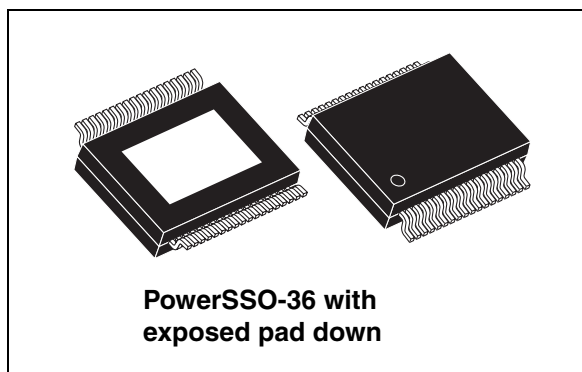


## 2 x 10-watt dual BTL class-D audio amplifier

### Features

- 10 W + 10 W continuous output power:  
 $R_L = 6 \Omega$ , THD = 10% at  $V_{CC} = 11 \text{ V}$
- 9.5 W + 9.5 W continuous output power:  
 $R_L = 8 \Omega$ , THD = 10% at  $V_{CC} = 12 \text{ V}$
- Wide range single supply operation (5 V - 18 V)
- High efficiency ( $\eta = 90\%$ )
- Four selectable, fixed gain settings of  
nominally 20 dB, 26 dB, 30 dB and 32 dB
- Differential inputs minimize common-mode  
noise
- Filterless operation
- No 'pop' at turn-on/off
- Standby and mute features
- Short-circuit protection
- Thermal overload protection
- Externally synchronizable



### Description

The TDA7491P 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 separate heatsink is required.

Furthermore, the filterless operation allows a reduction in the external component count.

The TDA7491P is pin-to-pin compatible with the TDA7491LP and TDA7491HV.

**Table 1. Device summary**

| Order code   | Operating temperature | Package         | Packaging     |
|--------------|-----------------------|-----------------|---------------|
| TDA7491P     | -40 to 85 °C          | PowerSSO-36 EPD | Tube          |
| TDA7491P13TR | -40 to 85 °C          | PowerSSO-36 EPD | Tape and reel |

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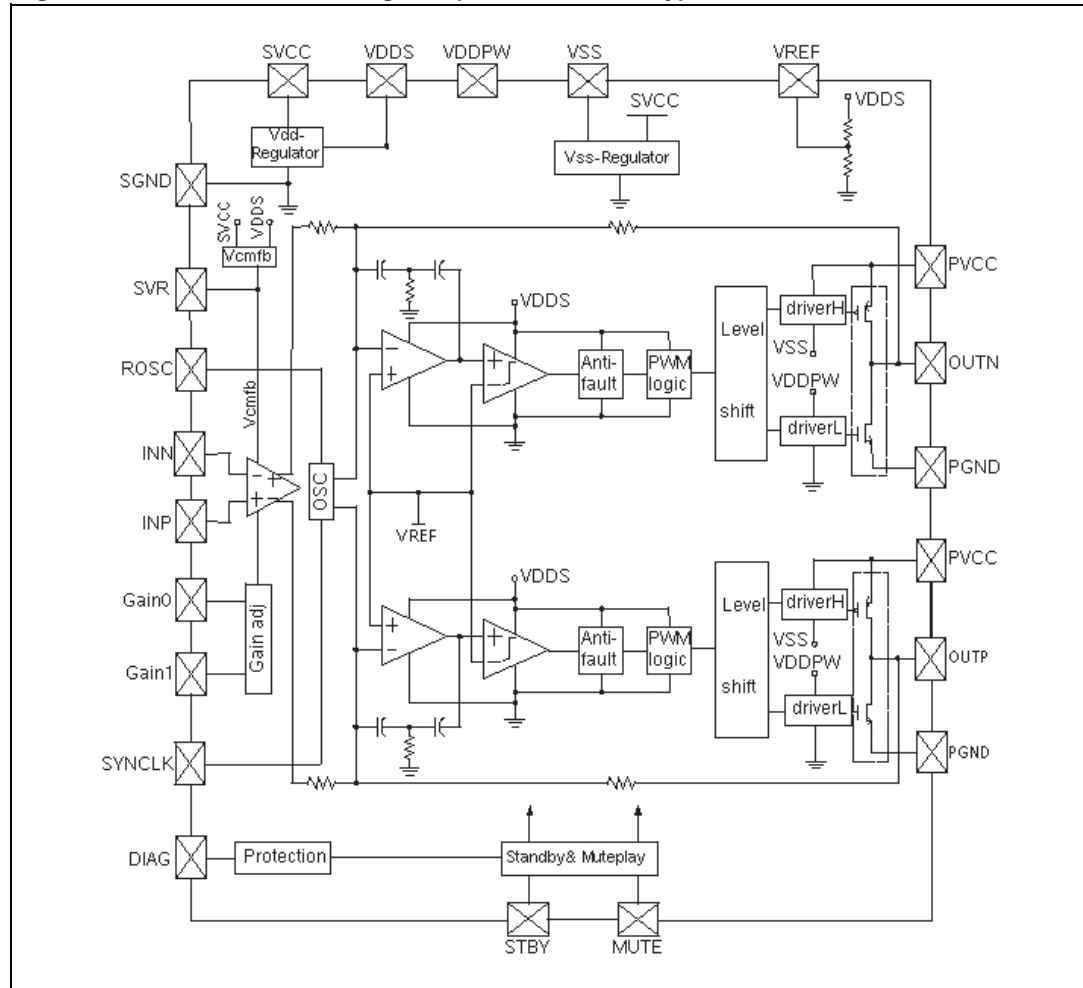
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# 1 Device block diagram

Figure 1 shows the block diagram of one of the two identical channels of the TDA7491P.

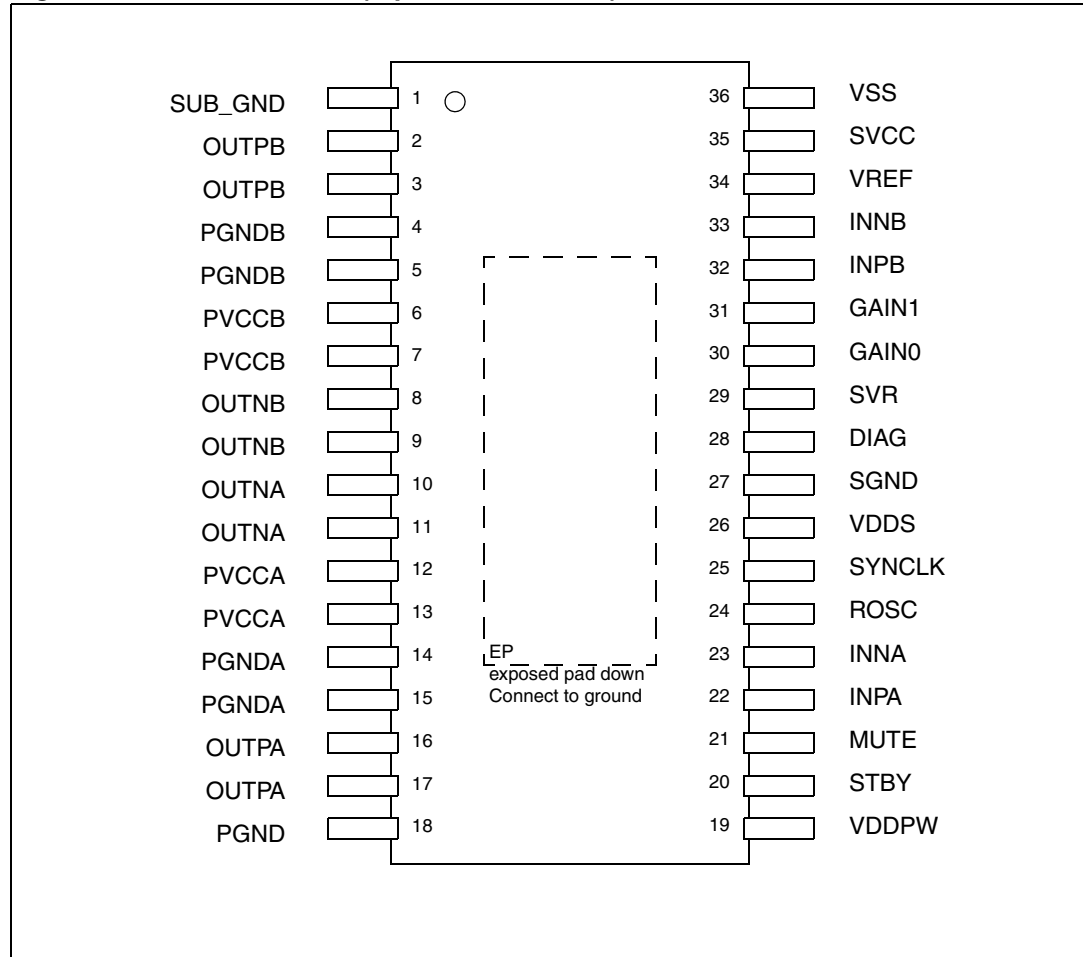
**Figure 1. Internal block diagram (one channel only)**



## 2 Pin description

### 2.1 Pin out

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



## 2.2 Pin list

**Table 2. Pin description list**

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

## 3 Electrical specifications

### 3.1 Absolute maximum ratings

**Table 3. Absolute maximum ratings**

| Symbol    | Parameter                                                                      | Value       | Unit |
|-----------|--------------------------------------------------------------------------------|-------------|------|
| $V_{CC}$  | DC supply voltage                                                              | 20          | V    |
| $V_I$     | Voltage limits for input pins STBY, MUTE, INNA, INPA, INNB, INPB, GAIN0, GAIN1 | -0.3 to 3.6 | V    |
| $T_{op}$  | Operating temperature                                                          | -40 to 85   | °C   |
| $T_j$     | Operating junction temperature                                                 | -40 to 150  | °C   |
| $T_{stg}$ | Storage temperature                                                            | -40 to 150  | °C   |

### 3.2 Thermal data

Refer also to [Section 5.9: Heatsink requirements on page 37](#).

**Table 4. Thermal data**

| Symbol           | Parameter                               | Min | Typ | Max | Unit |
|------------------|-----------------------------------------|-----|-----|-----|------|
| $R_{th\ j-case}$ | Thermal resistance, junction to case    | -   | 2   | 3   | °C/W |
| $R_{th\ j-amb}$  | Thermal resistance, junction to ambient | -   | 24  | -   |      |

### 3.3 Electrical specifications

Unless otherwise stated, the results in [Table 5](#) below are given for the conditions:  
 $V_{CC} = 11\text{ V}$ ,  $R_L$  (load) =  $6\ \Omega$ ,  $R_{OSC} = R3 = 39\text{ k}\Omega$ ,  $C8 = 100\text{ nF}$ ,  $f = 1\text{ kHz}$ ,  $G_V = 20\text{ dB}$ , and  
 $T_{amb} = 25\text{ }^\circ\text{C}$ .

**Table 5. Electrical specifications**

| Symbol       | Parameter                                | Condition                                                                                       | Min  | Typ | Max | Unit             |
|--------------|------------------------------------------|-------------------------------------------------------------------------------------------------|------|-----|-----|------------------|
| $V_{CC}$     | Supply voltage                           | -                                                                                               | 5    | -   | 18  | V                |
| $I_q$        | Total quiescent current                  | Without LC filter                                                                               | -    | 26  | 35  | mA               |
| $I_{qSTBY}$  | Quiescent current in standby             | -                                                                                               | -    | -   | 10  | $\mu\text{A}$    |
| $V_{OS}$     | Output offset voltage                    | Play mode                                                                                       | -100 | -   | 100 | mV               |
|              |                                          | Mute mode                                                                                       | -60  | -   | 60  | mV               |
| $I_{OCP}$    | Overcurrent protection threshold         | $R_L = 0\ \Omega$                                                                               | 3    | -   | -   | A                |
| $T_j$        | Junction temperature at thermal shutdown | -                                                                                               | -    | 150 | -   | $^\circ\text{C}$ |
| $R_i$        | Input resistance                         | Differential input                                                                              | 54   | 68  | -   | $\text{k}\Omega$ |
| $V_{UVP}$    | Undervoltage protection threshold        | -                                                                                               | -    | -   | 4.5 | V                |
| $R_{dsON}$   | Power transistor on resistance           | High side                                                                                       | -    | 0.2 | -   | $\Omega$         |
|              |                                          | Low side                                                                                        | -    | 0.2 | -   |                  |
| $P_o$        | Output power                             | THD = 10%                                                                                       | -    | 10  | -   | W                |
|              |                                          | THD = 1%                                                                                        | -    | 8.0 | -   |                  |
| $P_o$        | Output power                             | $R_L = 8\ \Omega$ , THD = 10%,<br>$V_{CC} = 12\text{ V}$                                        | -    | 9.5 | -   | W                |
|              |                                          | $R_L = 8\ \Omega$ , THD = 1%,<br>$V_{CC} = 12\text{ V}$                                         | -    | 7.2 | -   |                  |
| $P_D$        | Dissipated power                         | $P_o = 10\text{ W} + 10\text{ W}$ ,<br>THD = 10%                                                | -    | 2.0 | -   | W                |
| $\eta$       | Efficiency                               | $P_o = 10\text{ W} + 10\text{ W}$ ,<br>$R_L = 8\ \Omega$ , THD = 10%,<br>$V_{CC} = 12\text{ V}$ | -    | 90  | -   | %                |
| THD          | Total harmonic distortion                | $P_o = 1\text{ W}$                                                                              | -    | 0.1 | -   | %                |
| $G_V$        | Closed loop gain                         | GAIN0 = L, GAIN1 = L                                                                            | 18   | 20  | 22  | dB               |
|              |                                          | GAIN0 = L, GAIN1 = H                                                                            | 24   | 26  | 28  |                  |
|              |                                          | GAIN0 = H, GAIN1 = L                                                                            | 28   | 30  | 32  |                  |
|              |                                          | GAIN0 = H, GAIN1 = H                                                                            | 30   | 32  | 34  |                  |
| $\Delta G_V$ | Gain matching                            | -                                                                                               | -1   | -   | 1   | dB               |
| CT           | Crosstalk                                | $f = 1\text{ kHz}$ , $P_o = 1\text{ W}$                                                         | -    | 70  | -   | dB               |
| eN           | Total input noise                        | A Curve, $G_V = 20\text{ dB}$                                                                   | -    | 15  | -   | $\mu\text{V}$    |
|              |                                          | $f = 22\text{ Hz to } 22\text{ kHz}$                                                            | -    | 20  | -   |                  |

**Table 5. Electrical specifications (continued)**

| Symbol        | Parameter                      | Condition                                                                              | Min     | Typ | Max | Unit |
|---------------|--------------------------------|----------------------------------------------------------------------------------------|---------|-----|-----|------|
| SVRR          | Supply voltage rejection ratio | $f_r = 100 \text{ Hz}$ , $V_r = 1 \text{ Vpp}$ ,<br>$C_{SVR} = 10 \text{ }\mu\text{F}$ | -       | 50  | -   | dB   |
| $T_r$ , $T_f$ | Rise and fall times            | -                                                                                      | -       | 40  | -   | ns   |
| $f_{SW}$      | Switching frequency            | Internal oscillator,<br>master mode                                                    | 290     | 320 | 350 | kHz  |
| $f_{SWR}$     | Switching frequency range      | (1)                                                                                    | 250     | -   | 400 | kHz  |
| $V_{inH}$     | Digital input high (H)         | -                                                                                      | 2.3     | -   | -   | V    |
| $V_{inL}$     | Digital input low (L)          |                                                                                        | -       | -   | 0.8 |      |
| $A_{MUTE}$    | Mute attenuation               | $V_{MUTE} = \text{low}$ ,<br>$V_{STBY} = \text{high}$                                  | -       | 80  | -   | dB   |
| Function mode | Standby, mute and play modes   | $V_{STBY} < 0.5 \text{ V}$<br>$V_{MUTE} = X$                                           | Standby |     |     | -    |
|               |                                | $V_{STBY} > 2.9 \text{ V}$<br>$V_{MUTE} < 0.8 \text{ V}$                               | Mute    |     |     | -    |
|               |                                | $V_{STBY} > 2.9 \text{ V}$<br>$V_{MUTE} > 2.9 \text{ V}$                               | Play    |     |     | -    |

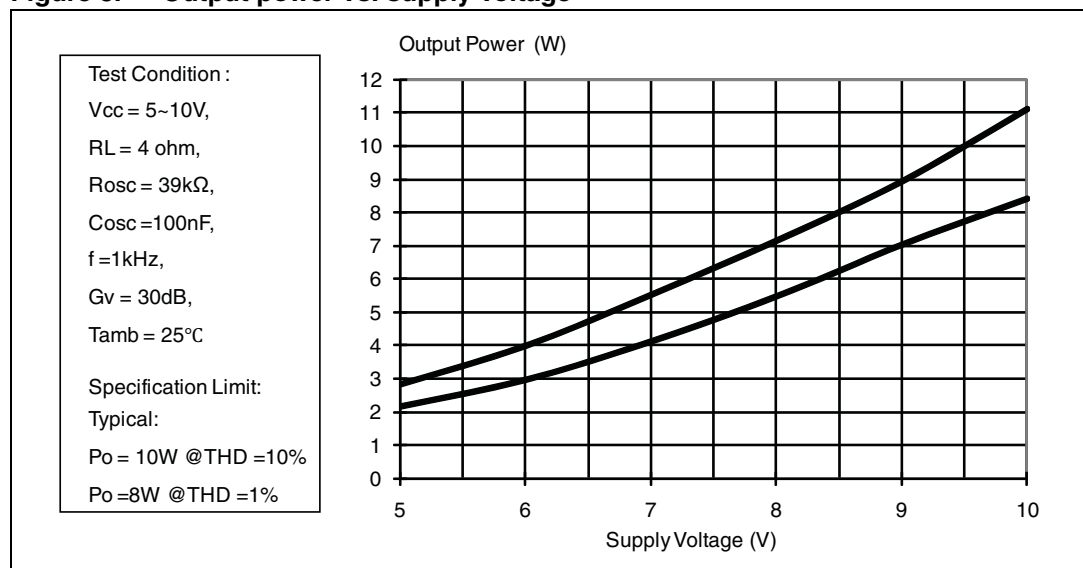
1. Refer to [Section 5.5: Internal and external clocks on page 32](#).

## 4 Characterization curves

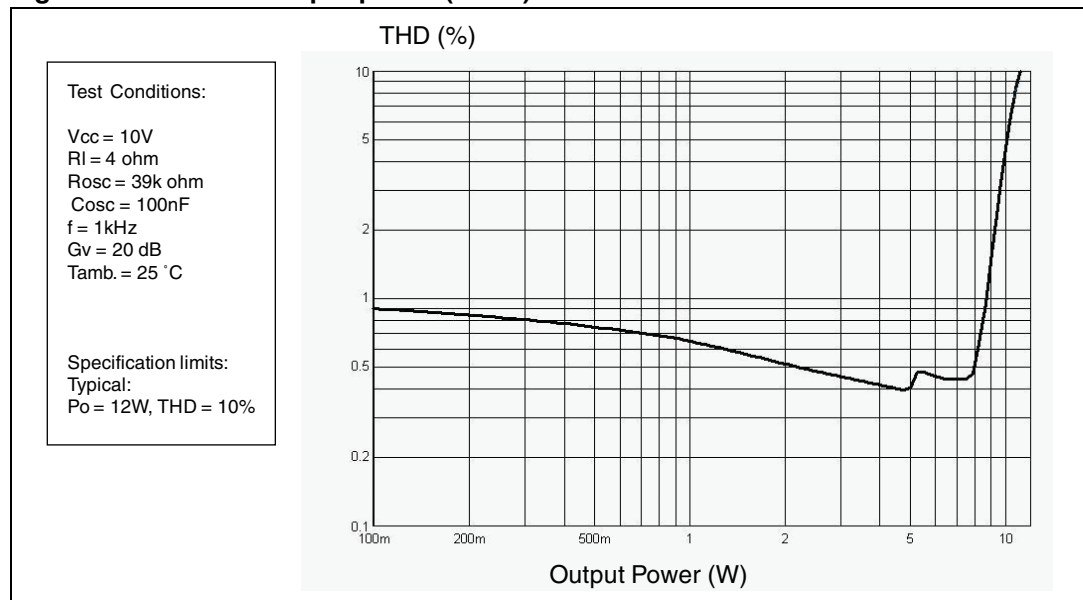
The following characterization curves were made using the TDA7491P demo board. The LC filter for the 4- $\Omega$  load uses components of 15  $\mu$ H and 470 nF, whilst that for the 6- $\Omega$  load uses 22  $\mu$ H and 220 nF and that for the 8- $\Omega$  load uses 33  $\mu$ H and 220 nF.

### 4.1 With 4- $\Omega$ load at $V_{CC} = 10$ V

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



**Figure 4. THD vs. output power (1 kHz)**



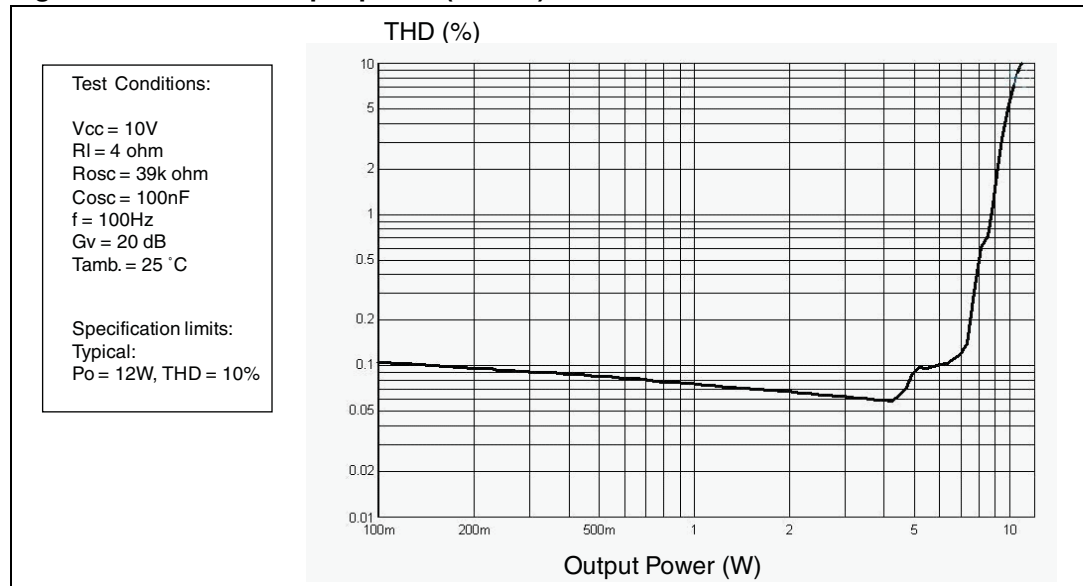
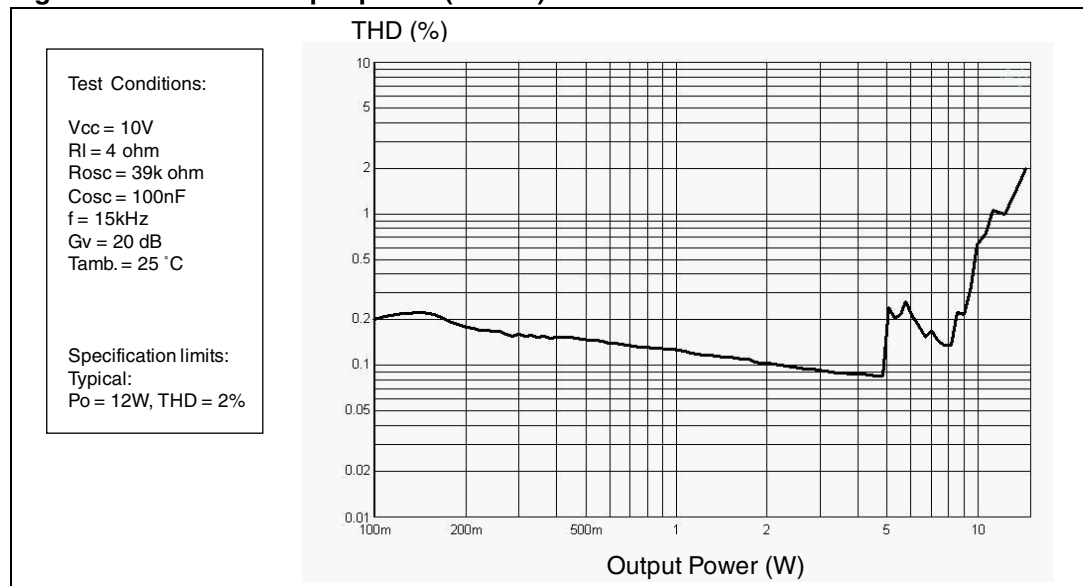
**Figure 5. THD vs. output power (100 Hz)****Figure 6. THD vs. output power (15 kHz)**

Figure 7. THD vs. frequency

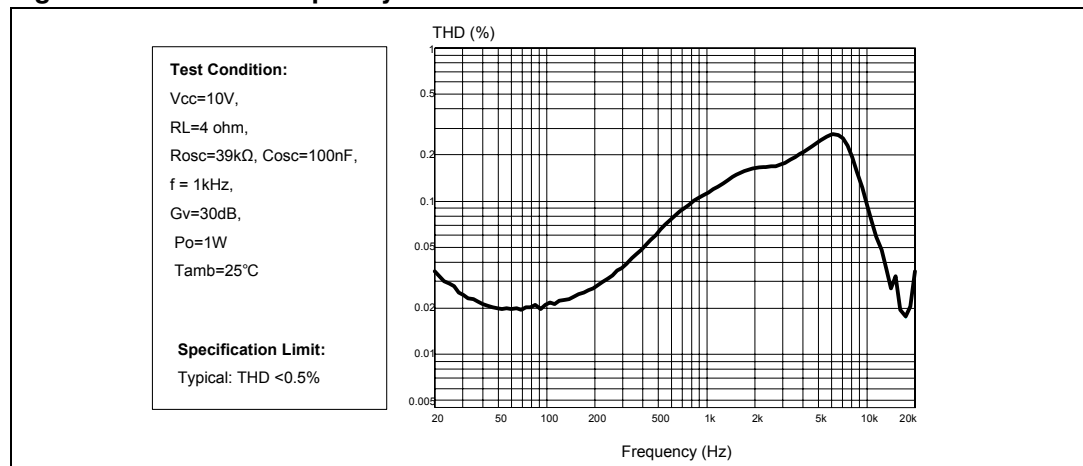


Figure 8. Frequency response

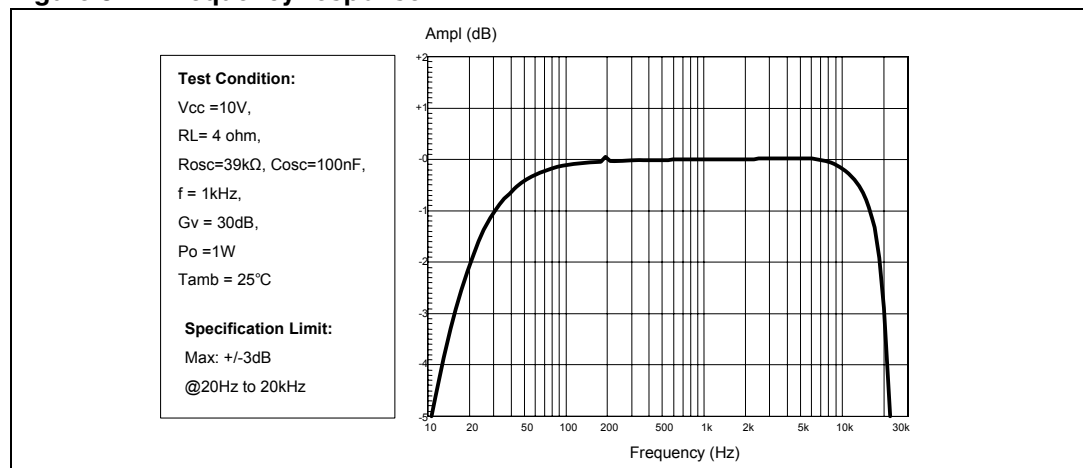


Figure 9. Crosstalk vs. frequency

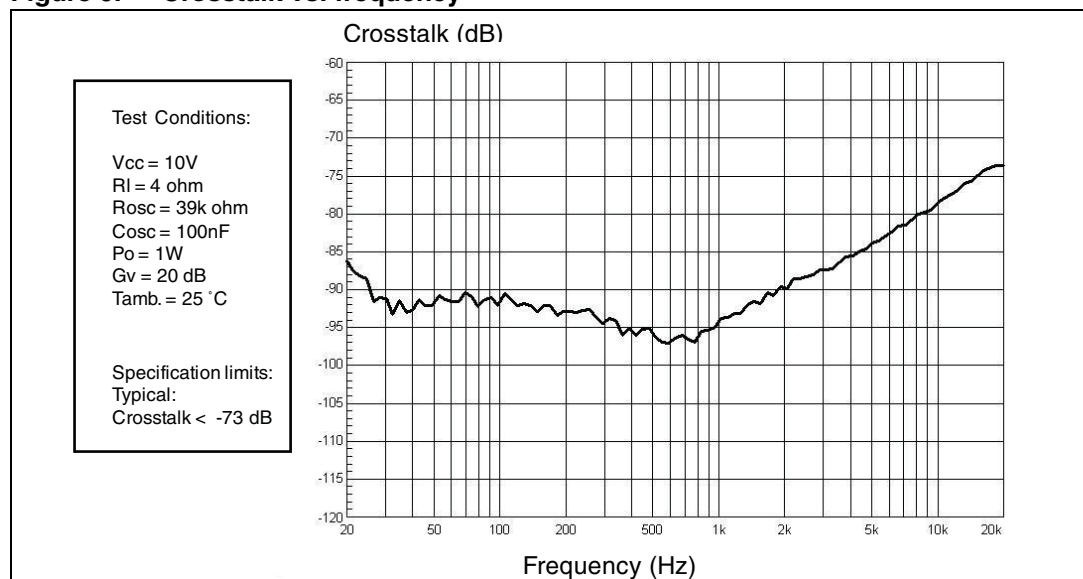


Figure 10. FFT (0 dB)

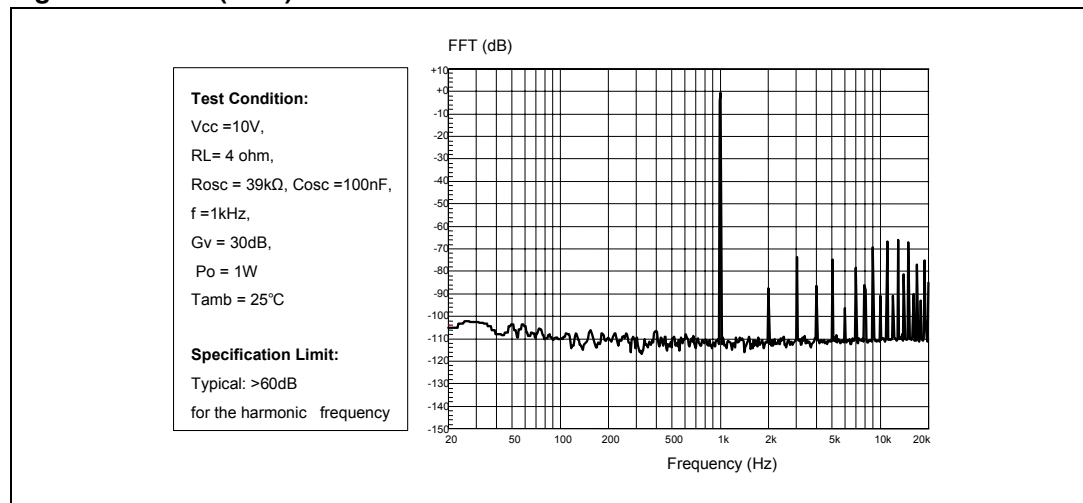


Figure 11. FFT (-60 dB)

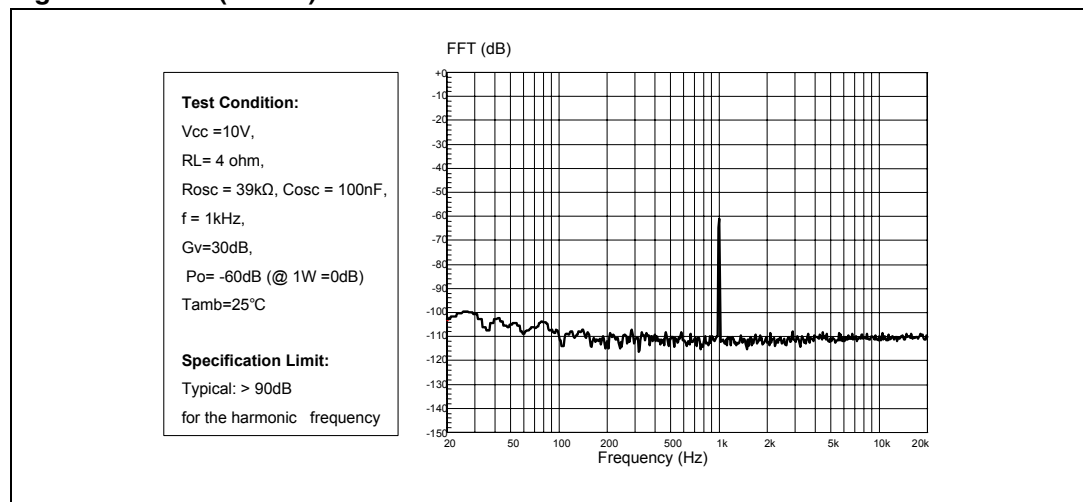


Figure 12. Power supply rejection ratio vs. frequency

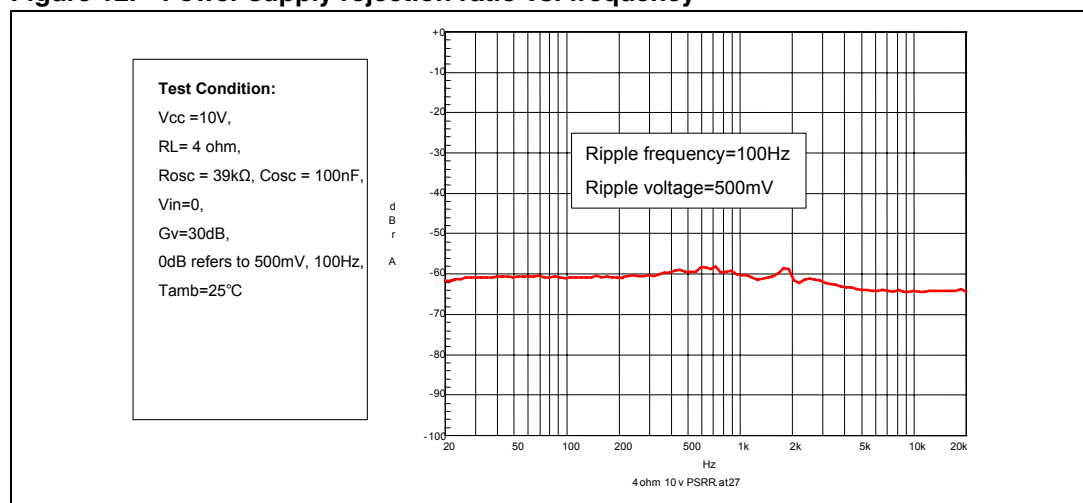


Figure 13. Power dissipation and efficiency vs. output power

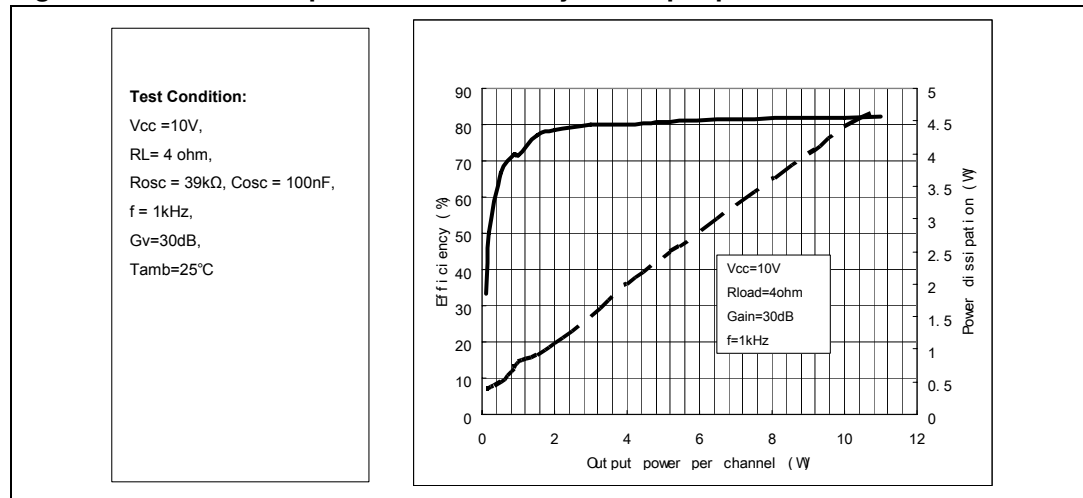


Figure 14. Attenuation vs. voltage on pin MUTE

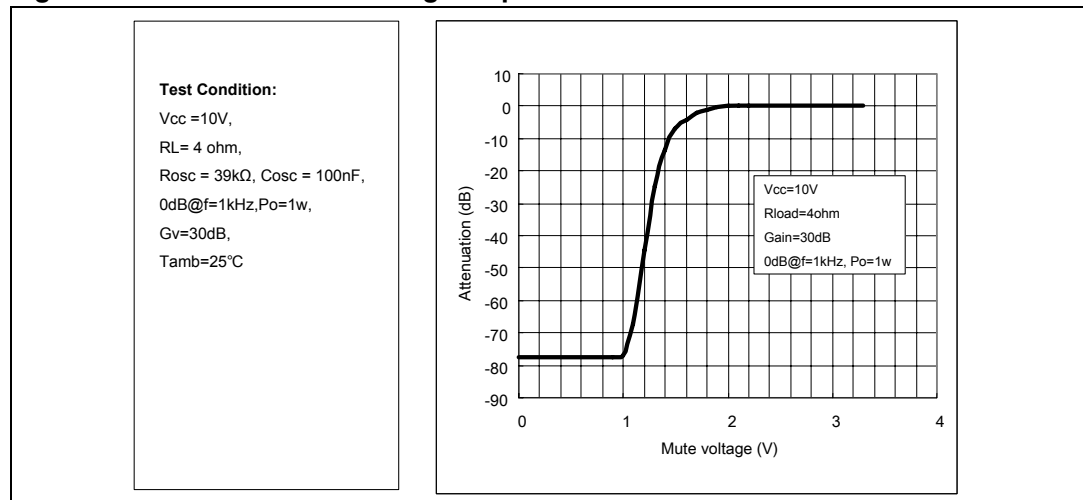


Figure 15. Current consumption vs. voltage on pin STBY

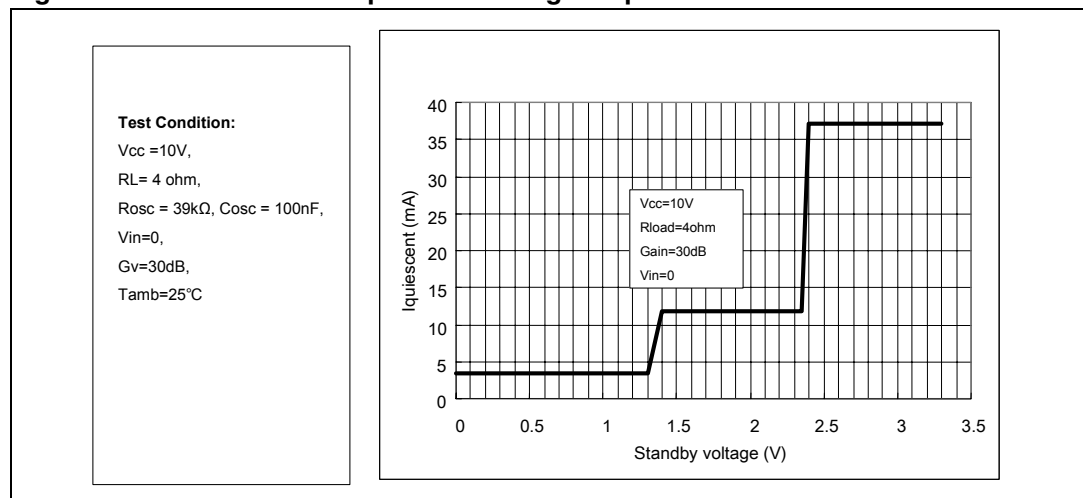
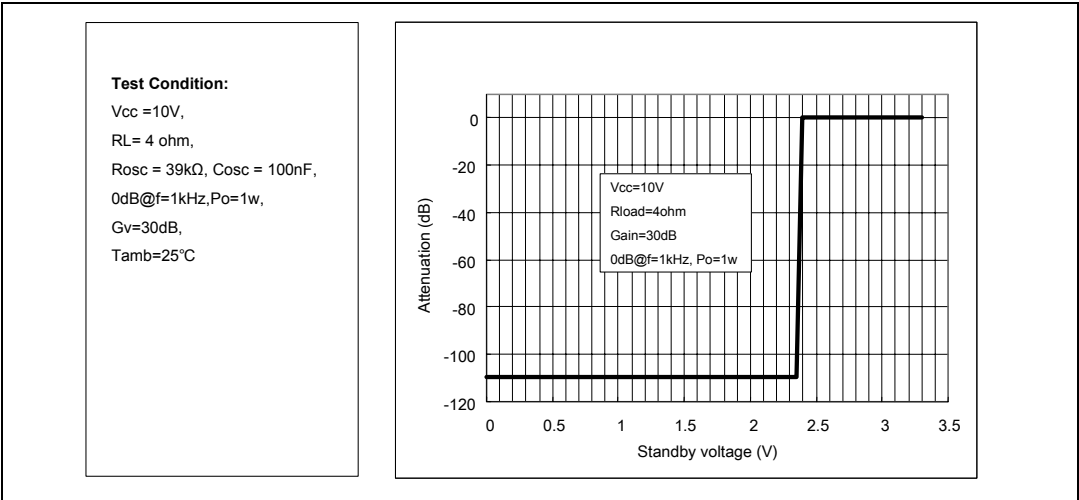
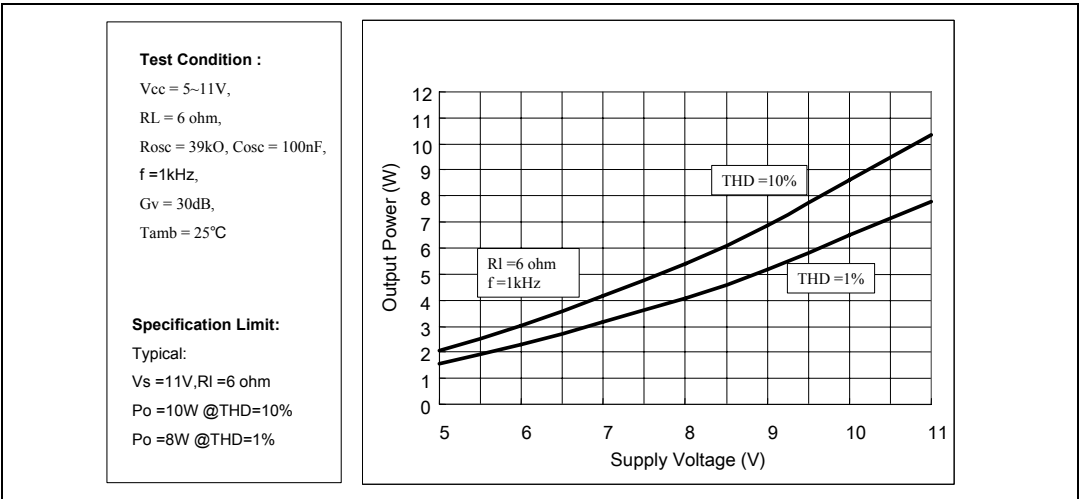


Figure 16. Attenuation vs. voltage on pin STBY



## 4.2 With 6-Ω load at $V_{CC} = 11\ V$

Figure 17. Output power vs. supply voltage



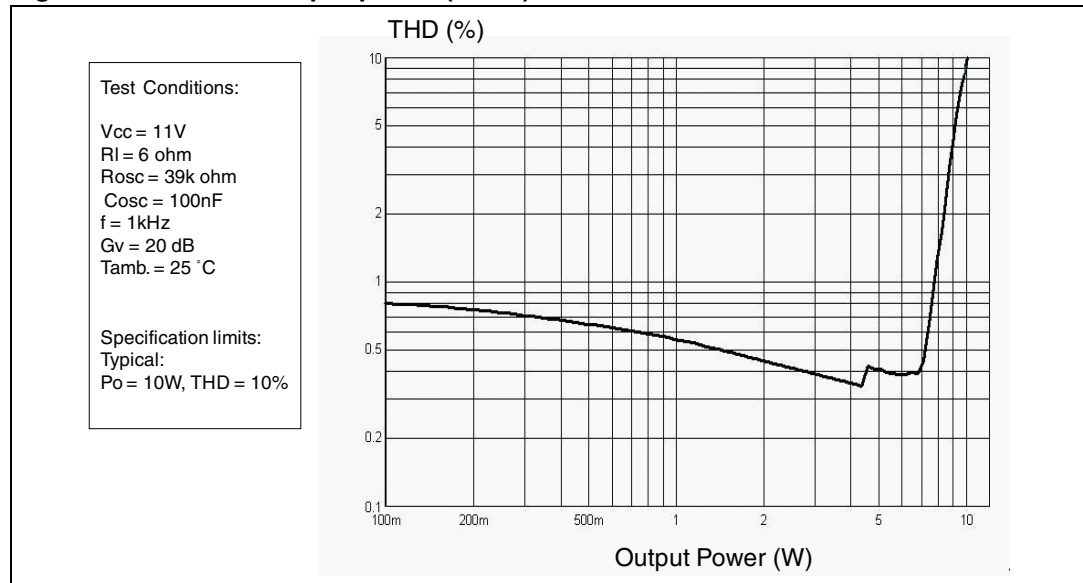
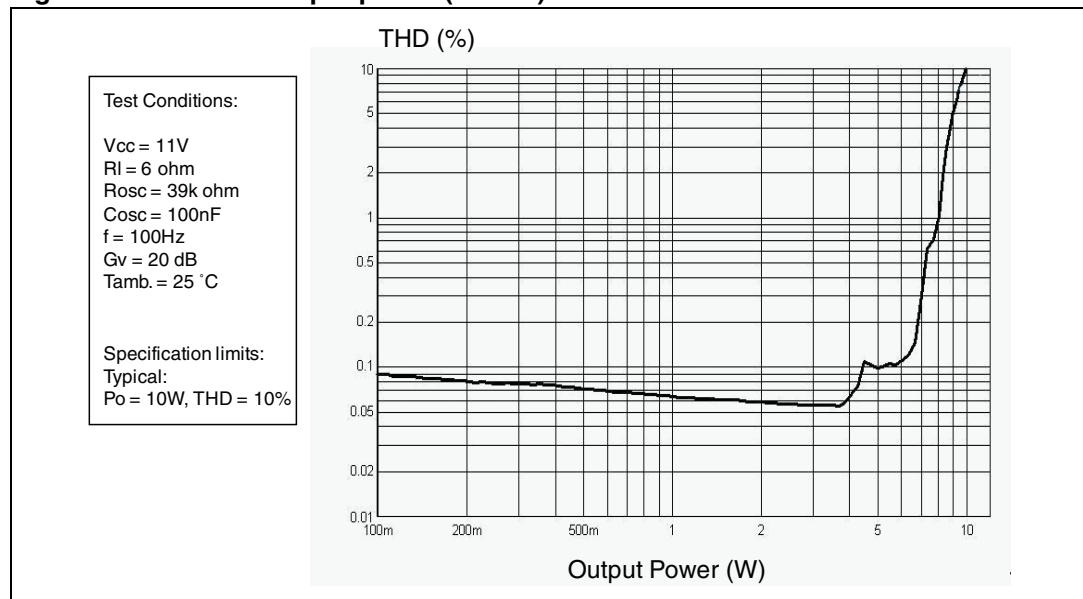
**Figure 18. THD vs. output power (1 kHz)****Figure 19. THD vs. output power (100 Hz)**

Figure 20. THD vs. output power (15 kHz)

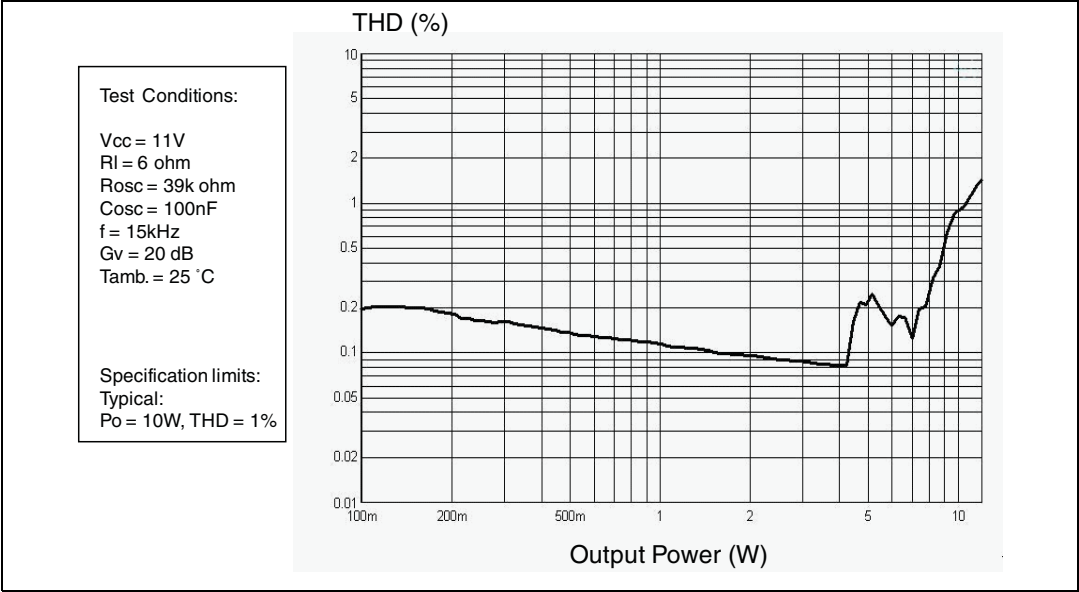
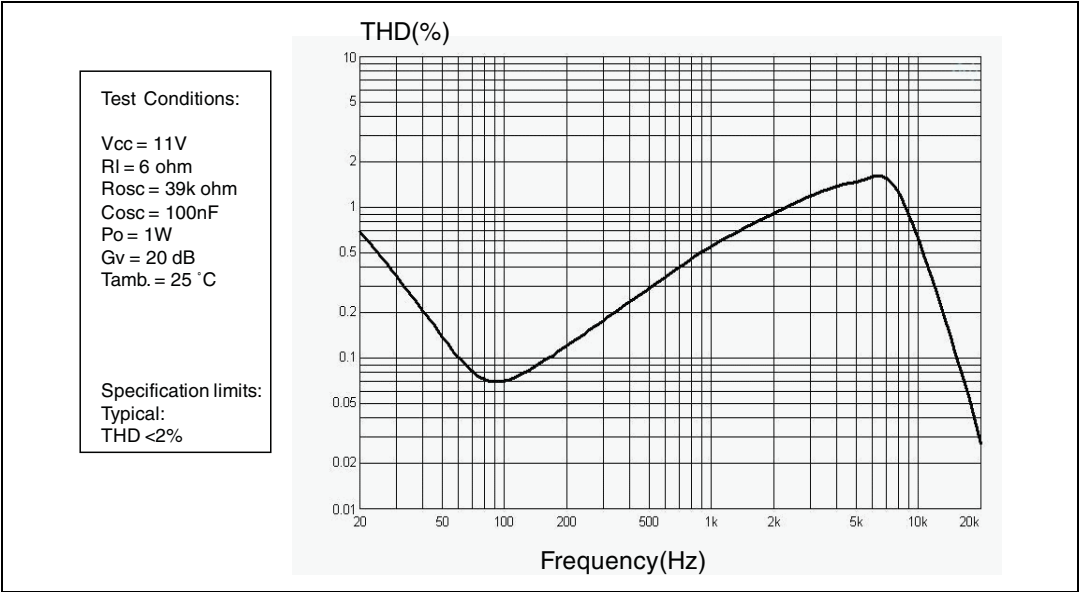


Figure 21. THD vs. frequency



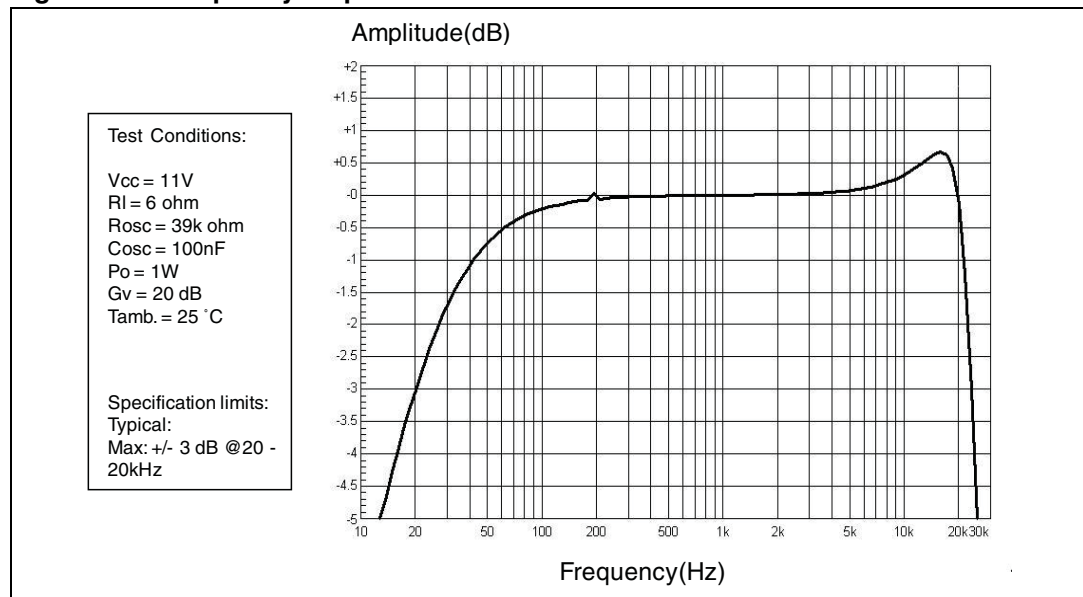
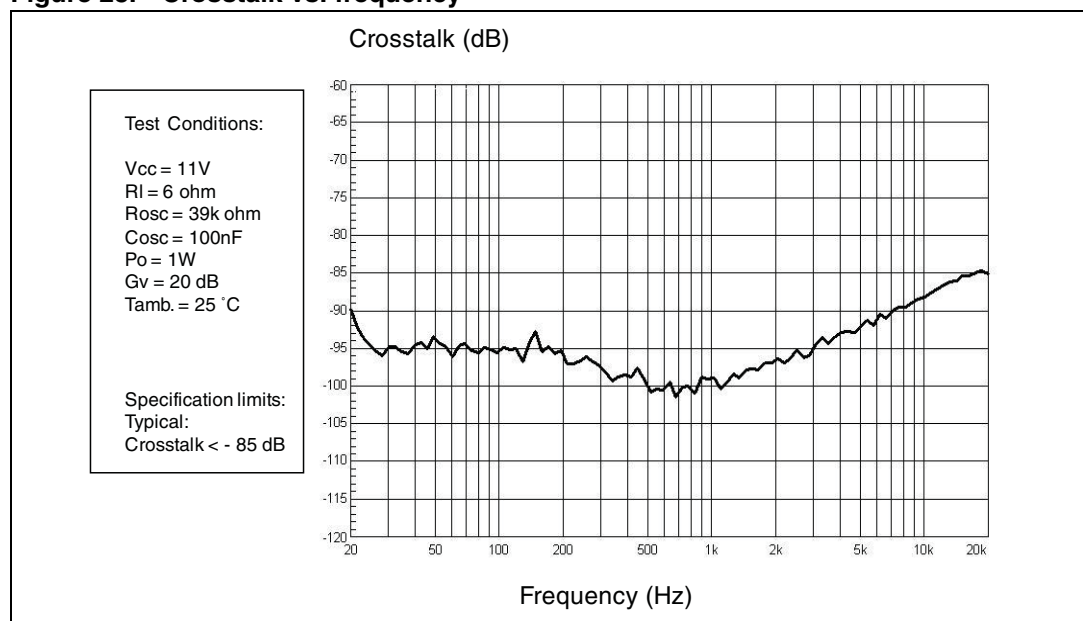
**Figure 22. Frequency response****Figure 23. Crosstalk vs. frequency**

Figure 24. FFT (0 dB)

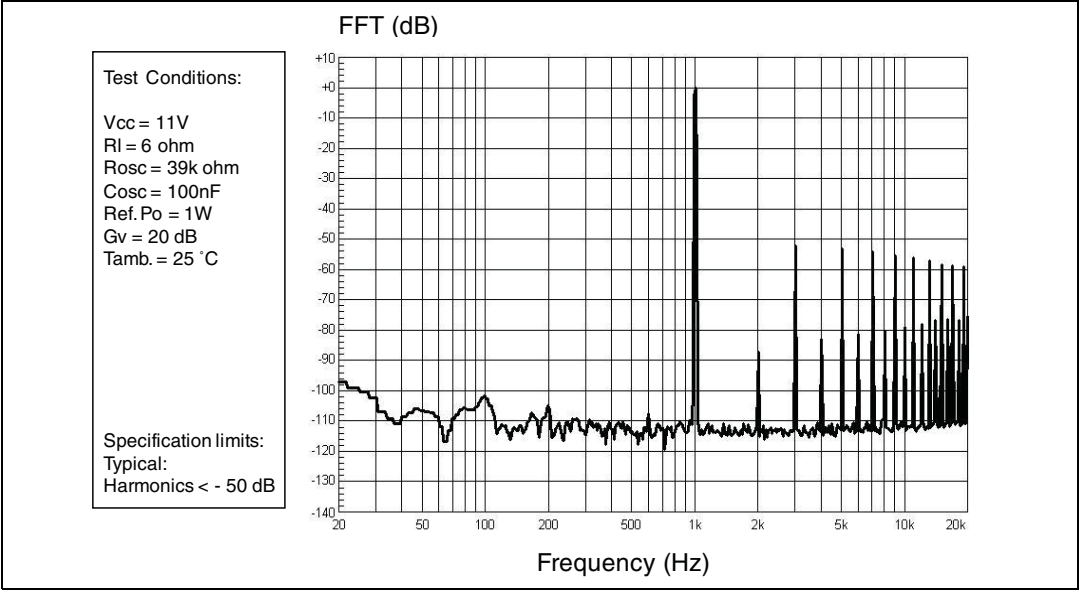


Figure 25. FFT (-60 dB)

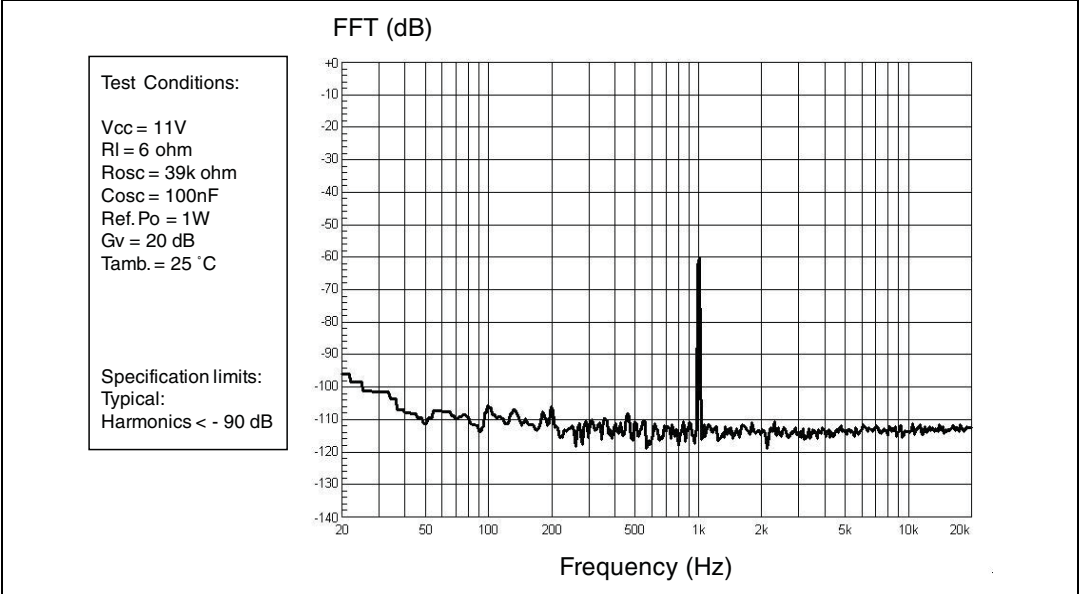


Figure 26. Power supply rejection ratio vs. frequency

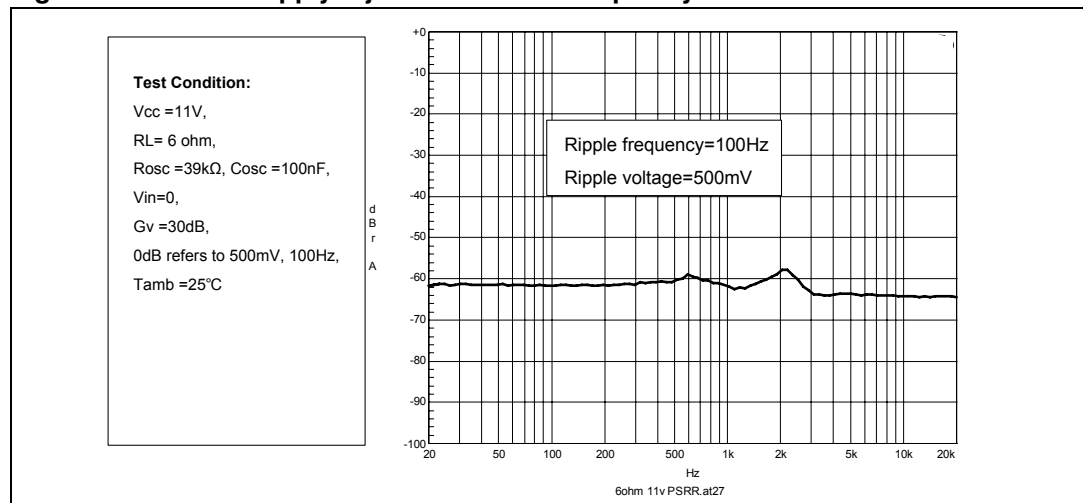
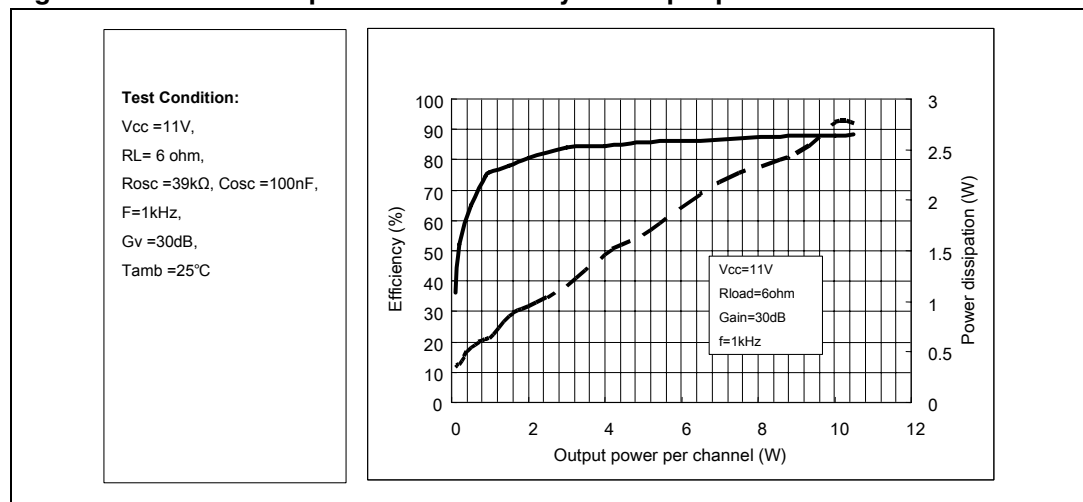


Figure 27. Power dissipation and efficiency vs. output power



4.3 With 8-Ω load at  $V_{CC} = 12\text{ V}$

Figure 28. Output power vs. supply voltage

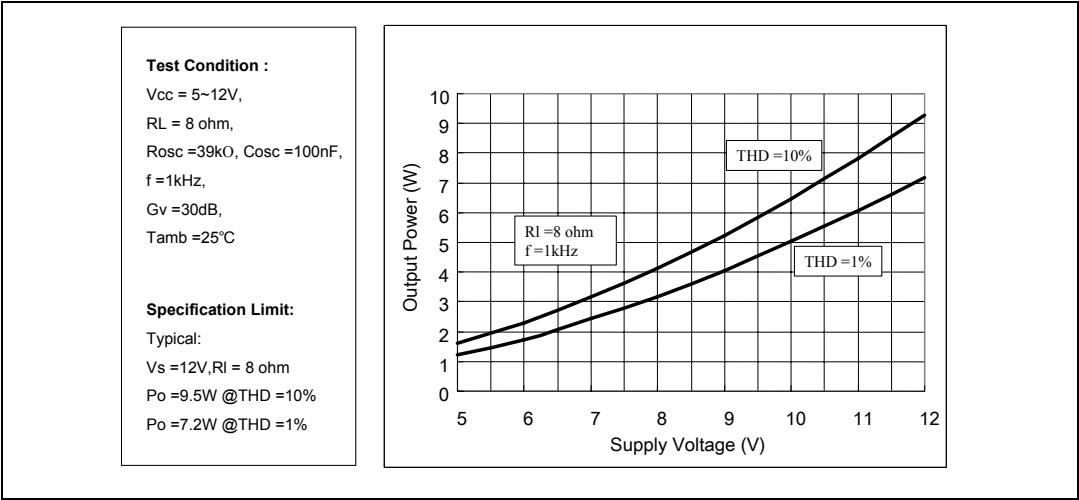
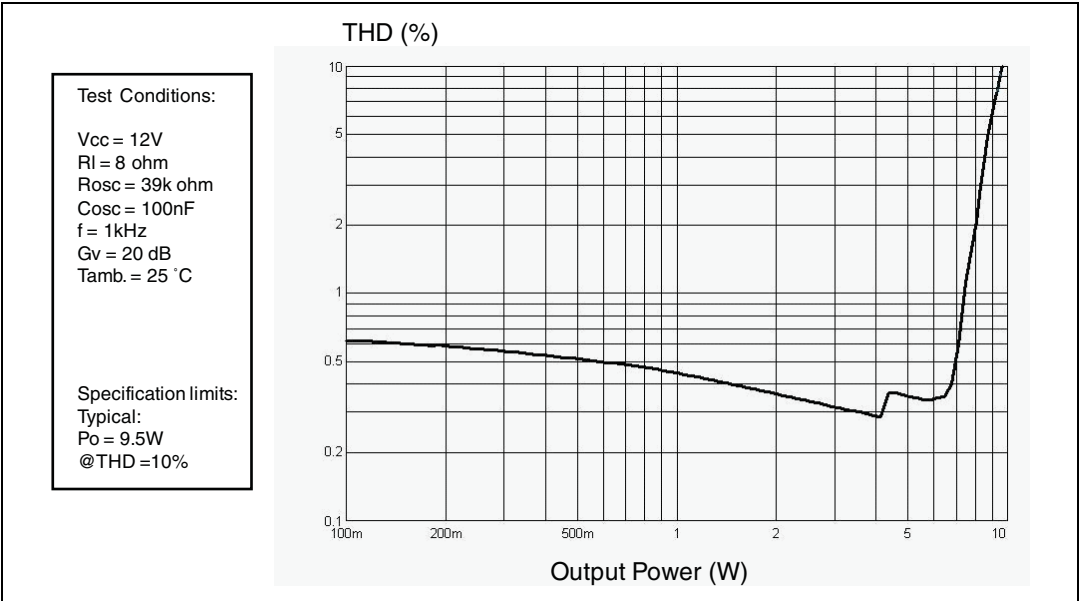


Figure 29. THD vs. output power (1 kHz)



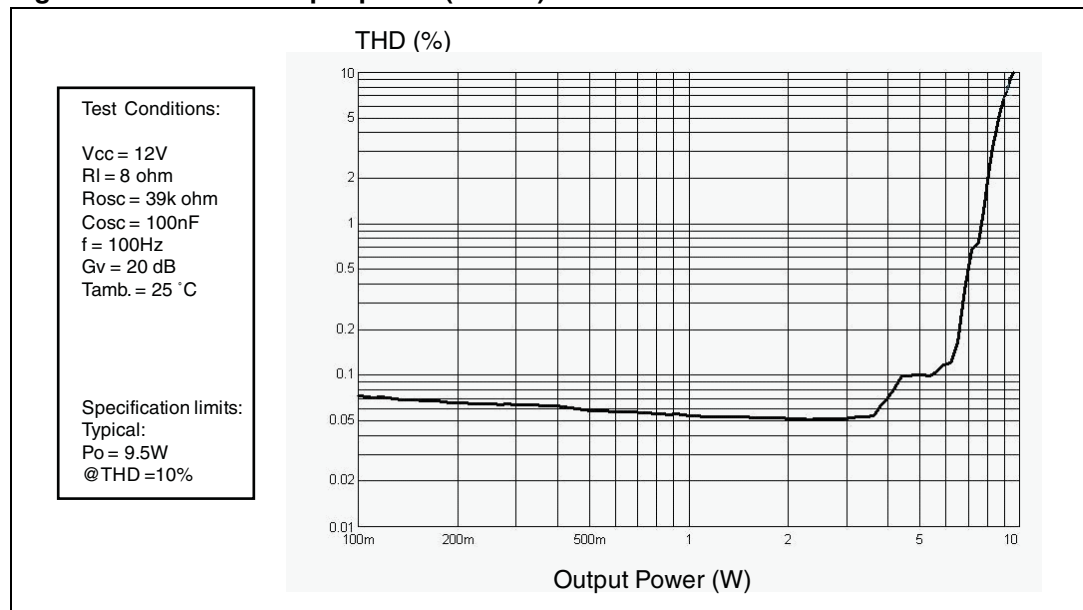
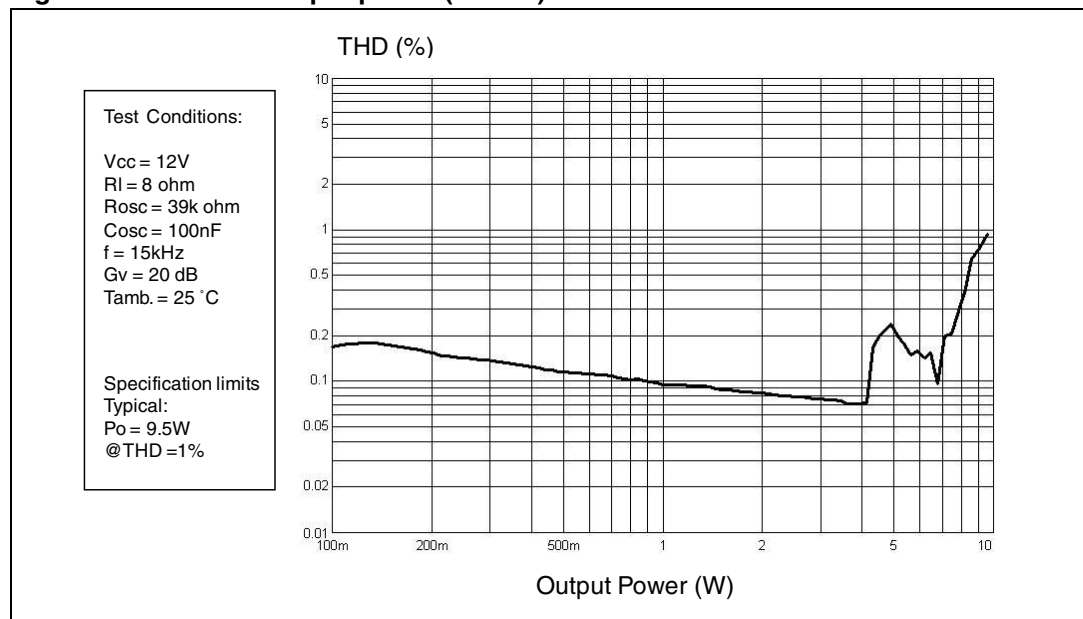
**Figure 30. THD vs. output power (100 Hz)****Figure 31. THD vs. output power (15 kHz)**

Figure 32. THD vs. frequency

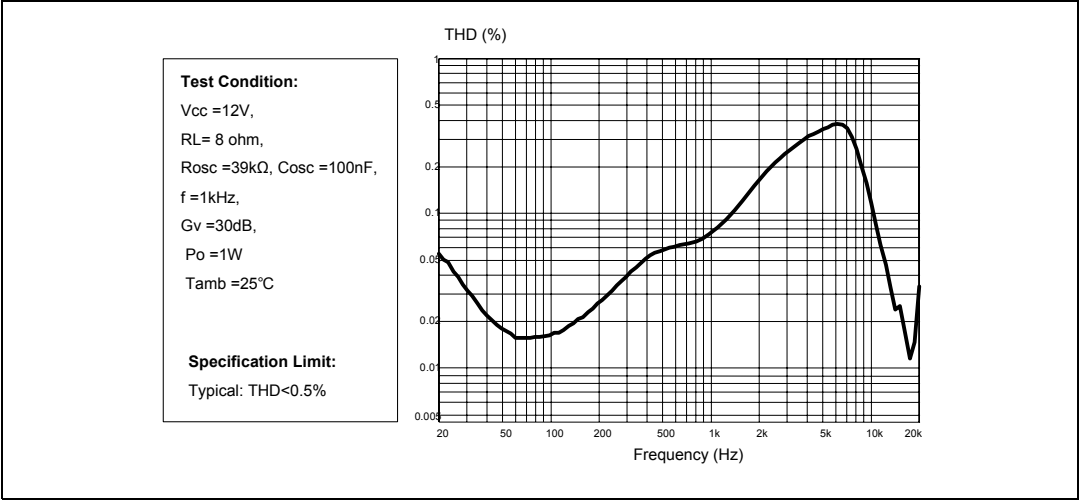
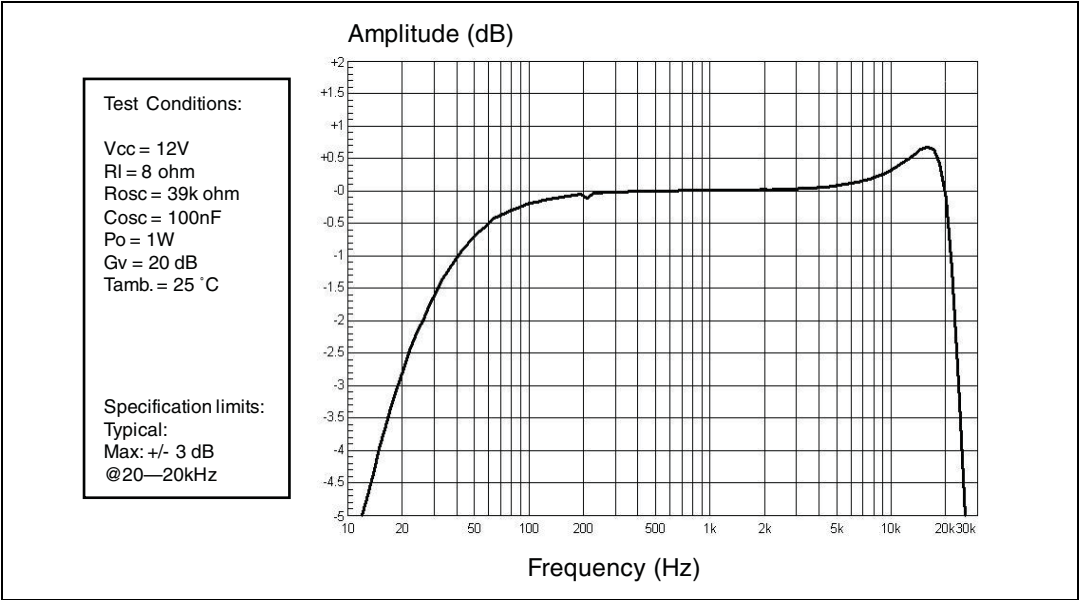


Figure 33. Frequency response



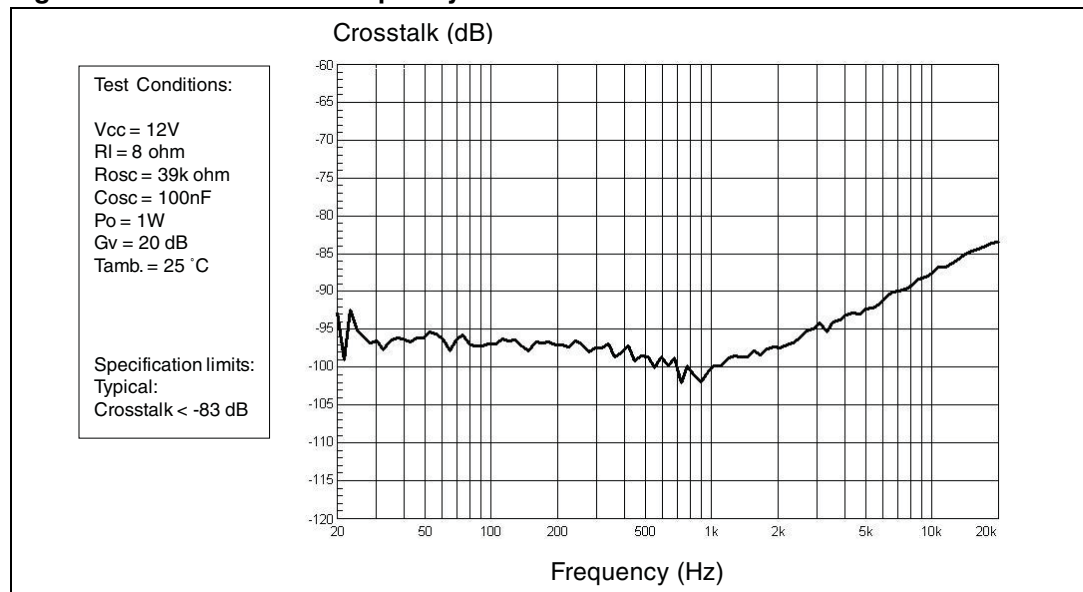
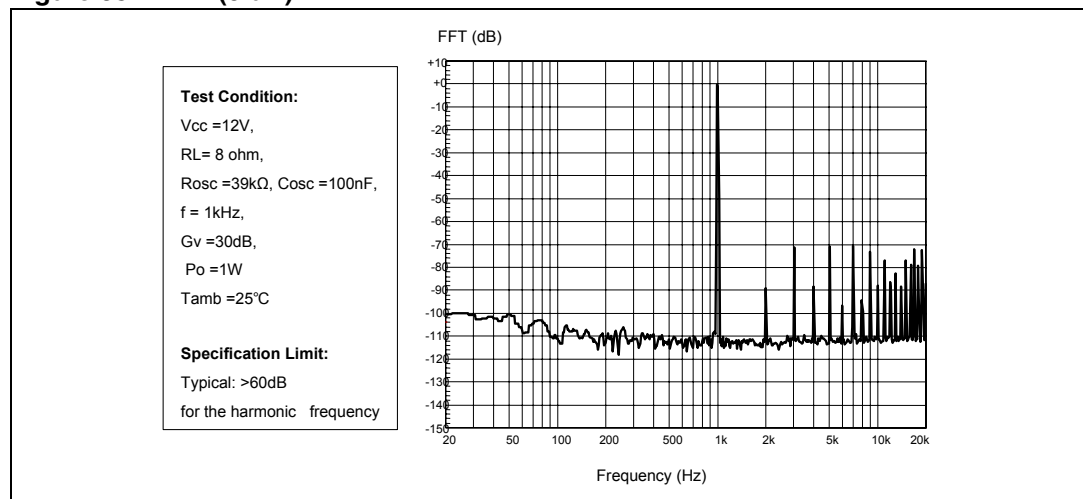
**Figure 34. Crosstalk vs. frequency****Figure 35. FFT (0 dB)**

Figure 36. FFT (-60 dB)

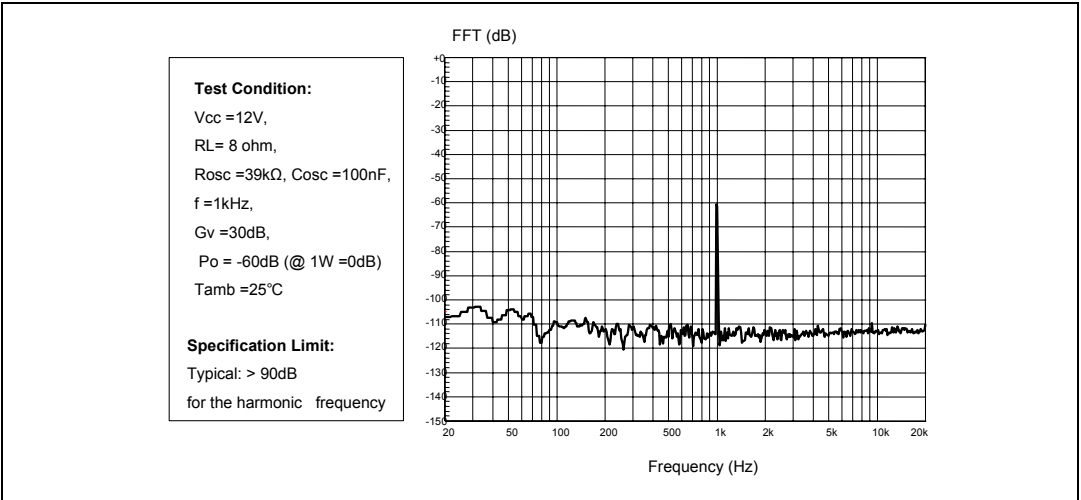


Figure 37. Power supply rejection ratio vs. frequency

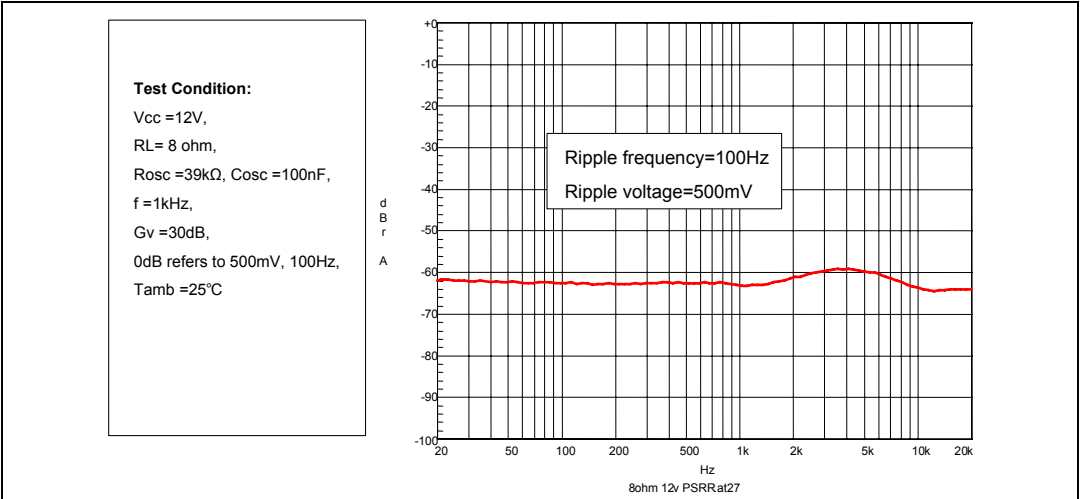
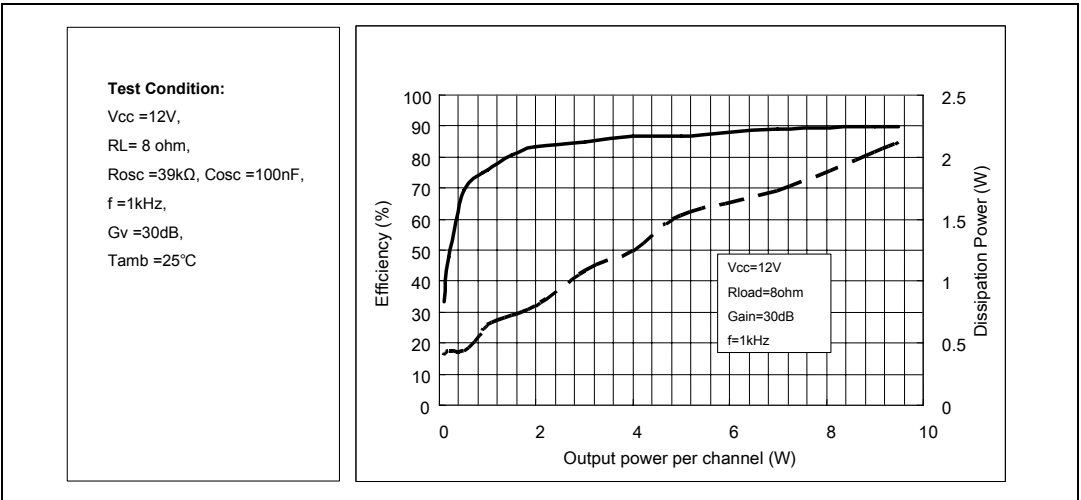


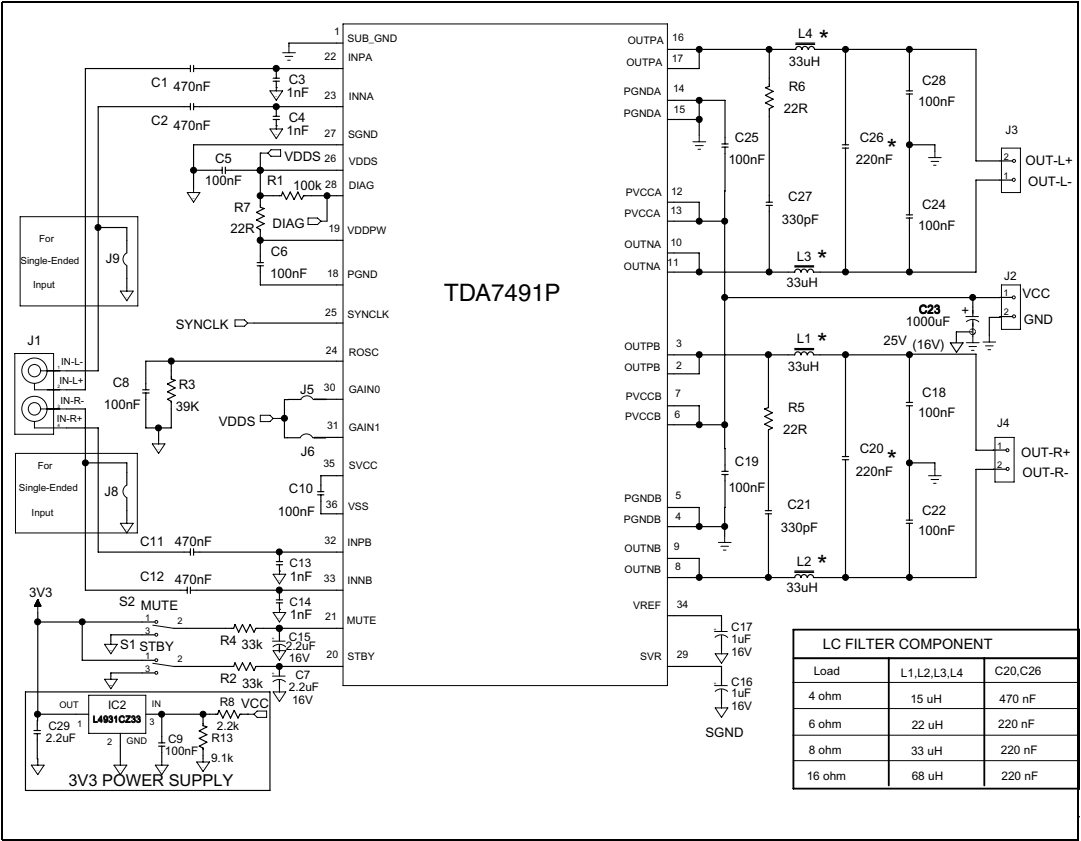
Figure 38. Power dissipation and efficiency vs. output power



# 5 Applications information

## 5.1 Applications circuit

Figure 39. Applications circuit for class-D amplifier



## 5.2 Mode selection

The three operating modes, defined below, of the TDA7491P are set by the two inputs STBY (pin 20) and MUTE (pin 21) as shown in [Table 6](#).

- 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.

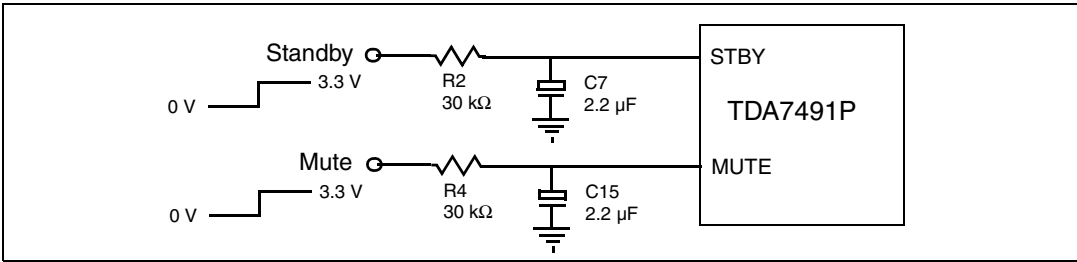
The protection functions of the TDA7491P are implemented by pulling down the voltages of the STBY and MUTE inputs shown in [Figure 40](#). The input current of the corresponding pins must be limited to 200  $\mu$ A.

**Table 6. Mode settings**

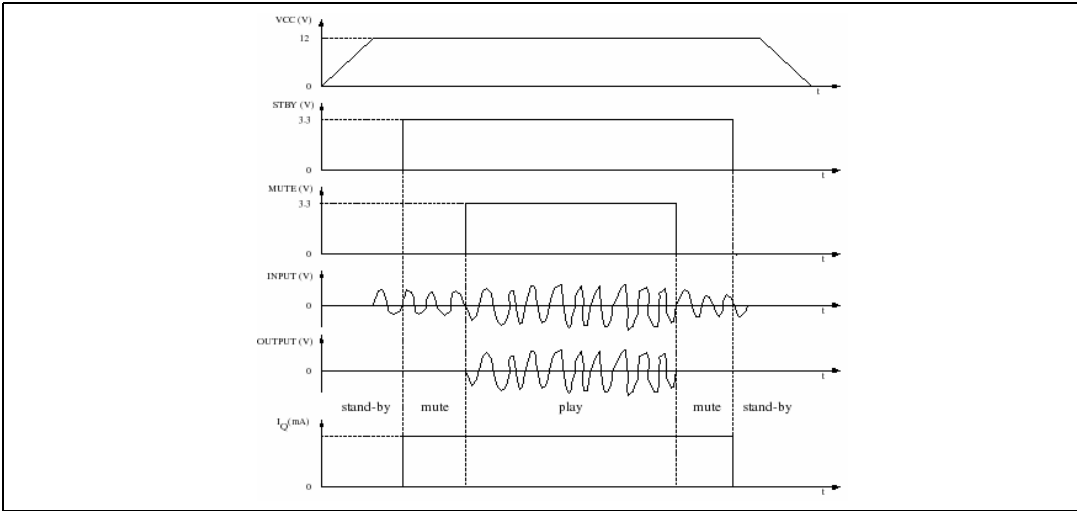
| Mode    | Voltage level on pin STBY | Voltage level on pin MUTE |
|---------|---------------------------|---------------------------|
| Standby | L <sup>(1)</sup>          | X (don't care)            |
| Mute    | H <sup>(1)</sup>          | L                         |
| Play    | H                         | H                         |

1. Refer to  $V_{STBY}$  and  $V_{MUTE}$  in [Table 5: Electrical specifications on page 11](#) for the drive levels for L and H

**Figure 40. Standby and mute circuits**



**Figure 41. Turn-on/off sequence for minimizing speaker “pop”**



### 5.3 Gain setting

The gain of the TDA7491P is set by the two inputs, GAIN0 (pin 30) and GAIN1 (pin 31). Internally, the gain is set by changing the feedback resistors of the amplifier.

**Table 7. Gain settings**

| Voltage level on pin GAIN0 | Voltage level on pin GAIN1 | Nominal gain, $G_v$ (dB) |
|----------------------------|----------------------------|--------------------------|
| L <sup>(1)</sup>           | L <sup>(1)</sup>           | 20                       |
| L                          | H                          | 26                       |
| H                          | L                          | 30                       |
| H                          | H                          | 32                       |

1. Refer to  $V_{inL}$  and  $V_{inH}$  in [Table 5: Electrical specifications on page 11](#) for the drive levels for L and H

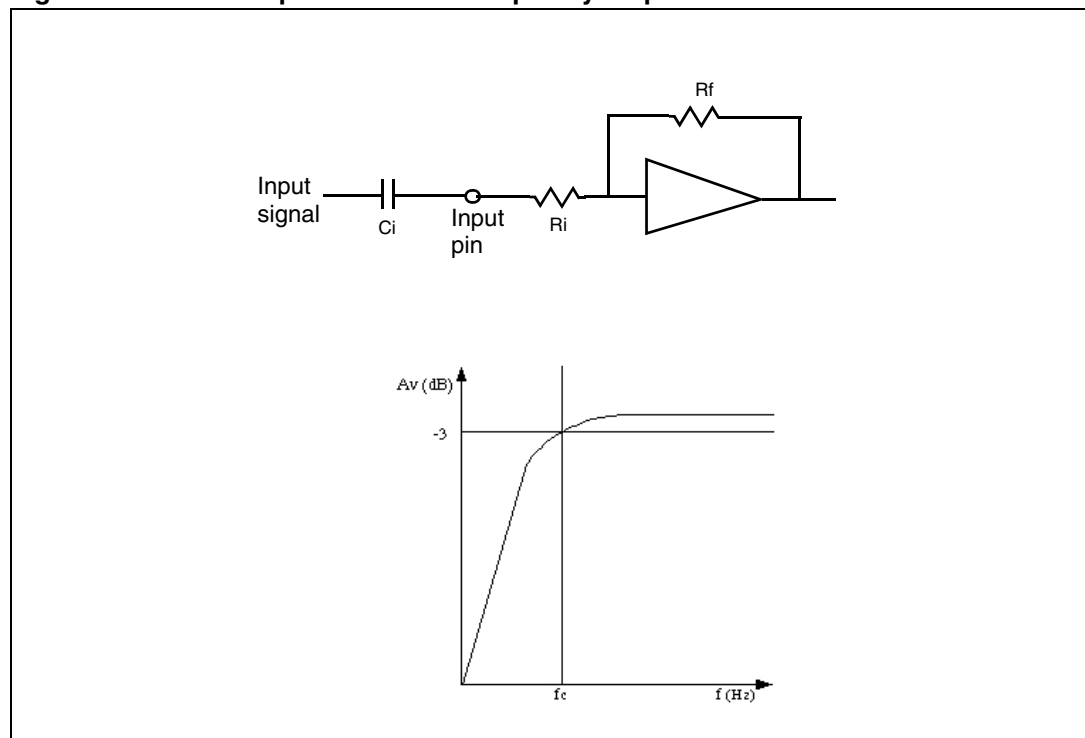
### 5.4 Input resistance and capacitance

The input impedance is set by an internal resistor  $R_i = 68\text{ k}\Omega$  (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 42](#). For  $C_i = 220\text{ nF}$  the high-pass filter cut-off frequency is below 20 Hz:

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

**Figure 42. Device input circuit and frequency response**



## 5.5 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 TDA7491P 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.

### 5.5.1 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](#).

### 5.5.2 Slave mode (external clock)

In order to accept an external clock input, 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](#).

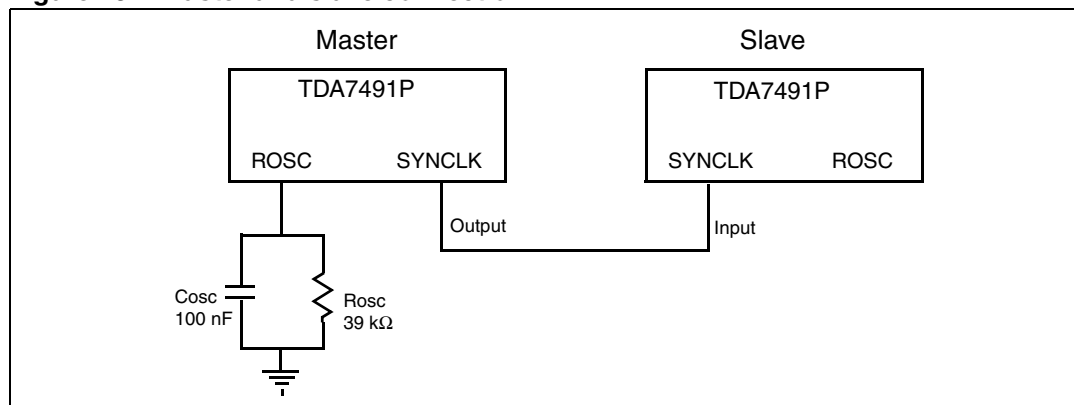
The output switching frequency of the slave devices is:

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

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

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

**Figure 43. Master and slave connection**



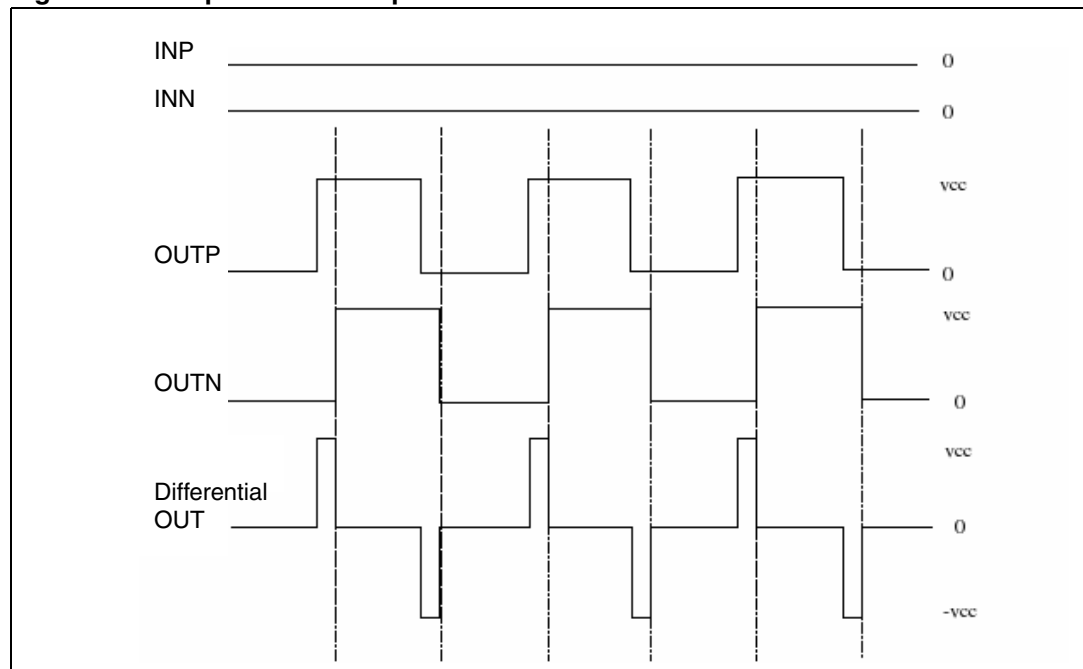
## 5.6 Modulation

The output modulation scheme of the BTL is called unipolar pulse width modulation (PWM). The differential output voltages change between 0 V and  $+V_{CC}$  and between 0 V and  $-V_{CC}$ . This is in contrast to the traditional bipolar PWM outputs which change between  $+V_{CC}$  and  $-V_{CC}$ .

An advantage of this scheme is that it effectively doubles the switching frequency of the differential output waveform on the load then reducing the current ripple accordingly. The OUTP and OUTN are in the same phase almost overlapped when the input is zero under this condition, then the switching current is low and the related losses in the load are low. In practice, a short delay is introduced between these two outputs in order to avoid the BTL outputs switching simultaneously when the input is zero.

Figure 44 shows the resulting differential output voltage and current when a positive, zero and negative input signal is applied. The resulting differential voltage on the load has a double frequency with respect to outputs OUTP and OUTN then resulting in reduced current ripple.

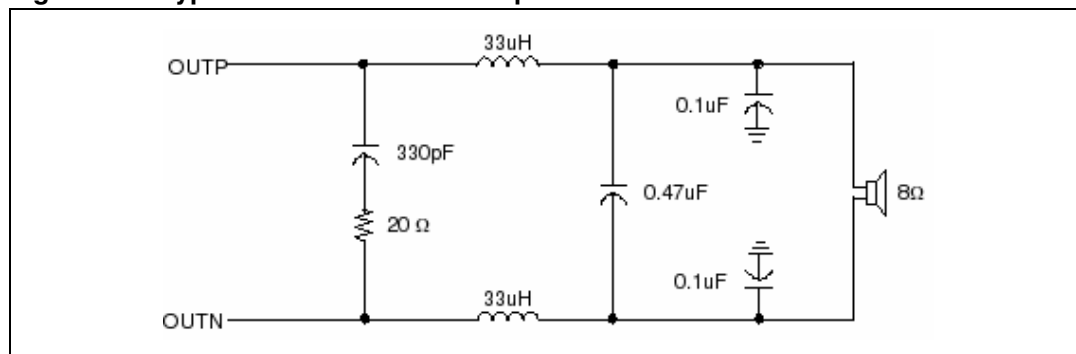
**Figure 44. Unipolar PWM output**



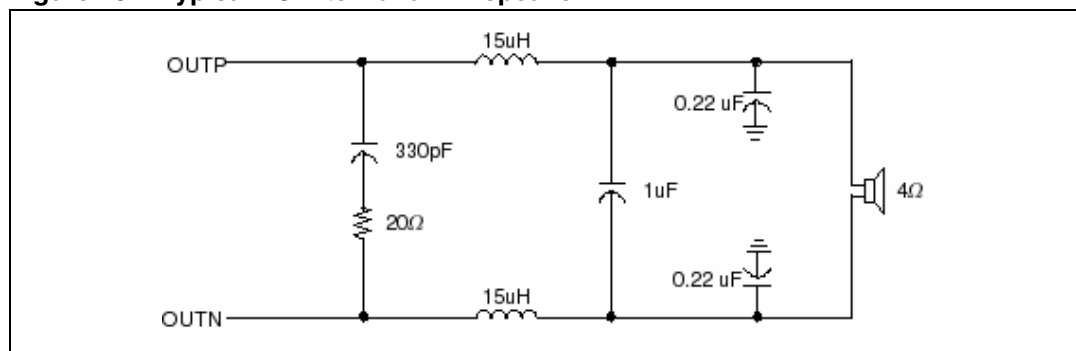
### 5.6.1 Reconstruction low-pass filter

Standard applications use a low-pass filter before the speaker. The cut-off frequency should be higher 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 cut-off frequency of 27 kHz, are shown in [Figure 45](#) and [Figure 46](#) below.

**Figure 45. Typical LC filter for an 8-Ω speaker**



**Figure 46. Typical LC filter for a 4-Ω speaker**



### 5.6.2 Filterless modulation

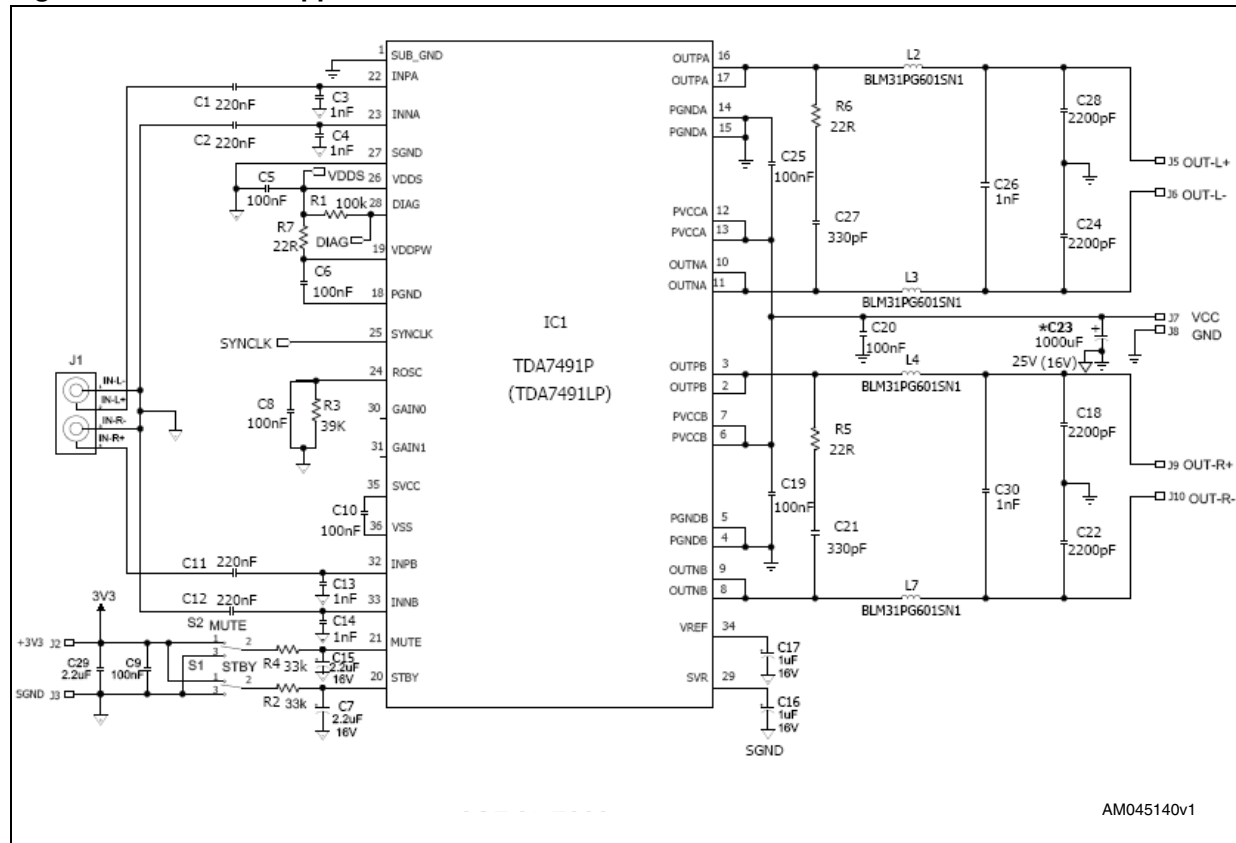
TDA7491P can be used without a filter at the IC outputs, because the frequency of the TDA7491P output is beyond the audio frequency, the audio signal can be recovered by the inherent inductance of the speaker and natural filter of the human ear.

The reconstruction of the audio signal on the load is usually achieved using a complete LC filter (such as a Butterworth) solution that guarantees good audio performance, high efficiency and EMI suppression. The LC component values should be computed by considering the target audio band and the PWM switching frequency. The cut-off frequency must lie well below the switching frequency and above the upper audio frequency. In particular, the following schematic gives a guideline for a cut-off frequency of about 30 kHz for both 6- and 8-Ω speakers.

Thanks to its advanced modulation approach, aimed to improve both driving efficiency and radiating emissions, the device is even able to drive a load with a very low component count. With this cost-saving filtering scheme the TDA7491P complies with the EMI specifications FCC class B. [Figure 47 on page 35](#) shows the simplified schematic adopted for the test and the relevant emission curve at full output power.

Emission tests have been performed with a 1-m length of twisted speaker wire with ferrite beads. Changing the type of the ferrite bead requires care due to factors such as its effectiveness in the EMC frequency range and impedance stability over the rated current range. An output snubber network further improves the emissions and this should be tuned according to the actual PCB, layout and component characteristics.

**Figure 47. Filterless application schematic**



## 5.7 Protection functions

The TDA7491P is fully protected against undervoltages, overcurrents and thermal overloads as explained here.

### Undervoltage protection (UVP)

If the supply voltage drops below the value of  $V_{UVP}$  given in [Table 5: Electrical specifications on page 11](#) 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 of  $I_{OCP}$  given in [Table 5: Electrical specifications on page 11](#) 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.

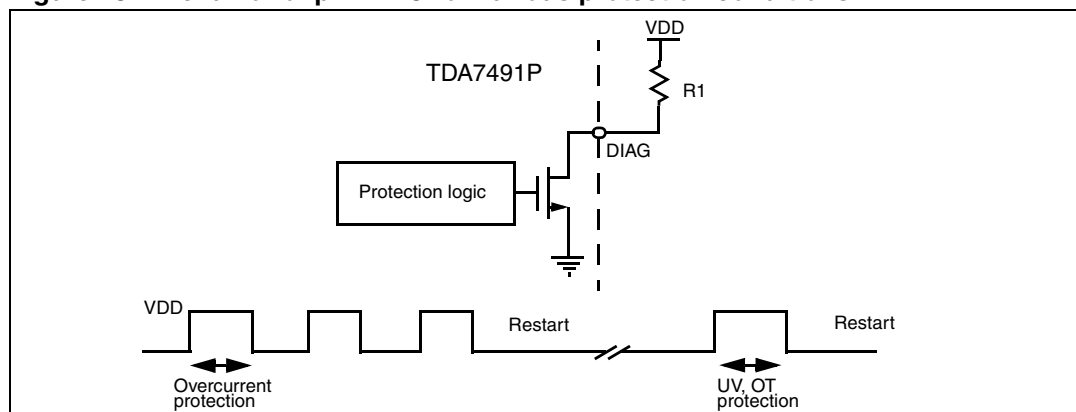
### Thermal protection (OTP)

If the junction temperature,  $T_j$ , reaches 145 °C (nominal), 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 11](#) the device shuts down and the output is forced to the high impedance state. When the device cools sufficiently the device restarts.

## 5.8 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 (<18 V) by a pull-up resistor whose value is limited by the maximum sinking current (200  $\mu$ A) of the pin.

**Figure 48. Behavior of pin DIAG for various protection conditions**



## 5.9 Heatsink requirements

Due to the high efficiency of the class-D amplifier a 2-layer PCB can easily provide the heatsinking capability for low to medium power outputs.

Using such a PCB with a copper ground layer of  $3 \times 3 \text{ cm}^2$  and 16 vias connecting it to the contact area for the exposed pad, a thermal resistance, junction to ambient (in natural air convection), of  $24 \text{ }^\circ\text{C/W}$  can be achieved.

The dissipated power within the device depends primarily on the supply voltage, load impedance and output modulation level. With the TDA7491P driving  $2 \times 6 \text{ }\Omega$  with a supply of  $11 \text{ V}$  then the maximum device dissipation is approximately  $2 \text{ W}$ .

When this power is dissipated at the maximum ambient temperature of  $85 \text{ }^\circ\text{C}$  and the device is mounted on the above PCB then the junction temperature could reach:

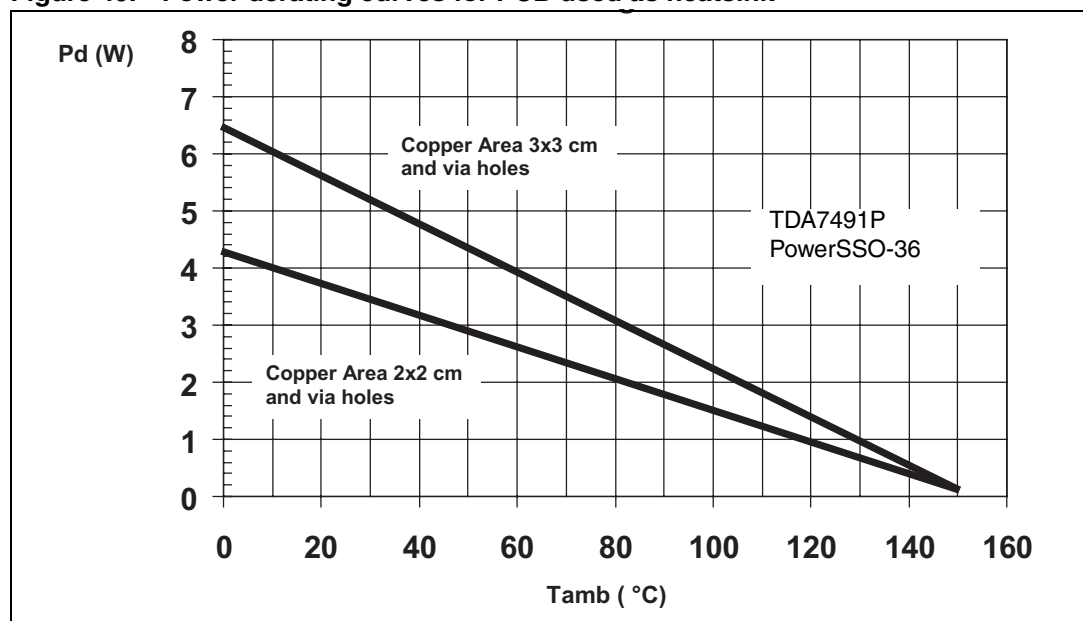
$$T_j = T_{\text{amb}} + P_d \cdot R_{j\text{-amb}} = 85 + 2 \cdot 24 = 133 \text{ }^\circ\text{C}$$

However, this temperature is sufficiently low to avoid triggering thermal warning.

With a musical program the dissipated power is about 40% less than the above maximum value. This leads to a junction temperature of around only  $115 \text{ }^\circ\text{C}$  with the  $9 \text{ cm}^2$  copper ground. A commensurately smaller heatsink can thus be used.

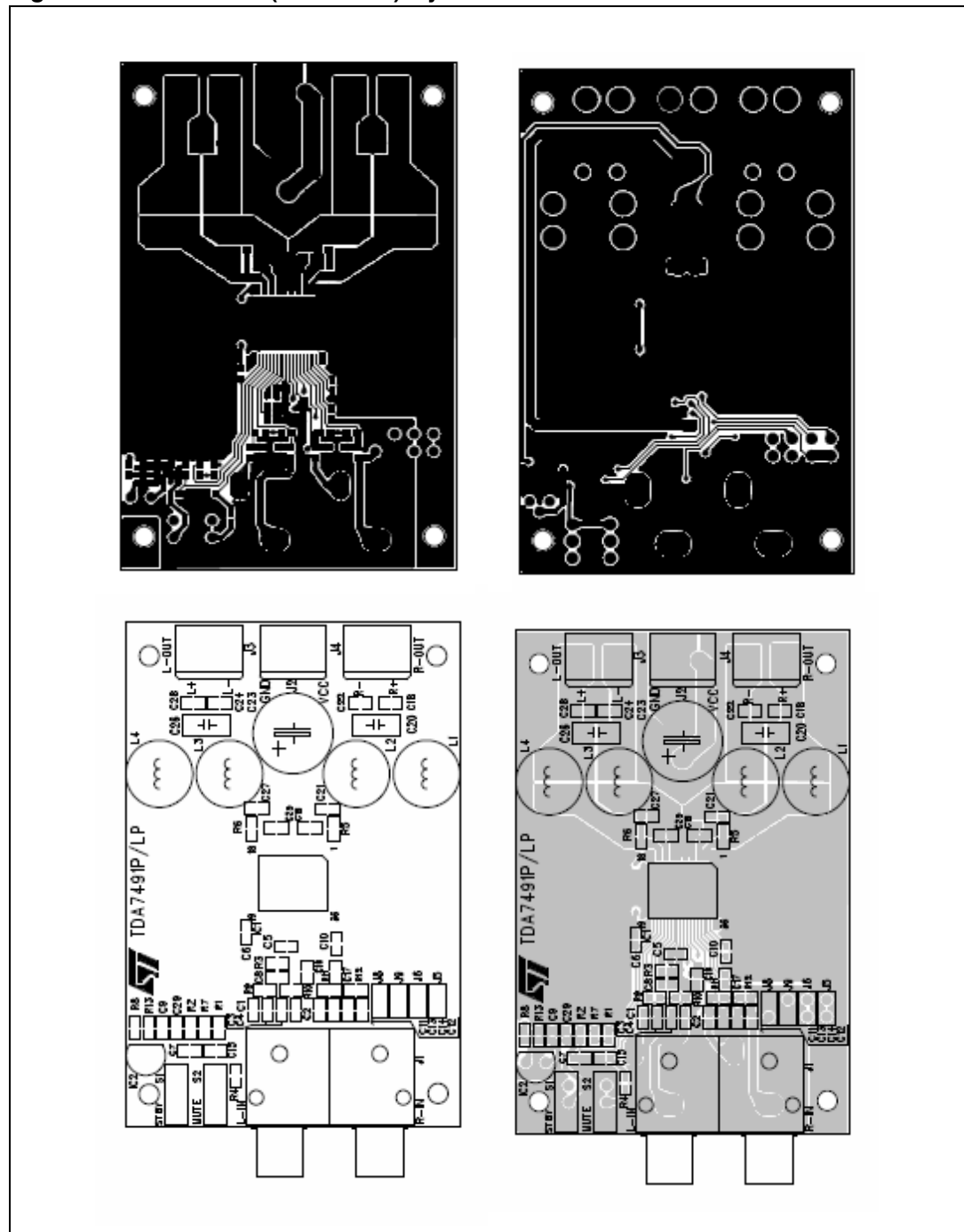
Figure 49 shows the power derating curve for the PowerSSO-36 package on PCBs with copper areas of  $2 \times 2 \text{ cm}^2$  and  $3 \times 3 \text{ cm}^2$ .

**Figure 49. Power derating curves for PCB used as heatsink**



## 5.10 Test board

Figure 50. Test board (TDA7491P) layout



## 6 Package mechanical data

The TDA7491P comes in a 36-pin PowerSSO package with exposed pad down (EPD).

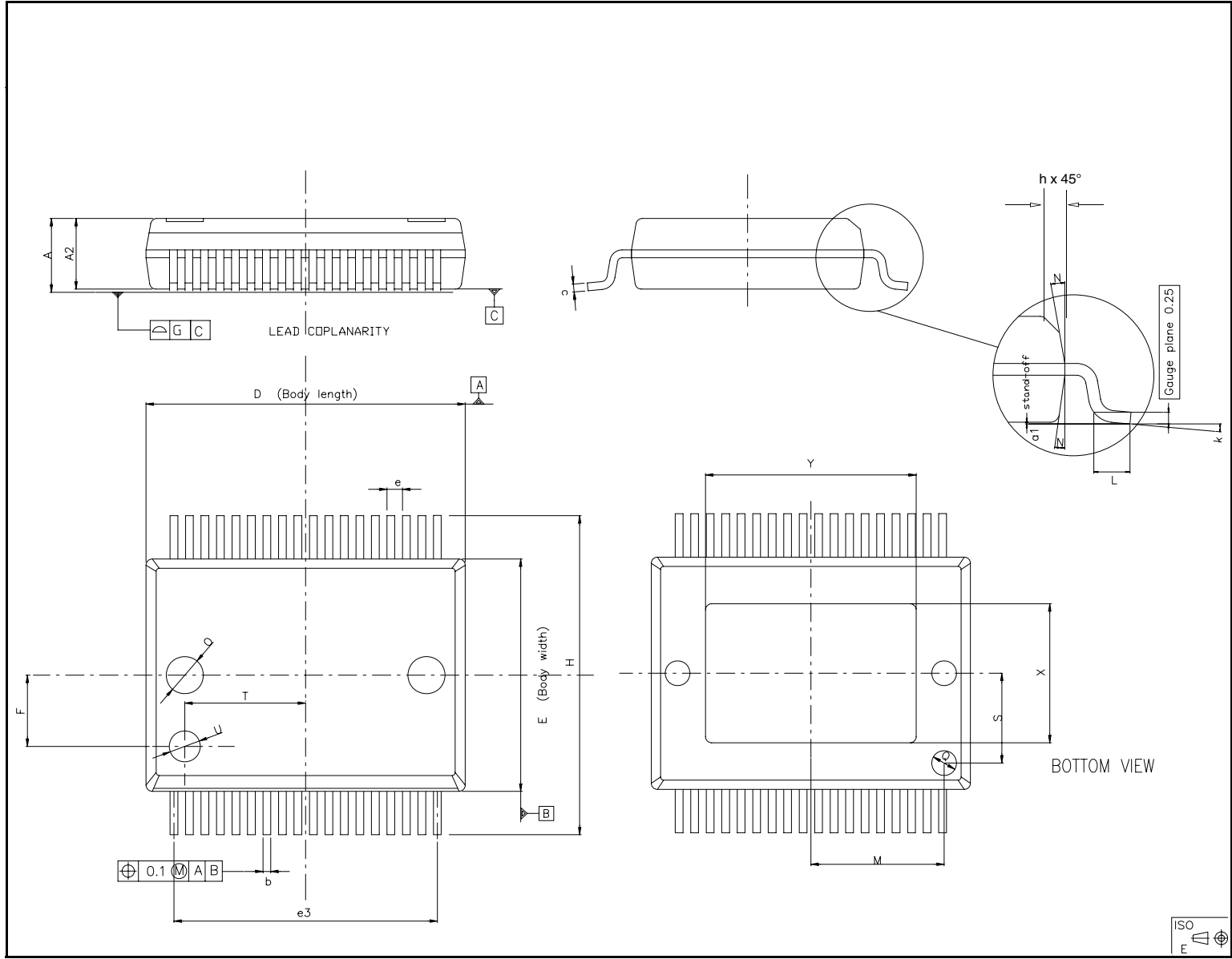
*Figure 51* below shows the package outline and *Table 9* gives the dimensions.

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

| Symbol | Dimensions in mm |      |            | Dimensions in inches |       |            |
|--------|------------------|------|------------|----------------------|-------|------------|
|        | Min              | Typ  | Max        | Min                  | Typ   | Max        |
| A      | 2.15             | -    | 2.47       | 0.085                | -     | 0.097      |
| A2     | 2.15             | -    | 2.40       | 0.085                | -     | 0.094      |
| a1     | 0.00             | -    | 0.10       | 0.000                | -     | 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      | 6.50             | -    | 7.10       | 0.256                | -     | 0.280      |

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 51. PowerSSO-36 EPD outline drawing



## 7 Revision history

**Table 10. Document revision history**

| Date        | Revision | Changes                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
|-------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 02-Jul-2007 | 1        | Initial release.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 15-Oct-2008 | 2        | Updated characterization curves.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              |
| 23-Jun-2009 | 3        | Updated text concerning oscillator R and C in <a href="#">Section 3.3: Electrical specifications on page 11</a><br>Updated condition for I <sub>q</sub> test, added V <sub>UVP</sub> maximum value, updated THD maximum value, updated STBY and MUTE voltages in <a href="#">Table 5: Electrical specifications on page 11</a><br>Updated equation for f <sub>SW</sub> <a href="#">on page 11</a> and <a href="#">on page 32</a><br>Updated <a href="#">Figure 39: Applications circuit for class-D amplifier on page 29</a><br>Updated <a href="#">Section 5.7: Protection functions on page 36</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 04-Sep-2009 | 4        | Added text for exposed pad in <a href="#">Figure 2 on page 8</a><br>Added text for exposed pad in <a href="#">Table 2 on page 9</a><br>Updated exposed pad Y (Min) dimension in <a href="#">Table 9 on page 39</a><br>Updated supply voltage for pin DIAG pull-up resistor in <a href="#">Section 5.8 on page 36</a> .                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        |
| 07-Mar-2011 | 5        | Updated operating temperature range in <a href="#">Table 1 on page 1</a><br>Modified description of pins 10, 11 in <a href="#">Table 2 on page 9</a><br>Added V <sub>I</sub> and updated operating temperature range in <a href="#">Table 3: Absolute maximum ratings on page 10</a><br>Updated <a href="#">Table 4: Thermal data on page 10</a><br>Updated <a href="#">Table 5: Electrical specifications on page 11</a><br>Updated introduction and characterization curves in <a href="#">Section 4 on page 13</a><br>Moved test board layout to <a href="#">Section 5.10 on page 38</a><br>Moved package mechanical data to <a href="#">Section 6 on page 39</a><br>Updated applications circuit in <a href="#">Figure 39 on page 29</a><br>Updated <a href="#">Table 7: Gain settings on page 31</a><br>Updated <a href="#">Section 5.6: Modulation on page 33</a><br>Added <a href="#">Figure 47: Filterless application schematic on page 35</a><br>Removed overvoltage protection from <a href="#">Section 5.7: Protection functions on page 36</a><br>Updated <a href="#">Section 5.9: Heatsink requirements on page 37</a><br>Updated exposed pad dimension Y in <a href="#">Table 9 on page 39</a> |
| 18-Jan-2012 | 6        | Updated <a href="#">Table 7: Gain settings</a>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |

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