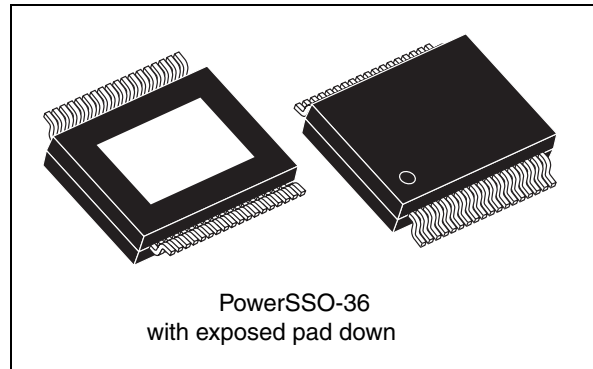


## 25-watt + 25-watt dual BTL class-D audio amplifier

### Features

- 25 W + 25 W continuous output power at THD = 10% with  $V_{CC} = 20\text{ V}$  and  $R_L = 8\ \Omega$
- Wide-range single-supply operation (8 - 26 V)
- High efficiency ( $\eta = 90\%$ )
- Four selectable, fixed gain settings of nominally 21.6 dB, 27.6 dB, 31.1 dB and 33.6 dB
- Differential inputs minimize common-mode noise
- Standby and mute features
- Short-circuit protection
- Thermal overload protection
- Externally synchronizable
- ECOPACK<sup>®</sup>, environmentally-friendly package



### Description

The TDA7492P is a dual BTL class-D audio amplifier with single power supply, designed for LCD TVs and monitors.

Thanks to the high efficiency and exposed-pad-down (EPD) package no heatsink is required.

**Table 1. Device summary**

| Order code   | Operating temp. range | Package         | Packaging     |
|--------------|-----------------------|-----------------|---------------|
| TDA7492P     | -40 to 85 °C          | PowerSSO-36 EPD | Tube          |
| TDA7492P13TR | -40 to 85 °C          | PowerSSO-36 EPD | Tape and reel |

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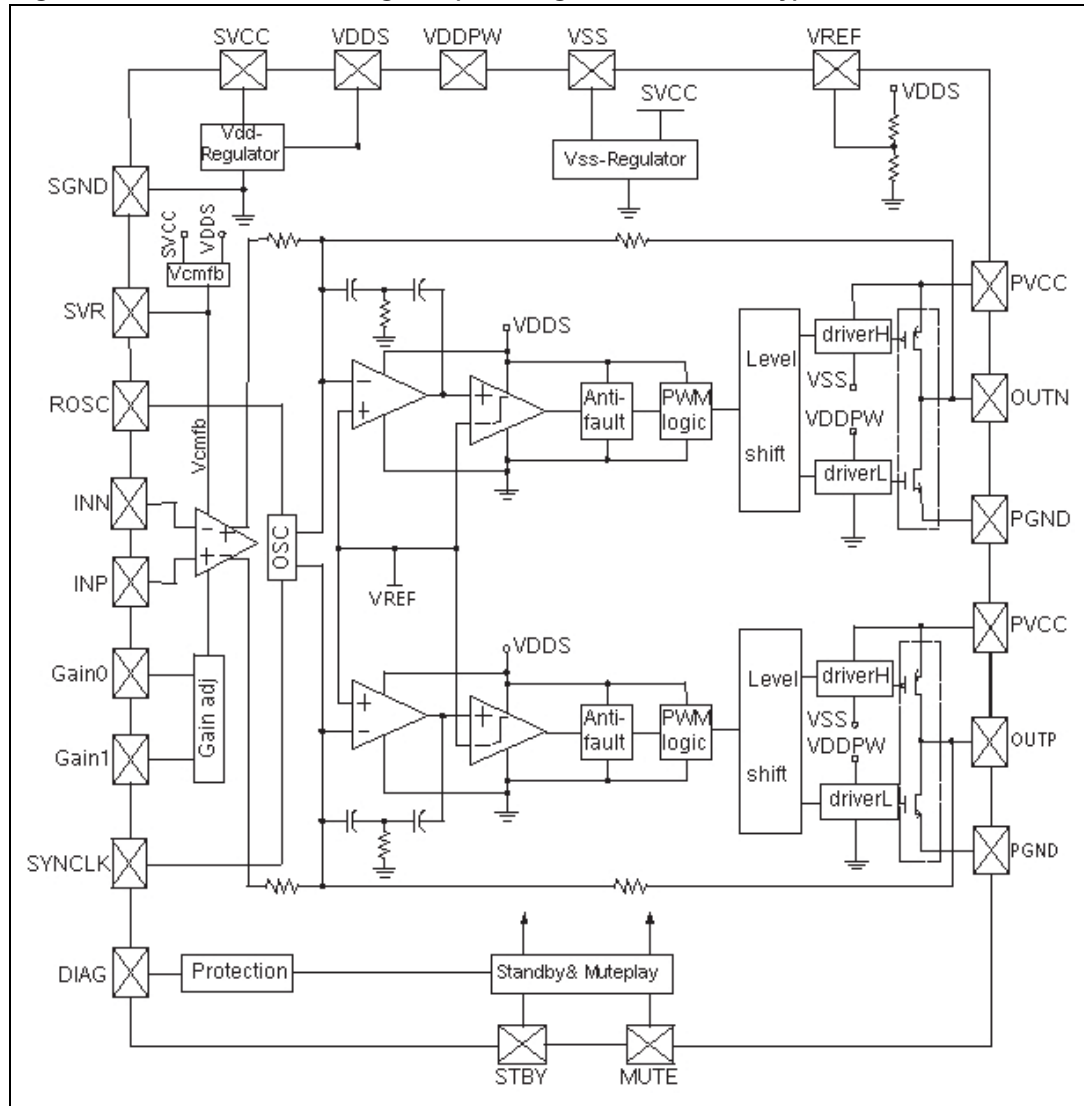
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# 1 Device block diagram

Figure 1 shows the block diagram of one of the two identical channels of the TDA7492P.

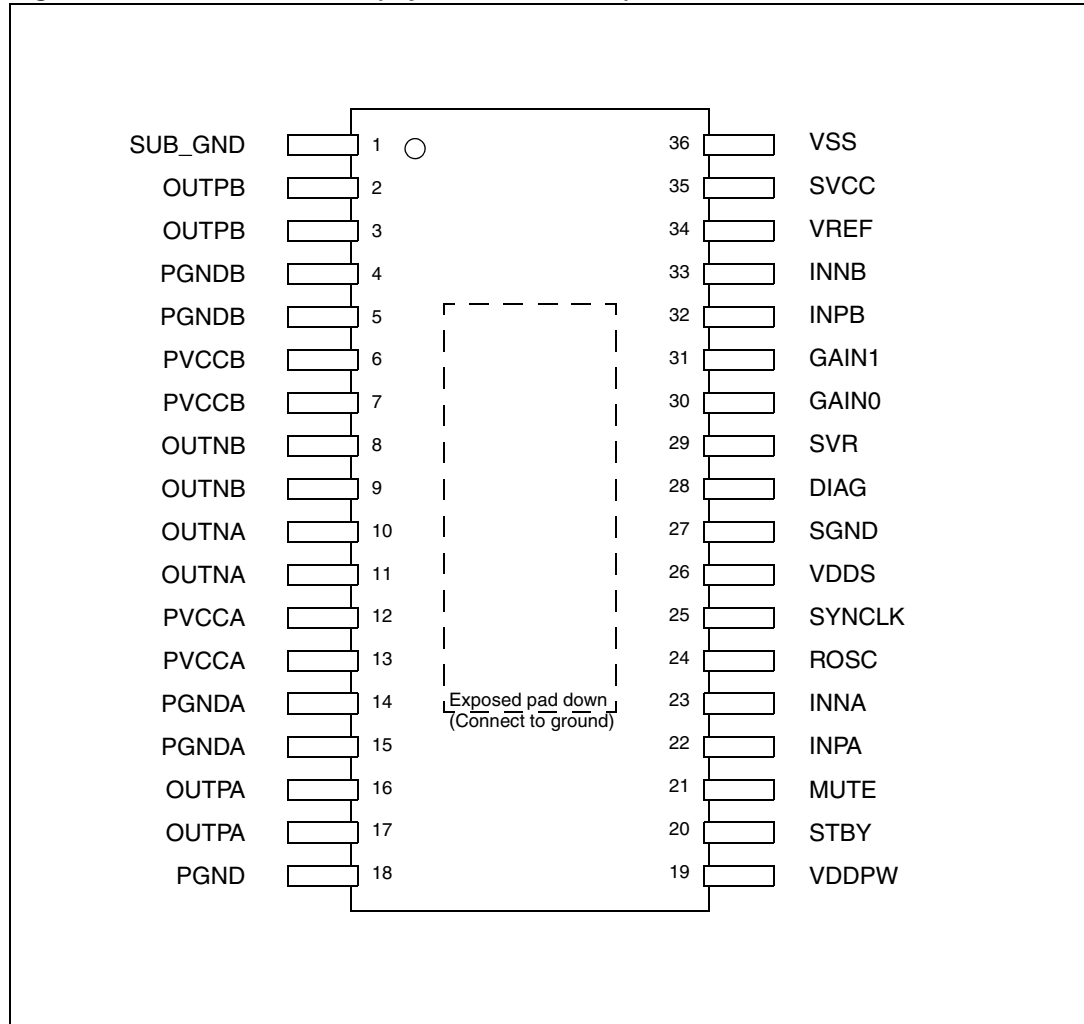
Figure 1. Internal block diagram (showing one channel only)



## 2 Pin description

### 2.1 Pinout

Figure 2. Pin connections (top view, PCB view)



## 2.2 Pin list

**Table 2. Pin description list**

| Number | Name    | Type | Description   |
|--------|---------|------|---|
| 1      | SUB_GND | PWR  | Connect to the frame  |
| 2,3    | OUTPB   | O    | Positive PWM for right channel  |
| 4,5    | PGNDB   | PWR  | Power stage ground for right channel                                  |
| 6,7    | PVCCB   | PWR  | Power supply for right channel  |
| 8,9    | OUTNB   | O    | Negative PWM output for right channel                                 |
| 10,11  | OUTNA   | O    | Negative PWM output for left channel                                  |
| 12,13  | PVCCA   | PWR  | Power supply for left channel   |
| 14,15  | PGNDA   | PWR  | Power stage ground for left channel                                   |
| 16,17  | OUTPA   | O    | Positive PWM output for left channel                                  |
| 18     | PGND    | PWR  | Power stage ground  |
| 19     | VDDPW   | O    | 3.3-V (nominal) regulator output referred to ground for power stage   |
| 20     | STBY    | I    | Standby mode control  |
| 21     | MUTE    | I    | Mute mode control   |
| 22     | INPA    | I    | Positive differential input of left channel                           |
| 23     | INNA    | I    | Negative differential input of left channel                           |
| 24     | ROSC    | O    | Master oscillator frequency-setting pin                               |
| 25     | SYNCLK  | I/O  | Clock in/out for external oscillator                                  |
| 26     | VDDS    | O    | 3.3-V (nominal) regulator output referred to ground for signal blocks |
| 27     | SGND    | PWR  | Signal ground   |
| 28     | DIAG    | O    | Open-drain diagnostic output  |
| 29     | SVR     | O    | Supply voltage rejection  |
| 30     | GAIN0   | I    | Gain setting input 1  |
| 31     | GAIN1   | I    | Gain setting input 2  |
| 32     | INPB    | I    | Positive differential input of right channel                          |
| 33     | INNB    | I    | Negative differential input of right channel                          |
| 34     | VREF    | O    | Half VDDS (nominal) referred to ground                                |
| 35     | SVCC    | PWR  | Signal power supply   |
| 36     | VSS     | O    | 3.3-V (nominal) regulator output referred to power supply             |
| -      | EP      | PWR  | Exposed pad for connection to ground plane as heatsink                |

### 3 Electrical specifications

#### 3.1 Absolute maximum ratings

**Table 3. Absolute maximum ratings**

| Symbol             | Parameter  | Value       | Unit |
|--------------------|--|-------------|------|
| V <sub>CCMAX</sub> | DC supply voltage for pins PVCCA, PVCCB, SVCC                                      | 30          | V    |
| V <sub>I</sub>     | Voltage limits for input pins STANDBY, MUTE, INNA, INPA, INN B, INPB, GAIN0, GAIN1 | -0.3 to 3.6 | V    |
| T <sub>op</sub>    | Operating temperature  | -40 to 85   | °C   |
| T <sub>j</sub>     | Junction temperature   | -40 to 150  | °C   |
| T <sub>stg</sub>   | Storage temperature  | -40 to 150  | °C   |

#### 3.2 Thermal data

**Table 4. Thermal data**

| Symbol                 | Parameter                               | Min | Typ               | Max | Unit |
|------------------------|---|-----|-------------------|-----|------|
| R <sub>th j-case</sub> | Thermal resistance, junction to case    | -   | 2                 | 3   | °C/W |
| R <sub>th j-amb</sub>  | Thermal resistance, junction to ambient | -   | 24 <sup>(1)</sup> | -   | °C/W |

1. FR4 with vias to copper area of 9 cm<sup>2</sup>

#### 3.3 Electrical specifications

Unless otherwise stated, the results in [Table 5](#) below are given for the conditions:

V<sub>CC</sub> = 20 V, R<sub>L</sub> (load) = 8 Ω, R<sub>OSC</sub> = R3 = 39 kΩ, C8 = 100 nF, f = 1 kHz, G<sub>V</sub> = 21.6 dB, and T<sub>amb</sub> = 25 °C.

**Table 5. Electrical specifications**

| Symbol             | Parameter                                  | Condition            | Min | Typ | Max  | Unit |
|--------------------|--|----------------------|-----|-----|------|------|
| V <sub>CC</sub>    | Supply voltage for pins PVCCA, PVCCB, SVCC | -                    | 8   | -   | 26   | V    |
| I <sub>q</sub>     | Total quiescent                            | -                    | -   | 26  | 35   | mA   |
| I <sub>qSTBY</sub> | Quiescent current in standby               | -                    | -   | 2.5 | 5.0  | μA   |
| V <sub>OS</sub>    | Output offset voltage                      | Play mode            | -   | -   | ±100 | mV   |
|                    |  | Mute mode            | -   | -   | ±60  | mV   |
| I <sub>OC</sub> P  | Overcurrent protection threshold           | R <sub>L</sub> = 0 Ω | 3.8 | 4.2 | -    | A    |
| T <sub>jSD</sub>   | Junction temperature at thermal shutdown   | -                    | -   | 150 | -    | °C   |
| R <sub>i</sub>     | Input resistance                           | Differential input   | 48  | 60  | -    | kΩ   |



Table 5. Electrical specifications (continued)

| Symbol       | Parameter                         | Condition  | Min  | Typ     | Max  | Unit     |
|--------------|-----------------------------------|--|------|---------|------|----------|
| $V_{OVP}$    | Overvoltage protection threshold  | -  | 28   | 29      | -    | V        |
| $V_{UVP}$    | Undervoltage protection threshold | -  | -    | -       | 7    | V        |
| $R_{dsON}$   | Power transistor on resistance    | High side  | -    | 0.2     | -    | $\Omega$ |
|              |                                   | Low side   | -    | 0.2     | -    |          |
| $P_o$        | Output power                      | THD = 10%  | -    | 25      | -    | W        |
|              |                                   | THD = 1%   | -    | 20      | -    |          |
| $P_o$        | Output power                      | $V_{CC} = 12$ V, THD = 10%                               | -    | 9.5     | -    | W        |
|              |                                   | $V_{CC} = 12$ V, THD = 1%                                | -    | 7.2     | -    |          |
| $P_D$        | Power dissipated by device        | $P_o = 25$ W + 25 W,<br>THD = 10%                        | -    | 5.0     | -    | W        |
| $\eta$       | Efficiency                        | $P_o = 10$ W + 10 W                                      | 80   | 90      | -    | %        |
| THD          | Total harmonic distortion         | $P_o = 1$ W  | -    | 0.1     | 0.4  | %        |
| $G_V$        | Closed-loop gain                  | GAIN0 = L, GAIN1 = L                                     | 20.6 | 21.6    | 22.6 | dB       |
|              |                                   | GAIN0 = L, GAIN1 = H                                     | 26.6 | 27.6    | 28.6 |          |
|              |                                   | GAIN0 = H, GAIN1 = L                                     | 30.1 | 31.1    | 32.1 |          |
|              |                                   | GAIN0 = H, GAIN1 = H                                     | 32.6 | 33.6    | 34.6 |          |
| $\Delta G_V$ | Gain matching                     | -  | -    | $\pm 1$ | dB   |          |
| CT           | Cross talk                        | $f = 1$ kHz  | -    | 50      | -    | dB       |
| eN           | Total input noise                 | A Curve, $G_V = 20$ dB                                   | -    | 20      | -    | $\mu$ V  |
|              |                                   | $f = 22$ Hz to 22 kHz                                    | -    | 25      | 35   |          |
| SVRR         | Supply voltage rejection ratio    | $f_r = 100$ Hz, $V_r = 0.5$ V,<br>$C_{SVR} = 10$ $\mu$ F | 40   | 50      | -    | dB       |
| $T_r, T_f$   | Rise and fall times               | -  | -    | 50      | -    | ns       |
| $f_{SW}$     | Switching frequency               | Internal oscillator                                      | 290  | 310     | 330  | kHz      |
| $f_{SWR}$    | Output switching frequency range  | With internal oscillator <sup>(1)</sup>                  | 250  | -       | 400  | kHz      |
|              |                                   | With external oscillator <sup>(2)</sup>                  | 250  | -       | 400  |          |
| $V_{inH}$    | Digital input high (H)            | -  | 2.3  | -       | -    | V        |
| $V_{inL}$    | Digital input low (L)             |  | -    | -       | 0.8  |          |
| $A_{MUTE}$   | Mute attenuation                  | $V_{MUTE} = 1$ V   | 60   | 80      | -    | dB       |

1.  $f_{SW} = 10^6 / ((16 * R_{OSC} + 182) * 4)$  kHz,  $f_{SYNCLK} = 2 * f_{SW}$  with  $R3 = 39$  k $\Omega$ , see [Figure 20](#).

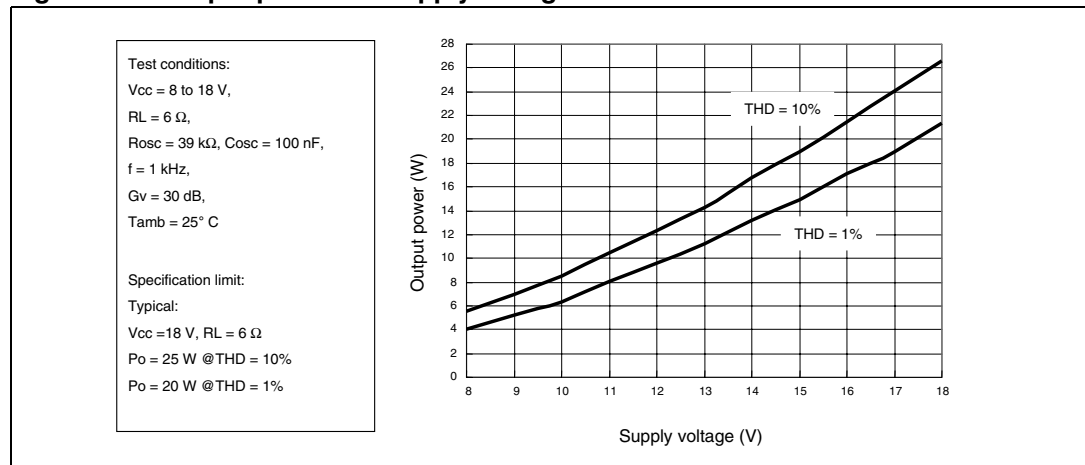
2.  $f_{SW} = f_{SYNCLK} / 2$  with the frequency of the external oscillator.

## 4 Characterization curves

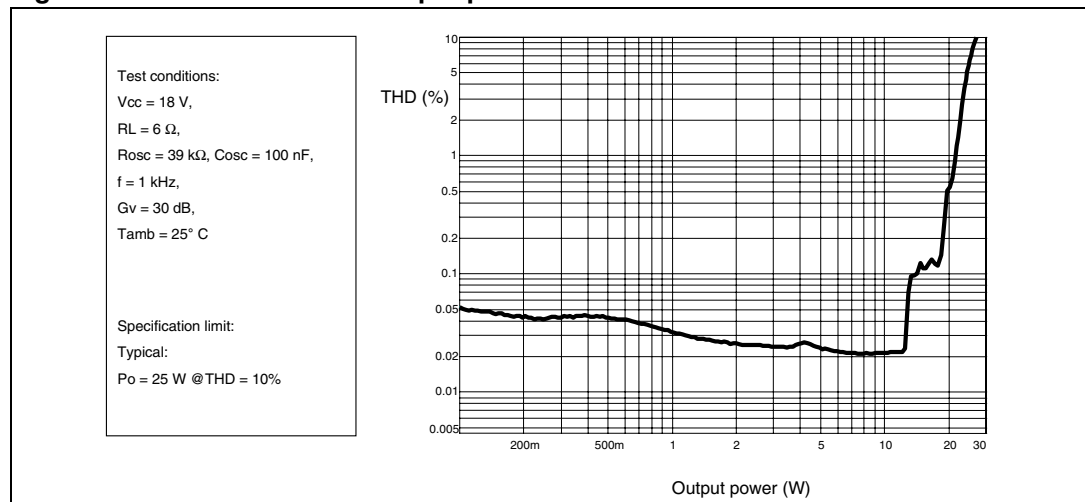
The following characterizations were made using the SZ-LAB-TDA7492P demo board. The layout is shown in [Figure 19 on page 16](#). The LC filter for the 6 Ω load used 22 μH and 220 nF components, whilst that for the 8 Ω load used 33 μH and 220 nF.

### 4.1 Characterizations for 6 Ω loads with 18 V

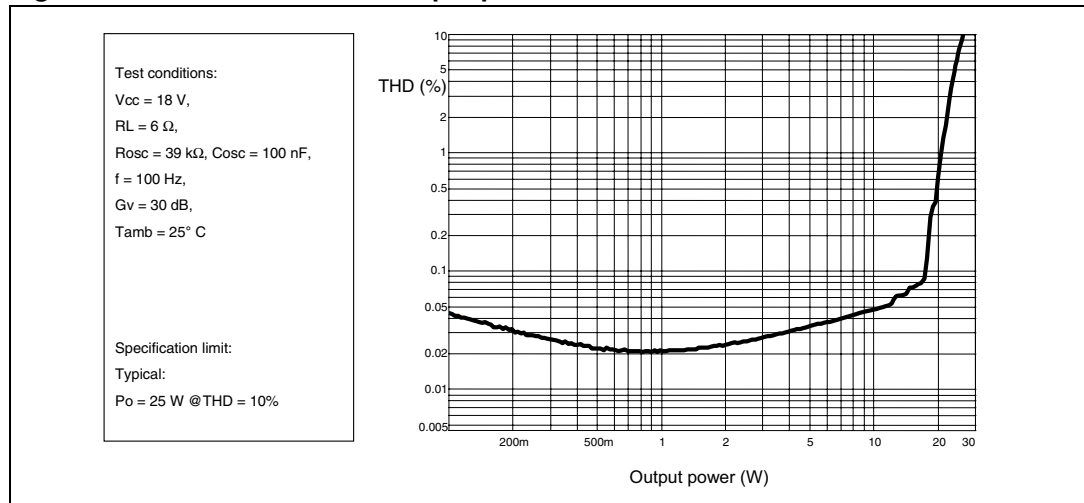
**Figure 3. Output power vs. supply voltage**



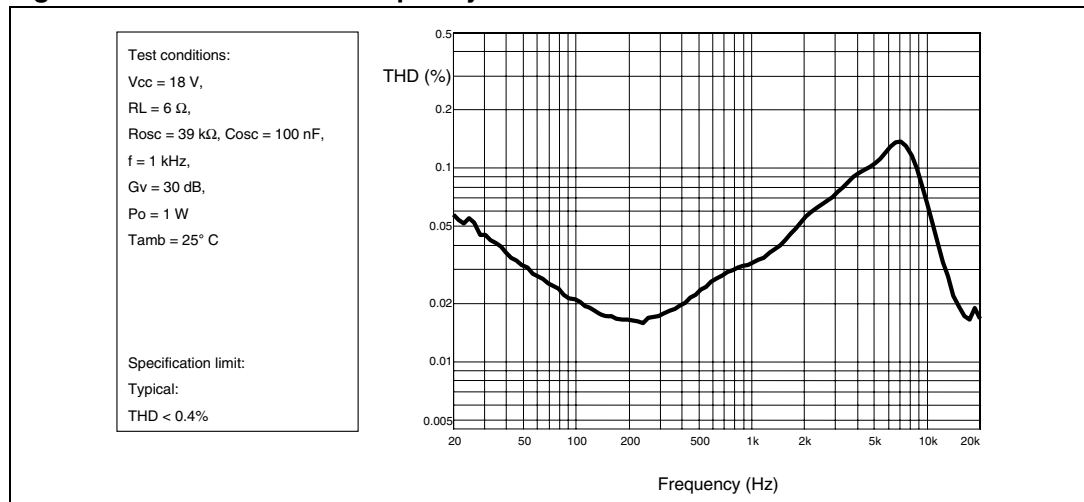
**Figure 4. THD at 1 kHz vs. output power**



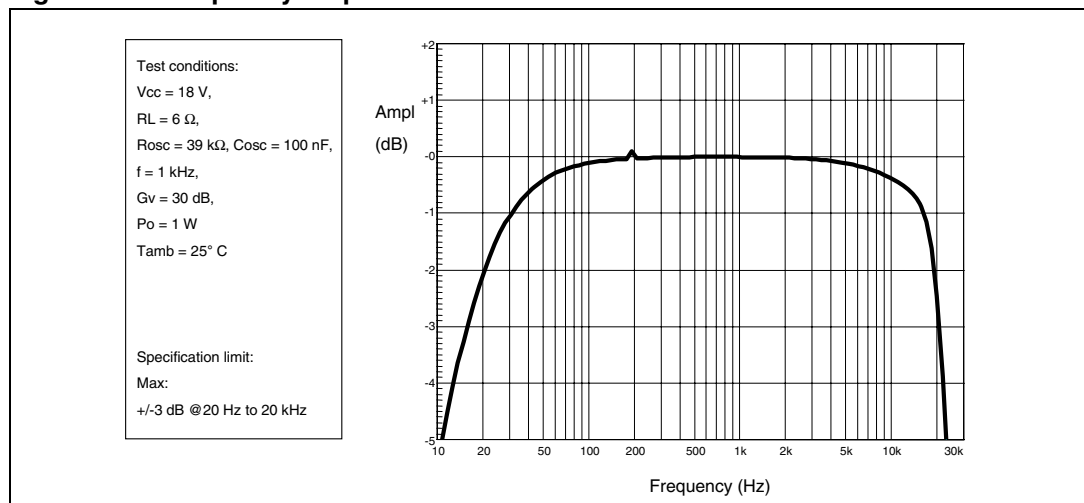
**Figure 5. THD at 100 Hz vs. output power**



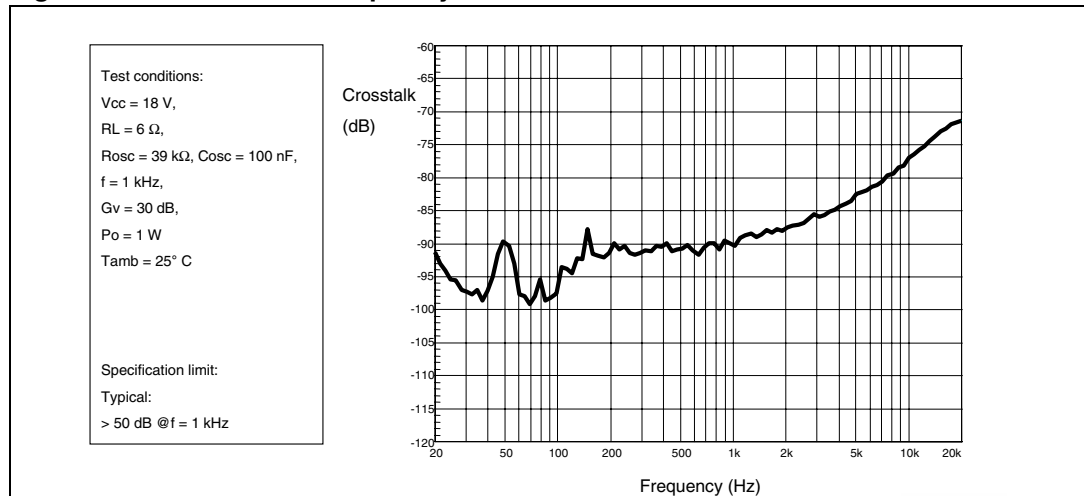
**Figure 6. THD at 1 W vs. frequency**



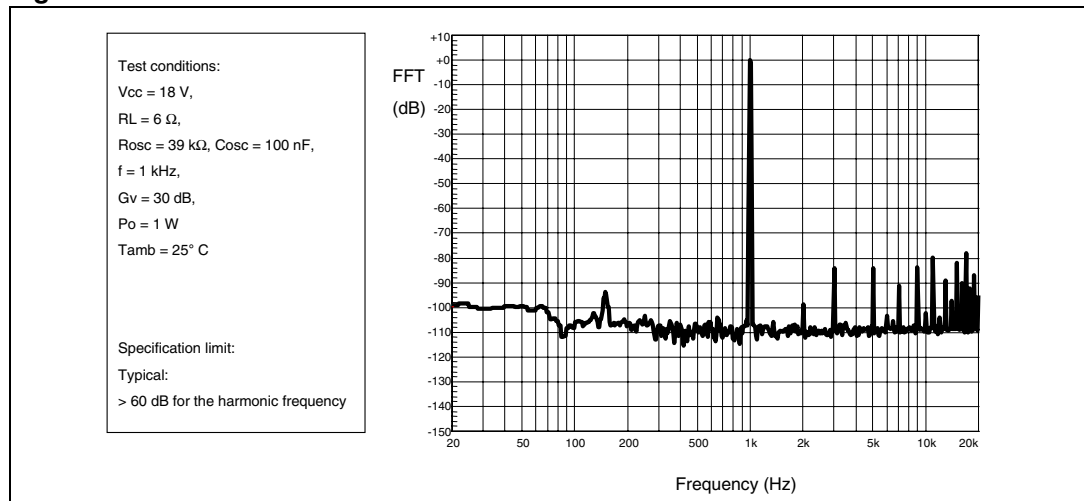
**Figure 7. Frequency response**



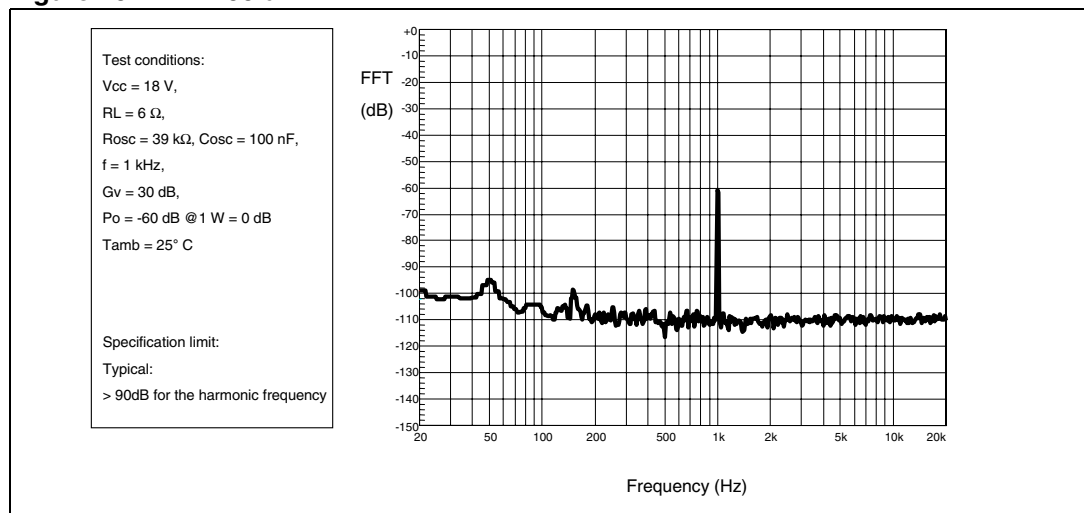
**Figure 8. Crosstalk vs frequency**



**Figure 9. FFT 0 dB**



**Figure 10. FFT -60 dB**



## 4.2 Characterizations for 8 Ω loads with 20 V

Figure 11. Output power vs supply voltage

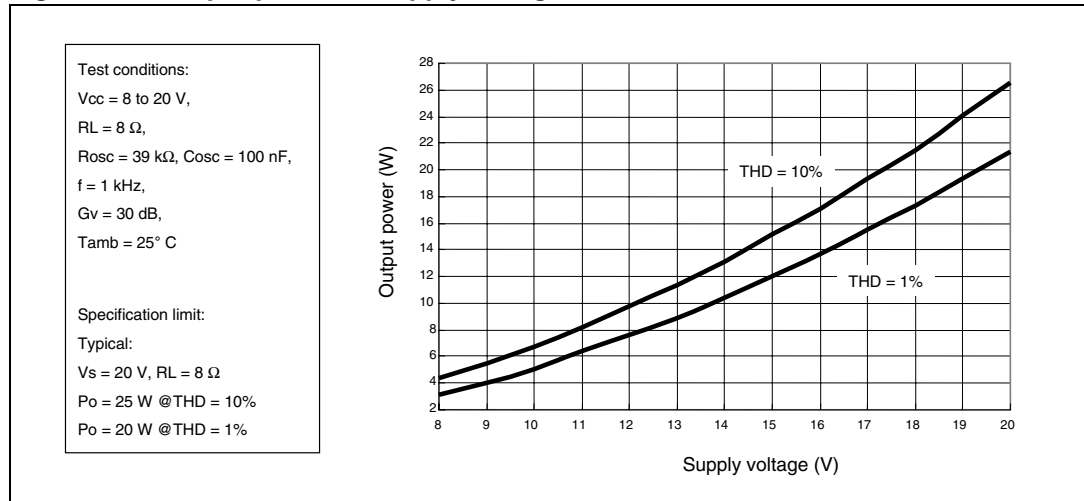


Figure 12. THD at 1 kHz vs output power

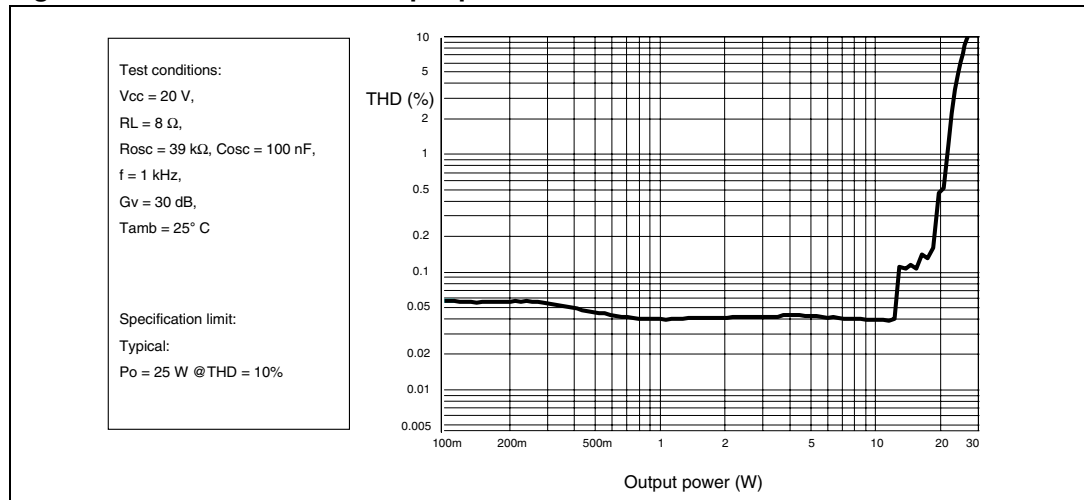


Figure 13. THD at 100 Hz vs output power

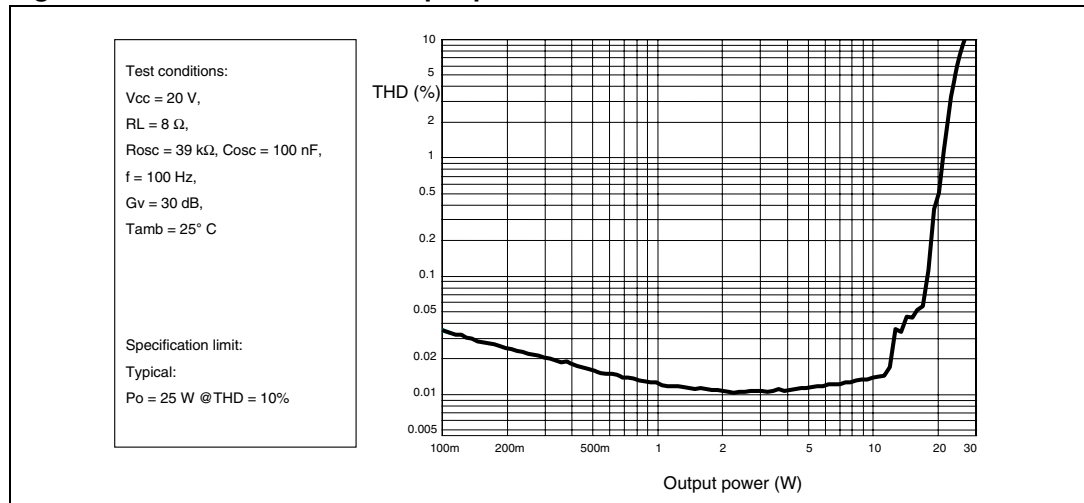


Figure 14. THD at 1 W vs frequency

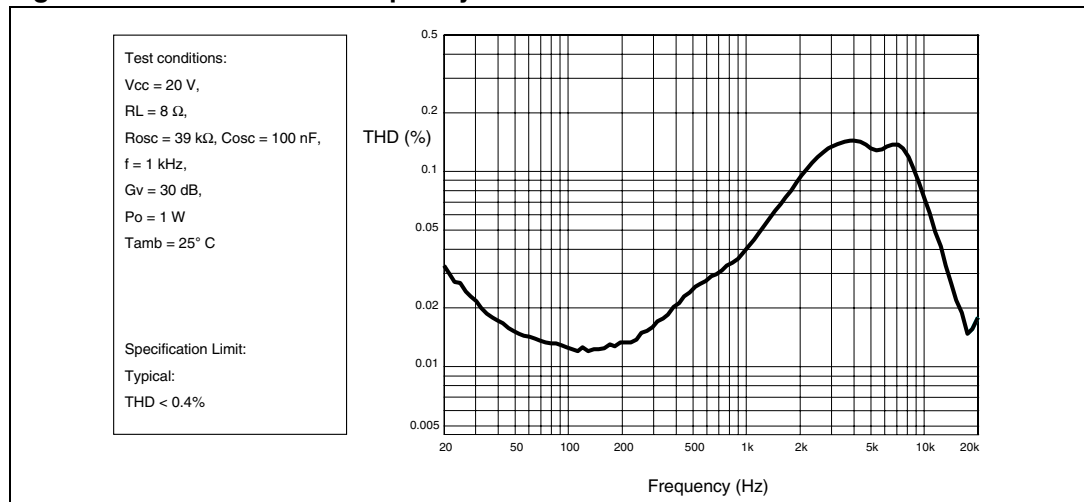
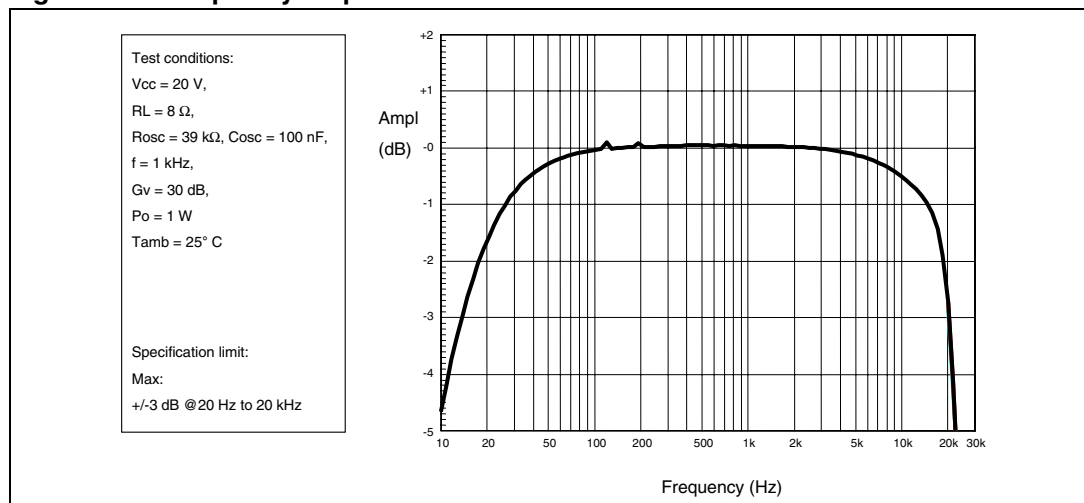
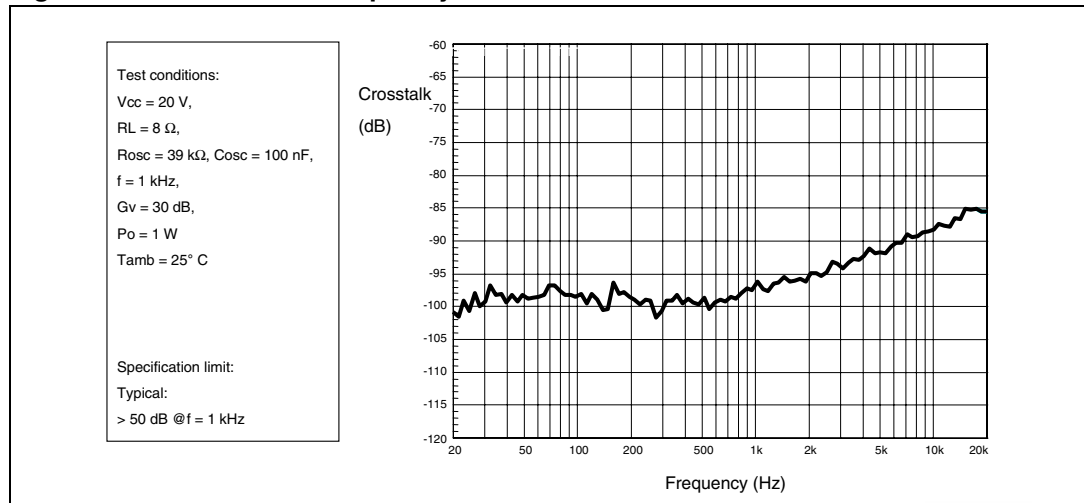


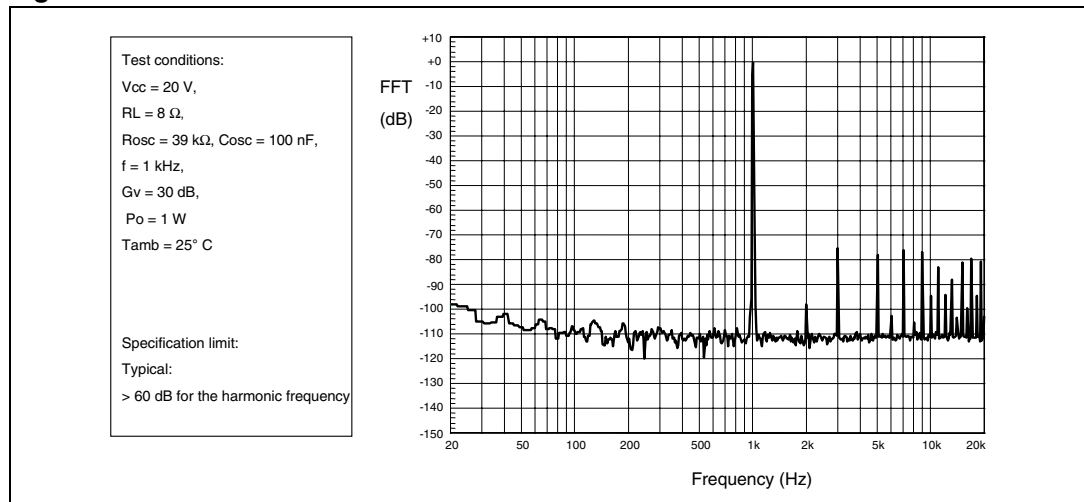
Figure 15. Frequency response



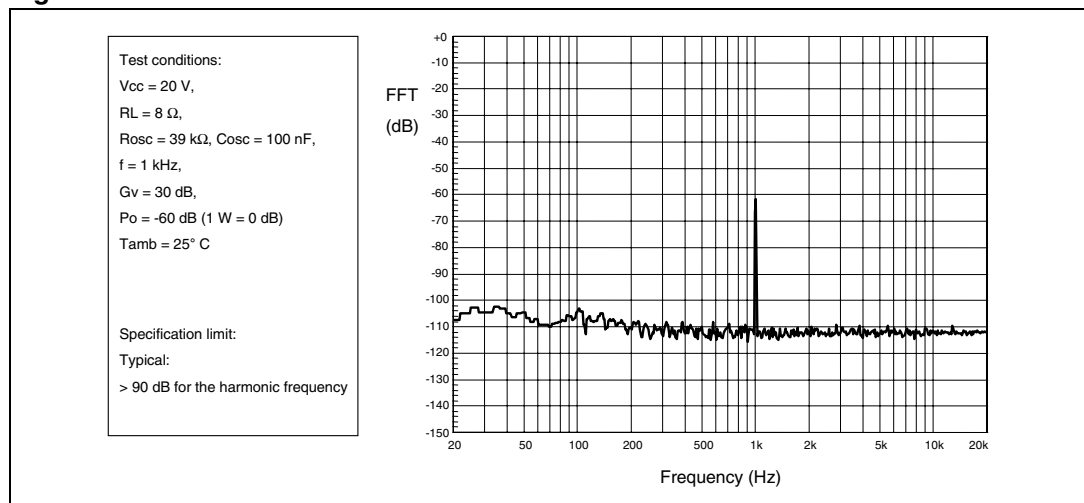
**Figure 16. Crosstalk vs frequency**



**Figure 17. FFT 0 dB**



**Figure 18. FFT -60 dB**









# 5 Applications circuit

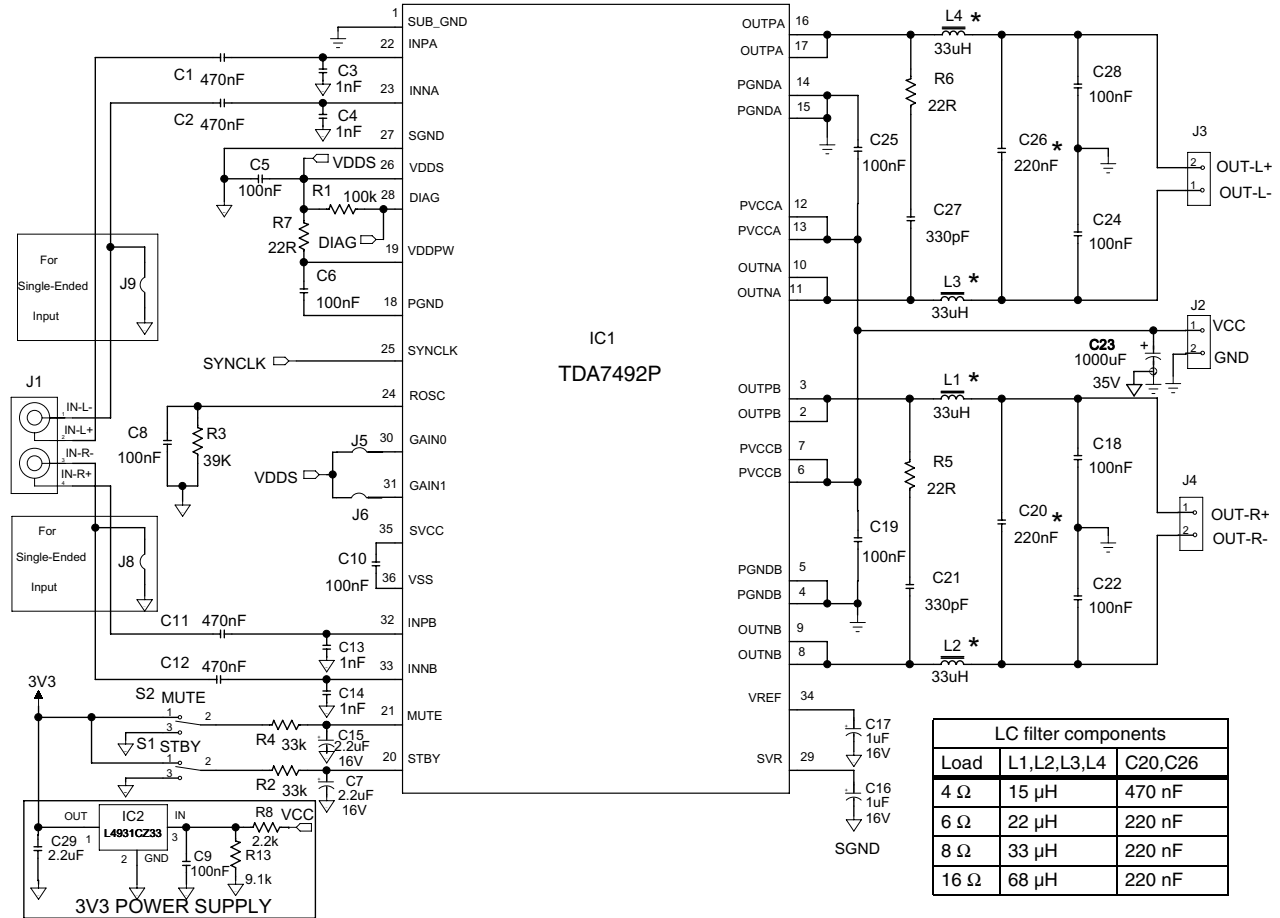
Figure 20. Applications circuit for class-D amplifier

Jumper settings for gain:

| GAIN0 : GAIN1 | Nominal gain |
|---------------|--------------|
| 0 V : 0 V     | 21.6 dB      |
| 0 V : 3.3 V   | 27.6 dB      |
| 3.3 V : 0 V   | 31.1 dB      |
| 3.3 V : 3.3 V | 33.6 dB      |

Switch settings for standby, mute and play:

| STBY : MUTE   | Mode    |
|---------------|---------|
| 0 V : 0 V     | Standby |
| 0 V : 3.3 V   | Standby |
| 3.3 V : 0 V   | Mute    |
| 3.3 V : 3.3 V | Play    |



| LC filter components |             |         |
|----------------------|-------------|---------|
| Load                 | L1,L2,L3,L4 | C20,C26 |
| 4 Ω                  | 15 μH       | 470 nF  |
| 6 Ω                  | 22 μH       | 220 nF  |
| 8 Ω                  | 33 μH       | 220 nF  |
| 16 Ω                 | 68 μH       | 220 nF  |

## 6 Applications information

### 6.1 Mode selection

The three operating modes of the TDA7492P are set by the two inputs STBY (pin 20) and MUTE (pin 21).

- Standby mode: all circuits are turned off, very low current consumption.
- Mute mode: inputs are connected to ground and the positive and negative PWM outputs are at 50% duty cycle.
- Play mode: the amplifiers are active.

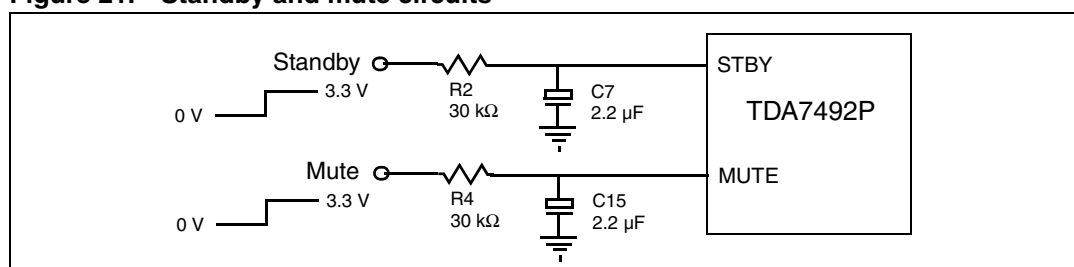
The protection functions of the TDA7492P are enabled by pulling down the voltages of the STBY and MUTE inputs shown in *Figure 21*. The input current of the corresponding pins must be limited to 200  $\mu$ A.

**Table 6. Mode settings**

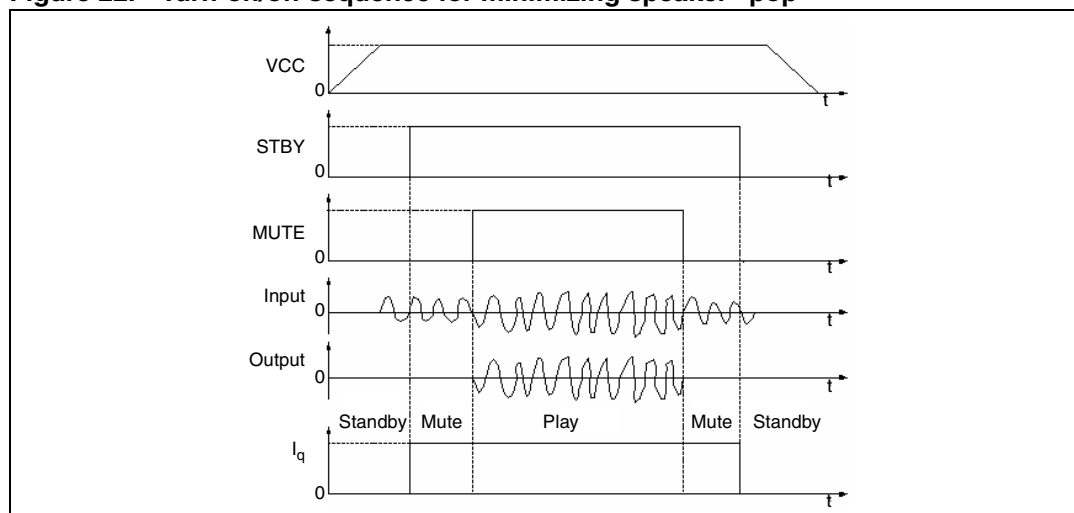
| Mode selection | STBY  | MUTE           |
|----------------|-------|----------------|
| Standby        | L (1) | X (don't care) |
| Mute           | H (1) | L              |
| Play           | H     | H              |

1. Drive levels defined in *Table 5: Electrical specifications on page 8*

**Figure 21. Standby and mute circuits**



**Figure 22. Turn-on/off sequence for minimizing speaker “pop”**



## 6.2 Gain setting

The gain of the TDA7492P is set by the two inputs, GAIN0 (pin 30) and GAIN1 (pin31). Internally, the gain is set by changing the feedback resistors of the amplifier.

**Table 7. Gain settings**

| GAIN0 | GAIN1 | Nominal gain, $G_v$ (dB) |
|-------|-------|--------------------------|
| 0     | 0     | 21.6                     |
| 0     | 1     | 27.6                     |
| 1     | 0     | 31.1                     |
| 1     | 1     | 33.6                     |

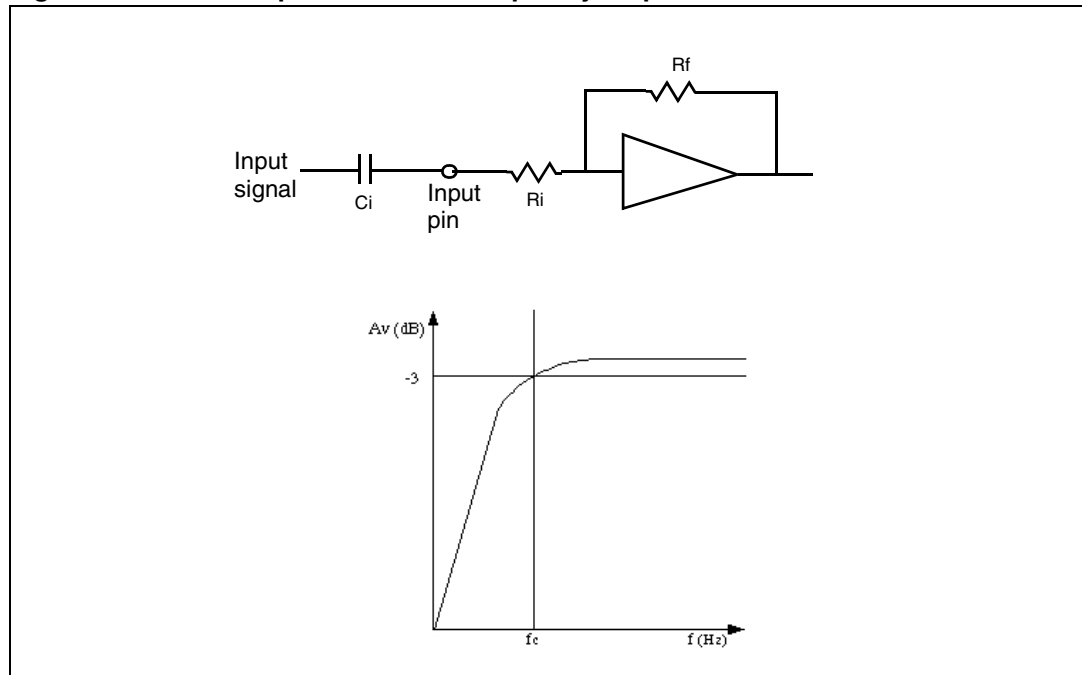
## 6.3 Input resistance and capacitance

The input impedance is set by an internal resistor  $R_i = 60 \text{ k}\Omega$  (typical). An input capacitor ( $C_i$ ) is required to couple the AC input signal.

The equivalent circuit and frequency response of the input components are shown in [Figure 23](#). For  $C_i = 470 \text{ nF}$  the high-pass filter cutoff frequency is below 20 Hz:

$$f_c = 1 / (2 * \pi * R_i * C_i)$$

**Figure 23. Device input circuit and frequency response**



## 6.4 Internal and external clocks

The clock of the class-D amplifier can be generated internally or can be driven by an external source.

If two or more class-D amplifiers are used in the same system, it is recommended that all devices operate at the same clock frequency. This can be implemented by using one TDA7492P as master clock, while the other devices are in slave mode (that is, externally clocked). The clock interconnect is via pin SYNCLK of each device. As explained below, SYNCLK is an output in master mode and an input in slave mode.

### 6.4.1 Master mode (internal clock)

Using the internal oscillator, the output switching frequency,  $f_{SW}$ , is controlled by the resistor,  $R_{OSC}$ , connected to pin ROSC:

$$f_{SW} = 10^6 / ((16 * R_{OSC} + 182) * 4) \text{ kHz}$$

where  $R_{OSC}$  is in  $k\Omega$ .

In master mode, pin SYNCLK is used as a clock output pin, whose frequency is:

$$f_{SYNCLK} = 2 * f_{SW}$$

For master mode to operate correctly then resistor  $R_{OSC}$  must be less than 60  $k\Omega$  as given below in [Table 8](#).

### 6.4.2 Slave mode (external clock)

In order to accept an external clock input the pin ROSC must be left open, that is, floating. This forces pin SYNCLK to be internally configured as an input as given in [Table 8](#).

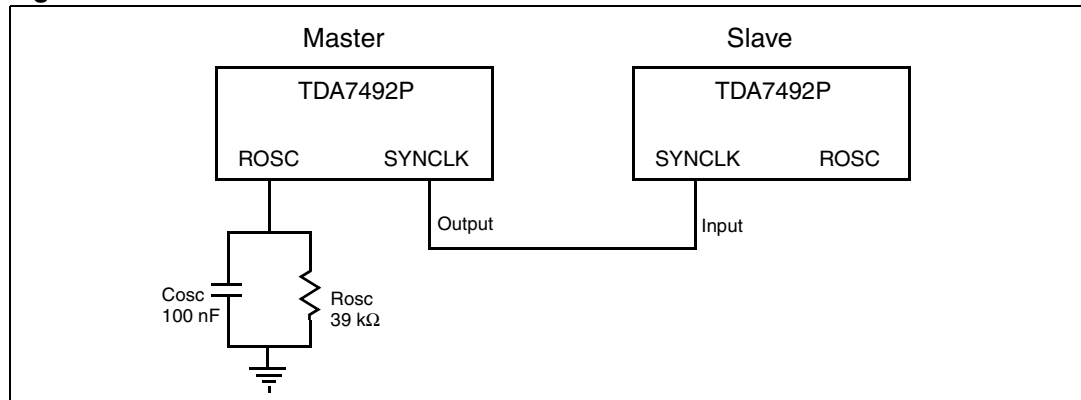
The output switching frequency of the slave devices is:

$$f_{SW} = f_{SYNCLK} / 2$$

**Table 8. How to set up SYNCLK**

| Mode   | ROSC                           | SYNCLK |
|--------|--------------------------------|--------|
| Master | $R_{OSC} < 60 \text{ k}\Omega$ | Output |
| Slave  | Floating (not connected)       | Input  |

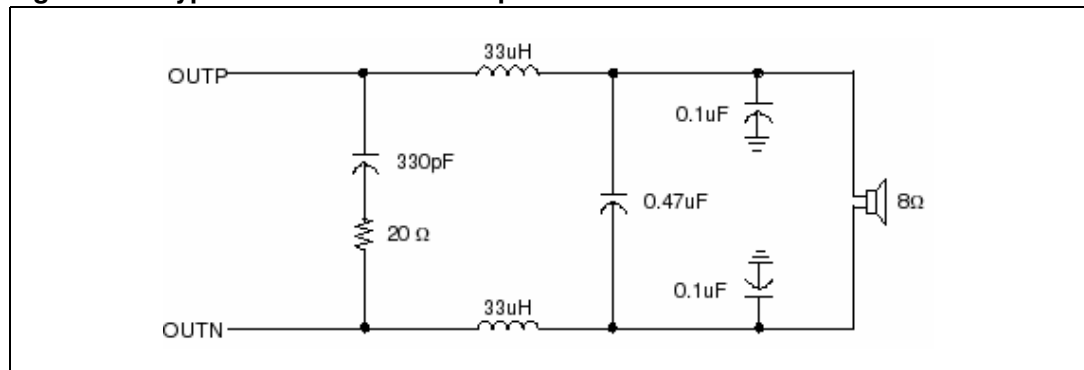
**Figure 24. Master and slave connection**



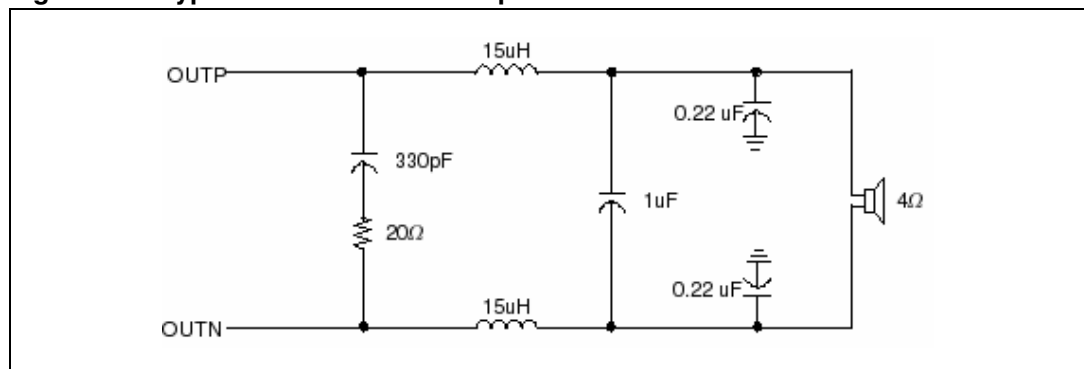
### 6.5 Output low-pass filter

To avoid EMI problems, it may be necessary to use a low-pass filter before the speaker. The cutoff frequency should be larger than 22 kHz and much lower than the output switching frequency. It is necessary to choose the L-C component values depending on the loud speaker impedance. Some typical values, which give a cutoff frequency of 27 kHz, are shown in [Figure 25](#) and [Figure 26](#) below.

**Figure 25. Typical LC filter for a 8-Ω speaker**



**Figure 26. Typical LC filter for a 4-Ω speaker**



## 6.6 Protection functions

The TDA7492P is fully protected against overvoltages, undervoltages, overcurrents and thermal overloads as explained here.

### Overvoltage protection (OVP)

If the supply voltage exceeds the value for  $V_{OVP}$  given in [Table 5: Electrical specifications on page 8](#) the overvoltage protection is activated which forces the outputs to the high-impedance state. When the supply voltage drops to below the threshold value the device restarts.

### Undervoltage protection (UVP)

If the supply voltage drops below the value for  $V_{UVP}$  given in [Table 5: Electrical specifications on page 8](#) the undervoltage protection is activated which forces the outputs to the high-impedance state. When the supply voltage recovers the device restarts.

### Overcurrent protection (OCP)

If the output current exceeds the value for  $I_{OCP}$  given in [Table 5: Electrical specifications on page 8](#) the overcurrent protection is activated which forces the outputs to the high-impedance state. Periodically, the device attempts to restart. If the overcurrent condition is still present then the OCP remains active. The restart time,  $T_{OC}$ , is determined by the R-C components connected to pin STBY.

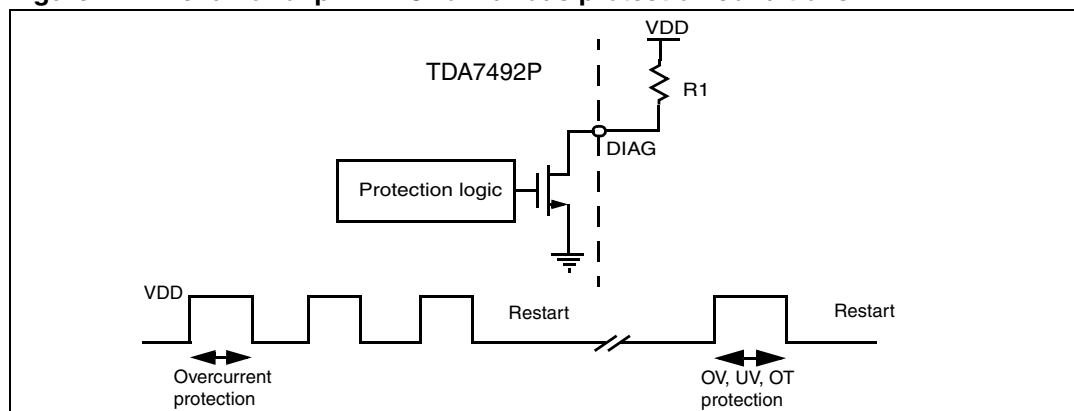
### Thermal protection (OTP)

If the junction temperature,  $T_j$ , reaches 145 °C (nominally), the device goes to mute mode and the positive and negative PWM outputs are forced to 50% duty cycle. If the junction temperature reaches the value for  $T_j$  given in [Table 5: Electrical specifications on page 8](#) the device shuts down and the output is forced to the high-impedance state. When the device cools sufficiently the device restarts.

## 6.7 Diagnostic output

The output pin DIAG is an open-drain transistor. When the protection is activated it is in the high-impedance state. The pin can be connected to a power supply (<26 V) by a pull-up resistor whose value is limited by the maximum sinking current (200  $\mu$ A) of the pin.

**Figure 27. Behavior of pin DIAG for various protection conditions**



## 7 Package mechanical data

The TDA7492P comes in a 36-pin PowerSSO package with exposed pad down.

[Figure 28](#) below shows the package outline and [Table 9](#) gives the dimensions.

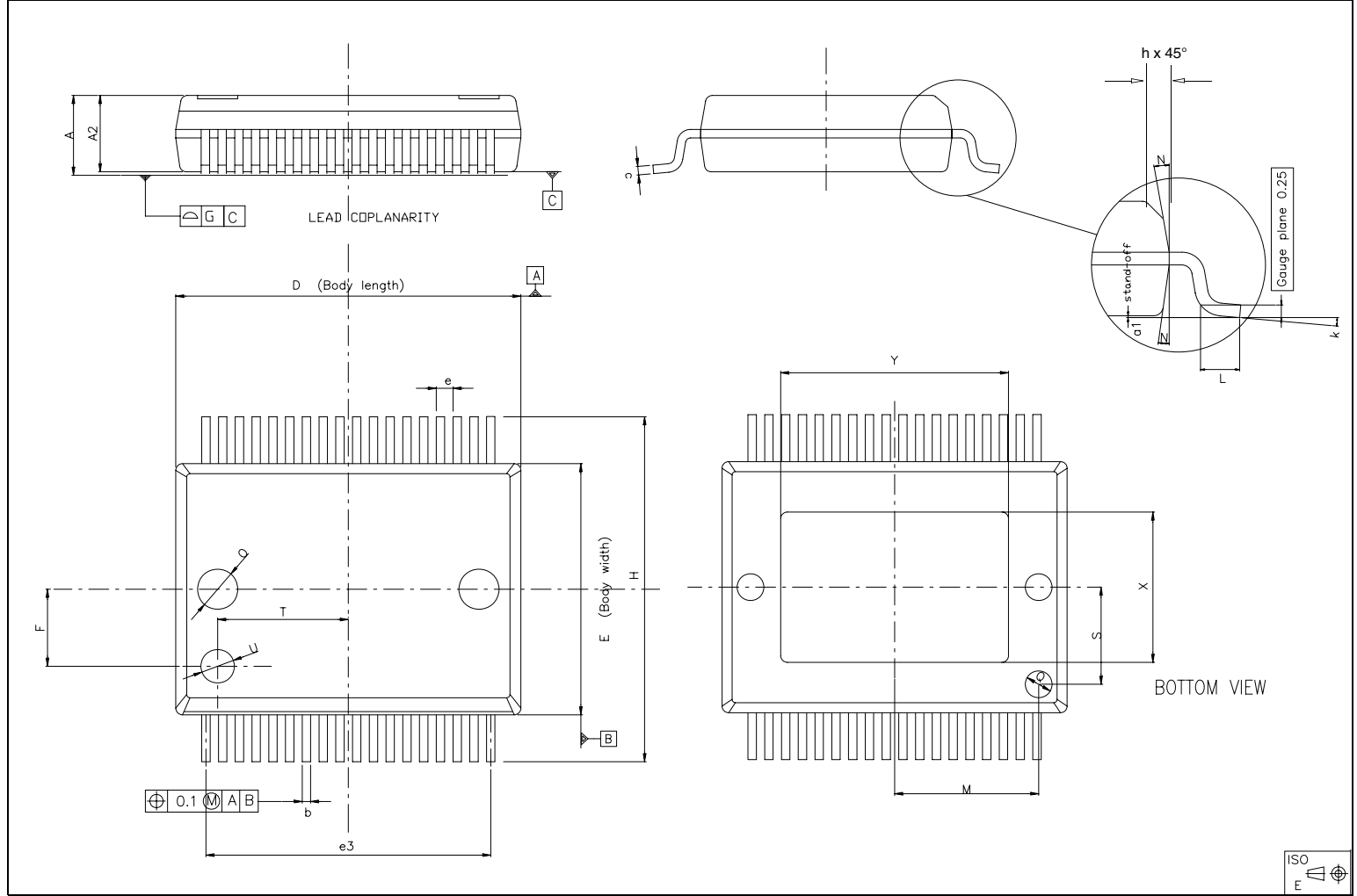
**Table 9. PowerSSO-36 EPD dimensions**

| Symbol | Dimensions in mm |      |            | Dimensions in inches |       |            |
|--------|------------------|------|------------|----------------------|-------|------------|
|        | Min              | Typ  | Max        | Min                  | Typ   | Max        |
| A      | 2.15             | -    | 2.45       | 0.085                | -     | 0.096      |
| A2     | 2.15             | -    | 2.35       | 0.085                | -     | 0.093      |
| a1     | 0                | -    | 0.10       | 0                    | -     | 0.004      |
| b      | 0.18             | -    | 0.36       | 0.007                | -     | 0.014      |
| c      | 0.23             | -    | 0.32       | 0.009                | -     | 0.013      |
| D      | 10.10            | -    | 10.50      | 0.398                | -     | 0.413      |
| E      | 7.40             | -    | 7.60       | 0.291                | -     | 0.299      |
| e      | -                | 0.5  | -          | -                    | 0.020 | -          |
| e3     | -                | 8.5  | -          | -                    | 0.335 | -          |
| F      | -                | 2.3  | -          | -                    | 0.091 | -          |
| G      | -                | -    | 0.10       | -                    | -     | 0.004      |
| H      | 10.10            | -    | 10.50      | 0.398                | -     | 0.413      |
| h      | -                | -    | 0.40       | -                    | -     | 0.016      |
| k      | 0                | -    | 8 degrees  | 0                    | -     | 8 degrees  |
| L      | 0.60             | -    | 1.00       | 0.024                | -     | 0.039      |
| M      | -                | 4.30 | -          | -                    | 0.169 | -          |
| N      | -                | -    | 10 degrees | -                    | -     | 10 degrees |
| O      | -                | 1.20 | -          | -                    | 0.047 | -          |
| Q      | -                | 0.80 | -          | -                    | 0.031 | -          |
| S      | -                | 2.90 | -          | -                    | 0.114 | -          |
| T      | -                | 3.65 | -          | -                    | 0.144 | -          |
| U      | -                | 1.00 | -          | -                    | 0.039 | -          |
| X      | 4.10             | -    | 4.70       | 0.161                | -     | 0.185      |
| Y      | 4.90             | -    | 7.10       | 0.193                | -     | 0.280      |

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



Figure 28. PowerSSO-36 EPD outline drawing





## 8 Revision history

**Table 10. Document revision history**

| Date        | Revision | Changes   |
|-------------|----------|---|
| 30-Sep-2008 | 1        | Initial release.  |
| 11-May-2009 | 2        | Updated supply operating range to 8 V - 26 V <a href="#">on page 1</a><br>Changed C1 to C8 at beginning of <a href="#">Section 3.3 on page 8</a><br>Updated <a href="#">Table 5: Electrical specifications on page 8</a> for $V_{CC}$ min, $V_{OS}$ min/max and added new parameter $V_{UV}$<br>Updated <a href="#">Figure 20: Applications circuit for class-D amplifier on page 17</a><br>Inserted brackets in equation in <a href="#">Table 5</a> footnote and in <a href="#">Section 6.4.1 on page 20</a><br>Updated values in UVP and OCP in <a href="#">Section 6.6 on page 22</a><br>Updated voltage to "<26 V" in <a href="#">Section 6.7 on page 22</a><br>Updated max dimensions for A and A2 in <a href="#">Table 9: PowerSSO-36 EPD dimensions on page 23</a> . |
| 02-Sep-2009 | 3        | Updated value for $G_V$ at head of <a href="#">Section 3.3 on page 8</a><br>Updated package Y (Min) dimension in <a href="#">Table 9 on page 23</a> .   |
| 19-Jan-2011 | 4        | Updated operating temperature range<br>Updated datasheet presentation.  |
| 12-Sep-2011 | 5        | Updated OUTNA in <a href="#">Table 2: Pin description list</a>  |

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