TEXAS INSTRUMENTS

PCM4104EVM

Evaluation Module

User's Guide

December 2004

SBAU097A

IMPORTANT NOTICE

Texas Instruments Incorporated and its subsidiaries (TI) reserve the right to make corrections, modifications, enhancements, improvements, and other changes to its products and services at any time and to discontinue any product or service without notice. Customers should obtain the latest relevant information before placing orders and should verify that such information is current and complete. All products are sold subject to TI's terms and conditions of sale supplied at the time of order acknowledgment.

TI warrants performance of its hardware products to the specifications applicable at the time of sale in accordance with TI's standard warranty. Testing and other quality control techniques are used to the extent TI deems necessary to support this warranty. Except where mandated by government requirements, testing of all parameters of each product is not necessarily performed.

TI assumes no liability for applications assistance or customer product design. Customers are responsible for their products and applications using TI components. To minimize the risks associated with customer products and applications, customers should provide adequate design and operating safeguards.

TI does not warrant or represent that any license, either express or implied, is granted under any TI patent right, copyright, mask work right, or other TI intellectual property right relating to any combination, machine, or process in which TI products or services are used. Information published by TI regarding third-party products or services does not constitute a license from TI to use such products or services or a warranty or endorsement thereof. Use of such information may require a license from a third party under the patents or other intellectual property of the third party, or a license from TI under the patents or other intellectual property of TI.

Reproduction of information in TI data books or data sheets is permissible only if reproduction is without alteration and is accompanied by all associated warranties, conditions, limitations, and notices. Reproduction of this information with alteration is an unfair and deceptive business practice. TI is not responsible or liable for such altered documentation.

Resale of TI products or services with statements different from or beyond the parameters stated by TI for that product or service voids all express and any implied warranties for the associated TI product or service and is an unfair and deceptive business practice. TI is not responsible or liable for any such statements.

Following are URLs where you can obtain information on other Texas Instruments products and application solutions:

Products		**Applications**	
Amplifiers	amplifier.ti.com	Audio	www.ti.com/audio
Data Converters	dataconverter.ti.com	Automotive	www.ti.com/automotive
DSP	dsp.ti.com	Broadband	www.ti.com/broadband
Interface	interface.ti.com	Digital Control	www.ti.com/digitalcontrol
Logic	logic.ti.com	Military	www.ti.com/military
Power Mgmt	power.ti.com	Optical Networking	www.ti.com/opticalnetwork
Microcontrollers	microcontroller.ti.com	Security	www.ti.com/security
		Telephony	www.ti.com/telephony
		Video & Imaging	www.ti.com/video
		Wireless	www.ti.com/wireless

Mailing Address: Texas Instruments
Post Office Box 655303 Dallas, Texas 75265

EVM IMPORTANT NOTICE

Texas Instruments (TI) provides the enclosed product(s) under the following conditions:

This evaluation kit being sold by TI is intended for use for **ENGINEERING DEVELOPMENT OR EVALUATION PURPOSES ONLY** and is not considered by TI to be fit for commercial use. As such, the goods being provided may not be complete in terms of required design-, marketing-, and/or manufacturing-related protective considerations, including product safety measures typically found in the end product incorporating the goods. As a prototype, this product does not fall within the scope of the European Union directive on electromagnetic compatibility and therefore may not meet the technical requirements of the directive.

Should this evaluation kit not meet the specifications indicated in the EVM User's Guide, the kit may be returned within 30 days from the date of delivery for a full refund. THE FOREGOING WARRANTY IS THE EXCLUSIVE WARRANTY MADE BY SELLER TO BUYER AND IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED, OR STATUTORY, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE.

The user assumes all responsibility and liability for proper and safe handling of the goods. Further, the user indemnifies TI from all claims arising from the handling or use of the goods. Please be aware that the products received may not be regulatory compliant or agency certified (FCC, UL, CE, etc.). Due to the open construction of the product, it is the user's responsibility to take any and all appropriate precautions with regard to electrostatic discharge.

EXCEPT TO THE EXTENT OF THE INDEMNITY SET FORTH ABOVE, NEITHER PARTY SHALL BE LIABLE TO THE OTHER FOR ANY INDIRECT, SPECIAL, INCIDENTAL, OR CONSEQUENTIAL DAMAGES.

TI currently deals with a variety of customers for products, and therefore our arrangement with the user **is not exclusive**.

TI assumes **no liability for applications assistance, customer product design, software performance, or infringement of patents or services described herein**.

Please read the EVM User's Guide and, specifically, the EVM Warnings and Restrictions notice in the EVM User's Guide prior to handling the product. This notice contains important safety information about temperatures and voltages. For further safety concerns, please contact the TI application engineer.

Persons handling the product must have electronics training and observe good laboratory practice standards.

No license is granted under any patent right or other intellectual property right of TI covering or relating to any machine, process, or combination in which such TI products or services might be or are used.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

EVM WARNINGS AND RESTRICTIONS

It is important to operate this EVM with the operating conditions specified within Table 2−1 of this document.

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

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

During normal operation, some circuit components may have case temperatures greater than 37°C. The EVM is designed to operate properly with certain components above 60°C as long as the input and output ranges are maintained. These components include but are not limited to linear regulators, switching transistors, pass transistors, and current sense resistors. These types of devices can be identified using the EVM schematic located in the EVM User's Guide. When placing measurement probes near these devices during operation, please be aware that these devices may be very warm to the touch.

Mailing Address:

Texas Instruments
Post Office Box 655303
Dallas, Texas 75265

Preface

Read This First

About This Manual

This user's guide provides the information needed to set up and operate the PCM4104EVM evaluation module. For a more detailed description of the PCM4104, please refer to the product datasheet available from the Texas Instruments web site at http://www.ti.com. Additional support documents are listed in the sections of this guide entitled *Related Documentation from Texas Instruments* and *Additional Documentation*.

How to Use This Manual

Throughout this document, the acronym **EVM** and the phrase **evaluation module** are synonymous with the PCM4104EVM.

Chapter 1 provides a product overview for the PCM4104 four-channel audio digital-to-analog (D/A) converter. The PCM4104EVM block diagram and primary features are also discussed.

Chapter 2 provides general information regarding EVM handling and unpacking, as well as absolute operating conditions for power supplies and input/output connections.

Chapter 3 provides general hardware descriptions and configuration information for the EVM. The information in this chapter is designed to guide the user with the EVM setup.

Chapter 4 includes the EVM electrical schematic, PCB layout, and the bill of materials.

Information About Cautions and Warnings

This book may contain cautions and warnings.

This is an example of a caution statement.

A caution statement describes a situation that could potentially damage your software or equipment.

This is an example of a warning statement.

A warning statement describes a situation that could potentially cause harm to you.

The information in a caution or a warning is provided for your protection. Please read each caution and warning carefully.

Related Documentation From Texas Instruments

The following documents provide information regarding Texas Instrument integrated circuits used in the assembly of the PCM4104EVM. These documents are available from the TI web site. The last character of the literature number corresponds to the document revision, which is current at the time of the writing of this user's guide. Newer revisions may be available from the TI web site at http://www.ti.com or by calling the Texas Instruments Literature Response Center at (800) 477−8924 or the Product Information Center at (972) 644−5580. When ordering, identify the document(s) by both title and literature number.

Data Sheets:	**Literature Number:**
NE5534A	SLOS070
PCM4104	SBAS291
REG103	SBVS010
REG1117	SBVS001
SN74AHC245	SCLS230
SN74ALVC244	SCES188
SN74ALVC245	SCES271
SN74CBTLV3257	SCDS040
SN74LVC1G04	SCES214

Additional Documentation

The following documents or references provide information regarding selected non-TI components used in the assembly of the PCM4104EVM. These documents are available from the corresponding manufacturer.

Data Sheets:	**Manufacturer:**
CS8414	Cirrus Logic, web site: http://www.cirrus.com
TORX173	Toshiba, web site: http://www.toshiba.com

If You Need Assistance

If you have questions regarding either the use of this evaluation module or the information contained in the accompanying documentation, please contact the Texas Instruments Product Information Center at (972) 644−5580 or visit the TI Semiconductor Online Technical Support pages at http://www.ti.com.

FCC Warning

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

Trademarks

All trademarks are the property of their respective owners.

Contents

Figures

Tables

Chapter 1

Introduction

This chapter provides a brief technical overview of the PCM4104 four-channel audio, digital-to-analog (D/A) converter, as well as a general description and feature list for the PCM4104EVM.

Topic **Page**

1.1 PCM4104 Product Overview

The PCM4104 is a high-performance, four-channel D/A converter designed for use in professional audio applications. The PCM4104 supports 16- to 24-bit linear PCM input data and sampling frequencies up to 216kHz. The PCM4104 uses an 8x oversampling digital interpolation filter, followed by a multilevel delta-sigma modulator and a single-pole switched capacitor output filter. This architecture provides excellent dynamic and sonic performance, as well as a high tolerance to clock phase jitter.

The PCM4104 incorporates a flexible audio serial port, which accepts 16- to 24-bit PCM audio data in both standard audio formats (Left Justified, Right Justified, and Philips I^2S) and time division multiplexed (TDM) formats. The TDM formats are especially useful for interfacing to the synchronous serial ports of digital signal processors. The TDM formats support daisy-chaining of two PCM4104 devices on a single three-wire serial interface (for sampling frequencies up to 108kHz), forming a high-performance 8-channel audio D/A conversion system.

The PCM4104 offers two modes for configuration control: Software and Standalone. Software mode makes use of a four-wire serial peripheral interface (SPI) port to access internal control registers, allowing configuration of the full PCM4104 feature set. Standalone mode offers a more limited subset of the functions available in Software mode, while allowing for a simplified pin programmed configuration mode.

Functional block diagrams, showing both Standalone and Software modes, are shown in Figure 1−1 and Figure 1−2. The following bullets summarize the features accessible in both Standalone and Software modes.

Standalone Mode Configuration Controls (pin-programmed)

- ❑ Sampling Mode
- ❑ Audio Data Format Selection
- ❑ TDM Sub-Frame Selection
- ❑ All-Channel Soft Mute
- ❑ Digital De-Emphasis Filters for 32kHz, 44.1kHz, and 48kHz Sampling Frequencies
- ❑ Reset and Power Down

Software Mode Configuration Controls (register-programmed)

- ❑ Sampling Mode
- ❑ Audio Data Format Selection
- ❑ BCK and LRCK Polarity
- ❑ TDM Sub-Frame Selection (pin-programmed)
- ❑ All-Channel and Per-Channel Soft Mute (All-Channel Mute may also be pin-programmed)
- ❑ Zero Data Mute
- ❑ Digital De-Emphasis Filters for 32kHz, 44.1kHz, and 48kHz Sampling Frequencies
- ❑ Per-Channel Digital Output Attenuation, Providing an Integrated Volume Control Function
- ❑ Output Phase Inversion
- ❑ Reset and Power Down

For additional information regarding the PCM4104, please refer to the product datasheet available from the TI web site, located at www.ti.com.

Figure 1−1. PCM4104 Functional Block Diagram, Standalone Mode

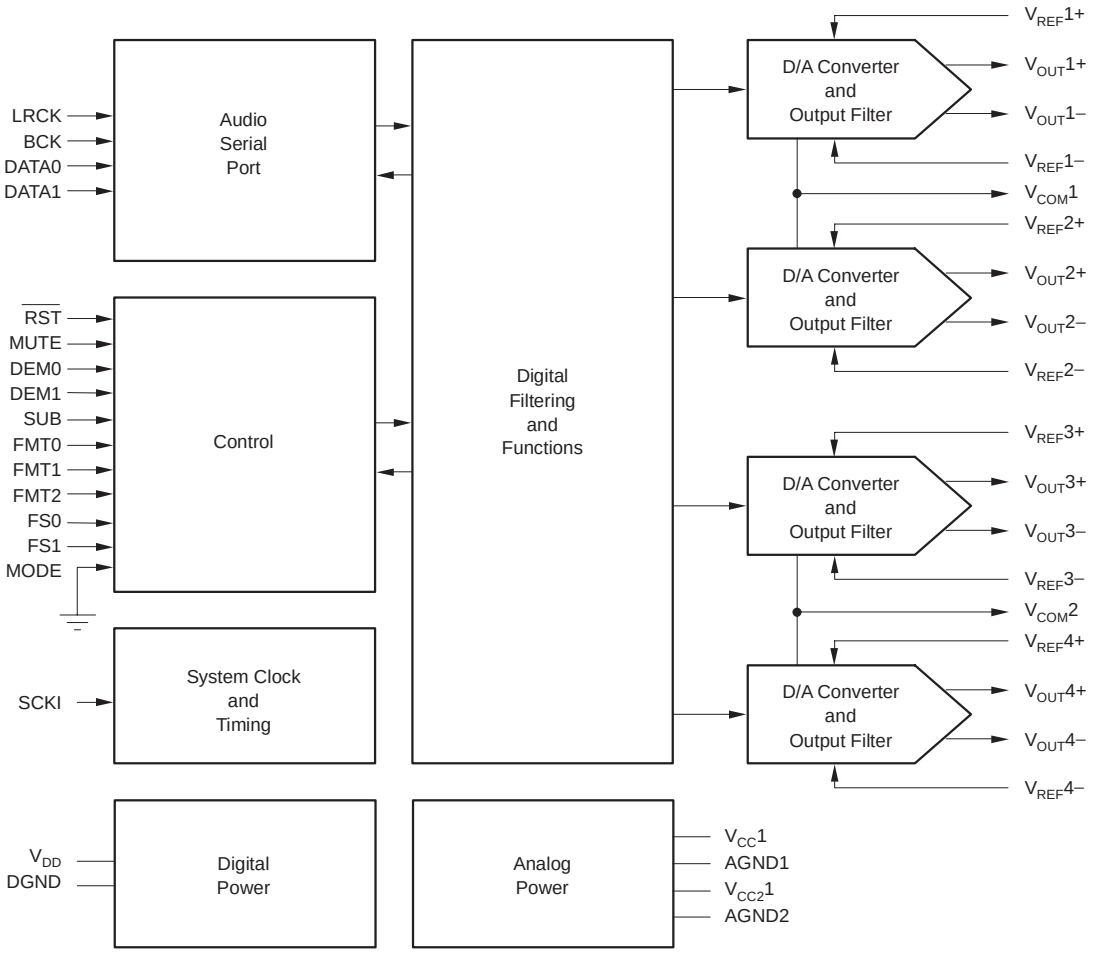
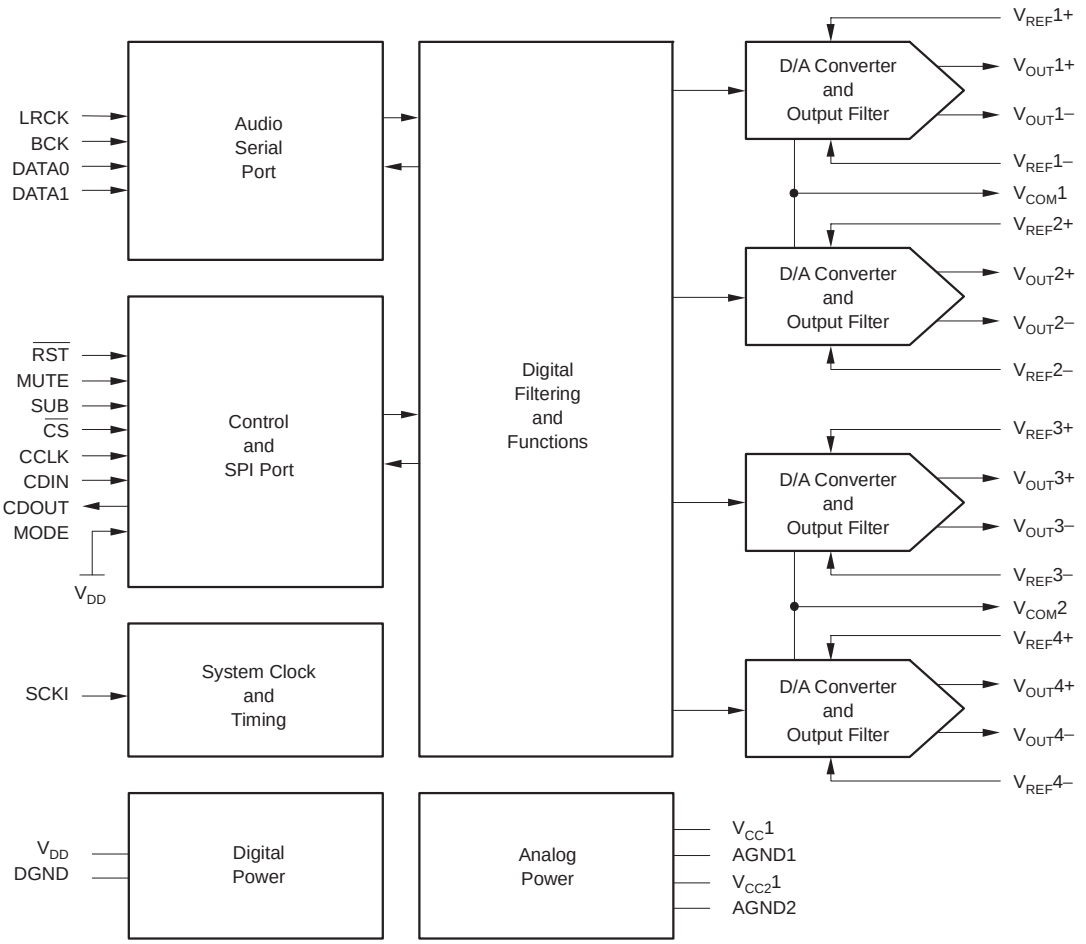


Figure 1−2. PCM4104 Functional Block Diagram, Software Mode



1.2 PCM4104EVM Features

The PCM4104EVM provides a convenient platform for evaluating the performance and functionality of the PCM4104 product. Key EVM features include:

- ❑ Two PCM4104 audio D/A converters, providing an eight-channel D/A conversion system.
- ❑ Single-ended analog outputs, each with a 2nd-order analog filter and an RCA output jack.
- ❑ A buffered audio serial port, supporting connection to DSP serial ports.
- ❑ An onboard AES3 receiver, supporting 75Ω coaxial cable input (up to 108kHz sampling rate).
- ❑ An optical receiver, supporting TOSLINK™ optical input connection to the AES3 receiver.
- ❑ A buffered host port supports connection to an external microprocessor or DSP.
- ❑ Flexible power supply configuration using either onboard regulators or external supplies.

1.3 PCM4104EVM Description and Block Diagram

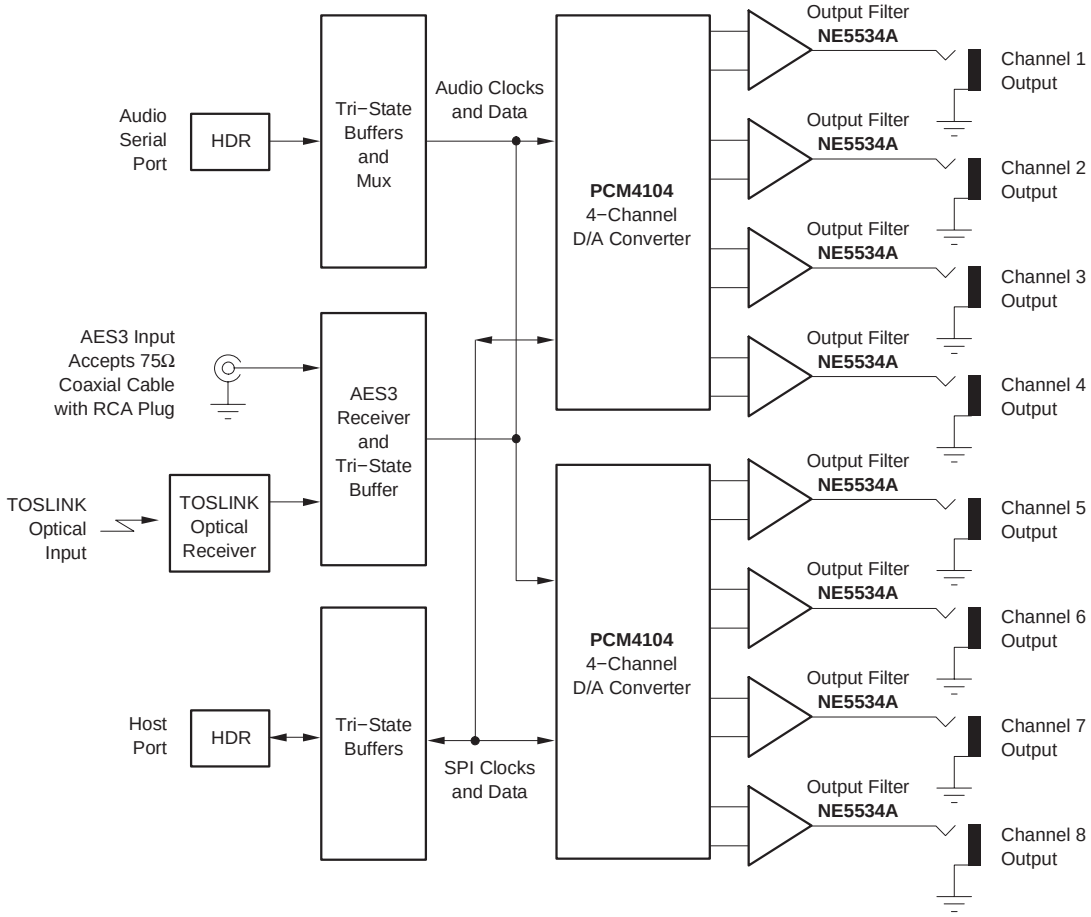
The block diagram for the PCM4104EVM is shown in Figure 1−3. Audio data is input at the audio serial port, AES3 input, or the optical data input. A switch on the EVM allows the user to select the audio clock and data source, which is either the audio serial port or the AES3 receiver output. When using the audio serial port, data for the eight audio channels can be input independently, so that each channel can carry its own program data. When using the AES3 receiver, only two channels of data are available. The left channel data is routed to channels 1, 3, 5, and 7, whereas the right channel data is routed to channels 2, 4, 6, and 8.

Each PCM4104 analog output is filtered by an external 2nd-order Butterworth low-pass active filter circuit. The active filter provides additional attenuation of the out-of-band noise produced by the delta-sigma conversion process, while providing band limiting suitable for high-resolution audio reproduction.

The PCM4104EVM can be configured to operate in either Standalone or Software mode. In Standalone mode, onboard switches provide direct control of dedicated input pins that are used to select sampling mode, audio data format, de-emphasis filtering, and all-channel soft mute. In Software mode, the PCM4104EVM can be controlled through the buffered host port interface, which can be connected to a microprocessor, digital signal processor, or another device capable of operating the PCM4104 SPI port. When the PCM4104EVM is configured in Standalone mode, the host port interface buffer is disabled, with all outputs set to a high-impedance state.

Although not shown in Figure 1−3, the PCM4104EVM provides support for various power-supply options. Power-supply configuration is discussed in more detail in Chapter 3 of this document.

Figure 1−3. Simplified Functional Block Diagram for the PCM4104EVM



Chapter 2

Getting Started

This chapter provides information regarding PCM4104EVM handling and unpacking, as well as absoute maximum operating conditions.

Topic **Page**

2.1 Electrostatic Discharge

Electrostatic Discharge

Failure to observe proper electrostatic discharge (ESD) handling precautions may result in damage to EVM components.

Many of the components on the PCM4104EVM are susceptible to damage by electrostatic discharge. Customers are advised to observe proper ESD handling procedure when unpacking and handling the EVM, including the use of a grounded wrist strap at an approved ESD workstation. Failure to observe ESD handling procedures may result in damage to EVM components.

2.2 Unpacking the EVM

Upon opening the PCM4104EVM package, please check to make sure that the following items are included:

- ❑ One PCM4104EVM
- ❑ One printed copy of the PCM4104 datasheet
- ❑ One printed copy of the PCM4104EVM user's guide

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

2.3 Absolute Operating Conditions

Absolute Operating Conditions

Exceeding the absolute maximum operating conditions may result in damamge to the EVM and/or the equipment connected to it.

The user should be aware of the absolute maximum operating conditions for the PCM4104EVM. Exceeding these conditions may result in damage to the EVM and the equipment connected to it. Table 2−1 summarizes the critical data points.

Table 2−1. Absolute Operating Conditions

Power Supplies	+12V	+15.0VDC max
	−12V	−15.0VDC max
	EXT +5V_A	+6.0VDC max
	EXT +5V_D	+6.0VDC max
	EXT +3.3V	+3.6VDC max
Audio Serial Port and Host Port I/O	V_{IH}	+3.6V max
	V_{IL}	−0.3V min
AES3 75Ω Coaxial Cable Input	V_{IH}	+7.0V max
	V_{IL}	−0.5V min

Chapter 3

Hardware Description and Configuration

This chapter provides the hardware description and configuration information for the PCM4104EVM.

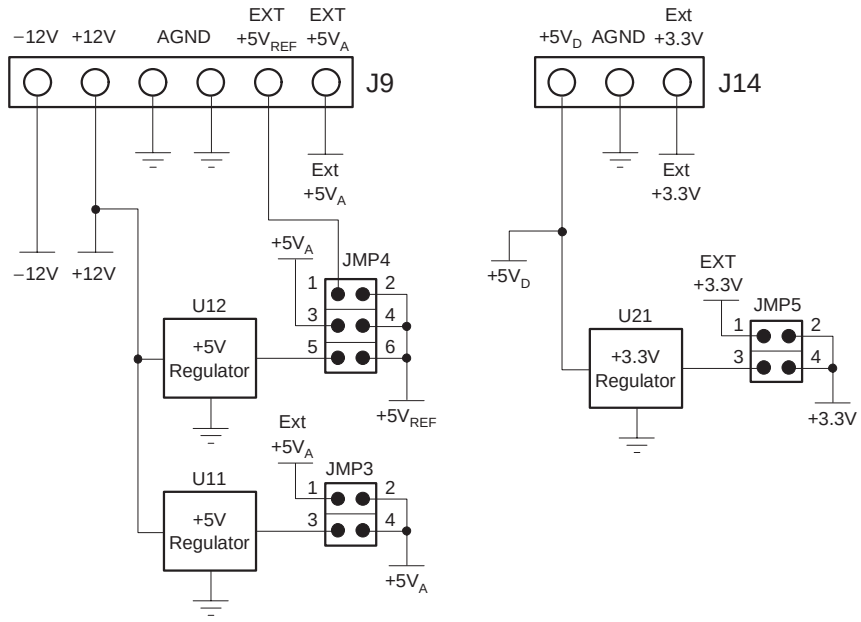
Topic **Page**

3.1 Power Supplies

The PCM4104EVM requires a minimum of three power supplies for operation. For the analog section of the board, both +12V and −12V DC power supplies are required. A +5V analog supply, along with a +5V reference supply, may be derived from the +12V supply using onboard linear voltage regulators, or alternatively, may be supplied from external power supply. For the digital section of the board, a single +5V DC power supply is required. A +3.3V digital supply may be derived from the +5V digital supply using an onboard linear voltage regulator, or alternatively, may be supplied from an external supply.

The analog power supplies are connected to the EVM via terminal block J9. The digital power supplies are connected via terminal block J14. Figure 3−1 illustrates the power supply configuration options for the PCM4104EVM.

Figure 3−1. Power Supply Configuration



3.2 Analog Output Ports

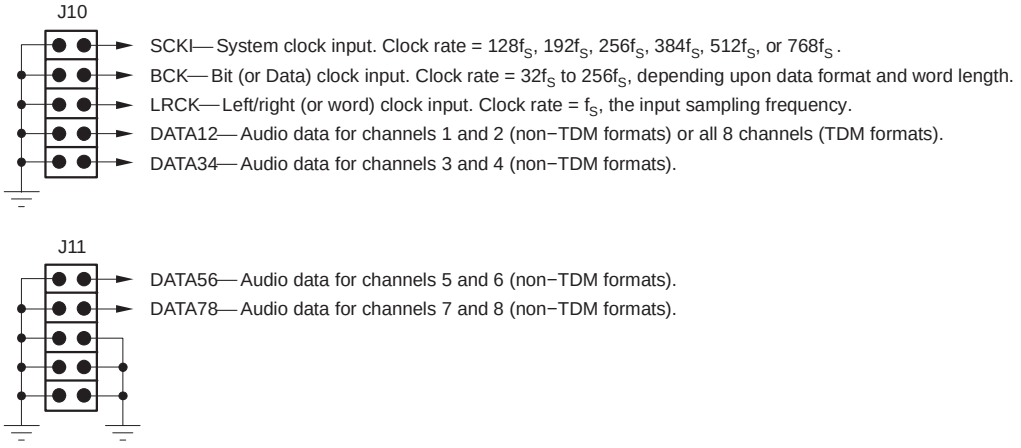
The PCM4104 includes two PCM4104 devices, providing a total of eight analog output channels. Each channel includes an external active filter circuit, which performs both low-pass filtering and differential-to-single-ended signal conversion. The gain of the active filter stage is approximately equal to 1.6. The −3dB corner of the filter is approximately 166kHz. The outputs of the filters are made available at connectors J1 through J8, which correspond to channels 1 through 8, respectively. RCA jacks are used for the output connectors.

The operational amplifier IC selected for use in the active filter circuits is the Texas Instruments NE5534A, which exhibits low input voltage noise and total harmonic distortion. The datasheet typical dynamic performance specifications for the PCM4104 are obtainable using this device. Other bipolar input op amps with equivalent or superior specifications should yield similar results. Using popular FET input audio op amps, such as the TI/Burr-Brown OPA134 or OPA604, will yield dynamic range measurements that are 1dB to 2dB worse than the datasheet typical specifications, while THD+N specifications will be equivalent to the published typical specifications.

3.3 Audio Serial Port

The PCM4104EVM provides a buffered interface to the audio serial ports for both PCM4104 devices. The audio serial port is comprised of headers J10 and J11, along with buffers U13 through U15. Figure 3−2 illustrates the audio port connections and definitions.

Figure 3−2. Audio Serial Port Interface Pin Definitions



NOTE: Refer to the PCM4104 data sheet for additional details regarding audio serial port operation.

The audio serial port includes the system clock (SCKI), bit clock (BCK), and left/right word clock (LRCK) inputs, which are common to both U1 and U2. Since these clocks are common to both PCM4104 devices, they will both operate at the same input sampling frequency.

The DATA12 input provides data for channels 1 and 2 for non-TDM data formats, while data for all eight channels are provided at DATA12 for TDM data formats. The DATA34, DATA56, and DATA78 inputs carry data for the corresponding channels when using non-TDM data formats.

Switch SW3 is used to enable/disable the audio serial port buffers and to select between TDM and non-TDM modes of operation. Table 3−1 illustrates the options for switch SW3.

Table 3−1. Audio Data Source and Mode Selection Using Switch SW3

$\overline{\text{ASP}}$	Audio Data Source
LO	Audio Serial Port (headers J10 and J11)
HI	AES3 Receiver (input via connector J13 or TOSLINK)

TDM	Audio Serial Port Mode
LO	Non-TDM (left-justified, right-justified, I^2S data formats)
HI	TDM (TDM data formats only)

Audio data format selection for Standalone mode is detailed in section 3.5.1 of this chapter. In Software mode, audio data formats are selected using a control register, programmed through the host port interface. Refer to the PCM4104 datasheet for control register definitions.

The audio serial port signals are compatible with +3.3V logic input/output levels. The port buffers (U13 and U14) are not +5V tolerant.

3.4 AES3 Input Ports

The PCM4104 includes an AES3 receiver IC (U19), which provides audio data and clock recovery for AES3 formatted input data streams. Both professional- and consumer-formatted AES3 data streams are supported. The coaxial cable input at RCA jack input J13 accepts 75Ω connections, and is suitable for connecting to audio test equipment and consumer S/PDIF data sources, such as CD or DVD players. The Toshiba TOSLINK optical receiver provides an interface to consumer audio players that have only optical digital outputs. Jumpers JMP1 and JMP2 are used to select between coaxial cable and optical inputs. Table 3−2 illustrates the jumper options.

Table 3−2. AES3 Input Selection

JMP1	JMP2	AES3 Input Source
Shorted	Open	75Ω Coaxial Cable Input (J13)
Open	Shorted	TOSLINK Optical Input

When selected as the audio data source (see Table 3−1), the AES3 receiver will provide the system clock (SCKI), bit clock (BCK), left/right word clock (LRCK), and I^2S formatted stereo audio data required by the D/A converters. Sampling rates up to and including 108kHz are supported. The AES3 receiver provides a $256f_S$ system clock output rate, along with a $64f_S$ bit clock output rate. The appropriate sampling mode and audio data format pins or bits must be set for the PCM4104. For sampling mode, select either Single Rate or Dual Rate, depending upon the sampling frequency. For data format, select the 24-Bit I^2S.

When using the AES3 receiver as the data source, only linear PCM stereo audio data is acceptable for use with the PCM4104. Encoded or compressed audio data is not acceptable, as the PCM4104 has no decoding capabilities. The recovered left-channel data is routed to channels 1, 3, 5, and 7, while the recovered right-channel data is routed to channels 2, 4, 6, and 8. The AES3 data source is useful for testing purposes, as well as stereo playback when performing listening tests.

3.5 Configuration Modes

The PCM4104EVM may be configured for either Standalone or Software control modes. The MODE element of switch SW1 is used to set the control mode. Table 3−3 shows the MODE switch options.

Table 3−3. Selecting the Configuration Mode

MODE	Configuration Mode
LO	Standalone (switch SW1 used for all settings)
HI	Software (external control via the host port interface)

In Standalone mode, switch SW1 is used to configure the sampling mode, audio data format, digital de-emphasis filter, and all-channel soft mute functions. Standalone mode configuration is discussed in more detail in section 3.5.1 of this chapter.

In Software mode, the PCM4104 is configured by writing control registers through the PCM4104 serial peripheral interface (SPI) port. The SPI port is accessed using the buffered host port interface at header J12. The host port interface is discussed in more detail in section 3.5.2 of this chapter.

3.5.1 Standalone Mode Configuration

As mentioned in the previous section of this chapter, Standalone mode allows both PCM4104 devices to be configured using switch SW1. Standalone mode provides access to a subset of the PCM4104 feature set, while providing a simplified configuration mode requiring no external host. Table 3−4 summarizes the options available in Standalone mode using switch SW1. Refer to the PCM4104 datasheet for additional information regarding the functions listed in Table 3−4.

Table 3−4. Standalone Configuration Using Switch SW1 (MODE = LO)

MUTE			All-Channel Soft Mute
LO			Disabled, Outputs are On
HI			Enabled, Outputs are Muted

DEM1	DEM0		Digital De-Emphasis Filter
LO	LO		Disabled
LO	HI		Enabled for f_S = 48kHz
HI	LO		Enabled for f_S = 44.1kHz
HI	HI		Enabled for f_S = 32kHz

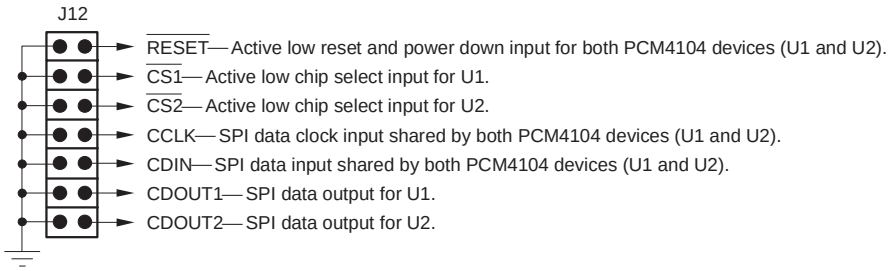
FMT2	FMT1	FMT0	Audio Data Format
LO	LO	LO	24-Bit Left Justified
LO	LO	HI	24-Bit I^2S
LO	HI	LO	TDM with No BCK Delay
LO	HI	HI	TDM with One BCK Delay
HI	LO	LO	24-Bit Right Justified
HI	LO	HI	20-Bit Right Justified
HI	HI	LO	18-Bit Right Justified
HI	HI	HI	16-Bit Right Justified

FS1	FS0		Sampling Mode
LO	LO		Single Rate
LO	HI		Dual Rate
HI	LO		Quad Rate
HI	HI		− Not Used −

3.5.2 Software Mode Configuration Using the Host Port

The PCM4104 includes a buffered host port for interfacing to an external microprocessor, DSP, or other devices that can support synchronous serial port operation for communications with the PCM4104 serial peripheral interface (SPI) port. Figure 3−3 illustrates the port connections and definitions.

Figure 3−3. Host Port Interface Pin Definitions



NOTE: Refer to the PCM4104 data sheet for additional details regarding SPI port operation.

The port signals are compatible with +3.3V logic input/output levels. The port buffer (U16) is not +5V tolerant.

The host port interface connections include a common bit clock (CCLK), serial data input (CDIN), and reset ($\overline{RST}$), used by both PCM4104 devices. Separate chip selects ($\overline{CS1}$ and $\overline{CS2}$) are provided to allow individual write or read access to U1 or U2. In addition, separate serial data outputs (CDOUT1 and CDOUT2) are provided to support individual read access for both devices.

3.6 Reset Function

The PCM4104 includes an onboard reset switch, SW2, which is a normally open, momentary-contact pushbutton switch. The $\overline{RST}$ inputs for both U1 and U2 are normally pulled up to the +3.3V supply by a 10kΩ resistor (R65). Depressing switch SW2 forces the reset signal to a low logic level and releasing switch SW2 initiates a reset sequence.

The node controlled by switch SW2 is also connected to the $\overline{RESET}$ pin on host port header J12. When not using the host port, the $\overline{RESET}$ pin of header J12 should be left floating. The pull-up resistor ensures that the reset signal to the D/A converters is normally pulled to a high logic level.

Chapter 4

Schematic, PCB Layout, and Bill of Materials

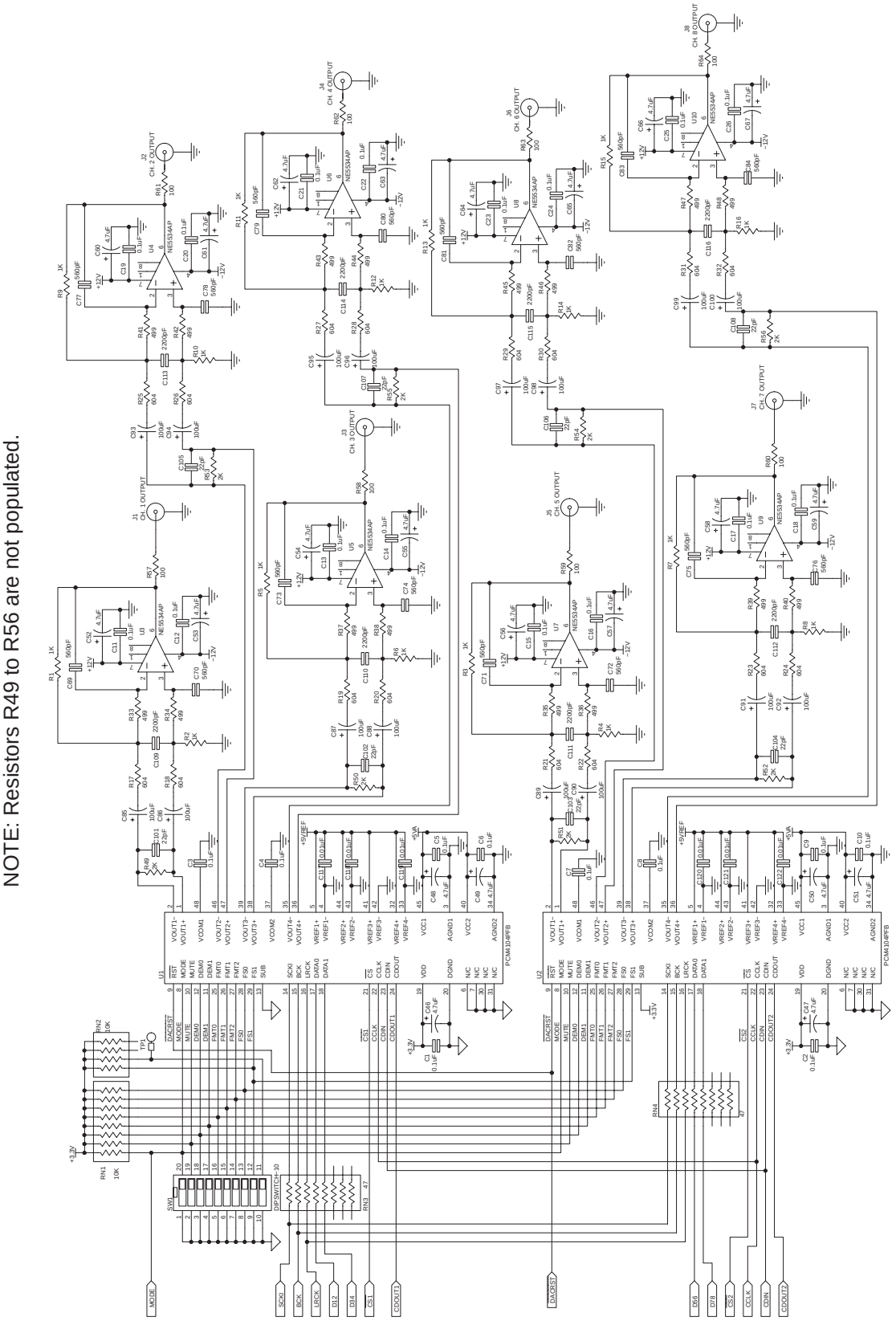
This chapter provides the electrical schematic and physical layout information for the PCM4104EVM. The bill of materials is included for component and manufacturer reference.

Topic **Page**

4.1 Schematic

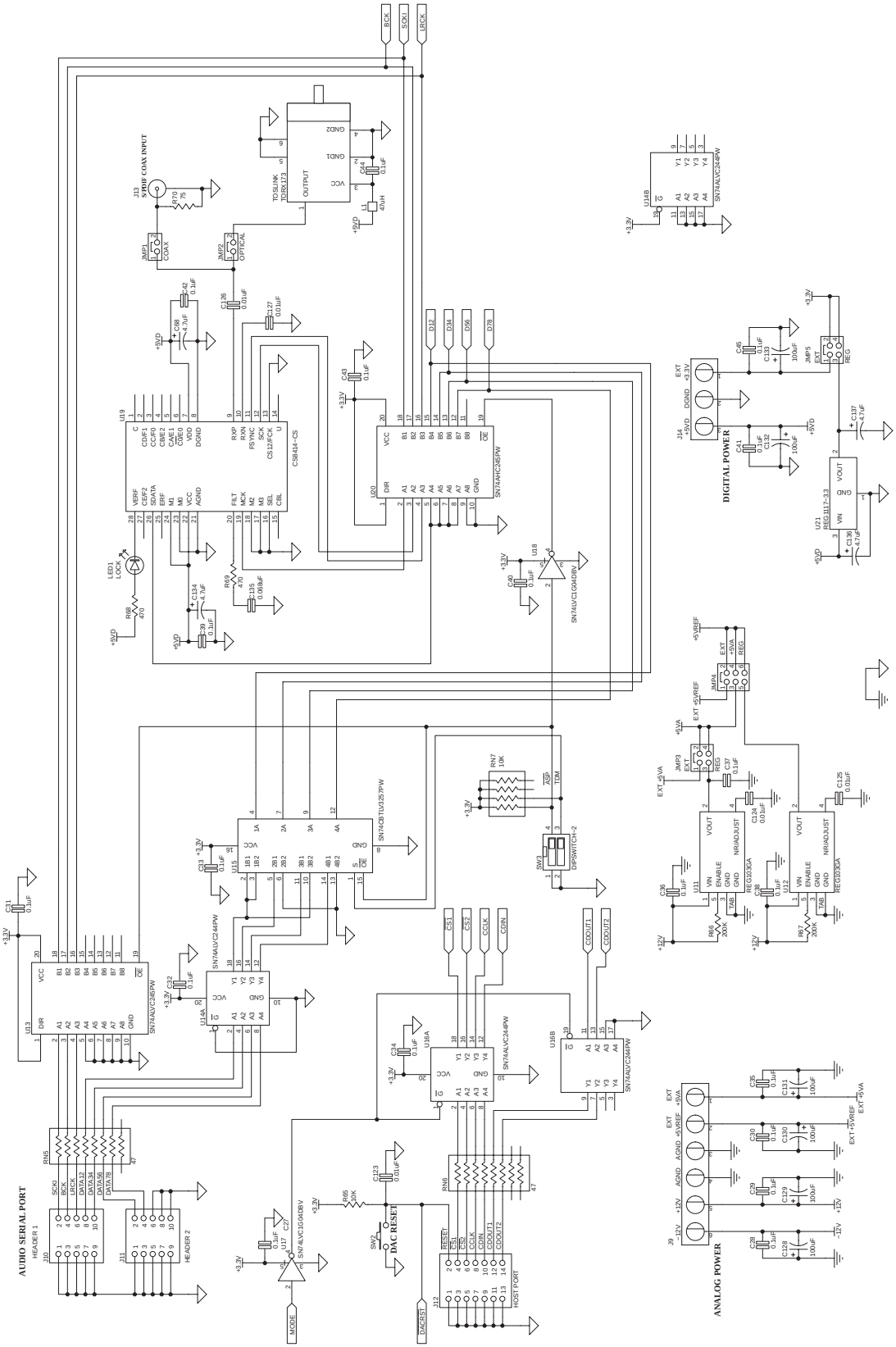
The electrical schematic for the PCM4104EVM is shown in Figure 4−1 and Figure 4−2. The analog section is shown in Figure 4−1 and the digital section shown in Figure 4−2. Descriptions of the components shown on the schematics are listed in Table 4−1.

Figure 4−1. PCM4104EVM Schematic Diagram: Analog Section



NOTE: Resistors R49 to R56 are not populated.

Figure 4−2. PCM4104EVM Schematic Diagram: Digital Section



4.2 Printed Circuit Board (PCB) Layout

The PCM4104EVM is a four-layer PCB with the following layer structure:

Layer 1: Top (Component Side)

Layer 2: Ground Plane

Layer 3: Power

Layer 4: Bottom (Solder Side)

Figure 4−3 through Figure 4−8 show the top-side silk screen, along with the top, ground plane, power, and bottom layers of the printed circuit assembly.

Figure 4−3. Top-Side Silkscreen

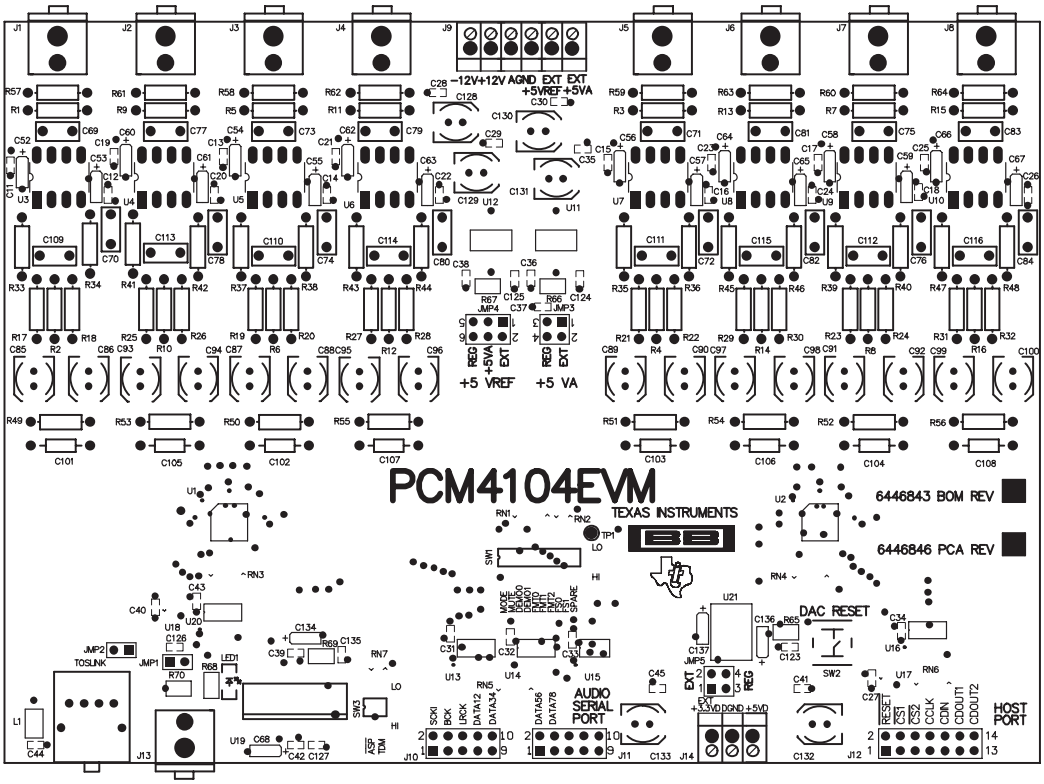


Figure 4−4. Bottom-Side Silkscreen

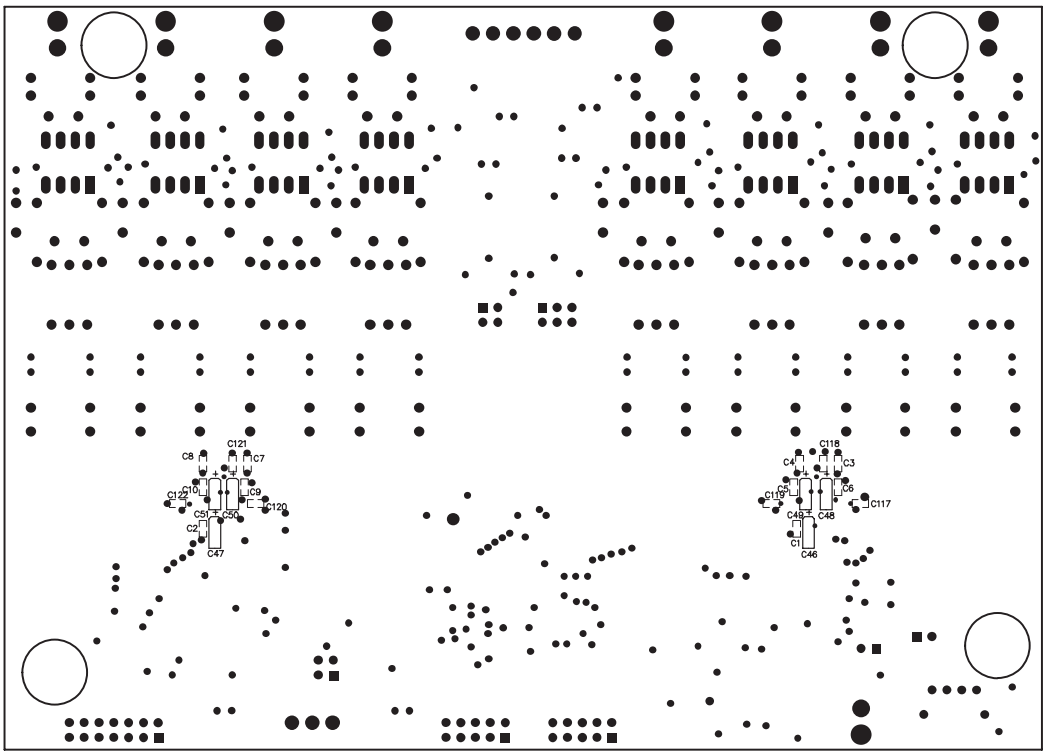


Figure 4−5. Top Layer (component side)

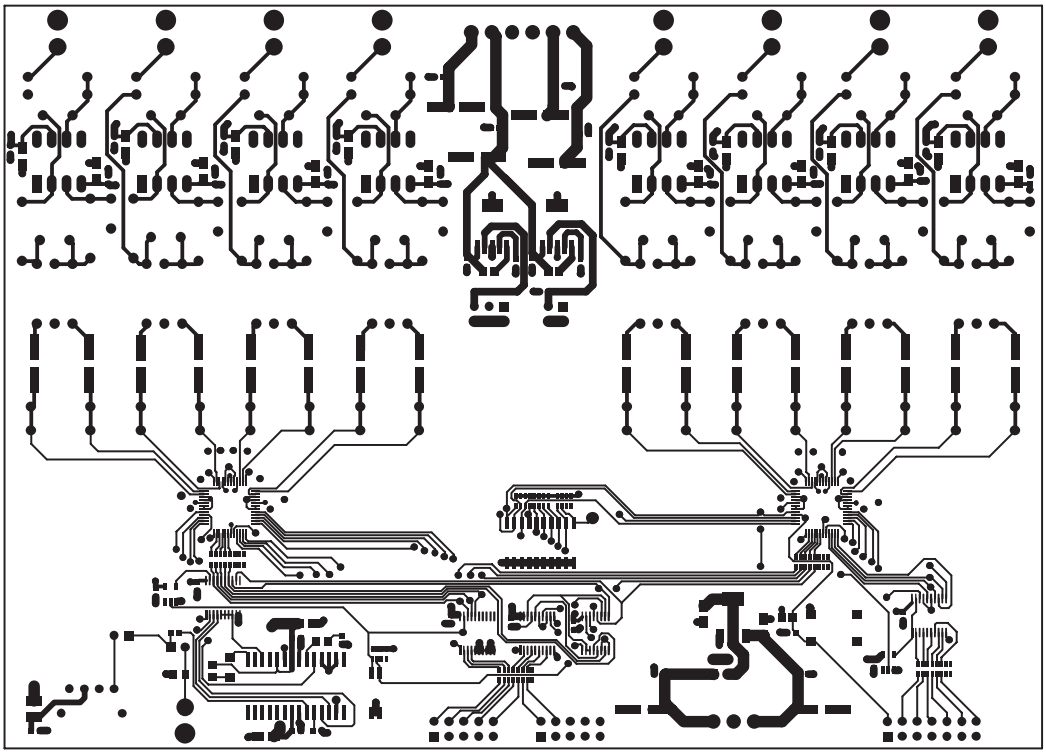


Figure 4−6. Ground Plane Layer

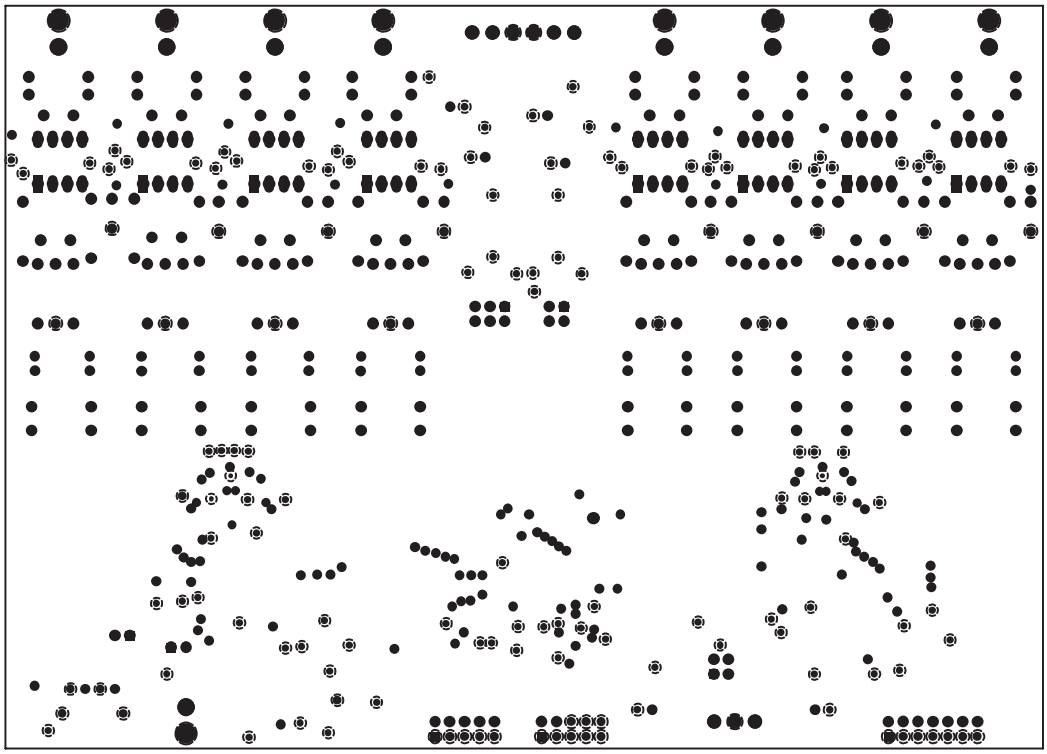


Figure 4−7. Power Layer

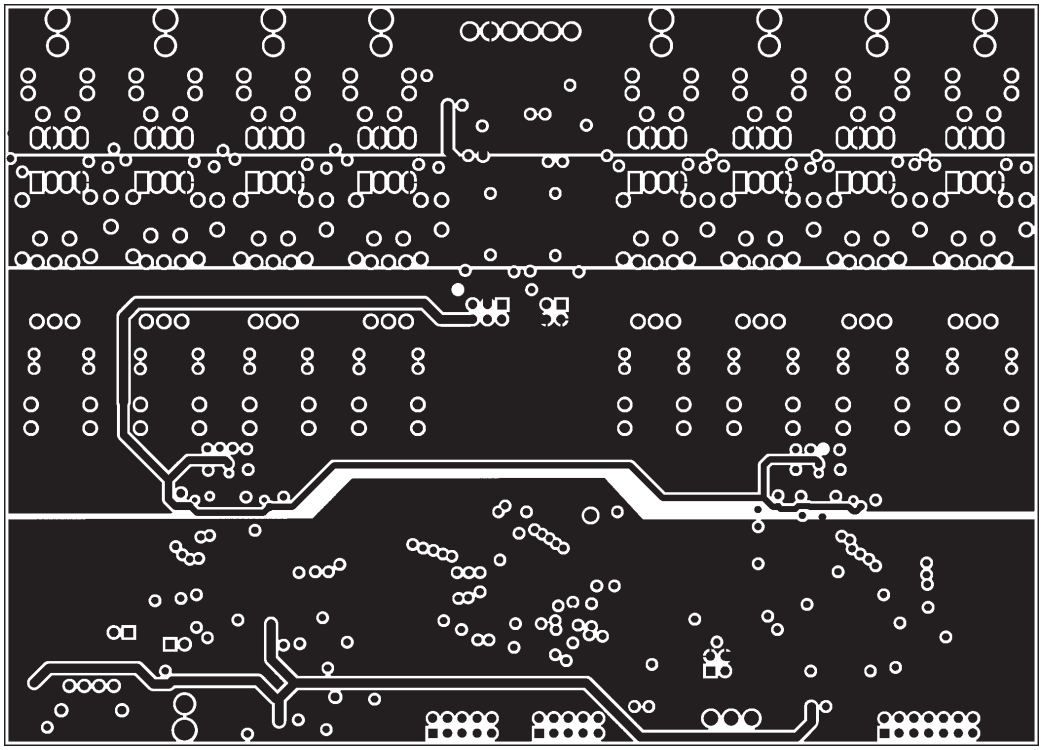
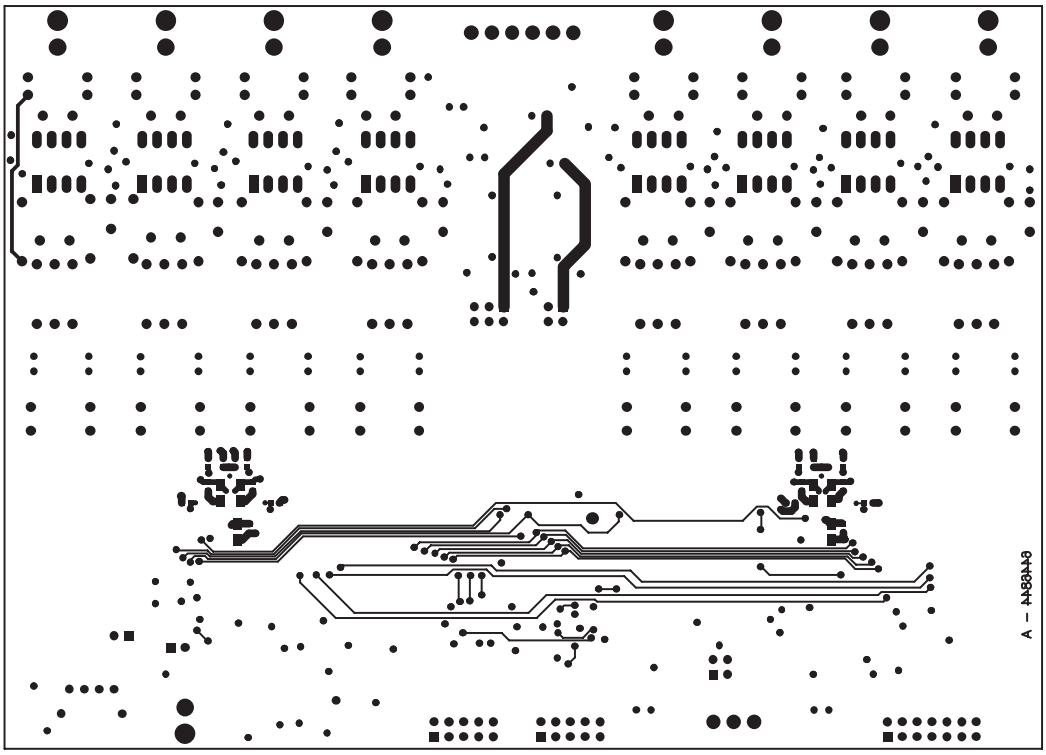


Figure 4−8. Bottom Layer (solder side)



4.3 Bill of Materials

The bill of materials, listing the components used in the assembly of the PCM4104EVM, is shown in Table 4−1.

Table 4−1. PCM4104EVM Bill of Materials

ITEM	VALUE	REFERENCE DESIGNATOR	QTY PER BD	MFG	MFG PART NUMBER	DESCRIPTION
1	22pF	C101−C108	8	KEMET	C410C220J1G5CA7200	Capacitor, NPO/C0G ceramic, 22pF ±5%, 100V, axial lead
2	560pF	C69−C84	16	Panasonic	ECQ−B1H561JF	Capacitor, poly film, 560pF ±5%, 50V, radial lead
3	2200pF	C109−C116	8	Panasonic	ECQ−B1H222JF	Capacitor, poly film, 2200pF ±5%, 50V, radial lead
4	0.068µF	C135	1	KEMET	C0603C683K9RACTU	Chip capacitor, X7R ceramic, 0.068µF ±10%, 6.3V, size = 0603
5	0.01µF	C117−C127	11	KEMET	C0603C103K5RACTU	Chip capacitor, X7R ceramic, 0.01µF ±10%, 50V, size = 0603
6	0.1µF	C1−C45	45	KEMET	C0603C104K4RACTU	Chip capacitor, X7R ceramic, 0.1µF ±10%, 16V, size = 0603
7	4.7µF	C46−C68, C134, C136, C137	26	KEMET	T494A475M016AS	Chip capacitor, low ESR tantalum, 4.7µF ±20%, 16V, size = A
8	100µF	C85−C100, C128−C133	22	Panasonic	EEV−FK1C101P	Capacitor, aluminum electrolytic, 100µF ±20%, 16V, surface-mount
9		J1−J8, J13	9	CUI Stack	RCJ−041	RCA phono jack, black shell
10		J9	1	Weidmuller	9967720000	3.5mm PCB terminal block, 6 poles
11		J10, J11	2	Samtec	TSW−105−07−G−D	Terminal strip, 10-pin (5x2)
12		J12	1	Samtec	TSW−107−07−G−D	Terminal strip, 14-pin (7x2)
13		J14	1	Weidmuller	1699680000	3.5mm PCB terminal block, 3 poles
14		JMP1,JMP2	2	Samtec	TSW−102−07−G−S	Terminal strip, 2-pin (2x1)
15		JMP3, JMP5	2	Samtec	TSW−102−07−G−D	Terminal strip, 4-pin (2x2)
16		JMP4	1	Samtec	TSW−103−07−G−D	Terminal strip, 6-pin (3x2)
17	47µH	L1	1	Panasonic	ELJ−FA470KF	Inductor, surface-mount 47µH ±10%, size = 1210
18		LED1	1	Lumex	SML−LX1206GC−TR	Green LED, SMT, size = 1206
19	75Ω	R70	1	Panasonic	ERJ−6ENF75R0V	Resistor, thick film chip, 75Ω, 1%, 1/10W, size = 0805
20	100Ω	R57−R64	8	Vishay Dale	CMF−55 1000BT−9	Resistor, metal film, axial leads, 100Ω, 0.1%, 1/4W
21	470Ω	R68, R69	2	Panasonic	ERJ−6GEYJ471V	Resistor, thick film chip, 470Ω, 5%, 1/8W, size = 0805
22	499Ω	R33−R48	16	Vishay Dale	CMF−55 4990BT−9	Resistor, metal film, axial leads, 499Ω, 0.1%, 1/4W
23	604Ω	R17−R32	16	Vishay Dale	CMF−55 6040BT−9	Resistor, metal film, axial leads, 604Ω, 0.1%, 1/4W

Table 4−1. PCM4104EVM Bill of Materials (continued)

ITEM	VALUE	REFERENCE DESIGNATOR	QTY PER BD	MFG	MFG PART NUMBER	DESCRIPTION
24	1kΩ	R1−R16	16	Vishay Dale	CMF−55 1001BT−9	Resistor, metal film, axial leads, 1kΩ, 0.1%, 1/4W
25	2kΩ	R49−R56	8	Vishay Dale	CMF−55 2001BT−9	Resistor, metal film, axial leads, 2kΩ, 0.1%, 1/4W, not populated
26	10kΩ	R65	1	Panasonic	ERJ−6ENF1002V	Resistor, thick film chip, 10kΩ, 1%, 1/10W, size = 0805
27	200kΩ	R66, R67	2	Panasonic	ERJ−6ENF2003V	Resistor, thick film chip, 200kΩ, 1%, 1/10W, size = 0805
28	47Ω	RN3−RN6	4	CTS	742C163470J	Thick film chip resistor array, 47Ω, 16-terminal, 8 resistors, isolated
29	10kΩ	RN1	1	CTS	742C163103J	Thick film chip resistor array, 10kΩ, 16-terminal, 8 resistors, isolated
30	10kΩ	RN2, RN7	2	CTS	742C083103J	Thick film chip resistor array, 10kΩ, 8-terminal, 4 resistors, isolated
31		SW1	1	ITT Industries/ C&K	TDA10H0SK1	DIP switch, 10-element, half pitch, surface-mount, tape-sealed
32		SW2	1	OMRON	B3S−1000	Momentary tact switch, surface-mount w/o ground terminal
33		SW3	1	ITT Industries/ C&K	TDA02H0SK1	DIP switch, 2-element, half-pitch, surface-mount, tape-sealed
34		TOSLINK	1	Toshiba	TORX173	TOSLINK optical receiver for S/PDIF digital audio interface
35		U1, U2	2	TI	PCM4104PFB	Four-channel audio D/A converter
36		U3−U10	8	TI	NE5534AP	Low noise operational amplifier
37		U11, U12	2	TI	REG103GA−5	Linear voltage regulator, +5V
38		U13	1	TI	SN74ALVC245PW	Octal bus transceiver
39		U14, U16	2	TI	SN74ALVC244PW	Octal buffer/driver
40		U15	1	TI	SN74CBTLV3257PW	Quad 1-of-2 FET mux/demux
41		U17, U18	2	TI	SN74LVC1G04DBV	Single inverter
42		U19	1	Cirrus Logic	CS8414−CS	96kHz digital audio receiver
43		U20	1	TI	SN74AHC245PW	Octal bus transceiver, +5V tolerant inputs with +3.3V power supply
44		U21	1	TI	REG1117−3.3	Linear voltage regulator, +3.3V
45			4	3M Bumpon	SJ−5003	Rubber feet, adhesive-backed
46			4	Samtec	SNT−100−BK−G−H	Shorting blocks
47			8	MILL−MAX	111−93−308−41−001−000	8-pin DIP sockets