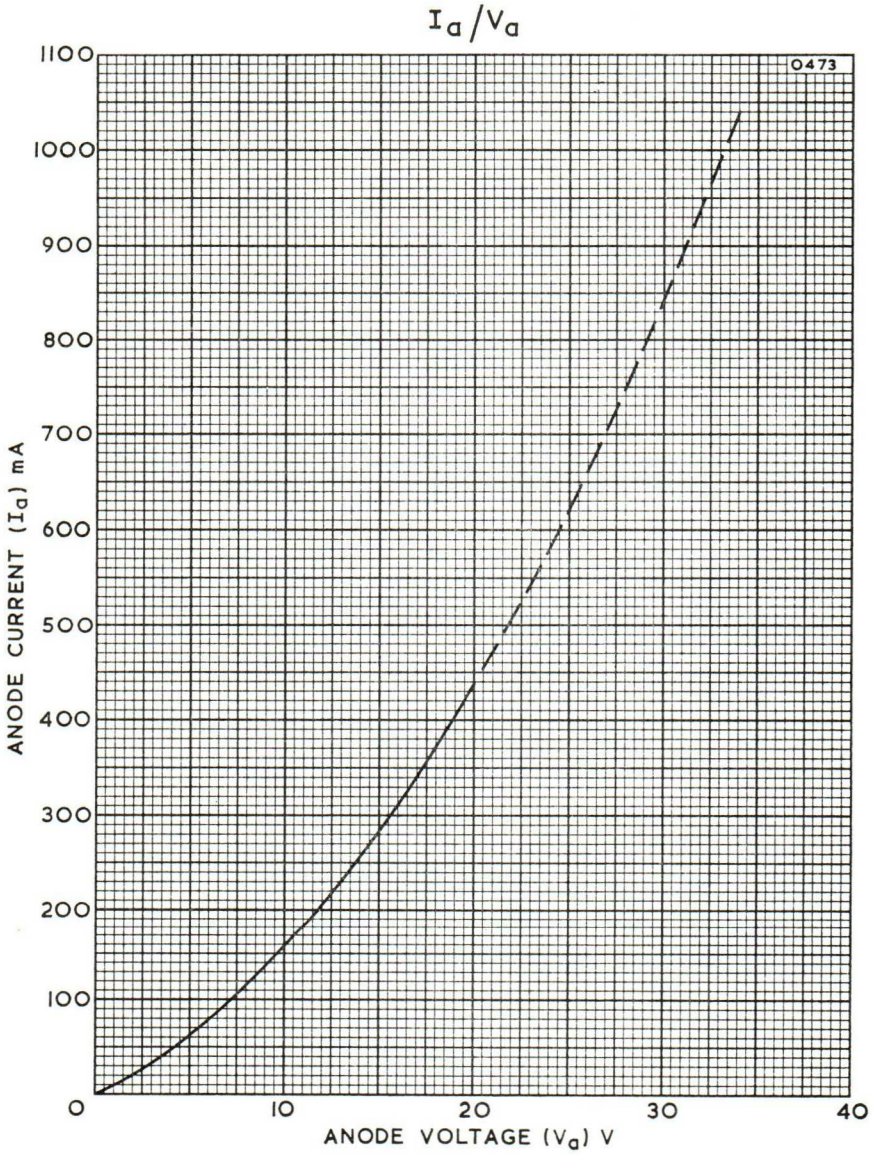
CHARACTERISTICS

Anode Current	I_a	440	mA
Internal Resistance	r_i	45·5	Ω

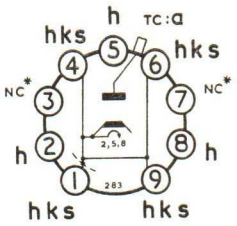
Note:

Insertion of a 1·0W non-inductive 330Ω carbon resistor between pins 3 and 5 is recommended to improve the high-tension properties of the valve. If no resistor is used, pins 3 and 4 should be interconnected.

THORN—AEI RADIO & VALVES TUBES LTD.


I_a/V_a
0473
1100
1000
900
800
700
600
500
400
300
200
100
0
ANODE CURRENT (I_a) mA
10
20
30
40
ANODE VOLTAGE (V_a) V

HIGH VOLTAGE HALF WAVE RECTIFIER FOR FLYBACK E.H.T. SUPPLIES



B9A Base

Heater Voltage	V_h	2·0	V
Heater Current	I_h	0·35	A

RATINGS (Flyback Pulse)† ←

Maximum Peak Inverse Voltage (Absolute)	PIV(max)	27	kV
Maximum Peak Inverse Voltage (Design Centre)	PIV(max)	23·5	kV
Maximum Mean Anode Current (Design Centre)	$I_{a(av)max}$	0·2	mA ←
Maximum Peak Anode Current (Design Centre)	$i_{a(pk)max}$	60	mA ←

† The pulse ratings are for television line scan where the applied voltage pulse does not exceed 15% of one scanning cycle or 15 microseconds duration. ←

INTER-ELECTRODE CAPACITANCES

Anode to Heater, Cathode and Shield	$c_{a-h,k,s}$	1·3‡	pF ←

‡ Total capacity including unscreened B9A ceramic holder i.e. without can or skirt.

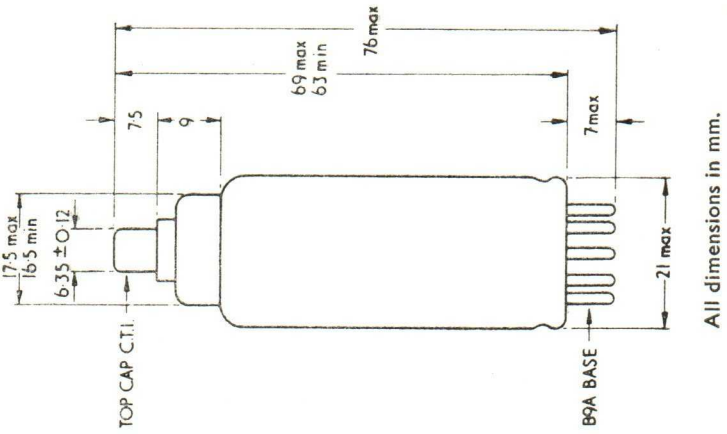
MOUNTING POSITION—Unrestricted

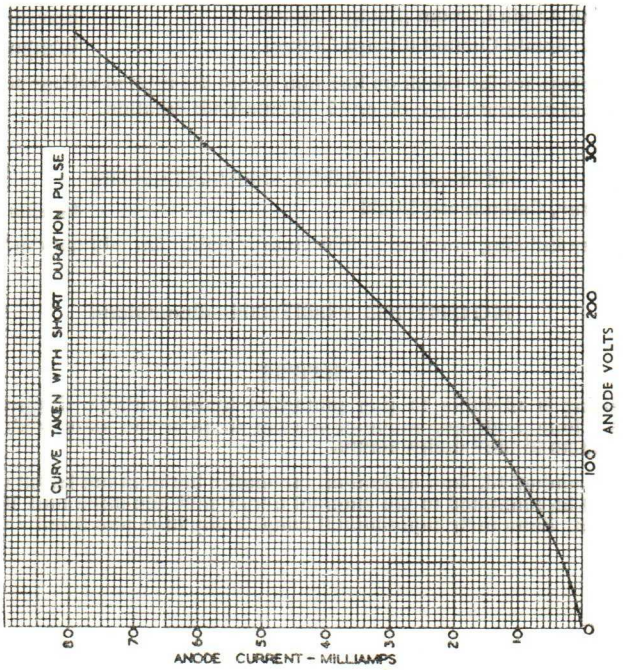
NOTES ←

X-Ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this valve whilst it is in use at a PIV in excess of 16kV design centre.

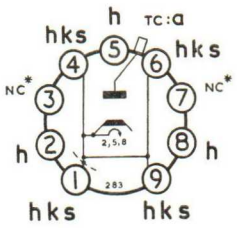
* Pins 3 and 7 marked NC have no internal connection but must not be left unconnected. They should be connected to the external circuit with not more than 100V between adjacent pins. Some early experimental samples may have pins 3 and 7 connected to cathode.

Indicates a change ←


76 max
69 max
63 min
7·5
9
7 max
17·5 max
16·5 min
6·35 ± 0·12
21 max
TOP CAP CT1.
B9A BASE
All dimensions in mm.


CURVE TAKEN WITH SHORT DURATION PULSE
ANODE VOLTS
300
200
100
0
80
70
60
50
40
30
20
10
ANODE CURRENT – MILLIAMPS

HIGH VOLTAGE HALF WAVE RECTIFIER FOR FLYBACK E.H.T. SUPPLIES



B9A Base

Heater Voltage	V_h	2·0	V
Heater Current	I_h	0·35	A

RATINGS (Flyback Pulse)†

Maximum Peak Inverse Voltage (Absolute)	PIV(max)	27	kV
Maximum Peak Inverse Voltage (Design Centre)	PIV(max)	23·5	kV
Maximum Mean Anode Current (Design Centre)	$I_{a(av)max}$	0·2	mA
Maximum Peak Anode Current (Design Centre)	$i_{a(pk)max}$	60	mA

† The pulse ratings are for television line scan where the applied voltage pulse does not exceed 15% of one scanning cycle or 15 microseconds duration.

INTER-ELECTRODE CAPACITANCES

Anode to Heater, Cathode and Shield	$C_{a-h,k,s}$	1·3‡	pF

‡ Total capacity including unscreened B9A ceramic holder i.e. without can or skirt.

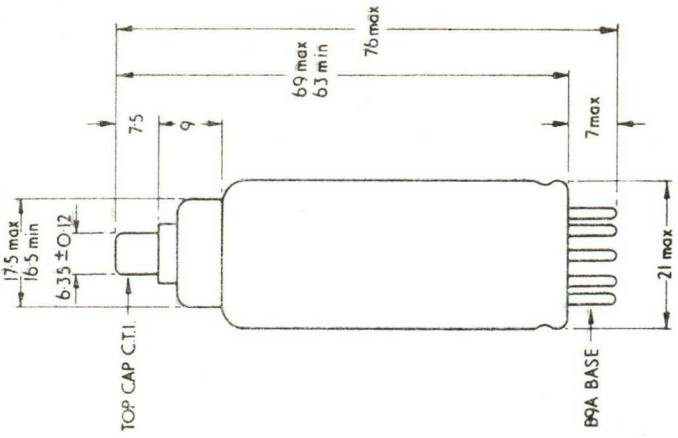
MOUNTING POSITION—Unrestricted

NOTES

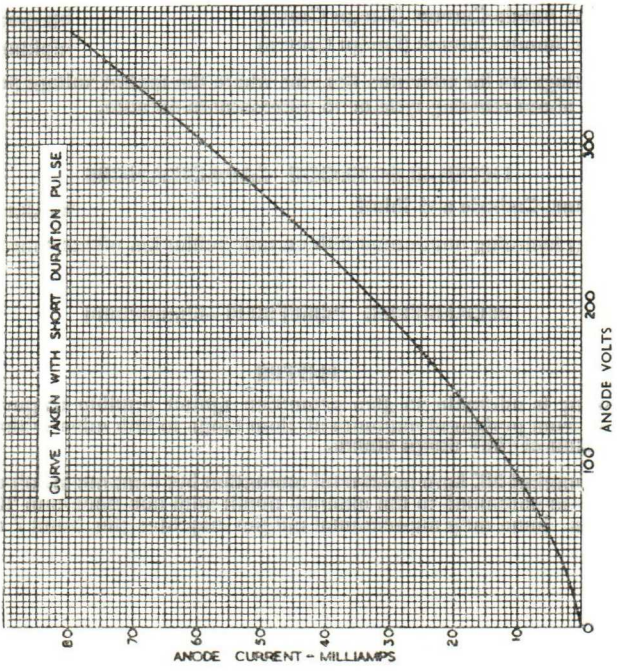
X-Ray shielding is advisable to give protection against possible danger of personal injury arising from prolonged exposure at close range to this valve whilst it is in use at a PIV in excess of 16kV design centre.

* Pins 3 and 7 marked NC have no internal connection but must not be left unconnected. They should be connected to the external circuit with not more than 100V between adjacent pins. Some early experimental samples may have pins 3 and 7 connected to cathode.

Indicates a change



All dimensions in mm.



U191

EFFICIENCY DIODE

Indirectly heated—for series operation

GENERAL

The U191 is intended for use as an Efficiency Diode in television receivers having series connected heaters and is suitable for A.C./D.C. operation.

RATING

Heater Current (amps)	I_h		0·3
Heater Voltage (volts)	V_h		19·0
Maximum Peak Inverse Anode Voltage (kV)	P.I.V. (max)		4·5*‡
Maximum Anode Current (mean) (mA)	$I_{a\ (av)\ max}$	120	150
Maximum Anode Current (peak) (mA)	$I_{a\ (pk)\ max}$	600	450
Maximum Heater-Cathode Voltage (volts) (h—ve, D.C. + Peak A.C.)	$V_{h-k(max)}$		900†
Maximum Heater-Cathode Voltage (h—ve, pulse) (kV)	$V_{h-k\ (pk)\ max}$		4·5*‡
Maximum Heater to Anode Volts (h+ve pulse) (kV)	$V_{a-h\ (max)}$		3*

* Rated for T.V. Line Scan where the duty cycle does not exceed 15% and the pulse duration does not exceed 15 μ secs.

† Measured with respect to the higher potential heater pin. The D.C. component should not exceed 600 volts.

‡ 4·5 kV is a Design Centre Rating. The absolute rating of 5·3 kV must not be exceeded

INTER-ELECTRODE CAPACITANCES (pF)

Anode to Heater plus Cathode	$c_{a-h,k}$	7·7
Cathode to Heater plus Anode	$c_{k-h,a}$	9·0

THORN — AEI RADIO VALVES & TUBES LTD.

U191

EFFICIENCY DIODE

Indirectly heated—for series operation

DIMENSIONS

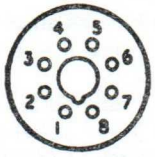
Maximum Overall Length (mm)	90
Maximum Diameter (mm)	32
Maximum Seated Height (mm)	77
Approximate Nett Weight (ozs)	1¼
Approximate Packed Weight (ozs)	2¼

MOUNTING POSITION—Unrestricted

BULB—Clear

TOP CAP—CT1

BASE—International Octal (IO5)



Viewed from Free End of Pins

CONNECTIONS

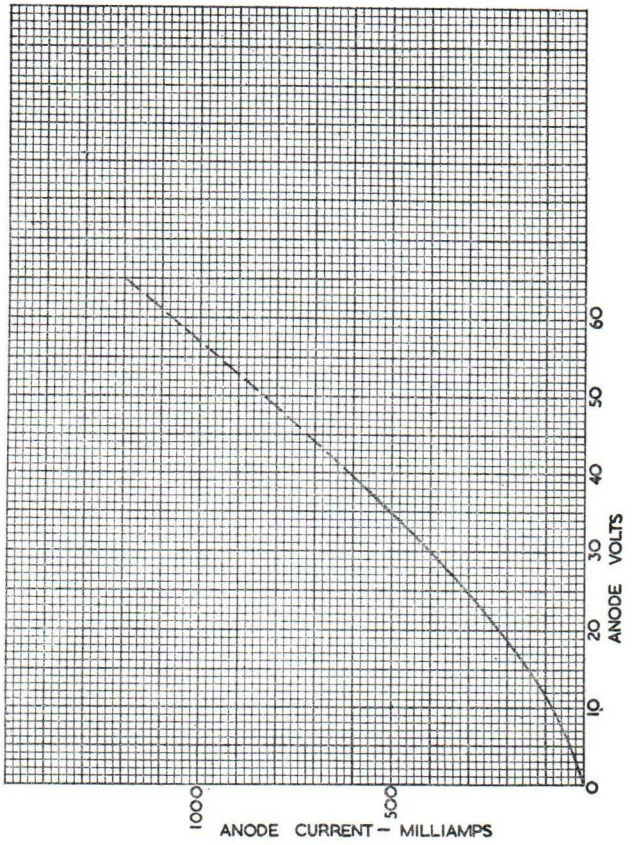
Pin 1	No Pin	NP
Pin 2	Internal Connection	IC
Pin 3	Internal Connection	IC
Pin 4	No Pin	NP
Pin 5	Anode	a
Pin 6	No Pin	NP
Pin 7	Heater	h
Pin 8	Heater	h
Cap	Cathode	k

NOTE: When the anode is pulsed, it is recommended that contacts 1 and 6 on the valve holder should be removed.

U191

EFFICIENCY DIODE

Indirectly heated—for series operation



THORN — AEI RADIO VALVES & TUBES LTD.

U192/PY82
HALF WAVE RECTIFIER
Indirectly heated—for series operation

←

GENERAL

The U192/PY82 is a miniature based Half Wave rectifier intended for use in AC/DC powered equipment having series connected heater chains.

RATING

Heater Current	I_h	0·3 A	
Heater Voltage	V_h	19·0 V	
Maximum Anode Voltage (r.m.s.)	$V_{a(rms)max}$	250 V	
Maximum DC Output Current	$I_{a(max)}$	180 mA	
Maximum Peak Inverse Voltage	P.I.V.(max)	700 V	
Maximum Reservoir Condenser	C_{max}	60* μF	
Maximum Anode Voltage (r.m.s.)	$V_{a(max)}$	200 210 220 230 240 250 V	←
Minimum Surge Limiting Resistance (absolute)	R_{lim}	28.5 30 40 60 80 100 Ω	←
Maximum Heater/Cathode Voltage (peak, heater negative)	$v_{h-k(max)}$	550† V	

* Allowable tolerance +80%. When two U192 are parallel connected C_{max}=100 μF and each anode must have a surge limiting resistor not less than the minimum value quoted in Typical Operation.

† Maximum AC 220 Vr.m.s. + Maximum DC 250 V measured with respect to the higher potential heater pin.

DIMENSIONS

Maximum Overall Length	78·5 mm
Maximum Diameter	22·2 mm
Maximum Seated Height	71·5 mm
Approximate Nett Weight	$\frac{1}{4}$ozs
Approximate Packed Weight	$\frac{3}{4}$ozs

Indicates a change ←

THORN — AEI RADIO VALVES & TUBES LTD.

U192/PY82
HALF WAVE RECTIFIER
Indirectly heated—for series operation

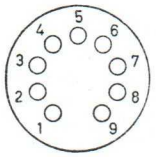
←

MOUNTING POSITION—Unrestricted

TYPICAL OPERATION

DC Load Current				I_{out}			180	mA
DC Rectified Output				V_{out}			195	V
Reservoir Capacity				C			60	μF
Anode Voltage (r.m.s.)	V_a	200	210	220	230	240	250	V
Recommended Anode Surge Limiting Resistance	R_a	30	45	65	85	105	125	Ω

BASE—Noval (B9A)



Viewed from free end of pins.

CONNECTIONS

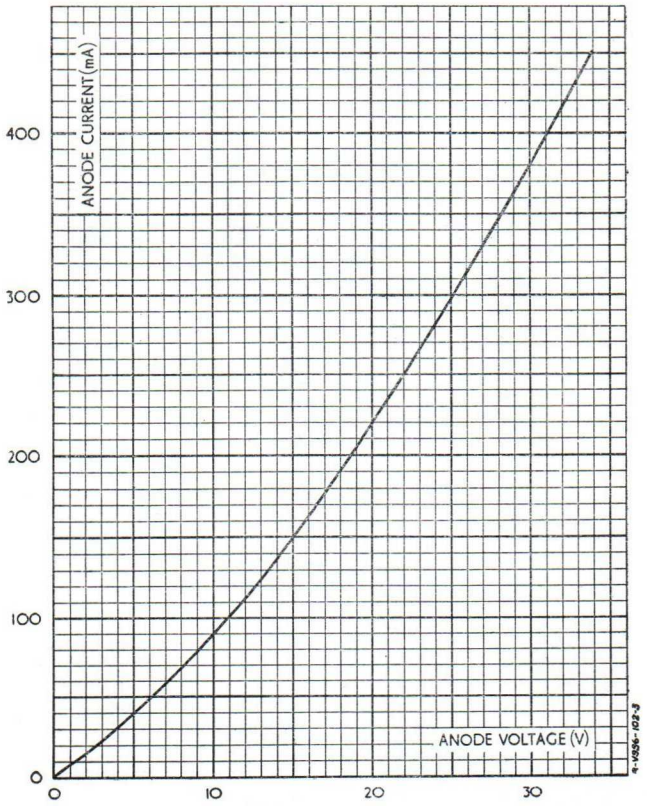
Pin 1	Internal Connection	IC
Pin 2	Internal Connection	IC
Pin 3	Cathode	k
Pin 4	Heater	h
Pin 5	Heater	h
Pin 6	Internal Connection	IC
Pin 7	Internal Connection	IC
Pin 8	Internal Connection	IC
Pin 9	Anode	a

Indicates a change ←

THORN — AEI RADIO VALVES & TUBES LTD.

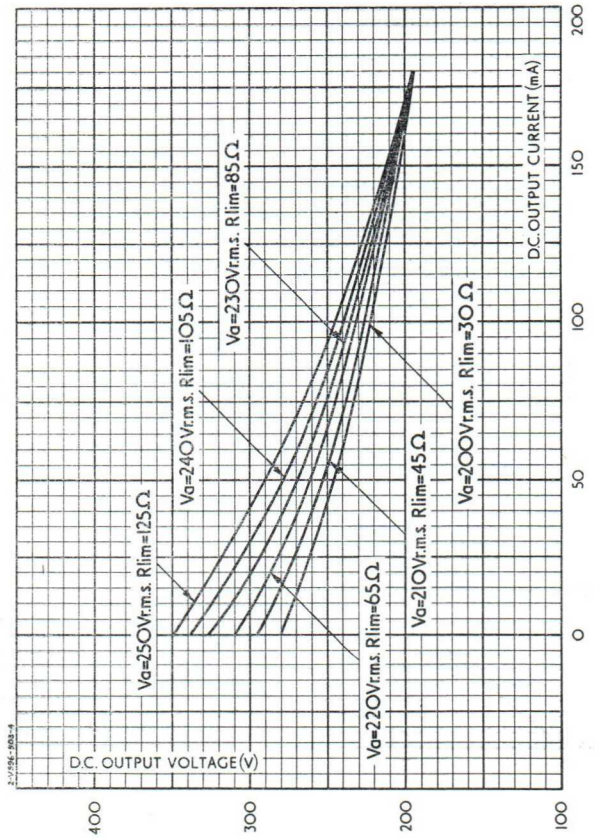
U192/PY82
HALF WAVE RECTIFIER
Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVE : I_a/V_a



U192/PY82
HALF WAVE RECTIFIER
Indirectly heated—for series operation

AVERAGE CHARACTERISTIC CURVES : Regulation
C = 60 μF



U381/UY85 ←

HALF WAVE RECTIFIER

Indirectly heated—for series operation

TENTATIVE

GENERAL

The U381/UY85 is a miniature based indirectly heated Half Wave Rectifier intended for use in AC/DC powered radio receivers having series connected heater chains.

RATING

Heater Voltage	(volts)	V_h	38.0
Heater Current	(amps)	I_h	0.1
Maximum Anode Voltage (r.m.s.)	(volts)	$V_{a(max)}$	250 ←
Maximum DC Output Current	(mA)	$I_{a(max)}$	110
Maximum Peak Inverse Voltage	(volts)	P.I.V. (max)	700
Maximum Reservoir Condenser	(μF)		100
Minimum Surge Limiting Resistance	(ohms)		100
Maximum Heater to Cathode Voltage (DC + Peak AC)	(volts)	$V_{h\text{-}k(max}$	550*

* Cathode positive to heater.

DIMENSIONS

Maximum Overall Length	(mm)	67.5
Maximum Diameter	(mm)	22.2
Maximum Seated Height	(mm)	60.5
Approximate Nett Weight	(ozs)	$\frac{1}{2}$
Approximate Packed Weight	(ozs)	$\frac{3}{4}$

MOUNTING POSITION – Unrestricted

Indicates a change ←

THORN — AEI RADIO VALVES & TUBES LTD.

U381/UY85 ←

HALF WAVE RECTIFIER

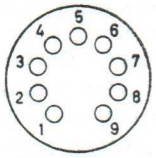
Indirectly heated—for series operation

TENTATIVE

TYPICAL OPERATION

D.C. Load Current	(mA)	I_a	110
A.C. Input Voltage (r.m.s.)	(volts)	$V_{in(rms)}$	250
D.C. Rectified Output Voltage	(volts)	V_{out}	245
Reservoir Capacity	(μF)		100
Surge Limiting Resistance	(ohms)		100

BASE – Noval (B9A)



Viewed from free end of pins

VALVE HOLDER

Ediswan Clix VH599/9, VH499/9 & VH19/9 series.

CONNECTIONS

Pin 1	Internal Connection	IC
Pin 2	Internal Connection	IC
Pin 3	Cathode	k
Pin 4	Heater	h
Pin 5	Heater	h
Pin 6	Internal Connection	IC
Pin 7	Internal Connection	IC
Pin 8	Internal Connection	IC
Pin 9	Anode	a

Indicates a change ←

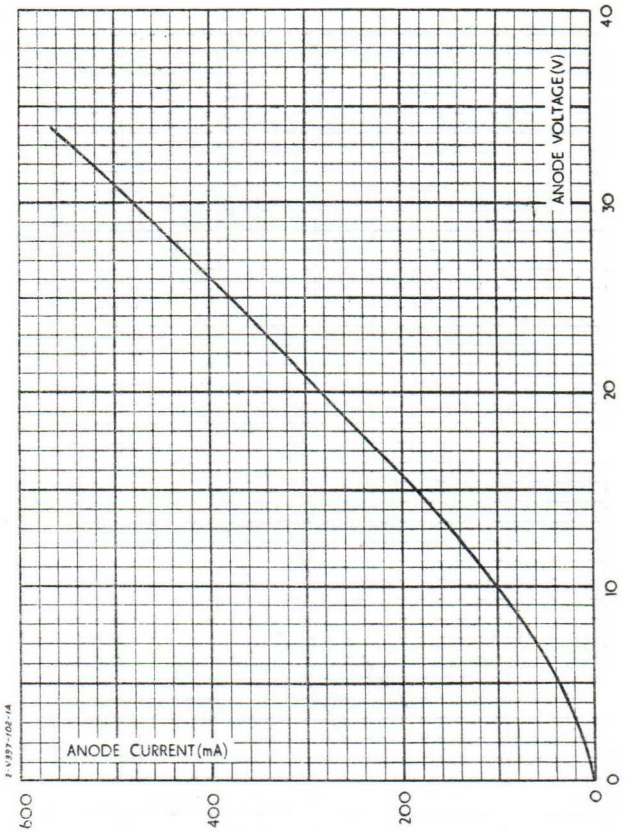
U381/UY85

HALF WAVE RECTIFIER

Indirectly heated—for series operation

TENTATIVE

CHARACTERISTIC CURVE: I_a/V_a



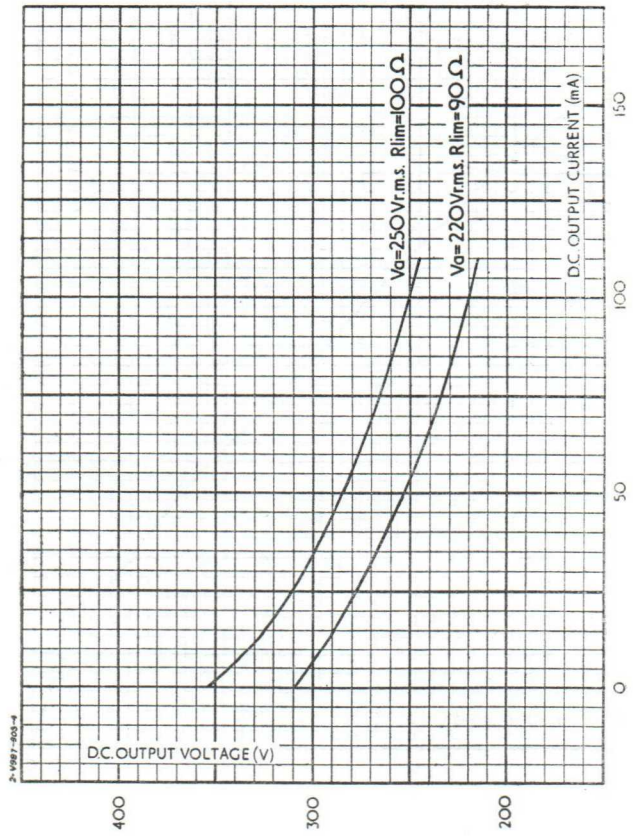
U381/UY85

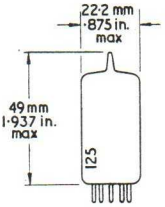
HALF WAVE RECTIFIER

Indirectly heated—for series operation

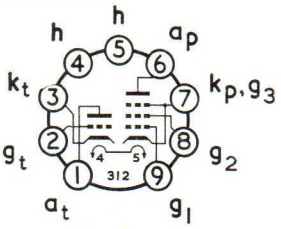
TENTATIVE

CHARACTERISTIC CURVES: Regulation
C=100μF





A.F. TRIODE PENTODE



GENERAL

This valve is a triode and output pentode designed primarily for use in A.F. applications.

Heater Current	I_h	0·1	A
Heater Voltage	V_h	38	V

RATINGS

		Triode	Pentode	
Maximum Anode Dissipation	$P_{a(max)}$	3·5	5·4	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	—	1·2	W
Speech and Music		—	2·4	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	550	V
Maximum Anode Voltage	$V_{a(max)}$	250	250	V
Maximum Screen Grid Supply Voltage	$V_{g2(b)max}$	—	550	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	—	250	V
Maximum Heater to Cathode Voltage	$V_{h\text{-}k(max)}$			
Heater Positive		100	100	V
Maximum Cathode Current	$I_{k(max)}$	15	45	mA
Maximum Control Grid to Cathode Resistance	$R_{g1\text{-}k(max)}$			
Self Bias		—	500	kΩ
Fixed Bias		1·0	0·25	MΩ
Grid Current Bias		22	—	MΩ

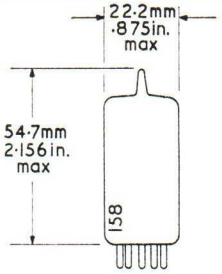
INTER-ELECTRODE CAPACITANCES

		Triode	Pentode	
Input	c_{in}	2·3	5·7	pF
Output	c_{out}	0·32	4·7	pF
Anode to Control Grid	$c_{a\text{-}g1}$	1·6	<0·2	pF
Control Grid to Heater	$c_{g1\text{-}h}$	—	0·4	pF

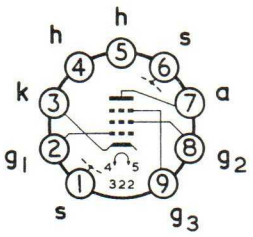
OPERATING CHARACTERISTICS

		Triode	Pentode	
Anode Voltage	V_a	170	170	V
Screen Grid Voltage	V_{g2}	—	170	V
Control Grid Voltage	V_{g1}	−1·5	−9·5	V
Anode Current	I_a	1·6	30	mA
Screen Grid Current	I_{g2}	—	5·0	mA
Mutual Conductance	g_m	2·1	5·5	mA/V
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	40	53	kΩ
Amplification Factor	μ	82	—	
Inner Amplification Factor	$\mu_{g1\text{-}g2}$	—	10	

THORN—AEI RADIO VALVES & TUBES LTD.



VARIABLE-MU H.F. PENTODE



B9A Base

GENERAL

This variable-mu H.F. pentode is designed primarily for use as an H.F. or I.F. amplifier.

Heater Current	I_h	0·1	A
Heater Voltage	V_h	12·6	V

RATINGS

Maximum Anode Dissipation	$P_{a(max)}$	2·25	W
Maximum Screen Grid Dissipation	$P_{g2(max)}$	0·45	W
Maximum Anode Supply Voltage	$V_{a(b)max}$	550	V
Maximum Anode Voltage	$V_{a(max)}$	250	V
Maximum Screen Grid Supply Voltage	$V_{g2(b)max}$	550	V
Maximum Screen Grid Voltage	$V_{g2(max)}$	250	V
Maximum Heater to Cathode Voltage	$V_{h\text{-}k(max)}$	150	V
Maximum Cathode Current	$I_{k(max)}$	16·5	mA
Maximum Grid to Cathode Resistance	$R_{g1\text{-}k(max)}$	3·0	MΩ
Maximum Heater to Cathode Resistance	$R_{h\text{-}k(max)}$	20	kΩ

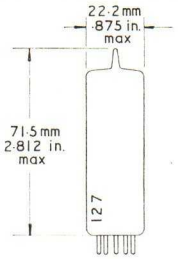
INTER-ELECTRODE CAPACITANCES

Input	c_{in}	5·5	pF
Output	c_{out}	5·1	pF
Anode to Grid 1	$c_{a\text{-}g1}$	<0·002	pF
Grid 1 to Heater	$c_{g1\text{-}h}$	0·05	pF

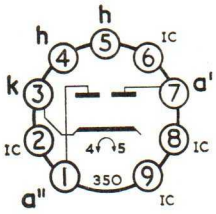
CHARACTERISTICS

Anode Voltage	V_a	170	V
Screen Grid Voltage	V_{g2}	110	V
Control Grid Voltage	V_{g1}	−2·0	V
Anode Current	I_a	12	mA
Screen Grid Current	I_{g2}	3·9	mA
Mutual Conductance	g_m	3·8	mA/V
Inner Amplification Factor	$\mu_{g1\text{-}g2}$	21	
Valve Anode Resistance ($\delta v_a/\delta i_a$)	r_a	0·5	MΩ
Control Grid Voltage for $g_m/10$	$V_{g1(gm/10)}$	−10	V

THORN—AEI RADIO VALVES & TUBES LTD.



FULL-WAVE RECTIFIER



B9A Base

GENERAL

Heater Voltage	V_h	6·3	V
Heater Current	I_h	1·0	A

RATINGS

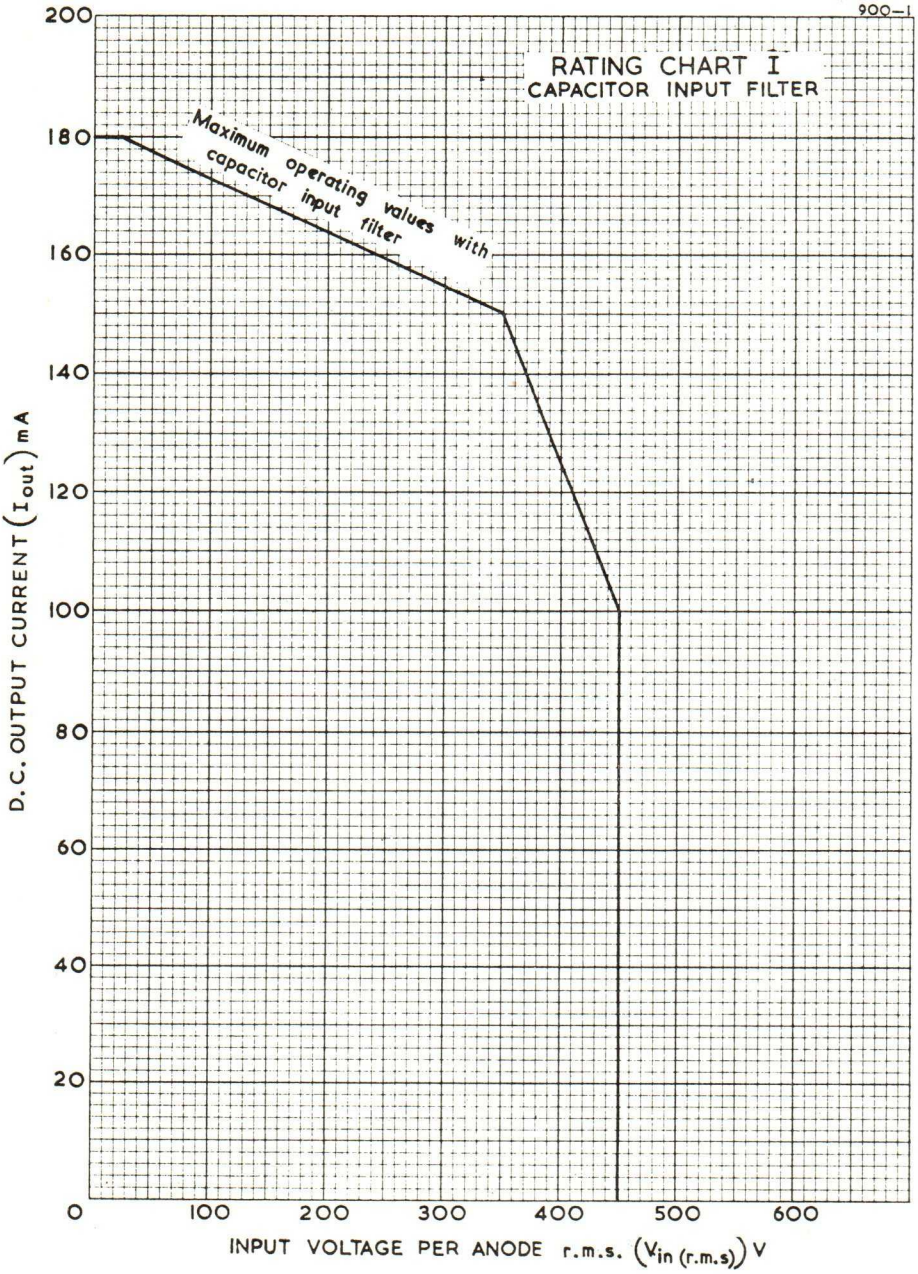
Maximum Peak Inverse Voltage	PIV_{max}	1·3	kV
Maximum Peak Current (each Anode)	$i_{a(pk)max}$	500	mA
Maximum Surge Current (each Anode)	$i_{a(sur)max}$	1·8	A
Maximum Anode Supply Voltage	$V_{a(b)max}$	See Rating Chart 1	
Maximum D.C. Output Current	$I_{out(max)}$	See Rating Chart 1	
Maximum Heater to Cathode Voltage (Heater Negative)	$V_{h-k(max)}$	500	V
Maximum Reservoir Capacitor	C_{max}	50	μF

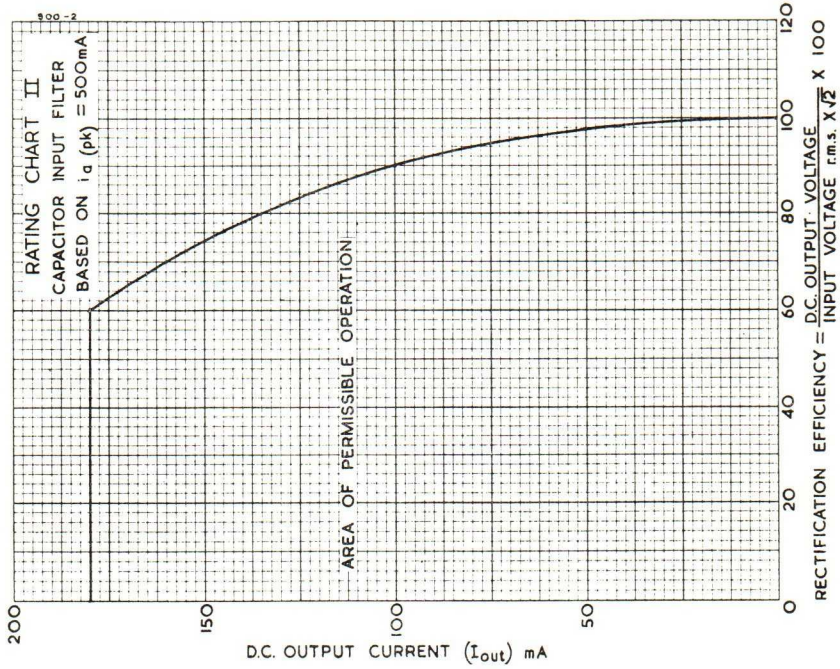
TYPICAL OPERATION AS A FULL-WAVE RECTIFIER

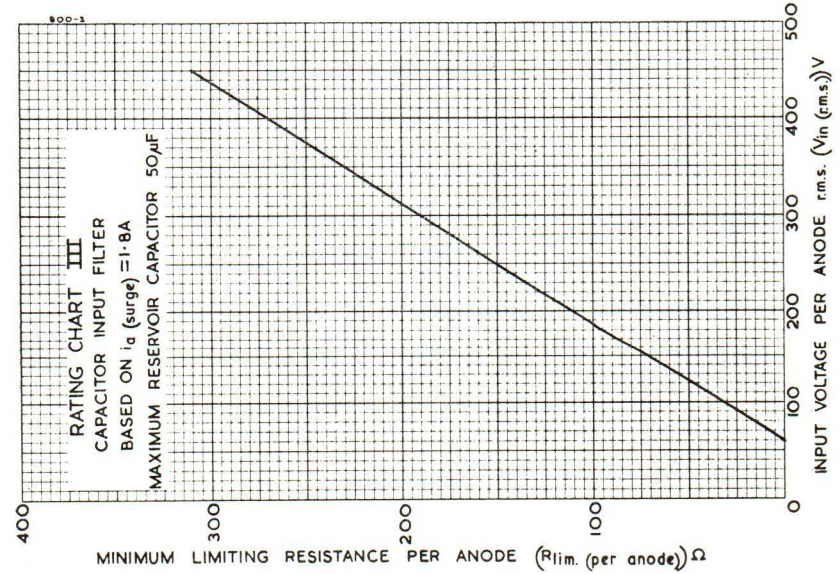
CAPACITOR INPUT

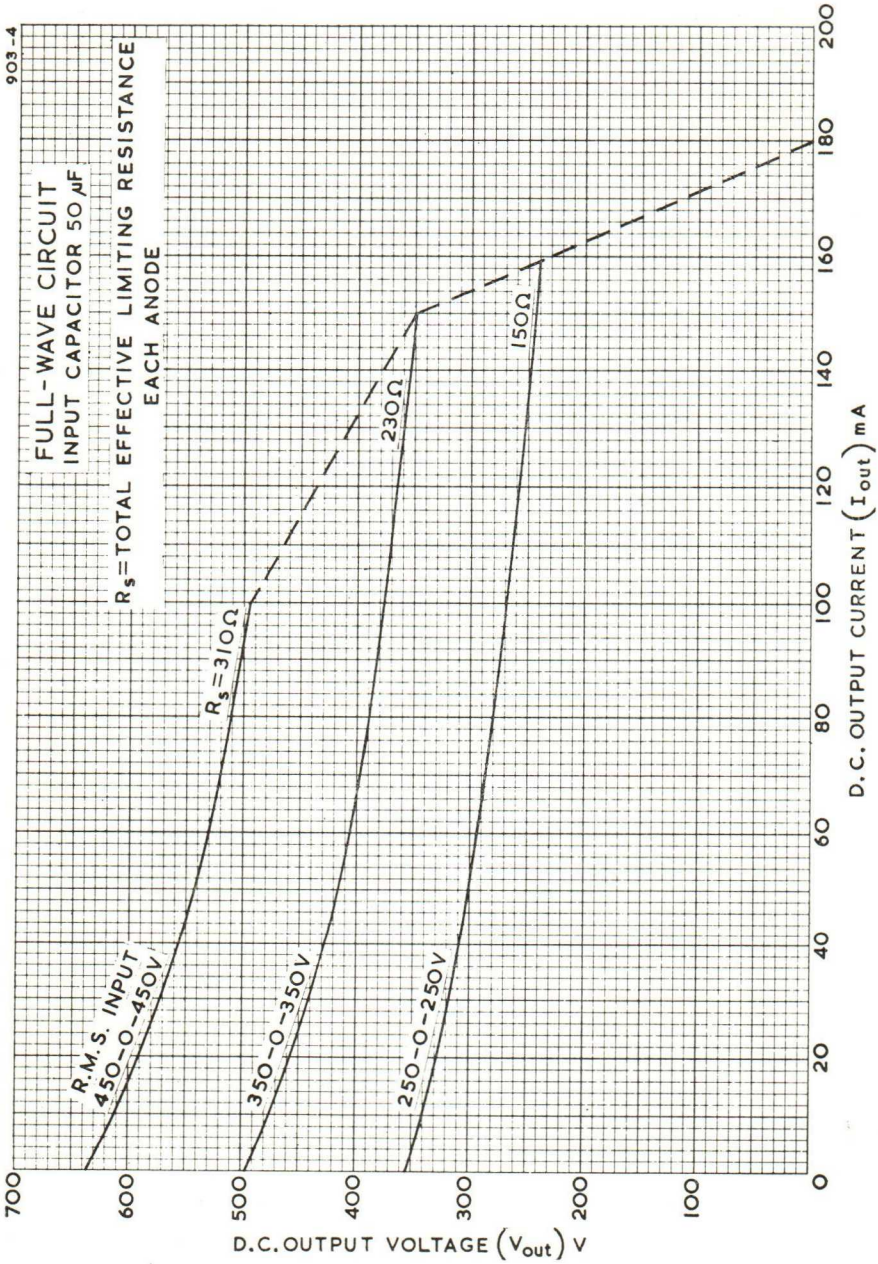
Input Voltage per Anode (r.m.s.)	$V_{in(r.m.s.)}$	250	350	450	V
D.C. Output Current	I_{out}	160	150	100	mA
D.C. Output Voltage	V_{out}	245	352	497	V
Limiting Resistance each Anode	R_{lim} (per anode)	150	230	310	Ω
Reservoir Capacitor	C	50	50	50	μF

MOUNTING POSITION—Unrestricted


900-1
RATING CHART I
CAPACITOR INPUT FILTER
Maximum operating values with capacitor input filter
200
180
160
140
120
100
80
60
40
20
0
100
200
300
400
500
600
D.C. OUTPUT CURRENT (I_{out}) mA
INPUT VOLTAGE PER ANODE r.m.s. ($V_{in\ (r.m.s)}$) V


900-2
RATING CHART II
CAPACITOR INPUT FILTER
BASED ON ia (pk) = 500mA
AREA OF PERMISSIBLE OPERATION
200
150
100
50
0
20
40
60
80
100
120
D.C. OUTPUT CURRENT (Iout) mA
RECTIFICATION EFFICIENCY = D.C. OUTPUT VOLTAGE / INPUT VOLTAGE r.m.s. X √2 X 100


900-3
RATING CHART III
CAPACITOR INPUT FILTER
BASED ON ia (surge) = 1·8A
MAXIMUM RESERVOIR CAPACITOR 50μF
400
300
200
100
0
100
200
300
400
500
MINIMUM LIMITING RESISTANCE PER ANODE (Rlim. (per anode)) Ω
INPUT VOLTAGE PER ANODE r.m.s. (Vin (r.m.s.)) V


903-4
FULL-WAVE CIRCUIT
INPUT CAPACITOR 50 μF
R_s=TOTAL EFFECTIVE LIMITING RESISTANCE EACH ANODE
R_s=310Ω
230Ω
150Ω
R.M.S. INPUT
450-0-450V
350-0-350V
250-0-250V
D.C. OUTPUT CURRENT (I_{out}) mA
D.C. OUTPUT VOLTAGE (V_{out}) V
0
20
40
60
80
100
120
140
160
180
200
100
200
300
400
500
600
700

REPLACEMENT TYPES

FREQUENCY CHANGERS	RATING						
Type	V_h (Volts)	I_h (Amps)	$V_{a(max)}$ (Volts)	$V_{g2(max)}$ (Volts)	g_c (μA/V)	r_a (MΩ)	
IC1 Pentagrid	1·4	0·05	90 90*	67·5 67·5*	300	0·6	
Base Connections	(1)	(2)	(3) (4)	(5)	(6)	(7)	
B7G	f—	a	$g_{2,4}$ g_1	f—,g_5	g_3	f+	
IC2 Pentagrid	1·4	0·05	90 85*	60 30*	325	0·65	
Base Connections	(1)	(2)	(3) (4)	(5)	(6)	(7)	
B7G	f—	a	g_2 g_1	g_4	g_3	f+,g_5	
IC3 Pentagrid	1·4	0·025	90 85*	60 35*	300	0·8	
Base Connections	(1)	(2)	(3) (4)	(5)	(6)	(7)	
B7G	f—	a	g_2 g_1	g_4	g_3	f+,g_5	
6C9 Triode Heptode	6·3	0·45	T.150,H.250 H.250*	250 100*	650	3	
Base Connections	(1)	(2) (3)	(4) (5)	(6)	(7)	(8)	
B8A	h	a_h a_t	$g_{1(t)}$,g_3 $g_{2,4}$	$g_{1(h)}$	k,s	h	
6C31 Triode Heptode	6·3	0·83	T.150,H.250 H.250*	250 100*	870	1·2	
Base Connections	(1)	(2)	(3) (4) (5)	(6) (7)	(8)	(TC)	
IO	M	h	a_h $g_{2,4}$ $g_{3,t}$	a_t h	k	g_1	
10C1 Triode Heptode	28	0·1	T.150,H.250 H.175*	250 100*	650	2·2	
Base Connections	(1)	(2) (3)	(4) (5)	(6)	(7)	(8)	
B8A	h	a_h a_t	$g_{1(t)}$,g_3 $g_{2,4}$	$g_{1(h)}$	k,s	h	
10C2 Triode Pentode	28	0·1	T.150,P.250 P.150*	250 150*	2100	—	
Base Connections	(1)	(2) (3)	(4) (5)	(6)	(7)	(8)	
B8A	h	a_p a_t	g_t g_2	$g_{1(p)}$	k,s	h	

* Parameter conditions

THORN — AEI RADIO VALVES & TUBES LTD.

REPLACEMENT TYPES

FREQUENCY CHANGERS—Continued	RATING					
Type	Vh (Volts)	Ih (Amps)	Va(max) (Volts)	Vg2(max) (Volts)	gc (μA/V)	ra (MΩ)
DK91 Pentagrid	1·4	0·05	90 90*	67·5 67·5*	300	0·6
Base Connections	(1)	(2)	(3) (4)	(5)	(6)	(7)
B7G	f—	a	$g_{2,4}$ g_1	f—,g_5	g_3	f+
DK92 Pentagrid	1·4	0·05	90 85*	60 30*	325	0·65
Base Connections	(1)	(2)	(3) (4)	(5)	(6)	(7)
B7G	f—	a	g_2 g_1	g_4	g_3	f+,g_5
TH41 Triode Heptode	4	1·3	T.150,H.250 H.250*	250 100*	870	1·2
Base Connections	(1) (2) (3)	(4) (5)	(6)	(7)	(8)	(TC)
MO	h k a_h	a_t g_t,g_3	M	$g_{2,4}$	h	$g_{1(h)}$
TH233 Triode Heptode	23	0·2	T.150,H.250 H.175*	250 100*	770	1·0
Base Connections	(1) (2) (3)	(4) (5)	(6)	(7)	(8)	(TC)
MO	h k a_h	a_t $g_{1(t)},g_3$	M	$g_{2,4}$	h	$g_{1(h)}$
TP25 Triode Pentode	2	0·2	T.150,P.150 P.120*	150 60*	260	—
Base Connections	(1) (2) (3)	(4) (5)	(6)	(7)	(8)	(TC)
MO	f NC	a_p a_t g_t	M	g_2	f	$g_{1(p)}$

* Parameter conditions

REPLACEMENT TYPES

PENTODES	RATING						
Type	V_h (volts)	I_h (Amps)	V_a(max) (Volts)	V_{g2}(max) (Volts)	V_{g1} (Volts)	g_m mA/V
IF1 Variable MU R.F. Pentode	1·4	0·025	90 64*	90 64*	0*	0·85
Base Connections	(1)	(2)	(3) (4)	(5)	(6)	(7)
B7G	f—,g_3,s	a	g_2 IC	f—,g_3,s	g_1	f+
IF2 R.F. Pentode	1·4	0·05	110 90*	90 90*	0*	1·025
Base Connections	(1)	(2)	(3) (4)	(5)	(6)	(7)
B7G	f—,g_3,s	a	g_2 NC	f—,g_3,s	g_1	f+
IF3 Variable MU R.F. Pentode	1·4	0·05	90 90*	67·5 67·5*	0*	0·9
Base Connections	(1)	(2)	(3) (4)	(5)	(6)	(7)
B7G	f—,g_3,s	a	g_2 NC	f—,g_3,s	g_1	f+
IFD1 Diode A.F. Pentode	1·4	0·025	90 67·5*	90 67·5*	—1·5*	0·17
Base Connections	(1)	(2)	(3) (4)	(5)	(6)	(7)
B7G	f—,g_3	IC	a_d g_2	a	g_1	f+
IFD9 Diode L.F. Pentode	1·4	0·05	90	90	—	—
Base Connections	(1)	(2)	(3) (4)	(5)	(6)	(7)
B7G	f—,g_3	NC	a_d g_2	a	g_1	f+
IP1 Output Pentode	1·4	0·05	90 85*	90 85*	—5·2*	1·4
Base Connections	(1)	(2)	(3) (4)	(5)	(6)	(7)
B7G	f	a	g_2 NC	f_{ct},g_3	g_1	f
IP10 Output Pentode	1·4	0·1	90 90*	67·5 67·5*	—7*	1·58
Base Connections	(1)	(2)	(3) (4)	(5)	(6)	(7)
B7G	f	a	g_1 g_2	f_{ct},g_3	a	f

* Parameter conditions

REPLACEMENT TYPES

PENTODES *Continued*	RATING							
Type	V_h (Volts)	I_h (Amps)	V_a(max) (Volts)		V_{g2}(max) (Volts)		V_{g1} (Volts)	g_m mA/V
IP11 Output Pentode	1·4	0·1	90 90*		90 90*		—4·5*	2·15
Base Connections B7G	(1) f	(2) a	(3) g_2	(4) NC	(5) f_{ct},g_3		(6) g_1	(7) f
6FI R.F. Pentode	6·3	0·35	250 200*		250 200*		—1·8*	9
Base Connections B8A	(1) h	(2) a	(3) g_3,s	(4) g_2	(5) k	(6) g_1	(7) k	(8) h
6FI1 R.F. Pentode	6·3	0·2	250 250*		150 100*		—1·8*	2·2
Base Connections B8A	(1) h	(2) a	(3) s	(4) g_3	(5) g_2	(6) g_1	(7) k	(8) h
6FI2 R.F. Pentode	6·3	0·3	250 250*		250 250*		—2*	7·5
Base Connections B7G	(1) g_1	(2) k	(3) h	(4) h	(5) a		(6) g_3	(7) g_2
6FI3 R.F. Pentode	6·3	0·35	250 200*		250 200*		—1·8*	9
Base Connections B8A	(1) h	(2) a	(3) s	(4) g_3	(5) g_2	(6) g_1	(7) k	(8) h
6FI4 T.V. Screened Pentode	6·3	0·35	250 140*		250 140*		—1·25*	10·6
Base Connections B8A	(1) h	(2) a	(3) s	(4) g_3	(5) g_2	(6) g_1	(7) k	(8) h
6FI5 Variable MU R.F. Pentode	6·3	0·2	250 250*		250 100*		—2·5*	2·3
Base Connections B8A	(1) h	(2) a	(3) s	(4) g_3	(5) g_2	(6) g_1	(7) k	(8) h

* Parameter conditions

REPLACEMENT TYPES

PENTODES *Continued*	RATING						
Type	V_h (volts)	I_h (Amps)	V_a(max) (Volts)	V_{g2}(max) (Volts)	V_{g1} (Volts)	g_m mA/V
10F1 R.F. Pentode	22	0·1	250 200*	250 200*	—1·8*	9
Base Connections B8A	(1) h	(2) a	(3) g_3,s	(4) g_2	(5) k	(6) g_1	(7) k	(8) h
10F9 Variable MU R. F. Pentode	13	0·1	250 175*	250 100*	—2·5*	2·3
Base Connections B8A	(1) h	(2) a	(3) s	(4) g_3	(5) g_2	(6) g_1	(7) k	(8) h
20F2 R.F. Pentode	11	0·2	250 140*	250 140*	—1·25*	10·6
Base Connections B8A	(1) h	(2) a	(3) s	(4) g_3	(5) g_2	(6) g_1	(7) k	(8) h
DAF91 Diode L. F. Pentode	1·4	0·05	90	90	—	—
Base Connections B7G	(1) f—,g_3	(2) NC	(3) ad	(4) g_2	(5) a	(6) g_1	(7) f+
DAF96 Diode A.F. Pentode	1·4	0·025	90 67·5*	90 67·5*	—1·5*	0·17
Base Connections B7G	(1) f—,g_3	(2) IC	(3) ad	(4) g_2	(5) a	(6) g_1	(7) f+
DF91 Variable MU R.F. Pentode	1·4	0·05	90 90*	67·5 67·5*	0*	0·9
Base Connections B7G	(1) f—,g_3,s	(2) a	(3) g_2	(4) NC	(5) f—,g_3,s	(6) g_1	(7) f+

* Parameter conditions

REPLACEMENT TYPES

PENTODES *Continued*	RATING						
Type	V_h (volts)	I_h (Amps)	$V_{a(max)}$ (Volts)	$V_{g2(max)}$ (Volts)	V_{g1} (Volts)	g_m mA/V
DF92 R.F. Pentode	1·4	0·05	110 90*	90 90*	0*	1·025
Base Connections	(1)	(2)	(3) (4)	(5)	(6)	(7)
B7G	f—,g_3,s	a	g_2 NC	f—,g_3,s	g_1	f+
DF96 Variable MU R. F. Pentode	1·4	0·025	90 64*	90 64*	0*	0·85
Base Connections	(1)	(2)	(3) (4)	(5)	(6)	(7)
B7G	f—,g_3,s	a	g_2 IC	f—,g_3,s	g_1	f+
DL92 Output Pentode	1·4	0·1	90 90*	67·5 67·5*	—7*	1·58
Base Connections	(1)	(2)	(3) (4)	(5)	(6)	(7)
B7G	f	a	g_1 g_2	f_{ct},g_3	a	f
DL94 Output Pentode	1·4	0·1	90 90*	90 90*	—4·5*	2·15
Base Connections	(1)	(2)	(3) (4)	(5)	(6)	(7)
B7G	f	a	g_2 NC	f_{ct},g_3	g_1	f
DL96 Output Pentode	1·4	0·05	90 85*	90 85*	—5·2*	1·4
Base Connections	(1)	(2)	(3) (4)	(5)	(6)	(7)
B7G	f	a	g_2 NC	f_{ct},g_3	g_1	f
EF91 R.F. Pentode	6·3	0·3	250 250*	250 250*	—2*	7·5
Base Connections	(1)	(2)	(3) (4)	(5)	(6)	(7)
B7G	g_1	k	h h	a	g_3	g_2

* Parameter conditions

REPLACEMENT TYPES

PENTODES *Continued*	RATING								
Type	V_h (volts)	I_h (Amps)	$V_{a(max)}$ (Volts)		$V_{g2(max)}$ (Volts)		V_{g1} (Volts)		g_m mA/V
PEN25 Output Pentode	2	0·15	150 120*		150 120*		—3·6*		3
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)		(8)
MO	f—	NP	a	g_2	g_1	NC	NP		f+
PEN44 Beam Power Amplifier	4	2·1	275 260*		275 270*		—11·1*		10·6
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)		(8)
MO	h	k	a	g2	g1	M	NP		h
PEN45 Beam Power Amplifier	4	1·75	250 250*		250 250*		—8·5*		8·8
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)		(8)
MO	h	k	a	g_2	g_1	M	NP		h
PEN45DD Beam Power Amplifier	4	2	250 250*		250 250*		—8·5*		8·8
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(TC)
MO	h	k	a	g_2	d_2	M	d_1	h	g_1
PEN46 Beam Power Amplifier	4	1·75	350 100*		240 100*		0*		8·5
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(TC)
MO	h	k	NC	g_2	g_1	NC	NP	h	a
PEN383 Beam Power Amplifier	38	0·2	200 100*		200 100*		0*		12
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)		(8)
MO	h	k	a	g_2	g_1	M	NP		h

* Parameter conditions

REPLACEMENT TYPES

PENTODES *Continued*	RATING							
Type	V_h (volts)	Ih (Amps)	$V_{a(max)}$ (Volts)		$V_{g2(max)}$ (Volts)		V_{g1} (Volts)	gm mA/V
PEN384 Beam Power Amplifier	38	0·2	250 100*		250 100*		0*	12·5
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
MO	h	k	a	g_2	g_1	M	NC	h
QP25 Double Pentode	2	0·2	120 100*		120 100*		0*	3
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
MO	f—	NC	a′	g_2	g'_1	g''_1	a″	f+
SP41 H.F. Pentode	4	0·95	250 200*		250 200*		—1·5*	8·5
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8) (TC)
MO	h	k	a	g_2	g_3	M	NC	h g_1
SP42 Video Output Pentode	4	0·95	200 200*		200 100*		0*	9
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8) (TC)
MO	h	k	a	g_2	g_3	M	NP	h g_1
SP61 H.F. Pentode	6·3	0·6	250 200*		250 200*		—1·5*	8·5
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8) (TC)
MO	h	k	a	g_2	g_3	M	NC	h g_1
SP181 H.F. Pentode	18	0·2	250 200*		250 200*		—1·5*	8·5
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8) (TC)
MO	h	k	a	g_2	g_3	M	NC	h g_1
VP23 Variable MU R.F. Pentode	2	0·05	150 120*		150 60*		—1·5*	1·08
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8) (TC)
MO	f—	NP	a	g_2	g_3	M	NP	f+ g_1

* Parameter conditions

REPLACEMENT TYPES

PENTODES *Continued*	RATING								
Type	V_h (Volts)	I_h (Amps)	V_a(max) (Volts)	V_{g2}(max) (Volts)	V_{g1} (Volts)	gm mA/V
VP41 Variable MU R.F. Pentode	4	0·65	250 250*	250 200*	0*	3
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(TC)
MO	h	k	a	g_2	g_3	M	NC	h	g_1
VP133 Variable MU R.F. Pentode	13	0·2	200 200*	200 150*	0*	3·1
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(TC)
MO	h	k	a	g_2	g_3	M	NC	h	g_1

* Parameter conditions

REPLACEMENT TYPES

TETRODES	RATING							
Type	V_h (Volts)	I_h (Amps)	$V_{a(max)}$ (Volts)		$V_{g2(max)}$ (Volts)		V_{g1} (Volts)	g_m mA/V
6P1 Beam Power Amplifier	6·3	0·8	250 250*		250 250*		—8·5*	8·8
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
IO	NC	h	a	g_2	g_1	NP	h	k
6P25 Beam Power Amplifier	6·3	1·1	250 250*		250 250*		—8·5*	8·8
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
IO	M	h	a	g_2	g_1	NP	h	k
6P26 Beam Power Amplifier	6·3	0·6	250		250		—	—
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
IO	NC	h	a	g_2	g_1	NC	h	k
6P28 Beam Power Amplifier	6·3	1·1	400 100*		275 250*		—8·8*	9·5
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8) (TC)
IO	NC	h	NC	g_2	g_1	NP	h	k a
10P13 Beam Power Amplifier	40	0·1	250 150*		250 150*		—	7·5
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
B8A	h	a	IC	IC	g_2	g_1	k	h
10P14 Beam Power Amplifier	40	0·1	250 175*		250 175*		—9·4*	7·2
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
IO	NC	h	a	g_2	g_1	NC	h	k

* Parameter conditions

REPLACEMENT TYPES

TETRODES *Continued*	RATING								
Type	V_h (Volts)	I_h (Amps)	V_a(max) (Volts)	V_{g2}(max) (Volts)	V_{g1} (Volts)	g_m mA/V
20P1 Beam Power Amplifier	38	0·2	400 150*	250 150*	—	7·3
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(TC)
IO	NC	h	NC	g_2	g_1	NP	h	k	a
20P3 Beam Power Amplifier	20	0·2	250 175*	250 175*	—9·4*	7·2
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
IO	NC	h	a	g_2	g_1	NP	h	k
20P4 Beam Power Amplifier	38	0·2	400	250	—	—
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(TC)
IO	NC	h	NC	g_2	g_1	NP	h	k	a
20P5 Beam Power Amplifier	20	0·2	250 150*	250 150*	—	7·5
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
B8A	h	a	IC	IC	g_2	g_1	k	h

Obsolete.

* Parameter conditions

REPLACEMENT TYPES

TRIODES	RATING							
Type	V_h (Volts)	I_h (Amps)	V_a(max) (Volts)		V_g (Volts)		g_m mA/V	μ
6L1 Twin Triode	6·3	0·4	250 200*		—		2·8	16
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
B8A	h	a″	g″	k″	a′	g′	k′	h
6L18 Oscillator Triode	6·3	0·3	250 150*		—		7·6	17
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
B8A	h	a	IC	s	IC	g_1	k	h
6L19 Double Triode	6·3	0·4	250 200*		—		3·3	55
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
B8A	h	a″	g″	k″	a′	g′	k′	h
6L34 V.H.F. Triode	6·3	0·3	250 250*		—1·5*		8·5	90
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
B7G	g_1	k	h	h	k	g_1	a	
6LD3 Double Diode Triode	6·3	0·23	300 250*		—3*		1·3	70
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
B8A	h	a	g_1	s	a″d	a′d	k	h
6LD20 Double Diode Triode	6·3	0·25	250 100*		0*		3·4	31·5
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
B8A	h	a	g_1	s	a″d	a′d	k	h
10L1 V.H.F. Triode	19	0·1	250 250*		—1·5*		8·5	90
Base Connections	(1)	(2)	(3)	(4)	(5)		(6)	(7)
B7G	g_1	k	h	h	k		g_1	a

* Parameter conditions

REPLACEMENT TYPES

TRIODES *Continued*	RATING							
Type	V_h (Volts)	I_h (Amps)	$V_{a(max)}$ (Volts)		V_g (Volts)		g_m mA/V	μ
10LD3 Double Diode Triode	14	0·1	250 100*		—1*		1·4	70
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
B8A	h	a	g_1	s	a''_d	a'_d	k	h
10LD11 Double Diode Triode	15	0·1	250 100*		0*		3·4	31·5
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
B8A	h	a	g_1	s	a''_d	a'_d	k	h
20L1 Twin Triode	12·6	0·2	250 200*		—		2·8	16
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
B8A	h	a''	g''	k''	a'	g'	k'	h
EC91 V.H.F. Triode	6·3	0·3	250 250*		—1·5*		8·5	90
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	
B7G	g_1	k	h	h	k	g_1	a	
HL23 Triode	2	0·05	150 100*		0*		1·5	32
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
MO	f—	NP	a	NP	g_1	M	NP	f+
HL23DD Double Diode Triode	2	0·05	150 100*		0*		1·2	25
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8) (TC)
MO	f—	NC	a	NC	a''_d	M	a'_d	f+ g_1
HL41 Triode	4	0·65	250 100*		0*		3·5	36
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
MO	h	k	a	NC	g	M	NP	h

* Parameter conditions

REPLACEMENT TYPES

TRIODES *Continued*	RATING								
Type	V_h (Volts)	I_h (Amps)	V_a(max) (Volts)			V_g (Volts)	g_m mA/V	μ	
HL41DD Double Diode Triode	4	0·65	250 100*			0*	2·5	30	
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(TC)
MO	h	k	a	NC	a''_d	M	a'_d	h	g_1
HL42DD Double Diode Triode	4	0·65	250 100*			0*	2·9	23	
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(TC)
MO	h	k	a	NC	a''_d	M	a'_d	h	g_1
HL133DD Double Diode Triode	13	0·2	250 100*			0*	2·5	32	
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(TC)
MO	h	k	a	NC	d_2	M	d_1	h	g_1
P61 Triode	6·3	0·6	250 100*			0*	8	17	
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	
MO	h	k	a	NC	g	M	NC	h	

* Parameter conditions

REPLACEMENT TYPES

DIODES	RATING					
Type	V_h (Volts)	I_h (Amps)	PIV(max) (Volts)	$I_{a(av)max}$ (mA)	$I_{a(pk)max}$ (mA)	$V_{h\text{-}k(max)}$ (Volts)DC
6D1 T.V. Diode	6·3	0·15	350	5	50	150
Base : B3G						
20D1 Double Diode	9·5	0·2	500	9	50	300
Base Connections B7G	(1) k′	(2) a″	(3) h	(4) h	(5) k″	(6) s	(7) a′
D1 T.V. Diode	4	0·2	500	—	50	150
Base : B3G						
DD41 Double Diode	4	0·5	—	5	—	100
Base Connections MO	(1) h	(2) k′	(3) a′	(4) s	(5) a″	(6) M	(7) k″	(8) h
EA50 T.V. Diode	6·3	0·15	350	5	50	150
Base : B3G						
U251 Efficiency Diode	25	0·3	7,000	120	720	2,000
Base Connections B9A	(1) IC	(2) IC	(3) IC	(4) h	(5) h	(6) IC	(7) IC	(8) IC	(9) a	(TC) k
U281 Efficiency Diode	28	0·2	3,000	120	600	400
Base Connections IO	(1) NC	(2) h	(3) NC	(4) NP	(5) a	(6) NP	(7) h	(8) k
U282 Efficiency Diode	28	0·2	4,500	120	600	400
Base Connections IO	(1) NC	(2) NC	(3) k	(4) NP	(5) NC	(6) NP	(7) h	(8) h	(TC) a
U301 Efficiency Diode	28	0·2	4,500	150	450	900
Base Connections IO	(1) NP	(2) IC	(3) IC	(4) NP	(5) a	(6) NP	(7) h	(8) h	(TC) k

REPLACEMENT TYPES

DIODES *Continued*	RATING			
Type	V (Volts)	I_h (Amps)	V_a(max) (Volts)	I_k(max) (mA) (DC)
6D3 Slow Heating Diode	6·3	0·3	250	5

OBSOLETE

Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)
B7G	a	k	h	h	a	NC	NC

REPLACEMENT TYPES

RECTIFIERS	RATING							
TYPE	V_h (Volts)	I_h (Amps)	$V_{a(max)}$ (Volts)	PIV(max) (Volts)	$I_{a(av)max}$ (mA)		$I_{a(pk)max}$ (mA)	
U22 H. W. Rectifier	2	2	5,200	14,500	1		20	
Base Connections	(1)	(2) (3)	(4)	(5)	(6)	(7)	(8)	(TC)
MO	h,k,s	NP NC	NP	NC	NP	NP	h	a
U24 H. W. Rectifier	2	0·15	7,800	20,000	0·5		15	
Base Connections	(1)	(2) (3)	(4)	(5)	(6)	(7)	(8)	(TC)
IO	NC	h NC	NC	NC	NC	h,k	s	a
U201 H. W. Rectifier	20	0·2	250	750	90		700	
Base Connections	(1)	(2) (3)	(4)	(5)	(6)	(7)	(8)	
IO	NC	h NC	NP	a	NP	h	k	
U403 H. W. Rectifier	40	0·2	250	—	120		960	
Base Connections	(1)	(2) (3)	(4)	(5)	(6)	(7)	(8)	
MO	h	NP k	NP	a	M	NP	h	
U404 H. W. Rectifier	40	0·1	250	750	90		700	
Base Connections	(1)	(2) (3)	(4)	(5)	(6)	(7)	(8)	
B8A	h	a NC	IC	IC	IC	k	h	
U801 H. W. Rectifier	80	0·2	250	1,500	300		—	
Base Connections	(1)	(2) (3)	(4)	(5)	(6)	(7)	(8)	
IO	k′	h a′	a″	a‴	a″″	h	k″	
UU5 F. W. Rectifier	4	2·3	500	1,600	120		480	
Base Connections	(1)		(2)	(3)		(4)		
B4	a′		a″	h,k		h		
UU6 F. W. Rectifier	4	1·4	350	—	120		—	
Base Connections	(1)	(2) (3)	(4)	(5)	(6)	(7)	(8)	
MO	h,k	NP a	NP	a	M	NP	h	

REPLACEMENT TYPES

RECTIFIERS *Continued*	RATING							
TYPE	V_h (Volts)	I_h (Amps)	$V_{a(max)}$ (Volts)	PIV(max) (Volts)	$I_{a(av)max}$ (mA)		$I_{a(pk)max}$ (mA)	
UU7 F. W. Rectifier	4	2·3	400	—	180		—	
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
MO	h,k	NP	a	NP	a	M	NP	h
UU8 F. W. Rectifier	4	2·8	350	—	250		—	
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
MO	h,k	NP	a′	NP	a″	M	NP	h
UU9 F. W. Rectifier	6·3	0·58	350	1100	90		360	
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
B8A	h	a″	IC	IC	IC	a′	k	h
UU10 F. W. Rectifier	4	2·3	500	1,600	180		720	
Base Connections	(1)		(2)	(3)			(4)	
B4	a′		a″	h,k			h	

REPLACEMENT TYPES

THYRATRONS	RATING							
Type	V_h (Volts)		I_h (Amps)	V_a(max) (Volts)		Control Ratio	I_a(pk)max (mA)	
6K25 Thyratron	6·3		1	400		20	500	
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
IO	M	h	a	NC	g	NC	h	k
T4I Thyratron	4		1·5	400		20	500	
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
MO	h	k	a	NC	g_1	M	NP	h

REPLACEMENT TYPES

TUNING INDICATORS	RATING						
Type	V_h (Volts)	I_h (Amps)	V_a(max) (Volts)	V_t(max) (Volts)	V_t(min) (Volts)	I_k(max) (mA)	
6M1 Tuning Indicator	6·3	0·3	250	250	—	—	
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7) (8)
IO	NC	h	a	t	g	NP	h k
6M2 Tuning Indicator	6·3	0·2	300	250	90	5	
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7) (8)
IO	IC	h	a″	g	t	a′	h k
10M1 Tuning Indicator	18	0·1	250	250	—	—	
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7) (8)
IO	NC	h	a	t	g	NP	h k
EM35 Tuning Indicator	6·3	0·2	300	250	90	5	
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7) (8)
IO	IC	h	a″	g	t	a′	h k
ME91 Tuning Indicator	9	0·2	200	200	—	—	
Base Connections	(1)	(2)	(3)	(4)	(5)	(6)	(7) (8)
MO	h	k	a	NC	g	NC	t h