# A.F. OUTPUT PENTODE

Pentode intended for use as A.F. power amplifier.

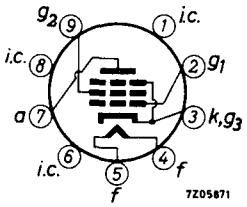
| QUICK REFERENCE DATA | | | |
|---|---|---|---|
| Anode current | $I_a$ | 48 | mA |
| Transconductance | S | 11.3 | mA/V |
| Amplification factor | $\mu_{g_2g_1}$ | 19 | |
| Output power | $W_o$ | 6.0 | W |

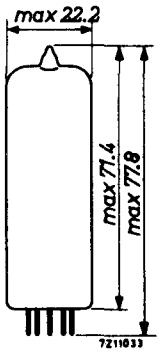
**HEATING:** Indirect by A.C. or D.C.; parallel supply

| | | | |
|---|---|---|---|
| Heater voltage | $V_f$ | 6.3 | V |
| Heater current | $I_f$ | 760 | mA |

**DIMENSIONS AND CONNECTIONS** Dimensions in mm

Base: Noval




**CAPACITANCES**

| | | | |
|---|---|---|---|
| Anode to all except grid No.1 | $C_{a(g_1)}$ | 6.5 | pF |
| Grid No.1 to all except anode | $C_{g_1(a)}$ | 10.8 | pF |
| Anode to grid No.1 | $C_{ag_1}$ | max. 0.5 | pF |
| Grid No.1 to heater | $C_{g_1f}$ | max. 0.25 | pF |

## OPERATING CHARACTERISTICS

Class A

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Anode voltage | $V_a$ | | | 250 | | | V |
| Grid No.2 voltage | $V_{g_2}$ | | | 250 | | | V |
| Grid No.1 voltage | $V_{g_1}$ | | | -7.3 | | | V |
| Cathode resistor | $R_k$ | | | 135 | | | Ω |
| Load resistance | $R_{a\sim}$ | | | 5.2 | | | kΩ |
| Grid No.1 driving voltage | $V_i$ | 0 | 0.3 | 3.4 | 4.3 | 4.7 [2] | $V_{RMS}$ |
| Anode current | $I_a$ | 48 | – | – | 49.5 | 49.2 | mA |
| Grid No.2 current | $I_{g_2}$ | 5.5 | – | – | 10.8 | 11.6 | mA |
| Transconductance | S | 11.3 | – | – | – | – | mA/V |
| Amplification factor | $\mu_{g_2g_1}$ | 19 | – | – | – | – | |
| Internal resistance | $R_i$ | 38 | – | – | – | – | kΩ |
| Output power | $W_o$ [1] | 0 | 0.05 | 4.5 | 5.7 | 6.0 | W |
| Distortion, total | $d_{tot}$ [1] | – | – | 6.8 | 10 | – | % |
| second harmonic | $d_2$ [1] | – | – | 3.0 | 2.0 | – | % |
| third harmonic | $d_3$ [1] | – | – | 5.8 | 9.5 | – | % |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Anode voltage | $V_a$ | | | 250 | | | V |
| Grid No.2 voltage | $V_{g_2}$ | | | 250 | | | V |
| Grid No.1 voltage | $V_{g_1}$ | | | -7.3 | | | V |
| Cathode resistor | $R_k$ | | | 135 | | | Ω |
| Load resistance | $R_{a\sim}$ | | | 4.5 | | | kΩ |
| Grid No.1 driving voltage | $V_i$ | 0 | 0.3 | 3.5 | 4.4 | 4.8 [2] | $V_{RMS}$ |
| Anode current | $I_a$ | 48 | – | – | 50.6 | 50.5 | mA |
| Grid No.2 current | $I_{g_2}$ | 5.5 | – | – | 10 | 11 | mA |
| Transconductance | S | 11.3 | – | – | – | – | mA/V |
| Amplification factor | $\mu_{g_2g_1}$ | 19 | – | – | – | – | |
| Internal resistance | $R_i$ | 38 | – | – | – | – | kΩ |
| Output power | $W_o$ [1] | 0 | 0.05 | 4.5 | 5.7 | 6.0 | W |
| Distortion, total | $d_{tot}$ [1] | – | – | 7.5 | 10 | – | % |
| second harmonic | $d_2$ [1] | – | – | 5.7 | 5.0 | – | % |
| third harmonic | $d_3$ [1] | – | – | 4.5 | 8 | – | % |

[1]) Measured with fixed bias
[2]) At $I_{g_1} = +0.3\ \mu A$

**OPERATING CHARACTERISTICS** (continued)

Class A (continued)

| | | | | | | |
|---|---|---|---|---|---|---|
| Anode voltage | $V_a$ | | | 250 | | V |
| Grid No.2 voltage | $V_{g_2}$ | | | 250 | | V |
| Grid No.1 voltage | $V_{g_1}$ | | | -8.4 | | V |
| Cathode resistor | $R_k$ | | | 210 | | Ω |
| Load resistance | $R_{a\sim}$ | | | 7 | | kΩ |
| Grid No.1 driving voltage | $V_i$ | 0 | 0.3 | 3.5 | 5.5 [2] | $V_{RMS}$ |
| Anode current | $I_a$ | 36 | – | 36.8 | 36 | mA |
| Grid No.2 current | $I_{g_2}$ | 4.1 | – | 8.5 | 14.6 | mA |
| Transconductance | S | 10 | – | – | – | mA/V |
| Amplification factor | $\mu_{g_2g_1}$ | 19 | – | – | – | |
| Internal resistance | $R_i$ | 40 | – | – | – | kΩ |
| Output power | $W_o$ [1] | 0 | 0.05 | 4.2 | 5.6 | W |
| Distortion, total | $d_{tot}$ [1] | – | – | 10 | – | % |
| second harmonic | $d_2$ [1] | – | – | 1.7 | – | % |
| third harmonic | $d_3$ [1] | – | – | 8.7 | – | % |

| | | | | | | |
|---|---|---|---|---|---|---|
| Anode voltage | $V_a$ | | | 250 | | V |
| Grid No.2 voltage | $V_{g_2}$ | | | 210 | | V |
| Grid No.1 voltage | $V_{g_1}$ | | | -6.4 | | V |
| Cathode resistor | $R_k$ | | | 160 | | Ω |
| Load resistance | $R_{a\sim}$ | | | 7 | | kΩ |
| Grid No.1 driving voltage | $V_i$ | 0 | 0.3 | 3.4 | 3.8 [2] | $V_{RMS}$ |
| Anode current | $I_a$ | 36 | – | 36.6 | 36.5 | mA |
| Grid No.2 current | $I_{g_2}$ | 3.9 | – | 7.3 | 8.0 | mA |
| Transconductance | S | 10.4 | – | – | – | mA/V |
| Amplification factor | $\mu_{g_2g_1}$ | 19 | – | – | – | |
| Internal resistance | $R_i$ | 40 | – | – | – | kΩ |
| Output power | $W_o$ [1] | 0 | 0.05 | 4.3 | 4.7 | W |
| Distortion, total | $d_{tot}$ [1] | – | – | 10 | – | % |
| second harmonic | $d_2$ [1] | – | – | 1.8 | – | % |
| third harmonic | $d_3$ [1] | – | – | 9.3 | – | % |

1) Measured with fixed bias
2) At $I_{g_1} = +0.3\ \mu A$

**OPERATING CHARACTERISTICS** (continued)

Class B, two tubes in push-pull

| | | | | | | |
|---|---|---|---|---|---|---|
| Anode voltage | $V_a$ | 250 | | 300 | | V |
| Grid No.2 voltage | $V_{g_2}$ | 250 | | 300 | | V |
| Grid No.1 voltage | $V_{g_1}$ | -11.6 | | -14.7 | | V |
| Load resistance | $R_{aa\sim}$ | 8 | | 8 | | kΩ |
| Grid No.1 driving voltage | $V_i$ | 0 | 8 | 0 | 10 | $V_{RMS}$ |
| Anode current | $I_a$ | 2x10 | 2x37.5 | 2x7.5 | 2x46 | mA |
| Grid No.2 current | $I_{g_2}$ | 2x1.1 | 2x7.5 | 2x0.8 | 2x11 | mA |
| Output power | $W_o$ | 0 | 11 | 0 | 17 | W |
| Distortion | $d_{tot}$ | - | 3 | - | 4 | % |

Class AB, two tubes in push-pull

| | | | | | | |
|---|---|---|---|---|---|---|
| Anode voltage | $V_a$ | 250 | | 300 | | V |
| Grid No.2 voltage | $V_{g_2}$ | 250 | | 300 | | V |
| Common cathode resistor | $R_k$ | 130 | | 130 | | Ω |
| Load resistance | $R_{aa\sim}$ | 8 | | 8 | | kΩ |
| Grid No.1 driving voltage | $V_i$ | 0 | 8 | 0 | 10 | $V_{RMS}$ |
| Anode current | $I_a$ | 2x31 | 2x37.5 | 2x36 | 2x46 | mA |
| Grid No.2 current | $I_{g_2}$ | 2x3.5 | 2x7.5 | 2x4 | 2x11 | mA |
| Output power | $W_o$ | 0 | 11 | 0 | 17 | W |
| Distortion | $d_{tot}$ | - | 3 | - | 4 | % |

## OPERATING CHARACTERISTICS IN TRIODE CONNECTION

($g_2$ connected to a)

Class A

| | | | | | |
|---|---|---|---|---|---|
| Anode voltage | $V_a$ | 250 | | | V |
| Cathode resistor | $R_k$ | 270 | | | Ω |
| Load resistance | $R_{a\sim}$ | 3.5 | | | kΩ |
| Grid No.1 driving voltage | $V_i$ | 0 | 1.0 | 6.7 | $V_{RMS}$ |
| Anode current | $I_a$ | 34 | – | 36 | mA |
| Output power | $W_o$ | – | 0.05 | 1.95 | W |
| Distortion | $d_{tot}$ | – | – | 9 | % |

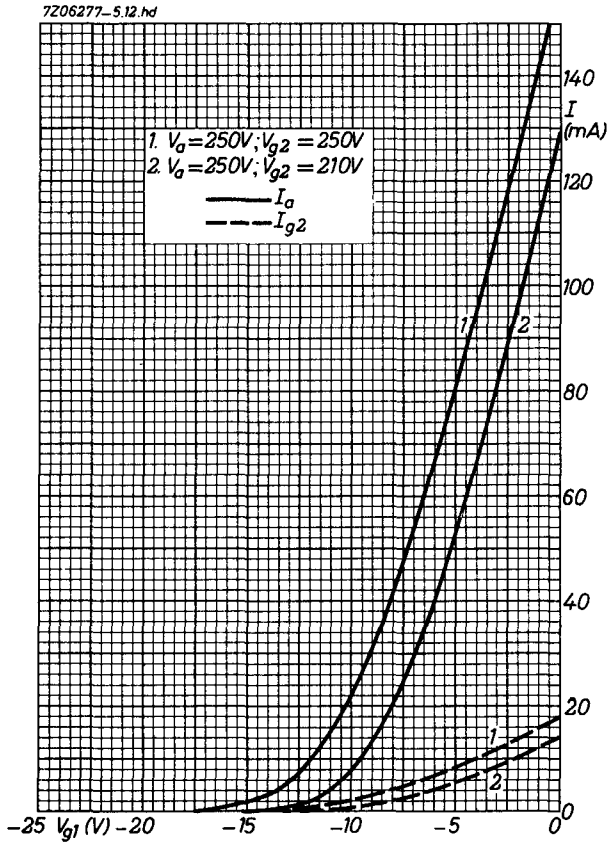
Class AB, two tubes in push-pull

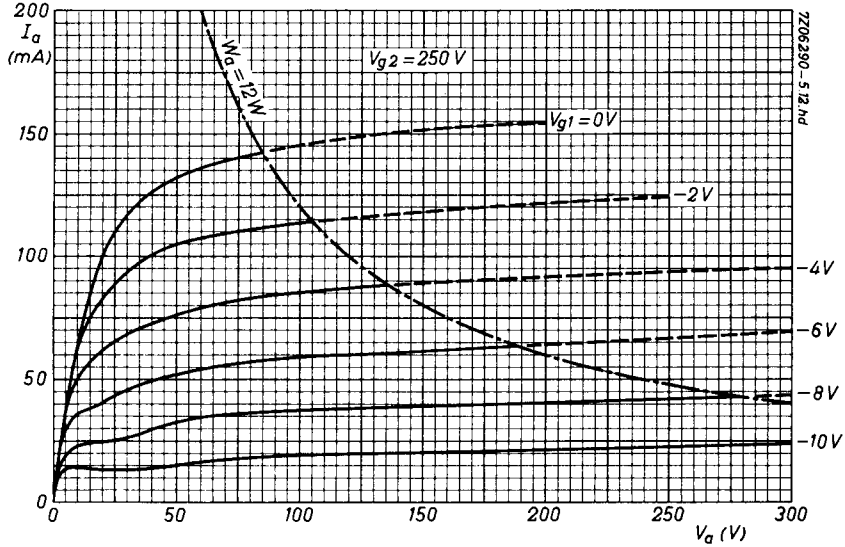
| | | | | | | |
|---|---|---|---|---|---|---|
| Anode voltage | $V_a$ | 250 | | 300 | | V |
| Common cathode resistor | $R_k$ | 270 | | 270 | | Ω |
| Load resistance | $R_{aa\sim}$ | 10 | | 10 | | kΩ |
| Grid No.1 driving voltage | $V_i$ | 0 | 8.3 | 0 | 10 | $V_{RMS}$ |
| Anode current | $I_a$ | 2x20 | 2x21.7 | 2x24 | 2x26 | mA |
| Output power | $W_o$ | 0 | 3.4 | 0 | 5.2 | W |
| Distortion | $d_{tot}$ | – | 2.5 | – | 2.5 | % |
| Grid No.1 driving voltage for $W_o$ = 50 mW | $V_i$ | 0.95 | | 0.9 | | $V_{RMS}$ |

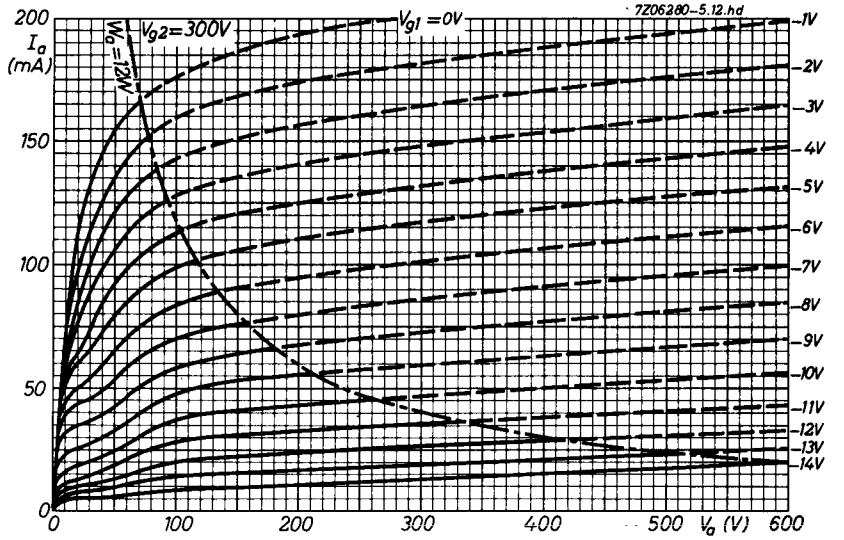
**LIMITING VALUES** (Design centre rating system)

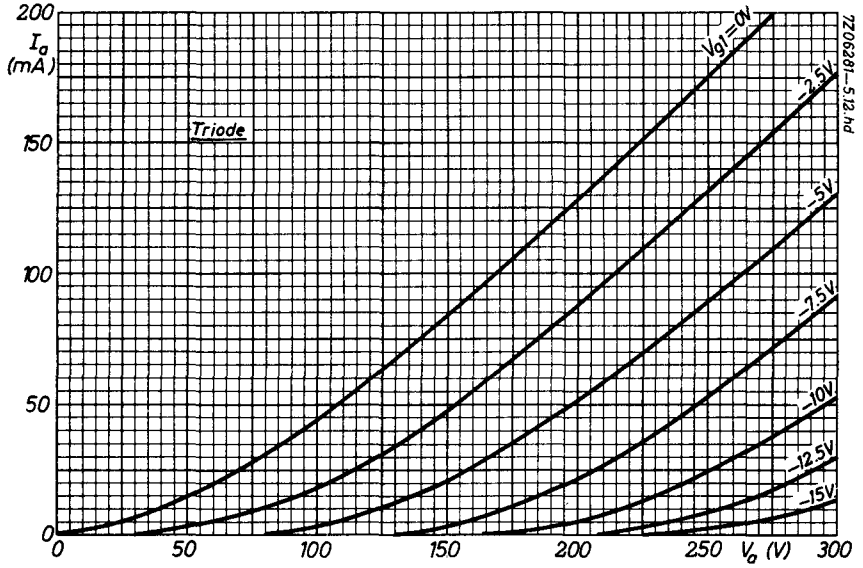
| | | | | |
|---|---|---|---|---|
| Anode voltage | $V_{a_o}$ | max. | 550 | V |
| | $V_a$ | max. | 300 | V [1] |
| Anode dissipation | $W_a$ | max. | 12 | W [1] |
| Grid No.2 voltage | $V_{g_{2o}}$ | max. | 550 | V |
| | $V_{g_2}$ | max. | 300 | V [1] |
| Grid No.2 dissipation | $W_{g_2}$ | max. | 2 | W |
| | $W_{g_{2p}}$ | max. | 4 | W |
| Grid No.1 voltage | $-V_{g_1}$ | max. | 100 | V |
| Cathode current | $I_k$ | max. | 65 | mA |
| Grid No.1 resistor | | | | |
| for automatic bias | $R_{g_1}$ | max. | 1 | MΩ |
| for fixed bias | $R_{g_1}$ | max. | 0.3 | MΩ |
| Cathode to heater voltage | $V_{kf}$ | max. | 100 | V |

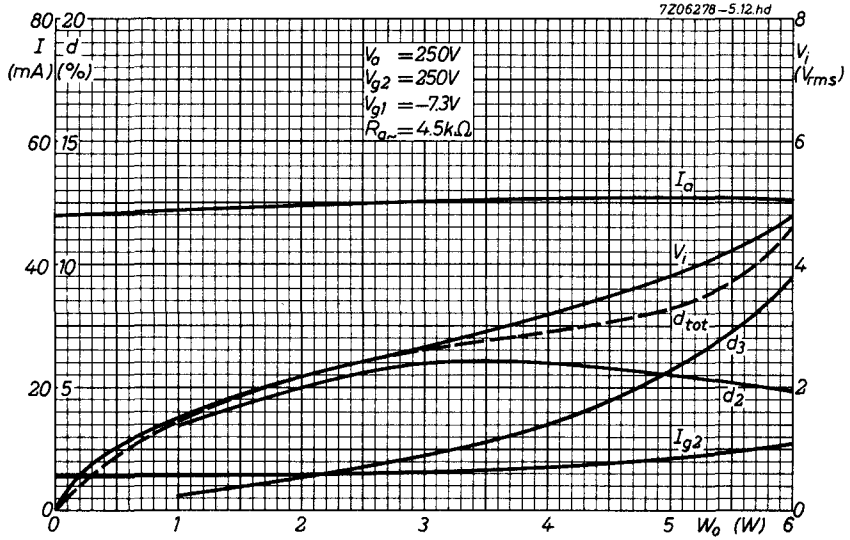
[1]) When the heater and positive voltages are obtained from a storage battery by means of a vibrator, the max. values of $V_a$ and $V_{g_2}$ are 250 V and that of $W_a$ is 9 W.

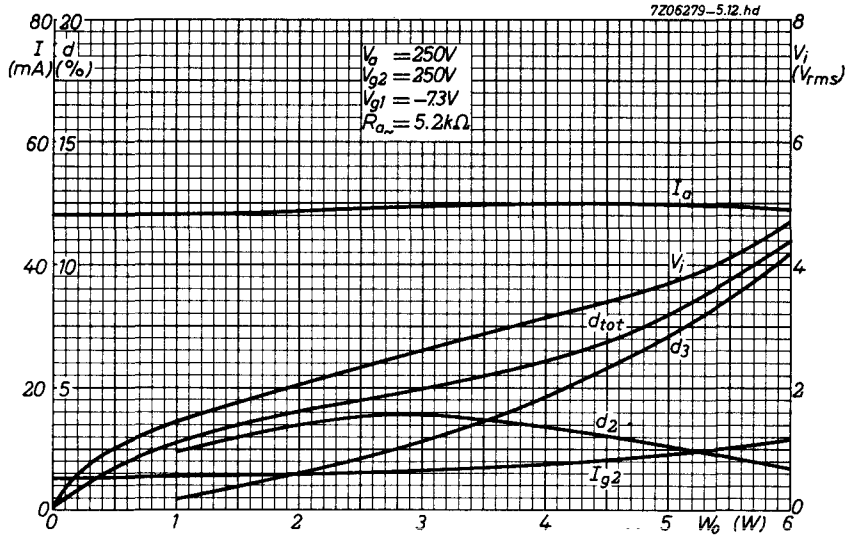

7Z06277-5.12.hd
1. $V_a$=250V; $V_{g2}$ = 250V
2. $V_a$=250V; $V_{g2}$ = 210V
$I_a$
$I_{g2}$
I (mA)
140
120
100
80
60
40
20
0
1
2
1
2
−25 $V_{g1}$ (V) −20
−15
−10
−5
0

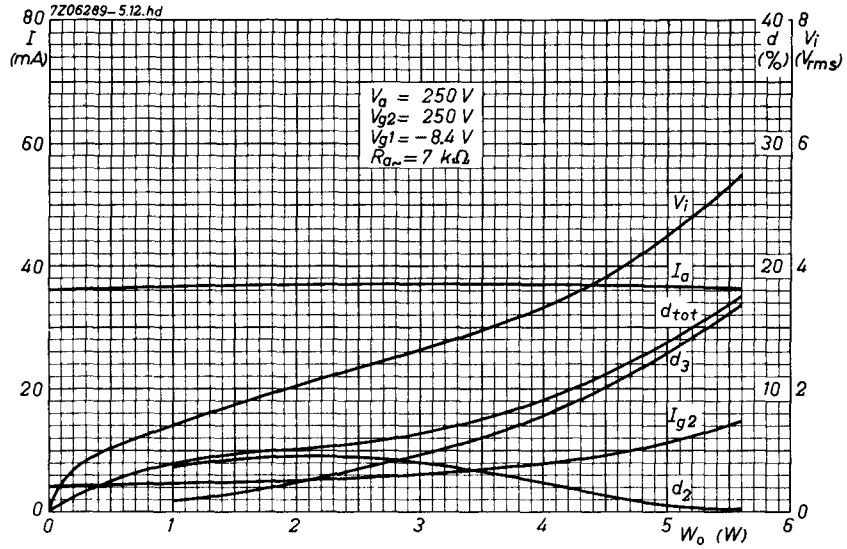

200
$I_a$
(mA)
150
100
50
0
$W_a$ = 12W
$V_{g2}$ = 250 V
$V_{g1}$ = 0V
−2V
−4V
−6V
−8V
−10V
0
50
100
150
200
250
300
$V_a$ (V)
7Z06290-5.12.hd

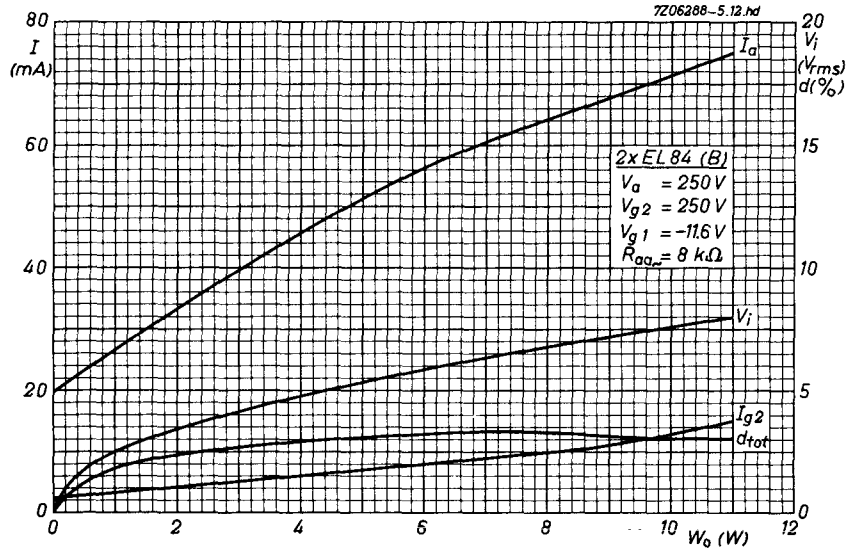

200
$I_a$
(mA)
150
100
50
0
$W_a$ = 12W
$V_{g2}$=300V
$V_{g1}$ =0V
-1V
-2V
-3V
-4V
-5V
-6V
-7V
-8V
-9V
-10V
-11V
-12V
-13V
-14V
0
100
200
300
400
500
$V_a$ (V)
600
7Z06280-5.12.hd

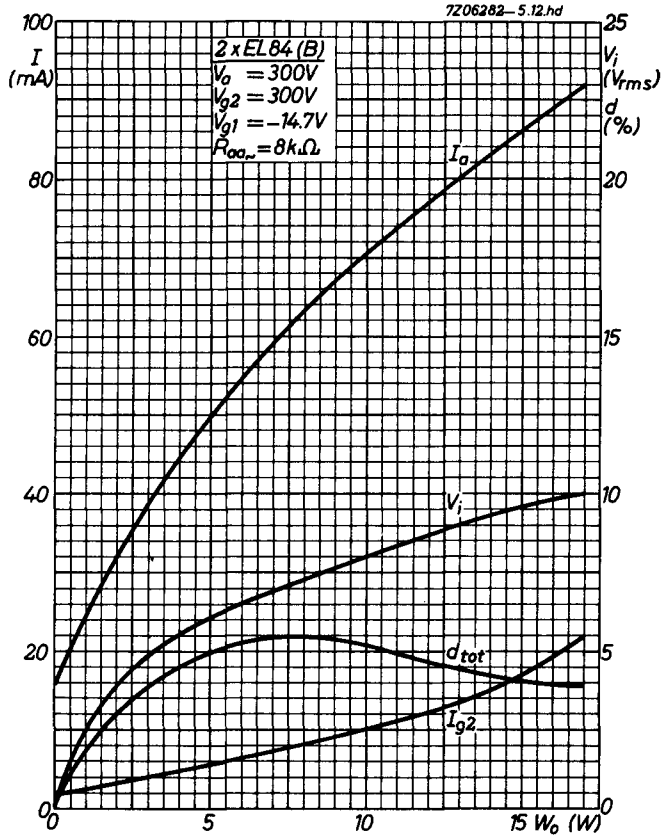

200
$I_a$ (mA)
150
100
50
0
Triode
$V_{g1}$=0V
-2.5V
-5V
-7.5V
-10V
-12.5V
-15V
0
50
100
150
200
250
$V_a$ (V)
300
ZZ06281-5.12.hd

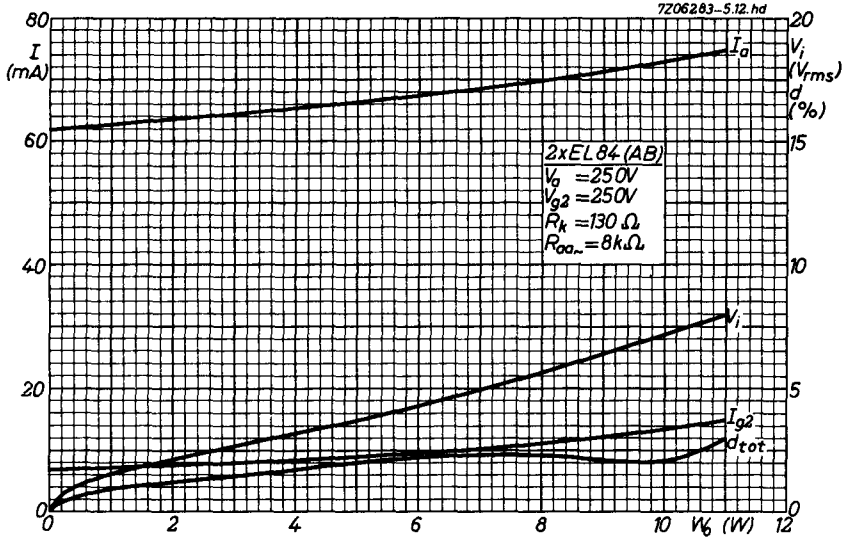

7Z06278-5.12.hd
I (mA)
d (%)
Vi (Vrms)
Va =250V
Vg2 =250V
Vg1 =-7.3V
Ra~ =4.5kΩ
Ia
Vi
dtot
d3
d2
Ig2
Wa (W)

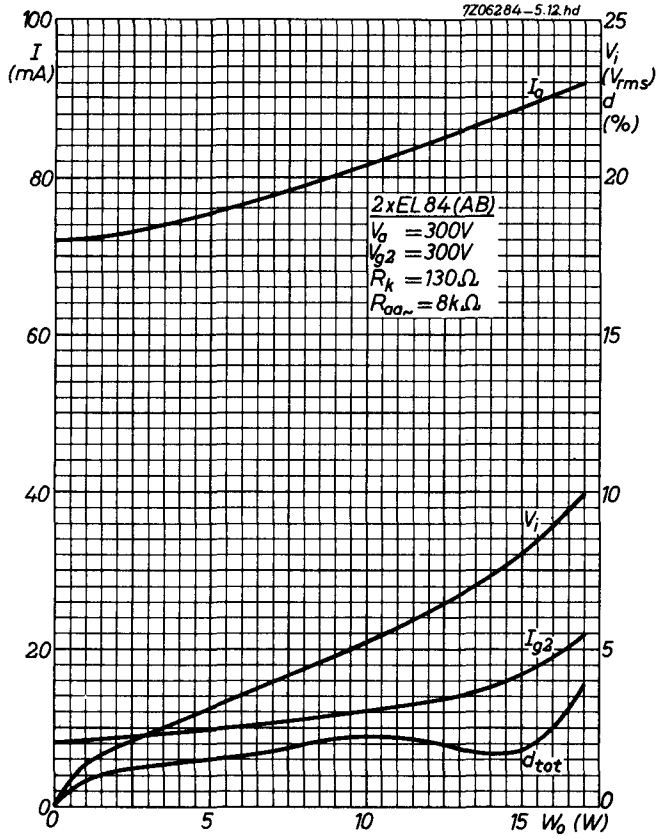

7Z06279-5.12.hd
I (mA)
d (%)
Vi (Vrms)
Va =250V
Vg2 =250V
Vg1 =-7.3V
Ra~ =5.2kΩ
Ia
Vi
dtot
d3
d2
Ig2
Wa (W)


7Z06289-5.12.hd
I (mA)
d (%)
Vi (Vrms)
Va = 250 V
Vg2 = 250 V
Vg1 = −8.4 V
Ra~ = 7 kΩ
Vi
Ia
dtot
d3
Ig2
d2
Wo (W)


7Z06288-5.12.hd
I (mA)
Vi (Vrms) d(%)
Ia
2x EL 84 (B)
Va = 250 V
Vg2 = 250 V
Vg1 = −11.6 V
Raa~ = 8 kΩ
Vi
Ig2
dtot
Wo (W)


7Z06282–5.12.hd
2 x EL84 (B)
$V_a$ = 300V
$V_{g2}$ = 300V
$V_{g1}$ = −14.7V
$R_{aa\sim}$ = 8kΩ
$I_a$
$V_i$
$d_{tot}$
$I_{g2}$
I (mA)
$V_i$ ($V_{rms}$)
d (%)
100
80
60
40
20
0
25
20
15
10
5
0
0
5
10
15 $W_o$ (W)


7Z06283-5.12.hd
80
I
(mA)
60
40
20
0
20
Vi
(Vrms)
d
(%)
15
10
5
0
Ia
Vi
Ig2
dtot
2xEL84 (AB)
Vb =250V
Vg2 =250V
Rk =130 Ω
Raa~ =8kΩ
0
2
4
6
8
10
Vb (W)
12


7Z06284-5.12.hd
100
I
(mA)
80
60
40
20
0
25
$V_i$
($V_{rms}$)
d
(%)
20
15
10
5
0
0
5
10
15
$W_o$ (W)
$I_a$
$V_i$
$I_{g2}$
$d_{tot}$
2xEL84(AB)
$V_a$ =300V
$V_{g2}$ =300V
$R_k$ =130Ω
$R_{aa\sim}$ =8kΩ

PHILIPS

Data handbook

Electronic components and materials

# EL84

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| 14 | 14 | 1969.01 |
| 15 | FP | 1999.03.20 |