

# DATA SHEET

## **TDA1553CQ**

**2 × 22 W stereo BTL car radio  
power amplifier with loudspeaker  
protection and 3-state mode switch**

Product specification  
Supersedes data of July 1994  
File under Integrated Circuits, IC01

1995 Dec 15

## 2 × 22 W stereo BTL car radio power amplifier with loudspeaker protection and 3-state mode switch

### TDA1553CQ

#### FEATURES

- Few peripheral components
- High output power
- Low output offset voltage
- Fixed gain
- Loudspeaker protection
- Good ripple rejection
- 3-state mode switch (operating, mute, standby)
- Load dump protection
- AC and DC short-circuit safe to ground and to  $V_P$
- Thermally protected
- Reverse polarity safe
- High energy handling capability at the outputs ( $V_P = 0$ )
- Electrostatic discharge protection
- No switch-on/switch-off pop
- Flexible leads
- Low thermal resistance.

#### GENERAL DESCRIPTION

The TDA1553CQ is a monolithic integrated class-B output amplifier in a 13-lead plastic DIL-bent-SIL power package. It contains 2 × 22 W amplifiers in BTL configuration.

The device is primarily developed for car radio applications.

#### QUICK REFERENCE DATA

| SYMBOL                    | PARAMETER                       | CONDITIONS                                                 | MIN. | TYP. | MAX. | UNIT |
|---------------------------|---------------------------------|------------------------------------------------------------|------|------|------|------|
| $V_P$                     | positive supply voltage         |                                                            |      |      |      |      |
|                           | operating                       |                                                            | 6    | 14.4 | 18   | V    |
|                           | non-operating                   |                                                            | –    | –    | 30   | V    |
|                           | load dump                       |                                                            | –    | –    | 45   | V    |
| $I_{ORM}$                 | repetitive peak output current  |                                                            | –    | –    | 4    | A    |
| $I_q$                     | total quiescent current         |                                                            | –    | 80   | –    | mA   |
| $I_{stb}$                 | standby current                 |                                                            | –    | 40   | 100  | μA   |
| $ Z_i $                   | input impedance                 |                                                            | 50   | –    | –    | kΩ   |
| $T_{vj}$                  | virtual junction temperature    |                                                            | –    | –    | 150  | °C   |
| <b>Stereo application</b> |                                 |                                                            |      |      |      |      |
| $P_O$                     | output power                    | at 4 Ω; THD = 10%                                          | –    | 22   | –    | W    |
| SVRR                      | supply voltage ripple rejection | $R_s = 0 \Omega$ ; $f = 100 \text{ Hz to } 10 \text{ kHz}$ | 48   | –    | –    | dB   |
| $ \Delta V_O $            | DC output offset voltage        |                                                            | –    | –    | 150  | mV   |
| $\alpha_{cs}$             | channel separation              |                                                            | 40   | –    | –    | dB   |
| $ \Delta G_v $            | channel unbalance               |                                                            | –    | –    | 1    | dB   |

#### ORDERING INFORMATION

| TYPE<br>NUMBER | PACKAGE |                                                                  |          |
|----------------|---------|------------------------------------------------------------------|----------|
|                | NAME    | DESCRIPTION                                                      | VERSION  |
| TDA1553CQ      | DBS13P  | plastic DIL-bent-SIL power package; 13 leads (lead length 12 mm) | SOT141-6 |

# $2 \times 22\text{ W}$ stereo BTL car radio power amplifier with loudspeaker protection and 3-state mode switch

TDA1553CQ

## BLOCK DIAGRAM

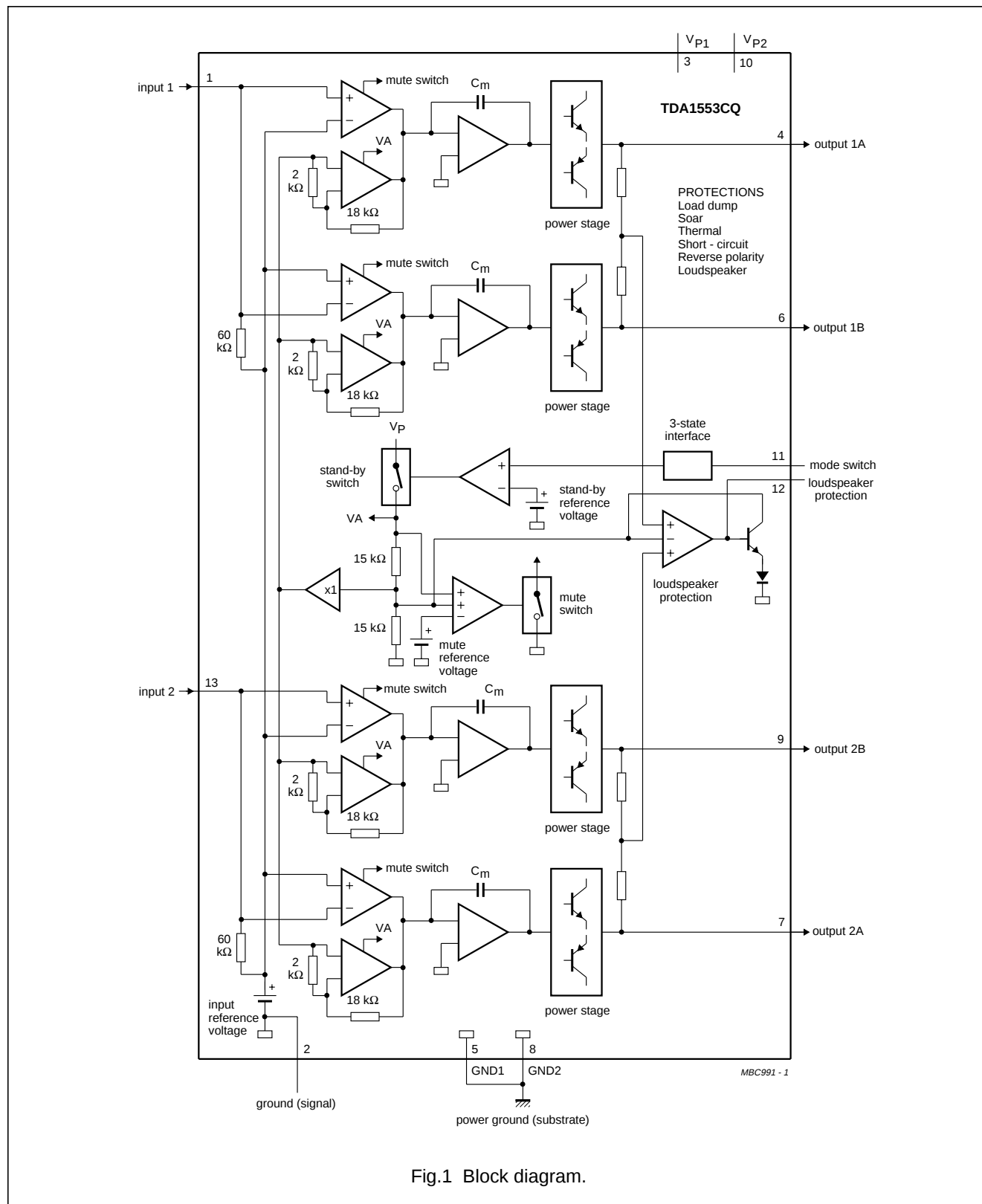


Fig.1 Block diagram.

2 × 22 W stereo BTL car radio power amplifier with  
loudspeaker protection and 3-state mode switch

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PINNING

| SYMBOL          | PIN | DESCRIPTION            |
|-----------------|-----|------------------------|
| IN1             | 1   | input 1                |
| GND(S)          | 2   | signal ground          |
| V <sub>P1</sub> | 3   | supply voltage         |
| OUT1A           | 4   | output 1A              |
| GND1            | 5   | power ground 1         |
| OUT1B           | 6   | output 1B              |
| OUT2A           | 7   | output 2A              |
| GND2            | 8   | power ground 2         |
| OUT2B           | 9   | output 2B              |
| V <sub>P2</sub> | 10  | supply voltage         |
| MODE            | 11  | mode switch input      |
| LSP             | 12  | loudspeaker protection |
| IN2             | 13  | input 2                |

FUNCTIONAL DESCRIPTION

The TDA1553CQ 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 the device are:

3-state mode switch

- standby: low supply current (<100 µA)
- mute: input signal suppressed
- operating: normal on condition.

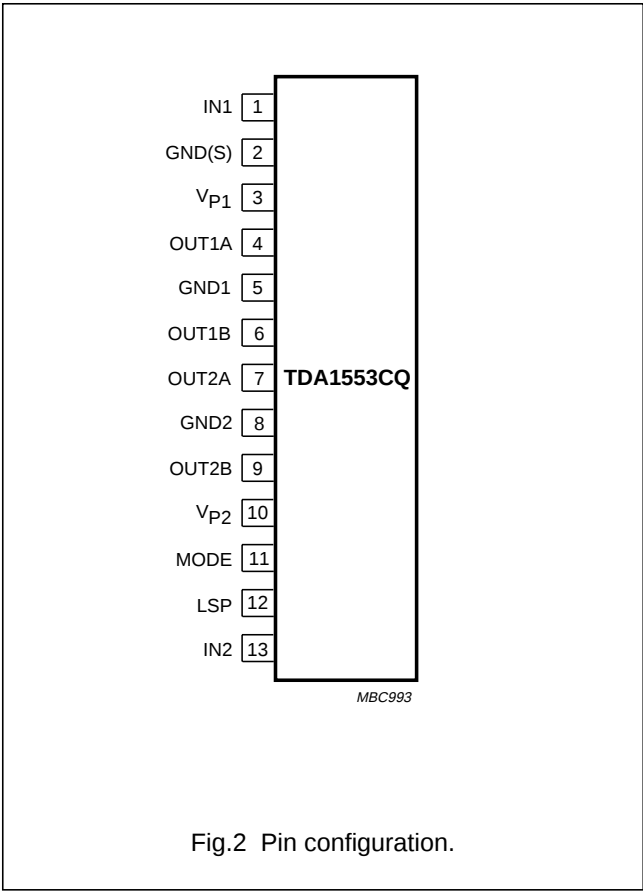
Loudspeaker protection

When a short-circuit to ground occurs, 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.

Pin 12 detects the status of the protection circuit (e.g. for diagnostic purposes).

Short-circuit protection

If any output is short-circuited to ground during the standby mode, it becomes impossible to switch the circuit to the mute or operating condition. In this event the supply current will be limited to a few milliamps.



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LIMITING VALUES

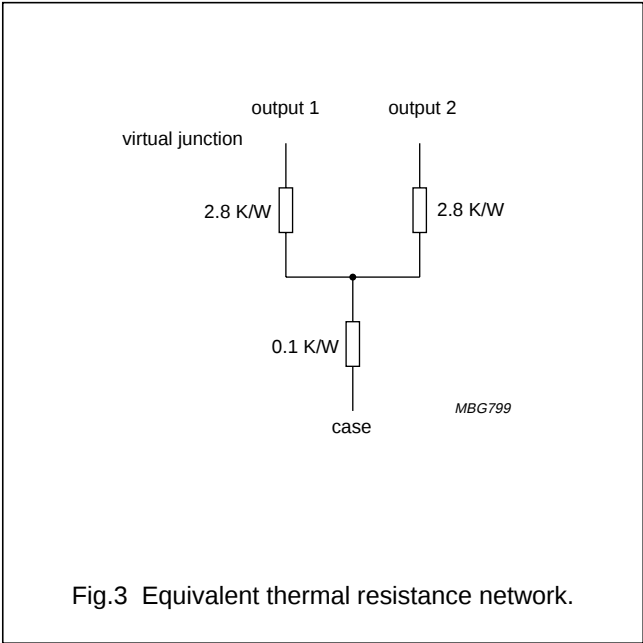
In accordance with the absolute maximum system (IEC 134).

| SYMBOL           | PARAMETER                             | CONDITION                                | MIN. | MAX. | UNIT |
|------------------|---------------------------------------|------------------------------------------|------|------|------|
| V <sub>P</sub>   | positive supply voltage               |                                          |      |      |      |
|                  | operating                             |                                          | –    | 18   | V    |
|                  | non-operating                         |                                          | –    | 30   | V    |
|                  | load dump protection                  | during 50 ms;<br>t <sub>r</sub> ≥ 2.5 ms | –    | 45   | V    |
| I <sub>OSM</sub> | non-repetitive peak output current    |                                          | –    | 6    | A    |
| I <sub>ORM</sub> | repetitive peak output current        |                                          | –    | 4    | A    |
| T <sub>stg</sub> | storage temperature range             |                                          | –55  | +150 | °C   |
| T <sub>amb</sub> | operating ambient temperature range   |                                          | –40  | +85  | °C   |
| T <sub>vj</sub>  | virtual junction temperature          |                                          | –    | 150  | °C   |
| V <sub>psc</sub> | AC and DC short-circuit safe voltage  |                                          | –    | 18   | V    |
|                  | energy handling capability at outputs | V <sub>P</sub> = 0                       | –    | 200  | mJ   |
| V <sub>pr</sub>  | reverse polarity                      |                                          | –    | 6    | V    |
| P <sub>tot</sub> | total power dissipation               |                                          | –    | 60   | W    |

THERMAL CHARACTERISTICS

In accordance with IEC 747-1.

| SYMBOL              | PARAMETER                                               | VALUE | UNIT |
|---------------------|---------------------------------------------------------|-------|------|
| R <sub>th j-a</sub> | thermal resistance from junction to ambient in free air | 40    | K/W  |
| R <sub>th j-c</sub> | thermal resistance from junction to case (see Fig.3)    | 1.5   | K/W  |



## 2 × 22 W stereo BTL car radio power amplifier with loudspeaker protection and 3-state mode switch

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### DC CHARACTERISTICS

$V_P = 14.4\text{ V}$ ;  $T_{\text{amb}} = 25\text{ °C}$ ; measured in Fig.4; unless otherwise specified.

| SYMBOL                                                                         | PARAMETER                           | CONDITIONS                   | MIN.   | TYP.      | MAX.     | UNIT     |
|--------------------------------------------------------------------------------|-------------------------------------|------------------------------|--------|-----------|----------|----------|
| Supply                                                                         |                                     |                              |        |           |          |          |
| V <sub>P</sub>                                                                 | positive supply voltage             | note 1                       | 6      | 14.4      | 18       | V        |
| I <sub>q</sub>                                                                 | quiescent current                   | R <sub>L</sub> = ∞<br>note 2 | –<br>– | 80<br>5.5 | 160<br>– | mA<br>mA |
| Operating condition                                                            |                                     |                              |        |           |          |          |
| V <sub>11</sub>                                                                | mode switch voltage level           |                              | 2.2    | –         | 7        | V        |
| I <sub>11</sub>                                                                | mode switch current                 | V <sub>11</sub> = 2.2 V      | –      | 50        | 100      | μA       |
| V <sub>O</sub>                                                                 | DC output voltage                   | note 3                       | –      | 6.9       | –        | V        |
| ΔV <sub>O</sub>                                                                | DC output offset voltage            |                              | –      | –         | 150      | mV       |
| Mute condition                                                                 |                                     |                              |        |           |          |          |
| V <sub>11</sub>                                                                | mode switch voltage level           |                              | 0      | –         | 0.6      | V        |
| I <sub>11</sub>                                                                | mode switch current                 | V <sub>11</sub> = 0.6 V      | –      | 50        | 100      | μA       |
| V <sub>O</sub>                                                                 | DC output voltage                   | note 3                       | –      | 6.9       | –        | V        |
| ΔV <sub>O</sub>                                                                | DC output offset voltage            |                              | –      | –         | 150      | mV       |
| standby condition                                                              |                                     |                              |        |           |          |          |
| I <sub>11</sub>                                                                | mode switch 3-state leakage current |                              | –      | –         | 10       | μA       |
| I <sub>stb</sub>                                                               | standby current                     | I <sub>11</sub> = 0 μA       | –      | 40        | 100      | μA       |
| Loudspeaker protection                                                         |                                     |                              |        |           |          |          |
| ΔV <sub>4-6</sub>   or<br> ΔV <sub>7-9</sub>                                   | DC voltage across R <sub>L</sub>    |                              | –      | –         | 1        | V        |
| Protection active ( ΔV <sub>4-6</sub>   or  ΔV <sub>7-9</sub>   ≥ 1.0 V)       |                                     |                              |        |           |          |          |
| I <sub>12</sub>                                                                | current information                 |                              | –      | 25        | –        | μA       |
| V <sub>12</sub>                                                                | voltage information                 |                              | 3.6    | –         | –        | V        |
| Protection not active ( ΔV <sub>4-6</sub>   and  ΔV <sub>7-9</sub>   ≤ 0.15 V) |                                     |                              |        |           |          |          |
| V <sub>12</sub>                                                                | voltage information                 |                              | –      | –         | 0.3      | V        |

### Notes

1. The circuit is DC adjusted at  $V_P = 6$  to  $18\text{ V}$  and AC operating at  $V_P = 9$  to  $18\text{ V}$ .
2. If any output is short-circuited to ground during the standby mode and in this condition the circuit is switched to mute or operating condition.
3. At  $18\text{ V} < V_P < 30\text{ V}$  the DC output voltage  $\leq V_P/2$ .

## 2 × 22 W stereo BTL car radio power amplifier with loudspeaker protection and 3-state mode switch

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### AC CHARACTERISTICS

$V_P = 14.4\text{ V}$ ;  $R_L = 4\ \Omega$ ;  $f = 1\text{ kHz}$ ;  $T_{\text{amb}} = 25\text{ °C}$ ; measured in Fig.4; unless otherwise specified.

| SYMBOL         | PARAMETER                          | CONDITIONS                                                 | MIN. | TYP.            | MAX. | UNIT          |
|----------------|------------------------------------|------------------------------------------------------------|------|-----------------|------|---------------|
| $P_O$          | output power                       | $V_P = 14.4\text{ V}$                                      |      |                 |      |               |
|                |                                    | THD = 0.5%                                                 | 15   | 17              | –    | W             |
|                |                                    | THD = 10%                                                  | 20   | 22              | –    | W             |
| THD            | total harmonic distortion          | $P_O = 1\text{ W}$                                         | –    | 0.1             | –    | %             |
| $P_O$          | output power                       | $V_P = 13.2\text{ V}$                                      |      |                 |      |               |
|                |                                    | THD = 0.5%                                                 | –    | 12              | –    | W             |
|                |                                    | THD = 10%                                                  | –    | 17              | –    | W             |
| B              | power bandwidth                    | THD = 0.5%; $P_O = -1\text{ dB}$ ;<br>with respect to 15 W | –    | 20 to<br>15 000 | –    | Hz            |
| $f_l$          | low frequency roll-off             | at $-1\text{ dB}$ ; note 1                                 | –    | 25              | –    | Hz            |
| $f_h$          | high frequency roll-off            | at $-1\text{ dB}$                                          | 20   | –               | –    | kHz           |
| $G_v$          | closed loop voltage gain           |                                                            | 25   | 26              | 27   | dB            |
| SVRR           | supply voltage ripple<br>rejection | note 2                                                     |      |                 |      |               |
|                | on                                 |                                                            | 48   | –               | –    | dB            |
|                | mute                               |                                                            | 48   | –               | –    | dB            |
|                | standby                            |                                                            | 80   | –               | –    | dB            |
| $ Z_i $        | input impedance                    |                                                            | 50   | 60              | 75   | k $\Omega$    |
| $V_{no}$       | noise output voltage               | note 3                                                     |      |                 |      |               |
|                | on                                 |                                                            | –    | 70              | 120  | $\mu\text{V}$ |
|                | on                                 |                                                            | –    | 100             | –    | $\mu\text{V}$ |
| $V_{no}$       | noise output voltage<br>mute       | notes 3 and 4                                              | –    | 60              | –    | $\mu\text{V}$ |
| $\alpha_{cs}$  | channel separation                 | $R_S = 10\text{ k}\Omega$                                  | 40   | –               | –    | dB            |
| $ \Delta G_v $ | channel unbalance                  |                                                            | –    | –               | 1    | dB            |
| $V_O$          | output voltage in mute             | note 5                                                     | –    | –               | 2    | mV            |

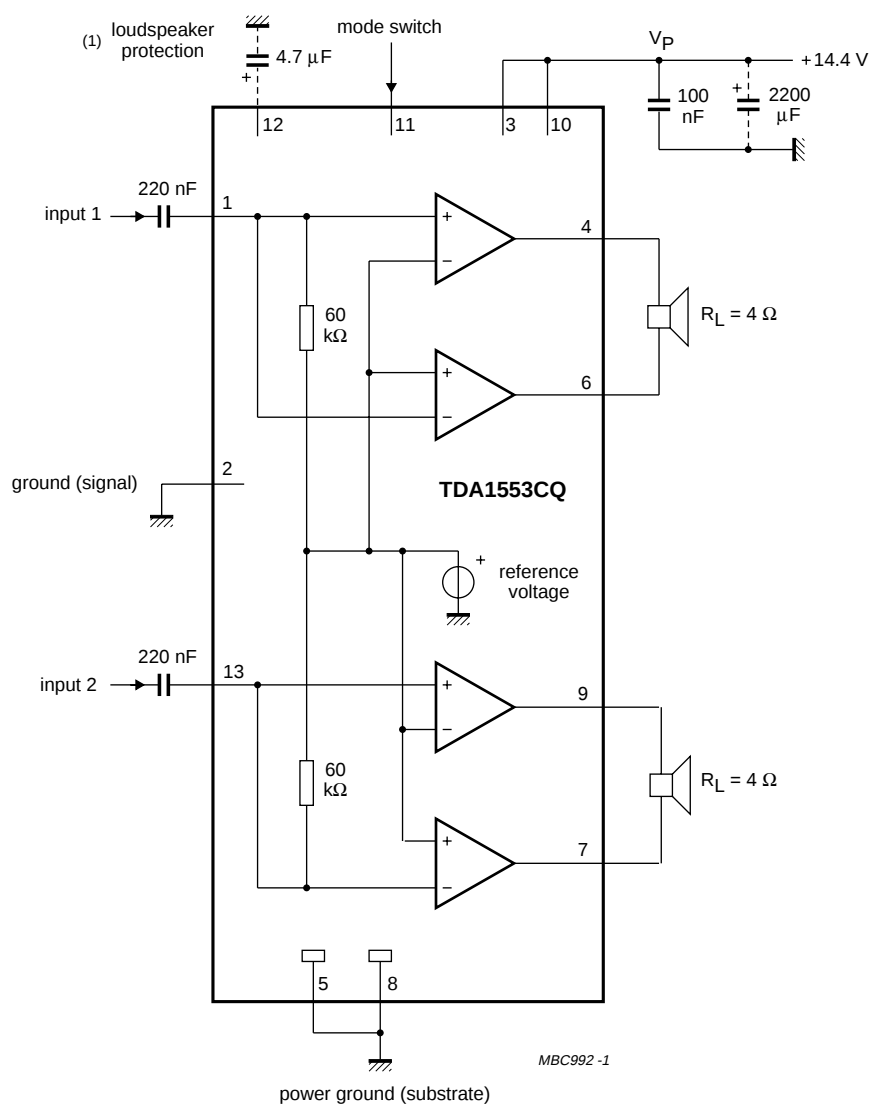
### Notes

- Frequency response externally fixed.
- Ripple rejection measured at the output with a source-impedance of  $0\ \Omega$ , maximum ripple amplitude of 2 V (p-p) and at a frequency between 100 Hz and 10 kHz.
- Noise measured in a bandwidth of 20 Hz to 20 kHz.
- Noise output voltage independent of  $R_S$  ( $V_i = 0\text{ V}$ ).
- $V_i = V_{I\text{max}} = 1\text{ V RMS}$ .

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## APPLICATION INFORMATION



(1) With  $C = 4.7\ \mu\text{F}$  the delay time of the loudspeaker protection is typically 0.5 s.

Fig.4 Stereo BTL application diagram.

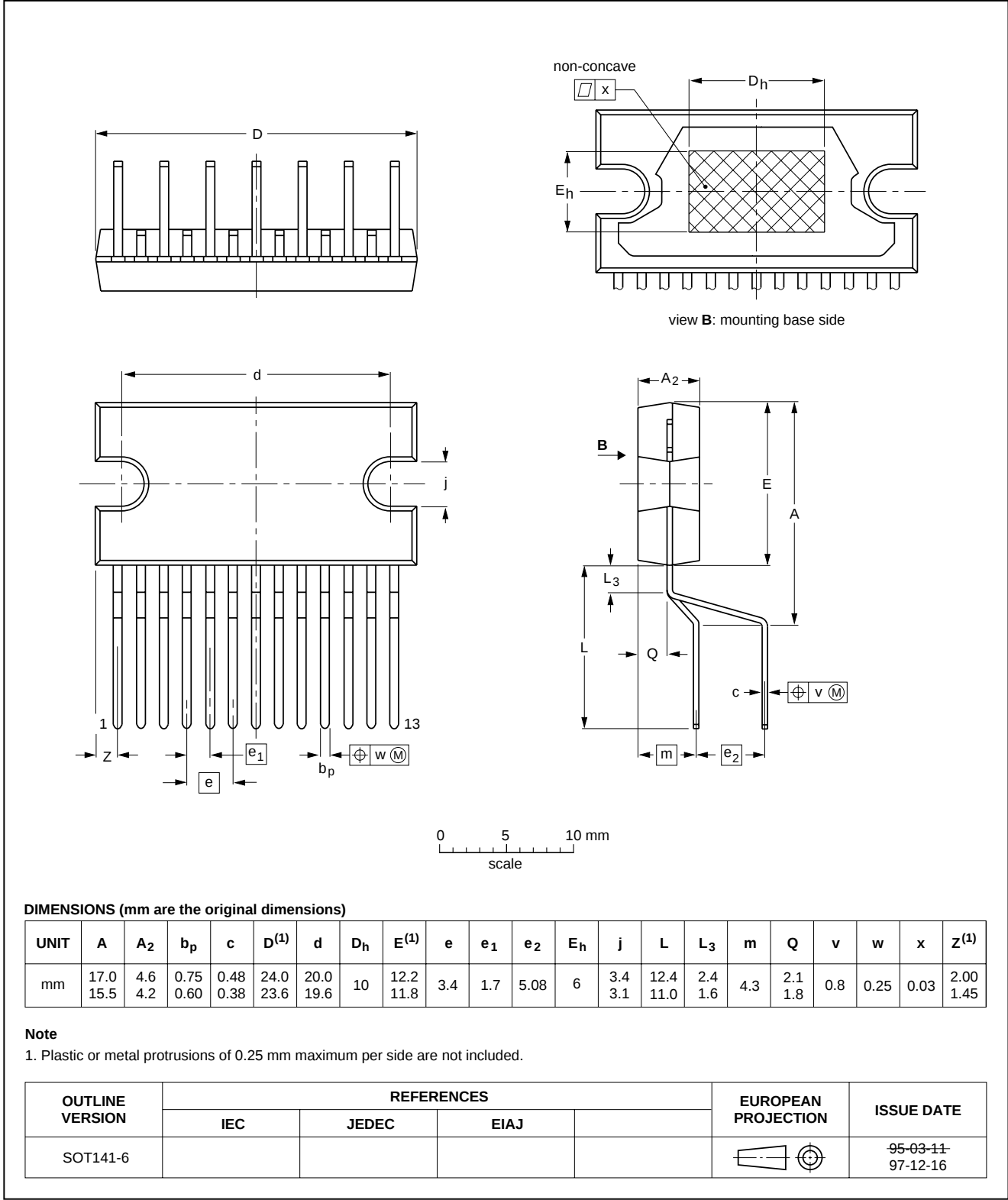
2 × 22 W stereo BTL car radio power amplifier with  
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PACKAGE OUTLINE

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

SOT141-6



## 2 × 22 W stereo BTL car radio power amplifier with loudspeaker protection and 3-state mode switch

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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 ( $T_{\text{stg max}}$ ). 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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