

# DATA SHEET

## **TDA1517ATW**

**8 W BTL or  $2 \times 4$  W SE power  
amplifier**

Product specification  
Supersedes data of 2001 Feb 14

2001 Apr 17



## 8 W BTL or 2 × 4 W SE power amplifier

## TDA1517ATW

## FEATURES

- Requires very few external components
- Flexibility in use: mono Bridge-Tied Load (BTL) and stereo Single-Ended (SE); it should be noted that in stereo applications the outputs of both amplifiers are in opposite phase
- High output power
- Low offset voltage at output (important for BTL)
- Fixed gain
- Good ripple rejection
- Mode select switch (operating, mute and standby)
- AC and DC short-circuit safe to ground and  $V_P$
- Electrostatic discharge protection
- Thermal protection
- Reverse polarity safe
- Capable of handling high energy on outputs ( $V_P = 0$  V)
- No switch-on/switch-off plop
- Low thermal resistance.

## GENERAL DESCRIPTION

The TDA1517ATW is an integrated class-AB output amplifier contained in a plastic heatsink thin shrink small outline package (HTSSOP20). The device is primarily developed for multimedia applications.

## QUICK REFERENCE DATA

| SYMBOL                 | PARAMETER                       | CONDITIONS                  | MIN. | TYP. | MAX. | UNIT             |
|------------------------|---------------------------------|-----------------------------|------|------|------|------------------|
| $V_P$                  | supply voltage                  |                             | 6    | 12   | 18   | V                |
| $I_{ORM}$              | repetitive peak output current  |                             | –    | –    | 2.5  | A                |
| $I_{q(tot)}$           | total quiescent current         |                             | –    | 40   | 80   | mA               |
| $I_{stb}$              | standby current                 |                             | –    | 0.1  | 100  | $\mu$ A          |
| <b>SE application</b>  |                                 |                             |      |      |      |                  |
| $P_o$                  | output power                    | THD = 10%; $R_L = 4 \Omega$ | –    | 4    | –    | W                |
| SVRR                   | supply voltage ripple rejection | $R_S = 0 \Omega$            | 46   | –    | –    | dB               |
| $\alpha_{cs}$          | channel separation              | $R_S = 10 \text{ k}\Omega$  | 40   | 55   | –    | dB               |
| $V_{n(o)}$             | noise output voltage            | $R_S = 0 \Omega$            | –    | 50   | –    | $\mu$ V          |
| $ Z_i $                | input impedance                 |                             | 50   | –    | –    | $\text{k}\Omega$ |
| <b>BTL application</b> |                                 |                             |      |      |      |                  |
| $P_o$                  | output power                    | THD = 10%; $R_L = 8 \Omega$ | –    | 8    | –    | W                |
| SVRR                   | supply voltage ripple rejection | $R_S = 0 \Omega$            | 50   | –    | –    | dB               |
| $ \Delta V_{OO} $      | output offset voltage           |                             | –    | –    | 150  | mV               |
| $V_{n(o)(offset)}$     | noise output offset voltage     | $R_S = 0 \Omega$            | –    | 70   | –    | $\mu$ V          |
| $ Z_i $                | input impedance                 |                             | 25   | –    | –    | $\text{k}\Omega$ |

## ORDERING INFORMATION

| TYPE<br>NUMBER | PACKAGE  |                                                                                                             |          |
|----------------|----------|-------------------------------------------------------------------------------------------------------------|----------|
|                | NAME     | DESCRIPTION                                                                                                 | VERSION  |
| TDA1517ATW     | HTSSOP20 | plastic thermal enhanced thin shrink small outline package;<br>20 leads; body width 4.4 mm; exposed die pad | SOT527-1 |

8 W BTL or  $2 \times 4$  W SE power amplifier

## TDA1517ATW

## BLOCK DIAGRAM

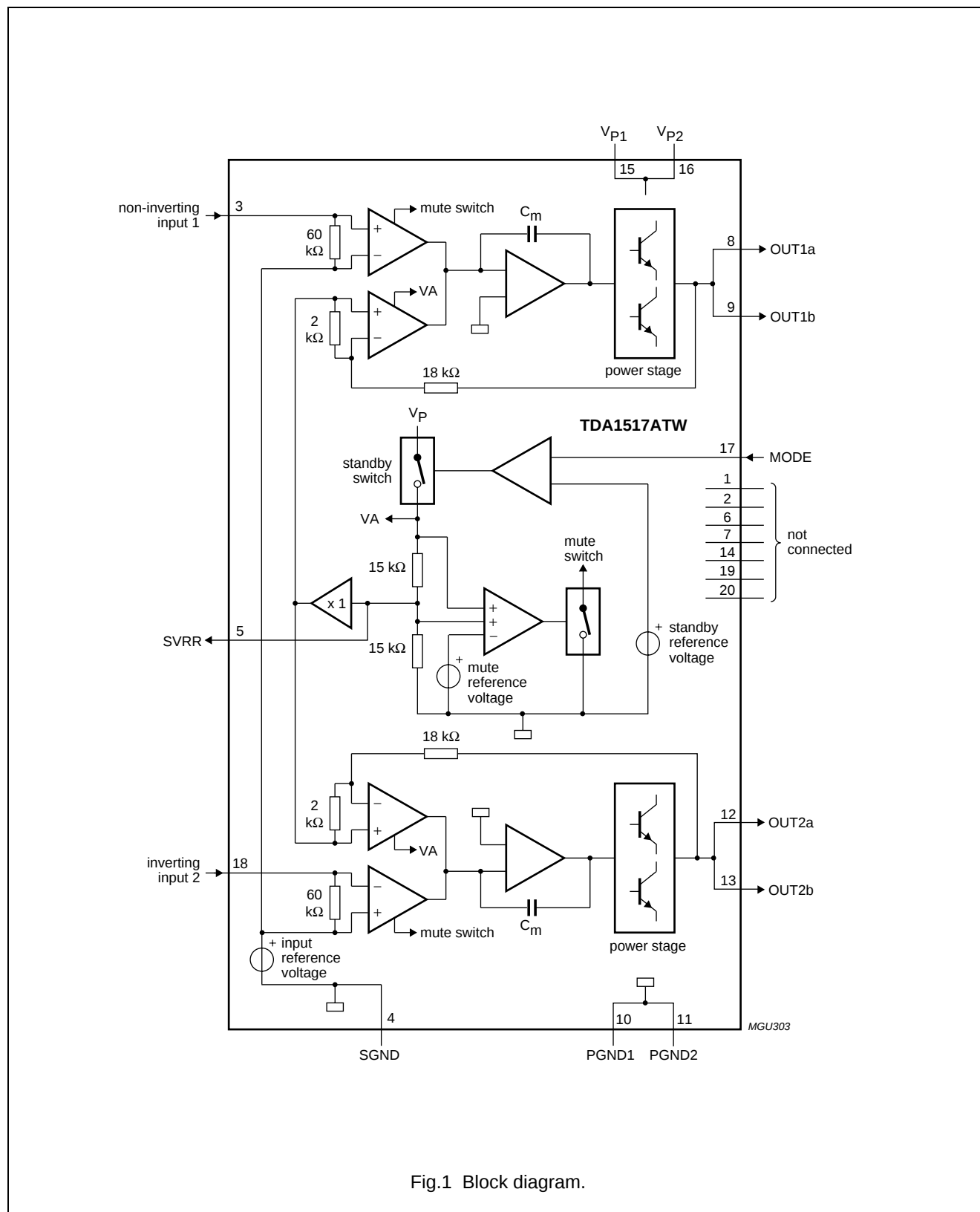


Fig.1 Block diagram.

## 8 W BTL or 2 × 4 W SE power amplifier

## TDA1517ATW

## PINNING

| SYMBOL          | PIN | DESCRIPTION                     |
|-----------------|-----|---------------------------------|
| n.c.            | 1   | not connected                   |
| n.c.            | 2   | not connected                   |
| IN1+            | 3   | non-inverting input 1           |
| SGND            | 4   | signal ground                   |
| SVRR            | 5   | supply voltage ripple rejection |
| n.c.            | 6   | not connected                   |
| n.c.            | 7   | not connected                   |
| OUT1a           | 8   | output 1a                       |
| OUT1b           | 9   | output 1b                       |
| PGND1           | 10  | power ground 1                  |
| PGND2           | 11  | power ground 2                  |
| OUT2a           | 12  | output 2a                       |
| OUT2b           | 13  | output 2b                       |
| n.c.            | 14  | not connected                   |
| V <sub>P1</sub> | 15  | supply voltage 1                |
| V <sub>P2</sub> | 16  | supply voltage 2                |
| MODE            | 17  | mode select switch              |
| IN2–            | 18  | inverting input 2               |
| n.c.            | 19  | not connected                   |
| n.c.            | 20  | not connected                   |

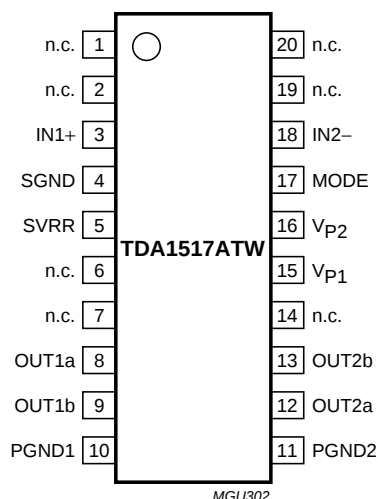


Fig.2 Pin configuration.

## FUNCTIONAL DESCRIPTION

The TDA1517ATW contains two identical amplifiers with differential input stages. This device can be used for Bridge-Tied Load (BTL) or Single-Ended (SE) applications. The gain of each amplifier is fixed at 20 dB. A special feature of this device is the mode select switch. Since this pin has a very low input current (<40 µA), a low cost supply switch can be used. With this switch the TDA1517ATW can be switched into three modes:

- Standby: low supply current
- Mute: input signal suppressed
- Operating: normal on condition.

## 8 W BTL or 2 × 4 W SE power amplifier

## TDA1517ATW

**LIMITING VALUES**

In accordance with the Absolute Maximum Rating System (IEC 60134).

| SYMBOL    | PARAMETER                             | CONDITIONS  | MIN. | MAX. | UNIT. |
|-----------|---------------------------------------|-------------|------|------|-------|
| $V_P$     | supply voltage                        |             | –    | 18   | V     |
| $V_{PSC}$ | AC and DC short-circuit-safe voltage  |             | –    | 18   | V     |
| $V_{rp}$  | reverse polarity voltage              |             | –    | 6    | V     |
| $ERG_o$   | energy handling capability at outputs | $V_P = 0$ V | –    | 200  | mJ    |
| $I_{OSM}$ | non-repetitive peak output current    |             | –    | 4    | A     |
| $I_{ORM}$ | repetitive peak output current        |             | –    | 2.5  | A     |
| $P_{tot}$ | total power dissipation               |             | –    | 5    | W     |
| $T_{vj}$  | virtual junction temperature          |             | –    | 150  | °C    |
| $T_{stg}$ | storage temperature                   |             | –55  | +150 | °C    |
| $T_{amb}$ | ambient temperature                   |             | –40  | +85  | °C    |

**THERMAL CHARACTERISTICS**

| SYMBOL          | PARAMETER | CONDITIONS | VALUE | UNIT |
|-----------------|-----------|------------|-------|------|
| tb <sub>f</sub> |           |            | –     | –    |

**DC CHARACTERISTICS**

$V_P = 12$  V;  $T_{amb} = 25$  °C; measured in Fig.3; unless otherwise specified.

| SYMBOL                     | PARAMETER                 | CONDITIONS        | MIN. | TYP. | MAX.  | UNIT |
|----------------------------|---------------------------|-------------------|------|------|-------|------|
| <b>Supply</b>              |                           |                   |      |      |       |      |
| $V_P$                      | supply voltage            | note 1            | 6.0  | 12   | 18    | V    |
| $I_q$                      | quiescent current         | $R_L = \infty$    | –    | 40   | 80    | mA   |
| <b>Operating condition</b> |                           |                   |      |      |       |      |
| $V_{MODE(oper)}$           | mode switch voltage level |                   | 8.5  | –    | $V_P$ | V    |
| $I_{MODE(oper)}$           | mode switch current       | $V_{MODE} = 12$ V | –    | 15   | 40    | μA   |
| $V_O$                      | DC output voltage         |                   | –    | 5.7  | –     | V    |
| $ \Delta V_{OO} $          | DC output offset voltage  |                   | –    | –    | 150   | mV   |
| <b>Mute condition</b>      |                           |                   |      |      |       |      |
| $V_{MODE(mute)}$           | mode switch voltage level |                   | 3.3  | –    | 6.4   | V    |
| $V_O$                      | DC output voltage         |                   | –    | 5.7  | –     | V    |
| $ \Delta V_{OO} $          | DC output offset voltage  |                   | –    | –    | 150   | mV   |
| <b>Standby condition</b>   |                           |                   |      |      |       |      |
| $V_{MODE(stb)}$            | mode switch voltage level |                   | 0    | –    | 2     | V    |
| $I_{stb}$                  | standby current           |                   | –    | 0.1  | 100   | μA   |

**Note**

1. The circuit is DC adjusted at  $V_P = 6$  to 18 V and AC operating at  $V_P = 8.5$  to 18 V.

## 8 W BTL or 2 × 4 W SE power amplifier

## TDA1517ATW

## AC CHARACTERISTICS

$V_P = 12\text{ V}$ ;  $f = 1\text{ kHz}$ ;  $T_{\text{amb}} = 25\text{ °C}$ ; unless otherwise specified.

| SYMBOL                         | PARAMETER                        | CONDITIONS                                                                             | MIN.           | TYP.            | MAX.          | UNIT                                            |
|--------------------------------|----------------------------------|----------------------------------------------------------------------------------------|----------------|-----------------|---------------|-------------------------------------------------|
| <b>SE application; note 1</b>  |                                  |                                                                                        |                |                 |               |                                                 |
| $P_O$                          | output power                     | note 2<br>THD = 1%<br>THD = 10%                                                        | 2.5<br>3       | 3.3<br>4        | –<br>–        | W<br>W                                          |
| THD                            | total harmonic distortion        | $P_O = 1\text{ W}$                                                                     | –              | 0.1             | –             | %                                               |
| $f_{ro(L)}$                    | low frequency roll-off           | –1 dB; note 3                                                                          | –              | 25              | –             | Hz                                              |
| $f_{ro(H)}$                    | high frequency roll off          | –1 dB                                                                                  | 20             | –               | –             | kHz                                             |
| $G_V$                          | voltage gain                     |                                                                                        | 19             | 20              | 21            | dB                                              |
| $ \Delta G_V $                 | channel balance                  |                                                                                        | –              | –               | 1             | dB                                              |
| SVRR                           | supply voltage ripple rejection  | note 4<br>on<br>mute<br>standby                                                        | 46<br>46<br>80 | –<br>–<br>–     | –<br>–<br>–   | dB<br>dB<br>dB                                  |
| $ Z_i $                        | input impedance                  |                                                                                        | 50             | 60              | 75            | k $\Omega$                                      |
| $V_{n(o)(rms)}$                | noise output voltage (RMS value) | note 5<br>on; $R_S = 0\text{ }\Omega$<br>on; $R_S = 10\text{ k}\Omega$<br>mute; note 6 | –<br>–<br>–    | 50<br>70<br>50  | –<br>100<br>– | $\mu\text{V}$<br>$\mu\text{V}$<br>$\mu\text{V}$ |
| $\alpha_{CS}$                  | channel separation               | $R_S = 10\text{ k}\Omega$                                                              | 40             | 55              | –             | dB                                              |
| $V_{O(mute)}$                  | output voltage in mute           | note 7                                                                                 | –              | –               | 2             | mV                                              |
| <b>BTL application; note 8</b> |                                  |                                                                                        |                |                 |               |                                                 |
| $P_O$                          | output power                     | note 2<br>THD = 1%<br>THD = 10%                                                        | 5<br>6.5       | 6.6<br>8.0      | –<br>–        | W<br>W                                          |
| THD                            | total harmonic distortion        | $P_O = 1\text{ W}$                                                                     | –              | 0.03            | –             | %                                               |
| $f_{ro(L)}$                    | low frequency roll-off           | –1 dB; note 3                                                                          | –              | 25              | –             | Hz                                              |
| $f_{ro(H)}$                    | high frequency roll off          | –1 dB                                                                                  | 20             | –               | –             | kHz                                             |
| $G_V$                          | voltage gain                     |                                                                                        | 25             | 26              | 27            | dB                                              |
| SVRR                           | supply voltage ripple rejection  | note 4<br>on<br>mute<br>standby                                                        | 50<br>50<br>80 | –<br>–<br>–     | –<br>–<br>–   | dB<br>dB<br>dB                                  |
| $ Z_i $                        | input impedance                  |                                                                                        | 25             | 30              | 38            | k $\Omega$                                      |
| $V_{n(o)(rms)}$                | noise output voltage (RMS value) | note 5<br>on; $R_S = 0\text{ }\Omega$<br>on; $R_S = 10\text{ k}\Omega$<br>mute; note 6 | –<br>–<br>–    | 70<br>100<br>60 | –<br>200<br>– | $\mu\text{V}$<br>$\mu\text{V}$<br>$\mu\text{V}$ |
| $V_{O(mute)}$                  | output voltage in mute           | note 7                                                                                 | –              | –               | 2             | mV                                              |

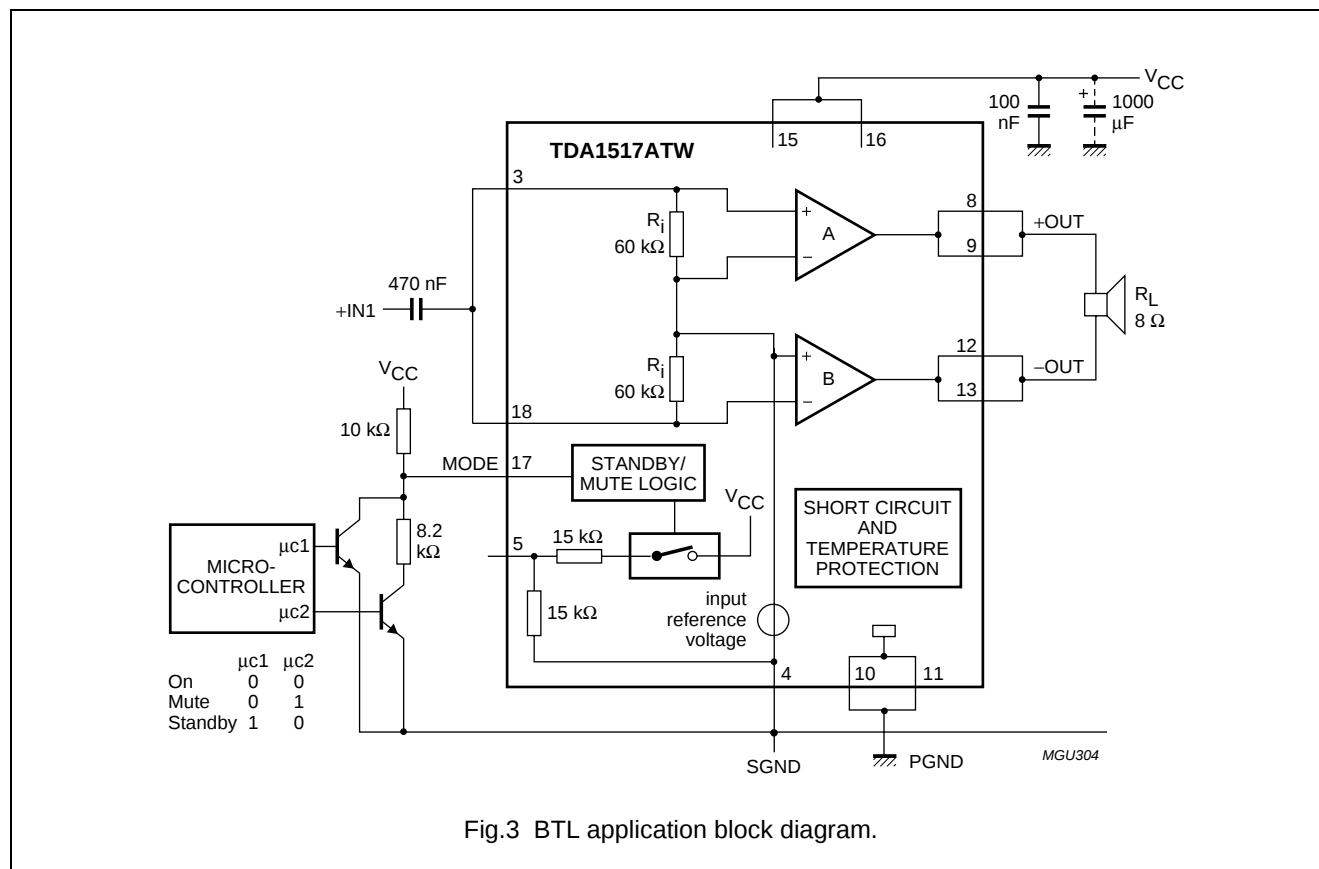
8 W BTL or  $2 \times 4$  W SE power amplifier

## TDA1517ATW

## Notes to the characteristics

1.  $R_L = 4 \Omega$ , measured in Fig.4.
2. Output power is measured directly at the output pins of the IC.
3. Frequency response externally fixed.
4.  $V_{\text{ripple}} = V_{\text{ripple(max)}} = 2 \text{ V (p-p)}$ ;  $R_S = 0 \Omega$ .
5. Noise voltage measured in a bandwidth of 20 Hz to 20 kHz.
6. Noise output voltage independent of  $R_S$ .
7.  $V_i = V_{i(\text{max})} = 1 \text{ V (RMS)}$ .
8.  $R_L = 8 \Omega$ , measured in Fig.3.

## APPLICATION INFORMATION



# 8 W BTL or 2 × 4 W SE power amplifier

## TDA1517ATW

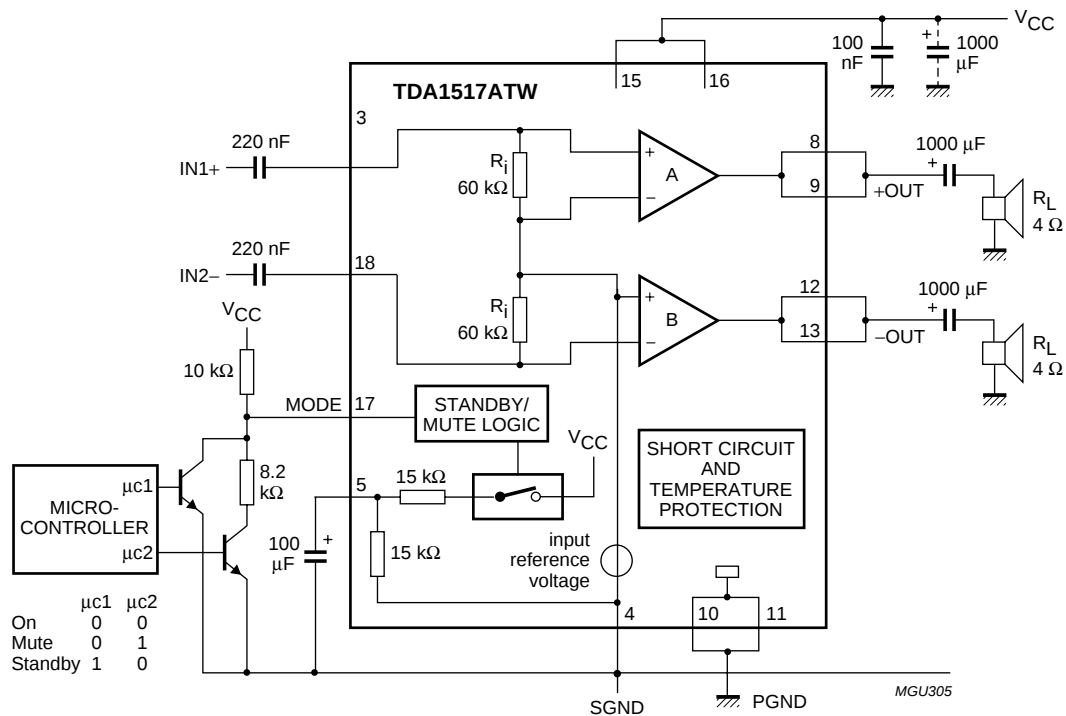


Fig.4 SE application block diagram.

### Test conditions

$T_{amb} = 25\text{ }^{\circ}\text{C}$ ; unless otherwise specified:  $V_P = 12\text{ V}$ , BTL application,  $f = 1\text{ kHz}$ ,  $R_L = 8\text{ }\Omega$ , fixed gain = 26 dB, audio band-pass: 22 Hz to 22 kHz. In the figures as a function of frequency a band-pass of 10 Hz to 80 kHz was applied.

The BTL application block diagram is shown in Fig.3. The PCB layout [which accommodates both the mono (BTL) and stereo (single-ended) application] is shown in Fig.6.

### Printed-Circuit Board (PCB) layout and grounding

For high system performance levels certain grounding techniques are imperative. The input reference grounds have to be tied to their respective source grounds and must have separate traces from the power ground traces; this will separate the large (output) signal currents from interfering with the small AC input signals. The small signal ground traces should be located physically as far as possible from the power ground traces. Supply and output traces should be as wide as possible for delivering maximum output power.

Proper supply bypassing is critical for low noise performance and high power supply rejection. The respective capacitor locations should be as close as possible to the device and grounded to the power ground. Decoupling the power supply also prevents unwanted oscillations. For suppressing higher frequency transients (spikes) on the supply line a capacitor with low ESR (typical 0.1  $\mu\text{F}$ ) has to be placed as close as possible to the device. For suppressing lower frequency noise and ripple signals, a large electrolytic capacitor (e.g. 1000  $\mu\text{F}$  or greater) must be placed close to the IC.

In single-ended (stereo) application a bypass capacitor connected to pin SVR reduces the noise and ripple on the midrail voltage. For good THD and noise performance a low ESR capacitor is recommended.

### Input configuration

It should be noted that the DC level of the input pins is approximately 2.1 V; a coupling capacitor is therefore necessary.

## 8 W BTL or 2 × 4 W SE power amplifier

## TDA1517ATW

The formula for the cut-off frequency at the input is as

$$\text{follows: } f_{IC} = \frac{1}{2 \times \pi \times R_i C_i}$$

$$\text{thus } f_{IC} = \frac{1}{2 \times \pi \times 30 \times 10^{-3} \times 470 \times 10^{-9}} = 11 \text{ Hz}$$

As can be seen it is not necessary to use high capacitor values for the input; so the delay during switch-on, which is necessary for charging the input capacitors, can be minimized. This results in a good low frequency response and good switch-on behaviour.

In stereo applications (single-ended) coupling capacitors on both input and output are necessary. It should be noted that the outputs of both amplifiers are in opposite phase.

### Built-in protection circuits

The IC contains two types of protection circuits:

- Short-circuits the outputs to ground, the supply to ground and across the load: short-circuit is detected and controlled by a SOAR protection circuit
- Thermal shut-down protection: the junction temperature is measured by a temperature sensor. Thermal foldback is activated at a junction temperature of >150 °C.

### Output power

The output power as a function of supply voltage has been measured on the output pins and at THD = 10%. The maximum output power is limited by the maximum allowable power dissipation and the maximum available output current, 2.5 A repetitive peak current.

### Supply voltage ripple rejection

The SVRR has been measured without an electrolytic capacitor on pin 5 and at a bandwidth of 10 Hz to 80 kHz. The curves for operating and mute condition (respectively) were measured with  $R_{source} = 0 \Omega$ . Only in single-ended applications is an electrolytic capacitor (e.g. 100 µF) on pin 5 necessary to improve the SVRR behaviour.

### Headroom

A typical music CD requires at least 12 dB (is factor 15.85) dynamic headroom (compared with the average power output) for passing the loudest portions without distortion. The following calculation can be made for this application at  $V_P = 12 \text{ V}$  and  $R_L = 8 \Omega$ :  $P_O$  at THD = 0.1% is approximately 5 W (see Fig.7).

Average listening level without any distortion yields:

$$P_{ALL} = \frac{P_{tot}}{\text{factor}} = \frac{5}{15.85} = 315 \text{ mW}$$

The power dissipation can be derived from Fig.11 for 0 dB and 12 dB headroom.

**Table 1** Power rating

| RATING                              | HEADROOM | POWER DISSIPATION |
|-------------------------------------|----------|-------------------|
| $P_O = 5 \text{ W}$<br>(THD = 0.1%) | 0 dB     | 3.5 W             |
|                                     | 12 dB    | 2.0 W             |

Thus for the average listening level (music power) a power dissipation of 2.0 W can be used for the thermal PCB calculation; see Section "Thermal behaviour (PCB design considerations)".

### Mode pin

For the 3 functional modes: standby, mute and operate, the MODE pin can be driven by a 3-state logic output stage, e.g. a microcontroller with some extra components for DC-level shifting; see Fig.10 for the respective DC levels.

- Standby mode is activated by a low DC level between 0 and 2 V. The power consumption of the IC will be reduced to <0.12 mW.
- Mute mode is activated by a DC level between 3.3 and 6.4 V. The outputs of the amplifier will be muted (no audio output); however the amplifier is DC biased and the DC level of the output pins stays at half the supply voltage. The input coupling capacitors are charged when in mute mode to avoid pop-noise.
- The IC will be in the operating condition when the voltage at pin MODE is between 8.5 V and  $V_{CC}$ .

### Switch-on/switch-off

To avoid audible plops during switch-on and switch-off of the supply voltage, the MODE pin has to be set in standby condition ( $V_{CC}$  level) before the voltage is applied (switch-on) or removed (switch-off). The input and SVRR capacitors are smoothly charged during mute mode.

The turn-on and turn-off time can be influenced by an RC-circuit connected to the MODE pin. Switching the device or the MODE pin rapidly on and off may cause 'click and pop' noise. This can be prevented by proper timing on the MODE pin. Further improvement in the BTL application can be obtained by connecting an electrolytic capacitor (e.g. 100 µF) between the SVRR pin and signal ground.

8 W BTL or 2 × 4 W SE power amplifier

TDA1517ATW

Thermal behaviour (PCB design considerations)

The typical thermal resistance [ $R_{th(j-a)}$ ] of the IC in the HTSSOP20 package is 37 K/W if the IC is soldered on a printed-circuit board with double sided 35  $\mu$ m copper with a minimum area of approximately 30 cm<sup>2</sup>. The actual usable thermal resistance depends strongly on the mounting method of the device on the printed-circuit board, the soldering method and the area and thickness of the copper on the printed-circuit board.

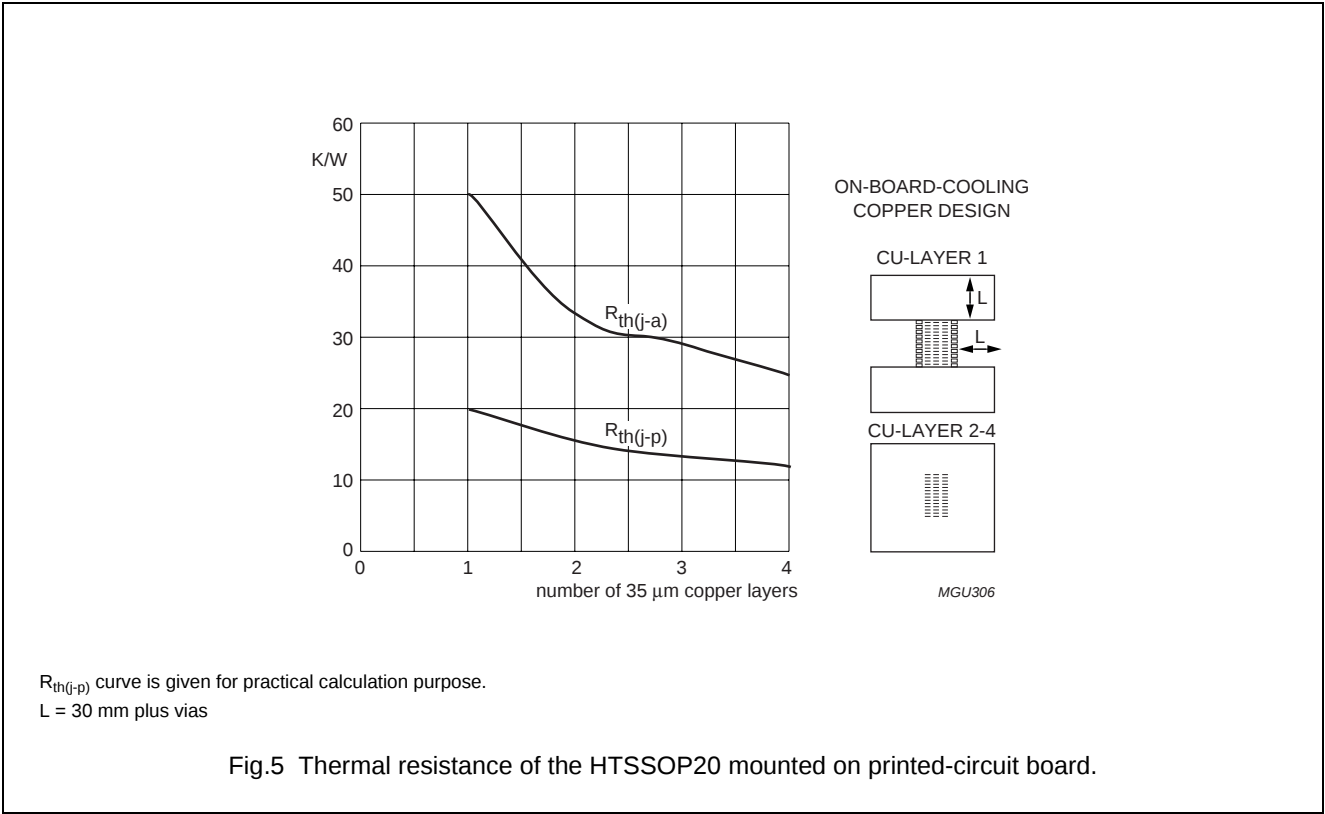
The bottom ‘heat-spreader’ of the IC has to be soldered efficiently on the ‘thermal land’ of the copper area of the printed-circuit board using the re-flow solder technique.

A number of thermal vias in the ‘thermal land’ provide a thermal path to the opposite copper site of the printed-circuit board. The size of the surface layers should be as large as needed to dissipate the heat.

The thermal vias (0.3 mm  $\varnothing$ ) in the ‘thermal land’ should not use web construction techniques, because those will have high thermal resistance; continuous connection completely around the via-hole is recommended.

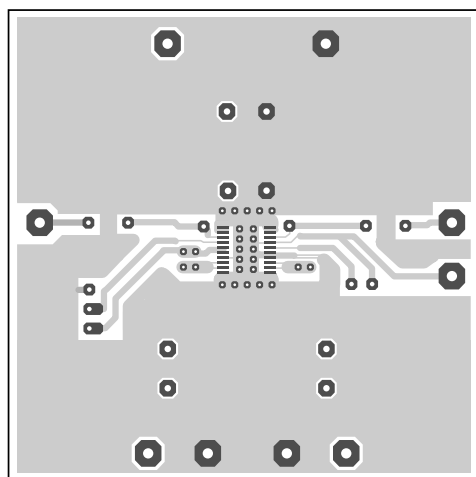
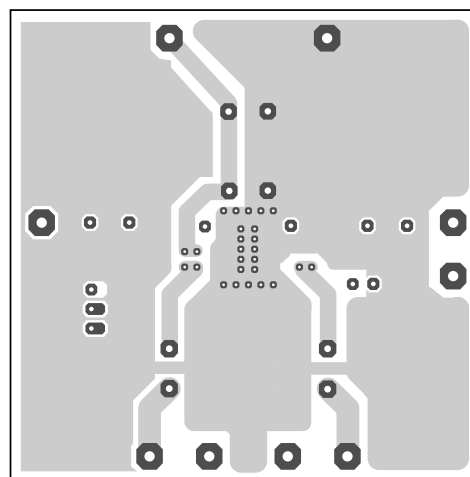
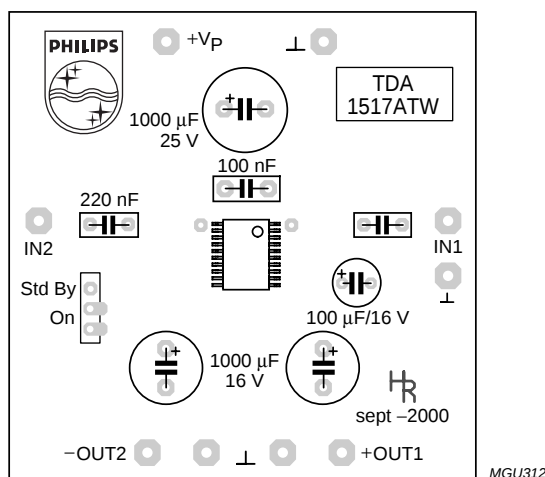
For a maximum ambient temperature of 60 °C the following calculation can be made: for the application at  $V_P = 12$  V and  $R_L = 8 \Omega$  the (ALL-) music power dissipation approximately 2.0 W;  
 $T_{j(max)} = T_{amb} + P \times R_{th(j-a)} = 60\text{ °C} + 2.0 \times 37 = 134\text{ °C}.$

Note: the above calculation holds for application at ‘average listening level’ music output signals. Applying (or testing) with sine wave signals will produce approximately twice the music power dissipation; at worst case condition this can activate the maximum temperature protection.



8 W BTL or  $2 \times 4$  W SE power amplifier

## TDA1517ATW

top view  
bottom copper layouttop view  
top copper layouttop view  
component layout

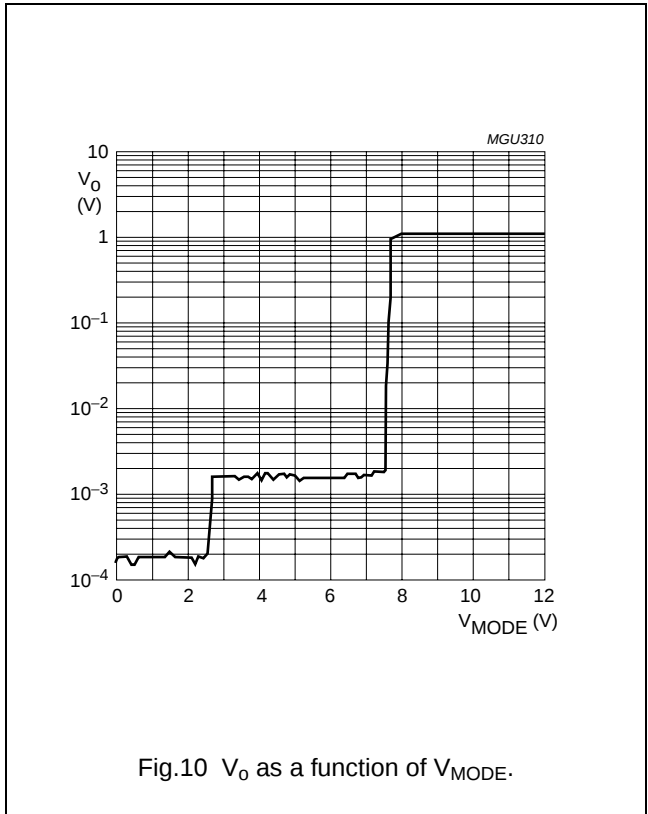
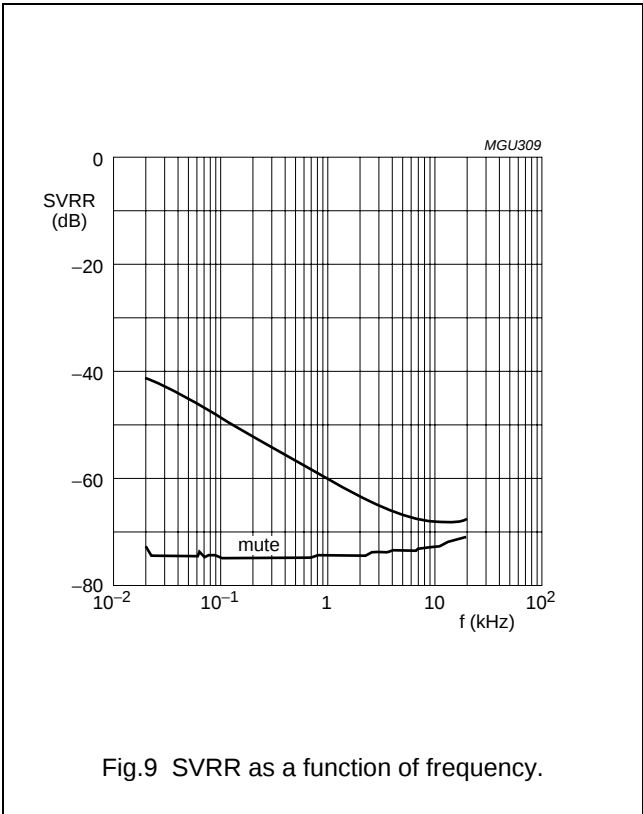
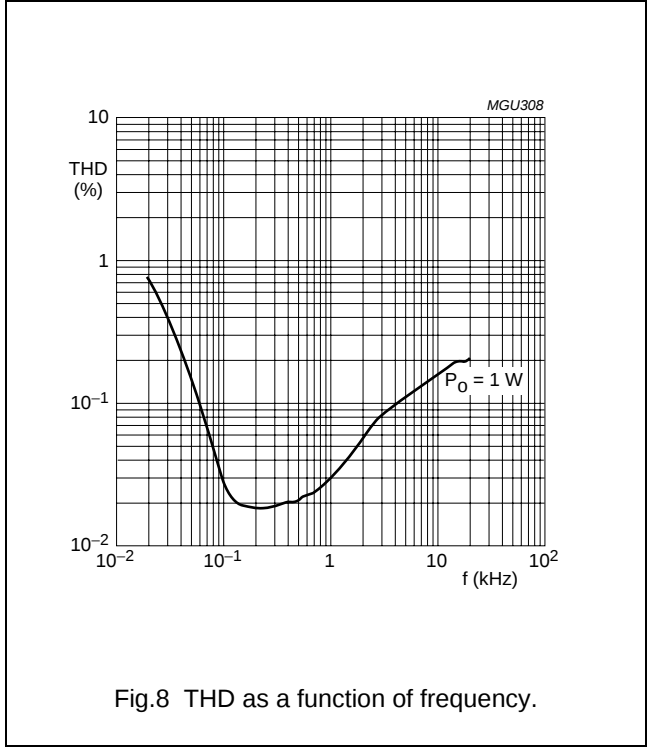
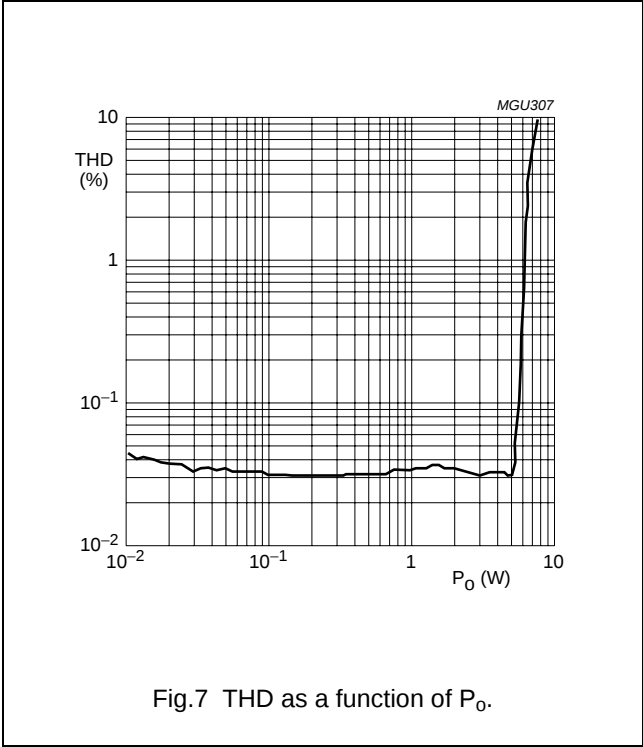
For BTL applications the two 1000 µF/16 V capacitors must be replaced by 0 Ω jumpers.

Fig.6 Printed-circuit board layout for BTL and SE application.

8 W BTL or 2 × 4 W SE power amplifier

TDA1517ATW

Typical performance characteristics for BTL application at  $V_P = 12\text{ V}$  and  $R_L = 8\ \Omega$



8 W BTL or 2 × 4 W SE power amplifier

TDA1517ATW

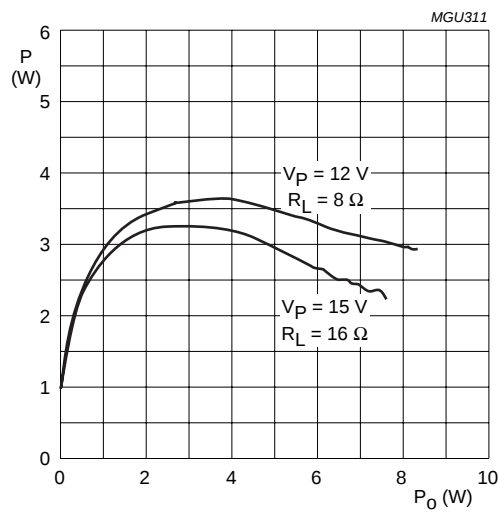


Fig.11 Power dissipation as a function of  $P_o$ .

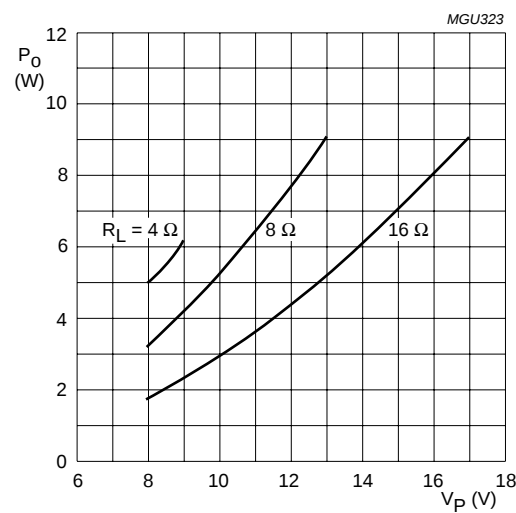


Fig.12  $P_o$  as a function of  $V_P$ .

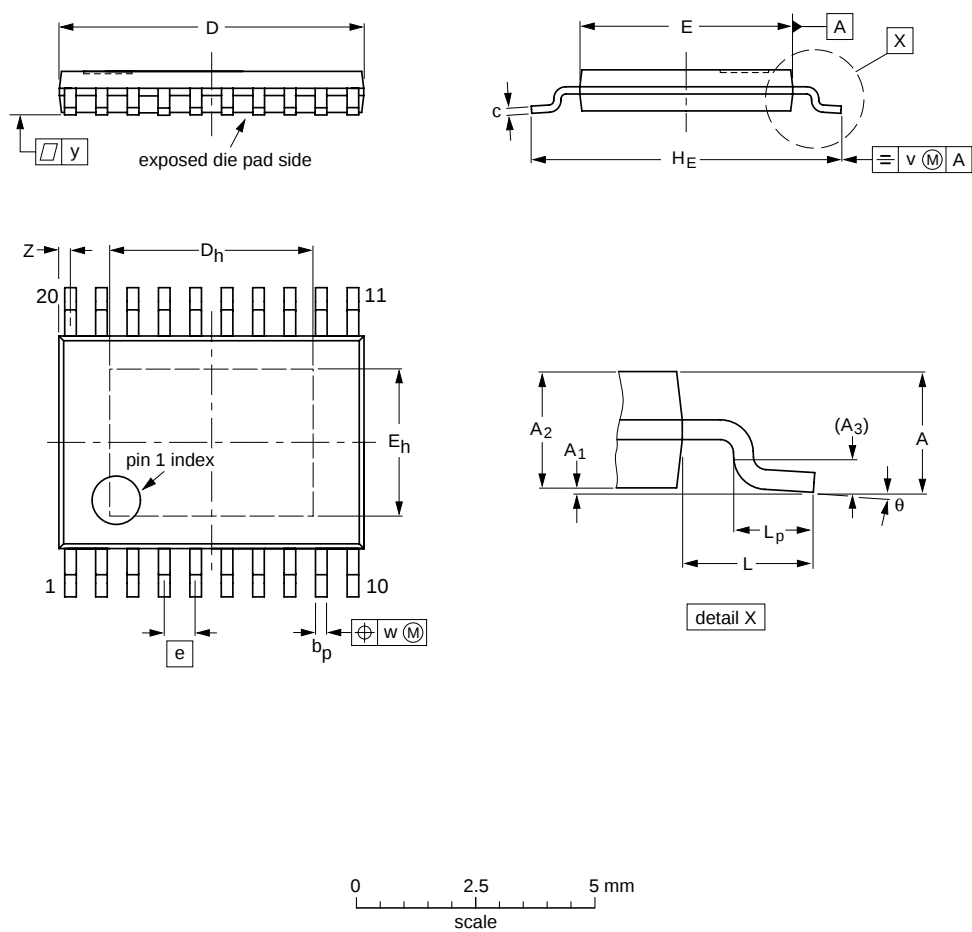
8 W BTL or 2 × 4 W SE power amplifier

TDA1517ATW

PACKAGE OUTLINE

HTSSOP20: plastic thermal enhanced thin shrink small outline package; 20 leads;  
body width 4.4 mm; exposed die pad

SOT527-1



DIMENSIONS (mm are the original dimensions)

| UNIT | A<br>max. | A <sub>1</sub> | A <sub>2</sub> | A <sub>3</sub> | b <sub>p</sub> | c            | D <sup>(1)</sup> | D <sub>h</sub> | E <sup>(2)</sup> | E <sub>h</sub> | e    | H <sub>E</sub> | L | L <sub>p</sub> | v   | w    | y   | z <sup>(1)</sup> | θ        |
|------|-----------|----------------|----------------|----------------|----------------|--------------|------------------|----------------|------------------|----------------|------|----------------|---|----------------|-----|------|-----|------------------|----------|
| mm   | 1.1       | 0.15<br>0.05   | 0.95<br>0.80   | 0.25           | 0.30<br>0.19   | 0.20<br>0.09 | 6.6<br>6.4       | 4.3<br>4.1     | 4.5<br>4.3       | 3.1<br>2.9     | 0.65 | 6.6<br>6.2     | 1 | 0.75<br>0.50   | 0.2 | 0.13 | 0.1 | 0.5<br>0.2       | 8°<br>0° |

- Notes
1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
  2. Plastic interlead protrusions of 0.25 mm maximum per side are not included.

| OUTLINE<br>VERSION | REFERENCES |        |       |  | EUROPEAN<br>PROJECTION                                                                | ISSUE DATE            |
|--------------------|------------|--------|-------|--|---------------------------------------------------------------------------------------|-----------------------|
|                    | IEC        | JEDEC  | JEITA |  |                                                                                       |                       |
| SOT527-1           |            | MO-153 |       |  |  | 03-04-07-<br>05-11-02 |

## 8 W BTL or 2 × 4 W SE power amplifier

## TDA1517ATW

**SOLDERING****Introduction to soldering surface mount packages**

This text gives a very brief insight to a complex technology. A more in-depth account of soldering ICs can be found in our *"Data Handbook IC26; Integrated Circuit Packages"* (document order number 9398 652 90011).

There is no soldering method that is ideal for all surface mount IC packages. Wave soldering can still be used for certain surface mount ICs, but it is not suitable for fine pitch SMDs. In these situations reflow soldering is recommended.

**Reflow soldering**

Reflow soldering requires solder paste (a suspension of fine solder particles, flux and binding agent) to be applied to the printed-circuit board by screen printing, stencilling or pressure-syringe dispensing before package placement.

Several methods exist for reflowing; for example, convection or convection/infrared heating in a conveyor type oven. Throughput times (preheating, soldering and cooling) vary between 100 and 200 seconds depending on heating method.

Typical reflow peak temperatures range from 215 to 250 °C. The top-surface temperature of the packages should preferably be kept below 220 °C for thick/large packages, and below 235 °C for small/thin packages.

**Wave soldering**

Conventional single wave soldering is not recommended for surface mount devices (SMDs) or printed-circuit boards with a high component density, as solder bridging and non-wetting can present major problems.

To overcome these problems the double-wave soldering method was specifically developed.

If wave soldering is used the following conditions must be observed for optimal results:

- Use a double-wave soldering method comprising a turbulent wave with high upward pressure followed by a smooth laminar wave.
- For packages with leads on two sides and a pitch (e):
  - larger than or equal to 1.27 mm, the footprint longitudinal axis is **preferred** to be parallel to the transport direction of the printed-circuit board;
  - smaller than 1.27 mm, the footprint longitudinal axis **must** be parallel to the transport direction of the printed-circuit board.

The footprint must incorporate solder thieves at the downstream end.

- For packages with leads on four sides, the footprint must be placed at a 45° angle to the transport direction of the printed-circuit board. The footprint must incorporate solder thieves downstream and at the side corners.

During placement and before soldering, the package must be fixed with a droplet of adhesive. The adhesive can be applied by screen printing, pin transfer or syringe dispensing. The package can be soldered after the adhesive is cured.

Typical dwell time is 4 seconds at 250 °C.

A mildly-activated flux will eliminate the need for removal of corrosive residues in most applications.

**Manual soldering**

Fix the component by first soldering two diagonally-opposite end leads. Use a low voltage (24 V or less) soldering iron applied to the flat part of the lead. Contact time must be limited to 10 seconds at up to 300 °C.

When using a dedicated tool, all other leads can be soldered in one operation within 2 to 5 seconds between 270 and 320 °C.

## 8 W BTL or 2 × 4 W SE power amplifier

## TDA1517ATW

## Suitability of surface mount IC packages for wave and reflow soldering methods

| PACKAGE                                             | SOLDERING METHOD                  |                       |
|-----------------------------------------------------|-----------------------------------|-----------------------|
|                                                     | WAVE                              | REFLOW <sup>(1)</sup> |
| BGA, HBGA, LFBGA, SQFP, TFBGA                       | not suitable                      | suitable              |
| HBCC, HLQFP, HSQFP, HSOP, HTQFP, HTSSOP, HVQFN, SMS | not suitable <sup>(2)</sup>       | suitable              |
| PLCC <sup>(3)</sup> , SO, SOJ                       | suitable                          | suitable              |
| LQFP, QFP, TQFP                                     | not recommended <sup>(3)(4)</sup> | suitable              |
| SSOP, TSSOP, VSO                                    | not recommended <sup>(5)</sup>    | suitable              |

## Notes

1. All surface mount (SMD) packages are moisture sensitive. Depending upon the moisture content, the maximum temperature (with respect to time) and body size of the package, there is a risk that internal or external package cracks may occur due to vaporization of the moisture in them (the so called popcorn effect). For details, refer to the Drypack information in the *"Data Handbook IC26; Integrated Circuit Packages; Section: Packing Methods"*.
2. These packages are not suitable for wave soldering as a solder joint between the printed-circuit board and heatsink (at bottom version) can not be achieved, and as solder may stick to the heatsink (on top version).
3. If wave soldering is considered, then the package must be placed at a 45° angle to the solder wave direction. The package footprint must incorporate solder thieves downstream and at the side corners.
4. Wave soldering is only suitable for LQFP, TQFP and QFP packages with a pitch (e) equal to or larger than 0.8 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.65 mm.
5. Wave soldering is only suitable for SSOP and TSSOP packages with a pitch (e) equal to or larger than 0.65 mm; it is definitely not suitable for packages with a pitch (e) equal to or smaller than 0.5 mm.

## 8 W BTL or 2 × 4 W SE power amplifier

## TDA1517ATW

## DATA SHEET STATUS

| DOCUMENT STATUS <sup>(1)</sup> | PRODUCT STATUS <sup>(2)</sup> | DEFINITION                                                                            |
|--------------------------------|-------------------------------|---------------------------------------------------------------------------------------|
| Objective data sheet           | Development                   | This document contains data from the objective specification for product development. |
| Preliminary data sheet         | Qualification                 | This document contains data from the preliminary specification.                       |
| Product data sheet             | Production                    | This document contains the product specification.                                     |

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