

VOLTAGE AMPLIFYING PENTODE

EF86

Low-noise pentode for use as r.c. coupled a.f. voltage amplifier, particularly suitable for the early stages of high-gain audio amplifiers, microphone pre-amplifiers and tape recorders.

HEATER

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

V_h	6.3	V
I_h	200	mA

CAPACITANCES (measured without an external shield)

C_{out}	5.1	pF←
C_{in}	3.8	pF
C_{a-g1}	<50	mpF
C_{g1-h}	<2.5	mpF

CHARACTERISTICS

V_a	250	V
V_{g3}	0	V
V_{g2}	140	V
I_a	3.0	mA
I_{g2}	600	μA
V_{g1}	-2.2	V←
g_m	2.2	mA/V←
r_a	2.0	MΩ←
μ_{g1-g2}	38	
$V_{g1} \text{ max. } (I_{g1} = +0.3 \mu A)$	-1.3	V

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

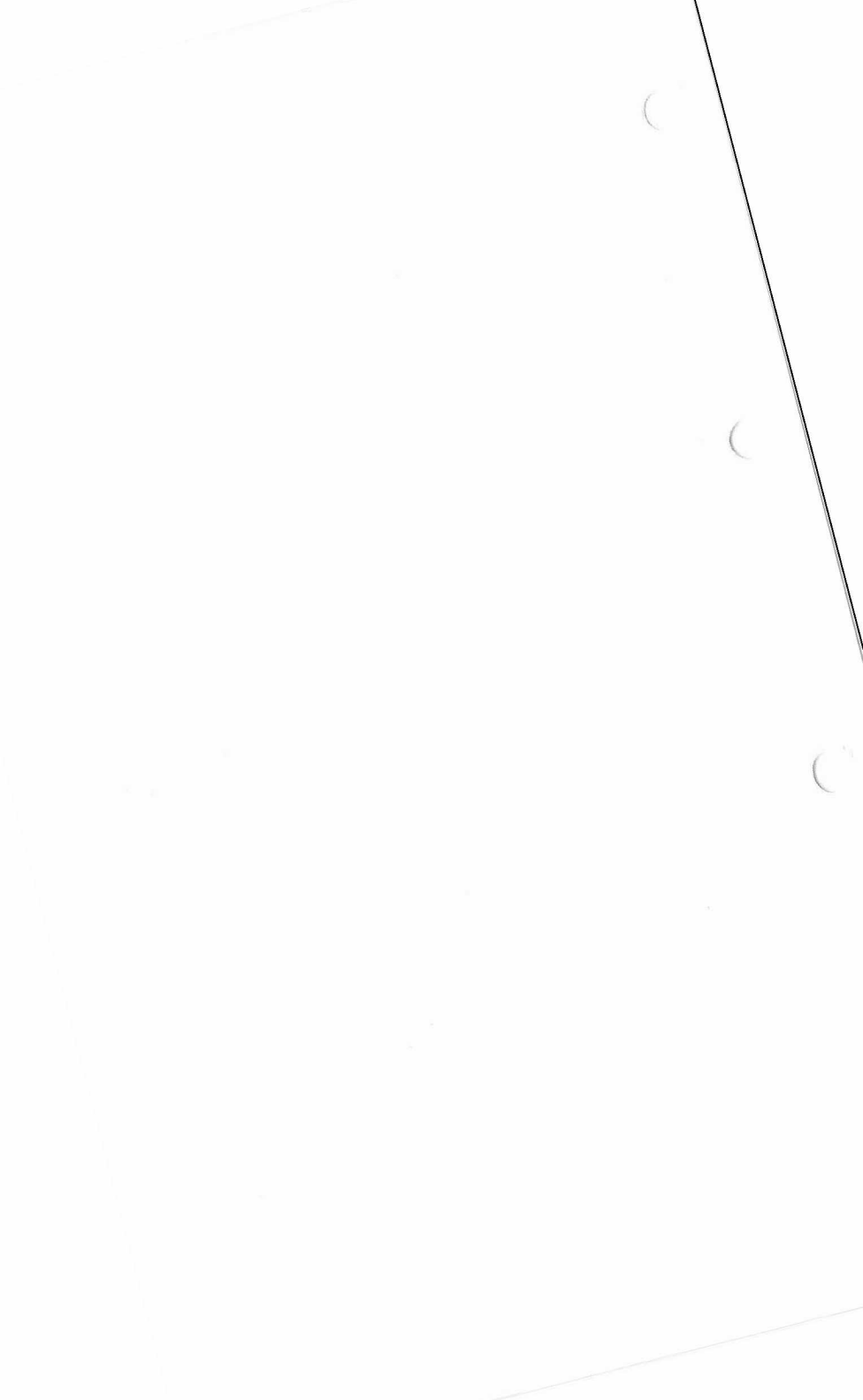
Pentode connection

V_b (V)	R_a (kΩ)	R_{g2} (MΩ)	R_k (kΩ)	I_k (mA)	$\frac{V_{out}^\dagger}{V_{in}}$	V_{out}^* (V _{r.m.s.})	R_{g1}^{**} (kΩ)
400	100	0.39	1.0	3.2	140	85	330
350	100	0.39	1.0	2.75	134	74	330
300	100	0.39	1.0	2.4	129	62	330
250	100	0.39	1.0	2.0	123	50	330
200	100	0.39	1.0	1.55	117	38	330
150	100	0.39	1.0	1.05	110	27	330
400	220	1.0	2.2	1.45	210	72	680
350	220	1.0	2.2	1.3	205	62	680
300	220	1.0	2.2	1.1	194	53	680
250	220	1.0	2.2	0.9	185	44	680
200	220	1.0	2.2	0.75	173	35	680
150	220	1.0	2.2	0.5	147	22	680

*Output voltage at $D_{tot} = 5\%$.

**Grid resistor of following valve.

† $\frac{V_{out}}{V_{in}}$ measured with $V_{in} = 100 \text{ mV r.m.s.}$



OPERATING NOTES

1. Hum

When used as a normal voltage amplifier with a line voltage of 250V, an anode load of $100k\Omega$ and a grid resistor of $470k\Omega$ the maximum hum level of the valve alone is $5\mu V$, the average value being about $3\mu V$ when operated with one side of the heater earthed. This can be further reduced by centre-tapping the heater to earth. Under these conditions the nominal hum level is $1\mu V$. The low level of hum attained with this valve can be completely masked by that due to an unsuitable valveholder, in which excessive leakage and capacitive coupling between pins will introduce considerable hum.

2. Noise

The low-frequency noise generated by a valve is most conveniently specified as an equivalent voltage on the control grid for a specific bandwidth. For the EF86 under normal conditions, i.e. line voltage of 250V and an anode load of $100k\Omega$, the equivalent noise voltage is approximately $2\mu V$ for the frequency range of 25 to 10,000c/s.

3. Microphony

Care in the design of the valve to ensure that the electrode structure and its mounting are as rigid as possible has reduced the microphony of the EF86 to a very low level. There are no appreciable internal resonances at frequencies below 1,000c/s. At higher frequencies the effect of vibration is usually negligible on account of the damping provided by the chassis and the valveholder. In high-gain applications such as tape recording care should be taken in siting the valve, particularly when a loudspeaker is present in the same cabinet or when a motor is mounted on the same chassis. In such cases a flexible mounting for the valveholder or a separate weighted sub-chassis is advisable.

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

V_b (V)	R_a (k Ω)	I_a (mA)	R_k (k Ω)	$\frac{V_{out}\ddagger}{V_{in}}$	V_{out}^* (V r.m.s.)	D_{tot}^* (%)	$R_{g1}\ddagger$ (k Ω)
400	47	3.6	1.2	26	68	5.2	150
350	47	3.15	1.2	25	58	5.0	150
300	47	2.7	1.2	25	46	4.6	150
250	47	2.25	1.2	25	36	4.3	150
200	47	1.8	1.2	24	24	3.9	150
400	100	2.0	2.2	28	75	4.8	330
350	100	1.8	2.2	28	63	4.7	330
300	100	1.5	2.2	27.5	51	4.6	330
250	100	1.25	2.2	27.5	42	4.2	330
200	100	1.0	2.2	27	30	4.0	330
400	220	1.1	3.9	29	71	4.3	680
350	220	0.95	3.9	29	60	4.3	680
300	220	0.8	3.9	29	52	4.2	680
250	220	0.7	3.9	28	42	3.9	680
200	220	0.55	3.9	28	30	3.7	680

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

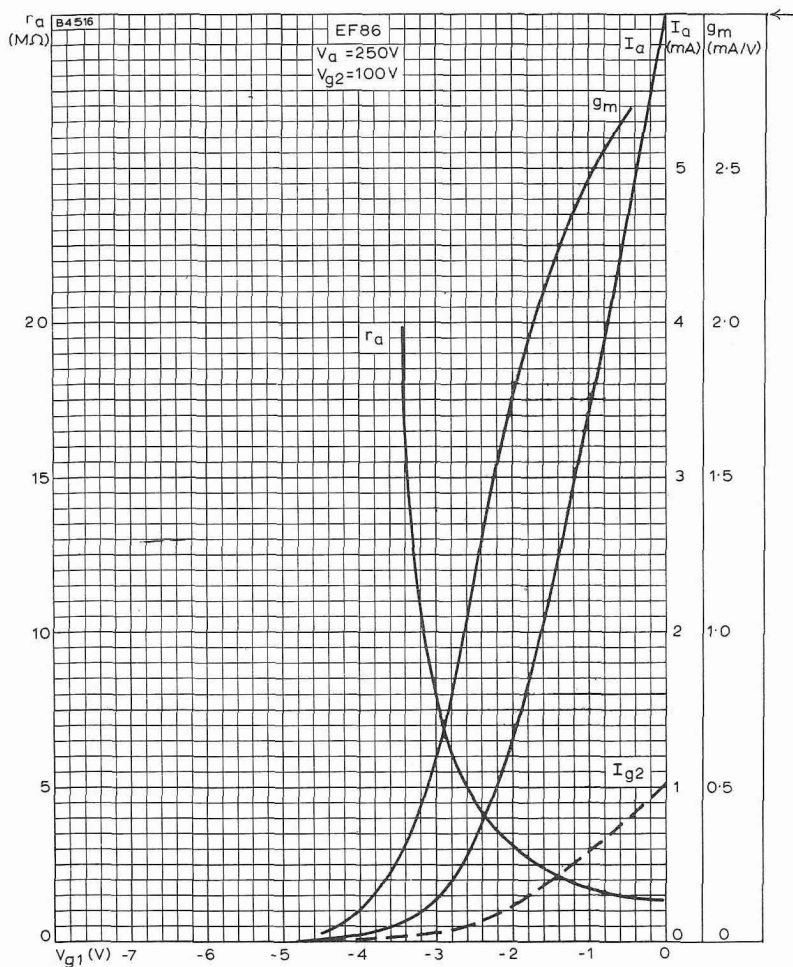
$\ddagger$ Grid resistor of the following valve.

$\ddagger \frac{V_{out}}{V_{in}}$ measured with $V_{in} = 100\text{mV r.m.s.}$

RATINGS (ABSOLUTE MAXIMUM SYSTEM)

$V_{a(b)} \text{ max.}$	550	V
$V_a \text{ max.}$	300	V
$p_a \text{ max.}$	1.0	W
$V_{g2(b)} \text{ max.}$	550	V
$V_{g2} \text{ max.}$	200	V
$p_{g2} \text{ max.}$	200	mW
$I_k \text{ max.}$	6.0	mA
$R_{g1-k} \text{ max. (} p_a > 200\text{mW)}$	3.0	M Ω
$R_{g1-k} \text{ max. (} p_a < 200\text{mW)}$	10	M Ω
$V_{h-k} \text{ max. (cathode positive)}$	100	V
$V_{h-k} \text{ max. (cathode negative)}$	50	V
* $R_{h-k} \text{ max.}$	20	k Ω

*When used as a phase inverter immediately preceding the output stage, $R_{h-k} \text{ max.}$ may be 120k Ω .

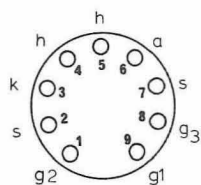
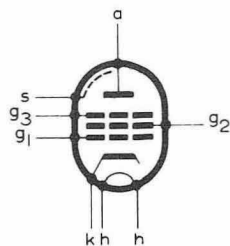


ANODE AND SCREEN-GRID CURRENTS, ANODE IMPEDANCE AND
MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
 $V_{g2} = 100V$

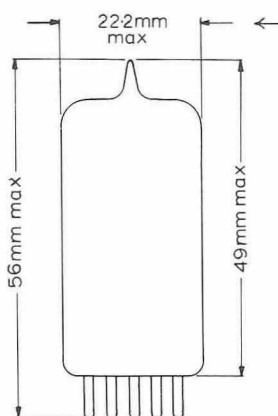
EF86

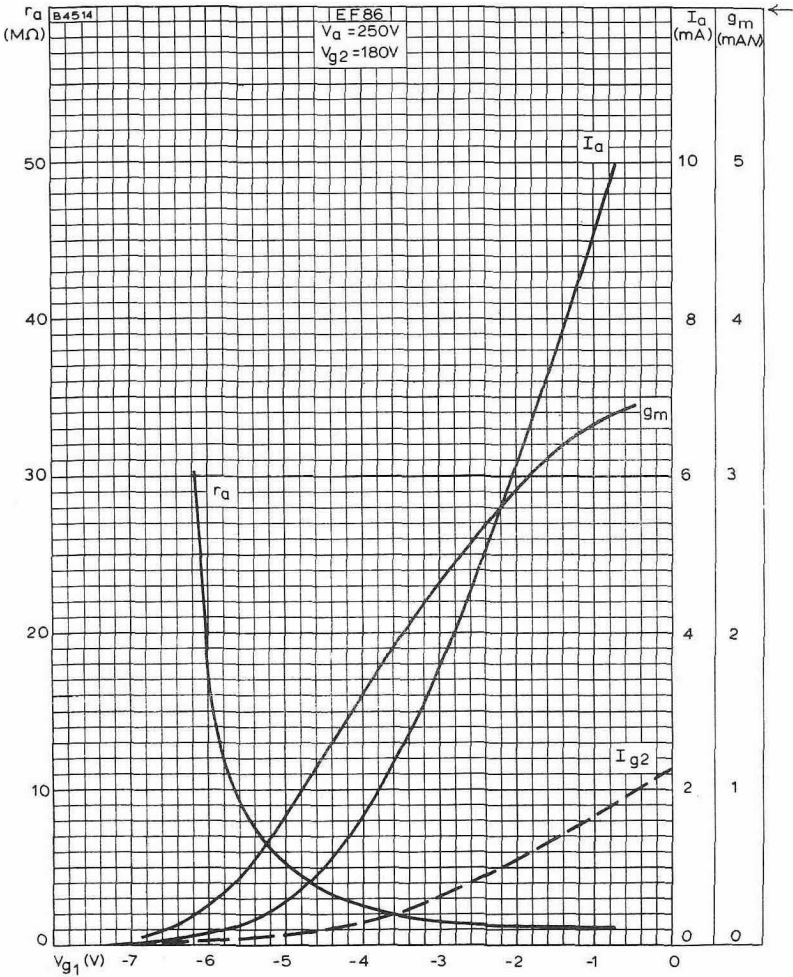
VOLTAGE AMPLIFYING PENTODE

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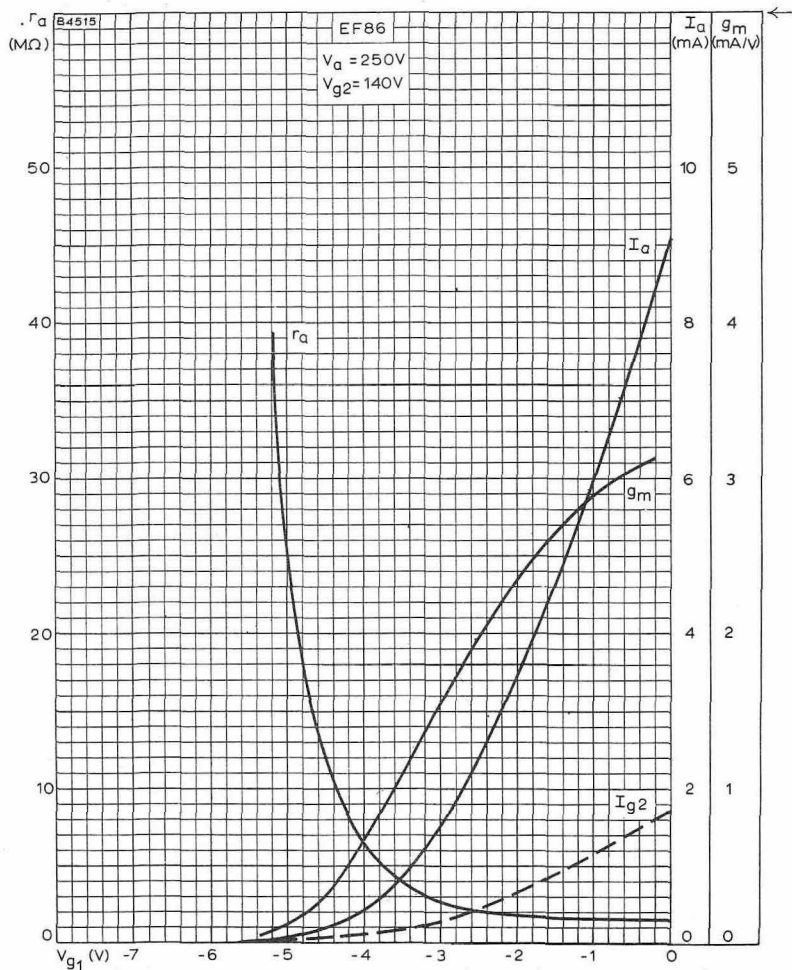


B9A Base



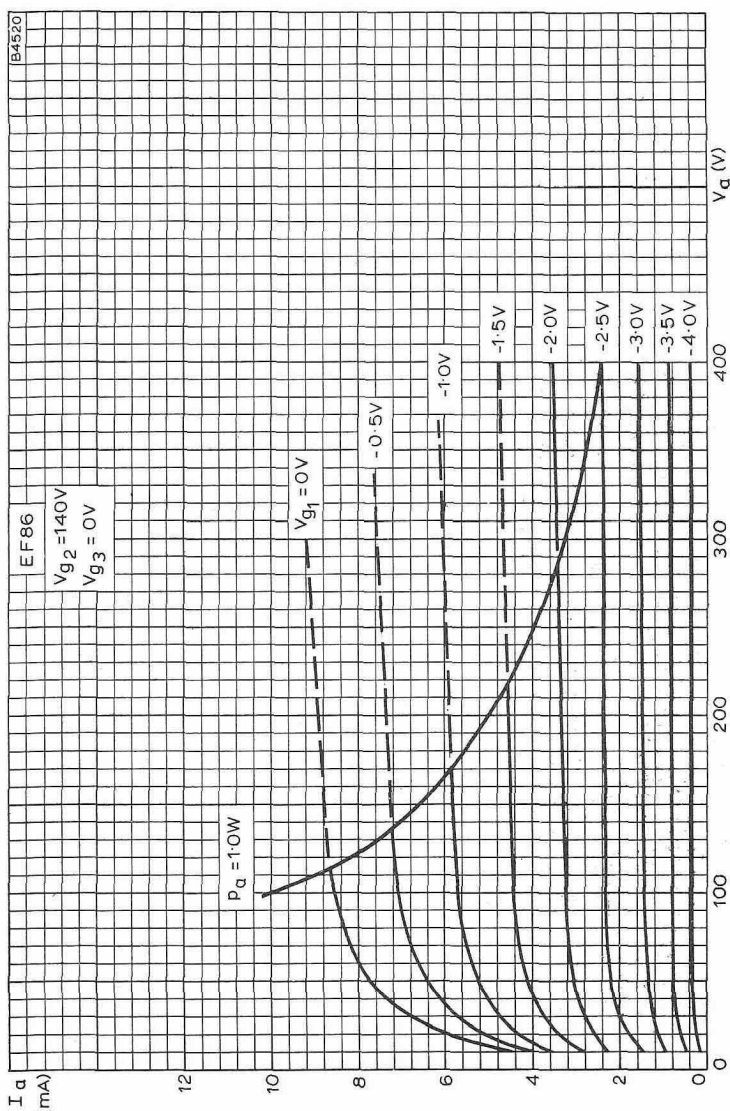


ANODE AND SCREEN-GRID CURRENTS, ANODE IMPEDANCE AND
MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.
 $V_{g2} = 180V$

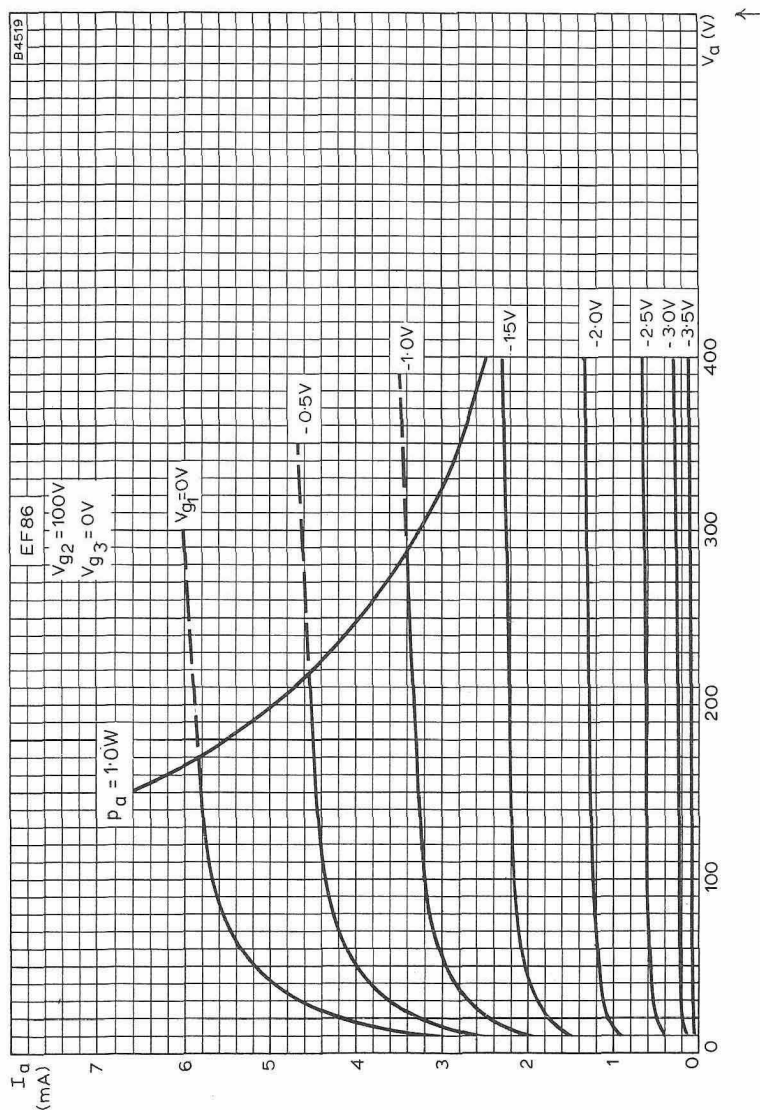


ANODE AND SCREEN-GRID CURRENTS, ANODE IMPEDANCE AND
 MUTUAL CONDUCTANCE PLOTTED AGAINST CONTROL-GRID VOLTAGE.

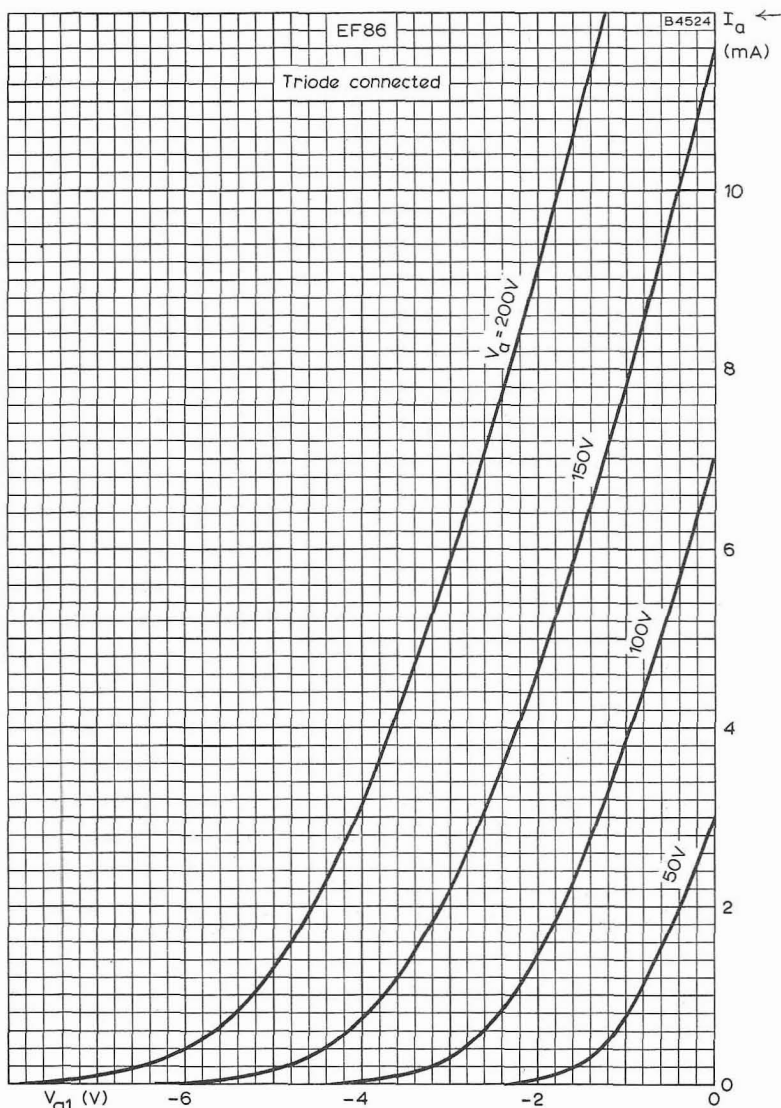
$V_{g2} = 140V$



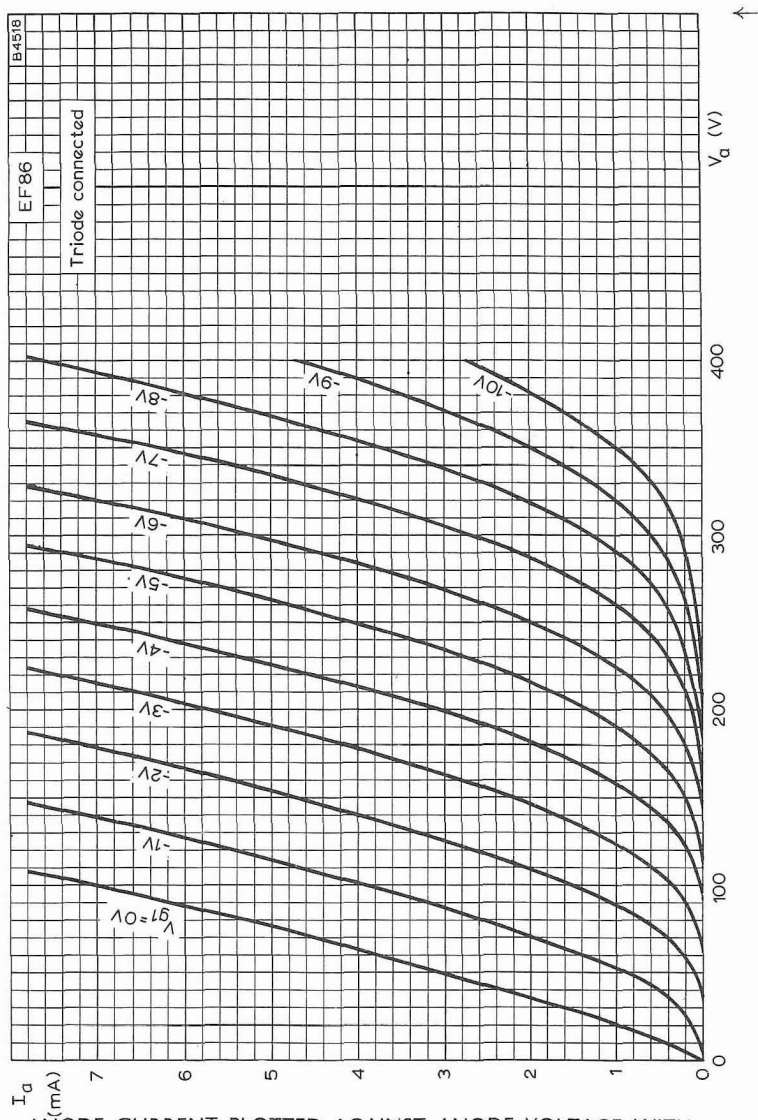
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH
CONTROL-GRID VOLTAGE AS PARAMETER. $V_{g2} = 140V$



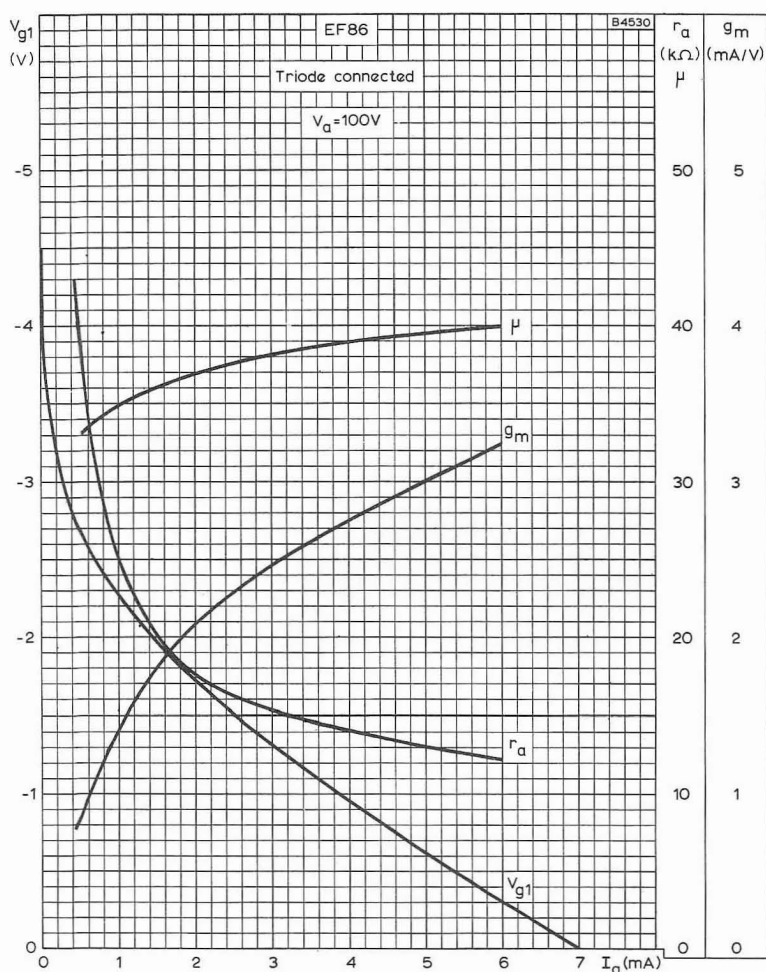
ANODE CURRENT PLOTTED AGAINST ANODE VOLTAGE WITH
CONTROL-GRID VOLTAGE AS PARAMETER, $V_{g2} = 100V$



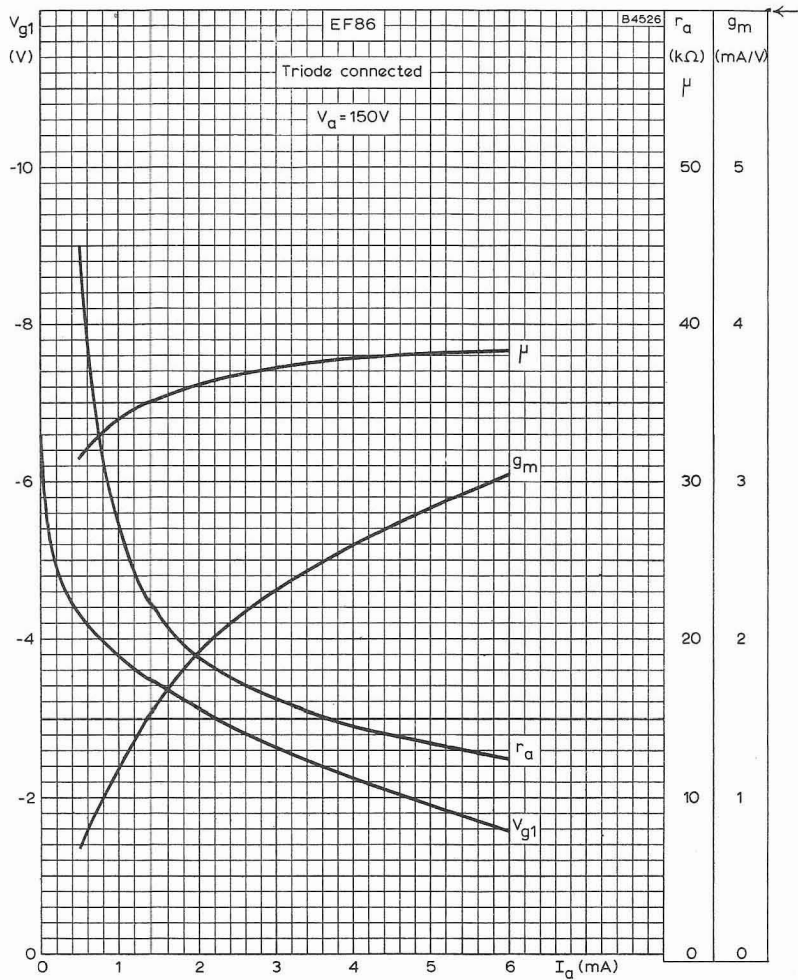
ANODE CURRENT PLOTTED AGAINST CONTROL-GRID VOLTAGE
WITH ANODE VOLTAGE AS PARAMETER WHEN TRIODE CONNECTED



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

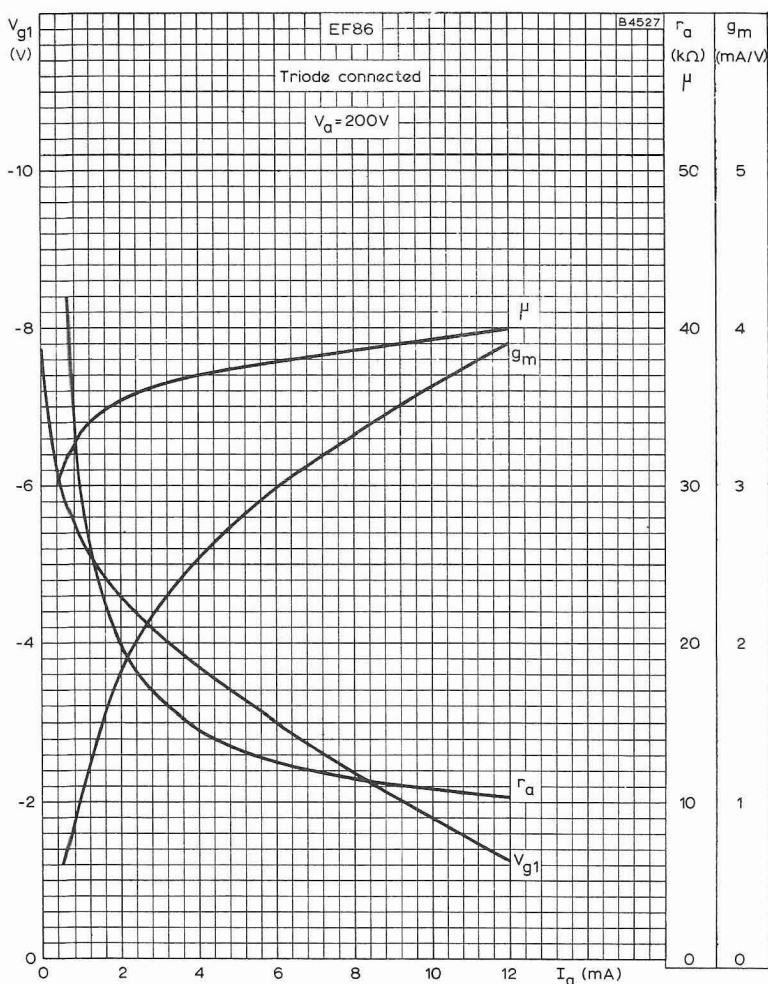


CONTROL-GRID VOLTAGE, MUTUAL CONDUCTANCE, AMPLIFICATION
FACTOR AND ANODE IMPEDANCE PLOTTED AGAINST ANODE CURRENT
WHEN TRIODE CONNECTED. $V_a = 100V$



CONTROL-GRID VOLTAGE, MUTUAL CONDUCTANCE, AMPLIFICATION
FACTOR AND ANODE IMPEDANCE PLOTTED AGAINST ANODE CURRENT
WHEN TRIODE CONNECTED. $V_a = 150V$





CONTROL-GRID VOLTAGE, MUTUAL CONDUCTANCE, AMPLIFICATION
FACTOR AND ANODE IMPEDANCE PLOTTED AGAINST ANODE CURRENT
WHEN TRIODE CONNECTED. $V_a = 200V$

