

# TAA3020EVM-PDK Evaluation Module

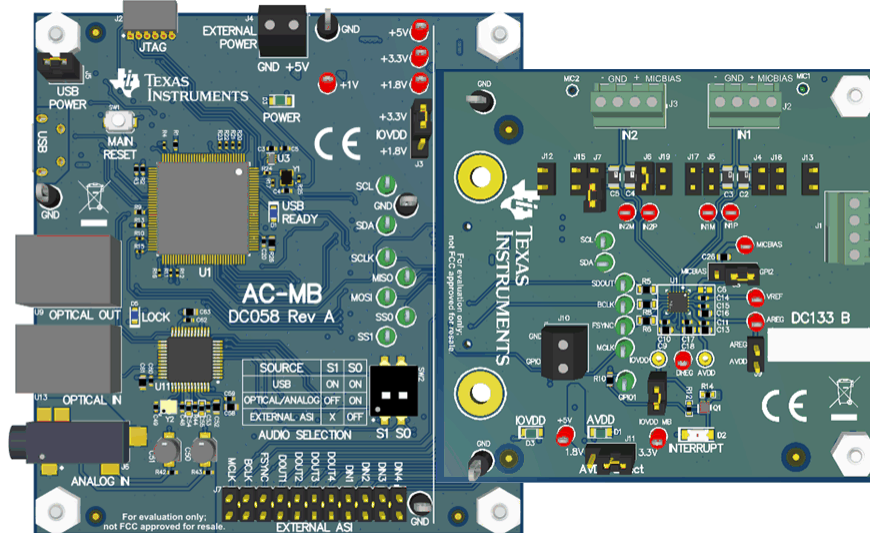


## 1 Features

- Complete evaluation kit for the TAA3020 two-channel ADC.
- Low-cost stereo ADC dynamic range of 104dB
- On-board microphones 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

## 2 Description

This user's guide describes the function and use of the TAA3020EVM-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.



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### 3 Evaluation Module Overview

#### 3.1 Introduction

The TAA3020EVM-PDK is an evaluation module (EVM) designed to demonstrate the performance and functionality of the TAA30x0 family of devices. The device performance differences are shown in [Table 3-1](#)

**Table 3-1. TAA3020 Family**

Device	SNR (dB)	Channel Count
TAA3020	104	Stereo ADC
TAA3040	104	Quad ADC

#### 3.2 Kit Contents

- TAA3020 device
- TAA3020 EVM/daughterboard
- AC-MB controller/motherboard

#### 3.3 Specifications

The TA3020EVM-PDK evaluation module (EVM) paired with the AC-MB, a flexible motherboard that provides power, control, and digital audio data to the evaluation module, allows the user to record audio signals. The configuration for the TAA3020 is done through the PurePath™ Console 3 (PPC3) GUI.

#### 3.4 Device Information

The TAA3020 is a high-performance, audio analog-to digital converter (ADC) that supports simultaneous sampling of up to two analog channels or four digital channels for a pulse density modulation (PDM) microphone input.

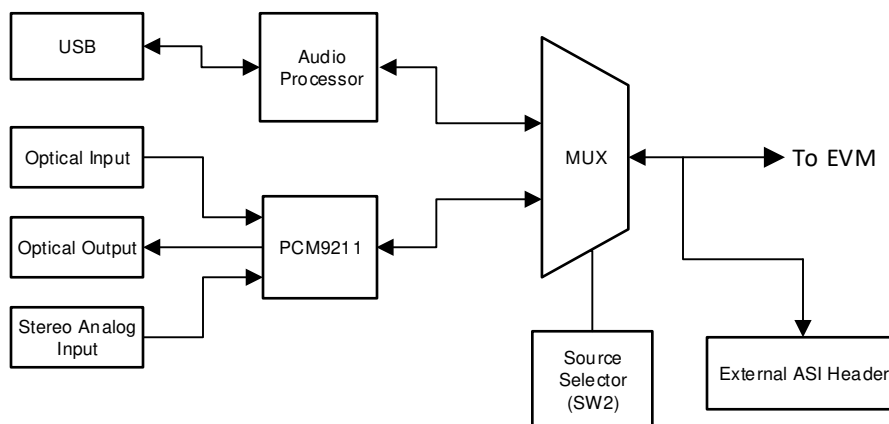
### 4 Hardware Overview

The evaluation kit consists of the TAA3020EVB 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 TAA3020 device and its input connections.

#### 4.1 AC-MB Settings

##### 4.1.1 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 4-1](#) shows a block diagram of the ASI routing on the AC-MB.



**Figure 4-1. AC-MB Audio Serial Interface Routing**

Switch SW2 on the AC-MB selects the audio serial bus that interfaces with the TAA3020EVB. 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 master for the audio serial interface, with three different modes of operation: USB, optical or analog, or external ASI.

#### 4.1.1.1 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).

The AC-MB is detected by the OS as an audio device with the name *TI USB Audio UAC2.0*. [Figure 4-2](#) illustrates the AC-MB audio setting for the USB mode of operation.



**Figure 4-2. AC-MB USB Audio Setting**

#### 4.1.1.2 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 4-3](#) shows the AC-MB audio setting for the optical and analog mode of operation.



**Figure 4-3. 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, I<sup>2</sup>S mode.

#### 4.1.1.3 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 4-4](#) shows the AC-MB audio setting for the external mode of operation.

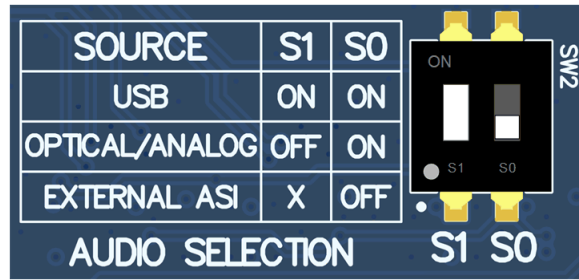


Figure 4-4. AC-MB External Audio Setting

Figure 4-4 shows how to connect the external audio interface, with the top row for the signal and the bottom row for ground.

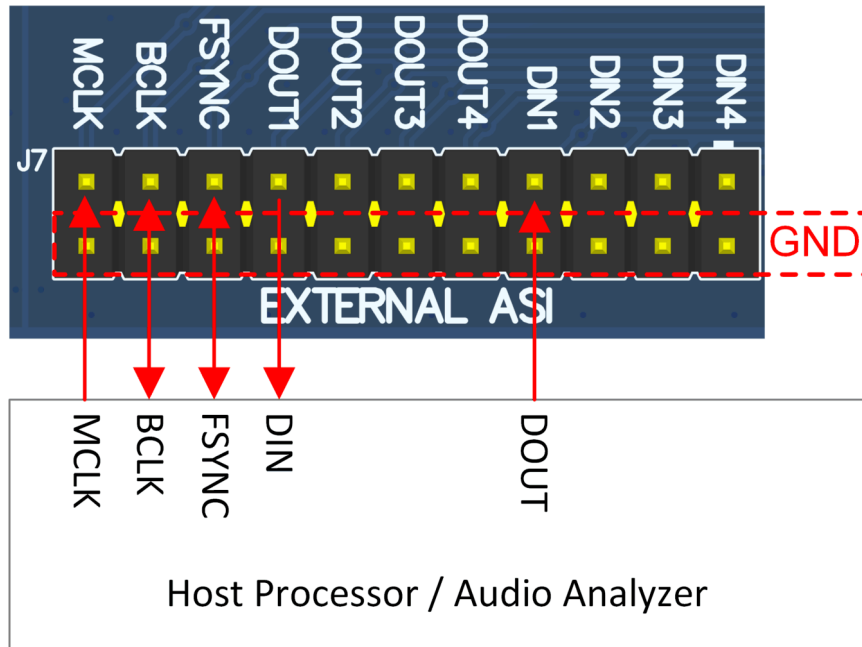
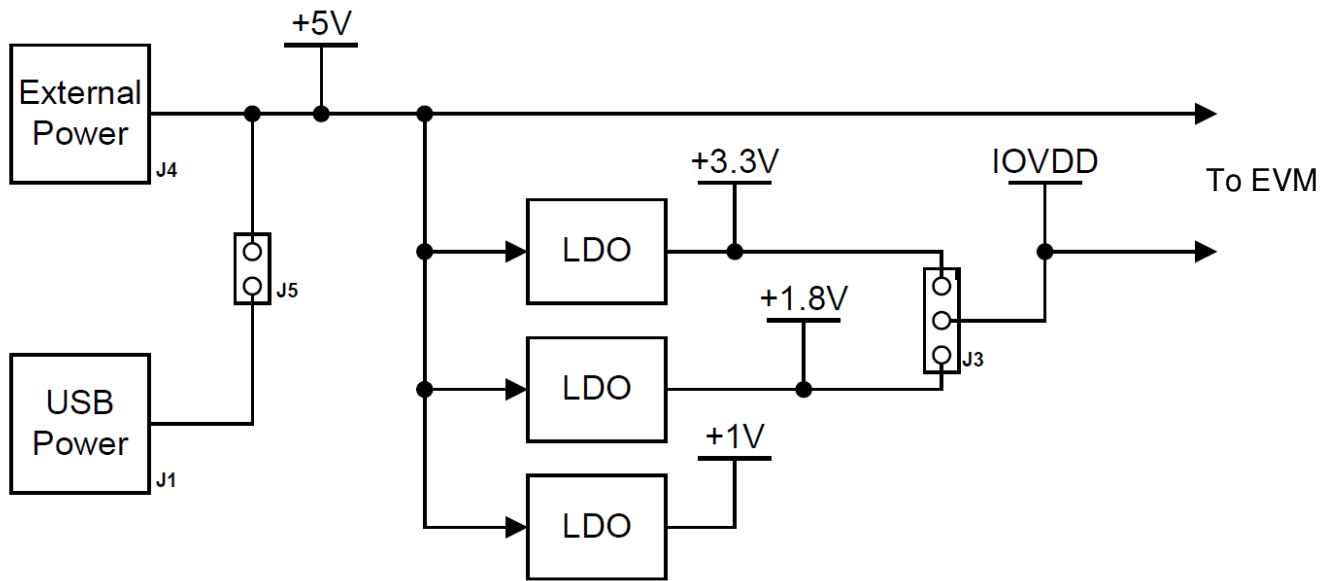


Figure 4-5. AC-MB Connection with External Audio Serial Interface

#### 4.1.2 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 4-6 shows a block diagram depicting the power structure of the AC-MB.



**Figure 4-6. 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.

## 4.2 TAA3020EVM-PDK Hardware Settings

The TAA3020 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 TAA3020 can optionally connect to onboard microphones for quick evaluation, and can be optionally configured to bypass the input decoupling capacitors for evaluating the functionality of digital microphones, GPIOs, or in DC coupled applications. [Figure 4-7](#) shows a diagram of the EVM input architecture.

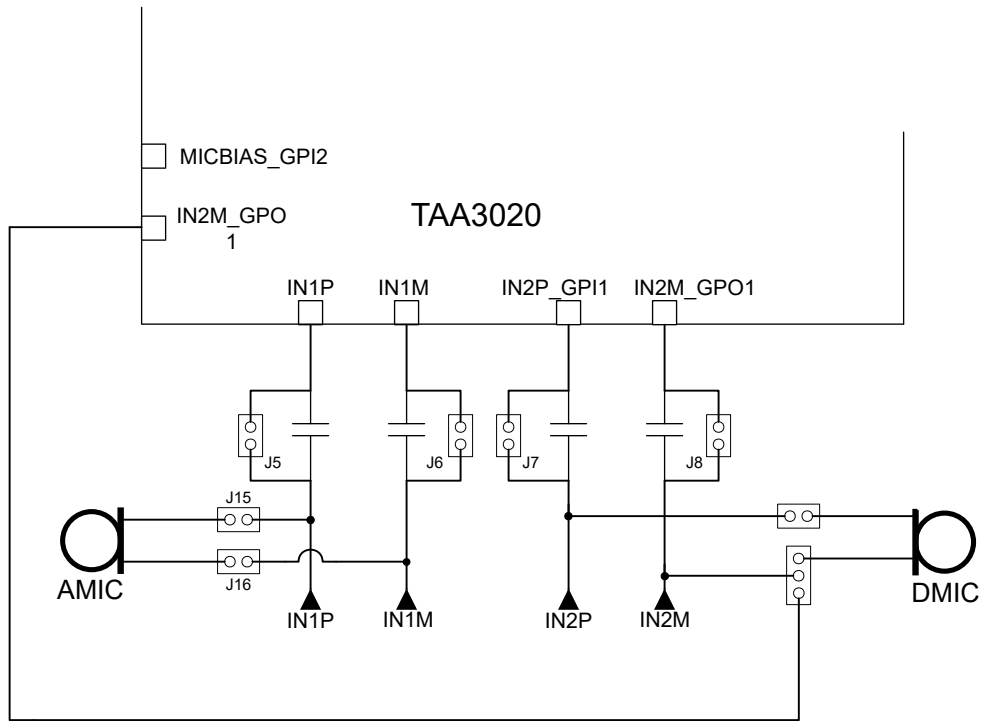


Figure 4-7. TAA3020EVB Input Architecture

### 4.2.1 Line Inputs

For the line input configuration (shown in Figure 4-8), the TAA3020 captures the audio signal provided through terminals J2 (IN1) and J3 (IN2). The input accepted in this mode is a differential, 2-VRMS, full-scale audio signal. If a single-ended source is used, then 1-VRMS signal is supported.

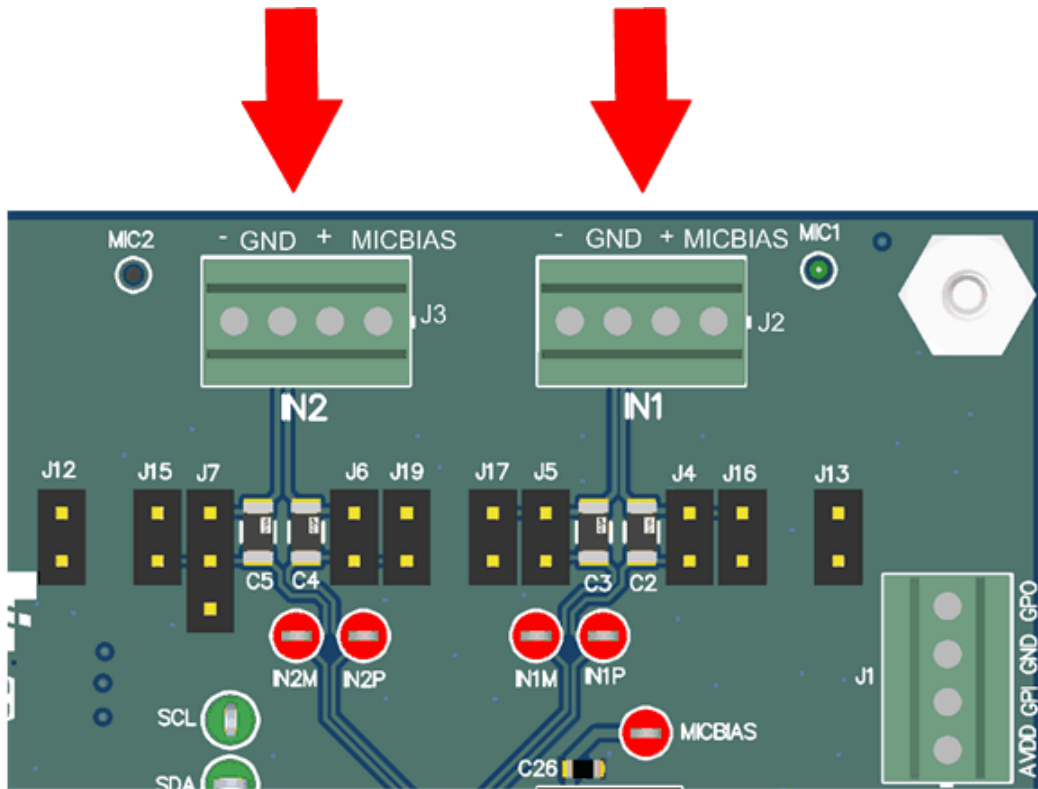


Figure 4-8. TAA3020EVB Connection for Line Input Application

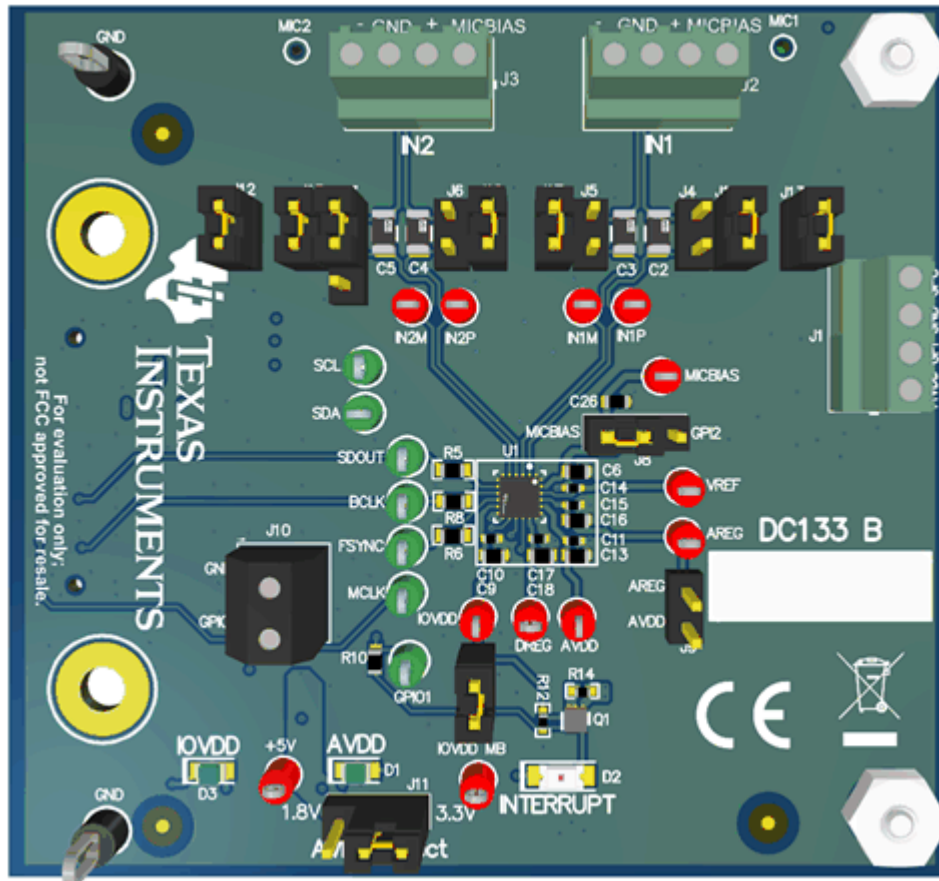


#### 4.2.2 Onboard Microphone Configuration

The TAA3020EVM-PDK comes equipped with 2 onboard microphones: 1x ICS-40740 analog microphone and 1x T5818 digital microphone. The ICS-40740 can be connected to IN1 and the T5818 can be connected to IN2 with onboard shunts using the jumper settings shown in [Table 4-1](#) and [Figure 4-9](#). MICBIAS is used to power the ICS-40740, so header J8 must be set to MICBIAS. There must not be any connections to J2 or J3 during onboard microphone use to preserve the performance of the microphones. The PCMD3140EVM-PDK only includes the T5818 digital microphone, but the same script in [Table 4-1](#) and [Figure 4-9](#) can be used for configuring the microphone.

**Table 4-1. Onboard Mic Jumper Configuration**

Jumper	Setting
J13	Short
J16	Short
J17	Short
J12	Short
J15	Short
J19	Short
J4	Open
J5	Open
J6	Open
J7	Open
J8	Pins 1-2; MICBIAS
J9	Open (if 3.3V AVDD is used) Short (if 1.8V AVDD is used)
J10	Open
J11	Pins 1-2: AVDD = 3.3V Pines 2-3: AVDD = 1/8V
J14	Short



**Figure 4-9. Onboard Mic Jumpers**

To configure the ADC for both onboard microphones, use the *Onboard Microphones* preset in the PPC3 GUI, or copy and paste the following script in I2C master app:

#####On-Board MIC Config#####

w 9c 02 81 #Wake up device and enable AREG

w 9c 01 01 #Software Reset

d 100 #Wait 100ms

w 9c 00 00 #Set page 0

w 9c 02 81 #Wake up device and enable AREG

d 10 #wait 10 ms

w 9c 0d 01 #Set Ch-3 data to ASI left slot 1

w 9c 22 41 #Set IN2M\_GPO1 to PDCMLK output (Default 3.072MHz)

w 9c 2b 50 #Set IN2P\_GPI1 to PDMDIN2 for channel 3 and 4

w 9c 73 A0 #Enable input Ch-1 and Ch-3

w 9c 74 A0 # Enable ASI Output Ch-1 and Ch-3 slots

w 9c 75 E0 # Power-up ADC, MICBIAS and PLL

### 4.2.3 External Microphone Configurations

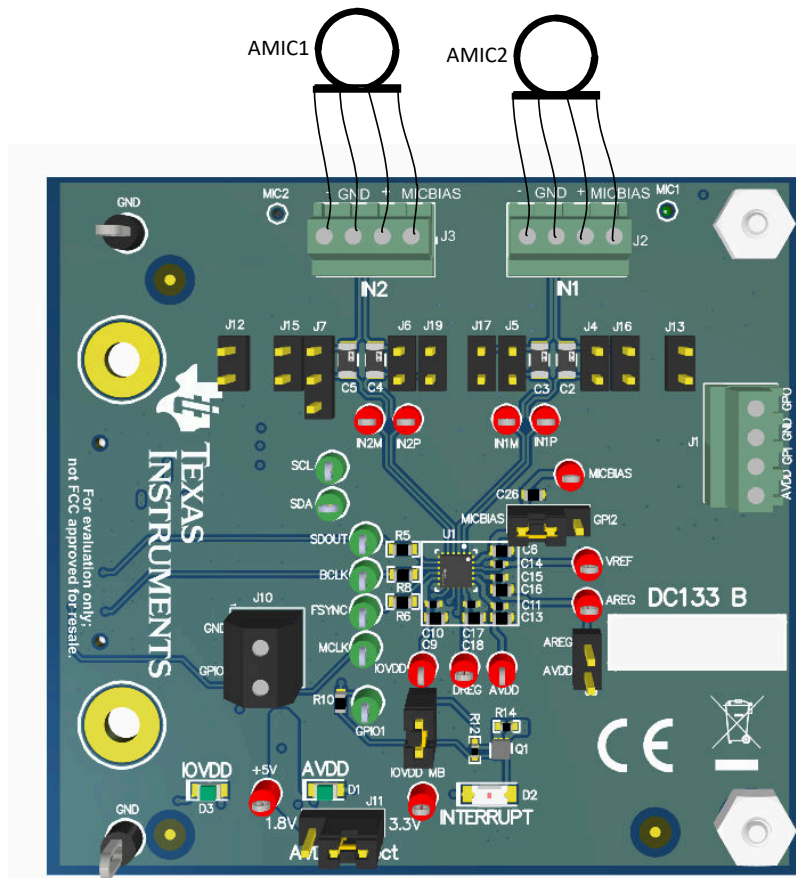
The TAA3020 family of devices support both analog and digital PDM inputs with up to 2 channels of analog input or 4 channels of digital PDM input. It is also possible to use various combinations of analog and digital inputs with up to 2 analog inputs and 2 digital inputs operating simultaneously.

Single-ended or differential analog inputs can be applied on the following pin pairs: IN1P, IN1M, IN2P\_GPI1, IN2M\_GPO1.

Digital PDM inputs can be applied to the following pins: IN2P\_GPI1, MICBIAS\_GPI2, GPIO1. A PDM clock can also be output on pins: IN2M\_GPO1, GPIO1.

On the EVM access to these pins is provided on terminals J1, J2, J3, and J10. [Figure 4-10](#), [Figure 4-11](#), and [Figure 4-12](#) illustrate the recommended pin connections for common use-cases.

Note, the GPIO1 pin is referenced to the IOVDD domain while IN2P\_GPI1, MICBIAS\_GPI2, and IN2M\_GPO1 are all referenced to AVDD. Thus, if using 2 analog mics in addition to digital mics it is recommended that AVDD and IOVDD be set to the same voltage or a level translator be placed between GPIO1 and the digital microphone. If only 1 analog mic is used then it is recommended to use IN1P and IN1M for the analog mic. If digital mics are used, it is recommended to use IN2M\_GPO1 to generate the PDMCLK signal.



**Figure 4-10. External Mics: 2x Analog Microphones**

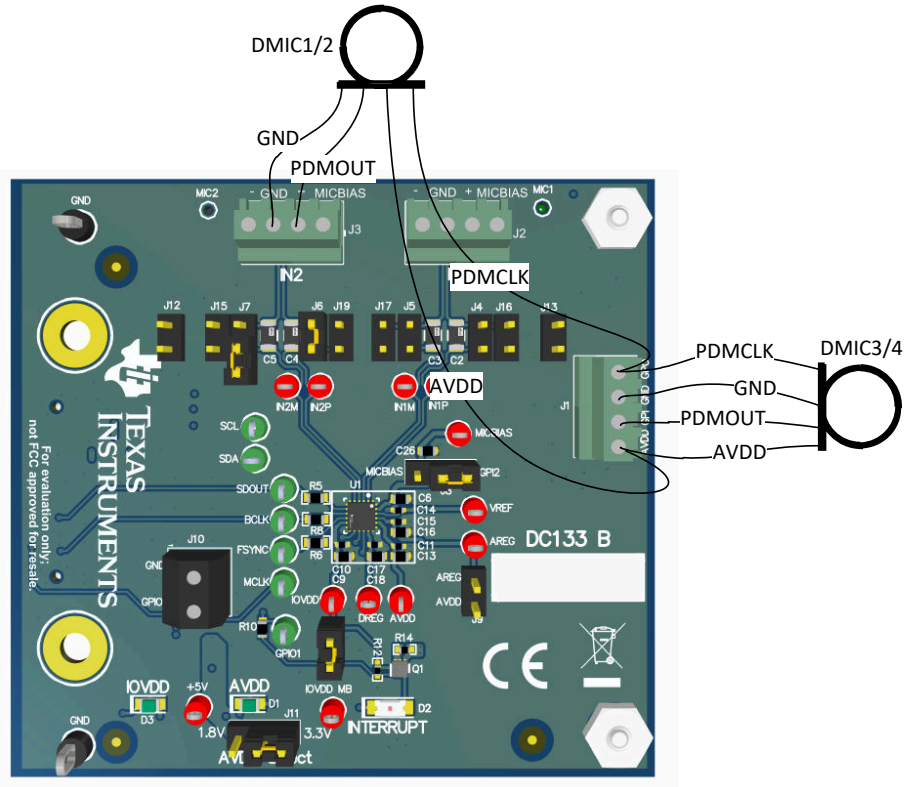
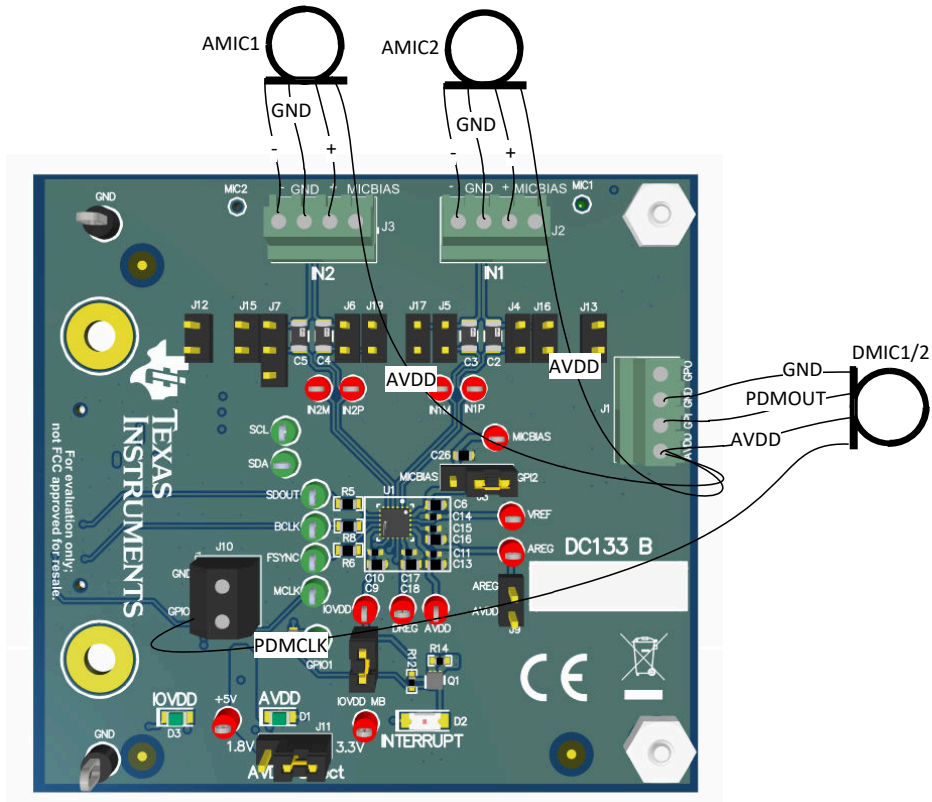


Figure 4-11. External Mics: 4x Digital Microphones



\*Requires AVDD = IOVDD

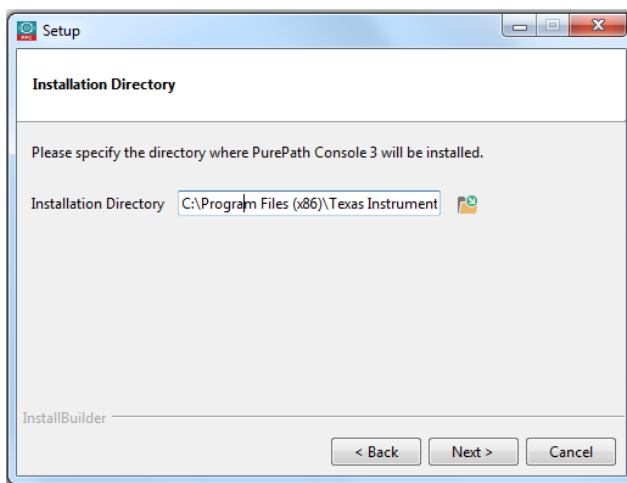
Figure 4-12. External Mics: 2x Analog and 2x Digital Microphones

## 5 Software Overview

Texas Instrument's 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.

### 5.1 PurePath Console 3 Installation

The TAA3020EVM-PDK GUI is an application that installs into the PPC3 framework. PPC3 must be installed prior to downloading the TAA3020EVM-PDK GUI. To download the PPC3, visit [www.ti.com/tool/PUREPATHCONSOLE](http://www.ti.com/tool/PUREPATHCONSOLE) and request access. If the PPC3 is already installed, proceed to [Section 5.2](#). [Figure 5-1](#) shows the setup directory for the PPC3 installation.



**Figure 5-1. PurePath Console 3 Installation**

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

## 5.2 TAA3020EVM GUI Installation

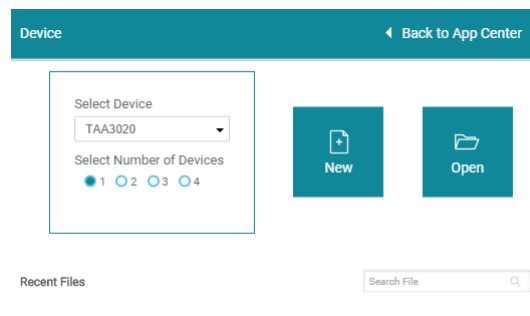
### 5.2.1 Software Setup

Open the PPC3 application in the directory chosen for the GUI installation in [Section 5.1](#). [Figure 5-2](#) shows the resulting app center window. Click on the TAA3020 app title.



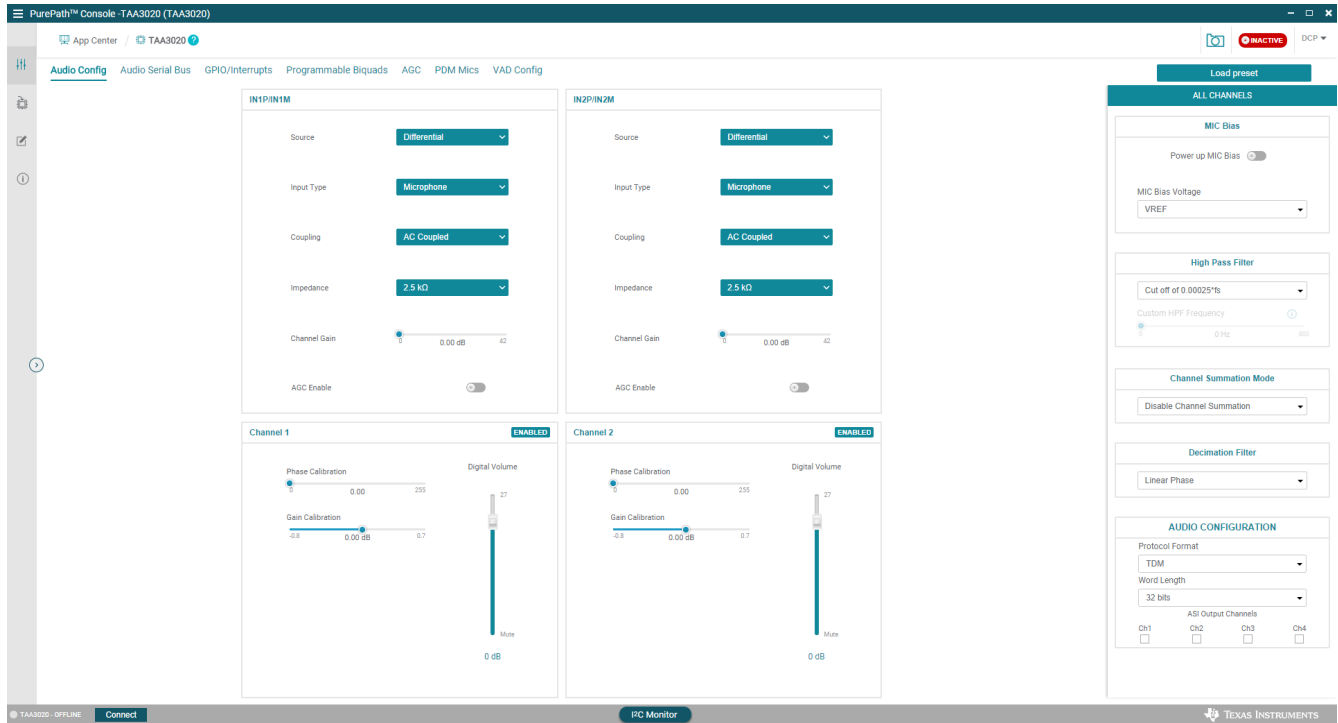
**Figure 5-2. PurePath Console 3 App Center**

The TAA3020 GUI is designed to work with up to four devices at any time. As shown in [Figure 5-3](#), choose the 1 device radial button and click *New*.



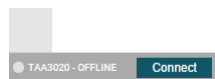
**Figure 5-3. Initial GUI Configuration**

As shown in [Figure 5-4](#), the GUI opens to the *Audio Config* tab.



**Figure 5-4. Audio Config Tab**

Before changing any parameters, check the lower left corner of the PPC3 window, as shown in [Figure 5-5](#), to verify that the EVM is connected. If no EVM is detected, the text will read *TAA3020 offline*. If the EVM is detected, a *Connect* button appears. Clicking this button connects the hardware.



**Figure 5-5. Hardware Connect**

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

## 6 GPIO1 Settings

The GPIO1 pin can be configured for a variety of different functions. [Figure 6-1](#) shows the possible settings. By default, the EVM is configured with GPIO1 connected to an interrupt LED to match the default GPIO1 configuration of the TAA3020 device. This setting causes the INTERRUPT LED on the board to light whenever an IRQ occurs, such as when the VAD is configured to generate an interrupt on voice detection. If GPIO1 is to be used a function other than interrupt, modifications may be required to the 0-Ω resistors installed. [Figure 6-2](#) shows a schematic for the GPIO1 pin layout.

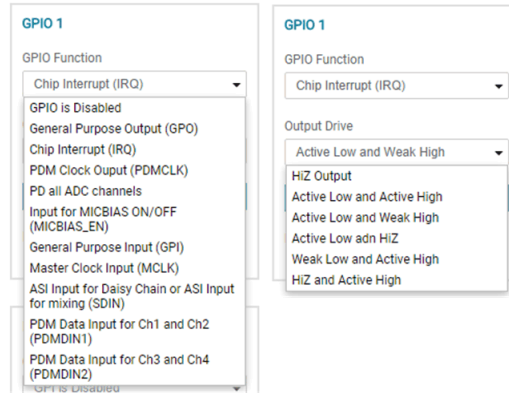


Figure 6-1. GPIO1 Function and Output Drive Settings

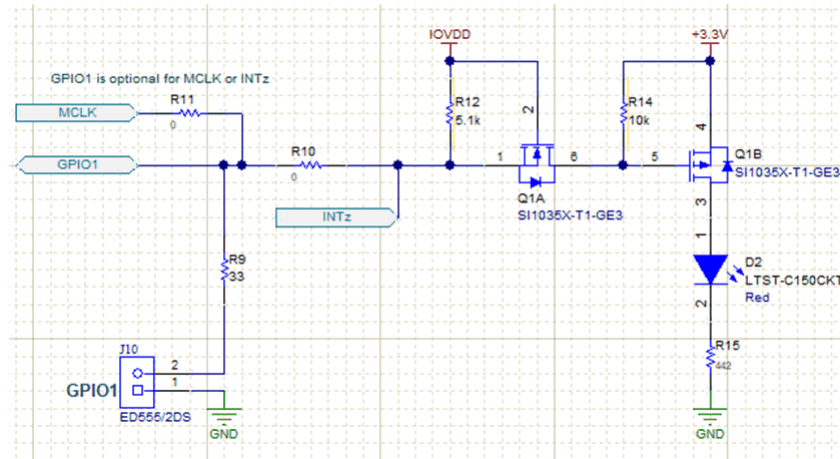


Figure 6-2. GPIO1 Schematic



## 7 Master Mode Operation

To operate TAA3020EVM-PDK in master mode, S1 and S0 on the AC-MB must first be set to "External ASI" as illustrated in [Figure 4-4](#).

The device does not have a dedicated MCLK pin, the master clock can be applied at GPIO1, IN2P\_GPI1, or MICBIAS\_GPI2. Since GPI1 and GPI2 are multipurpose pins shared with analog inputs and MICBIAS, using them as the MCLK input limits the devices functionality. It is recommended to use the GPIO1 pin for MCLK.

To use GPIO1 as MCLK the MCLK signal must either be applied at the J10 terminal, or at the "External ASI" header on the AC-MB board with the other clocks. To use the "External ASI" header, it is necessary to install a 0-Ohm resistor at R11 on the EVM, which is depopulated by default.

## 8 Quick Start

Configure the AC-MB for the USB audio (TDM) and the TAA3020EVB for the onboard microphone inputs.

The GUI comes with preset files to that can be used for easy initial setup. Select the *Load preset* option in the top corner of the GUI and load the *On Board Microphone* setting, as shown in [Figure 8-1](#) and [Figure 8-2](#). Be sure to populate the jumpers described in the settings as described in [Table 4-1](#).

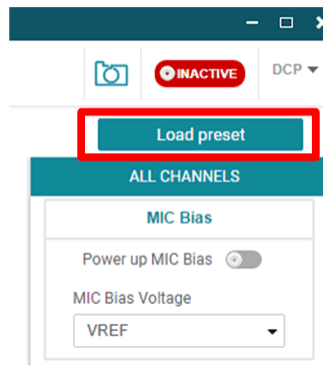


Figure 8-1. Loading Presets

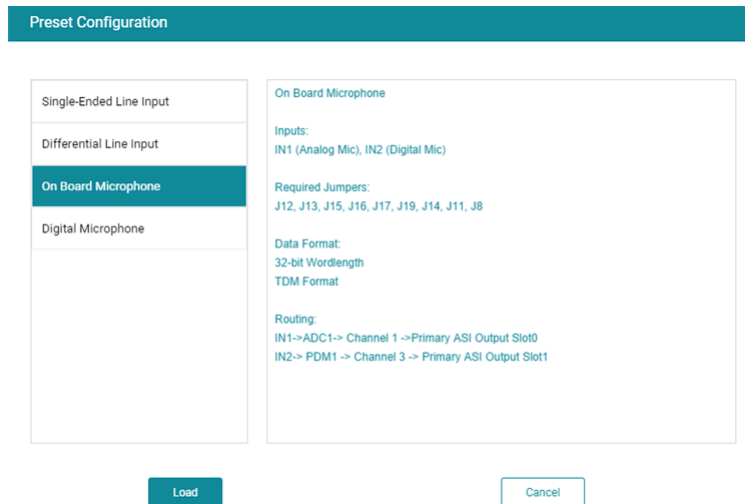
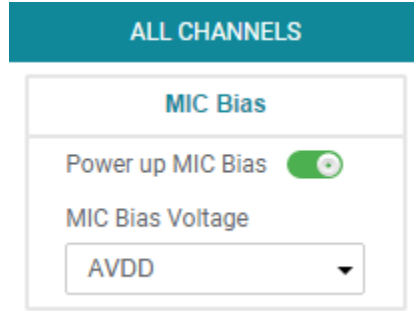


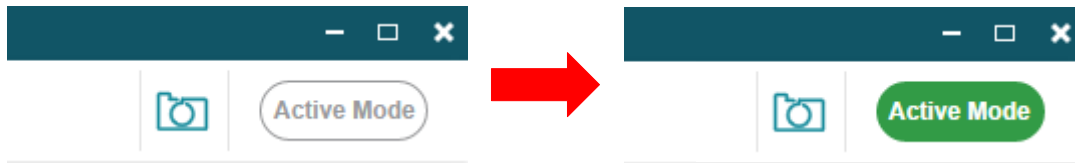
Figure 8-2. Onboard Mic Preset

As shown in [Figure 8-3](#), make sure AVDD is selected for the MIC bias voltage and powered up.



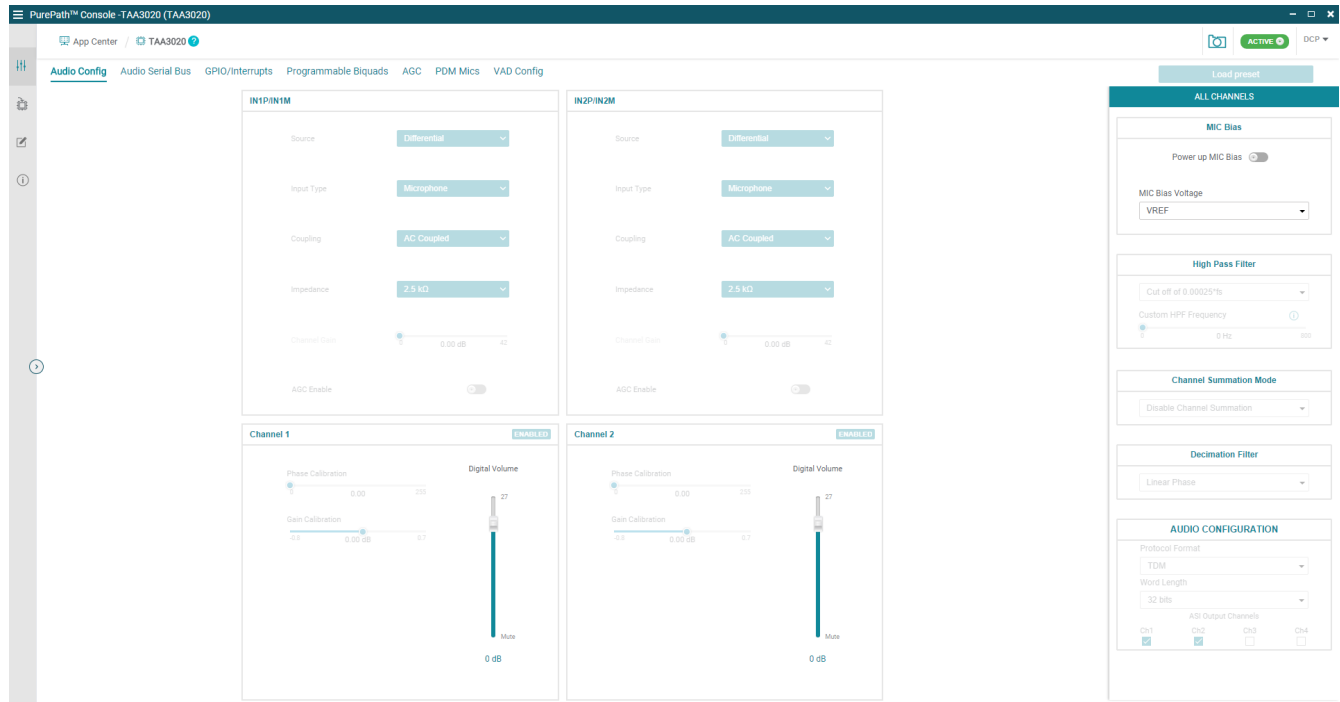
**Figure 8-3. MIC Bias Configuration**

The default state for the TAA3020 is standby mode and, with the exception of the channel digital volume, all device configurations must be done in standby mode. The TAA3020 does not provide a digital audio output in standby mode. [Figure 8-4](#) shows how to change the mode from standby to active.



**Figure 8-4. 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 8-5](#) shows which controls are disabled.



**Figure 8-5. Disabled Controls in Active Mode**

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

## 8.1 Configuring the Audio Serial Bus for the I<sup>2</sup>S Output

The TAA3020 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 I<sup>2</sup>S. This section describes how to configure the TAA3020EVM for a 2-channel I<sup>2</sup>S output to a USB audio at 16 bits and 48 kHz. Configure the AC-MB for USB audio as described in [Section 8](#). As shown in [Figure 8-6](#), select the audio serial bus tab.

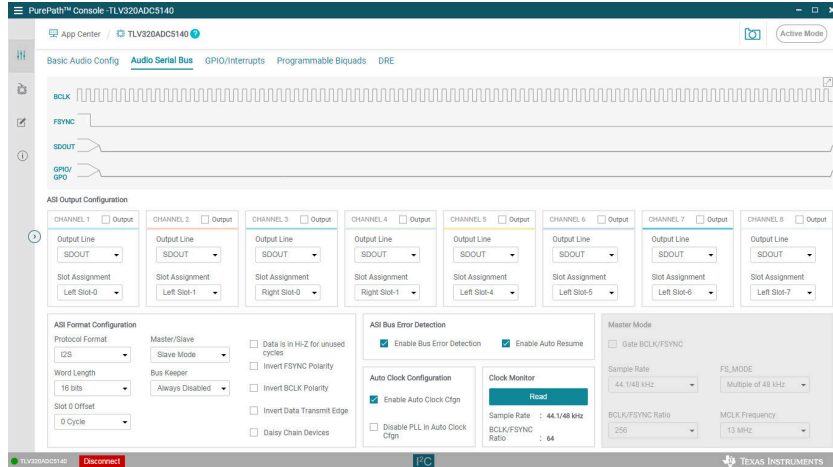


Figure 8-6. Audio Serial Bus Tab

In the ASI format configuration pane (shown in [Figure 8-7](#)), change the protocol format to I<sup>2</sup>S, and the word length to 16 bits.

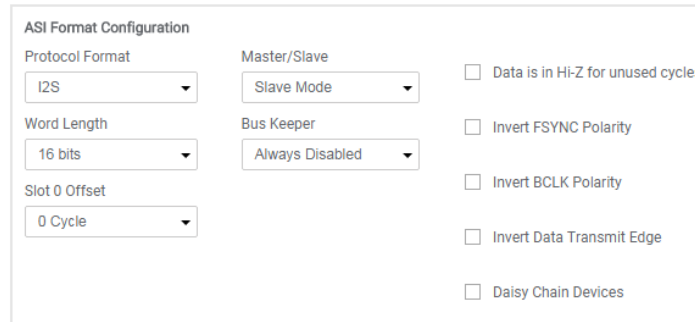


Figure 8-7. ASI Format Configuration

When the protocol format is changed to I<sup>2</sup>S in the GUI, the USB audio processor on the AC-MB also changes the audio format to I<sup>2</sup>S. 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 8-8](#), in the clock monitor pane.

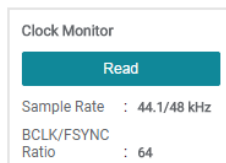
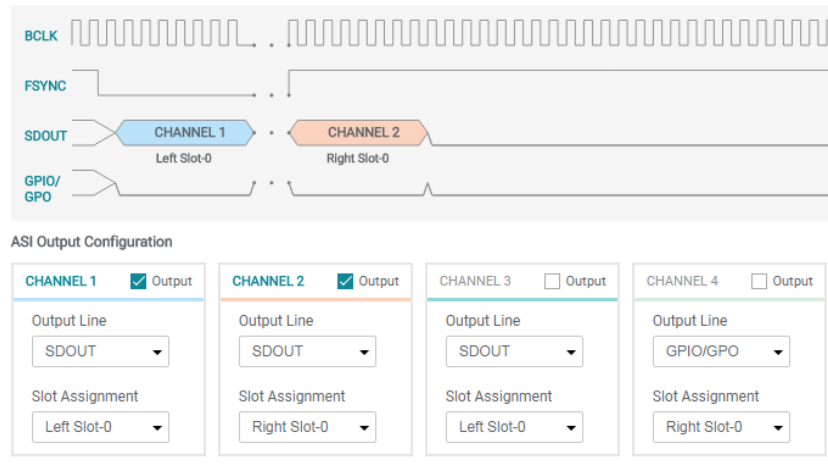


Figure 8-8. Clock Monitor Pane

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 8-9](#), 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.

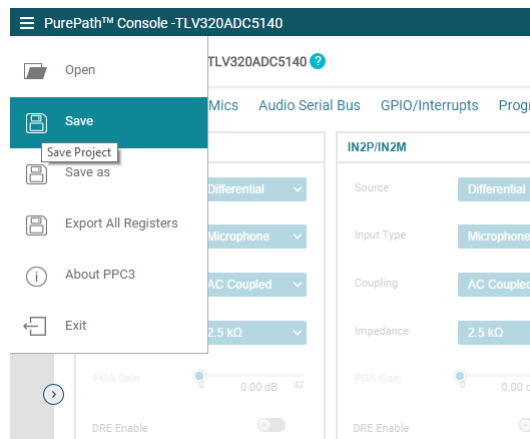


**Figure 8-9. Channel Output Configuration and Diagram**

The AC-MB USB audio currently supports only two channels per data line when in I<sup>2</sup>S 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.

## 8.2 Saving a Configuration

To save a configuration, as shown in [Figure 8-10](#), 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 8-10. Saving a Configuration in PPC3**

## 9 Schematic and Bill of Materials

### 9.1 TAA3020EVM-PDK Schematic and Bill of Materials

This section provides the schematics and bill of materials (BOM) for the ADCx120EVM-PDK.

#### 9.1.1 TAA3020EVM-PDK Schematic

Figure 9-1 shows the schematics for the TAA3020EVM-PDK.

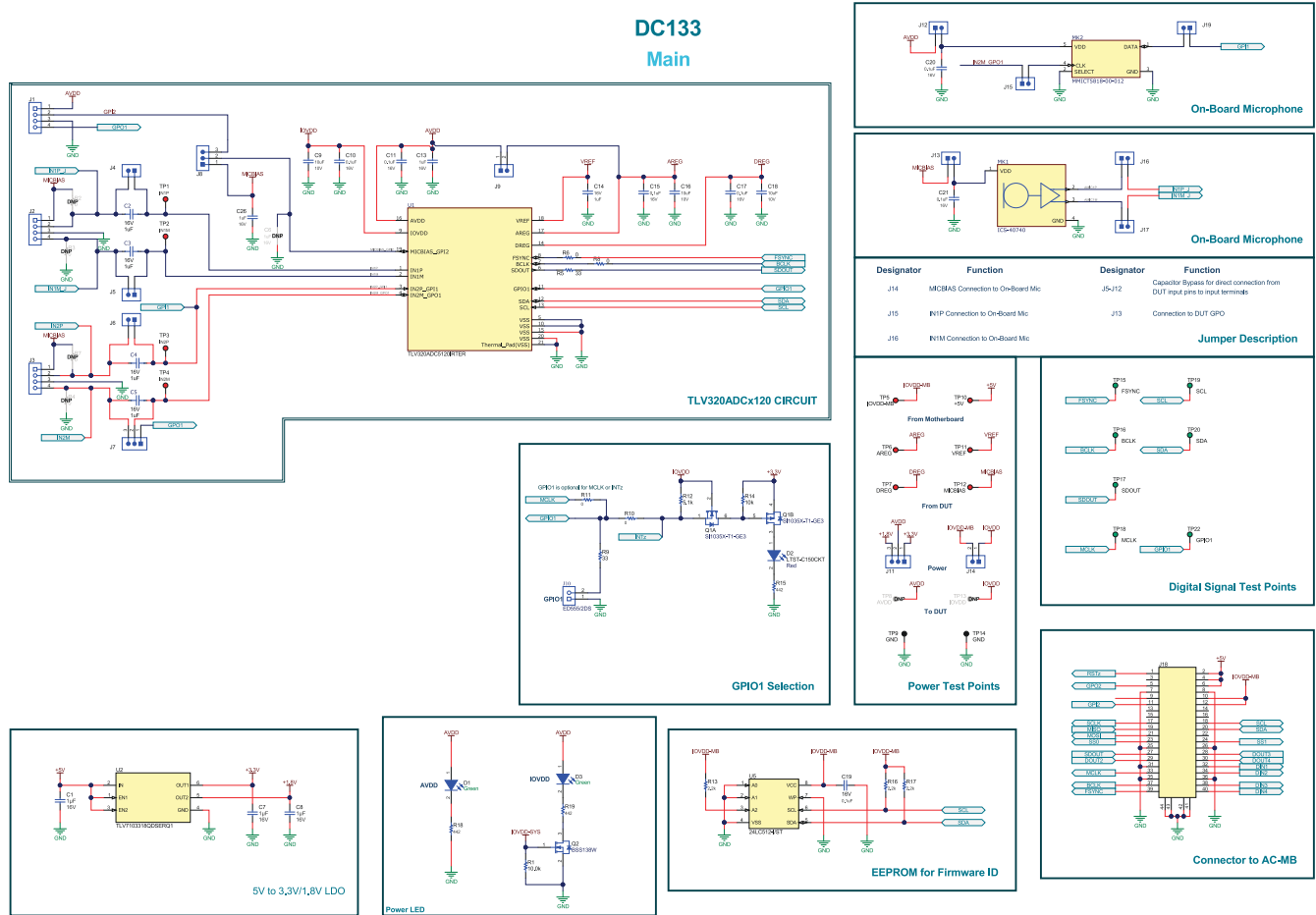


Figure 9-1. TAA3020EVM-PDK Schematics

### 9.1.2 TAA3020EVM-PDK Bill of Materials

Table 9-1 lists the BOM for the TAA3020EVM-PDK.

**Table 9-1. TAA3020EVM-PDK Bill of Materials**

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
C1, C7, C8	3	1uF	CAP, CERM, 1 $\mu$ F, 16 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	CGA3E1X7R1C10 5K080AC	TDK
C2, C3, C4, C5	4		1 $\mu$ F Film Capacitor 12V 10V Acrylic, Metallized 1206 (3216 Metric)	1206	FCA1206A105M-H3	Cornell Dubilier Electronics
C9, C16, C18	3	10uF	CAP, CERM, 10 $\mu$ F, 10 V, +/- 20%, X5R, 0603	0603	C1608X5R1A106 M080AC	TDK
C10, C11, C15, C17, C19, C20, C21	7	0.1uF	CAP, CERM, 0.1 $\mu$ F, 16 V, +/- 10%, X7R, 0402	0402	885012205037	Würth Elektronik
C13	1	1uF	CAP, CERM, 1 $\mu$ F, 16 V, +/- 10%, X7R, 0603	0603	885012206052	Würth Elektronik
C14	1	1uF	CAP, CERM, 1 $\mu$ F, 16 V, +/- 10%, X5R, 0402	0402	EMK105BJ105KV HF	Taiyo Yuden
C26	1	1uF	CAP, CERM, 1 $\mu$ F, 16 V, +/- 10%, X7R, 0603	0603	EMK107B7105KA -T	Taiyo Yuden
D1, D3	2	Green	LED, Green, SMD	LED_0805	LTST-C170KGKT	Lite-On
D2	1	Red	LED, Red, SMD	1206	LTST-C150CKT	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	3		Terminal Block, 2.54mm, 4x1, Brass, TH	Terminal Block, 2.54mm, 4-pole, TH	OSTVN04A150	On-Shore Technology
J4, J5, J6, J9, J12, J13, J14, J15, J16, J17, J19	11		Header, 100mil, 2x1, Gold, TH	2x1 Header	TSW-102-07-G-S	Samtec
J7, J8, J11	3		Header, 100mil, 3x1, Gold, TH	3x1 Header	TSW-103-07-G-S	Samtec
J10	1		Terminal Block, 3.5mm Pitch, 2x1, TH	7.0x8.2x6.5mm	ED555/2DS	On-Shore Technology

**Table 9-1. TAA3020EVM-PDK Bill of Materials (continued)**

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
J18	1		Connector, Header, High Speed, 20 pairs, SMT	QTE-020-01-X-D-A	QTE-020-01-L-D-A	Samtec
MK1	1		77Hz ~ 20kHz Analog Microphone MEMS (Silicon) 1.5V ~ 3.63V Omnidirectional (-37.5dB ±1dB @ 94dB SPL) Solder Pads	LGA4	ICS-40740	TDK
MK2	1		Bottom Port PDM Digital Output Multi-Mode Microphone	SMT_3MM50_2M M65	MMICT5818-00-012	TDK
Q1	1	20V	MOSFET, 2-CH, N/P-CH, 20 V, 0.18 A, SOT-563	SOT-563	SI1035X-T1-GE3	Vishay-Siliconix
Q2	1	50V	MOSFET, N-CH, 50 V, 0.21 A, SOT-323	SOT-323	BSS138W	Fairchild Semiconductor
R1	1	10.0k	RES, 10.0 k, 1%, 0.1 W, 0603	0603	CRCW060310K0FKEA	Vishay-Dale
R5, R9	2	33	RES, 33, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW060333R0JNEA	Vishay-Dale
R6, R8	2	0	RES, 0, 5%, 0.1 W, 0603	0603	CRCW06030000Z0EA	Vishay-Dale
R10, R11	2	0	RES, 0, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	RMCF0603ZT0R00	Stackpole Electronics Inc
R12	1	5.1k	RES, 5.1 k, 5%, 0.063 W, 0402	0402	CRCW04025K10JNED	Vishay-Dale
R13, R16, R17	3	2.2k	RES, 2.2 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04022K20JNED	Vishay-Dale
R14	1	10k	RES, 10 k, 5%, 0.063 W, 0402	0402	CRCW040210K0JNED	Vishay-Dale
R15, R18, R19	3	442	RES, 442, 1%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW0603442RFKEA	Vishay-Dale

**Table 9-1. TAA3020EVM-PDK Bill of Materials (continued)**

Designator	Quantity	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
TP1, TP2, TP3, TP4, TP5, TP6, TP7, TP10, TP11, TP12	10		Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone
TP9, TP14	2		Test Point, Multipurpose, Black, TH	Black Multipurpose Testpoint	5011	Keystone
TP15, TP16, TP17, TP18, TP19, TP20, TP22	7		Test Point, Miniature, Green, TH	Green Miniature Testpoint	5116	Keystone
U1	1		2-Channel, 768- kHz, Burr-Brown Audio ADC	WQFN20	TAA3020IRTER	Texas Instruments
U2	1		Automotive Catalog, Dual, 200mA, Low- IQ Low-Dropout Regulator for Portable Devices, DSE0006A (WSON-6)	DSE0006A	TLV7103318QDS ERQ1	Texas Instruments
U5	1		EEPROM, 512KBIT, 400KHZ, 8TSSOP	TSSOP-8	24LC512-I/ST	Microchip
C6	0	1uF	CAP, CERM, 1 uF, 16 V, +/- 10%, X7R, 0603	0603	EMK107B7105KA -T	Taiyo Yuden
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, R7	0	0	RES, 0, 5%, 0.1 W, 0603	0603	CRCW06030000Z 0EA	Vishay-Dale
TP8, TP13	0		Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone



## 9.2 AC-MB Schematic and Bill of Materials

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

### 9.2.1 AC-MB Schematic

Figure 9-2 shows the schematics for the AC-MB.

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

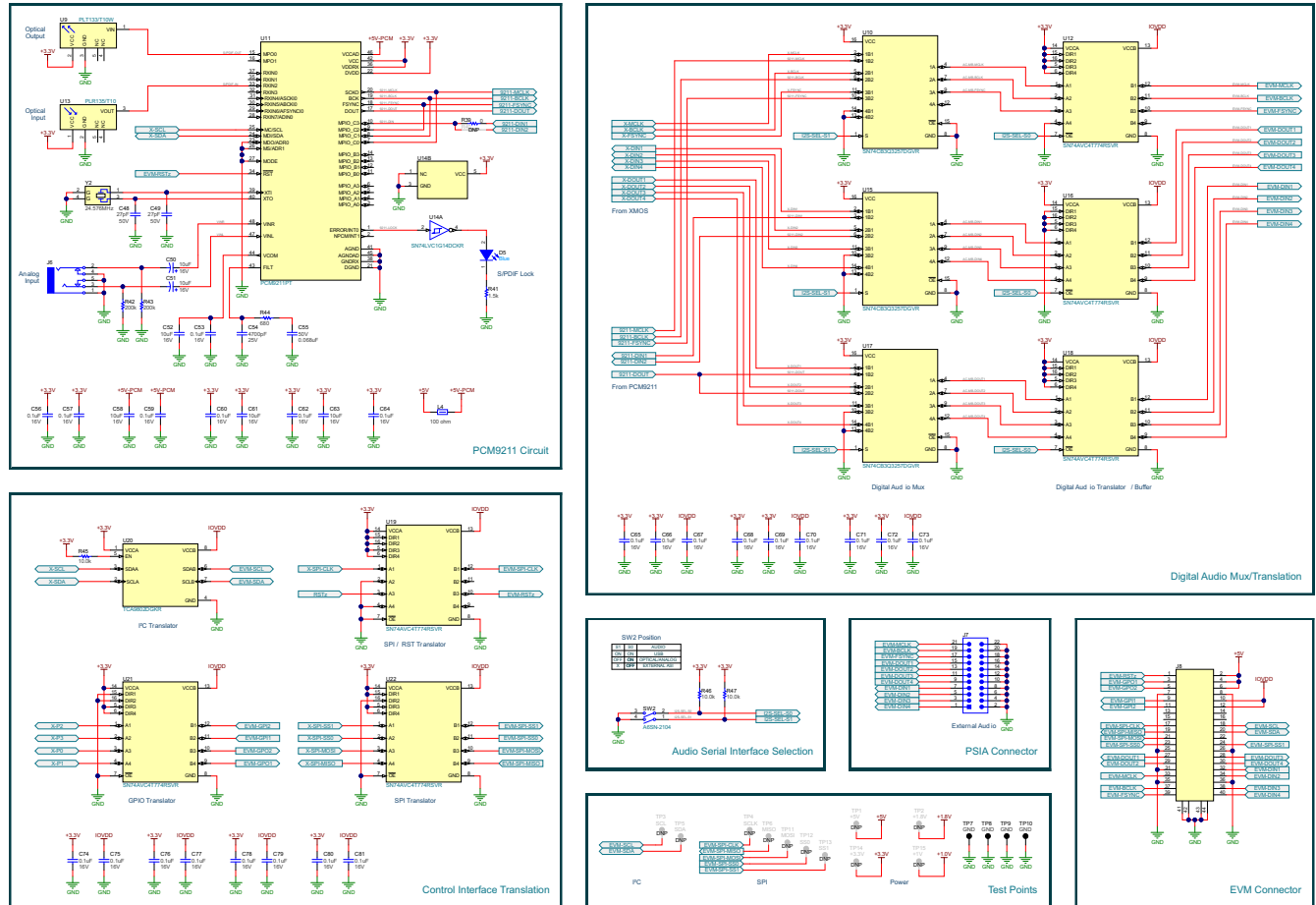


Figure 9-2. AC-MB Schematics

## 9.2.2 AC-MB Bill of Materials

Table 9-2 lists the BOM for the AC-MB.

**Table 9-2. AC-MB Bill of Materials**

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
C1	1	2.2uF	CAP, CERM, 2.2 uF, 16 V, +/- 10%, X7R, 0603	0603	EMK107BB7225K A-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	470pF	CAP, CERM, 470 pF, 50 V, +/- 5%, C0G/NPO, 0603	0603	06035A471JAT2A	AVX
C36, C37	2	22uF	CAP, CERM, 22 uF, 10 V, +/- 10%, X7R, 1206	1206	LMK316AB7226K L-TR	Taiyo Yuden
C39, C40, C41	3	1uF	CAP, CERM, 1 uF, 16 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0603	0603	CGA3E1X7R1C10 5K080AC	TDK
C47	1	1500pF	CAP, CERM, 1500 pF, 16 V, +/- 10%, X7R, 0603	0603	CGA1A2X7R1C15 2K030BA	TDK
C48, C49	2	27pF	CAP, CERM, 27 pF, 50 V, +/- 5%, C0G/NPO, 0402	0402	GJM1555C1H270 JB01	MuRata
C50, C51	2	10uF	CAP, AL, 10 uF, 16 V, +/- 20%, SMD	D3xL5.4mm	UWX1C100MCL2 GB	Nichicon
C52, C58, C61, C63	4	10uF	CAP, CERM, 10 uF, 16 V, +/- 20%, X5R, 0603	0603	EMK107BBJ106M A-T	Taiyo Yuden
C54	1	4700pF	CAP, CERM, 4700 pF, 16 V, +/- 10%, X7R, 0402	0402	885012205029	Würth Elektronik
C55	1	0.068 uF	CAP, CERM, 0.068 uF, 50 V, +/- 10%, X7R, AEC-Q200 Grade 1, 0402	0402	CGA2B3X7R1H68 3K050BB	TDK
D1, D5	2	Blue	LED, Blue, SMD	LED_0603	150060BS75000	Würth Elektronik
D2, D4	2	20V	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, 8mm 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
H11, H12	2		Standoff, Male/Male Thread, 5.15 mm, M3 x 0.5	Standoff	SO-0515-02-02-01	Samtec

**Table 9-2. AC-MB Bill of Materials (continued)**

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
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	35RASMT4BHNT RX	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	MPZ1608D101BT D25	TDK
R1	1	1.0k	RES, 1.0 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04021K00J NED	Vishay-Dale
R2, R3	2	2.2k	RES, 2.2 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW04022K20J NED	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-0733R 2L	Yageo America
R5	1	47.0k	RES, 47.0 k, 1%, 0.0625 W, 0402	0402	RC0402FR-0747K L	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	CRCW040247K0J NED	Vishay-Dale
R9	1	43.2	RES, 43.2, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040243R2F KED	Vishay-Dale
R13	1	10k	RES, 10 k, 5%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040210K0J NED	Vishay-Dale
R14, R41	2	1.5k	RES, 1.5 k, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06031K50J NEA	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	CRCW020110K0F KED	Vishay-Dale
R26	1	4.7	RES, 4.7, 5%, 0.1 W, AEC-Q200 Grade 0, 0603	0603	CRCW06034R70J NEA	Vishay-Dale
R30	1	25.5k	RES, 25.5 k, 1%, 0.05 W, 0201	0201	RC0201FR-0725K 5L	Yageo America
R31	1	51.0k	RES, 51.0 k, 1%, 0.05 W, 0201	0201	RC0201FR-0751K L	Yageo America
R32	1	40.2k	RES, 40.2 k, 1%, 0.063 W, AEC-Q200 Grade 0, 0402	0402	CRCW040240K2F KED	Vishay-Dale

**Table 9-2. AC-MB Bill of Materials (continued)**

Designator	Quantity	Value	Description	Package Reference	Part Number	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, 12V, 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, 200mA, 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	SN74CB3Q3257D GVR	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	SN74AVC4T774R SVR	Texas Instruments
U13	1		Photolink- Fiber Optic Receiver, TH	13.5x10x9.7mm	PLR135/T10	Everlight

**Table 9-2. AC-MB Bill of Materials (continued)**

Designator	Quantity	Value	Description	Package Reference	Part Number	Manufacturer
U14	1		Single Schmitt-Trigger Inverter, DCK0005A (SOT-SC70-5)	DCK0005A	SN74LVC1G14DC KR	Texas Instruments
U20	1		Level-Translating I2C Bus Buffer/ Repeater, DGK0008A (VSSOP-8)	DGK0008A	TCA9802DGK R	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	TPD2E001DRL R	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-24.000 MHZ-EJ-E-T	Abracon Corporation
Y2	1		Crystal, 24.576 MHz, 10pF, SMD	2.5x0.5x2.0mm	ABM10-24.576MH Z-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	RMCF0603ZT0R0 0	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

### 9.3 Matlab Audio Capture Example

The driver for the AC-MB may 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 chance 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);

```

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