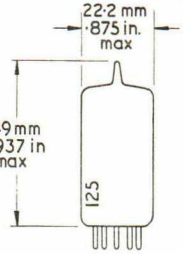
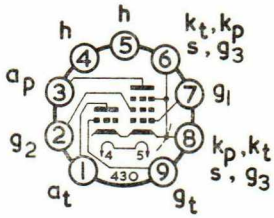


V.H.F. TRIODE PENTODE



†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.)	$V_{h-k(r.m.s.)max}$	200	200	V
Maximum Cathode Current	$I_{k(max)}$	18	15	mA
Maximum Grid to Cathode Resistance (Fixed Bias)	$R_{g1-k(max)}$	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.

TYPICAL OPERATION AS FREQUENCY CHANGER AND I.F. AMPLIFIER

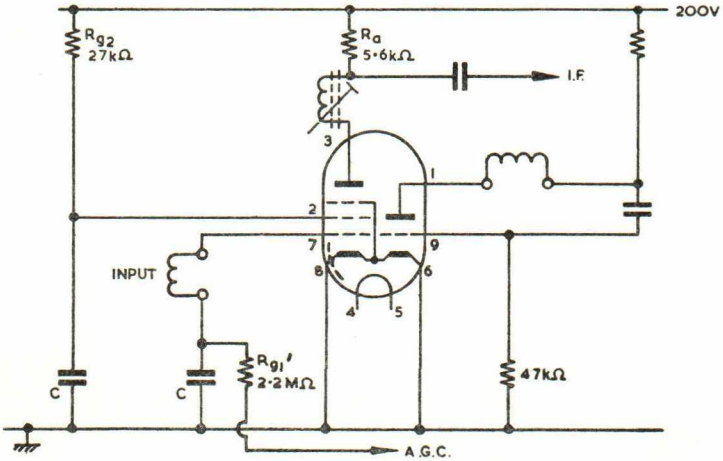
Grid current bias operation with A.G.C. Oscillator voltage injected into grid 1.

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	$\Delta c_{in(w)}$	—	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

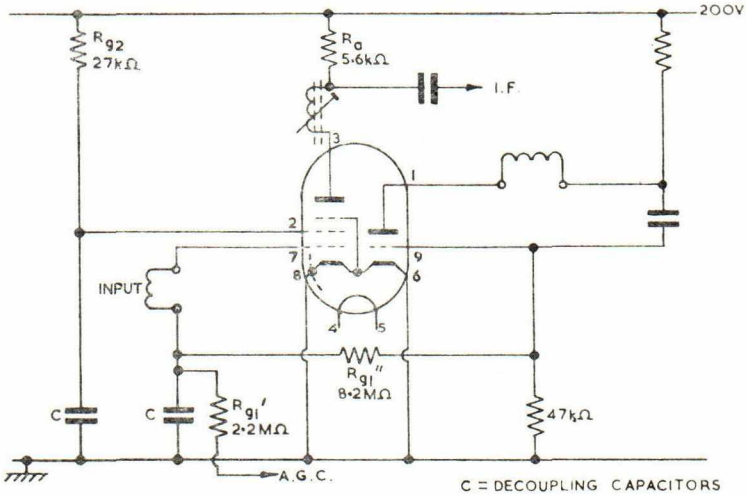
TYPICAL OPERATION AS FREQUENCY CHANGER AND I.F. AMPLIFIER

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.

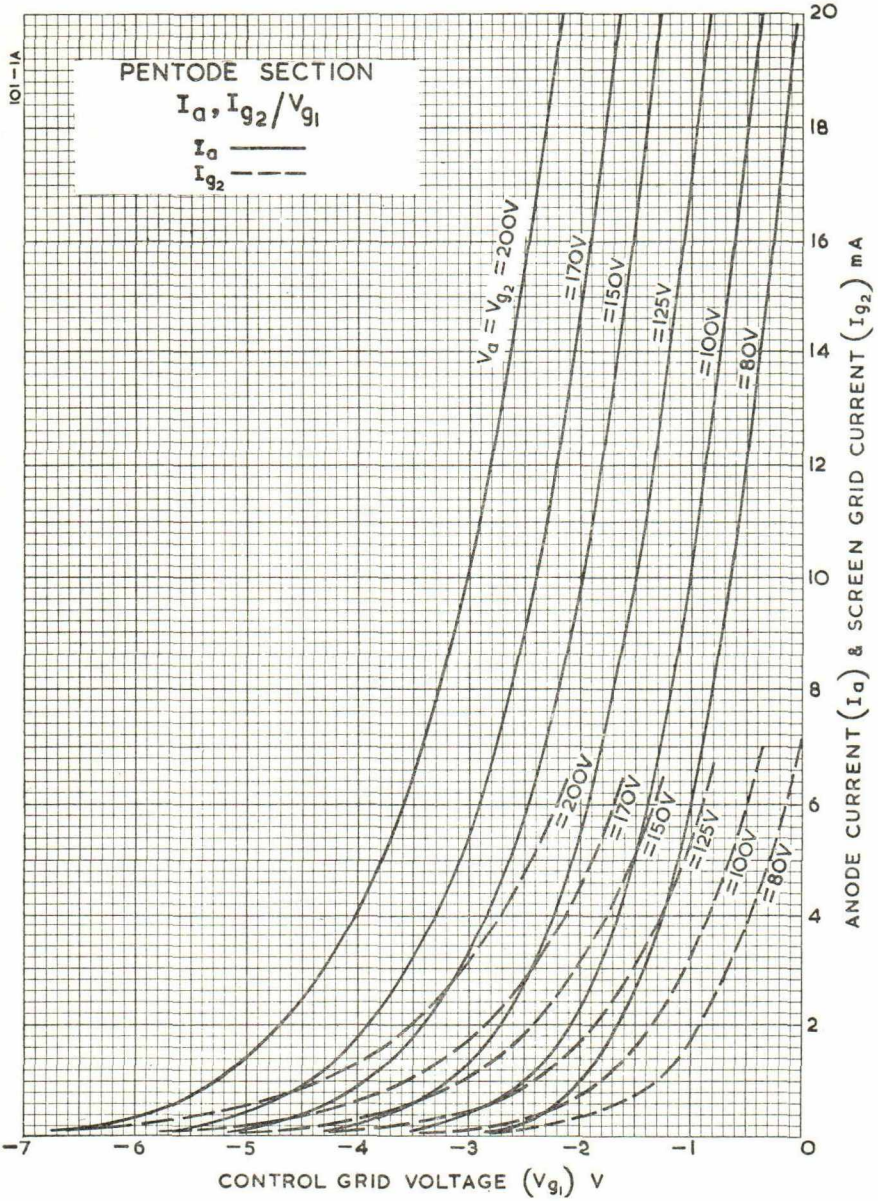
Pentode		F.C.	I.F.*	
Frequency	f	200	36	Mc/s
Supply Voltage	V_b	200	200	V
Anode Voltage (Decoupling Resistance, R_a=5·6kΩ) approx	V_a	160	125	V
Screen Grid Voltage (R_{g2}=27kΩ) approx	V_{g2}	140	92	V
Current through resistance $R_{g1'}$ ($R_{g1'}$=2·2MΩ)		1·6	0·3	μA
Resistance to provide Bias from Triode 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

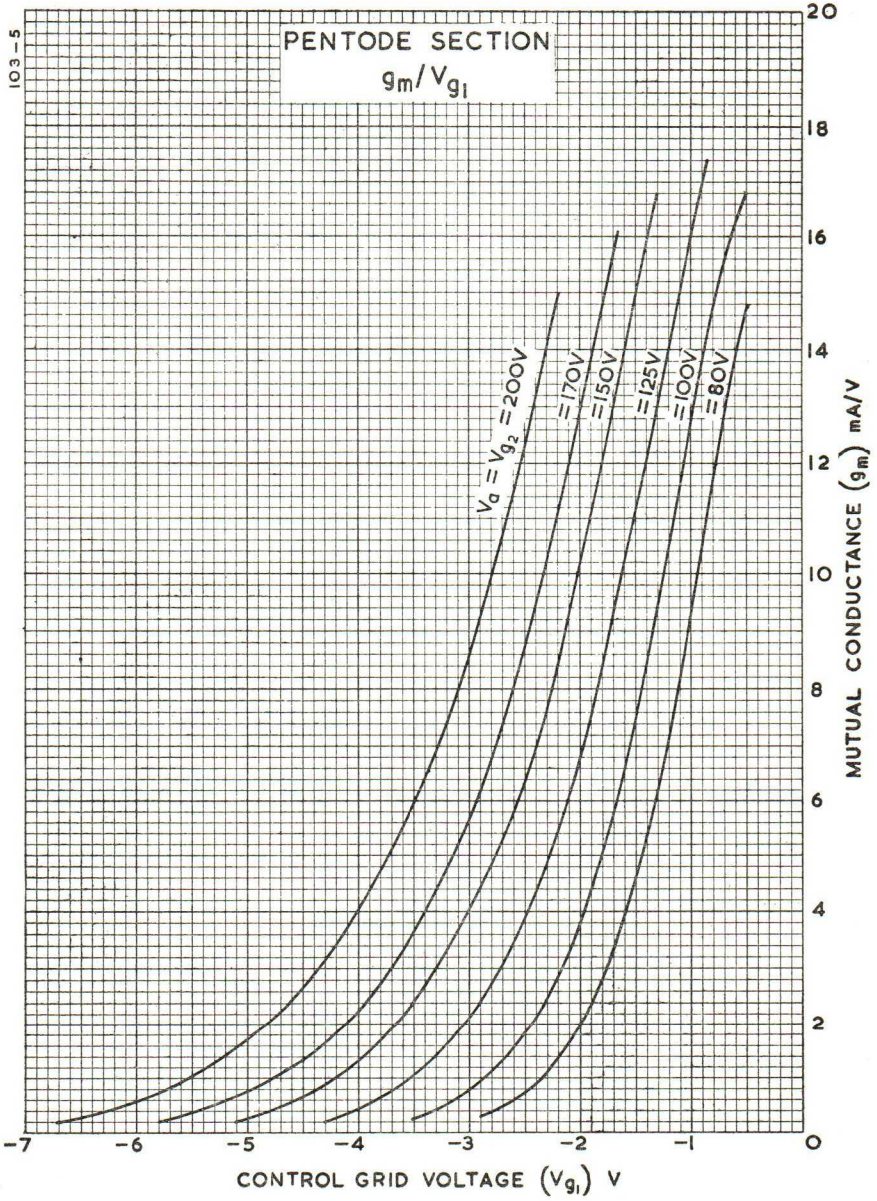
* Supply voltage removed from triode.

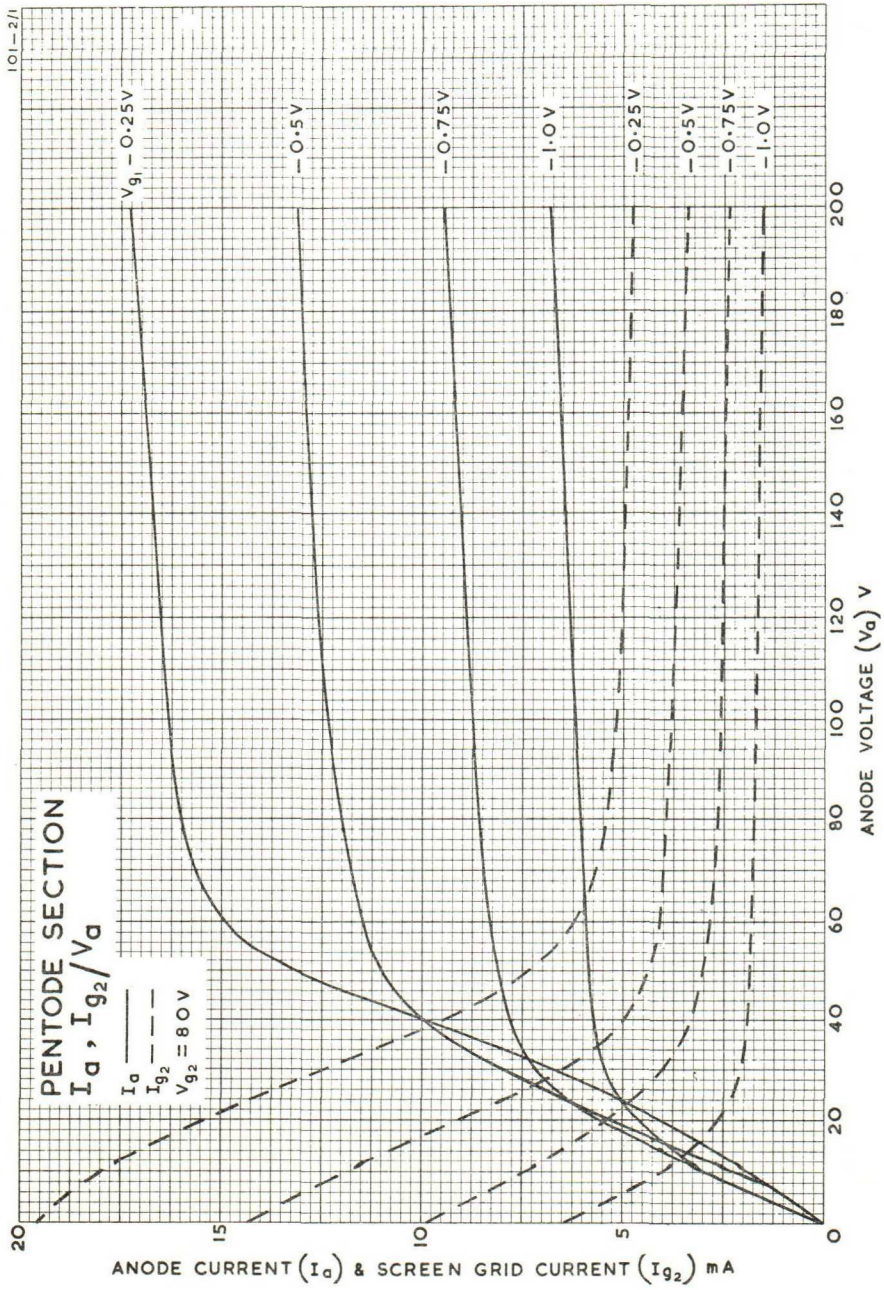
† With holder capacitance balanced out but with can.

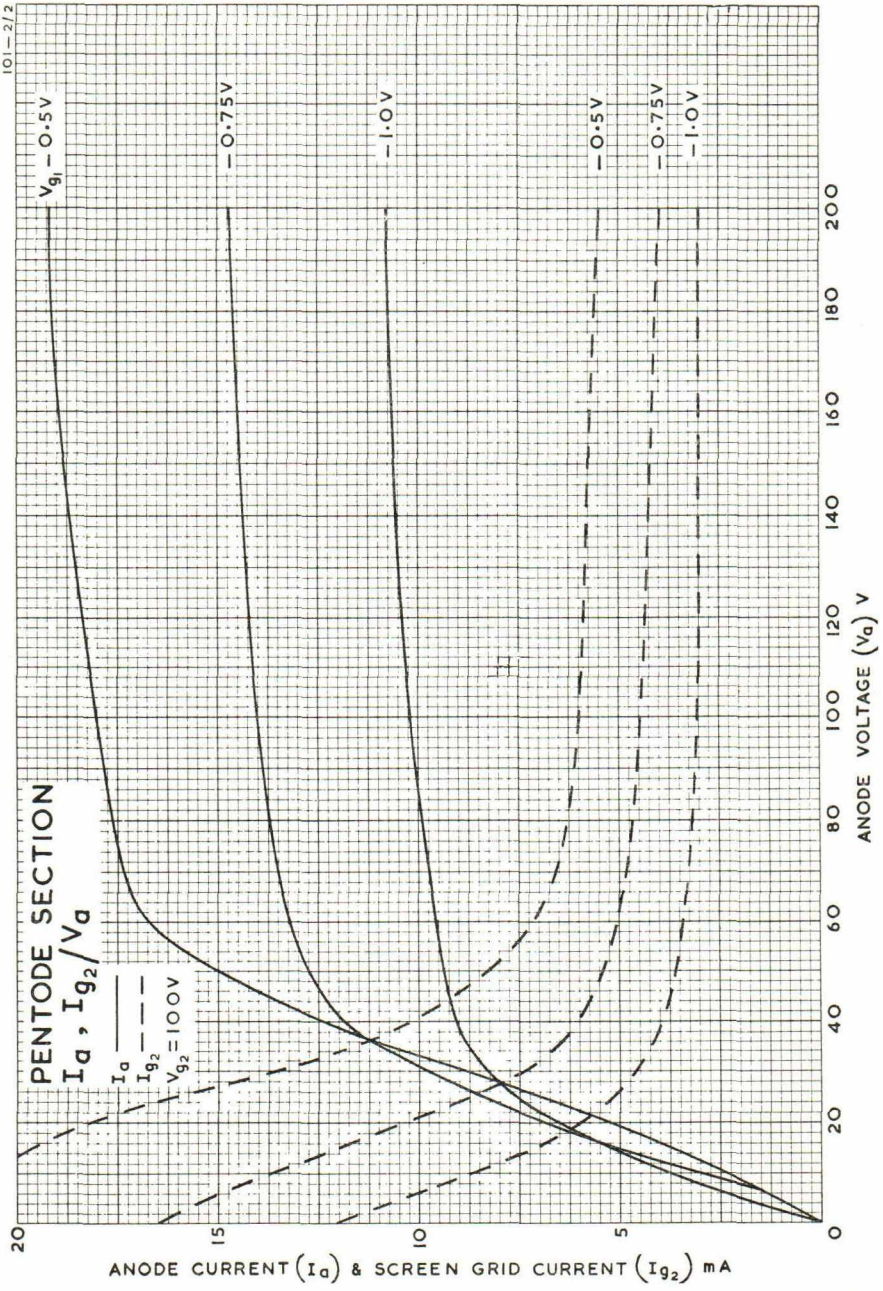


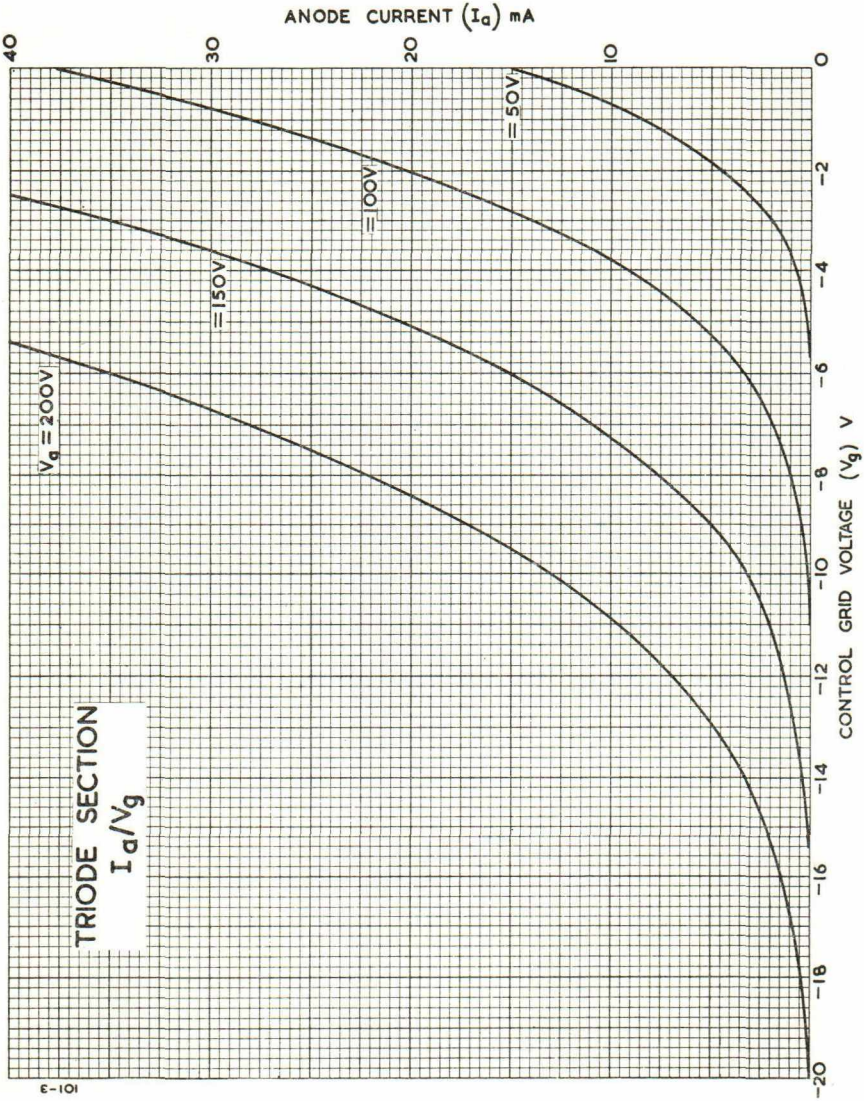
MOUNTING POSITION—Unrestricted

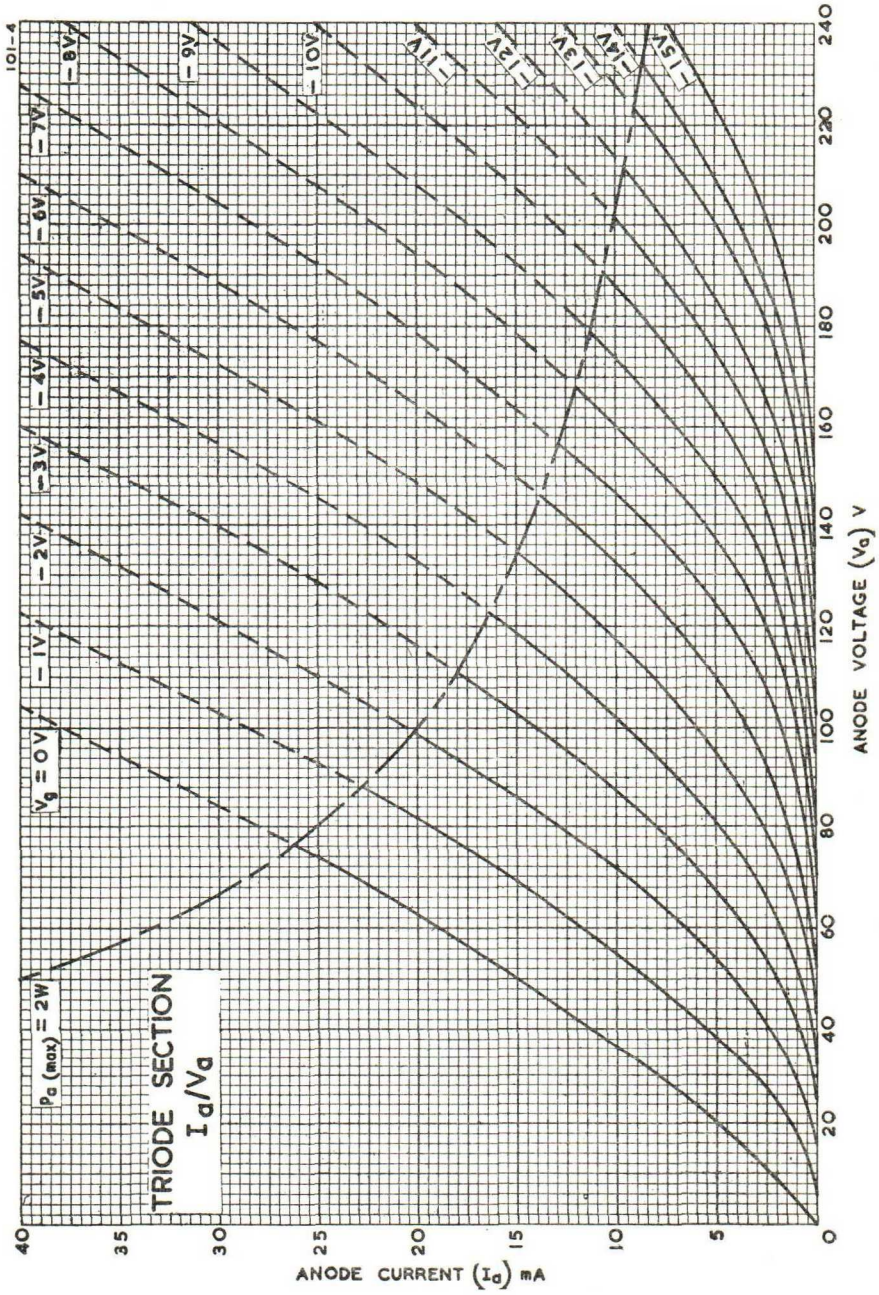

101-1A
PENTODE SECTION
$I_a, I_{g_2}/V_{g_1}$
I_a
I_{g_2}
$V_a = V_{g_2} = 200V$
$= 170V$
$= 150V$
$= 125V$
$= 100V$
$= 80V$
$= 200V$
$= 170V$
$= 150V$
$= 125V$
$= 100V$
$= 80V$
20
18
16
14
12
10
8
6
4
2
0
−7
−6
−5
−4
−3
−2
−1
0
ANODE CURRENT (I_a) & SCREEN GRID CURRENT (I_{g_2}) mA
CONTROL GRID VOLTAGE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

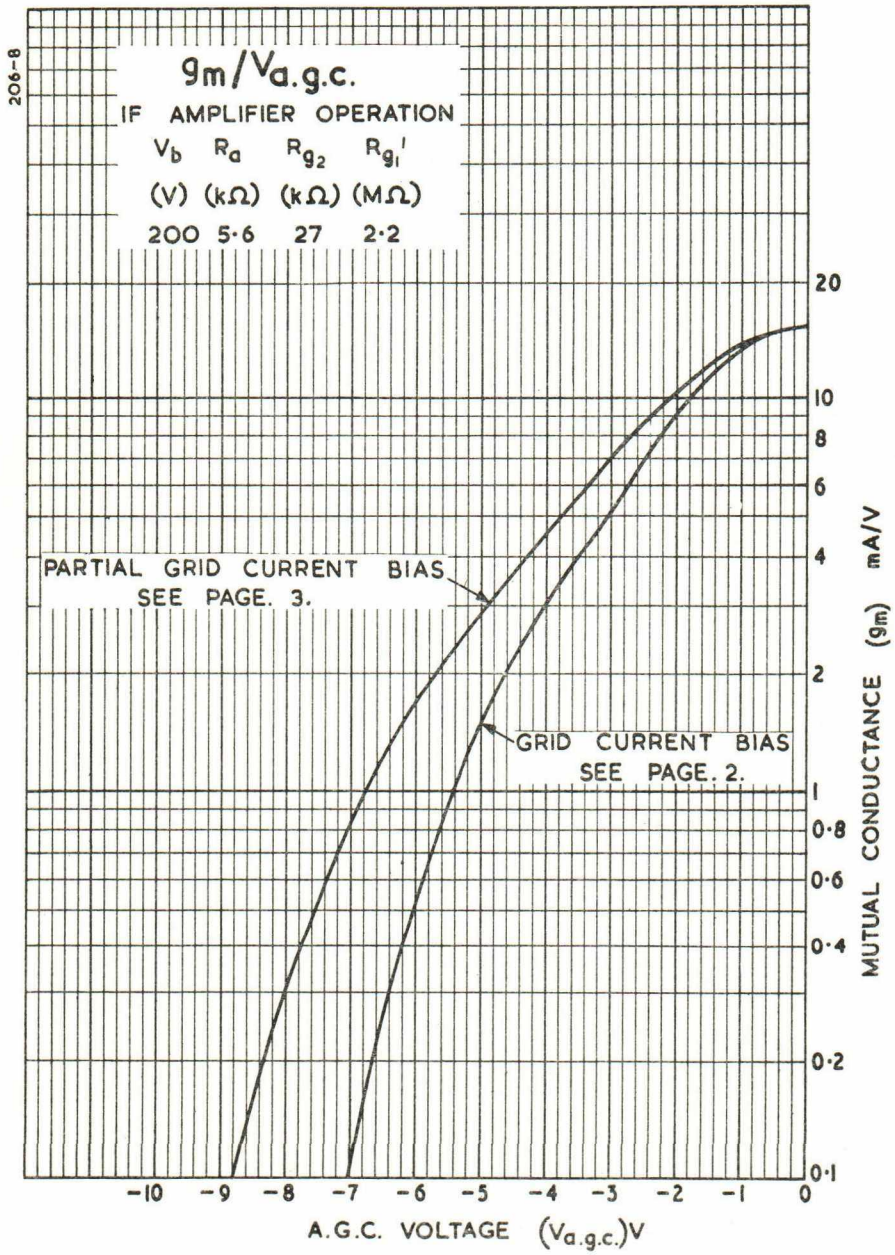

103-5
PENTODE SECTION
gm/Vg1
Va = Vg2 = 200V
= 170V
= 150V
= 125V
= 100V
= 80V
20
18
16
14
12
10
8
6
4
2
0
-7
-6
-5
-4
-3
-2
-1
MUTUAL CONDUCTANCE (gm) mA/V
CONTROL GRID VOLTAGE (Vg1) V

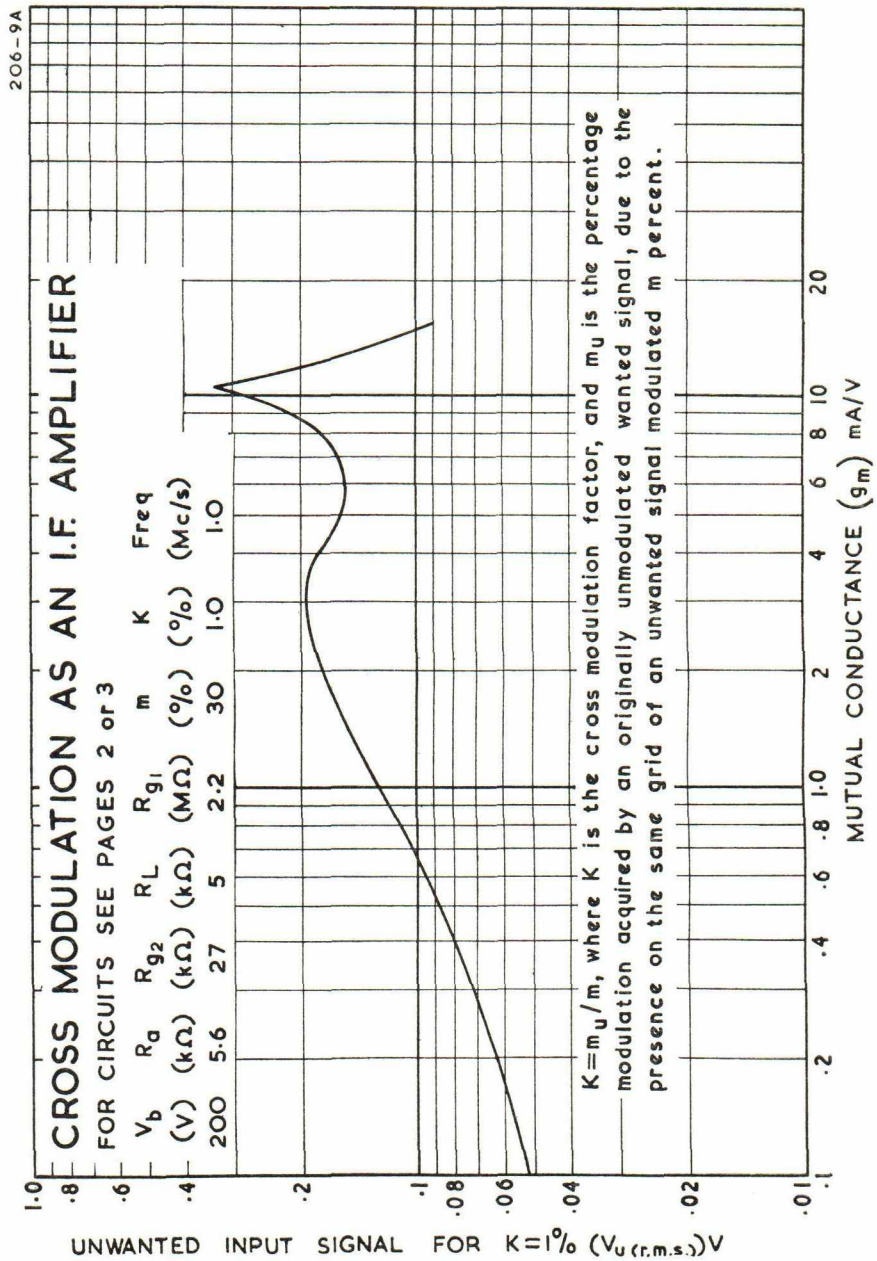

101-2/1
PENTODE SECTION
Ia , Ig2/Va
Ia
Ig2
Vg2 = 80 V
Vg1 -0·25V
-0·5V
-0·75V
-1·0V
-0·25V
-0·5V
-0·75V
-1·0V
ANODE VOLTAGE (Va) V
0
20
40
60
80
100
120
140
160
180
200
ANODE CURRENT (Ia) & SCREEN GRID CURRENT (Ig2) mA
0
5
10
15
20

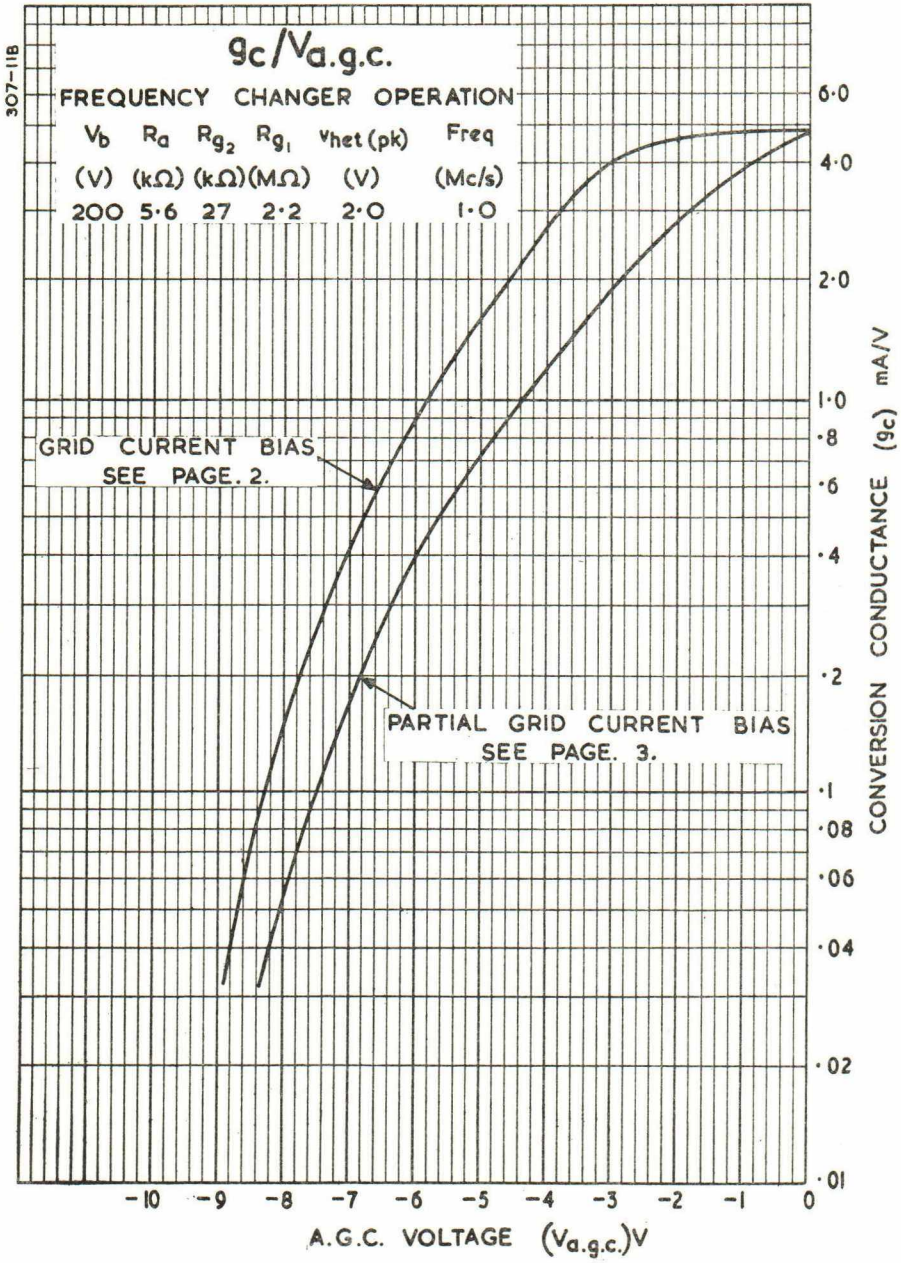

101-2/2
PENTODE SECTION
Ia , Ig2/Va
Ia
Ig2
Vg2=100V
Vg1 -0·5V
-0·75V
-1·0V
-0·5V
-0·75V
-1·0V
ANODE VOLTAGE (Va) V
0
20
40
60
80
100
120
140
160
180
200
ANODE CURRENT (Ia) & SCREEN GRID CURRENT (Ig2) mA
20
15
10
5

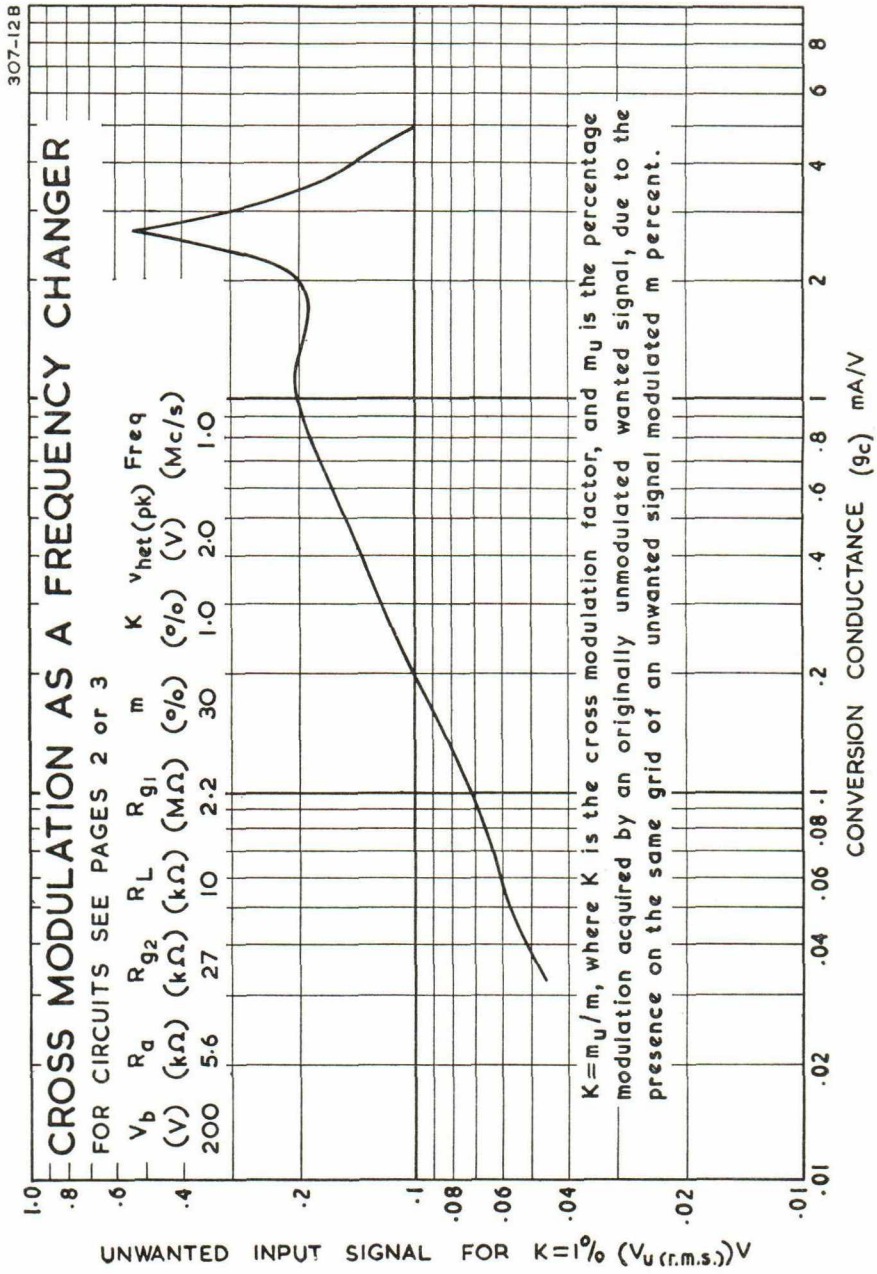

TRIODE SECTION
Ia/Vg
Va = 200V
= 150V
= 100V
= 50V
ANODE CURRENT (Ia) mA
40
30
20
10
0
CONTROL GRID VOLTAGE (Vg) V
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
E-101

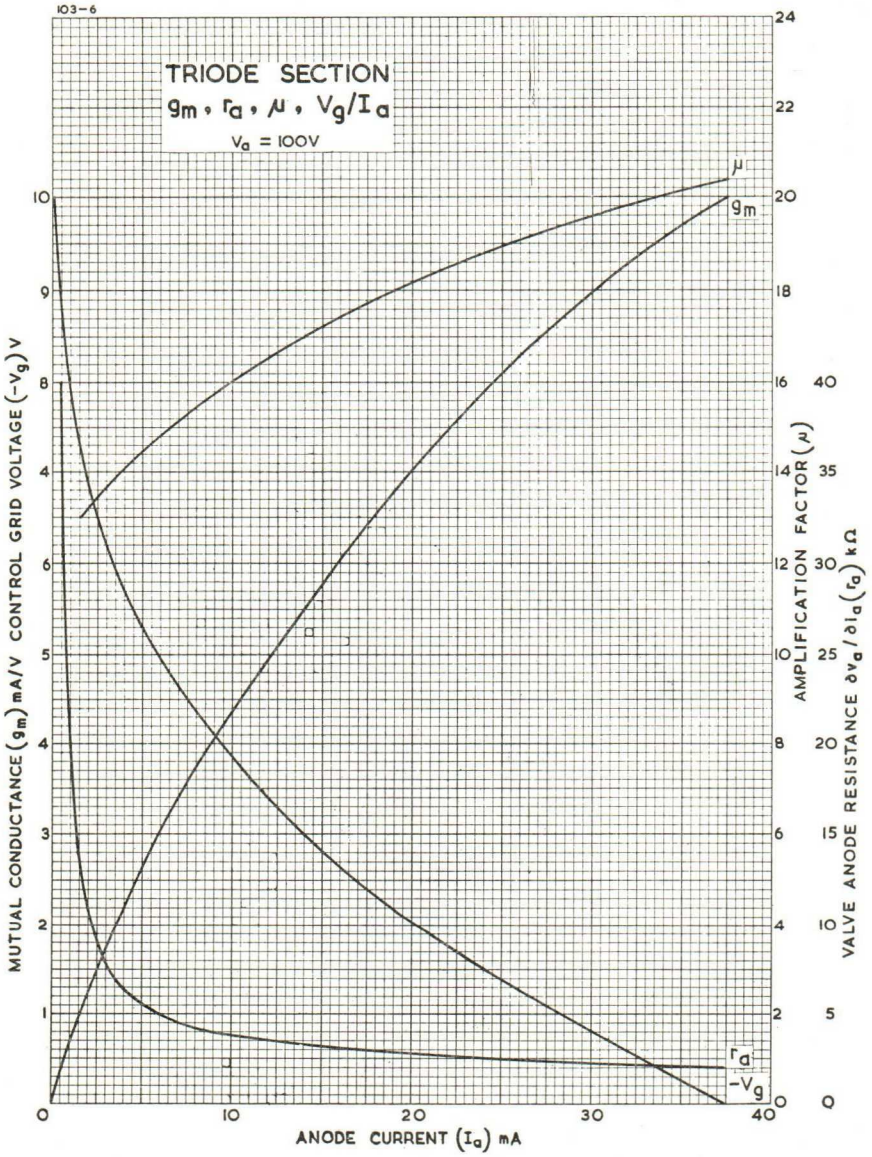

101-4
TRIODE SECTION
Ia/Va
Pa (max) = 2W
Vg = 0V
-1V
-2V
-3V
-4V
-5V
-6V
-7V
-8V
-9V
-10V
-11V
-12V
-13V
-14V
-15V
ANODE CURRENT (Ia) mA
ANODE VOLTAGE (Va) V
0
5
10
15
20
25
30
35
40
20
40
60
80
100
120
140
160
180
200
220
240


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) Ra (kΩ) Rg2 (kΩ) RL (kΩ) Rg1 (MΩ) m (%) K (%) Freq (Mc/s)
200 5·6 27 5 2·2 30 1·0 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.
1·0 ·8 ·6 ·4 ·2 ·1 ·08 ·06 ·04 ·02 ·01
UNWANTED INPUT SIGNAL FOR K=1% (Vu (r.m.s.))V
·1 ·2 ·4 ·6 ·8 1·0 2 4 6 8 10 20
MUTUAL CONDUCTANCE (gm) mA/V


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 Ra Rg2 RL Rg1 m K vhet(pk) Freq
(V) (kΩ) (kΩ) (kΩ) (MΩ) (%) (%) (V) (Mc/s)
200 5.6 27 10 2.2 30 1.0 2.0 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
1.0
.8
.6
.4
.2
.1
.08
.06
.04
.02
.01
.02
.04
.06
.08
.1
.2
.4
.6
.8
1
2
4
6
8


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
8
9
12
14
16
18
22
24
25
15
35