

SQ**PHILIPS****E88CC**

SPECIAL QUALITY, LONG LIFE, SHOCK AND VIBRATION RESISTANT
DOUBLE TRIODE with high mutual conductance and low noise
for use in cascode circuits, R.F. or I.F. amplifiers, mixer
or phase inverter stages or as multivibrator or cathode
follower in computers

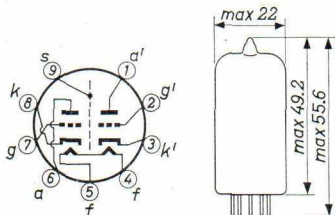
The E88CC has separate cathodes and will maintain its emis-
sion capabilities after long periods of operation under
cut-off conditions

HEATING

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

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

Heater current $I_f = 300 \text{ mA}$



Base: NOVAL with gold plated pins
(Dimensions in mm)

CHARACTERISTICS

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

Column II: Characteristics range values for equipment
design

Column III: Data indicating the end of life

Heater current

	I	II	III
Heater voltage	$V_f = 6.3$		V
Heater current	$I_f = 300$	285-315	285-315 mA

Capacitances (without external shield)

	I	II
Anode to all other elements except grid	$C_a(k+f+s) = 1.75$	1.55-1.95 pF
	$C_a(k'+f+s) = 1.65$	1.45-1.85 pF
Anode to cathode and heater	$C_a(k+f) = 0.5$	0.4-0.6 pF
	$C_a(k'+f) = 0.4$	0.3-0.5 pF

CHARACTERISTICS (continued)

Capacitances (continued)

		I	II
→ Grid to all other elements except anode	$C_{g(k+f+s)} = 3.3$	2.7-3.9	pF
	$C_{g'(k'+f+s)} = 3.3$	2.7-3.9	pF
→ Grid to cathode and heater	$C_{g(k+f)} = 3.3$	2.7-3.9	pF
	$C_{g'(k'+f)} = 3.3$	2.7-3.9	pF
Anode to grid	$C_{ag} = 1.4$	1.2-1.6	pF
	$C_{a'g'} = 1.4$	1.2-1.6	pF
Anode to all other elements except cathode	$C_{a(g+f+s)} = 3.0$	2.7-3.3	pF
	$C_{a'(g'+f+s)} = 2.9$	2.6-3.2	pF
Cathode to all other elements except anode	$C_{k(g+f+s)} = 6.0$	5.1-6.9	pF
	$C_{k'(g'+f+s)} = 6.0$	5.1-6.9	pF
Anode to cathode	$C_{ak} = 0.18$	0.14-0.22	pF
	$C_{a'k'} = 0.18$	0.14-0.22	pF
Anode to screen	$C_{as} = 1.3$	1.1-1.5	pF
	$C_{a's} = 1.3$	1.1-1.5	pF
Cathode to heater	$C_{kf} = 2.6$		pF
	$C_{k'f} = 2.7$		pF
→ Anode to anode of other section	$C_{aa'} = 0.025$	< 0.045	pF
Grid to grid of other section	$C_{gg'} =$	< 0.005	pF
Anode to grid of other section	$C_{ag'} =$	< 0.005	pF
	$C_{a'g} =$	< 0.005	pF
Grid to cathode of other section	$C_{gk'} =$	< 0.005	pF
	$C_{g'k} =$	< 0.005	pF

CHARACTERISTICS (continued)

Typical characteristics

	I	II	III
Anode supply voltage V_{ba}	= 100		V ¹⁾
Grid supply voltage V_{bg}	= +9		V ¹⁾
Cathode resistor R_k	= 680		Ω ¹⁾
Anode current I_a	= 15	14.2-15.8	13.5 mA
Mutual conductance S	= 12.5	10.5-15	9 mA/V
Amplification factor μ	= 33		
Grid current starting point V_g	= 0.75		V(RMS) ²⁾
Equivalent noise resistance R_{eq}	= 300		Ω ³⁾
Noise factor F	= 4.6		dB ⁴⁾
Input damping at $f = 100$ Mc/s r_g	= 3		k Ω

	I	II	III
Anode supply voltage V_{ba}	= 90		V
Cathode resistor R_k	= 120		Ω
Anode current I_a	= 12		mA
Mutual conductance S	= 11.5		mA/V

Hum voltage (referred to grid)

Measured with straight response curve filter; frequency of heater supply voltage 50 c/s + 3% 500 c/s; tubeholder fully screened

	I	II	III
Anode supply voltage V_{ba}	= 90		V
Anode current I_a	= 15		mA
Cathode resistor R_k	= 80		Ω
Cathode capacitor C_k	= 1000		μ F
Grid resistor R_g	= 0.5		M Ω
Hum voltage V_{ghum}		< 50	μ V

¹⁾ Operation of the tube under these conditions is recommended because of the small spread in characteristics

²⁾ A.C. input voltage for start of grid current
($I_g = + 0.3 \mu A$)

³⁾ Measured at $f = 45$ Mc/s

⁴⁾ Measured in a cascode circuit matched for minimum noise at $f = 200$ Mc/s

CHARACTERISTICS (continued)Negative grid current

	I	II	III
Anode voltage	$V_a = 90$		V
Anode current	$I_a = 15$		mA
Grid resistor	$R_g = 0.1$		MΩ
Negative grid current	$-I_g =$	< 0.1	$1.0 \mu A$

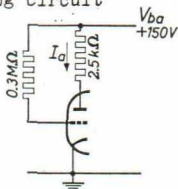
Typical characteristics for computer circuits

	I	II	III
Anode supply voltage	$V_{ba} = 150$		V ¹⁾
Anode current	$I_a = 33$	28-38	mA ²⁾

	I	II	III
Anode supply voltage	$V_{ba} = 60$		V ¹⁾
Anode current	$I_a =$	> 9	mA

	I	II	III
Anode supply voltage	$V_{ba} = V_{ba}' = 150$		V
Anode current	$I_a = I_{a}' = 0.1$		mA
Negative grid voltage	$-V_g = -V_g' = 6.5$	5.0-8.5	V
Unbalance	$ V_g - V_g' =$	< 2	2 V

	I	II	III
Anode supply voltage	$V_a = 150$		V
Grid voltage	$V_g = -15$		V
Anode current	$I_a =$	< 5	μA

¹⁾ Measuring circuit²⁾ Measuring time max. 1 sec.

CHARACTERISTICS (continued)Heater to cathode insulation

		I	II	III
Heater voltage	V_f	= 6.3		V
Voltage between heater and cathode (cathode negative)	V_{kf}	= 60		V
Heater to cathode current	I_{kf}	=	< 6	12 μ A

		I	II	III
Heater voltage	V_f	= 6.3		V
Voltage between heater and cathode (cathode positive)	V_{kf}	= 120		V
Cathode to heater current	I_{kf}	=	< 6	12 μ A

Insulation between two arbitrary electrodes

When measured between an electrode and cathode, the cathode should be positive

		I	II	III
Voltage	V	= 200		V
Insulation resistance	R_{isol}	=	> 100	20 M Ω

SHOCK RESISTANCE: about 500 g ¹⁾

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 g ¹⁾

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

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

Heater voltage	V_f	= 6.3 V
Anode supply voltage	$V_{ba} = V_{ba}'$	= 100 V
Grid supply voltage	$V_{bg} = V_{bg}'$	= +9 V
Cathode resistor	$R_k = R_k'$	= 680 Ω
Grid resistor	$R_g = R_g'$	= 47 k Ω
Voltage between cathode and heater (cathode negative)	$V_{kf} = V_{kf}'$	= 60 V

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

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

OPERATING CHARACTERISTICS AS OUTPUT TUBE CLASS A

Anode voltage	V_a	=	220	V
Load resistance	$R_{a\sim}$	=	20	k Ω
Grid bias	V_g	=	-6.5	V
Input voltage	V_i	=	0 1.5 4.5	V(RMS)
Anode current	I_a	=	6.5 - 9.2	mA
Output power	W_o	=	0 0.05 0.5	W
Total distortion	d_{tot}	=	- - 7	%

OPERATING CHARACTERISTICS AS PUSH-PULL OUTPUT TUBE CLASS B
(sinusoidal input voltage)

Anode voltage	V_a	=	200	V
Load resistance	$R_{aa\sim}$	=	22	k Ω
Grid bias	V_g	=	-6	V
Input voltage	V_i	=	0 0.9 4.0	V(RMS)
Anode current	I_a	=	2x5.0 - 2x9	mA
Output power	W_o	=	0 0.05 1.2	W
Total distortion	d_{tot}	=	- - 3	%

OPERATING CHARACTERISTICS AS PUSH-PULL OUTPUT TUBE CLASS B
(speech and music signals)

These values have been measured with sinusoidal input voltage. With full drive, however, the maximum permissible anode dissipation is exceeded. Therefore, operation with a sinusoidal input voltage is not allowed in this setting. When, however, the tube is operated with normal speech and music signals, the RMS-value of the input voltage will generally be less than 4 V so that in this case no overload of the tube will occur

Anode voltage	V_a	=	200	V
Load resistance	$R_{aa\sim}$	=	10	k Ω
Grid bias	V_g	=	-6	V
Input voltage	V_i	=	0 0.9 4.0	V(RMS)
Anode current	I_a	=	2x5.0 - 2x13.5	mA
Output power	W_o	=	0 0.05 1.5	W
Total distortion	d_{tot}	=	- - 4	%

OPERATING CHARACTERISTICS AS ADDITIVE MIXER

Anode supply voltage	V_{ba}	= 60	90	150 V
Anode resistor	R_a	= 0	1	3.9 k Ω
Grid resistor	R_g	= 1	1	1 M Ω
Oscillator voltage	V_{osc}	= 2.0	2.5	3.0 V(RMS)
Anode current	I_a	= 4.7	7.7	11 mA
Conversion conductance	S_c	= 2.9	3.5	4.1 mA/V
Internal resistance	R_i	= 8.3	7.0	6.1 k Ω

LIMITING VALUES (Design centre limits; each section)

Anode voltage in cold condition	V_{a0}	= max.	550 V
Anode voltage when anode current = 0 mA	$V_a(I_a = 0)$	= max.	400 V
Anode voltage	V_a	= max.	220 V
Anode voltage when anode dissipation < 0.8 W	$V_a(W_a < 0.8 \text{ W})$	= max.	250 V
Anode dissipation	W_a	= max.	1.5 W
Anode dissipation	W_a	= max.	1.8 W ¹⁾
Grid dissipation	W_g	= max.	0.03 W
Negative grid voltage	$-V_g$	= max.	100 V
Peak negative grid voltage	$-V_{gp}$	= max.	200 V ²⁾
Cathode current	I_k	= max.	20 mA
Peak cathode current	I_{kp}	= max.	100 mA ²⁾
Heater to cathode voltage			
cathode positive	V_{kf}	= max.	150 V
cathode negative	V_{kf}	= max.	100 V
Heater voltage	V_f	= 6.3 V $\pm$ 5 % ³⁾	
Bulb temperature	t_{bulb}	= max.	170 °C ³⁾

MAX. CIRCUIT VALUES

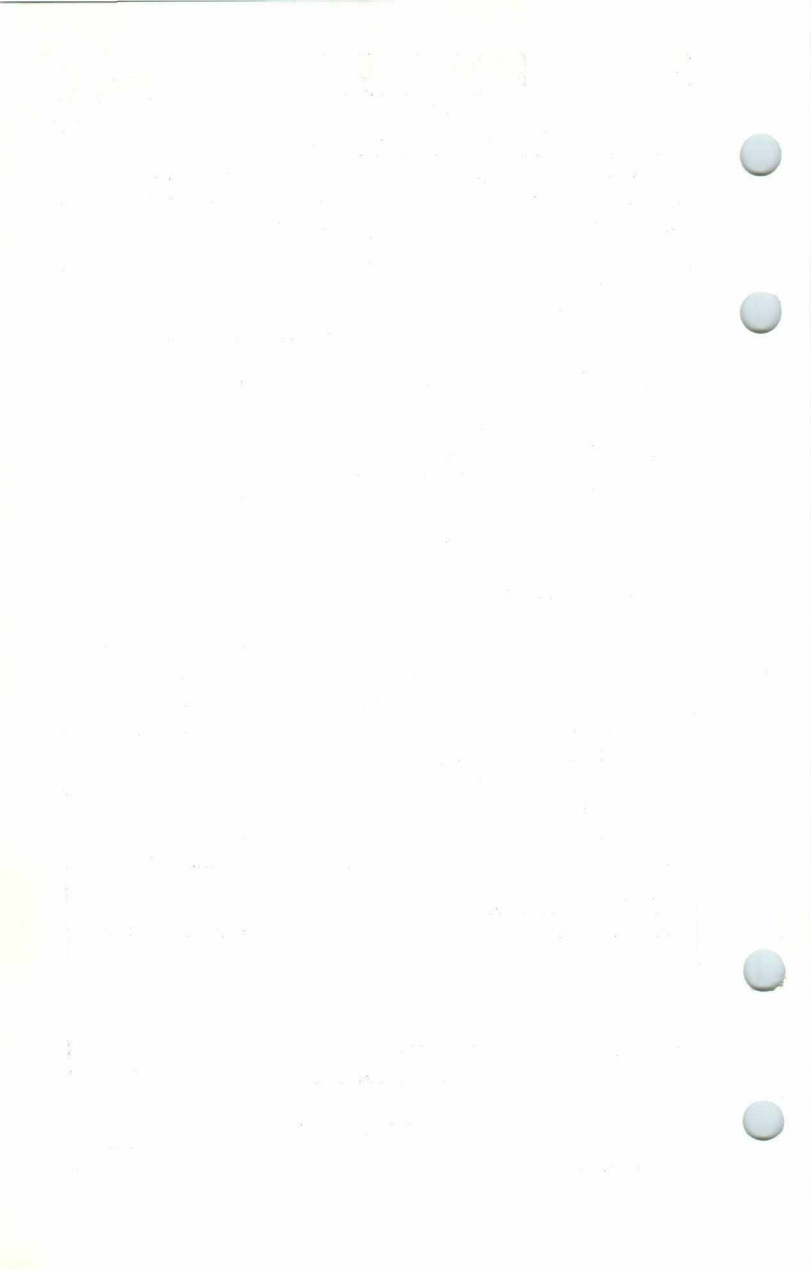
Grid resistor	R_g	= max.	1 M Ω ⁴⁾
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¹⁾ When $W_a + W_a'$ is less than 2 W

²⁾ Pulse duration max. 200 μ sec, duty factor max. 10 %

³⁾ Absolute limits

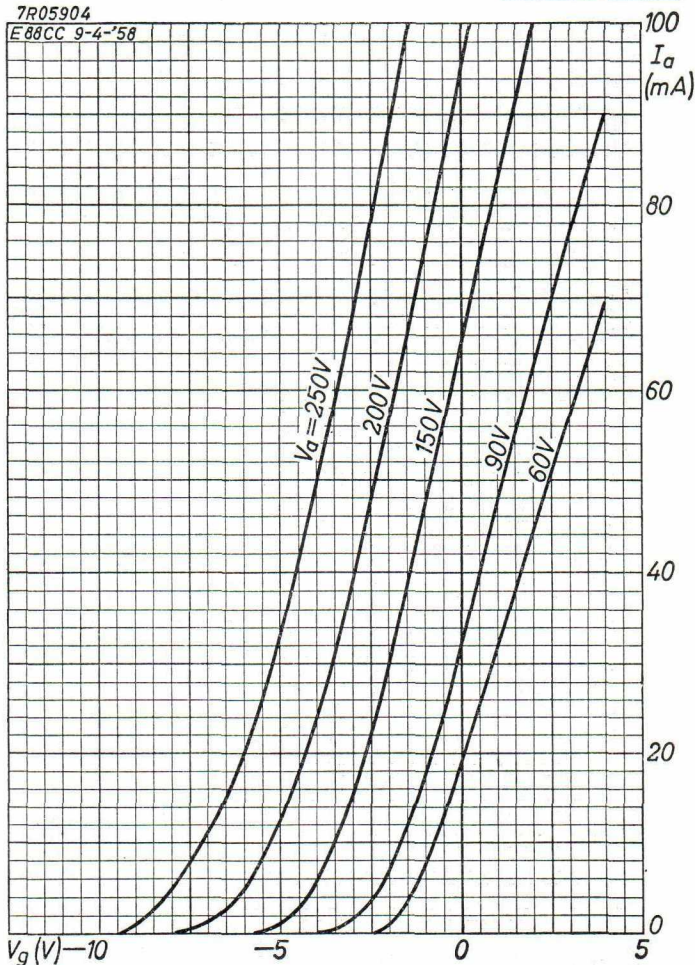
⁴⁾ Fixed bias is only permitted when $I_a < 5$ mA



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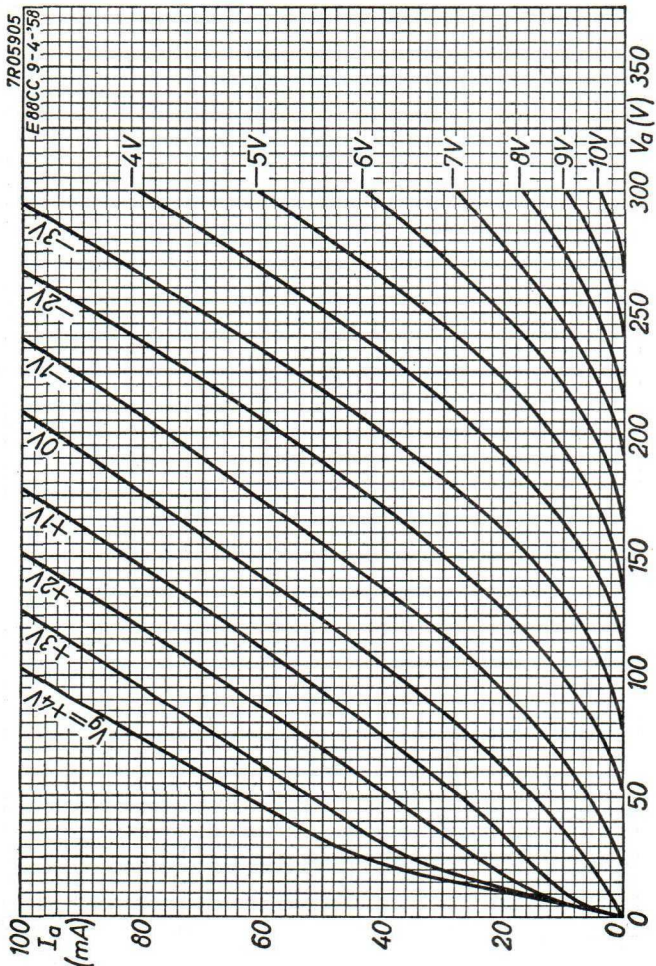
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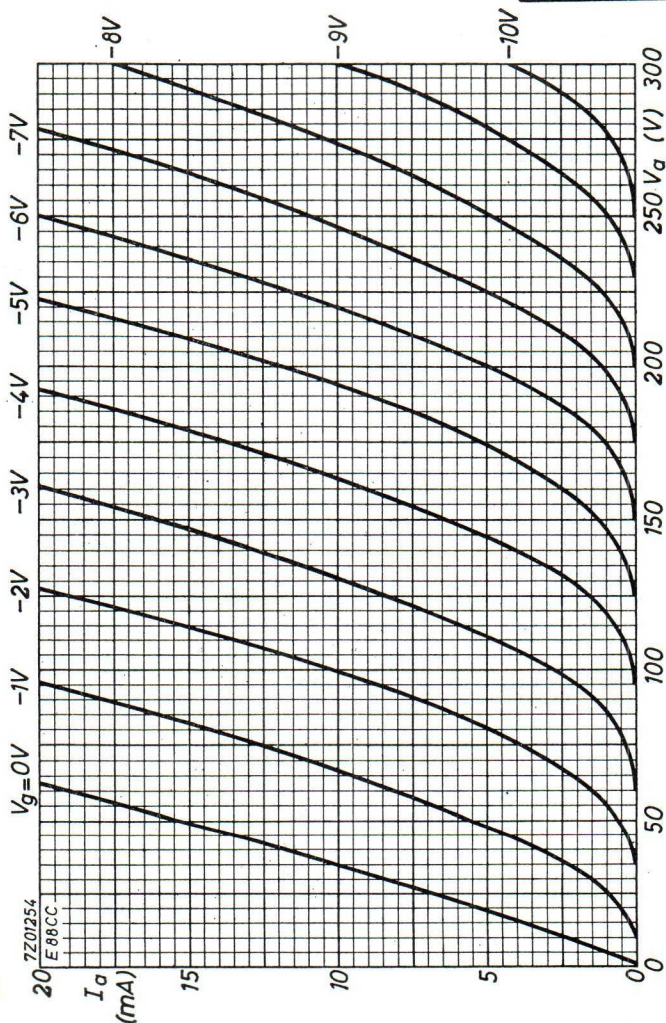
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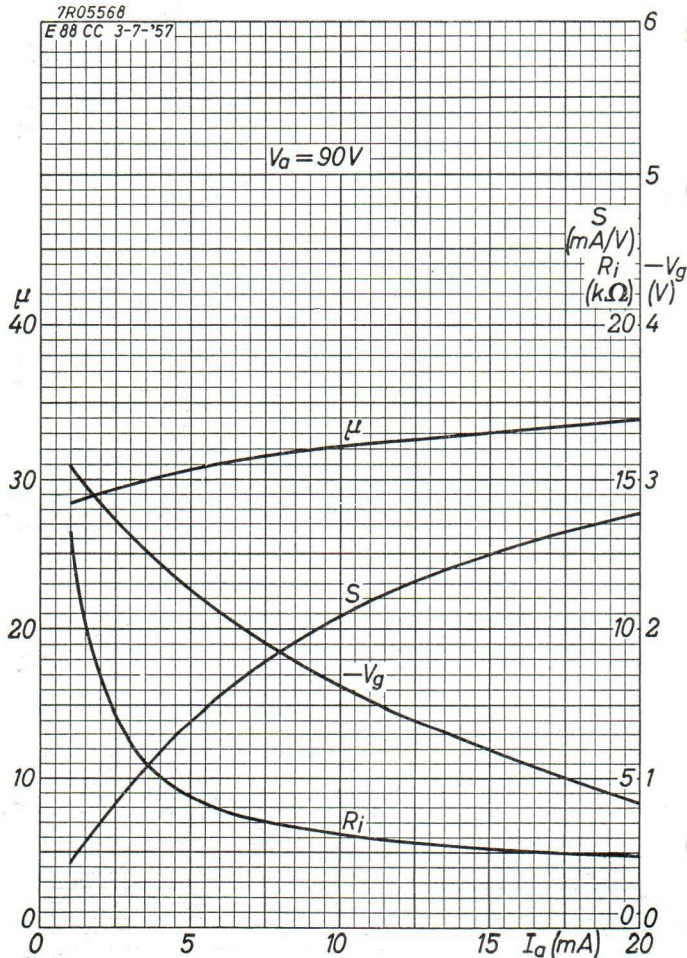
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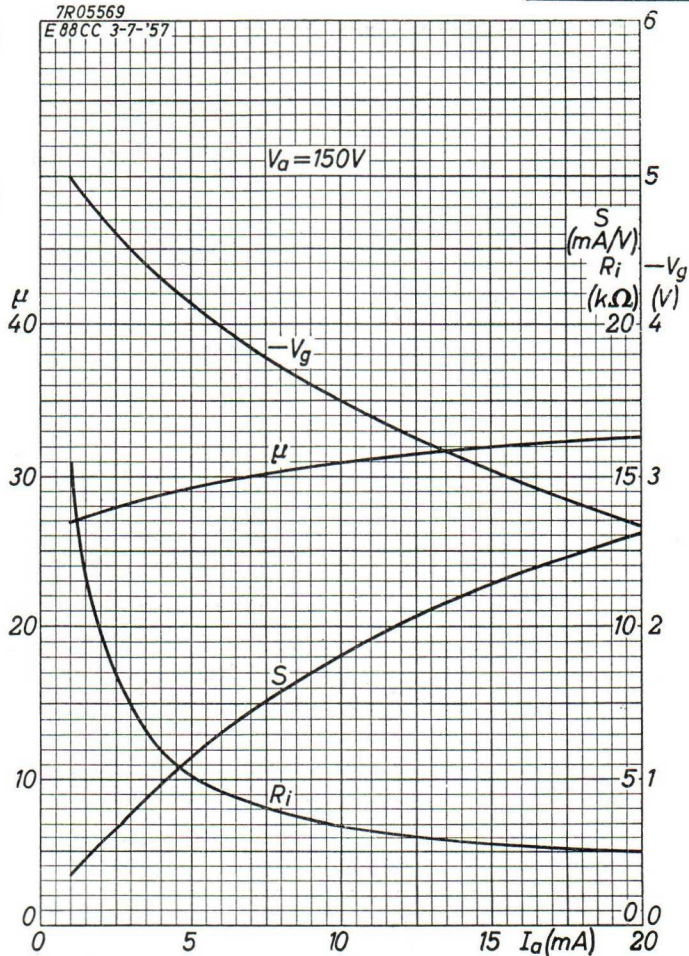
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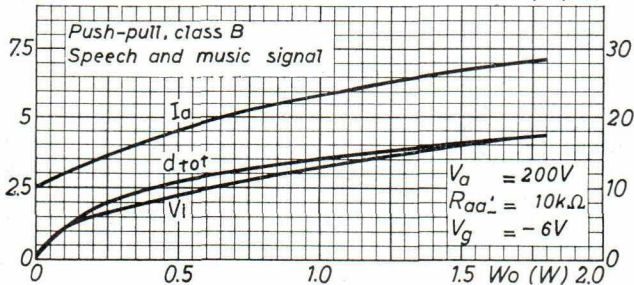
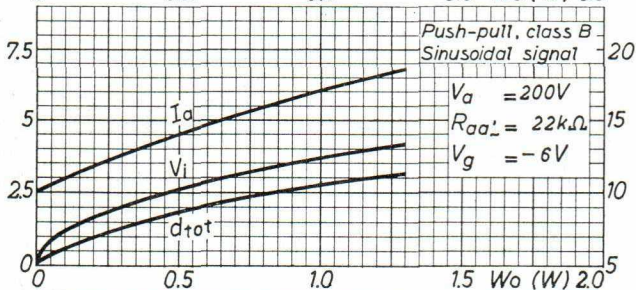
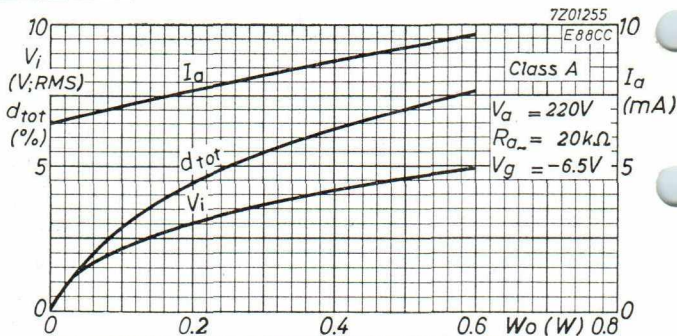
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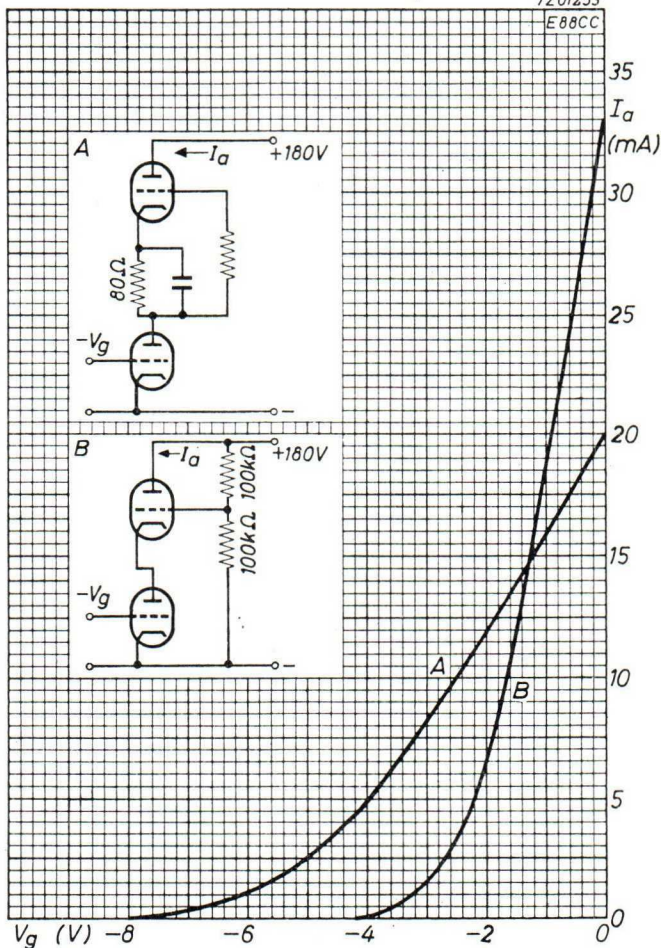
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