

DATA SHEET

TDA1553Q

**2 x 22 W BTL stereo car radio
power amplifier with loudspeaker
protection**

Product specification
File under Integrated Circuits, IC01

July 1994

2 x 22 W BTL stereo car radio power amplifier with loudspeaker protection

TDA1553Q

GENERAL DESCRIPTION

The TDA1553Q is an integrated class-B output amplifier in a 13-lead single-in-line (SIL) plastic power package. The circuit contains 2 x 22 W amplifiers in Bridge Tied Load (BTL) configuration. The device is primarily developed for car radio applications.

Features

- Requires very few external components
- High output power
- Low offset voltage at outputs
- Fixed gain
- Good ripple rejection
- Mute/stand-by switch
- Load dump protection
- AC and DC short-circuit-safe to ground and V_P
- Loudspeaker protection (LSP)
- Thermally protected
- Reverse polarity safe
- Capability to handle high energy on outputs ($V_P = 0$ V)
- Protected against electrostatic discharge
- No switch-on/switch-off plop
- Low thermal resistance
- Flexible leads

QUICK REFERENCE DATA

| PARAMETER | CONDITIONS | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|---------------------------------|--|----------------|------|------|------|--------------|
| Supply voltage range | | | | | | |
| operating | | V_P | 6.0 | 14.4 | 18.0 | V |
| non-operating | | V_P | – | – | 30 | V |
| load dump protected | | V_P | – | – | 45 | V |
| Repetitive peak output current | | I_{ORM} | – | – | 4 | A |
| Total quiescent current | | I_{tot} | – | 80 | 160 | mA |
| Stand-by current | | I_{sb} | – | 0.1 | 100 | μ A |
| Switch-on current | | I_{sw} | – | – | 60 | μ A |
| Input impedance | | $ Z_I $ | 50 | 60 | 75 | k Ω |
| Junction temperature | | T_j | – | – | 150 | $^{\circ}$ C |
| Stereo application | | | | | | |
| Output power | $R_L = 4 \Omega$; THD = 10% | P_o | 20 | 22 | – | W |
| Supply voltage ripple rejection | $R_S = 0 \Omega$ $f = 100$ Hz to 10 kHz | RR | 48 | – | – | dB |
| DC output offset voltage | | $ \Delta V_O $ | – | – | 150 | mV |
| Channel separation | | α | 40 | – | – | dB |
| Channel unbalance | | $ \Delta G_V $ | – | – | 1 | dB |

PACKAGE OUTLINE

13-lead SIL-bent-to-DIL; plastic power (SOT141R); SOT141-6; 1996 July 24.

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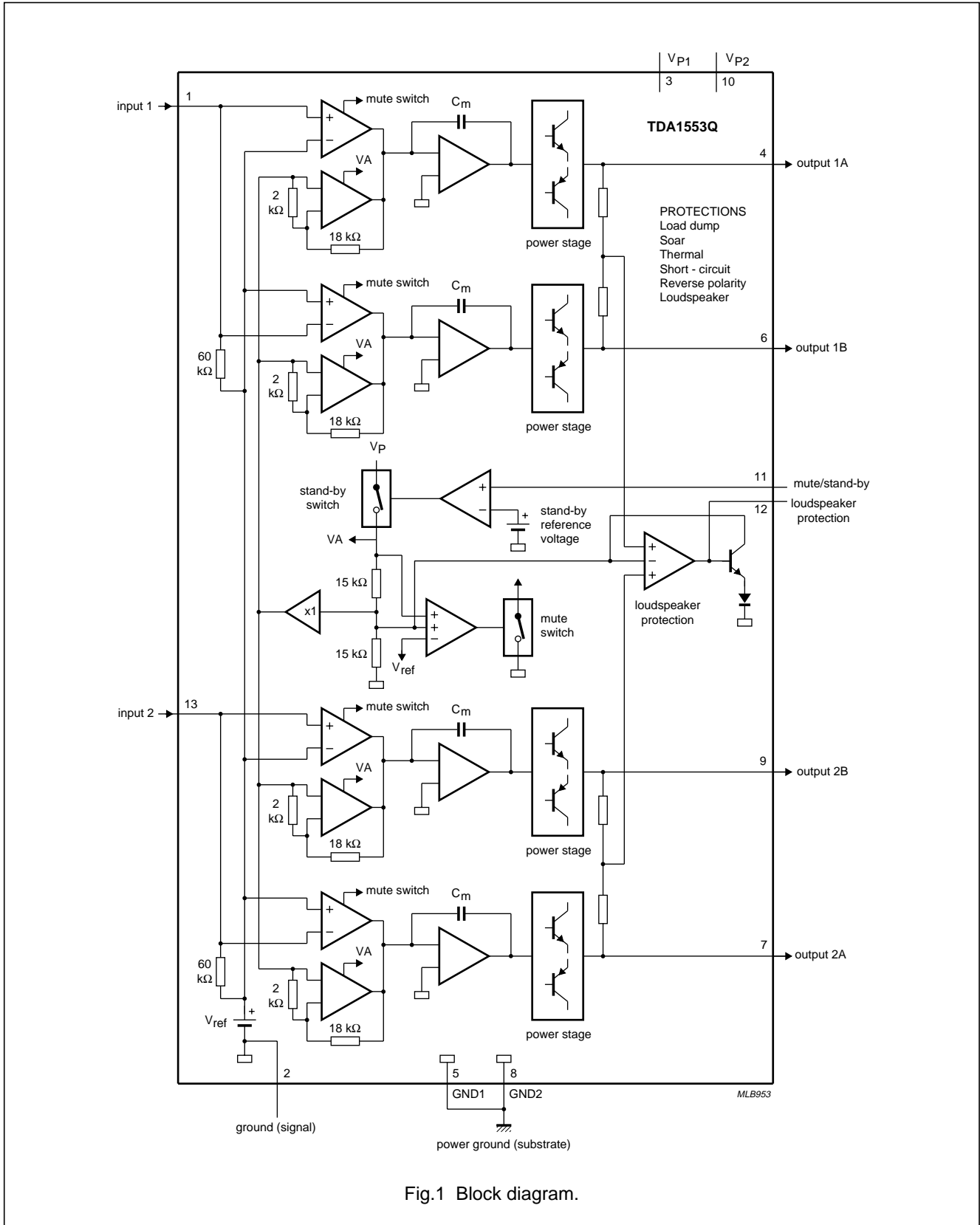


Fig.1 Block diagram.

2 x 22 W BTL stereo car radio power amplifier with loudspeaker protection

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PINNING

| | | | | | |
|---|-----------------|----------------------------|----|-----------------|----------------------------|
| 1 | IP1 | input 1 | 8 | GND2 | power ground 2 (substrate) |
| 2 | GND | ground (signal) | 9 | OUT2B | output 2B |
| 3 | V _{P1} | positive supply voltage 1 | 10 | V _{P2} | positive supply voltage 2 |
| 4 | OUT1A | output 1A | 11 | M/SS | mute/stand-by switch |
| 5 | GND1 | power ground 1 (substrate) | 12 | LSP | loudspeaker protection |
| 6 | OUT1B | output 1B | 13 | IP2 | input 2 |
| 7 | OUT2A | output 2A | | | |

FUNCTIONAL DESCRIPTION

The TDA1553Q contains two identical amplifiers with differential input stages and can be used for bridge applications. The gain of each amplifier is fixed at 26 dB. Special features of this device are:

Mute/stand-by switch

- low stand-by current (< 100 μ A)
- low mute/stand-by switching current (low cost supply switch)
- mute facility.

Loudspeaker protection

When a short-circuit to ground is made, which forces a DC voltage across the loudspeaker of ≥ 1 V, a built-in protection circuit becomes active and limits the DC voltage across the loudspeaker to ≤ 1 V. The delay time of the protection circuit can be controlled by an external capacitor connected to pin 12.

RATINGS

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

| PARAMETER | CONDITIONS | SYMBOL | MIN. | MAX. | UNIT |
|---------------------------------------|---|------------------|------|-------|--------------|
| Supply voltage | | | | | |
| operating | | V _P | – | 18 | V |
| non-operating | | V _P | – | 30 | V |
| load dump protected | during 50 ms; t _r \geq 2.5 ms | V _P | – | 45 | V |
| Non-repetitive peak output current | | I _{OSM} | – | 6 | A |
| Repetitive peak output current | | I _{ORM} | – | 4 | A |
| Storage temperature range | | T _{stg} | –55 | + 150 | $^{\circ}$ C |
| Junction temperature | | T _j | – | 150 | $^{\circ}$ C |
| AC and DC short-circuit-safe voltage | | V _{PSC} | – | 18 | V |
| Energy handling capability at outputs | V _P = 0 V | | – | 200 | mJ |
| Reverse polarity | | V _{PR} | – | 6 | V |
| Total power dissipation | see Fig.2 | P _{tot} | – | 60 | W |

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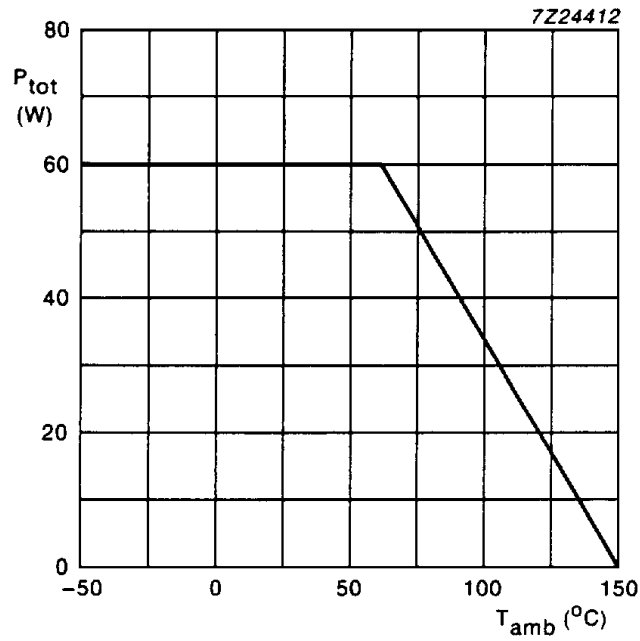


Fig.2 Power derating curve.

2 x 22 W BTL stereo car radio power amplifier with loudspeaker protection

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DC CHARACTERISTICS

$V_P = 14.4$ V; $T_{amb} = 25$ °C; measurements taken using Fig.3; unless otherwise specified

| PARAMETER | CONDITIONS | SYMBOL | MIN. | TYP. | MAX. | UNIT |
|---|--|------------------|------|------|------|---------|
| Supply | | | | | | |
| Supply voltage range | note 1 | V_P | 6.0 | 14.4 | 18.0 | V |
| Total quiescent current | | I_{tot} | – | 80 | 160 | mA |
| DC output voltage | note 2 | V_O | – | 6.9 | – | V |
| DC output offset voltage | | $ \Delta V_O $ | – | – | 150 | mV |
| Mute/stand-by switch | | | | | | |
| Switch-on voltage level | | V_{ON} | 8.5 | – | – | V |
| Mute condition | | | | | | |
| Output signal in mute position | $V_I = 1$ V (max.); $f = 1$ kHz | V_O | – | – | 2 | mV |
| DC output offset voltage (between pins 4 to 6 and 7 to 9) | | $ \Delta V_O $ | – | – | 150 | mV |
| Stand-by condition | | | | | | |
| DC current in stand-by condition | $V_{II} < 0.5$ V $0.5 \leq V_{II} < 2$ V | I_{sb} | – | – | 100 | μ A |
| | | I_{sb} | – | – | 500 | μ A |
| Switch-on current | | I_{sw} | – | 25 | 60 | μ A |
| Supply current | short-circuit to ground note 3 | I_p | – | 5.5 | – | mA |
| Loudspeaker protection | | | | | | |
| DC voltage across R_L pin 4 to pin 6 | | ΔV_{4-6} | – | – | 1 | V |
| pin 7 to pin 9 | | ΔV_{7-9} | – | – | 1 | V |
| Delay time | | t_d | – | 0.5 | – | s |
| <i>Protection active</i> | $ \Delta V_{4-6} $ or $ \Delta V_{7-9} \geq 1.0$ V | | | | | |
| Current information | | I_{12} | – | 25 | – | μ A |
| Voltage information | | V_{12} | 2 | – | – | V |
| <i>Protection not active</i> | $ \Delta V_{4-6} $ and $ \Delta V_{7-9} \leq 0.1$ V | | | | | |
| Voltage information | | V_{12} | – | – | 0.3 | V |

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AC CHARACTERISTICS

$V_P = 14.4\text{ V}$; $R_L = 4\ \Omega$; $f = 1\text{ kHz}$; $T_{\text{amb}} = 25\text{ }^\circ\text{C}$; measurements taken using Fig.3; unless otherwise specified

| PARAMETER | CONDITIONS | SYMBOL | MIN. | TYP. | MAX. | UNIT | |
|---------------------------------------|-------------------------------------|-------------------------------------|----------------------|----------------|------|------------|---------------|
| Output power | THD = 0.5% | P_o | 15 | 17 | – | W | |
| | THD = 10% | P_o | 20 | 22 | – | W | |
| Output power at $V_P = 13.2\text{ V}$ | THD = 0.5% | P_o | – | 12 | – | W | |
| | THD = 10% | P_o | – | 17 | – | W | |
| Total harmonic distortion | $P_o = 1\text{ W}$ | THD | – | 0.1 | – | % | |
| Power bandwidth | THD = 0.5% | B_w | – | 20 to 15000 | – | Hz | |
| | $P_o = -1\text{ dB}$ w.r.t. 15 W | | | | | | |
| Low frequency roll-off | note 4 | f_L | – | 25 | – | Hz | |
| | -1 dB | | | | | | |
| High frequency roll-off | -1 dB | f_H | 20 | – | – | kHz | |
| Closed loop voltage gain | | G_V | 25 | 26 | 27 | dB | |
| Supply voltage ripple rejection | notes 5, 6 | RR | 42 | – | – | dB | |
| | ON | RR | 48 | – | – | dB | |
| | mute | RR | 48 | – | – | dB | |
| | stand-by | RR | 80 | – | – | dB | |
| Input impedance | | $ Z_i $ | 50 | 60 | 75 | k Ω | |
| Noise output voltage (RMS value) | | | | | | | |
| | ON | $R_S = 0\ \Omega$; note 8 | $V_{\text{no(rms)}}$ | – | 70 | 120 | μV |
| | ON | $R_S = 10\ \text{k}\Omega$; note 8 | $V_{\text{no(rms)}}$ | – | 100 | – | μV |
| | mute | notes 8, 9 | $V_{\text{no(rms)}}$ | – | 60 | – | μV |
| Channel separation | | α | 40 | – | – | dB | |
| Channel unbalance | | $ \Delta G_V $ | – | – | 1 | dB | |

Notes to the characteristics

- The circuit is DC adjusted at $V_P = 6\text{ V}$ to 18 V and AC operating at $V_P = 8.5\text{ V}$ to 18 V .
- At $18\text{ V} < V_P < 30\text{ V}$ the DC output voltage $\leq V_P/2$.
- Conditions:
 - $V_{11} = 0\text{ V}$
 - short-circuit to GND
 - switch V_{11} to MUTE or ON condition (rise time $\geq 10\ \mu\text{s}$).
- Frequency response externally fixed.
- Ripple rejection measured at the output with a source impedance of $0\ \Omega$ (maximum ripple amplitude of 2 V).
- Frequency $f = 100\text{ Hz}$.
- Frequency between 1 kHz and 10 kHz .
- Noise voltage measured in a bandwidth of 20 Hz to 20 kHz .
- Noise output voltage independent of R_S ($V_1 = 0\text{ V}$).

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APPLICATION INFORMATION

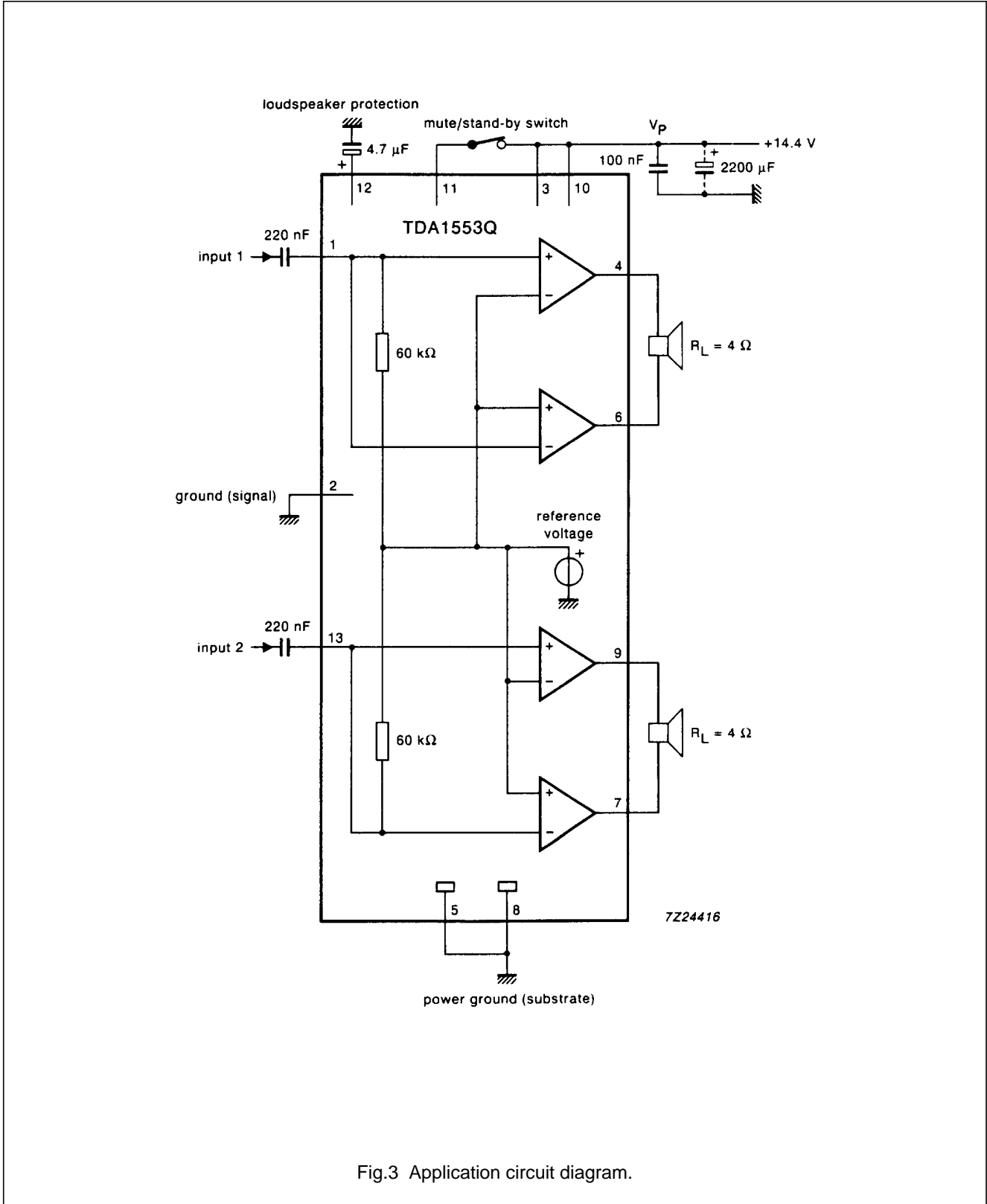


Fig.3 Application circuit diagram.

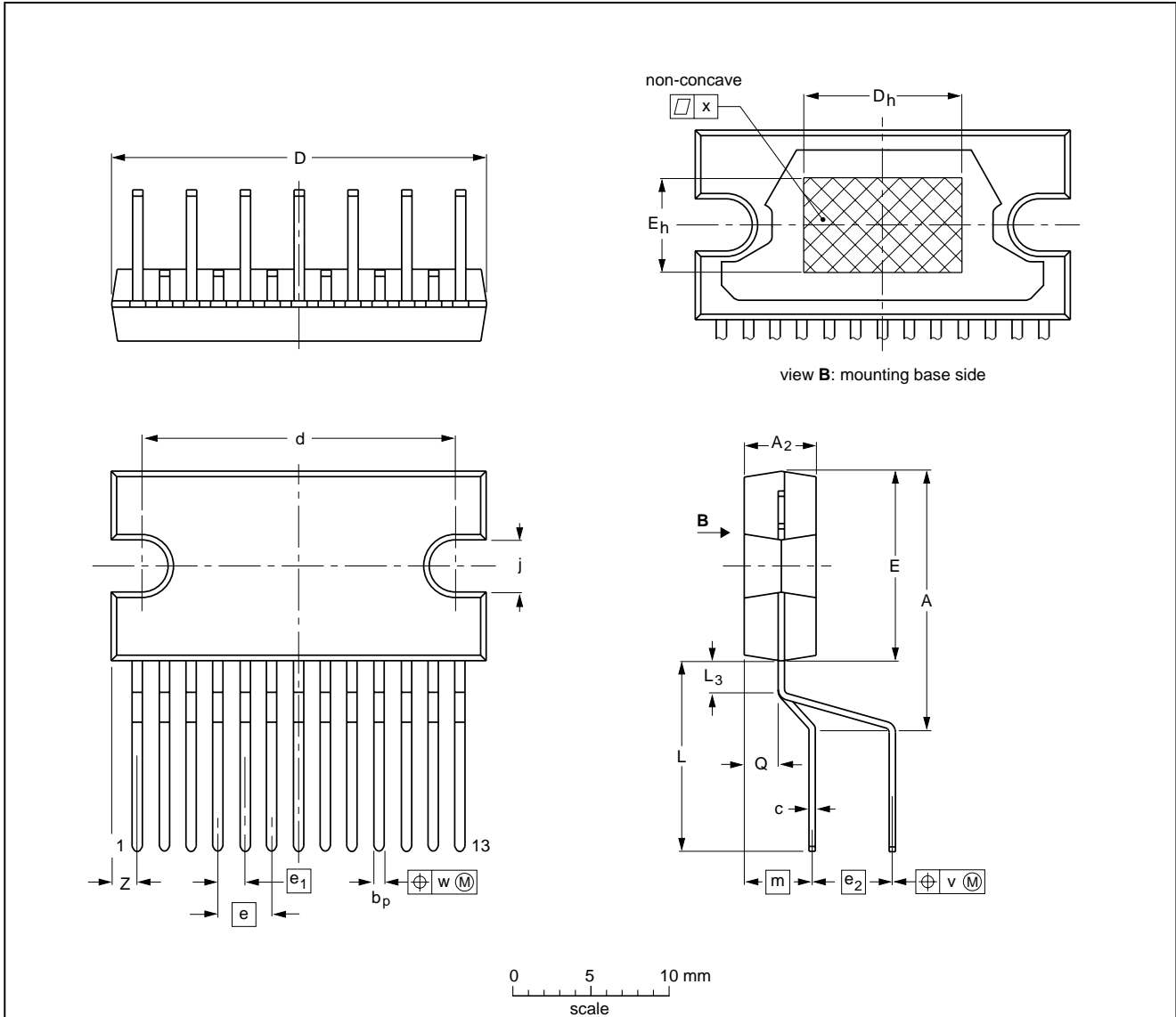
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PACKAGE OUTLINE

DBS13P: plastic DIL-bent-SIL power package; 13 leads (lead length 12 mm)

SOT141-6



DIMENSIONS (mm are the original dimensions)

| UNIT | A | A ₂ | b _p | c | D ⁽¹⁾ | d | D _h | E ⁽¹⁾ | e | e ₁ | e ₂ | E _h | j | L | L ₃ | m | Q | v | w | x | z ⁽¹⁾ |
|------|--------------|----------------|----------------|--------------|------------------|--------------|----------------|------------------|-----|----------------|----------------|----------------|------------|--------------|----------------|-----|------------|-----|------|------|------------------|
| mm | 17.0 15.5 | 4.6 4.2 | 0.75 0.60 | 0.48 0.38 | 24.0 23.6 | 20.0 19.6 | 10 | 12.2 11.8 | 3.4 | 1.7 | 5.08 | 6 | 3.4 3.1 | 12.4 11.0 | 2.4 1.6 | 4.3 | 2.1 1.8 | 0.8 | 0.25 | 0.03 | 2.00 1.45 |

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 | | | |
| SOT141-6 | | | | | | 92-11-17 95-03-11 |

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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

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