# 6W audio amplifier with preamplifier TDA1010A

The **TDA1010A** is a monolithic integrated class-B audio amplifier circuit in a 9-lead single in-line (SIL) plastic package. The device is primarily developed as a 6 W car radio amplifier for use with 4 Ω and 2 Ω load impedances. The wide supply voltage range and the flexibility of the IC make it an attractive proposition for record players and tape recorders with output powers up to 10 W.

Special features are:

- single in-line (SIL) construction for easy mounting
- separated preamplifier and power amplifier
- high output power
- low-cost external components
- good ripple rejection
- thermal protection

## QUICK REFERENCE DATA

| | | | | |
|---|---|---|---|---|
| Supply voltage range | $V_P$ | | 6 to 24 | V |
| Repetitive peak output current | $I_{ORM}$ | max. | 3 | A |
| Output power at pin 2; $d_{tot}$ = 10% | | | | |
| $V_P$ = 14,4 V; $R_L$ = 2 Ω | $P_o$ | typ. | 6,4 | W |
| $V_P$ = 14,4 V; $R_L$ = 4 Ω | $P_o$ | typ. | 6,2 | W |
| $V_P$ = 14,4 V; $R_L$ = 8 Ω | $P_o$ | typ. | 3,4 | W |
| $V_P$ = 14,4 V; $R_L$ = 2 Ω; with additional bootstrap resistor of 220 Ω between pins 3 and 4 | $P_o$ | typ. | 9 | W |
| Total harmonic distortion at $P_o$ = 1 W; $R_L$ = 4 Ω | $d_{tot}$ | typ. | 0,2 | % |
| Input impedance | | | | |
| preamplifier (pin 8) | $\|Z_i\|$ | typ. | 30 | kΩ |
| power amplifier (pin 6) | $\|Z_i\|$ | typ. | 20 | kΩ |
| Total quiescent current at $V_P$ = 14,4 V | $I_{tot}$ | typ. | 31 | mA |
| Sensitivity for $P_o$ = 5,8 W; $R_L$ = 4 Ω | $V_i$ | typ. | 10 | mV |
| Operating ambient temperature | $T_{amb}$ | | −25 to + 150 | °C |
| Storage temperature | $T_{stg}$ | | −55 to + 150 | °C |

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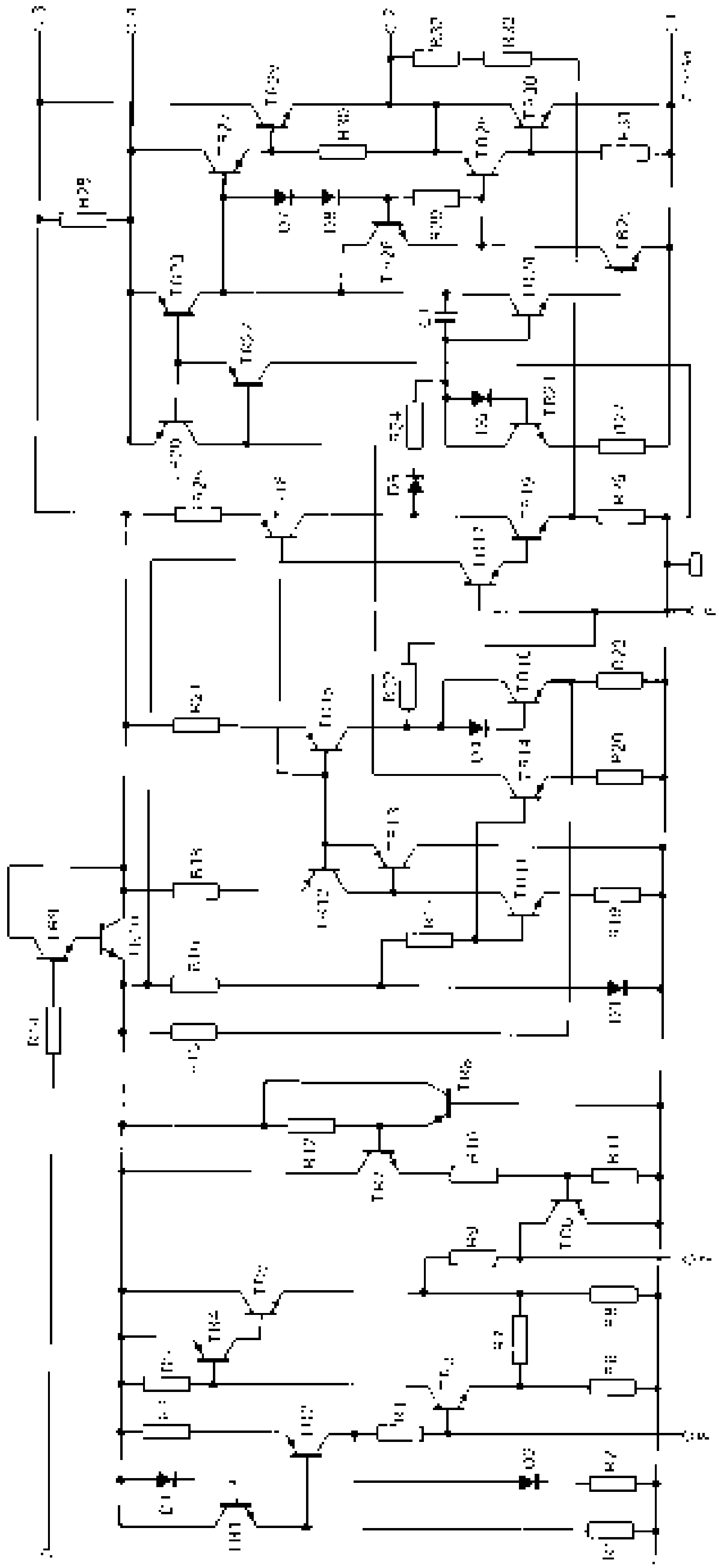

Fig. 1 Circuit diagram.

## 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. | 5 | A |
| Repetitive peak output current | $I_{ORM}$ | 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; without heatsink at $V_P$ = 14,4 V | $t_{sc}$ | max. | 100 | hours |

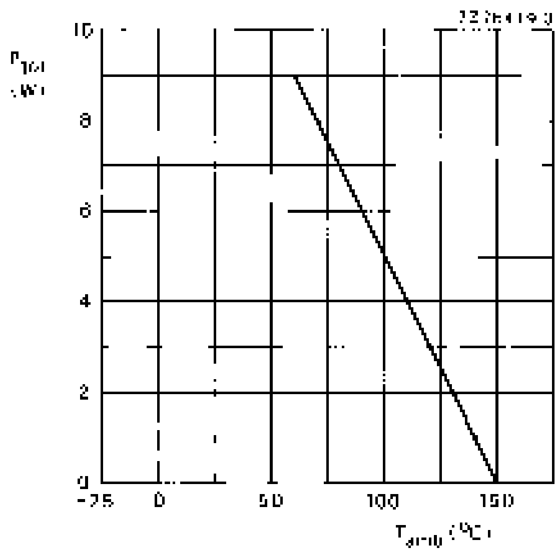


Fig. 2 Power derating curve.

## HEATSINK DESIGN

Assume $V_P$ = 14,4 V; $R_L$ = 2 Ω; $T_{amb}$ = 60 °C maximum; thermal shut-down starts at $T_j$ = 150 °C. The maximum sine-wave dissipation in a 2 Ω load is about 5,2 W. The maximum dissipation for music drive will be about 75% of the worst-case sine-wave dissipation, so this will be 3,9 W. Consequently, the total resistance from junction to ambient

$$R_{th\ j\text{-}a} = R_{th\ j\text{-}tab} + R_{th\ tab\text{-}h} + R_{th\ h\text{-}a} = \frac{150 - 60}{3,9} = 23\ \text{K/W}.$$

Since $R_{th\ j\text{-}tab}$ = 10 K/W and $R_{th\ tab\text{-}h}$ = 1 K/W,

$$R_{th\ h\text{-}a} = 23 - (10 + 1) = 12\ \text{K/W}.$$

## D.C. CHARACTERISTICS

| | | | | |
|---|---|---|---|---|
| Supply voltage range | $V_P$ | | 6 to 24 | V |
| Repetitive peak output current | $I_{ORM}$ | < | 3 | A |
| Total quiescent current at $V_P$ = 14,4 V | $I_{tot}$ | typ. | 31 | mA |

## A.C. CHARACTERISTICS

$T_{amb}$ = 25 °C; $V_P$ = 14,4 V; $R_L$ = 4 Ω; f = 1 kHz unless otherwise specified; see also Fig. 3.

| | | | | |
|---|---|---|---|---|
| A.F. output power (see Fig. 4) at $d_{tot}$ = 10%; measured at pin 2; with bootstrap | | | | |
| $V_P$ = 14,4 V; $R_L$ = 2 Ω (note 1) | $P_o$ | typ. | 6,4 | W |
| $V_P$ = 14,4 V; $R_L$ = 4 Ω (note 1 and 2) | $P_o$ | > | 5,9 | W |
| | | typ. | 6,2 | W |
| $V_P$ = 14,4 V; $R_L$ = 8 Ω (note 1) | $P_o$ | typ. | 3,4 | W |
| $V_P$ = 14,4 V; $R_L$ = 4 Ω; without bootstrap | $P_o$ | typ. | 5,7 | W |
| $V_P$ = 14,4 V; $R_L$ = 2 Ω; with additional bootstrap resistor of 220 Ω between pins 3 and 4 | $P_o$ | typ. | 9 | W |
| Voltage gain | | | | |
| preamplifier (note 3) | $G_{v1}$ | typ. | 24 | dB |
| | | | 21 to 27 | dB |
| power amplifier | $G_{v2}$ | typ. | 30 | dB |
| | | | 27 to 33 | dB |
| total amplifier | $G_{v\,tot}$ | typ. | 54 | dB |
| | | | 51 to 57 | dB |
| Total harmonic distortion at $P_o$ = 1 W | $d_{tot}$ | typ. | 0,2 | % |
| Efficiency at $P_o$ = 6 W | η | typ. | 75 | % |
| Frequency response (−3 dB) | B | | 80 Hz to 15 | kHz |
| Input impedance | | | | |
| preamplifier (note 4) | $\|Z_i\|$ | typ. | 30 | kΩ |
| | | | 20 to 40 | kΩ |
| power amplifier (note 5) | $\|Z_i\|$ | typ. | 20 | kΩ |
| | | | 14 to 26 | kΩ |
| Output impedance of preamplifier; pin 7 (note 5) | $\|Z_o\|$ | typ. | 20 | kΩ |
| | | | 14 to 26 | kΩ |
| Output voltage preamplifier (r.m.s. value) $d_{tot}$ < 1% (pin 7) (note 3) | $V_{o(rms)}$ | > | 0,7 | V |
| Noise output voltage (r.m.s. value; note 6) | | | | |
| $R_S$ = 0 Ω | $V_{n(rms)}$ | typ. | 0,3 | mV |
| $R_S$ = 8,2 kΩ | $V_{n(rms)}$ | typ. | 0,7 | mV |
| | | < | 1,4 | mV |
| Ripple rejection at f = 1 kHz to 10 kHz (note 7) | RR | > | 42 | dB |
| at f = 100 Hz; C2 = 1 μF | RR | > | 37 | dB |
| Sensitivity for $P_o$ = 5,8 W | $V_i$ | typ. | 10 | mV |
| Bootstrap current at onset of clipping; pin 4 (r.m.s. value) | $I_{4(rms)}$ | typ. | 30 | mA |

**Notes**

1. Measured with an ideal coupling capacitor to the speaker load.
2. Up to $P_o \leqslant 3$ W : $d_{tot} \leqslant 1\%$.
3. Measured with a load impedance of 20 kΩ.
4. Independent of load impedance of preamplifier.
5. Output impedance of preamplifier ($|Z_o|$) is correlated (within 10%) with the input impedance ($|Z_i|$) of the power amplifier.
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 tab must be electrically floating or connected to the substrate (pin 9).

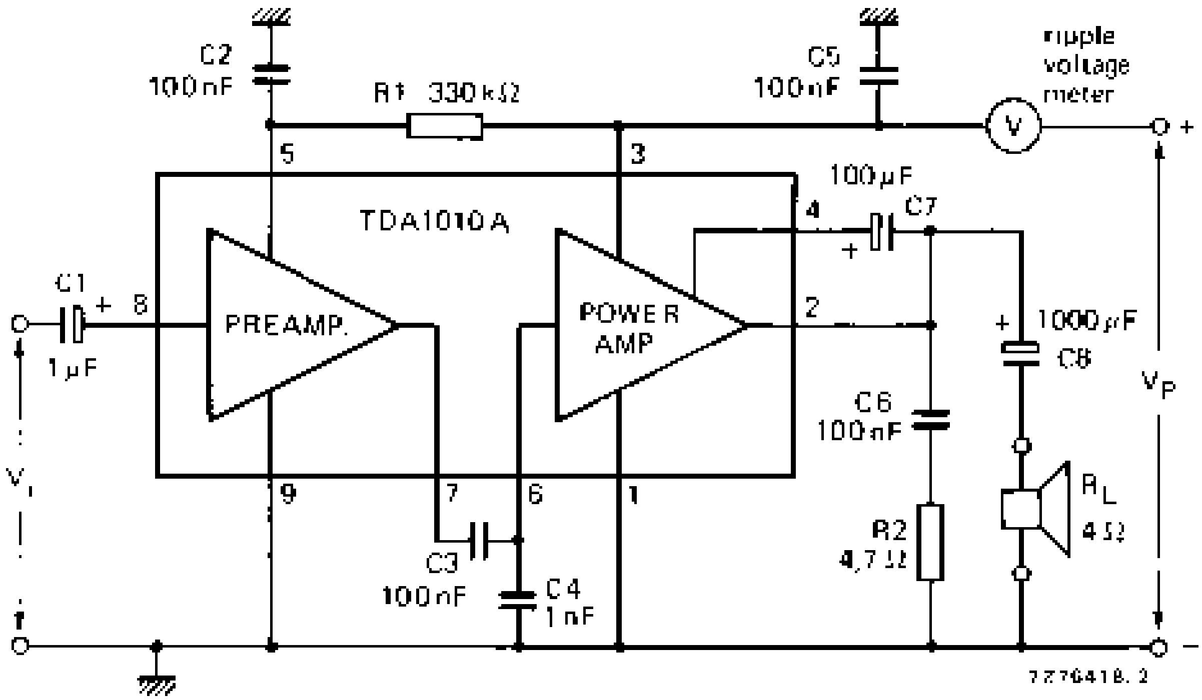


Fig. 3 Test circuit.

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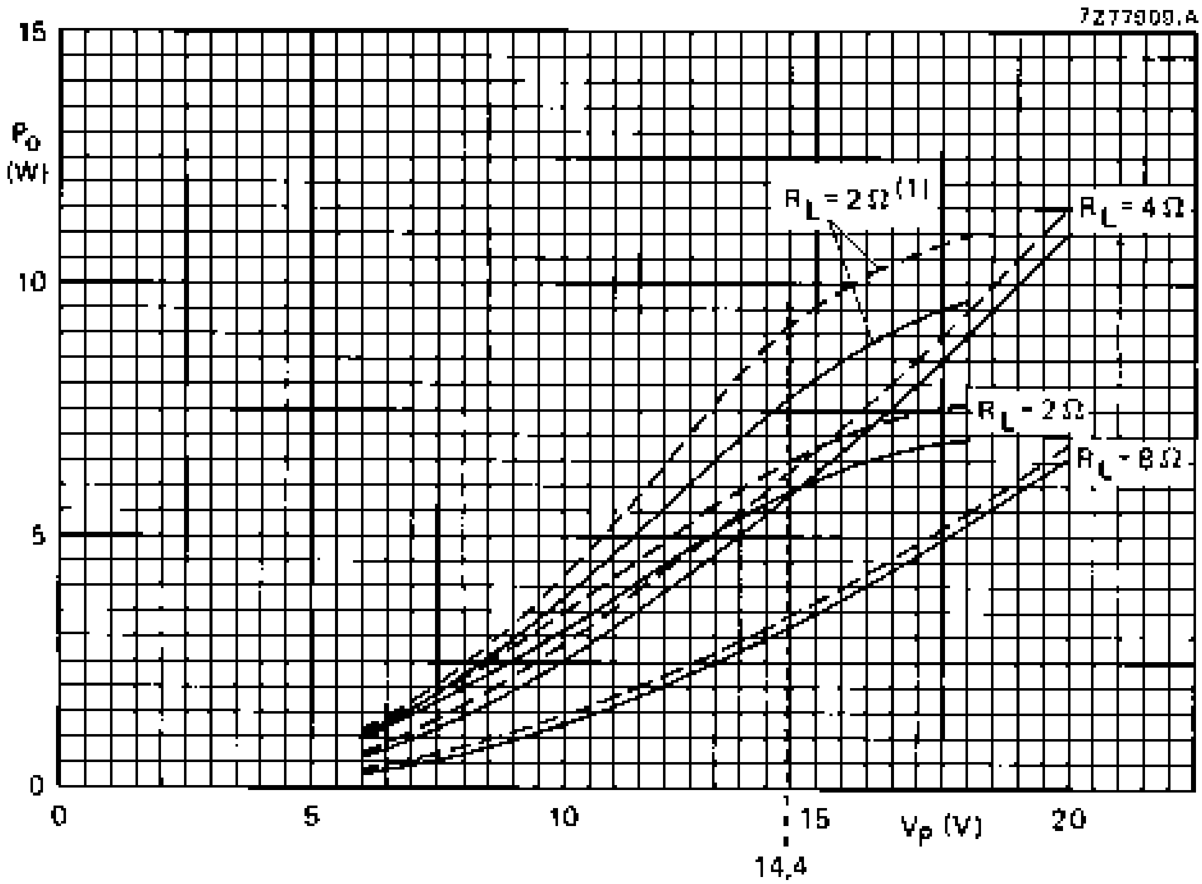


Fig. 4 Output power of the circuit of Fig. 3 as a function of the supply voltage with the load impedance as a parameter; typical values. Solid lines indicate the power across the load, dashed lines that available at pin 2 of the TDA1010. $R_L = 2\ \Omega$ (1) has been measured with an additional 220 Ω bootstrap resistor between pins 3 and 4. Measurements were made at f = 1 kHz, $d_{tot}$ = 10%, $T_{amb}$ = 25 °C.

Fig. 5 See next page.
Total harmonic distortion in the circuit of Fig. 3 as a function of the output power with the load impedance as a parameter; typical values. Solid lines indicate the power across the load, dashed lines that available at pin 2 of the TDA1010. $R_L = 2\ \Omega$ (1) has been measured with an additional 220 Ω bootstrap resistor between pins 3 and 4. Measurements were made at f = 1 kHz, $V_P$ = 14,4 V.

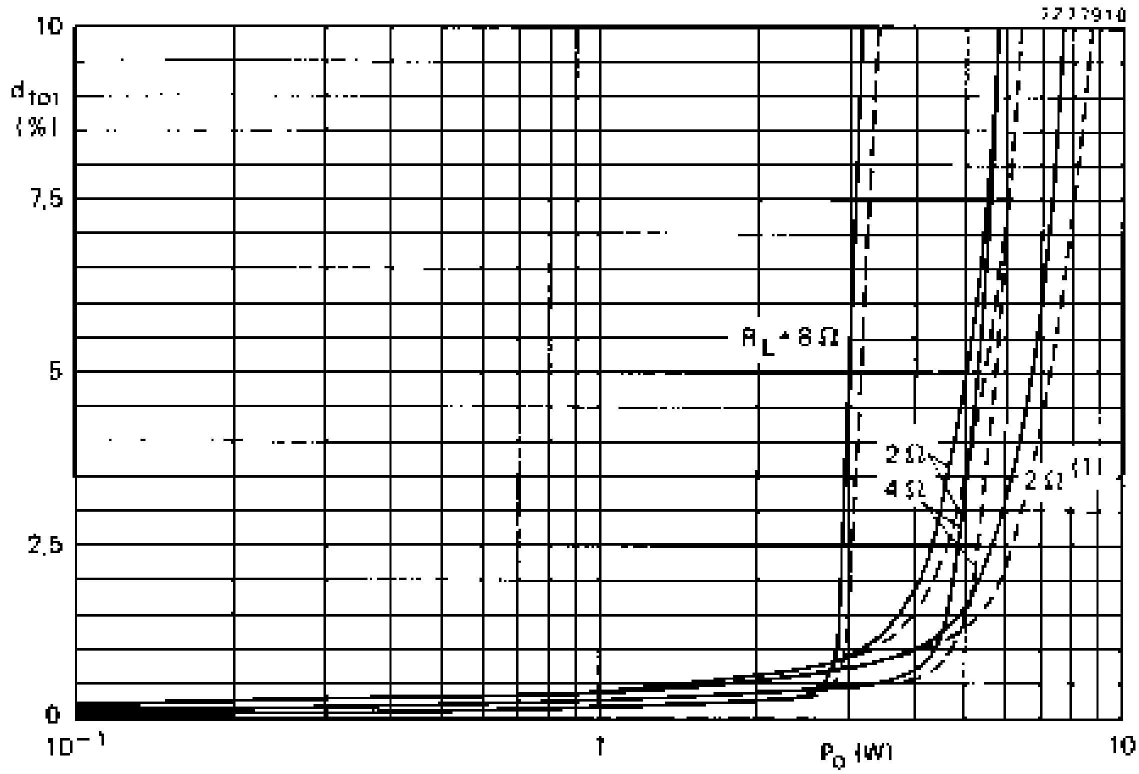


Fig. 5 For caption see preceding page.

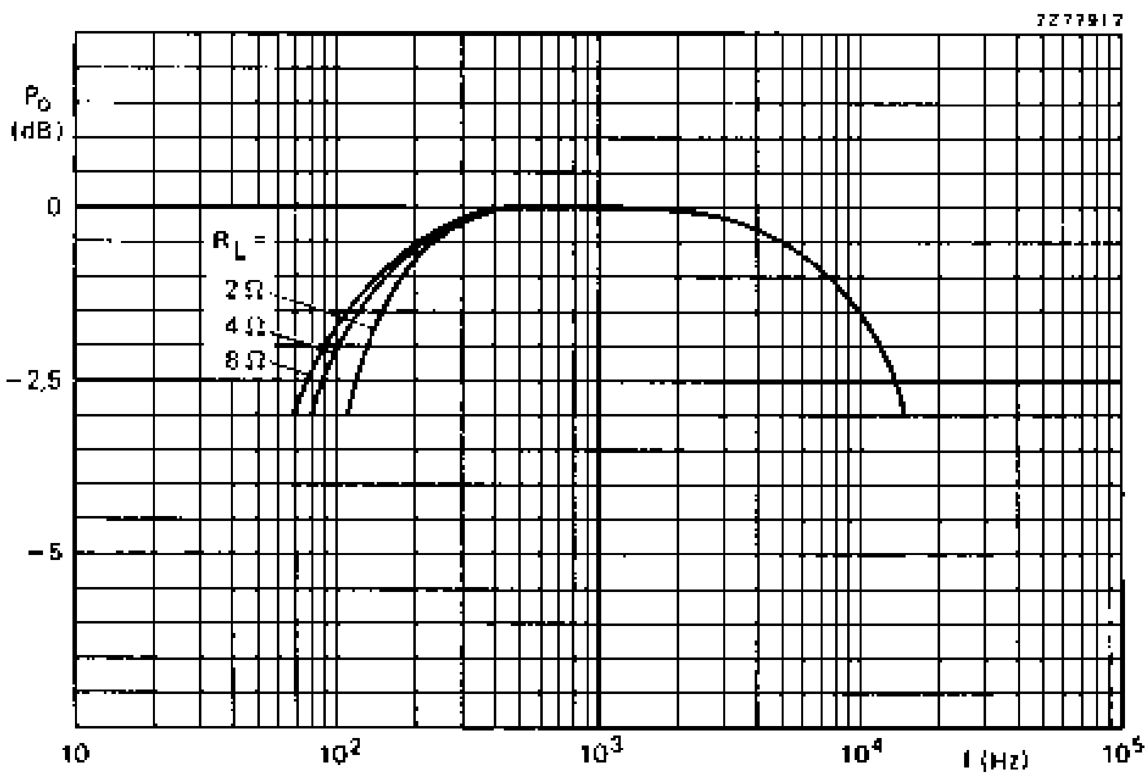


Fig. 6 Frequency characteristics of the circuit of Fig. 3 for three values of load impedance; typical values. $P_o$ relative to 0 dB = 1 W; $V_P$ = 14,4 V.

# 6W audio amplifier with preamplifier TDA1010A

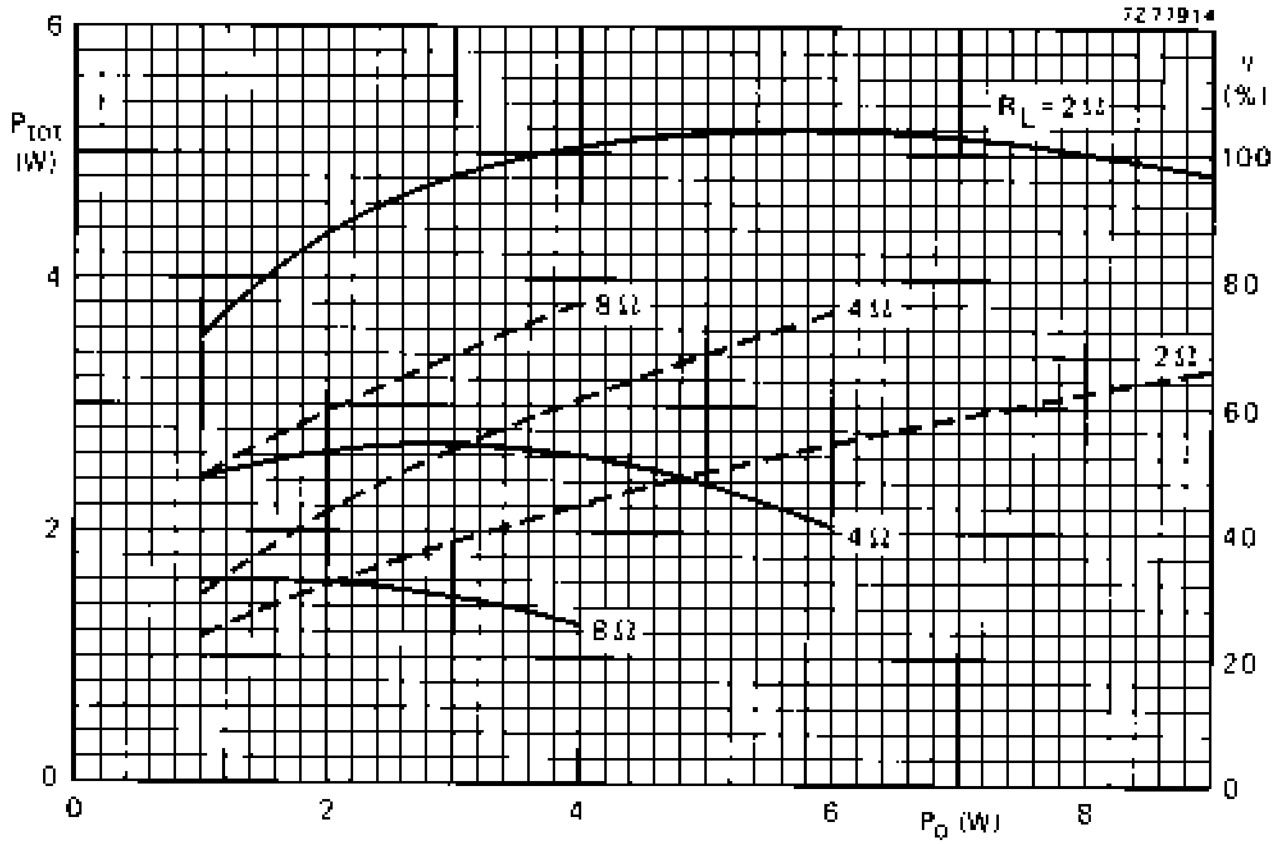


Fig. 7 Total power dissipation (solid lines) and the efficiency (dashed lines) of the circuit of Fig. 3 as a function of the output power with the load impedance as a parameter (for $R_L$ = 2 Ω an external bootstrap resistor of 220 Ω has been used); typical values. $V_P$ = 14,4 V; f = 1 kHz.

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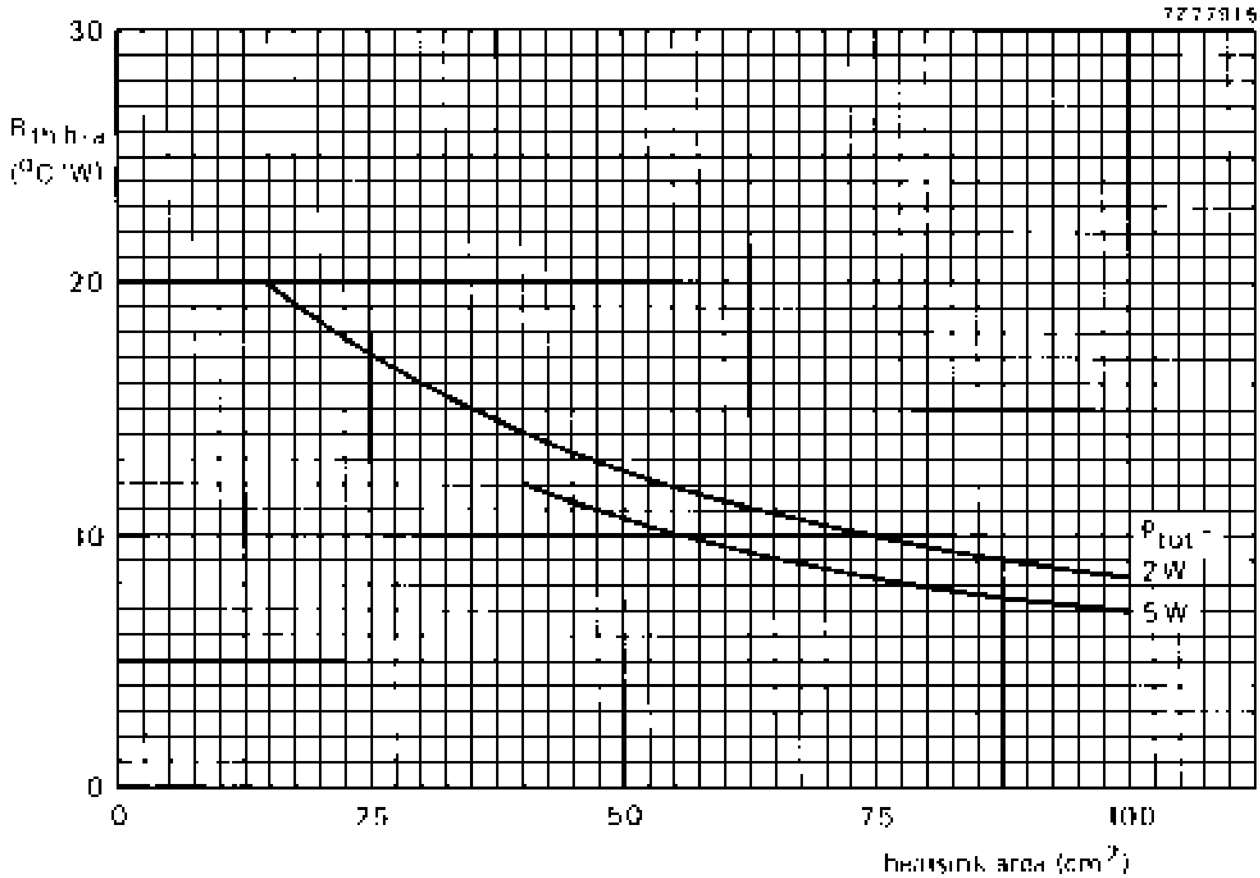


Fig. 8 Thermal resistance from heatsink to ambient of a 1,5 mm thick bright aluminium heatsink as a function of the single-sided area of the heatsink with the total power dissipation as a parameter.

## APPLICATION INFORMATION

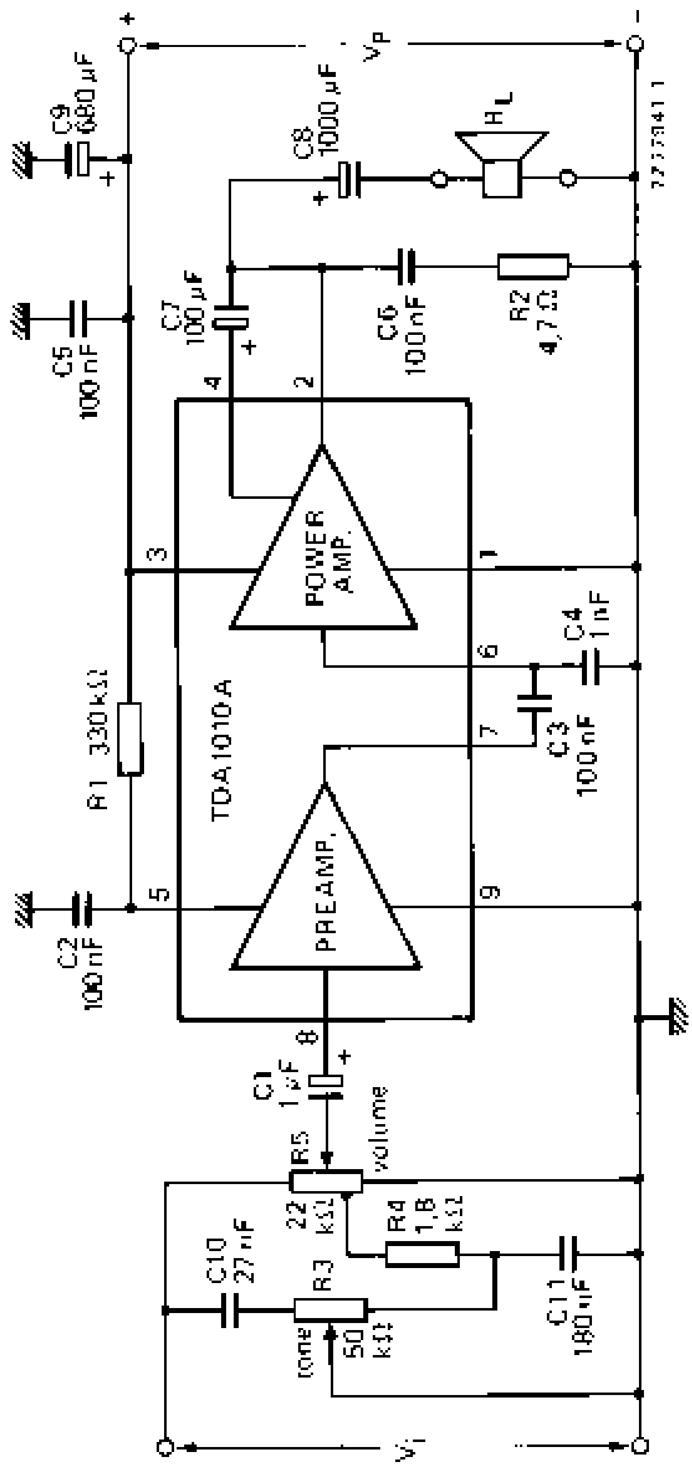


Fig 9 Complete mono audio amplifier of a car radio.

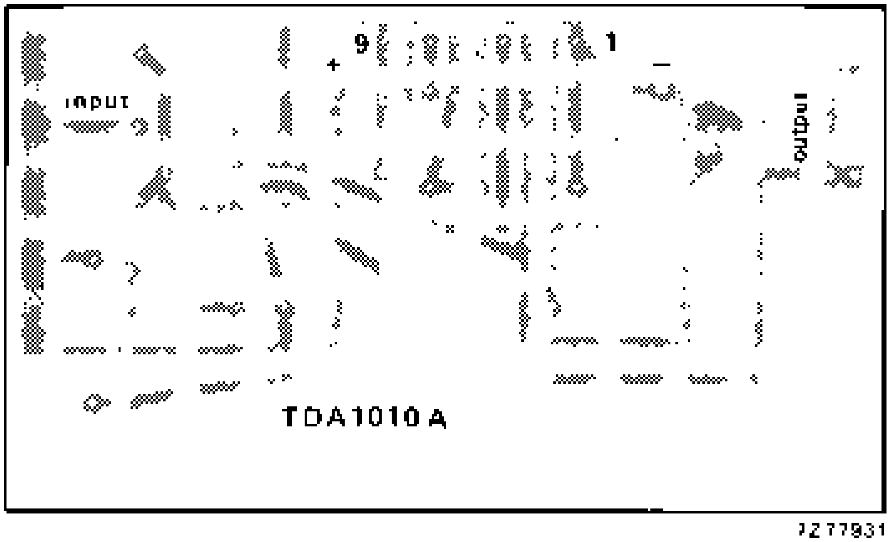


Fig. 10 Track side of printed-circuit board used for the circuit of Fig. 9; p.c. board dimensions 92 mm × 52 mm.

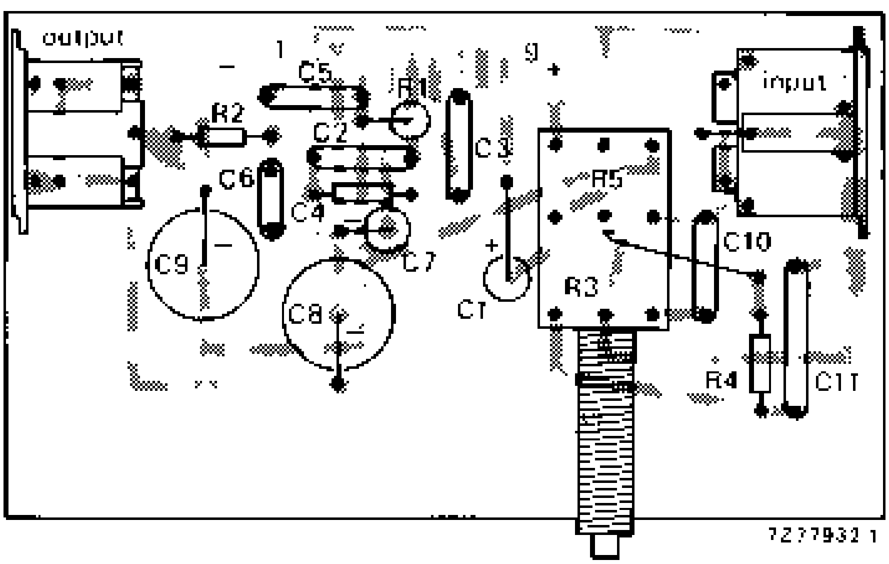


Fig. 11 Component side of printed-circuit board showing component layout used for the circuit of Fig. 9.

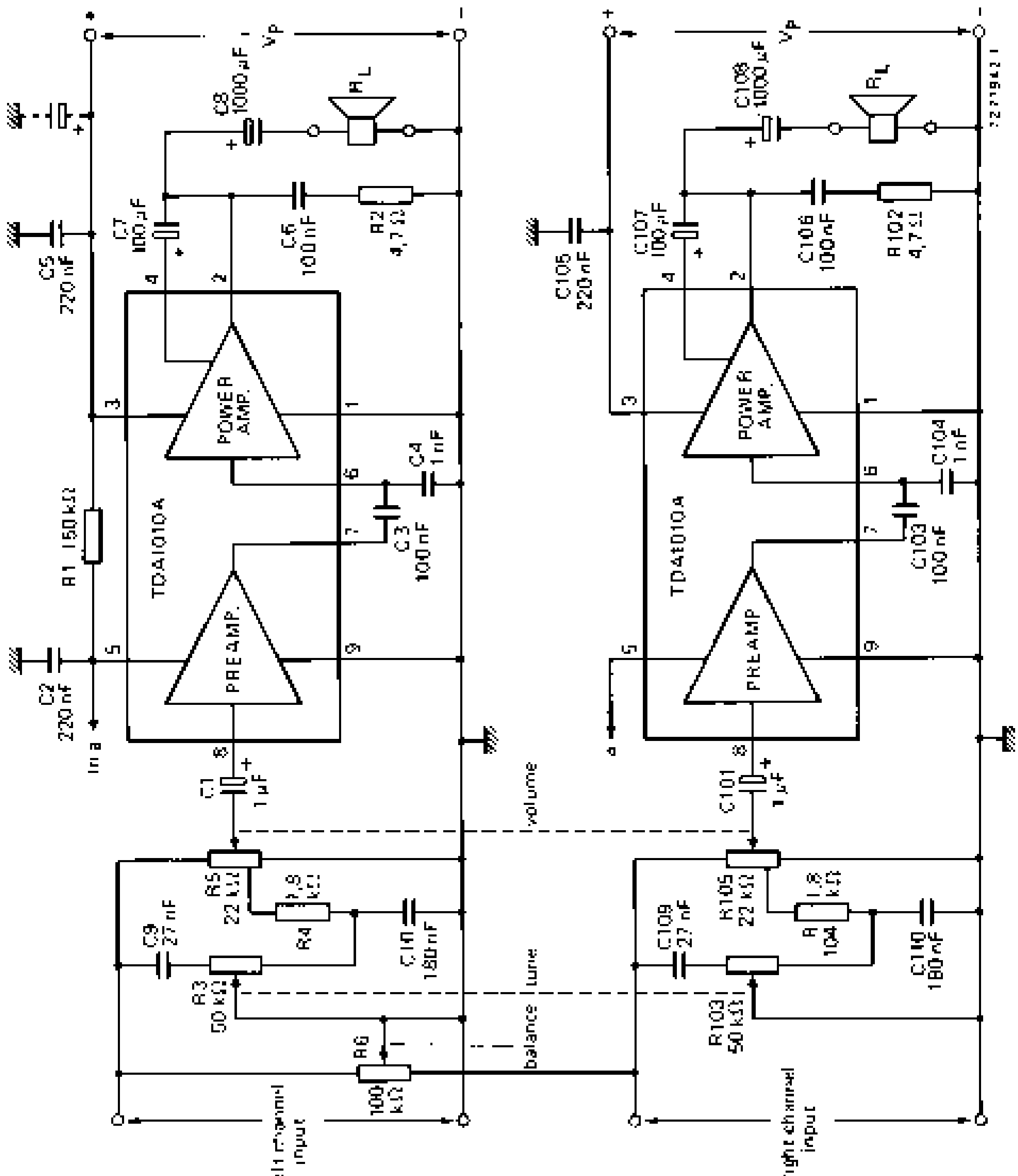


Fig. 12 Complete stereo car radio amplifier.

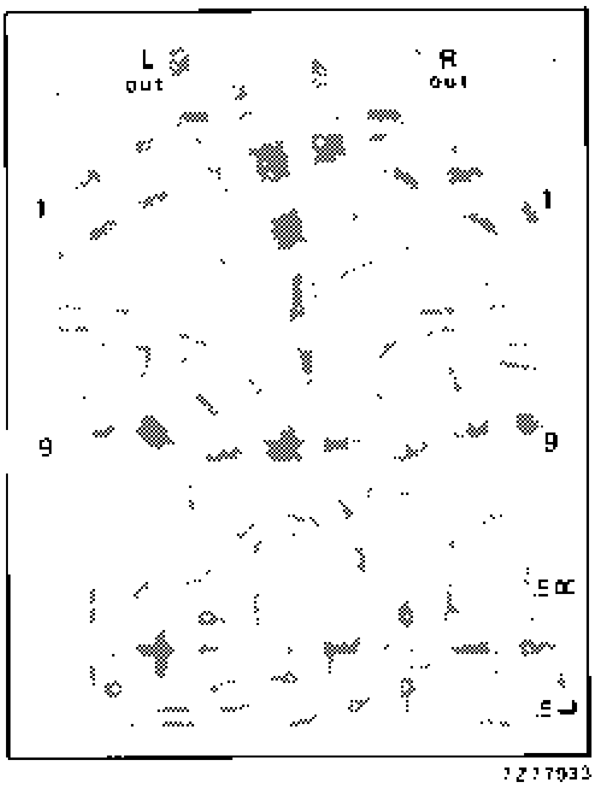


Fig. 13 Track side of printed-circuit board used for the circuit of Fig. 12; p.c. board dimensions 83 mm x 65 mm.

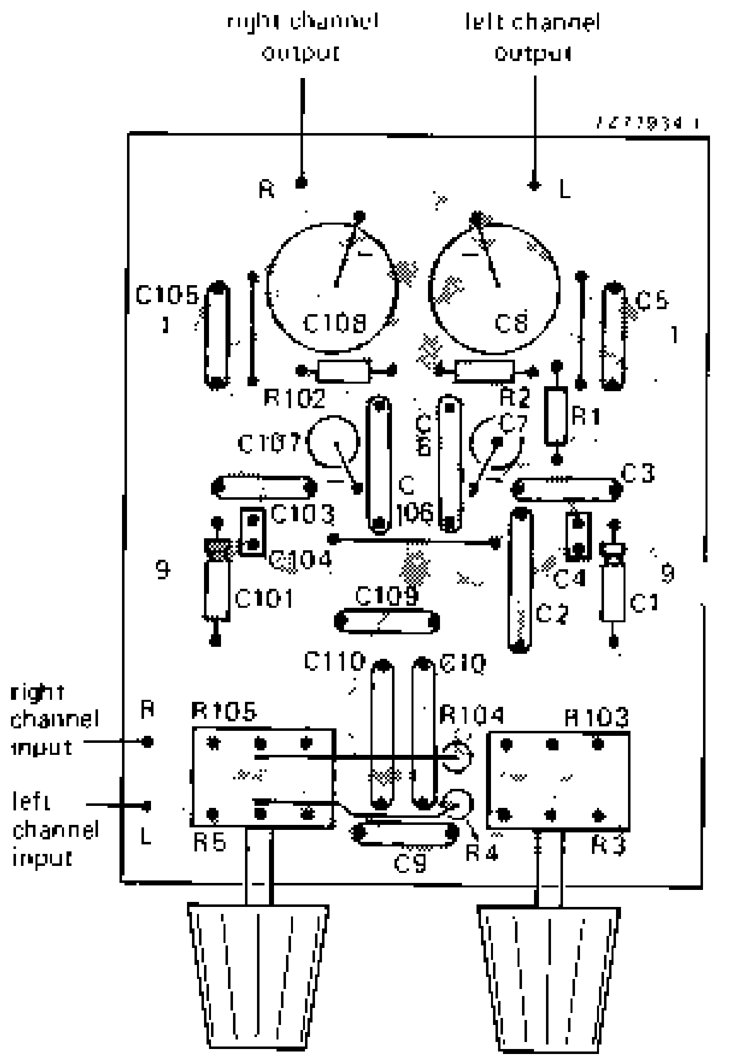


Fig. 14 Component side of printed-circuit board showing component layout used for the circuit of Fig. 12. Balance control is not on the p.c. board.

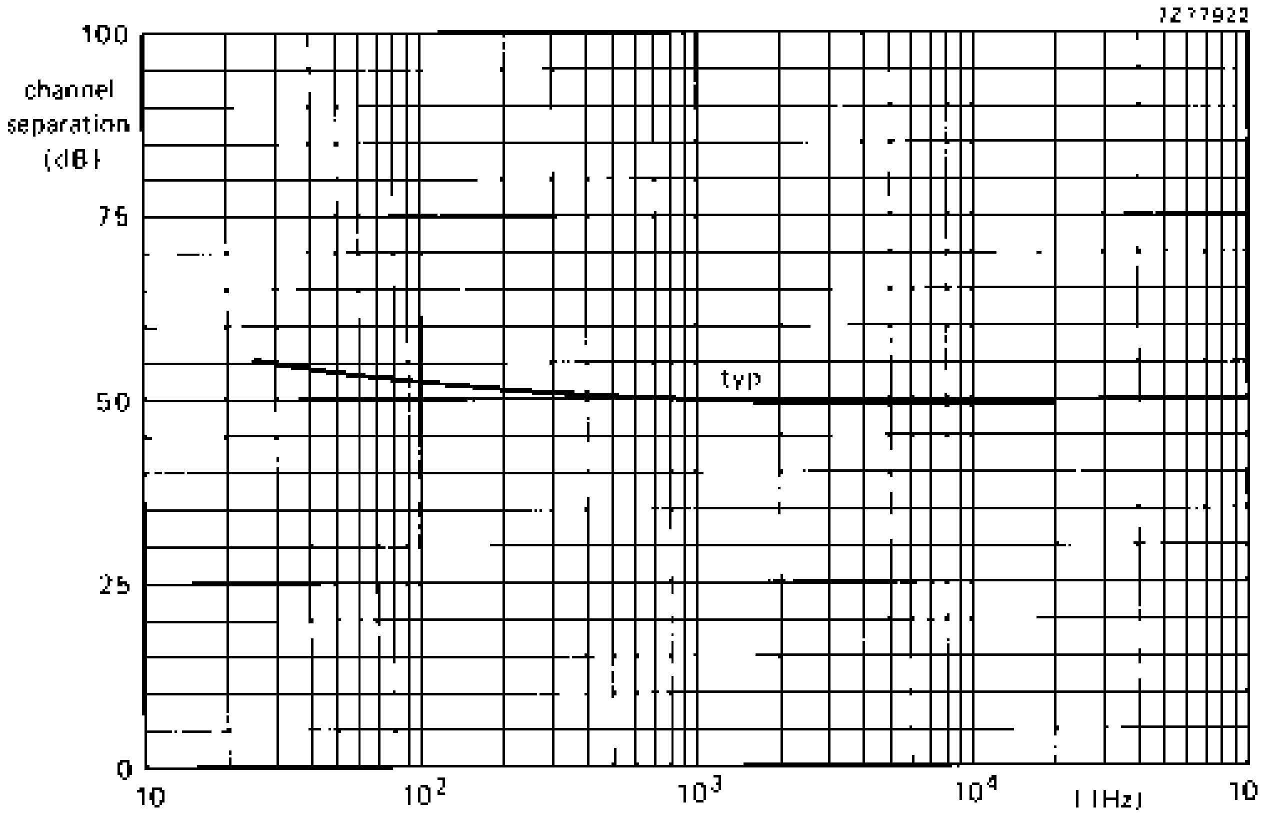


Fig. 15 Channel separation of the circuit of Fig. 12 as a function of the frequency.

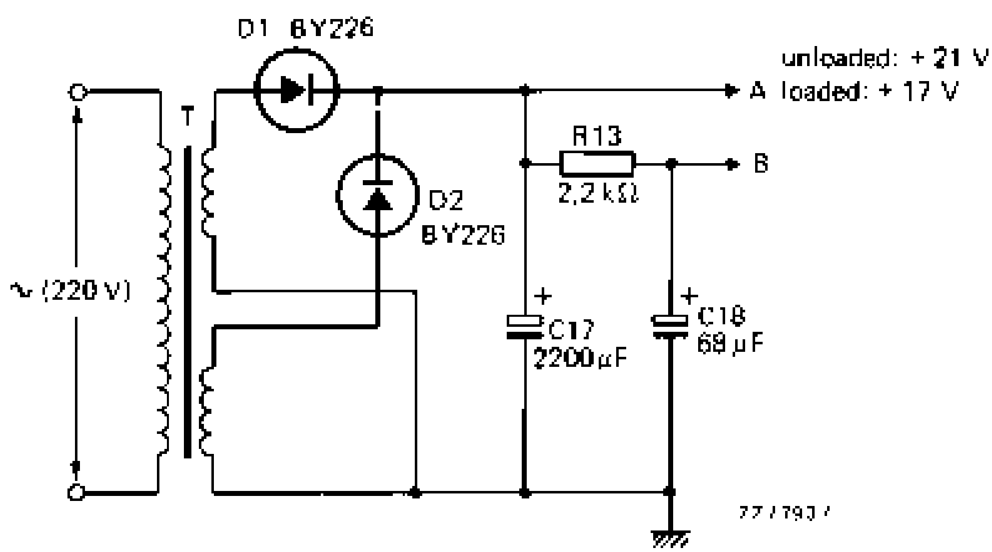


Fig. 16 Power supply of circuit of Fig. 17.

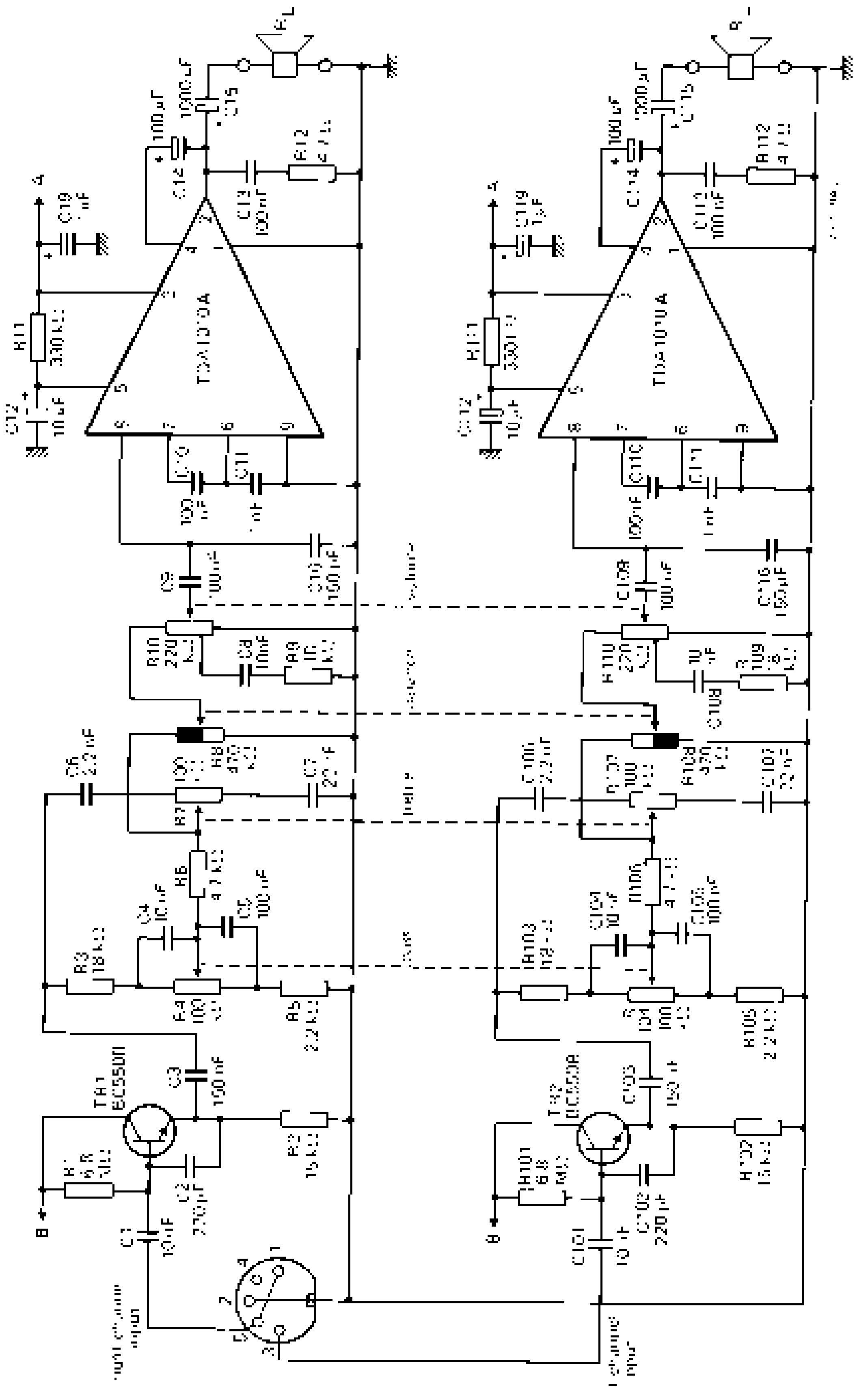

Fig. 17 Complete mains-fed ceramic stereo pick-up amplifier; for power supply see Fig. 16.

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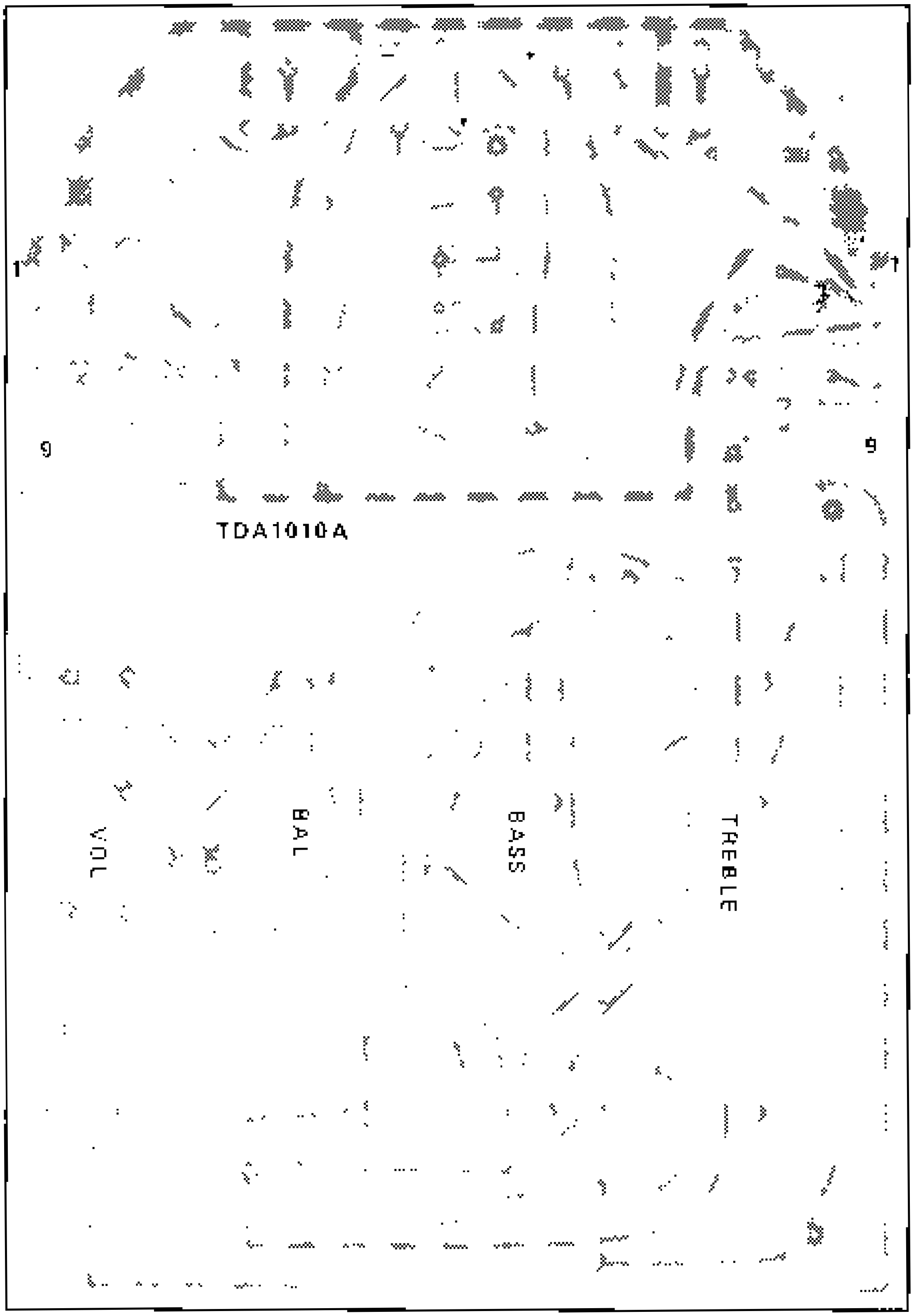


Fig. 18 Track side of printed-circuit board used for the circuit of Fig. 17 (Fig. 16 partly); p.c. board dimensions 169 mm x 118 mm.

# 6W audio amplifier with preamplifier TDA1010A

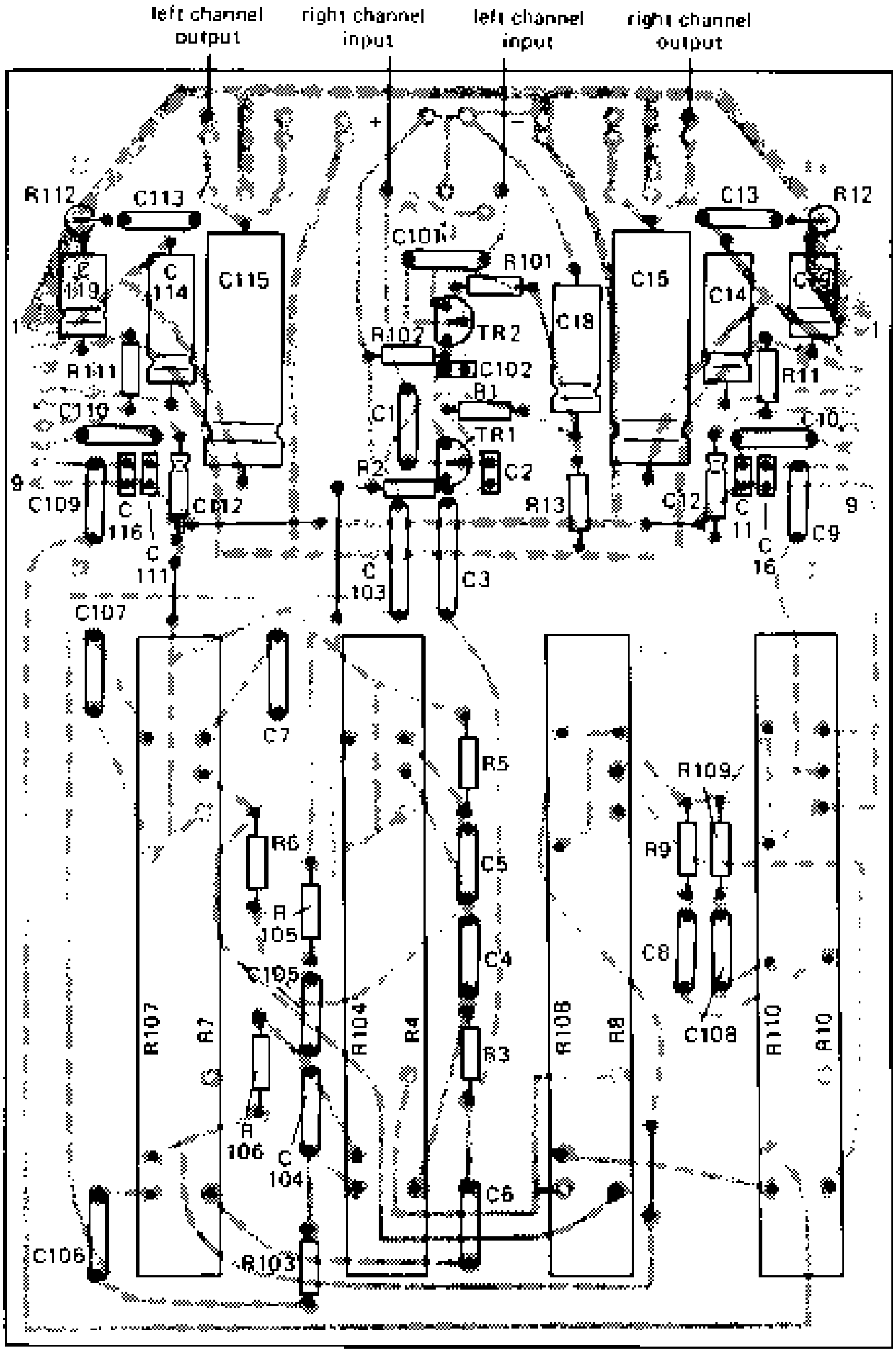


Fig. 19 Component side of printed-circuit board showing component layout used for the circuit of Fig. 17 (Fig. 16 partly).

# 6W audio amplifier with preamplifier TDA1010A

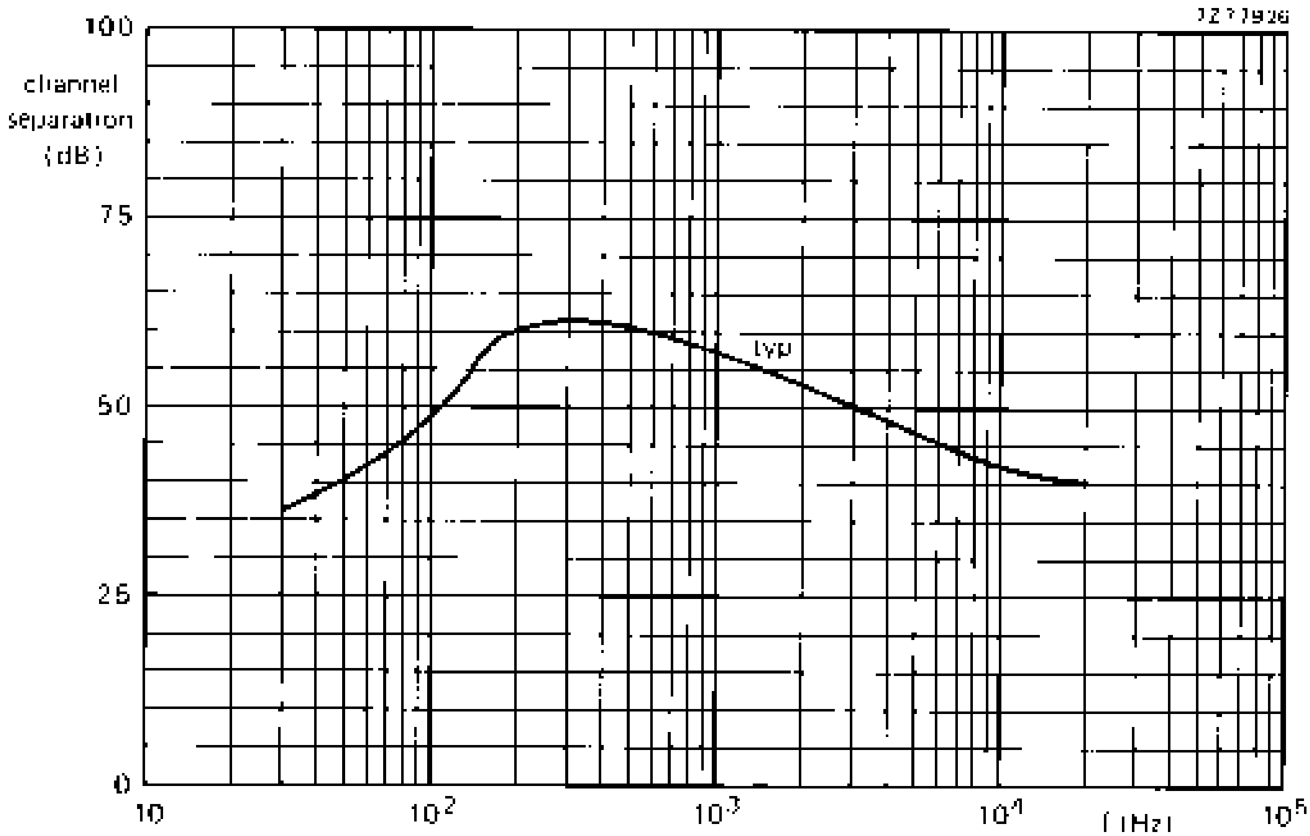


Fig. 20 Channel separation of the circuit of Fig. 17 as a function of frequency.