AN2725
Application note

Demonstration board user guidelines for the TS2012 filter-free stereo 2 x 2.8 W class D audio power amplifier

Introduction

This application note applies to the STEVAL-CCA007V1 demonstration board, designed to evaluate the stereo class D audio differential amplifier TS2012.

The document provides:

- a brief description of the TS2012 device,
- a description of the demonstration board and all of its components,
- the layout of the demonstration board.

About the TS2012

The TS2012 is a fully-differential class D stereo power amplifier that can drive up to 1.35 W into an 8 Ω load at 5 V per channel. It achieves outstanding efficiency compared to typical class AB audio amplifiers.

The device has four different gain settings that use two digital pins: G0 and G1. Pop and click reduction circuitry provides low on/off switch noise while allowing the device to start within 1 ms. Two standby pins (active low) allow each channel to be switched off independently.

The TS2012 is available in a 4 x 4 mm QFN20 package.

Key features of the TS2012

- Operating range from V_{CC} = 2.5 to 5.5 V
- Standby mode active low
- Output power per channel: 1.35 W at 5 V or 0.68 W at 3.6 V into 8 Ω with 1% THD+N max
- Output power per channel: 2.2 W at 5 V into 4 Ω with 1% THD+N max
- Four gain select settings: 6, 12, 18, 24 dB
- Low current consumption
- PSRR: 70 dB typ at 217 Hz with 6 dB gain
- Fast start-up phase: 1 ms
- Thermal shutdown protection
- QFN20 4 x 4 mm lead-free package

Refer to the datasheet for complete information on the TS2012.

1 Description of the demonstration board

The STEVAL-CCA007V1 is designed to evaluate the TS2012, a fully-differential class D stereo power amplifier. The TS2012 device, available in a QFN package, is mounted on a two-layer PCB with a copper area acting as a heatsink. Easily-accessible on-board connectors are used to change or drive the gain select pins (G0 and G1) and the standby control pins. The input configuration of the TS2012 can also be changed.

The differential **gain** of the TS2012 can be set to 6, 12 18, or 24 dB, depending on the logic level of the G0 pin (connected to pin 2 of the P3) and G1 pin (connected to pin 2 of the P2).

Table 1. Gain settings with G0 and G1 pins

G1	G0	P2	P3	Gain (dB)	Gain (V/V)
0	0			6	2
0	1			12	4
1	0			18	8
1	1			24	16

Note: There is an internal 300 kΩ (+/-20%) resistor between pins G0, G1 and GND. When the pins are floating (P2 and P3 included), the gain is 6 dB. In full standby mode (left and right channels OFF), these resistors are disconnected (HiZ input).

The **input configuration** is either capacitor-coupled or common-mode feedback. On the board, the connectors for the left channel (P13 and P14) and those for the right channel (P23 and P24) allow you to change the input configuration.

In the **capacitor-coupled configuration**, the -3 dB cut-off frequency F_C in Hz is:

$$F_c = \frac{1}{2\pi \cdot Z_{in} \cdot C_{in}}$$

with Z_{in} in Ω (Z_{in}= 30 kΩ typically), C_{in} in Farads, C13 = C14 and C23 = C24.

Note: On the TS2012 demonstration board C_{in} = C13 = C14 = C23 = C24 = 220 nF, which means that F_C = 24.1 Hz for both channels.

More information on component calculations is available in the TS2012 datasheet.

Table 2. Demonstration board connectors

Connector(s)	Description
P1	**Power connector** (V_{CC} and GND). Power supply voltage from 2.5 to 5.5 V.
P2, P3	**Gain setting** connectors - **P2** for the **G1** pin, **P3** for the **G0** pin of the TS2012. The connector pins are connected as follows: – 1 to V_{CC} – 2 of P2 to the G1 pin – 2 of P3 to the G0 pin – 3 to GND Jumper positions: – logical "1": pins 1 and 2 are shorted  – logical "0": pins 2 and 3 are shorted
P4, P5	**Standby control** connector - **P4** for the **right** channel, **P5** for the **left** channel. The connector pins are connected as follows: – 1 to V_{CC} – 2 of P4 to the STBYR pin of the TS2012 – 2 of P5 to the STBYL pin of the TS2012 – 3 to GND Jumper positions: –  when pins 1 and 2 are shorted, the channel is operating. –  when pins 2 and 3 are shorted or pin 2 is floating, the channel is in standby mode.
P11	Left channel positive input signal connectors (active input signal L_{in}+ and GND)
P12	Left channel negative input signal connectors (active input signal L_{in}- and GND)
P21	Right channel positive input signal connectors (active input signal R_{in}+ and GND)
P22	Right channel negative input signal connectors (active input signal R_{in}- and GND)
P13, P14, P23, P24	Input configuration: – capacitor coupled when P13 and P14 (P23 and P24) are disconnected. – common-mode feedback when P13 and P14 (P23 and P24) are shorted by jumpers.
P15	Left channel output signal connector (positive and negative output)
P25	Right channel output signal connector (positive and negative output)

Caution: When you apply the power supply through P1, **do not** invert the polarity as this will irreversibly damage the U1 amplifier.

Figure 1. Schematic diagram

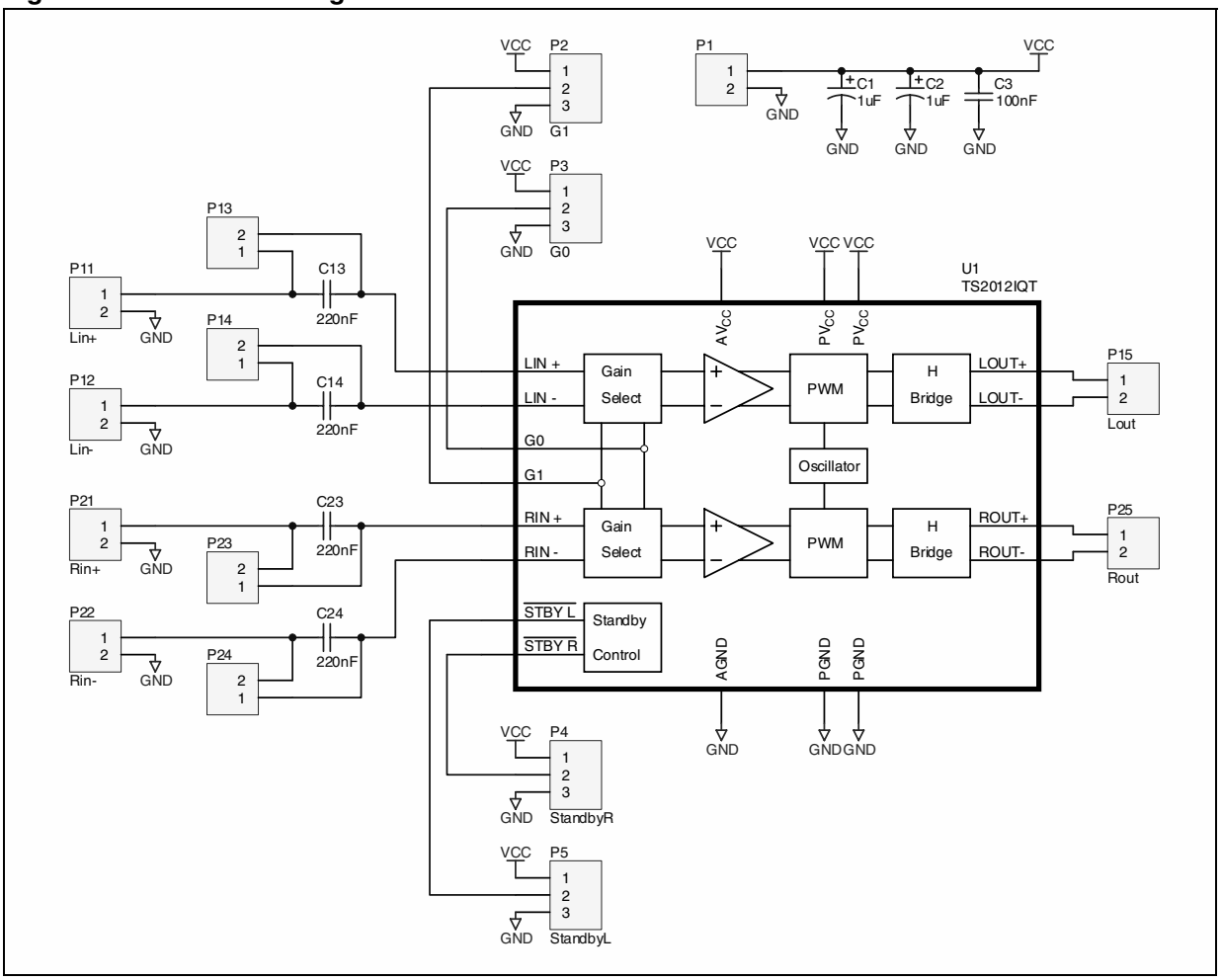


Table 3. Demonstration board component list

Designation	Quantity	Description
C1, C2, C3	3	1 µF/16 V, SMD ceramic capacitors, 0603
C12, C14, C23, C24	4	220 nF/16 V, SMD ceramic capacitor, 0603
P1, P11, P12, P13, P14, P15, P21, P22, P23, P24, P25	11	2-pin header, 2.54 mm pitch
P2, P3, P4, P5	4	3-pin header, 2.54 mm pitch
U1	1	TS2012IQT

2 Demonstration board layout

The following schematics show the layers and top view of the demonstration board.

Figure 2. PCB top layer

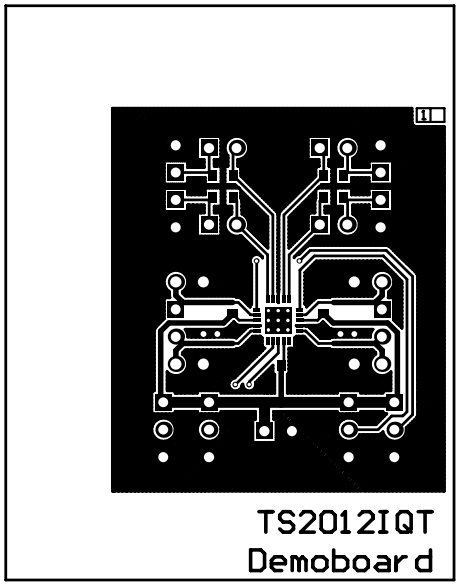


Figure 3. PCB bottom layer

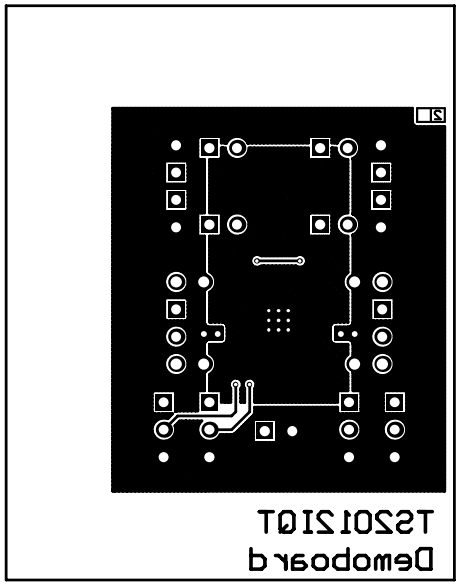
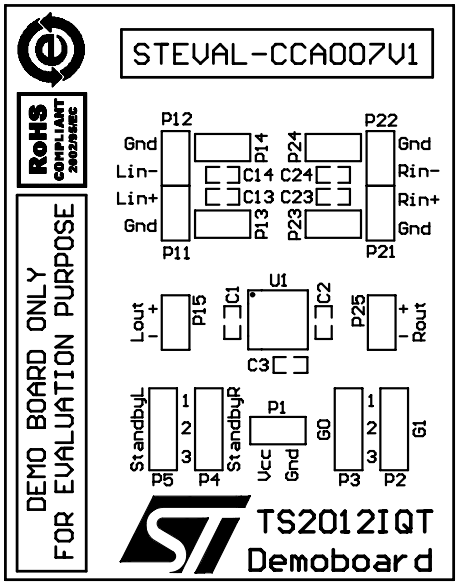


Figure 4. Demonstration board top view and dimensions



3 Conclusion

To order the board online, go to *http://www.st.com/stonline/domains/buy/buy_dev.htm*, and use the order code STEVAL-CCA007V1.

4 Revision history

Table 4. Document revision history

Date	Revision	Changes
28-Aug-2009	1	Initial release.