EVM User's Guide: DEM-PCM2912AEVM

DEM-PCM2912A Evaluation Module

Description

The DEM-PCM2912A EVM is a complete evaluation platform for the 16-bit, mono microphone input and stereo headphone output PCM2912A bus-powered audio codec with a USB interface. All necessary connectors and circuitry are provided for interfacing to audio test systems and commercial audio equipment.

A USB connector is mounted on the DEM-PCM2912A EVM. Stereo audio output and mono audio input are available on two stereo mini-jacks.

Get Started

- Order the EVM from the DEM-PCM2912AEVM product folder
- Download the latest PCM2912A data sheet from ti.com
- A PC with either Windows® 10 or MacOS®

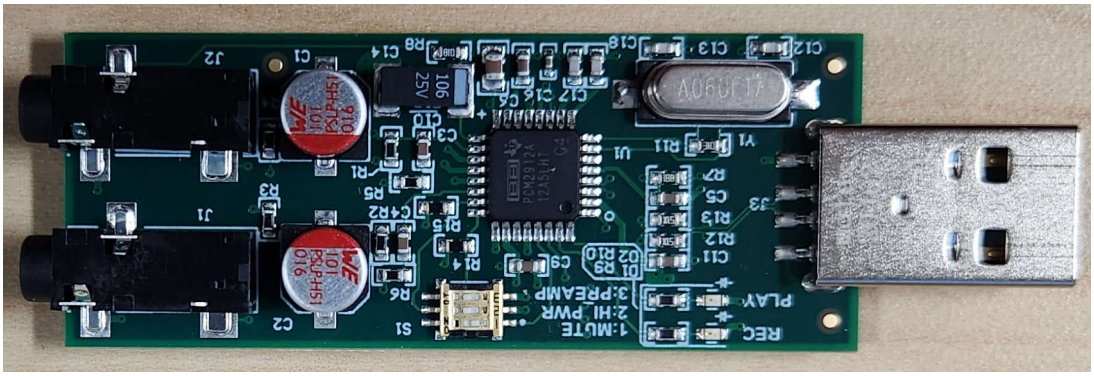
Features

Major features of the PCM2912A include:

- Analog Front End:
  - Microphone amplifier (+20 dB gain)
  - Mono input
- Analog Back End:
  - Stereo/Mono headphone amplifier or line output with volume
- Analog Performance:
  - Dynamic range: 90 dB (ADC)
  - Dynamic range: 90 dB (ADC)
  - 25-mW headphone output at R_L = 16 Ω
- Power-Supply Voltage
  - Single power supply of 5.0 V (V_{BUS})
- Low Power Dissipation:
  - 425 mW at analog-to-digital converter (ADC) and digital-to-analog converter (DAC) operation, 44.1 kHz
  - 0.8 mW in Suspend mode
- Sampling Frequency: 8 kHz, 11.025 kHz, 16 kHz, 22.05 kHz, 32 kHz, 44.1 kHz, 48 kHz for ADC and DAC
- Programmable Function:
  - –76-dB to 0-dB gain for analog outputs
  - –12-dB to +30-dB gain for analog inputs
  - –76-dB to 0-dB gain for sidetone
  - 0-dB/20-dB gain for microphone amplifier
  - High-pass filter: 0.078 ×f_S cutoff frequency
- Package: 32-pin TQFP
- Operating Temperature Range: –25°C to +85°C

Applications

- USB headset
- USB headphone
- USB speaker
- USB featured consumer audio product
- USB audio interface box
- USB monitor
- Video conference system



DEM-PCM2912A EVM Board

1 Evaluation Module Overview

1.1 Introduction

The PCM2912A is an audio codec with a USB interface for a USB headset, USB headphones, and a USB audio interface box that integrates mono input, stereo headphone output, an analog loopback line, a programmable gain amplifier (PGA), and microphone bias. The PCM2912A is available in a 32-pin TQFP package.

The DEM-PCM2912A EVM also carries the Microsoft Windows® Logo License certification from the Microsoft Windows Hardware Quality Labs (WHQL). The DEM-PCM2912A has successfully passed the Microsoft WLP test (DTM Audio) for Windows Vista® x86/x64 platforms.

1.2 Kit Contents

- PCM2912A device
- DEM-PCM2912AEVM Board

1.3 Specification

The DEM-PCM2912AEVM has a USB-A connector that allows plug-and-play evaluation of the PCM2912A device. The EVM has some hardware interfacing availability while programming is done via USB from the host computer.

Figure 1-1 illustrates the functional block diagram of the DEM-PCM2912A EVM.

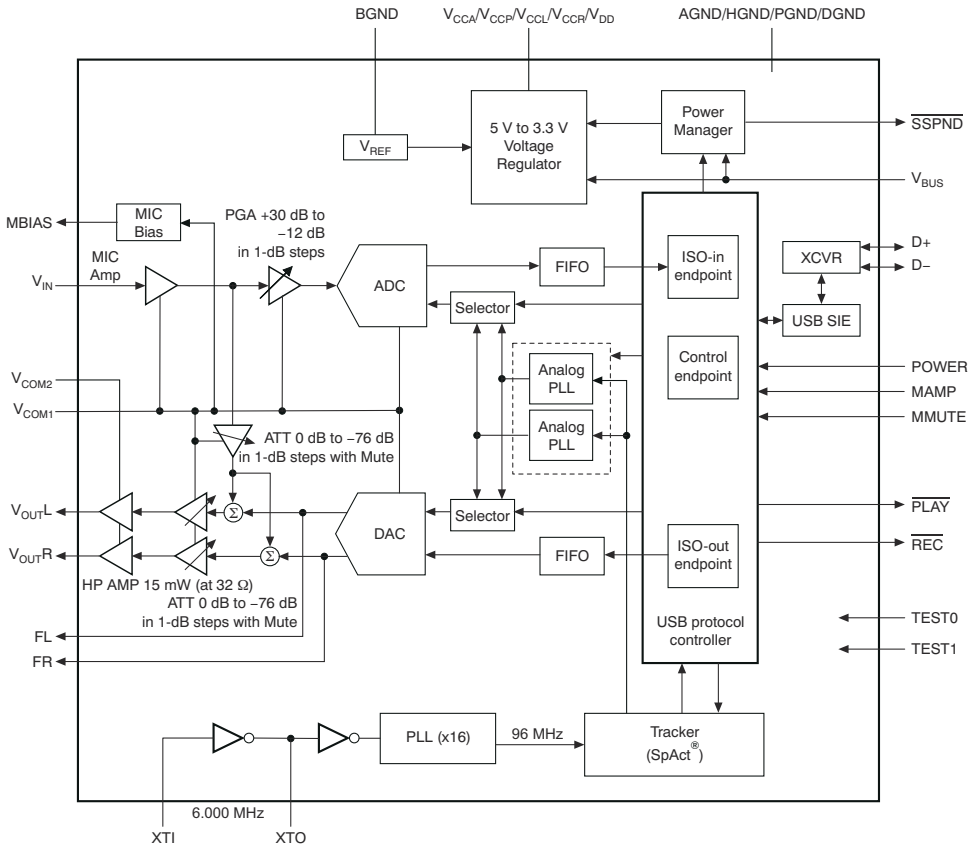


Figure 1-1. DEM-PCM2912A EVM Functional Block Diagram

1.4 Device Information

The PCM2912A is the Texas Instruments single-chip, USB stereo audio codec with a USB, 2.0-compliant, full-speed protocol controller and an analog front-end (AFE) function for headset applications.

2 Hardware

2.1 Pin Assignments and Terminal Functions

Figure 2-1 shows the pin assignments for the PCM2912A. Table 2-1 lists the terminal functions.

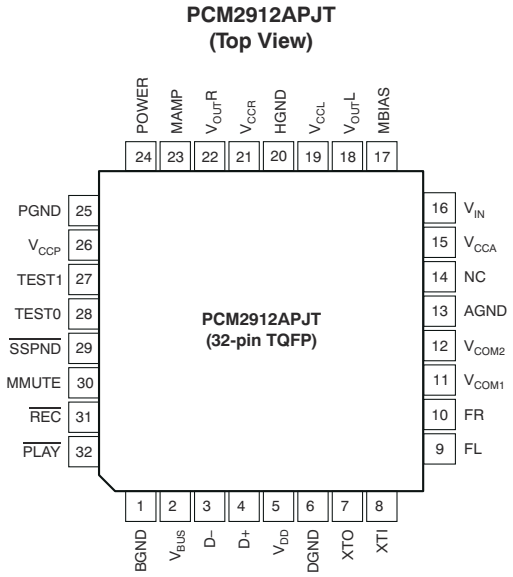


Figure 2-1. PCM2912A Pin Assignments

Table 2-1. PCM2912A Terminal Functions

Name	TQFP-36 Terminal	I/O	Description
BGND	1	–	Reference for internal regulator
V_{BUS}	2	–	Connect to USB power (V_{BUS})
D–	3	I/O	USB differential input/output minus
D+	4	I/O	USB differential input/output plus
V_{DD}	5	–	Digital power supply
DGND	6		Digital ground
XTO	7	O	Crystal oscillator output
XTI	8	I	Crystal oscillator input
FL	9	–	External filter pin of left channel (optional)
FR	10	–	External filter pin of right channel (optional)
V_{COM1}	11	–	Common voltage for ADC, DAC and analog front-end (V_{CCA}/2). Decoupling capacitor is connected to AGND.
V_{COM2}	12	–	Common voltage for headphone (V_{CCA}/2). Decoupling capacitor is connected to AGND.
AGND	13	–	Analog ground
NC	14	–	Not connected
V_{CCA}	15	–	Analog power supply
V_{IN}	16	I	ADC microphone input
MBIAS	17	O	Microphone bias output (0.75 V_{CCA})
V_{OUT}L	18	O	Headphone output for L-channel
V_{CCL}	19	–	Analog power supply for headphone amplifier of L-channel
HGND	20	–	Analog ground for headphone amplifier
V_{CCR}	21	-–	Analog power supply for headphone amplifier of R-channel
V_{OUT}R	22	O	Headphone output for R-channel
MAMP	23	I	Microphone preamplifier gain control (LOW: Preamplifier off; HIGH: Preamplifier on = +20 dB)

Table 2-1. PCM2912A Terminal Functions (continued)

Name	TQFP-36 Terminal	I/O	Description
POWER	24	I	Power consumption declaration select pin (LOW: 100 mA; HIGH: 500 mA)
PGND	25	–	Analog ground for microphone bias, microphone amplifier, and PGA
V_{CCP}	26	–	Analog power supply for PLL
TEST1	27	I	Test pin. Must be set to high.
TEST0	28	I	Test pin. Must be set to low.
$\overline{SSPND}$	29	O	Suspend flag (LOW: Suspend; HIGH: Operational state)
MMUTE	30	I	Microphone mute control, active high (LOW: Mute off; HIGH: Mute on)
$\overline{REC}$	31	O	Status output for record (LOW: Record; FLASH: Mute on record; HIGH: Stop)
$\overline{PLAY}$	32	O	Status output for playback (LOW: Playback; FLASH: Mute on playback; HIGH: Stop)

2.2 Interface and Connections

Table 2-2 lists the connector references for the DEM-PCM2912A EVM.

Table 2-2. DEM-PCM2912A EVM Connectors

Connectors	Part/Description
CN1	USB connector, type A
J1	Mono microphone input
J2	Headphone output terminal
D1	LED (red); record indicator (flash while muting)
D2	LED (green); playback indicator (flash while muting)
S1-1	Microphone mute switch (ON: Mute; OFF: Unmute)(1)
S1-2	Power select (ON: 100 mA; OFF: 500 mA)
S1-3	Microphone amplifier gain control (ON: 0 dB; OFF: +20dB)

(1) The status of SW1 (microphone mute switch) is not reflected in the Mic Mute status of the *Wave In* display on a Windows-based PC; the operating system does not support an HID function.

3 Software

3.1 Software Setup Guide

This chapter discusses how to set up the DEM-PCM2912A EVM on personal computers (PCs) equipped with any of a variety of major operating systems, including Microsoft Windows Vista®, Windows XP®, Windows 10®, and Macintosh® OS X.

3.1.1 Basic Operating Setup for Windows 10®

This section reviews how to set up the DEM-PCM2912A EVM for use with a PC equipped with the Microsoft Windows 10 operating system.

When the driver installation is complete, the EVM software is ready to use.

3.1.1.1 Basic Setup Before Evaluation

Follow these steps to set up the DEM-PCM2912A EVM for use with Windows 10.

1. Connect the USB connector of the DEM-PCM2912A EVM to an available USB connector (or hub) port on the lab PC. The DEM-PCM2912A EVM can be connected directly to the PC without an additional USB cable. After the EVM is connected to the PC, the standard Windows driver installs automatically to the PC. A custom driver for the DEM-PCM2912A is unnecessary to use the evaluation board.
2. Open the *Control Panel* from the Start menu (*Start→Control Panel)*. Open the *Sound* group from the Control Panel under *Hardware and Sound*.
3. Select the playback tab and confirm the USB audio codec appearance as the default playback device, as shown in Figure 3-1.
4. Select the recording tab and confirm the USB audio codec appearance as the default recording device, as shown in Figure 3-2.

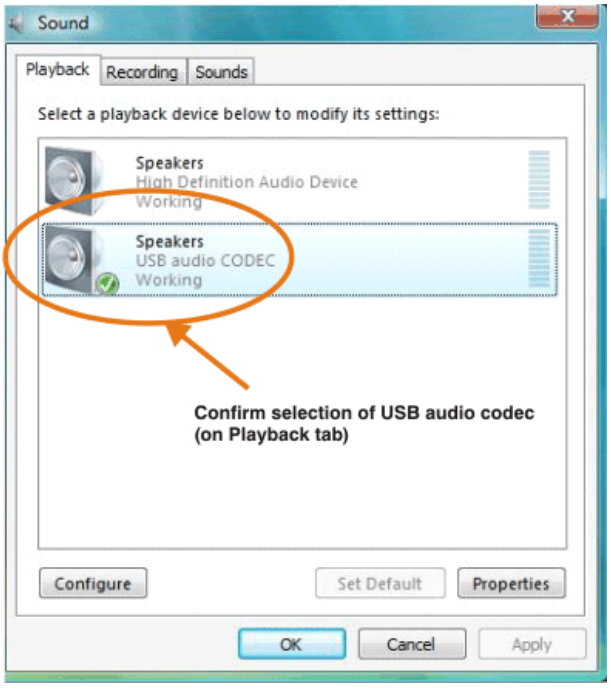


Figure 3-1. Sound—Playback Tab(Windows)

Figure 3-2. Sound—Recording Tab(Windows)

3.1.1.2 Volume and Mute Settings

Follow these steps to configure the volume settings for headphones, microphone, and the recording options.

To set the headphone volume:

1. Open the *Sound* options from the Control Panel. (*Start→Control Panel→Sound*)
2. Open the speaker properties of the USB audio codec from the Playback options and select the *Levels* tab, as Figure 3-3 illustrates.
3. Set the output volume, mute, and the balance for headphones from –76 dB to 0 dB.

To set the microphone sidetone:

1. Open the *Sound* options from the Control Panel. (*Start→Control Panel→Sound*)
2. Open the speaker properties of the USB audio codec from the Playback options and select the *Levels* tab, as Figure 3-3 illustrates.
3. Set the volume and the mute levels for the microphone sidetone from –76 dB to 0 dB.

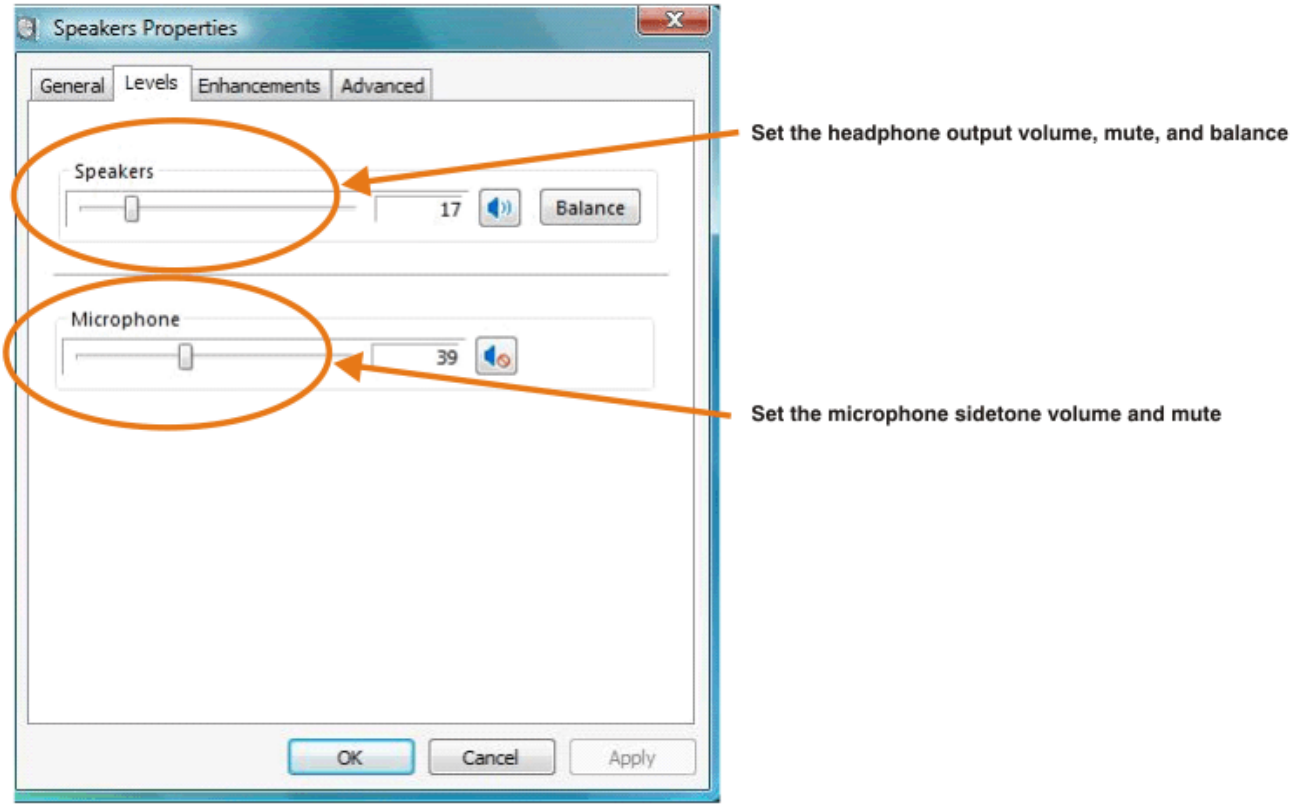


Figure 3-3. Speakers Properties—Levels Tab (Windows)

To set the record volume:

1. Open the *Sound* options from the Control Panel. (*Start→Control Panel→Sound*)
2. Open the microphone properties of the USB audio codec from the Record options and select the *Levels* tab, as Figure 3-4 illustrates.
3. Set the microphone volume and the recording mute level from –12 dB to +30 dB.

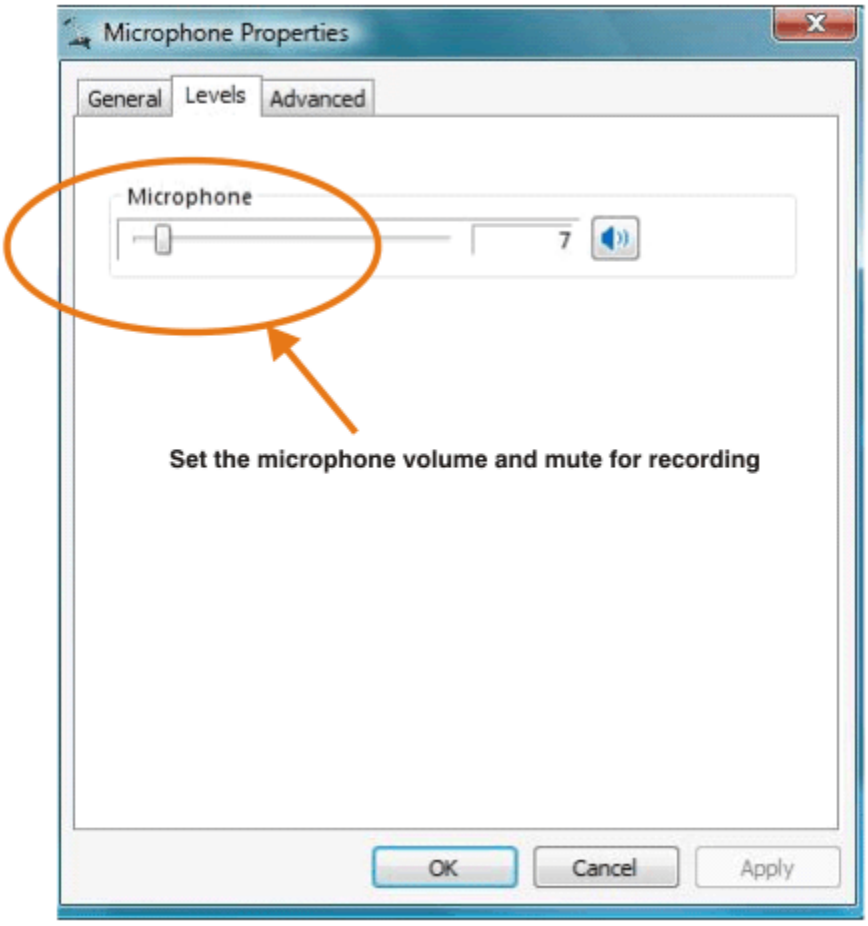


Figure 3-4. Microphone Properties—Levels Tab (Windows)

After this process is complete, the system volume setting for each component is maintained even if EVM is plugged in/out.

3.1.1.3 Sampling Frequency

Under the Windows operating system, select a specific sampling frequency because the sampling frequency cannot be changed on nearly all application software.

To set the DAC sampling frequency:

1. Open the *Sound* options from the Control Panel. (*Start→Control Panel→Sound*)
2. Open the speaker properties of the USB audio codec from the Playback options and select the *Advanced* tab, as Figure 3-5 illustrates.
3. Select the desired DAC sampling frequency from seven options: 8 kHz, 11.025 kHz,16 kHz, 22.5 kHz, 32 kHz, 44.1 kHz, and 48 kHz.

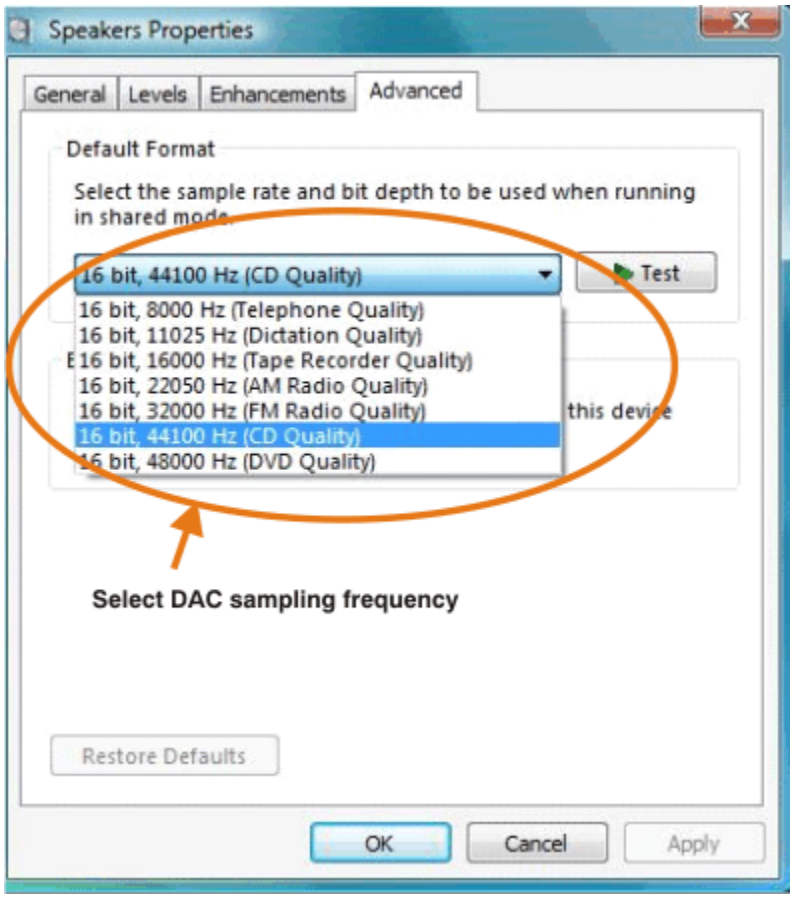


Figure 3-5. Speakers Properties—Advanced Tab (Windows)

To set the ADC sampling frequency:

1. Open the *Sound* options from the Control Panel. (*Start→Control Panel→Sound*)
2. Open the microphone properties of the USB audio codec from the Record options and select the *Advanced* tab, as Figure 3-6 illustrates.
3. Select the desired ADC sampling frequency from seven options: 8 kHz, 11.025 kHz,16 kHz, 22.5 kHz, 32 kHz, 44.1 kHz, and 48 kHz.

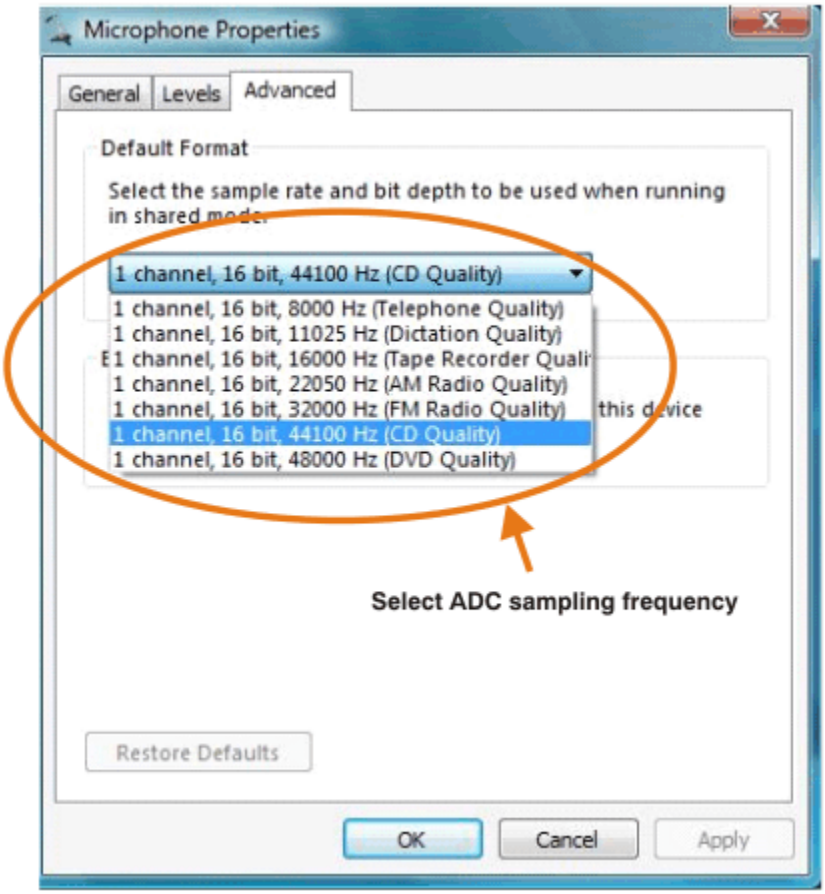


Figure 3-6. Microphone Properties—Advanced Tab (Windows)

3.1.2 Basic Operating Setup for Mac OS®

This section reviews how to set up the DEM-PCM2912A EVM for use with a Macintosh computer equipped with the Mac OS X (or later) operating system.

When the installation is complete, the EVM software is ready to use.

3.1.2.1 Basic Setup Before Evaluation

Follow these steps to set up the DEM-PCM2912A EVM for use with a Macintosh computer.

1. Connect the USB connector of the DEM-PCM2912A EVM to an available USB connector (or hub) port on the lab computer. The DEM-PCM2912A EVM can be connected directly to the PC without an additional USB cable.
   After the EVM is connected to the PC, the standard Mac OS driver installs automatically to the computer system. A custom driver for the DEM-PCM2912A is unnecessary.
2. Open the *System Environment Settings* from the Start menu. Open the *Sound* options from the System Environment settings.
3. Select the *Input* tab and confirm the USB audio codec appearance as the default recording device, as shown in Figure 3-7.

Figure 3-7. Sound—Input Tab (Mac OS)

4. Select the *Output* tab and confirm the USB audio codec appearance as the default playback device, as shown in Figure 3-8.

Figure 3-8. Sound—Output Tab (Mac OS)

This process confirms the proper recognition of the DEM-PCM2912A EVM by Mac OS X.

3.1.2.2 Volume Settings

Follow these steps to configure the volume settings for headphones, microphone, and the recording options.

To set the headphone volume:

1. Open the *Audio MIDI Settings* options (*Application→Utility→Set Audio MIDI*), as illustrated in Figure 3-9. Alternatively, open the *Output* tab of the *Sound* options, as illustrated in Figure 3-8.
2. Set the headphone volume and the audio output levels from –76 dB to 0 dB, and set the desired mute.

To set the record volume:

1. Open the *Audio MIDI Settings* options (*Application→Utility→Set Audio MIDI*), as illustrated in Figure 3-9. Alternatively, open the *Input* tab of the *Sound* options, as illustrated in Figure 3-7.
2. Set the recording level from –12 dB to +30 dB, and set the desired mute.

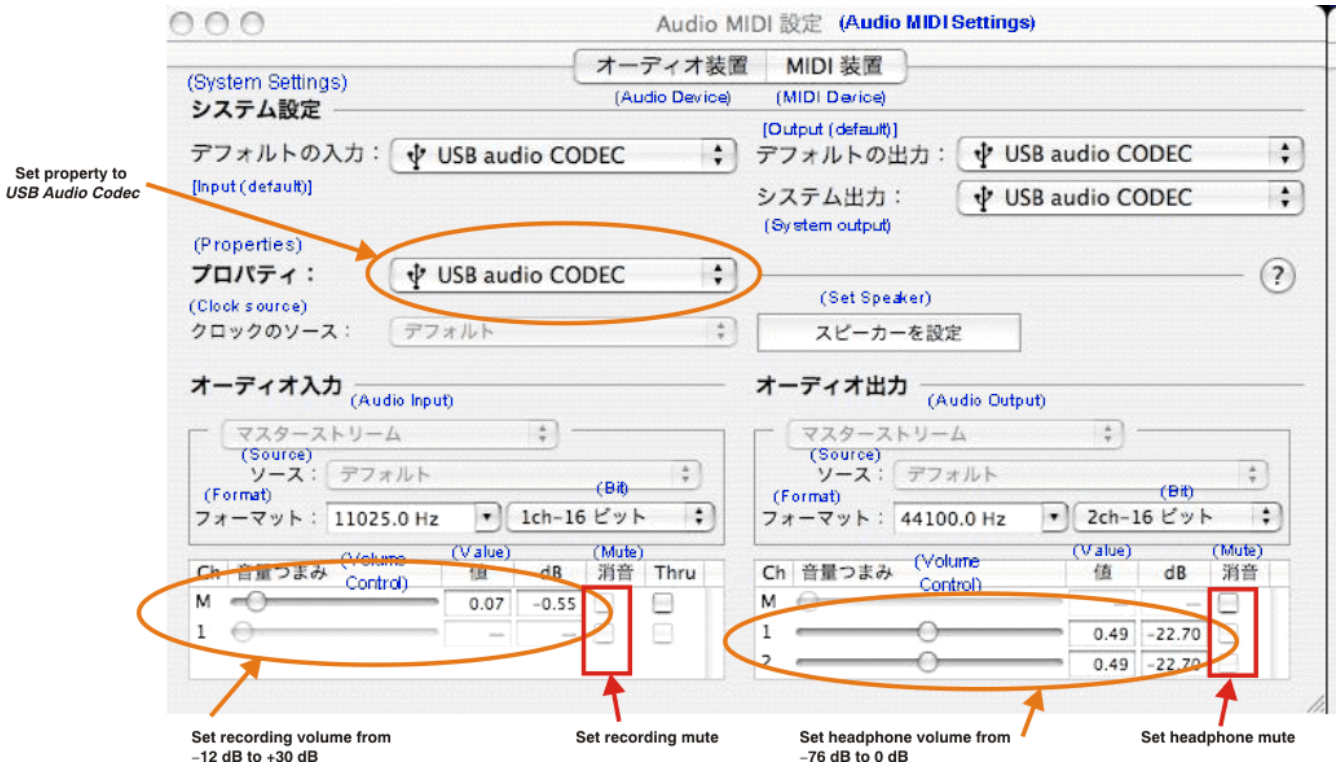


Figure 3-9. Audio Midi Setting Window (Mac OS)

To set the microphone sidetone:
The volume setting of the microphone sidetone is controlled by the individual application software on the Mac. For example, *Audio Recording* using QuickTime® (as shown in Figure 3-10) sets the microphone volume for sidetone from –76dB to 0 dB.

Figure 3-10. QuickTime Audio Recording Controls

After this process is complete, the system volume setting for each component is maintained even if EVM is plugged in/out.

3.1.2.3 Sampling Frequency

Under the Mac OS X operating system, select a specific sampling frequency because the sampling frequency cannot be changed on nearly all application software.

To set the DAC sampling frequency:

1. Open the *Audio MIDI Settings* options (*Application→Utility→Set Audio MIDI*), as illustrated in Figure 3-11.
2. Select the *Audio Input* tab in the *Set Audio MIDI* options group, as Figure 3-11 shows.
3. Select the desired DAC sampling frequency from seven options: 8 kHz, 11.025 kHz,16 kHz, 22.5 kHz, 32 kHz, 44.1 kHz, and 48 kHz.

To set the ADC sampling frequency:

1. Open the *Audio MIDI Settings* options (*Application→Utility→Set Audio MIDI*), as illustrated in Figure 3-11.
2. Select the *Audio Output* tab in the *Set Audio MIDI* options group, as shown in Figure 3-11.
3. Select the desired ADC sampling frequency from seven options: 8 kHz, 11.025 kHz,16 kHz, 22.5 kHz, 32 kHz, 44.1 kHz, and 48 kHz.

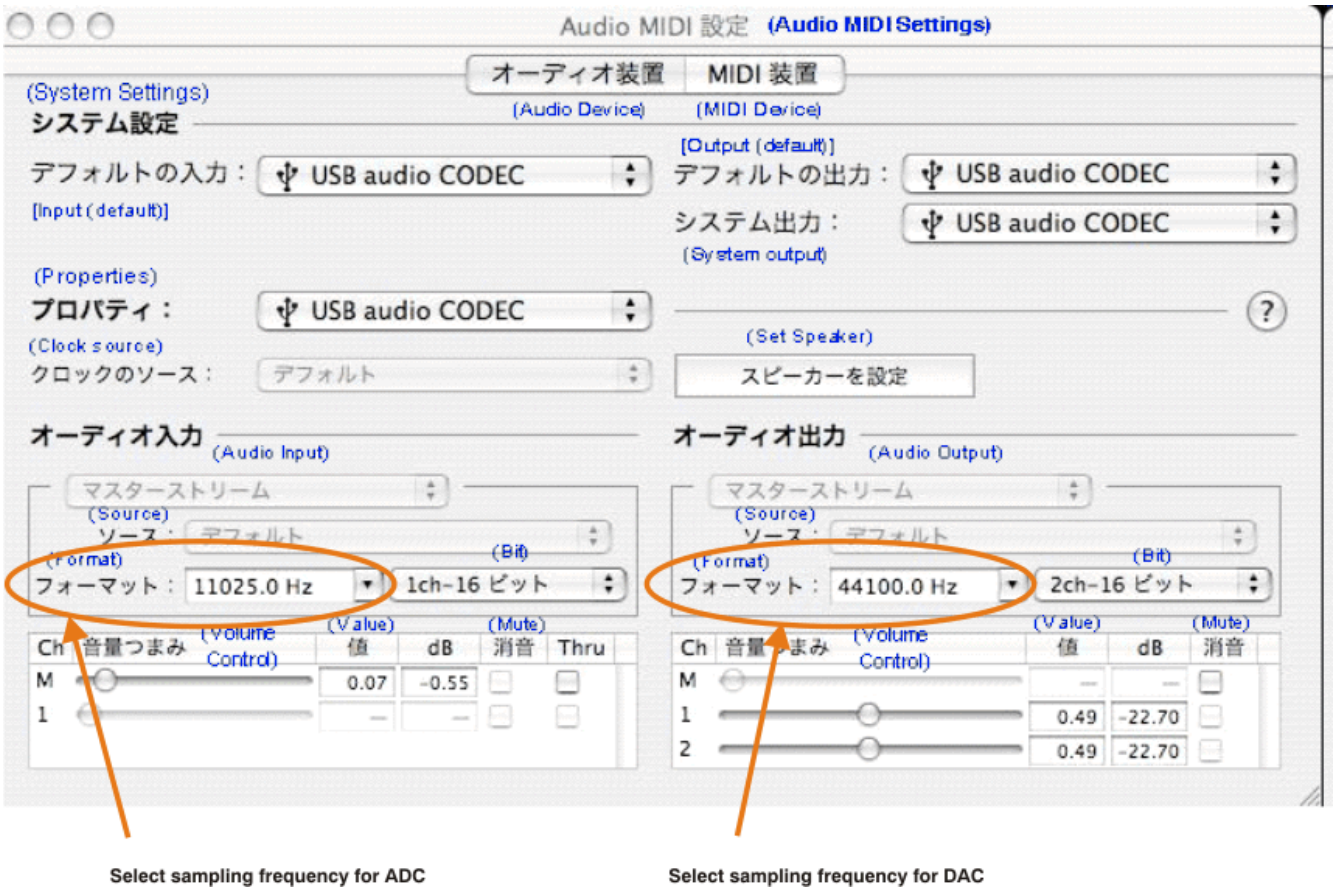


Figure 3-11. Audio Midi Setting Window (Mac OS)

4 Implementation Results

4.1 Evaluation Setup

For the DEM-PCM2912A EVM, the evaluation environment specifications are:

- Equipment used: Audio Precision, System Two Cascade Plus
- Power supply: V_{BUS} = 5V (Bus power setting)
- Temperature: Room/ambient

4.2 Performance Data and Results

This chapter discusses how to set up the DEM-PCM2912A EVM for performance evaluation using the Audio Precision SYS-2722® audio analyzer. The process of measuring dynamic characteristics is then presented, along with example characteristic data.

4.2.1 Measurements for Dynamic Characteristics

Typical dynamic performance graphs for playback and recording devices generally represent three performance characteristics (in addition to other specifications): total harmonic distortion and noise (THD+N); signal-to-noise ratio (SNR); and dynamic range (DR). For playback devices, channel separation is also a performance characteristic. These graphs also specify the test environment and measurement conditions required to meet typical performance values defined in the product data sheet.

4.2.2 Playback Performance

The DEM-PCM2912A EVM performance presented in this section was obtained under the following conditions:

- f_S = 44.1 kHz
- Output PGA (Speaker output volume): 0 dB
- Sidetone from microphone PGA: –76 dB (mute)
- R_L = 10 kΩ / 32 Ω / 16 Ω are inserted into headphone jack J2 for headphone output
- Jumper setting: S1-2 to 100 mA (ON) and S1-3 to 0 dB (ON)
- Application software for playback: Sound Recorder, Media Player and iTunes® for Windows Vista®/XP; QuickTime® and iTunes® for Mac OS X®.
- Equipment: AP2 Analog Analyzer (SYS-2722)

Configure the equipment as shown in Figure 4-1.

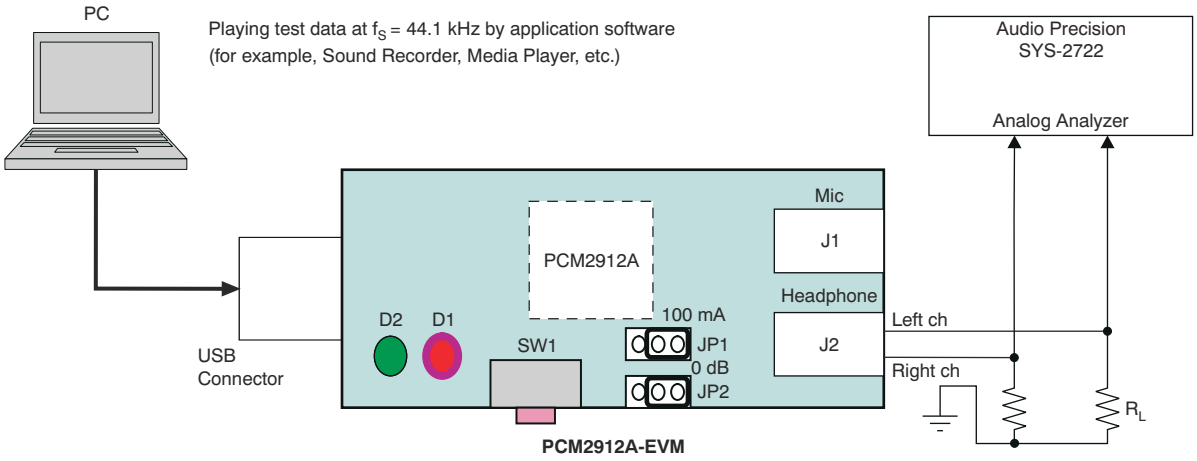


Figure 4-1. DEM-PCM2912A EVM Configuration for Playback Performance Measurement

Table 4-1. Line Output Playback Performance

Power Supply	Performance	Filter Setting	R_L	$V_{OUT}L$	$V_{OUT}R$
5.0 V	THD+N (0 dBFS at 1 kHz)	400 Hz to 20 kHz Pre-Anlr	10 kΩ	0.0086%	0.0085%
	SNR (BPZ input)	400 Hz to 20 kHz Pre-Anlr + A-weighting	10 kΩ	92.1 dB	92.1 dB
	DR (–60 dBFS input)	400 Hz to 20 kHz Pre-Anlr + A-weighting	10 kΩ	90.3 dB	90.5 dB
	Channel Separation (BPZ input for target channel)	400 Hz to 20 kHz Pre-Anlr	10 kΩ	89.3 dB	89.3 dB

Table 4-2. 32-Ω Headphone Output Playback Performance

Power Supply	Performance	Filter Setting	R_L	$V_{OUT}L$	$V_{OUT}R$
5.0 V	THD+N (0 dBFS at 1 kHz)	400 Hz to 20 kHz Pre-Anlr	32 Ω	0.026%	0.025%
	SNR (BPZ input)	400 Hz to 20 kHz Pre-Anlr + A-weighting	32 Ω	92.1 dB	92.1 dB
	DR (–60 dBFS input)	400 Hz to 20 kHz Pre-Anlr + A-weighting	32 Ω	89.4 dB	89.4 dB

Table 4-3. 16-Ω Headphone Output Playback Performance

Power Supply	Performance	Filter Setting	R_L	$V_{OUT}L$	$V_{OUT}R$
5.0 V	THD+N (0 dBFS at 1 kHz)	400 Hz to 20 kHz Pre-Anlr	16 Ω	0.044%	0.042%
	SNR (BPZ input)	400 Hz to 20 kHz Pre-Anlr + A-weighting	16 Ω	92.1 dB	92.1 dB
	DR (–60 dBFS input)	400 Hz to 20 kHz Pre-Anlr + A-weighting	16 Ω	89.4 dB	89.3 dB

4.2.3 Recording Performance

The DEM-PCM2912A EVM playback performance presented in this section was obtained under the following conditions:

- f_S = 44.1 kHz
- Input PGA (Microphone input volume): 0 dB
- Jumper setting: set S1-1 to Unmute (OFF), S1-2 to 100 mA (ON), and S1-3 to 0 dB (ON)
- Application software for playback: Sound Recorder, Media Player and ITunes for Windows Vista/XP; QuickTime and ITunes for Mac OS X.
- Use analog input data provided by the AP2 analog generator (SYS-2722) with unbalanced floating ground setting.

Configure the equipment as shown in Figure 4-2.

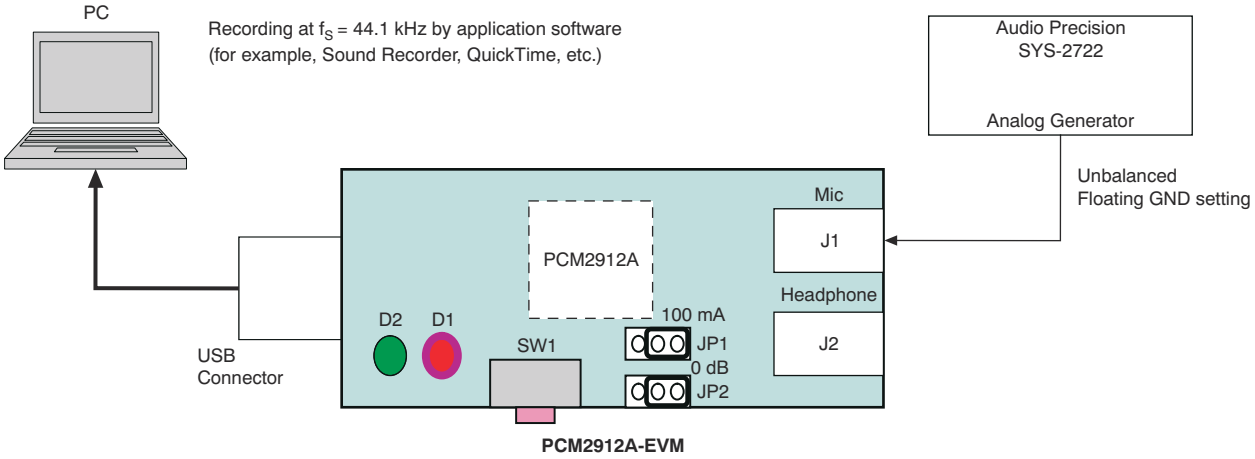


Figure 4-2. DEM-PCM2912A EVM Configuration for Recording Performance Measurement when Recording Data

Table 4-4. Line Input Recording Performance

Power Supply	Performance	Filter Setting	DOUT
5.0 V	THD+N (–1 dB at 1 kHz)	400 Hz to 20 kHz LP	0.008%
	SNR (BPZ input)	400 Hz to 20 kHz LP + A-weighting	92.5 dB
	DR (–60 dB input)	400 Hz to 20 kHz LP + A-weighting	90.5 dB

5 Hardware Design Files

This section provides the electrical and physical layout information for the DEM-PCM2912A EVM. The bill of materials is included for component and manufacturer reference.

Note

Board layouts are not to scale. These are intended to show how the board is laid out; the board layouts are not intended to be used for manufacturing DEM-PCM2912A EVM PCBs.

5.1 Schematics

The schematic for the DEM-PCM2912A EVM is shown in Figure 5-1.

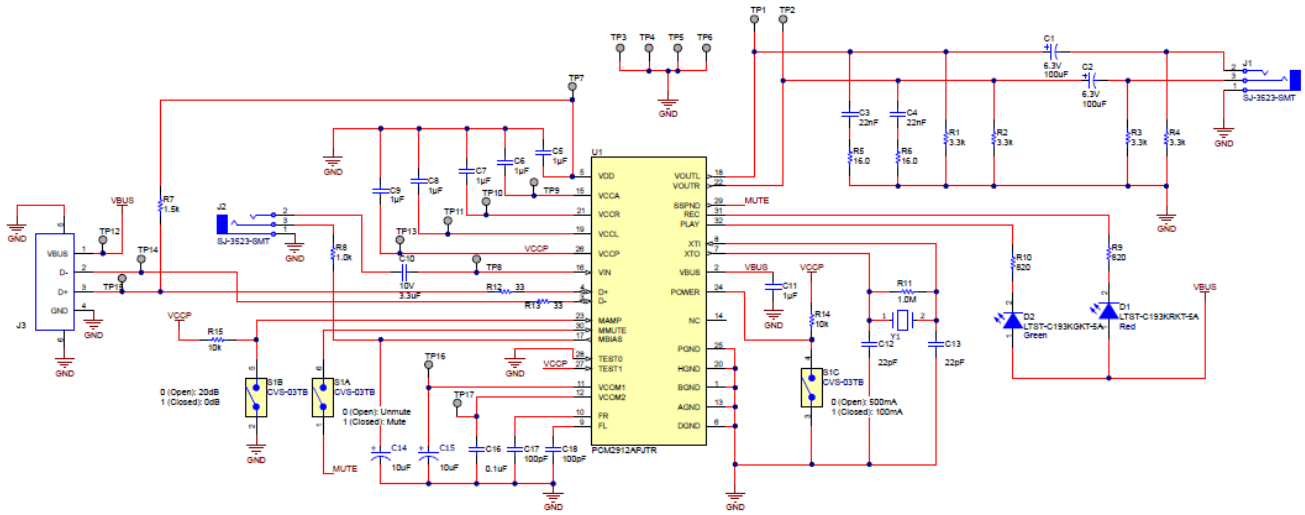


Figure 5-1. DEM-PCM2912A EVM Schematic

5.2 PCB Layout

Figure 5-2 through Figure 5-3 illustrate the printed circuit board (PCB) layout for the DEM-PCM2912A EVM.

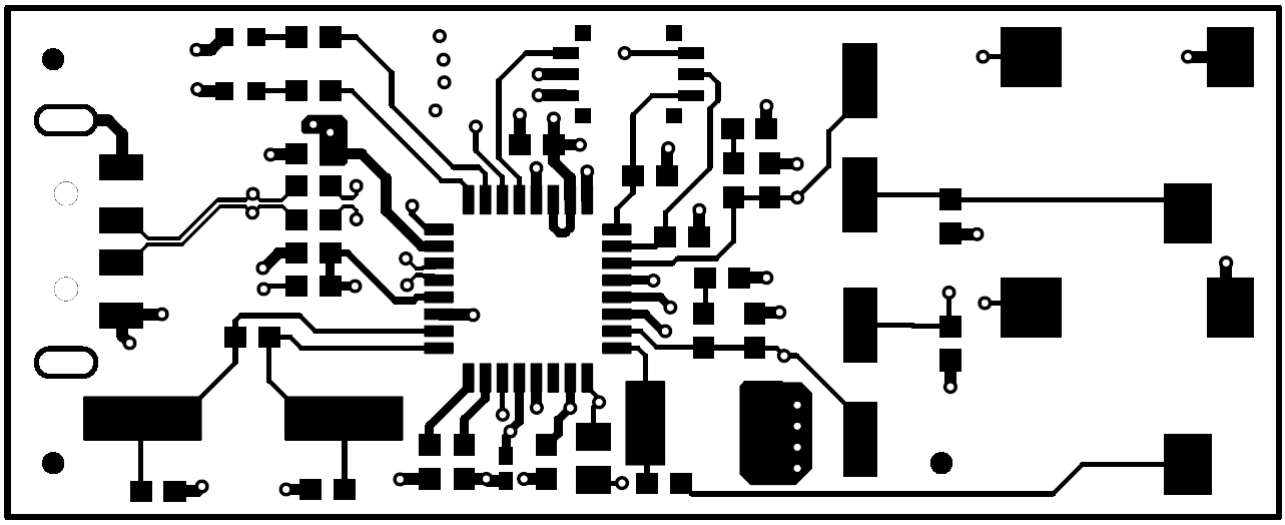


Figure 5-2. DEM-PCM2912A EVM Board Layout—Top Side

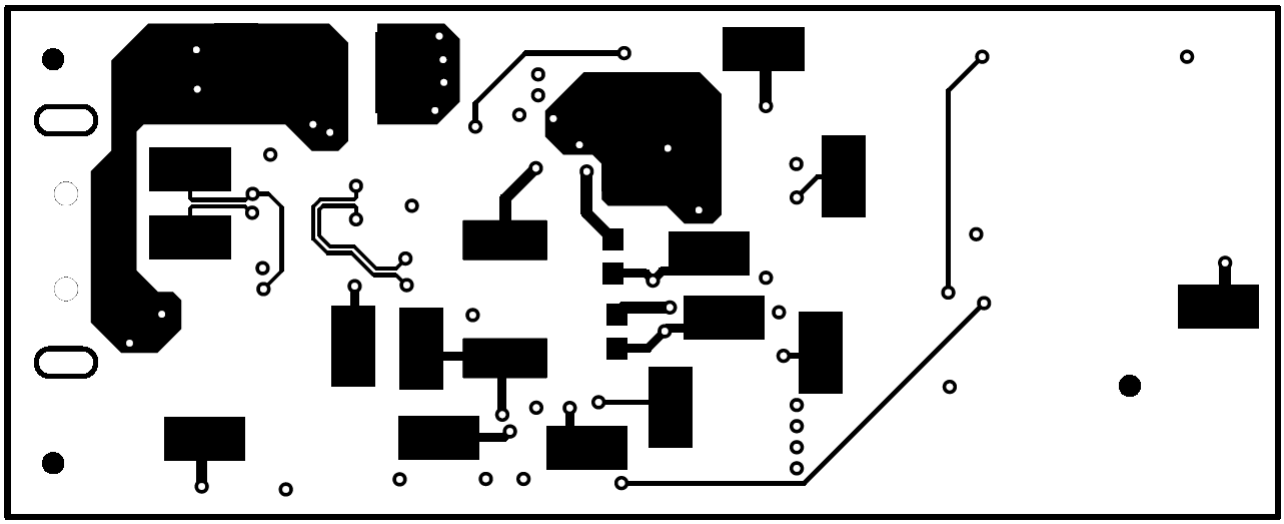


Figure 5-3. DEM-PCM2912A EVM Board Layout—Bottom Side

5.3 Bill of Materials (BOM)

Table 5-1 lists the bill of materials for the DEM-PCM2912A EVM.

Table 5-1. Bill of Materials

Designator	Quantity	Value	Description	Part Number	PackageReference	Manufacturer
C1, C2	2	100uF	CAP, Aluminum Polymer, 100 uF, 6.3 V, +/- 20%, 0.04 ohm, 6.3x5.8 SMD	6SVP100M	6.3x5.8	Panasonic
C3, C4	2	0.022uF	CAP, CERM, 0.022 uF, 25 V, +/- 10%, X7R, 0603	C0603C223K3RACTU	0603	Kemet
C5, C6, C7, C8, C9, C11	6	1uF	CAP, CERM, 1 uF, 16 V, +/- 10%, X7R, 0603	C1608X7R1C105K080AC	0603	TDK
C10	1	3.3uF	CAP, CERM, 3.3 uF, 10 V, +/- 10%, X5R, 0805	0805ZD335KAT2A	0805	AVX
C12, C13	2	22 pF	CAP, CERM, 22 pF, 50 V, +/- 5%, C0G/NP0, 0603	06035A220JAT2A	0603	AVX
C14, C15	2		10 µF Molded Tantalum Capacitors 25 V 0201 (0603 Metric) 1.4Ohm @ 100 kHz	TAZG106K025CRSZ0000	SMD2	AVX
C16	1	0.1uF	CAP, CERM, 0.1 uF, 10 V,+/- 10%, X5R, 0402	LMK105BJ104KV-F	0402	Taiyo Yuden
C17, C18	2	100 pF	CAP, CERM, 100 pF, 25 V, +/- 10%, X7R, 0603	06033C101KAT2A	0603	AVX
D1	1	Red	LED, Red, SMD	LTST-C193KRKT-5A	1.6x0.8mm	Lite-On
D2	1	Green	LED, Green, SMD	LTST-C193KGKT-5A	1.6x0.8mm	Lite-On
FID4, FID5, FID6	3		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
J1, J2	2		Audio Jack, 3.5mm, Stereo, R/A, SMT	SJ-3523-SMT	Audio Jack SMD	CUI Inc.
J3	1		Connector, Plug, USB Type A, R/A, Top Mount SMT	48037-1000	USB Type A right angle	Molex
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	THT-14-423-10	PCB Label 0.650 x 0.200 inch	Brady
R1, R2, R3, R4	4	3.3k	RES, 3.3 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW06033K30JNEA	0603	Vishay-Dale
R5, R6	2	16.0	RES, 16.0, 1%, 0.1 W, 0603	RC0603FR-0716RL	0603	Yageo
R7	1	1.5k	RES, 1.5 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW06031K50JNEA	0603	Vishay-Dale
R8	1	1.0k	RES, 1.0 k, 5%, 0.1 W, 0603	CRCW06031K00JNEA	0603	Vishay-Dale
R9, R10	2	820	RES, 820, 5%, 0.1 W, 0603	CRCW0603820RJNEA	0603	Vishay-Dale

Table 5-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	Part Number	PackageReference	Manufacturer
R11	1	1.0Meg	RES, 1.0 M, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	CRCW06031M00JNEA	0603	Vishay-Dale
R12, R13	2	33	RES, 33, 5%, 0.1 W, 0603	CRCW060333R0JNEA	0603	Vishay-Dale
R14, R15	2	10k	RES, 10 k, 5%, 0.1 W, 0603	CRCW060310K0JNEA	0603	Vishay-Dale
S1	1		DIP Switch, SPST, 3Pos, Slide, SMT	CVS-03TB	SW, 4.7x1.45x4mm	Copal Electronics
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP9, TP10, TP11, TP12, TP13, TP14, TP15, TP16, TP17	17		Test Point, Miniature, SMT	5019	Test Point, Miniature, SMT	Keystone
U1	1		Audio CODEC with USB Interface, Mono Microphone Input and Stereo Headphone Output, PJT0032A (TQFP-32)	PCM2912APJTR	PJT0032A	Texas Instruments
Y1	1		6 MHz ±30ppm Crystal 18 pF 100 Ohms HC-49/US	ABLS2-6.000MHZ-D4Y-T	SMT_11MM4_4MM7	Abracon

6 Additional Information

6.1 Trademarks

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7 Related Documentation

The following documents provide information regarding Texas Instruments integrated circuits used in the assembly of the DEM-PCM2912A EVM. These documents are available from the TI web site. The last character of the literature number corresponds to the document revision that is current at the time of the writing of this user's guide. Newer revisions are available from the TI web site at http://www.ti.com/ or call the Texas Instruments Literature Response Center at (800) 477−8924 or the Product Information Center at (972) 644−5580. When ordering, identify the documents by both title and literature number.

Data Sheet	Literature Number
PCM2912A Product data sheet	SLES230

8 Revision History

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

Changes from Revision * (January 2009) to Revision A (April 2024)	Page
• Updated document format to match current standards	1
• Updated schematics for new EVM revision	18
• Updated PCB layout images for new EVM revision	19

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.

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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.

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