

## PCM4202EVM User's Guide

This document provides the information needed to set up and operate the PCM4202EVM evaluation module (EVM). For a more detailed description of the PCM4202, please refer to the product datasheet available from the Texas Instruments web site at <http://www.ti.com>. Additional support documents are listed in the sections of this guide entitled **Related Documentation from Texas Instruments** and **Additional Documentation**. Throughout this document, the acronym **EVM** and the phrase *evaluation module* are synonymous with the PCM4202EVM. This user's guide includes setup and configuration instructions, information regarding absolute operating conditions for power supplies and input/output connections, an electrical schematic, PCB layout drawings, and a bill of materials (BOM) for the EVM.

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## 1 Introduction

The PCM4202 is a high-performance, two-channel stereo audio analog-to-digital (A/D) converter designed for use in professional and broadcast audio applications. The PCM4202 features simultaneous 24-bit linear PCM or 1-bit Direct Stream Digital (DSD) data output for both channels. Sampling rates up to 216kHz are supported for PCM output formats, while 64x or 128x oversampled 1-bit data is supported for the DSD output mode. Native support for both PCM and DSD data formats makes the PCM4202 ideal for use in a variety of audio recording and processing applications.

The PCM4202 features 1-bit delta-sigma ( $\Delta\Sigma$ ) modulators employing a novel density modulated dithering scheme, yielding improved dynamic performance. Differential voltage inputs are utilized for the modulators, providing excellent common-mode rejection. On-chip voltage references are provided for the modulators, in addition to generating DC common-mode bias voltage outputs for use with external input circuitry. Linear phase digital decimation filtering is provided for the 24-bit PCM output, with a minimum stop band attenuation of -100dB for all sampling modes.

The PCM output mode features clipping flag outputs for each channel, as well as a digital high-pass filter for DC removal. The PCM4202 is configured using dedicated input pins for sampling mode and audio data format selection, high-pass filter enable/disable, and reset/power-down operation.

A +5V power supply is required for the analog section of the device, while a +3.3V power supply is required for the digital circuitry. Figure 1 shows the functional block diagram of the PCM4202.

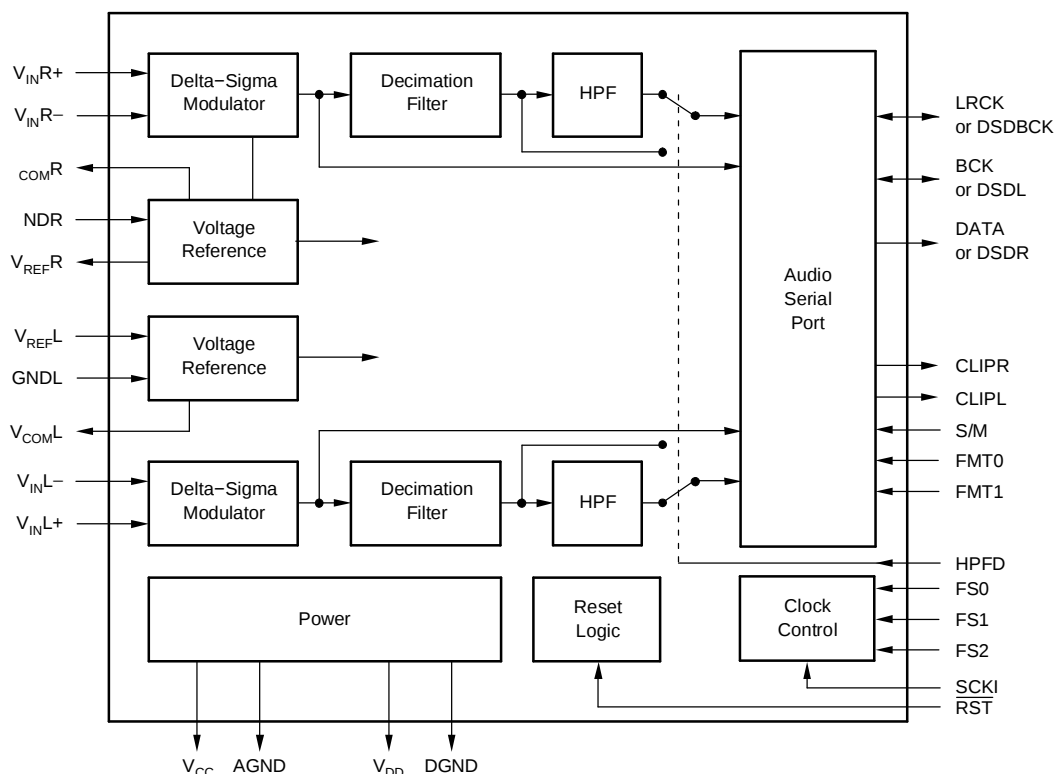


Figure 1. PCM4202 Functional Block Diagram

## 1.1 **PCM4204EVM Features**

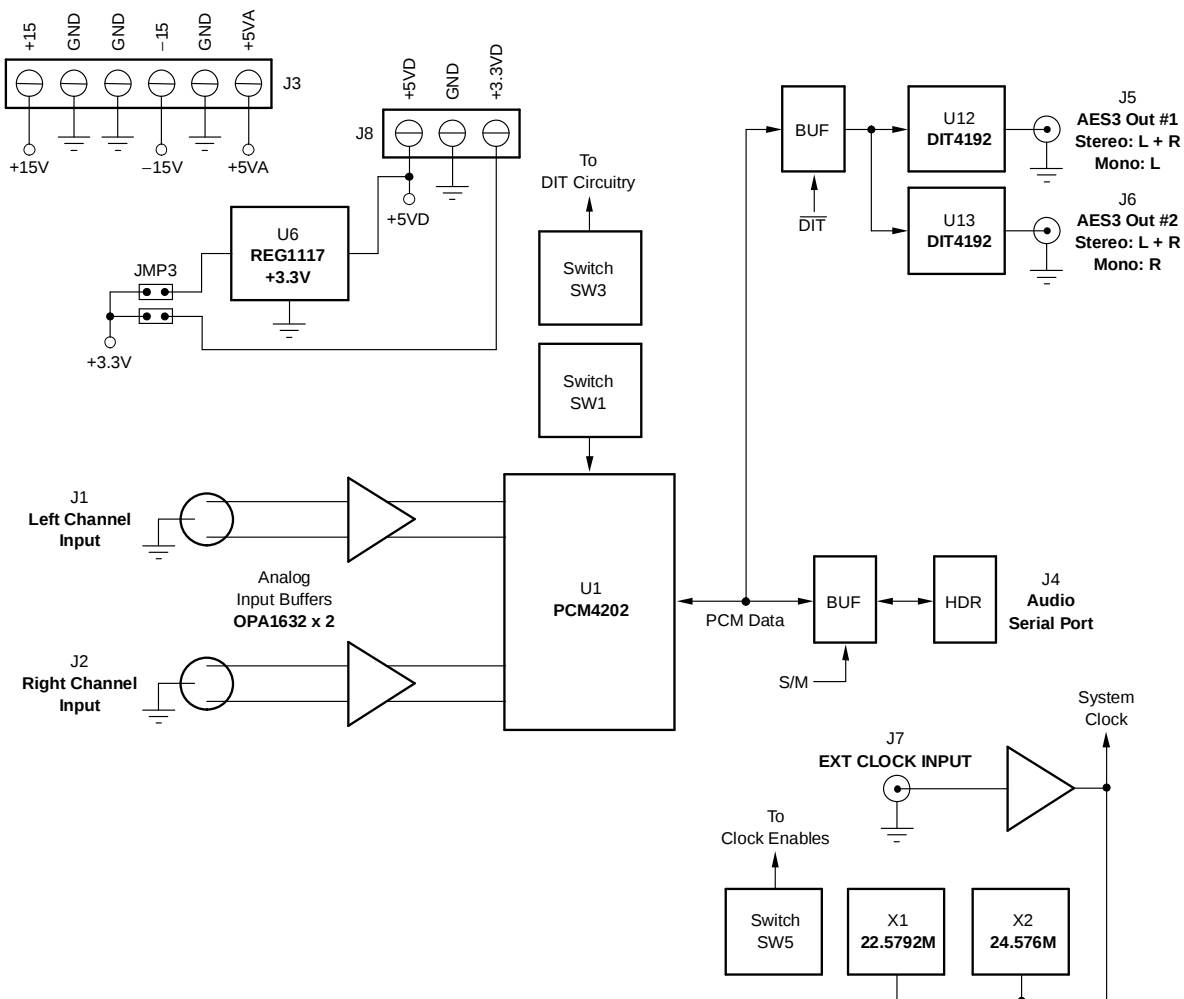
The PCM4202EVM provides a convenient platform for evaluating the performance and functionality of the PCM4202 product. The primary EVM features include:

- Simple configuration using onboard DIP switches
- Two differential voltage inputs supporting either 3-pin XLR or Balanced TRS connections
- Low-noise input buffer circuits utilizing the OPA1632 fully differential audio amplifier
- Two 75Ω AES3-encoded outputs, supporting operation up to 216kHz sampling rates
- Buffered Audio Serial Port supports a two-channel, 24-bit linear PCM data interface for external hardware and signal processors. Sampling rates up to 216kHz are supported.
- Two onboard system clock oscillators, operating at 22.5792MHz and 24.576MHz respectively, supporting standard PCM sampling rates, including 44.1kHz, 48kHz, 88.2kHz, 96kHz, 176.4kHz, and 192kHz.
- External system clock inputs supporting alternative sampling rates up to 216kHz.

The PCM4202EVM requires +15V, -15V, and +5V analog power supplies. Additionally, a +5V digital power supply is required, with a +3.3V digital supply being derived onboard using a linear voltage regulator IC.

## 1.2 **PCM4202EVM General Description and Functional Block Diagram**

The PCM4202EVM provides a complete platform for evaluating the performance and features of the PCM4202 stereo audio A/D converter. [Figure 2](#) illustrates the functional block diagram for the evaluation module.



**Figure 2. PCM4202EVM Functional Block Diagram**

Two differential analog inputs are supported at connectors J1 and J2, corresponding to Left and Right analog input channels, respectively. These connectors support either 3-pin male XLR or balanced TRS input plugs. Each of the analog inputs is buffered and filtered using a low noise input circuit, utilizing a Texas Instruments OPA1632 fully differential amplifier. The output of each buffer circuit is connected to a corresponding differential input of the PCM4202. The PCM4202 is then used to convert the analog signal to either a 24-bit linear PCM or 1-bit DSD representation in the digital domain.

The 24-bit PCM or 1-bit DSD data output is made available at header J4. The 24-bit PCM audio data is also made available at the AES3 encoded data outputs provided at RCA jacks J5 and J6. The buffered header is convenient for interfacing to external development hardware or digital signal processors, while the AES3 encoded outputs may be connected to audio test systems or commercial audio equipment.

Power is connected to the board at either terminal block J3 for the analog supplies, or at terminal block J8 for the digital supplies.

Manual reset circuits are provided for both the PCM4202 (U1) and the AES3 transmitters (U12 and U13). The ADC RESET switch (SW2) is utilized for resetting the A/D converter, while the DIT RESET switch (SW4) is utilized for resetting the AES3 transmitters.

The system or master clock for the evaluation module may be generated onboard or by an external clock source. Oscillators X1 and X2 operate at fixed clock frequencies of 22.5792MHz and 24.576MHz, respectively. The oscillators provide low jitter clock sources for measuring the performance of the PCM4202 in Master mode operation. Alternatively, an external clock source may be connected at J7 for Master mode operation, supporting alternate system clock and sampling frequencies. For Slave mode operation, the system clock is provided from an external source through header J4 and buffer U9. Switch SW5 provides clock configuration control for the oscillators and the external clock input at connector J7.

### 1.3 Related Documentation from Texas Instruments

The following documents provide information regarding Texas Instrument integrated circuits used in the assembly of the PCM4202EVM. The latest revisions of these documents are available from the TI web site at <http://www.ti.com>.

| Data Sheet             | Literature Number       |
|------------------------|-------------------------|
| PCM4202 Datasheet      | <a href="#">SBAS290</a> |
| DIT4192 Datasheet      | <a href="#">SBOS229</a> |
| OPA227 Datasheet       | <a href="#">SBOS110</a> |
| OPA1632 Datasheet      | <a href="#">SBOS286</a> |
| REG1117 Datasheet      | <a href="#">SBVS001</a> |
| SN74AHC08 Datasheet    | <a href="#">SCLS236</a> |
| SN74AHC14 Datasheet    | <a href="#">SCLS238</a> |
| SN74ALVC245 Datasheet  | <a href="#">SCES271</a> |
| SN74LVC1G125 Datasheet | <a href="#">SCES223</a> |

### 1.4 Additional Documentation

The following documents or references provide information regarding selected non-TI components used in the assembly of the PCM4202EVM. These documents are available from the corresponding manufacturer.

| Document/Reference              | Manufacturer                                                                     |
|---------------------------------|----------------------------------------------------------------------------------|
| SM7745H Series CMOS Oscillators | Pletronics ( <a href="http://www.pletronics.com">http://www.pletronics.com</a> ) |

## 2 Getting Started

This section provides information regarding handling and unpacking the PCM4202EVM, as well as absolute operating conditions for the unit.

### 2.1 Electrostatic Discharge Warning

**CAUTION**

Failure to observe proper ESD handling precautions may result in damage to EVM components.

Many of the components on the PCM4202EVM are susceptible to damage by electrostatic discharge (ESD). Customers are advised to observe proper ESD handling procedure when unpacking and handling the EVM, including the use of a grounded wrist strap at an approved ESD workstation. Failure to observe ESD handling procedures may result in damage to EVM components.

### 2.2 EVM Package Contents

Upon opening the PCM4202EVM package, please check to make sure that the following items are included:

- One PCM4202EVM
- One printed copy of the PCM4202 product datasheet
- One printed copy of this PCM4202EVM User's Guide

If any of these items are missing, please contact the Texas Instruments Product Information Center nearest you to inquire about replacements.

### 2.3 Absolute Operating Conditions

**CAUTION**

Exceeding the absolute operating conditions may result in damage to the evaluation module and/or the equipment connected to it.

The user should be aware of the absolute operating conditions for the PCM4202EVM. [Table 1](#) summarizes the critical data points.

**Table 1. Absolute Operating Conditions**

|                                                               | Min                 | Max                 | Units     |
|---------------------------------------------------------------|---------------------|---------------------|-----------|
| <b>Power Supplies</b>                                         |                     |                     |           |
| +15V                                                          | +5.0                | +16.0               | V         |
| -15V                                                          | -5.0                | -16.0               | V         |
| +5VA                                                          | +4.5                | +5.5                | V         |
| +5VD                                                          | +4.5                | +5.5                | V         |
| EXT +3.3V                                                     | +3.0                | +3.6                | V         |
| <b>Audio Serial Port (J4)</b>                                 |                     |                     |           |
| $V_{IH}$ , Input High Voltage ( $V_{DD} = +3.0V$ to $+3.6V$ ) | $0.7 \times V_{DD}$ | $V_{DD} + 0.3$      | V         |
| $V_{IL}$ , Input Low Voltage ( $V_{DD} = +3.0V$ to $+3.6V$ )  | -0.3                | $0.3 \times V_{DD}$ | V         |
| <b>Analog Inputs (connectors J1 and J2)</b>                   |                     |                     |           |
| Differential Input Voltage, RMS                               |                     | 7.9                 | $V_{RMS}$ |
| Differential Input Voltage, Peak-to-Peak                      |                     | 22.3                | $V_{PP}$  |

### 3 Hardware Description and Configuration

This section provides hardware description and configuration information for the PCM4202EVM.

#### 3.1 Power Supply Configuration

The PCM4202EVM requires three analog power supplies and one digital power supply for operation. The analog supplies are connected at terminal block J3, while the digital supply is connected at terminal block J8.

Analog supplies include +15V and -15V DC for powering the input buffer circuits, as well as +5.0V DC for powering the analog section of the PCM4202. All supplies should be rated for at least 500mA of output current.

The digital supply requires +5.0V DC and should be rated for at least 500mA of output current. The +5.0V supply is regulated to +3.3V DC by an onboard Texas Instruments REG1117 linear voltage regulator (U6), which is used to power the digital section of the PCM4202 and the majority of the support logic circuitry. The core logic and line driver sections of the AES3 transmitters (U12 and U13) utilize the +5.0V digital supply directly.

An optional external +3.3V DC digital power supply is supported at terminal block J8. Jumper JMP3 is utilized to select either the onboard voltage regulator (U6) or an external +3.3V power source. Shorting pins 1 and 2 together using the supplied jumper block selects the onboard +3.3V voltage regulator. Shorting pins 3 and 4 together will select the external +3.3V supply terminal (EXT +3.3VD) on terminal block J14. Only one source may be selected at any time.

## 3.2 Analog Inputs

The PCM4202EVM includes two Neutrik combo XLR connectors, which accept either 3-pin male XLR or ¼-inch TRS phono plugs. The connectors are numbered J1 and J2, corresponding to the left and right channels, respectively.

The analog inputs can accept up to a  $7.9V_{RMS}$  (or  $22.3V_{PP}$ ) differential input signal. This signal is then attenuated by a factor of 3.7 by the input buffer circuit, which corresponds to the  $6.0V_{PP}$  full-scale differential input voltage for the PCM4202 analog inputs.

The input buffer circuits are each comprised of a single OPA1632 fully differential audio amplifier and associated passive components. The input buffer provides active attenuation and low pass filtering for the analog input signal. The OPA1632 outputs are DC level-shifted by approximately +2.5V using the amplifiers  $V_{COMIN}$  input (pin 2), which are connected to a buffered version of either the PCM4202  $V_{COML}$  (pin 3) or  $V_{COMR}$  outputs (pin 26).

## 3.3 Audio Data Format Selection

Switch SW1 is used to select the audio data format for the PCM4202. [Table 2](#) summarizes the available audio data formats for both Slave and Master mode operation and the corresponding SW1 switch settings.

**Table 2. Audio Data Format Selection**

| FMT1 | FMT0 | Audio Data Format (Slave or Master Mode) |
|------|------|------------------------------------------|
| LO   | LO   | 24-Bit Left Justified PCM Data           |
| LO   | HI   | 24-Bit I <sup>2</sup> S PCM Data         |
| HI   | LO   | 24-Bit Right Justified PCM Data          |
| HI   | HI   | DSD Output Mode (Master Mode only)       |

For Slave mode operation, the Audio Serial Port header (connector J4) is utilized to interface to a Master device, such as a digital signal processor, FPGA, or an audio test system with a synchronous serial port interface. The system clock (SCKI), bit clock (BCK), and left/right word clock (LRCK) are generated by the Master device and are used to drive the SCKI (pin 18), BCK (pin 16), and LRCK (pin 17) inputs of the PCM4202. Serial audio data is output at DATA (pin 15). Slave mode supports PCM-formatted output data only. DSD output data is available only in Master mode.

For Master mode, the system clock is provided by one of the sources described in Section 3.4 of this document. The PCM4202 internally generates the BCK and LRCK clocks, which are then output to the Audio Serial Port header (connector J4) and the AES3 digital interface transmitters, which then drive output connectors J5 and J6.

Master mode may also be configured to support 1-bit DSD-formatted audio output data, as shown in [Table 2](#). For the DSD mode formats, header J4 provides the output interface. The DATA output functions as the Right channel DSD output (DSDR), the BCK output servers as the left channel DSD output (DSDL), and the LRCK output becomes the DSD bit clock (DSDBCK).

### 3.4 System Clock Configuration

Switch SW5 is used to select the system clock source for the PCM4202EVM. [Table 3](#) summarizes the available clock source options. The onboard oscillators support standard PCM sampling rates in Master mode, including 44.1kHz, 48kHz, 88.2kHz, 96kHz, 176.4kHz, and 192kHz. The external clock input (connector J7) may be used to supply alternate system clock frequencies that support alternative sample rates.

**Table 3. System Clock Source Selection**

| Switch SW5 |      |      | System Clock Source                               | Used for Master or Slave Mode Operation? |
|------------|------|------|---------------------------------------------------|------------------------------------------|
| EXT        | OSC1 | OSC0 |                                                   |                                          |
| LO         | LO   | LO   | External clock input at J7                        | Master                                   |
| HI         | LO   | LO   | External clock input at the SCKI pin of header J4 | Slave                                    |
| HI         | LO   | HI   | Oscillator X1, 22.5792MHz                         | Master                                   |
| HI         | HI   | LO   | Oscillator X2, 22.576MHz                          | Master                                   |

### 3.5 Sampling Mode Selection

The sampling mode of the PCM4202 is selected using switch SW1. [Table 4](#) through [Table 6](#) summarize the available sampling modes for both PCM and DSD output modes.

Single Rate sampling mode is designed for output sampling rates up to 54kHz. The modulator oversampling rate is set to 128x.

Dual Rate sampling mode is designed for output sampling rates greater than 54kHz and up to 108kHz. The modulator oversampling rate is set to 64x.

Quad Rate sampling mode is designed for output sampling rates greater than 108kHz and up to 216kHz. The modulator oversampling rate is set to 32x.

**Table 4. Sampling Mode Selection: PCM Slave Mode Audio Formats**

| FS2 | FS1 | FS0 | Sampling Mode                         |
|-----|-----|-----|---------------------------------------|
| LO  | LO  | LO  | Single Rate with Clock Auto-Detection |
| LO  | LO  | HI  | Dual Rate with Clock Auto-Detection   |
| LO  | HI  | LO  | Quad Rate with Clock Auto-Detection   |
| LO  | HI  | HI  | Reserved                              |
| HI  | LO  | LO  | Reserved                              |
| HI  | LO  | HI  | Reserved                              |
| HI  | HI  | LO  | Reserved                              |
| HI  | HI  | HI  | Reserved                              |

**Table 5. Sampling Mode Selection: PCM Master Mode Audio Formats**

| FS2 | FS1 | FS0 | Sampling Mode                        |
|-----|-----|-----|--------------------------------------|
| LO  | LO  | LO  | Single Rate with $f_{SCKI} = 768f_S$ |
| LO  | LO  | HI  | Single Rate with $f_{SCKI} = 512f_S$ |
| LO  | HI  | LO  | Single Rate with $f_{SCKI} = 384f_S$ |
| LO  | HI  | HI  | Single Rate with $f_{SCKI} = 256f_S$ |
| HI  | LO  | LO  | Dual Rate with $f_{SCKI} = 384f_S$   |
| HI  | LO  | HI  | Dual Rate with $f_{SCKI} = 256f_S$   |
| HI  | HI  | LO  | Quad Rate with $f_{SCKI} = 192f_S$   |
| HI  | HI  | HI  | Quad Rate with $f_{SCKI} = 128f_S$   |

**Table 6. Sampling Mode Selection: DSD Output Mode**

| FS2 | FS1 | FS0 | Sampling Mode                                      |
|-----|-----|-----|----------------------------------------------------|
| LO  | LO  | LO  | 128 $f_S$ DSD Output Rate with $f_{SCKI} = 768f_S$ |
| LO  | LO  | HI  | 128 $f_S$ DSD Output Rate with $f_{SCKI} = 512f_S$ |
| LO  | HI  | LO  | 128 $f_S$ DSD Output Rate with $f_{SCKI} = 384f_S$ |
| LO  | HI  | HI  | 128 $f_S$ DSD Output Rate with $f_{SCKI} = 256f_S$ |
| HI  | LO  | LO  | 64 $f_S$ DSD Output Rate with $f_{SCKI} = 384f_S$  |
| HI  | LO  | HI  | 64 $f_S$ DSD Output Rate with $f_{SCKI} = 256f_S$  |
| HI  | HI  | LO  | Reserved                                           |
| HI  | HI  | HI  | Reserved                                           |

### 3.6 Digital High-Pass Filter

The PCM4202 includes a digital high-pass filter function for both channels, designed for removing the DC component from the digitized signal. The high-pass filter is not available when using the DSD output mode. The high-pass filter function may be enabled or disabled using the HPFD switch on SW1. [Table 7](#) summarizes the operation of the HPFD switch.

**Table 7. Digital High-Pass Filter Configuration**

| HPFD | Digital High-Pass Filter Function |
|------|-----------------------------------|
| LO   | Enabled                           |
| HI   | Disabled                          |

### 3.7 Digital Interface Transmitter Configuration

Two Texas Instruments DIT4192 digital interface transmitters provide AES3-encoded outputs for the PCM4202EVM. Switch SW3 is utilized to configure the transmitters. The outputs of the transmitters are available at connectors J5 and J6, which are RCA phono jacks. These outputs are designed for use with 75Ω coaxial cable connections.

The transmitters are enabled using the  $\overline{\text{DIT}}$  switch of SW3. The  $\overline{\text{DIT}}$  switch operation is summarized in [Table 8](#).

**Table 8. Digital Interface Transmitter Configuration**

| $\overline{\text{DIT}}$ | Digital Interface Filter Function |
|-------------------------|-----------------------------------|
| LO                      | Enabled                           |
| HI                      | Disabled                          |

The audio data format for the transmitters is hardwired for 24-bit I<sup>2</sup>S data format. When using the transmitters, the PCM4202 audio data format must be set to 24-bit I<sup>2</sup>S, as shown in [Table 2](#).

Like the PCM4202, the DIT4192 transmitters must be configured for the proper master (or system) clock frequency. The transmitter master clock is driven by the same source as the PCM4202 system clock, as described in Section 3.4 of this document. [Table 9](#) summarizes the master clock options for the DIT4192 transmitters using switch SW3.

**Table 9. Transmitter Master Clock Configuration**

| CLK1 | CLK0 | Transmitter MCLK Frequency |
|------|------|----------------------------|
| LO   | LO   | 128f <sub>S</sub>          |
| LO   | HI   | 256f <sub>S</sub>          |
| HI   | LO   | 384f <sub>S</sub>          |
| HI   | HI   | 512f <sub>S</sub>          |

The DIT4192 transmitters may be operated in either Stereo or Mono mode. In Stereo mode, two channels of audio data are transmitted at the input sampling frequency. In Mono mode, two consecutive samples of only one channel are transmitted at one-half the input sampling rate. The Mono mode is useful for performance testing with f<sub>S</sub> = 176.4kHz or f<sub>S</sub> = 192kHz with a system that can only accept only half these rates. This is the case with the Audio Precision System Two Cascade or Cascade Plus test system, which was used for factory performance testing of the PCM4202. Mono mode can be used in conjunction with the Audio Precision Dual BNC digital input mode to test at sampling rates up to 216kHz.

The MONO switch on SW3 is used to enable or disable Mono mode operation. [Table 10](#) summarizes the operation of the MONO switch.

**Table 10. Transmitter Output Mode Configuration**

| MONO | Transmitter Output Mode                                                              |
|------|--------------------------------------------------------------------------------------|
| LO   | Stereo Mode<br>Left and Right channel data are output on both J5 and J6              |
| HI   | Mono Mode<br>Left channel data is output on J5<br>Right channel data is output on J6 |

### 3.8 Reset Operations

The PCM4202EVM includes two reset switches, SW2 and SW4. Both are momentary contact pushbutton switches that are normally open. SW2 provides the manual reset for the PCM4202 (U1), while switch SW4 provides the manual reset for the two DIT4192 transmitters (U12 and U13).

The PCM4202 may be reset at any time by momentarily pressing and then releasing switch SW2. This generates a reset pulse and initiates a reset sequence for the device.

For the DIT reset function, the output of the reset circuit is connected to the  $\overline{\text{RST}}$  pins of DIT4192 transmitters (U12 and U13). The transmitters may be reset only when the  $\overline{\text{DIT}}$  switch of SW3 is set LO by momentarily pressing and then releasing switch SW4. If the  $\overline{\text{DIT}}$  switch is set HI, the output of the AND gate in the reset circuit is forced low, which will force both transmitters into power-down mode. The transmitter reset circuit is shown in Figure 3.

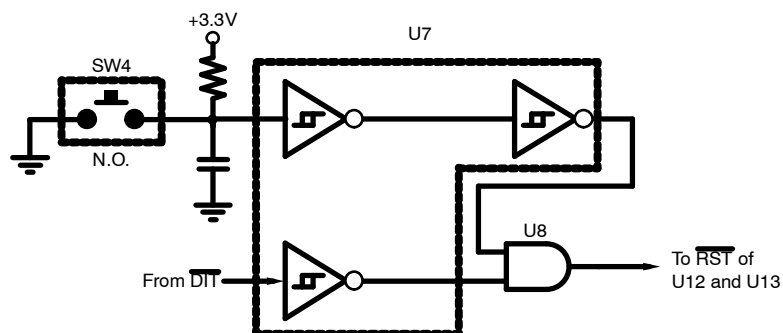


Figure 3. DIT (Transmitter) Reset Circuitry

## 4 Schematic, PCB Layout, and Bill of Materials

This section provides the electrical schematic and physical layout information for the PCM4202EVM. The bill of materials is included as a component reference.

### NOTE

Board layouts are not to scale. These figures are intended to show how the board is laid out; they are not intended to be used for manufacturing PCM4202EVM PCBs.

### 4.1 Schematic

The electrical schematic for the PCM4202EVM is shown in Figure 4. The components shown in the schematic are listed in Table 11 for reference.

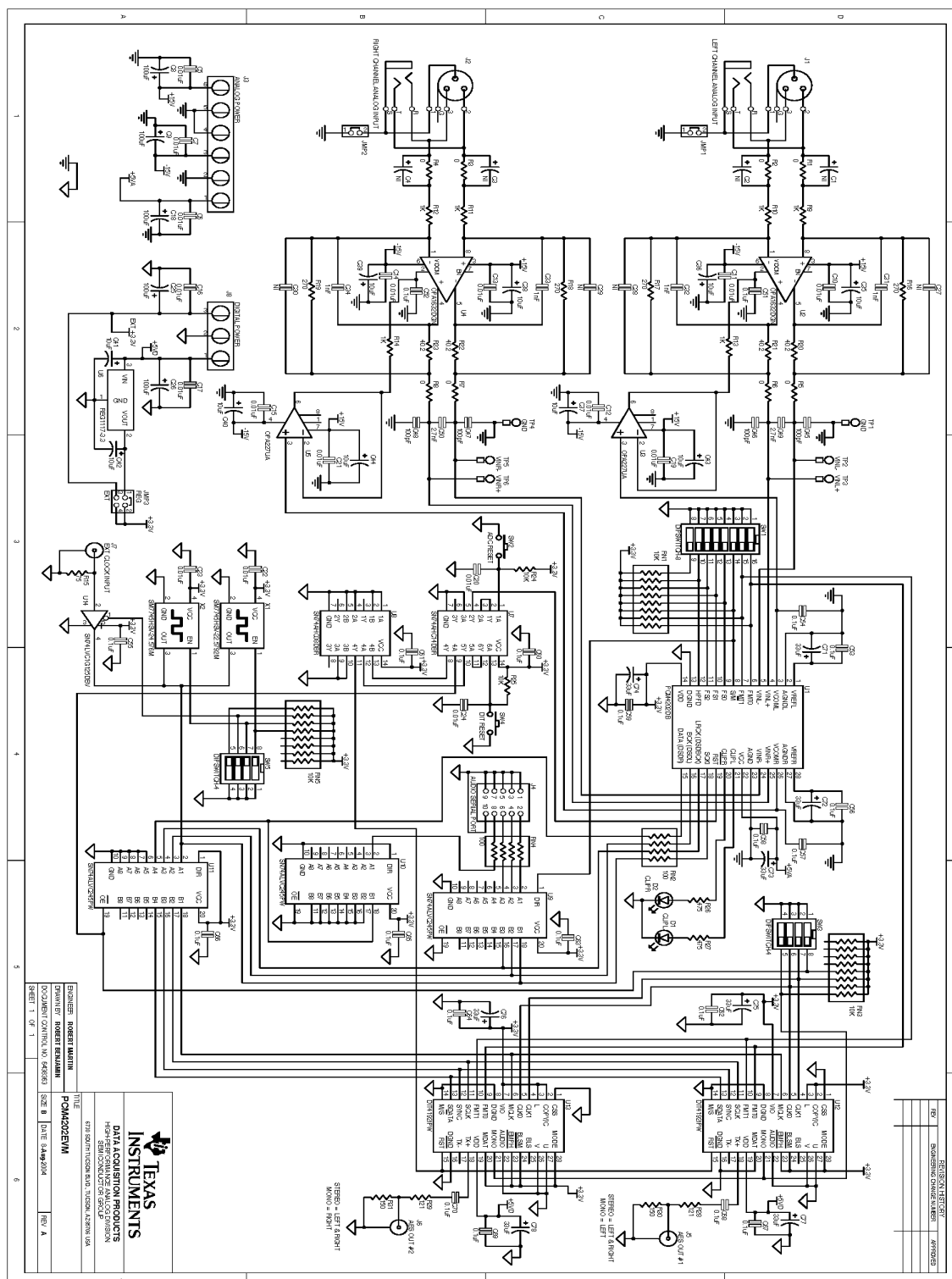


Figure 4. PCM4202EVM Schematic Diagram

## **4.2    PCB Layout**

The PCM4202EVM is a 4-layer printed circuit board with the following layer structure:

- Layer 1: Top (Component Side)
- Layer 2: Ground Plane
- Layer 3: Power
- Layer 4: Bottom (Solder Side)

The ground plane doubles as a heat sink for the PCM4202 PowerPAD package. Refer to the product datasheet for more information on the purpose and application of the PowerPAD connection.

[Figure 5](#) through [Figure 10](#) show the top side silk screen, along with the top, ground plane, power, and bottom layers of the printed circuit board.



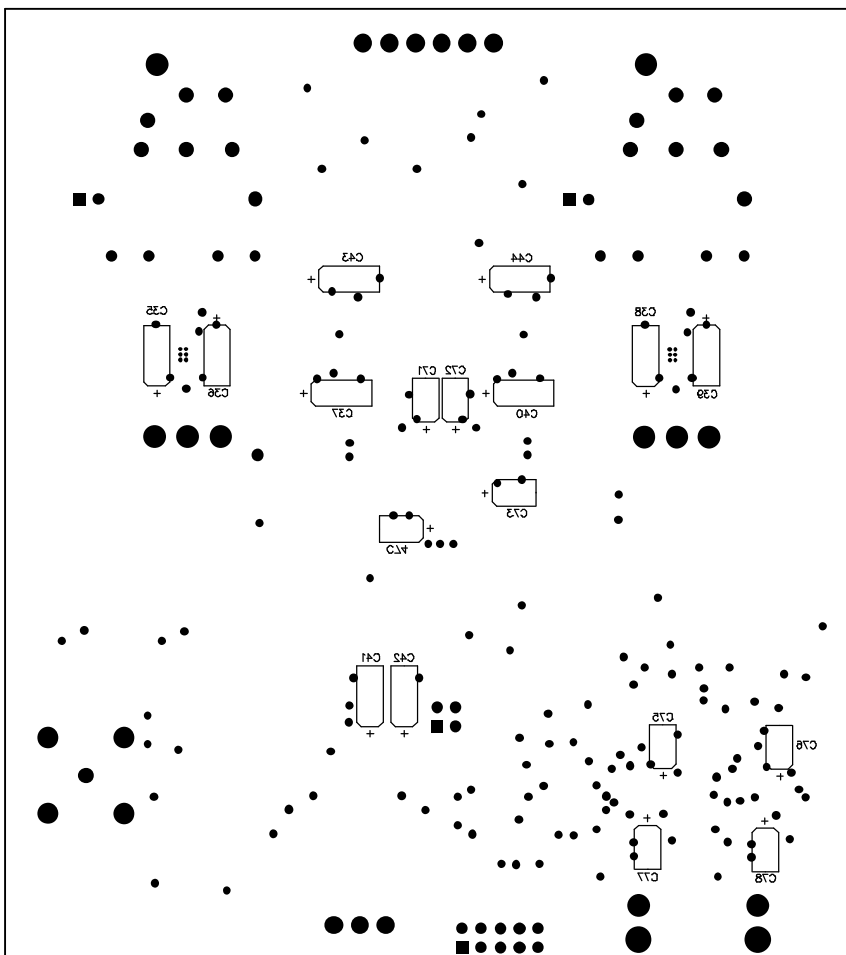


Figure 6. Bottom Side Silkscreen

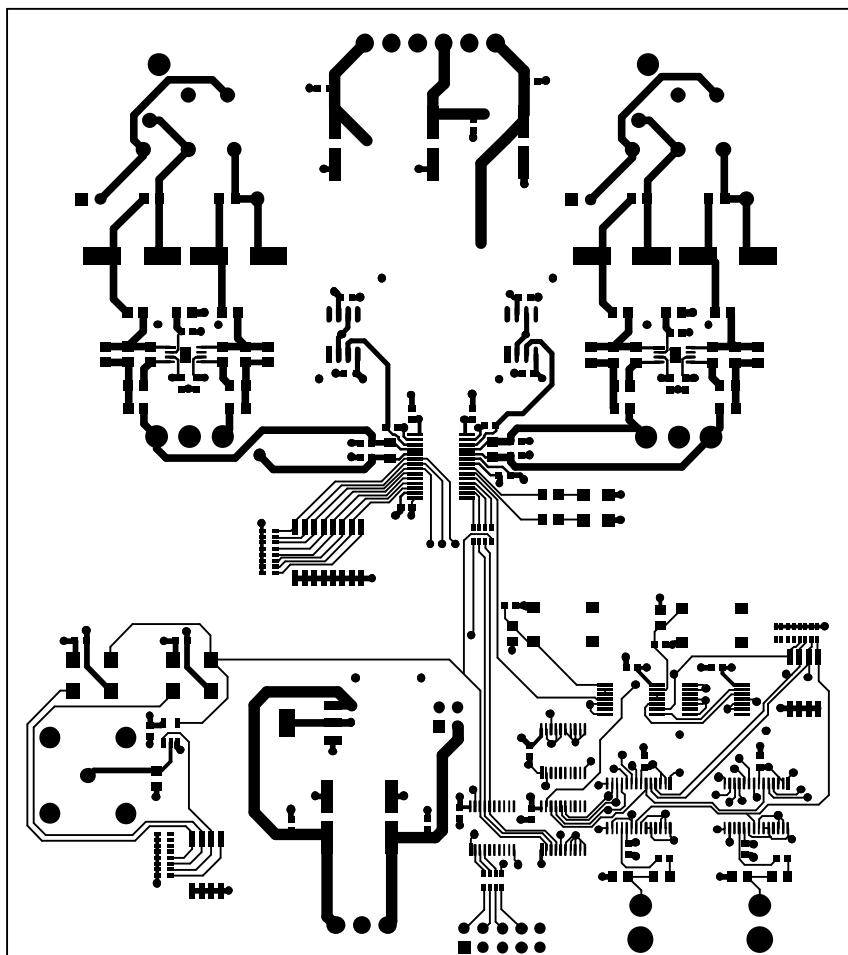
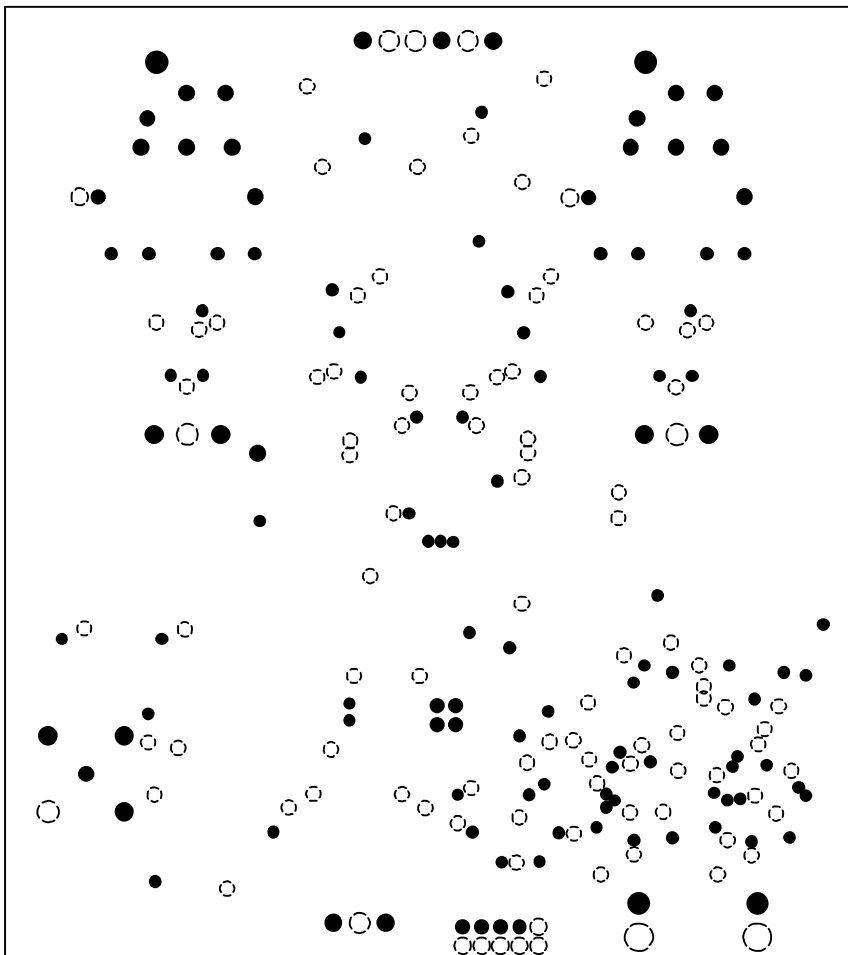


Figure 7. Top Layer (Component Side)



**Figure 8. Ground Plane Layer**

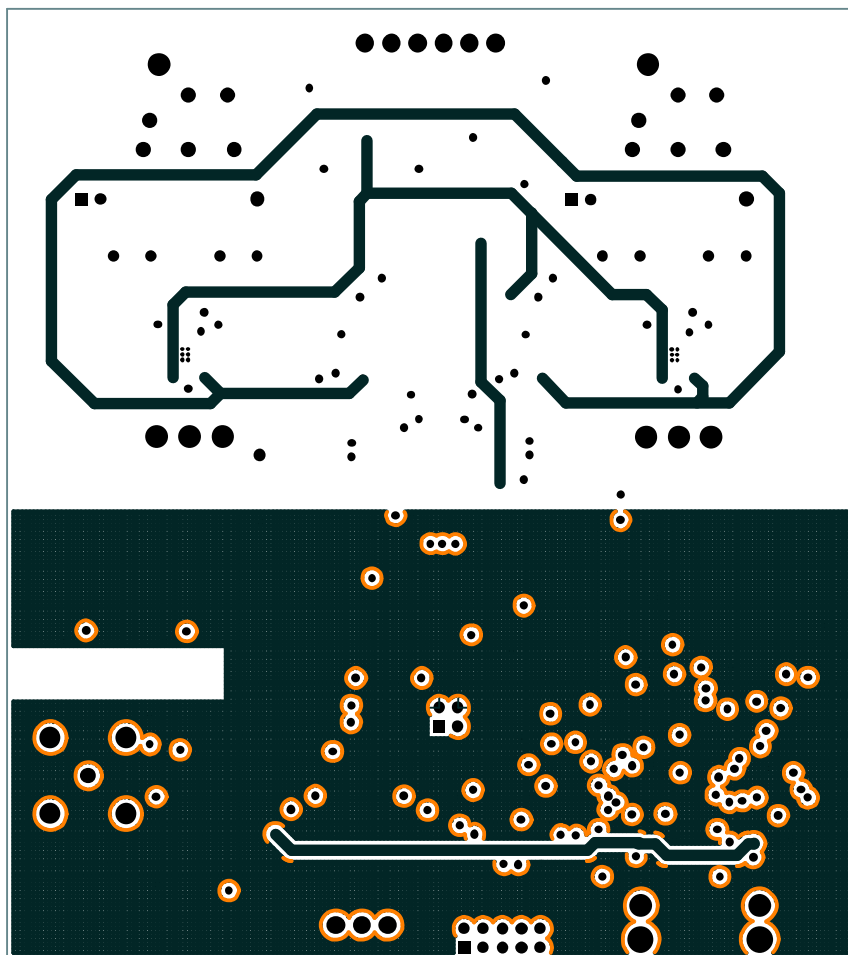


Figure 9. Power Plane Layer

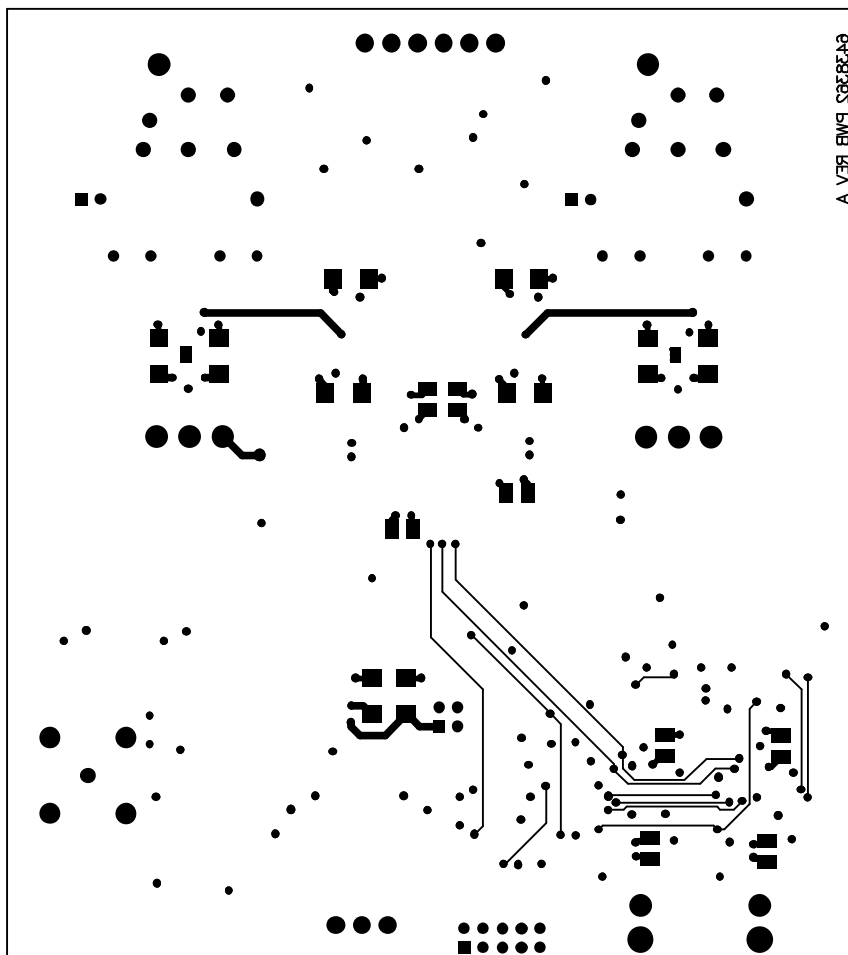


Figure 10. Bottom Layer (Solder Side)

### 4.3 Bill of Materials

The Bill of Materials, listing the components used in the assembly of the PCM4202EVM, is shown in [Table 11](#).

**Table 11. PCM4202EVM Bill of Materials**

| ITEM | VALUE        | Ref Des                 | QTY PER BOARD | MFR               | MFR PART NUMBER  | DESCRIPTION                                                                      |
|------|--------------|-------------------------|---------------|-------------------|------------------|----------------------------------------------------------------------------------|
| 1    | 100pF        | C45-C48                 | 4             | Kemet             | C0603C101J5GACTU | Chip Capacitor, C0G Ceramic, 100pF $\pm 5\%$ , 50WV, Size = 0603                 |
| 2    | 1nF          | C31-C34                 | 4             | Kemet             | C0805C102J3GAC   | Chip Capacitor, C0G Ceramic, 1nF $\pm 5\%$ , 25WV, Size = 0805                   |
| 3    | 2.7nF        | C49, C50                | 2             | Kemet             | C0805C272J3GAC   | Chip Capacitor, C0G Ceramic, 2.7nF $\pm 5\%$ , 25WV, Size = 0805                 |
| 4    | 0.01 $\mu$ F | C5-C7, C10-C17, C19-C24 | 17            | Kemet             | C0603C103J5RACTU | Chip Capacitor, X7R Ceramic, 0.01 $\mu$ F $\pm 5\%$ , 50WV, Size = 0603          |
| 5    | 0.1 $\mu$ F  | C51-C70                 | 20            | Kemet             | C0603C104J4RACTU | Chip Capacitor, X7R Ceramic, 0.1 $\mu$ F $\pm 5\%$ , 16WV, Size = 0603           |
| 6    | 10 $\mu$ F   | C35-C44                 | 10            | Kemet             | T494C106K025AS   | Chip Capacitor, Low ESR Tantalum, 10 $\mu$ F $\pm 10\%$ , 25WV, Size = C         |
| 7    | 33 $\mu$ F   | C71-C78                 | 8             | Kemet             | T494B336K010AS   | Chip Capacitor, Low ESR Tantalum, 33 $\mu$ F $\pm 10\%$ , 10WV, Size = B         |
| 8    | 100 $\mu$ F  | C8, C9, C18, C25, C26   | 5             | Panasonic         | EEV-FK1E101XP    | Capacitor, SMT Aluminum Electrolytic, 100 $\mu$ F $\pm 20\%$ , 25WV              |
| 9    |              | D1, D2                  | 2             | Lumex             | SML-LX1206IC-TR  | Red LED, Surface Mount, Size = 1206                                              |
| 10   |              | J1, J2                  | 2             | Neutrik           | NCJ6FI           | Combo Connector, Female XLR and TRS, Vertical PC Mount                           |
| 11   |              | J3                      | 1             | Weidmuller        | 9967720000       | 3.5mm PCB Terminal Block, 6 poles                                                |
| 12   |              | J4                      | 1             | Samtec            | TSW-105-07-G-D   | Terminal Strip, 10-pin (5x2)                                                     |
| 13   |              | J5, J6                  | 2             | CUI Stack         | RJC-041          | RCA Phono Jack, Black Shell                                                      |
| 14   |              | J7                      | 1             | Kings Electronics | KC-79-274-M06    | BNC Connector, Female, PC Mount                                                  |
| 15   |              | J8                      | 1             | Weidmuller        | 169968000        | 3.5mm PCB Terminal Block, 3 poles                                                |
| 16   |              | JMP1, JMP2              | 2             | Samtec            | TSW-102-07-G-S   | Terminal Strip, 2-pin (2x1)                                                      |
| 17   |              | JMP3                    | 1             | Samtec            | TSW-102-07-G-D   | Terminal Strip, 4-pin (2x2)                                                      |
| 18   | 0            | R1-R8                   | 8             | Panasonic         | ERJ-6EY0R00V     | Chip Resistor, 0 $\Omega$ , Shunt, Size = 0805                                   |
| 19   | 40.2         | R20-R23                 | 4             | Panasonic         | ERJ-6EN-F40R2V   | Chip Resistor, Thick Film, 1% Tolerance, 40.2 $\Omega$ , 1/10W, Size = 0805      |
| 20   | 75           | R15                     | 1             | Panasonic         | ERJ-6ENF75R0V    | Chip Resistor, Thick Film, 1% Tolerance, 75 $\Omega$ , 1/10W, Size = 0805        |
| 21   | 121          | R28, R29                | 2             | Panasonic         | ERJ-6ENF1210V    | Chip Resistor, Thick Film, 1% Tolerance, 121 $\Omega$ , 1/10W, Size = 0805       |
| 22   | 150          | R30, R31                | 2             | Panasonic         | ERJ-6ENF1500V    | Chip Resistor, Thick Film, 1% Tolerance, 150 $\Omega$ , 1/10W, Size = 0805       |
| 23   | 270          | R16-R19                 | 4             | Panasonic         | ERA-6YEB271V     | Chip Resistor, Metal Film, 0.1% Tolerance, 270 $\Omega$ , 1/10W, Size = 0805     |
| 24   | 475          | R26, R27                | 2             | Panasonic         | ERJ-6ENF4750V    | Chip Resistor, Thick Film, 1% Tolerance, 475 $\Omega$ , 1/10W, Size = 0805       |
| 25   | 1K           | R9-R14                  | 6             | Panasonic         | ERA-6YEB102V     | Chip Resistor, Metal Film, 0.1% Tolerance, 1k $\Omega$ , 1/10W, Size = 0805      |
| 26   | 10K          | R24, R25                | 2             | Panasonic         | ERJ-6ENF1002V    | Chip Resistor, Thick Film, 1% Tolerance, 10k $\Omega$ , 1/10W, Size = 0805       |
| 27   | 100          | RN2, RN4                | 2             | CTS               | 742C083101J      | Thick Film Chip Resistor Array, 100 $\Omega$ , 8-Terminal, 4 Resistors, Isolated |

**Table 11. PCM4202EVM Bill of Materials (continued)**

| ITEM | VALUE | Ref Des       | QTY PER BOARD | MFR                    | MFR PART NUMBER    | DESCRIPTION                                                                                       |
|------|-------|---------------|---------------|------------------------|--------------------|---------------------------------------------------------------------------------------------------|
| 28   | 10K   | RN1, RN3, RN5 | 3             | CTS                    | 742C163103J        | Thick Film Chip Resistor Array, 10k $\Omega$ , 16-Terminal, 8 Resistors, Isolated                 |
| 29   |       | SW1           | 1             | ITT Industries/<br>C&K | TDA08H0SK1         | DIP Switch, 8 Element, Half-Pitch, Surface-Mount, Tape Sealed                                     |
| 30   |       | SW2, SW4      | 2             | Omron                  | B3S-1000           | Momentary Tact Switch, SMT without Ground Terminal                                                |
| 31   |       | SW3, SW5      | 2             | ITT Industries/<br>C&K | TDA04H0SK1         | DIP Switch, 4 Element, Half-Pitch, Surface-Mount, Tape Sealed                                     |
| 32   |       | U1            | 1             | Texas Instruments      | PCM4202DB          | Stereo Audio A/D Converter                                                                        |
| 33   |       | U2, U4        | 2             | Texas Instruments      | OPA1632DGN         | Fully-Differential Audio Amplifier                                                                |
| 34   |       | U3, U5        | 2             | Texas Instruments      | OPA227UA           | Precision Operational Amplifier                                                                   |
| 35   |       | U7            | 1             | Texas Instruments      | SN74AHC14DBR       | Hex Schmitt-Trigger Inverters                                                                     |
| 36   |       | U8            | 1             | Texas Instruments      | SN74AHC08DBR       | Quad 2-Input Positive AND Gates                                                                   |
| 37   |       | U9-U11        | 3             | Texas Instruments      | SN74ALVC245PW      | Octal Bus Transceiver with Tri-State Outputs                                                      |
| 38   |       | U12, U13      | 2             | Texas Instruments      | DIT4192IPW         | 192kHz Digital Audio Transmitter                                                                  |
| 39   |       | U14           | 1             | Texas Instruments      | SN74LVC1G125DBV    | Single Non-Inverting Buffer with Tri-State Output                                                 |
| 40   |       | U6            | 1             | Texas Instruments      | REG1117-3.3        | Linear Voltage Regulator, +3.3V                                                                   |
| 41   |       | TP1-TP6       | 6             | Keystone Electronics   | 5006               | PCB Test Point, Compact, Through-hole                                                             |
| 42   |       | X1            | 1             | Pletronics             | SM7745HSW-22.5792M | +3.3V Surface-Mount Clock Oscillator, CMOS Output with Active High Enable, 22.5792MHz $\pm$ 50ppm |
| 43   |       | X2            | 1             | Pletronics             | SM7745HSW-24.576M  | +3.3V Surface-Mount Clock Oscillator, CMOS Output with Active High Enable, 24.576MHz $\pm$ 50ppm  |
| 44   |       |               | 3             | Samtec                 | SNT-100-BK-G-H     | Shorting Blocks                                                                                   |
| 42   |       |               | 4             | 3M Bumpon              | SJ-5003            | Self-Adhesive Rubber Feet                                                                         |

## FCC Warnings

This equipment is intended for use in a laboratory test environment only. It generates, uses, and can radiate radio frequency energy and has not been tested for compliance with the limits of computing devices pursuant to subpart J of part 15 of FCC rules, which are designed to provide reasonable protection against radio frequency interference. Operation of this equipment in other environments may cause interference with radio communications, in which case the user at his own expense will be required to take whatever measures may be required to correct this interference.

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## EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM with the operating conditions specified within [Table 1](#) of this document.

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.

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During normal operation, some circuit components may have case temperatures greater than 37°C. The EVM is designed to operate properly with certain components above 60°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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