# 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 Ω load impedance. The device can deliver up to 6 W into 4 Ω 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 V; $R_L$ = 4 Ω | $P_o$ | typ. 6,5 | W |
| $V_P$ = 12 V; $R_L$ = 4 Ω | $P_o$ | typ. 4,2 | W |
| $V_P$ = 9 V; $R_L$ = 4 Ω | $P_o$ | typ. 2,3 | W |
| $V_P$ = 6 V; $R_L$ = 4 Ω | $P_o$ | typ. 1,0 | W |
| Total harmonic distortion at $P_o$ = 1 W; $R_L$ = 4 Ω | $d_{tot}$ | typ. 0,2 | % |
| Input impedance preamplifier (pin 8) | $\lvert Z_i \rvert$ | > 100 | kΩ |
| 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 |

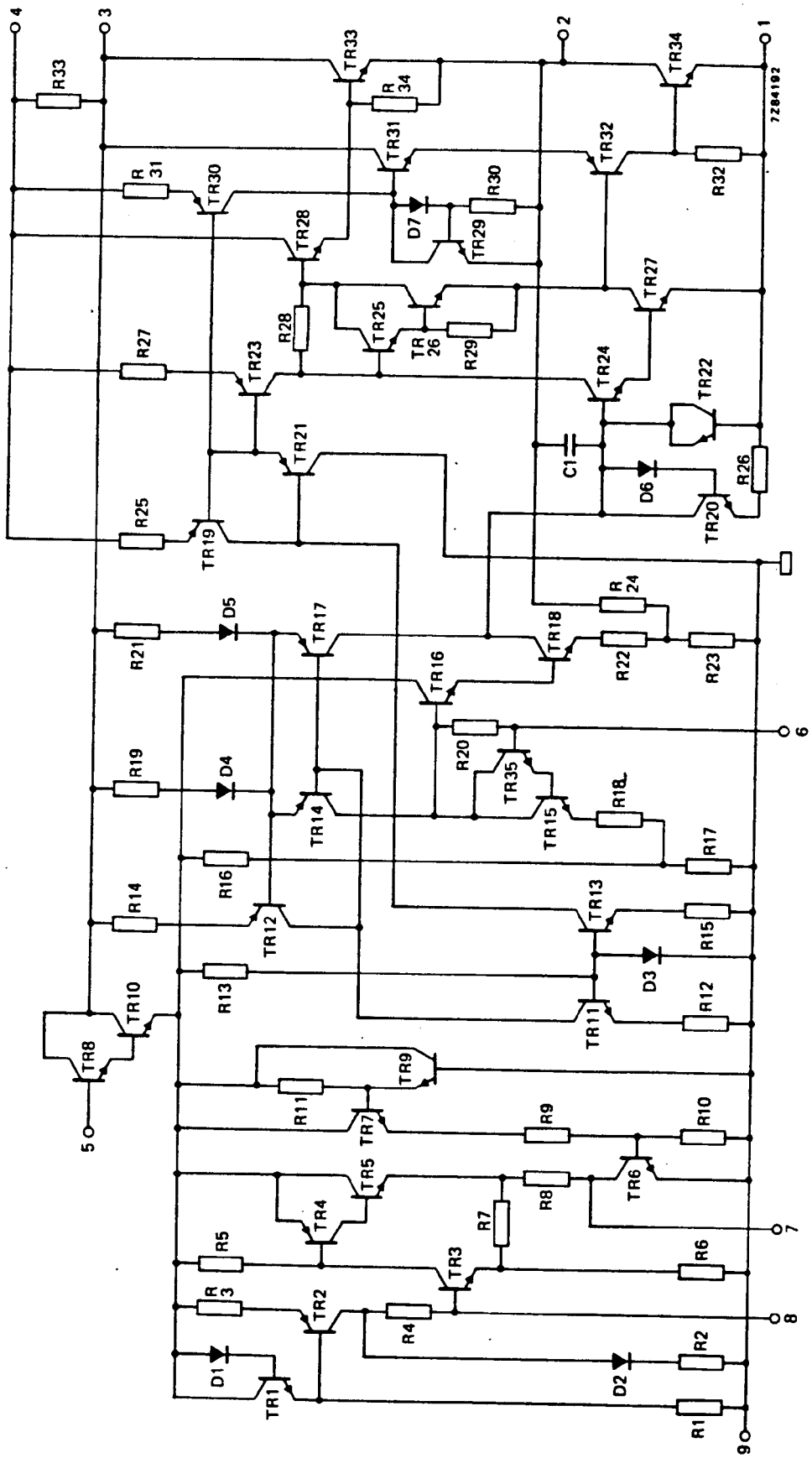


Fig. 1 Circuit diagram.

## 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 |

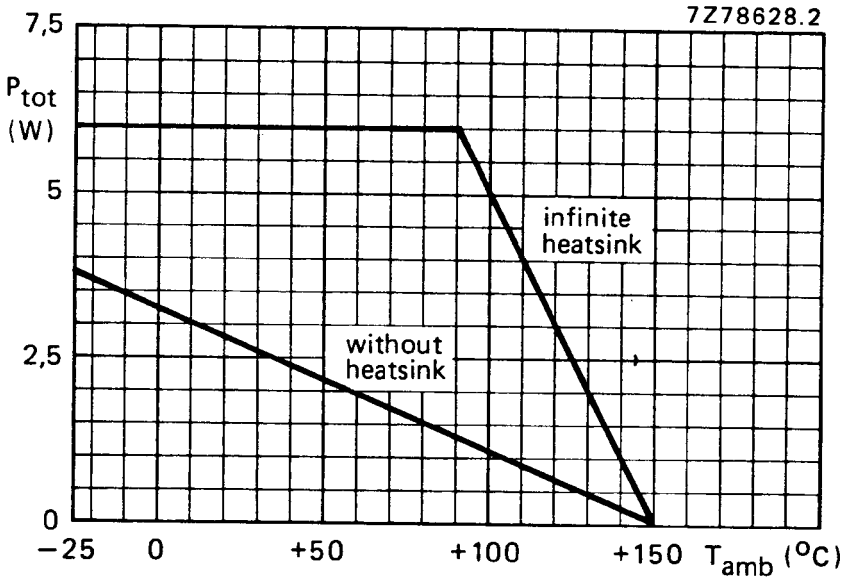


Fig. 2 Power derating curve.

## HEATSINK DESIGN

Assume $V_P$ = 12 V; $R_L$ = 4 Ω; $T_{amb}$ = 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):

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

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

## 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<br>< 22 | mA<br>mA |

## A.C. CHARACTERISTICS

$T_{amb}$ = 25 °C; $V_P$ = 12 V; $R_L$ = 4 Ω; 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 Ω | $P_o$ | typ. 6,5 | W |
| $V_P$ = 12 V; $R_L$ = 4 Ω | $P_o$ | > 3,6<br>typ. 4,2 | W<br>W |
| $V_P$ = 9 V; $R_L$ = 4 Ω | $P_o$ | typ. 2,3 | W |
| $V_P$ = 6 V; $R_L$ = 4 Ω | $P_o$ | typ. 1,0 | W |
| without bootstrap: | | | |
| $V_P$ = 12 V; $R_L$ = 4 Ω | $P_o$ | typ. 3,5 | W |
| Voltage gain: | | | |
| preamplifier (note 2) | $G_{v1}$ | typ. 23<br>21 to 25 | dB<br>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<br>< 1 | %<br>% |
| Frequency response; −3 dB (note 4) | B | 60 Hz to 15 | kHz |
| Input impedance: | | | |
| preamplifier (note 5) | $\lvert Z_{i1} \rvert$ | > 100<br>typ. 200 | kΩ<br>kΩ |
| Output impedance preamplifier | $\lvert Z_{o1} \rvert$ | typ. 1 | kΩ |
| 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 Ω | $V_{n(rms)}$ | typ. 0,5 | mV |
| $R_S$ = 10 kΩ | $V_{n(rms)}$ | typ. 0,8 | mV |
| Noise output voltage at f = 500 kHz (r.m.s. value) | | | |
| B = 5 kHz; $R_S$ = 0 Ω | $V_{n(rms)}$ | typ. 8 | μV |
| Ripple rejection (note 6) | | | |
| f = 1 to 10 kHz | RR | typ. 42 | dB |
| f = 100 Hz; C2 = 1 μF | 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 | μA |

Notes

1. Measured with an ideal coupling capacitor to the speaker load.
2. Measured with a load resistor of 20 kΩ.
3. Measured with R2 = 20 kΩ.
4. Measured at $P_O$ = 1 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 kΩ (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).

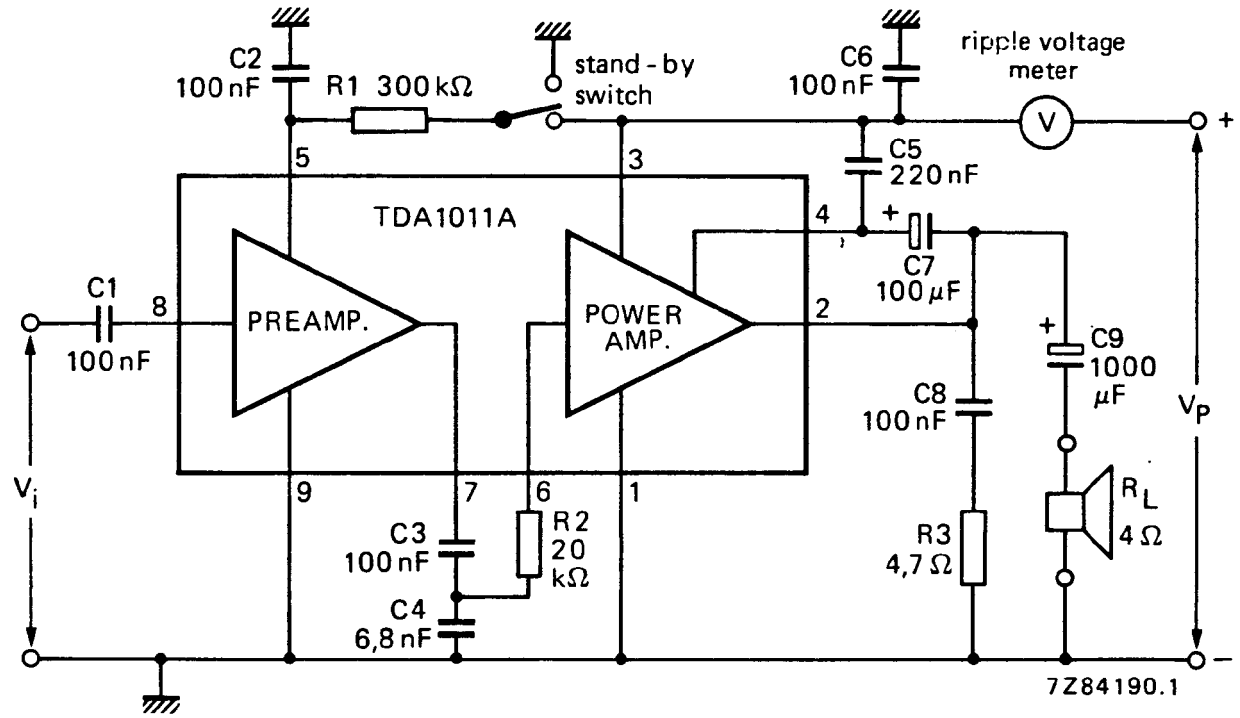


Fig. 3 Test circuit.

## APPLICATION INFORMATION

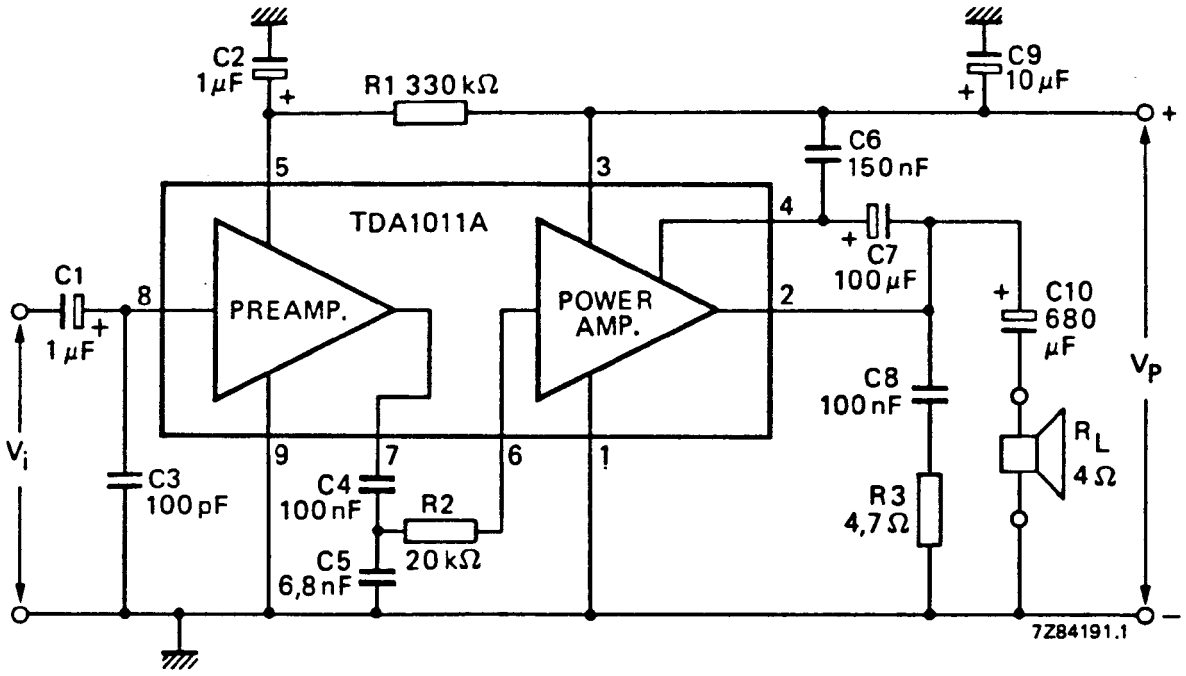


Fig. 4 Circuit diagram of a 4 W amplifier.

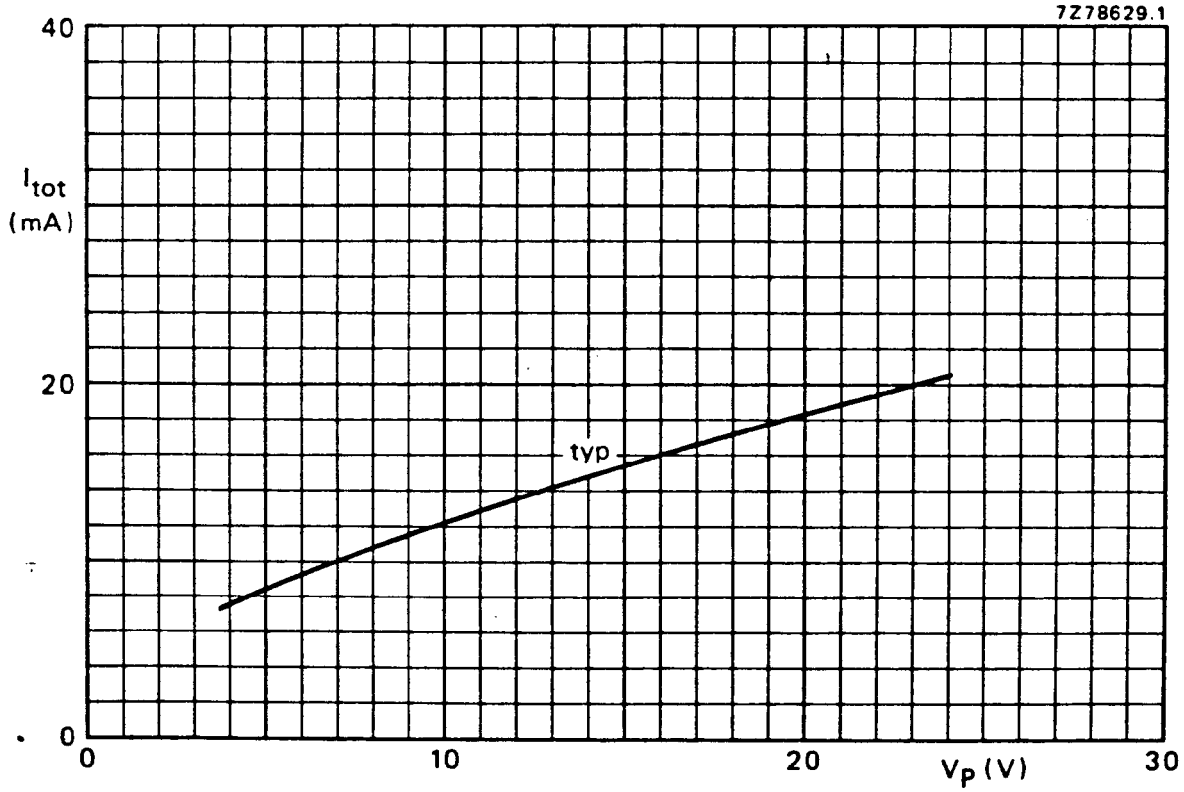


Fig. 5 Total quiescent current as a function of supply voltage.

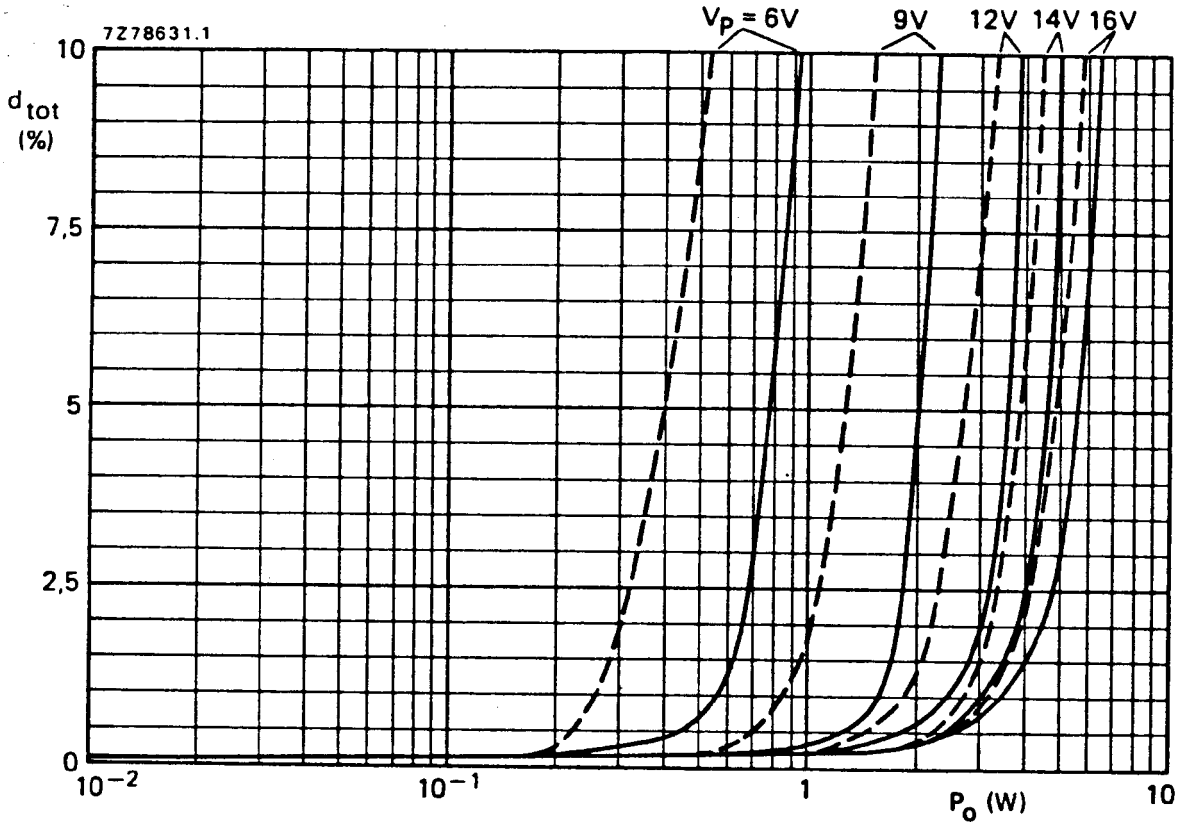


Fig. 6 Total harmonic distortion as a function of output power across $R_L$; —— with bootstrap; – – – without bootstrap; f = 1 kHz; typical values. The available output power is 5% higher when measured at pin 2 (due to series resistance of C10).

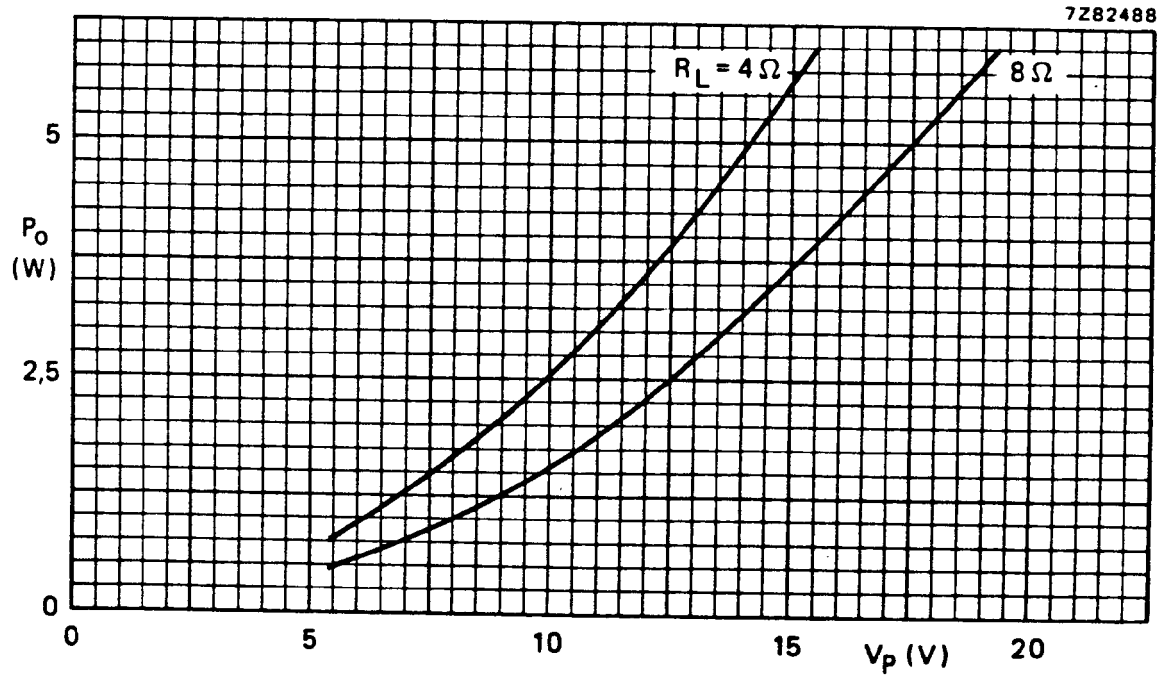


Fig. 7 Output power across $R_L$ as a function of supply voltage with bootstrap; $d_{tot}$ = 10%; typical values. The available output power is 5% higher when measured at pin 2 (due to series resistance of C1

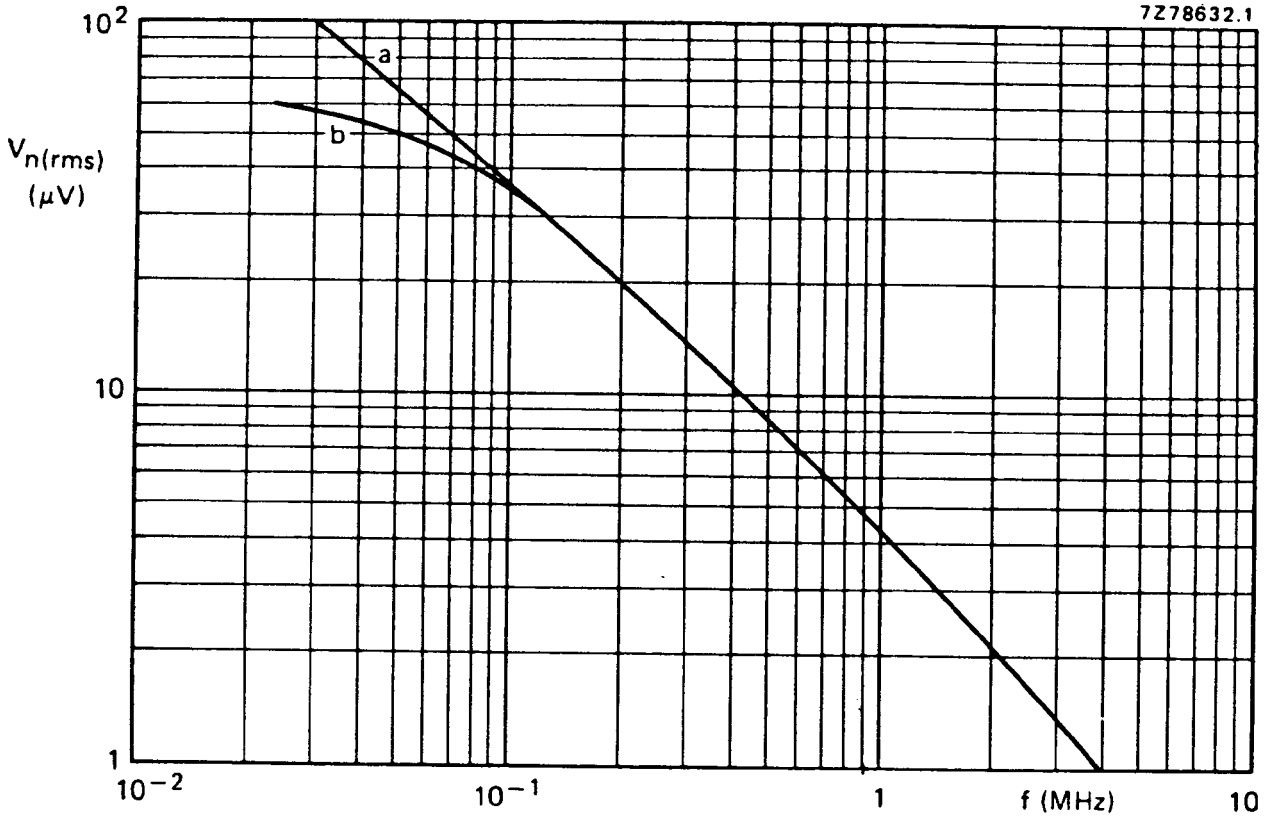


Fig. 8 Noise output voltage as a function of frequency; curve a: total amplifier; curve b: power amplifier; B = 5 kHz; $R_S$ = 0; typical values.