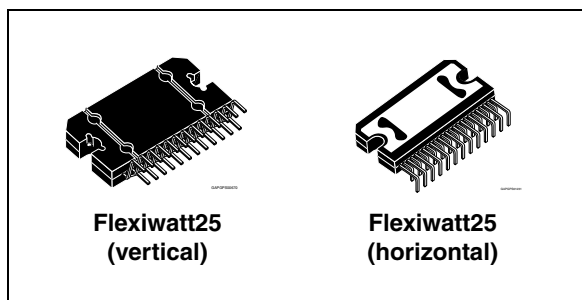


## 4 x 51 W quad bridge car radio amplifier

Datasheet – production data

### Features

- Superior output power capability:
  - 4 x 51 W/4  $\Omega$  max.
  - 4 x 45 W/4  $\Omega$  EIAJ
  - 4 x 30 W/4  $\Omega$  @ 14.4 V, 1 kHz, 10 %
  - 4 x 80 W/2  $\Omega$  max.
  - 4 x 77 W/2  $\Omega$  EIAJ
  - 4 x 55 W/2  $\Omega$  @ 14.4 V, 1 kHz, 10 %
- Multipower BCD technology
- MOSFET output power stage
- Excellent 2  $\Omega$  driving capability
- Hi-Fi class distortion
- Low output noise
- Standby function
- Mute function
- Automute at min. supply voltage detection
- Low external component count:
  - Internally fixed gain (26 dB)
  - No external compensation
  - No bootstrap capacitors
- On board 0.35 A high side driver
- Protections:
  - Output short circuit to GND, to  $V_S$ , across the load
  - Very inductive loads



- Overrating chip temperature with soft thermal limiter
- Output DC offset detection
- Load dump voltage
- Fortuitous open GND
- Reversed battery
- ESD

### Description

The TDA7560 is a breakthrough BCD (Bipolar / CMOS / DMOS) technology class AB audio power amplifier in Flexiwatt 25 package designed for high power car radio.

The fully complementary P-Channel/N-Channel output structure allows a rail to rail output voltage swing which, combined with high output current and minimized saturation losses sets new power references in the car-radio field, with unparalleled distortion performances.

**Table 1. Device summary**

| Order code | Package                  | Packing |
|------------|--------------------------|---------|
| TDA7560    | Flexiwatt25 (vertical)   | Tube    |
| TDA7560H   | Flexiwatt25 (horizontal) | Tube    |

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# 1 Block and pin connection diagram

Figure 1. Block diagram

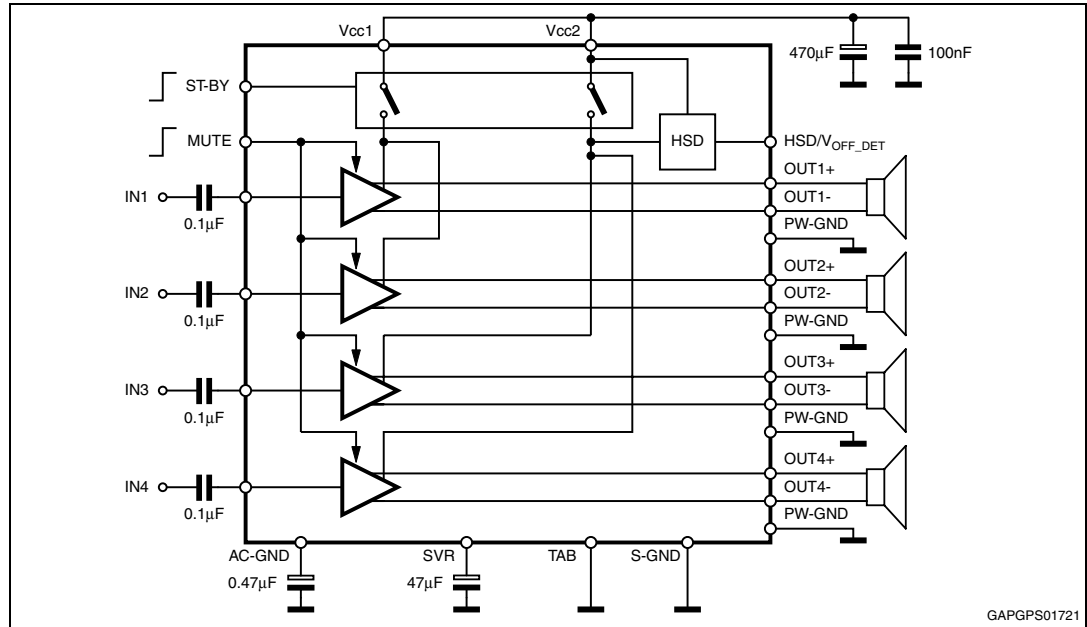
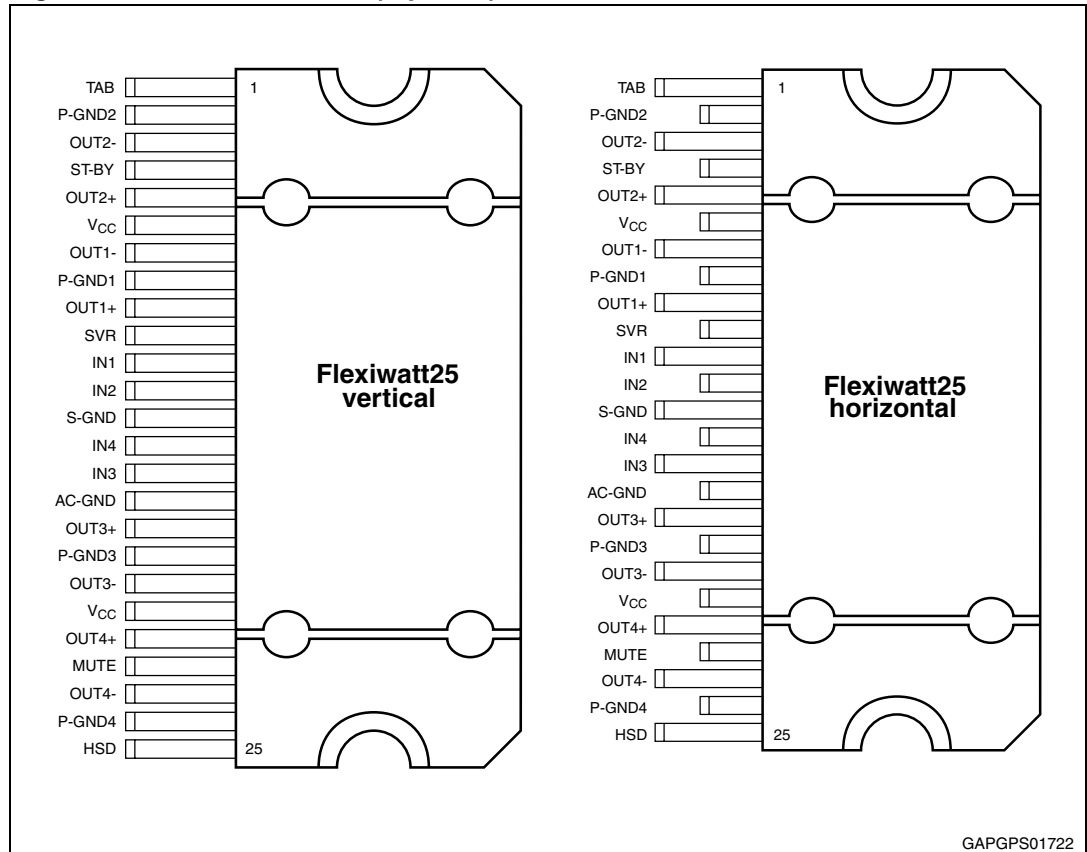


Figure 2. Pins connection (top view)



## 2 Electrical specifications

### 2.1 Absolute maximum ratings

Table 2. Absolute maximum ratings

| Symbol       | Parameter  | Value      | Unit |
|--------------|--|------------|------|
| $V_{CC}$     | Operating supply voltage   | 18         | V    |
| $V_{CC(DC)}$ | DC supply voltage  | 28         | V    |
| $V_{CC(pk)}$ | Peak supply voltage (for $t = 50$ ms)  | 50         | V    |
| $I_O$        | Output peak current  | 9          | A    |
|              | Repetitive (duty cycle 10 % at $f = 10$ Hz)<br>Non repetitive ( $t = 100$ $\mu$ s) | 10         | A    |
| $P_{tot}$    | Power dissipation $T_{case} = 70$ °C   | 80         | W    |
| $T_j$        | Junction temperature   | 150        | °C   |
| $T_{stg}$    | Storage temperature  | -55 to 150 | °C   |

### 2.2 Thermal data

Table 3. Thermal data

| Symbol           | Parameter                           | Value  | Unit |
|------------------|-------------------------------------|--------|------|
| $R_{th\ j-case}$ | Thermal resistance junction-to-case | Max. 1 | °C/W |

### 2.3 Electrical characteristics

Refer to the test and application diagram,  $V_S = 14.4$  V;  $R_L = 4$   $\Omega$ ;  $R_g = 600$   $\Omega$ ;  $f = 1$  kHz;  $T_{amb} = 25$  °C; unless otherwise specified.

Table 4. Electrical characteristics

| Symbol    | Parameter                                | Test condition             | Min. | Typ. | Max.     | Unit |
|-----------|--|----------------------------|------|------|----------|------|
| $I_{q1}$  | Quiescent current                        | $R_L = \infty$             | 80   | 200  | 320      | mA   |
| $V_{OS}$  | Output offset voltage                    | Play Mode                  | -    | -    | $\pm 50$ | mV   |
| $dV_{OS}$ | During mute ON/OFF output offset voltage | -                          | -    | -    | $\pm 60$ | mV   |
| $G_v$     | Voltage gain                             | -                          | 25   | 26   | 27       | dB   |
| $dG_v$    | Channel gain unbalance                   | -                          | -    | -    | $\pm 1$  | dB   |
| $P_o$     | Output power                             | $V_S = 13.2$ V; THD = 10 % | 23   | 25   | -        | W    |
|           |  | $V_S = 13.2$ V; THD = 1 %  | 16   | 19   | -        |      |
|           |  | $V_S = 14.4$ V; THD = 10 % | 28   | 30   | -        |      |
|           |  | $V_S = 14.4$ V; THD = 1 %  | 20   | 23   | -        |      |

Table 4. Electrical characteristics (continued)

| Symbol               | Parameter                        | Test condition  | Min.     | Typ.           | Max.         | Unit |
|----------------------|----------------------------------|---|----------|----------------|--------------|------|
| P <sub>O</sub>       | Output power                     | V <sub>S</sub> = 13.2 V; THD = 10 %, 2 Ω  | 42       | 45             | -            | W    |
|                      |                                  | V <sub>S</sub> = 13.2 V; THD = 1 %, 2 Ω   | 32       | 34             |              |      |
|                      |                                  | V <sub>S</sub> = 14.4 V; THD = 10 %, 2 Ω  | 50       | 55             |              |      |
|                      |                                  | V <sub>S</sub> = 14.4 V; THD = 1 %, 2 Ω   | 40       | 43             |              |      |
| P <sub>O EIAJ</sub>  | EIAJ output power <sup>(1)</sup> | V <sub>S</sub> = 13.7 V; R <sub>L</sub> = 4 Ω<br>V <sub>S</sub> = 13.7 V; R <sub>L</sub> = 2 Ω  | 41<br>72 | 45<br>77       | -            | W    |
| P <sub>O max.</sub>  | Max. output power <sup>(1)</sup> | V <sub>S</sub> = 14.4 V; R <sub>L</sub> = 4 Ω<br>V <sub>S</sub> = 14.4 V; R <sub>L</sub> = 2 Ω<br>V <sub>S</sub> = 15.2 V; R <sub>L</sub> = 4 Ω | 43<br>75 | 50<br>80<br>51 | -            | W    |
| THD                  | Distortion                       | P <sub>O</sub> = 4 W<br>P <sub>O</sub> = 15 W; R <sub>L</sub> = 2 Ω   | -        | 0.006<br>0.015 | 0.02<br>0.03 | %    |
| e <sub>No</sub>      | Output noise                     | "A" Weighted<br>Bw = 20 Hz to 20 kHz  | -        | 35<br>50       | 50<br>70     | μV   |
| SVR                  | Supply voltage rejection         | f = 100 Hz; V <sub>r</sub> = 1 V <sub>rms</sub>   | 50       | 70             | -            | dB   |
| f <sub>ch</sub>      | High cut-off frequency           | P <sub>O</sub> = 0.5 W  | 100      | 300            | -            | kHz  |
| R <sub>i</sub>       | Input impedance                  |   | 80       | 100            | 120          | KΩ   |
| C <sub>T</sub>       | Cross talk                       | f = 1 kHz P <sub>O</sub> = 4 W  | 60       | 70             | -            | dB   |
|                      |                                  | f = 10 kHz P <sub>O</sub> = 4 W   | 50       | 60             |              |      |
| I <sub>SB</sub>      | Standby current consumption      | V <sub>ST-BY</sub> = 1.5 V  | -        | -              | 20           | μA   |
|                      |                                  | V <sub>ST-BY</sub> = 0 V  | -        | -              | 10           |      |
| I <sub>pin5</sub>    | Standby pin current              | V <sub>ST-BY</sub> = 1.5 V to 3.5 V   | -        | -              | ±10          | μA   |
| V <sub>SB out</sub>  | Standby out threshold voltage    | (Amp: ON)   | 3.5      | -              | -            | V    |
| V <sub>SB in</sub>   | Standby in threshold voltage     | (Amp: OFF)  | -        | -              | 1.5          | V    |
| A <sub>M</sub>       | Mute attenuation                 | P <sub>Oref</sub> = 4 W   | 80       | 90             | -            | dB   |
| V <sub>M out</sub>   | Mute out threshold voltage       | (Amp: Play)   | 3.5      | -              | -            | V    |
| V <sub>M in</sub>    | Mute in threshold voltage        | (Amp: Mute)   | -        | -              | 1.5          | V    |
| V <sub>AM in</sub>   | VS automute threshold            | (Amp: Mute)<br>Att ≥ 80 dB; P <sub>Oref</sub> = 4 W   | 6.5      | 7              | 8            | V    |
|                      |                                  | (Amp: Play)<br>Att < 0.1 dB; P <sub>O</sub> = 0.5 W   |          | 7.5            |              |      |
| I <sub>pin22</sub>   | Muting pin current               | V <sub>MUTE</sub> = 1.5 V<br>(Sourced current)  | 7        | 12             | 18           | μA   |
|                      |                                  | V <sub>MUTE</sub> = 3.5 V   | -5       | -              | 18           | μA   |
| <b>HSD section</b>   |                                  |   |          |                |              |      |
| V <sub>dropout</sub> | Dropout voltage                  | I <sub>O</sub> = 0.35 A; V <sub>S</sub> = 9 to 16 V   | -        | 0.25           | 0.6          | V    |
| I <sub>prot</sub>    | Current limits                   | -   | 400      | -              | 800          | mA   |

Table 4. Electrical characteristics (continued)

| Symbol                          | Parameter                                    | Test condition  | Min.    | Typ.    | Max.    | Unit |
|---------------------------------|--|---|---------|---------|---------|------|
| <b>Offset detector (Pin 25)</b> |  |   |         |         |         |      |
| $V_{M\_ON}$                     | Mute voltage for DC offset detection enabled | $V_{ST-BY} = 5\text{ V}$  | 8       | -       | -       | V    |
| $V_{M\_OFF}$                    |  |   | -       | -       | 6       | V    |
| $V_{OFF}$                       | Detected differential output offset          | $V_{ST-BY} = 5\text{ V}; V_{mute} = 8\text{ V}$                               | $\pm 2$ | $\pm 3$ | $\pm 4$ | V    |
| $V_{25\_T}$                     | Pin 25 voltage for detection = True          | $V_{ST-BY} = 5\text{ V}; V_{mute} = 8\text{ V}$<br>$V_{OFF} > \pm 4\text{ V}$ | 0       | -       | 1.5     | V    |
| $V_{25\_F}$                     | Pin 25 voltage for detection = False         | $V_{ST-BY} = 5\text{ V}; V_{mute} = 8\text{ V}$<br>$V_{OFF} > \pm 2\text{ V}$ | 12      | -       | -       | V    |

1. Saturated square wave output.

## 2.4 Standard test and application circuit, and PCB layout

Figure 3. Standard test and application circuit

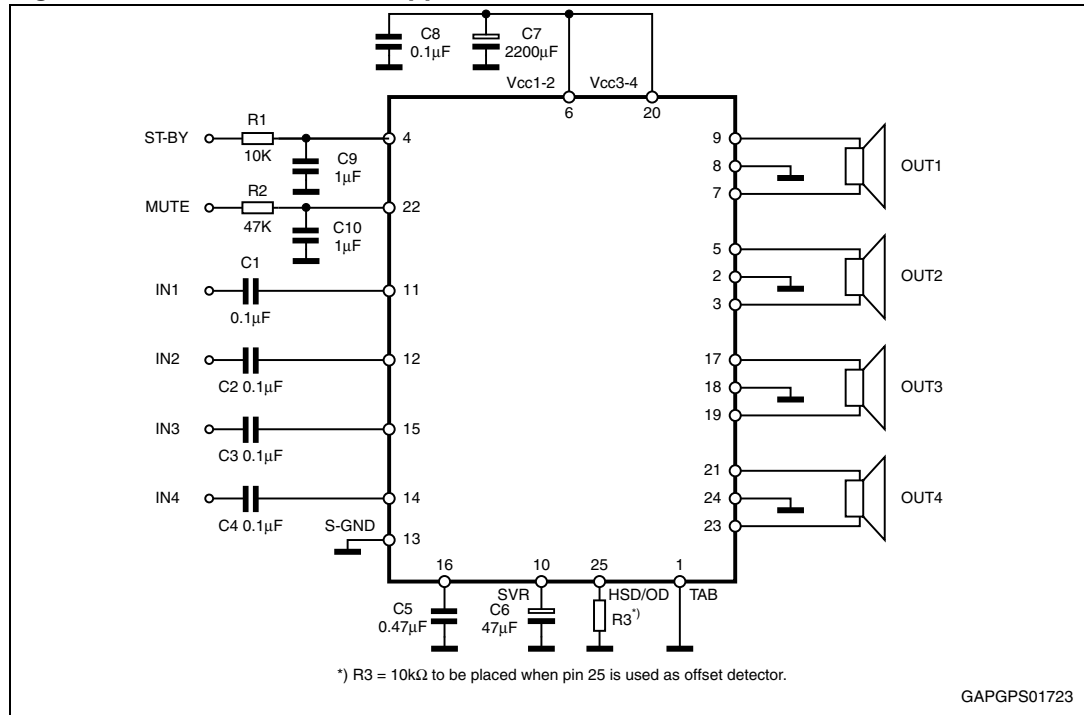
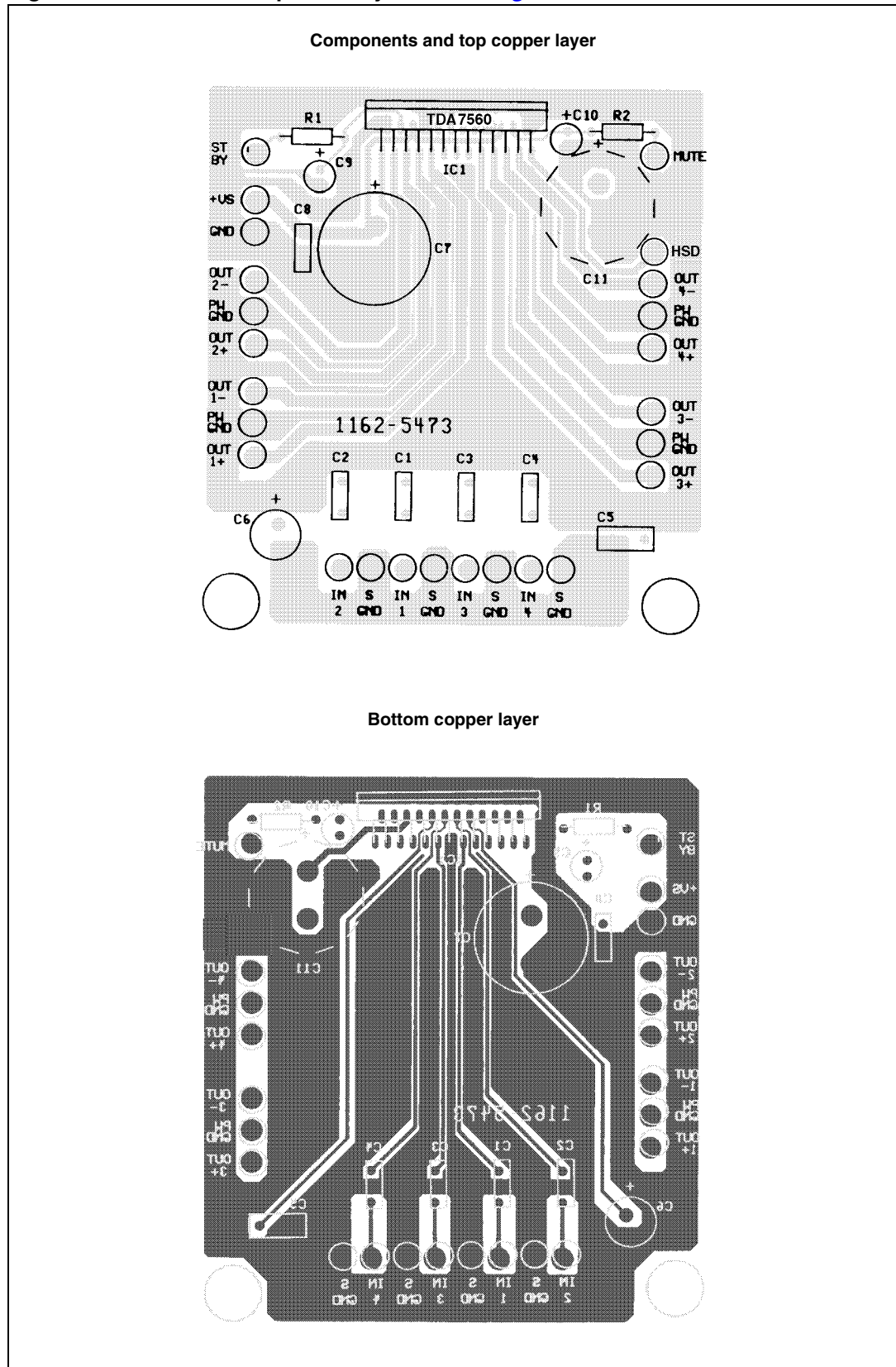


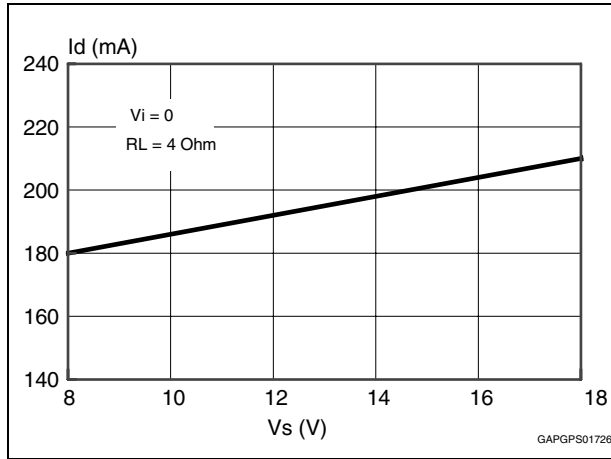


Figure 4. PCB and component layout of the [Figure 3](#).

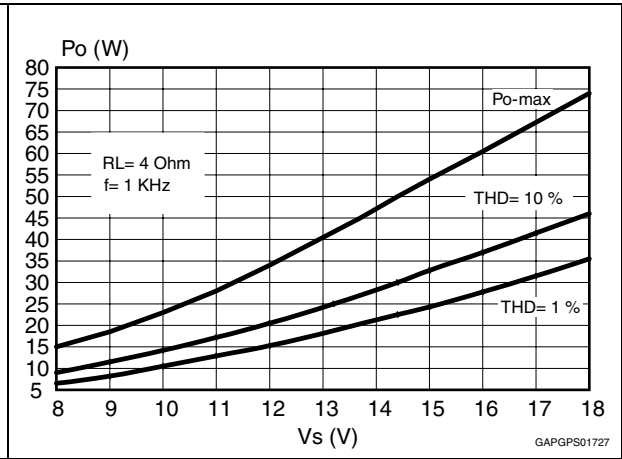


## 2.5 Electrical characteristics curves

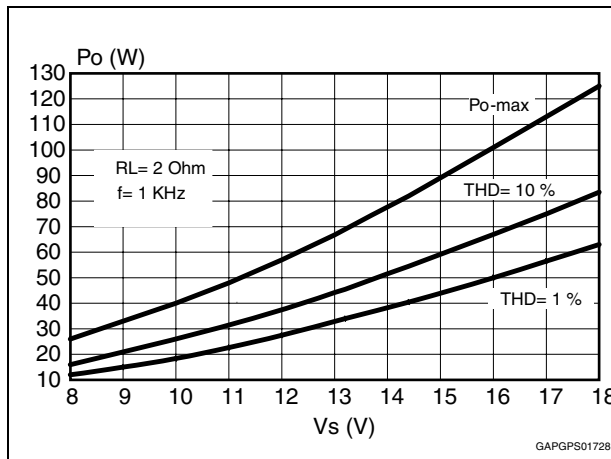
**Figure 5. Quiescent current vs. supply voltage**



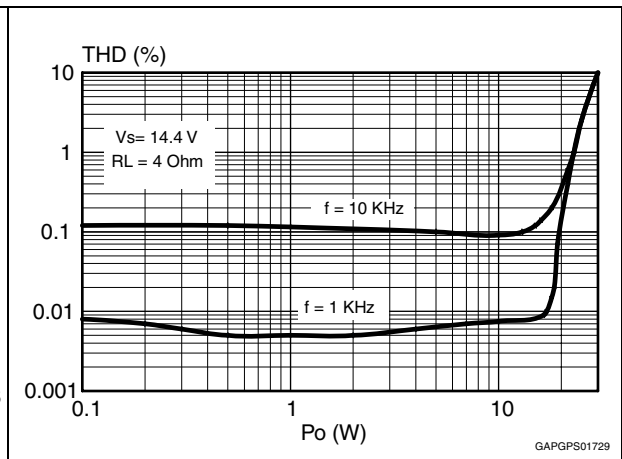
**Figure 6. Output power vs. supply voltage ( $R_L = 4\Omega$ )**



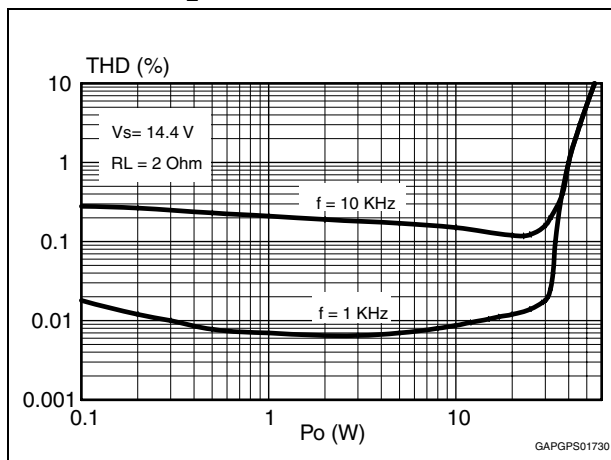
**Figure 7. Output power vs. supply voltage ( $R_L = 2\Omega$ )**



**Figure 8. Distortion vs. output power ( $R_L = 4\Omega$ )**



**Figure 9. Distortion vs. output power ( $R_L = 2\Omega$ )**



**Figure 10. Distortion vs. frequency ( $R_L = 4\Omega$ )**

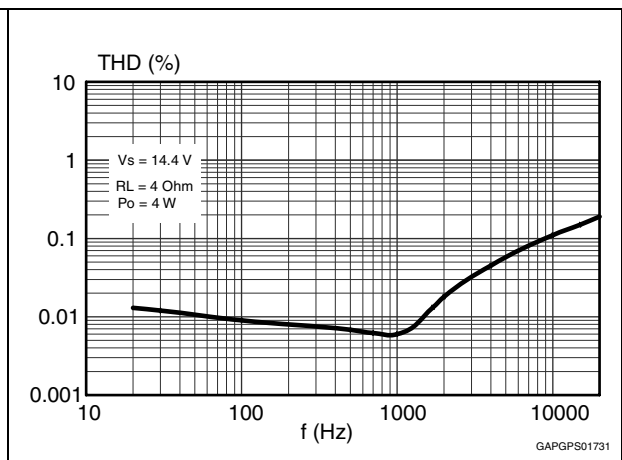


Figure 11. Distortion vs. frequency ( $R_L = 2\Omega$ )

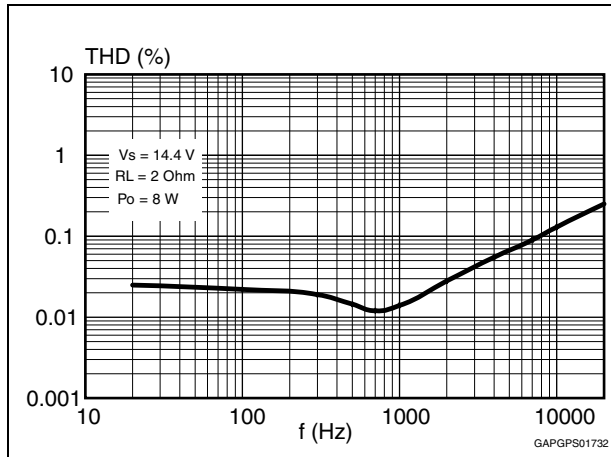


Figure 12. Crosstalk vs. frequency

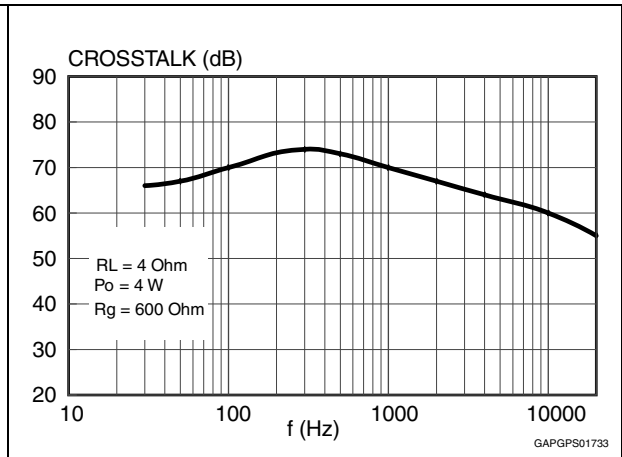


Figure 13. Supply voltage rejection vs. frequency

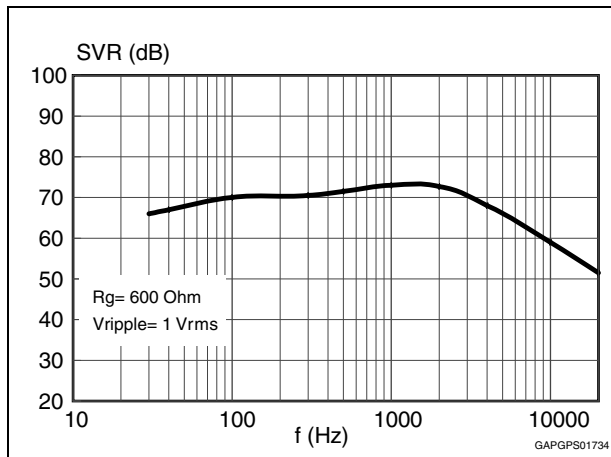


Figure 14. Output attenuation vs. supply voltage

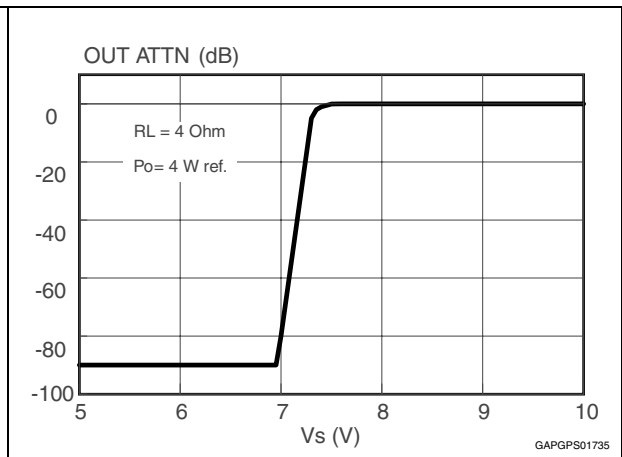


Figure 15. Output noise vs. source resistance

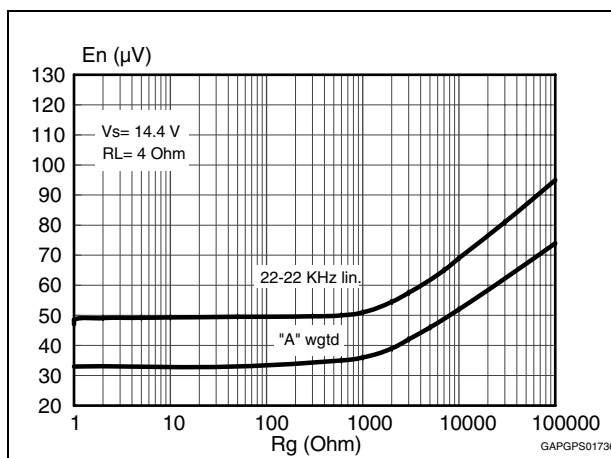
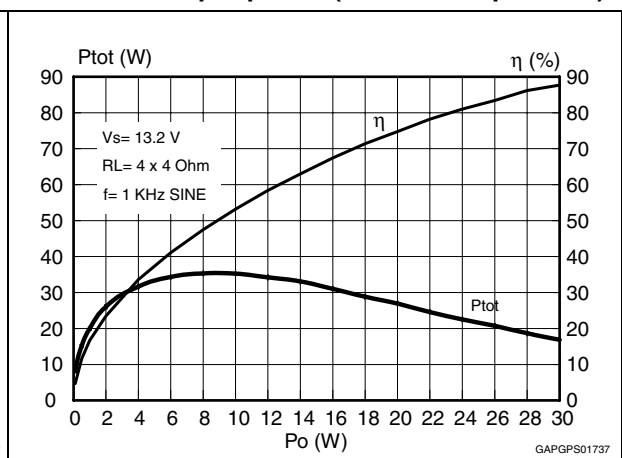
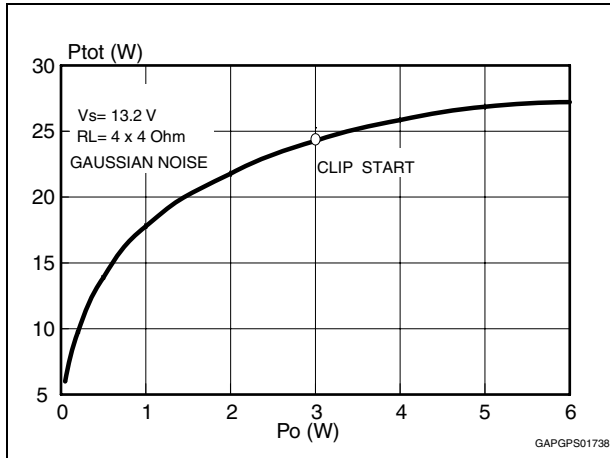


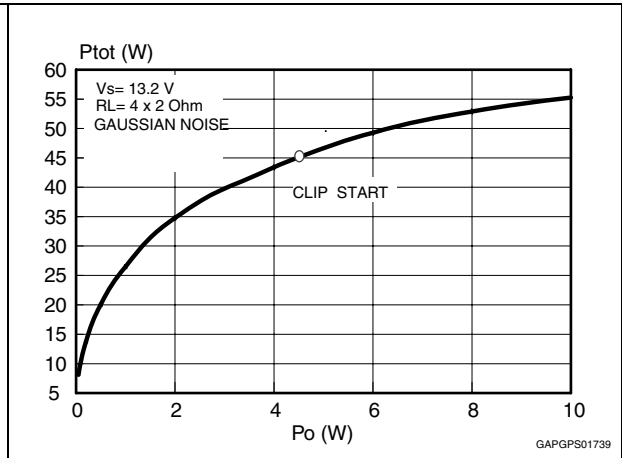
Figure 16. Power dissipation and efficiency vs. output power (sine-wave operation)



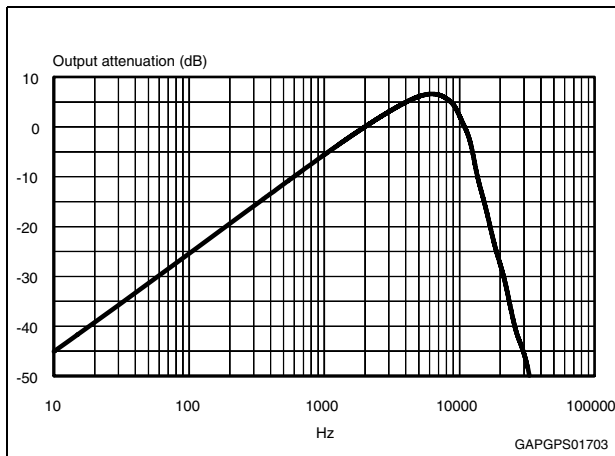
**Figure 17. Power dissipation vs. output power (music/speech simulation);**  
 $R_L = 4 \times 4\Omega$



**Figure 18. Power dissipation vs. output power (music/speech simulation);**  
 $R_L = 4 \times 2\Omega$



**Figure 19. ITU R-ARM frequency response, weighting filter for transient pop**



## 3 Application hints

(ref. to the circuit of [Figure 3](#))

### 3.1 SVR

Besides its contribution to the ripple rejection, the SVR capacitor governs the turn ON/OFF time sequence and, consequently, plays an essential role in the pop optimization during ON/OFF transients. To conveniently serve both needs, **ITS MINIMUM RECOMMENDED VALUE IS 10  $\mu$ F**.

### 3.2 Input stage

The TDA7560's inputs are ground-compatible and can stand very high input signals ( $\pm 8$  Vpk) without any performances degradation. If the standard value for the input capacitors (0.1  $\mu$ F) is adopted, the low frequency cut-off will amount to 16 Hz.

### 3.3 Standby and muting

Standby and Muting facilities are both CMOS-compatible. In absence of true CMOS ports or microprocessors, a direct connection to  $V_s$  of these two pins is admissible but a 470 kOhm equivalent resistance should be present between the power supply and the muting and ST-BY pins.

R-C cells have always to be used in order to smooth down the transitions for preventing any audible transient noises.

About the standby, the time constant to be assigned in order to obtain a virtually pop-free transition has to be slower than 2.5 V/ms.

### 3.4 DC offset detector

The TDA7560 integrates a DC offset detector to avoid that an anomalous DC offset on the inputs of the amplifier may be multiplied by the gain and result in a dangerous large offset on the outputs which may lead to speakers damage for overheating. The feature is enabled by the MUTE pin (according to [Table 4](#)) and works with the amplifier unmuted and with no signal on the inputs.

The DC offset detection is signaled out on the HSD pin. To ensure the correct functionality of the Offset Detector it is necessary to connect a pulldown 10 k $\Omega$  resistor between HSD and ground.

### 3.5 Heatsink definition

Under normal usage (4 Ohm speakers) the heatsink's thermal requirements have to be deduced from [Figure 17](#), which reports the simulated power dissipation when real music/speech programmes are played out. Noise with gaussian-distributed amplitude was employed for this simulation. Based on that, frequent clipping occurrence (worst-case) will cause  $P_{diss} = 26$  W. Assuming  $T_{amb} = 70$  °C and  $T_{CHIP} = 150$  °C as boundary conditions, the heatsink's thermal resistance should be approximately 2 °C/W. This would avoid any thermal shutdown occurrence even after long-term and full-volume operation

# 4 Package information

In order to meet environmental requirements, ST offers these devices in different grades of ECOPACK® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: [www.st.com](http://www.st.com).

ECOPACK® is an ST trademark.

**Figure 20. Flexiwatt25 (vertical) mechanical data and package dimensions**

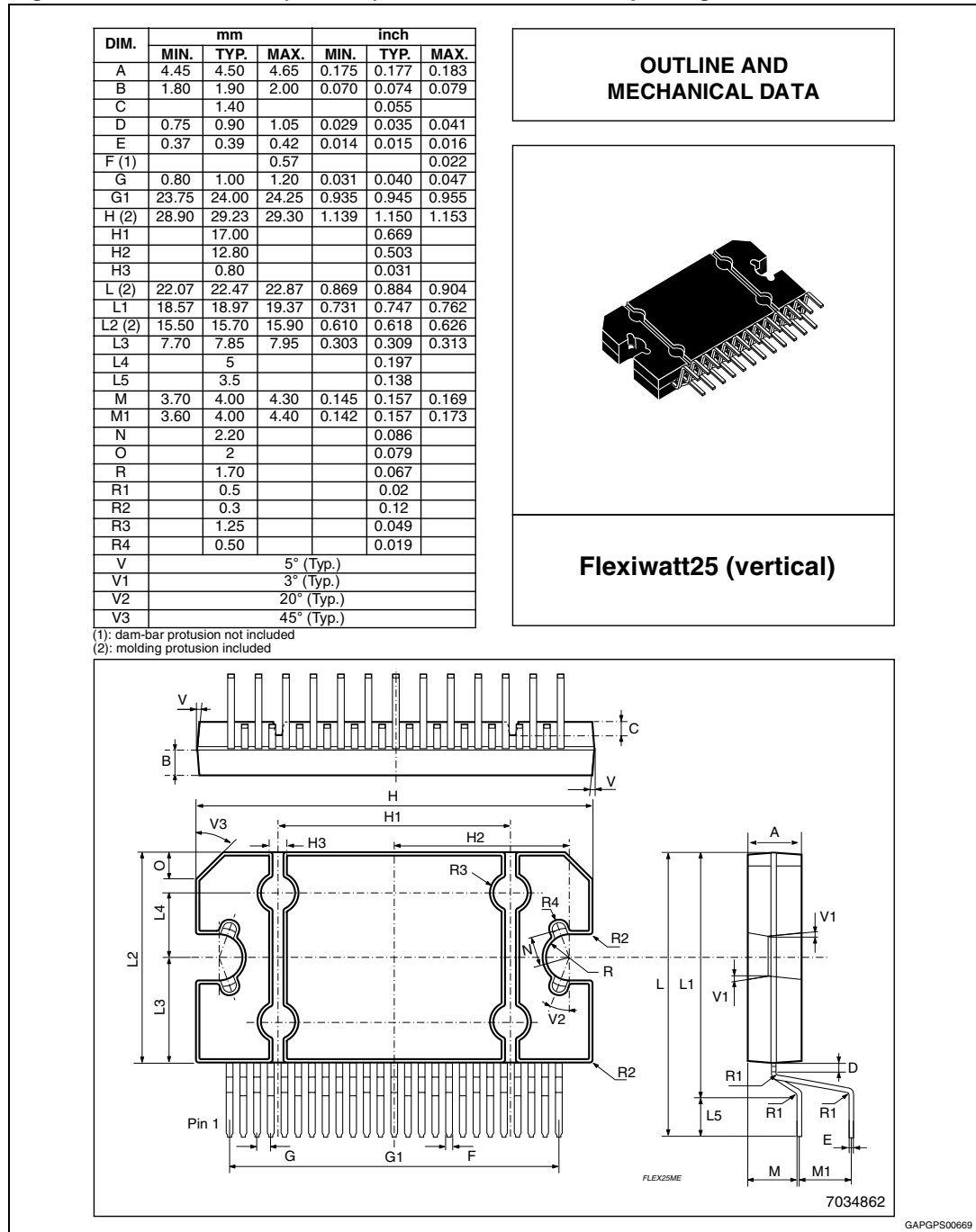
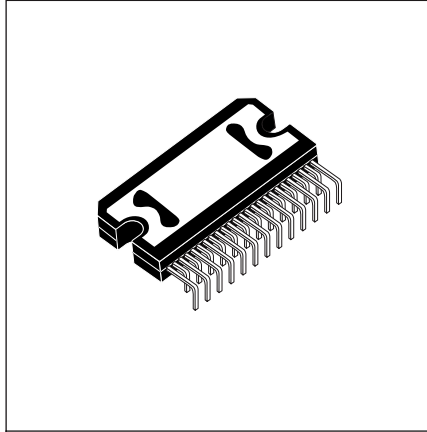


Figure 21. Flexiwatt25 (horizontal) mechanical data and package dimensions

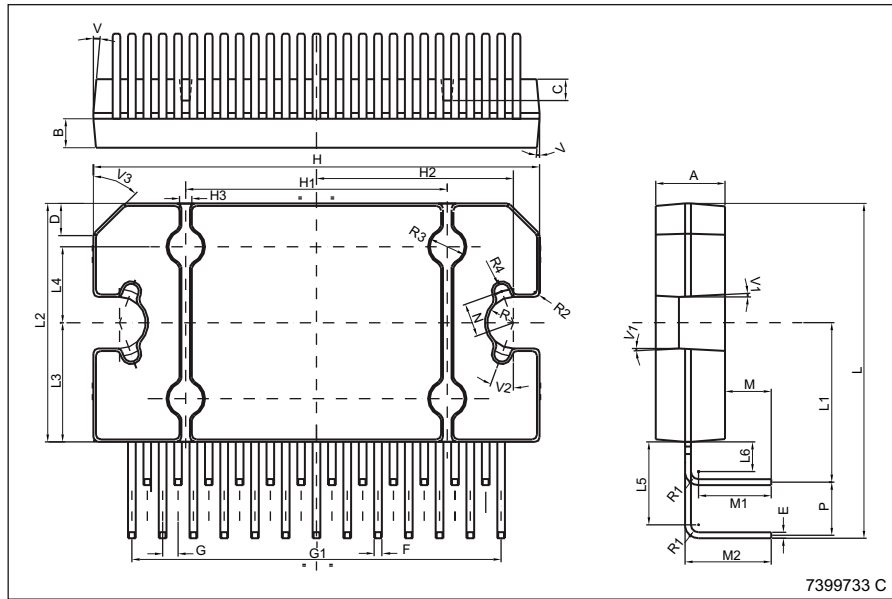
| DIM.              | mm         |       |       | inch  |       |       |
|-------------------|------------|-------|-------|-------|-------|-------|
|                   | MIN.       | TYP.  | MAX.  | MIN.  | TYP.  | MAX.  |
| A                 | 4.45       | 4.50  | 4.65  | 0.175 | 0.177 | 0.183 |
| B                 | 1.80       | 1.90  | 2.00  | 0.070 | 0.074 | 0.079 |
| C                 |            | 1.40  |       |       | 0.055 |       |
| D                 |            | 2.00  |       |       | 0.079 |       |
| E                 | 0.37       | 0.39  | 0.42  | 0.014 | 0.015 | 0.016 |
| F <sup>(1)</sup>  |            |       | 0.57  |       |       | 0.022 |
| G                 | 0.75       | 1.00  | 1.25  | 0.029 | 0.040 | 0.049 |
| G1                | 23.70      | 24.00 | 24.30 | 0.933 | 0.945 | 0.957 |
| H <sup>(2)</sup>  | 28.90      | 29.23 | 29.30 | 1.139 | 1.150 | 1.153 |
| H1                |            | 17.00 |       |       | 0.669 |       |
| H2                |            | 12.80 |       |       | 0.503 |       |
| H3                |            | 0.80  |       |       | 0.031 |       |
| L <sup>(2)</sup>  | 21.64      | 22.04 | 22.44 | 0.852 | 0.868 | 0.883 |
| L1                | 10.15      | 10.5  | 10.85 | 0.40  | 0.413 | 0.427 |
| L2 <sup>(2)</sup> | 15.50      | 15.70 | 15.90 | 0.610 | 0.618 | 0.626 |
| L3                | 7.70       | 7.85  | 7.95  | 0.303 | 0.309 | 0.313 |
| L4                |            | 5     |       |       | 0.197 |       |
| L5                | 5.15       | 5.45  | 5.85  | 0.203 | 0.214 | 0.23  |
| L6                | 1.80       | 1.95  | 2.10  | 0.070 | 0.077 | 0.083 |
| M                 | 2.75       | 3.00  | 3.50  | 0.108 | 0.118 | 0.138 |
| M1                |            | 4.73  |       |       | 0.186 |       |
| M2                |            | 5.61  |       |       | 0.220 |       |
| N                 |            | 2.20  |       |       | 0.086 |       |
| P                 | 3.20       | 3.50  | 3.80  | 0.126 | 0.138 | 0.15  |
| R                 |            | 1.70  |       |       | 0.067 |       |
| R1                |            | 0.50  |       |       | 0.02  |       |
| R2                |            | 0.30  |       |       | 0.12  |       |
| R3                |            | 1.25  |       |       | 0.049 |       |
| R4                |            | 0.50  |       |       | 0.02  |       |
| V                 | 5° (Typ.)  |       |       |       |       |       |
| V1                | 3° (Typ.)  |       |       |       |       |       |
| V2                | 20° (Typ.) |       |       |       |       |       |
| V3                | 45° (Typ.) |       |       |       |       |       |

**OUTLINE AND MECHANICAL DATA**



**Flexiwatt25 (Horizontal)**

(1): Dam-bar protusion not included; (2): Molding protusion included.



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## 5 Revision history

**Table 5. Document revision history**

| Date        | Revision | Changes  |
|-------------|----------|--|
| 20-Dec-2001 | 1        | Initial release.   |
| 10-Feb-2005 | 2        | Improved value from 75 to 20mA of the “standby current consumption” parameter in the <a href="#">Table 4: Electrical characteristics on page 6</a> .   |
| 18-Sep-2008 | 3        | Document reformatted.<br>Added new order code in Flexiwatt25 horizontal package.<br>Updated <a href="#">Figure 3: Standard test and application circuit</a> .<br>Updated <a href="#">Table 4: Electrical characteristics</a> .<br>Updated <a href="#">Section 3.4: DC offset detector</a> and <a href="#">Section 3.3: Standby and muting</a> .<br>Added <a href="#">Figure 19: ITU R-ARM frequency response, weighting filter for transient pop</a> . |
| 07-Nov-2008 | 4        | Modified max. values of the $V_{OS}$ and THD parameter in <a href="#">Table 4: Electrical characteristics</a> .  |
| 11-Sep-2012 | 5        | Updated <a href="#">Features on page 1</a> ;<br>Updated <a href="#">Section 2.3: Electrical characteristics</a> .  |



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