

# DATA SHEET

## **TDA1010A**

6 W audio power amplifier in car applications

10 W audio power amplifier in mains-fed applications

Product specification  
File under Integrated Circuits, IC01

November 1982

## 6 W audio power amplifier in car applications 10 W audio power amplifier in mains-fed

# 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  $\Omega$  and 2  $\Omega$  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; $R_L = 2$ $\Omega$	$P_o$	typ. 6,4	W
$V_P = 14,4$ V; $R_L = 4$ $\Omega$	$P_o$	typ. 6,2	W
$V_P = 14,4$ V; $R_L = 8$ $\Omega$	$P_o$	typ. 3,4	W
$V_P = 14,4$ V; $R_L = 2$ $\Omega$ ; with additional bootstrap resistor of 220 $\Omega$ between pins 3 and 4	$P_o$	typ. 9	W
Total harmonic distortion at $P_o = 1$ W; $R_L = 4$ $\Omega$	$d_{tot}$	typ. 0,2	%
Input impedance			
preamplifier (pin 8)	$ Z_i $	typ. 30	k $\Omega$
power amplifier (pin 6)	$ Z_i $	typ. 20	k $\Omega$
Total quiescent current at $V_P = 14,4$ V	$I_{tot}$	typ. 31	mA
Sensitivity for $P_o = 5,8$ W; $R_L = 4$ $\Omega$	$V_i$	typ. 10	mV
Operating ambient temperature	$T_{amb}$	-25 to + 150	$^{\circ}$ C
Storage temperature	$T_{stg}$	-55 to + 150	$^{\circ}$ C

### PACKAGE OUTLINE

9-lead SIL; plastic (SOT110B); SOT110-1; 1996 September 06.

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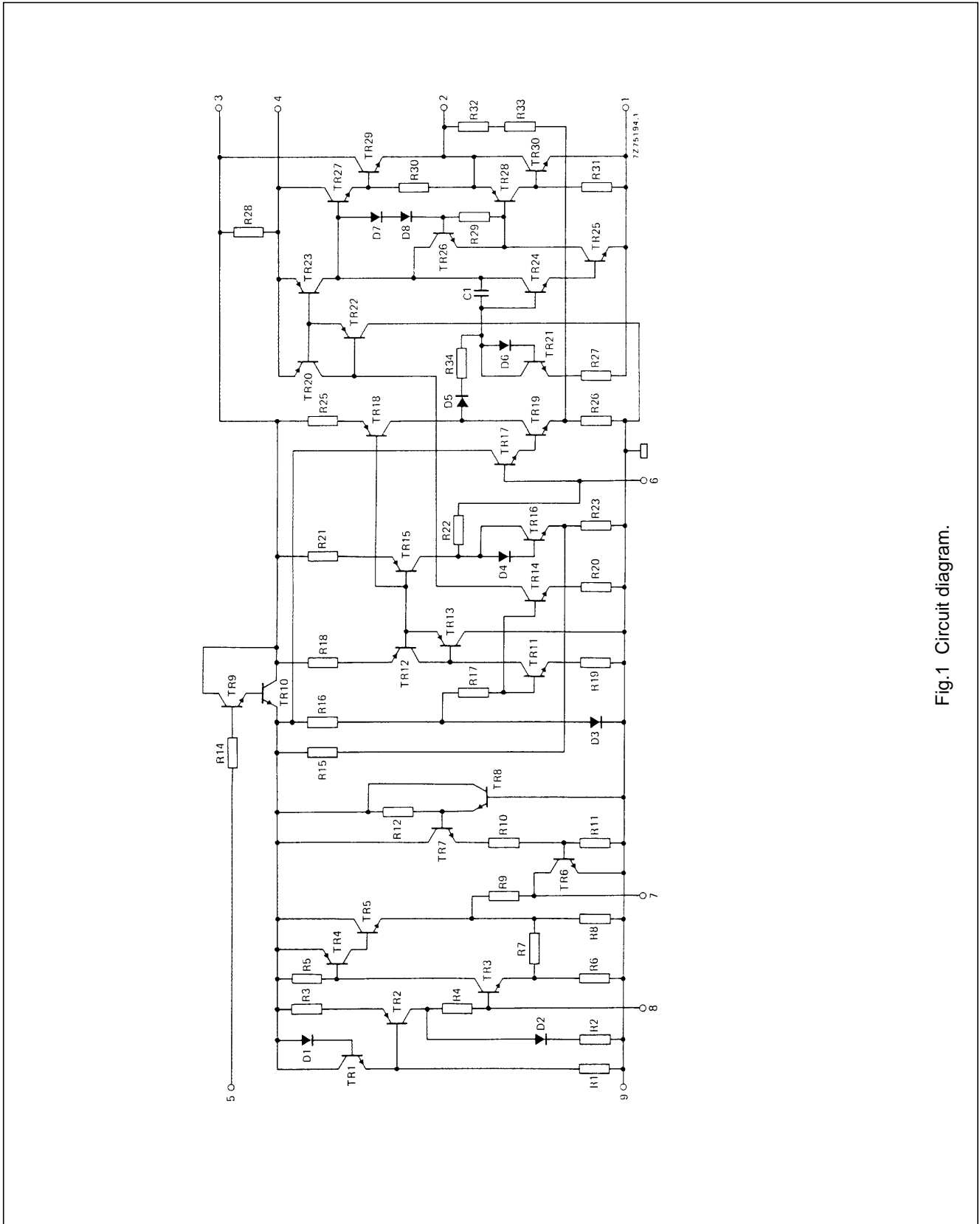


Fig.1 Circuit diagram.

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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.	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

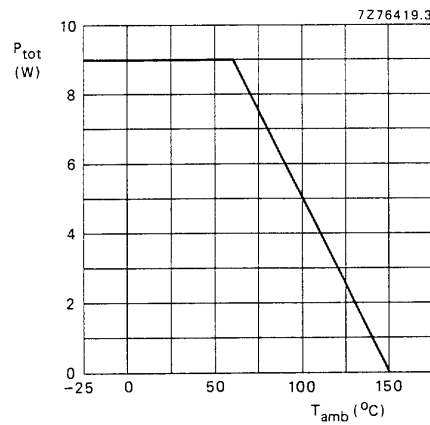


Fig.2 Power derating curve.

**HEATSINK DESIGN**

Assume  $V_P = 14,4$  V;  $R_L = 2 \Omega$ ;  $T_{amb} = 60$  °C maximum; thermal shut-down starts at  $T_j = 150$  °C. The maximum sine-wave dissipation in a  $2 \Omega$  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

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

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

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

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**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;  $R_L = 4$   $\Omega$ ;  $f = 1$  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;  $R_L = 2$   $\Omega$  (note 1)

$P_o$  typ. 6,4 W

$V_P = 14,4$  V;  $R_L = 4$   $\Omega$  (note 1 and 2)

$P_o$  > 5,9 W  
typ. 6,2 W

$V_P = 14,4$  V;  $R_L = 8$   $\Omega$  (note 1)

$P_o$  typ. 3,4 W

$V_P = 14,4$  V;  $R_L = 4$   $\Omega$ ; without bootstrap

$P_o$  typ. 5,7 W

$V_P = 14,4$  V;  $R_L = 2$   $\Omega$ ; with additional bootstrap resistor of 220  $\Omega$  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

$\eta$  typ. 75 %

Frequency response (-3 dB)

B 80 Hz to 15 kHz

Input impedance

preamplifier (note 4)

$|Z_i|$  typ. 30 k $\Omega$   
20 to 40 k $\Omega$

power amplifier (note 5)

$|Z_i|$  typ. 20 k $\Omega$   
14 to 26 k $\Omega$

Output impedance of preamplifier; pin 7 (note 5)

$|Z_o|$  typ. 20 k $\Omega$   
14 to 26 k $\Omega$

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)

$R_S = 0$   $\Omega$

$V_{n(rms)}$  typ. 0,3 mV

$R_S = 8,2$  k $\Omega$

$V_{n(rms)}$  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;  $C_2 = 1$   $\mu$ F

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

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Notes

1. Measured with an ideal coupling capacitor to the speaker load.
2. Up to  $P_o \leq 3\text{ W}$  :  $d_{tot} \leq 1\%$ .
3. Measured with a load impedance of  $20\text{ k}\Omega$ .
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  $2\text{ k}\Omega$  (maximum ripple amplitude: 2 V).
8. The tab must be electrically floating or connected to the substrate (pin 9).

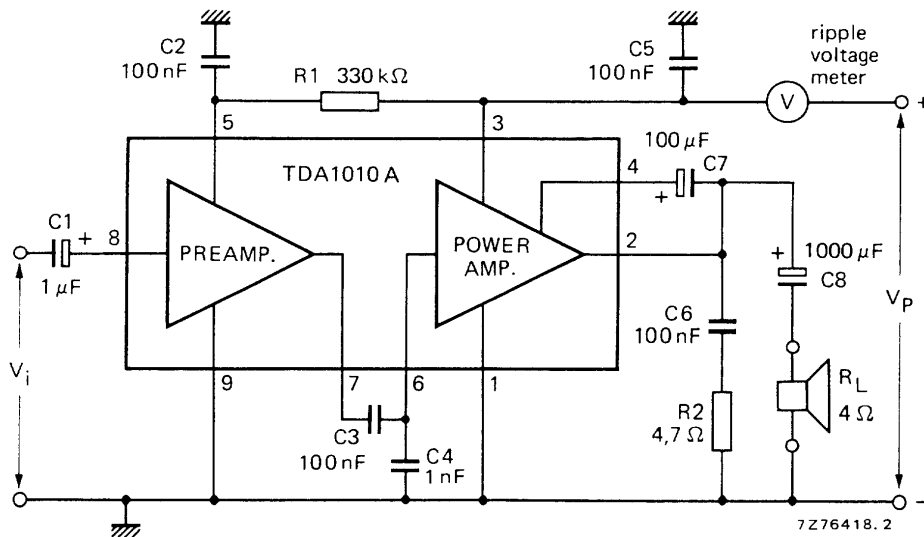


Fig.3 Test circuit.

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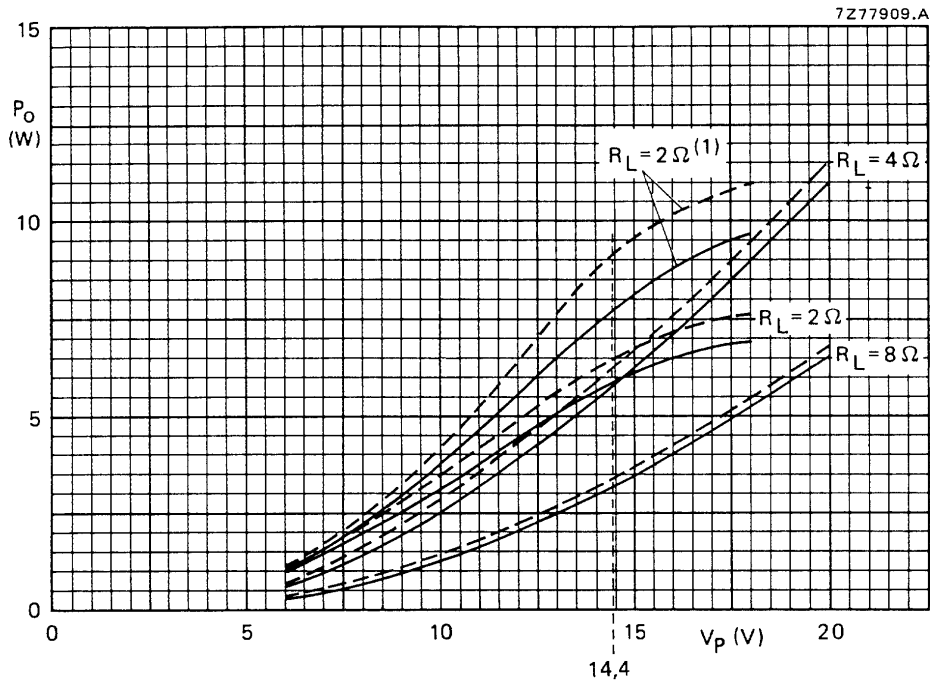


Fig.4 Output power of the circuit of Fig.3 as a function of the supply voltage with the load impedance as a parameter; typical values. Solid lines indicate the power across the load, dashed lines that available at pin 2 of the TDA1010.  $R_L = 2\ \Omega^{(1)}$  has been measured with an additional  $220\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

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  $220\ \Omega$  bootstrap resistor between pins 3 and 4. Measurements were made at  $f = 1\ \text{kHz}$ ,  $V_p = 14.4\ \text{V}$ .

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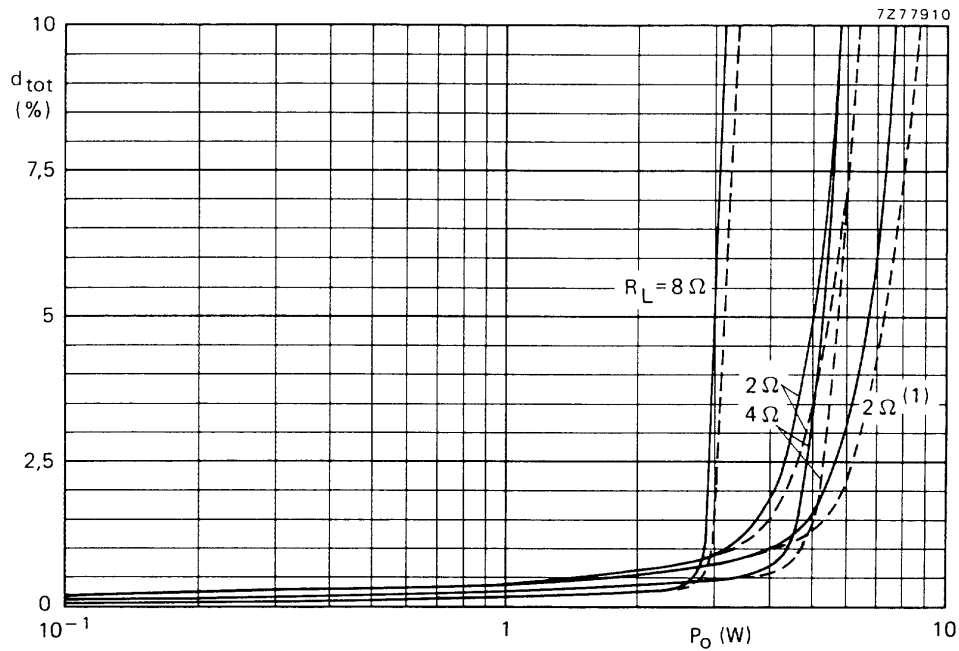


Fig.5 For caption see preceding page.

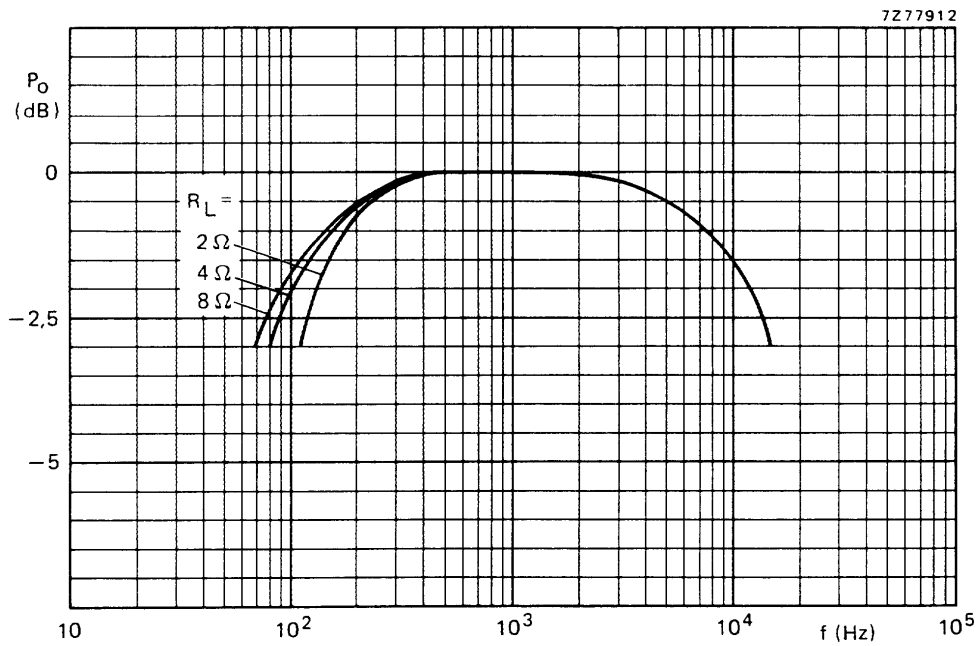


Fig.6 Frequency characteristics of the circuit of Fig.3 for three values of load impedance; typical values.  $P_o$  relative to 0 dB = 1 W;  $V_P = 14,4$  V.



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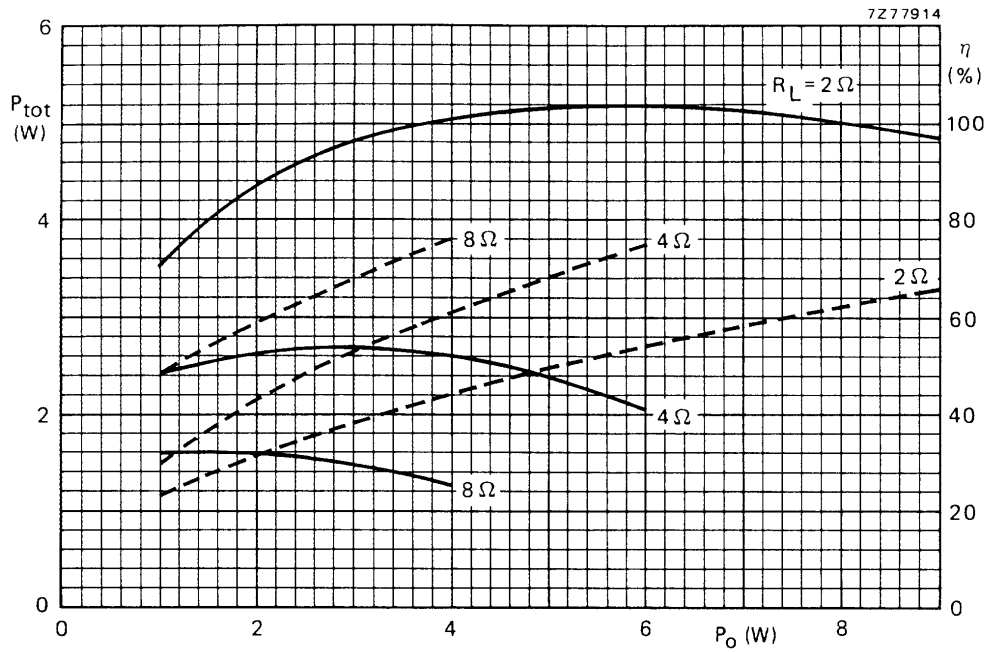


Fig.7 Total power dissipation (solid lines) and the efficiency (dashed lines) of the circuit of Fig.3 as a function of the output power with the load impedance as a parameter (for  $R_L = 2\ \Omega$  an external bootstrap resistor of  $220\ \Omega$  has been used); typical values.  $V_P = 14,4\ V$ ;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

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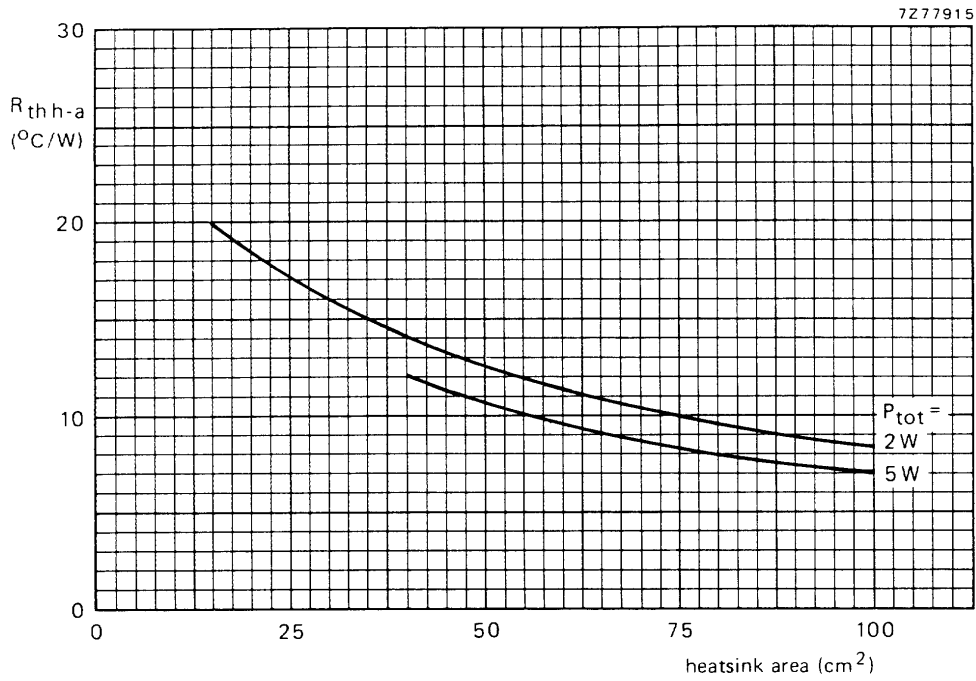


Fig.8 Thermal resistance from heatsink to ambient of a 1,5 mm thick bright aluminium heatsink as a function of the single-sided area of the heatsink with the total power dissipation as a parameter.

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APPLICATION INFORMATION

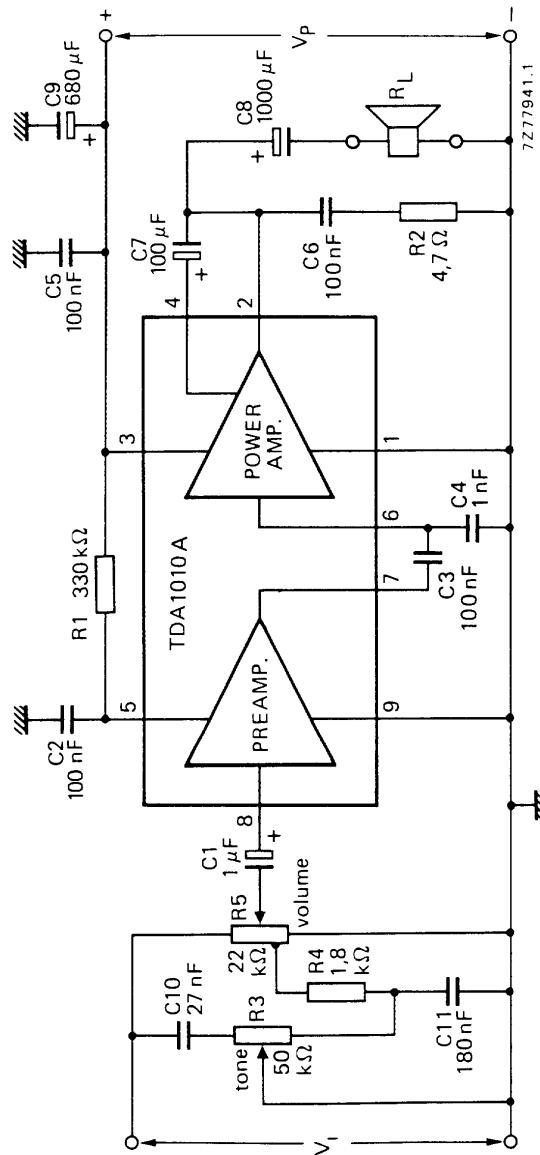
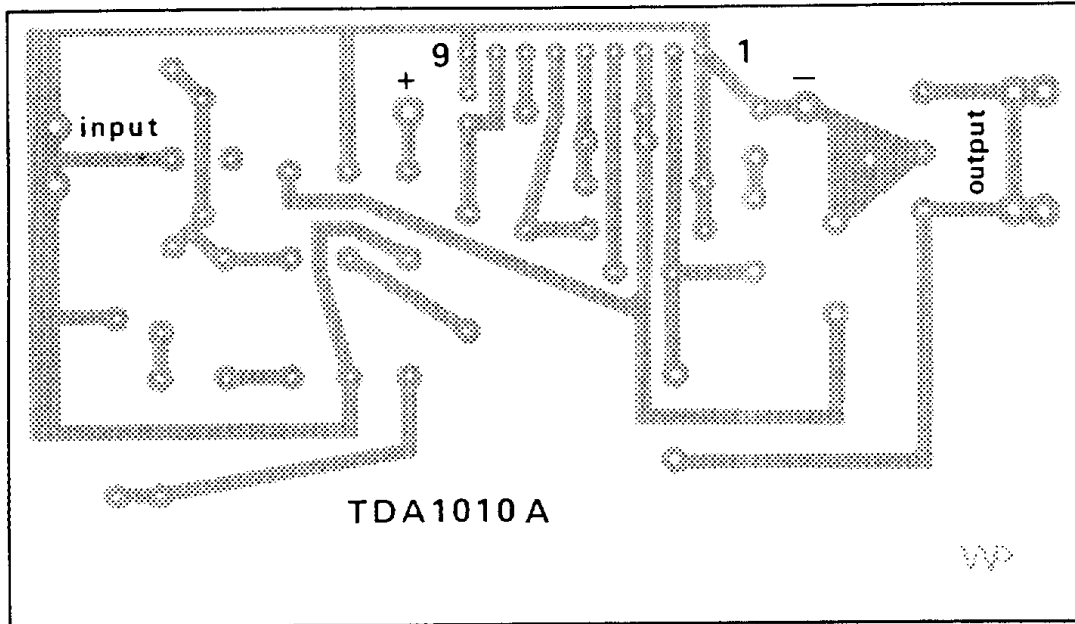


Fig.9 Complete mono audio amplifier of a car radio.

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

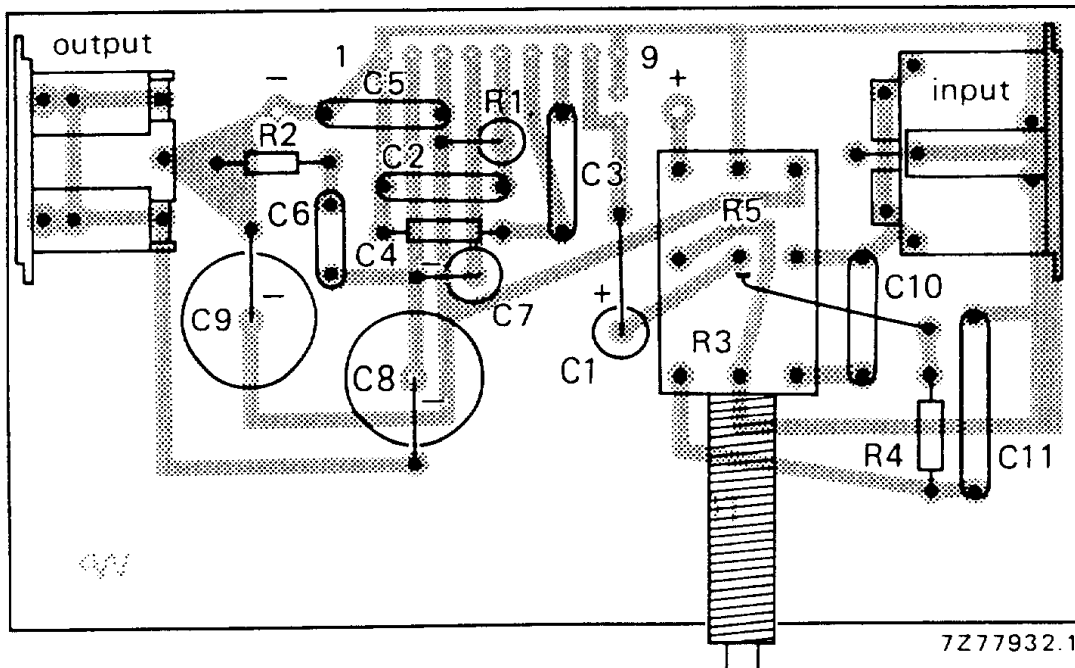


Fig.11 Component side of printed-circuit board showing component layout used for the circuit of Fig.9.

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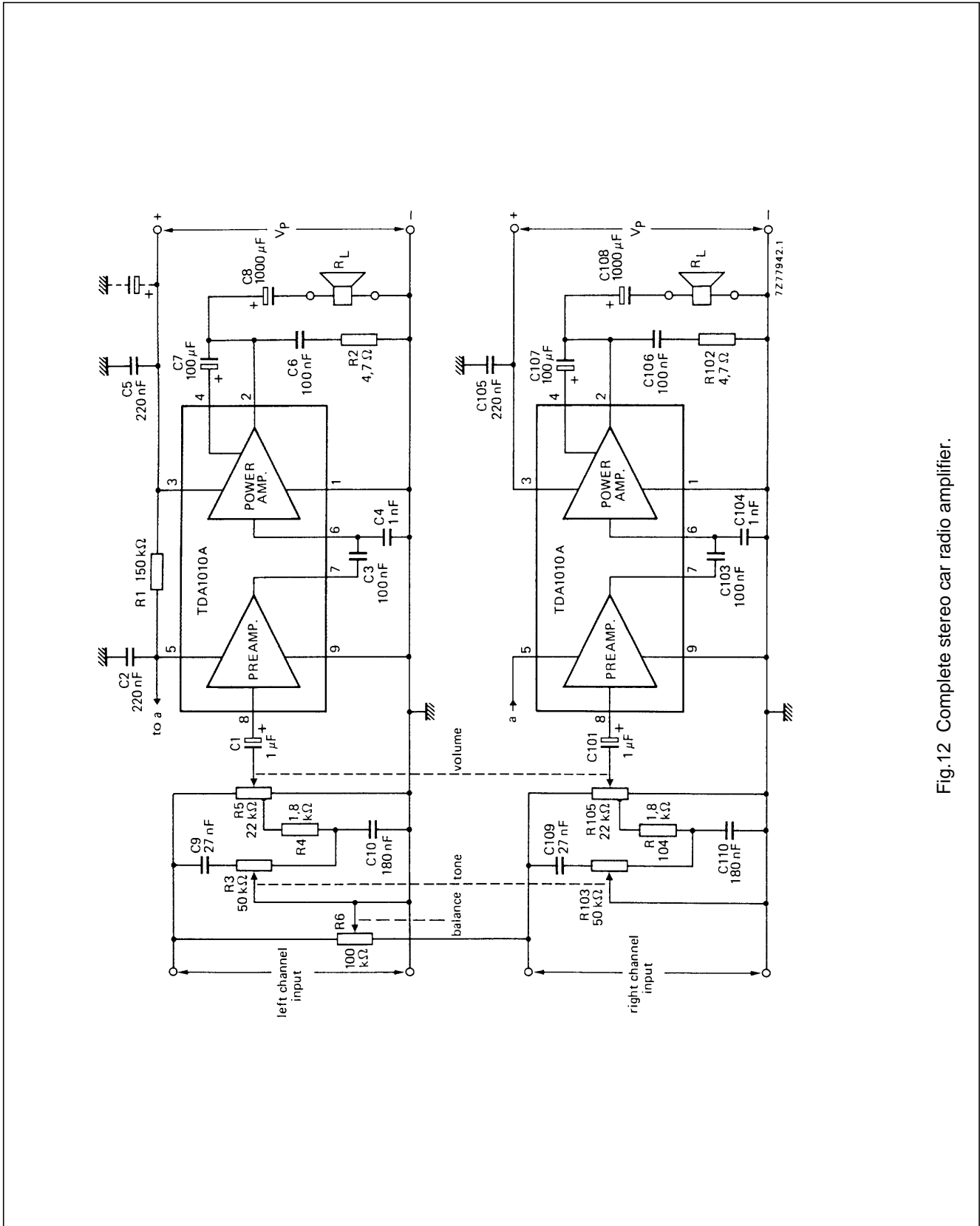
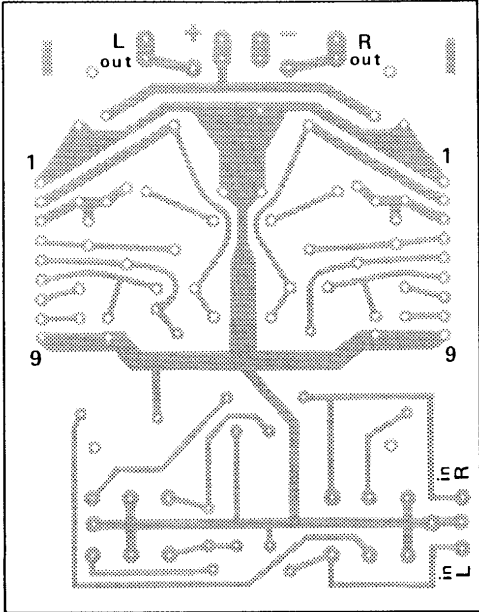


Fig.12 Complete stereo car radio amplifier.

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

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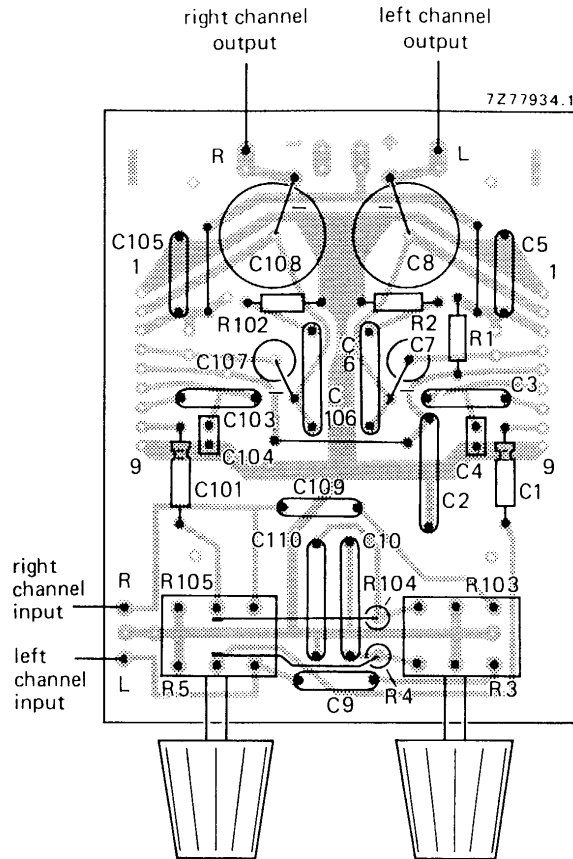


Fig.14 Component side of printed-circuit board showing component layout used for the circuit of Fig.12.  
 Balance control is not on the p.c. board.

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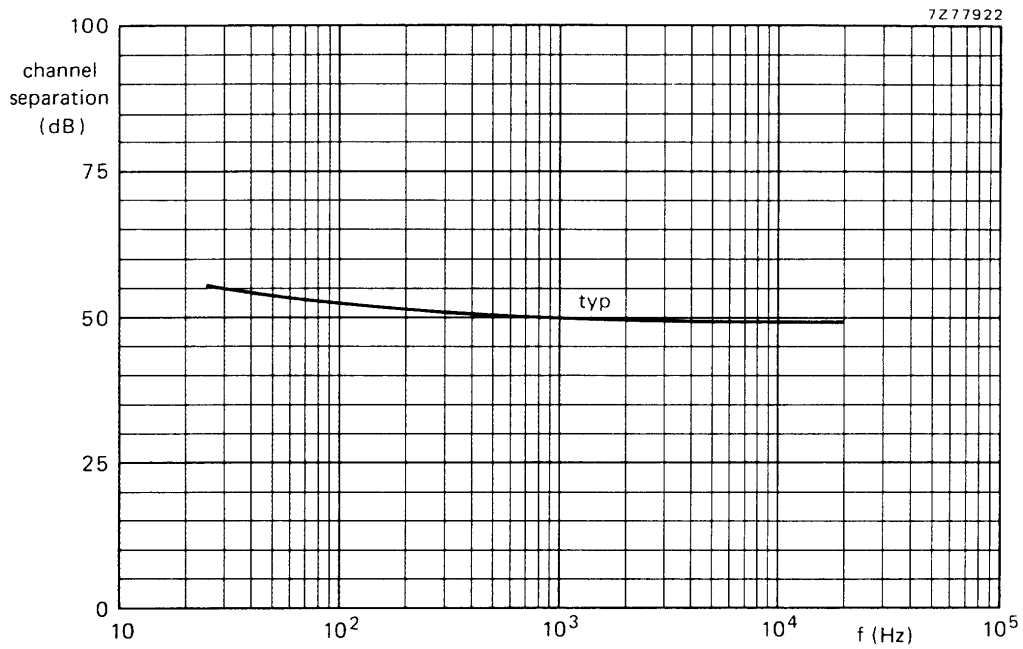


Fig.15 Channel separation of the circuit of Fig.12 as a function of the frequency.

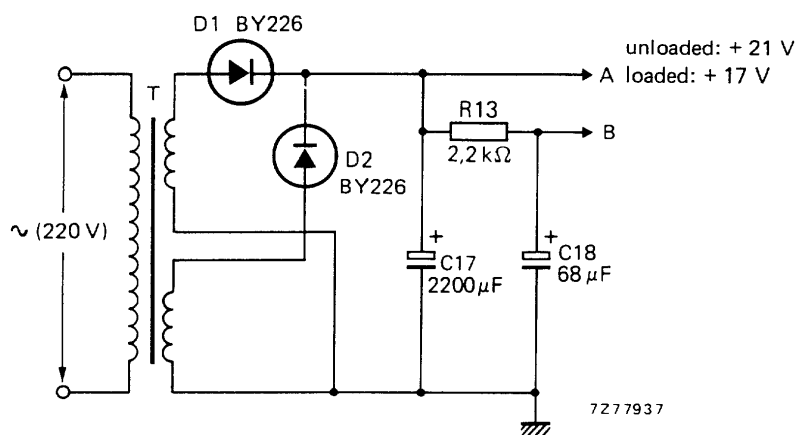


Fig.16 Power supply of circuit of Fig.17.



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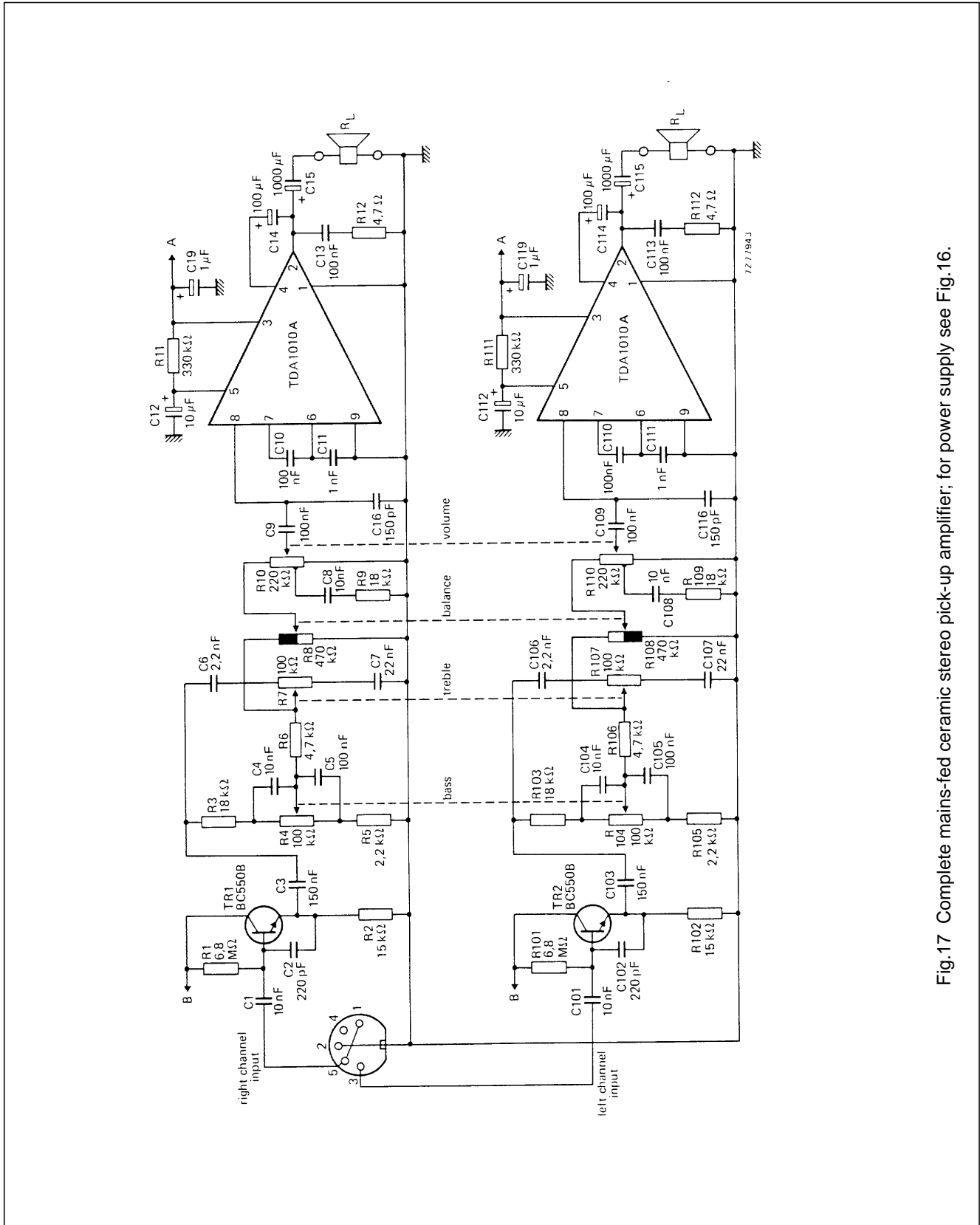


Fig.17 Complete mains-fed ceramic stereo pick-up amplifier; for power supply see Fig.16.

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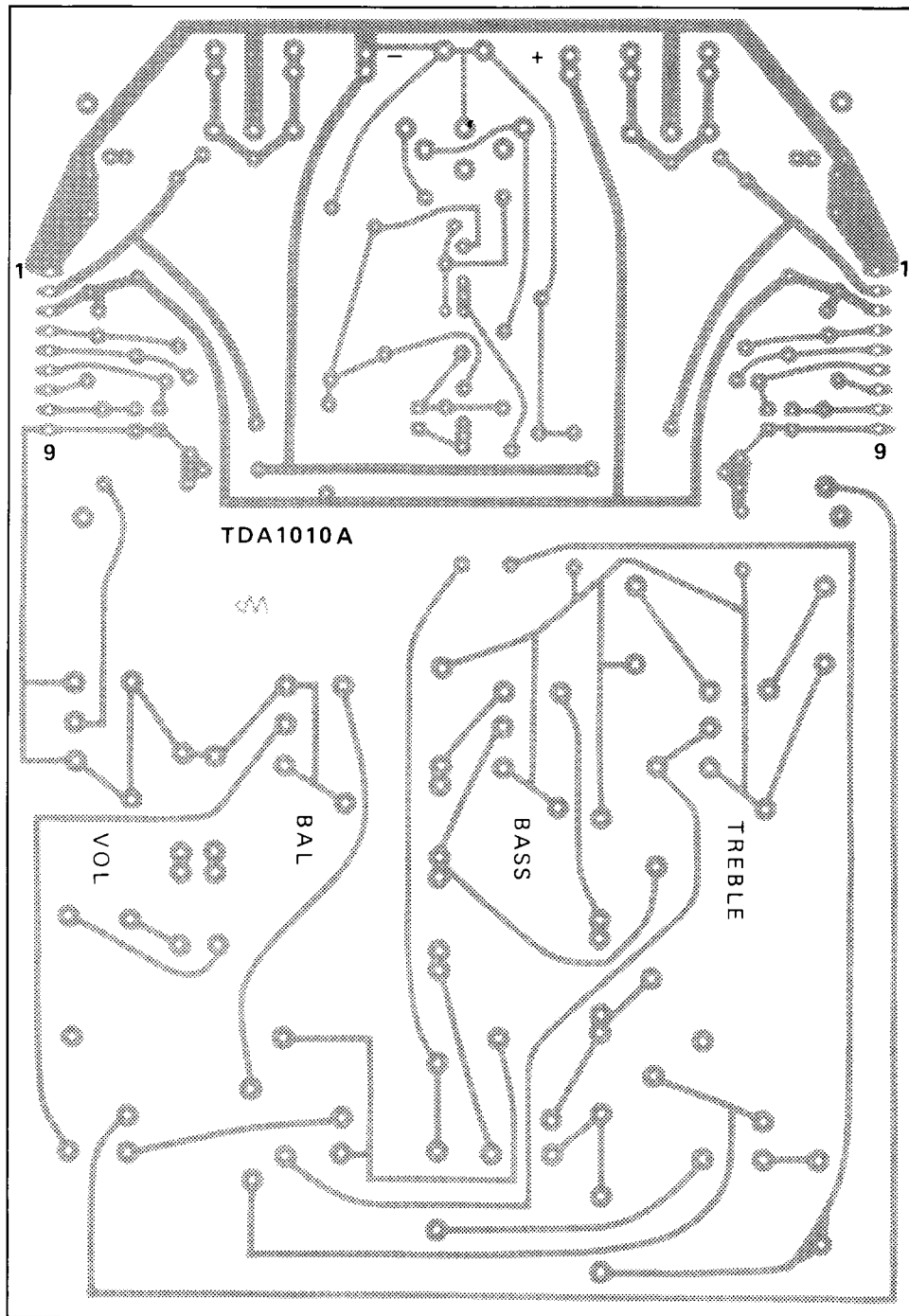


Fig.18 Track side of printed-circuit board used for the circuit of Fig.17 (Fig.16 partly); p.c. board dimensions 169 mm × 118 mm.

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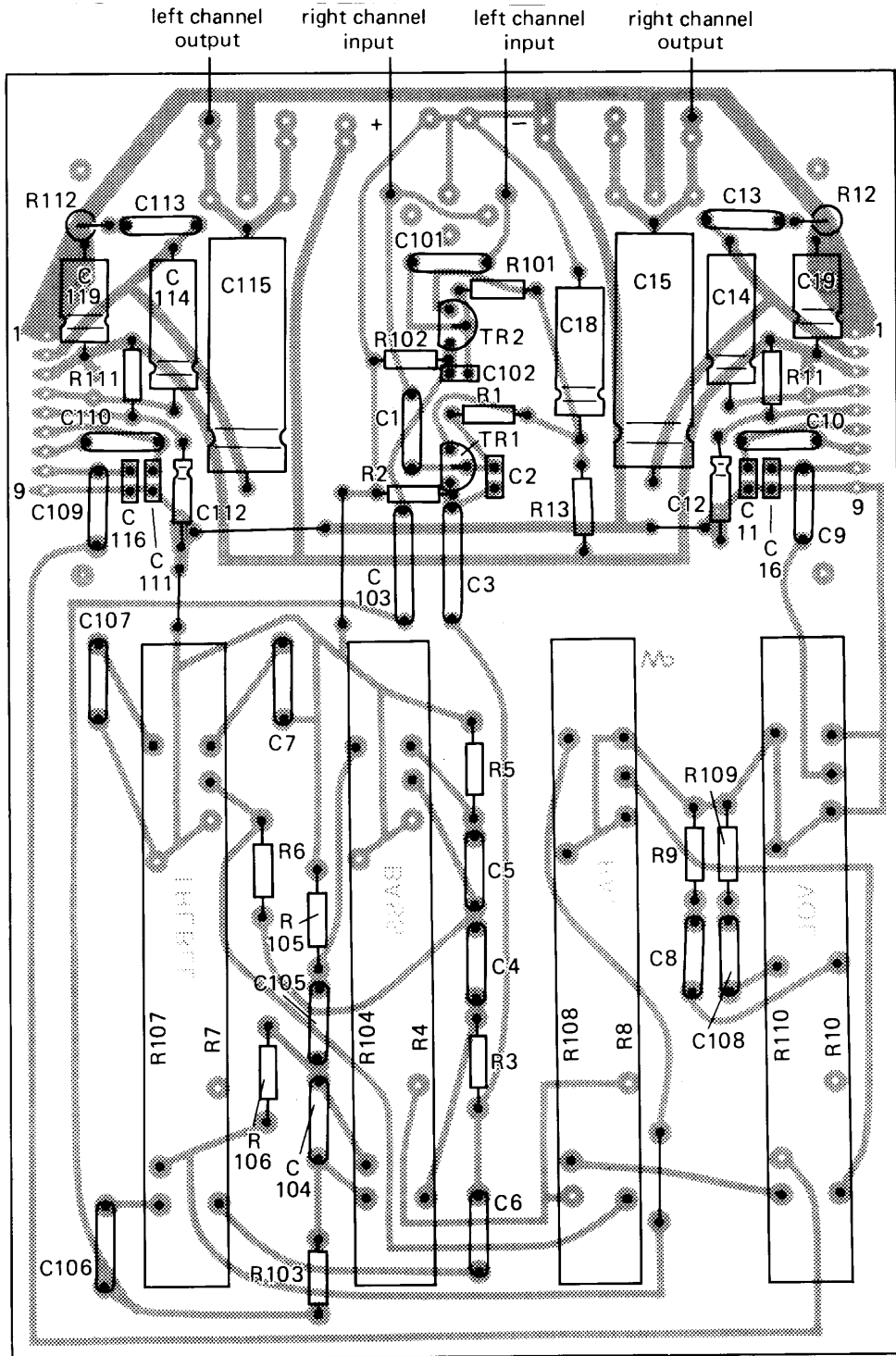
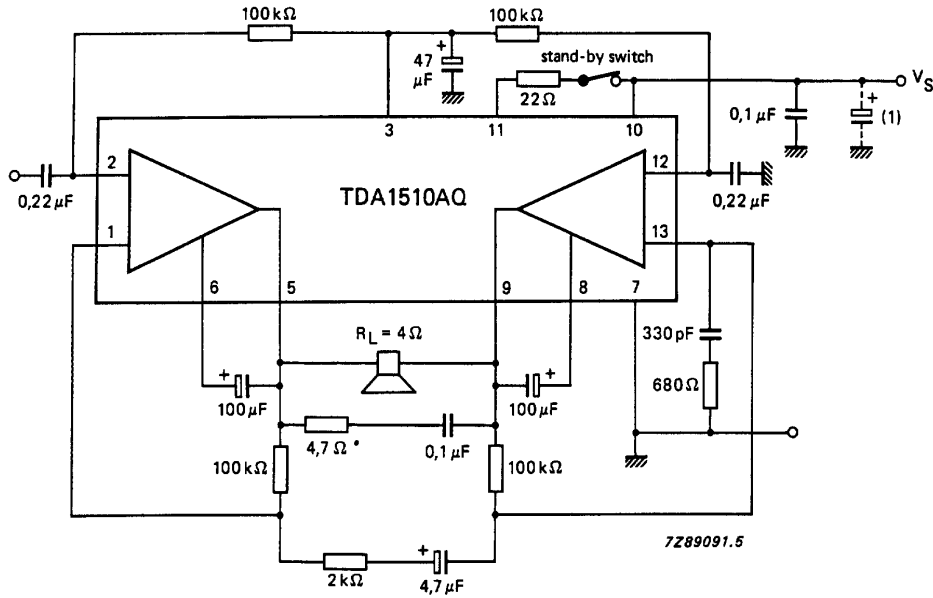


Fig.19 Component side of printed-circuit board showing component layout used for the circuit of Fig.17 (Fig.16 partly).

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(1) belongs to power supply

Fig.20 Channel separation of the circuit of Fig.18 as a function of frequency.

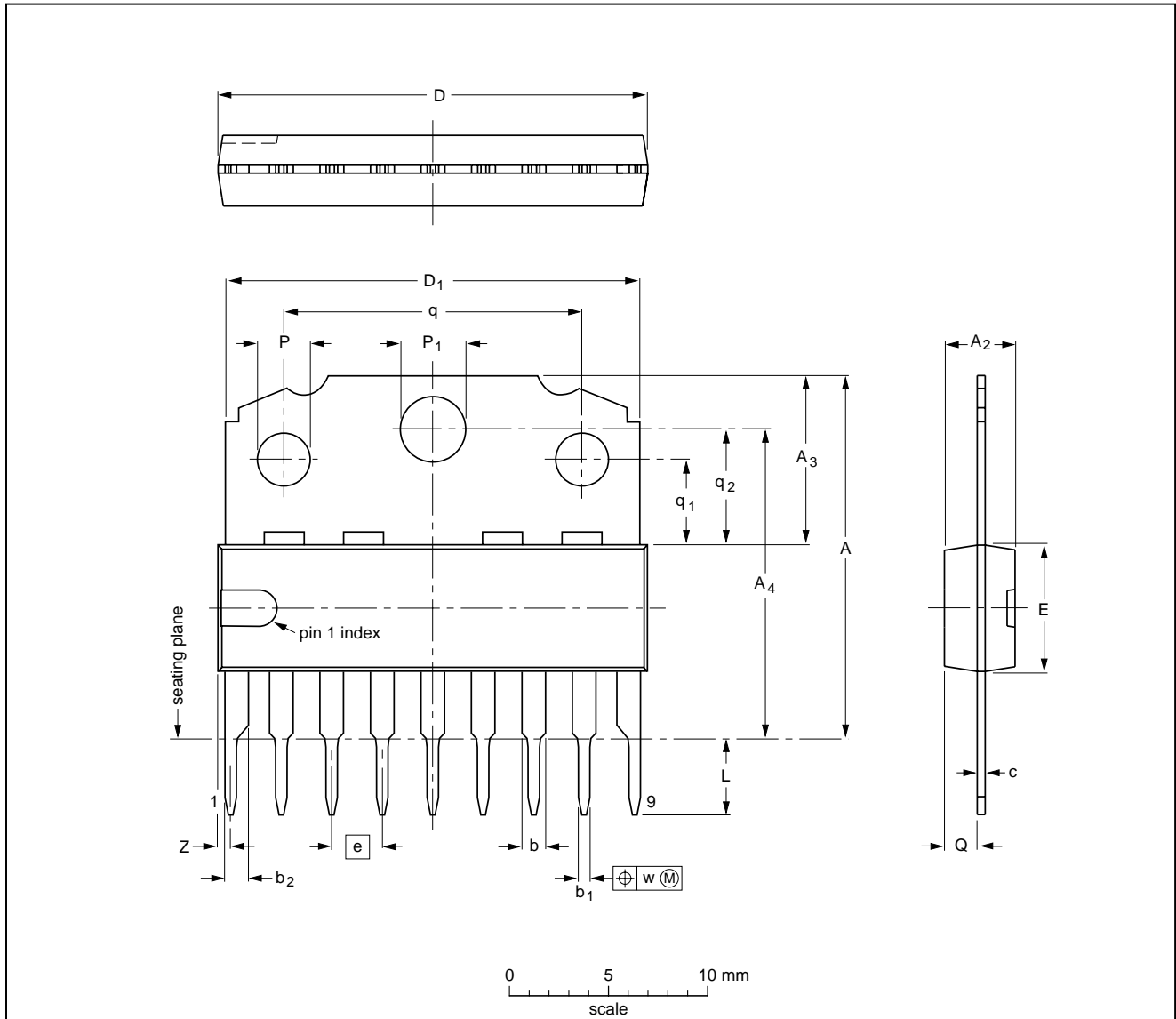
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PACKAGE OUTLINE

SIL9MPF: plastic single in-line medium power package with fin; 9 leads

SOT110-1



DIMENSIONS (mm are the original dimensions)

UNIT	A	A <sub>2</sub> max.	A <sub>3</sub>	A <sub>4</sub>	b	b <sub>1</sub>	b <sub>2</sub>	c	D <sup>(1)</sup>	D <sub>1</sub>	E <sup>(1)</sup>	e	L	P	P <sub>1</sub>	Q	q	q <sub>1</sub>	q <sub>2</sub>	w	Z <sup>(1)</sup> max.
mm	18.5 17.8	3.7	8.7 8.0	15.8 15.4	1.40 1.14	0.67 0.50	1.40 1.14	0.48 0.38	21.8 21.4	21.4 20.7	6.48 6.20	2.54	3.9 3.4	2.75 2.50	3.4 3.2	1.75 1.55	15.1 14.9	4.4 4.2	5.9 5.7	0.25	1.0

Note

1. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

OUTLINE VERSION	REFERENCES				EUROPEAN PROJECTION	ISSUE DATE
	IEC	JEDEC	EIAJ			
SOT110-1						92-11-17 95-02-25

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### SOLDERING

#### Introduction

There is no soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and surface mounted components are mixed on one printed-circuit board. However, wave soldering is not always suitable for surface mounted ICs, or for printed-circuits with high population densities. In these situations reflow soldering is often used.

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our "IC Package Databook" (order code 9398 652 90011).

#### Soldering by dipping or by wave

The maximum permissible temperature of the solder is 260 °C; solder at this temperature must not be in contact with the joint for more than 5 seconds. The total contact time of successive solder waves must not exceed 5 seconds.

The device may be mounted up to the seating plane, but the temperature of the plastic body must not exceed the specified maximum storage temperature ( $T_{stg\ max}$ ). If the printed-circuit board has been pre-heated, forced cooling may be necessary immediately after soldering to keep the temperature within the permissible limit.

#### Repairing soldered joints

Apply a low voltage soldering iron (less than 24 V) to the lead(s) of the package, below the seating plane or not more than 2 mm above it. If the temperature of the soldering iron bit is less than 300 °C it may remain in contact for up to 10 seconds. If the bit temperature is between 300 and 400 °C, contact may be up to 5 seconds.

### DEFINITIONS

Data sheet status	
Objective specification	This data sheet contains target or goal specifications for product development.
Preliminary specification	This data sheet contains preliminary data; supplementary data may be published later.
Product specification	This data sheet contains final product specifications.
Limiting values	
Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 134). Stress above one or more of the limiting values may cause permanent damage to the device. These are stress ratings only and operation of the device at these or at any other conditions above those given in the Characteristics sections of the specification is not implied. Exposure to limiting values for extended periods may affect device reliability.	
Application information	
Where application information is given, it is advisory and does not form part of the specification.	

### LIFE SUPPORT APPLICATIONS

These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. Philips customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify Philips for any damages resulting from such improper use or sale.