Texas Instruments

TAS5508-5142K7EVM User's Guide

Evaluation Module for the TAS5508B Digital Audio PWM Processor and TAS5142 Digital Amplifier Power Output Stage

User's Guide

June 2006

SLEU071

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Overview

The TAS5508-5142K7EVM PurePath Digital™ customer evaluation amplifier module demonstrates two audio integrated circuits, TAS5508B and TAS5142, from Texas Instruments (TI).

The TAS5508BPAG is a high-performance 32-bit (24-bit input) multichannel PurePath Digital pulse width modulator (PWM) based on Equibit™ technology, with a fully symmetrical AD modulation scheme. It accepts an input sample rate from 32 kHz to 192 kHz. The device also has digital audio processing (DAP) that provides 48-bit signal processing, advanced performance, and a high level of system integration. The device has interfaces for headphone output and power supply volume control (PSVC).

The TAS5142DKD is a compact, high-power, digital amplifier power stage designed to drive a 4-Ω loudspeaker up to 100 W/10% THD+N. It contains integrated gate drivers, four matched and electrically isolated enhancement-mode N-channel power DMOS transistors, and protection/fault-reporting circuitry.

The DKD package has a PowerPAD™ on the top side for heat transfer through a heatsink. The heatsink in this design is for evaluation purposes only.

This EVM, together with a TI input-USB board, is a complete 7-channel digital audio amplifier system, which includes digital input (S/PDIF), analog inputs, interface to PC, and DAP features, such as digital volume control, input and output mixers, auto mute, equalization, tone controls, loudness, dynamic range compression, and PSVC output. There are configuration options for stereo line level output, stereo headphone output, and power-stage failure protection.

This 6.1 system is designed for home-theater applications, such as A/V receivers, DVD minicomponent systems, home theater in a box (HTIB), DVD receivers, or plasma display panels (PDPs).

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1.1 TAS5508-5142K7EVM Features

- 7-channel PurePath Digital evaluation module (double-sided plated-through PCB layout)
- Stereo channel line output
- Stereo headphone output
- Self-contained protection system (short circuit and thermal)
- Standard I^2S and I^2C/control connector for TI input board
- Double-sided plated-through PCB layout

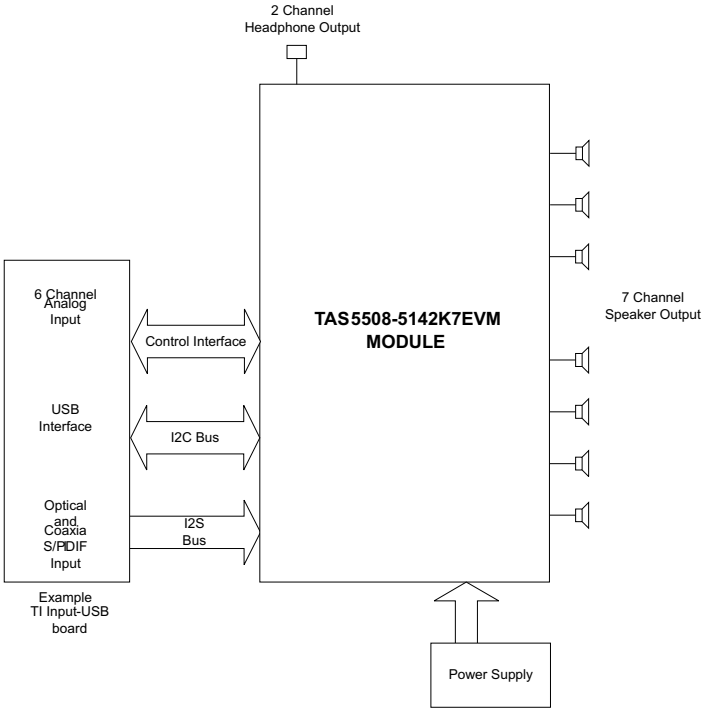


Figure 1-1. Integrated PurePath Digital™ Amplifier System

1.2 PCB Key Map

Physical structure for the TAS5508-5142K7EVM is illustrated in Figure 1-2.

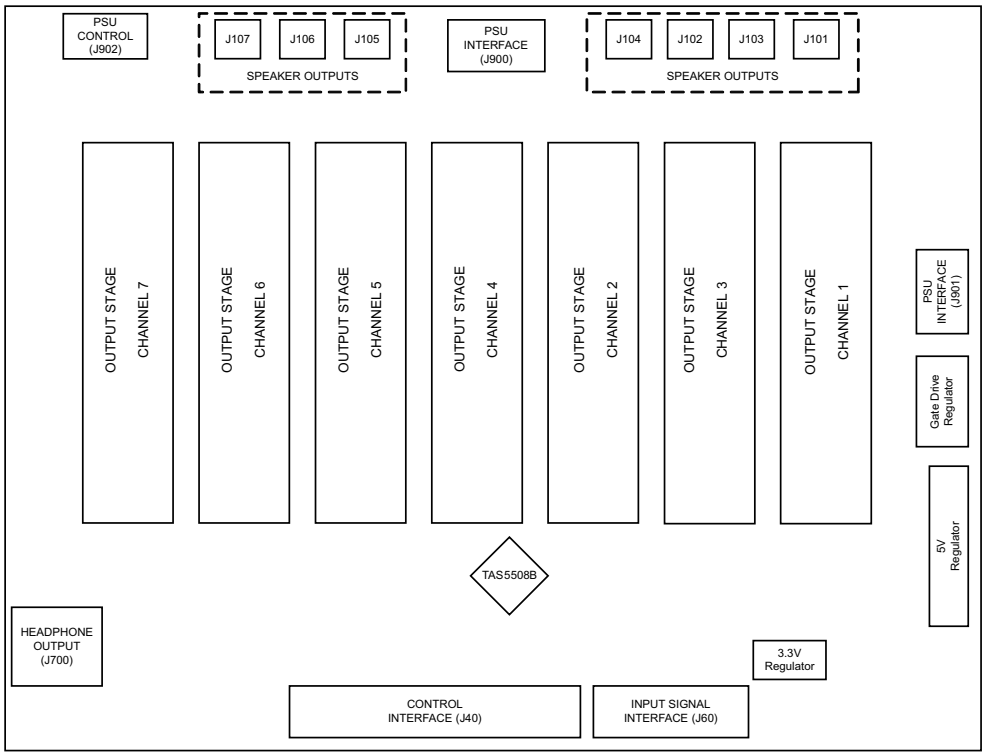


Figure 1-2. Physical Structure for TAS5508-5142K7EVM (Rough Outline)

System Interfaces

This chapter describes the TAS5508-5142K7EVM board in regards to power supplies and system interfaces.

2.1 Power Supply (PSU) Interface (J901 and J900)

The TAS5508-5142K7EVM module must be powered from external power supplies. High-end audio performance requires a stabilized power supply with low ripple voltage and low output impedance.

Note: The length of power-supply cable must be minimized. Increasing length of PSU cable is equal to increasing the distortion for the amplifier at high output levels and low frequencies.

Maximum output-stage supply voltage depends of the speaker load resistance. Please check the recommended maximum supply voltage in the TAS5142 data sheet.

Table 2-1. Recommended Supply Voltages

DESCRIPTION	VOLTAGE LIMITATIONS	CURRENT RECOMMENDATIONS
System power supply	15 V to 20 V	0.3 A
Output-stage power supply	0 V to 32 V	6 A(1)

(1) The rated current correspond to 2-channel full scale (80 W each), which most likely is adequate for a standard 8-channel amplifier design.

The recommended TAS5142 power-up sequence is shown in the figure below. For proper TAS5142 operation, the $\overline{\text{RESET}}$ signal should be kept low during power up. $\overline{\text{RESET}}$ is pulled low during power up for 200 ms by the onboard reset generator (U73).

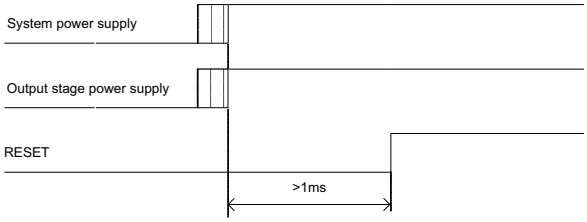
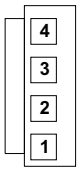


Figure 2-1. Recommended Power-Up Sequence



(PCB connector top view)

Figure 2-2. J901 and J900 Pin Numbers

Table 2-2. J901 Pin Description

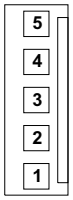
PIN NO.	NET-NAME AT SCHEMATICS	DESCRIPTION
1	PVDD	Output-stage power supply
2	SYSTEM	System power supply
3	GND	Ground
4	GND	Ground

Table 2-3. J900 Pin Description

PIN NO.	NET-NAME AT SCHEMATICS	DESCRIPTION
1	PVDD	Extra output-stage power supply
2	PVDD	Extra output-stage power supply
3	GND	Extra ground
4	GND	Extra ground

2.2 PSU Control Interface (J902)

This interface is used for onboard sensing of output supply voltage and for the power supply volume control (PSVC) signal.



(PCB connector top view)

Figure 2-3. J902 Pin Numbers

Table 2-4. J902 Pin Description

PIN NO.	NET-NAME AT SCHEMATICS	DESCRIPTION
1	—	Reserved for future use
2	PVDD	Sense of output power supply
3	GND	Ground
4	$\overline{\text{RESET}}$	System reset (bidirectional)
5	PSVC	Power supply volume control signal

2.3 Loudspeaker Connectors (J101 … J107)

CAUTION

Both positive and negative speaker outputs are floating and may not be connected to ground (e.g., through an oscilloscope).

(PCB connector top view)

Figure 2-4. J101 . . . J107 Pin Numbers

Table 2-5. J101 . . . J107 Pin Description

PIN NO.	NET-NAME AT SCHEMATICS	DESCRIPTION
1	OUT-1	Speaker negative output
2	OUT-2	Speaker positive output

2.4 Headphone Connector (J700)

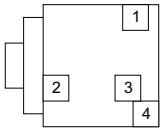


Figure 2-5. J700 Pin Numbers

Table 2-6. J700 Pin Description

PIN NO.	NET-NAME AT SCHEMATICS	DESCRIPTION
1	OUT-R	Right headphone output
2	GND	Ground
3	—	For future use
4	OUT-L	Left headphone output

2.5 Control Interface (J40)

This interface connects the TAS5508-5142K7EVM board to a TI input-USB board.

Table 2-7. J40 Pin Description

PIN NO.	NET-NAME AT SCHEMATICS	DESCRIPTION
1	GND	Ground
2	RESERVED	—
3	GND	Ground
4	$\overline{\text{RESET}}$	System reset (bidirectional). Activate $\overline{\text{MUTE}}$ before $\overline{\text{RESET}}$ for quiet reset.
5	$\overline{\text{BKND-ERR}}$	Backend error (or soft reset) provides reduced click and pop reset, without resetting I^2C volume register settings.
6	$\overline{\text{MUTE}}$	Ramp volume from any setting to noiseless soft mute. Mute can also be activated by I^2C.
7	$\overline{\text{PDN}}$	Power down. TAS5508B will go to power-down state when activated.
8	RESERVED	—
9	RESERVED	—
10	SDA	I^2C data clock

Table 2-7. J40 Pin Description (continued)

PIN NO.	NET-NAME AT SCHEMATICS	DESCRIPTION
11	GND	Ground
12	SCL	I^2C bit clock
13	RESERVED	—
14	RESERVED	—
15	RESERVED	—
16	RESERVED	—
17	GND	Ground
18	RESERVED	—
19	RESERVED	—
20	$\overline{SD}$	Shutdown error reporting for all channels. Activated if TAS5142 has high current or high temperature. See Chapter 3, *Protection.*
21	$\overline{SD}$	Shutdown reporting. Activated if one or more TAS5142 has high current or high temperature. Pin 21 connected to Pin 20. See Chapter 3, *Protection.*
22	$\overline{OTW}$	Temperature warning. Activated if TAS5142 has reached temperature warning level.
23	$\overline{OTW}$	Temperature warning. Activated if one or more TAS5142 has reached temperature warning level. Pin 23 connected to Pin 22.
24	$\overline{HP\text{-}SEL}$	Headphone select. Headphone active when LOW and inactive when HIGH. To use this pin, <100-Ω resistor must be placed for R50.
25	GND	Ground
26	GND	Ground
27	RESERVED	—
28	RESERVED	—
29	RESERVED	—
30	RESERVED	—
31	GND	Ground
32	GND	Ground
33	+5V	+5Vdc power supply (output)
34	+5V	+5Vdc power supply (output)

2.6 Digital Audio Interface (J60)

The digital audio interface contains digital audio signal data (I^2S), clocks, etc. Please see the *TAS5508B Data Manual* for signal timing and details not explained in this document.

Table 2-8. J60 Pin Description

PIN NO.	NET-NAME AT SCHEMATICS	DESCRIPTION
1	GND	Ground
2	MCLK	Master clock input. Low jitter system clock for PWM generation and reclocking. Ground connection from source to TAS5508B must be a low impedance connection.
3	GND	Ground
4	SDIN1	I^2S data 1, channel 1 and 2
5	SDIN2	I^2S data 2, channel 3 and 4
6	SDIN3	I^2S data 3
7	SDIN4	I^2S data 4
8	—	Reserved
9	—	Reserved
10	GND	Ground
11	SCLK	I^2S bit clock
12	GND	Ground
13	LRCLK	I^2S left-right clock
14	GND	Ground
15	—	Reserved
16	GND	Ground

Protection

This chapter describes the short-circuit protection and fault-reporting circuitry of the TAS5142 device.

3.1 Short-Circuit Protection and Fault-Reporting Circuitry

The TAS5142 is a self-protecting device that provides fault reporting (including high-temperature protection and short-circuit protection). The TAS5142 is configured in back-end auto-recovery mode and, therefore, resets automatically after all errors (M1, M2, and M3 are set low). This means that the device will restart itself after a error occasion and report through the $\overline{SD}$ error signal.

3.2 Fault Reporting

The $\overline{OTW}$ and $\overline{SD}$ outputs from the TAS5142 indicate fault conditions. Please refer to the *TAS5142 Data Manual* for a description of these pins.

Table 3-1. TAS5142 Warning/Error Signal Decoding

$\overline{OTW}$	$\overline{SD}$	DEVICE CONDITION
0	0	High-temperature error and/or high-current error
0	1	High-temperature warning
1	0	Undervoltage lockout or high-current error
1	1	Normal operation, no errors/warnings

The temperature warning signals at the TAS5508-5142K7EVM board are wired-OR to one temperature warning signal ($\overline{OTW}$ – pin 22 in control interface connector). Shutdown signals are wired-OR into one shutdown signal ($\overline{SD}$ – pin 20 in control interface connector).

The shutdown signals, together with the temperature warning signal, give chip state information as described in Table 3-1. Device fault-reporting outputs are open-drain outputs.

Related Documentation From Texas Instruments

The following is a list of documents that have detailed descriptions of the integrated circuits used in the design of the TAS5508-5142K7EVM. This information can be obtained at the URL http://www.ti.com.

- TAS5508B data sheet (SLES162)
- TAS5142 data sheet (SLES126)
- TPA112 data sheet (SLOS212)
- TPS3801K33 data sheet (SLVS219)
- LM317M data sheet (SLVS297)
- TPS76733 data sheet (SLVS208)

Additional documents

- TAS5508-5142K7EVM Application Report (SLEA055)
- PC Configuration Tool for TAS5508B (TAS5508 GUI ver. 4.0 or later)
- General Application Notes

4.1 Trademarks

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EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM within the input voltage range of 0 to 32 V and the output voltage range of 15 V to 20 V.

Exceeding the specified input range may cause unexpected operation and/or irreversible damage to the EVM. If there are questions concerning the input range, please contact a TI field representative prior to connecting the input power.

Applying loads outside of the specified output range may result in unintended operation and/or possible permanent damage to the EVM. Please consult the EVM User's Guide prior to connecting any load to the EVM output. If there is uncertainty as to the load specification, please contact a TI field representative.

During normal operation, some circuit components may have case temperatures greater than 75°C. The EVM is designed to operate properly with certain components above 75°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

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