# TDA1308; TDA1308A

## Class-AB stereo headphone driver

Rev. 04 — 25 January 2007 Product data sheet

## 1. General description

The TDA1308; TDA1308A is an integrated class-AB stereo headphone driver contained in an SO8, DIP8 or a TSSOP8 plastic package. The TDA1308AUK is available in an 8 bump wafer level chip-size package (WLCSP8). The device is fabricated in a 1 µm Complementary Metal Oxide Semiconductor (CMOS) process and has been primarily developed for portable digital audio applications.

The difference between the TDA1308 and the TDA1308A is that the TDA1308A can be used at low supply voltages.

## 2. Features

- Wide temperature range
- No switch ON/OFF clicks
- Excellent power supply ripple rejection
- Low power consumption
- Short-circuit resistant
- High performance
  - High signal-to-noise ratio
  - High slew rate
  - Low distortion
- Large output voltage swing

## 3. Quick reference data

**Table 1. Quick reference data**

*$V_{DD}$ = 5 V; $V_{SS}$ = 0 V; $T_{amb}$ = 25 °C; $f_i$ = 1 kHz; $R_L$ = 32 Ω; unless otherwise specified.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{DD}$ | supply voltage | TDA1308 | | | | |
| | | single supply | 3.0 | 5.0 | 7.0 | V |
| | | dual supply | 1.5 | 2.5 | 3.5 | V |
| | | TDA1308A | | | | |
| | | single supply | 2.4 | 5.0 | 7.0 | V |
| | | dual supply | 1.2 | 2.5 | 3.5 | V |
| $V_{SS}$ | negative supply voltage | TDA1308; dual supply | –1.5 | –2.5 | –3.5 | V |
| | | TDA1308A; dual supply | –1.2 | –2.5 | –3.5 | V |
| $I_{DD}$ | supply current | no load | - | 3 | 5 | mA |

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**Table 1. Quick reference data** *...continued*

*$V_{DD}$ = 5 V; $V_{SS}$ = 0 V; $T_{amb}$ = 25 °C; $f_i$ = 1 kHz; $R_L$ = 32 Ω; unless otherwise specified.*

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| $P_{tot}$ | total power dissipation | no load | | - | 15 | 25 | mW |
| $P_o$ | maximum output power | (THD + N)/S < 0.1 % | [1] | - | 40 | 80 | mW |
| (THD + N)/S | total harmonic distortion plus noise-to-signal ratio | | [1] | - | 0.03 | 0.06 | % |
| | | | [1] | - | –70 | –65 | dB |
| | | $R_L$ = 5 kΩ | [2] | - | –92 | –89 | dB |
| | | $R_L$ = 5 kΩ | [3] | - | –52 | –40 | dB |
| | | $R_L$ = 5 kΩ | | - | –101 | - | dB |
| S/N | signal-to-noise ratio | | | 100 | 110 | - | dB |
| $\alpha_{cs}$ | channel separation | | | - | 70 | - | dB |
| | | $R_L$ = 5 kΩ | [1] | - | 105 | - | dB |
| PSRR | power supply ripple rejection | $f_i$ = 100 Hz; $V_{ripple(p-p)}$ = 100 mV | | - | 90 | - | dB |
| $T_{amb}$ | ambient temperature | | | –40 | - | +85 | °C |

[1] $V_{DD}$ = 5 V; $V_{O(p-p)}$ = 3.5 V (at 0 dB).

[2] $V_{DD}$ = 2.4 V; $V_{O(p-p)}$ = 1.62 V (at –4.8 dBV); for TDA1308A only.

[3] $V_{DD}$ = 2.4 V; $V_{O(p-p)}$ = 1.19 V (at –7.96 dBV); for TDA1308A only.

## 4. Ordering information

**Table 2. Ordering information**

| Type number | Package | | |
|---|---|---|---|
| | Name | Description | Version |
| TDA1308 | DIP8 | plastic dual in-line package; 8 leads (300 mil) | SOT97-1 |
| TDA1308T | SO8 | plastic small outline package; 8 leads; body width 3.9 mm | SOT96-1 |
| TDA1308AT | SO8 | plastic small outline package; 8 leads; body width 3.9 mm | SOT96-1 |
| TDA1308AUK | WLCSP8 | wafer level chip-size package; 8 bumps; 0.61 × 0.84 × 0.38 mm | TDA1308AUK |
| TDA1308TT | TSSOP8 | plastic thin shrink small outline package; 8 leads; body width 3 mm | SOT505-1 |



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## 5. Block diagram

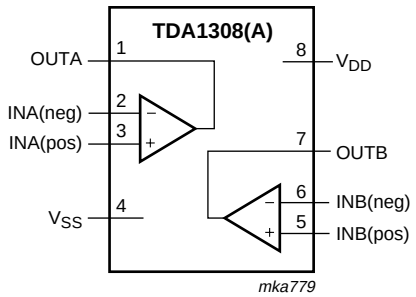



**Fig 1. Block diagram**

## 6. Pinning information

### 6.1 Pinning

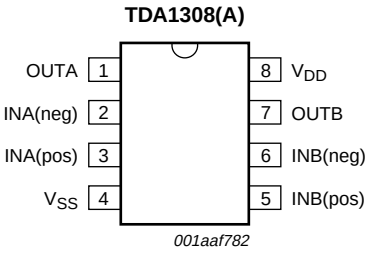



**Fig 2. Pin configuration TDA1308(A)**

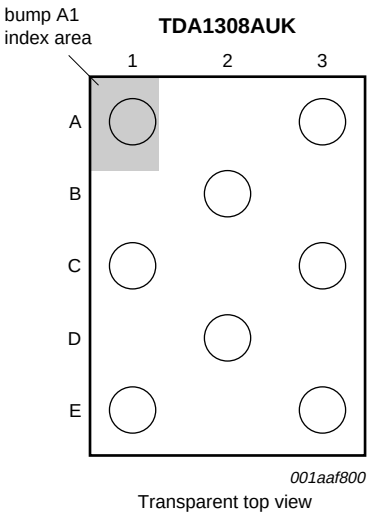



**Fig 3. Pin configuration TDA1308AUK**

### 6.2 Pin description

**Table 3. Pin description TDA1308(A)**

| Symbol | Pin | Description |
|---|---|---|
| OUTA | 1 | output A |
| INA(neg) | 2 | inverting input A |
| INA(pos) | 3 | non-inverting input A |
| $V_{SS}$ | 4 | negative supply |
| INB(pos) | 5 | non-inverting input B |


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**Table 3. Pin description TDA1308(A) *…continued***

| Symbol | Pin | Description |
|---|---|---|
| INB(neg) | 6 | inverting input B |
| OUTB | 7 | output B |
| $V_{DD}$ | 8 | positive supply |

**Table 4. Pin description TDA1308AUK**

| Symbol | Pin | Description |
|---|---|---|
| OUTA | A1 | output A |
| $V_{SS}$ | A3 | negative supply |
| INA(pos) | B2 | non-inverting input A |
| OUTB | C1 | output B |
| INA(neg) | C3 | inverting input A |
| INB(neg) | D2 | inverting input B |
| $V_{DD}$ | E1 | positive supply |
| INB(pos) | E3 | non-inverting input B |

## 7. Internal circuitry

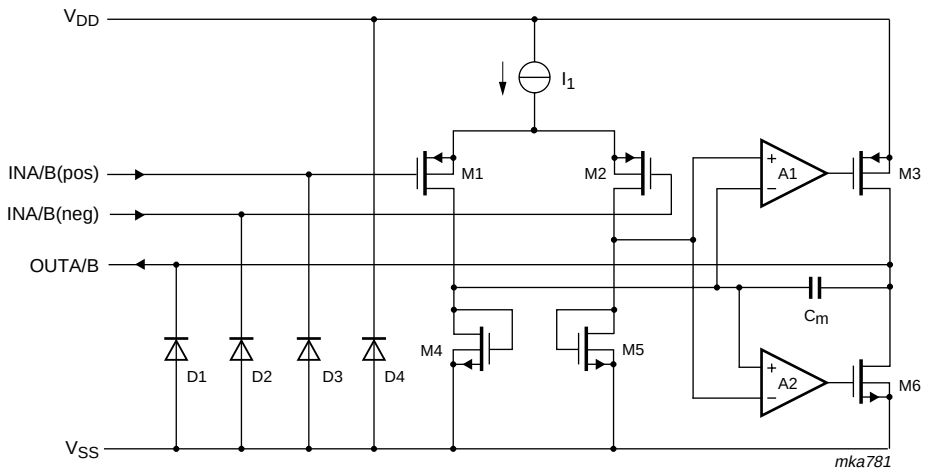



**Fig 4. Equivalent schematic diagram**



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## 8. Limiting values

**Table 5. Limiting values**

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

| Symbol | Parameter | Conditions | | Min | Max | Unit |
|---|---|---|---|---|---|---|
| $V_{DD}$ | supply voltage | | | 0 | 8.0 | V |
| $t_{SC(O)}$ | output short-circuit duration | $T_{amb}$ = 25 °C; $P_{tot}$ = 1 W | | 20 | - | s |
| $T_{stg}$ | storage temperature | | | −65 | +150 | °C |
| $T_{amb}$ | ambient temperature | | | −40 | +85 | °C |
| $V_{esd}$ | electrostatic discharge voltage | HBM | [1] | −2 | +2 | kV |
| | | MM | [2] | −200 | +200 | V |

[1] Human body model (HBM): C = 100 pF; R = 1500 Ω; 3 pulses positive plus 3 pulses negative.

[2] Machine model (MM): C = 200 pF; L = 0.5 mH; R = 0 Ω; 3 pulses positive plus 3 pulses negative.

## 9. Thermal characteristics

**Table 6. Thermal characteristics**

| Symbol | Parameter | Conditions | Typ | Unit |
|---|---|---|---|---|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | | | |
| | DIP8 | | 109 | K/W |
| | SO8 | | 210 | K/W |
| | TSSOP8 | | 220 | K/W |
| | WLCSP8 | | 1000 | K/W |



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## 10. Characteristics

**Table 7. Characteristics**

*$V_{DD}$ = 5 V; $V_{SS}$ = 0 V; $T_{amb}$ = 25 °C; $f_i$ = 1 kHz; $R_L$ = 32 Ω; unless otherwise specified.*

| Symbol | Parameter | Conditions | | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|---|
| **Supplies** | | | | | | | |
| $V_{DD}$ | supply voltage | TDA1308 | | | | | |
| | | single supply | | 3.0 | 5.0 | 7.0 | V |
| | | dual supply | | 1.5 | 2.5 | 3.5 | V |
| | | TDA1308A | | | | | |
| | | single supply | | 2.4 | 5.0 | 7.0 | V |
| | | dual supply | | 1.2 | 2.5 | 3.5 | V |
| $V_{SS}$ | negative supply voltage | TDA1308; dual supply | | –1.5 | –2.5 | –3.5 | V |
| | | TDA1308A; dual supply | | –1.2 | –2.5 | –3.5 | V |
| $I_{DD}$ | supply current | no load | | - | 3 | 5 | mA |
| $P_{tot}$ | total power dissipation | no load | | - | 15 | 25 | mW |
| **Static characteristics** | | | | | | | |
| $V_{I(os)}$ | input offset voltage | | | - | 10 | - | mV |
| $I_{bias}$ | input bias current | | | - | 10 | - | pA |
| $V_{CM}$ | common mode voltage | | | 0 | - | 3.5 | pA |
| $G_V$ | open-loop voltage gain | $R_L$ = 5 kΩ | | - | 70 | - | dB |
| $I_O$ | maximum output current | | | - | 60 | - | mA |
| $R_O$ | output resistance | (THD + N)/S < 0.1 % | | - | 0.25 | - | Ω |
| $V_O$ | output voltage swing | | [1] | 0.75 | - | 4.25 | V |
| | | $R_L$ = 16 Ω | [1] | 1.5 | - | 3.5 | V |
| | | $R_L$ = 5 kΩ | [1] | 0.1 | - | 4.9 | V |
| $\alpha_{cs}$ | channel separation | | | - | 70 | - | dB |
| | | $R_L$ = 5 kΩ | [1] | - | 105 | - | dB |
| PSRR | power supply ripple rejection | $f_i$ = 100 Hz; $V_{ripple(p-p)}$ = 100 mV | | - | 90 | - | dB |
| $C_L$ | load capacitance | | | - | - | 200 | pF |
| **Dynamic characteristics** | | | | | | | |
| (THD + N)/S | total harmonic distortion plus noise-to-signal ratio | | [2] | - | 0.03 | 0.06 | % |
| | | | [2] | - | –70 | –65 | dB |
| | | $R_L$ = 5 kΩ | [3] | - | –92 | –89 | dB |
| | | $R_L$ = 5 kΩ | [3] | - | –52 | –40 | dB |
| | | $R_L$ = 5 kΩ | [3] | - | 0.25 | 1.0 | % |
| | | $R_L$ = 5 kΩ | [2] | - | –101 | - | dB |
| | | $R_L$ = 5 kΩ | [2] | - | 0.0009 | - | % |
| S/N | signal-to-noise ratio | | | 100 | 110 | - | dB |
| $f_G$ | unity gain frequency | open-loop; $R_L$ = 5 kΩ | | - | 5.5 | - | MHz |
| $P_o$ | maximum output power | (THD + N)/S < 0.1 % | | - | 40 | 80 | mW |



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**Table 7. Characteristics** *...continued*

*$V_{DD}$ = 5 V; $V_{SS}$ = 0 V; $T_{amb}$ = 25 °C; $f_i$ = 1 kHz; $R_L$ = 32 Ω; unless otherwise specified.*

| Symbol | Parameter | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $C_i$ | input capacitance | | - | 3 | - | pF |
| SR | slew rate | unity gain inverting | - | 5 | - | V/µs |
| B | bandwidth | unity gain inverting | - | 20 | - | kHz |

[1] Values are proportional to $V_{DD}$; (THD + N)/S < 0.1 %.

[2] $V_{DD}$ = 5 V; $V_{O(p-p)}$ = 3.5 V (at 0 dB).

[3] $V_{DD}$ = 2.4 V; $V_{O(p-p)}$ = 1.19 V (at −7.96 dBV); for TDA1308A only.

## 11. Application information

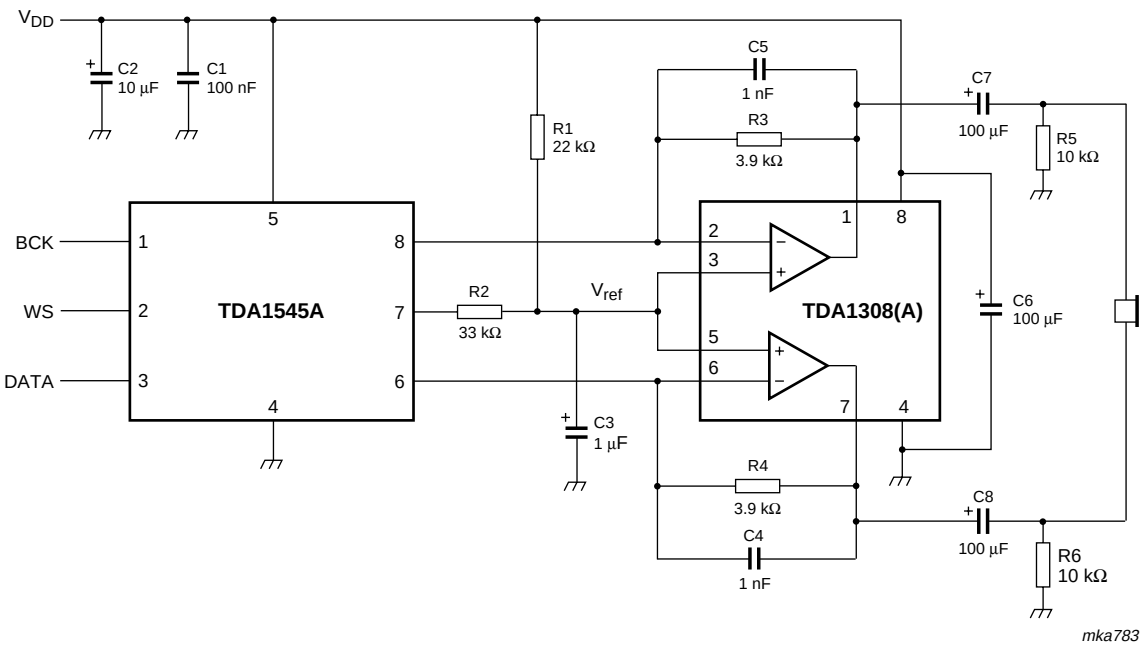



**Fig 5. Example of application with TDA1545A (stereo continuous calibration DAC)**



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## 12. Test information

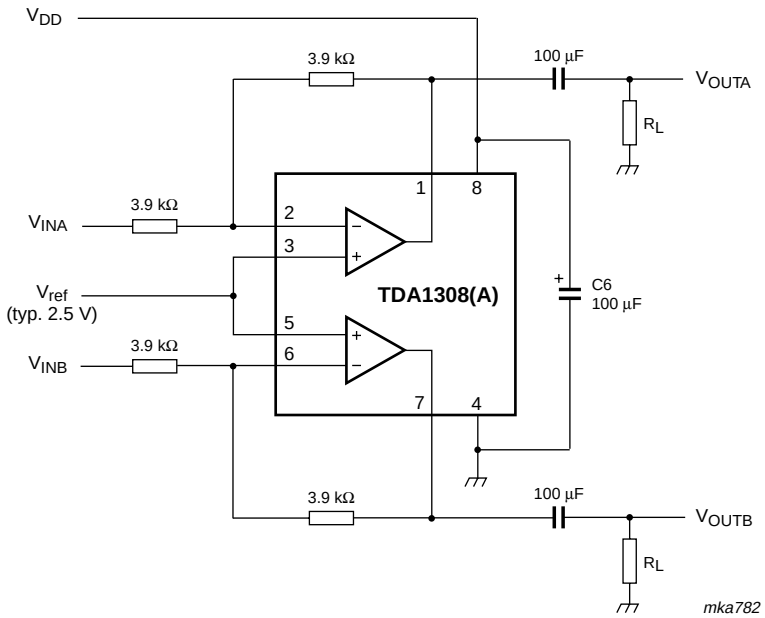



**Fig 6. Measurement circuit for inverting application**

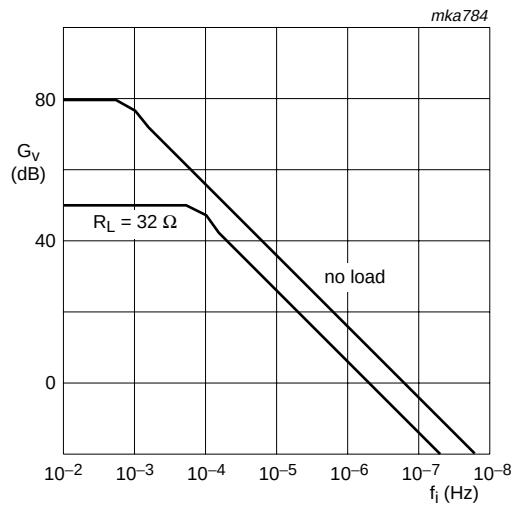



**Fig 7. Open-loop gain as a function of input frequency**

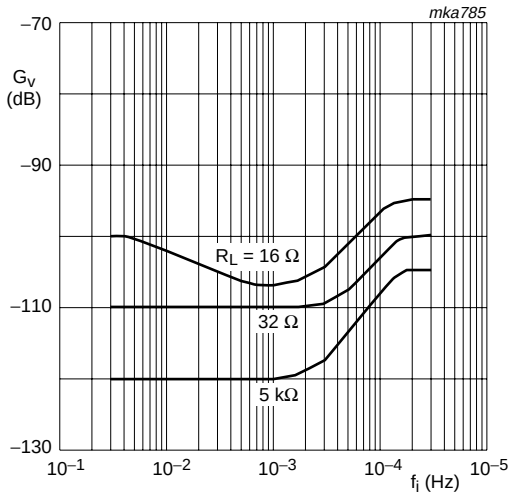



**Fig 8. Crosstalk as a function of input frequency**



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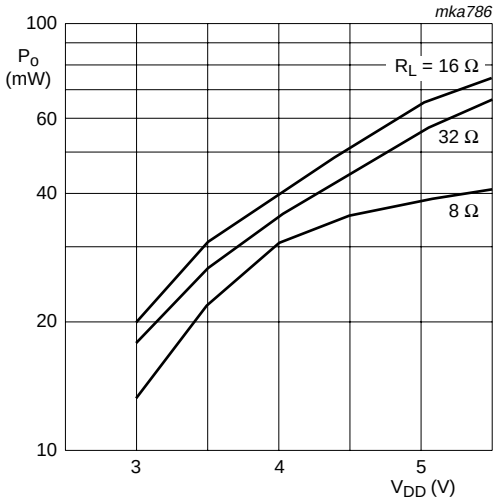



**Fig 9. Output power as a function of supply voltage**

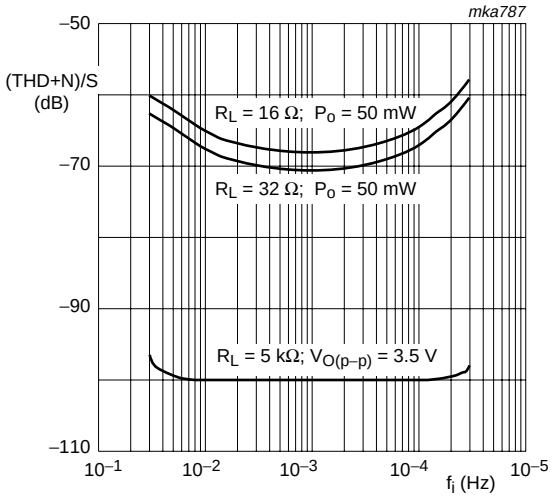



**Fig 10. Total harmonic distortion plus noise-to-signal ratio as a function of input frequency**

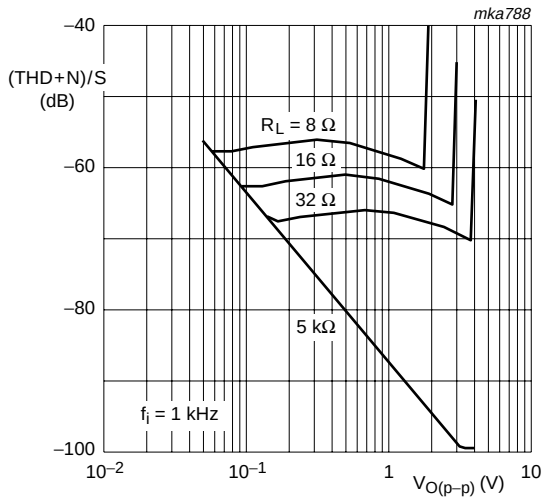



**Fig 11. Total harmonic distortion plus noise-to-signal ratio as a function of output voltage level**

## 12.1 Quality information

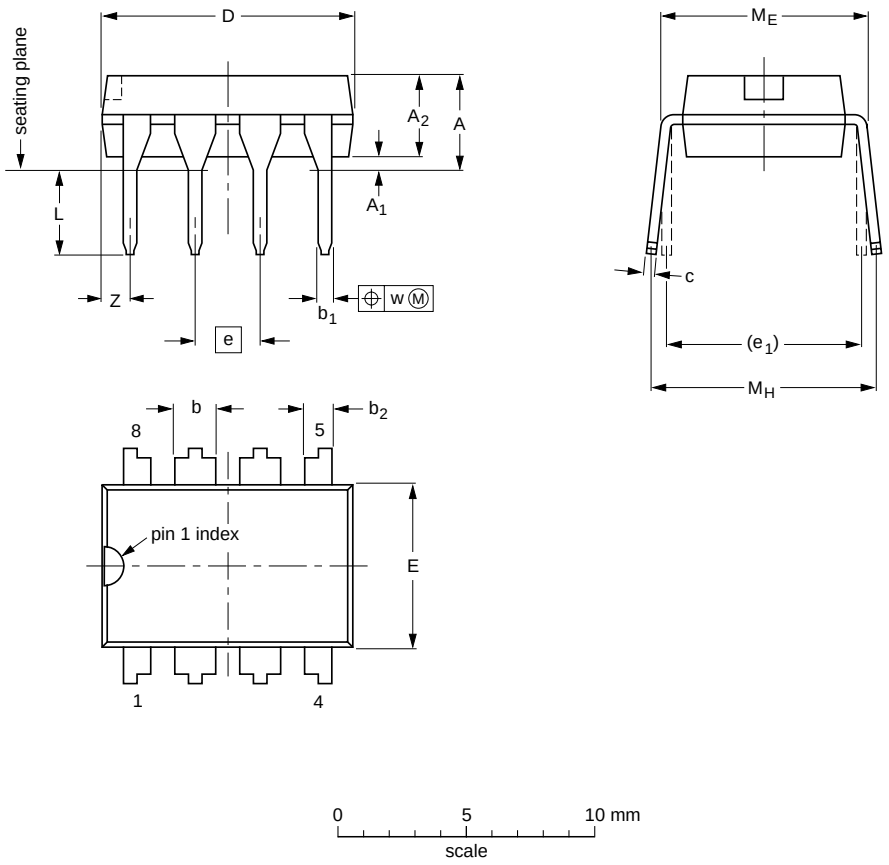
The *General Quality Specification for Integrated Circuits, SNW-FQ-611* is applicable.



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## 13. Package outline

**DIP8: plastic dual in-line package; 8 leads (300 mil)** **SOT97-1**




**DIMENSIONS (inch dimensions are derived from the original mm dimensions)**

| UNIT | A max. | $A_1$ min. | $A_2$ max. | b | $b_1$ | $b_2$ | c | D (1) | E (1) | e | $e_1$ | L | $M_E$ | $M_H$ | w | Z (1) max. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 4.2 | 0.51 | 3.2 | 1.73<br>1.14 | 0.53<br>0.38 | 1.07<br>0.89 | 0.36<br>0.23 | 9.8<br>9.2 | 6.48<br>6.20 | 2.54 | 7.62 | 3.60<br>3.05 | 8.25<br>7.80 | 10.0<br>8.3 | 0.254 | 1.15 |
| inches | 0.17 | 0.02 | 0.13 | 0.068<br>0.045 | 0.021<br>0.015 | 0.042<br>0.035 | 0.014<br>0.009 | 0.39<br>0.36 | 0.26<br>0.24 | 0.1 | 0.3 | 0.14<br>0.12 | 0.32<br>0.31 | 0.39<br>0.33 | 0.01 | 0.045 |

**Note**

1. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

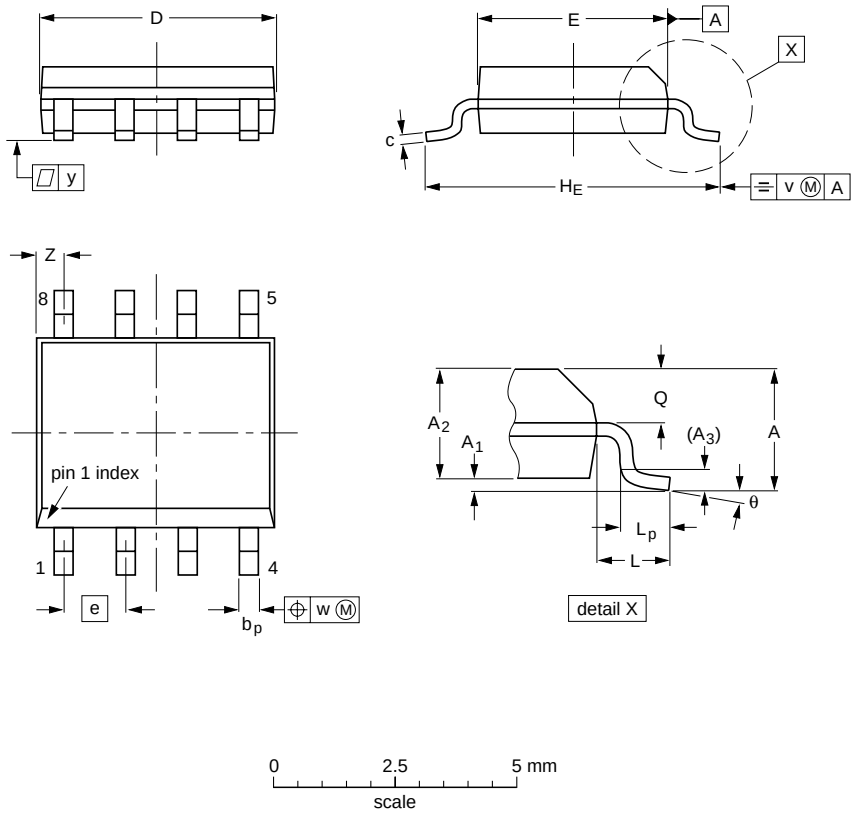
| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT97-1 | 050G01 | MO-001 | SC-504-8 | | | ~~99-12-27~~<br>03-02-13 |

**Fig 12. Package outline SOT97-1 (DIP8)**



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**SO8: plastic small outline package; 8 leads; body width 3.9 mm** **SOT96-1**




**DIMENSIONS (inch dimensions are derived from the original mm dimensions)**

| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | $D^{(1)}$ | $E^{(2)}$ | e | $H_E$ | L | $L_p$ | Q | v | w | y | $Z^{(1)}$ | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.75 | 0.25<br>0.10 | 1.45<br>1.25 | 0.25 | 0.49<br>0.36 | 0.25<br>0.19 | 5.0<br>4.8 | 4.0<br>3.8 | 1.27 | 6.2<br>5.8 | 1.05 | 1.0<br>0.4 | 0.7<br>0.6 | 0.25 | 0.25 | 0.1 | 0.7<br>0.3 | $8^o$<br>$0^o$ |
| inches | 0.069 | 0.010<br>0.004 | 0.057<br>0.049 | 0.01 | 0.019<br>0.014 | 0.0100<br>0.0075 | 0.20<br>0.19 | 0.16<br>0.15 | 0.05 | 0.244<br>0.228 | 0.041 | 0.039<br>0.016 | 0.028<br>0.024 | 0.01 | 0.01 | 0.004 | 0.028<br>0.012 | |

**Notes**

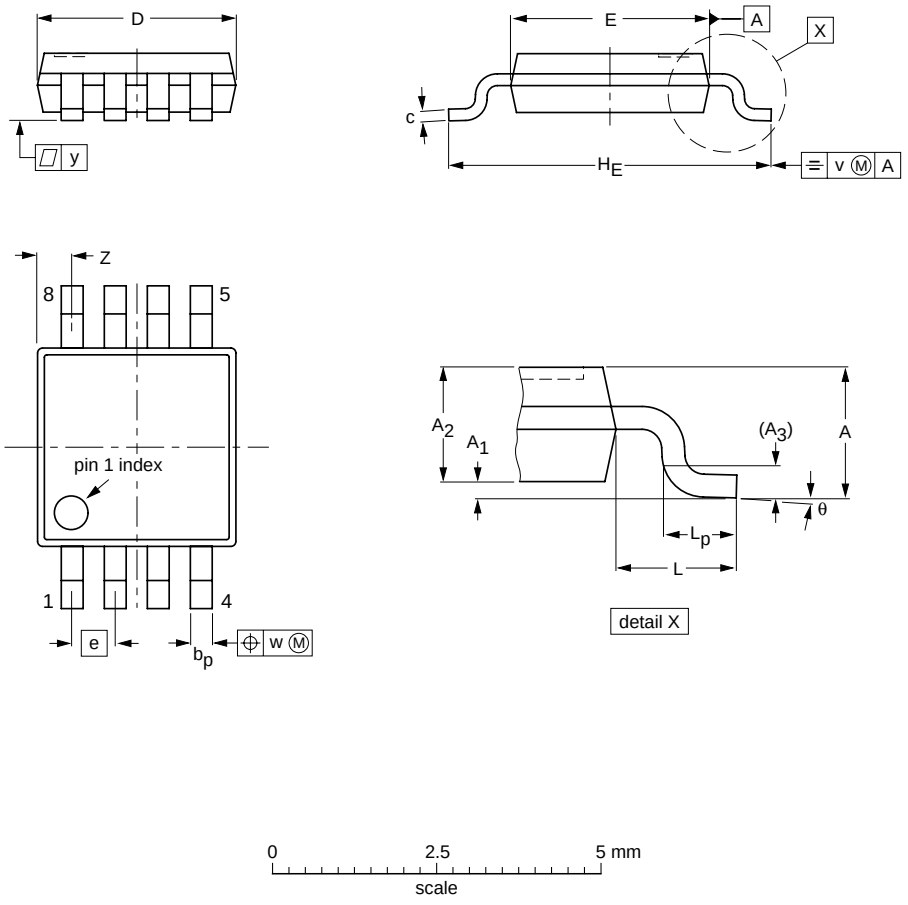
1. Plastic or metal protrusions of 0.15 mm (0.006 inch) maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm (0.01 inch) maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT96-1 | 076E03 | MS-012 | | | | ~~99-12-27~~<br>03-02-18 |

**Fig 13. Package outline SOT96-1 (SO8)**


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**TSSOP8: plastic thin shrink small outline package; 8 leads; body width 3 mm** **SOT505-1**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A max. | $A_1$ | $A_2$ | $A_3$ | $b_p$ | c | $D^{(1)}$ | $E^{(2)}$ | e | $H_E$ | L | $L_p$ | v | w | y | $Z^{(1)}$ | θ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 1.1 | 0.15<br>0.05 | 0.95<br>0.80 | 0.25 | 0.45<br>0.25 | 0.28<br>0.15 | 3.1<br>2.9 | 3.1<br>2.9 | 0.65 | 5.1<br>4.7 | 0.94 | 0.7<br>0.4 | 0.1 | 0.1 | 0.1 | 0.70<br>0.35 | 6°<br>0° |

**Notes**

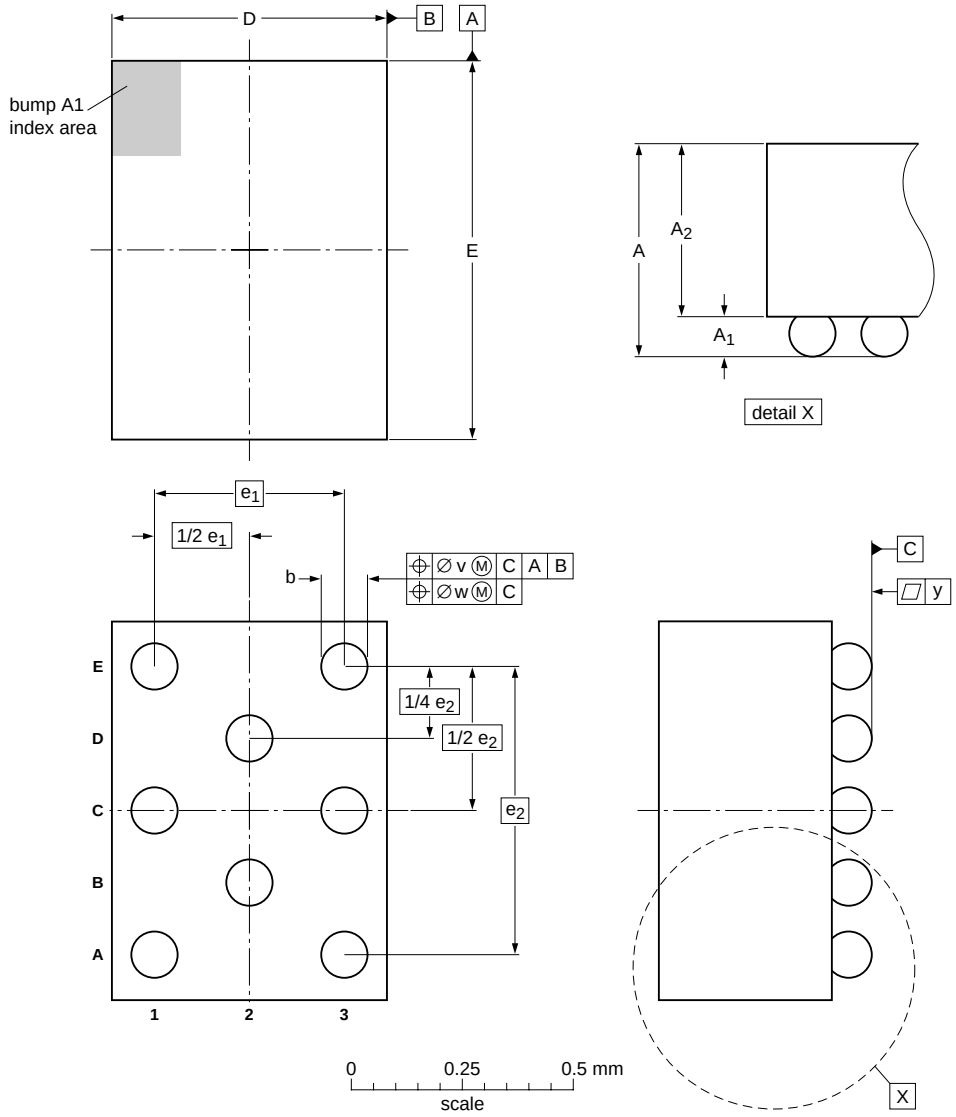
1. Plastic or metal protrusions of 0.15 mm maximum per side are not included.
2. Plastic or metal protrusions of 0.25 mm maximum per side are not included.

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| SOT505-1 | | | | | | ~~99-04-09~~<br>03-02-18 |

**Fig 14. Package outline SOT505-1 (TSSOP8)**


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**WLCSP8: wafer level chip-size package; 8 bumps; 0.61 x 0.84 x 0.38 mm** **TDA1308AUK**




**DIMENSIONS (mm are the original dimensions)**

| UNIT | A max | $A_1$ | $A_2$ | b | D | E | $e_1$ | $e_2$ | v | w | y |
|---|---|---|---|---|---|---|---|---|---|---|---|
| mm | 0.49 | 0.10<br>0.07 | 0.39<br>0.37 | 0.123<br>0.091 | 0.65<br>0.57 | 0.88<br>0.80 | 0.396 | 0.588 | 0.15 | 0.05 | 0.08 |

| OUTLINE VERSION | REFERENCES | | | | EUROPEAN PROJECTION | ISSUE DATE |
|---|---|---|---|---|---|---|
| | IEC | JEDEC | JEITA | | | |
| TDA1308AUK | | | | | | ~~06-11-20~~<br>06-12-15 |

**Fig 15. Package outline TDA1308AUK (WLCSP8)**


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# 14. Soldering

This text provides a very brief insight into a complex technology. A more in-depth account of soldering ICs can be found in Application Note *AN10365 "Surface mount reflow soldering description"*.

## 14.1 Introduction to soldering

Soldering is one of the most common methods through which packages are attached to Printed Circuit Boards (PCBs), to form electrical circuits. The soldered joint provides both the mechanical and the electrical connection. There is no single soldering method that is ideal for all IC packages. Wave soldering is often preferred when through-hole and Surface Mount Devices (SMDs) are mixed on one printed wiring board; however, it is not suitable for fine pitch SMDs. Reflow soldering is ideal for the small pitches and high densities that come with increased miniaturization.

## 14.2 Wave and reflow soldering

Wave soldering is a joining technology in which the joints are made by solder coming from a standing wave of liquid solder. The wave soldering process is suitable for the following:

- Through-hole components
- Leaded or leadless SMDs, which are glued to the surface of the printed circuit board

Not all SMDs can be wave soldered. Packages with solder balls, and some leadless packages which have solder lands underneath the body, cannot be wave soldered. Also, leaded SMDs with leads having a pitch smaller than ~0.6 mm cannot be wave soldered, due to an increased probability of bridging.

The reflow soldering process involves applying solder paste to a board, followed by component placement and exposure to a temperature profile. Leaded packages, packages with solder balls, and leadless packages are all reflow solderable.

Key characteristics in both wave and reflow soldering are:

- Board specifications, including the board finish, solder masks and vias
- Package footprints, including solder thieves and orientation
- The moisture sensitivity level of the packages
- Package placement
- Inspection and repair
- Lead-free soldering versus PbSn soldering

## 14.3 Wave soldering

Key characteristics in wave soldering are:

- Process issues, such as application of adhesive and flux, clinching of leads, board transport, the solder wave parameters, and the time during which components are exposed to the wave
- Solder bath specifications, including temperature and impurities


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## 14.4 Reflow soldering

Key characteristics in reflow soldering are:

- Lead-free versus SnPb soldering; note that a lead-free reflow process usually leads to higher minimum peak temperatures (see Figure 16) than a PbSn process, thus reducing the process window
- Solder paste printing issues including smearing, release, and adjusting the process window for a mix of large and small components on one board
- Reflow temperature profile; this profile includes preheat, reflow (in which the board is heated to the peak temperature) and cooling down. It is imperative that the peak temperature is high enough for the solder to make reliable solder joints (a solder paste characteristic). In addition, the peak temperature must be low enough that the packages and/or boards are not damaged. The peak temperature of the package depends on package thickness and volume and is classified in accordance with Table 8 and 9

**Table 8. SnPb eutectic process (from J-STD-020C)**

| Package thickness (mm) | Package reflow temperature (°C) | |
|---|---|---|
| | Volume ($mm^3$) | |
| | < 350 | ≥ 350 |
| < 2.5 | 235 | 220 |
| ≥ 2.5 | 220 | 220 |

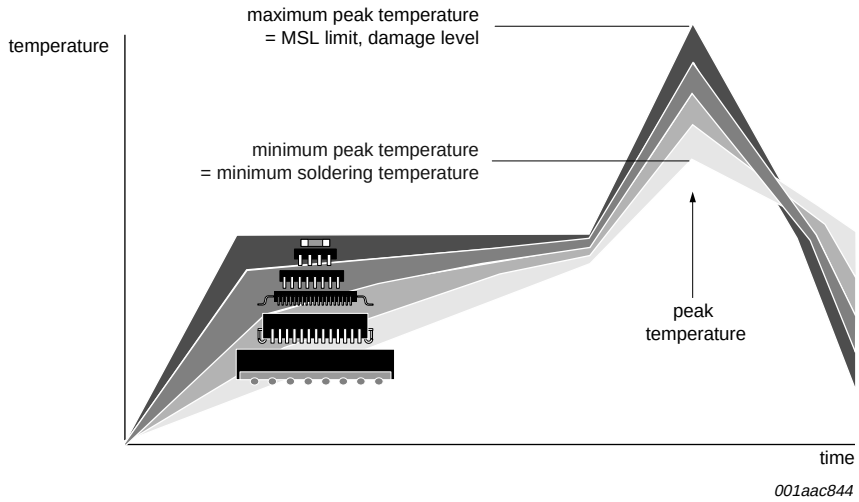
**Table 9. Lead-free process (from J-STD-020C)**

| Package thickness (mm) | Package reflow temperature (°C) | | |
|---|---|---|---|
| | Volume ($mm^3$) | | |
| | < 350 | 350 to 2000 | > 2000 |
| < 1.6 | 260 | 260 | 260 |
| 1.6 to 2.5 | 260 | 250 | 245 |
| > 2.5 | 250 | 245 | 245 |

Moisture sensitivity precautions, as indicated on the packing, must be respected at all times.

Studies have shown that small packages reach higher temperatures during reflow soldering, see Figure 16.


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MSL: Moisture Sensitivity Level

**Fig 16. Temperature profiles for large and small components**

For further information on temperature profiles, refer to Application Note *AN10365 "Surface mount reflow soldering description"*.



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## 15. Revision history

**Table 10. Revision history**

| Document ID | Release date | Data sheet status | Change notice | Supersedes |
|---|---|---|---|---|
| TDA1308_A_4 | 20070125 | Product data sheet | - | TDA1308_A_3 |
| Modifications: | • The format of this data sheet has been redesigned to comply with the new identity guidelines of NXP Semiconductors<br>• Legal texts have been adapted to the new company name where appropriate<br>• Type number TDA1308AUK has been added | | | |
| TDA1308_A_3 | 20020719 | Product specification | - | TDA1308_A_2 |
| TDA1308_A_2 | 20020227 | Product specification | - | TDA1308_1 |
| TDA1308_1 | 19940905 | Product specification | - | - |


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| Document status[1][2] | Product status[3] | Definition |
|---|---|---|
| Objective [short] data sheet | Development | This document contains data from the objective specification for product development. |
| Preliminary [short] data sheet | Qualification | This document contains data from the preliminary specification. |
| Product [short] data sheet | Production | This document contains the product specification. |

[1] Please consult the most recently issued document before initiating or completing a design.

[2] The term 'short data sheet' is explained in section "Definitions".

[3] The product status of device(s) described in this document may have changed since this document was published and may differ in case of multiple devices. The latest product status information is available on the Internet at URL http://www.nxp.com.

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