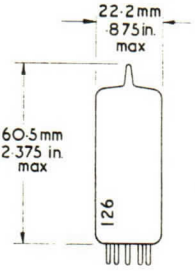
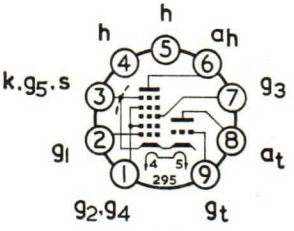


TRIODE HEPTODE FREQUENCY CHANGER



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

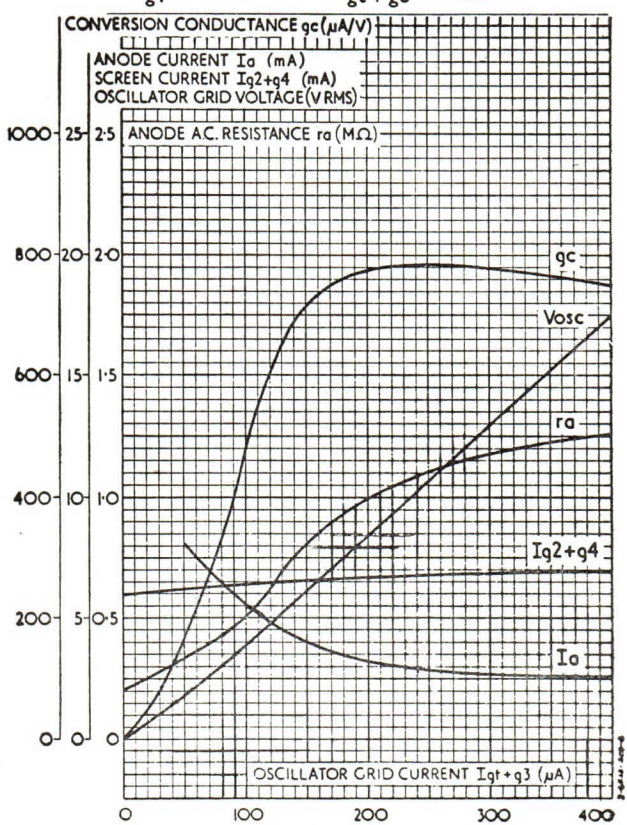
APPROXIMATE WEIGHT

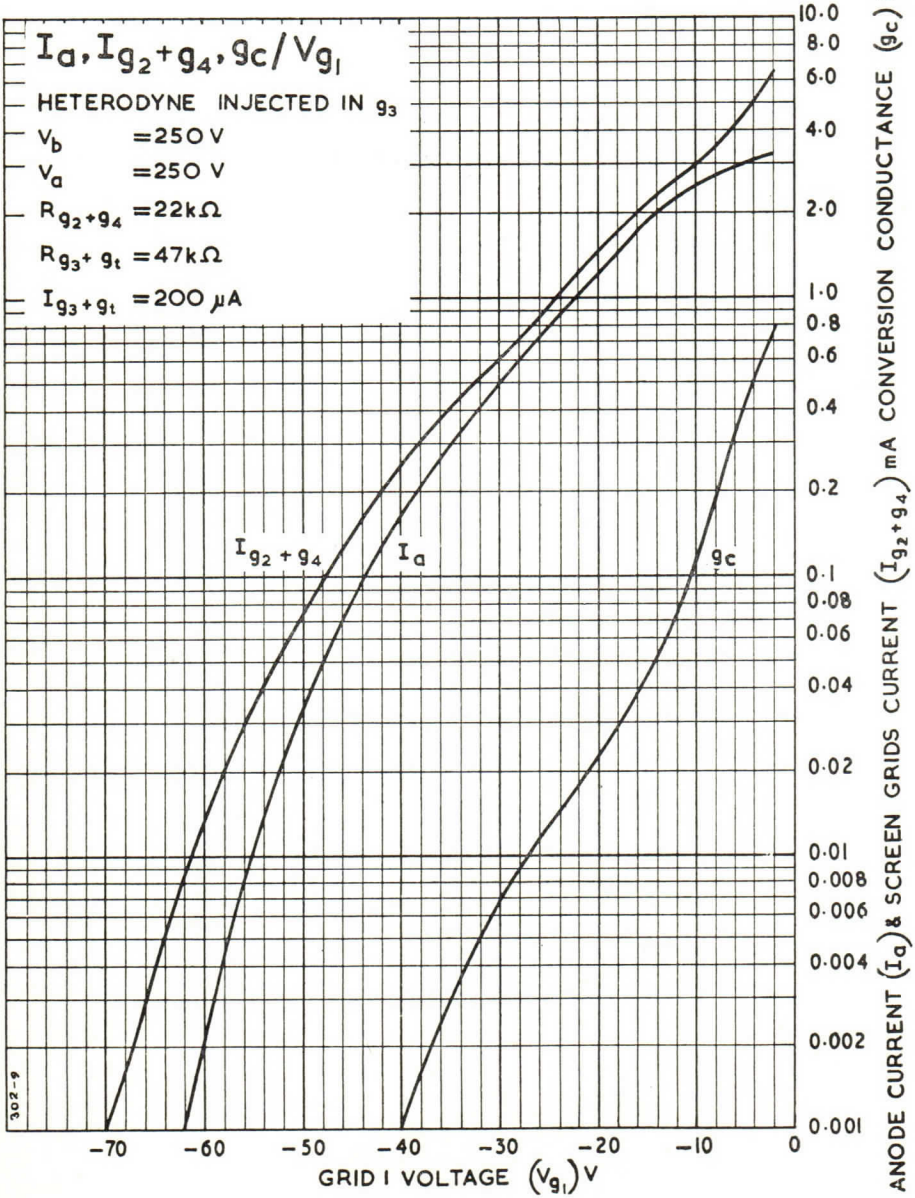
Net	0·5	oz
Packed	0·75	oz

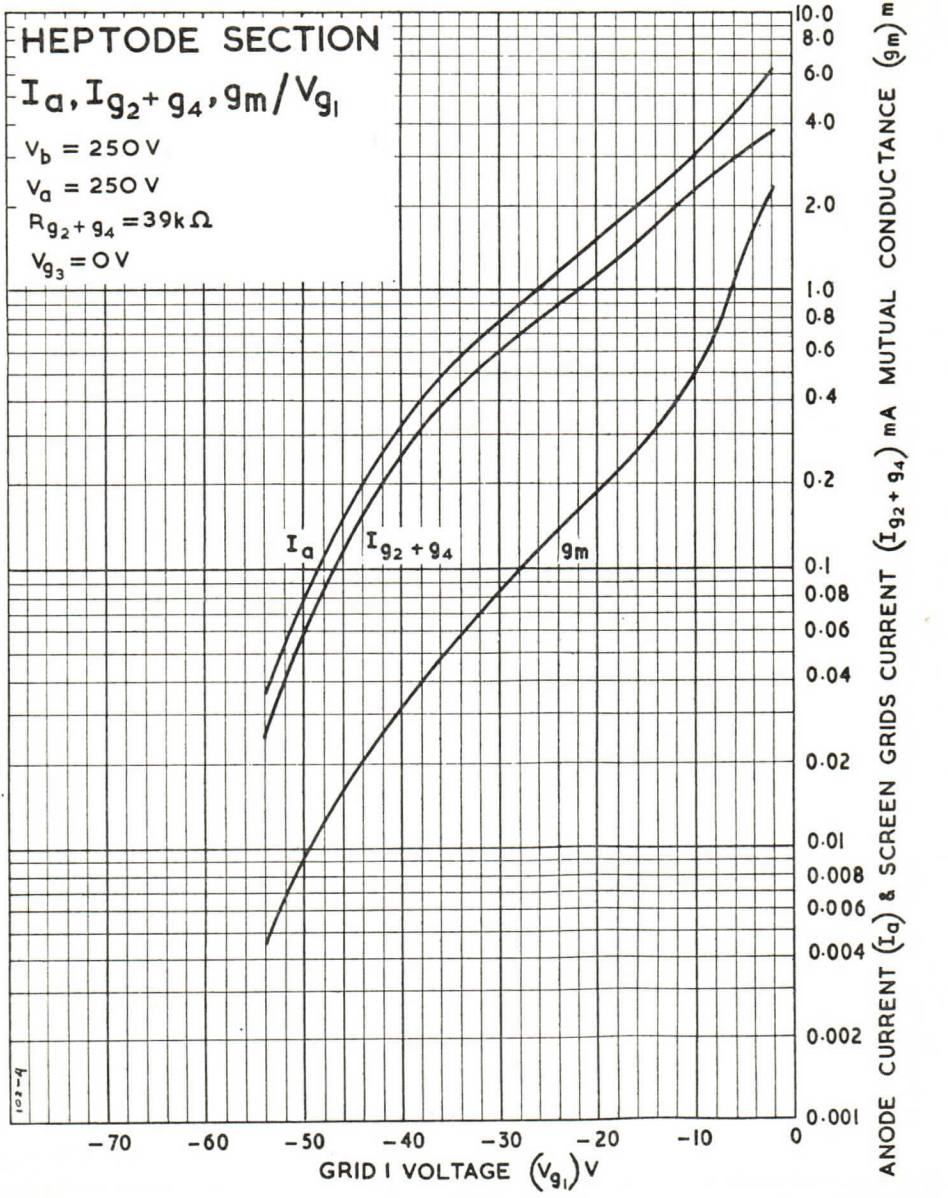
AVERAGE CHARACTERISTIC CURVES:
$I_a, I_{g2}, g_c, r_a, V_{osc}/I_{gt}+g3$

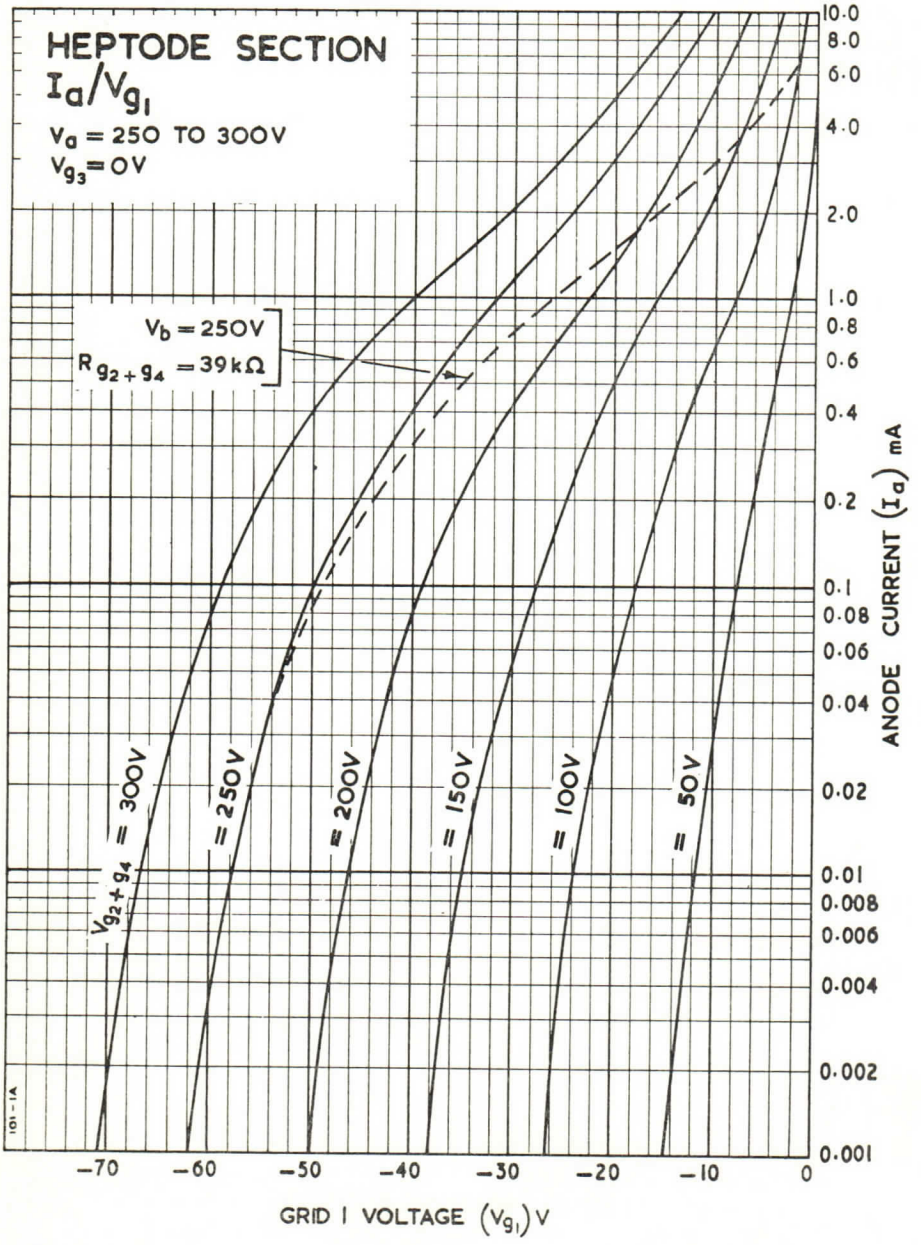
$V_a = 250V$ $R_{g2}+g4 = 22k\Omega$

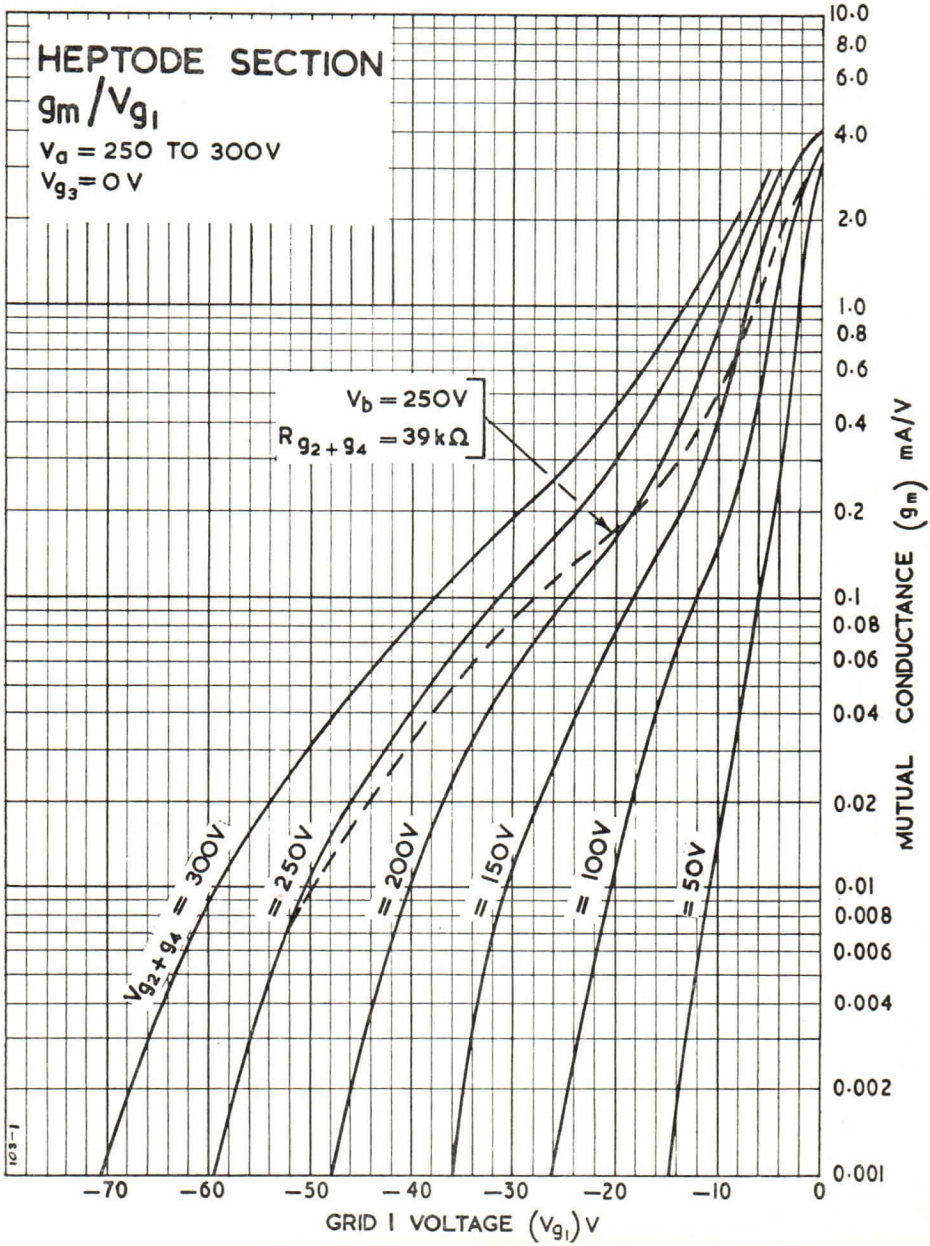
$V_{g1} = -2V$ $R_{gt}+g3 = 47k\Omega$

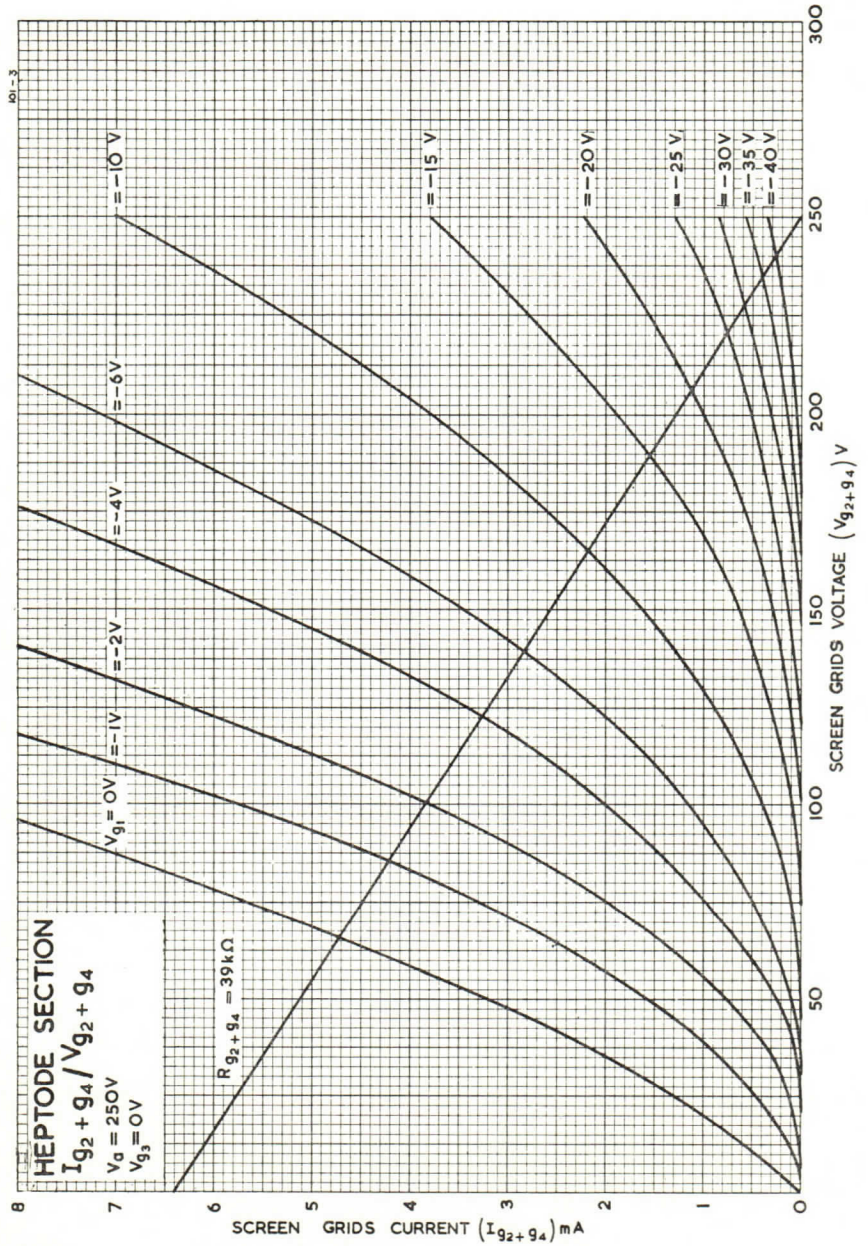


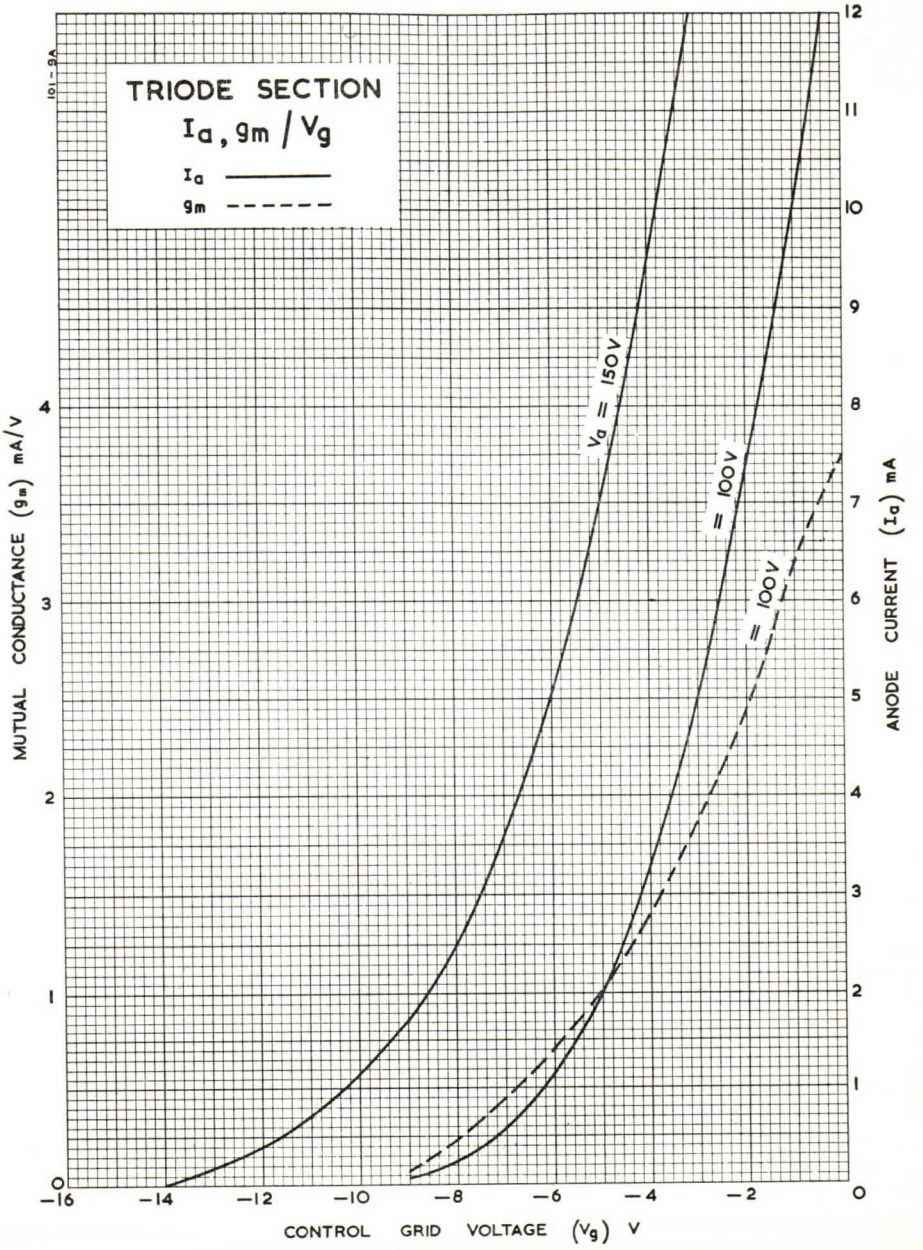

Ia, Ig2+g4, gc/Vg1
HETERODYNE INJECTED IN g3
Vb =250 V
Va =250 V
Rg2+g4 =22kΩ
Rg3+ gt =47kΩ
Ig3+gt =200 μA
Ig2 + g4
Ia
gc
302-9
10·0
8·0
6·0
4·0
2·0
1·0
0·8
0·6
0·4
0·2
0·1
0·08
0·06
0·04
0·02
0·01
0·008
0·006
0·004
0·002
0·001
−70
−60
−50
−40
−30
−20
−10
0
GRID I VOLTAGE (Vg1) V
ANODE CURRENT (Ia) & SCREEN GRIDS CURRENT (Ig2+g4) mA CONVERSION CONDUCTANCE (gc) mA/V


HEPTODE SECTION
$I_a, I_{g_2+g_4}, g_m / V_{g_1}$
V_b = 250 V
V_a = 250 V
$R_{g_2+g_4}$ = 39k Ω
V_{g_3} = 0 V
I_a
$I_{g_2+g_4}$
g_m
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 MUTUAL CONDUCTANCE (g_m) mA/V
−70
−60
−50
−40
−30
−20
−10
0
GRID 1 VOLTAGE (V_{g_1}) 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
ANODE CURRENT (I_a) mA
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
−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 1 VOLTAGE (Vg1) V
I-5-1


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
101-96
Va = 150V
Va = 100V
Va = 100V
MUTUAL CONDUCTANCE (gm) mA/V
ANODE CURRENT (Ia) mA
CONTROL GRID VOLTAGE (Vg) V
0
1
2
3
4
−16
−14
−12
−10
−8
−6
−4
−2
0
1
2
3
4
5
6
7
8
9
10
11
12

CHARACTERISTIC CURVES: I_a/V_a

Triode Section