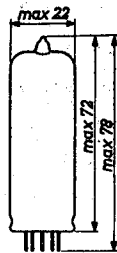
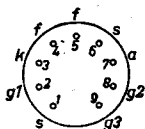
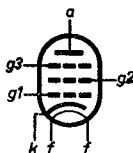


OUTPUT PENTODE for use in professional equipment (life longer than 10 000 hours)
 PENTHODE DE SORTIE pour utilisation dans l'équipement professionnel (durée plus longue que 10 000 heures)
 ENDPENTODE zur Verwendung in professionellen Anlagen (Lebensdauer länger als 10 000, Stunden)

Heating : indirect by A.C. or D.C. series or parallel supply
 Chauffage: indirect par C.A. ou C.C. alimentation série ou parallèle
 Heizung : indirect durch Wechsel- oder Gleichstrom; Serien- oder Parallelspeisung

$V_f = 6,3 \text{ V } ^1)$
 $I_f = 0,75 \text{ A } ^1)$

Dimensions in mm
 Dimensions en mm
 Abmessungen in mm



Base, culot, Sockel: Noval

Capacitances
 Capacités
 Kapazitäten

$C_a = 7,0 \pm 0,5 \text{ pF}$
 $C_{g1} = 11,5 \pm 0,7 \text{ pF}$
 $C_{g1} < 0,1 \text{ pF}$
 $C_{g1f} < 0,25 \text{ pF}$
 $C_{kf} = 7,0 \text{ pF}$

¹⁾ See page 2
 Voir page 2
 Siehe Seite 2

SPECIAL QUALITY, LONG LIFE, SHOCK AND VIBRATION RESISTANT
OUTPUT PENTODE

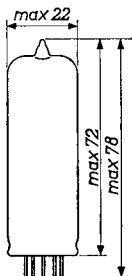
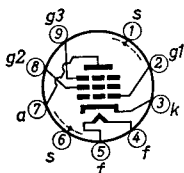
HEATING

Indirect by A.C. or D.C.; series or parallel supply

Heater voltage $V_f = 6.3 \text{ V}$

Heater current $I_f = 0.7 \text{ A}$

Dimensions in mm



Base: NOVAL with gold plated pins

CHARACTERISTICS

Column I: Setting of the tube and typical (average) measuring results of new tubes

II: Characteristics range values for equipment design

III: Data indicating the end point of life

Capacitances

Grid No.1 to all other elements except anode

	I	II
C_{g_1}	= 10.0	9.2-10.8 pF

Anode to all other elements except grid No.1

C_a	= 6.8	6.3- 7.3 pF
-------	-------	-------------

Anode to grid No.1

C_{ag_1}	=	< 0.15 pF
------------	---	-----------

Grid No.1 to heater

C_{g_1f}	=	< 0.25 pF
------------	---	-----------

Cathode to heater

C_{kf}	= 7.0	pF
----------	-------	----

Heater current

	I	II	III
Heater voltage	$V_f = 6.3$		V
Heater current	$I_f = 0.7$	0.665-0.735	0.665-0.735 A

- 1) In order to obtain a useful tube life of 10 000 hours in the case of parallel supply, the maximum variation of V_f should be less than $\pm 5\%$ (absolute limits).

In order to obtain a useful tube life of 10 000 hours in the case of series supply, the maximum variation of I_f due to voltage fluctuations and tolerances in the parts should be less than $\pm 1.5\%$ (absolute limits).

Afin d'obtenir une durée du tube de 10 000 heures en cas d'alimentation - parallèle la variation max. de V_f sera de moins de $\pm 5\%$ (limites absolues). Afin d'obtenir une durée du tube de 10 000 heures en cas d'alimentation - série la variation max. de I_f par suite de fluctuations de la tension et de tolérances des accessoires sera de moins de $\pm 1,5\%$ (limites absolues).

Zur Erhaltung einer nützlichen Lebensdauer der Röhre von 10 000 Stunden bei Parallelbetrieb soll die max. Schwankung von V_f weniger als $\pm 5\%$ betragen (absolute Grenzen).

Zur Erhaltung einer nützlichen Lebensdauer der Röhre von 10 000 Stunden bei Serienbetrieb soll die max. Schwankung von I_f infolge Spannungsschwankungen und Streuungen der Einzelteile weniger als $\pm 1,5\%$ betragen (absolute Grenzen).

- 2) The end point of life is reached when one or more of these characteristics have changed to the following values:

Le tube est arrivé à la fin de sa durée si une ou quelques-unes de ces caractéristiques sont changées jusqu'aux valeurs suivantes:

Das Ende der Lebensdauer ist erreicht, wenn eine oder mehrere dieser Kennwerte bis folgende Werte geändert sind:

$$I_a \leq 21 \text{ mA}$$

$$I_{g2} \leq 2,0 \text{ mA}$$

$$S \leq 6,0 \text{ mA/V}$$

$$-I_{g1} \geq 1 \text{ }\mu\text{A}$$

CHARACTERISTICS (continued)

<u>Typical characteristics</u>		I	II	III
Anode supply voltage	$V_{ba} = 204.5$			V
Grid No.3 voltage	$V_{g3} = 0$			V
Grid No.2 supply voltage	$V_{bg2} = 204.5$			V
Cathode resistor	$R_k = 130$			Ω
Anode current	$I_a = 30$		26.5-33.5	21 mA
Grid No.2 current	$I_{g2} = 4.1$		2.7- 5.5	2.0 mA
Mutual conductance	$S = 9.0$		7.4-10.6	6.0 mA/V

Output power

		I	II	III
Anode voltage	$V_a = 200$			V
Grid No.3 voltage	$V_{g3} = 0$			V
Grid No.2 voltage	$V_{g2} = 200$			V
Anode current	$I_a = 30$			mA
Load resistance	$R_{a\sim} = 7$			k Ω
Output power	$W_o = 2.7$		> 2.0	W

Negative grid current

		I	II	III
Anode supply voltage	$V_{ba} = 204.5$			V
Grid No.3 voltage	$V_{g3} = 0$			V
Grid No.2 supply voltage	$V_{bg2} = 204.5$			V
Cathode resistor	$R_k = 130$			Ω
Grid No.1 resistor	$R_{g1} = 0.5$			M Ω
Negative grid No.1 current	$-I_{g1} =$		< 0.5	1.0 μ A

Cut-off voltage

		I	II	III
Anode voltage	$V_a = 200$			V
Grid No.3 voltage	$V_{g3} = 0$			V
Grid No.2 voltage	$V_{g2} = 200$			V
Grid No.1 voltage	$V_{g1} = -14$			V
Anode current	$I_a =$		< 0.2	mA

Operating characteristics for use as output tube
 Caractéristiques d'utilisation comme tube de sortie
 Betriebsdaten als Endröhre

Va	=	200	250 V
Vg3	=	0	0 V
Vg2	=	200	- V
Vbg2	=	-	250 V
Rg2	=	-	1 kΩ
Rk	=	130	270 Ω
-I _{g1}	= max.	0,5 ²)	- μA
I _a (V _i =0)	=	30±3,5 ²)	24 mA
I _{g2} (V _i =0)	=	4,1±1,4 ²)	3,3 mA
S	=	9,0±1,6 ²)	- mA/V
R _i	=	90	- kΩ
u _{g2g1}	=	21,5	-
W _o	{ Ra ~ = 7 kΩ dtot = 10 % }	=	2,7 - W
W _o	{ Ra ~ = 10 kΩ dtot = 10 % }	=	- 2,8 W
-V _{g1} (I _{g1} = +0,3 μA)	= max.	1,3	- V
I _a (V _{g1} = -14 V)	= max.	0,2	- mA

Hum voltage
 Tension de ronflement { R_{g1} = 1 MΩ } V_{g1} = max. 250 μV
 Brummspannung { f = 50 c/s }

Insulation k-f (V_{kf} = 120 V) R_{kf} = min. 5 MΩ
 Isolation k-f

Shock and vibration. The tube can withstand vibrations of 2.5 g and 50 c/s lasting up to 96 hours and can likewise withstand impact accelerations of about 500 g (measured with the N.R.L. impact machine for electronic devices, lifting the hammer over an angle of 30°).

Chocs et vibrations. Le tube peut résister à des vibrations de 2,5 g et de 50 c/s pendant 96 heures et à une accélération par choc d'environ 500 g (mesurée avec la machine N.R.L. à percussion pour des dispositifs électroniques, en élevant le marteau d'un angle de 30°).

Stöße und Schwingungen. Die Röhre kann Schwingungen von 2,5 g bei 50 Hz während 96 Stunden aushalten und kann eine Stossbeschleunigung von etwa 500 g vertragen (gemessen mit der N.R.L. Stössmaschine für elektronische Vorrichtungen wobei der Hammer über einen Winkel von 30° gehoben wird).

2) See page 2; voir page 2; Siehe Seite 2

CHARACTERISTICS (continued)Hum voltage

		I	II	III
Anode voltage	V_a	= 200		V
Grid No.3 voltage	V_{g3}	= 0		V
Grid No.2 voltage	V_{g2}	= 200		V
Cathode resistor	R_k	= 130		Ω
Anode resistor	R_a	= 1		k Ω
Hum voltage	V_{g1hum}	=	< 0.25	mV ¹⁾

Insulation between heater and cathode

		I	II	III
Voltage between heater and cathode (cathode positive)	$V_{kf}(k \text{ pos.})$	= 120		V
Series resistor	R	= 1		M Ω
Current from cathode to heater	I_{kf}	=	< 15	20 μ A

Insulation between the electrodes

		I	II	III
Voltage between two arbitrary electrodes	V	= 300		V ²⁾
Insulation resistance	R_{isol}	=	> 50	10 M Ω

LIFE EXPECTANCY: 10 000 hours under the following life-test conditions:

Heater voltage	V_f	= 6.3 V
Anode voltage	V_a	= 200 V
Grid No.3 voltage	V_{g3}	= 0 V
Grid No.2 voltage	V_{g2}	= 200 V
Cathode resistor	R_k	= 130 Ω
Voltage between cathode and heater (cathode positive)	$V_{kf}(k \text{ pos.})$	= 120 V

The data indicating the end point of life are given in column III under the heading "Characteristics".

¹⁾ Hum voltage referred to grid No.1, measured with straight response filter. Frequency of heater supply voltage 50 c/s. Centre tap of heater transformer grounded.

²⁾ When measured between the cathode and another electrode, the cathode should be positive

Operating characteristics class AB, two tubes
 Caractéristiques d'utilisation classe AB, deux tubes
 Betriebsdaten Klasse AB, zwei Röhren

$V_a =$	200		250	V
$V_{g2} =$	200		250	V
$V_{g3} =$	0		0	V
$R_k =$	130		150	Ω
$R_{aa} =$	9		9 k Ω	
$V_i =$	0	0,31	5,2	
			0	0,32
			7,8	V_{eff}
$I_a =$	2x20,6	-	2x24,6	2x23,5
				-
				2x29,5 mA
$I_{g2} =$	2x 2,8	-	2x 4,9	2x 3,2
				-
				2x 6,6 mA
$W_o =$	-	0,05	5,7	-
				0,05
				9,0 W
$d_{tot} =$	-	-	3,0	-
				-
				4,5 %

Limiting values (absolute values)

Caractéristiques limites (valeurs absolues)

Grenzdaten (absolute Werte)

V_{a0}	= max.	600 V
V_a	= max.	300 V
W_a	= max.	8 W
V_{g20}	= max.	600 V
V_{g2}	= max.	300 V
W_{g2}	= max.	2,6 W
$-V_{g1}$	= max.	100 V
$-V_{g3}$	= max.	100 V
I_k	= max.	50 mA
V_{kf}	= max.	120 V
R_{kf}	= max.	20 k Ω ³⁾
R_{g1}	= max.	1 M Ω ⁴⁾

Bulb temperature

Température de l'ampoule = max. 225 °C

Kolbentemperatur

³⁾ For stable operation it is advisable to restrict R_{kf} to values < 20 k Ω

Afin d'obtenir une opération stable il est recommandable de limiter R_{kf} à des valeurs < 20 k Ω

Zur Erhaltung einer stabilen Wirkung ist es empfehlenswert R_{kf} auf Werte < 20 k Ω zu beschränken

⁴⁾ With automatic grid bias

Avec polarisation automatique

Mit automatischer Gittervorspannung

CHARACTERISTICS (continued)SHOCK RESISTANCE: about 500 g²)

Forces as applied by the NRL impact machine for electronic devices caused by 5 blows of the hammer lifted over an angle of 30° in each of four different positions of the tube.

VIBRATION RESISTANCE: 2.5 g²)

Vibrational forces for a period of 32 hours at a frequency of 50 c/s in each of three directions

OPERATING CHARACTERISTICS for use as output tube

Anode voltage	V_a	=	200	250 V
Grid No.3 voltage	V_{g3}	=	0	0 V
Grid No.2 voltage	V_{g2}	=	200	250 V
Grid No.2 resistor	R_{g2}	=	-	1 kΩ
Cathode resistor	R_k	=	130	270 Ω
Anode current	I_a	=	30	24 mA
Grid No.2 current	I_{g2}	=	4.1	3.3 mA
Mutual conductance	S	=	9	- mA/V
Internal resistance	R_i	=	52	- kΩ
Amplification factor of grid No.2 with respect to grid No.1	μ_{g2g1}	=	21.5	-
Load resistance	$R_{a\sim}$	=	7	10 kΩ
Output power	W_o	=	2.7	2.8 W
Total distortion	d_{tot}	=	10	10 %

OPERATING CHARACTERISTICS class AB, two tubes

Anode voltage	V_a	=	200	V
Grid No.3 voltage	V_{g3}	=	0	V
Grid No.2 voltage	V_{g2}	=	200	V
Cathode resistor	R_k	=	130	Ω
Load resistance	$R_{aa\sim}$	=	9	kΩ
Input voltage	V_1	=	0 0.31	5.2 V(RMS)
Anode current	I_a	=	2x20.6	- 2x24.6 mA
Grid No.2 current	I_{g2}	=	2x 2.8	- 2x 4.9 mA
Output power	W_o	=	0 0.05	5.7 W
Total distortion	d_{tot}	=	-	- 3.0 %

²) See page 3

OPERATING CHARACTERISTICS class AB, two tubes (continued)

Anode voltage	V_a	=	250	V
Grid No.3 voltage	V_{g3}	=	0	V
Grid No.2 voltage	V_{g2}	=	250	V
Cathode resistor	R_k	=	150	Ω
Load resistance	R_{aa}	=	9	k Ω
Input voltage	V_i	=	0 0.32	7.8 V(RMS)
Anode current	I_a	=	2x23.5	- 2x29.5 mA
Grid No.2 current	I_{g2}	=	2x 3.2	- 2x 6.6 mA
Output power	W_o	=	0 0.05	9.0 W
Total distortion	d_{tot}	=	-	- 4.5 %

LIMITING VALUES (Absolute limits)

Anode voltage in cold condition	V_{a0}	= max.	600 V
Anode voltage	V_a	= max.	300 V
Anode dissipation	W_a	= max.	8 W
Negative grid No.3 voltage	$-V_{g3}$	= max.	100 V
Grid No.2 voltage in cold condition	V_{g20}	= max.	600 V
Grid No.2 voltage	V_{g2}	= max.	300 V
Grid No.2 dissipation	W_{g2}	= max.	2.6 W
Negative grid No.1 voltage	$-V_{g1}$	= max.	100 V
Cathode current	I_k	= max.	50 mA
Voltage between heater and cathode	V_{kf}	= max.	120 V
Heater voltage in case of parallel supply	V_f	=	6.3 V \pm 5 %
Heater current in case of series supply	I_f	=	0.7 A \pm 1.5 %
Bulb temperature	t_{bulb}	=	225 $^{\circ}$ C

LIMITING VALUES FOR CIRCUIT DESIGN

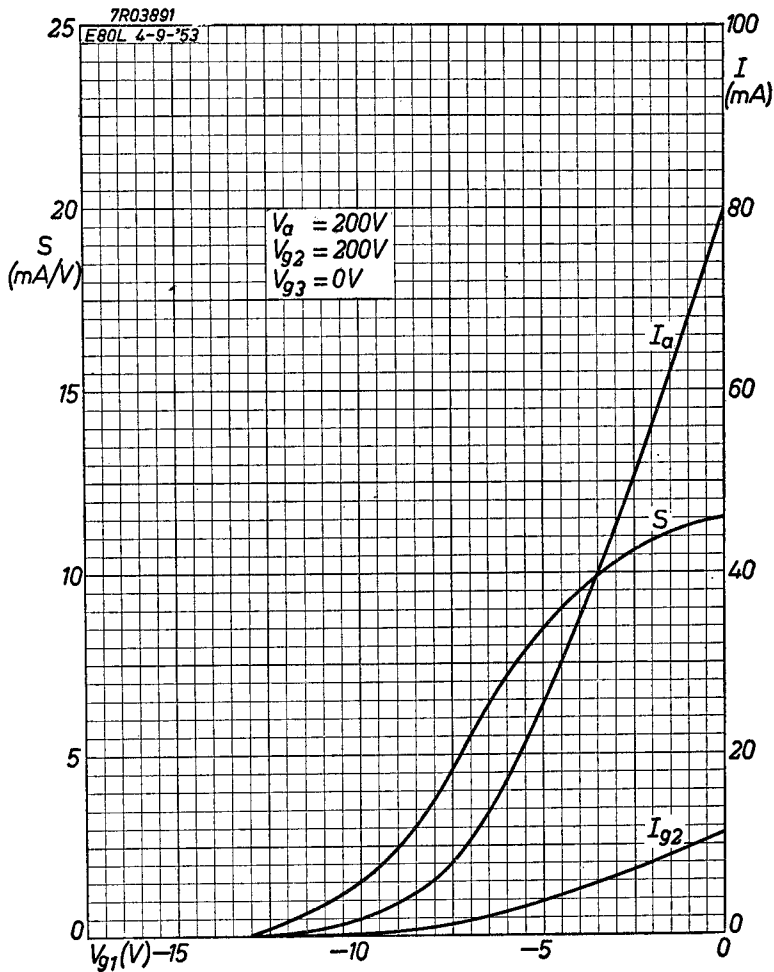
Grid No.1 circuit resistance in case of automatic bias	R_{g1}	= max.	1 M Ω
Circuit resistance between cathode and heater	R_{kf}	= max.	20 k Ω

¹⁾ These test conditions are only given for evaluation of the ruggedness of the tube and should by no means be interpreted as suitable operating conditions

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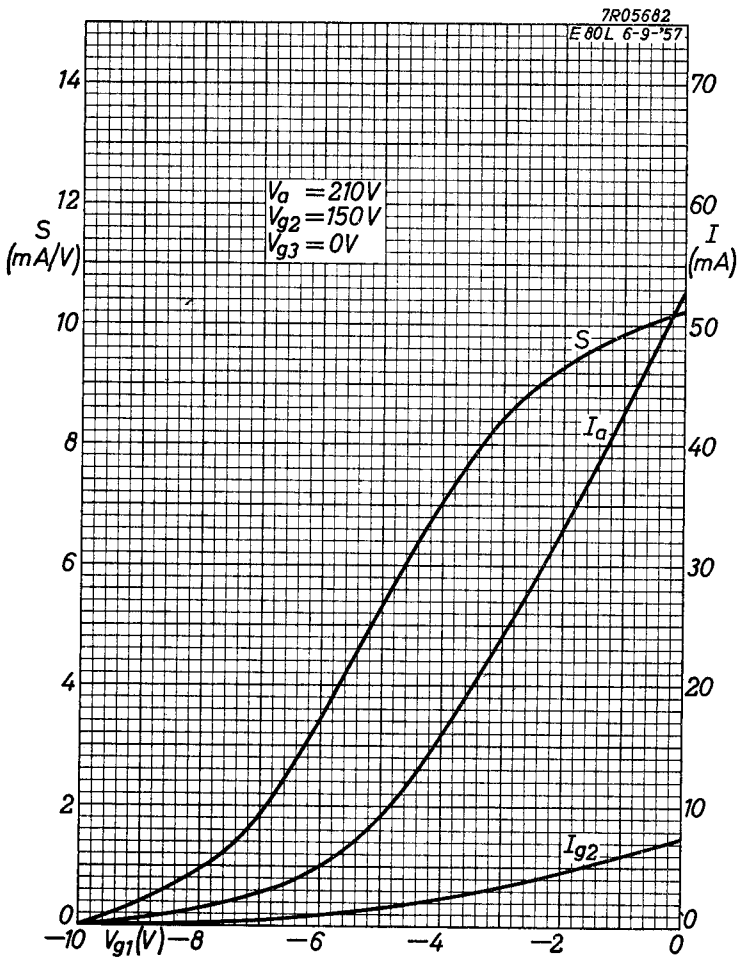
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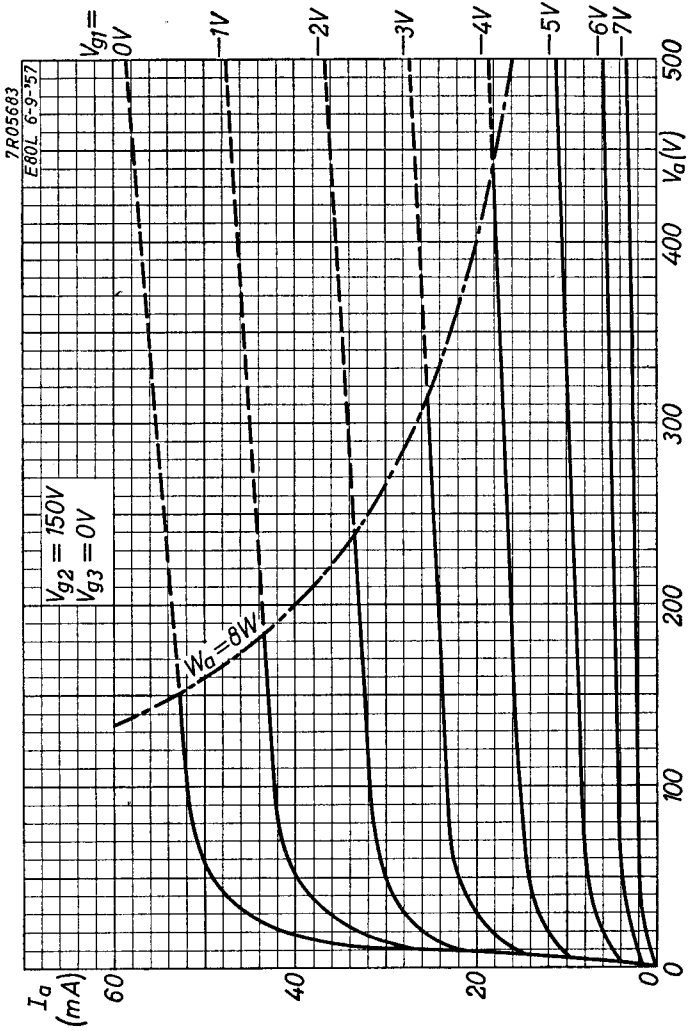


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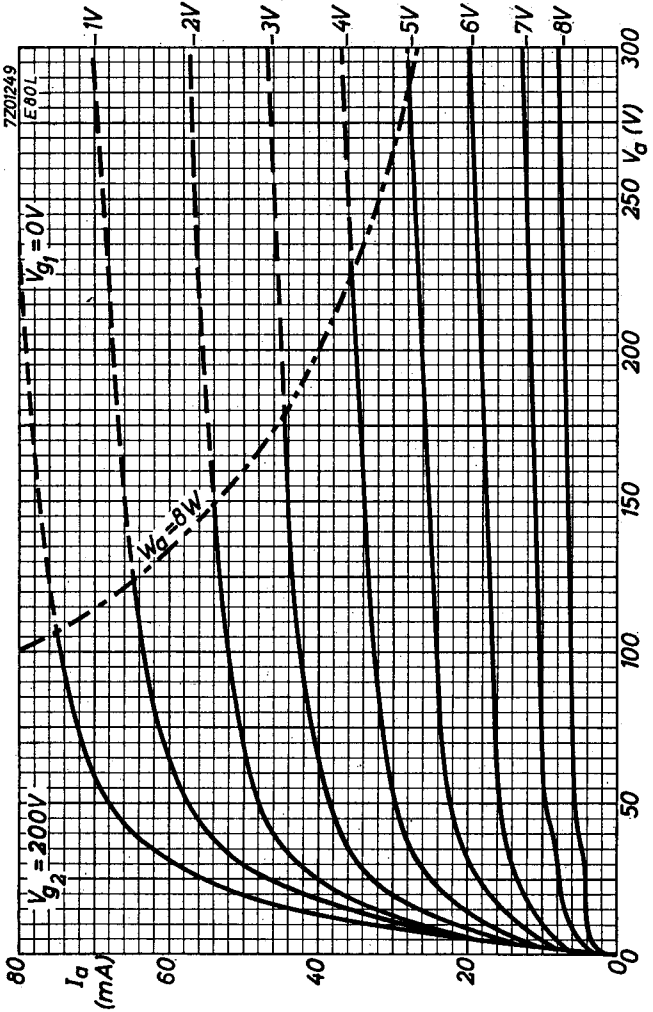
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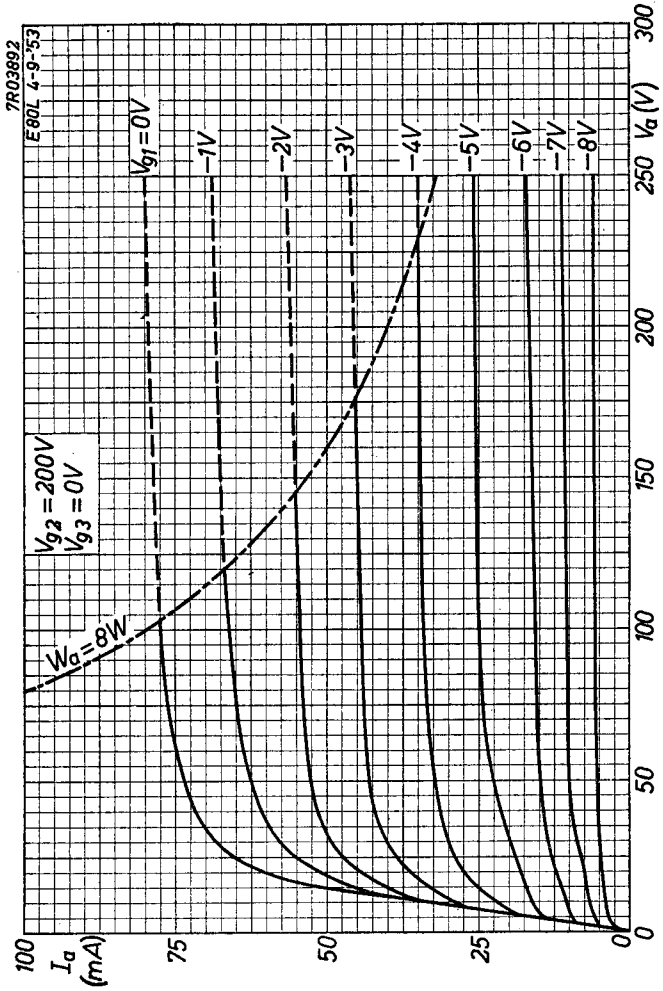
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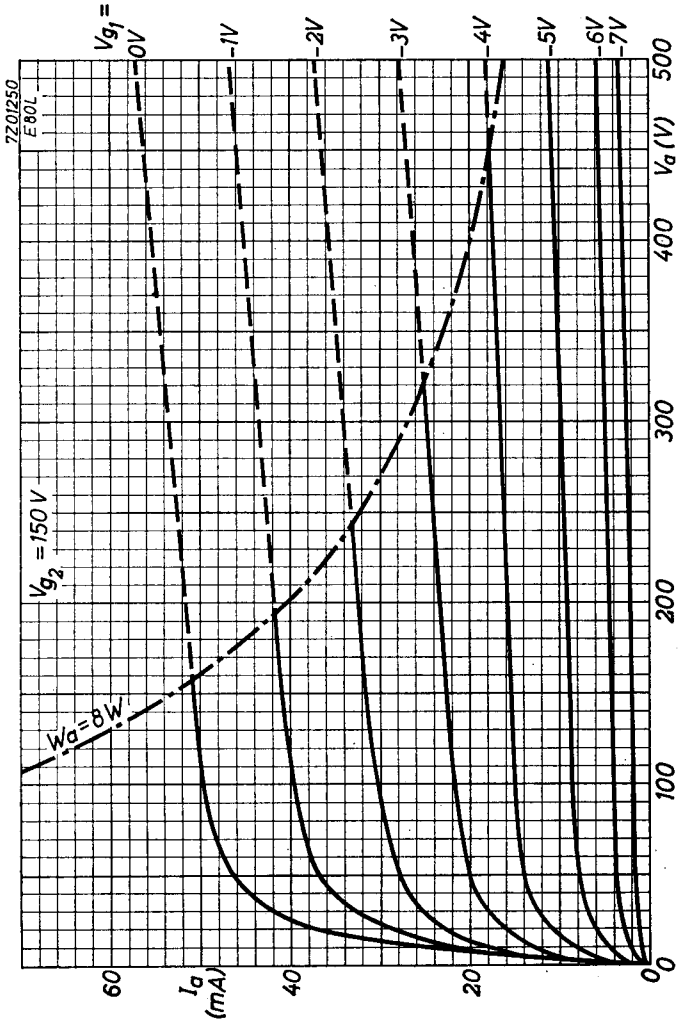


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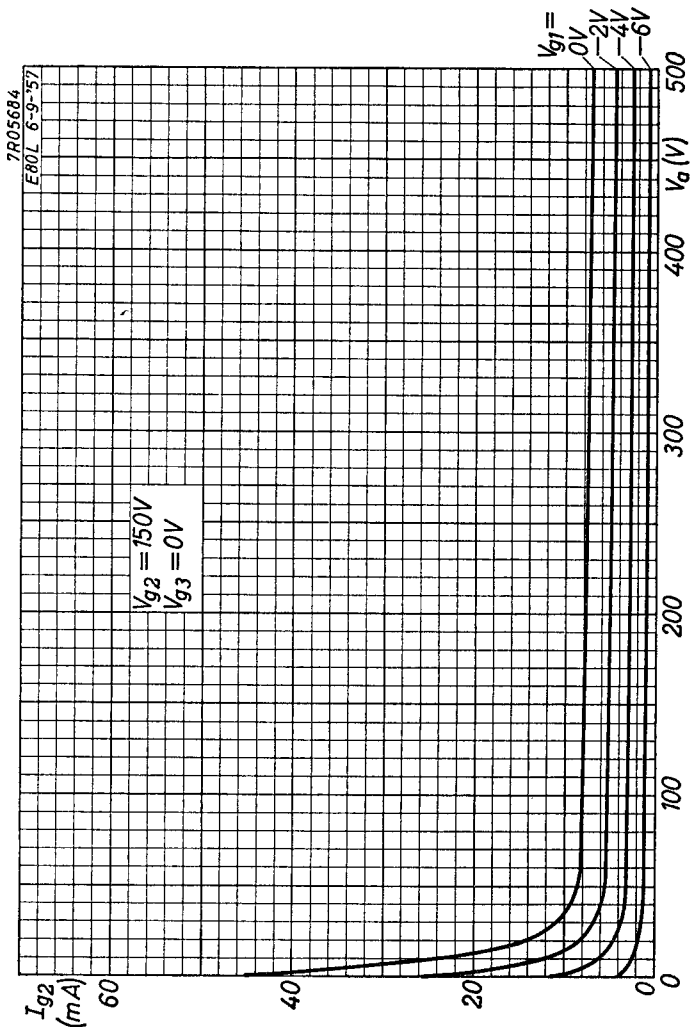


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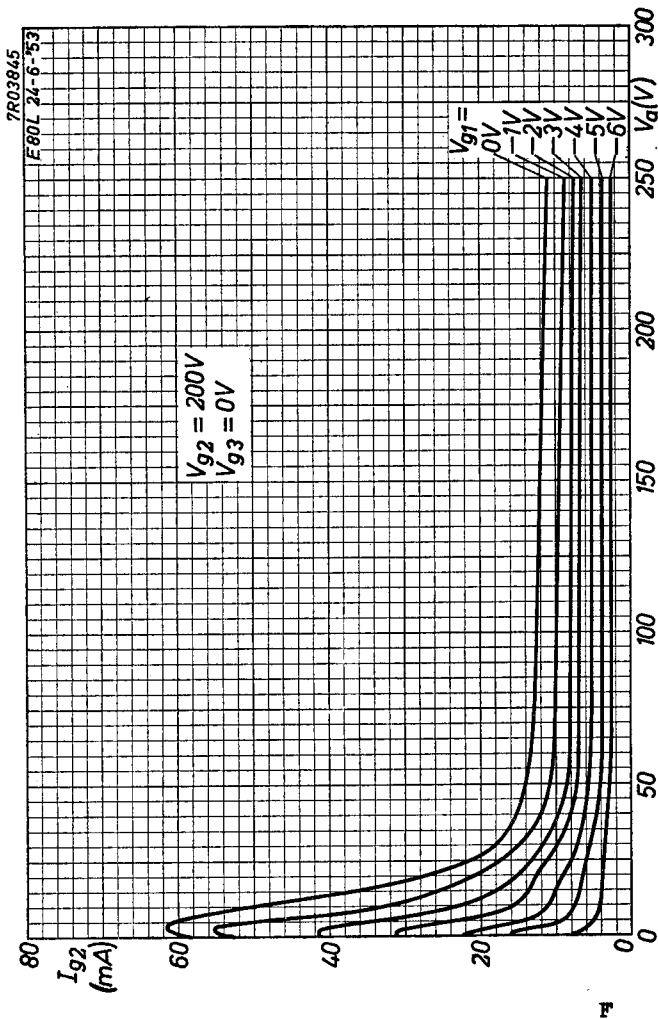


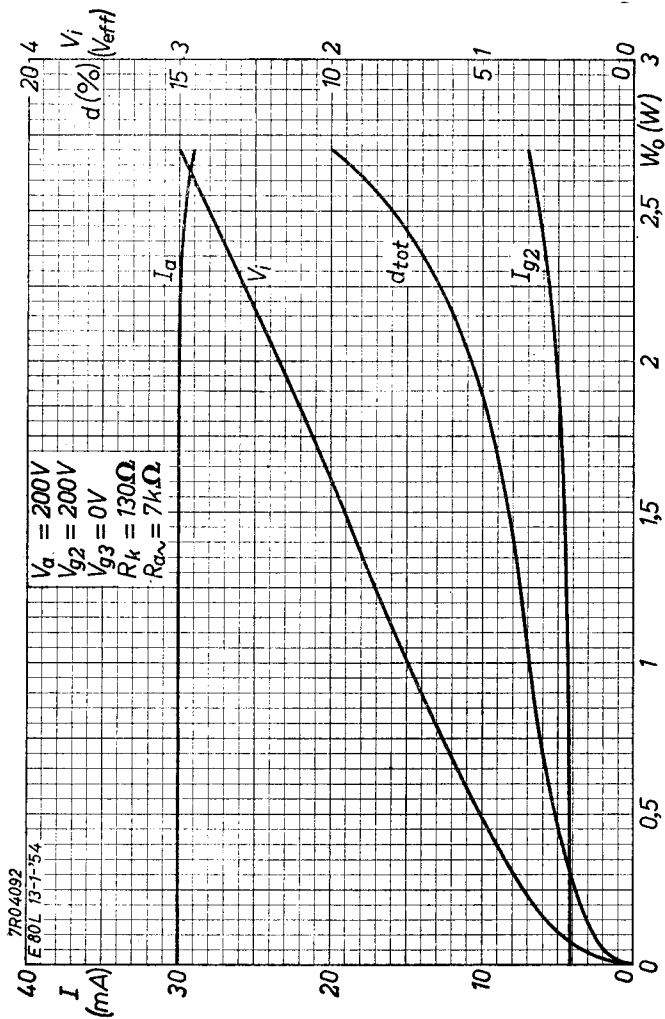
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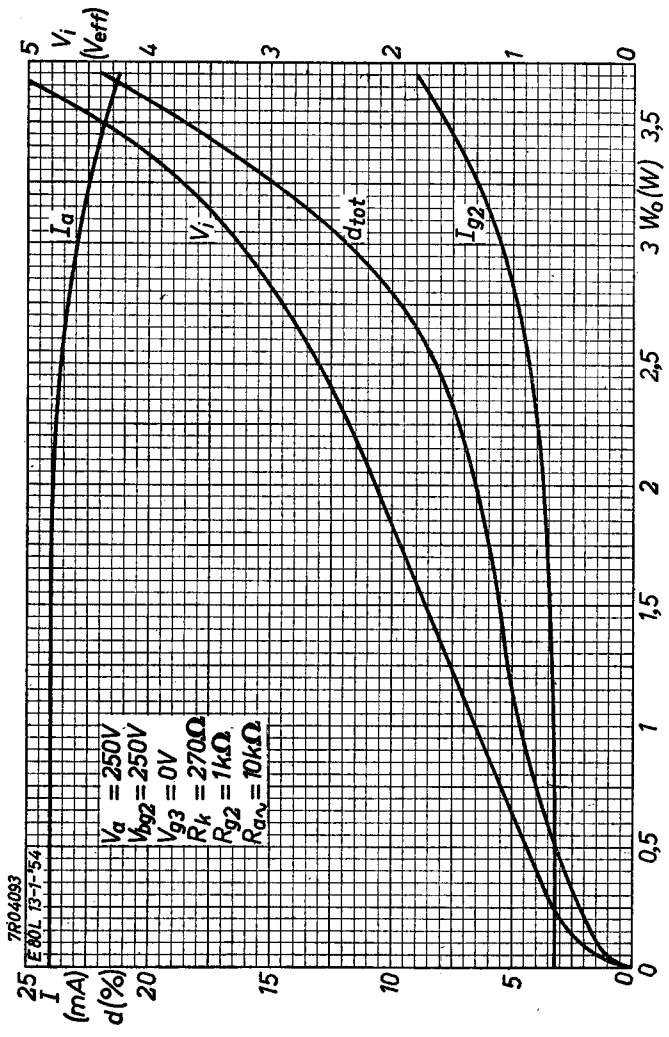
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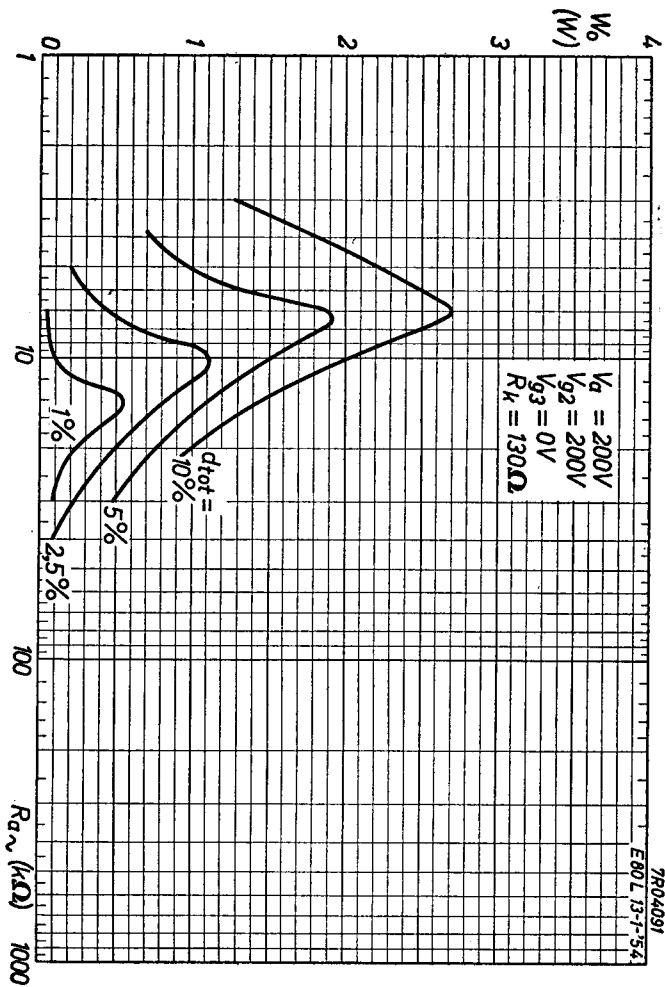
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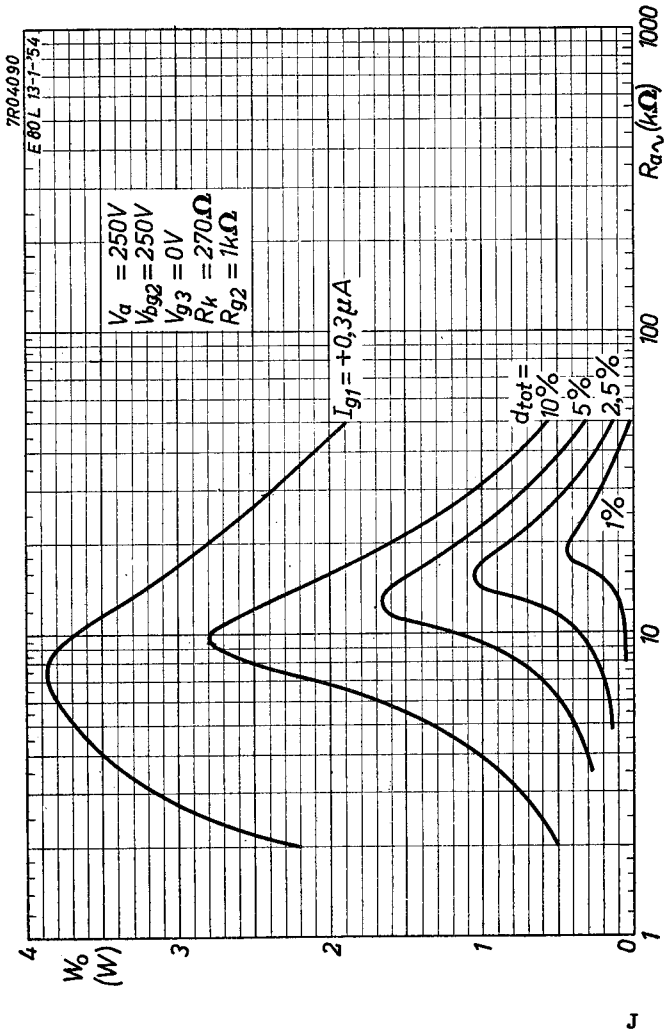
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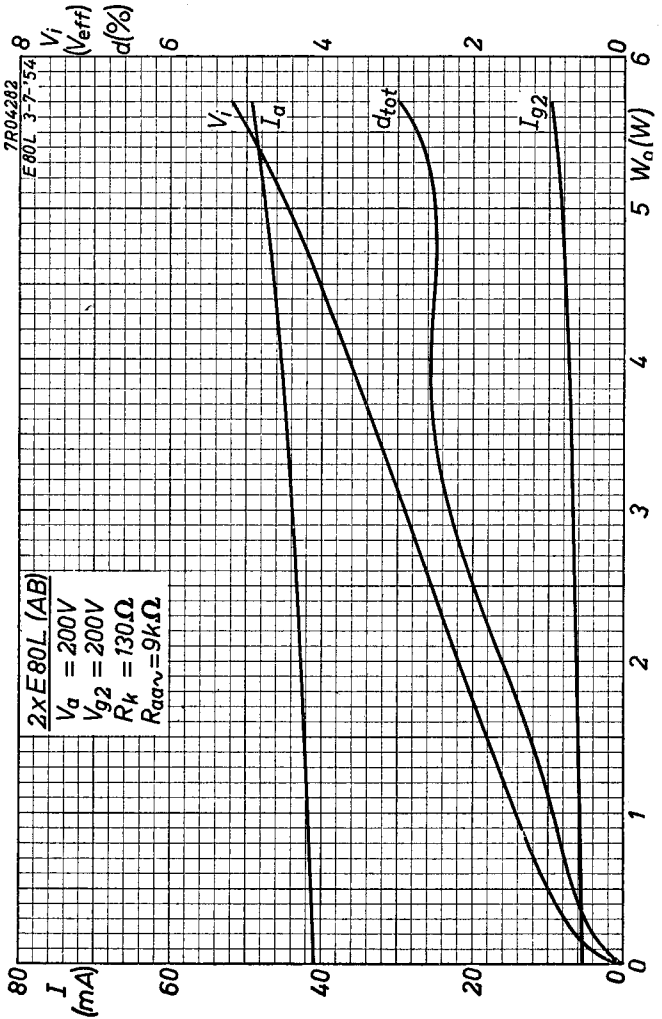
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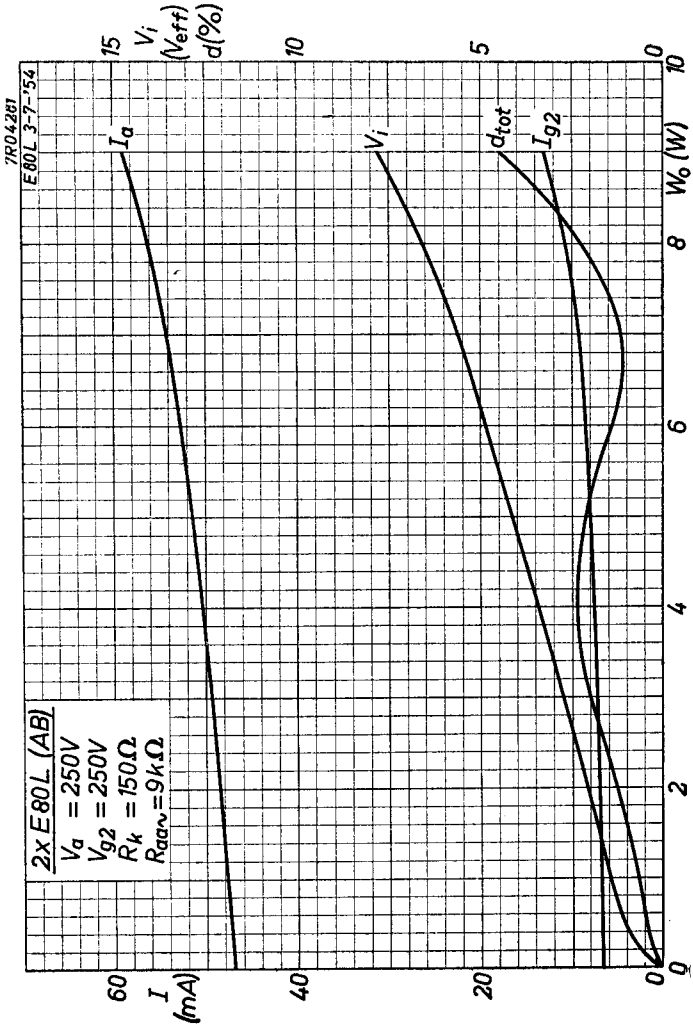
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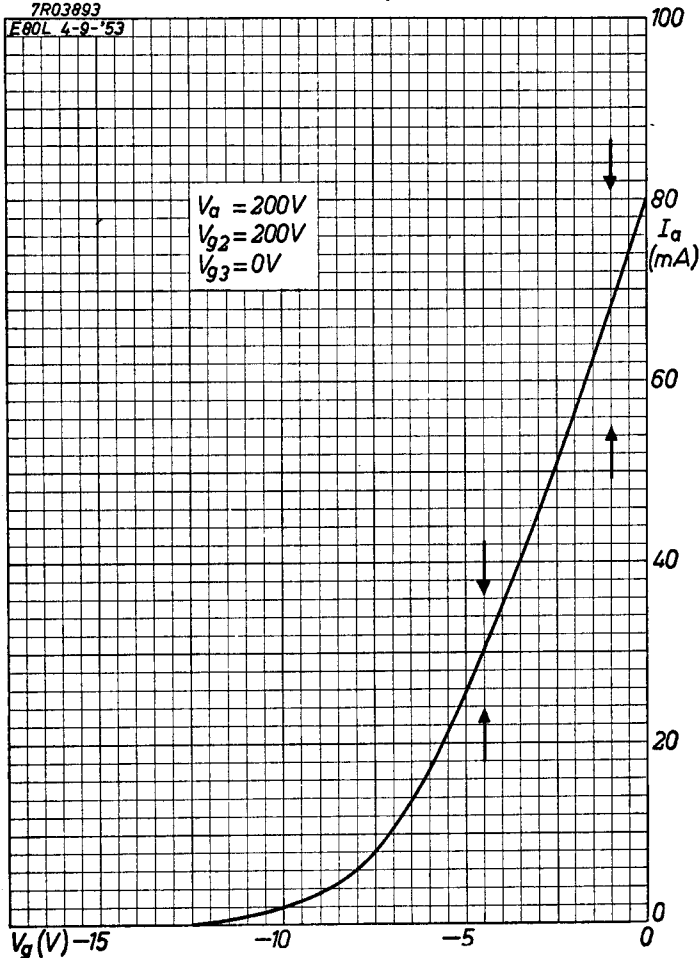


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Upper and lower current limits are indicated by arrows
Les limites supérieures et inférieures du courant sont indiquées par des flèches
Die oberen und unteren Stromgrenzen sind mittels Pfeile angegeben

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*Electronic
Tube*

HANDBOOK

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