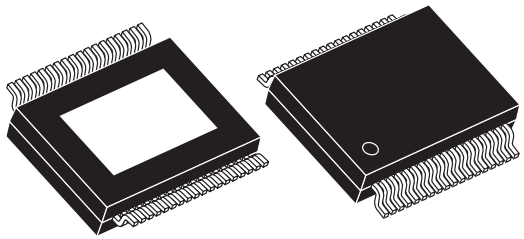
TDA7492P

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 V and R_L = 8 Ω
- Wide-range single-supply operation (8 - 26 V)
- High efficiency (η = 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®, environmentally-friendly package



PowerSSO-36
with exposed pad down

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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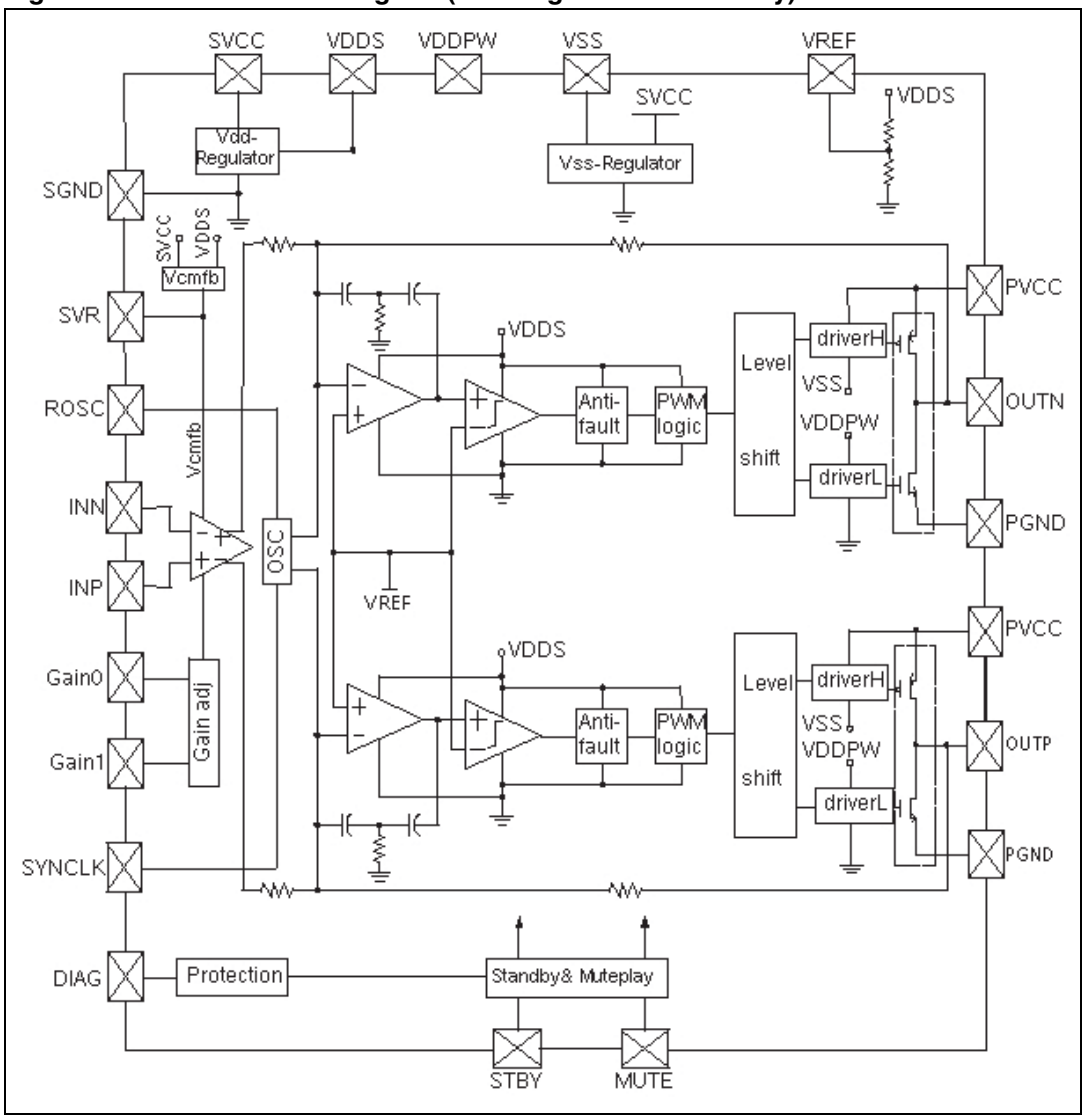
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1 Device block diagram

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

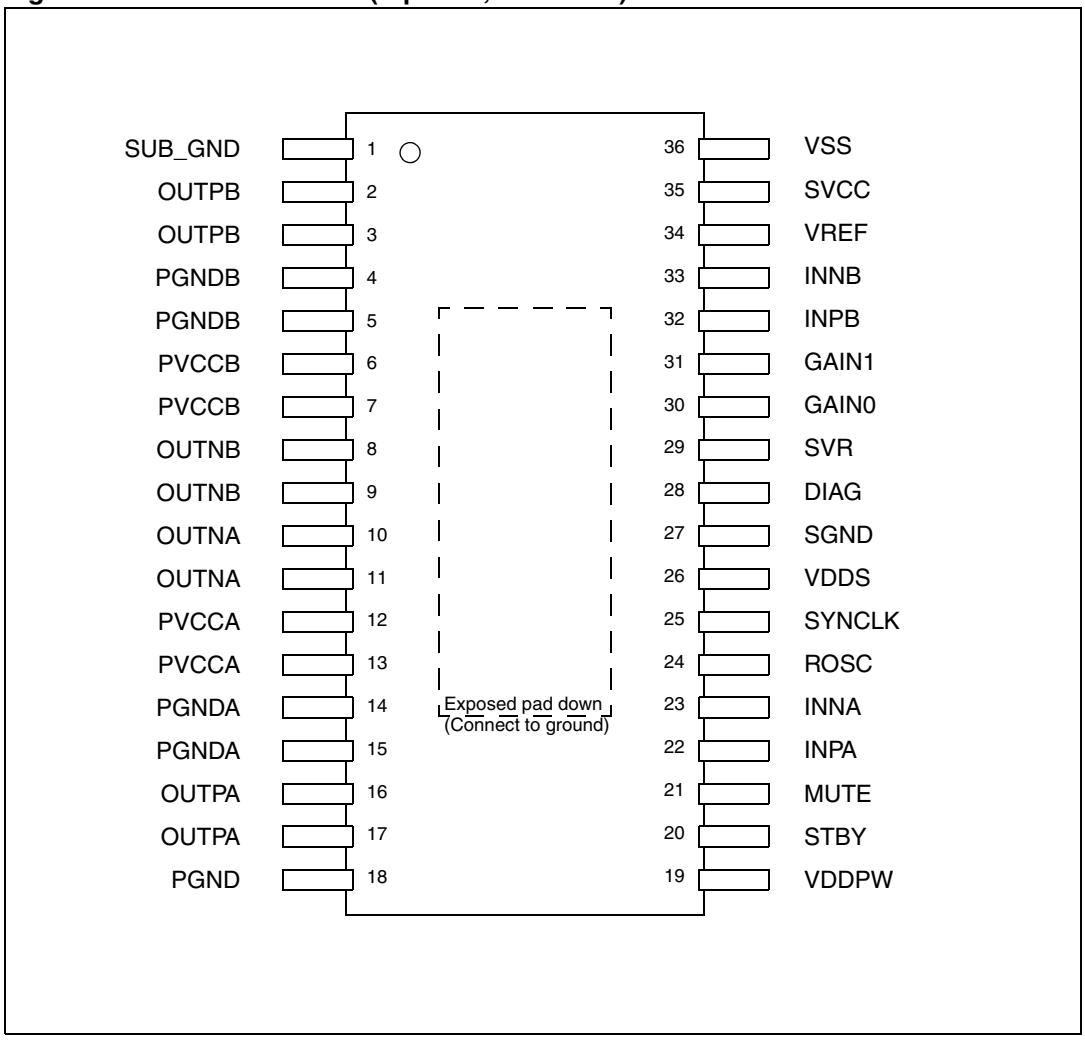
Figure 1. Internal block diagram (showing one channel only)



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_{CCMAX}	DC supply voltage for pins PVCCA, PVCCB, SVCC	30	V
VI	Voltage limits for input pins STANDBY, MUTE, INNA, INPA, INNB, INPB, GAIN0, GAIN1	-0.3 to 3.6	V
T_{op}	Operating temperature	-40 to 85	°C
T_j	Junction temperature	-40 to 150	°C
T_{stg}	Storage temperature	-40 to 150	°C

3.2 Thermal data

Table 4. Thermal data

Symbol	Parameter	Min	Typ	Max	Unit
$R_{th\ j\text{-}case}$	Thermal resistance, junction to case	-	2	3	°C/W
$R_{th\ j\text{-}amb}$	Thermal resistance, junction to ambient	-	24 (1)	-	°C/W

1. FR4 with vias to copper area of 9 cm^2

3.3 Electrical specifications

Unless otherwise stated, the results in *Table 5* below are given for the conditions: V_{CC} = 20 V, R_L (load) = 8 Ω, R_{OSC} = R3 = 39 kΩ, C8 = 100 nF, f = 1 kHz, G_V = 21.6 dB, and Tamb = 25 °C.

Table 5. Electrical specifications

Symbol	Parameter	Condition	Min	Typ	Max	Unit
V_{CC}	Supply voltage for pins PVCCA, PVCCB, SVCC	-	8	-	26	V
I_q	Total quiescent	-	-	26	35	mA
I_{qSTBY}	Quiescent current in standby	-	-	2.5	5.0	µA
V_{OS}	Output offset voltage	Play mode	-	-	±100	mV
		Mute mode	-	-	±60	mV
I_{OCP}	Overcurrent protection threshold	R_L = 0 Ω	3.8	4.2	-	A
T_{jSD}	Junction temperature at thermal shutdown	-	-	150	-	°C
R_i	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	-	Ω
		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, THD = 10%	-	5.0	-	W
η	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	
ΔG_V	Gain matching	-	-	-	±1	dB
CT	Cross talk	f = 1 kHz	-	50	-	dB
eN	Total input noise	A Curve, G_V = 20 dB	-	20	-	μV
		f = 22 Hz to 22 kHz	-	25	35	
SVRR	Supply voltage rejection ratio	fr = 100 Hz, Vr = 0.5 V, C_{SVR} = 10 μF	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 (1)	250	-	400	kHz
		With external oscillator (2)	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 kΩ, 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

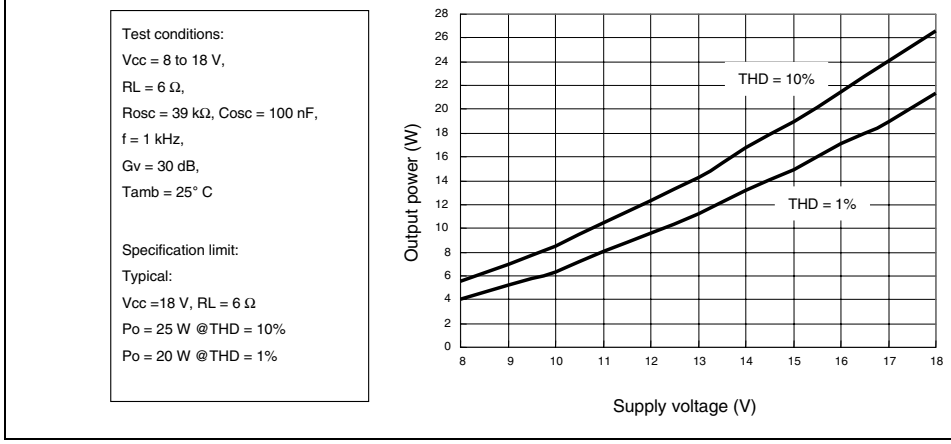


Figure 4. THD at 1 kHz vs. output power

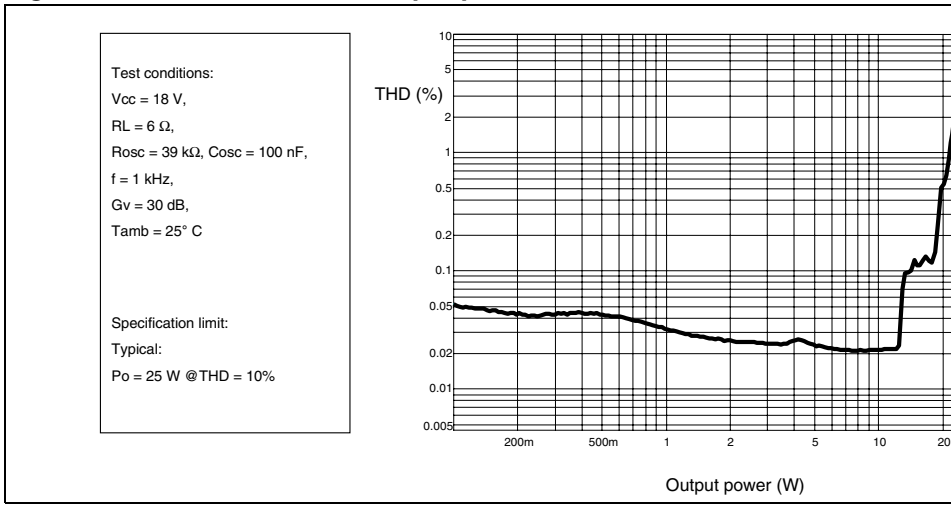


Figure 5. THD at 100 Hz vs. output power

Test conditions:
Vcc = 18 V,
RL = 6 Ω,
Rosc = 39 kΩ, Cosc = 100 nF,
f = 100 Hz,
Gv = 30 dB,
Tamb = 25° C

Specification limit:
Typical:
Po = 25 W @THD = 10%

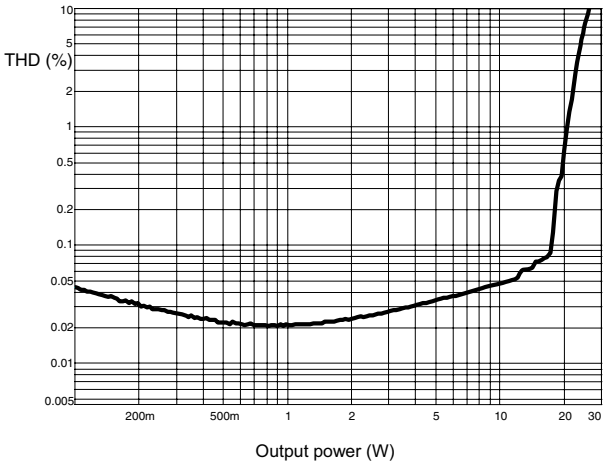


Figure 6. THD at 1 W vs. frequency

Test conditions:
Vcc = 18 V,
RL = 6 Ω,
Rosc = 39 kΩ, Cosc = 100 nF,
f = 1 kHz,
Gv = 30 dB,
Po = 1 W
Tamb = 25° C

Specification limit:
Typical:
THD < 0.4%

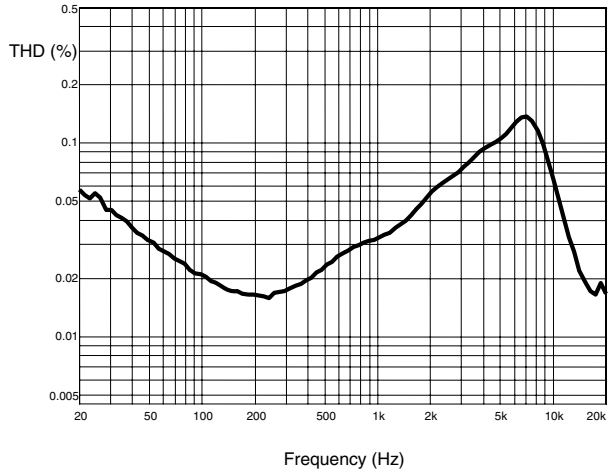


Figure 7. Frequency response

Test conditions:
Vcc = 18 V,
RL = 6 Ω,
Rosc = 39 kΩ, Cosc = 100 nF,
f = 1 kHz,
Gv = 30 dB,
Po = 1 W
Tamb = 25° C

Specification limit:
Max:
+/-3 dB @20 Hz to 20 kHz

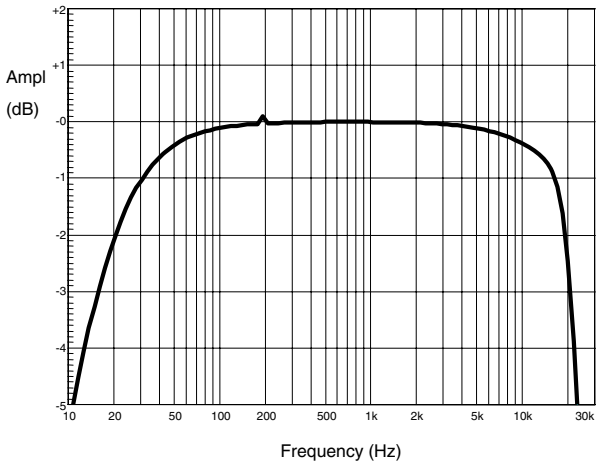


Figure 8. Crosstalk vs frequency

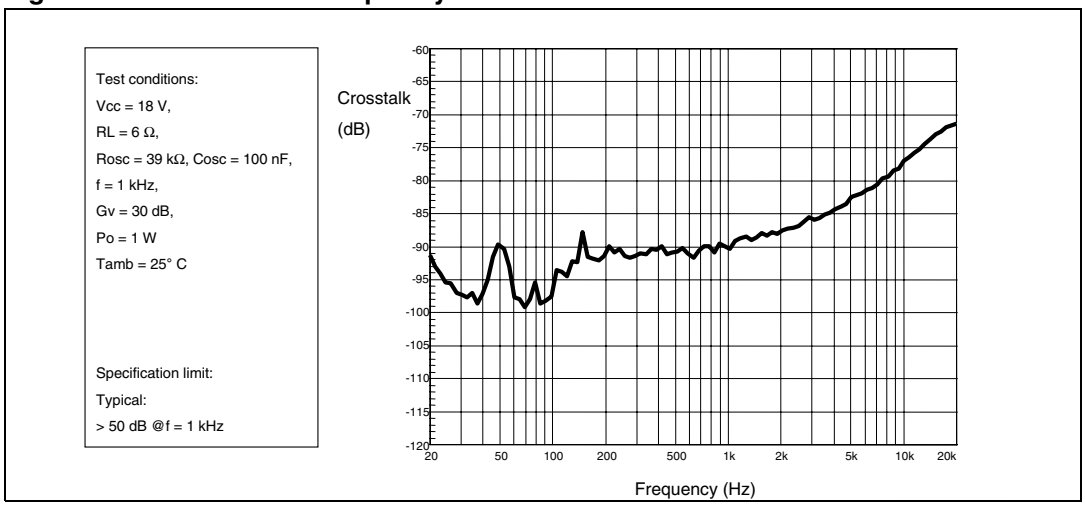


Figure 9. FFT 0 dB

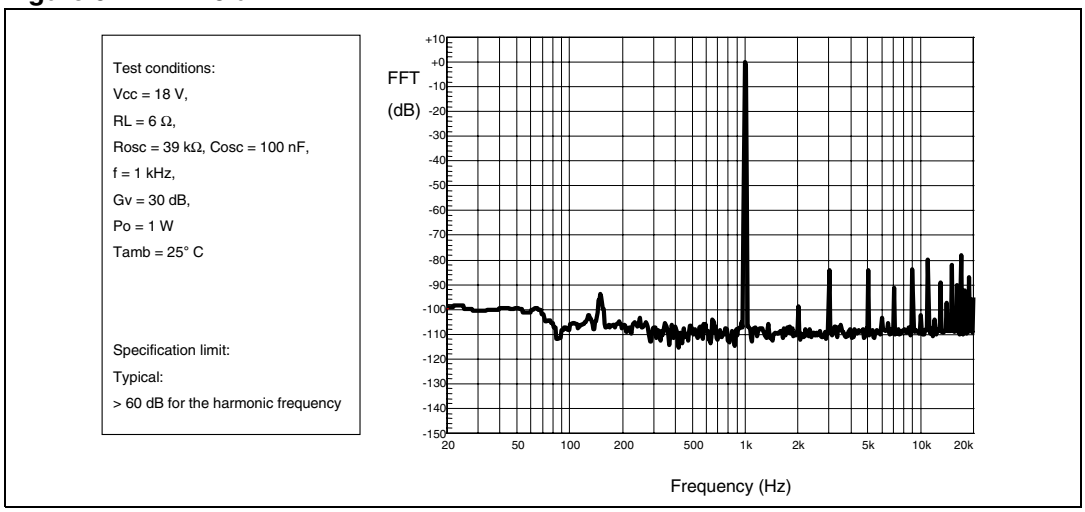
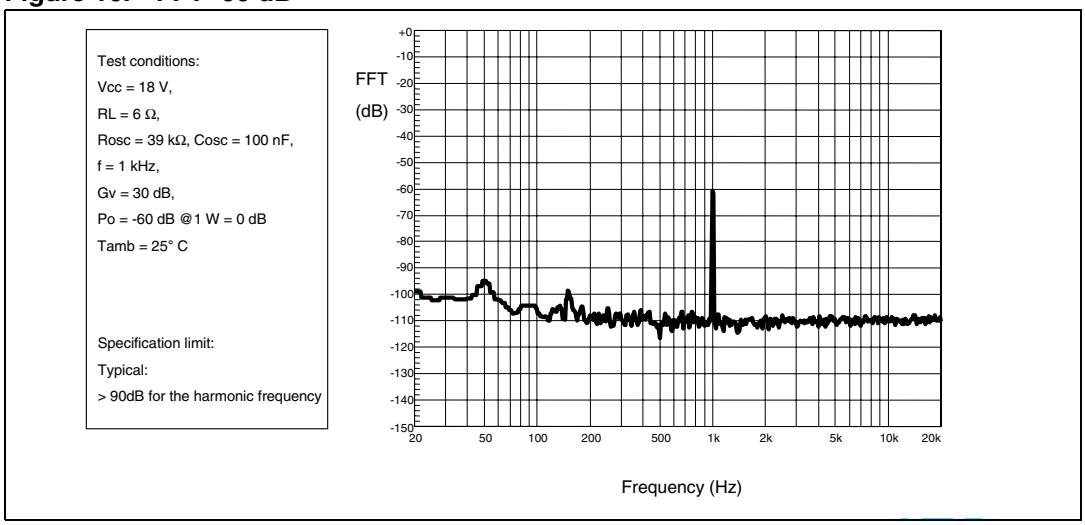


Figure 10. FFT -60 dB



4.2 Characterizations for 8 Ω loads with 20 V

Figure 11. Output power vs supply voltage

Test conditions:
Vcc = 8 to 20 V,
RL = 8 Ω,
Rosc = 39 kΩ, Cosc = 100 nF,
f = 1 kHz,
Gv = 30 dB,
Tamb = 25° C

Specification limit:
Typical:
Vs = 20 V, RL = 8 Ω
Po = 25 W @THD = 10%
Po = 20 W @THD = 1%

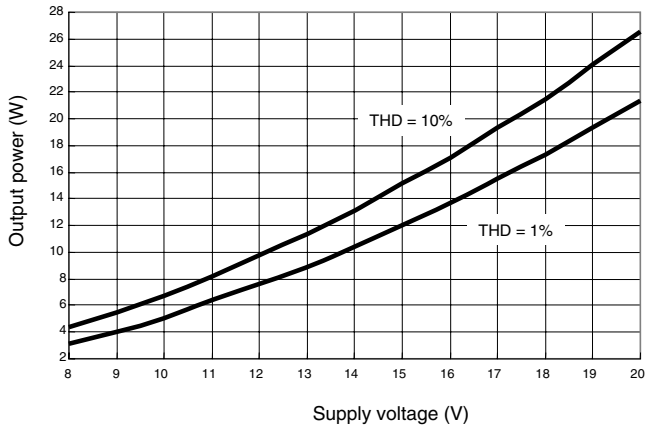


Figure 12. THD at 1 kHz vs output power

Test conditions:
Vcc = 20 V,
RL = 8 Ω,
Rosc = 39 kΩ, Cosc = 100 nF,
f = 1 kHz,
Gv = 30 dB,
Tamb = 25° C

Specification limit:
Typical:
Po = 25 W @THD = 10%

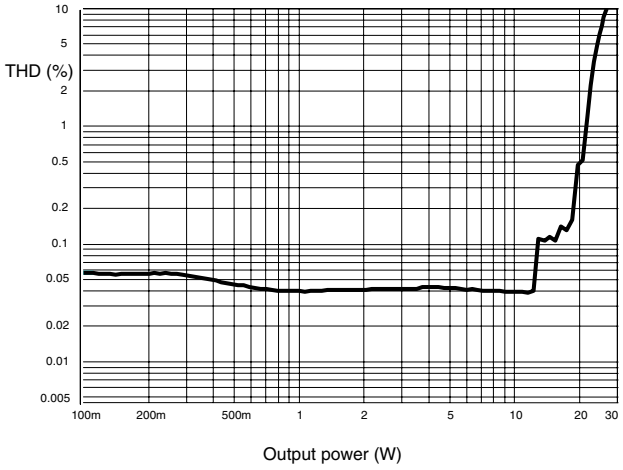


Figure 13. THD at 100 Hz vs output power

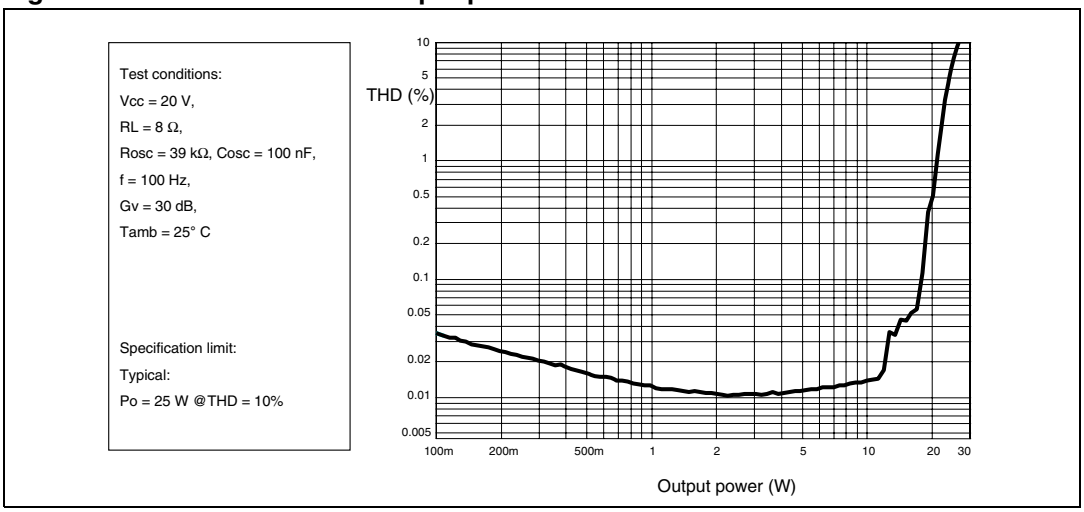


Figure 14. THD at 1 W vs frequency

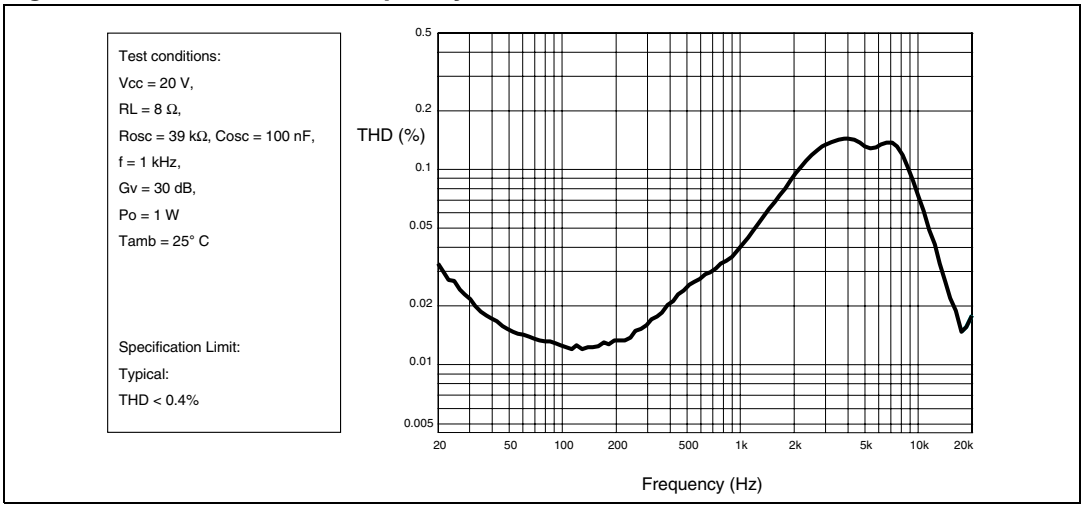


Figure 15. Frequency response

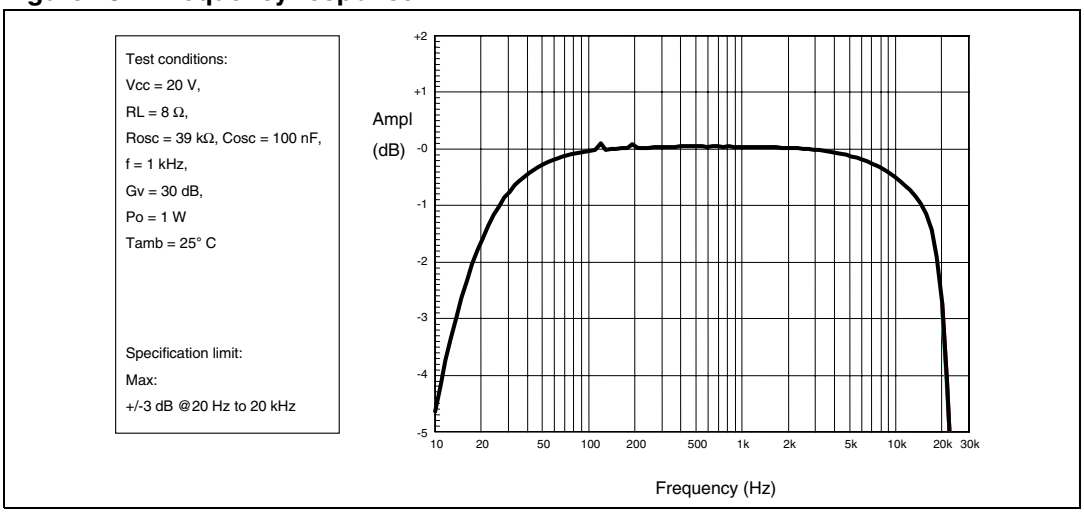


Figure 16. Crosstalk vs frequency

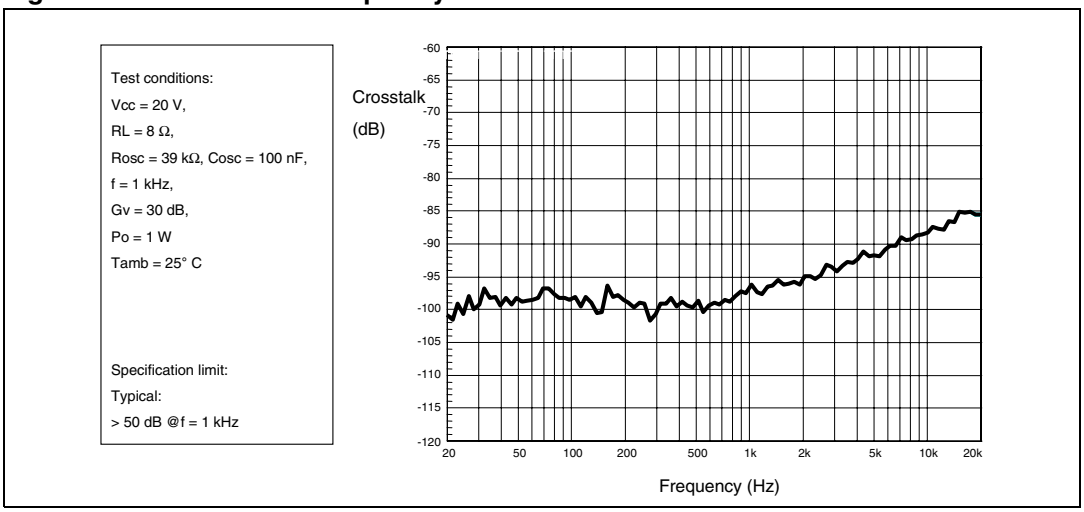


Figure 17. FFT 0 dB

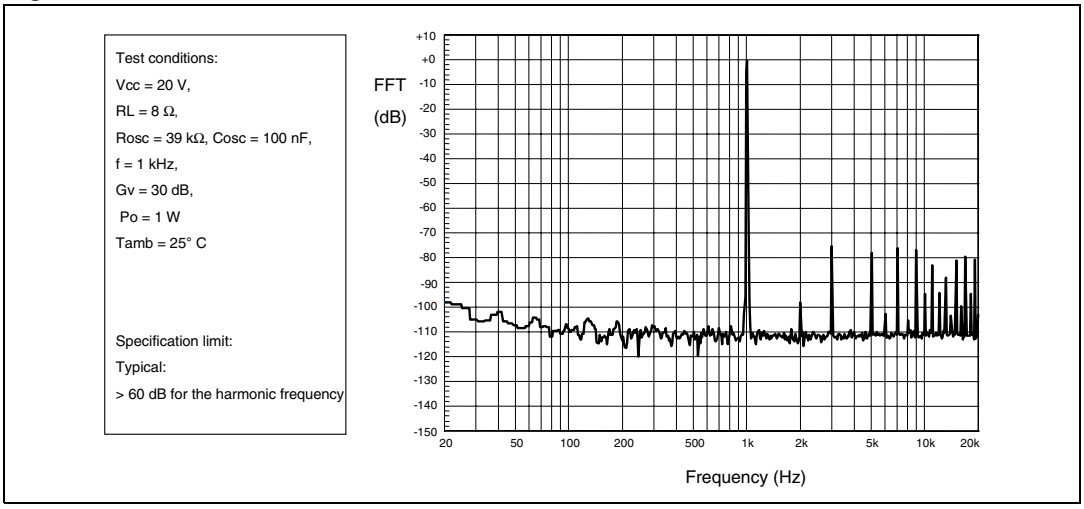


Figure 18. FFT -60 dB

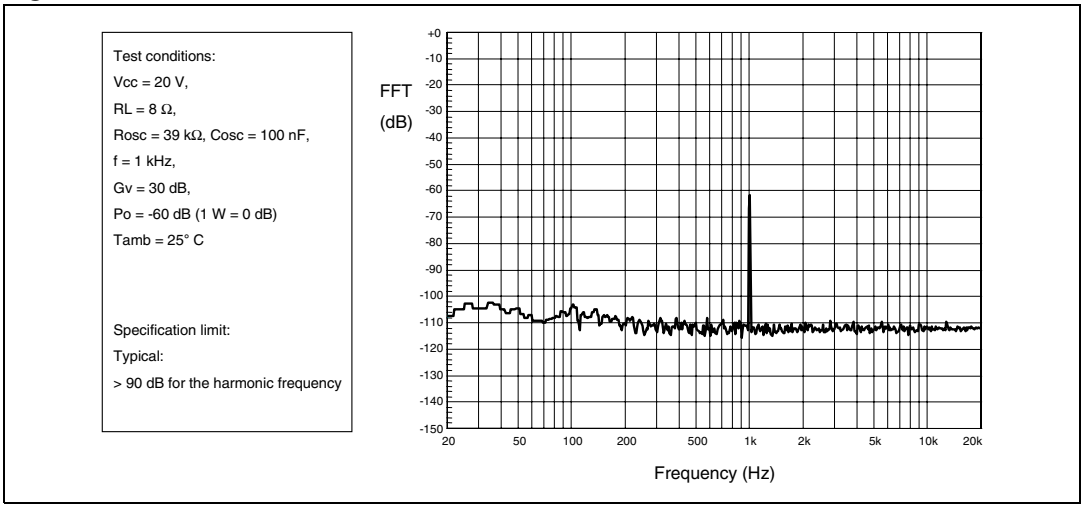
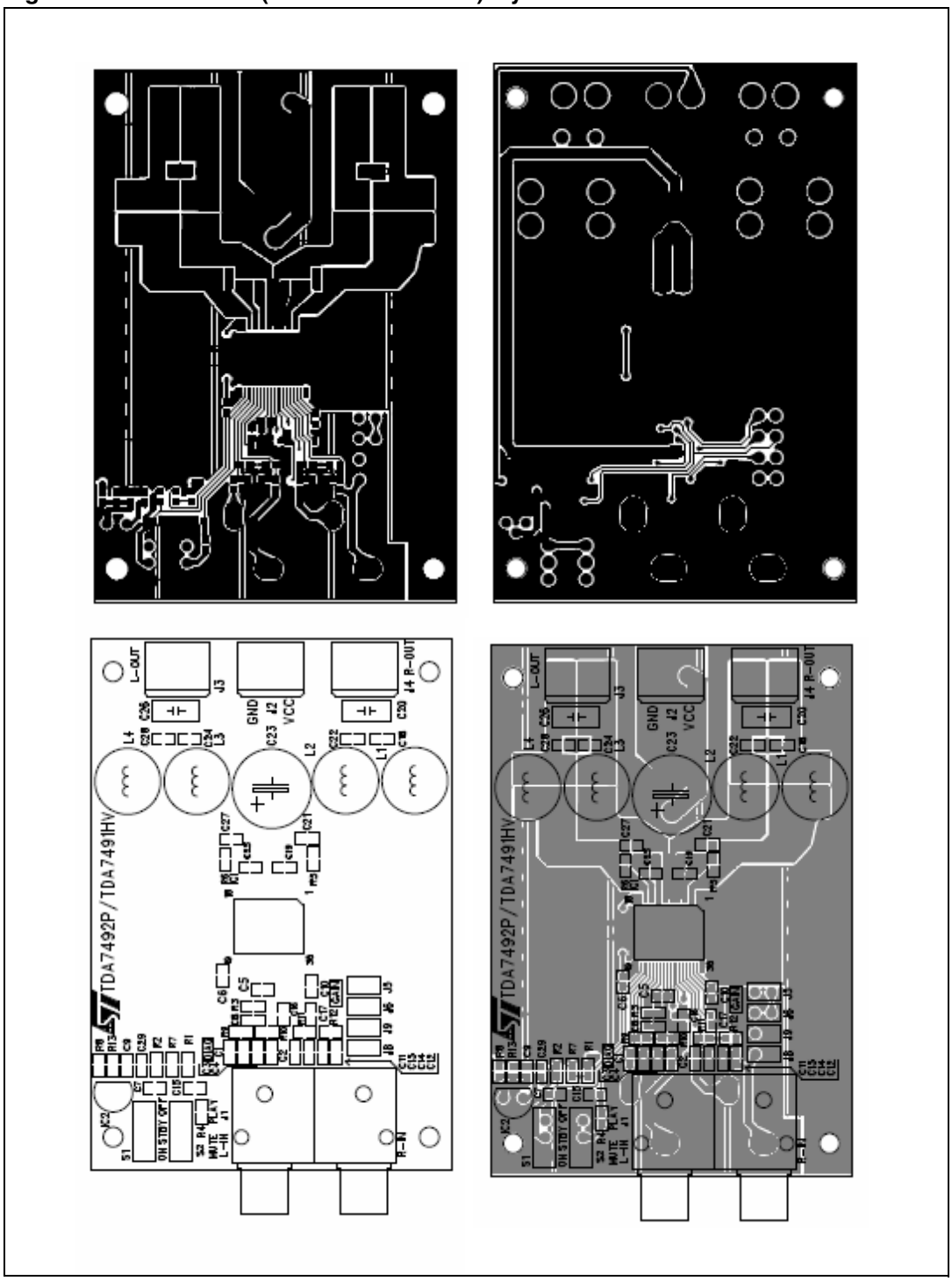
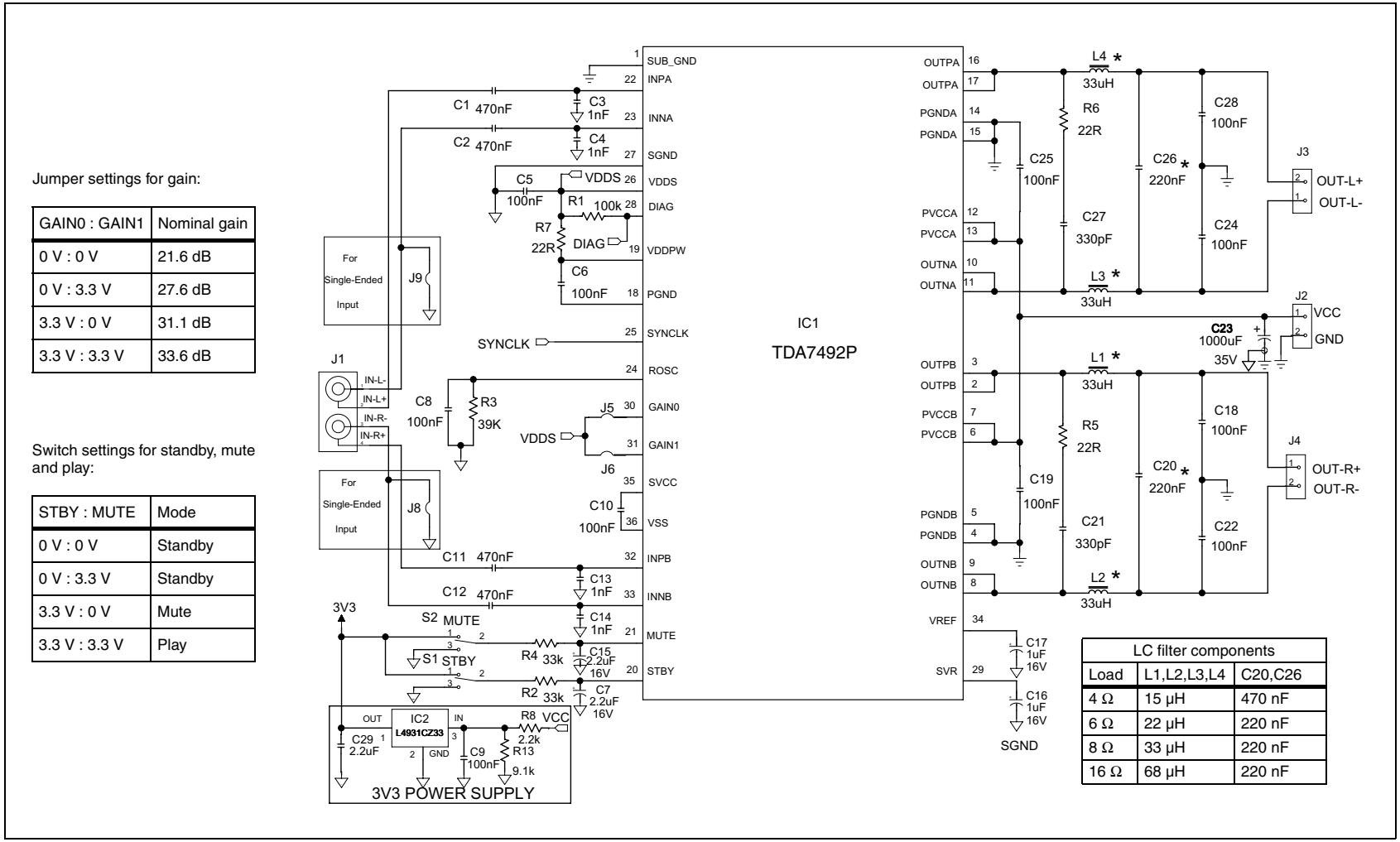


Figure 19. Test board (SZ-LAB-TDA7492P) layout



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 µA.

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

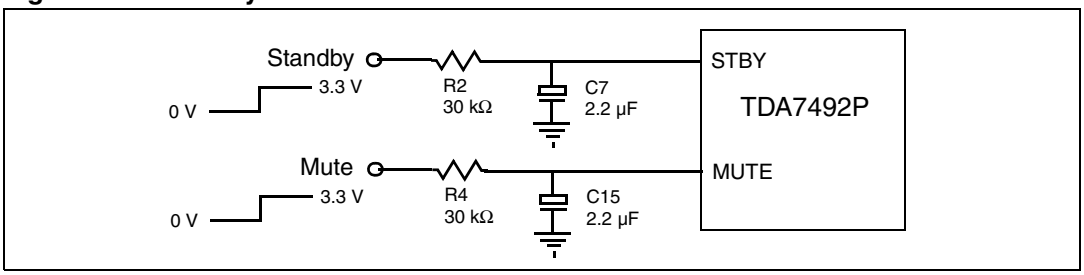
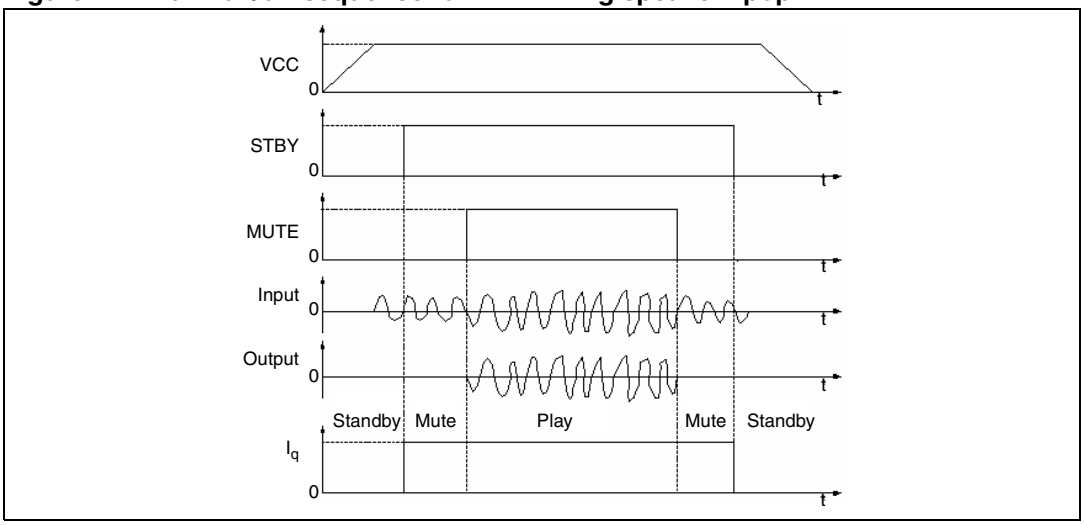


Figure 22. Turn-on/off sequence for minimizing speaker "pop"



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

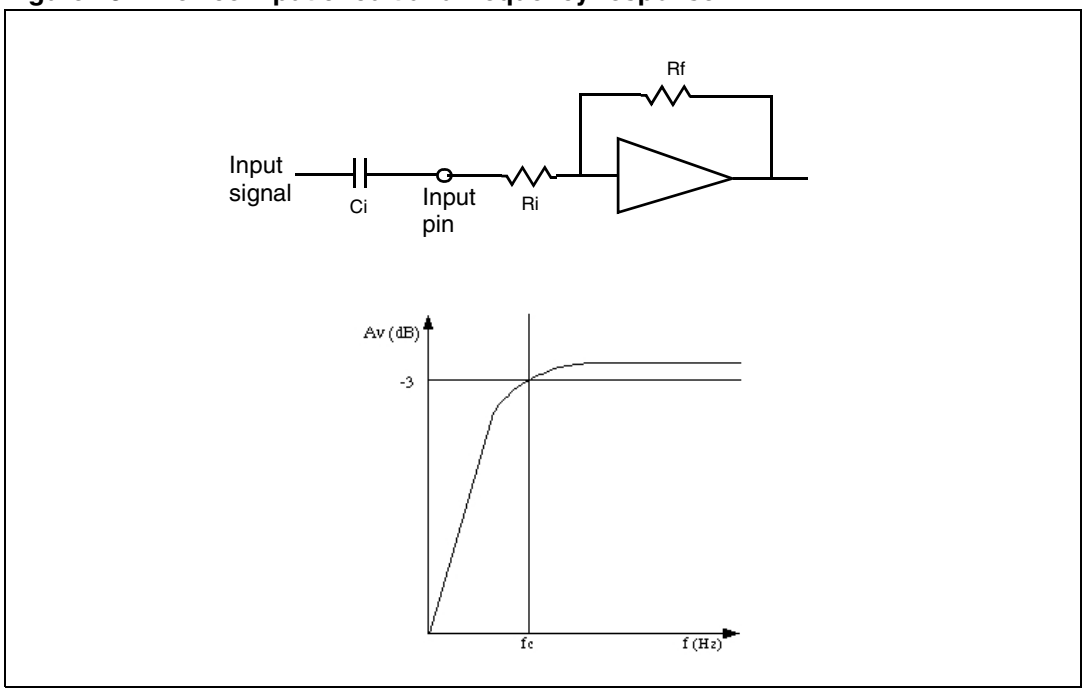
6.3 Input resistance and capacitance

The input impedance is set by an internal resistor Ri = 60 kΩ (typical). An input capacitor (Ci) is required to couple the AC input signal.

The equivalent circuit and frequency response of the input components are shown in *Figure 23*. For Ci = 470 nF the high-pass filter cutoff frequency is below 20 Hz:

$$fc = 1 / (2 * \pi * Ri * Ci)$$

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 kΩ.

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 kΩ 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*.

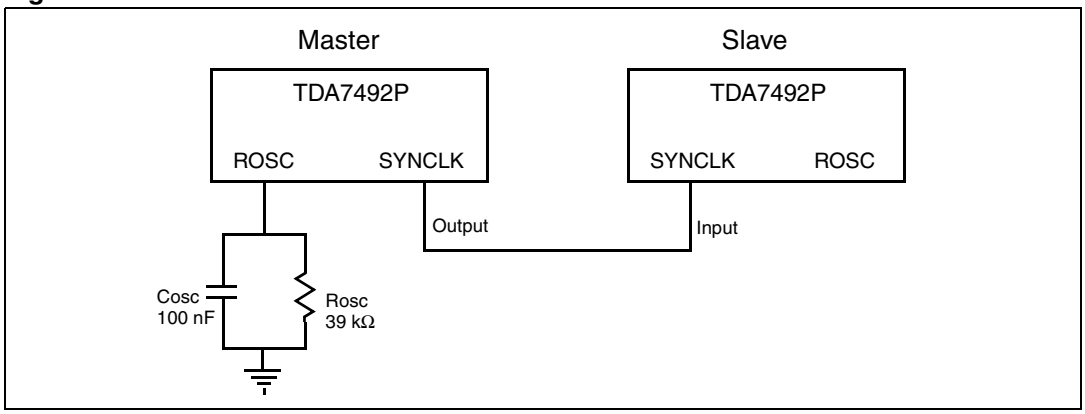
The output switching frequency of the slave devices is:

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

Table 8. How to set up SYNCLK

Mode	ROSC	SYNCLK
Master	R_{OSC} < 60 kΩ	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

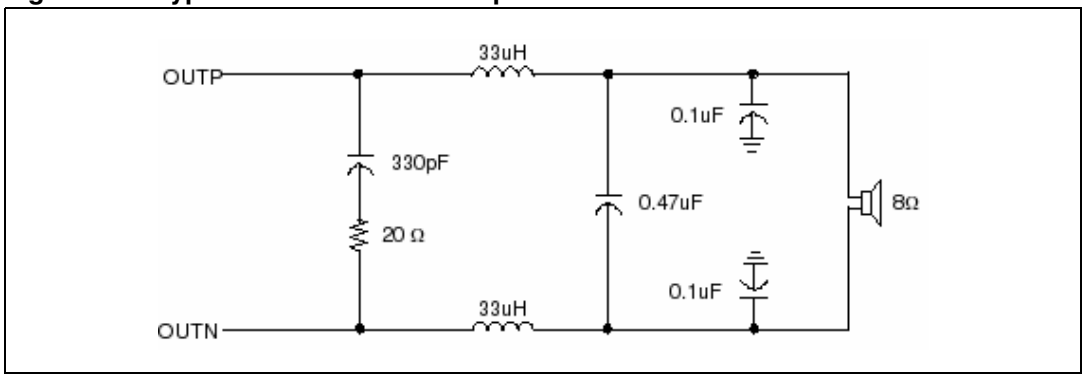
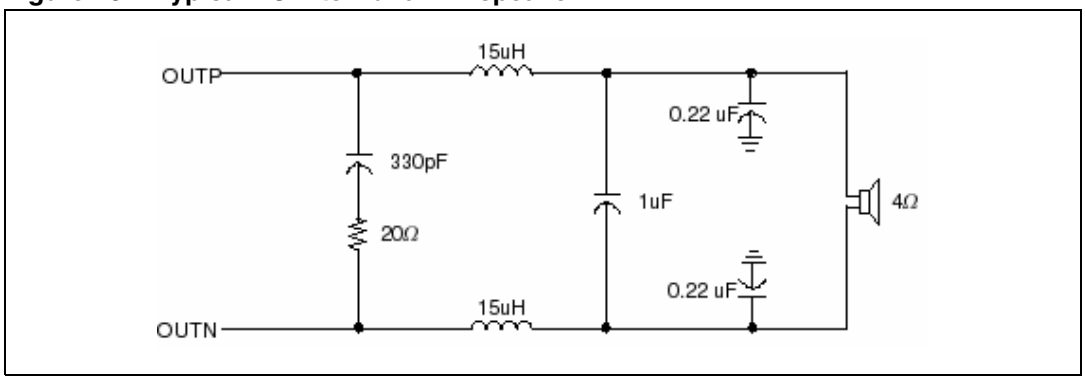


Figure 26. Typical LC filter for a 4-Ω speaker



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.

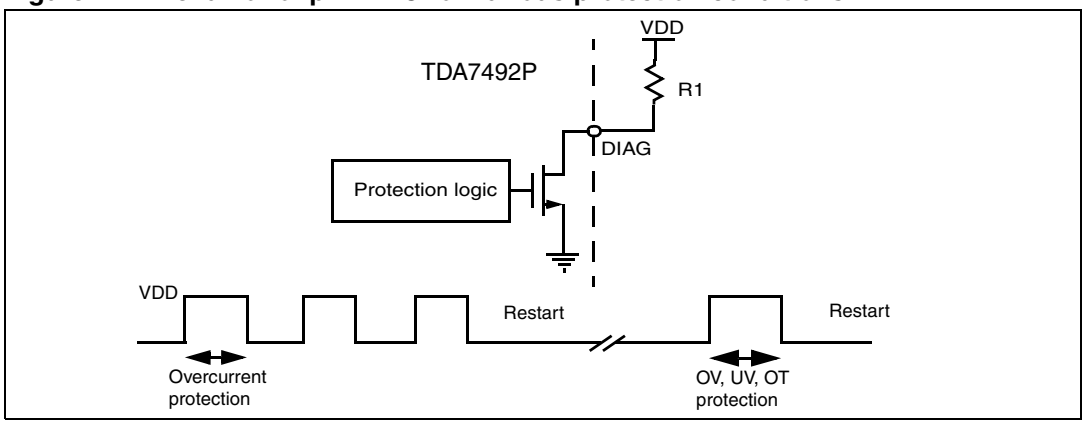
Thermal protection (OTP)

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 µA) 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® packages, depending on their level of environmental compliance. ECOPACK® specifications, grade definitions and product status are available at: *www.st.com*. ECOPACK® is an ST trademark.

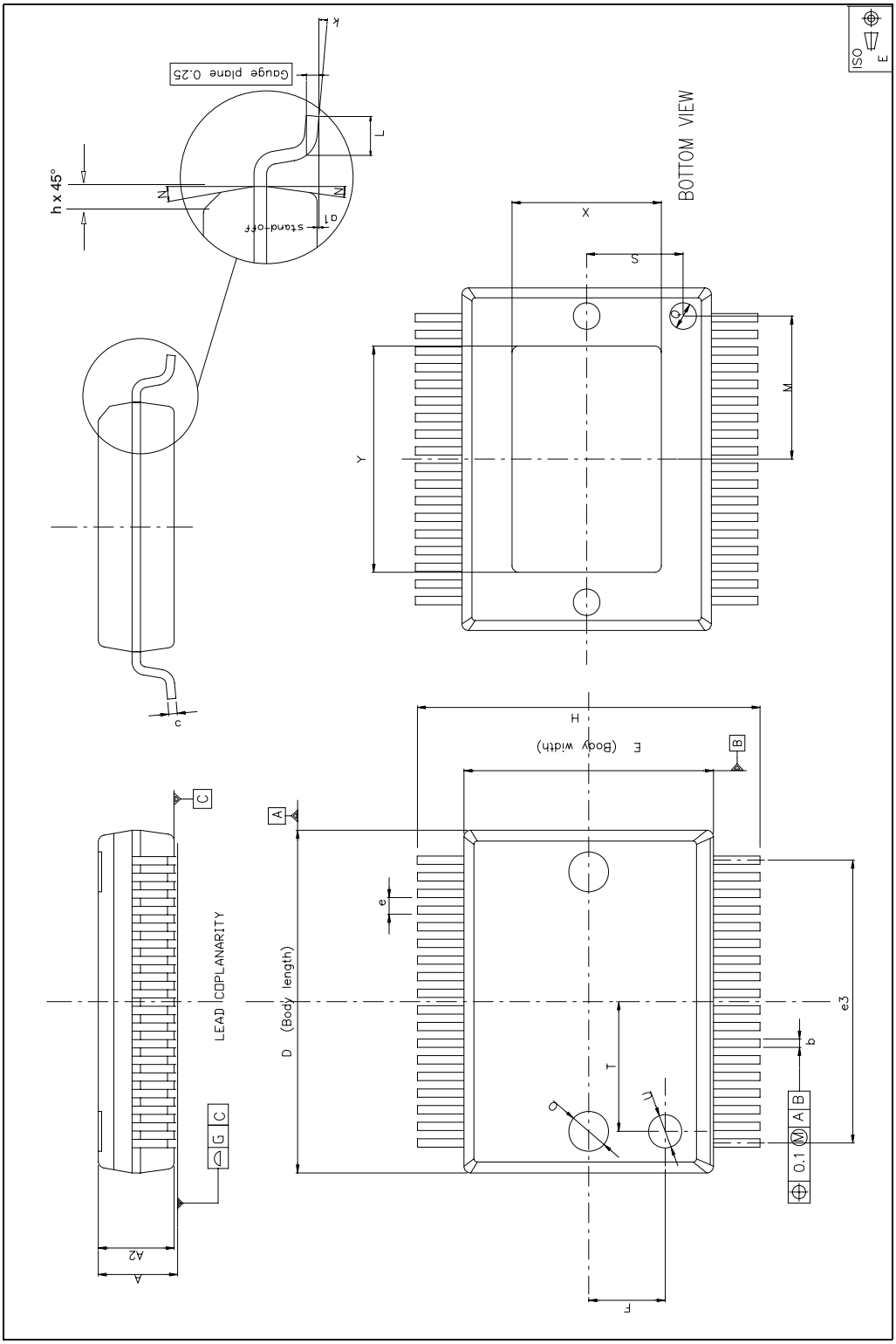


Figure 28. PowerSSO-36 EPD outline drawing

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

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