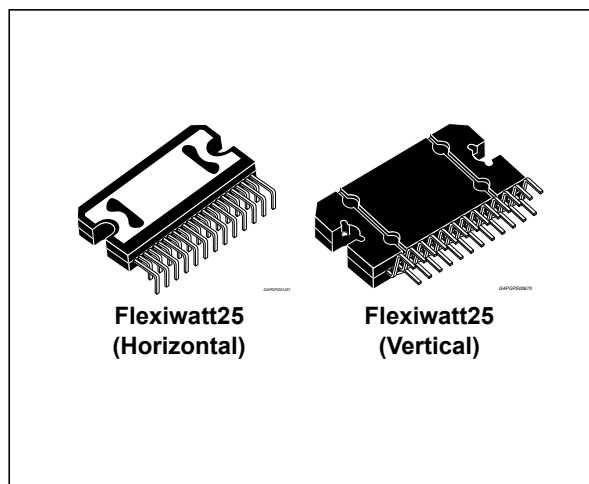


## 4 x 48 W MOSFET quad bridge power amplifier

Datasheet - production data



### Features

- Multipower BCD technology
- High output power capability:
  - 4 x 48 W/4  $\Omega$  max.
  - 4 x 28 W/4  $\Omega$  @ 14.4 V, 1 kHz, 10%
  - 4 x 72 W/2  $\Omega$  max.
- 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
- Output DC offset detector
- Protections:
  - Output short circuit to GND, to  $V_S$ , across the load
  - Very inductive loads
  - Overrating chip temperature with soft thermal limiter
  - Load dump voltage
  - Fortuitous open GND
  - Reversed battery
  - ESD

### Description

The TDA7851F is a breakthrough MOSFET technology class AB audio power amplifier, designed for high-power car radio.

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

Table 1. Device summary

| Order code    | Package                  | Packing |
|---------------|--------------------------|---------|
| TDA7851F      | Flexiwatt25 (vertical)   | Tube    |
| TDA7851FH-QIX | Flexiwatt25 (horizontal) | Tube    |

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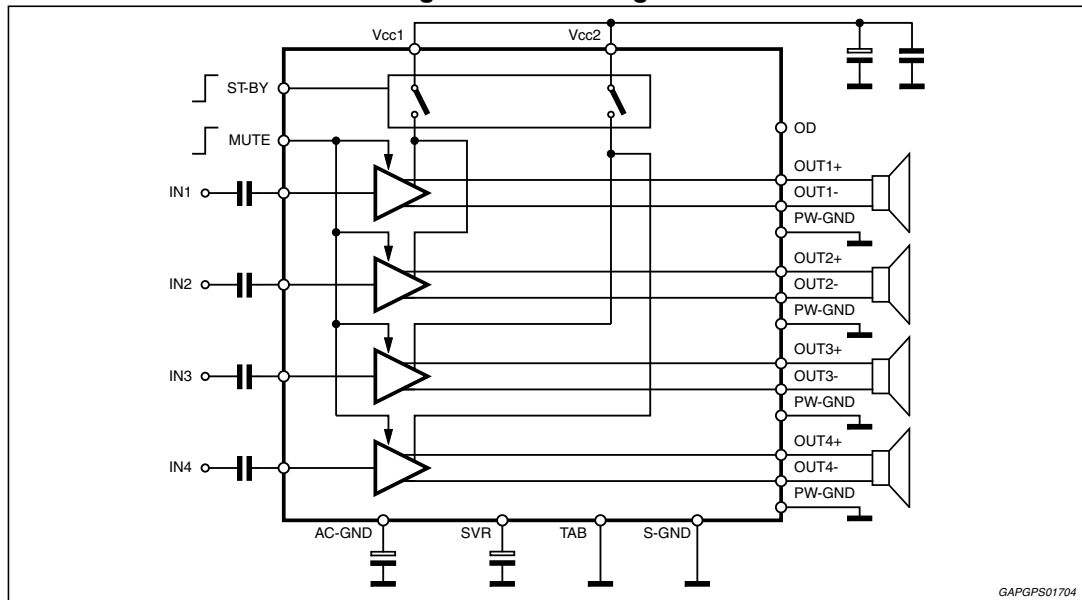
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# 1 Block diagram and application circuit

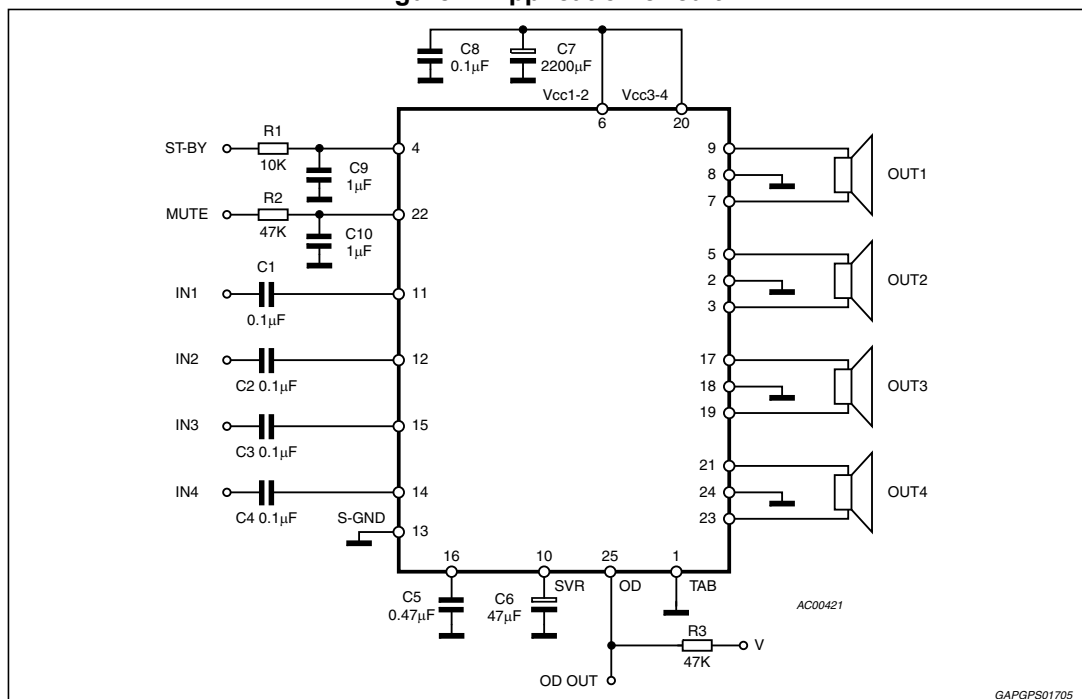
## 1.1 Block diagram

Figure 1. Block diagram



## 1.2 Application circuit

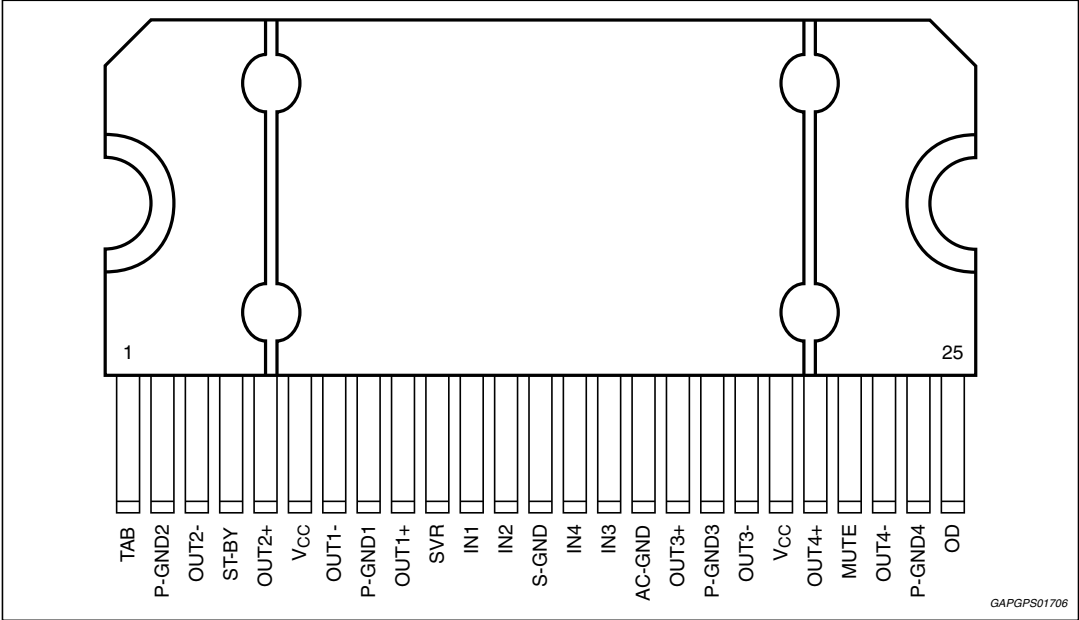
Figure 2. Application circuit



2 Pin description

2.1 Pin connection

Figure 3. Pin connection (top view)



2.2 Thermal data

Table 2. Thermal data

| Symbol                 | Parameter                               | Value | Unit |
|------------------------|-----------------------------------------|-------|------|
| R <sub>th j-case</sub> | Thermal resistance junction-to-case max | 1     | °C/W |

## 3 Electrical specifications

### 3.1 Absolute maximum ratings

Table 3. Absolute maximum ratings

| Symbol      | Parameter                                                  | Value      | Unit |
|-------------|------------------------------------------------------------|------------|------|
| $V_S$       | Operating supply voltage                                   | 18         | V    |
| $V_{S(DC)}$ | DC supply voltage                                          | 28         | V    |
| $V_{S(pk)}$ | Peak supply voltage (for $t = 50$ ms)                      | 50         | V    |
| $I_O$       | Output peak current<br>Non repetitive ( $t = 100$ $\mu$ s) | 10         | A    |
|             | Repetitive (duty cycle 10% at $f = 10$ Hz)                 | 9          | A    |
| $P_{tot}$   | Power dissipation $T_{case} = 70$ °C                       | 85         | W    |
| $T_j$       | Junction temperature                                       | 150        | °C   |
| $T_{stg}$   | Storage temperature                                        | -55 to 150 | °C   |

### 3.2 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 |
|---------------|---------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------|------|----------------|---------|------|
| $V_S$         | Supply voltage range                        | -                                                                                                                                             | 8    | -              | 18      | V    |
| $I_{q1}$      | Quiescent current                           | $R_L = \infty$                                                                                                                                | 100  | 150            | 300     | mA   |
| $V_{OS}$      | Output offset voltage                       | Play mode / Mute mode                                                                                                                         | -60  | -              | +60     | mV   |
| $dV_{OS}$     | During mute ON/OFF output offset voltage    | ITU R-ARM weighted<br>see <a href="#">Figure 18</a>                                                                                           | -10  | -              | +10     | mV   |
|               | During standby ON/OFF output offset voltage |                                                                                                                                               | -10  | -              | +10     | mV   |
| $G_v$         | Voltage gain                                | -                                                                                                                                             | 25   | 26             | 27      | dB   |
| $dG_v$        | Channel gain unbalance                      | -                                                                                                                                             |      |                | $\pm 1$ | dB   |
| $P_o$         | Output power                                | $V_S = 14.4$ V; THD = 10%                                                                                                                     | 25   | 28             | -       | W    |
|               |                                             | $V_S = 14.4$ V; THD = 1%                                                                                                                      |      | 22             | -       | W    |
|               |                                             | $V_S = 14.4$ V; THD = 10%, 2 $\Omega$                                                                                                         | -    | 48             | -       | W    |
|               |                                             | $V_S = 14.4$ V; THD = 1%, 2 $\Omega$                                                                                                          |      | 38             | -       | W    |
| $P_{o\ max.}$ | Max. output power <sup>(1)</sup>            | $V_S = 14.4$ V; $R_L = 4$ $\Omega$<br>$V_S = 14.4$ V; $R_L = 2$ $\Omega$ ;<br>$V_S = 15.2$ V; $R_L = 4$ $\Omega$ (square wave input (2 Vrms)) | -    | 45<br>75<br>48 | -       | W    |

Table 4. Electrical characteristics (continued)

| Symbol                 | Parameter                     | Test condition                                                                                  | Min.    | Typ.     | Max.    | Unit                           |
|------------------------|-------------------------------|-------------------------------------------------------------------------------------------------|---------|----------|---------|--------------------------------|
| THD                    | Distortion                    | $P_O = 4\text{ W}$                                                                              | -       | 0.01     | 0.05    | %                              |
| $e_{No}$               | Output noise                  | "A" Weighted<br>$Bw = 20\text{ Hz to }20\text{ kHz}$                                            | -       | 35<br>50 | 100     | $\mu\text{V}$<br>$\mu\text{V}$ |
| SVR                    | Supply voltage rejection      | $f = 100\text{ Hz}; V_r = 1\text{ Vrms}$                                                        | 50      | 70       | -       | dB                             |
| $f_{ch}$               | High cut-off frequency        | $P_O = 0.5\text{ W}$                                                                            | 100     | 300      | -       | kHz                            |
| $R_i$                  | Input Impedance               | -                                                                                               | 70      | 100      | 130     | k $\Omega$                     |
| $C_T$                  | Cross talk                    | $f = 1\text{ kHz } P_O = 4\text{ W}$<br>$f = 10\text{ kHz } P_O = 4\text{ W}$                   | 60      | 70<br>60 | -<br>-  | dB<br>dB                       |
| $I_{SB}$               | Standby current consumption   | $V_{St-By} = 1.2\text{ V}$                                                                      | -       | -        | 20      | $\mu\text{A}$                  |
|                        |                               | $V_{St-By} = 0$                                                                                 | -       | -        | 10      | $\mu\text{A}$                  |
| $I_{pin5}$             | Standby pin current           | $V_{St-By} = 1.2\text{ V to }2.6\text{ V}$                                                      | -       | -        | $\pm 1$ | $\mu\text{A}$                  |
| $V_{SB\ out}$          | Standby out threshold voltage | (Amp: ON)                                                                                       | 2.6     | -        |         | V                              |
| $V_{SB\ in}$           | Standby in threshold voltage  | (Amp: OFF)                                                                                      | -       | -        | 1.2     | V                              |
| $A_M$                  | Mute attenuation              | $P_{Oref} = 4\text{ W}$                                                                         | 80      | 90       |         | dB                             |
| $V_{M\ out}$           | Mute out threshold voltage    | (Amp: Play)                                                                                     | 2.6     | -        |         | V                              |
| $V_{M\ in}$            | Mute in threshold voltage     | (Amp: Mute)                                                                                     | -       | -        | 1.2     | V                              |
| $V_{AM\ in}$           | $V_S$ automute threshold      | (Amp: Mute)<br>Att. $\geq 80\text{ dB}; P_{Oref} = 4\text{ W}$                                  | 6.7     | 7        |         | V                              |
|                        |                               | (Amp: Play)<br>Att. $< 0.1\text{ dB}; P_O = 0.5\text{ W}$                                       |         | 7.5      | 8       | V                              |
| $I_{pin23}$            | Muting pin current            | $V_{MUTE} = 1.2\text{ V}$<br>(Sourced current)                                                  | 7       | 12       | 18      | $\mu\text{A}$                  |
|                        |                               | $V_{MUTE} = 2.6\text{ V}$                                                                       | -5      | -        | 18      | $\mu\text{A}$                  |
| <b>Offset detector</b> |                               |                                                                                                 |         |          |         |                                |
| $V_{OFF}$              | Detected diff. output offset  | $V_{ST-BY} = 5\text{ V}$                                                                        | $\pm 1$ | $\pm 2$  | $\pm 3$ | V                              |
| $V_{OFF\_SAT}$         | Off detector sat voltage      | $V_O > \pm 3\text{ V}, I_{off\ Det} = 1\text{ mA}$<br>$0\text{ V} < V_{off\ Det} < 18\text{ V}$ | -       | 0.2      | 0.4     | V                              |
| $V_{OFF\_LK}$          | Off detector leakage current  | $V_O < \pm 1\text{ V}$                                                                          | -       | 0        | 15      | $\mu\text{A}$                  |

1. Saturated square wave output

### 3.3 Electrical characteristics curves

Figure 4. Quiescent current vs. supply voltage

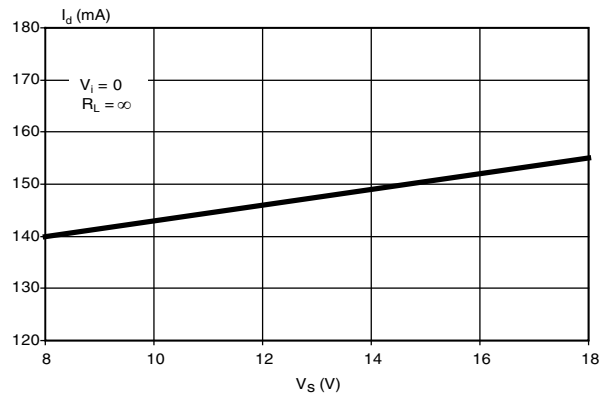
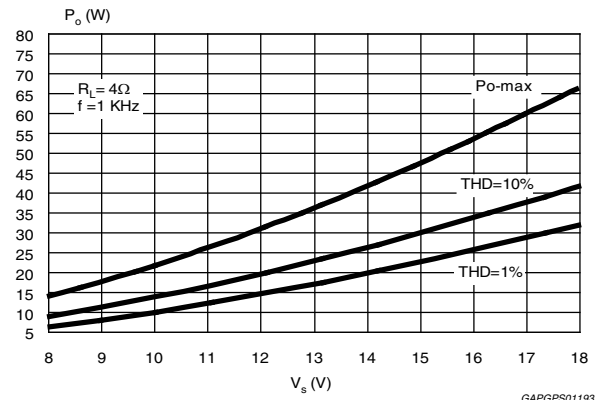
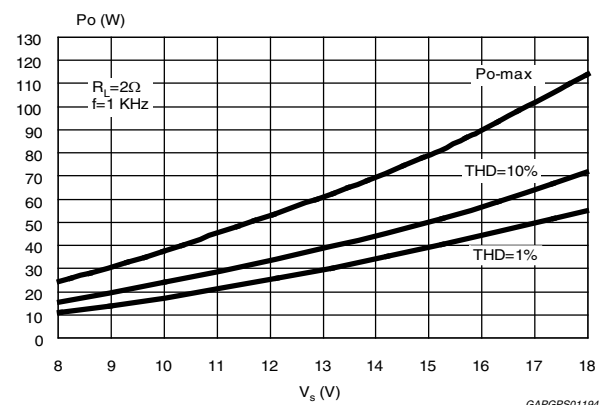
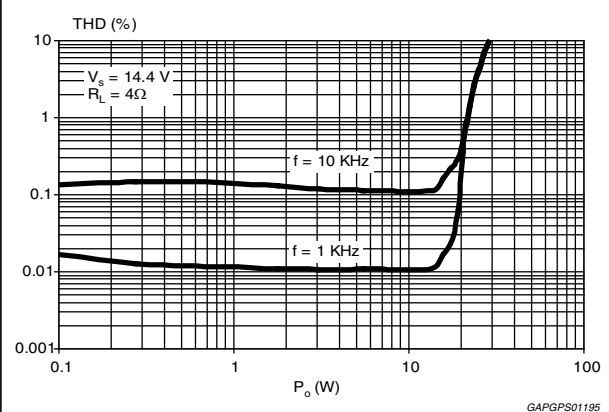
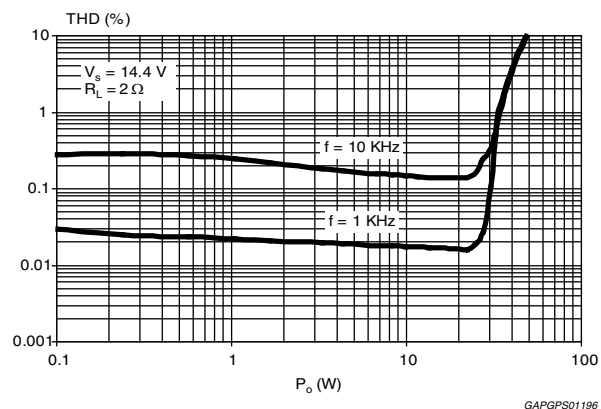
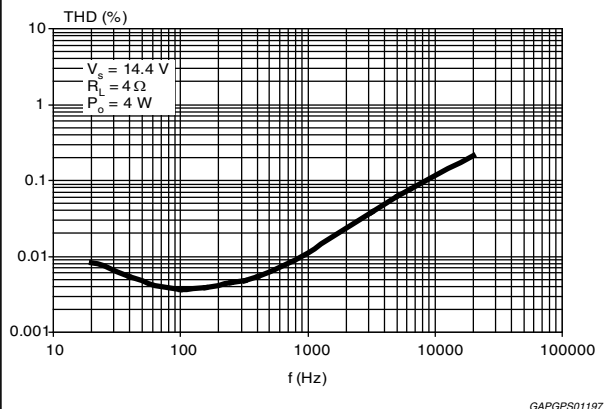
Figure 5. Output power vs. supply voltage ( $R_L = 4 \Omega$ )Figure 6. Output power vs. supply voltage ( $R_L = 2 \Omega$ )Figure 7. Distortion vs. output power ( $R_L = 4 \Omega$ )Figure 8. Distortion vs. output power ( $R_L = 2 \Omega$ )Figure 9. Distortion vs. frequency ( $R_L = 4 \Omega$ )

Figure 10. Distortion vs. frequency ( $R_L = 2\ \Omega$ )

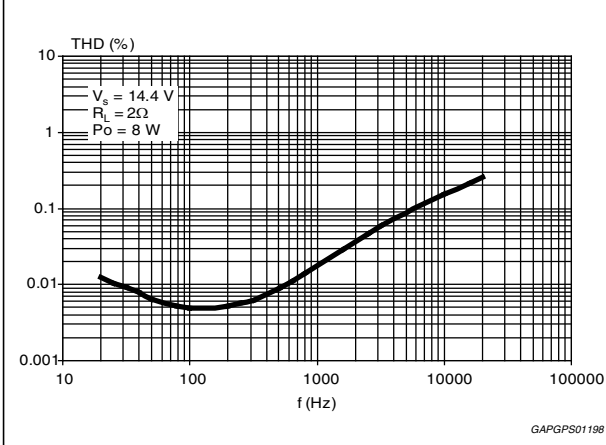


Figure 11. Crosstalk vs. frequency

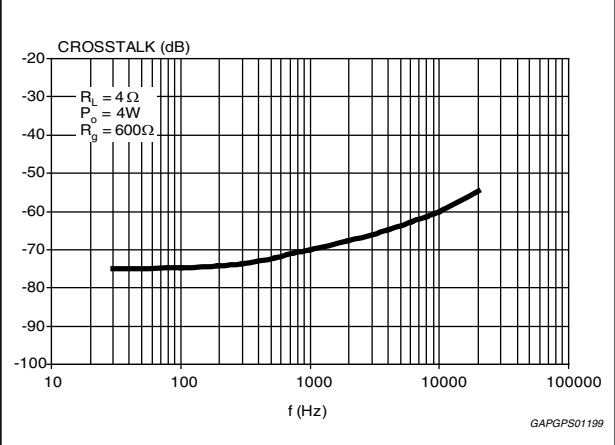


Figure 12. Supply voltage rejection vs. frequency

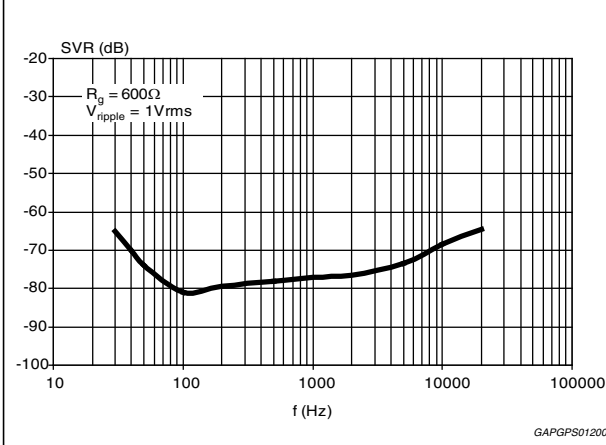


Figure 13. Output attenuation vs. supply voltage

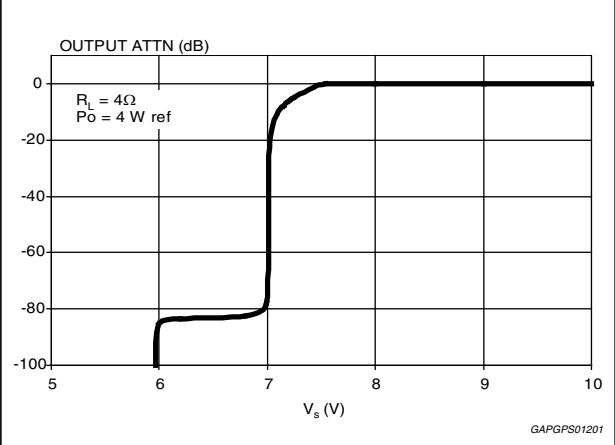


Figure 14. Power dissipation and efficiency vs. output power ( $R_L = 4\ \Omega$ , SINE)

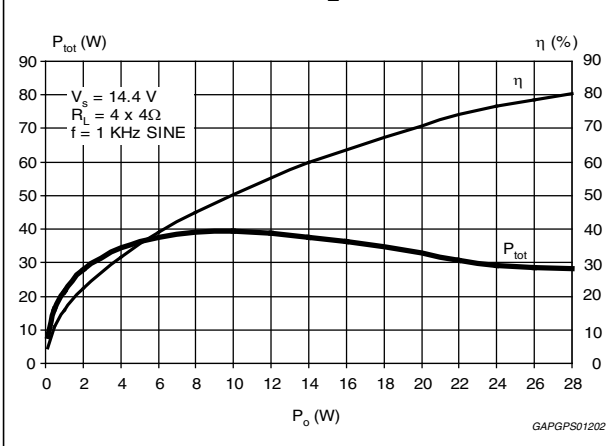
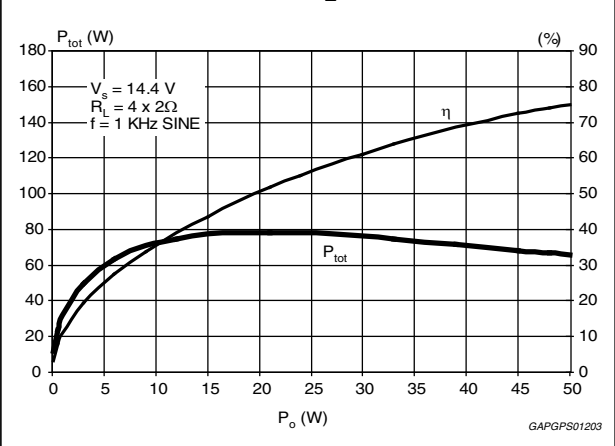
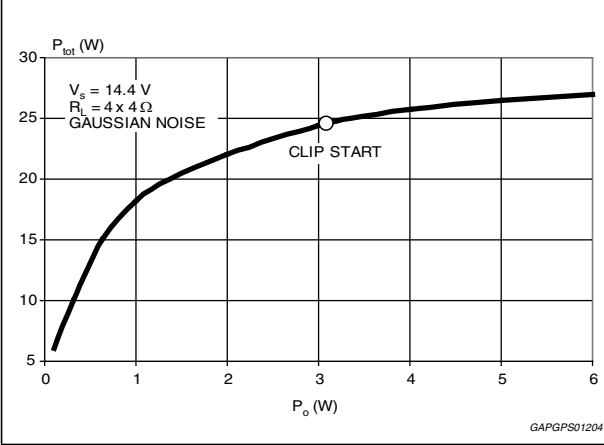


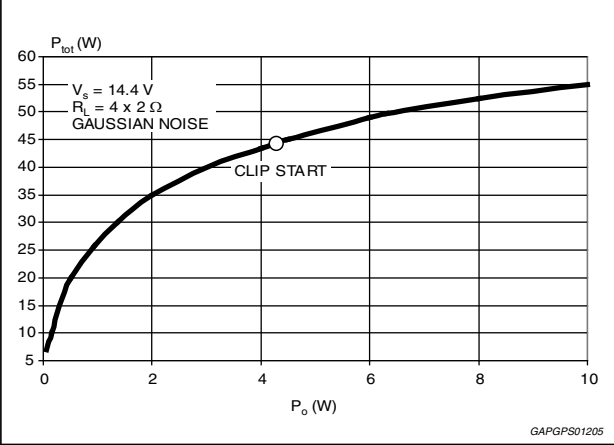
Figure 15. Power dissipation and efficiency vs. output power ( $R_L = 2\ \Omega$ , SINE)



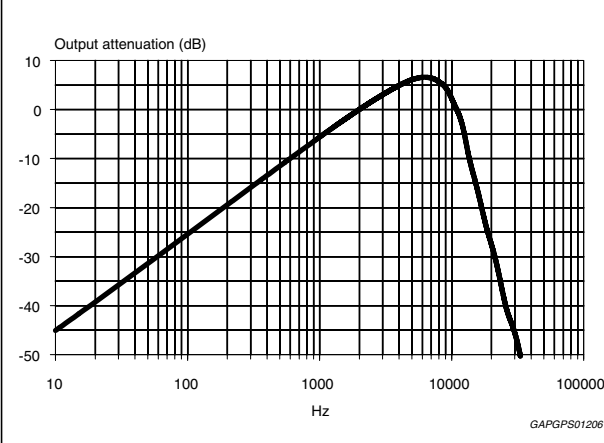
**Figure 16. Power dissipation vs. output power**  
( $R_L = 4\ \Omega$ , audio program simulation)



**Figure 17. Power dissipation vs. output power**  
( $R_L = 2\ \Omega$ , audio program simulation)



**Figure 18. ITU R-ARM frequency response,**  
weighting filter for transient pop



## 4 Application hints

### 4.1 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**.

### 4.2 Input stage

The TDA7851's inputs are ground-compatible and can stand very high input signals ( $\pm 8$  Vpk) without any performance degradation.

If the standard value for the input capacitors (0.1  $\mu$ F) is adopted, the low frequency cut-off amounts to 16 Hz.

The input capacitors should be 1/4 of the capacitor connected to AC-GND pin for optimum pop performance.

### 4.3 Standby and muting

Standby and muting facilities are both CMOS-compatible. In absence of true CMOS ports or microprocessors, a direct connection to Vs of these two pins is admissible but a 470 k $\Omega$  equivalent resistance should be present between the power supply and muting and standby pins.

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

About 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.

### 4.4 Heatsink definition

Under normal usage (4 Ohm speakers) the heatsink's thermal requirements have to be deduced from [Figure 16](#), which reports the simulated power dissipation when real music/speech programmers are played out. Noise with Gaussian-distributed amplitude was employed for this simulation. Based on that, frequent clipping occurrence (worst-case) causes  $P_{diss} = 26$  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.



Table 5. Flexiwatt 25 (vertical) package mechanical data (continued)

| Ref               | Dimensions  |       |       |                       |        |        |
|-------------------|-------------|-------|-------|-----------------------|--------|--------|
|                   | Millimeters |       |       | Inches <sup>(1)</sup> |        |        |
|                   | Min.        | Typ.  | Max.  | Min.                  | Typ.   | Max.   |
| F <sup>(2)</sup>  | -           | -     | 0.570 | -                     | -      | 0.0224 |
| G                 | 0.80        | 1.00  | 1.20  | 0.0315                | 0.0394 | 0.0472 |
| G1                | 23.75       | 24.00 | 24.25 | 0.9350                | 0.9449 | 0.9547 |
| H <sup>(3)</sup>  | 28.90       | 29.23 | 29.30 | 1.1378                | 1.1508 | 1.1535 |
| H1                | -           | 17.00 | -     | -                     | 0.6693 | -      |
| H2                | -           | 12.80 | -     | -                     | 0.5039 | -      |
| H3                | -           | 0.80  | -     | -                     | 0.0315 | -      |
| L                 | 22.07       | 22.47 | 22.87 | 0.8689                | 0.8846 | 0.9004 |
| L1                | 18.57       | 18.97 | 19.37 | 0.7311                | 0.7469 | 0.7626 |
| L2 <sup>(3)</sup> | 15.50       | 15.70 | 15.90 | 0.6102                | 0.6181 | 0.6260 |
| L3                | 7.70        | 7.85  | 7.95  | 0.3031                | 0.3091 | 0.3130 |
| L4                | -           | 5.00  | -     | -                     | 0.1969 | -      |
| L5                | 3.35        | 3.50  | 3.65  | 0.1319                | 0.1378 | 0.1437 |
| M                 | 3.70        | 4.00  | 4.30  | 0.1457                | 0.1575 | 0.1693 |
| M1                | 3.60        | 4.00  | 4.40  | 0.1417                | 0.1575 | 0.1732 |
| N                 | -           | 2.20  | -     | -                     | 0.0866 | -      |
| O                 | -           | 2.00  | -     | -                     | 0.0787 | -      |
| R                 | -           | 1.70  | -     | -                     | 0.0669 | -      |
| R1                | -           | 0.50  | -     | -                     | 0.0197 | -      |
| R2                | -           | 0.30  | -     | -                     | 0.0118 | -      |
| R3                | -           | 1.25  | -     | -                     | 0.0492 | -      |
| R4                | -           | 0.50  | -     | -                     | 0.0197 | -      |
| V                 | 5°          |       |       | 5°                    |        |        |
| V1                | 3°          |       |       | 3°                    |        |        |
| V2                | 20°         |       |       | 20°                   |        |        |
| V3                | 45°         |       |       | 45°                   |        |        |

1. Values in inches are converted from mm and rounded to 4 decimal digits.

2. Dam-bar protusion not included.

3. Molding protusion included.

## 5.2 Flexiwatt 25 (horizontal) package information

Figure 20. Flexiwatt 25 (horizontal) package outline

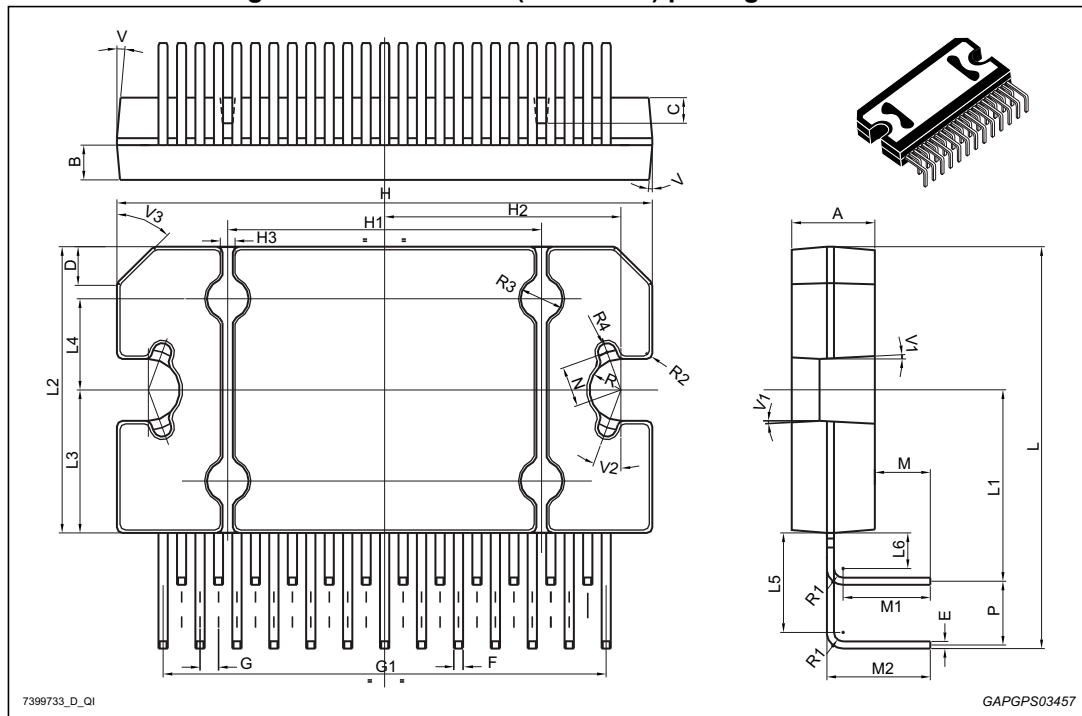


Table 6. Flexiwatt 25 (horizontal) package mechanical data

| Ref              | Dimensions  |       |       |                       |        |        |
|------------------|-------------|-------|-------|-----------------------|--------|--------|
|                  | Millimeters |       |       | Inches <sup>(1)</sup> |        |        |
|                  | Min.        | Typ.  | Max.  | Min.                  | Typ.   | Max.   |
| A                | 4.45        | 4.50  | 4.65  | 0.1752                | 0.1772 | 0.1831 |
| B                | 1.80        | 1.90  | 2.00  | 0.0709                | 0.0748 | 0.0787 |
| C                | -           | 1.40  | -     | -                     | 0.0551 | -      |
| D                | -           | 2.00  | -     | -                     | 0.0787 | -      |
| E                | 0.37        | 0.39  | 0.42  | 0.0146                | 0.0154 | 0.0165 |
| F <sup>(2)</sup> | -           | -     | 0.57  | -                     | -      | 0.0224 |
| G                | 0.75        | 1.00  | 1.25  | 0.0295                | 0.0394 | 0.0492 |
| G1               | 23.70       | 24.00 | 24.30 | 0.9331                | 0.9449 | 0.9567 |
| H <sup>(3)</sup> | 28.90       | 29.23 | 29.30 | 1.1378                | 1.1508 | 1.1535 |
| H1               | -           | 17.00 | -     | -                     | 0.6693 | -      |
| H2               | -           | 12.80 | -     | -                     | 0.5039 | -      |
| H3               | -           | 0.80  | -     | -                     | 0.0315 | -      |
| L                | 21.64       | 22.04 | 22.44 | 0.8520                | 0.8677 | 0.8835 |

Table 6. Flexiwatt 25 (horizontal) package mechanical data (continued)

| Ref               | Dimensions  |       |       |                       |        |        |
|-------------------|-------------|-------|-------|-----------------------|--------|--------|
|                   | Millimeters |       |       | Inches <sup>(1)</sup> |        |        |
|                   | Min.        | Typ.  | Max.  | Min.                  | Typ.   | Max.   |
| L1                | 10.15       | 10.5  | 10.85 | 0.3996                | 0.4134 | 0.4272 |
| L2 <sup>(3)</sup> | 15.50       | 15.70 | 15.90 | 0.6102                | 0.6181 | 0.6260 |
| L3                | 7.70        | 7.85  | 7.95  | 0.3031                | 0.3091 | 0.3130 |
| L4                | -           | 5     | -     | -                     | 0.1969 | -      |
| L5                | 5.15        | 5.45  | 5.85  | 0.2028                | 0.2146 | 0.2303 |
| L6                | 1.80        | 1.95  | 2.10  | 0.0709                | 0.0768 | 0.0827 |
| M                 | 2.75        | 3.00  | 3.50  | 0.1083                | 0.1181 | 0.1378 |
| M1                | -           | 4.73  | -     | -                     | 0.1862 | -      |
| M2                | -           | 5.61  | -     | -                     | 0.2209 | -      |
| N                 | -           | 2.20  | -     | -                     | 0.0866 | -      |
| P                 | 3.20        | 3.50  | 3.80  | 0.1260                | 0.1378 | 0.1496 |
| R                 | -           | 1.70  | -     | -                     | 0.0669 | -      |
| R1                | -           | 0.50  | -     | -                     | 0.0197 | -      |
| R2                | -           | 0.30  | -     | -                     | 0.0118 | -      |
| R3                | -           | 1.25  | -     | -                     | 0.0492 | -      |
| R4                | -           | 0.50  | -     | -                     | 0.0197 | -      |
| V                 | 5°          |       |       | 5°                    |        |        |
| V1                | 3°          |       |       | 3°                    |        |        |
| V2                | 20°         |       |       | 20°                   |        |        |
| V3                | 45°         |       |       | 45°                   |        |        |

1. Values in inches are converted from mm and rounded to 4 decimal digits.

2. Dam-bar protusion not included.

3. Molding protusion included.

## 6 Revision history

Table 7. Document revision history

| Date        | Revision | Changes                                                                                                                                                                       |
|-------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 09-Jul-2010 | 1        | Initial release.                                                                                                                                                              |
| 13-Jun-2012 | 2        | Updated: <i>Features on page 1</i> ;<br><i>Section 3.2: Electrical characteristics on page 7</i> .                                                                            |
| 18-Sep-2013 | 3        | Updated disclaimer.                                                                                                                                                           |
| 05-Feb-2016 | 4        | Updated <i>Table 1: Device summary on page 1</i> (added new order code).<br>Updated <i>Section 5: Package information</i> (added Flexiwatt25 horizontal package information). |

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