

2 to 6W audio power amplifier with preamplifier

TDA1011A

The TDA1011A is a monolithic integrated audio amplifier circuit in a 9-lead single in-line (SIL) plastic package. The device is especially designed for portable radio and recorder applications and delivers up to 4 W in a $4\ \Omega$ load impedance. The device can deliver up to 6 W into $4\ \Omega$ at 16 V loaded supply in mains-fed applications. The maximum permissible supply voltage of 24 V makes this circuit very suitable for d.c. and a.c. apparatus, while the low applicable supply voltage of 5,4 V permits 9 V applications. The power amplifier has an inverted input/output which makes the circuit optimal for applications with active tone control and spatial stereo. Special features are:

- single in-line (SIL) construction for easy mounting
- separated preamplifier and power amplifier
- high output power
- thermal protection
- high input impedance
- low current drain
- limited noise behaviour at radio frequencies

QUICK REFERENCE DATA

Supply voltage range	V_P	5,4 to 20 V
Peak output current	I_{OM}	max. 3 A
Output power at $d_{tot} = 10\%$		
$V_P = 16\text{ V}; R_L = 4\ \Omega$	P_O	typ. 6,5 W
$V_P = 12\text{ V}; R_L = 4\ \Omega$	P_O	typ. 4,2 W
$V_P = 9\text{ V}; R_L = 4\ \Omega$	P_O	typ. 2,3 W
$V_P = 6\text{ V}; R_L = 4\ \Omega$	P_O	typ. 1,0 W
Total harmonic distortion at $P_O = 1\text{ W}; R_L = 4\ \Omega$	d_{tot}	typ. 0,2 %
Input impedance		
preamplifier (pin 8)	$ Z_i $	> 100 k Ω
Total quiescent current	I_{tot}	typ. 14 mA
Operating ambient temperature	T_{amb}	-25 to + 150 °C
Storage temperature	T_{stg}	-55 to + 150 °C

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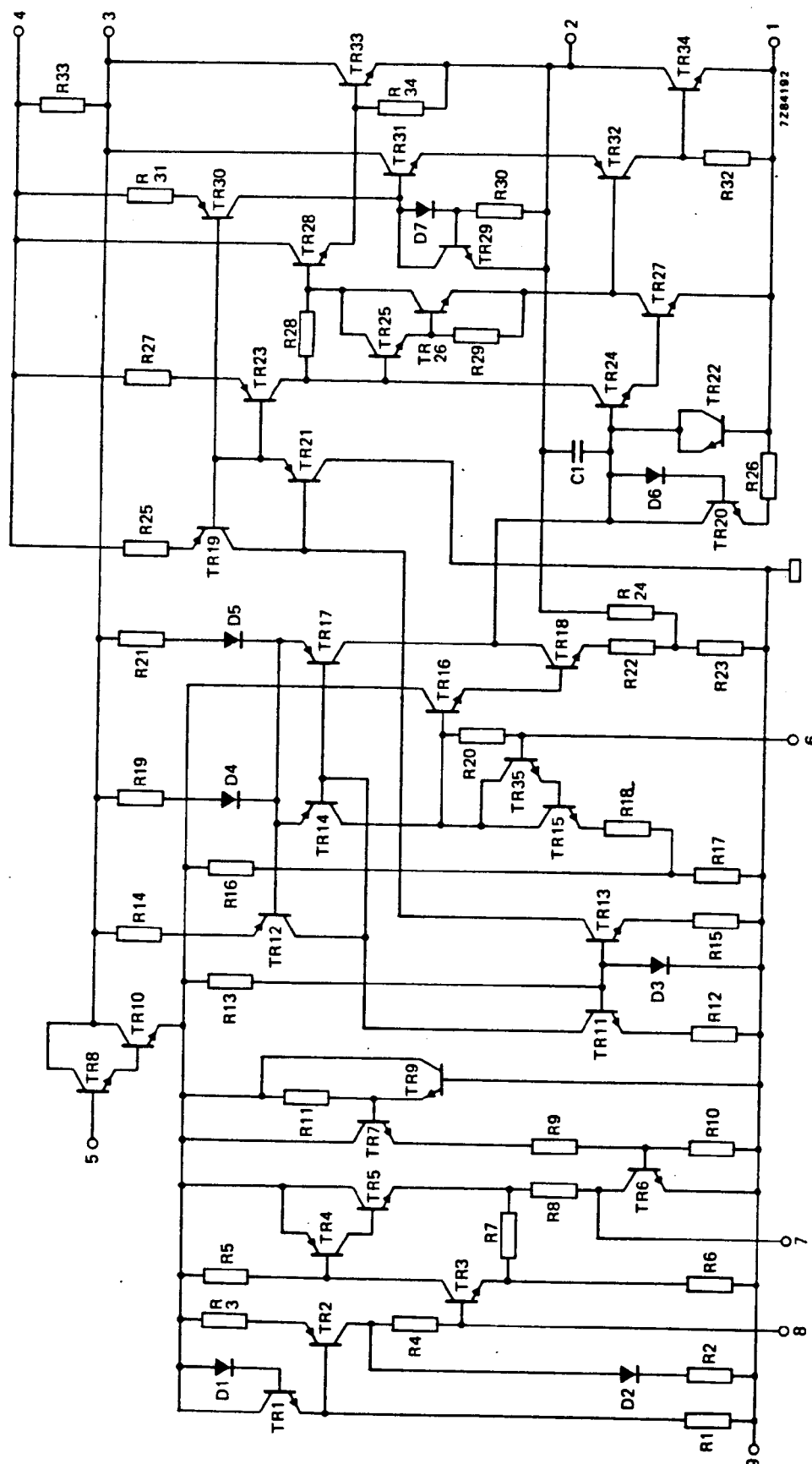


Fig. 1 Circuit diagram.

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RATINGS

Limiting values in accordance with the Absolute Maximum System (IEC 134)

Supply voltage	V_P	max.	24 V
Peak output current	I_{OM}	max.	3 A
Total power dissipation			see derating curve Fig. 2
Storage temperature	T_{stg}		-55 to + 150 °C
Operating ambient temperature	T_{amb}		-25 to + 150 °C
A.C. short-circuit duration of load during sine-wave drive; $V_P = 12$ V	t_{sc}	max.	100 hours

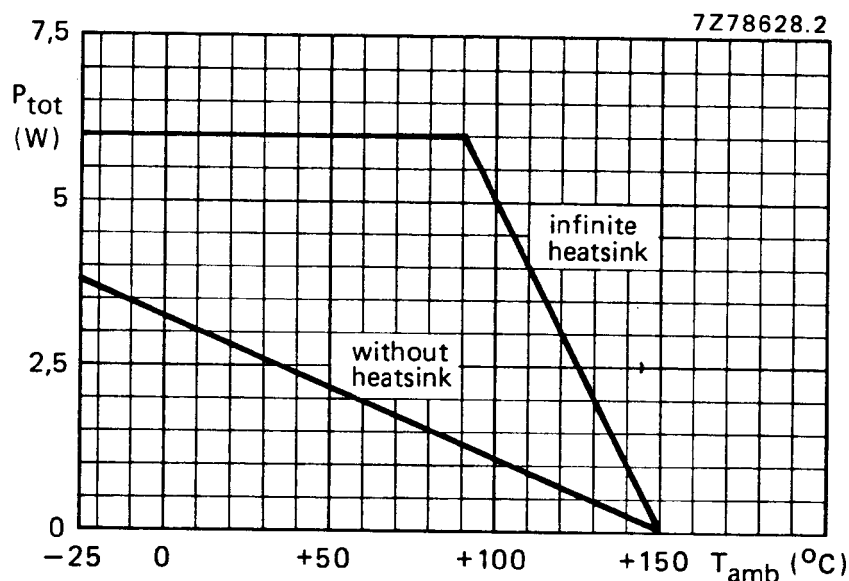


Fig. 2 Power derating curve.

HEATSINK DESIGN

Assume $V_P = 12$ V; $R_L = 4 \Omega$; $T_{amb} = 60$ °C maximum; $P_O = 3,8$ W.

The maximum sine-wave dissipation is 1,8 W.

The derating of 10 K/W of the package requires the following external heatsink (for sine-wave drive):

$$R_{th j-a} = R_{th j-tab} + R_{th tab-h} + R_{th h-a} = \frac{150 - 60}{1,8} = 50 \text{ K/W.}$$

Since $R_{th j-tab} = 10$ K/W and $R_{th tab-h} = 1$ K/W, $R_{th h-a} = 50 - (10 + 1) = 39$ K/W.

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D.C. CHARACTERISTICS

Supply voltage range	V_P	5,4 to 20 V
Repetitive peak output current	I_{ORM}	< 2 A
Total quiescent current at $V_P = 12$ V	I_{tot}	typ. 14 mA < 22 mA

A.C. CHARACTERISTICS

$T_{amb} = 25^\circ\text{C}$; $V_P = 12$ V; $R_L = 4\ \Omega$; $f = 1$ kHz unless otherwise specified; see also Fig. 3.

A.F. output power at $d_{tot} = 10\%$ (note 1)

with bootstrap:

$V_P = 16$ V; $R_L = 4\ \Omega$ P_O typ. 6,5 W

$V_P = 12$ V; $R_L = 4\ \Omega$ P_O > 3,6 W
typ. 4,2 W

$V_P = 9$ V; $R_L = 4\ \Omega$ P_O typ. 2,3 W

$V_P = 6$ V; $R_L = 4\ \Omega$ P_O typ. 1,0 W

without bootstrap:

$V_P = 12$ V; $R_L = 4\ \Omega$ P_O typ. 3,5 W

Voltage gain:

preamplifier (note 2) G_{V1} typ. 23 dB
21 to 25 dB

power amplifier (note 3) G_{V2} typ. 29 dB

total amplifier (note 3) $G_{V\ tot}$ typ. 52 dB

Total harmonic distortion at $P_O = 1,5$ W d_{tot} typ. 0,3 %
< 1 %

Frequency response; -3 dB (note 4) B 60 Hz to 15 kHz

Input impedance:

preamplifier (note 5) $|Z_{i1}|$ > 100 k Ω
typ. 200 k Ω

Output impedance preamplifier $|Z_{o1}|$ typ. 1 k Ω

Output voltage preamplifier (r.m.s. value)

$d_{tot} < 1\%$ (note 2) $V_{O(rms)}$ > 1,2 V

Noise output voltage (r.m.s. value; note 6)

$R_S = 0\ \Omega$ $V_{n(rms)}$ typ. 0,5 mV

$R_S = 10$ k Ω $V_{n(rms)}$ typ. 0,8 mV

Noise output voltage at $f = 500$ kHz (r.m.s. value)

$B = 5$ kHz; $R_S = 0\ \Omega$ $V_{n(rms)}$ typ. 8 μ V

Ripple rejection (note 6)

$f = 1$ to 10 kHz RR typ. 42 dB

$f = 100$ Hz; $C_2 = 1\ \mu$ F RR > 35 dB

Bootstrap current at onset of clipping; pin 4 (r.m.s. value) $I_{4(rms)}$ typ. 35 mA

Stand-by current at maximum V_P (note 8) I_{sb} < 100 μ A

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Notes

1. Measured with an ideal coupling capacitor to the speaker load.
2. Measured with a load resistor of $20\text{ k}\Omega$.
3. Measured with $R2 = 20\text{ k}\Omega$.
4. Measured at $P_O = 1\text{ W}$; the frequency response is mainly determined by C1 and C3 for the low frequencies and by C4 for the high frequencies.
5. Independent of load impedance of preamplifier.
6. Unweighted r.m.s. noise voltage measured at a bandwidth of 60 Hz to 15 kHz (12 dB/octave).
7. Ripple rejection measured with a source impedance between 0 and $2\text{ k}\Omega$ (maximum ripple amplitude: 2 V).
8. The total current when disconnecting pin 5 or short-circuited to ground (pin 9).
9. The tab must be electrically floating or connected to the substrate (pin 9).

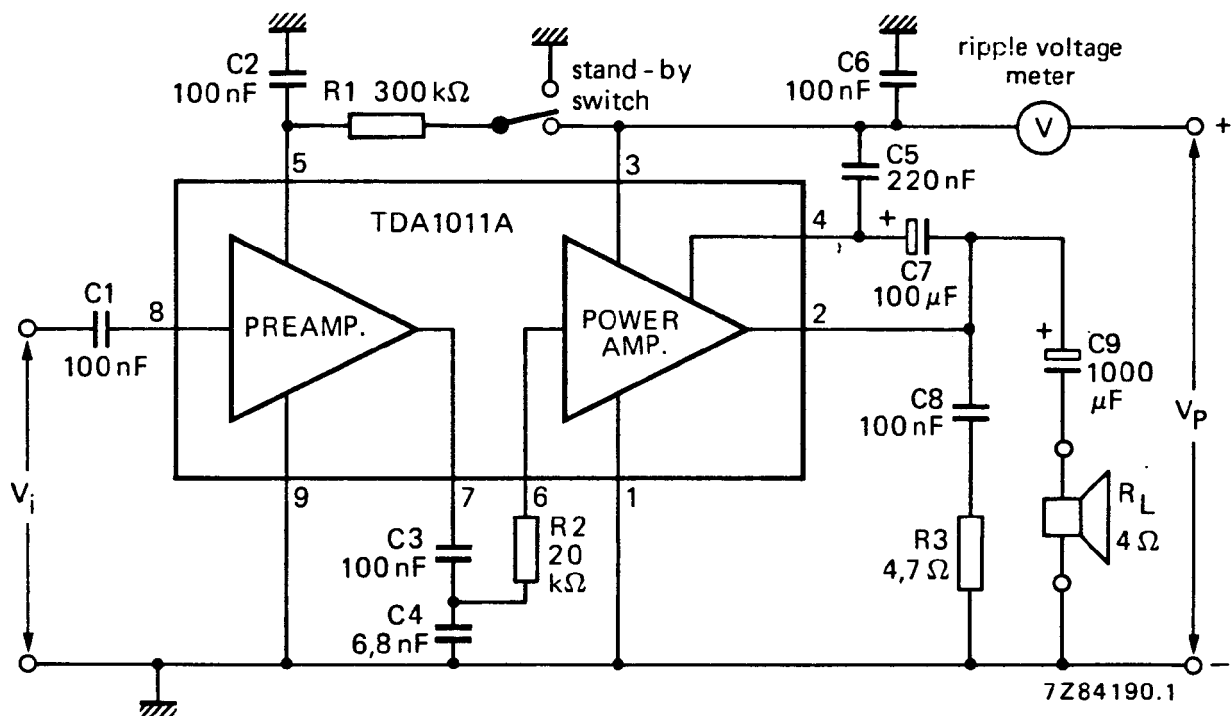


Fig. 3 Test circuit.

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APPLICATION INFORMATION

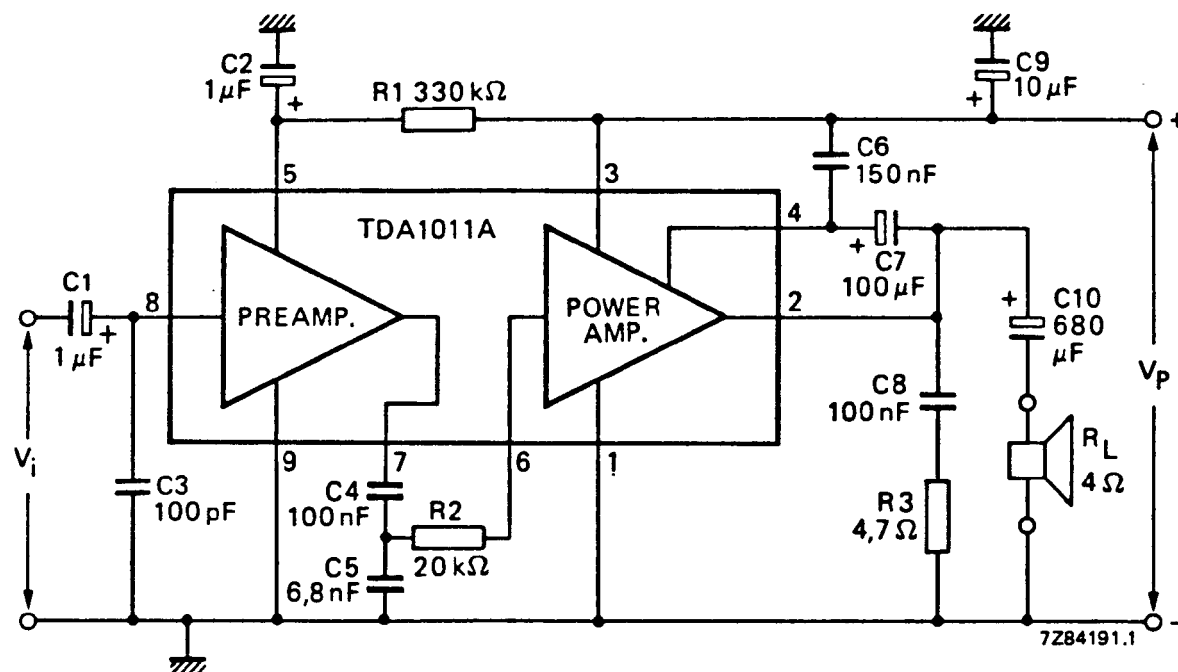


Fig. 4 Circuit diagram of a 4 W amplifier.

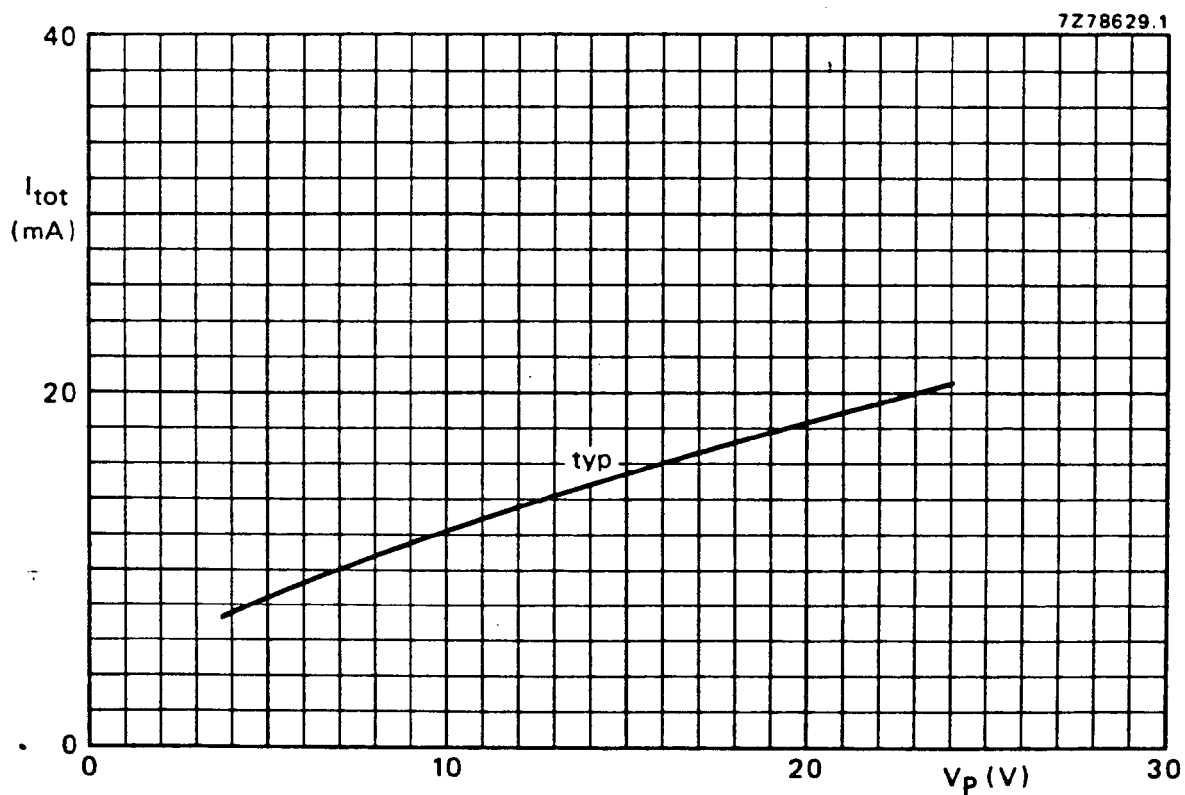


Fig. 5 Total quiescent current as a function of supply voltage.

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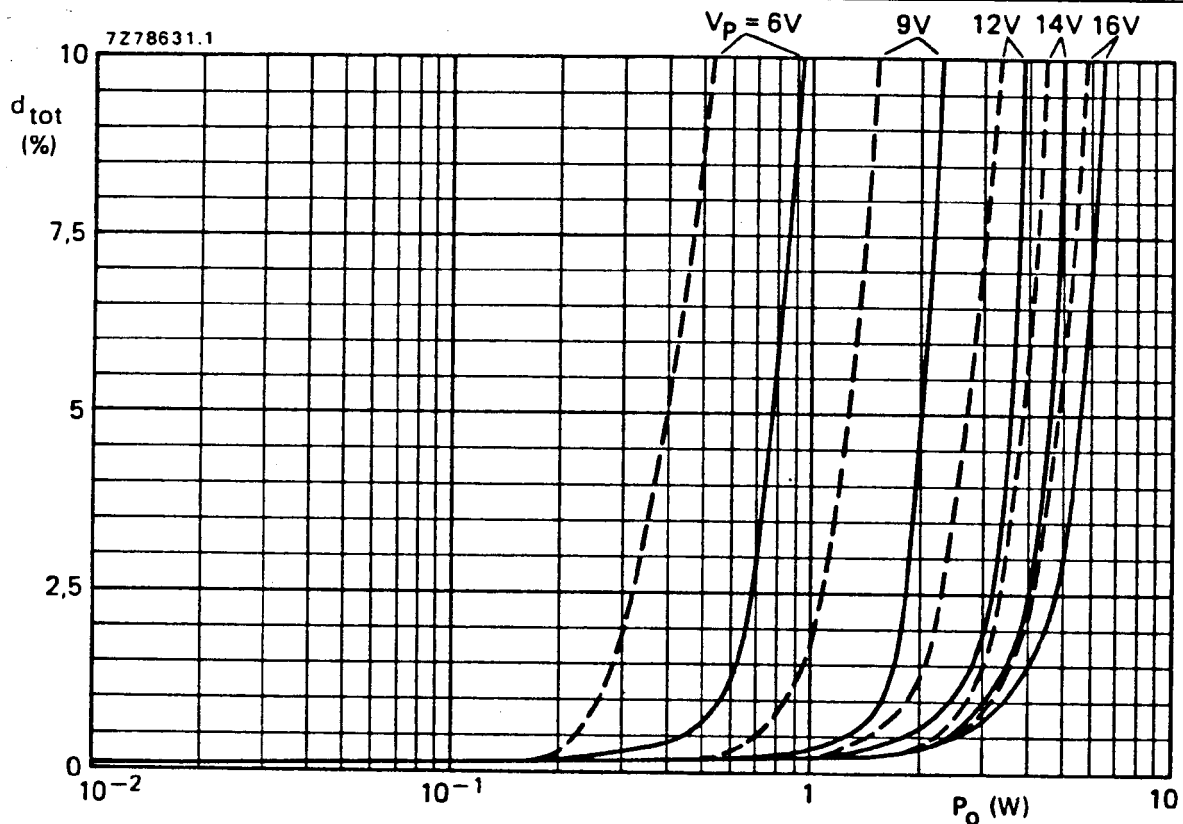


Fig. 6 Total harmonic distortion as a function of output power across R_L ; — with bootstrap; - - - without bootstrap; $f = 1$ kHz; typical values. The available output power is 5% higher when measured at pin 2 (due to series resistance of C10).

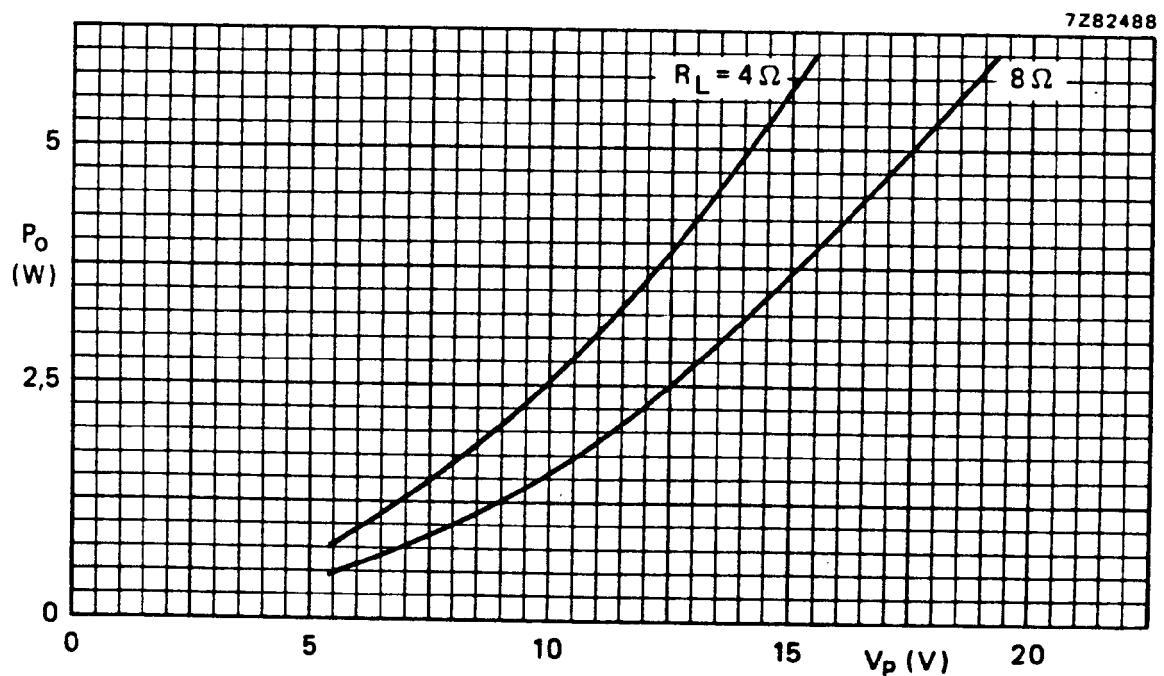


Fig. 7 Output power across R_L as a function of supply voltage with bootstrap; $d_{tot} = 10\%$; typical values. The available output power is 5% higher when measured at pin 2 (due to series resistance of C1).

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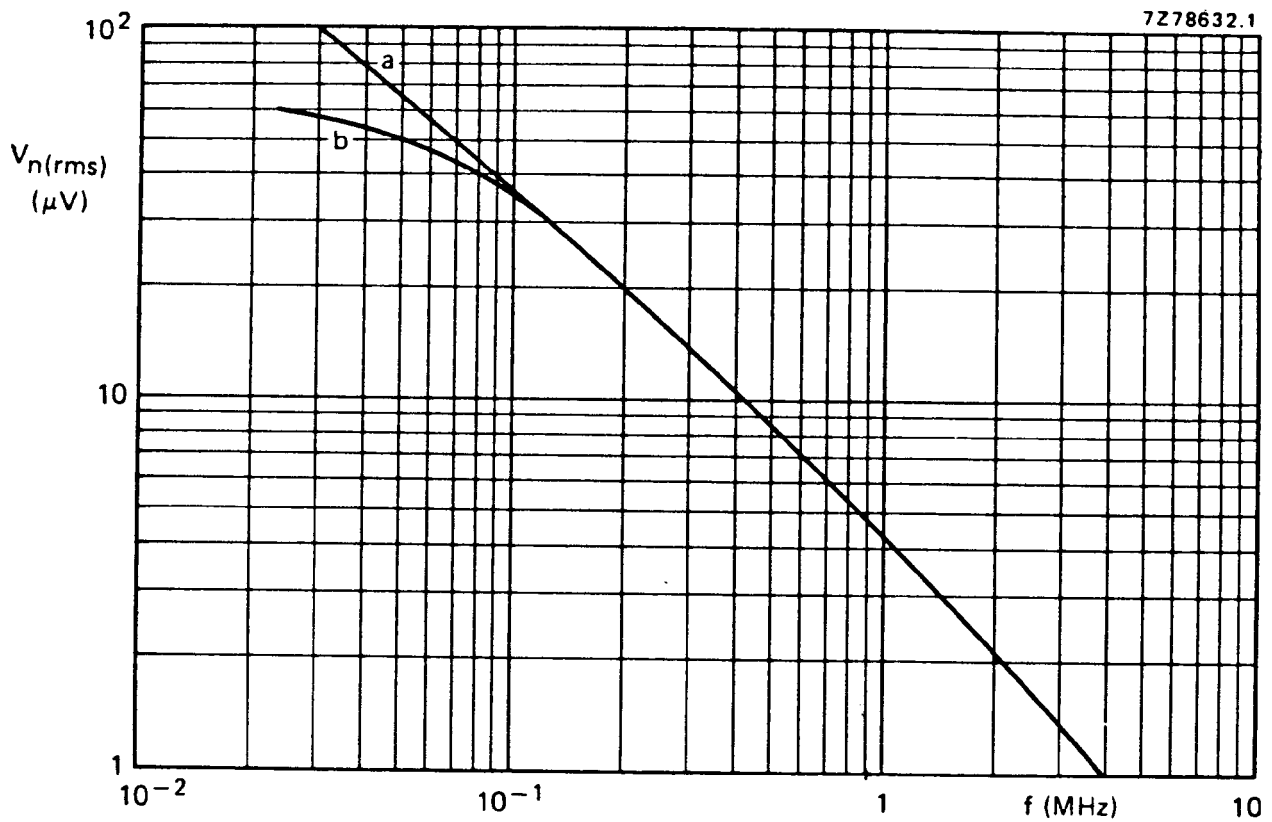


Fig. 8 Noise output voltage as a function of frequency; curve a: total amplifier; curve b: power amplifier; $B = 5$ kHz; $R_S = 0$; typical values.