RF BROADBAND PENTODE 7721

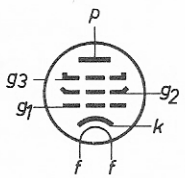
Design and Application

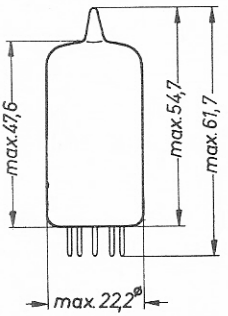
The 7721 is a miniature pentode designed for rf broadband amplifiers in telecommunication systems. It is also useful in low-noise input stages, frequency multipliers, and pulse and distributed amplifiers.

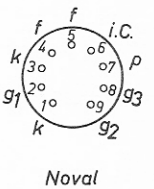
Features of the tube include low noise and high transconductance. When used in on-off control applications, the tube will maintain its emission capabilities after long periods of operation under cutoff conditions.

Quality features

Long life (the average life is more than 10,000 hours)
Reliability
Close tolerances
Cathode free from interface







Noval

Dimensions in mm

Base: Miniature button, 9 pin, E9-1
Envelope: T-6-1/2
Socket: Siemens Rel stv 99c

Weight: approx. 10 gm
Mounting position: any

Heating

Heater voltage	=	6.3	V (1)
Heater current	=	315 ± 16	mA

indirect by AC or DC, parallel supply

Capacitances

		without external shield	with external (2) shield	
Input	=	10 ± 1.0	10.1 ± 1.0	µµf
Input at a cathode current = 28 mAdc	=	17	17.1	µµf
Output	=	2.1 ± 0.3	3.3 ± 0.4	µµf
Plate to grid No. 1	≤	0.040	0.035	µµf
Plate to cathode	<	0.050		µµf
Plate to cathode, grid No. 2	=	0.32 ± 0.04		µµf
Plate to cathode, grid No. 2, grid No. 3	=	2.0 ± 0.3		µµf
Plate to heater	<	0.10		µµf
Grid No. 1 to cathode	=	6.8 ± 0.7		µµf
Grid No. 1 to cathode, grid No. 2	=	9.5 ± 1.0		µµf
Grid No. 1 to cathode, grid No. 2, grid No. 3	=	10 ± 1.0		µµf

Triode connection (grid No. 2 to plate, grid No. 3 to cathode)

Input	=	7.3	µµf
Output	=	3.1	µµf
Plate to grid No. 1	=	2.7	µµf

Triode connection (grid No. 2 and grid No. 3 to plate)

Input	=	6.7	µµf
Output	=	1	µµf
Plate to grid No. 1	=	3.3	µµf

(1) The life-guarantee provides a maximum variation of the heater voltage of less than ± 5 % (absolute limits)

(2) Internal diameter of external shield = 22.2 mm

Characteristics

		min	bogey	max	
Plate supply voltage	=		190		Vdc
Grid No. 3 voltage	=		0		Vdc
Grid No. 2 supply voltage	=		160		Vdc
Grid No. 1 supply voltage	=		+10		Vdc
Cathode resistor	=		400		ohms
Plate current	=	21	22	23	mAdc
Grid No. 2 current	=	5.4	6	6.6	mAdc
Transconductance	=	30000	35000	40000	µmhos
Amplification factor of grid No. 2 with respect to grid No. 1	≈		80		
Plate resistance	=		0.12		Meg
Equivalent grid noise resistance	=		150		ohms
Input conductance at 100 Mc	=		1000		µmhos (1)
Ratio of transconductance to the sum of input and output capacitance	=		2900		$\frac{\mu mhos}{\mu\mu f}$
Figure of merrit $S_m/2\pi$ (Cin' + Cout + 5 µµf)	=		230		Mc (2)
Noise figure	≦		7		db (3)
Negative grid current	≦			0.3	µAdc

Triode connection (Grid No. 2 to plate, grid No. 3 to cathode)

Plate supply voltage	=		160		Vdc
Grid No. 3 voltage	=		0		Vdc
Grid No. 1 supply voltage	=		+10		Vdc
Cathode resistor	=		470		ohms
Plate current	=		24		mAdc
Transconductance	=		41000		µmhos
Amplification factor	≈		77		
Plate resistance	=		1900		ohms
Equivalent grid noise resistance	=		65		ohms

When the value of cathode capacitor is greater than 10 µf, the value of the grid resistor must be greater than 1000 ohms.

(1) Measured with the two cathode connections in parallel
(2) Cin' = input capacitance during operation
(3) Measured at 100 Mc and matched for minimum noise

Maximum Ratings

Plate voltage at zero plate current	max.	400	Vdc	
Plate voltage	max.	220	Vdc	
Plate dissipation	max.	4.2	W	
Grid No. 2 voltage at zero grid No. 2 current	max.	400	Vdc	
Grid No. 2 voltage	max.	180	Vdc	
Grid No. 2 dissipation	max.	1.0	W	
Negative grid No. 1 voltage	max.	30	Vdc	
Positive grid No. 1 voltage	max.	0	Vdc	
Grid No. 1 resistor	max.	0.5	Meg	(1)
Cathode current	max.	30	mAdc	
Heater-cathode voltage				
Heater positive with respect to cathode	max.	60	V	
Heater negative with respect to cathode	max.	120	V	
Heater-cathode resistor	max.	20000	ohms	
Bulb temperature	max.	190	°C	

Special Tests and Ratings

Transconductance phase angle

Transconductance phase angle at 100 Mc	=	22	degrees

Measured with the two cathode connections in parallel

Interelectrode Resistance

Grid to all at 50 Vdc	>	200	Meg
Plate to all at 300 Vdc	>	500	Meg
Heater negative with respect to cathode at 100 Vdc	>	20	Meg
Heater positive with respect to cathode at 100 Vdc	>	20	Meg

Measuring by E_f = 6.3 V

End of life

Plate current	≤	20	mAdc
Transconductance	≥	24500	µmhos
Negative grid current	≤	1.0	µAdc

Test conditions: see characteristics for R_k = 400 ohms

(1) With automatic grid bias

Harmonic distortion

Plate supply voltage		=	190		Vdc
Grid No. 3 voltage		=	0		Vdc
Grid No. 2 supply voltage		=	160		Vdc
Grid No. 1 supply voltage		=	+10		Vdc
Cathode resistor		=	400		ohms
Plate load resistor		=	1000		ohms
Frequency		=	300		kc
Plate current		=	22		mA
Power output	P_o	=	1	120	mW (1)
Ratio between harmonic wave and plate current	q	=	-27	-6	db (2)
Power level	n_p	=	0	21	db (3)
Ratio between second harmonic and fundamental wave	a_{k2}	=	48	23	db (4)
Ratio between third harmonic and fundamental wave	a_{k3}	=	84	40	db (4)

(1) P_o = (ac component of plate current of the fundamental wave)^2 x Resistance in series with plate

(2) $q = 20 \log \frac{\text{rms value of ac component of plate current of the fundamental wave}}{\text{dc plate current in operation without signal}}$

(3) $n_p = 10 \log \frac{\text{power output of the fundamental wave}}{\text{relative value 1 mW}}$

(4) $a_{k2/3} = -20 \log \frac{\text{rms value of ac component of plate current of 2nd or 3rd harmonic}}{\text{rms value of ac component of the plate current of the fundamental wave}}$

Characteristics

$I_b, I_{c2} = f(E_{c1})$ $\quad I_b, I_{c2} = f(E_b)$

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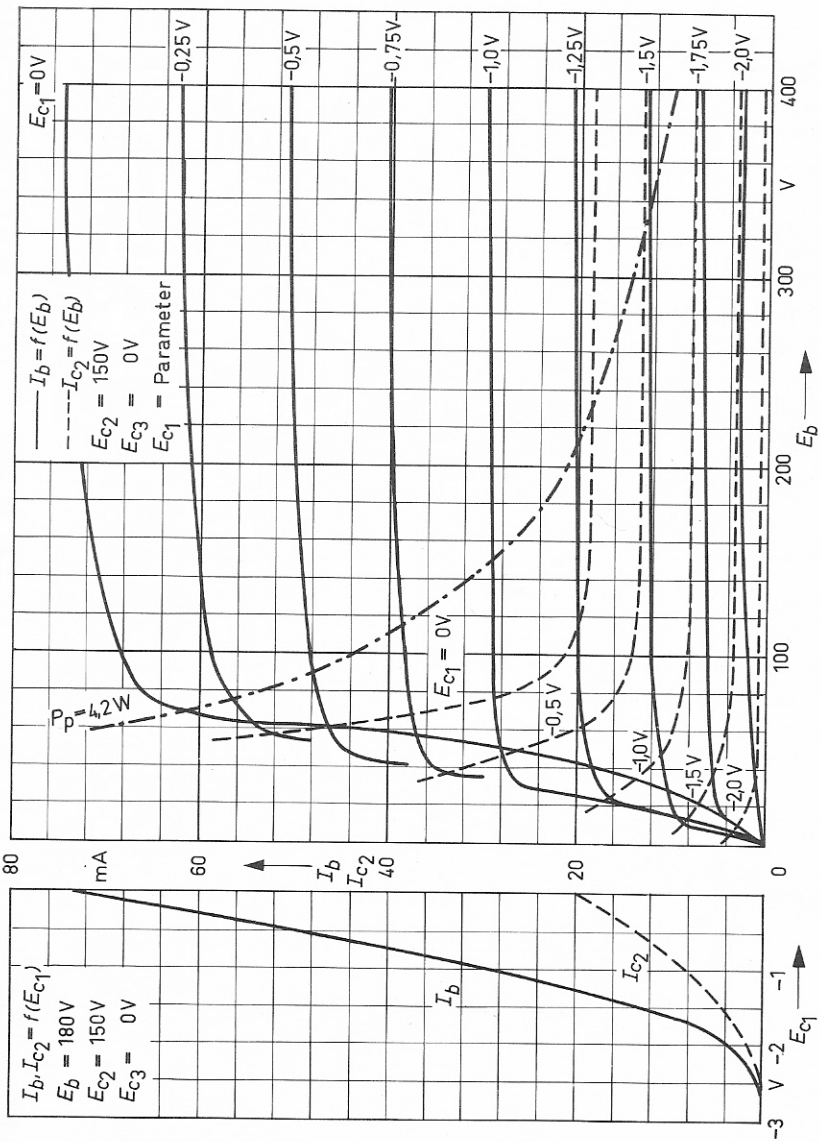
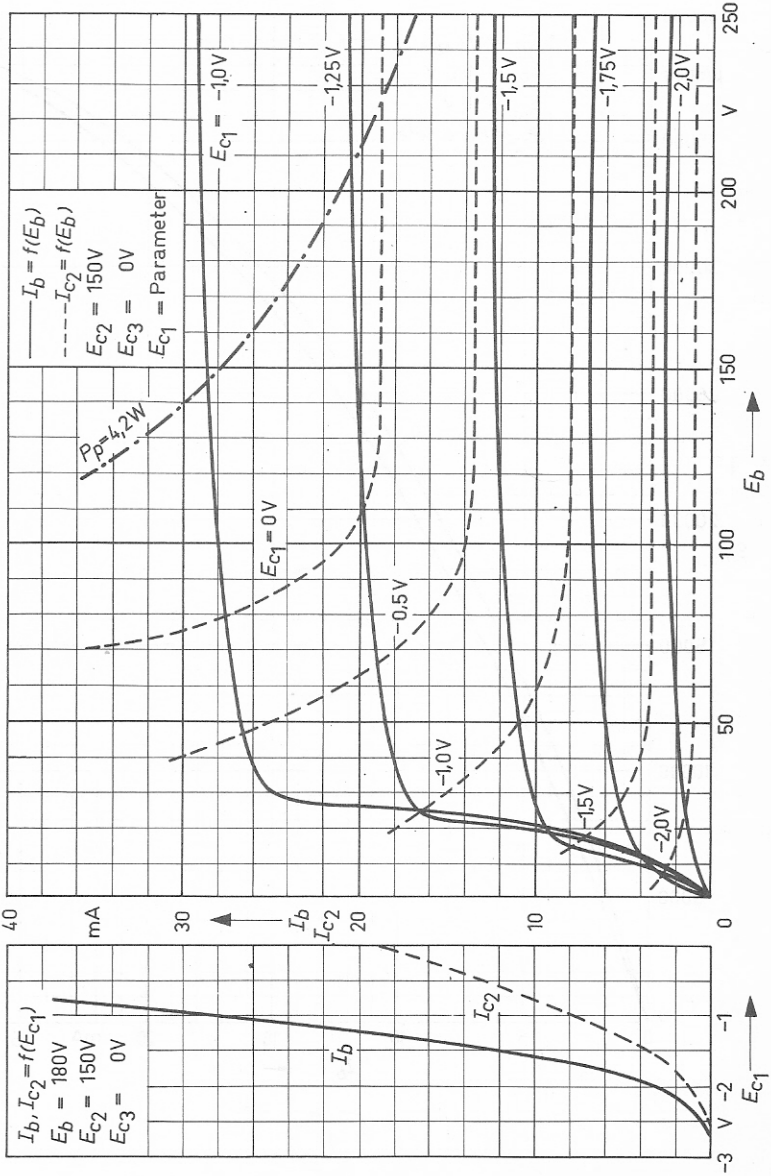
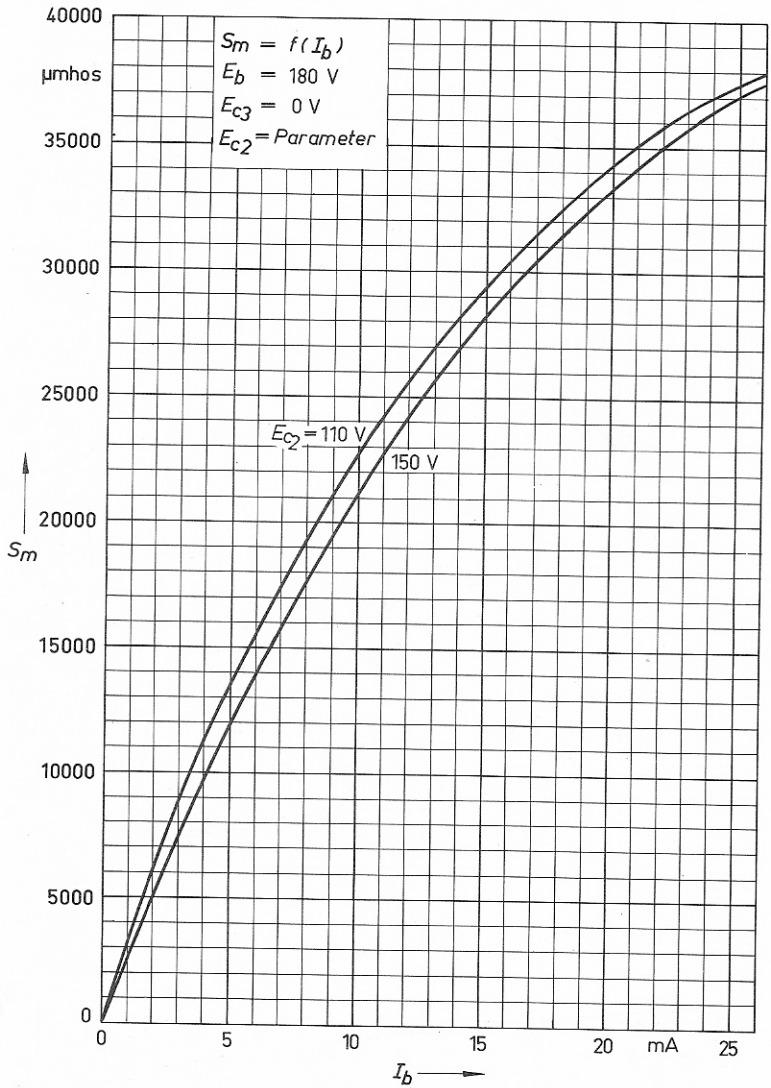
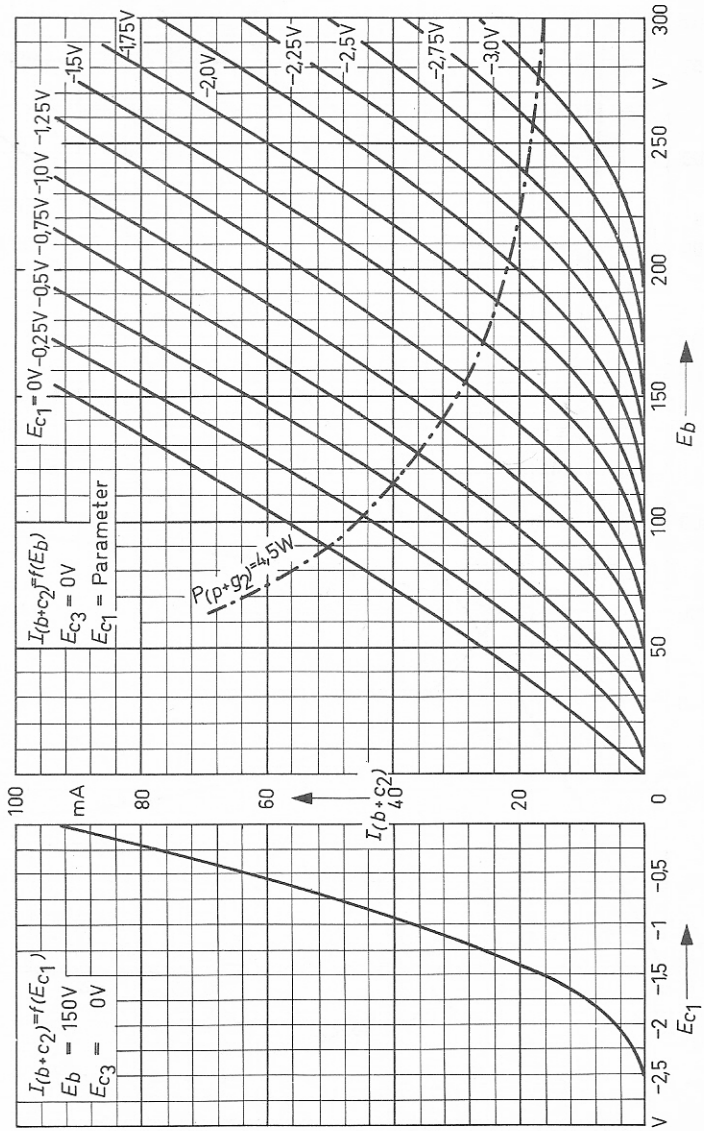


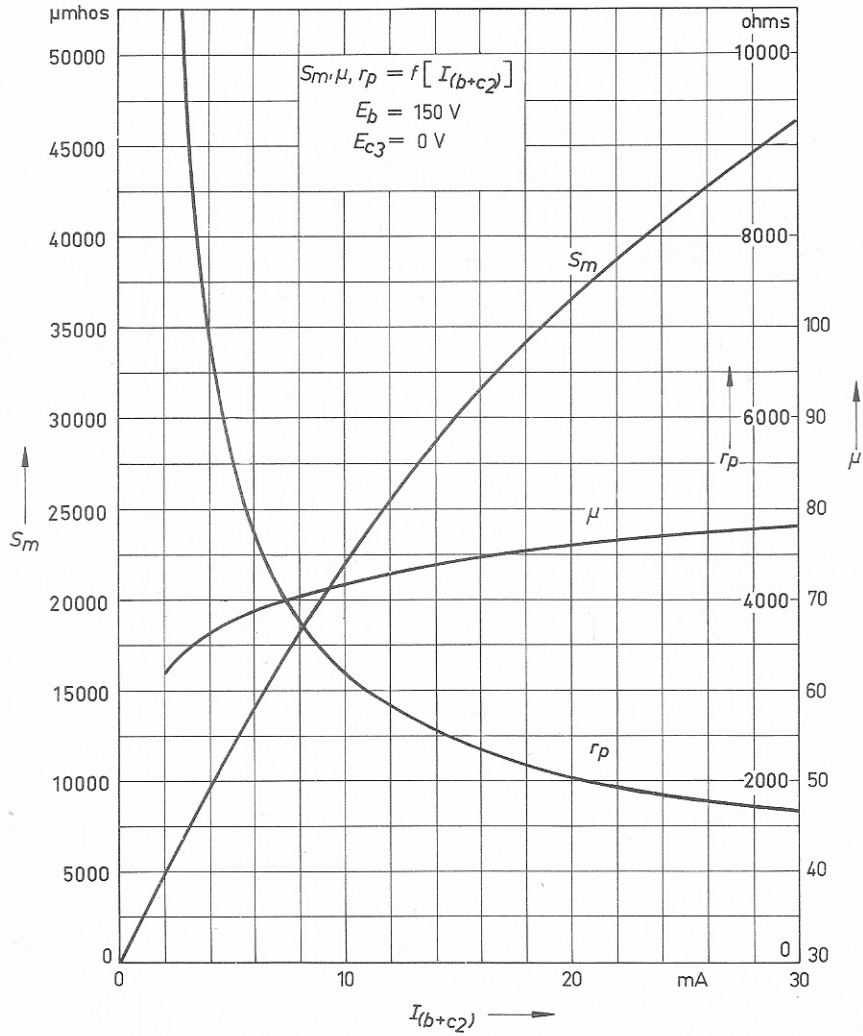

$I_b = f(E_b)$
$I_{c2} = f(E_b)$
E_{c2} = 150V
E_{c3} = 0V
E_{c1} = Parameter
P_b=4,2W
E_{c1} = -1,0 V
-1,25V
-1,5 V
-1,75V
-2,0V
E_{c1} = 0 V
-0,5 V
-1,0 V
-1,5V
-2,0V
250
200
150
100
50
0
V
E_b
40
30
20
10
0
mA
I_b
I_{c2}
$I_b, I_{c2} = f(E_{c1})$
E_b = 180V
E_{c2} = 150V
E_{c3} = 0V
I_b
I_{c2}
-3 V -2 -1
E_{c1}

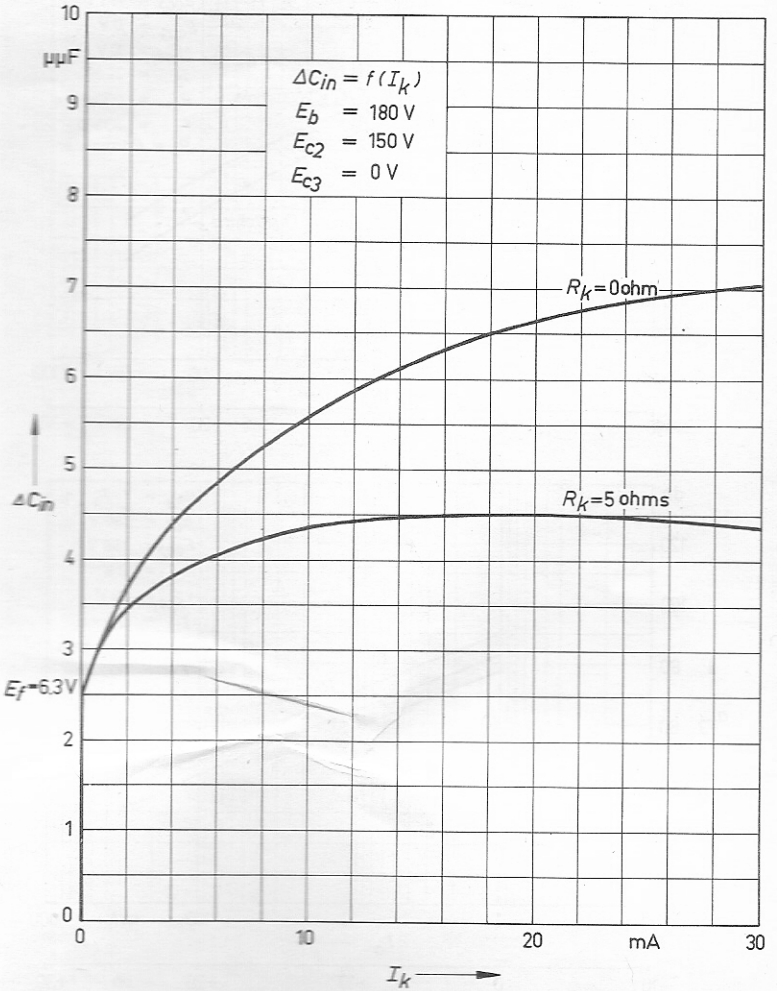

40000
µmhos
35000
30000
25000
20000
15000
10000
5000
0
S_m
$S_m = f(I_b)$
E_b = 180 V
E_{c3} = 0 V
E_{c2} = Parameter
E_{c2} = 110 V
150 V
0
5
10
15
20
mA
25
I_b

Triode connection



Triode connection




10
µµF
9
8
7
6
5
4
3
2
1
0
$\Delta C_{in} = f(I_k)$
E_b = 180 V
E_{c2} = 150 V
E_{c3} = 0 V
R_k=0ohm
R_k=5 ohms
ΔC_{in}
E_f=6.3V
0
10
20
mA
30
I_k

Harmonic Distortion Characteristics

$a_{k2} = f(P_o, n_p)$ $a_{k3} = f(P_o, n_p)$

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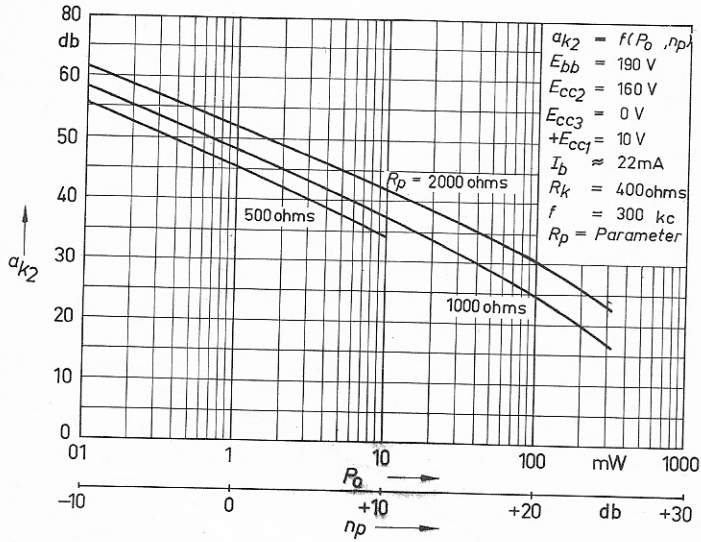

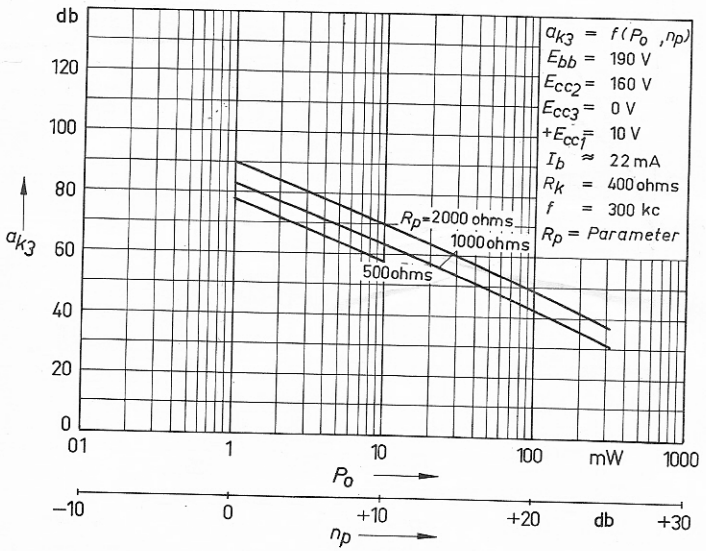

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