

# DATA SHEET

## **TDA8928J**

Power stage 2 x 10 or 1 x 20 W  
class-D audio amplifier

Preliminary specification  
Supersedes data of 2004 Feb 04

2004 May 05

# Power stage 2 x 10 or 1 x 20 W class-D audio amplifier

## TDA8928J

|                 |        |  |
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# Power stage 2 x 10 or 1 x 20 W class-D audio amplifier

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## 1 FEATURES

- High efficiency (> 90 %)
- Supply voltage from  $\pm 7.5$  V to  $\pm 30$  V
- Very low quiescent current
- High output power
- Diagnostic output
- Usable as a stereo Single-Ended (SE) amplifier
- Electrostatic discharge protection (pin to pin)
- No heatsink required.

## 2 APPLICATIONS

- Television sets
- Home-sound sets
- Multimedia systems
- All mains fed audio systems.

## 3 GENERAL DESCRIPTION

The TDA8928J is a switching power stage for a high efficiency class-D audio power amplifier system.

With this power stage a compact  $2 \times 10$  W self oscillating digital amplifier system can be built, operating with high efficiency and very low dissipation. No heatsink is required. The system operates over a wide supply voltage range from  $\pm 7.5$  V up to  $\pm 30$  V and consumes a very low quiescent current.

## 4 QUICK REFERENCE DATA

| SYMBOL                                   | PARAMETER               | CONDITIONS  | MIN.      | TYP.       | MAX.     | UNIT |
|--|-------------------------|---|-----------|------------|----------|------|
| <b>General</b>                           |                         |   |           |            |          |      |
| $V_P$                                    | supply voltage          |   | $\pm 7.5$ | $\pm 12.5$ | $\pm 30$ | V    |
| $I_{q(\text{tot})}$                      | total quiescent current | no load connected; $V_P = \pm 12.5$ V               | –         | 25         | 45       | mA   |
| $\eta$                                   | efficiency              | $P_o = 10$ W; $R_L = 8 \Omega$ ; $V_P = \pm 12.5$ V | –         | 90         | –        | %    |
| <b>Stereo single-ended configuration</b> |                         |   |           |            |          |      |
| $P_o$                                    | output power            | $R_L = 8 \Omega$ ; THD = 10 %; $V_P = \pm 12.5$ V   | 9         | 10         | –        | W    |
|  |                         | $R_L = 16 \Omega$ ; THD = 10 %; $V_P = \pm 12.5$ V  | –         | 5          | –        | W    |

## 5 ORDERING INFORMATION

| TYPE NUMBER | PACKAGE |  |          |
|-------------|---------|--|----------|
|             | NAME    | DESCRIPTION  | VERSION  |
| TDA8928J    | DBS17P  | plastic DIL-bent-SIL power package; 17 leads (lead length 7.7 mm)              | SOT243-3 |
| TDA8928ST   | RDBS17P | plastic rectangular DIL-bent-SIL power package; 17 leads (row spacing 2.54 mm) | SOT577-2 |

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6 BLOCK DIAGRAM

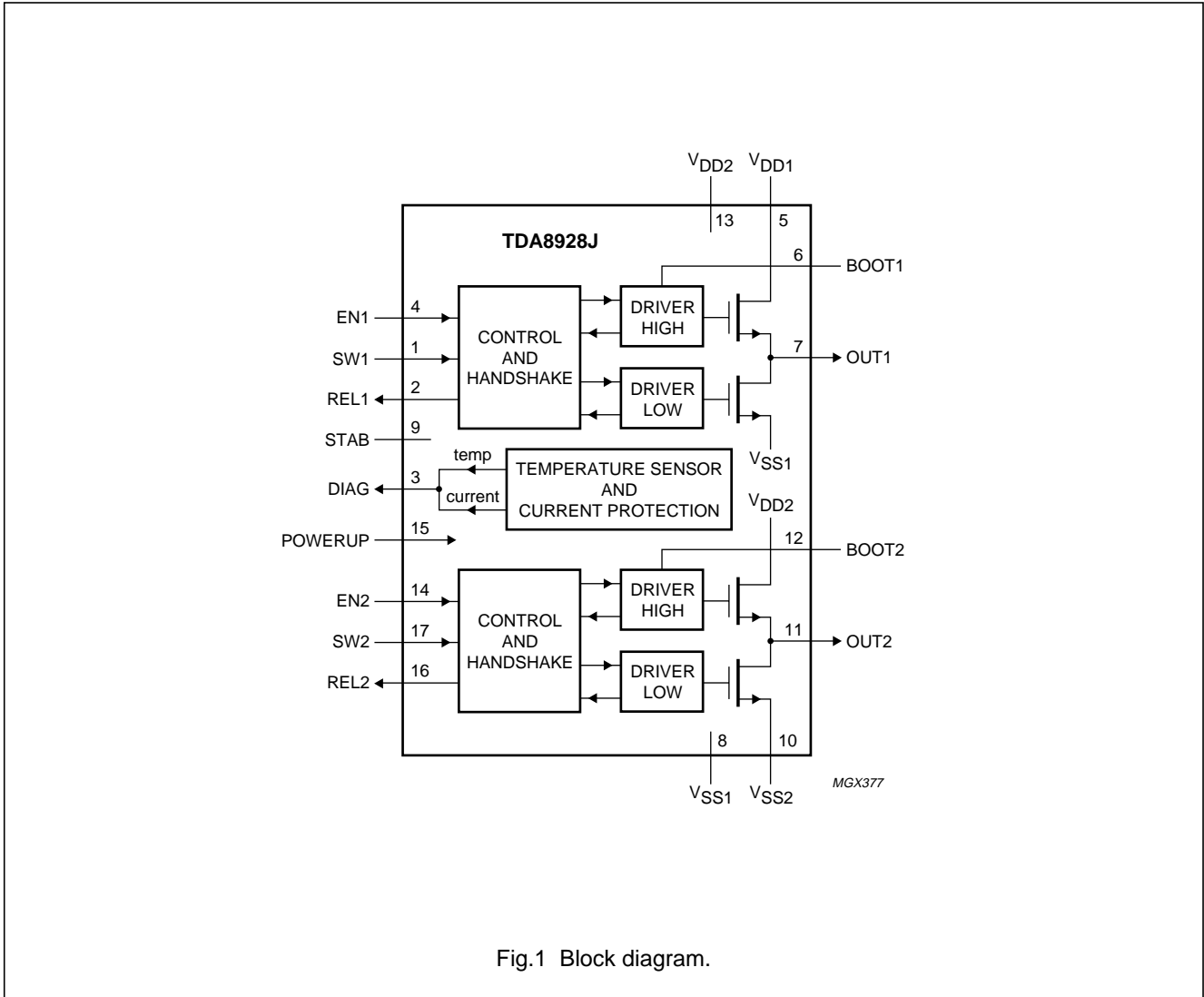


Fig.1 Block diagram.

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7 PINNING

| SYMBOL           | PIN | DESCRIPTION  |
|------------------|-----|--|
| SW1              | 1   | digital switch input; channel 1                                      |
| REL1             | 2   | digital control output; channel 1                                    |
| DIAG             | 3   | digital open-drain output for overtemperature and overcurrent report |
| EN1              | 4   | digital enable input; channel 1                                      |
| V <sub>DD1</sub> | 5   | positive power supply; channel 1                                     |
| BOOT1            | 6   | bootstrap capacitor; channel 1                                       |
| OUT1             | 7   | PWM output; channel 1  |
| V <sub>SS1</sub> | 8   | negative power supply; channel 1                                     |
| STAB             | 9   | decoupling internal stabilizer for logic supply                      |
| V <sub>SS2</sub> | 10  | negative power supply; channel 2                                     |
| OUT2             | 11  | PWM output; channel 2  |
| BOOT2            | 12  | bootstrap capacitor; channel 2                                       |
| V <sub>DD2</sub> | 13  | positive power supply; channel 2                                     |
| EN2              | 14  | digital enable input; channel 2                                      |
| POWERUP          | 15  | enable input for switching on internal reference sources             |
| REL2             | 16  | digital control output; channel 2                                    |
| SW2              | 17  | digital switch input; channel 2                                      |

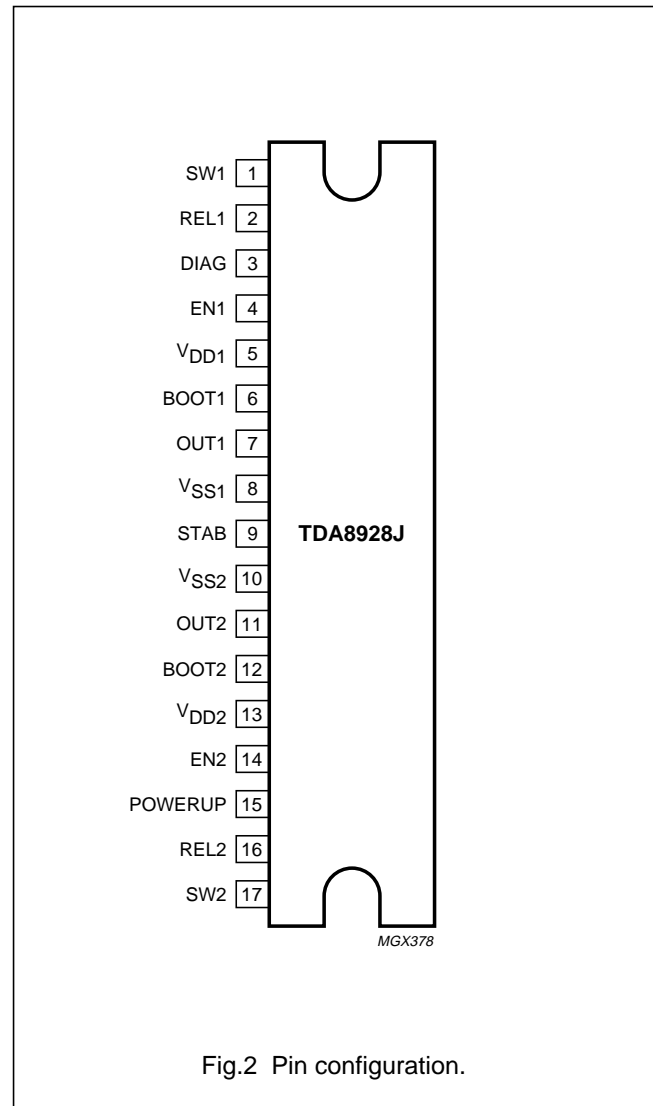


Fig.2 Pin configuration.

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### 8 FUNCTIONAL DESCRIPTION

The TDA8928J is a two-channel audio power amplifier system using class-D technology.

The power stage TDA8928J is used for driving the loudspeaker load. It performs a level shift from the low-power digital PWM signal, at logic levels, to a high-power PWM signal that switches between the main supply lines. A 2nd-order low-pass filter converts the PWM signal into an analog audio signal across the loudspeaker.

#### 8.1 Power stage

The power stage contains high-power DMOS switches, drivers, timing and handshaking between the power switches and some control logic (see Fig.1).

The following functions are available:

- Switch (pins SW1 and SW2): digital inputs; switching from  $V_{SS}$  to  $V_{SS} + 12$  V and driving the power DMOS switches
- Release (pins REL1 and REL2): digital outputs; switching from  $V_{SS}$  to  $V_{SS} + 12$  V; follow pin SW1 and SW2 with a small delay. Note: for self oscillating applications this pin is not used
- Power-up (pin POWERUP): must be connected to a continuous supply voltage of at least  $V_{SS} + 5$  V with respect to  $V_{SS}$
- Enable (pins EN1 and EN2): digital inputs; at a level of  $V_{SS}$  the power DMOS switches are open and the PWM outputs are floating; at a level of  $V_{SS} + 12$  V the power stage is operational
- Diagnostics (pin DIAG): digital open-drain output; pulled down to  $V_{SS}$  if the maximum temperature or maximum current is exceeded.

#### 8.2 Protection

Temperature and short-circuit protection sensors are included in the TDA8928J. The diagnostic output is pulled down to  $V_{SS}$  in the event that the maximum current or maximum temperature is exceeded. The system shuts itself down when pin DIAG is connected to pins EN1 and EN2.

##### 8.2.1 MAXIMUM TEMPERATURE

Pin DIAG becomes LOW if the junction temperature ( $T_j$ ) exceeds 150 °C. Pin DIAG becomes HIGH again if  $T_j$  is dropped to approximately 130 °C, so there is a hysteresis of approximately 20 °C.

##### 8.2.2 MAXIMUM CURRENT

When the loudspeaker terminals are short-circuited this will be detected by the current protection. Pin DIAG becomes LOW if the output current exceeds the maximum output current of 2 A. Pin DIAG becomes HIGH again if the output current drops below 2 A. The output current is limited at the maximum current detection level when pin DIAG is connected to pins EN1 and EN2.

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### 9 LIMITING VALUES

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

| SYMBOL         | PARAMETER   | CONDITIONS   | MIN.                   | MAX.                   | UNIT        |
|----------------|---|--|------------------------|------------------------|-------------|
| $V_P$          | supply voltage                                    |  | –                      | ±30                    | V           |
| $V_{P(sc)}$    | supply voltage for short-circuits across the load |  | –                      | ±30                    | V           |
| $I_{ORM}$      | repetitive peak current in output pins            |  | –                      | 2                      | A           |
| $T_{stg}$      | storage temperature                               |  | –55                    | +150                   | °C          |
| $T_{amb}$      | ambient temperature                               |  | –40                    | +85                    | °C          |
| $T_{vj}$       | virtual junction temperature                      |  | –                      | 150                    | °C          |
| $V_{esd(HBM)}$ | electrostatic discharge voltage (HBM)             | note 1<br>all pins with respect to $V_{DD}$ (class 1a)<br>all pins with respect to $V_{SS}$ (class 1a)<br>all pins with respect to each other (class 1a) | –500<br>–1500<br>–1500 | +500<br>+1500<br>+1500 | V<br>V<br>V |
| $V_{esd(MM)}$  | electrostatic discharge voltage (MM)              | note 2<br>all pins with respect to $V_{DD}$ (class B)<br>all pins with respect to $V_{SS}$ (class B)<br>all pins with respect to each other (class B)    | –250<br>–250<br>–250   | +250<br>+250<br>+250   | V<br>V<br>V |

#### Notes

- Human Body Model (HBM);  $R_s = 1500 \Omega$ ;  $C = 100 \text{ pF}$ .
- Machine Model (MM);  $R_s = 10 \Omega$ ;  $C = 200 \text{ pF}$ ;  $L = 0.75 \mu\text{H}$ .

### 10 THERMAL CHARACTERISTICS

| SYMBOL        | PARAMETER                                   | CONDITIONS  | VALUE | UNIT |
|---------------|---|-------------|-------|------|
| $R_{th(j-a)}$ | thermal resistance from junction to ambient | in free air | 40    | K/W  |
| $R_{th(j-c)}$ | thermal resistance from junction to case    | in free air | 1.5   | K/W  |

### 11 QUALITY SPECIFICATION

In accordance with "SNW-FQ611" if this device is used as an audio amplifier.

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### 12 DC CHARACTERISTICS

$V_P = \pm 12.5$  V;  $T_{amb} = 25$  °C; measured in test diagram of Fig.4; unless otherwise specified.

| SYMBOL   | PARAMETER                            | CONDITIONS                 | MIN.      | TYP.       | MAX.     | UNIT    |
|--|--------------------------------------|----------------------------|-----------|------------|----------|---------|
| <b>Supply</b>                                      |                                      |                            |           |            |          |         |
| $V_P$  | supply voltage                       |                            | $\pm 7.5$ | $\pm 12.5$ | $\pm 30$ | V       |
| $I_{q(tot)}$                                       | total quiescent current              | no load connected          | –         | 25         | 45       | mA      |
|  |                                      | outputs floating           | –         | 5          | 10       | mA      |
| <b>Internal stabilizer logic supply (pin STAB)</b> |                                      |                            |           |            |          |         |
| $V_{O(STAB)}$                                      | stabilizer output voltage            | referenced to $V_{SS}$     | 11.7      | 13         | 14.3     | V       |
| <b>Switch inputs (pins SW1 and SW2)</b>            |                                      |                            |           |            |          |         |
| $V_{IH}$   | HIGH-level input voltage             | referenced to $V_{SS}$     | 10        | –          | 15       | V       |
| $V_{IL}$   | LOW-level input voltage              | referenced to $V_{SS}$     | 0         | –          | 2        | V       |
| <b>Control outputs (pins REL1 and REL2)</b>        |                                      |                            |           |            |          |         |
| $V_{OH}$   | HIGH-level output voltage            | referenced to $V_{SS}$     | 10        | –          | 15       | V       |
| $V_{OL}$   | LOW-level output voltage             | referenced to $V_{SS}$     | 0         | –          | 2        | V       |
| <b>Diagnostic output (pin DIAG, open-drain)</b>    |                                      |                            |           |            |          |         |
| $V_{OL}$   | LOW-level output voltage             | $I_{DIAG} = 1$ mA; note 1  | 0         | –          | 1.0      | V       |
| $I_{LO}$   | output leakage current               | no error condition         | –         | –          | 50       | $\mu$ A |
| <b>Enable inputs (pins EN1 and EN2)</b>            |                                      |                            |           |            |          |         |
| $V_{IH}$   | HIGH-level input voltage             | referenced to $V_{SS}$     | 9         | –          | 15       | V       |
| $V_{IL}$   | LOW-level input voltage              | referenced to $V_{SS}$     | 0         | 5          | –        | V       |
| $V_{EN(hys)}$                                      | hysteresis voltage                   |                            | –         | 4          | –        | V       |
| $I_{I(EN)}$  | input current                        |                            | –         | –          | 300      | $\mu$ A |
| <b>Switching-on input (pin POWERUP)</b>            |                                      |                            |           |            |          |         |
| $V_{POWERUP}$                                      | operating voltage                    | referenced to $V_{SS}$     | 5         | –          | 12       | V       |
| $I_{I(POWERUP)}$                                   | input current                        | $V_{POWERUP} = 12$ V       | –         | 100        | 170      | $\mu$ A |
| <b>Temperature protection</b>                      |                                      |                            |           |            |          |         |
| $T_{diag}$   | temperature activating diagnostic    | $V_{DIAG} = V_{DIAG(LOW)}$ | 150       | –          | –        | °C      |
| $T_{hys}$  | hysteresis on temperature diagnostic | $V_{DIAG} = V_{DIAG(LOW)}$ | –         | 20         | –        | °C      |
| <b>Current protection</b>                          |                                      |                            |           |            |          |         |
| $I_{O(ocpl)}$                                      | overcurrent protection level         |                            | –         | 2.1        | –        | A       |

#### Note

1. Temperature sensor or maximum current sensor activated.



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### 13 AC CHARACTERISTICS

$V_P = \pm 12.5$  V;  $T_{amb} = 25$  °C; unless otherwise specified.

| SYMBOL                                  | PARAMETER                 | CONDITIONS                                   | MIN.             | TYP. | MAX. | UNIT |
|---|---------------------------|--|------------------|------|------|------|
| <b>Single-ended application; note 1</b> |                           |  |                  |      |      |      |
| $P_o$                                   | output power              | $R_L = 8 \Omega$                             |                  |      |      |      |
|   |                           | THD = 0.5 %                                  | 7 <sup>(2)</sup> | 8    | –    | W    |
|   |                           | THD = 10 %                                   | 9 <sup>(2)</sup> | 10   | –    | W    |
|   |                           | $R_L = 16 \Omega$                            |                  |      |      |      |
|   |                           | THD = 0.5 %                                  | –                | 4    | –    | W    |
|   |                           | THD = 10 %                                   | –                | 5    | –    | W    |
| THD                                     | total harmonic distortion | $P_o = 1$ W; note 3                          |                  |      |      |      |
|   |                           | $f_i = 1$ kHz                                | –                | 0.05 | 0.1  | %    |
|   |                           | $f_i = 10$ kHz                               | –                | 0.2  | –    | %    |
| $\eta$                                  | efficiency endstage       | $P_o = 2 \times 10$ W; $f_i = 1$ kHz; note 4 | –                | 90   | –    | %    |

#### Notes

- $V_P = \pm 12.5$  V;  $R_L = 8 \Omega$ ;  $f_i = 1$  kHz;  $f_{osc} = 310$  kHz;  $R_S = 0.1 \Omega$  (series resistance of filter coil);  $T_{amb} = 25$  °C; measured in reference design (SE application) shown in Fig.5; unless otherwise specified.
- Indirectly measured; based on  $R_{ds(on)}$  measurement.
- Total Harmonic Distortion (THD) is measured in a bandwidth of 22 Hz to 20 kHz (AES 17 brickwall filter). When distortion is measured using a low-order low-pass filter a significantly higher value will be found, due to the switching frequency outside the audio band. Measured using the typical application circuit, given in Fig.5.
- Efficiency for power stage.

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14 SWITCHING CHARACTERISTICS

$V_P = \pm 12.5\text{ V}$ ;  $T_{amb} = 25\text{ }^\circ\text{C}$ ; measured in Fig.4; unless otherwise specified.

| SYMBOL   | PARAMETER                               | CONDITIONS                            | MIN. | TYP. | MAX. | UNIT     |
|--|---|---------------------------------------|------|------|------|----------|
| <b>PWM outputs (pins OUT1 and OUT2); see Fig.3</b> |   |                                       |      |      |      |          |
| $t_r$  | rise time                               |                                       | –    | 30   | –    | ns       |
| $t_f$  | fall time                               |                                       | –    | 30   | –    | ns       |
| $t_{blank}$  | blanking time                           |                                       | –    | 70   | –    | ns       |
| $t_{PD}$   | propagation delay                       | from pin SW1 (SW2) to pin OUT1 (OUT2) | –    | 200  | –    | ns       |
| $t_{W(min)}$                                       | minimum pulse width                     |                                       | –    | 220  | 270  | ns       |
| $R_{ds(on)}$                                       | on-resistance of the output transistors |                                       | –    | 0.2  | 0.4  | $\Omega$ |

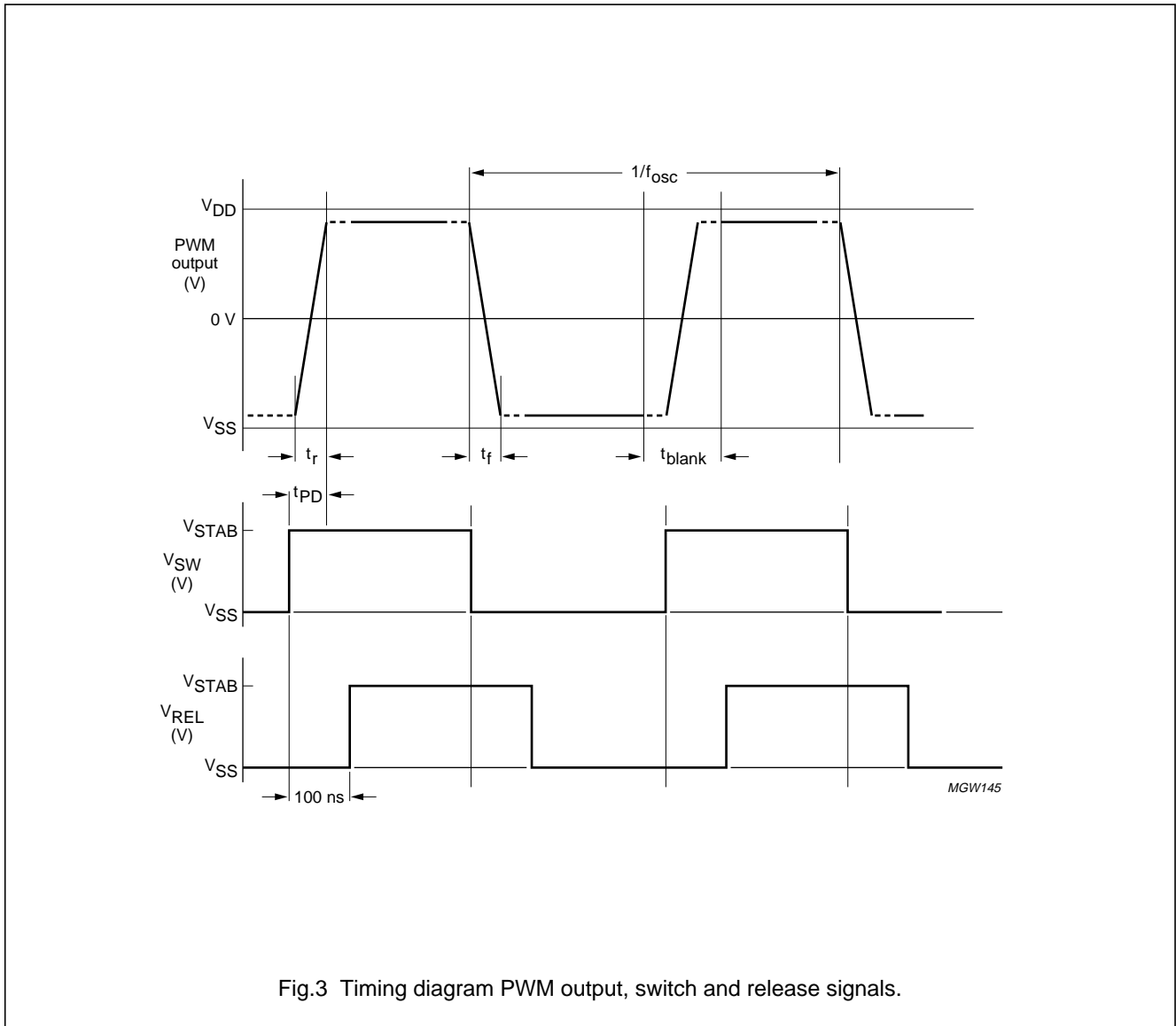


Fig.3 Timing diagram PWM output, switch and release signals.

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15 TEST AND APPLICATION INFORMATION

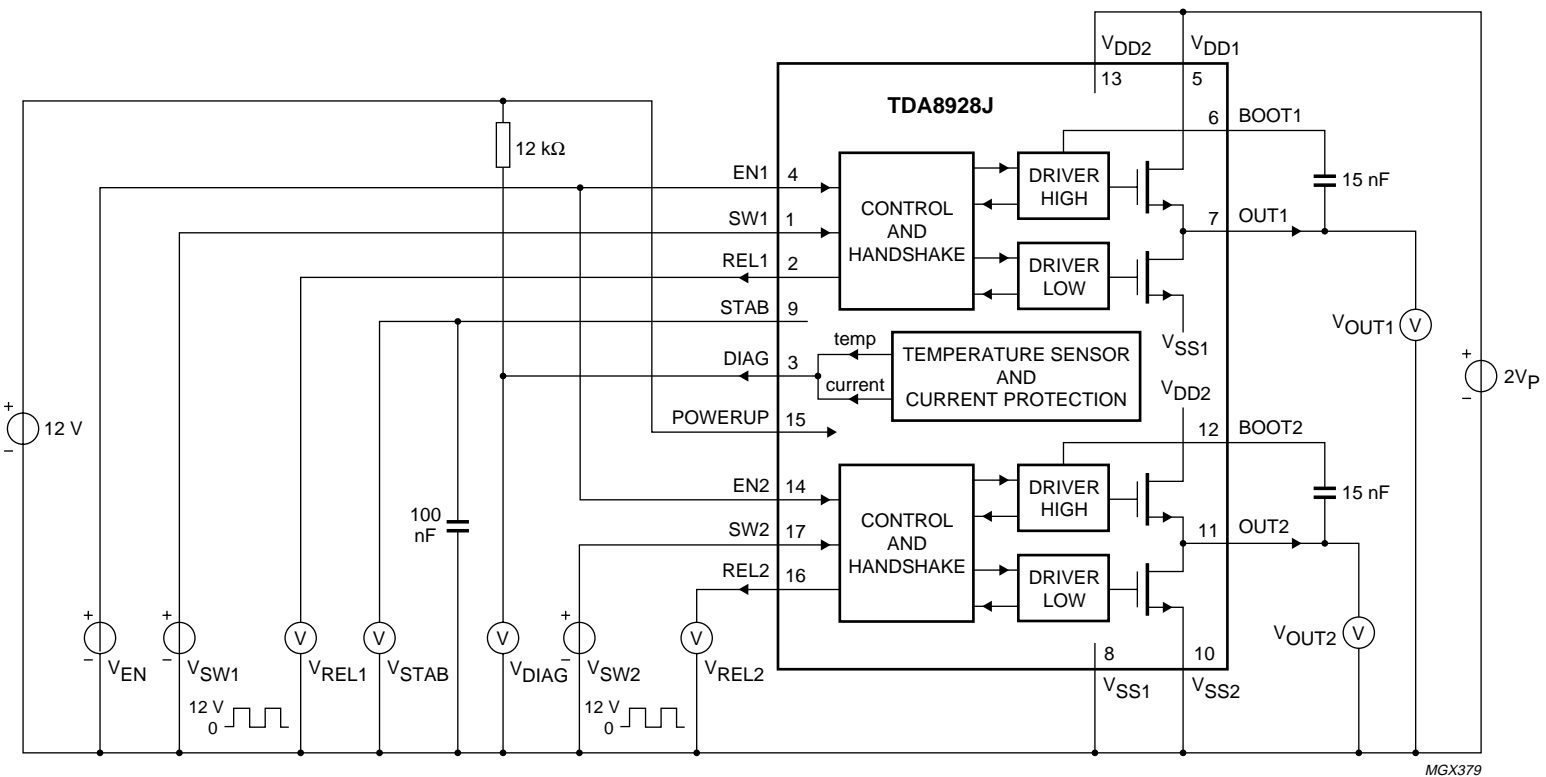


Fig.4 Test diagram.

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### 15.1 SE application

For a SE application the application diagram as shown in Fig.5 can be used.

### 15.2 Package ground connection

The heatsink of the TDA8928J is connected internally to  $V_{SS}$ .

### 15.3 Output power

The output power in SE self oscillating class-D applications can be estimated using the formula

$$P_{O(1\%)} = \frac{\left[ \frac{R_L}{(R_L + R_{ds(on)} + R_s)} \times V_P \right]^2}{2 \times R_L}$$

The maximum current  $I_{O(max)} = \frac{[V_P]}{R_L + R_{ds(on)} + R_s}$  should not exceed 2 A.

Where:

$R_L$  = load impedance

$R_s$  = series resistance of filter coil

$P_{O(1\%)}$  = output power just at clipping.

The output power at THD = 10 %:  $P_{O(10\%)} = 1.25 \times P_{O(1\%)}$ .

### 15.4 Reference design

The reference design for a self oscillating class-D system for the TDA8928J is shown in Fig.5. The Printed-Circuit Board (PCB) layout is shown in Figs 6, 7 and 8. The bill of materials is given in Section 15.4.2.

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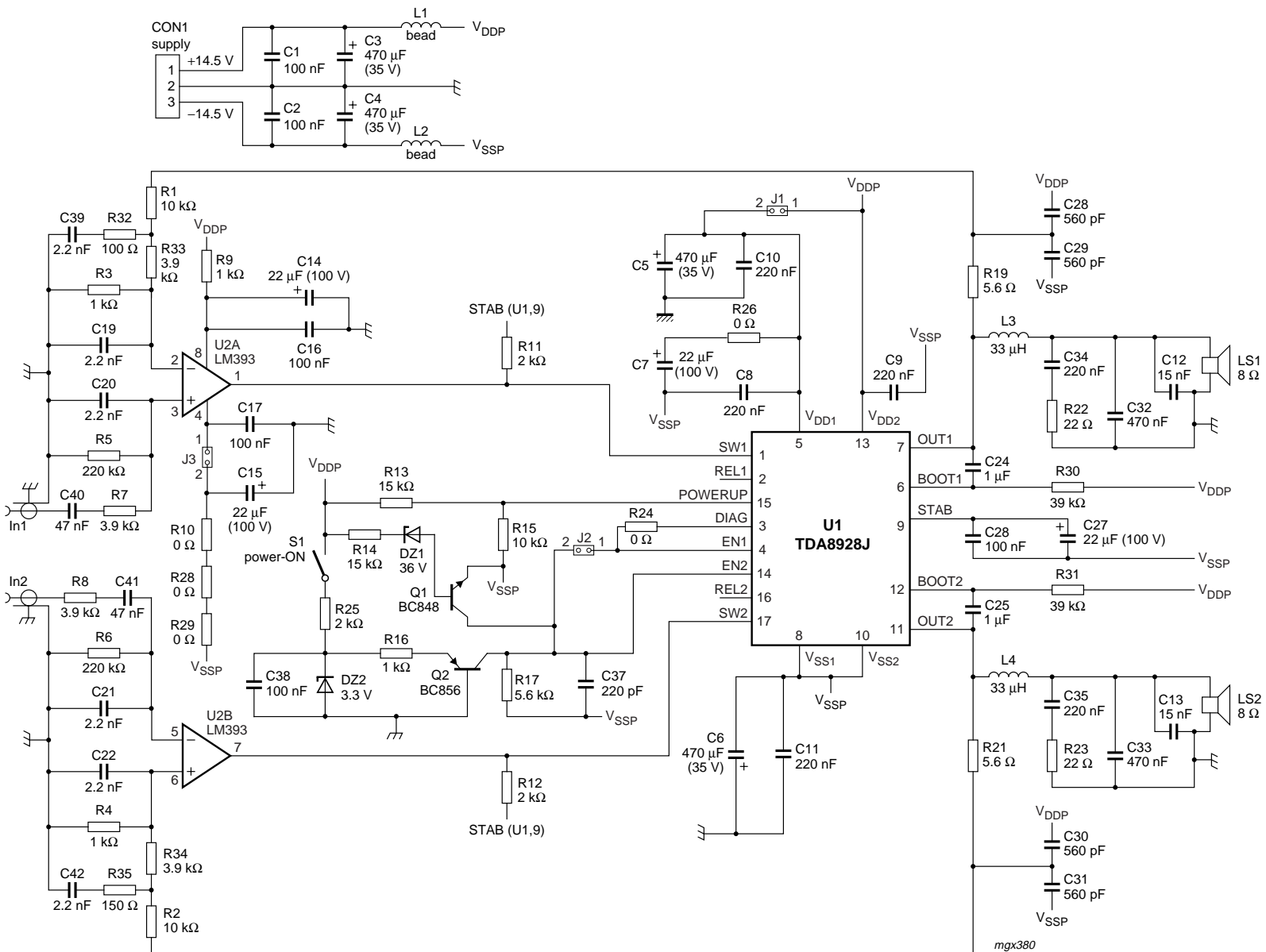


Fig.5 Single-ended self oscillating class-D system application diagram for TDA8928J.

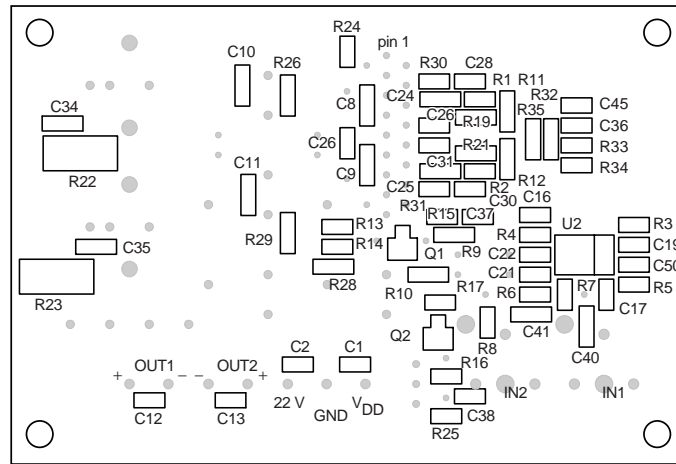
mgx380

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15.4.1 PRINTED-CIRCUIT BOARD

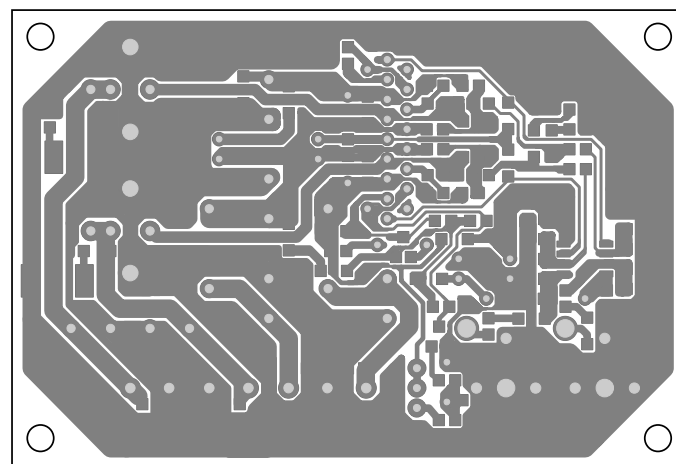
The printed-circuit board dimensions are 8.636 × 5.842 cm; single-sided copper of 35 µm; silk screen on both sides; 79 holes; 94 components (32 resistors and 41 capacitors).



Bottom silk

MDB615

Fig.6 Printed-circuit board (bottom silk) layout for TDA8928J.



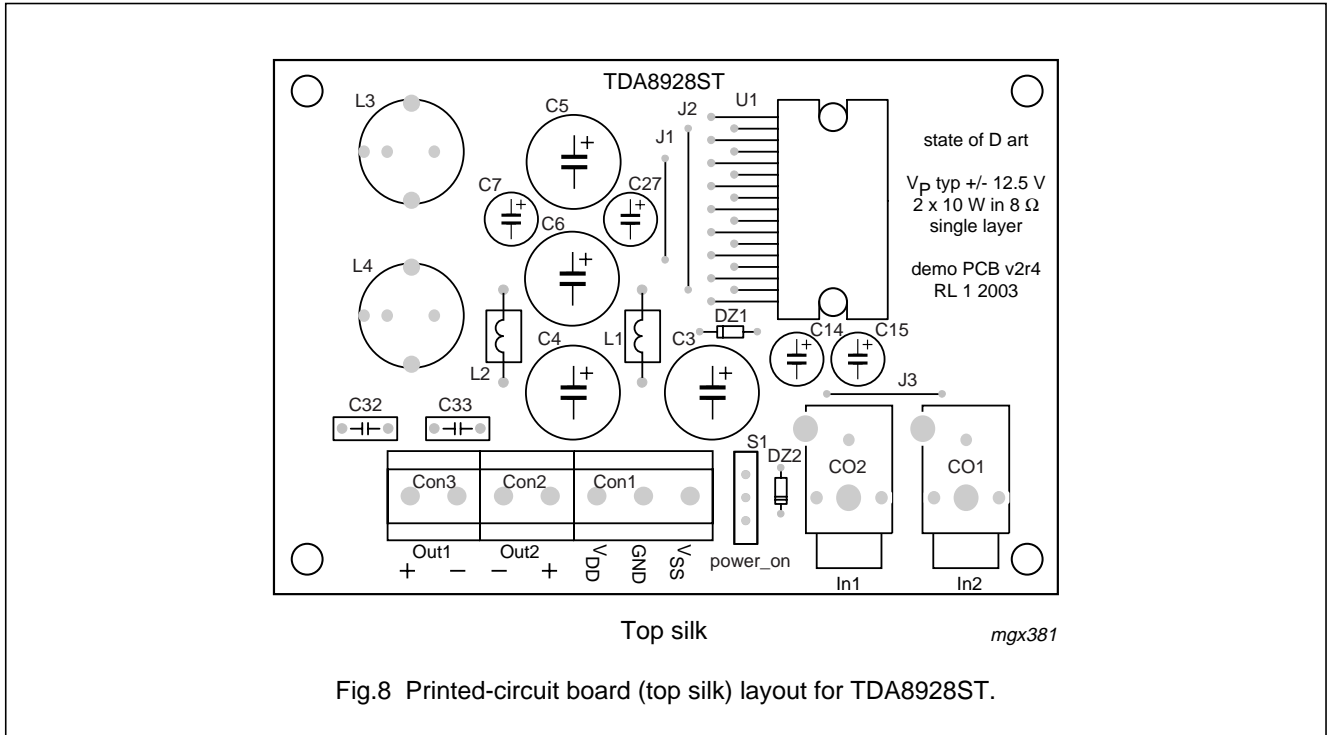
Bottom copper

MDB617

Fig.7 Printed-circuit board (bottom copper) layout for TDA8928J.

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15.4.2 BILL OF MATERIALS

| COMPONENT             | DESCRIPTION                                      | TYPE                                | COMMENTS  |
|-----------------------|--|-------------------------------------|---|
| U1                    | TDA8928ST  | Philips Semiconductors,<br>SOT577-2 |   |
| U2                    | LM393AD  | National, SO8                       | alternatives: TI<br>semiconductors and On<br>semiconductors |
| DZ1                   | 36 V Zener diode                                 | BZX-79C36V, DO-35                   | used as jumper  |
| DZ2                   | 3.3 V Zener diode                                | BZX-79C3V3, DO-35                   | used as jumper, optional                                    |
| Q1                    | BC848 transistor                                 | NPN, SOT23                          |   |
| Q2                    | BC856 transistor                                 | PNP, SOT23                          |   |
| L1, L2                | bead   | Murata BL01RN1-A62                  | used as jumper  |
| L3, L4                | 33 $\mu$ H coil                                  | Toko 11RHBP-330M ws                 | totally shielded  |
| S1                    | power-on switch                                  | PCB switch, SACME<br>09-03290-01    | optional  |
| Con1                  | V <sub>SS</sub> , GND, V <sub>DD</sub> connector | Augat 5KEV-03                       | optional  |
| Con2, Con3            | Out2, Out1 connector                             | Augat 5KEV-02                       | optional  |
| CO1, CO2              | In1, In2 connector                               | Cinch Farnell 152-396               | optional  |
| J1, J2, J3            | wire   | Jumpers, D = 0.5 mm                 |   |
| <b>Capacitors</b>     |  |                                     |   |
| C37                   | 220 pF, 50 V                                     | SMD0805                             |   |
| C28, C29, C30,<br>C31 | 560 pF, 100 V                                    | SMD0805                             | 50 V is OK  |

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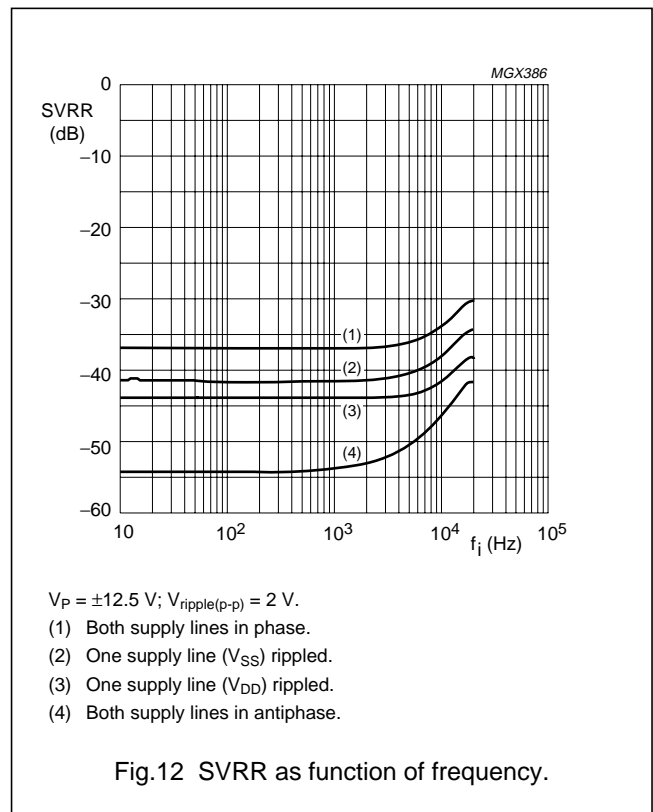
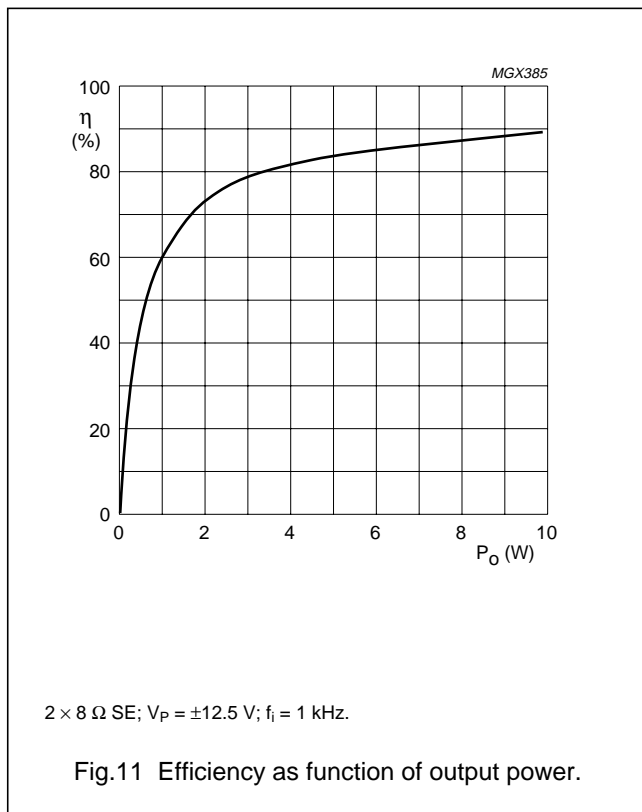
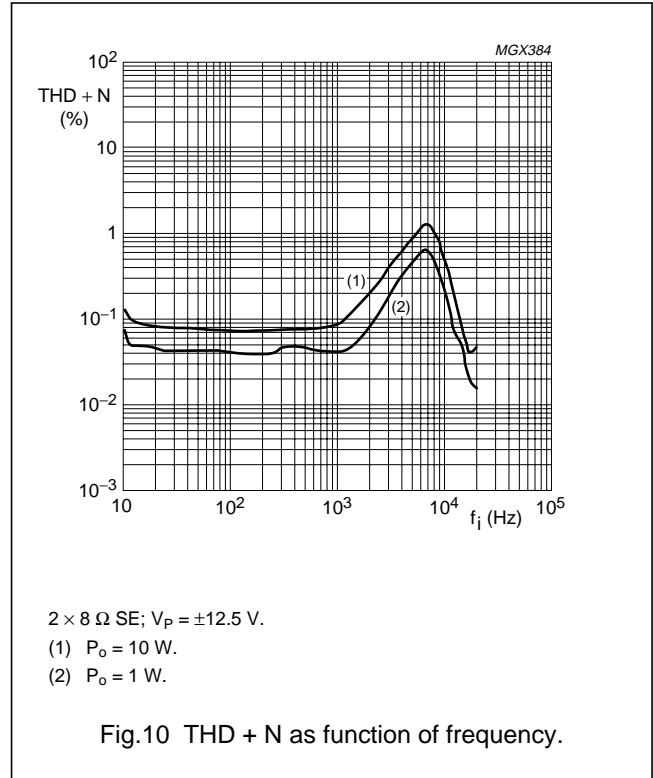
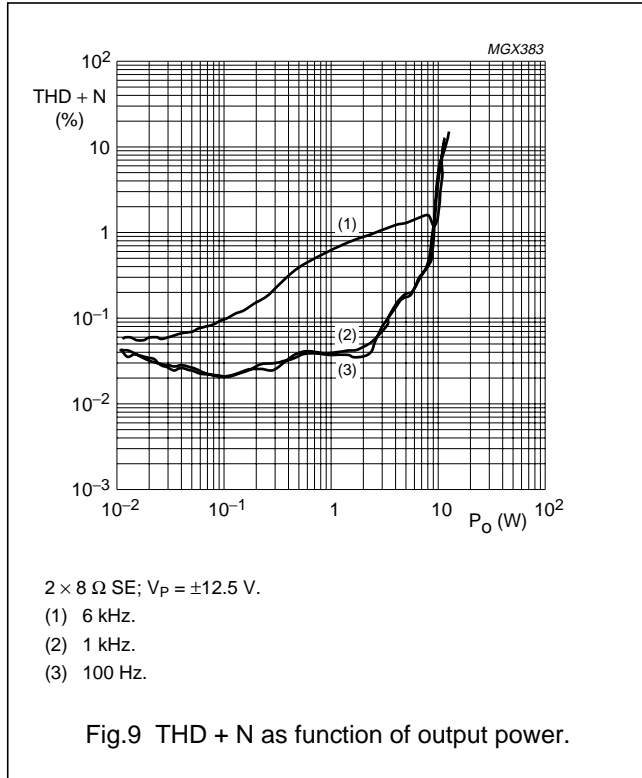
| COMPONENT                       | DESCRIPTION                           | TYPE                               | COMMENTS   |
|---------------------------------|---------------------------------------|------------------------------------|--|
| C19, C20, C21,<br>C22, C39, C42 | 2.2 nF, 50 V                          | SMD0805                            |  |
| C12, C13                        | 15 nF, 50 V                           | SMD0805                            |  |
| C40, C41                        | 47 nF, 50 V                           | SMD1206                            |  |
| C1, C2, C16, C17,<br>C26, C38   | 100 nF, 50 V                          | SMD0805                            |  |
| C8, C9, C10, C11,<br>C34, C35   | 220 nF, 50 V                          | SMD1206                            | C8 to C11 used as jumper                                 |
| C32, C33                        | 470 nF, 63 V                          | MKT                                |  |
| C24, C25                        | 1 $\mu$ F, 16 V                       | SMD1206                            | 1206 due to supply range                                 |
| C7, C14, C15,<br>C27            | 22 $\mu$ F, 100 V                     | Panasonic NHG Series<br>ECA1JHG220 | 63 V is OK   |
| C3, C4, C5, C6                  | 470 $\mu$ F, 35 V                     | Panasonic M Series<br>ECA1VM471    |  |
| C18, C23, C36                   | these capacitors have been<br>removed |                                    |  |
| <b>Resistors</b>                |                                       |                                    |  |
| R10, R26, R28,<br>R29           | 0 $\Omega$                            | SMD1206                            | used as jumpers  |
| R24                             | 0 $\Omega$                            | SMD0805                            | short-circuited in a new<br>printed-circuit board layout |
| R19, R21                        | 5.6 $\Omega$ , 0.25 W                 | SMD1206                            | 1206 due to dissipation                                  |
| R22, R23                        | 22 $\Omega$ , 1 W                     | SMD2512                            | 2512 due to dissipation                                  |
| R35                             | 150 $\Omega$                          | SMD1206                            | used as jumper   |
| R32                             | 100 $\Omega$                          | SMD1206                            | used as jumper   |
| R9                              | 1 k $\Omega$                          | SMD1206                            | used as jumper   |
| R3, R4, R16                     | 1 k $\Omega$                          | SMD0805                            |  |
| R11, R12                        | 2 k $\Omega$                          | SMD1206                            | used as jumpers  |
| R25                             | 2 k $\Omega$                          | SMD0805                            |  |
| R7, R8, R33, R34                | 3.9 k $\Omega$                        | SMD0805                            |  |
| R17                             | 5.6 k $\Omega$                        | SMD0805                            |  |
| R1, R2, R15                     | 10 k $\Omega$                         | SMD0805                            |  |
| R13, R14                        | 15 k $\Omega$                         | SMD0805                            |  |
| R30, R31                        | 39 k $\Omega$                         | SMD0805                            |  |
| R5, R6                          | 220 k $\Omega$                        | SMD0805                            |  |
| R18, R20, R27                   | these resistors have been<br>removed  |                                    |  |



Power stage 2 x 10 or 1 x 20 W class-D audio amplifier

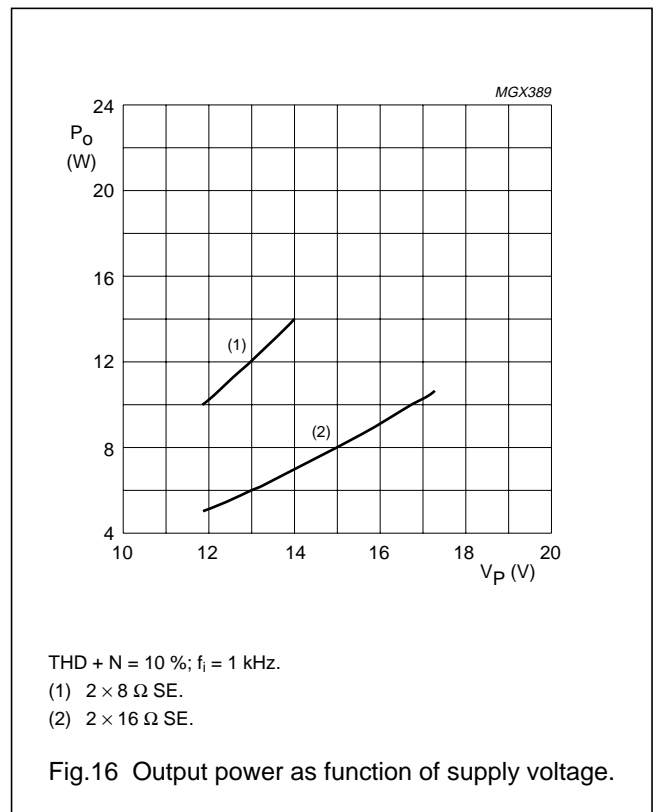
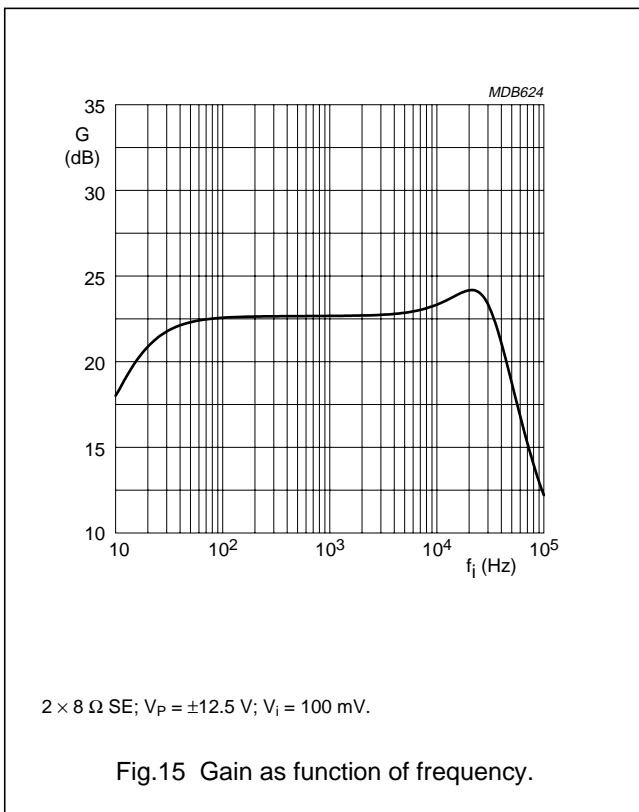
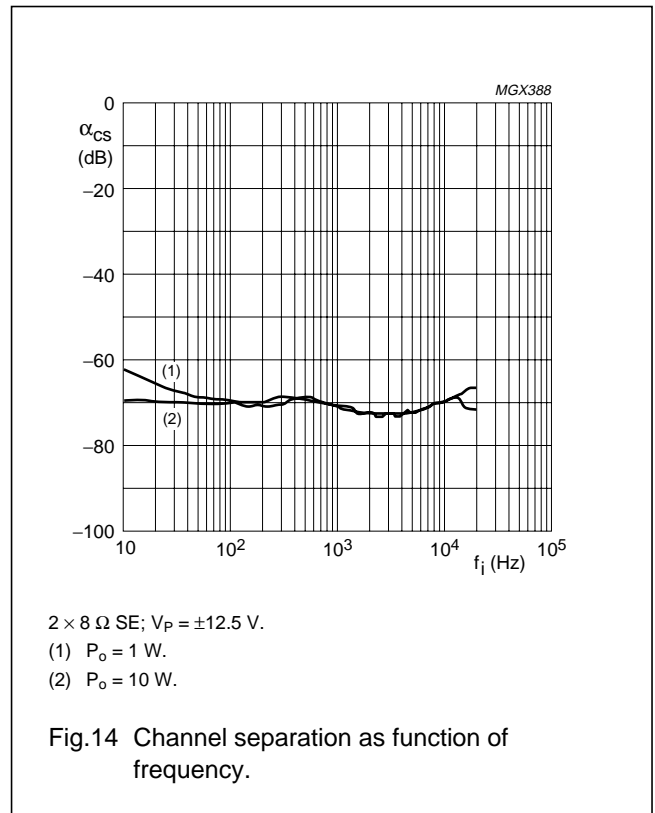
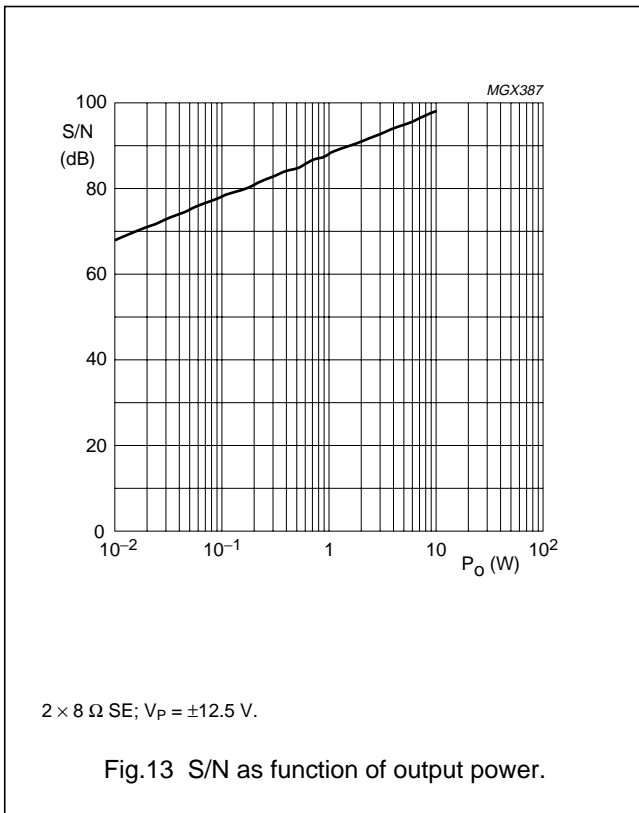
TDA8928J

15.5 Curves measured in reference design



Power stage 2 x 10 or 1 x 20 W class-D audio amplifier

TDA8928J



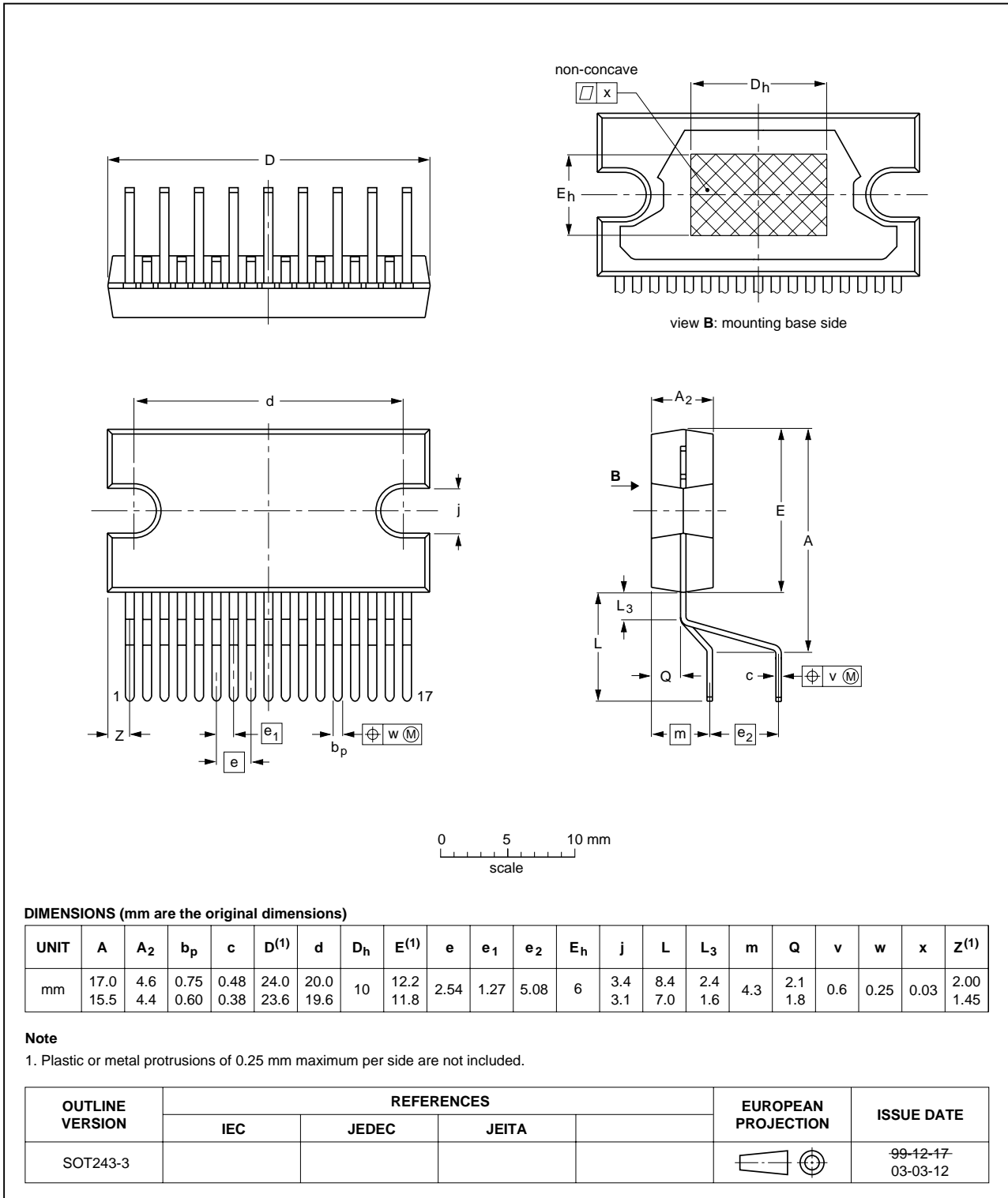
Power stage 2 x 10 or 1 x 20 W class-D  
audio amplifier

TDA8928J

16 PACKAGE OUTLINE

DBS17P: plastic DIL-bent-SIL power package; 17 leads (lead length 7.7 mm)

SOT243-3

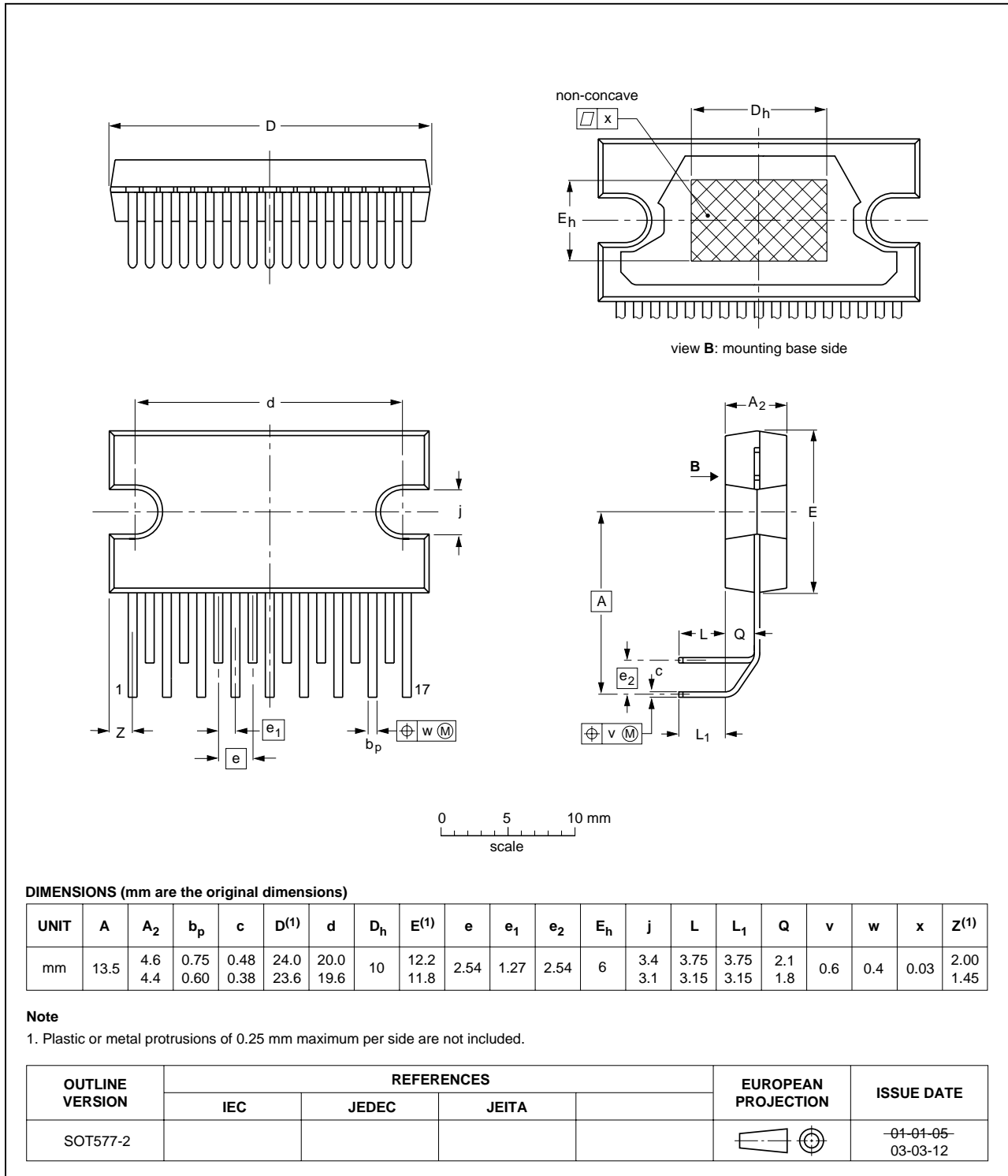


Power stage 2 x 10 or 1 x 20 W class-D  
audio amplifier

TDA8928J

RDBS17P: plastic rectangular-DIL-bent-SIL power package; 17 leads  
(row spacing 2.54 mm)

SOT577-2



## Power stage 2 x 10 or 1 x 20 W class-D audio amplifier

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### 17 SOLDERING

#### 17.1 Introduction to soldering through-hole mount packages

This text gives a brief insight to wave, dip and manual soldering. 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).

Wave soldering is the preferred method for mounting of through-hole mount IC packages on a printed-circuit board.

#### 17.2 Soldering by dipping or by solder wave

Driven by legislation and environmental forces the worldwide use of lead-free solder pastes is increasing. Typical dwell time of the leads in the wave ranges from 3 to 4 seconds at 250 °C or 265 °C, depending on solder material applied, SnPb or Pb-free respectively.

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.

#### 17.3 Manual soldering

Apply the soldering iron (24 V or less) to the lead(s) of the package, either 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.

#### 17.4 Suitability of through-hole mount IC packages for dipping and wave soldering methods

| PACKAGE                         | SOLDERING METHOD |                         |
|---------------------------------|------------------|-------------------------|
|                                 | DIPPING          | WAVE                    |
| CPGA, HCPGA                     | –                | suitable                |
| DBS, DIP, HDIP, RDBS, SDIP, SIL | suitable         | suitable <sup>(1)</sup> |
| PMFP <sup>(2)</sup>             | –                | not suitable            |

#### Notes

- For SDIP packages, the longitudinal axis must be parallel to the transport direction of the printed-circuit board.
- For PMFP packages hot bar soldering or manual soldering is suitable.

## Power stage 2 x 10 or 1 x 20 W class-D audio amplifier

TDA8928J

### 18 DATA SHEET STATUS

| LEVEL | DATA SHEET STATUS <sup>(1)</sup> | PRODUCT STATUS <sup>(2)(3)</sup> | DEFINITION   |
|-------|----------------------------------|----------------------------------|--|
| I     | Objective data                   | Development                      | This data sheet contains data from the objective specification for product development. Philips Semiconductors reserves the right to change the specification in any manner without notice.  |
| II    | Preliminary data                 | Qualification                    | This data sheet contains data from the preliminary specification. Supplementary data will be published at a later date. Philips Semiconductors reserves the right to change the specification without notice, in order to improve the design and supply the best possible product.             |
| III   | Product data                     | Production                       | This data sheet contains data from the product specification. Philips Semiconductors reserves the right to make changes at any time in order to improve the design, manufacturing and supply. Relevant changes will be communicated via a Customer Product/Process Change Notification (CPCN). |

#### Notes

1. Please consult the most recently issued data sheet before initiating or completing a design.
2. The product status of the device(s) described in this data sheet may have changed since this data sheet was published. The latest information is available on the Internet at URL <http://www.semiconductors.philips.com>.
3. For data sheets describing multiple type numbers, the highest-level product status determines the data sheet status.

### 19 DEFINITIONS

**Short-form specification** — The data in a short-form specification is extracted from a full data sheet with the same type number and title. For detailed information see the relevant data sheet or data handbook.

**Limiting values definition** — Limiting values given are in accordance with the Absolute Maximum Rating System (IEC 60134). 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.

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## **Contact information**

For additional information please visit <http://www.semiconductors.philips.com>. Fax: +31 40 27 24825

For sales offices addresses send e-mail to: [sales.addresses@www.semiconductors.philips.com](mailto:sales.addresses@www.semiconductors.philips.com).

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