EVM User's Guide: PCM1754EVM

PCM175x Evaluation Module

Description

This EVM features the PCM175x, a stereo digital-to-analog converter (DAC) that easily interfaces with audio DSP and decoder chips through industry-standard audio data formats of 16-bit or 24-bit data. This EVM supports operation of the PCM1753 device in software mode, or the PCM1754 device in hardware mode.

Get Started

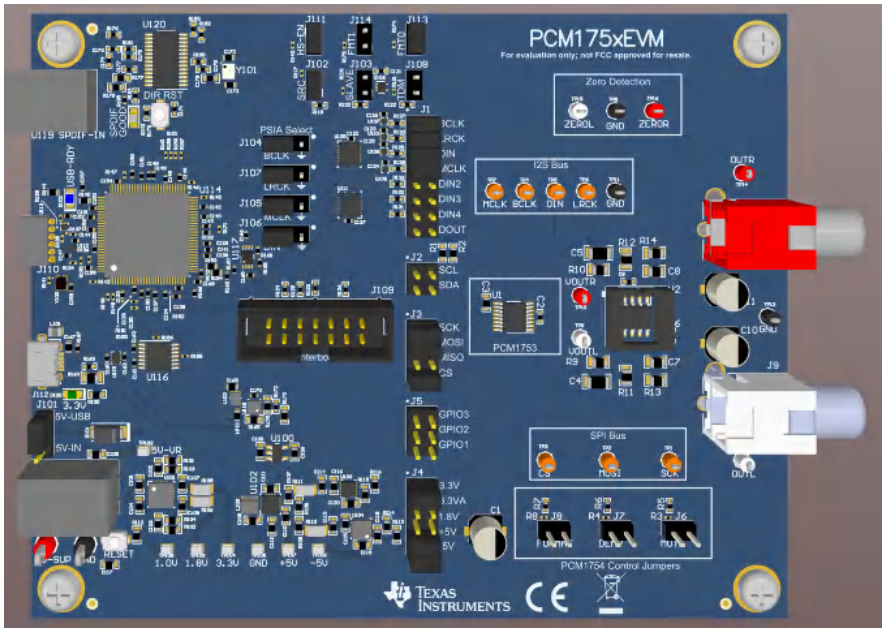
1. Order the EVM from the PCM175x product page.
2. Download the latest PCM175x data sheet.

Features

- 24-bit resolution
- Analog performance (VCC = 5V):
  - Dynamic range: 106dB
  - SNR: 106dB, typical
  - THD+N: 0.002%, typical
  - Full-scale output: 4VPP, typical
- 4× or 8× oversampling digital filter
  - Stop-band attenuation: –50dB
  - Pass-band ripple: ±0.04dB
- Sampling frequency: 5kHz to 200kHz
- System clock: 128fS, 192fS, 256fS, 384fS, 512fS, 768fS, 1152fS with auto detect
- Hardware control (PCM1754)
  - I2S and 16-bit word, right-justified
  - 44.1kHz digital de-emphasis
  - Soft mute
  - Zero flag for L-, R-channel common output

Applications

- A/V receivers
- HDTV receivers
- Car audio systems
- Applications requiring 24-bit audio



1 Evaluation Module Overview

1.1 Introduction

This user's guide describes the characteristics, operation, and use of the PCM175x evaluation module. Throughout this document, the terms evaluation board, evaluation module, and EVM are synonymous with the PCM175xEVM. A complete printed-circuit board (PCB) description, schematic diagram, and bill of materials (BOM) are also included. For questions and support go to the E2E forums (e2e.ti.com).

The main contents of this document are:

- Hardware descriptions and implementation
- Design information

1.2 Kit Contents

Table 1-1 details the contents of the EVM kit.

Table 1-1. PCM175xEVM Kit Content

Item	Quantity
PCM1753 or PCM1754 device	1
PCM175xEVM	1
USB-A to USB-Micro Cable	1

1.3 Specification

The PCM175xEVM allows users to quickly begin evaluating the performance of the 24-bit 192kHz audio DAC, the PCM175x. The board comes ready to use and supports audio data via USB, Optical S/PDIF, and PSIA connection for measurement and debug. The configuration for the PCM1754 device is done through the various Multi-Function pins (FMT, MUTE, DEMP). The PCM1753 is controlled through a three-wire (ML, MC, MD) serial control port that supports register-write functions.

When using the board with a specific audio source, the on-board configuration jumpers must be connected and disconnected as described in the relevant audio source section. For USB Audio, the onboard XMOS controller performs USB to I2S conversion, and is recognized as a USB 2.0 compatible audio device in Windows 10. The board also accepts and can run on USB power, with the option to use an external DC 5V supply.

1.4 Device Information

- PCM1753, a software-controlled audio DAC with 106dB dynamic range
- PCM1754, a hardware-controlled audio DAC with 106dB dynamic range

2 Hardware

This section describes the overall system setup for the EVM. A PC sends the audio data stream to the EVM through a USB connection or an optical SPDIF input.

2.1 Recommended Hardware

The following hardware is recommend when using this guide:

- PCM175xEVM
- USB micro cable (Included) for Audio Streaming and Power (and Board Configuration if using PCM1753)
- Optical Cable for S/PDIF Audio Streaming
- Windows PC

2.2 USB Quick Start

Figure 2-1 and Figure 2-2 illustrate the top and bottom of the PCM175xEVM.

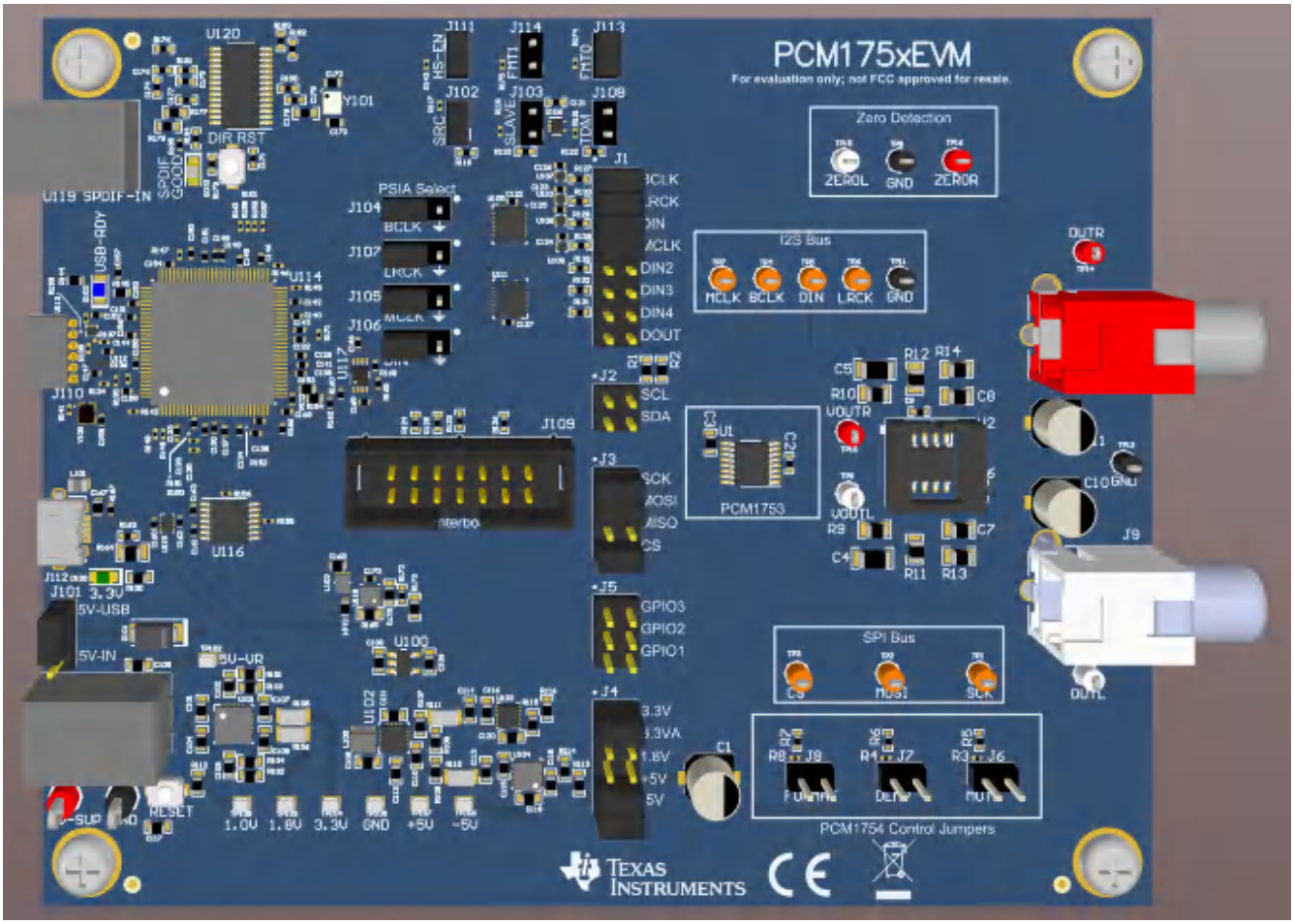


Figure 2-1. EVM Board (Top Side)

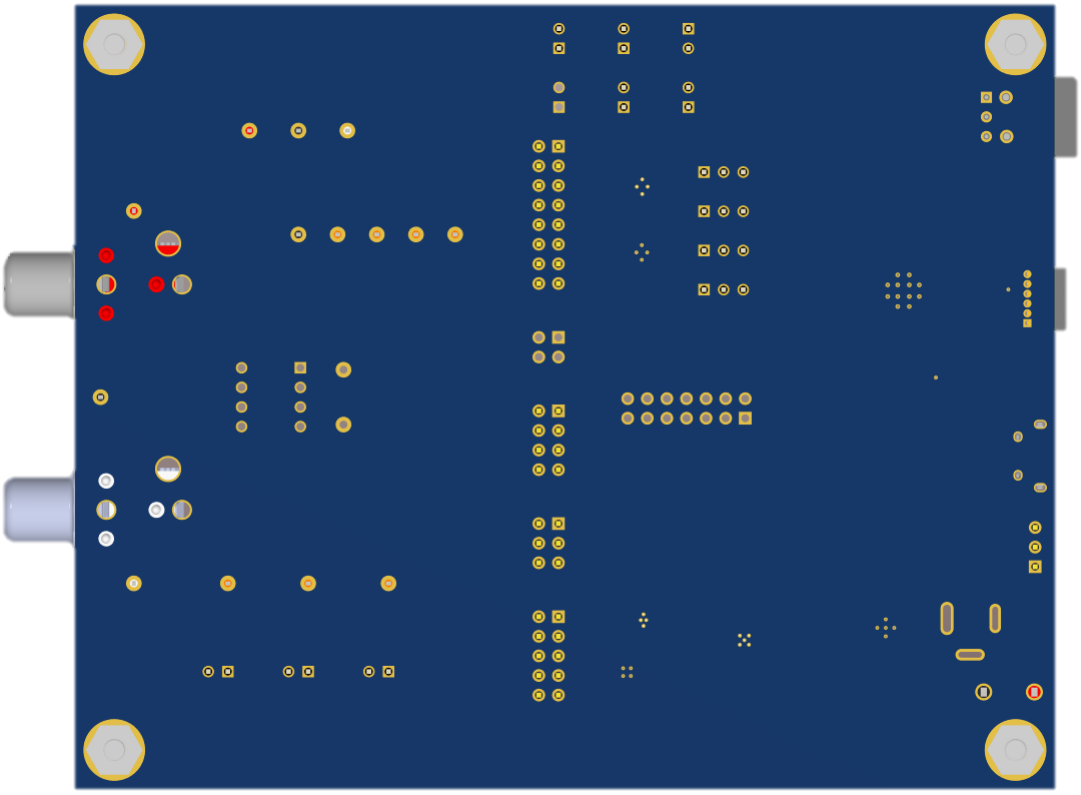


Figure 2-2. EVM Board (Bottom Side)

Use the following when connecting and configuring the board for 48kHz USB Audio mode:

1. Verify that the board is powered off, and that the USB cable is disconnected.
2. Install the control jumpers as shown in Table 2-1.
3. Verify that the signal bridge jumpers are installed as shown in Table 2-2.
4. Connect the USB cable from the PC to the PCM175xEVM.
5. The board is recognized as a TI USB Audio UAC2.0 device. If the board is not, disconnect the board, install the HS-EN Jumper (J111), and reconnect.

Table 2-1. Jumper Configuration (USB Quick Start Mode)

Jumper	Description	Configuration for USB
J101	Power Select	5V-USB
J102	Source Select	Remove(1)
J103	Target Mode	Remove(1)
J104	BCLK PSIA	Install 3&2 (Left-Hand Side)
J105	MCLK PSIA	Install 3&2 (LHS)
J106	DIN PSIA	Install 3&2 (LHS)
J107	LRCK PSIA	Install 3&2 (LHS)
J108	TDM-SEL	DNP (N/A)
J111	HS-EN	Install
J113	FMT0	Don't Care(1)
J114	FMT1	Don't Care(1)

(1) When using software for board configuration (PCM1753), do not install this jumper.

Table 2-2. Signal Bridge Jumpers to Install (USB Quick Start Mode)

Jumper	Position	Signal
J1	1	BCLK
J1	2	LRCK
J1	3	DIN
J1	4	MCLK
J3	1	SCK1
J3	2	PICO1
J3	4	CS1
J4	1	3.3V
J4	4	+5V
J4	5	-5V

1. When this EVM is in hardware mode (PCM1754), do not install this jumper.

2.3 Windows USB Audio Mode

When the J111 jumper HS-Enable is installed the PCM175xEVM will identify itself as TI USB Audio UAC2.0 and a USB Audio class 2 device. If the jumper is removed before power up, the PCM175xEVM will enumerate as a TI USB Audio UAC1.0 device.

2.4 Board Setup By Mode

The following sections describe the setup and configuration for each operating mode of the PCM175xEVM.

2.4.1 USB Mode

This mode is the same as described in Section 2.2. The PCM175xEVM allows for configuration of the onboard XMOS Controller, and PCM1753 through the SPI protocol. This can be used to configure settings such as oversampling, audio data format, and the PCM1753 de-emphasis filter. See Software for details on using SPI to configure the PCM1753.

2.4.2 Optical Audio Mode

The PCM175xEVM also supports optical input to the PCM175x using the DIR9001 96 kHz Audio Receiver.

The following steps describe how to configure the board for Optical Audio Input:

1. Verify that the board is powered off, and that the USB cable is disconnected.
2. Install the control jumpers as shown in Table 2-3.
3. Verify that the signal bridge jumpers are installed as shown in Table 2-2.
4. Configure the FMT0 and FMT1 jumpers for desired operation. Note that if software control is to be used (PCM1753), these jumpers are left unpopulated.
5. Connect the USB cable from the PC to the EVM to supply power to the board.
6. Connect the Optical cable from the audio source to the optical input (U119) on the EVM.

Table 2-3. Jumper Configuration (Optical Audio Mode)

Jumper	Description	Configuration
J101	Power Select	5V-USB
J102	Source Select	Install(1)
J103	Target Mode	Remove(1)
J108	TDM-SEL	DNP (N/A)
J105	MCLK PSIA	Install 3&2 (Left-Hand Side)
J104	BCLK PSIA	Install 3 & 2 (LHS)
J107	LRCK PSIA	Install 3&2 (LHS)
J106	DIN PSIA	Install 3&2 (LHS)
J111	HS-EN	Don't Care

Table 2-3. Jumper Configuration (Optical Audio Mode) (continued)

Jumper	Description	Configuration
J113	FMT0	See Table 2-4 (1)
J114	FMT1	See Table 2-4 (1)

(1) When using software for board configuration (PCM1753), do not install this jumper.

Table 2-4. DIR9001 Format Options

FMT1(1)	FMT0(1)	Audio Data Output
Install	Install	16-bit, MSB-first, right-justified
Install	Remove	24-bit, MSB-first, right-justified
Remove	Install	24-bit, MSB-first, left-justified
Remove	Remove	24-bit, MSB-first, I^2S

(1) When using software for board configuration (PCM1753), do not install this jumper.

2.4.3 PSIA Mode

Jumpers J104 through J107 allow for direct input of I2S signals to the PCM175x. To make use of these, the I2S signal must be injected between the center post of the PSIA connectors and ground. For convenience, these two pins are the rightmost pins on this collection of jumpers. To configure the EVM for this mode set the jumpers as shown in Table 2-5, and power the board by connecting via USB cable to a PC.

Table 2-5. Jumper Configuration (PSIA Mode)

Jumper	Description	Configuration for USB
J104	BCLK PSIA	Connect BCLK (Right-Hand Side)
J105	MCLK PSIA	Connect MCLK (RHS)
J106	DIN PSIA	Connect DIN (RHS)
J107	LRCK PSIA	Connect LRCK (RHS)

2.4.4 USB Control Mode

The USB interface is an XMOS device that handles I2S audio and control from the PC with the use of the TI USB Audio Driver. The XMOS device can operate in USB Audio 2.0 mode or USB Audio 1.0 mode. This allows up to 192kHz audio with 8 channels in and 8 channels out. To operate in the USB Audio 2.0 mode, the TI USB audio 2.0 driver must be installed and J111 of the EVM must be set correctly according to Table 2-6.

Table 2-6. HS-EN (J111) – High Speed Enable

Setting	Function
Installed	High Speed USB
Removed	Full Speed USB

2.5 Hardware Configuration

This section describes the hardware elements of the board.

2.5.1 Audio Controller

The audio controller (left) side of the EVM uses an XMOS 32-bit multicore microcontroller to handle communications with the device. This microcontroller platform is used in multiple audio EVMs in the TI DAC product line. There are three connectors on the left side of the device. First, J112 is a USB micro connection on the center left side of the EVM. This is used to source power to the EVM. Second, an optional power connection for J100 is on the bottom left side of the board. This is an unpopulated 2.1mm × 5.5mm power supply jack. Last, U119 is an optical cable input connector that is used to send an SPDIF input to the device.

2.5.2 USB and Optical

To communicate with the onboard PCM175x, the board includes both USB (J112) and Optical (U119) connectors. To monitor these, several onboard LEDs are included to indicate connection status and are summarized in Table 2-7.

Table 2-7. USB and SPDIF Indicators

Indicator	Description
3.3 V (D100)	Digital 3.3V status Indicator
USB Ready (D102)	Status of the USB IC connection to the PC. If lit, the controller is communicating via USB properly
SPDIF Good (D103)	SPDIF Data is being received by the DIR9001

2.5.3 EVM Power Tree

The PCM175xEVM uses a 5V USB input to power the entire board. Figure 2-3 shows the rails created onboard the PCM175xEVM, and the devices used to generate them. The PCM175xEVM has a footprint to include a 5V-DC mini barrel connector, but does not require this for regular operation. As such J101 (J2 on the figure) must be set to use 5V-USB power, which is sufficient for all operating modes of the board. The ±5V rails are used for the OPA1678 audio amplifier, to create the actively filtered signal.

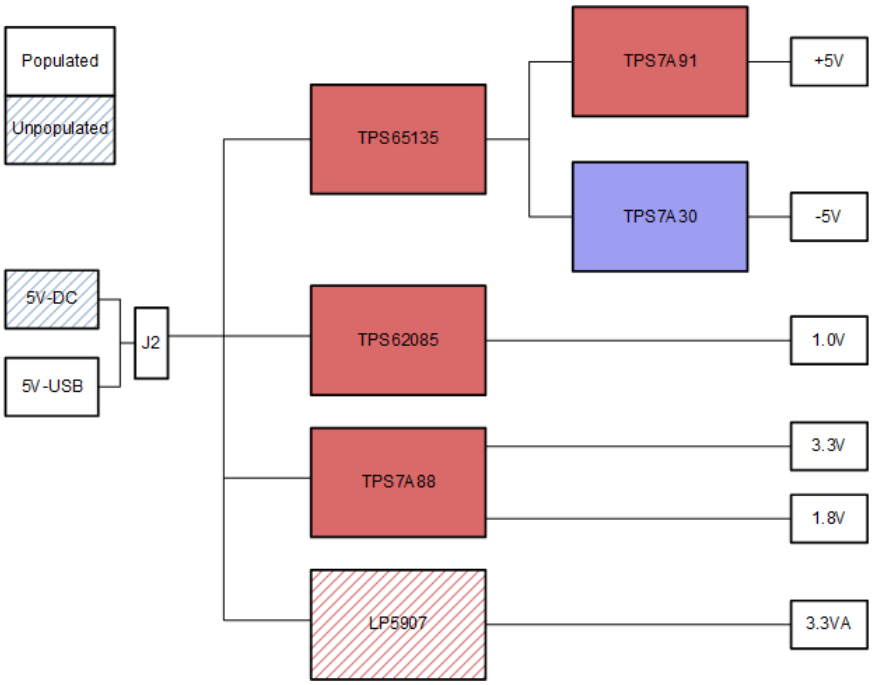


Figure 2-3. PCM175xEVM Power Tree

2.5.4 EVM Audio Device

The right side of the board contains the PCM175x, the audio device for this EVM. External power for the audio device side of the EVM is supplied from the bridge power headers. The audio device side of the EVM contains a set of jumpers for pin configurations of the hardware-controlled PCM1754, amplifier buffers for the output signals, and headers and jacks for analog outputs of the device and board.

2.5.4.1 EVM Audio Device Headers

This section only refers to the hardware controlled PCM1754. Digital headers with connections to the PCM1754 are provided with J6, J7, and J8. Each of these digital pins is connected to a 3.3V supply through a 10-kΩ resistor acting as a pull-up. Inserting a jumper pulls the digital pin to ground. These headers, from right to left, are:

- MUTE – Hardware mute control
- DEMP – Hardware de-emphasis control
- FORMAT – Selects the data format

Table 2-8 shows the jumper definitions of the EVM Audio Device Headers. These jumpers are removed when using the PCM1753.

Table 2-8. EVM Audio Device Jumper Definitions

Jumper	Function	Positions
J6	MUTE	**Install:** Mute OFF **Remove:** Mute ON
J7	DEMP	**Install:** 44.1kHz de-emphasis OFF **Remove:** 44.1kHz de-emphasis ON
J8	FORMAT	**Install:** 16- to 24-bit, I2S Format **Remove:** 16-bit right-justified

2.5.4.2 PCM175x Output Filter

The PCM175xEVM uses a multiple-feedback low pass filter with an OPA1678 Audio Operational Amplifier. Figure 2-4 shows the filter design and component values. A 10µF capacitor is included in series with the output to block DC and low frequency components.

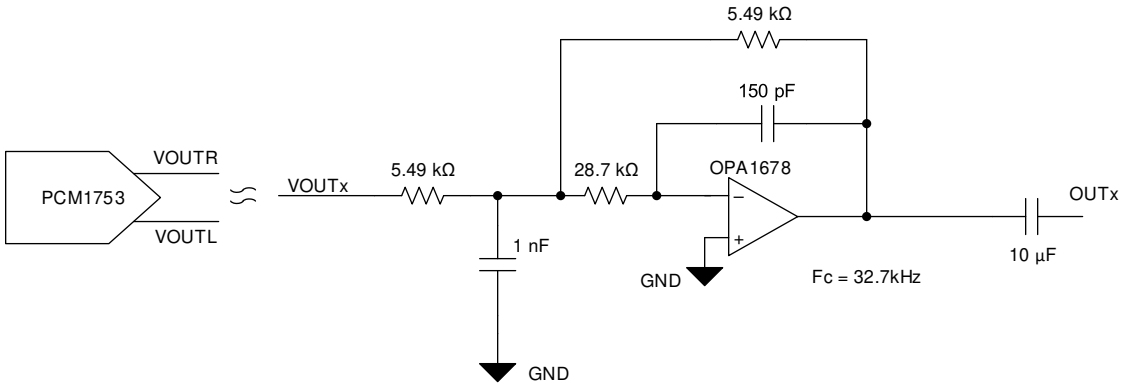


Figure 2-4. PCM175x Output Filter

2.5.4.3 DIP Adapter Footprint

Figure 2-5 shows the dip adapter footprint surrounding the OPA1681 amplifier included in the filter. If evaluation with another amplifier is desired, then the OPA1678 can be removed, and a DIP adapter board with an amplifier can be used to replace the amplifier within the filter circuit. The pinout for the dip footprint is shown in Figure 2-6.

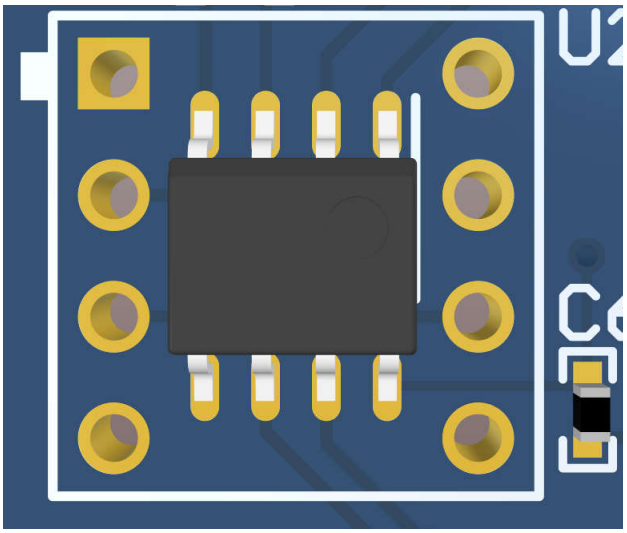


Figure 2-5. Amplifier DIP Adapter Footprint

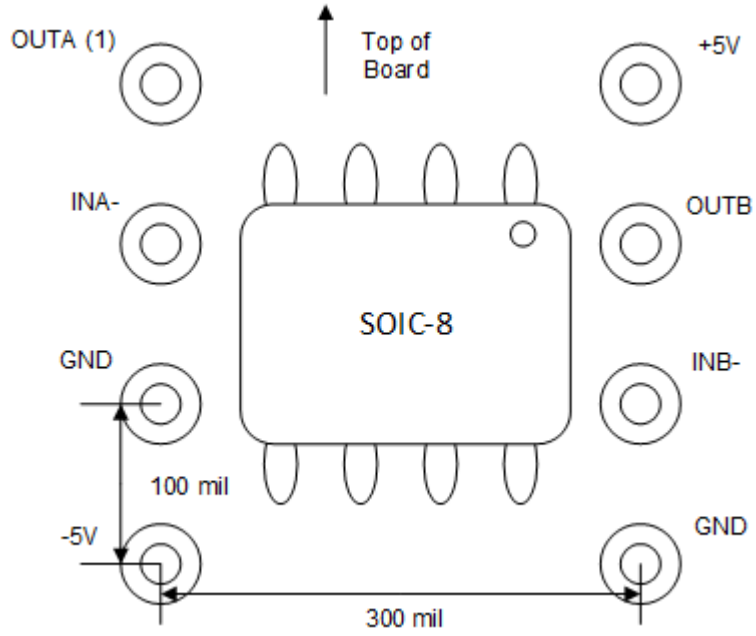


Figure 2-6. DIP Adapter Pinout

3 Software

3.1 Software Overview

This section only refers to the software-controlled PCM1753. The PCM1753 device has many programmable functions which can be controlled in the software control mode. The functions are controlled by programming the internal registers using the ML, MC, and MD pins. The serial control interface is a 3-wire serial port, which operates asynchronously to the audio serial interface. The serial control interface is used to program the on-chip mode registers. The control interface includes MD (pin 13), MC (pin 14), and ML (pin 15).

These pins are analogous to the SPI protocol. The MD pin is the serial data input (PICO), used to program the mode registers. The MC pin is the serial bit clock (SCK), used to shift data into the control port. The ML pin is the control port latch clock (CS).

3.1.1 Register Write Operation

All write operations for the serial control port use 16-bit data words. Figure 3-1 lists the control data word format. The most significant bit must be a 0. There are seven bits, labeled IDX[6:0], that set the register index (or address) for the write operation. The least significant eight bits, D[7:0], contain the data to be written to the register specified by IDX[6:0]. Refer to the PCM1753 Datasheet for specific descriptions of the user-programmable mode control registers.

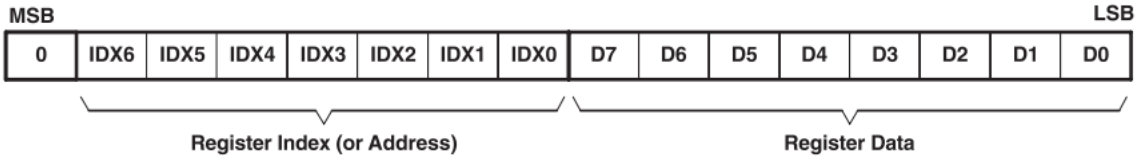


Figure 3-1. Control Data Word Format for MD

Figure 3-2 lists the functional timing diagram for writing to the serial control port. ML is held at a logic 1 state until a register needs to be written. To start the register write cycle, ML is set to logic 0. Sixteen clocks are then provided on MC, corresponding to the 16 bits of the control data word on MD. After the sixteenth clock cycle has completed, ML is set to logic 1 to latch the data into the indexed mode control register.

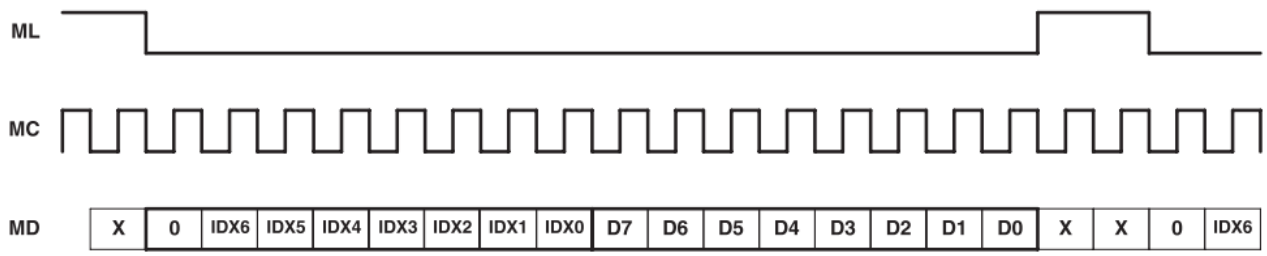


Figure 3-2. Register Write Operation

3.1.2 Board Configuration for Software Mode

Table 3-1 shows how the jumpers are configured for use with the PCM1753EVM. With the board powered off, board jumpers can be removed and installed as needed.

Table 3-1. Jumper Configuration for Software Mode

Jumper	Description	Configuration
J101	Power Select	5V-USB
J102	Source Select	Remove
J103	Target Mode	Remove
J104	BCLK PSIA	Install 3&2 (Left-Hand Side)
J105	MCLK PSIA	Install 3&2 (LHS)
J106	DIN PSIA	Install 3&2 (LHS)
J107	LRCK PSIA	Install 3&2 (LHS)
J108	TDM-SEL	DNP (N/A)
J111	HS-EN	Install
J113	FMT0	Remove
J114	FMT1	Remove
J3-1	SCK	Install
J3-2	PICO	Install
J3-3	POCI	Don't Care
J3-4	CS	Install

4 Hardware Design Files

4.1 Schematic

Figure 4-1 to Figure 4-5 display the EVM schematics.

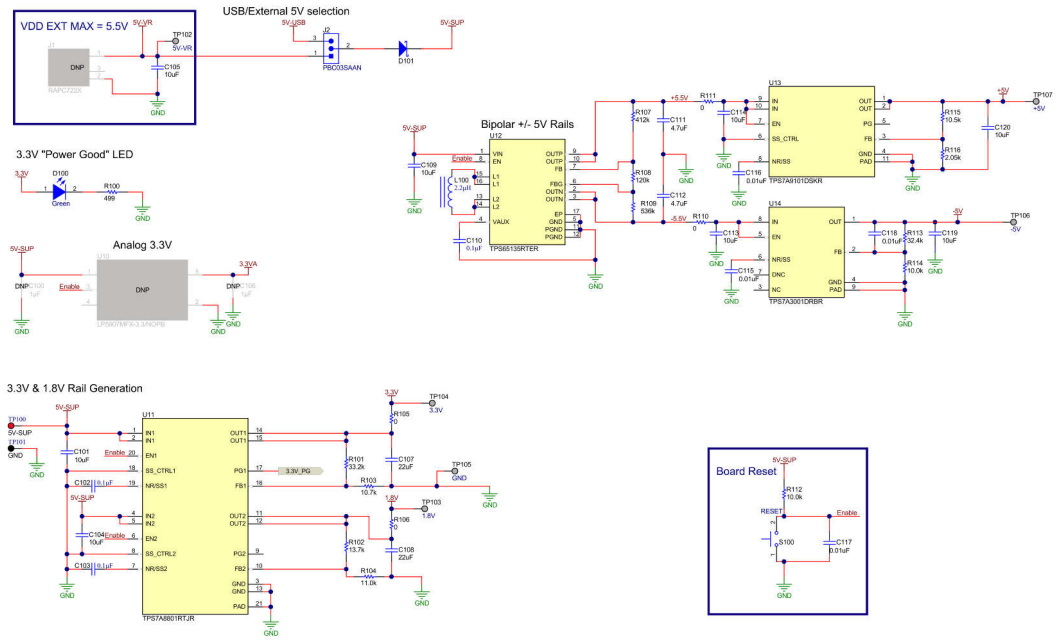


Figure 4-1. PCM175xEVM Schematics (1 of 5)

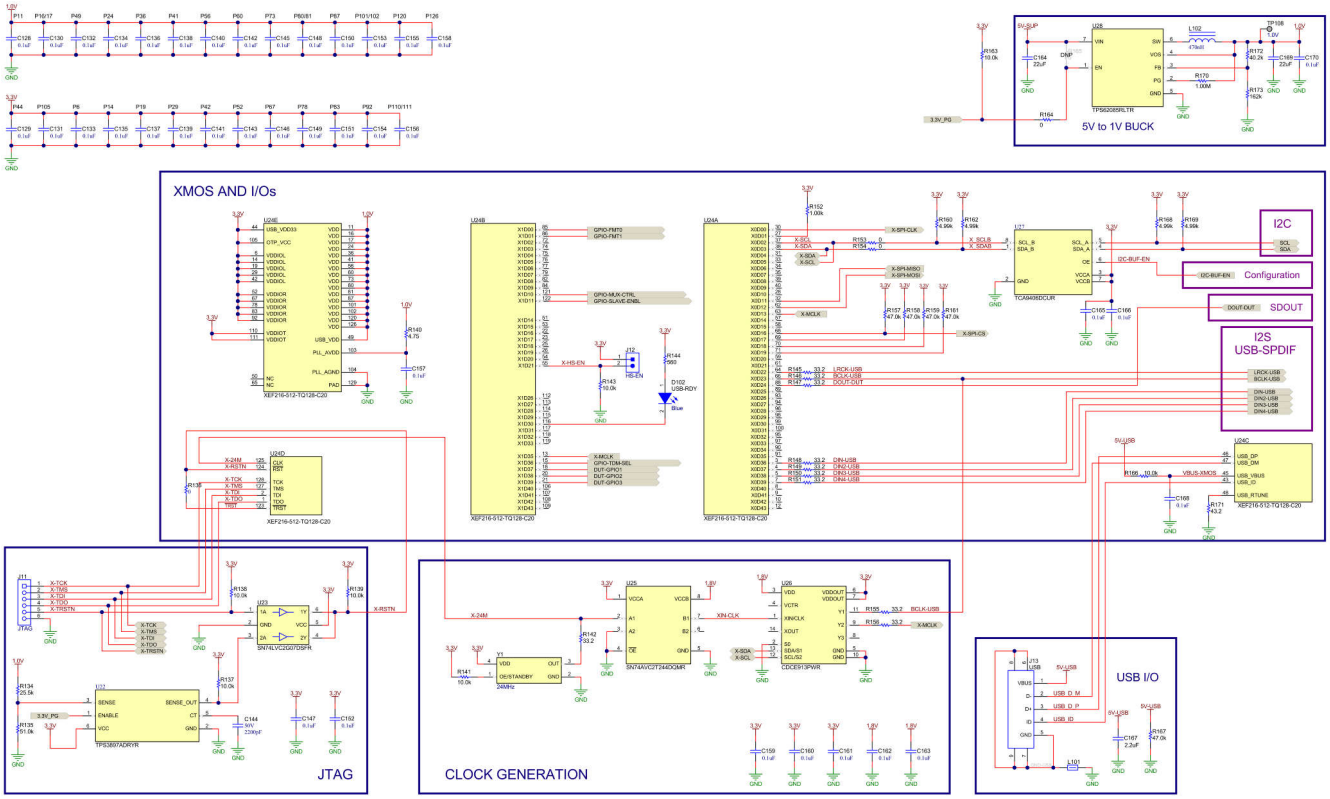


Figure 4-2. PCM175xEVM Schematics (2 of 5)

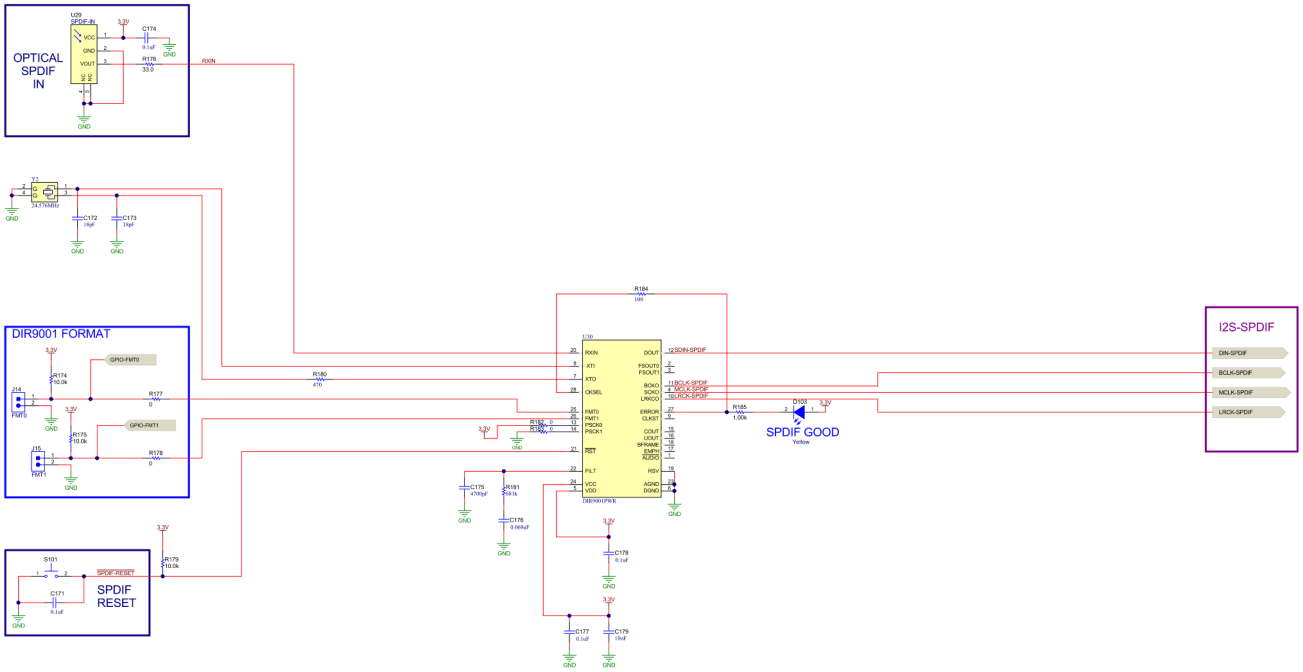


Figure 4-3. PCM175xEVM Schematics (3 of 5)

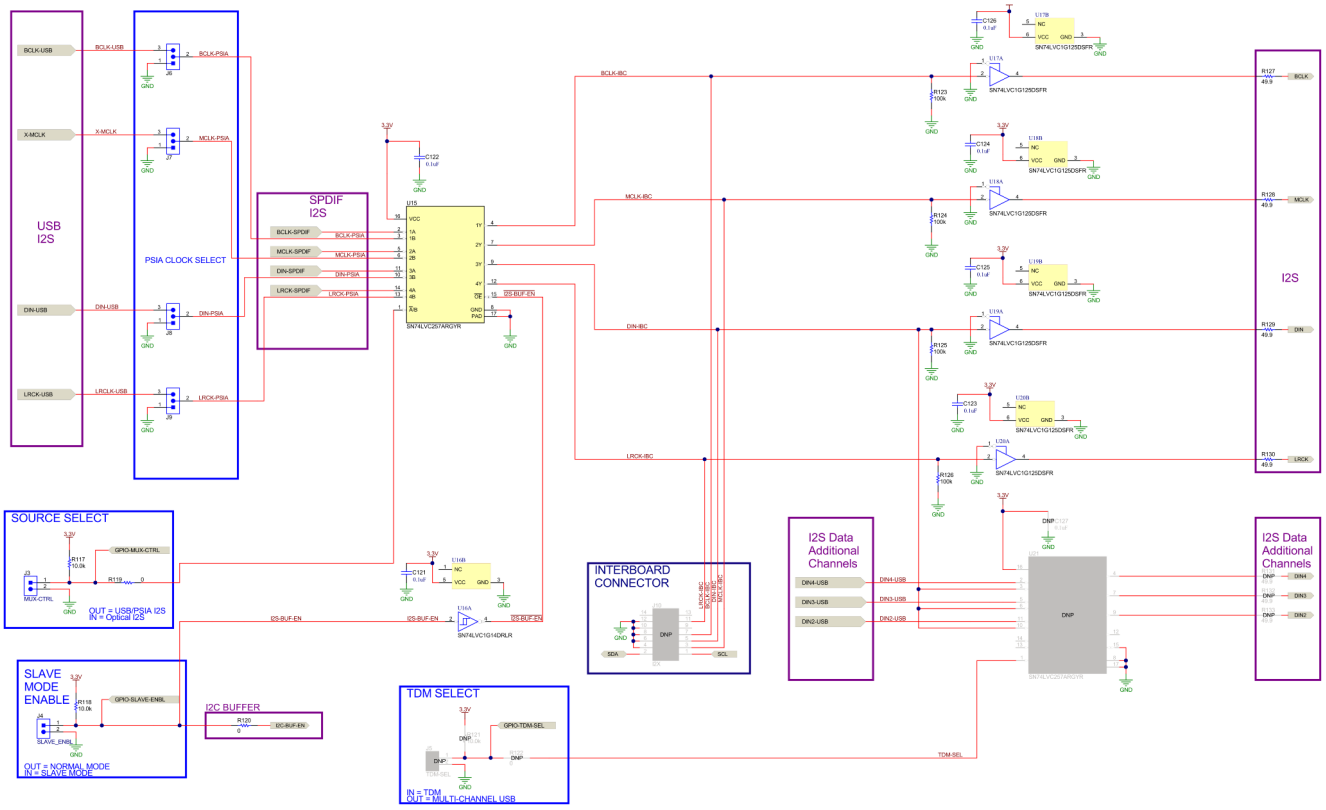


Figure 4-4. PCM175xEVM Schematics (4 of 5)

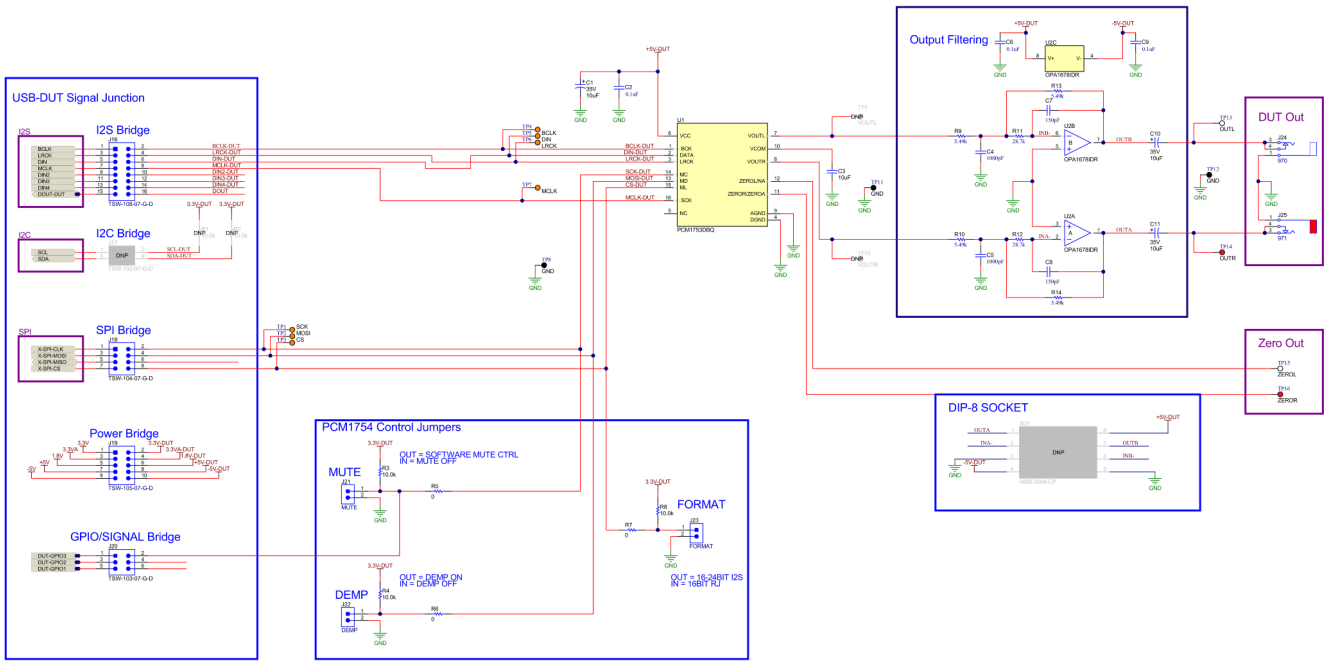


Figure 4-5. PCM175xEVM Schematics (5 of 5)

4.2 PCB Layouts

Figure 4-6 through Figure 4-9 show the layout of the components for the PCM175xEVM board.

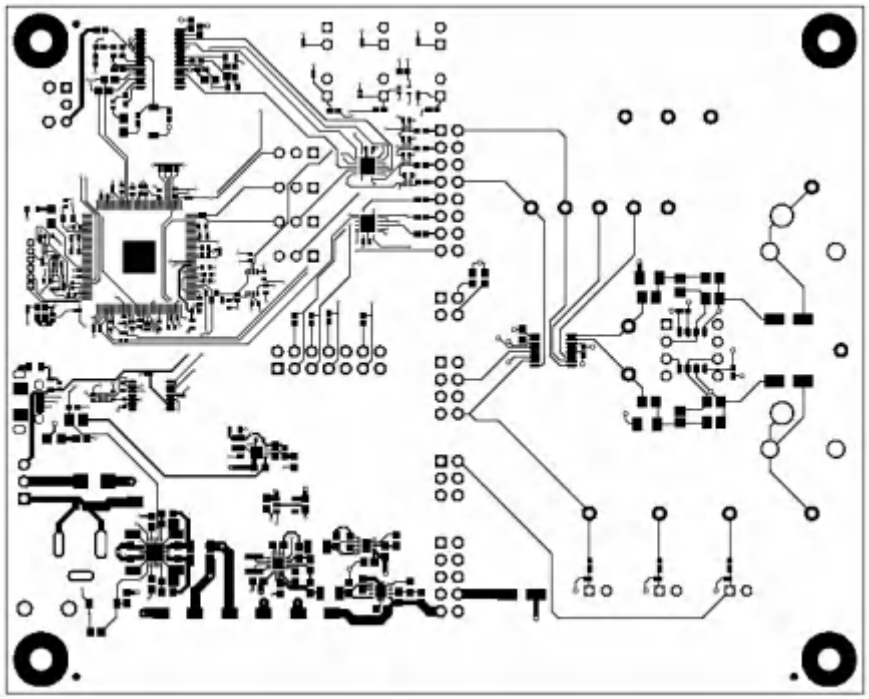


Figure 4-6. PCM175xEVM PCB Top Layer Layout

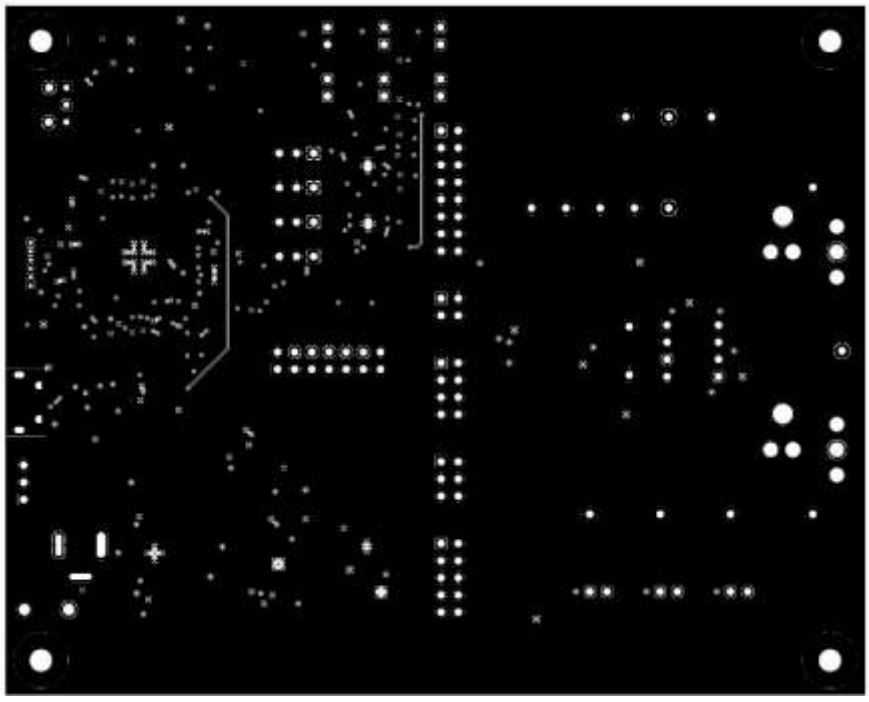


Figure 4-7. PCM175xEVM PCB Mid-Layer 1 Layout (Ground Plane)

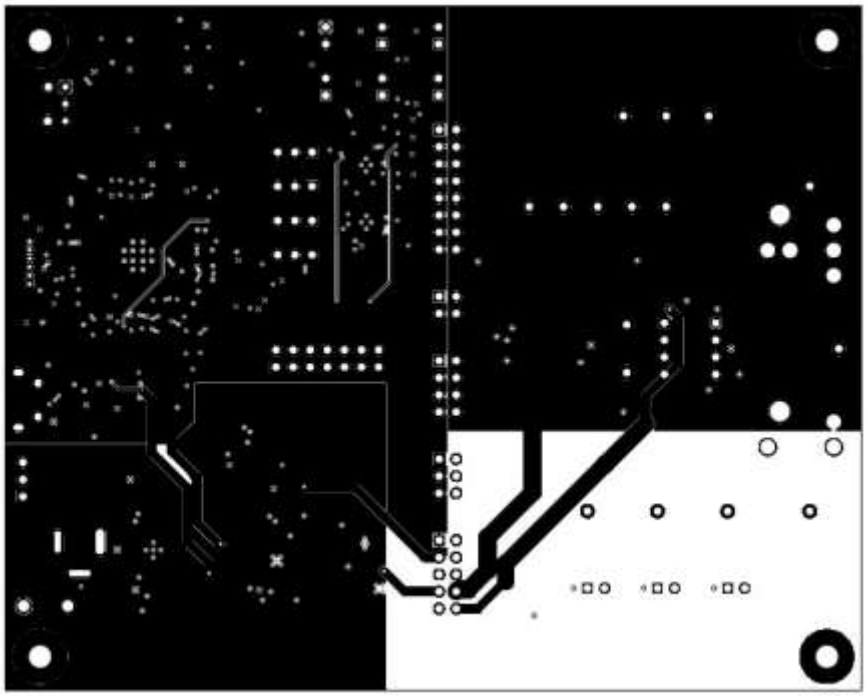


Figure 4-8. PCM175xEVM PCB Mid-Layer 2 Layout

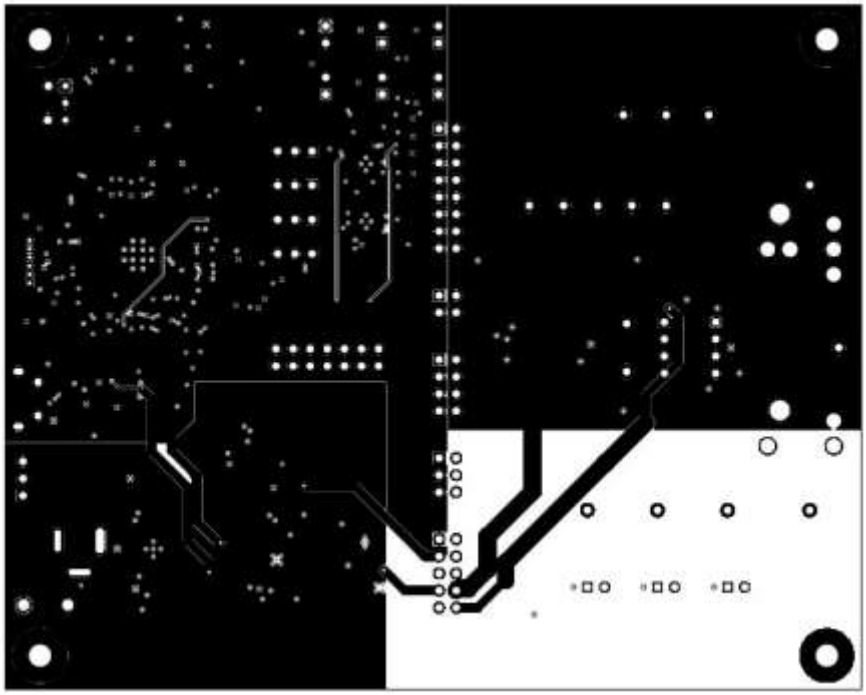


Figure 4-9. PCM175xEVM PCB Bottom Layer Layout

4.3 Bill of Materials

Table 4-1 shows the EVM BOM.

Table 4-1. PCM175xEVM BOM

Designator	QTY	Value	Description	Package Reference	Part Number	Manufacturer
PCB1	1		Printed Circuit Board		DC093	Any

Table 4-1. PCM175xEVM BOM (continued)

Designator	QTY	Value	Description	Package Reference	Part Number	Manufacturer
C1, C10, C11	3	10uF	CAP, AL, 10 uF, 35 V, +/- 20%, 1.8 ohm, SMD	SMT Radial C	EEE-FC1V100R	Panasonic
C2, C6, C9, C121, C122, C123, C124, C125, C126, C128, C129, C130, C131, C132, C133, C134, C135, C136, C137, C138, C139, C140, C141, C142, C143, C145, C146, C147, C148, C149, C150, C151, C152, C153, C154, C155, C156, C157, C158, C159, C160, C161, C162, C163, C165, C166, C168, C170, C171, C174, C177, C178	52	0.1uF	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X7R, 0402	0402	0402YC104KAT2A	AVX
C3, C101, C104, C105, C109, C113, C114, C119, C120	9	10uF	CAP, CERM, 10 uF, 10 V, +/- 20%, X5R, 0603	0603	GRM188R61A106ME69D	MuRata
C4, C5	2	1000pF	CAP, CERM, 1000 pF, 100 V, +/- 5%, C0G/NP0, 1206	1206	12061A102JAT2A	AVX
C7, C8	2	150pF	CAP, CERM, 150 pF, 50 V, +/- 5%, C0G/NP0, 0805	0805	C0805C151J5GACTU	Kemet
C102, C103, C110	3	0.1uF	CAP, CERM, 0.1 µF, 25 V,+/- 10%, X5R, 0603	0603	CL10A104KA8NNNC	Samsung Electro-Mechanics
C107, C108, C164, C169	4	22uF	CAP, CERM, 22 uF, 10 V, +/- 20%, X5R, 0603	0603	GRM187R61A226ME15D	MuRata
C111, C112	2	4.7uF	CAP, CERM, 4.7 uF, 16 V, +/- 10%, X5R, 0603	0603	GRM188R61C475KAAJ	MuRata
C115, C116, C117, C118	4	0.01uF	CAP, CERM, 0.01 uF, 50 V, +/- 5%, C0G/NP0, 0603	0603	GRM1885C1H103JA01D	MuRata
C144	1	2200pF	CAP, CERM, 2200 pF, 50 V, +/- 5%, X7R, 0402	0402	CL05B222JB5NNNC	Samsung Electro-Mechanics
C167	1	2.2uF	CAP, CERM, 2.2 uF, 10 V, +/- 10%, X7R, 0603	0603	C1608X7R1A225K080AC	TDK
C172, C173	2	18pF	CAP, CERM, 18 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	06035A180JAT2A	AVX
C175	1	4700pF	CAP, CERM, 4700 pF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	CGA2B2X7R1H472K050BA	TDK
C176	1	0.068uF	CAP, CERM, 0.068 uF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	CGA2B3X7R1H683K050BB	TDK
C179	1	10uF	CAP, CERM, 10 uF, 10 V, +/- 20%, X5R, 0603	0603	C1608X5R1A106M080AC	TDK
D100	1	Green	LED, Green, SMD	0805 LED	LTST-C171GKT	Lite-On

Table 4-1. PCM175xEVM BOM (continued)

Designator	QTY	Value	Description	Package Reference	Part Number	Manufacturer
D101	1	100V	Diode, Schottky, 100 V, 1 A, SMA	SMA	B1100-13-F	Diodes Inc.
D102	1	Blue	LED, Blue, SMD	LED_0805	LTST-C170TBKT	Lite-On
D103	1	Yellow	LED, Yellow , SMD	0805 LED	LTST-C170KSKT	Lite-On
H1, H3, H5, H7	4		Standoff, Hex, 0.5"L #4-40 Nylon	Standoff	1902C	Keystone
H2, H4, H6, H8	4		Machine Screw, Round, #4-40 x 1/4, Nylon, Philips panhead	Screw	NY PMS 440 0025 PH	B&F Fastener Supply
J2	1		Header, 100mil, 3x1, Gold, TH	PBC03SAAN	PBC03SAAN	Sullins Connector Solutions
J3, J4, J12, J14, J15, J21, J22, J23	8		Header, 100mil, 2x1, Tin, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions
J6, J7, J8, J9	4		Header, 100mil, 3x1, Tin, TH	Header, 3 PIN, 100mil, Tin	PEC03SAAN	Sullins Connector Solutions
J11	1		Receptacle, 50mil, 6x1, Gold, R/A, TH	6x1 Receptacle	LPPB061NGCN-RC	Sullins Connector Solutions
J13	1		Connector, Receptacle, Micro-USB Type AB, R/A, Bottom Mount SMT	Connector, USB Micro AB	DX4R205JJAR1800	JAE Electronics
J16	1		Header, 100mil, 8x2, Gold, TH	8x2 Header	TSW-108-07-G-D	Samtec
J18	1		Header, 100mil, 4x2, Gold, TH	4x2 Header	TSW-104-07-G-D	Samtec
J19	1		Header, 100mil, 5x2, Gold, TH	5x2 Header	TSW-105-07-G-D	Samtec
J20	1		Header, 100mil, 3x2, Gold, TH	3x2 Header	TSW-103-07-G-D	Samtec
J24	1		RCA Jack, White, R/A, TH	PC Mount Phono Jack-White, TH	970	Keystone
J25	1		RCA Jack, Red, R/A, TH	PC Mount Phono Jack-Red, TH	971	Keystone
L100	1	2.2uH	Inductor, Shielded, Ferrite, 2.2 µH, 1.1 A, 0.114 ohm, SMD	3x3mm	NR3010T2R2M	Taiyo Yuden
L101	1	600 ohm	Ferrite Bead, 600 ohm @ 100 MHz, 2 A, 0805	0805	MPZ2012S601AT000	TDK
L102	1	470nH	Inductor, Shielded, Ferrite, 470 nH, 2.35 A, 0.0528 ohm, AEC-Q200 Grade 1, SMD	2.0x1.6x1.0mm	SRN2010TA-R47Y	Bourns
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650 x 0.200 inch	THT-14-423-10	Brady
R3, R4, R8, R117, R118, R137, R138, R139, R141, R143, R174, R175	12	10.0k	RES, 10.0 k, 1%, 0.05 W, 0201	0201	RC0201FR-0710KL	Yageo America
R5, R6, R7, R119, R120, R182, R183	7	0	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	0402	ERJ-2GE0R00X	Panasonic
R9, R10, R13, R14	4	5.49k	RES, 5.49 k, 0.5%, 0.1 W, 0805	0805	RR1220P-5491-D-M	Susumu Co Ltd
R11, R12	2	28.7k	RES, 28.7 k, 0.5%, 0.1 W, 0805	0805	RR1220P-2872-D-M	Susumu Co Ltd
R100	1	499	RES, 499, 1%, 0.1 W, 0603	0603	RC0603FR-07499RL	Yageo
R101	1	33.2k	RES, 33.2 k, 1%, 0.1 W, 0603	0603	RC0603FR-0733K2L	Yageo
R102	1	13.7k	RES, 13.7 k, 1%, 0.1 W, 0603	0603	RC0603FR-0713K7L	Yageo
R103	1	10.7k	RES, 10.7 k, 1%, 0.1 W, 0603	0603	RC0603FR-0710K7L	Yageo
R104	1	11.0k	RES, 11.0 k, 1%, 0.1 W, 0603	0603	RC0603FR-0711KL	Yageo

Table 4-1. PCM175xEVM BOM (continued)

Designator	QTY	Value	Description	Package Reference	Part Number	Manufacturer
R105, R106, R110, R111	4	0	RES, 0, 1%, 0.5 W, 1206	1206	5108	Keystone
R107	1	412k	RES, 412 k, 1%, 0.1 W, 0603	0603	RC0603FR-07412KL	Yageo
R108	1	120k	RES, 120 k, 1%, 0.1 W, 0603	0603	RC0603FR-07120KL	Yageo
R109	1	536k	RES, 536 k, 1%, 0.1 W, 0603	0603	RC0603FR-07536KL	Yageo
R112, R114	2	10.0k	RES, 10.0 k, 1%, 0.1 W, 0603	0603	RC0603FR-0710KL	Yageo
R113	1	32.4k	RES, 32.4 k, 1%, 0.1 W, 0603	0603	RC0603FR-0732K4L	Yageo
R115	1	10.5k	RES, 10.5 k, 0.1%, 0.1 W, 0603	0603	RG1608P-1052-B-T5	Susumu Co Ltd
R116	1	2.05k	RES, 2.05 k, 0.1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	ERA-3AEB2051V	Panasonic
R123, R124, R125, R126	4	100k	RES, 100 k, 1%, 0.0625 W, 0402	0402	RC0402FR-07100KL	Yageo America
R127, R128, R129, R130	4	49.9	RES, 49.9, 1%, 0.063 W, 0402	0402	RC0402FR-0749R9L	Yageo America
R134	1	25.5k	RES, 25.5 k, 1%, 0.05 W, 0201	0201	RC0201FR-0725K5L	Yageo America
R135	1	51.0k	RES, 51.0 k, 1%, 0.05 W, 0201	0201	RC0201FR-0751KL	Yageo America
R136	1	0	RES, 0, 5%, .05 W, AEC-Q200 Grade 0, 0201	0201	ERJ-1GN0R00C	Panasonic
R140	1	4.75	RES, 4.75, 1%, 0.1 W, 0603	0603	RC0603FR-074R75L	Yageo
R142, R145, R146, R147, R148, R149, R150, R151, R155, R156	10	33.2	RES, 33.2, 1%, 0.05 W, 0201	0201	RC0201FR-0733R2L	Yageo America
R144	1	560	RES, 560, 5%, 0.1 W, 0603	0603	RC0603JR-07560RL	Yageo
R152, R185	2	1.00k	RES, 1.00 k, 1%, 0.0625 W, 0402	0402	RC0402FR-071KL	Yageo America
R153, R154, R177, R178	4	0	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	ERJ-3GEY0R00V	Panasonic
R157, R158, R159, R161	4	47.0k	RES, 47.0 k, 1%, 0.05 W, 0201	0201	RC0201FR-0747KL	Yageo America
R160, R162, R168, R169	4	4.99k	RES, 4.99 k, 1%, 0.063 W, 0402	0402	RC0402FR-074K99L	Yageo America
R163, R166	2	10.0k	RES, 10.0 k, 1%, 0.1 W, 0402	0402	ERJ-2RKF1002X	Panasonic
R164	1	0	RES, 0, 5%, 0.125 W, 0805	0805	RC0805JR-070RL	Yageo America
R167	1	47.0k	RES, 47.0 k, 1%, 0.0625 W, 0402	0402	RC0402FR-0747KL	Yageo America
R170	1	1.00Meg	RES, 1.00 M, 1%, 0.1 W, 0603	0603	RC0603FR-071ML	Yageo
R171	1	43.2	RES, 43.2, 1%, 0.05 W, 0201	0201	RC0201FR-0743R2L	Yageo America
R172	1	40.2k	RES, 40.2 k, 1%, 0.1 W, AEC-Q200 Grade 0, 0402	0402	ERJ-2RKF4022X	Panasonic
R173	1	162k	RES, 162 k, 1%, 0.1 W, 0603	0603	RC0603FR-07162KL	Yageo
R176	1	33.0	RES, 33.0, 1%, 0.1 W, 0402	0402	ERJ-2RKF33R0X	Panasonic
R179	1	10.0k	RES, 10.0 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	RMCF0402FT10K0	Stackpole Electronics Inc
R180	1	470	RES, 470, 1%, 0.063 W, 0402	0402	RC0402FR-07470RL	Yageo America
R181	1	681k	RES, 681 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402681KFKED	Vishay-Dale
R184	1	100	RES, 100, 1%, 0.1 W, 0402	0402	ERJ-2RKF1000X	Panasonic

Table 4-1. PCM175xEVM BOM (continued)

Designator	QTY	Value	Description	Package Reference	Part Number	Manufacturer
S100, S101	2		Switch, Tactile, SPST-NO, 0.05A, 12V, SMT	Switch, 4.4x2x2.9 mm	TL1015AF160QG	E-Switch
TP1, TP2, TP3, TP4, TP5, TP6, TP7	7		Test Point, Miniature, Orange, TH	Orange Miniature Testpoint	5003	Keystone
TP8, TP11, TP12	3		Test Point, Miniature, Black, TH	Black Miniature Testpoint	5001	Keystone
TP13, TP15	2		Test Point, Miniature, White, TH	White Miniature Testpoint	5002	Keystone
TP14, TP16	2		Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone
TP100	1		Test Point, Multipurpose, Red, TH	Red Multipurpose Testpoint	5010	Keystone
TP101	1		Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint	5011	Keystone
U1	1		Catalog 106dB SNR Stereo DAC (S/W Control), DBQ0016A (SSOP-16)	DBQ0016A	PCM1753DBQ	Texas Instruments
U2	1		Low Distortion, Low Noise, General Purpose Audio Op Amp, D0008A (SOIC-8)	D0008A	OPA1678IDR	Texas Instruments
U11	1		Dual, 1-A, Low Noise (3.8-uVRMS), LDO Voltage Regulator, RTJ0020D (WQFN-20)	RTJ0020D	TPS7A8801RTJR	Texas Instruments
U12	1		Single-Inductor, Multiple-Output(SIMO) Regulator, 2.5 to 5.5 V, -40 to 85 degC, 16-pin QFN (RTE16), Green (RoHS & no Sb/Br)	RTE0016C	TPS65135RTER	Texas Instruments
U13	1		1-A, High-Accuracy, Low-Noise LDO Voltage Regulator, DSK0010A (WSON-10)	DSK0010A	TPS7A9101DSKR	Texas Instruments
U14	1		Vin -3V to -36V, -200mA, Ultra-Low Noise, High PSRR, Low-Dropout Linear Regulator, DRB0008A (VSON-8)	DRB0008A	TPS7A3001DRBR	Texas Instruments
U15	1		Quadruple 2-Line To 1-Line Data Selector/Multiplexer With 3-State Outputs, RGY0016A (VQFN-16)	RGY0016A	SN74LVC257ARGYR	Texas Instruments
U16	1		Single Schmitt-Trigger Inverter, DRL0005A, LARGE T&R	DRL0005A	SN74LVC1G14DRLR	Texas Instruments
U17, U18, U19, U20	4		Single Bus Buffer Gate With 3-State Outputs, DSF0006A, LARGE T&R	DSF0006A	SN74LVC1G125DSFR	Texas Instruments
U22	1		Single-Channel Ultra-Small Adjustable Supervisory Circuit With Active-High Open-Drain Output, DRY0006A (USON-6)	DRY0006A	TPS3897ADRYR	Texas Instruments
U23	1		Enhanced Product Dual Buffer/Driver with Open-Drain Output, DCK0006A (SOT-SC70-6)	DSF0006A	SN74LVC2G07DSFR	Texas Instruments
U24	1		IC MCU 512KB RAM, 128TQFP	TQFP-128	XEF216-512-TQ128-C20	XMOS semiconductor
U25	1		Dual-Bit Dual-Supply Bus Transceiver, DQM0008A (X2SON-8)	DQM0008A	SN74AVC2T244DQMR	Texas Instruments
U26	1		Programmable 1-PLL VCXO Clock Synthesizer with 2.5-V or 3.3-V LVCMOS Outputs, PW0014A (TSSOP-14)	PW0014A	CDCE913PWR	Texas Instruments
U27	1		2-Bit Bidirectional 1-MHz I2C Bus and SMBus Voltage-Level Shifter, DCU0008A (VSSOP-8)	DCU0008A	TCA9406DCUR	Texas Instruments

Table 4-1. PCM175xEVM BOM (continued)

Designator	QTY	Value	Description	Package Reference	Part Number	Manufacturer
U28	1		3-A Step-Down Converter with DCS-Control and Hiccup Short Circuit Protection in 2x2 HotRod Package, RLT0007A (VSON-HR-7)	RLT0007A	TPS62085RLTR	Texas Instruments
U29	1		Photolink- Fiber Optic Receiver, TH	13.5x10x9.7mm	PLR135/T10	Everlight
U30	1		96 kHz Digital Audio Receiver, 50 ps Jitter, 3.3V, -40 to 85 degC, 28-Pin TSSOP (PW), Green (RoHS & no Sb/Br)	PW0028A	DIR9001PWR	Texas Instruments
Y1	1		OSC, 24 MHz, 2.25 - 3.63 V, SMD	2x1.6mm	ASTMLPA-24.000MHZ-EJ-E-T	Abracon Corporation
Y2	1		Crystal, 24.576 MHz, 10pF, SMD	2.5x0.5x2.0mm	ABM10-24.576MHZ-E20-T	Abracon Corporation
C100, C106	0	1uF	CAP, CERM, 1 µF, 16 V,+/- 10%, X7R, 0603	0603	CL10B105KO8NFNC	Samsung Electro-Mechanics
C127	0	0.1uF	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X7R, 0402	0402	0402YC104KAT2A	AVX
FID1, FID2, FID3	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
J1	0		Power Jack, mini, 2.1mm OD, R/A, TH	Jack, 14.5x11x9mm	RAPC722X	Switchcraft
J5	0		Header, 100mil, 2x1, Tin, TH	Header, 2 PIN, 100mil, Tin	PEC02SAAN	Sullins Connector Solutions
J10	0		Header (shrouded), 100 mil, 7x2, Gold, TH	7x2 Shrouded Header	SBH11-PBPC-D07-ST-BK	Sullins Connector Solutions
J17	0		Header, 100mil, 2x2, Gold, TH	2x2 Header	TSW-102-07-G-D	Samtec
R1, R2	0	10.0k	RES, 10.0 k, 1%, 0.1 W, 0603	0603	CRCW060310K0FKEA	Vishay-Dale
R121	0	10.0k	RES, 10.0 k, 1%, 0.05 W, 0201	0201	RC0201FR-0710KL	Yageo America
R122	0	0	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0402	0402	ERJ-2GE0R00X	Panasonic
R131, R132, R133	0	49.9	RES, 49.9, 1%, 0.063 W, 0402	0402	RC0402FR-0749R9L	Yageo America
R165	0	0	RES, 0, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	ERJ-3GEY0R00V	Panasonic
TP9	0		Test Point, Miniature, White, TH	White Miniature Testpoint	5002	Keystone
TP10	0		Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone
U10	0		250-mA Ultra-Low-Noise, Low-IQ LDO, DBV0005A (SOT-23-5)	DBV0005A	LP5907MFX-3.3/NOPB	Texas Instruments
U21	0		Quadruple 2-Line To 1-Line Data Selector/Multiplexer With 3-State Outputs, RGY0016A (VQFN-16)	RGY0016A	SN74LVC257ARGYR	Texas Instruments
XU1	0		Socket, DIP-8, 2.54 mm Pitch	Socket, DIP-8, 2.54 mm Pitch	4808-3004-CP	3M

5 Additional Information

Trademarks

All trademarks are the property of their respective owners.

6 Related Documentation

- PCM1753 24-bit 192-kHz Sampling Enhanced Multi-Level Delta-Sigma Audio Digital-to-Analog Converter data sheet
- PCM1754 24-bit 192-kHz Sampling Enhanced Multi-Level Delta-Sigma Audio Digital-to-Analog Converter data sheet

7 Revision History

NOTE: Page numbers for previous revisions may differ from page numbers in the current version.

DATE	REVISION	NOTES
March 2026	*	Initial Release

STANDARD TERMS FOR EVALUATION MODULES

1. *Delivery:* TI delivers TI evaluation boards, kits, or modules, including any accompanying demonstration software, components, and/or documentation which may be provided together or separately (collectively, an “EVM” or “EVMs”) to the User (“User”) in accordance with the terms set forth herein. User's acceptance of the EVM is expressly subject to the following terms.

   1.1 EVMs are intended solely for product or software developers for use in a research and development setting to facilitate feasibility evaluation, experimentation, or scientific analysis of TI semiconductors products. EVMs have no direct function and are not finished products. EVMs shall not be directly or indirectly assembled as a part or subassembly in any finished product. For clarification, any software or software tools provided with the EVM (“Software”) shall not be subject to the terms and conditions set forth herein but rather shall be subject to the applicable terms that accompany such Software

   1.2 EVMs are not intended for consumer or household use. EVMs may not be sold, sublicensed, leased, rented, loaned, assigned, or otherwise distributed for commercial purposes by Users, in whole or in part, or used in any finished product or production system.

2 *Limited Warranty and Related Remedies/Disclaimers*:

   2.1 These terms do not apply to Software. The warranty, if any, for Software is covered in the applicable Software License Agreement.

   2.2 TI warrants that the TI EVM will conform to TI's published specifications for ninety (90) days after the date TI delivers such EVM to User. Notwithstanding the foregoing, TI shall not be liable for a nonconforming EVM if (a) the nonconformity was caused by neglect, misuse or mistreatment by an entity other than TI, including improper installation or testing, or for any EVMs that have been altered or modified in any way by an entity other than TI, (b) the nonconformity resulted from User's design, specifications or instructions for such EVMs or improper system design, or (c) User has not paid on time. Testing and other quality control techniques are used to the extent TI deems necessary. TI does not test all parameters of each EVM. User's claims against TI under this Section 2 are void if User fails to notify TI of any apparent defects in the EVMs within ten (10) business days after delivery, or of any hidden defects with ten (10) business days after the defect has been detected.

   2.3 TI's sole liability shall be at its option to repair or replace EVMs that fail to conform to the warranty set forth above, or credit User's account for such EVM. TI's liability under this warranty shall be limited to EVMs that are returned during the warranty period to the address designated by TI and that are determined by TI not to conform to such warranty. If TI elects to repair or replace such EVM, TI shall have a reasonable time to repair such EVM or provide replacements. Repaired EVMs shall be warranted for the remainder of the original warranty period. Replaced EVMs shall be warranted for a new full ninety (90) day warranty period.

WARNING

Evaluation Kits are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems.

User shall operate the Evaluation Kit within TI’s recommended guidelines and any applicable legal or environmental requirements as well as reasonable and customary safeguards. Failure to set up and/or operate the Evaluation Kit within TI’s recommended guidelines may result in personal injury or death or property damage. Proper set up entails following TI’s instructions for electrical ratings of interface circuits such as input, output and electrical loads.

NOTE:

EXPOSURE TO ELECTROSTATIC DISCHARGE (ESD) MAY CAUSE DEGREDATION OR FAILURE OF THE EVALUATION KIT; TI RECOMMENDS STORAGE OF THE EVALUATION KIT IN A PROTECTIVE ESD BAG.

3 *Regulatory Notices:*

3.1 *United States*

3.1.1 *Notice applicable to EVMs not FCC-Approved:*

FCC NOTICE: This kit is designed to allow product developers to evaluate electronic components, circuitry, or software associated with the kit to determine whether to incorporate such items in a finished product and software developers to write software applications for use with the end product. This kit is not a finished product and when assembled may not be resold or otherwise marketed unless all required FCC equipment authorizations are first obtained. Operation is subject to the condition that this product not cause harmful interference to licensed radio stations and that this product accept harmful interference. Unless the assembled kit is designed to operate under part 15, part 18 or part 95 of this chapter, the operator of the kit must operate under the authority of an FCC license holder or must secure an experimental authorization under part 5 of this chapter.

3.1.2 *For EVMs annotated as FCC – FEDERAL COMMUNICATIONS COMMISSION Part 15 Compliant:*

CAUTION

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

FCC Interference Statement for Class A EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

FCC Interference Statement for Class B EVM devices

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- *Reorient or relocate the receiving antenna.*
- *Increase the separation between the equipment and receiver.*
- *Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.*
- *Consult the dealer or an experienced radio/TV technician for help.*

3.2 *Canada*

3.2.1 *For EVMs issued with an Industry Canada Certificate of Conformance to RSS-210 or RSS-247*

Concerning EVMs Including Radio Transmitters:

This device complies with Industry Canada license-exempt RSSs. Operation is subject to the following two conditions:

(1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Concernant les EVMs avec appareils radio:

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes: (1) l'appareil ne doit pas produire de brouillage, et (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

Concerning EVMs Including Detachable Antennas:

Under Industry Canada regulations, this radio transmitter may only operate using an antenna of a type and maximum (or lesser) gain approved for the transmitter by Industry Canada. To reduce potential radio interference to other users, the antenna type and its gain should be so chosen that the equivalent isotropically radiated power (e.i.r.p.) is not more than that necessary for successful communication. This radio transmitter has been approved by Industry Canada to operate with the antenna types listed in the user guide with the maximum permissible gain and required antenna impedance for each antenna type indicated. Antenna types not included in this list, having a gain greater than the maximum gain indicated for that type, are strictly prohibited for use with this device.

Concernant les EVMs avec antennes détachables

Conformément à la réglementation d'Industrie Canada, le présent émetteur radio peut fonctionner avec une antenne d'un type et d'un gain maximal (ou inférieur) approuvé pour l'émetteur par Industrie Canada. Dans le but de réduire les risques de brouillage radioélectrique à l'intention des autres utilisateurs, il faut choisir le type d'antenne et son gain de sorte que la puissance isotrope rayonnée équivalente (p.i.r.e.) ne dépasse pas l'intensité nécessaire à l'établissement d'une communication satisfaisante. Le présent émetteur radio a été approuvé par Industrie Canada pour fonctionner avec les types d'antenne énumérés dans le manuel d'usage et ayant un gain admissible maximal et l'impédance requise pour chaque type d'antenne. Les types d'antenne non inclus dans cette liste, ou dont le gain est supérieur au gain maximal indiqué, sont strictement interdits pour l'exploitation de l'émetteur

3.3 *Japan*

3.3.1 *Notice for EVMs delivered in Japan:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_01.page 日本国内に輸入される評価用キット、ボードについては、次のところをご覧ください。

https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-delivered-in-japan.html

3.3.2 *Notice for Users of EVMs Considered "Radio Frequency Products" in Japan:* EVMs entering Japan may not be certified by TI as conforming to Technical Regulations of Radio Law of Japan.

If User uses EVMs in Japan, not certified to Technical Regulations of Radio Law of Japan, User is required to follow the instructions set forth by Radio Law of Japan, which includes, but is not limited to, the instructions below with respect to EVMs (which for the avoidance of doubt are stated strictly for convenience and should be verified by User):

1. Use EVMs in a shielded room or any other test facility as defined in the notification #173 issued by Ministry of Internal Affairs and Communications on March 28, 2006, based on Sub-section 1.1 of Article 6 of the Ministry's Rule for Enforcement of Radio Law of Japan,
2. Use EVMs only after User obtains the license of Test Radio Station as provided in Radio Law of Japan with respect to EVMs, or
3. Use of EVMs only after User obtains the Technical Regulations Conformity Certification as provided in Radio Law of Japan with respect to EVMs. Also, do not transfer EVMs, unless User gives the same notice above to the transferee. Please note that if User does not follow the instructions above, User will be subject to penalties of Radio Law of Japan.

【無線電波を送信する製品の開発キットをお使いになる際の注意事項】 開発キットの中には技術基準適合証明を受けていないものがあります。 技術適合証明を受けていないもののご使用に際しては、電波法遵守のため、以下のいずれかの措置を取っていただく必要がありますのでご注意ください。

1. 電波法施行規則第6条第1項第1号に基づく平成18年3月28日総務省告示第173号で定められた電波暗室等の試験設備でご使用いただく。
2. 実験局の免許を取得後ご使用いただく。
3. 技術基準適合証明を取得後ご使用いただく。

なお、本製品は、上記の「ご使用にあたっての注意」を譲渡先、移転先に通知しない限り、譲渡、移転できないものとします。

上記を遵守頂けない場合は、電波法の罰則が適用される可能性があることをご留意ください。 日本テキサス・インスツルメンツ株式会社

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西新宿三井ビル

3.3.3 *Notice for EVMs for Power Line Communication:* Please see http://www.tij.co.jp/lsds/ti_ja/general/eStore/notice_02.page

電力線搬送波通信についての開発キットをお使いになる際の注意事項については、次のところをご覧ください。https://www.ti.com/ja-jp/legal/notice-for-evaluation-kits-for-power-line-communication.html

3.4 *European Union*

3.4.1 *For EVMs subject to EU Directive 2014/30/EU (Electromagnetic Compatibility Directive)*:

This is a class A product intended for use in environments other than domestic environments that are connected to a low-voltage power-supply network that supplies buildings used for domestic purposes. In a domestic environment this product may cause radio interference in which case the user may be required to take adequate measures.

4 *EVM Use Restrictions and Warnings:*

4.1 EVMS ARE NOT FOR USE IN FUNCTIONAL SAFETY AND/OR SAFETY CRITICAL EVALUATIONS, INCLUDING BUT NOT LIMITED TO EVALUATIONS OF LIFE SUPPORT APPLICATIONS.

4.2 User must read and apply the user guide and other available documentation provided by TI regarding the EVM prior to handling or using the EVM, including without limitation any warning or restriction notices. The notices contain important safety information related to, for example, temperatures and voltages.

4.3 *Safety-Related Warnings and Restrictions:*

4.3.1 User shall operate the EVM within TI's recommended specifications and environmental considerations stated in the user guide, other available documentation provided by TI, and any other applicable requirements and employ reasonable and customary safeguards. Exceeding the specified performance ratings and specifications (including but not limited to input and output voltage, current, power, and environmental ranges) for the EVM may cause personal injury or death, or property damage. If there are questions concerning performance ratings and specifications, User should contact a TI field representative prior to connecting interface electronics including input power and intended loads. Any loads applied outside of the specified output range may also result in unintended and/or inaccurate operation and/or possible permanent damage to the EVM and/or interface electronics. Please consult the EVM user 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, even with the inputs and outputs kept within the specified allowable ranges, some circuit components may have elevated case temperatures. These components include but are not limited to linear regulators, switching transistors, pass transistors, current sense resistors, and heat sinks, which can be identified using the information in the associated documentation. When working with the EVM, please be aware that the EVM may become very warm.

4.3.2 EVMs are intended solely for use by technically qualified, professional electronics experts who are familiar with the dangers and application risks associated with handling electrical mechanical components, systems, and subsystems. User assumes all responsibility and liability for proper and safe handling and use of the EVM by User or its employees, affiliates, contractors or designees. User assumes all responsibility and liability to ensure that any interfaces (electronic and/or mechanical) between the EVM and any human body are designed with suitable isolation and means to safely limit accessible leakage currents to minimize the risk of electrical shock hazard. User assumes all responsibility and liability for any improper or unsafe handling or use of the EVM by User or its employees, affiliates, contractors or designees.

4.4 User assumes all responsibility and liability to determine whether the EVM is subject to any applicable international, federal, state, or local laws and regulations related to User's handling and use of the EVM and, if applicable, User assumes all responsibility and liability for compliance in all respects with such laws and regulations. User assumes all responsibility and liability for proper disposal and recycling of the EVM consistent with all applicable international, federal, state, and local requirements.

5. *Accuracy of Information:* To the extent TI provides information on the availability and function of EVMs, TI attempts to be as accurate as possible. However, TI does not warrant the accuracy of EVM descriptions, EVM availability or other information on its websites as accurate, complete, reliable, current, or error-free.

6. *Disclaimers:*

6.1 EXCEPT AS SET FORTH ABOVE, EVMS AND ANY MATERIALS PROVIDED WITH THE EVM (INCLUDING, BUT NOT LIMITED TO, REFERENCE DESIGNS AND THE DESIGN OF THE EVM ITSELF) ARE PROVIDED "AS IS" AND "WITH ALL FAULTS." TI DISCLAIMS ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, REGARDING SUCH ITEMS, INCLUDING BUT NOT LIMITED TO ANY EPIDEMIC FAILURE WARRANTY OR IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT OF ANY THIRD PARTY PATENTS, COPYRIGHTS, TRADE SECRETS OR OTHER INTELLECTUAL PROPERTY RIGHTS.

6.2 EXCEPT FOR THE LIMITED RIGHT TO USE THE EVM SET FORTH HEREIN, NOTHING IN THESE TERMS SHALL BE CONSTRUED AS GRANTING OR CONFERRING ANY RIGHTS BY LICENSE, PATENT, OR ANY OTHER INDUSTRIAL OR INTELLECTUAL PROPERTY RIGHT OF TI, ITS SUPPLIERS/LICENSORS OR ANY OTHER THIRD PARTY, TO USE THE EVM IN ANY FINISHED END-USER OR READY-TO-USE FINAL PRODUCT, OR FOR ANY INVENTION, DISCOVERY OR IMPROVEMENT, REGARDLESS OF WHEN MADE, CONCEIVED OR ACQUIRED.

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