

EVM User's Guide: PCMX140Q1EVM-PDK

PCMX140Q1EVM-PDK Evaluation Module



Description

The PCMX140Q1EVM-PDK is an evaluation module (EVM) that allows the user to test the capabilities of the PCMX140-Q1 family of devices, which is a quad-channel, high-performance audio analog-to-digital converter (ADC). The PCMX140-Q1 is intended for voice-activated systems, professional microphones, audio conferencing, portable computing, communication, entertainment, and automotive applications. The PCMX140Q1EVM-PDK is paired with the AC-MB (included in the kit), a flexible motherboard that provides power, control, and digital audio data to the EVM.

Get Started

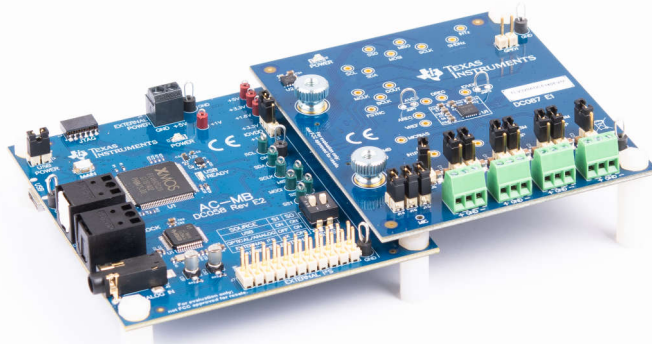
1. Order the EVM from the [PCMX140Q1EVM-PDK](#) product page.
2. Download the latest PCMX140-Q1 data sheet.
3. Request access and download PPC3 GUI and the associated PCMX140Q1EVM-PDK app from the [PCMX140Q1EVM-PDK](#) product page.

Features

- Complete performance demonstration kit (PDK) for PCMX140-Q1
- High-performance audio ADC: 106, 108, or 113-dB dynamic range
- Dynamic Range Enhancer (DRE) improves dynamic range performance in far field applications (PCM5140-Q1, and PCM6140-Q1 only)
- Rail-to-Rail CMRR performance mode (PCM6140-Q1 only)
- Onboard microphone provided for voice-recording testing
- Direct access to digital audio signals and control interface for simple end-system integration
- USB connection to PC provides power, control, and streaming audio data for easy evaluation
- Easy evaluation and demonstration via PurePath™ Console software platform (PUREPATHCONSOLE)

Applications

- [Microphone array systems](#)
- Voice-activated digital assistants
- Teleconferencing systems
- [Security and surveillance systems](#)



1 Evaluation Module Overview

1.1 Introduction

This user's guide describes the function and use of the PCMx140Q1EVM-PDK. This document includes the hardware configuration instructions, a quick-start guide, jumper and connector descriptions, software description, schematics, and printed circuit board (PCB) layout that demonstrate TI's recommended practices for these devices.

1.2 Kit Contents

- ADC3140EVM-PDK evaluation module
- Audio converters motherboard (AC-MB)

1.3 Specification

The PCMx140Q1EVM-PDK evaluation module (EVM) paired with the AC-MB, a flexible motherboard which provides power, control, and digital audio data to the evaluation module allows the user to record and playback audio signals. The configuration for the PCMx140-Q1 family of devices is done through the PurePath Console 3 (PPC3) GUI.

1.4 Device Information

The PCMx140Q1EVM-PDK is an evaluation module (EVM) designed to demonstrate the performance and functionality of the PCMx140-Q1 family of devices. This family includes the devices shown in [Table 1-1](#) with differences in performance and function noted.

Table 1-1. PCMx140-Q1 Family

Device	SNR Without DRE (dB)	SNR With DRE (dB)
PCM3140-Q1	106	N/A
PCM5140-Q1	108	120
PCM6140-Q1	112	123

2 Hardware

2.1 System Overview

Figure 2-1 shows an overview of the system.

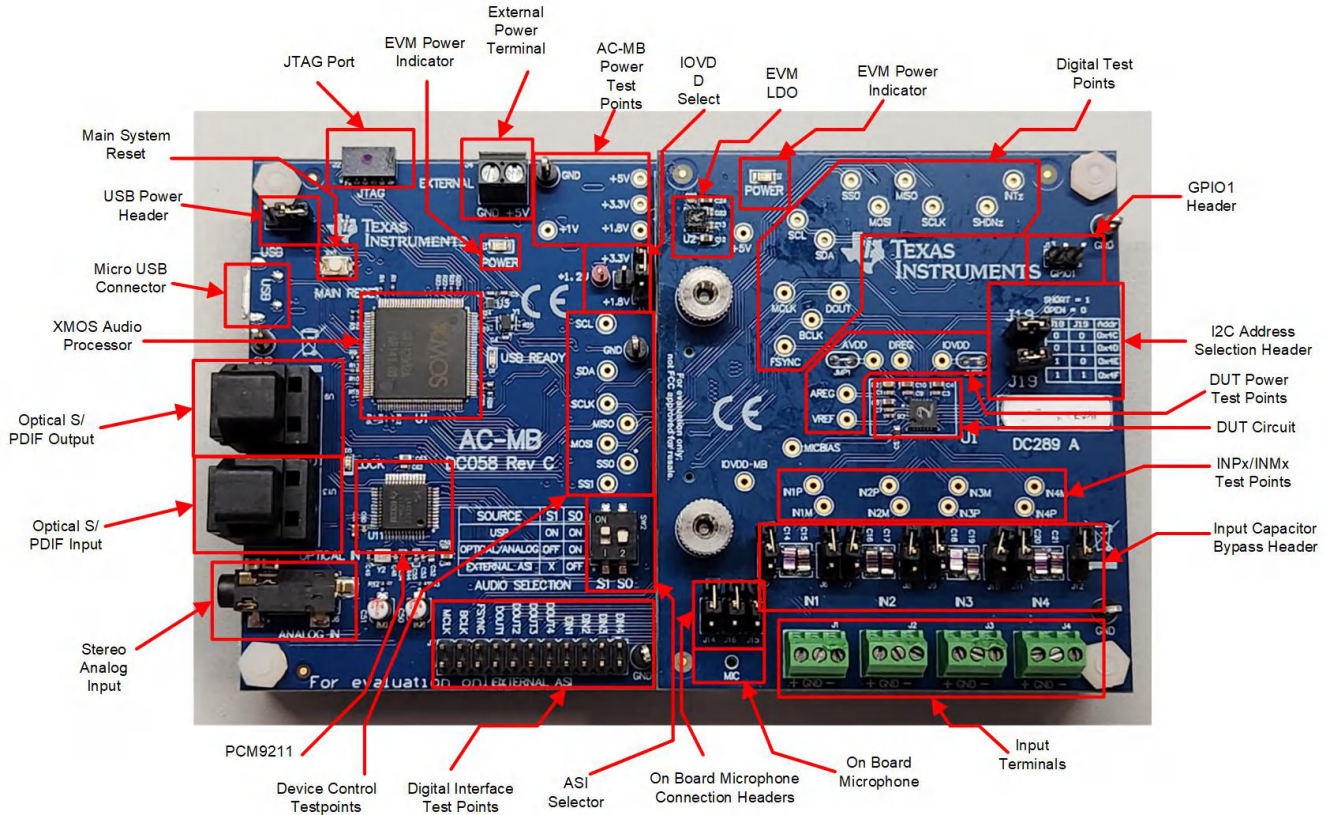


Figure 2-1. System Overview

2.2 Hardware Overview

The evaluation kit consists of the PCMx140Q1EVM daughterboard and the AC-MB motherboard. The motherboard is used to provide power, control, and digital audio signals to the evaluation module. The daughterboard contains the PCMx140-Q1 device and the input connections. A detailed functional overview of the PCMx140Q1EVM system is described in [Section 2.1](#).

2.2.1 AC-MB Settings

2.2.1.1 Audio Serial Interface Settings

The AC-MB provides the digital audio digital signals to the evaluation module from the universal serial bus (USB), optical, stereo jack, and external audio serial interface (ASI) header. [Figure 2-2](#) shows a block diagram of the ASI routing on the AC-MB.

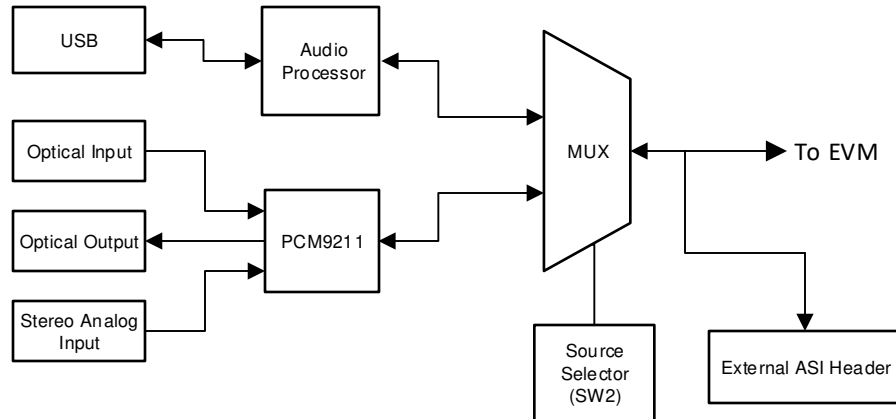


Figure 2-2. AC-MB Audio Serial Interface Routing

Switch SW2 on the AC-MB selects the audio serial bus that interfaces with the TLV320ADC5140EVB. Next to switch SW2, the AC-MB has a quick reference table to identify the audio serial interface source options and switch settings. The AC-MB acts as the controller for the audio serial interface, with three different modes of operation (see [Figure 2-3](#)): USB, optical or analog, or external ASI.

2.2.1.1.1 USB

The serial interface clocks and data are provided from the USB interface. The sampling rate and format are determined by the USB audio class driver on the operating system. The default settings for the USB audio interface are 32-bit frame size, 48-kHz sampling rate, BCLK and FSYNC ratio is 256, and the format is time-division multiplexing (TDM).

2.2.1.1.2

The AC-MB is detected by the OS as an audio device with the name *TI USB Audio UAC2.0*. Figure 2-3 shows the AC-MB audio setting for the USB mode of operation.

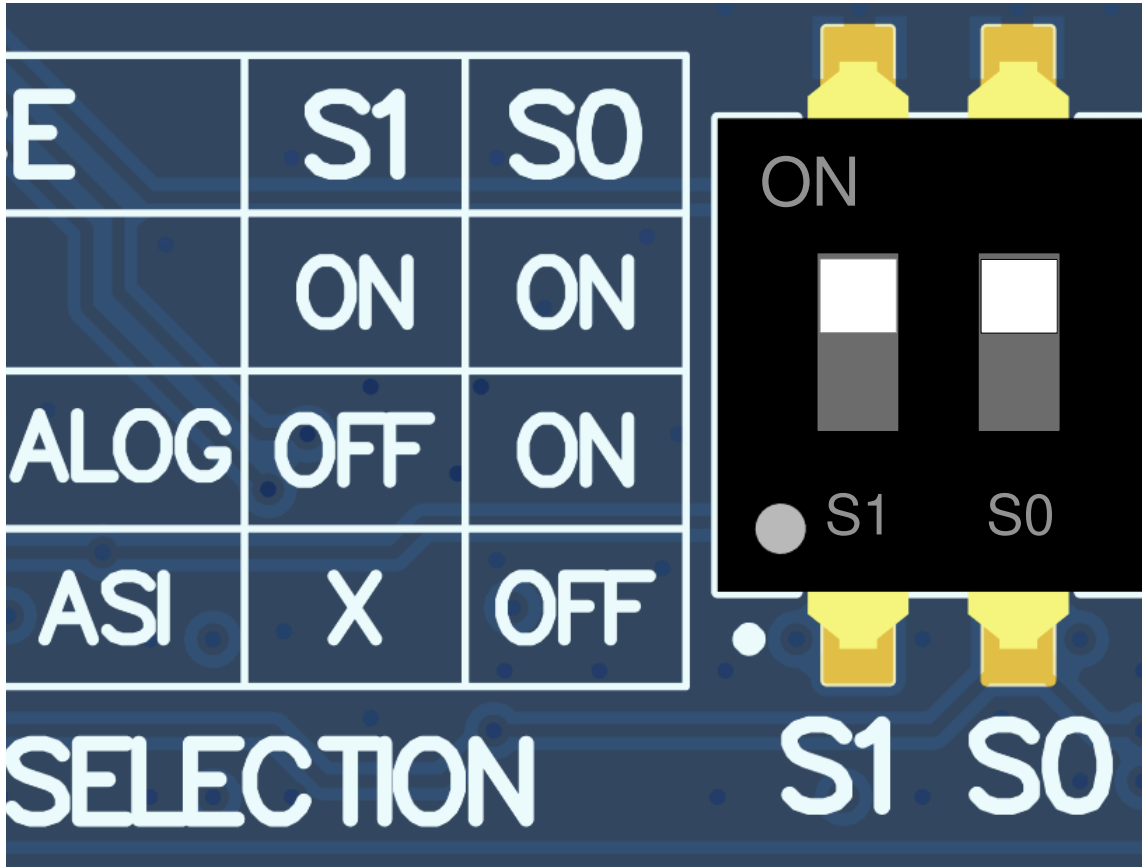


Figure 2-3. AC-MB USB Audio Setting

2.2.1.1.3 Optical or Auxiliary Analog Audio Input

Serial interface signals are provided from the PCM9211 digital transceiver, which is capable of sending digital data to the EVB from an analog input or optical input. Meanwhile, the data from the EVB can be streamed through the optical output. Figure 2-4 shows the AC-MB audio setting for the optical and analog mode of operation.

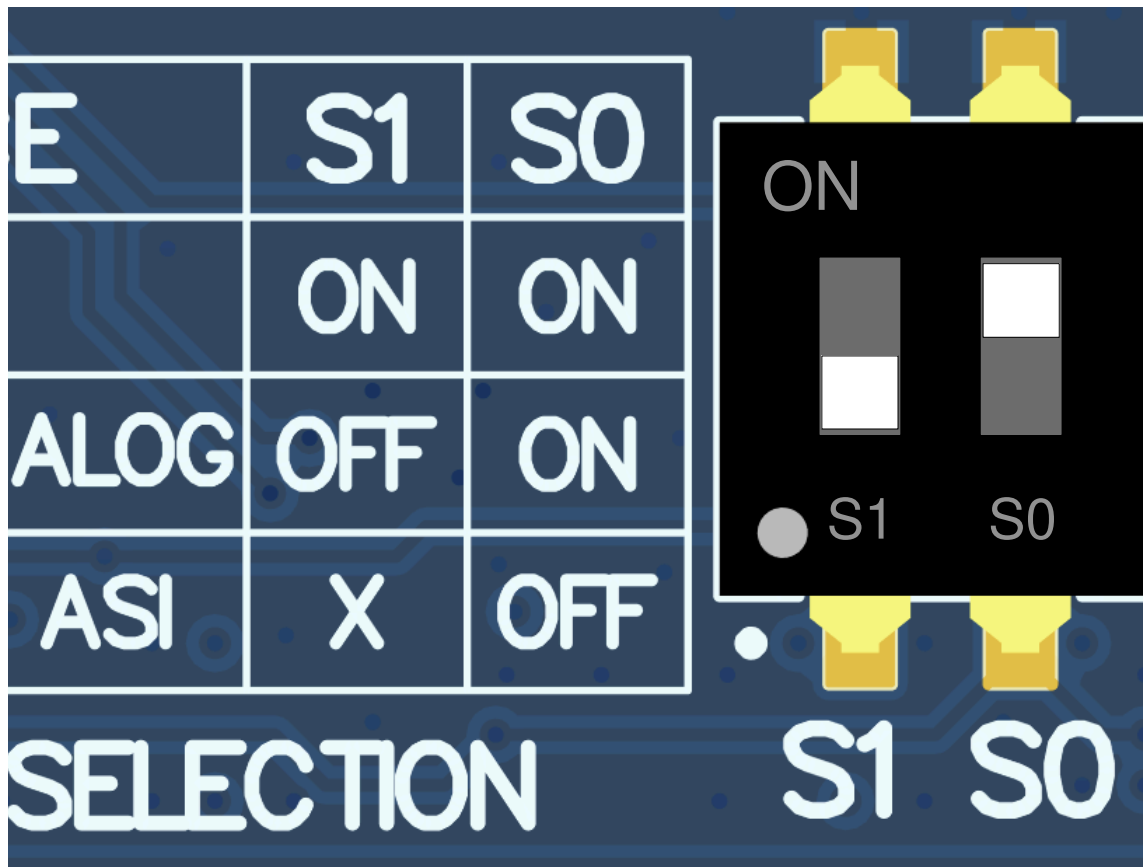


Figure 2-4. AC-MB Optical or Auxiliary Analog Audio Setting

The optical output of the AC-MB streams the data captured on the EVM with the format determined by the input source used. When there is an optical input connected, the LOCK LED must be ON, and the PCM9211 streams the audio serial interface clocks with the format determined by the optical input frame. The digital data from the optical input is streamed to the evaluation module. If the optical input is not connected, the PCM9211 captures the input signal provided through the analog input, and streams the signal to the evaluation module. This feature can be useful when a digital input DAC is connected to the AC-MB, providing an analog input for quick evaluation. In Auxiliary Analog Audio mode the audio serial interface format is fixed to a 24-bit, 48-kHz, I²S mode.

2.2.1.1.4 External

In this mode, the audio serial interface clocks for the evaluation board are provided through connector J7 from an external source. This architecture allows the use of an external system to communicate with the evaluation board, such as a different host processor or test equipment (for instance, Audio Precision PSIA). The clocks generated from the USB interface and PCM9211 are isolated with this setting. Figure 2-5 shows the AC-MB audio setting for the external mode of operation.

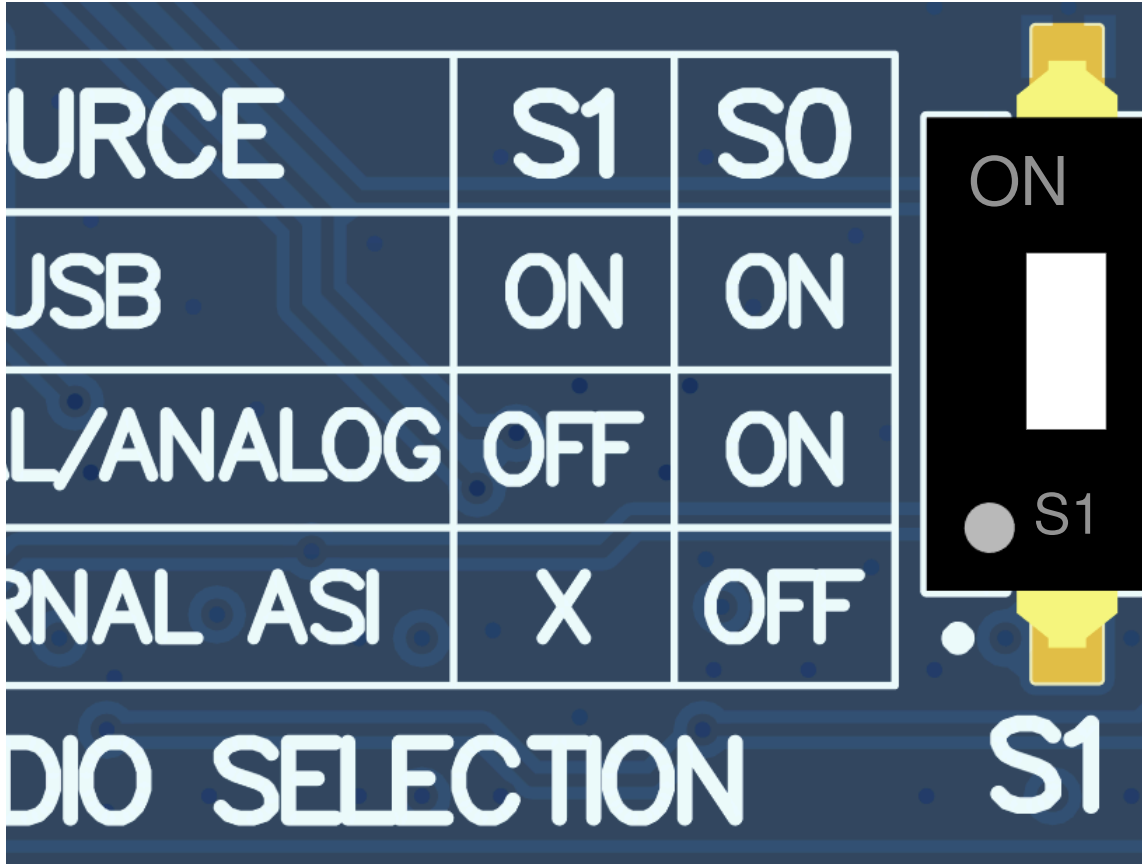


Figure 2-5. AC-MB External Audio Setting

Figure 2-6 shows how to connect the external audio interface, with the bottom row for the signal and the top row for ground.

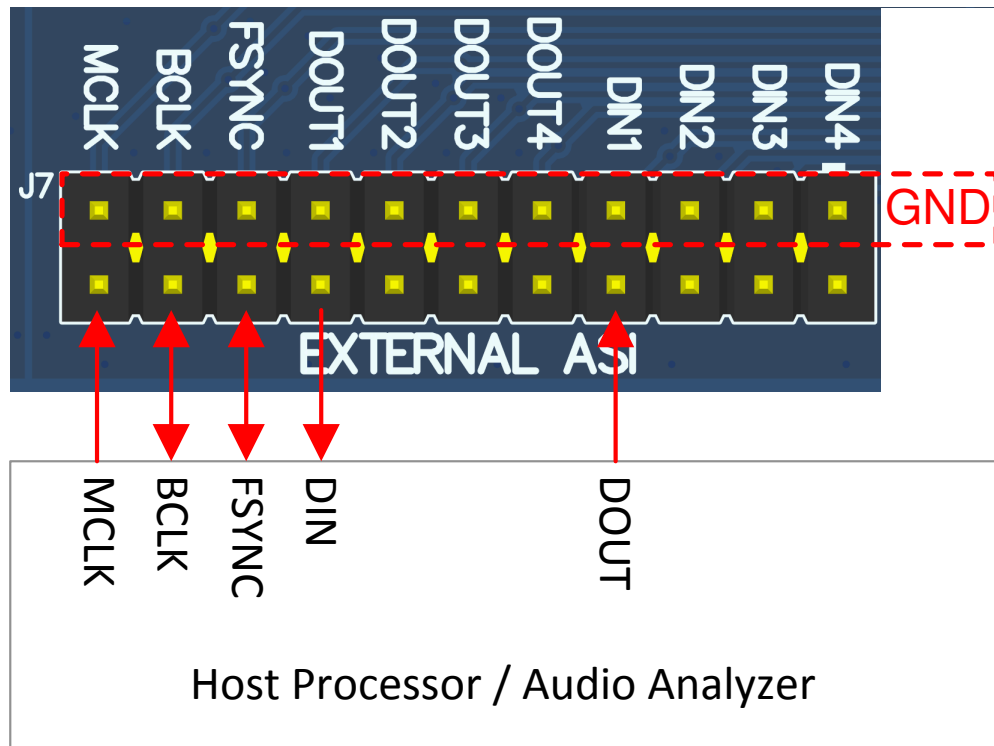


Figure 2-6. AC-MB Connection with External Audio Serial Interface

2.2.1.2 AC-MB Power Supply

The complete EVM system is powered from a single 5-V power supply. However, the motherboard has different low-dropout regulators (LDOs) integrated that provide the required power supplies to the different blocks of the board. Figure 2-7 shows a block diagram depicting the power structure of the AC-MB.

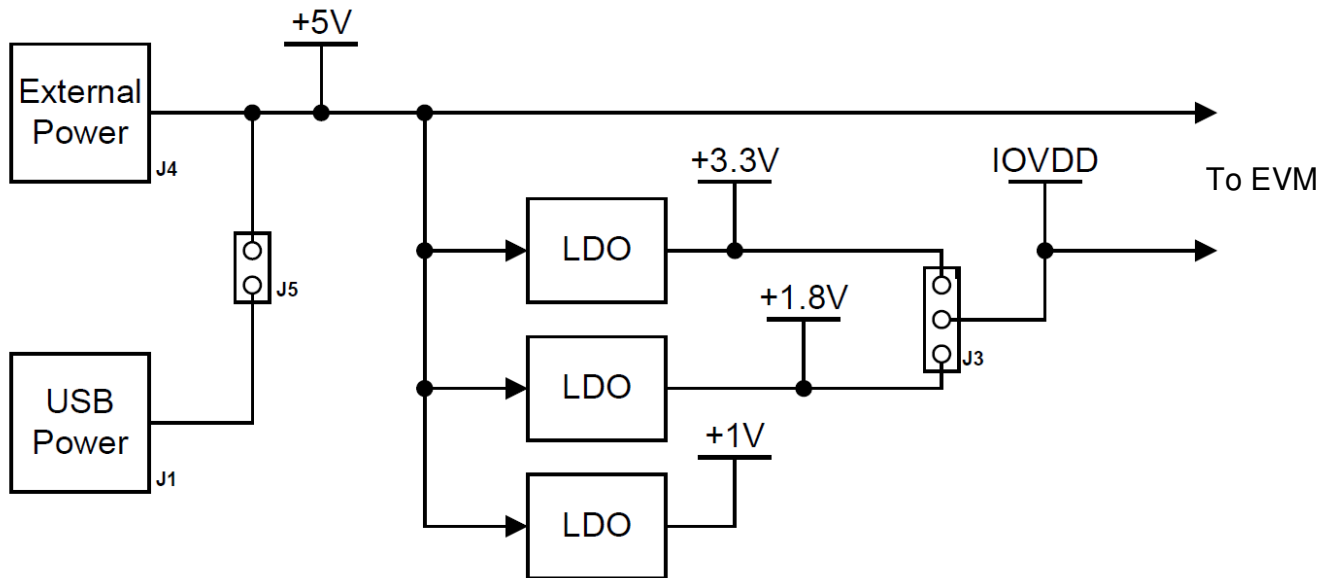


Figure 2-7. Power-Supply Distribution of the AC-MB

The AC-MB can be powered from the host computer by using the USB 5-V power supply (VBUS) by shorting header J5, USB POWER. Additionally, the AC-MB can be powered from an external power supply connected to terminal J4, EXTERNAL POWER. Header J5 must be open for external supply operation. The IOVDD voltage for the digital signals that is provided to the evaluation module is generated on the motherboard from the main power supply (USB or external). The voltage levels available are 1.8 V and 3.3 V, and can be selected via the J3 header IOVDD. For 1.8-V operation, short pins 2 and 3 of header J3; for 3.3-V operation, short pins 1 and 2. When the motherboard is fully powered and the power supplies from the onboard LDOs are correct, the green POWER LED (D3) turns ON. The USB READY LED indicates that a successful USB communication is established between the AC-MB and the host computer.

2.2.2 PCMx140Q1EVM-PDK Hardware Settings

The PCMx140-Q1 evaluation module has several input configuration options and offers extensive flexibility to allow the user to evaluate the device across multiple operation modes. The different operation modes are highlighted in this section. The INxP and INxM pins of the PCMx140-Q1 can optionally connect to an onboard microphone for quick evaluation, and can be optionally configured to bypass the input decoupling capacitors for evaluating the functionality of the digital microphones or GPIOs. [Figure 2-8](#) shows the architecture of the inputs to the evaluation module.

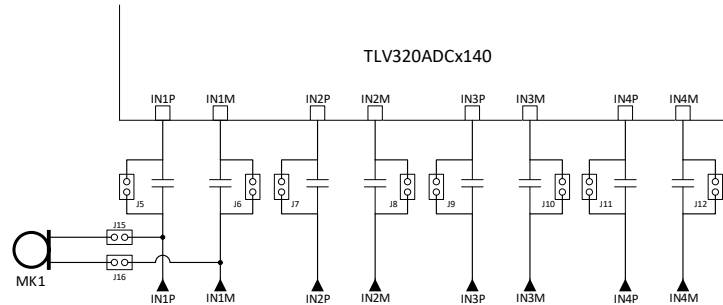


Figure 2-8. PCMx140Q1EVM Input Architecture

When using I2C control, headers J18 and J19 pull down the device pins ADDR0 and ADDR1. This allows the EVM to respond to the 4 different I2C addresses available in the device. [Table 2-1](#) shows the 7bit I2C addresses that correspond to each combination of J18 and J19.

Table 2-1. I2C Address Selection

J18	J19	Address
0	0	0x4C
0	1	0x4D
1	0	0x4E
1	1	0x4F

2.2.2.1 Line Inputs

For the line input configuration (shown in [Figure 2-9](#)), the PCMx140Q1 captures the audio signal provided through terminals J2 (IN1), J3 (IN2), J4 (IN3), and J5 (IN4). The input accepted in this mode is a differential, 2-VRMS, full-scale audio signal. If a single-ended source is used, the 1-VRMS signal is supported.

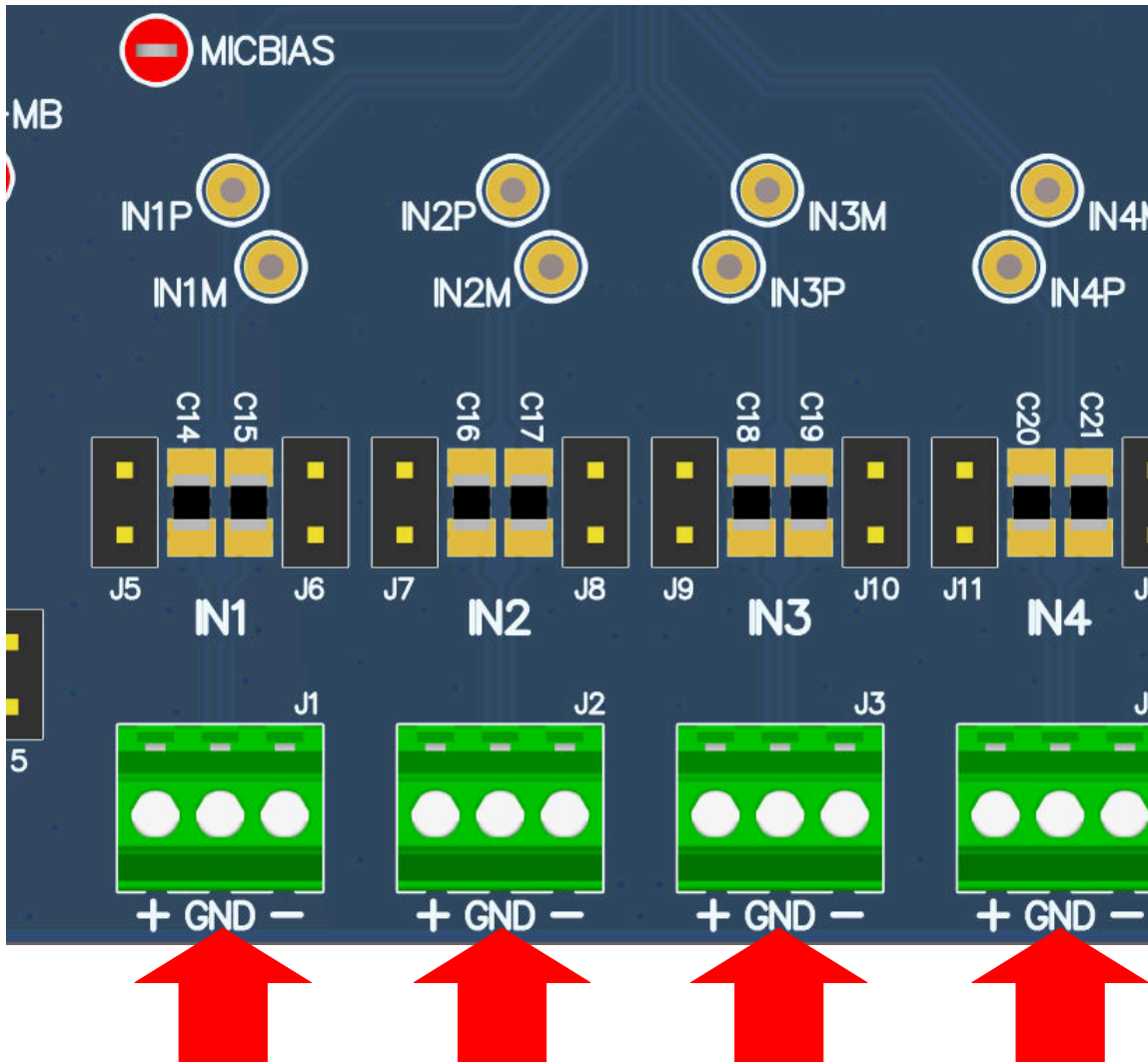


Figure 2-9. PCMx140Q1EVM Connection for Line Input Application

2.2.2.2 Onboard Microphone Input

For the onboard microphone input configuration (shown in Figure 2-10), the PCMx140Q1 records the audio captured from the microphones located on the bottom edge of the board. MICBIAS is used to power the onboard microphone, so header J14 must be shorted. There must not be any connections to J1 during onboard microphone use to preserve the performance of the microphone.

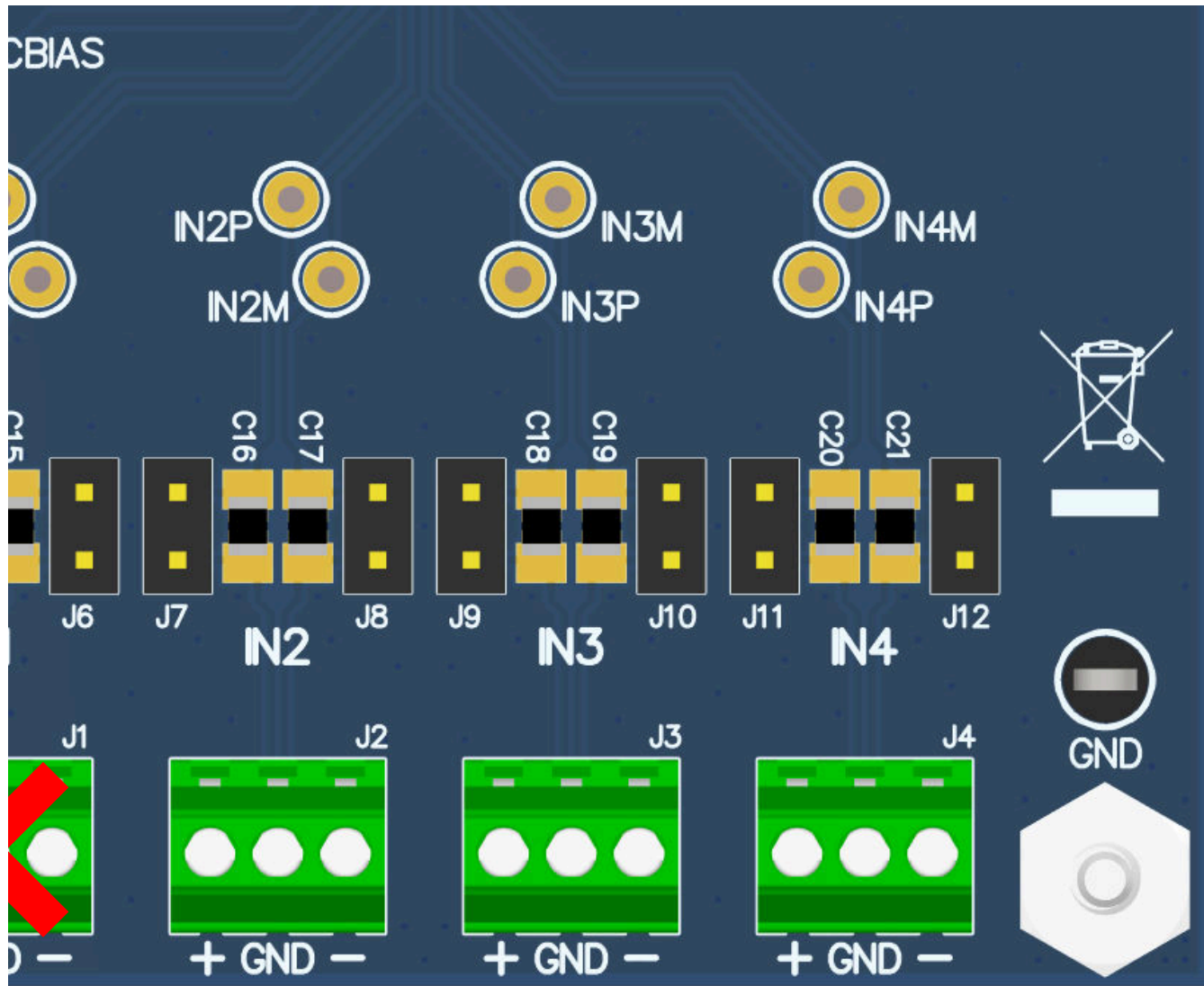


Figure 2-10. PCMx140Q1EVM Connection for the Onboard Microphone Test

3 Software

3.1 Software Overview

Texas Instruments' PurePath™ Console 3 (PPC3) graphical development suite is a program that serves as a platform for many of TI's audio products. PPC3 is designed to simplify the evaluation, configuration, and debug process associated with the development of audio products.

3.1.1 PurePath Console 3 Installation

The PCMx140Q1EVM-PDK GUI is an application that installs into the PPC3 framework. PPC3 must be installed prior to downloading the PCMx140Q1EVM-PDK GUI. To download the PPC3, visit www.ti.com/tool/PUREPATHCONSOLE and request access. If the PPC3 is already installed, proceed to [Section 3.1.2](#). [Figure 3-1](#) shows the setup directory for the PPC3 installation.

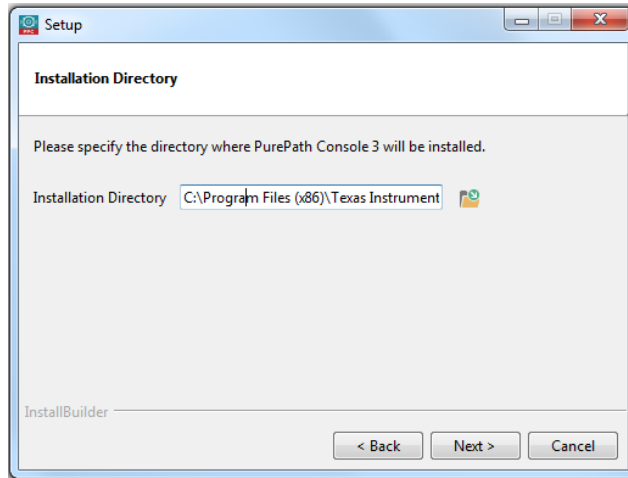


Figure 3-1. PurePath Console 3 Installation

Open the PPC3 installer and follow the instructions in the setup wizard.

3.1.2 PCMx140Q1EVM GUI Installation

3.1.2.1 Software Setup

Open the PPC3 application in the directory chosen for the GUI installation in [Section 3.1.1](#). [Figure 3-2](#) shows the resulting app center window. Click on the *PCMx140Q1* app tile.



Figure 3-2. PurePath Console 3 App Center

The PCMx140Q1 GUI is designed to work with up to four devices at any time. As shown in [Figure 3-3](#), choose the 1 device radial button and click *New*.

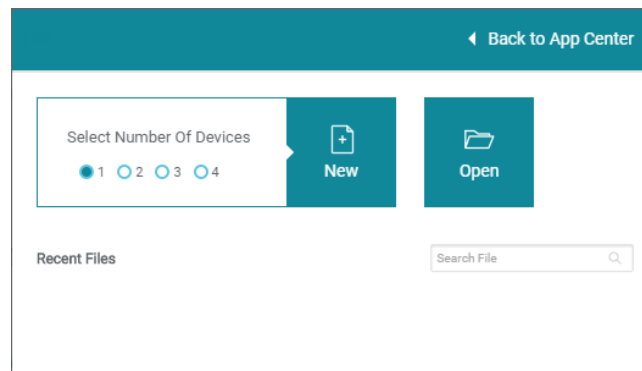


Figure 3-3. Initial GUI Configuration

As shown in [Figure 3-4](#), the GUI opens to the *Audio Config* tab.

Figure 3-4. Audio Config Tab

Before changing any parameters, check the lower left corner of the PPC3 window, as shown in [Figure 3-5](#), to verify that the EVM is connected. If there is not an EVM detected, then the text reads *PCMx140Q1 offline*. If the EVM is detected, then a *Connect* button appears. Clicking this button connects the hardware.

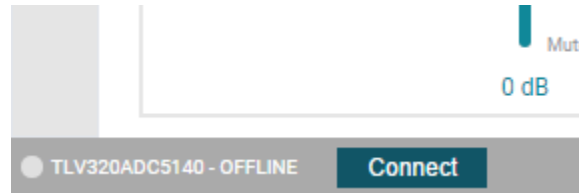


Figure 3-5. Hardware Connect

When the hardware is connected, the *Connect* button changes to read *Disconnect*, and the device is ready to be configured.

3.2 Quick Start

Configure the AC-MB for the USB audio (TDM) and the PCMx140Q1EVM for the onboard microphone input.

All configurations for this example are done on the audio configuration tab. In the *Audio Configuration* block in the lower right portion of the audio configuration tab (as shown in [Figure 3-6](#)), select a word length of 16 bits, and enable the ASI output channel 1.

Figure 3-6. Audio Configuration

As shown in [Figure 3-7](#), select *AVDD* for the MIC bias voltage and power-up the MIC bias.

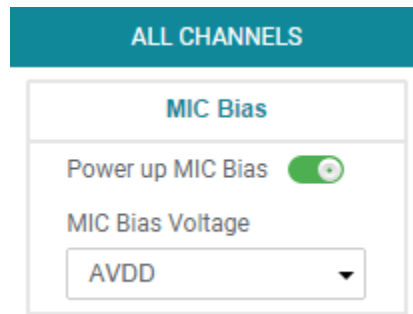


Figure 3-7. MIC Bias Configuration

The default state for the PCMx140Q1 is standby mode and, with the exception of the channel digital volume, all device configurations must be done in standby mode. The PCMx140Q1 does not provide a digital audio output in standby mode. [Figure 3-8](#) shows how to change the mode from standby to active.

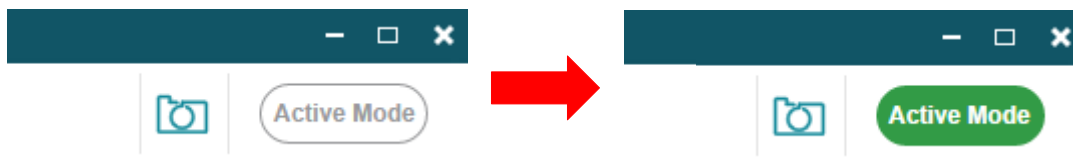


Figure 3-8. Standby to Active Mode

When active mode is enabled, any controls not configurable in active mode are grayed out. These controls can be changed again when the device is brought out of active mode. [Figure 3-9](#) shows which controls are disabled.

Figure 3-9. Disabled Controls in Active Mode

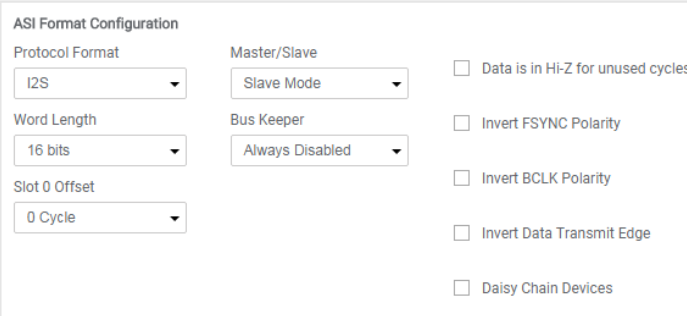
Audio can now be captured on your PC using the audio program of your choice.

3.2.1 Configuring the Audio Serial Bus for the I²S Output

The PCMx140Q1 features a highly flexible audio serial bus that can be configured to implement a wide range of data formats. The default format is TDM, however the GUI can be used to change the data format to I²S. This section describes how to configure the PCMx140Q1EVM for a 2-channel I²S output to a USB audio at 16 bits and 48 kHz. Configure the AC-MB for USB audio as described in [Section 3.2](#). As shown in [Figure 3-10](#), select the audio serial bus tab.

Figure 3-10. Audio Serial Bus Tab

In the ASI format configuration pane (shown in [Figure 3-11](#)), change the protocol format to I²S, and the word length to 16 bits.



ASI Format Configuration		
Protocol Format	Master/Slave	<input type="checkbox"/> Data is in Hi-Z for unused cycles
I2S	Slave Mode	<input type="checkbox"/> Invert FSYNC Polarity
Word Length	Bus Keeper	<input type="checkbox"/> Invert BCLK Polarity
16 bits	Always Disabled	<input type="checkbox"/> Invert Data Transmit Edge
Slot 0 Offset		<input type="checkbox"/> Daisy Chain Devices
0 Cycle		

Figure 3-11. ASI Format Configuration

When the protocol format is changed to I²S in the GUI, the USB audio processor on the AC-MB also changes the audio format to I²S. The GUI reads the ASI status register (page 0 register 0x15), providing the detected sampling rate and BCLK and FSYNC ratio. The ASI status register can also be read manually in the audio serial bus tab by clicking the *Read* button, as shown in Figure 3-12, in the clock monitor pane.

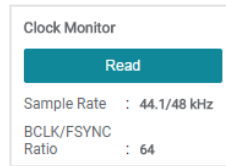


Figure 3-12. Clock Monitor Pane

The default slot assignment for channel 1 is left slot 0 and the default slot assignment for channel 2 is left slot 1. As shown in Figure 3-13, change the channel 2 slot assignment to right slot 0. The diagram at the top of the window updates to display the data format and slots selected.

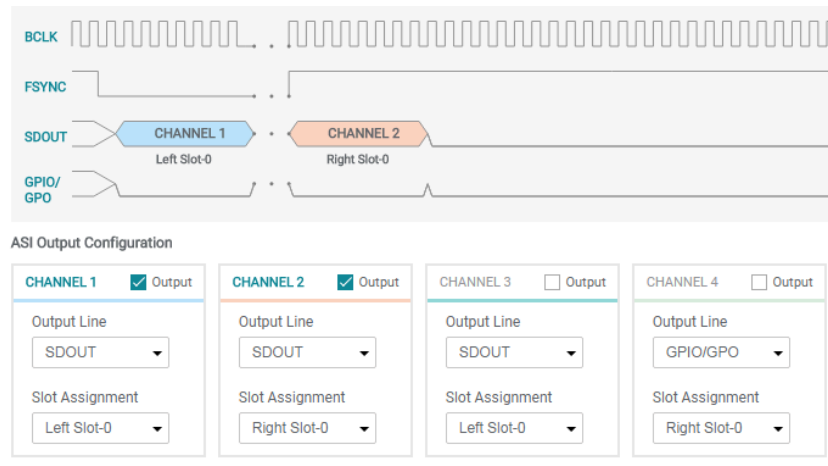


Figure 3-13. Channel Output Configuration and Diagram

3.2.2

The AC-MB USB audio currently supports only two channels per data line when in I²S mode and the BCLK and FSYNC ratio is fixed at 64. The EVM is now ready for use with the audio recording program of your choice.

3.2.3 Saving a Configuration

To save a configuration, as shown in [Figure 3-14](#), click the upper left corner of the PPC3 window and select *Save*. The configuration is saved as a .ppc3 file. To load a saved configuration, click the upper left corner of the PPC3 window and select *Open*. Navigate to the location of the saved .ppc3 file, and click *Open*.

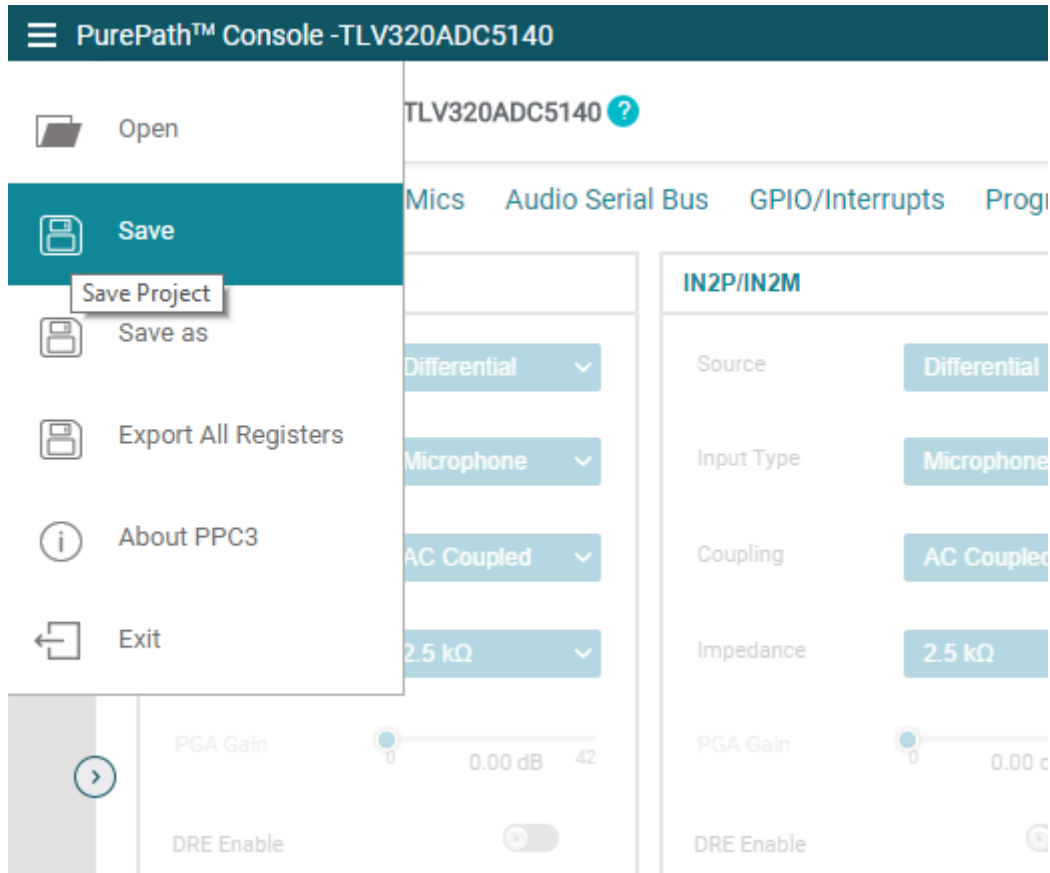


Figure 3-14. Saving a Configuration in PPC3

3.3 Matlab Audio Capture Example

The driver for the AC-MB can be controlled with Matlab, allowing for some automated testing. The following code demonstrates capturing audio from the AC-MB with Matlab. This example requires the Audio Toolbox™.

```

        if ismac % macOS driver
deviceReader = audioDeviceReader( 'Device', 'TI USB Audio 2.0',...
'SampleRate', 48000, ...
'NumChannels', 8 ,...
'BitDepth', '32-bit float',...
'OutputDataType','double');
elseif ispc % windows driver
deviceReader = audioDeviceReader( 'Driver','ASIO', 'Device', 'Texas Instruments USB Audio ...',...
'SampleRate', 48000, ...
'NumChannels', 8 ,...
'BitDepth', '32-bit float',...
'OutputDataType','double');
end
setup(deviceReader);% Setup the device reader
% Play out a file through PC and capture in the EVM
infile_name = 'infile_name';% Read audiophile infile_name
fileReader = dsp.AudioFileReader( infile_name );% Create fileReader object
fileInfo = audioinfo(infile_name);% Copy info from infile_name
filewriter = dsp.AudioFilewriter( outfile_name, 'SampleRate', deviceReader.SampleRate, 'DataType',
'int32');% Create filewriter object
audioOut = audioDevicewriter('SampleRate', fileInfo.SampleRate);% Setup audio playback
setup( audioOut, zeros(deviceReader.SamplesPerFrame, fileInfo.NumChannels) );
while ~isDone(fileReader)% For each block played out, record the block from EVM
audioToPlay = fileReader();% Read a chunk of audio from infile_name
audioOut(audioToPlay);% Play a chunk of audio
[audioRead, numOverrun] = deviceReader();% Grab a chunk of audio from EVM
filewriter(audioRead);% Write the chunk of audio from EVM to a file
end
release(audioOut);% Close all objects
release(fileReader);
release(filewriter);
release(deviceReader);

```

4 Hardware Design Files

4.1 PCMX140Q1EVM-PDK Schematic and Bill of Materials

This section provides the schematics and bill of materials (BOM) for the PCMX140Q1EVM-PDK.

4.1.1 PCMX140Q1EVM-PDK Schematic

Figure 4-1 shows the schematics for the PCMX140Q1EVM-PDK.

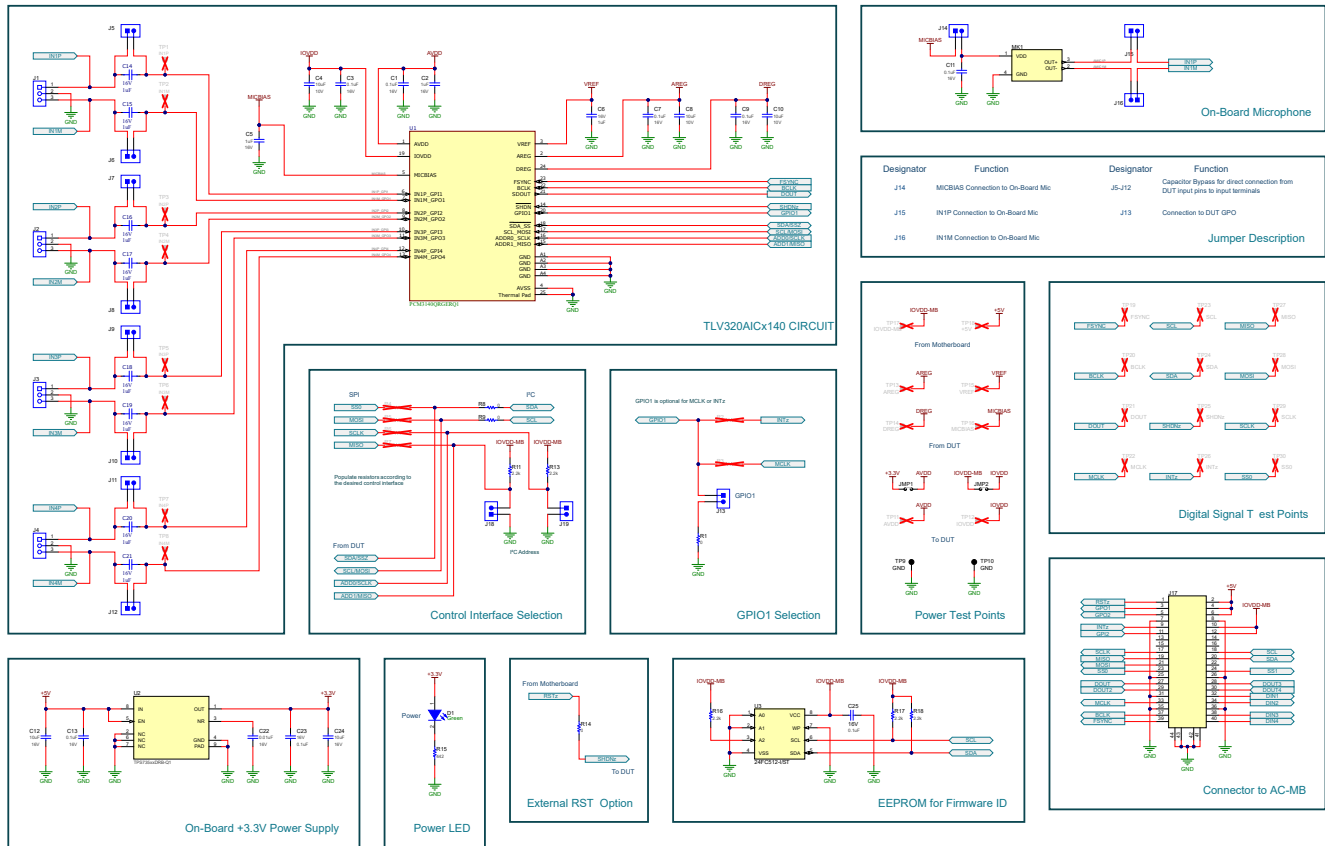


Figure 4-1. PCMX140Q1EVM-PDK Schematics

4.1.2 PCB Layouts

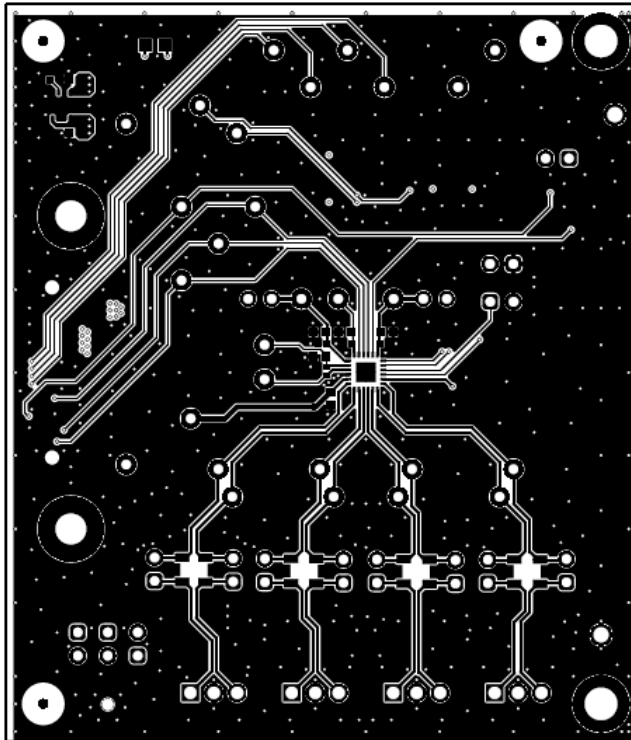


Figure 4-2. Top Layer

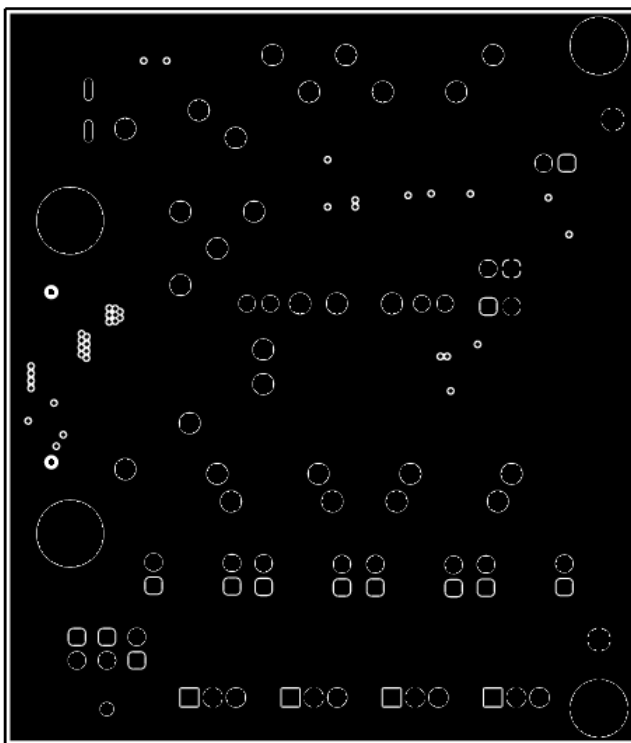


Figure 4-3. Ground Layer

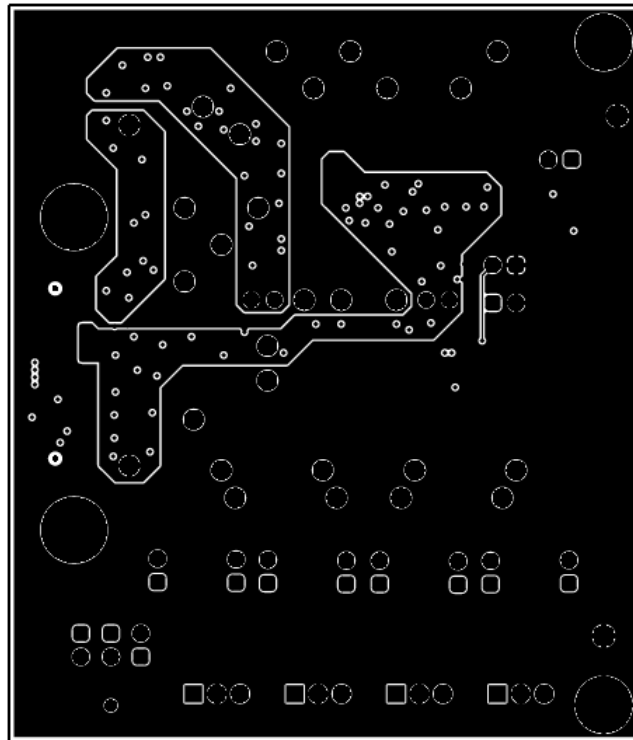


Figure 4-4. Power Layer

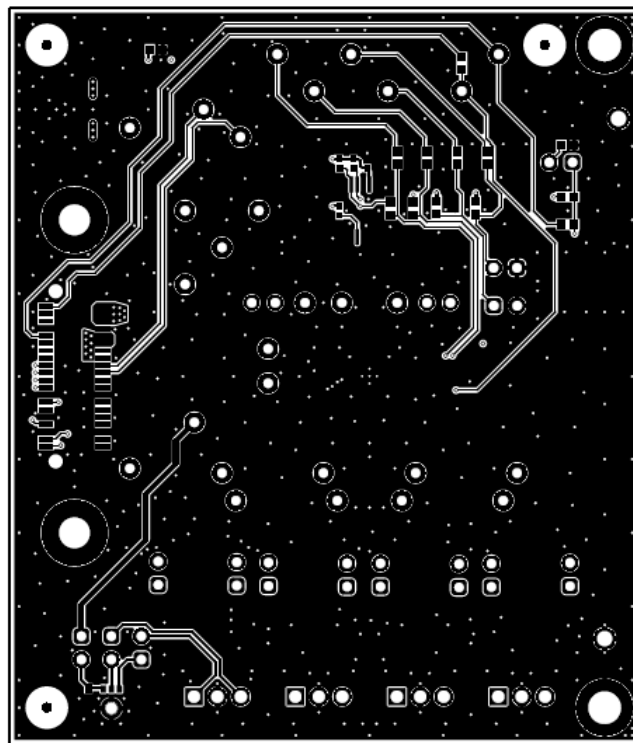


Figure 4-5. Bottom Layer

4.1.3 PCMX140Q1EVM-PDK Bill of Materials

Table 4-1 lists the BOM for the PCMX140Q1EVM-PDK.

Table 4-1. PCMX140Q1EVM-PDK Bill of Materials

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
C1, C3, C7, C9, C11, C13, C23, C25	8	0.1uF	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X7R, 0402	0402	8.85012E+11	Wurth Elektronik
C2	1	1uF	CAP, CERM, 1 uF, 16 V, +/- 10%, X7R, 0603	0603	8.85012E+11	Wurth Elektronik
C4, C8, C10	3	10uF	CAP, CERM, 10 uF, 10 V, +/- 20%, X5R, 0603	0603	C1608X5R1A106M080AC	TDK
C5	1	1uF	CAP, CERM, 1 uF, 16 V, +/- 10%, X7R, 0603	0603	EMK107B7105KA-T	Taiyo Yuden
C6	1	1uF	CAP, CERM, 1 uF, 16 V, +/- 10%, X5R, 0402	0402	EMK105BJ105KVHF	Taiyo Yuden
C12, C24	2	10uF	CAP, CERM, 10 uF, 16 V, +/- 20%, X5R, 0603	0603	EMK107BBJ106MA-T	Taiyo Yuden
C14, C15, C16, C17, C18, C19, C20, C21	8	1uF	1 uF Film Capacitor 12 V 10 V Acrylic, Metallized 1206 (3216 Metric)	1206	FCA1206A105M-H3	Cornell Dubilier Electronics
C22	1	0.01uF	CAP, CERM, 0.01 uF, 16 V, +/- 10%, X7R, 0402	0402	520L103KT16T	AT Ceramics
D1	1	Green	LED, Green, SMD	LED_0805	LTST-C170KGKT	Lite-On
H1, H3	2		Small nylon hex nut, 0.10 thick with a 0.250 outside diameter and a 4-40 threading	Hex Nut,4-40 Thread, 250" Head Dia	9605	Keystone
H2, H4	2		HEX STANDOFF 4-40 NYLON 3/4"	HEX STANDOFF 4-40 NYLON 3/4"	4804	Keystone
J1, J2, J3, J4	4		CONN TERM BLOCK 2.54MM 3POS PCB	HDR3	OSTVN03A150	On Shore Technology
J5, J6, J7, J8, J9, J10, J11, J12, J13, J14, J15, J16, J18, J19	14		Header, 100mil, 2x1, Gold, TH	2x1 Header	TSW-102-07-G-S	Samtec
J17	1		Connector, Header, High Speed, 20 pairs, SMT	QTE-020-01-X-D-A	QTE-020-01-L-D-A	Samtec
JMP1, JMP2	2		Jumper Wire, 100mil spacing, pkg of 200, TH	Wire Jumper	923345-01-C	3M
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
MK1	1		Ultra-Low Noise Microphone with Differential Output, LGA-4	4x3mm, LGA	ICS-40720	InvenSense
R1, R8, R9, R14	4	0	RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	RMCF0603ZT0R00	Stackpole Electronics Inc
R11, R13	2	2.2k	RES, 2.2 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	ERJ-3GEYJ222V	Panasonic
R15	1	442	RES, 442, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW0603442RFKEA	Vishay-Dale
R16, R17, R18	3	2.2k	RES, 2.2 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04022K20JNED	Vishay-Dale

Table 4-1. PCMx140Q1EVM-PDK Bill of Materials (continued)

Designator	Qty	Value	Description	Package Reference	Part Number	Manufacturer
SH1, SH2, SH3, SH4, SH5, SH6, SH7, SH8, SH9, SH10, SH11, SH12, SH13	13	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec
TP9, TP10	2		Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint	5011	Keystone
U1	1		Quad-Channel, 768-kHz, Burr-Brown Audio ADC	VQFN24	PCM3140QRGERQ1	Texas Instruments
U2	1		500-mA, Low Quiescent Current, Low-Noise, High PSRR, Low-Dropout Linear Regulator for Automotive, DRB0008B (VSON-8)	DRB0008B	TPS73533QDRBRQ1	Texas Instruments
U3	1		512K I2C Serial EEPROM, TSSOP	TSSOP-8	24FC512-I/ST	Microchip
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
R2, R3, R4, R5, R6, R7	0	0	RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	RMCF0603ZT0R00	Stackpole Electronics Inc
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP8, TP11, TP12, TP13, TP14, TP15, TP16, TP17, TP18	0		Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone
TP19, TP20, TP21, TP22, TP23, TP24, TP25, TP26, TP27, TP28, TP29, TP30	0		Test Point, Miniature, Green, TH	Green Miniature Testpoint	5116	Keystone

4.2 AC-MB Schematic and Bill of Materials

This section provides the schematics and BOM for the AC-MB.

4.2.1 AC-MB Schematic

Figure 4-6 shows the schematics for the AC-MB.

Audio Converters Motherboard DC058 Rev A
PCM9211, Audio Interface and Test Points

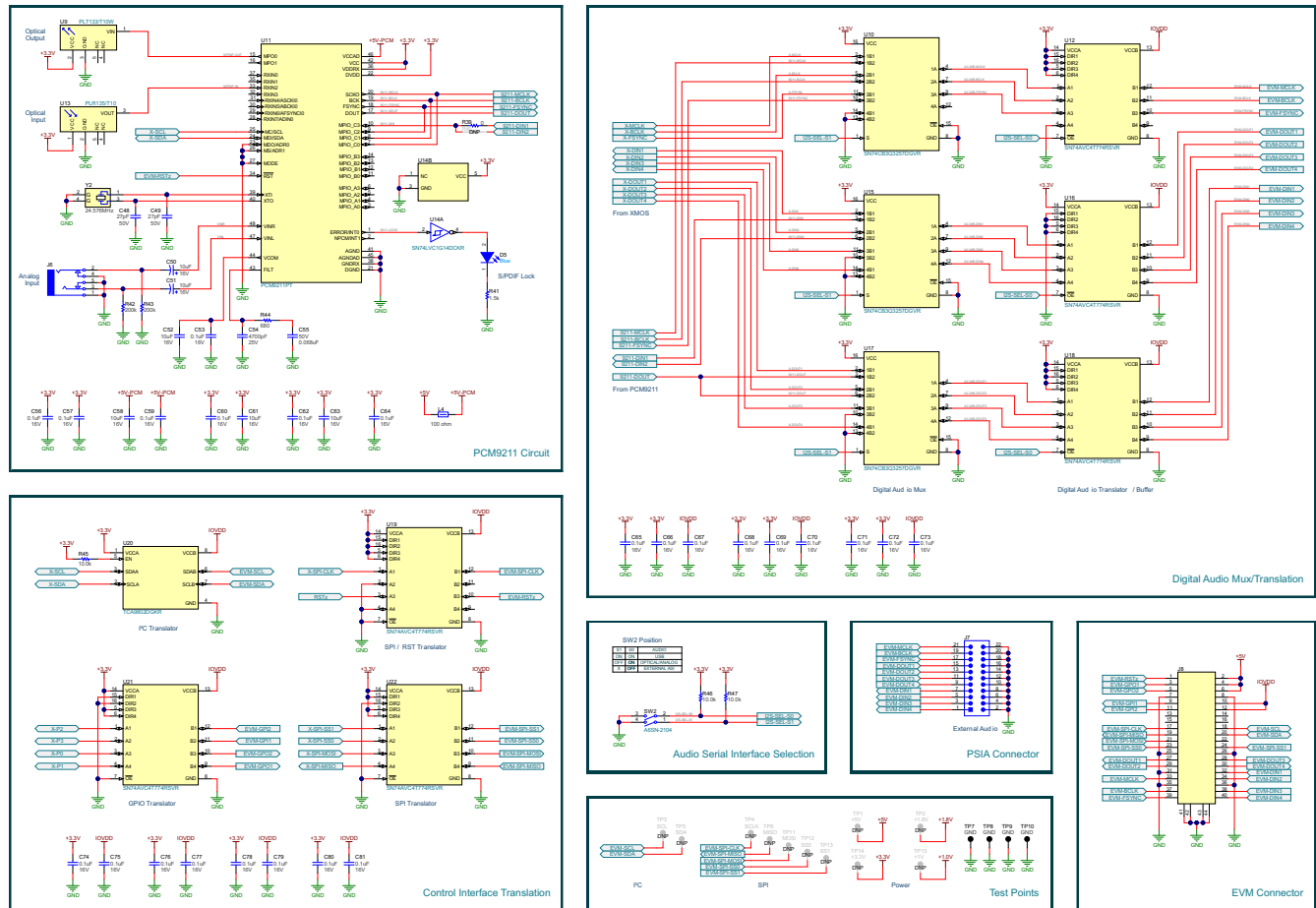


Figure 4-6. AC-MB Schematics

4.2.2 PCB Layouts

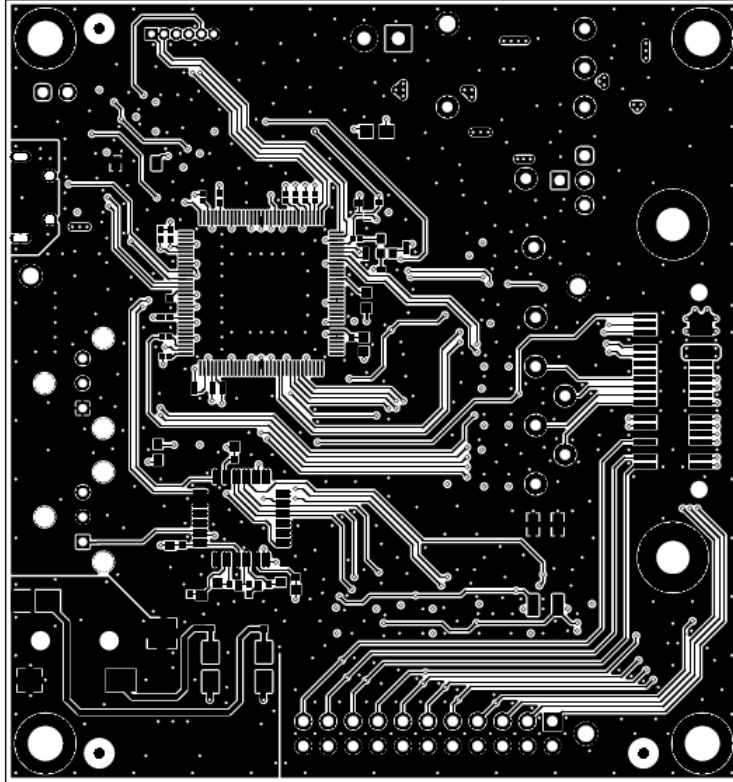


Figure 4-7. Top Layer

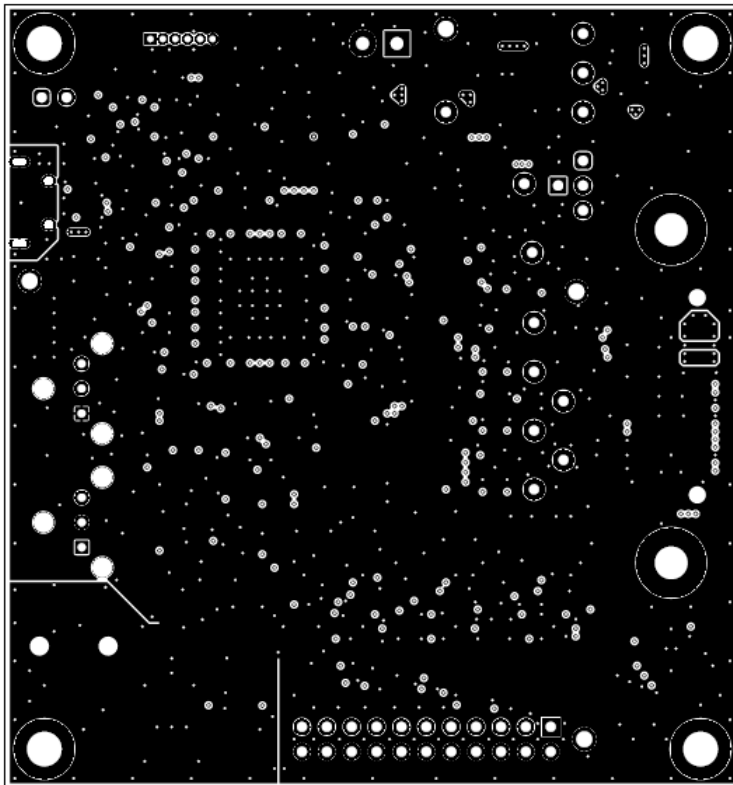


Figure 4-8. Ground Layer

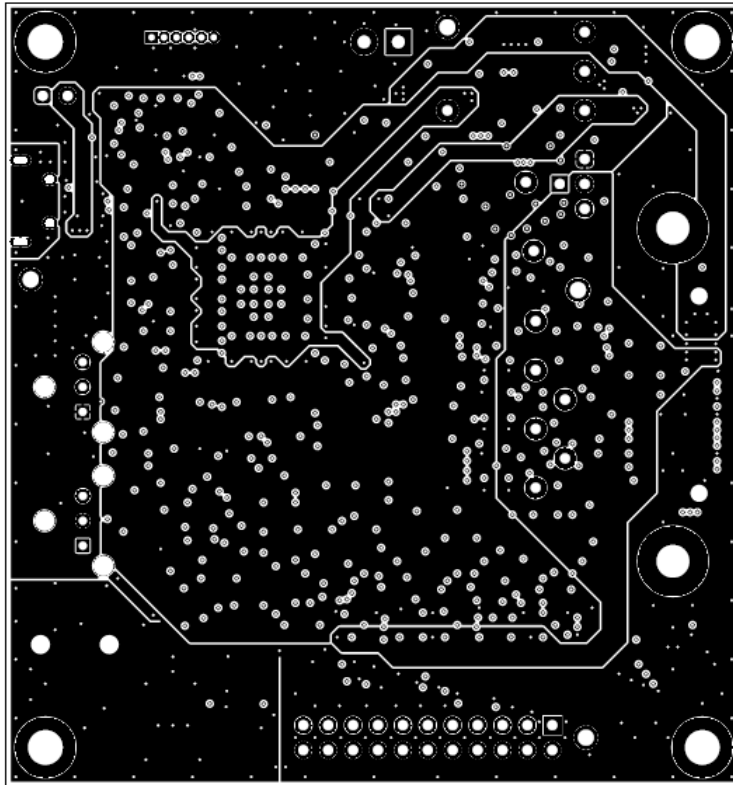


Figure 4-9. Power Layer

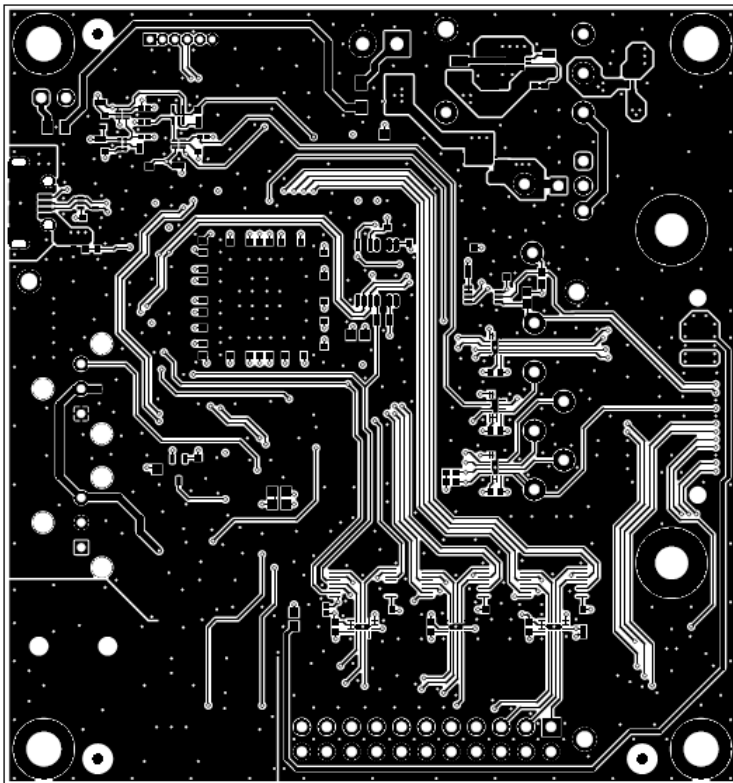


Figure 4-10. Bottom Layer

4.2.3 AC-MB Bill of Materials

Table 4-2 lists the BOM for the AC-MB.

Table 4-2. AC-MB Bill of Materials

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
!PCB1	1		Printed Circuit Board		DC058	Any
C1	1	2.2uF	CAP, CERM, 2.2 uF, 16 V, +/- 10%, X7R, 0603	0603	EMK107BB7225KA-T	Taiyo Yuden
C2, C3, C4, C5, C6, C7, C8, C9, C10, C11, C12, C13, C14, C15, C16, C17, C18, C19, C20, C21, C22, C23, C24, C25, C26, C27, C28, C29, C30, C31, C32, C33, C34, C38, C42, C43, C44, C45, C46, C53, C56, C57, C59, C60, C62, C64, C65, C66, C67, C68, C69, C70, C71, C72, C73, C74, C75, C76, C77, C78, C79, C80, C81, C82	64	0.1uF	CAP, CERM, 0.1 uF, 16 V, +/- 10%, X7R, 0402	0402	885012205037	Würth Elektronik
C35	1	470 pF	CAP, CERM, 470 pF, 50 V, +/- 5%, C0G/NP0, 0603	0603	06035A471JAT2A	AVX
C36, C37	2	22uF	CAP, CERM, 22 uF, 10 V, +/- 10%, X7R, 1206	1206	LMK316AB7226KL-TR	Taiyo Yuden
C39, C40, C41	3	1uF	CAP, CERM, 1 uF, 16 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	CGA3E1X7R1C105K080 AC	TDK
C47	1	1500 pF	CAP, CERM, 1500 pF, 16 V, +/- 10%, X7R, 0603	0603	CGA1A2X7R1C152K030 BA	TDK
C48, C49	2	27 pF	CAP, CERM, 27 pF, 50 V, +/- 5%, C0G/NP0, 0402	0402	GJM1555C1H270JB01	MuRata
C50, C51	2	10uF	CAP, AL, 10 uF, 16 V, +/- 20%, SMD	D3xL5.4mm	UWX1C100MCL2GB	Nichicon
C52, C58, C61, C63	4	10uF	CAP, CERM, 10 uF, 16 V, +/- 20%, X5R, 0603	0603	EMK107BBJ106MA-T	Taiyo Yuden
C54	1	4700 pF	CAP, CERM, 4700 pF, 16 V, +/- 10%, X7R, 0402	0402	885012205029	Würth Elektronik
C55	1	0.068uF	CAP, CERM, 0.068 uF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	CGA2B3X7R1H683K050 BB	TDK
D1, D5	2	Blue	LED, Blue, SMD	LED_0603	150060BS75000	Würth Elektronik
D2, D4	2	20 V	Diode, Schottky, 20 V, 1 A, SOD-123FL	SOD-123FL	MBR120LSFT1G	ON Semiconductor
D3	1	Green	LED, Green, SMD	LED_0805	LTST-C170KGKT	Lite-On
H1, H2, H3, H4	4		Small nylon hex nut, 0.10 thick with a 0.250 outside diameter and a 4-40 threading	Hex Nut, 4-40 Thread, 250" Head Dia	9605	Keystone
H5, H6	2		Thumb Nut, M3 x 0.5 Thread, 8 mm Head Dia		96115A420	McMaster Carr
H7, H8, H9, H10	4		Standoff, Hex, Male/Female, 4-40, Nylon, 1/2"	Standoff, Hex, Male/Female, 4-40, Nylon, 1/2"	4802	Keystone

Table 4-2. AC-MB Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
H11, H12	2		Standoff, Male/Male Thread, 5.15 mm, M3 x 0.5	Standoff	SO-0515-02-02-01	Samtec
J1	1		Connector, Receptacle, Micro-USB Type AB, R/A, Bottom Mount SMT	Connector, USB Micro AB	DX4R205JJAR1800	JAE Electronics
J2	1		Receptacle, 50mil, 6x1, Gold, R/A, TH	6x1 Receptacle	LPPB061NGCN-RC	Sullins Connector Solutions
J3	1		Header, 100mil, 3x1, Gold, TH	3x1 Header	TSW-103-07-G-S	Samtec
J4	1		Terminal Block, 3.5mm Pitch, 2x1, TH	7.0x8.2x6.5mm	ED555/2DS	On-Shore Technology
J5	1		Header, 2.54 mm, 2x1, Tin, TH	Header, 2.54 mm, 2x1, TH	TSW-102-07-T-S	Samtec
J6	1		Audio Jack, 3.5mm, Stereo, R/A, SMT	Phone Jack, 6x5x17mm	35RASMT4BHNTRX	Switchcraft
J7	1		Header, 2.54 mm, 11x2, Gold, TH	Header, 11x2, 2.54mm, TH	TSW-111-07-G-D	Samtec
J8	1		Connector, SMT, Receptacle, High Speed, 20 pairs	QSE-020-01-X-D-A	QSE-020-01-L-D-A	Samtec
L1, L3	2	600 ohm	Ferrite Bead, 600 ohm @ 100 MHz, 2 A, 0805	0805	MPZ2012S601AT000	TDK
L2	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
L4	1	100 ohm	Ferrite Bead, 100 ohm @ 100 MHz, 1 A, 0603	0603	MPZ1608D101BTD25	TDK
R1	1	1.0k	RES, 1.0 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04021K00JNED	Vishay-Dale
R2, R3	2	2.2k	RES, 2.2 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04022K20JNED	Vishay-Dale
R4, R10, R11, R12, R15, R16, R18, R19, R20, R21, R22, R23, R24	13	33.2	RES, 33.2, 1%, 0.05 W, 0201	0201	RC0201FR-0733R2L	Yageo America
R5	1	47.0k	RES, 47.0 k, 1%, 0.0625 W, 0402	0402	RC0402FR-0747KL	Yageo America
R6	1	10.0k	RES, 10.0 k, 1%, 0.1 W, 0402	0402	ERJ-2RKF1002X	Panasonic
R7, R8	2	47k	RES, 47 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040247K0JNED	Vishay-Dale
R9	1	43.2	RES, 43.2, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040243R2FKED	Vishay-Dale
R13	1	10k	RES, 10 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040210K0JNED	Vishay-Dale
R14, R41	2	1.5k	RES, 1.5 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06031K50JNEA	Vishay-Dale
R17	1	0	RES, 0, 5%, 0.05 W, AEC-Q200 Grade 1, 0201	0201	ERJ-1GE0R00C	Panasonic
R25, R27, R28, R29, R34, R35, R37, R45, R46, R47	10	10.0k	RES, 10.0 k, 1%, 0.05 W, 0201	0201	CRCW020110K0FKED	Vishay-Dale
R26	1	4.7	RES, 4.7, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06034R70JNEA	Vishay-Dale
R30	1	25.5k	RES, 25.5 k, 1%, 0.05 W, 0201	0201	RC0201FR-0725K5L	Yageo America
R31	1	51.0k	RES, 51.0 k, 1%, 0.05 W, 0201	0201	RC0201FR-0751KL	Yageo America
R32	1	40.2k	RES, 40.2 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040240K2FKED	Vishay-Dale

Table 4-2. AC-MB Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
R33	1	1.00Meg	RES, 1.00 M, 1%, 0.125 W, AEC-Q200 Grade 0, 0805	0805	CRCW08051M00FKEA	Vishay-Dale
R36	1	162k	RES, 162 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402162KFKED	Vishay-Dale
R38	1	442	RES, 442, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW0603442RFKEA	Vishay-Dale
R39	1	0	RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	RMCF0603ZT0R00	Stackpole Electronics Inc
R42, R43	2	200k	RES, 200 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402200KJNED	Vishay-Dale
R44	1	680	RES, 680, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW0402680RJNED	Vishay-Dale
SH1, SH2	2	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec
SW1	1		Switch, Tactile, SPST-NO, 0.05A, 12 V, SMT	Switch, 4.4x2x2.9 mm	TL1015AF160QG	E-Switch
SW2	1		Switch, Slide, 2 SPST, Off-On, 0.025 A, 24 VDC, SMT	7x7.5mm	A6SN-2104	Omron Electronic Components
TP7, TP8, TP9, TP10	4		Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint	5011	Keystone
U1	1		IC MCU 512KB RAM, 128TQFP	TQFP-128	XEF216-512-TQ128-C20	XMOS semiconductor
U2	1		Programmable 1-PLL VCXO Clock Synthesizer with 2.5-V or 3.3-V LVCMOS Outputs, PW0014A (TSSOP-14)	PW0014A	CDCE913PWR	Texas Instruments
U3	1		Dual-Bit Dual-Supply Bus Transceiver, DQE0008A, LARGE T&R	DQE0008A	SN74AVC2T244DQER	Texas Instruments
U4, U7	2		Enhanced Product Dual Buffer/Driver with Open-Drain Output, DCK0006A (SOT-SC70-6)	DSF0006A	SN74LVC2G07DSFR	Texas Instruments
U5	1		Single-Channel Ultra-Small Adjustable Supervisory Circuit With Active-High Open-Drain Output, DRY0006A (USON-6)	DRY0006A	TPS3897ADRYR	Texas Instruments
U6	1		Automotive Catalog, Dual, 200 mA, Low-IQ Low-Dropout Regulator for Portable Devices, DSE0006A (WSO6N-6)	DSE0006A	TLV7103318QDSERQ1	Texas Instruments
U8	1		Low-Quiescent-Current 1% Accurate Supervisor With Programmable Delay, DSE0006A (WSO6N-6)	DSE0006A	TPS389018DSER	Texas Instruments
U9	1		Photolink- Fiber Optic Transmitter, TH	13.5x10x9.7mm	PLT133/T10W	Everlight
U10, U15, U17	3		4-Bit One-of-2 FET Multiplexer/Demultiplexer 2.5-V/3.3-V Low-Voltage, High-Bandwidth Bus Switch, DGV0016A (TVSOP-16)	DGV0016A	SN74CB3Q3257DGVR	Texas Instruments
U11	1		216 kHz Digital Audio Interface Transceiver (DIX) with Stereo ADC and Routing, PCM, S / PDIF, ADC, 4.5 - 5.5V for Analog, 2.9 - 3.6V for DIX, -40 to 85 degC, 48-Pin LQFP (PT), Green (RoHS & no Sb/Br)	PT0048A	PCM9211PT	Texas Instruments
U12, U16, U18, U19, U21, U22	6		4-Bit Dual-Supply Bus Transceiver With Configurable Voltage-Level Shifting and 3-State Outputs, RSV0016A (UQFN-16)	RSV0016A	SN74AVC4T774RSVR	Texas Instruments
U13	1		Photolink- Fiber Optic Receiver, TH	13.5x10x9.7mm	PLR135/T10	Everlight

Table 4-2. AC-MB Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer
U14	1		Single Schmitt-Trigger Inverter, DCK0005A (SOT-SC70-5)	DCK0005A	SN74LVC1G14DCKR	Texas Instruments
U20	1		Level-Translating I2C Bus Buffer/Repeater, DGK0008A (VSSOP-8)	DGK0008A	TCA9802DGKR	Texas Instruments
U23	1		Low-Capacitance + / - 15 kV ESD-Protection Array for High-Speed Data Interfaces, 2 Channels, -40 to +85 degC, 5-pin SOT (DRL), Green (RoHS & no Sb/Br)	DRL0005A	TPD2E001DRLR	Texas Instruments
VR1	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
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, 10 pF, SMD	2.5x0.5x2.0mm	ABM10-24.576MHZ-E20-T	Abracon Corporation
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A
R40	0	0	RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	RMCF0603ZT0R00	Stackpole Electronics Inc
TP1, TP2, TP14, TP15	0		Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone
TP3, TP4, TP5, TP6, TP11, TP12, TP13	0		Test Point, Miniature, Green, TH	Green Miniature Testpoint	5116	Keystone

5 Additional Information

5.1 Trademarks

PurePath™ is a trademark of Texas Instruments.

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6 Related Documentation

Table 6-1. PCMx140-Q1 Family and Related Data Sheet

Device	Data Sheet
PCM3140-Q1	SBASAU6
PCM5140-Q1	SBASAU5
PCM6140-Q1	SBASAU4

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