EVM User's Guide: TAC5301Q14B4EVM-K

TAC5301-Q1 Evaluation Module

Description

The TAC5301Q14B4EVM-K evaluation module (EVM) allows the user to test the capabilities of Texas Instruments' TAC5301-Q1, a low-power, mono audio codec for automotive applications. The evaluation module is paired with the AC-MB, a flexible motherboard which provides power, control and digital audio data to the evaluation module.

Get Started

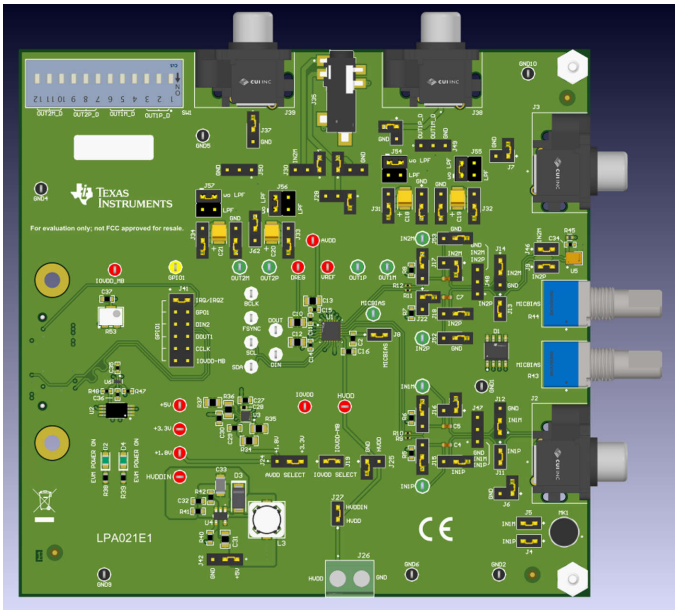
1. Order the EVM from TAC5301-Q1 product folder.
2. Download the latest TAC5301-Q1 data sheet.
3. Request access and download PPC3 GUI from TAC5301-Q1 product folder.

Features

- Complete evaluation kit for the TAC5301-Q1 mono audio codec
- 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

Applications

- Emergency call (e-call)
- Telematics control unit
- Automotive active noise cancellation
- Automotive head units



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1 Evaluation Module Overview

1.1 Introduction

This user's guide describes the functionality of the TAC5301Q14B4EVM-K EVM evaluation kit.

The TAC5301Q14B4EVM is an evaluation module (EVM) designed to demonstrate the performance and functionality of the TAC5301 device. The TAC5301 is a mono codec with an ADC SNR of 101dB and DAC SNR of 110dB.

1.2 Kit Contents

- TAC5301-Q1 device
- TAC5301Q14B4EVM daughterboard
- AC-MB Controller/motherboard

1.3 Specification

The TAC5301Q14B4EVM evaluation module (EVM) paired with the AC-MB, a flexible motherboard which provides power, control and digital audio data to the evaluation module allows user to record and playback audio signal. The configuration for the TAC5301-Q1 device is done through the PurePath Console 3 (PPC3) GUI.

1.4 Device Information

- TAC5301-Q1: a low power, Mono Audio Codec with integrated programmable high-voltage micbias

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2 Hardware

2.1 Hardware Overview

The evaluation kit consists of the TAC5301Q14B4EVM daughterboard and the AC-MB controller board. The controller board is used to provide power, control, and digital audio signals to the evaluation module. The daughterboard contains the TAC5301-Q1 device and the input/output connections.

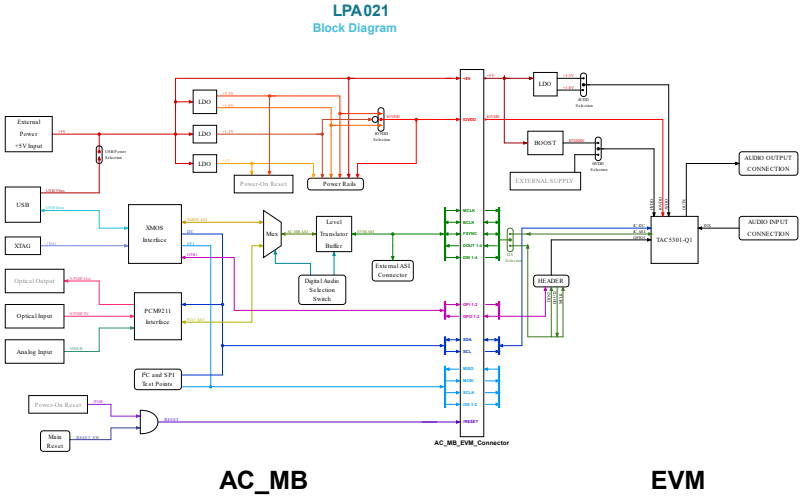


Figure 2-1. TAC5301-Q1 EVM Block Diagram

2.2 AC-MB Settings

2.2.1 Audio Serial Interface Settings

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

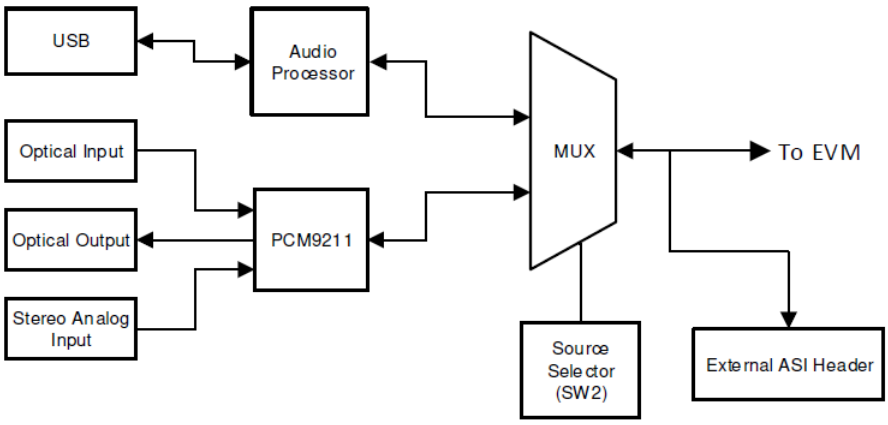


Figure 2-2. AC-MB Audio Interface Block Diagram

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Switch SW2 on the AC-MB selects the audio serial bus that interfaces with the PCM6xx0EVM. 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: USB, optical or analog, or external ASI.

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, 48kHz sampling rate, BCLK and FSYNC ratio is 256, and the format is time division multiplexing (TDM).

2.2.1.1 USB Mode

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

2.2.1.2 Optical or Auxiliary Analog Audio Input Mode

Serial interface signals are provided from the PCM9211 digital transceiver, which is capable of sending digital data to the EVM from an analog input or optical input. Meanwhile, the data from the EVM 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 Input 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, then 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 digital-to-analog converter (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, 48kHz, I2S mode.

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2.2.1.3 External Audio Interface Mode

In this mode, the audio serial interface clocks for the evaluation board are provided through connector J7 from an external source. This architecture allows an external system to be used for communication with the evaluation board, such as a different host processor or test equipment (Audio Precision™). 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 Interface Setting

Figure 2-6 shows how to connect the external audio interface. Odd numbered pins are signal carrying, and even numbered pins are connected to ground.

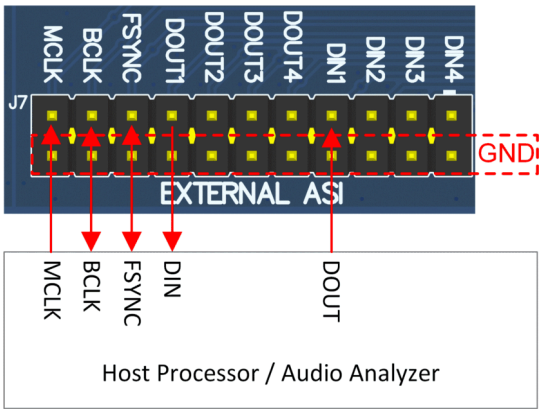


Figure 2-6. AC-MB Connection with External Audio Serial Interface

2.2.2 AC-MB Power Supply

The complete EVM system is powered from a single 5V 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.

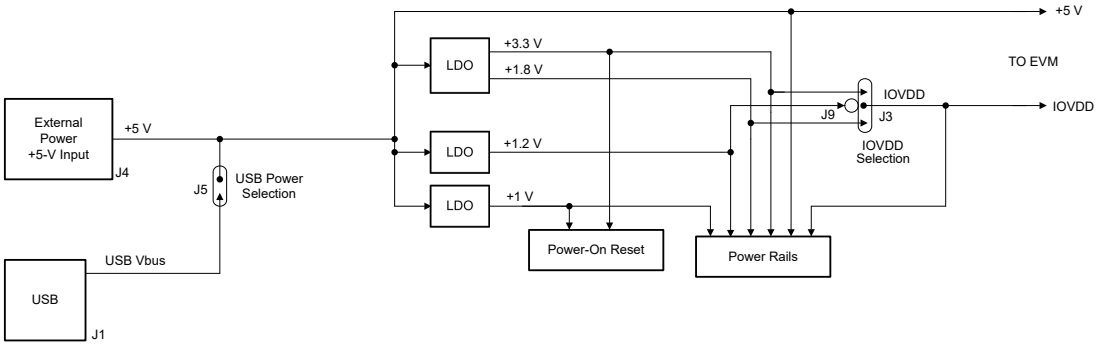


Figure 2-7. Power-Supply Distribution of the AC-MB

The AC-MB can be powered from the host computer by using the USB 5V 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

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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 1.2V, 1.8V, and 3.3V and can be selected via the J9 and J3 IOVDD header. For 1.2V operation, short pin 1 of header J9 and pin 2 of header J3; for 1.8V operation, short pins 2 and 3 of header J3; for 3.3V operation, short pins 1 and 2 of header J3. The green POWER LED (D3) turns ON when the motherboard is fully powered and the power supplies from the onboard LDOs are correct. The USB READY LED indicates a successful USB communication between the AC-MB and the host computer.

2.3 TAC5301Q14B4EVM-K Hardware Settings

2.3.1 TAC5301-Q1 EVM Input Hardware Settings

The TAC5301-Q1 evaluation module has several input configuration options. The EVM allows the user to evaluate the device across multiple operation modes. The different operation modes are highlighted in this section.

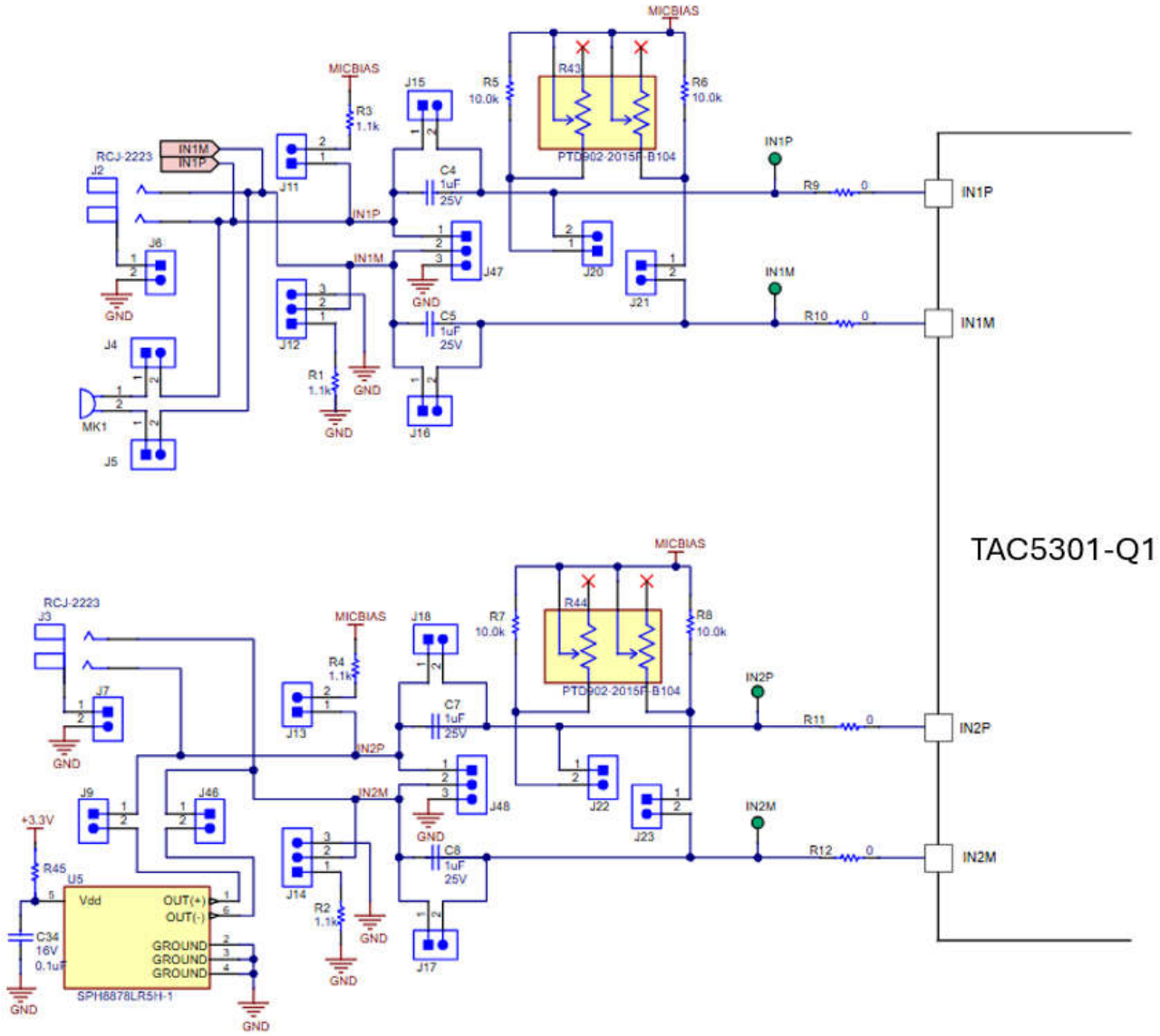


Figure 2-8. TAC5301-Q1 EVM Input Architecture for Channel 1 and 2

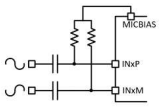
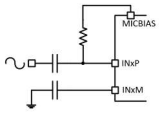
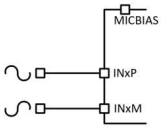
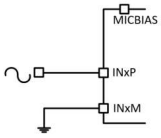
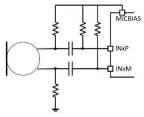
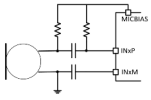
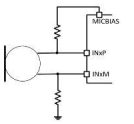
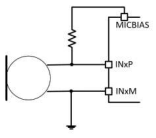
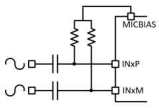
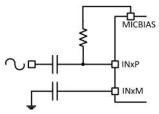
The IN1 and IN2 input architecture allows these two channels to be quickly configured to support any of the supported operation modes. The TAC5301-Q1 consists of two pairs of analog input pins (INxP and INxM) that can be configured as either differential or single-ended inputs for the recording channel. The device supports

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recording of up to one analog channel and integrates an input swap feature to select the input pins for recording between the IN1x and IN2x using the low-power single-channel ADC.

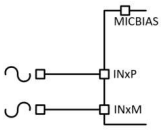
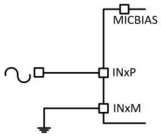
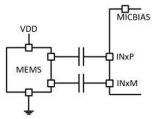
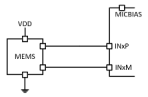
The INxP and INxM pins of the TAC5301-Q1 can optionally connect to onboard microphones for quick evaluation of a microphone in AC- or DC-coupled modes. Jumper configuration details can be found in Table 2-1. The IN2P and IN2M can be connected to GND through jumper J52 and J53 as shown in Figure 2-8.

Table 2-1. Input Jumper Configuration

Input Terminal	Input Mode	Installed Jumpers	Uninstalled Jumpers	Input Swing	Topology	Register
IN1	LINE-IN Differential, AC-coupled	J8, J20, J21	J4, J5, J6, J11, J12, J15, J16	$2V_{RMS}$		B0_P0_R80, B0_P1_R115
	LINE-IN Single-ended, AC-coupled	J6, J8, J12 (2-3), J20, J21	J4, J5, J11, J15, J16	$1V_{RMS}$		B0_P0_R80, B0_P1_R115
	LINE-IN Differential, DC-coupled	J15, J16	J4, J5, J6, J11, J12, J20, J21, J8 (DUT MICBIAS is not used)	$2V_{RMS}$		B0_P0_R80
	LINE-IN Single-ended, DC-coupled	J6, J12 (2-3), J15, J16	J4, J5, J11, J20, J21, J8 (DUT MICBIAS is not used)	$1V_{RMS}$		B0_P0_R80
	On-board Electret Condenser Microphone (ECM) Differential, AC-coupled	J4, J5, J8, J11, J12 (1-2), J20, J21	J6, J15, J16	Refer to Microphone data sheet		B0_P0_R80, B0_P1_R115
	On-board Electret Condenser Microphone (ECM) Single-ended, AC-coupled	J4, J5, J8, J11, J12 (2-3), J20	J6, J15, J16, J21	Refer to Microphone data sheet		B0_P0_R80, B0_P1_R115
	On-board Electret Condenser Microphone (ECM) Differential, DC-coupled	J4, J5, J8, J11, J12 (1-2), J15, J16	J6, J20, J21	Refer to Microphone data sheet		B0_P0_R80, B0_P1_R115
	On-board Electret Condenser Microphone (ECM) Single-ended, DC-coupled	J4, J5, J8, J11, J12 (2-3), J15, J16	J6, J20, J21	Refer to Microphone data sheet		B0_P0_R80, B0_P1_R115
IN2	LINE-IN Differential, AC-coupled	J8, J22, J23	J7, J9, J13, J14, J17, J18, J46	$2V_{RMS}$		B0_P0_R85, B0_P1_R115
	LINE-IN Single-ended, AC-coupled	J7, J8, J14 (2-3), J22, J23	J9, J13, J17, J18, J46	$1V_{RMS}$		B0_P0_R85, B0_P1_R115

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Table 2-1. Input Jumper Configuration (continued)

Input Terminal	Input Mode	Installed Jumpers	Uninstalled Jumpers	Input Swing	Topology	Register
	LINE-IN Differential, DC-coupled	J17, J18	J7, J9, J13, J14, J22, J23, J46, J8 (DUT MICBIAS is not used)	$2V_{RMS}$		B0_P0_R85
	LINE-IN Single-ended, DC-coupled	J7, J14 (2-3), J17, J18	J9, J13, J22, J23, J46, J8 (DUT MICBIAS is not used)	$1V_{RMS}$		B0_P0_R85
	On-board Analog MEMS microphone, AC-coupled	J8, J9, J22, J23, J46	J7, J13, J14, J17, J18	Refer to Microphone data sheet		B0_P0_R85, B0_P1_R115
	On-board Analog MEMS microphone, DC-coupled	J9, J17, J18, J46	J7, J13, J14, J22, J23, J8 (DUT MICBIAS is not used)	Refer to Microphone data sheet		B0_P0_R85, B0_P1_R115

2.3.1.1 Line Inputs

For the line input configuration shown in , the TAC5301-Q1 captures the audio signal provided through RCA terminals J2 (IN1), J3 (IN2) or header J47 or J48. The RCA white connector is connected to the INxP and RCA red connector is connected to the INxM. Depending on differential or single-ended configuration, populate J6 or J7 jumper as described in Table 2-1 accordingly. 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. The gang potentiometer R43 and R44 provide the input bias resistors for this AC-Coupled input mode depending on the desired input swing and impedance.

2.3.1.2 On-board Microphone Input

For the on-board microphone input configuration shown in Figure 2-8, the TAC5301-Q1 records the audio captured from MK1 (ECM) or U5 (Analog MEMS) microphones. For U5, the audio port is located at the bottom of the board. Electret Microphone (MK1) is connected to IN1P/M and MICBIAS is used to power the on-board microphone, so header J8 must be installed. The MEMS microphone (U5) can be configured as a single-ended or differential input and connected to IN2P/M. There must not be any connections to J2 or J3 while the on-board microphone is used to preserve the performance of the microphone. There is a possibility that gain adjustment is needed in the device depending on the microphone sensitivity.

2.3.2 TAC5301-Q1 EVM Output Hardware Settings

The TAC5301-Q1 evaluation module has several output configuration options and offers flexibility to allow the user to evaluate the device with different load conditions and configurations. The different configurations are highlighted in this section.

The EVM analog audio output port provides option for AC/DC-Coupled and filter or filter-less paths for easy evaluation. By default, the filter components are not populated.

Switch SW1 allows users to select respective loads for each output pair for 16 Ohm, 604 Ohm or 10K Ohm if needed. These resistors are for quick evaluation and can be bypassed for actual load. SW1 and the output RCA connectors are located on the top left hand side shown in Figure 2-9.

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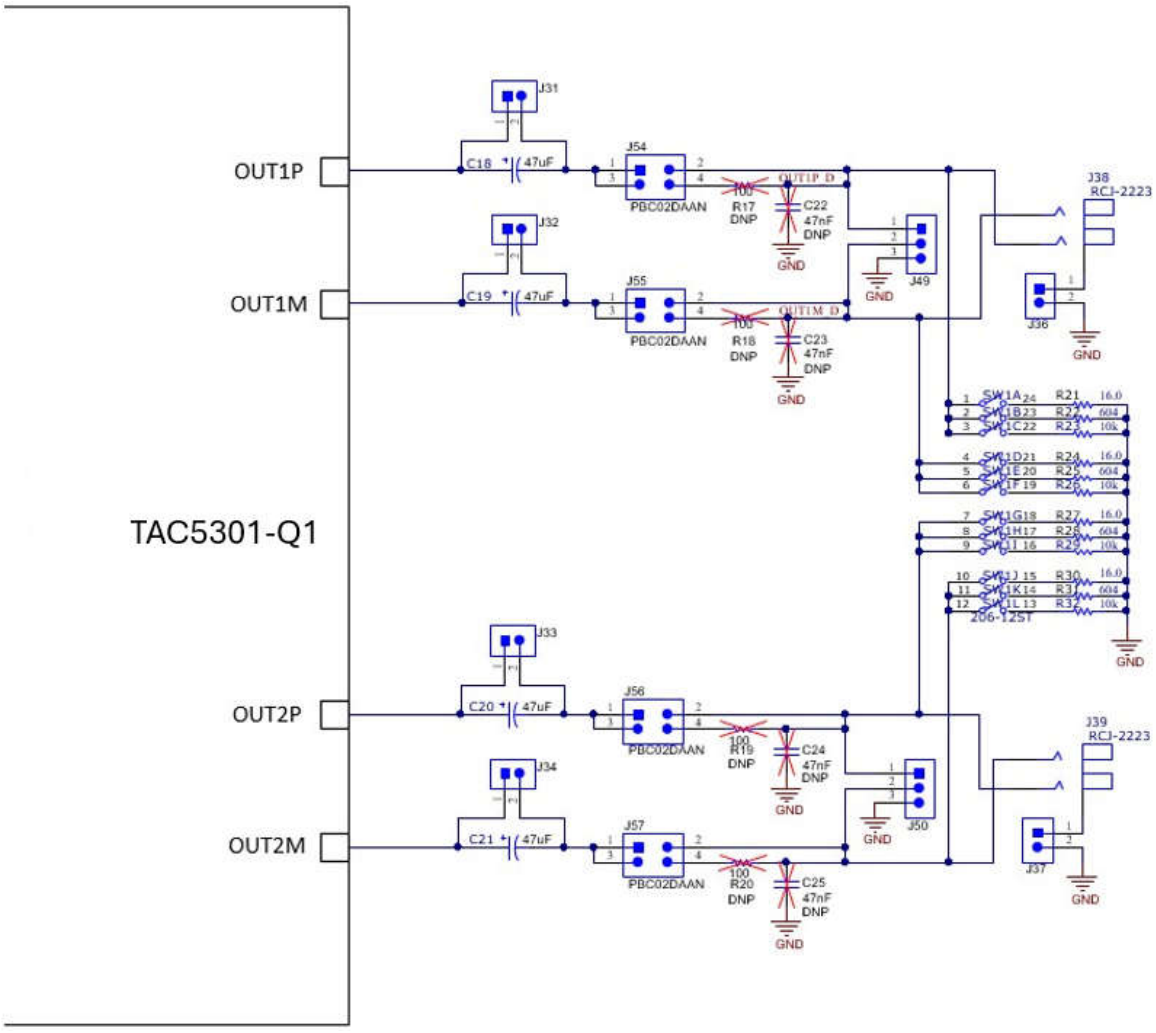


Figure 2-9. TAC5301-Q1 EVM Output Architecture for Channel 1 and 2

OUT1 and OUT2 audio output pins have connection options with external load or the on-board load selections. A pair of RCA connectors, white from OUTP and red from OUTM, allow users to connect to external device as differential or single ended. Jumper header J36 or J37 must be populated if single-ended is desired or removed otherwise for differential configuration. Since the TAC5301-Q1 is a mono output device, the OUT2 output pins can be connected to GND by populating J61 and J62.

Table 2-2. SW1 Pin

SW1 pin	Load Configuration	Resistor Rating	Output Module Register Setting
1, 4, 7, 10	16 Ω	0.5W	B0_P0_R101
2, 5, 8, 11	604 Ω	0.125W	B0_P0_R101
3, 6, 9, 12	10kΩ	0.4W	B0_P0_R101

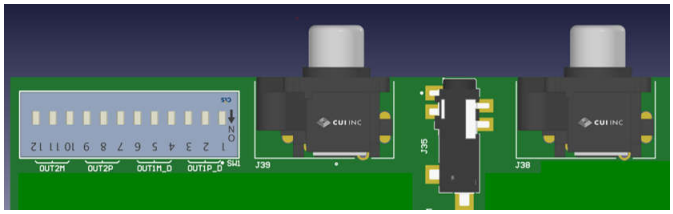


Figure 2-10. TAC5301-Q1 Analog Output Connections

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2.4 GPIO1 Hardware Configurations

GPIO1 has many configuration options through J41 header, but only one setting is allowed at a time. GPIO1 can be configured for general purpose input output and Audio Serial Interface can be configured as either MCLK, DIN or DOUT in controller or target mode. This is shown in the figure below.

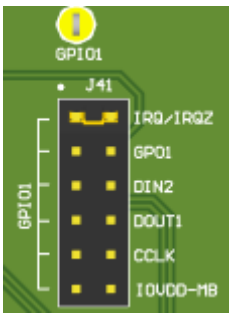


Figure 2-11. GPIO1 Configuration

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3 Software

3.1 Software Description

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.

3.2 PurePath Console 3 Installation

The TAC5301-Q1 EVM GUI is an application that installs into the PPC3 framework. PPC3 must be installed prior to downloading the TAC5301-Q1 EVM GUI. Request access for PPC3 through PUREPATHCONSOLE. If the PPC3 is already installed, then proceed to TAC5301-Q1 EVM GUI. PurePath Console 3 Installation shows the setup directory for the PPC3 installation.

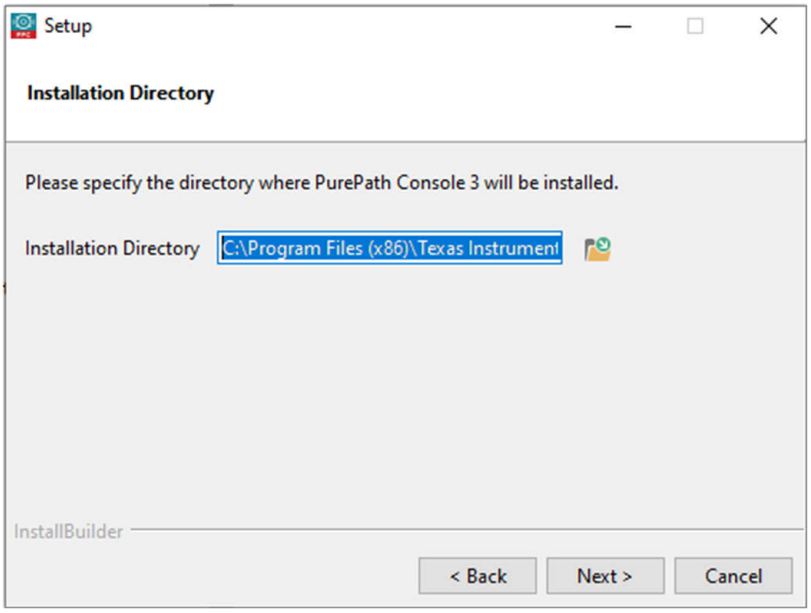


Figure 3-1. PurePath Console 3 Installation

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

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3.2.1 USB Audio Setup

Note: When using the USB audio interface, the Texas Instruments USB audio device control panel, shown in Figure 3-2, opens with the input setting configured for 8 channel, 32 bits. For USB audio, 32-bit mode must be used on the EVM as well.

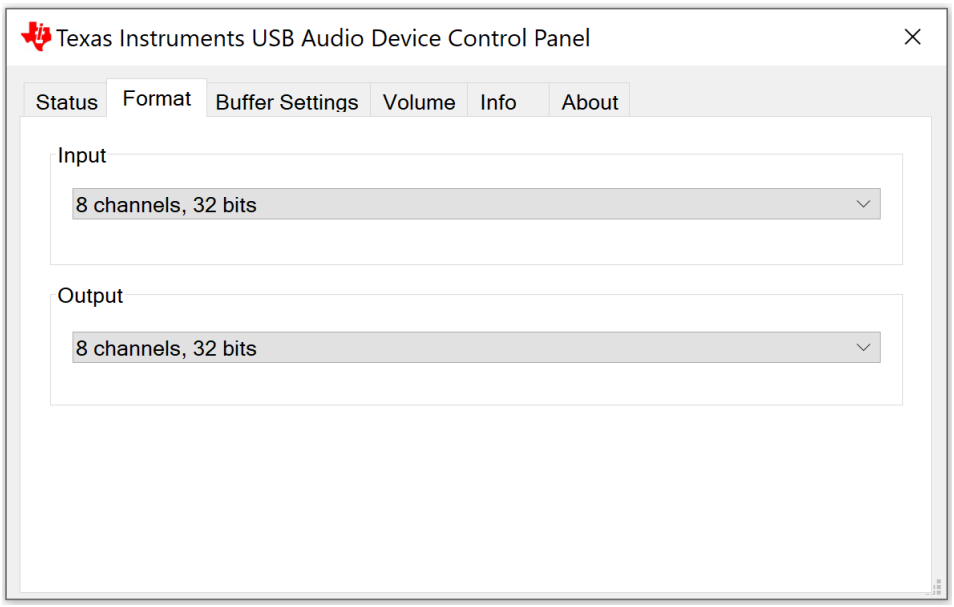


Figure 3-2. Texas Instruments USB Audio Device Control Panel

3.3 TAC5301-Q1 EVM GUI

Open the PPC3 application in the directory selected for the GUI installation in Section 3.2. Figure 3-3 shows the resulting app center window. Click on the TAC5301-Q1 app tile.



Figure 3-3. PurePath Console 3 App Center

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The TAC5301-Q1 GUI is designed to work with up to four devices at any time. Select the number of devices and click *New*.

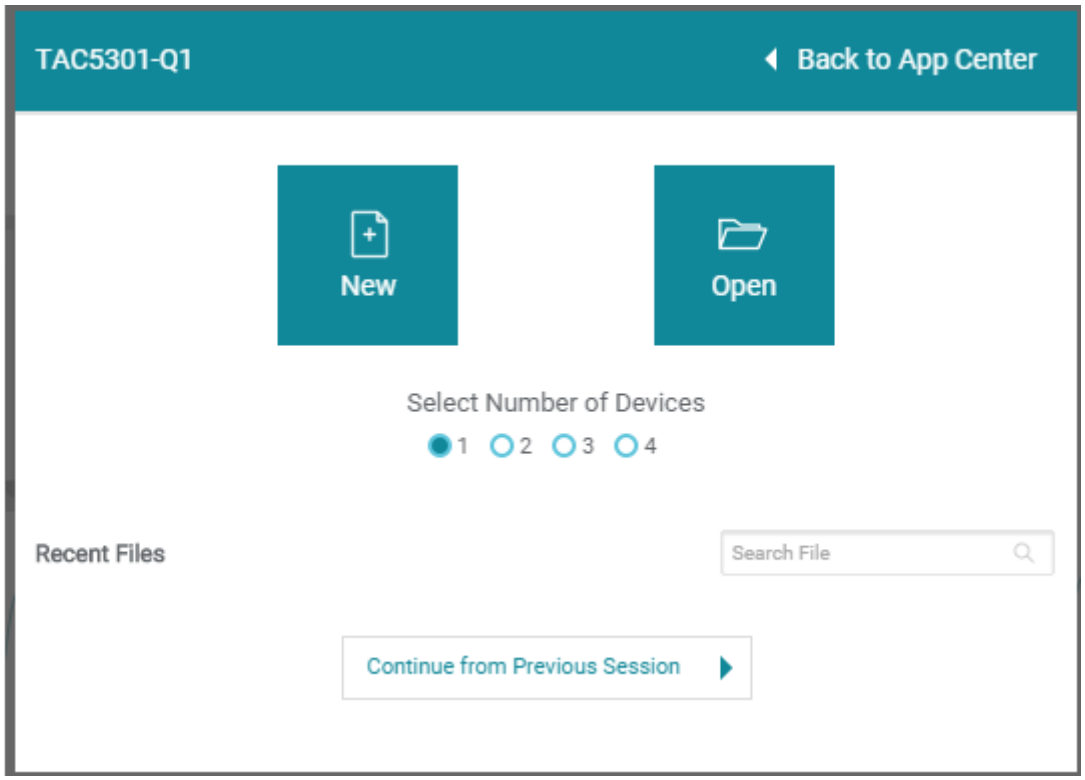


Figure 3-4. Select Device Configuration

The GUI loads the default configuration and a warning message appears. Select either to update the GUI with device values or overwrite the device with GUI values; either selection works for the initial setup.

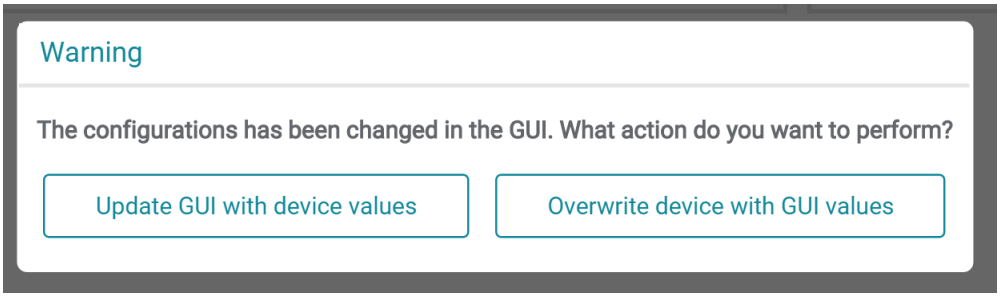


Figure 3-5. Update GUI-Device

The default tabs of the connected device are displayed as shown below.

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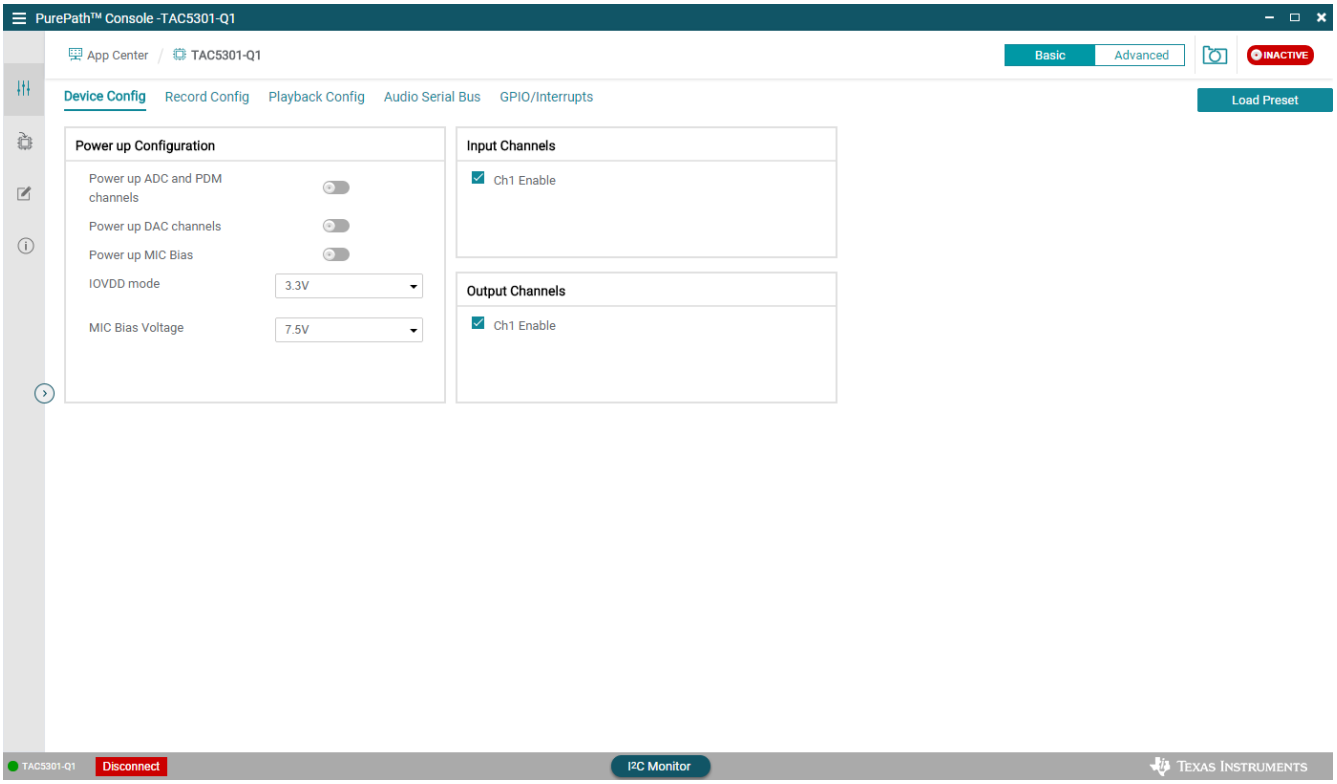


Figure 3-6. Device Config Tab

Before changing any parameters, check the lower left corner of the PPC3 window to verify that the EVM is connected. If no EVM is detected, the text reads TAC5301-Q1 - OFFLINE as shown in Figure 3-7. To connect, plug the USB cable to the computer and click Connect.



Figure 3-7. Hardware Connect Button

To activate the GUI, click the *INACTIVE* red button to change to *ACTIVE* green button, which displays that the device is now in operation. The user configures the TAC5301-Q1 in PPC3, and then activate the device. Once the device is activated, some controls are grayed out until the *ACTIVE* button is deactivated.

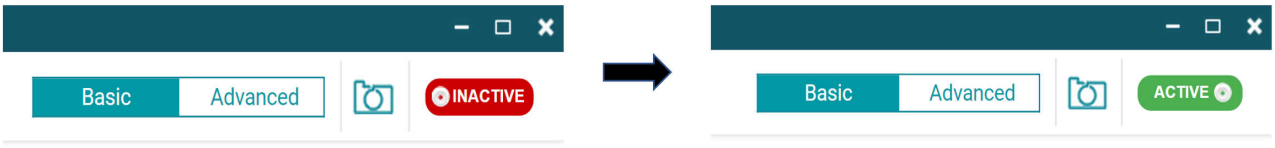


Figure 3-8. Activate GUI

3.3.1 Software Overview

The TAC5301-Q1 EVM control software allows for the configuration of the TAC5301Q14B4EVM-PDK. The application is organized into three main views: Configuration, End System Integration, and Register Map. These views are detailed in this section. Some controls in these tabs are grayed out when the tabs are not applicable to the selected device variant.

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3.3.2 Configuration View

The configuration view, shown in Figure 3-9, contains all of the tools used to configure and program the TAC5301-Q1 EVM. This view has tabs for each of the device configurations and each is described in this section.

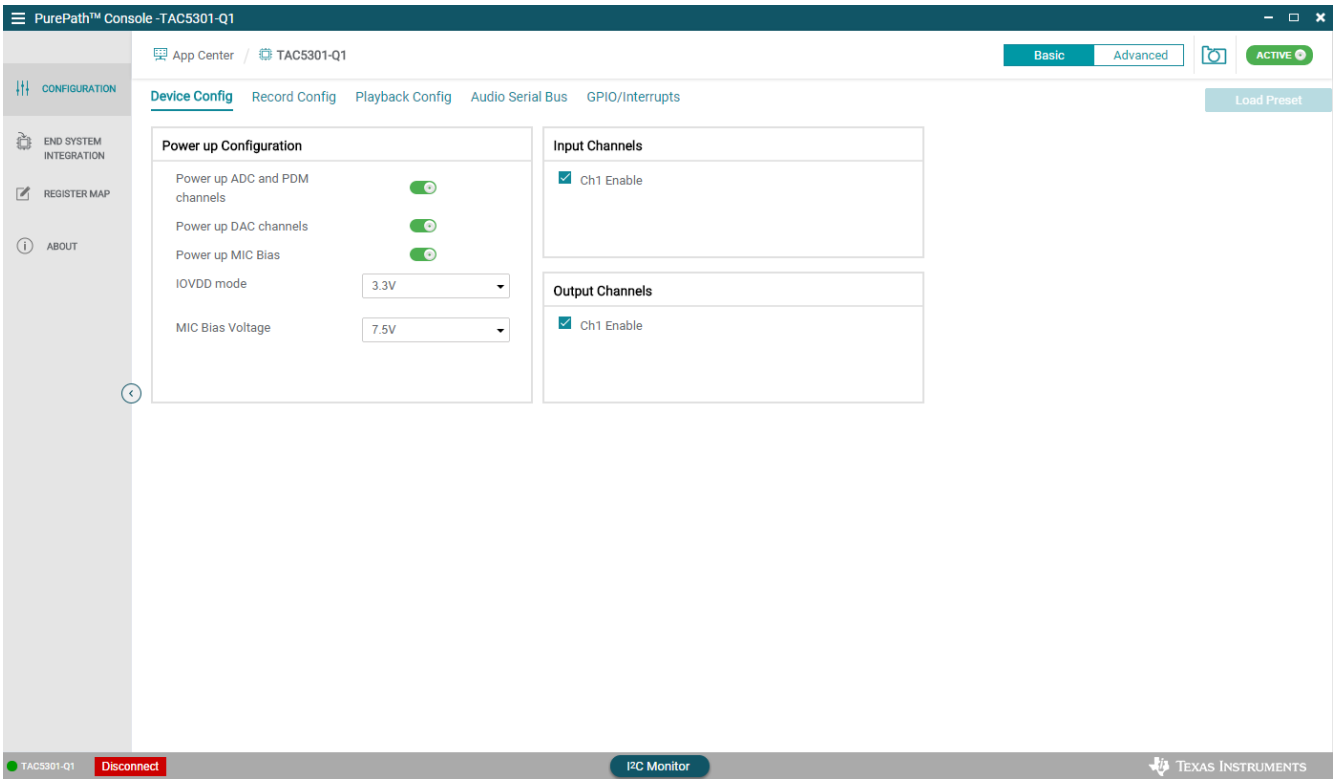


Figure 3-9. Configuration View

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3.3.2.1 Device Config Tab

The Device Config tab contains the controls for powering up/enabling the ADC, DAC, and MIC Bias individually, as well as channel enable, and selections for the IOVDD and MIC Bias level.

The ADC and MIC Bias powers up automatically when the GUI is *ACTIVE* if the Input Ch1 Enable box is checked. Similarly, the DAC powers up automatically when the GUI is *ACTIVE* if the Output Ch1 Enable box is checked.

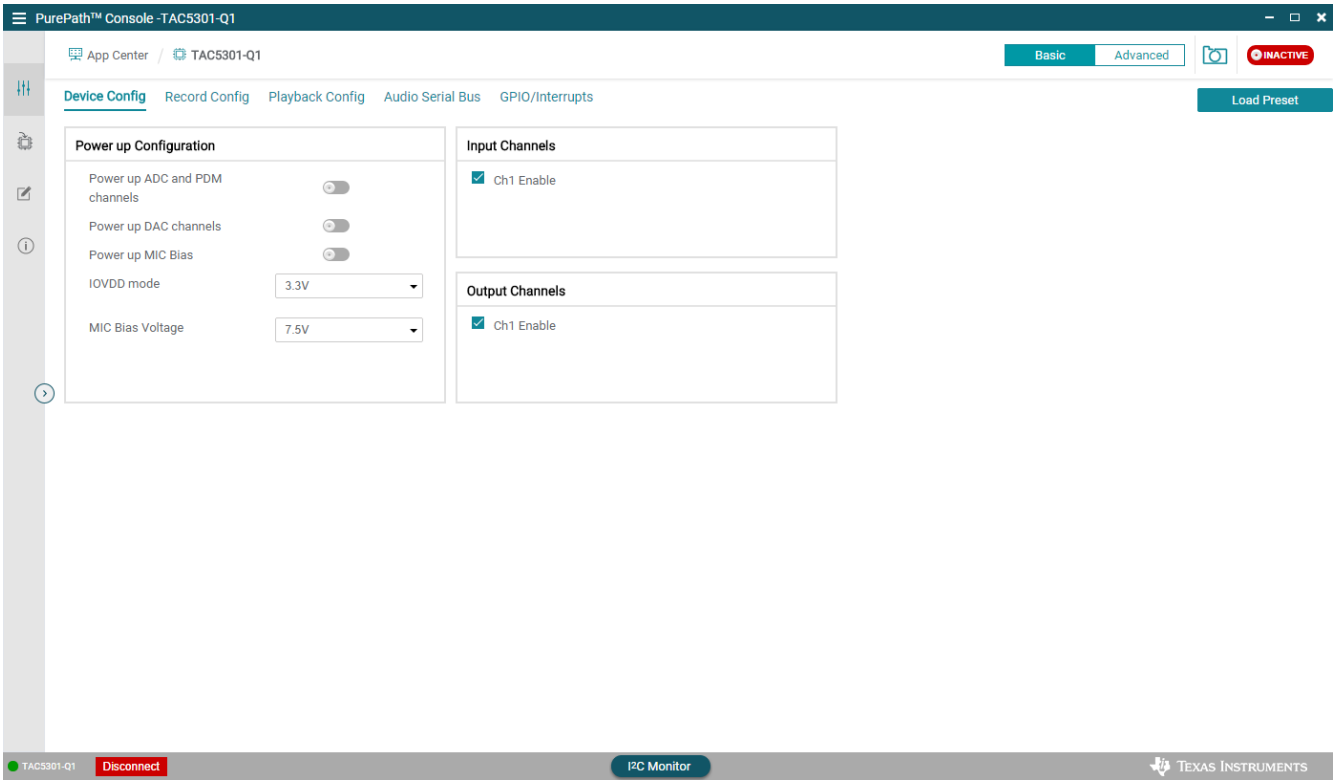


Figure 3-10. Device Config Tab

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3.3.2.2 Record Config Tab

The Record Config tab contains the controls for the analog input: the input source (differential versus single-ended), the bandwidth (audio versus wide), and the coupling type (AC-coupled versus DC-coupled). The tab also features sliders for adjusting the digital volume as well as the phase and gain calibrations. On the right-hand side, there are dropdown menus for selecting the high-pass filter (HPF) cutoff frequency and the latency of the decimation filter.

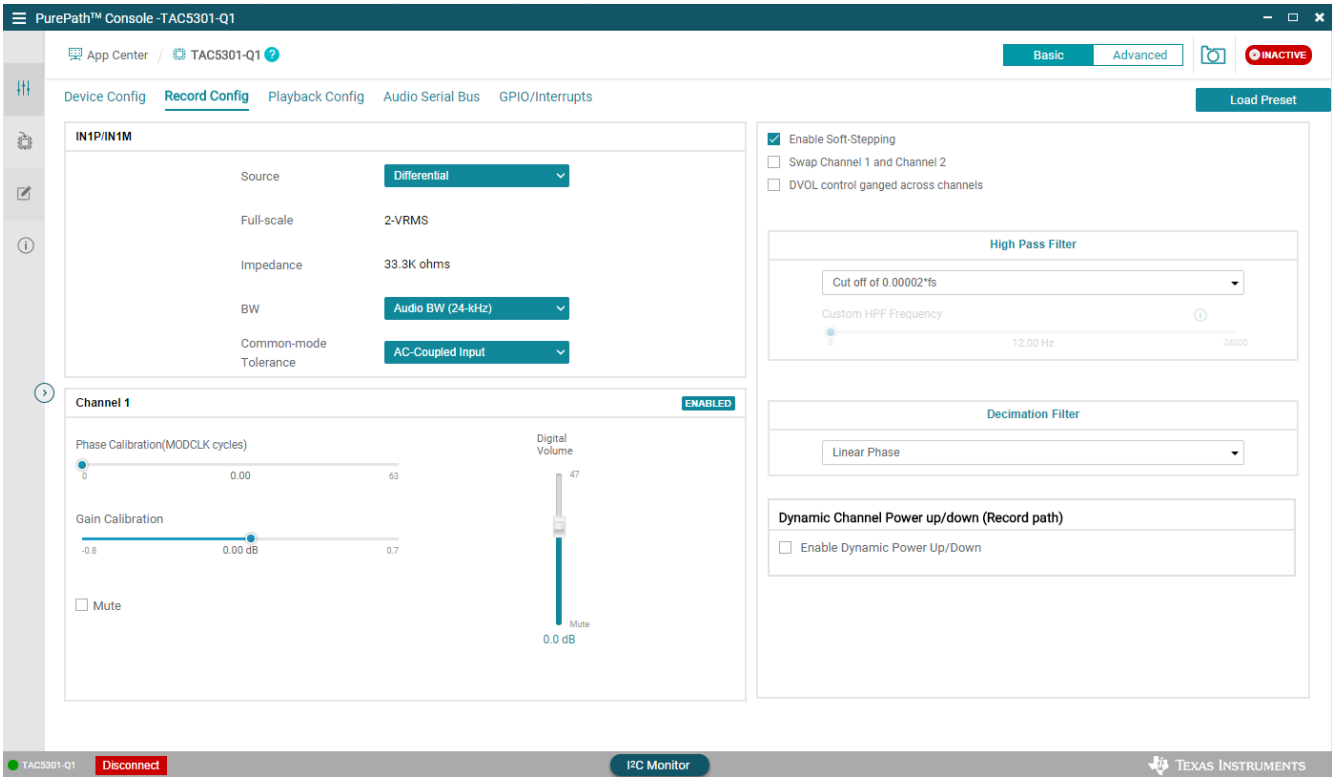


Figure 3-11. Record Config Tab

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3.3.2.3 Playback Config Tab

The Playback Config tab provides the configurations to set the audio analog output configuration type, the output driver and gain level, as well as the bandwidth and output common voltage (VCOM), each selectable from the respective dropdown menu. On the right hand side, the tab provides the high pass filter (HPF) cutoff frequency and the latency of the DAC filter. This tab also includes gain calibration and digital volume sliders to adjust the output level.

Depending on the selection of output configuration, some of the controls are grayed out, which means these controls are not available to configure.

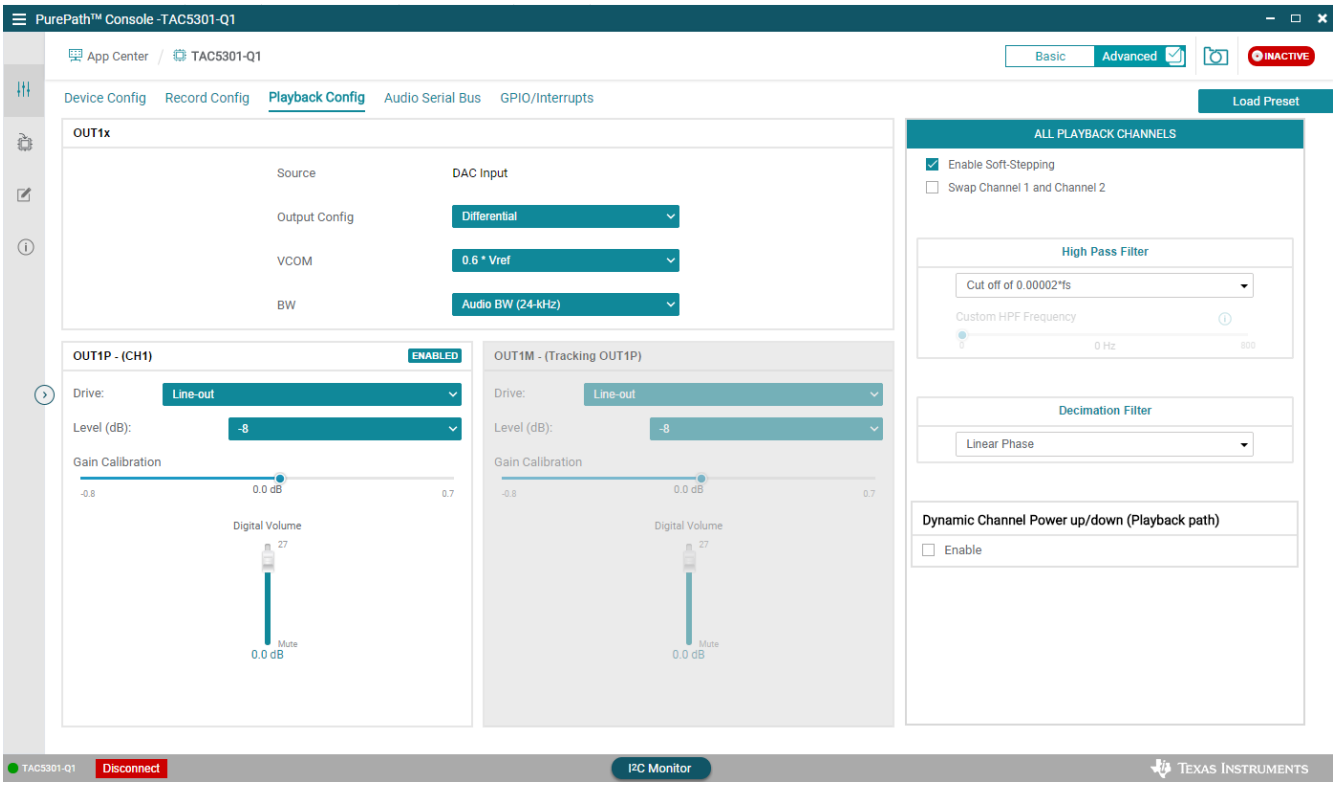


Figure 3-12. Playback Config Tab

3.3.2.4 Audio Serial Bus Tab

The TAC5301-Q1 features a very flexible audio serial bus, allowing this device to function seamlessly with a wide range of DSPs, SoCs, or other audio devices. The Audio Serial Bus tab provides controls to configure the EVM to the required audio protocol format, sample rate, word length, and channel slot assignment for both transmit (ADC) and receive (DAC) data paths.

In addition to the primary audio serial bus, the device supports a secondary audio serial bus when needed to interface with an external controller/device with the same flexibility.

3.3.2.4.1 Configuring Primary Audio Serial Bus

The main configurations for the Audio Serial Bus are under the Primary ASI Format Configuration box. This allows the user to select between TDM, I2S, or LJ protocol, 16, 20, 24, or 32 bit word length, and controller or target mode from the dropdown selections. There are also checkboxes available to invert the FSYNC or BCLK polarity, or data transmit edge to increase flexibility and match any clocking format.

The Sample Rate can also be edited in this window. The default is Auto Detection of the FSYNC pin, but in case the user prefers to provide the value in the GUI, the dropdown under Sample Rate can be switched to Provided By User, which makes the Sample Rate box editable.

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Controller Mode must be selected to edit the settings in the Controller Mode box, which is grayed out when Target Mode is selected. Controller Mode requires GPIO1 to be configured as CCLK to operate, which is done in the CCLK Selection dropdown in this window.

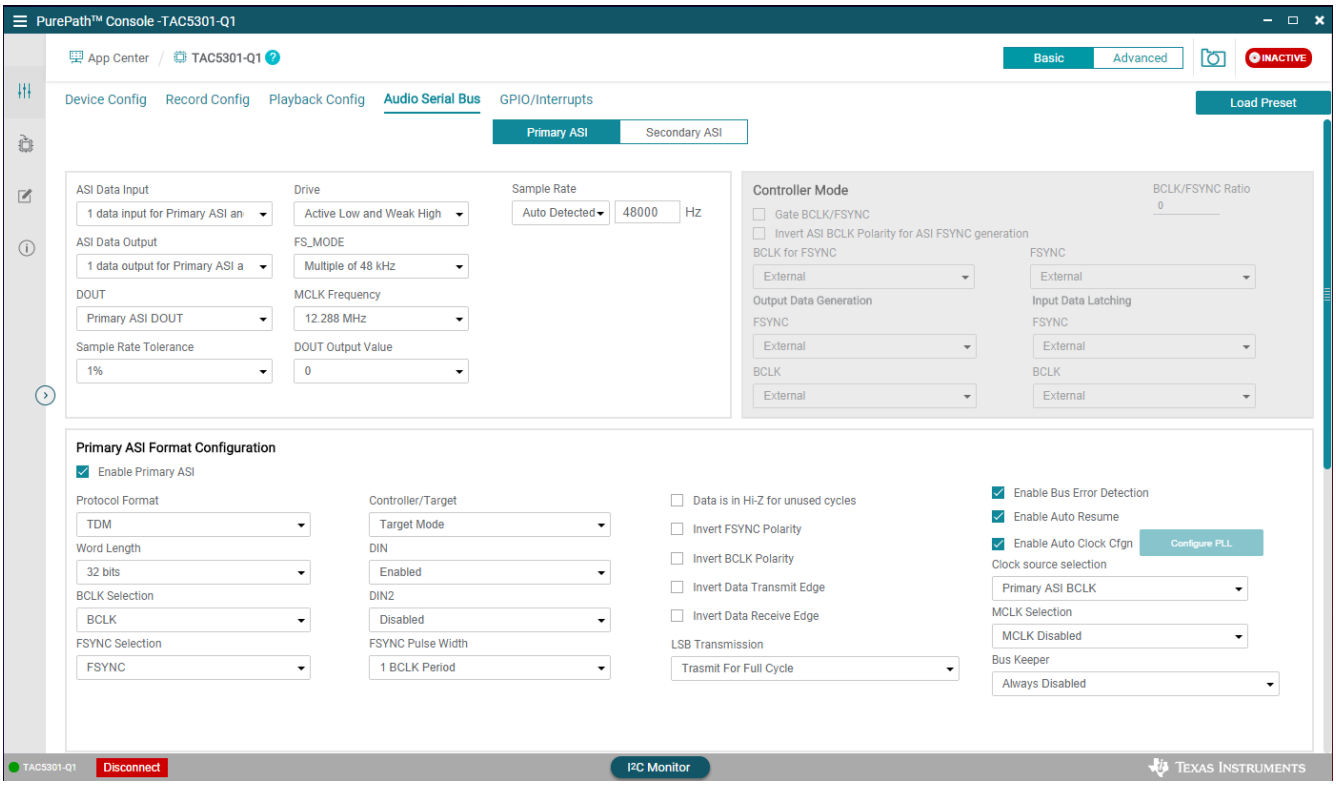


Figure 3-13. Primary Audio Serial Bus

The Audio Serial Bus tab also provides a visual of the audio serial bus to establish the format matches between audio transmitter and receiver.

Each ADC channel can be individually enabled or tri-stated on the audio bus by selecting in the TX output dropdown. Each channel must also have a unique slot assignment configuration. Since TAC5301-Q1 is a mono-channel ADC, only one channel must be enabled on the TX serial bus.

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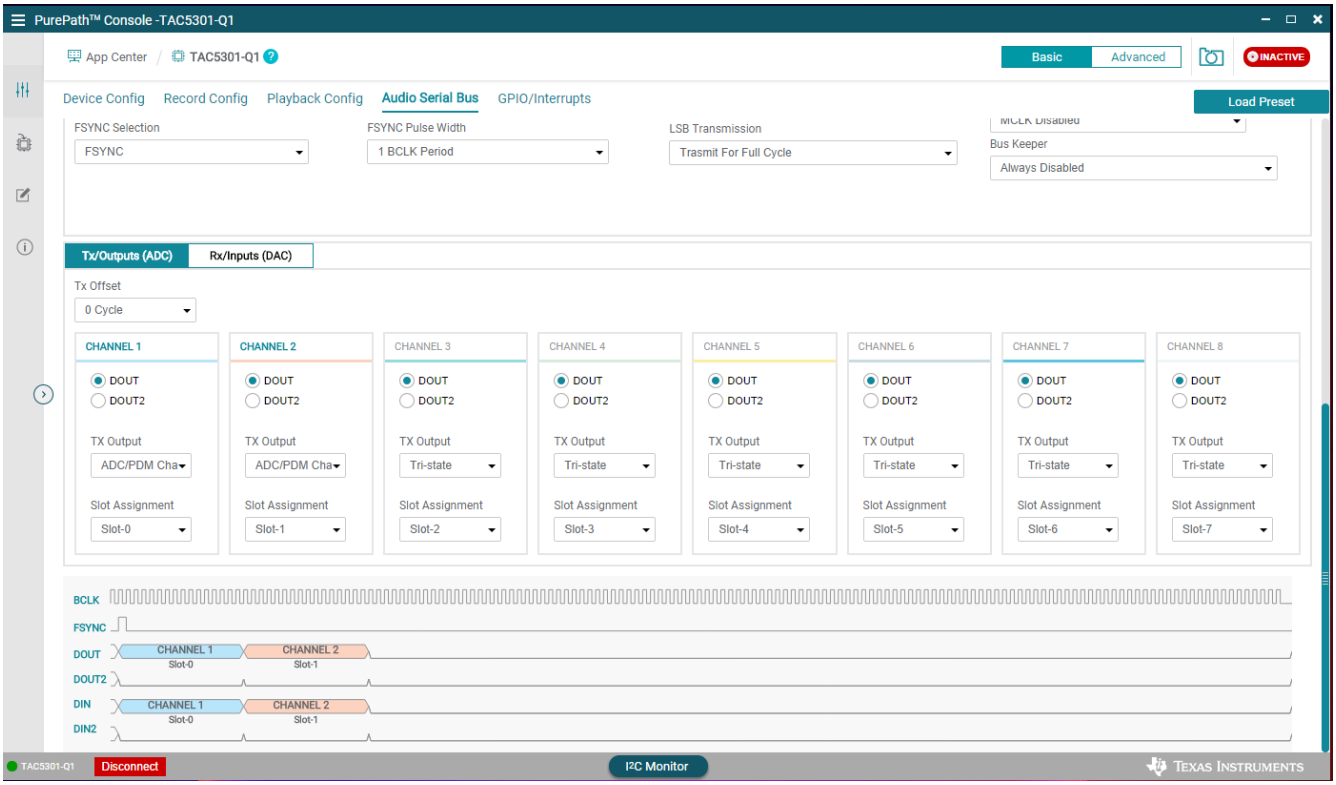


Figure 3-14. Primary Audio Serial Bus TX

To switch to the DAC view, select the RX/Inputs (DAC) tab and the DAC channels appears. Each DAC channel can be individually enabled or tri-stated on the audio bus by selecting in the RX output dropdown. Each channel must also have a unique slot assignment configuration. The DAC can output two channels in the Stereo Single-Ended output configuration, otherwise only one channel can be output on the RX bus.

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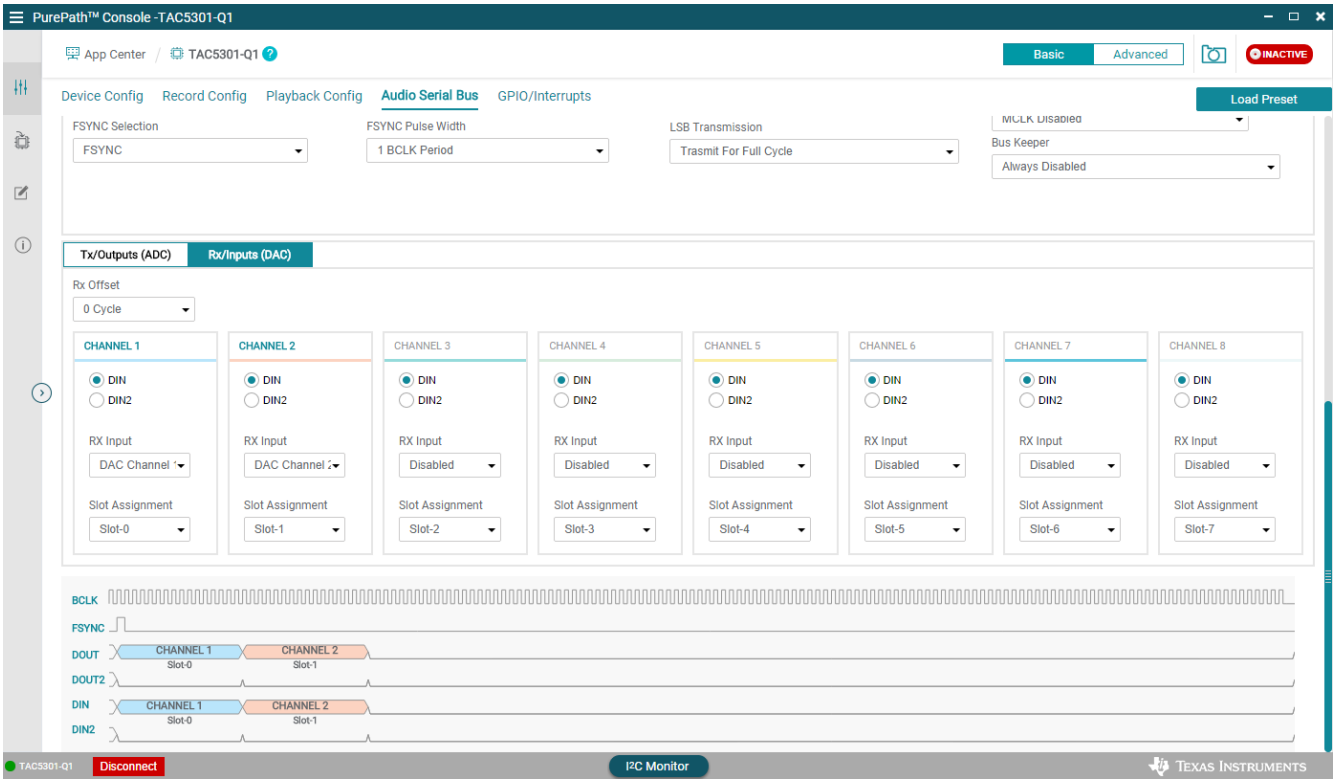


Figure 3-15. Primary Audio Serial Bus RX

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3.3.2.4.2 Configuring Secondary Audio Serial Bus

A similar audio serial bus setting to the Primary interface is available under the Secondary ASI tab when a second audio serial bus is needed. To enable the secondary ASI, the box under Secondary ASI Format Configuration must be checked. For ease of configuration, there is another checkbox to set the Secondary ASI identically to the settings of the Primary ASI. Otherwise, the settings can be configured separately, with the same options available as the Primary ASI tab.

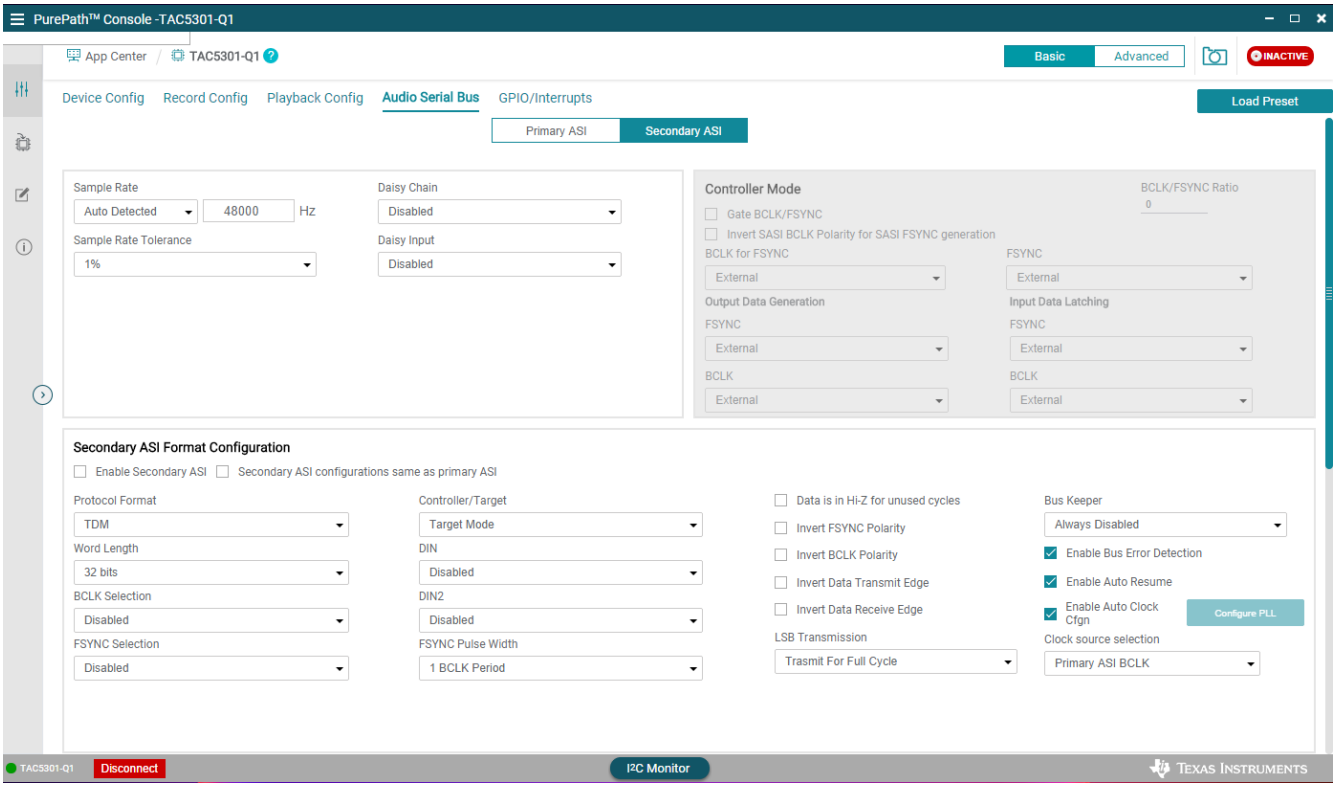


Figure 3-16. Secondary Audio Serial Bus

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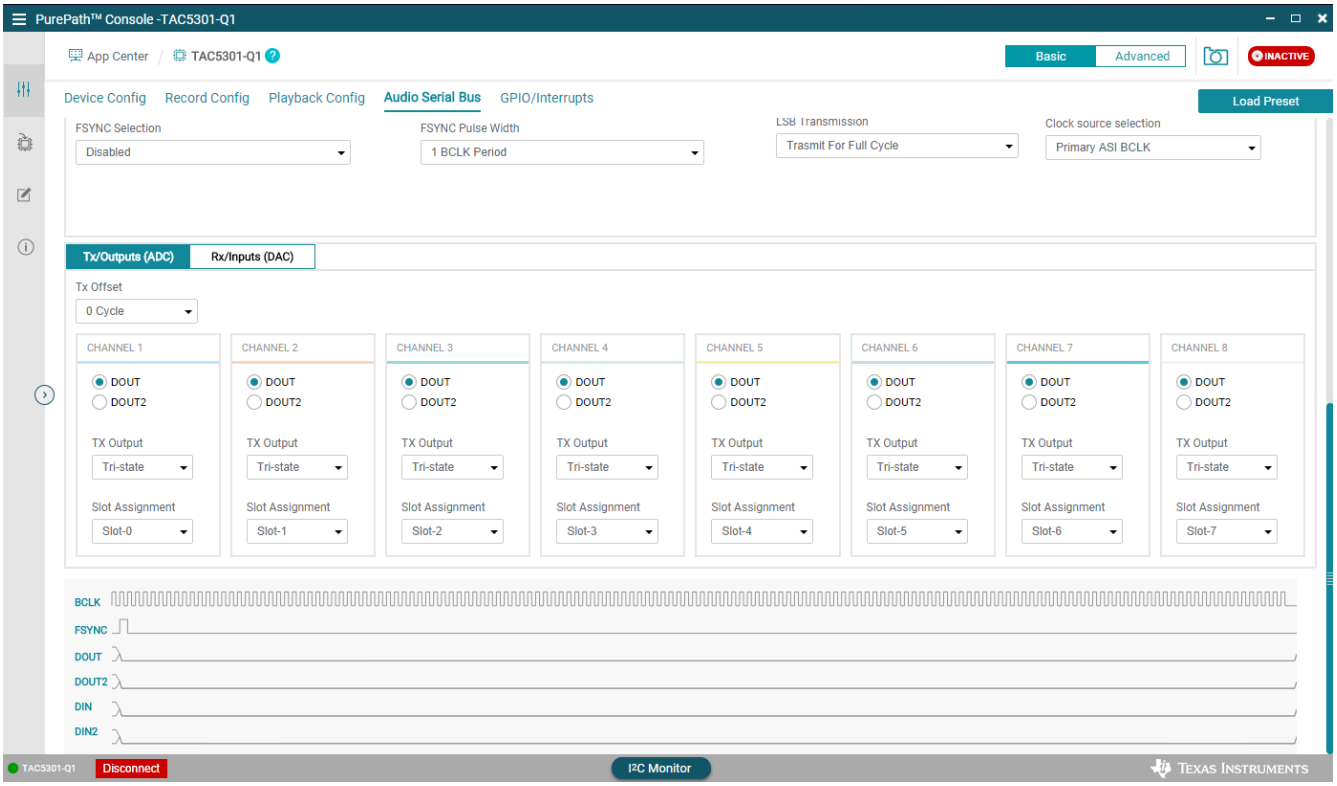


Figure 3-17. Secondary Audio Serial Bus TX

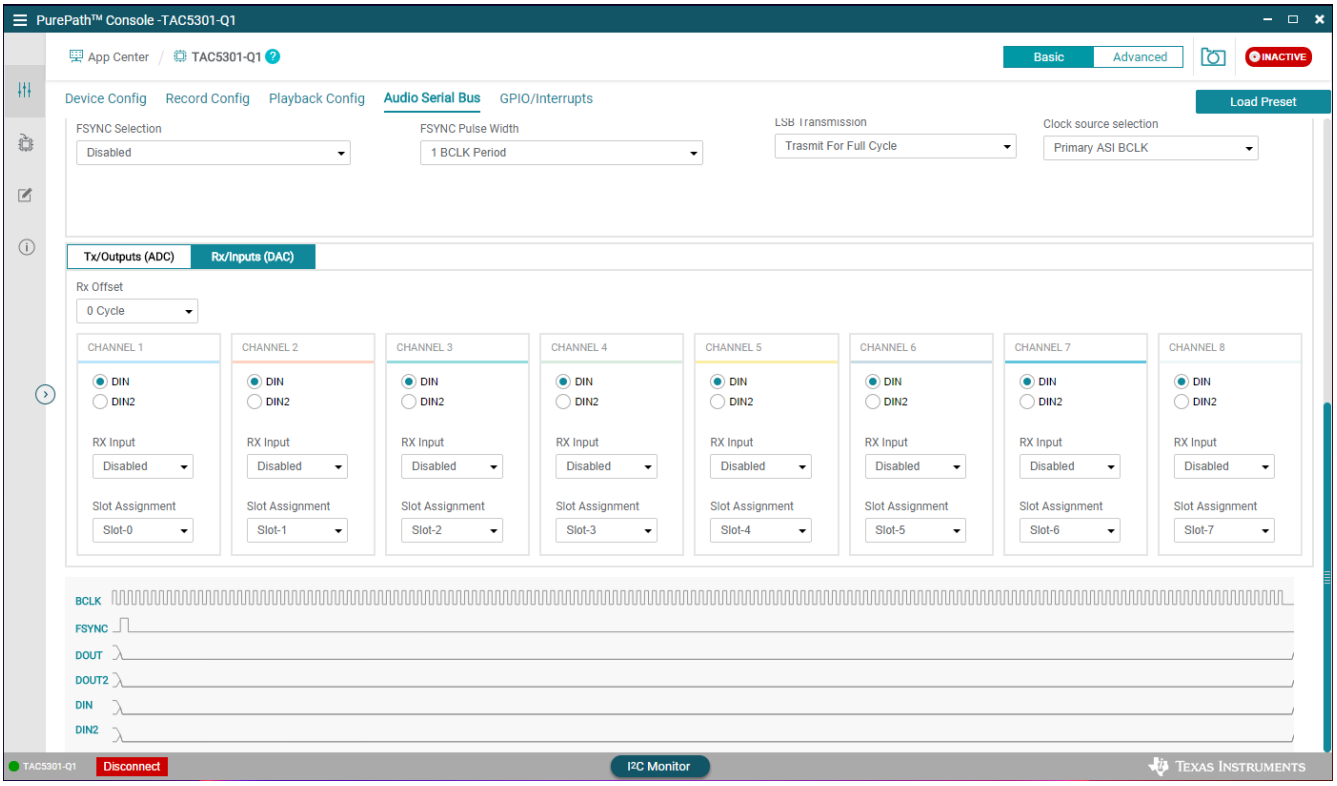


Figure 3-18. Secondary Audio Serial Bus RX

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3.3.2.4.3 Example Configuring I2S Interface

The TAC5301-Q1 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/LJ. This section shows a configuration example for a 2-channel I2S output to a USB audio at 16 bits and 48kHz.

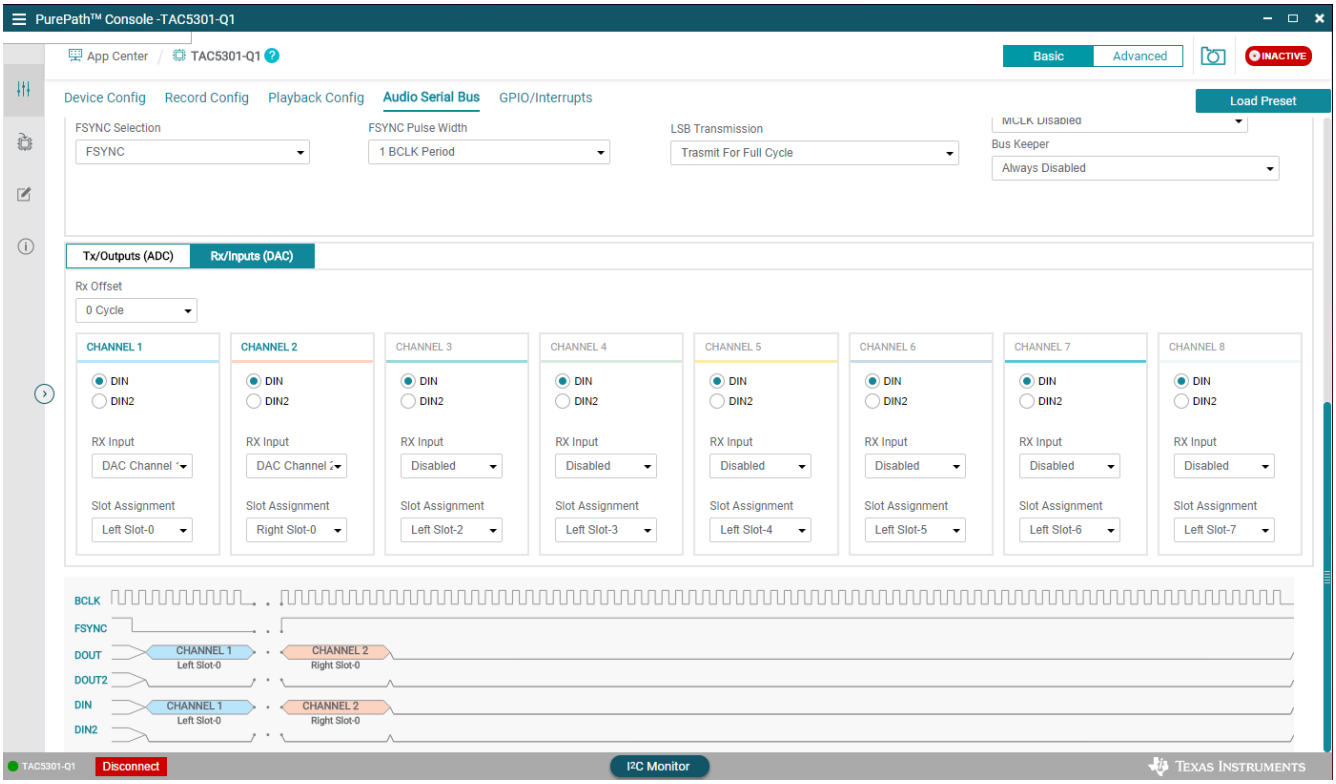


Figure 3-19. Configuring I2S Example

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3.3.2.5 GPIO/Interrupts Tab

As shown in the figure below, the GPIO function and interrupt behavior can be configured in this tab. There is one General Purpose Input Output (GPIO1) on the TAC5301-Q1. This general-purpose input/output driver also provide several multiplexing functions that can be selected in the GPIO1 Function dropdown. Depending on the selection, some controls are grayed out.

On the right side is the Interrupt selection, which has the interrupt settings as well as flag update/status of the respective interrupt. The Update button can be clicked for a live readback of the latched registers. If an LED turns red, this means this interrupt has been triggered. The checkbox next to each interrupt can be unchecked to unmask the fault to output the interrupt to GPIO1 if configured as an IRQ pin.

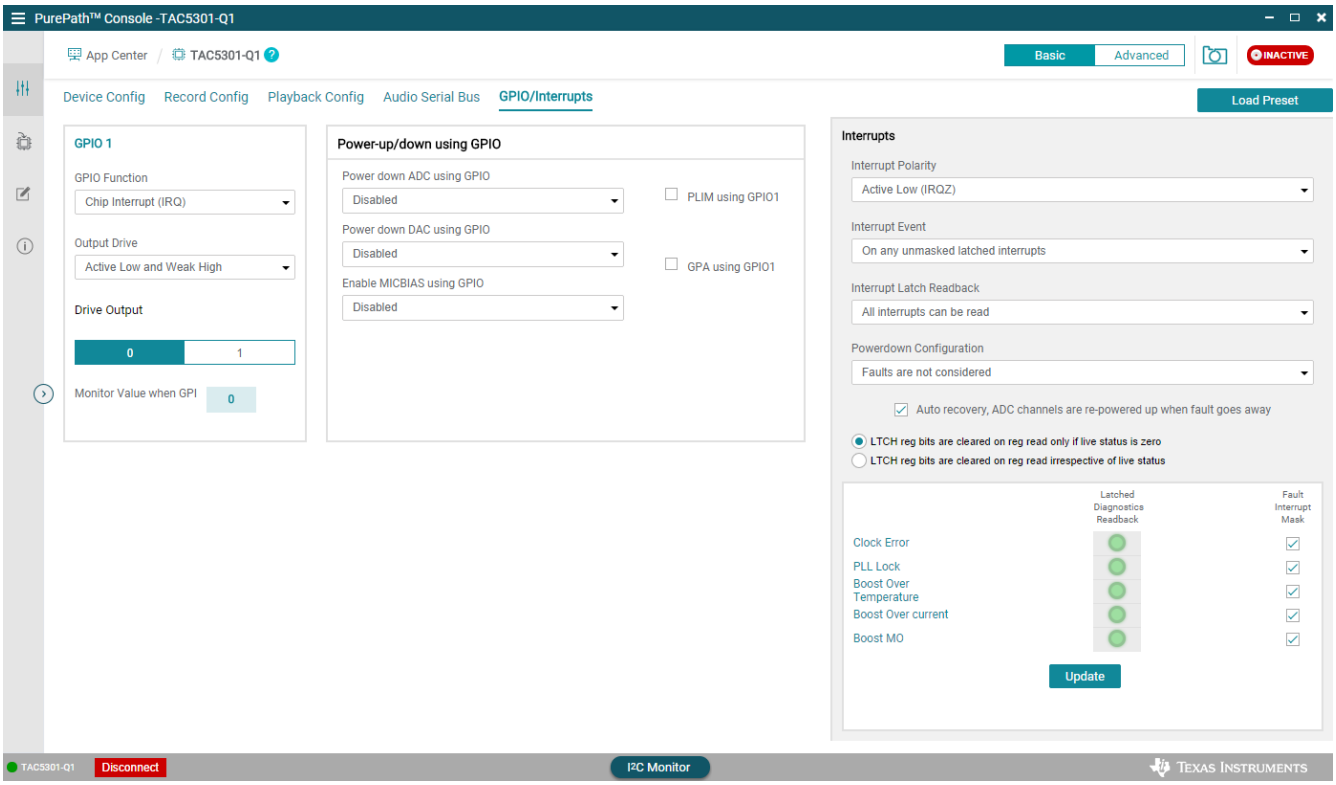


Figure 3-20. GPIO/Interrupts Tab

3.3.2.6 Advanced Tabs

The following tabs are available in the Advanced feature. Click the checkbox in the Advanced tab in the top right of the window to display a selection of other features. Select the feature and click Apply to reveal the tab in the toolbar.

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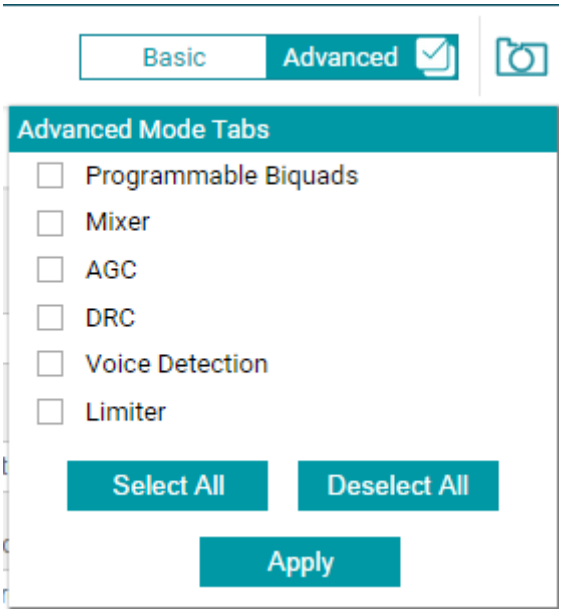


Figure 3-21. Advanced Mode Tabs

3.3.2.6.1 Programmable Biquads Tab

Configuration of the biquad filters is made easy with the GUI in the Programmable Biquads tab. Biquad coefficients can be generated using the filter designers within PPC3, or coefficients from an external filter design tool can be manually entered. Each biquad can be configured individually and then the gain and phase responses can be shown for individual channels or for all channels. Note PPC3 uses the detected sampling rate from the audio serial bus tab to determine the biquad coefficients. The TAC5301-Q1 device must be receiving the desired sampling rate when the audio serial bus tab is opened, and the clock monitor must be updated by clicking on the Read button. If no EVM is connected, PPC3 assumes a sample rate of 48kHz for all biquad calculations.

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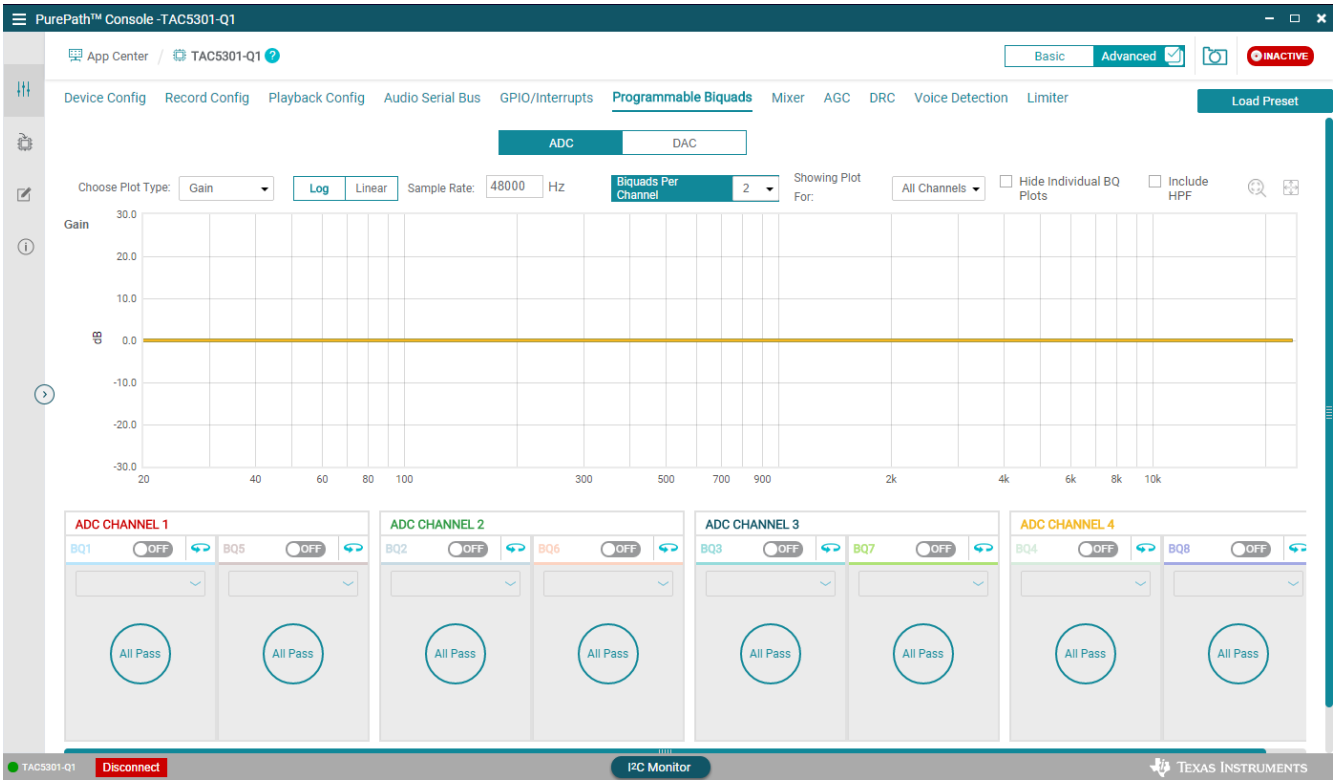


Figure 3-22. Programmable ADC Biquads Tab

To enable an individual biquad, click the ON/OFF slider for the specific biquad under the desired channel. By default, 2 biquad filters are enabled per channel. This can be changed to 0, 1, 2, or 3 biquads per channel in the dropdown in the middle of the screen in the top row.

Once the biquad is enabled, the dropdown in the BQx box reveals several filter types that can be selected to design the biquad filter. The box auto populates with the configurable parameters for the selected filter. The user can click the spinning arrow next to the ON/OFF slider to view the filter coefficients generated by the parameter selection. This window can also be used manually input the filter coefficients for a filter designed with an external tool.

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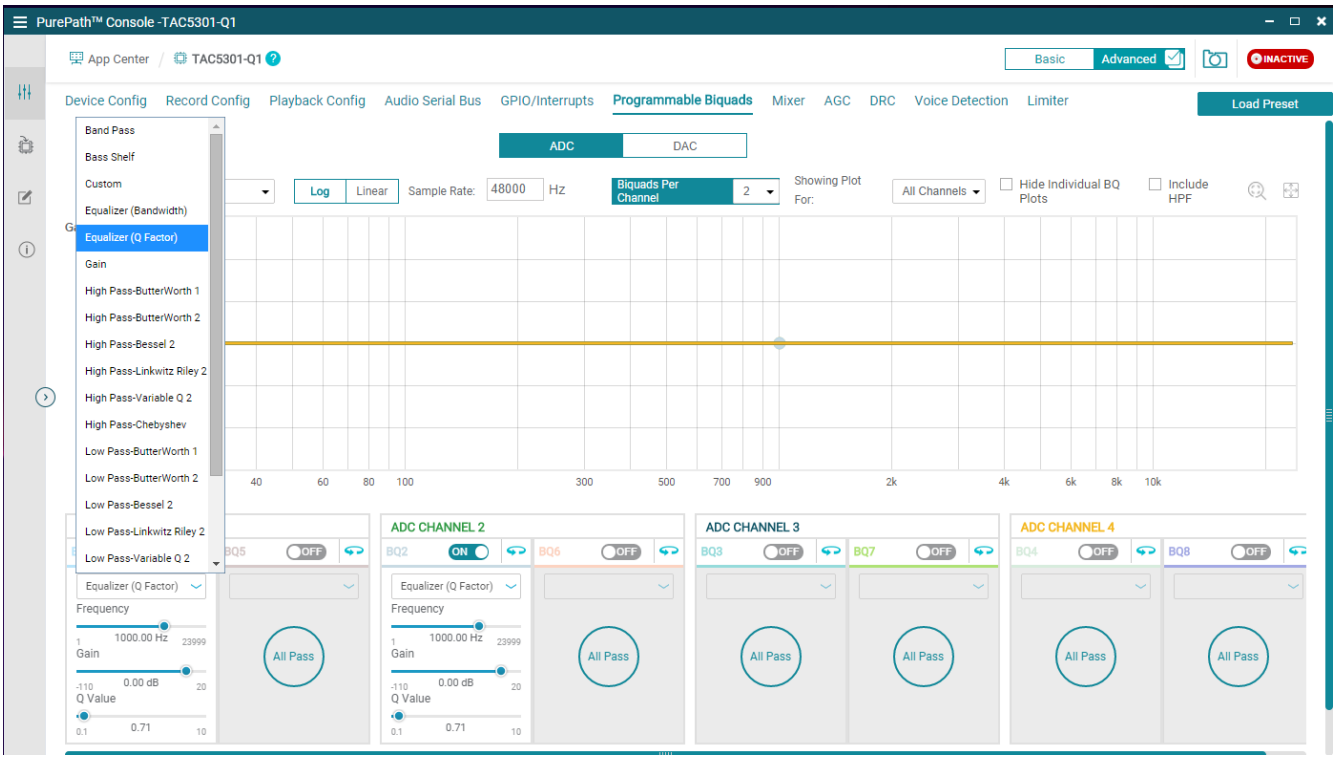


Figure 3-23. Programmable Biquads Filter Types

A similar configuration tab is available for the DAC channels by selecting the DAC tab near the top of the screen.

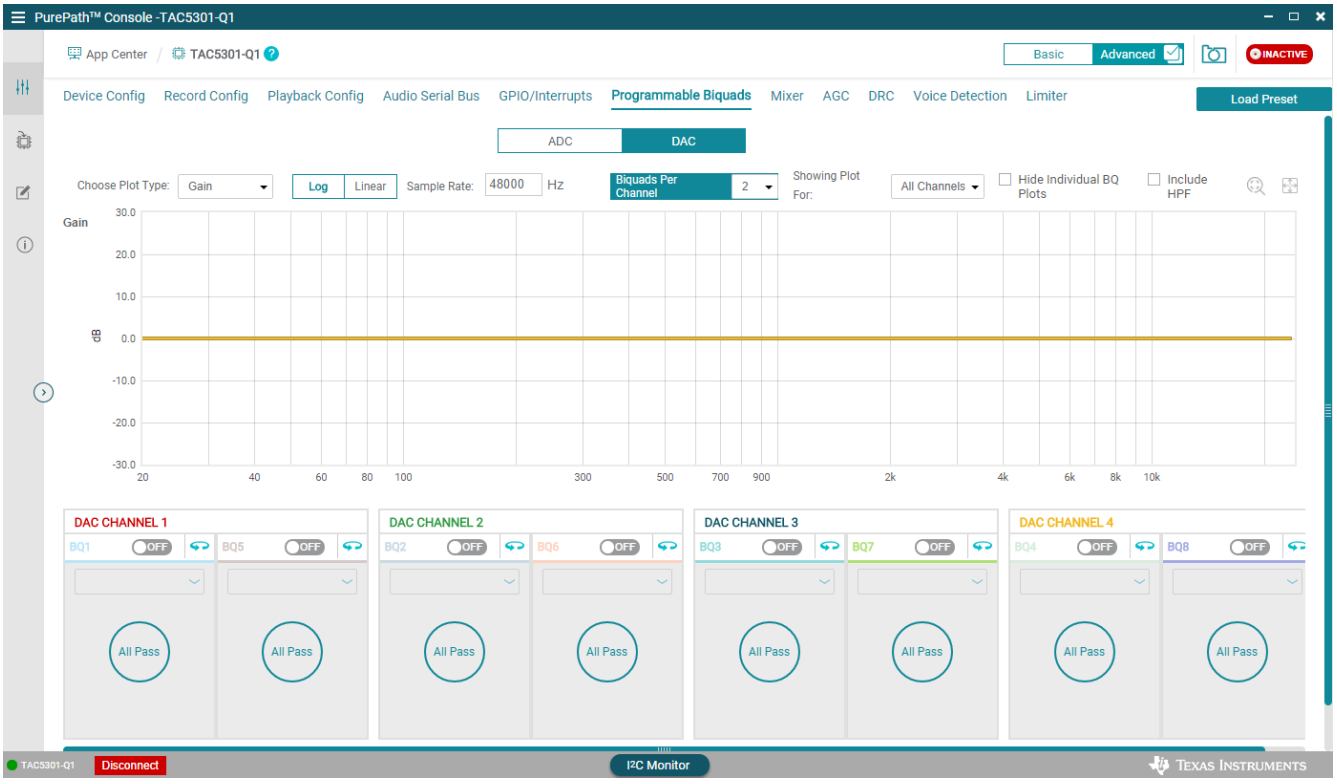


Figure 3-24. Programmable DAC Biquads Tab

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3.3.2.6.2 Mixer Tab

The TAC5301-Q1 device supports several mixing features, allowing the user to mix the data from input channel 1 to any channels 1-4. Each channel has a coefficient slider to select the factor (between -1.0 to 1.0) by which to multiply the channel 1 input to output to that channel.

The ADC tab also offers Loopback and Auxiliary Mixer functions. See TAC5x1x and TAC5x1x-Q1 Digital Channel Mixers - Configurations and Application for more details on these functions.

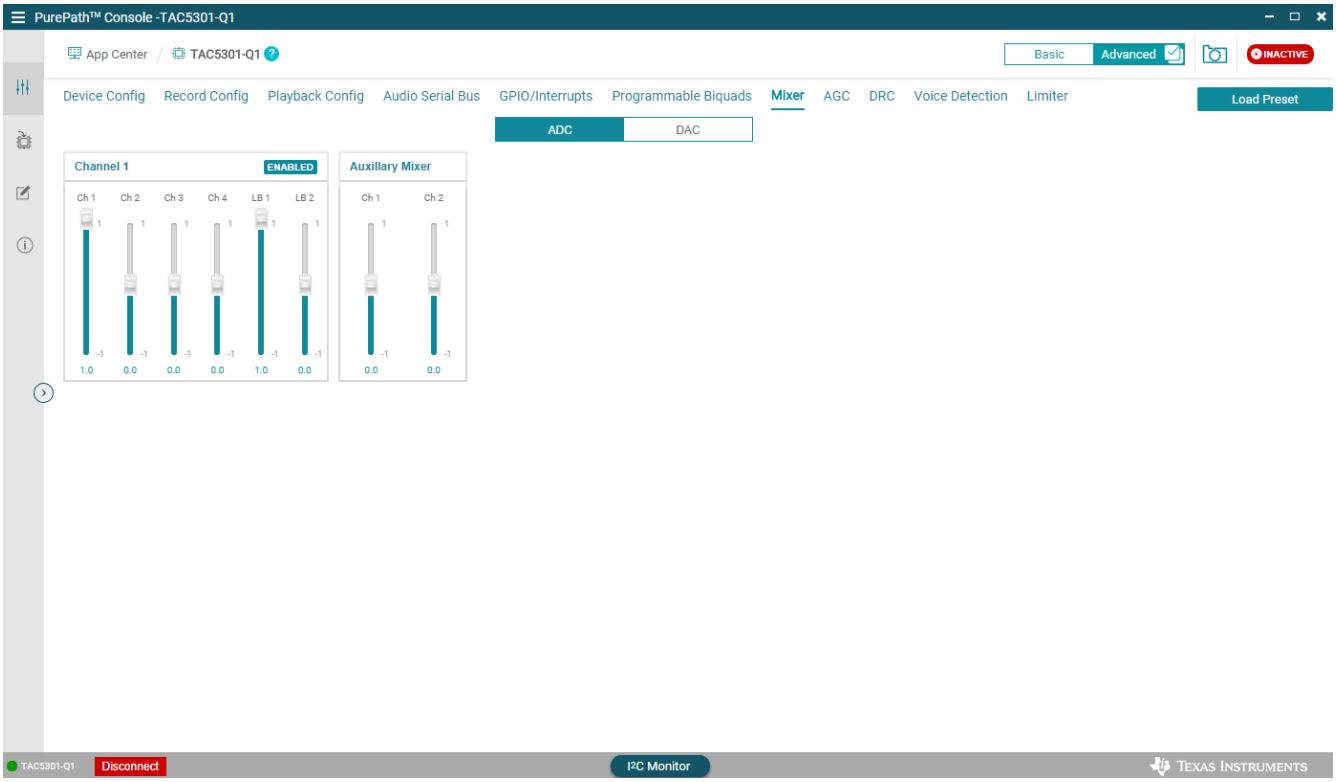


Figure 3-25. ADC Mixer Tab

The DAC signal chain mixers can be configured on the DAC tab on the Mixer page.

This tab also features options to set the Envelope Modulator, and Beep and Chirp signal generators. These can be enabled in the SIG GEN checkboxes at the end of the Channel 1 mixers. See the Tone Generation and Application Modes of TAx5x1x Devices for more details on setting these parameters.

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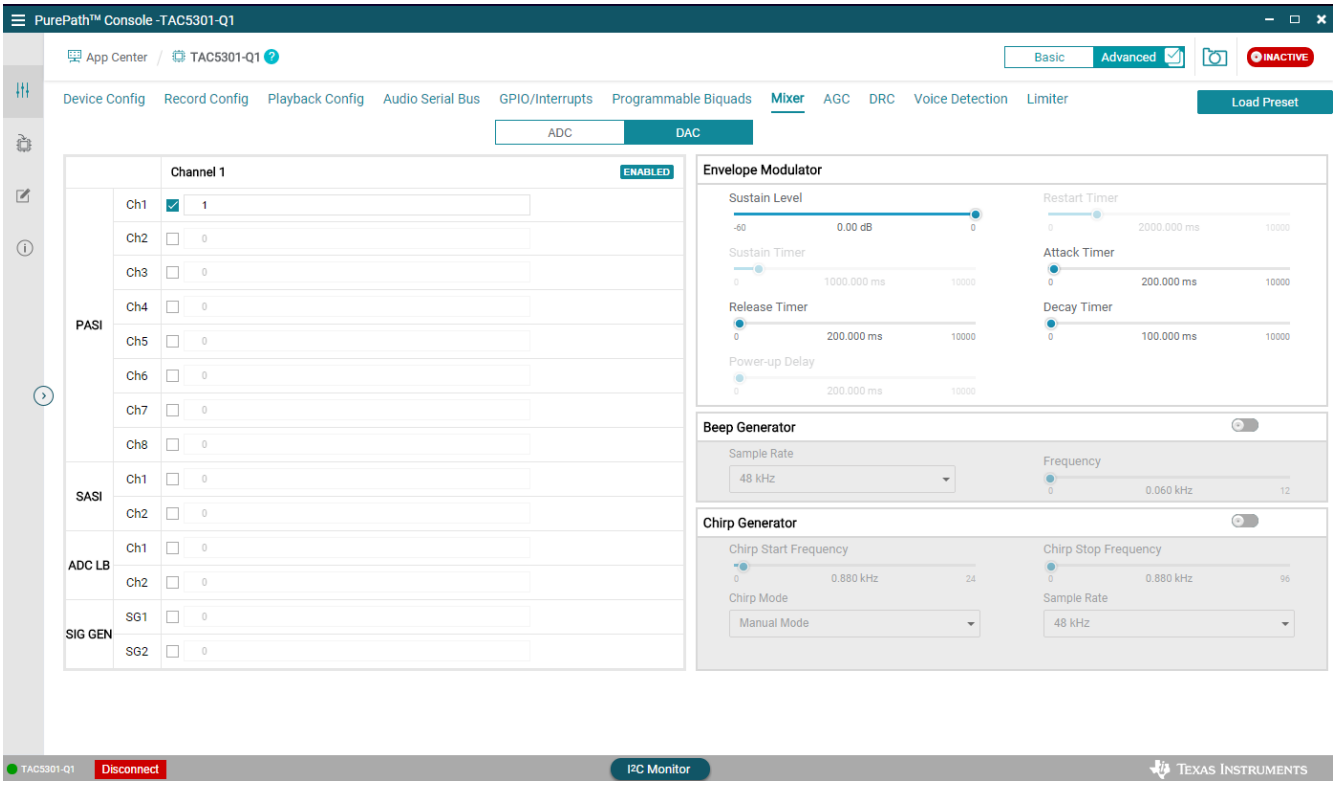


Figure 3-26. DAC Mixer Tab

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3.3.2.6.3 Automatic Gain Control (AGC) Tab

The device includes an automatic gain controller (AGC) for ADC recording. The AGC parameters are global and are configured in the AGC tab. To enable the AGC on the ADC channel, select the Disabled button in the top right of the AGC Enable box, and check next to ADC Channel 1. These software controls are grayed out and inactive while the device is in active mode, as AGC settings must not be changed easily.

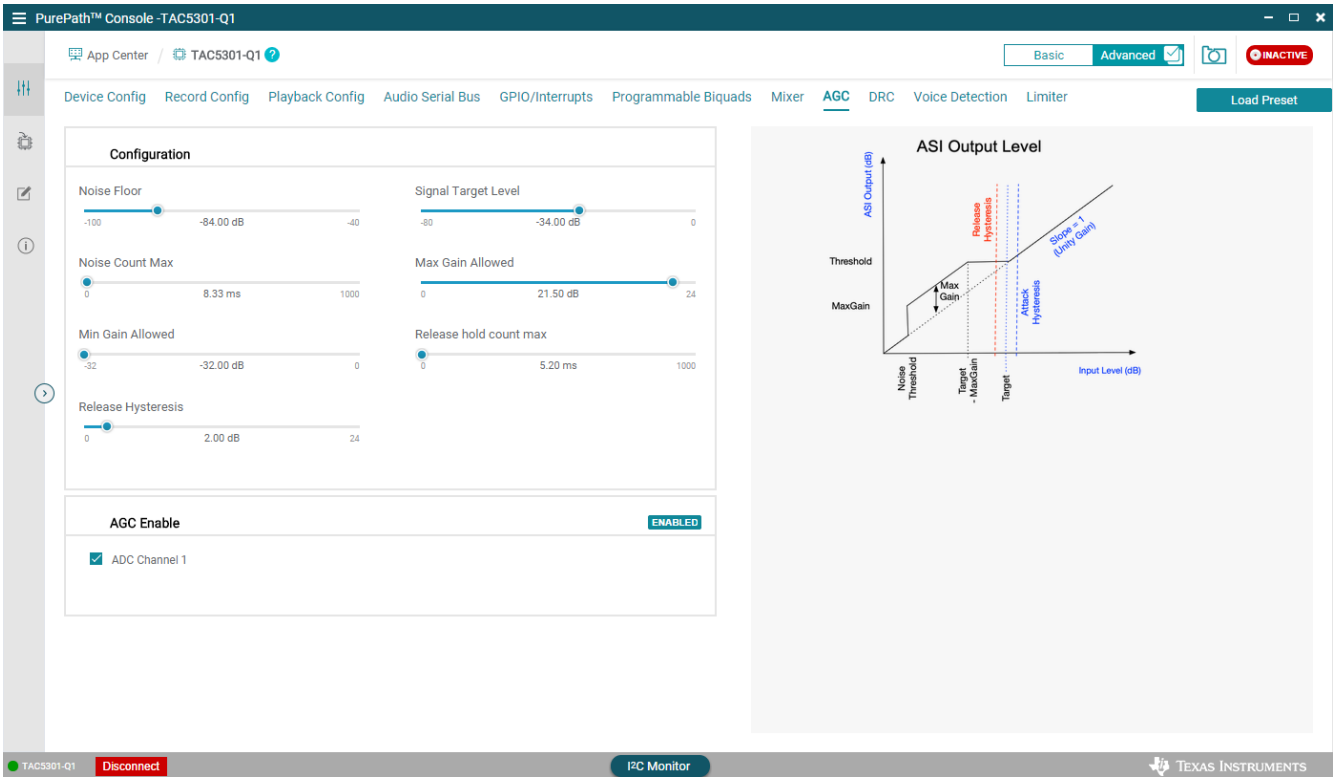


Figure 3-27. AGC Tab

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3.3.2.6.4 Dynamic Range Controller (DRC) Tab

The TAC5301-Q1 features a Dynamic Range Controller for DAC playback. The DRC parameters are global and can be configured in the DRC tab. To enable the DRC on the DAC channel, click the Disabled button in the top right of the DRC Enable box, and check next to DAC Channel 1.

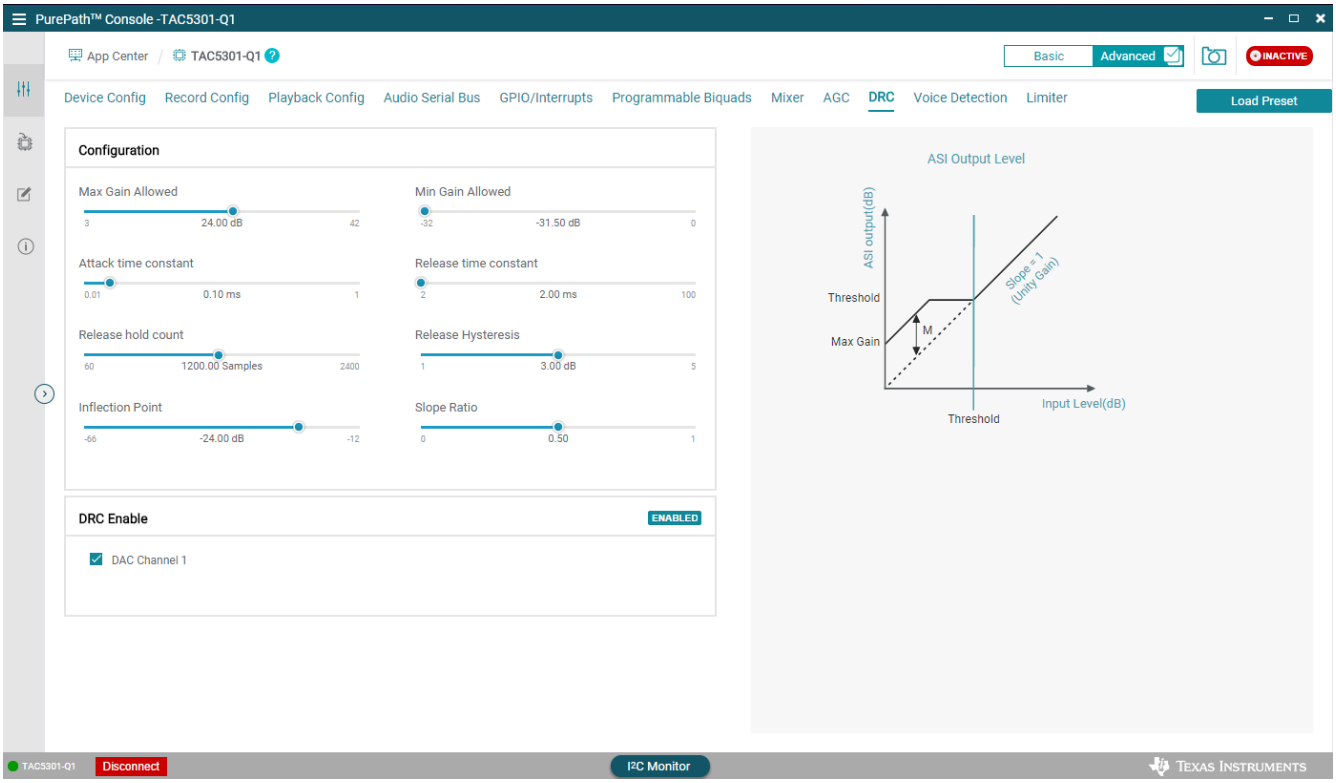


Figure 3-28. DRC Tab

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3.3.2.6.5 Voice Detection (VAD) Tab

The TAC5301-Q1 supports Voice Detection on the ADC path, with adjustable parameters in this tab. See How to use the Voice Activity Detection for more information on how to interpret and set these parameters.

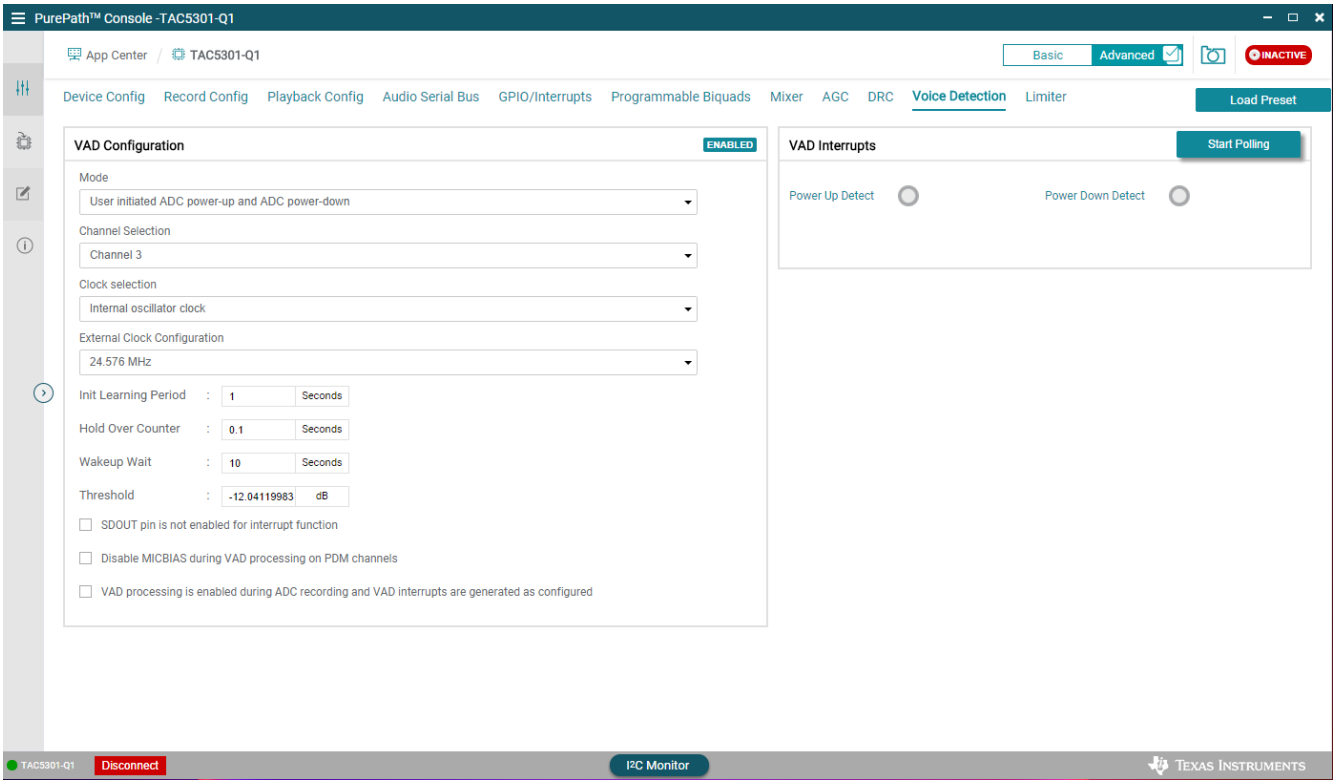


Figure 3-29. Voice Activity Detection

3.3.2.6.6 Limiter Tab

Finally, the TAC5301-Q1 supports features in the DAC signal chain for Brown-Out Protection, Distortion Limiter, and Thermal Foldback. These can be individually enabled and parameters configured in the Limiter tab.

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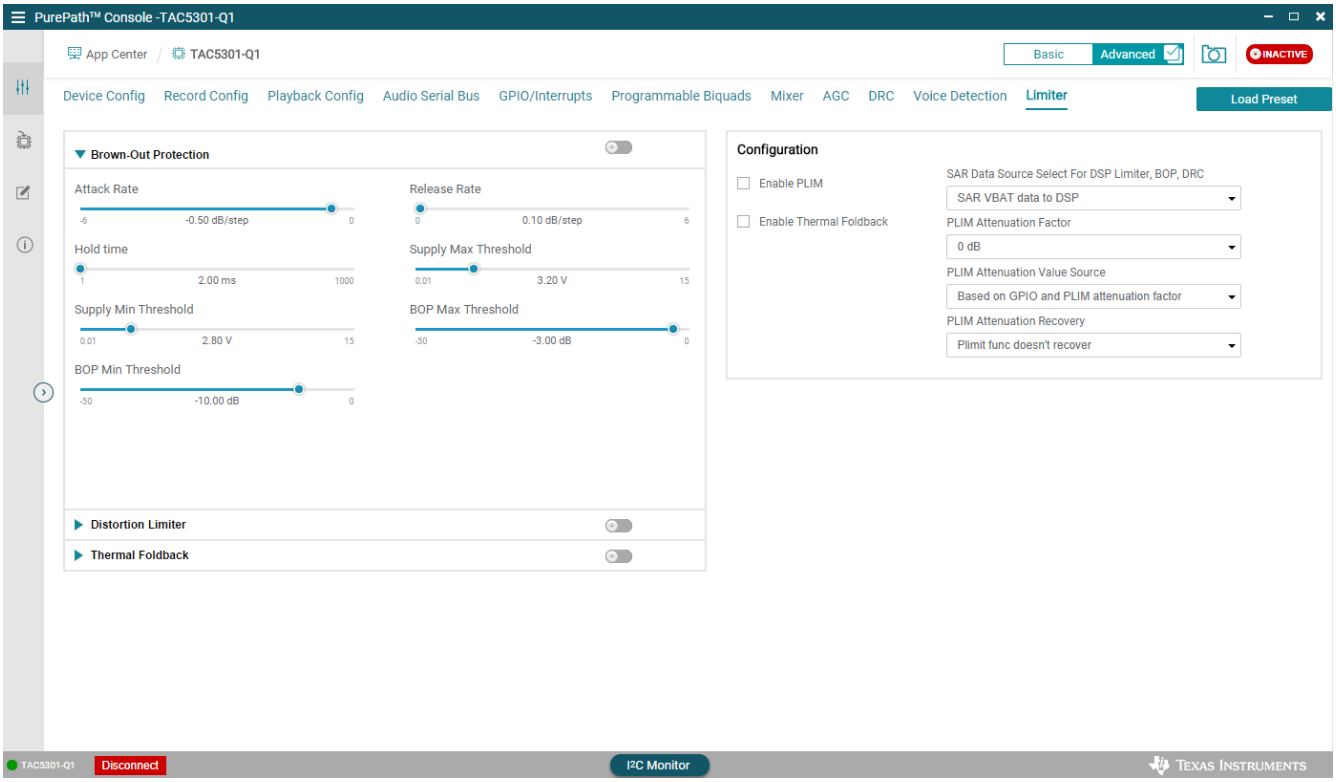


Figure 3-30. Limiter Tab

3.3.2.7 End System Integration View

The End System Integration view provides methods for exporting the current configuration to a header (.h) or .cfg file. The header file can be used for quick integration with a simple microcontroller.

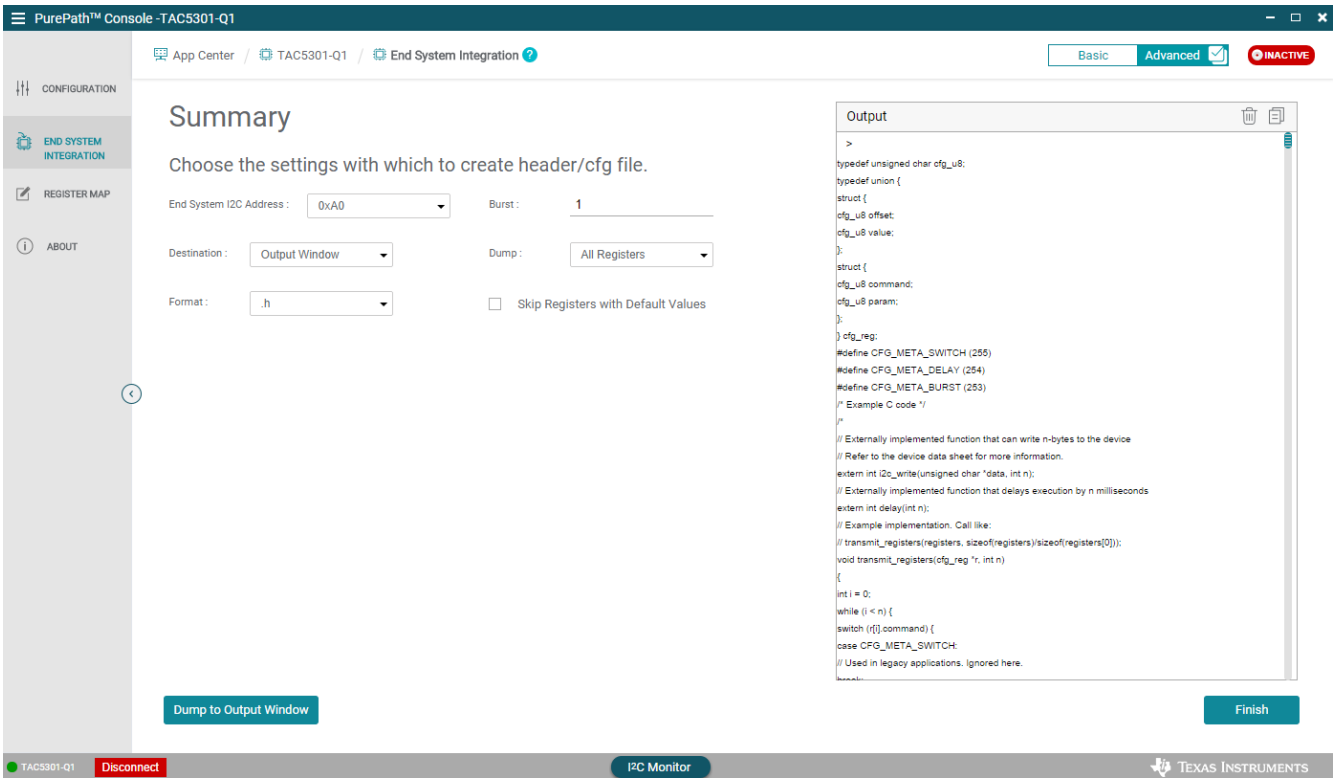


Figure 3-31. End System Configuration

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3.3.2.8 Register Map View

The register map view provides a view of page 0, page 1 and page 3 of the register map.

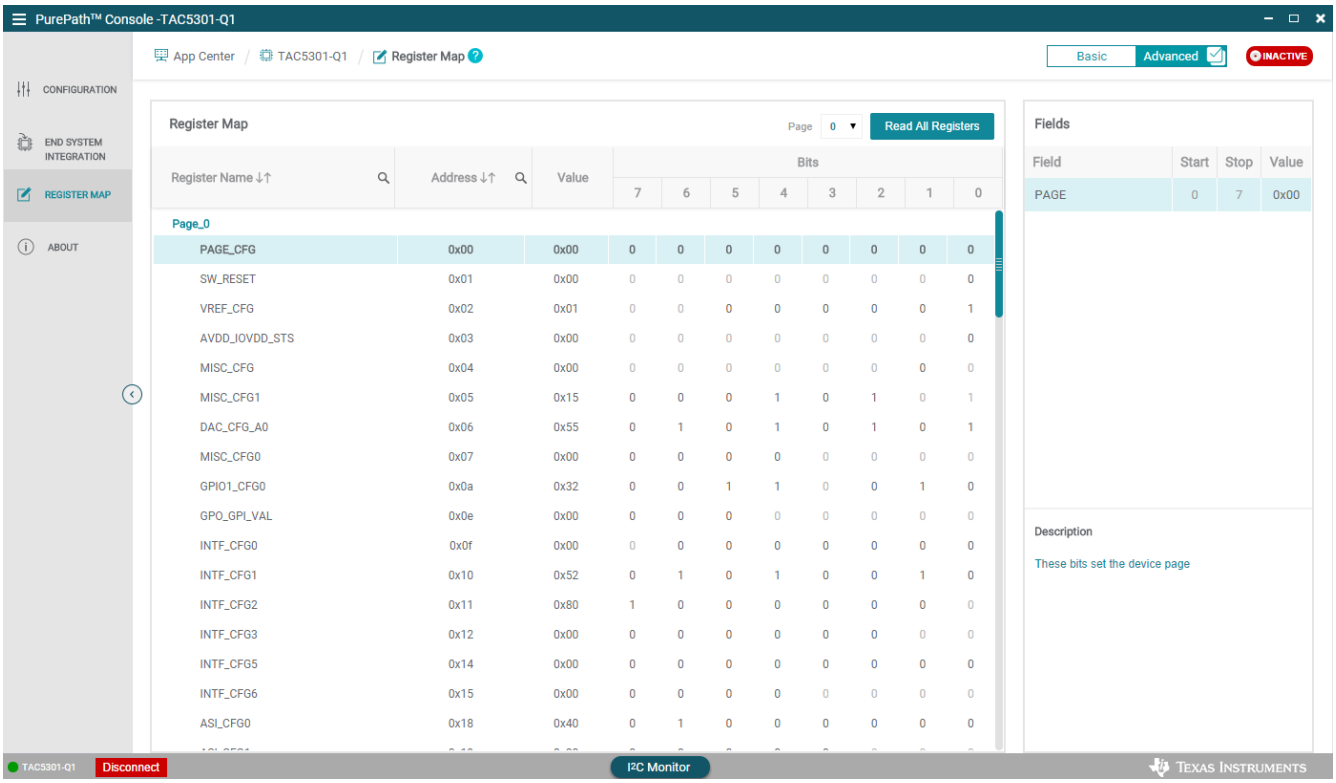


Figure 3-32. Register Map View

3.3.2.9 I2C Monitor View

The I2C Monitor tab allows user to load existing device configuration files or direct I2C transactions to configure the device registers. To access this window panel, click on the I2C Monitor button at the bottom of the GUI and the I2C monitor window opens as shown Figure 3-33. By clicking the green circle in the top right of the window, the user can record the I2C transactions made when making a change in the GUI. This is helpful in identifying which registers correspond to which GUI settings.

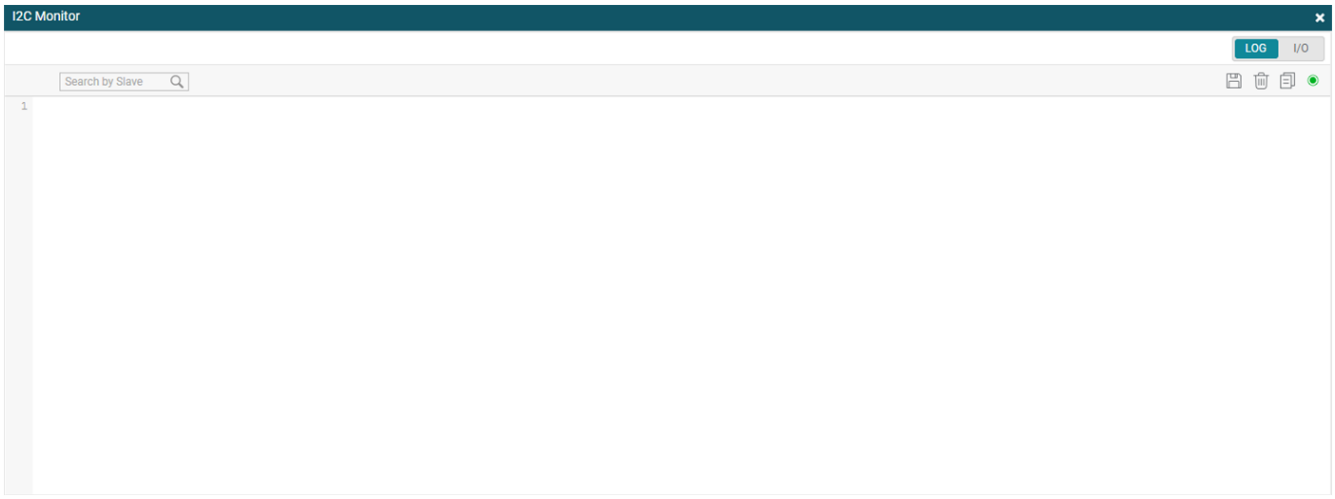


Figure 3-33. I2C Monitor Window

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Click on the I/O button in the top right corner to access the input/output panel. This window allows a custom script to be uploaded to the EVM. The output window displays whether each I2C command is executed successfully, or if there is an error.

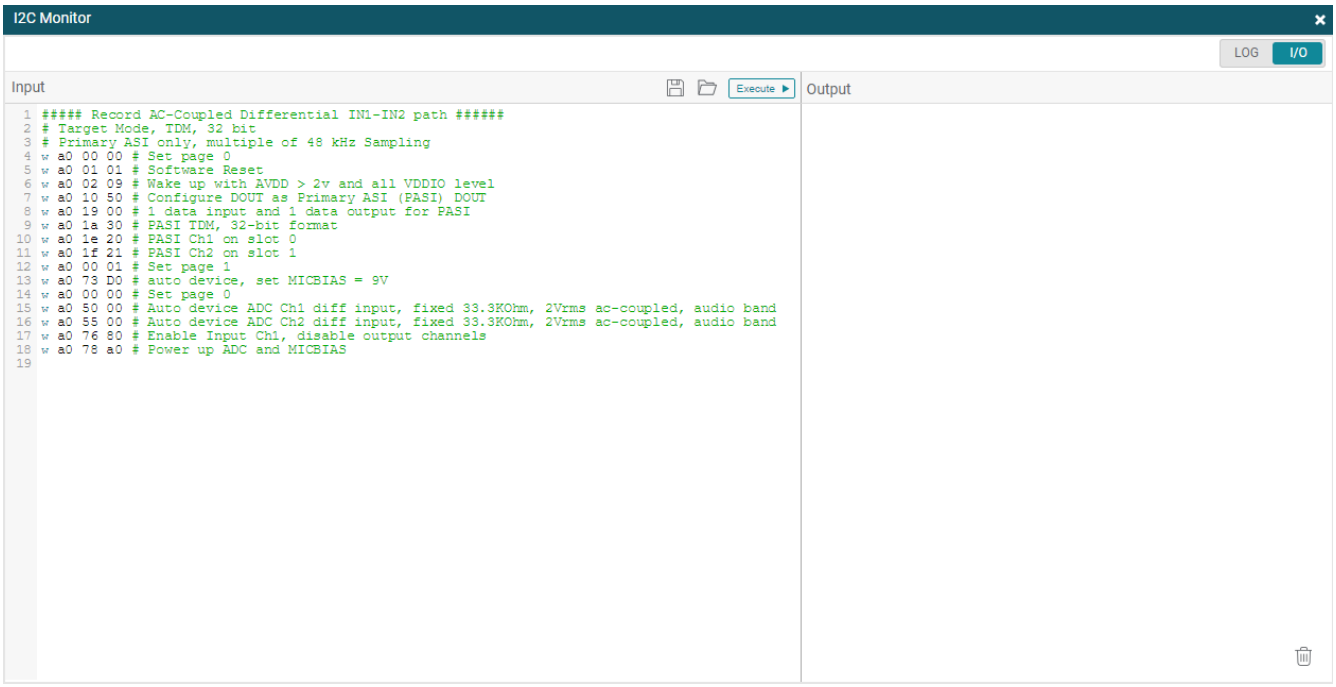


Figure 3-34. I2C Monitor I/O Window

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3.4 Configuration Examples

The following are several examples to configure the device into the respective paths. The user can copy the settings below and paste into the I2C Monitor window.

- Target Mode, Differential AC-coupled Recording with PASI.

This configuration is for differential audio recording (ADC) with a 48kHz sampling rate, TDM format, and 32-bit depth.

```
##### Record AC-Coupled Differential IN1-IN2 path ######
# Target Mode, TDM, 32 bit
# Primary ASI only, multiple of 48kHz Sampling

w a0 00 00        # Set page 0
w a0 01 01        # Software Reset
w a0 02 09        # Wake up with AVDD > 2v and all VDDIO level
w a0 10 50        # Configure DOUT as Primary ASI (PASI) DOUT
w a0 19 00        # 1 data input and 1 data output for PASI
w a0 1a 30        # PASI TDM, 32-bit format
w a0 1e 20        # PASI Ch1 on slot 0
w a0 1f 21        # PASI Ch2 on slot 1
w a0 00 01        # Set page 1
w a0 73D0        # auto device, set MICBIAS = 9V
w a0 00 00        # Set page 0
w a0 50 00        # Auto device ADC Ch1 diff input, fixed 33.3KOhm, 2Vrms ac-coupled, audio band
w a0 55 00        # Auto device ADC Ch2 diff input, fixed 33.3KOhm, 2Vrms ac-coupled, audio band
w a0 76 80        # Enable Input Ch1, disable output channels
w a0 78a0        # Power up ADC and MICBIAS
```

- Target Mode, Single-Ended AC-coupled Recording with PASI.

This configuration is for single-ended audio recording (ADC) with a 48kHz sampling rate, I2S format, and 32-bit depth.

```
##### Record AC-Coupled Single-Ended IN1-IN2 path ######
# Target Mode, I2S, 32 bit
# Primary ASI only, multiple of 48KHz Sampling

w a0 00 00        # Set page 0
w a0 01 01        # Software Reset
w a0 02 09        # Wake up with AVDD > 2v and all VDDIO level
w a0 10 50        # Configure DOUT as Primary ASI (PASI) DOUT
w a0 19 00        # 1 data input and 1 data output for PASI
w a0 1a 70        # PASI I2S, 32-bit format
w a0 1e 20        # PASI Ch1 on Left slot 0
w a0 1f 30        # PASI Ch2 on Right slot 0
w a0 00 01        # Set page 1
w a0 73d0        # auto device, set MICBIAS = 9V
w a0 00 00        # Set page 0
w a0 50 40        # Auto device ADC Ch1 SE input, fixed 33.3KOhm, ac-coupled, audio band
w a0 55 40        # Auto device ADC Ch2 SE input, fixed 33.3KOhm, ac-coupled, audio band
w a0 76c0        # Enable Input Ch1, disable output channels
w a0 78a0        # Power up ADC and MICBIAS
```


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- Controller Mode, Differential AC-coupled Recording with PASI.

This configuration is for differential audio recording (ADC) with 48kHz sampling rate, I2S format and 32-bit depth, and CCLK of 12.288MHz.

```
##### Record AC-Coupled Differential IN1-IN2 path ######
# Controller Mode, I2S, 32-bit, GPIO1 = CCLK from BCLK2 @ 12.288MHz
# Primary ASI only, multiple of 48kHz Sampling

w a0 00 00        # Set page 0
w a0 01 01        # Software Reset
w a0 02 09        # Wake up with AVDD > 2v and all VDDIO level
w a0 0a 10        # configure GPIO1 as input
w a0 0f 20        # Set GPIO1=CCLK
w a0 10 50        # Configure DOUT as Primary ASI (PASI) DOUT
w a0 19 00        # 1 data input and 1 data output for PASI
w a0 1a 70        # PASI I2S, 32-bit format
w a0 1e 20        # PASI Ch1 on Left slot 0
w a0 1f 30        # PASI Ch2 on Right slot 0
w a0 32 50        # PASI Fs=48KHz with auto clock configuration
w a0 34 48        # PLL always enabled with fractional allowed and from fixed clk frequency
w a0 37 30        # Use CCLK=12.288MHz, PASI in controller mode
w a0 38 80        # Use internal BCLK for FSYNC generation in controller mode
w a0 39 40        # Set controller mode BCLK/FSYNC ratio to 64 = h40
w a0 00 01        # Set page 1
w a0 73d0        # auto device, set MICBIAS = 9V
w a0 00 00        # Set page 0
w a0 50 00        # Auto device ADC Ch1 diff input, fixed 33.3KOhm, 2Vrms ac-coupled, audio band
w a0 55 00        # Auto device ADC Ch2 diff input, fixed 33.3KOhm, 2Vrms ac-coupled, audio band
w a0 76c0        # Enable Input Ch1 and Ch2, disable output channels
w a0 78a0        # Power up ADC and MICBIAS
```

- Target Mode, Differential DC-coupled Recording with PASI.

This configuration is for differential audio recording (ADC) with a 48kHz sampling rate, I2S format, and 32-bit depth.

```
##### Record DC-Coupled IN1-IN2 path ######
# Target Mode, I2S, 32 bit
# Primary ASI only, multiple of 48kHz Sampling
#
w a0 00 00    # Set page 0
w a0 01 01    # Software Reset
w a0 02 09    # Wake up with AVDD > 2v and all VDDIO level
w a0 10 50    # Configure DOUT as Primary ASI (PASI) DOUT
w a0 19 00    # 1 data input and 1 data output for PASI
w a0 1a 70    # PASI I2S, 32-bit format
w a0 1e 20    # PASI Ch1 on Left slot 0
w a0 1f 30    # PASI Ch2 on Right slot 0
w a0 00 01    # Set page 1
w a0 73d0    # auto device, set MICBIAS = 9V
w a0 00 00    # Set page 0
w a0 50 04    # Auto device ADC Ch1 DIFF input, fixed 33.3KOhm, ac/dc-coupled, audio band
w a0 55 04    # Auto device ADC Ch2 DIFF input, fixed 33.3KOhm, ac/dc-coupled, audio band
w a0 76c0    # Enable Input Ch1 and Ch2, disable output channels
w a0 78a0    # Power up ADC and MICBIAS
```


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- Target Mode Playback to Differential LINEOUT with PASI.

This configuration is for differential audio playback (DAC) with a 48kHz sampling rate, TDM format, and 32-bit depth.

```
##### Playback Differential LINEOUT Path ######
# Target Mode, TDM, 32 bit
# Primary ASI only, multiple of 48kHz Sampling
#
w a0 00 00    # Set page 0
w a0 01 01    # Software Reset
w a0 02 09    # Wake up with AVDD > 2v and all VDDIO level
w a0 11 80    # Enable PASI DIN
w a0 19 00    # 1 data inputs and 1 data outputs for PASI
w a0 1a 30    # PASI TDM, 32-bit format
w a0 28 20    # PASI DIN Ch1 on TDM slot 0
w a0 29 21    # PASI DIN Ch2 on TDM slot 1
w a0 64 20    # Configure OUT1P/M as differential from DAC1
w a0 65 20    # Configure OUT1P LINEOUT 0dB audio band
w a0 66 20    # Configure OUT1M LINEOUT 0dB 2Vrms Differential
w a0 6b 20    # Configure OUT2P/M as differential from DAC2
w a0 6c 20    # Configure OUT2P LINEOUT 0dB audio band
w a0 6d 20    # Configure OUT2M LINEOUT 0dB 2Vrms Differential
w a0 76 0c    # Disable all input channels and enable output channel 1 and 2
w a0 78 40    # Power up all DAC channel
```

- Target Mode Playback to Single-Ended LINEOUT with PASI.

This configuration is for single-ended mono audio playback (DAC) with a 48kHz sampling rate, TDM format, and 32-bit depth.

```
##### Playback Single-Ended Mono LINEOUT Path ######
# Target Mode, TDM, 32 bit
# Primary ASI only, multiple of 48kHz Sampling
#
w a0 00 00    # Set page 0
w a0 01 01    # Software Reset
w a0 02 09    # Wake up with AVDD > 2v and all VDDIO level
w a0 11 80    # Enable PASI DIN
w a0 19 00    # 1 data inputs and 1 data outputs for PASI
w a0 1a 30    # PASI TDM, 32-bit format
w a0 28 20    # PASI DIN Ch1 on TDM slot 0
w a0 29 21    # PASI DIN Ch2 on TDM slot 1
w a0 64 28    # Configure OUT1P as mono single-ended from DAC1
w a0 65 20    # Configure OUT1P LINEOUT 0dB audio band
w a0 66 20    # Configure 2Vrms Differential
w a0 6b 28    # Configure OUT2P as mono single-ended from DAC2
w a0 6c 20    # Configure OUT2P LINEOUT 0dB audio band
w a0 6d 20    # Configure 2Vrms Differential
w a0 76 0c    # Disable all input channels and enable output channel 1 and 2
w a0 78 40    # Power up all DAC channel
```


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- Target Mode Playback to Differential headphones with PASI.

This configuration is for differential audio playback (DAC) with a 48kHz sampling rate, I2S format, and 32-bit depth.

```
##### Playback Differential Headphone Path ######
# Target Mode, I2S, 32-bit
# Primary ASI only, multiple of 48kHz Sampling
# Playback through Stereo OUT1P and OUT2P for Headphone
#
w a0 00 00    # Set page 0
w a0 01 01    # Software Reset
w a0 02 09    # Wake up with AVDD > 2v and all VDDIO level
w a0 11 80    # Enable PASI DIN
w a0 19 00    # 1 data input and 1 data output for PASI
w a0 1a 70    # PASI I2S, 32 bit format
w a0 28 20    # PASI DIN Ch1 on Left slot 0
w a0 29 30    # PASI DIN Ch2 on Right slot 0
w a0 64 20    # Configure OUT1P/M as differential from DAC1
w a0 65 60    # Configure OUT1P as Headphone 0dB audio band
w a0 66 60    # Configure OUT1M as Headphone 0dB audio band
w a0 6b 20    # Configure OUT2P/M as differential from DAC2
w a0 6c 60    # Configure OUT2P as Headphone 0dB audio band
w a0 6d 60    # Configure OUT2M as Headphone 0dB audio band
w a0 76 0c    # Enable output channel 1 and 2 and disable all input channels
w a0 78 40    # Power up DAC channel
```

- Target Mode Playback to Mono Single-Ended headphones with PASI

This configuration is for mono single-ended audio playback (DAC) with a 48kHz sampling rate, I2S format, and 32-bit depth.

```
##### Playback Single-Ended Headphone Path ######
# Target Mode, I2S, 32 bit
# Primary ASI only, multiple of 48kHz Sampling
# Playback through mono OUT1P and OUT2P for Headphone
#
w a0 00 00    # Set page 0
w a0 01 01    # Software Reset
w a0 02 09    # Wake up with AVDD > 2v and all VDDIO level
w a0 11 80    # Enable PASI DIN
w a0 19 00    # 1 data input and 1 data output for PASI
w a0 1a 70    # PASI I2S, 32-bit format
w a0 28 20    # PASI DIN Ch1 on Left slot 0
w a0 29 30    # PASI DIN Ch2 on Right slot 0
w a0 64 28    # Configure OUT1P as mono single-ended from DAC1
w a0 65 60    # Configure OUT1P as Headphone 0dB audio band
w a0 66 60    # Configure 2Vrms Differential
w a0 6b 28    # Configure OUT2P as mono single-ended from DAC2
w a0 6c 60    # Configure OUT2P as Headphone 0dB audio band
w a0 6d 60    # Configure 2Vrms Differential
w a0 76 0c    # Enable output channel 1 and 2 and disable all input channels
w a0 78 40    # Power up DAC channel
```


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4 Hardware Design Files

This section provides the schematics, layout example and bill of materials (BOM) for the TAC5301Q14B4EVM-K.

4.1 Schematics

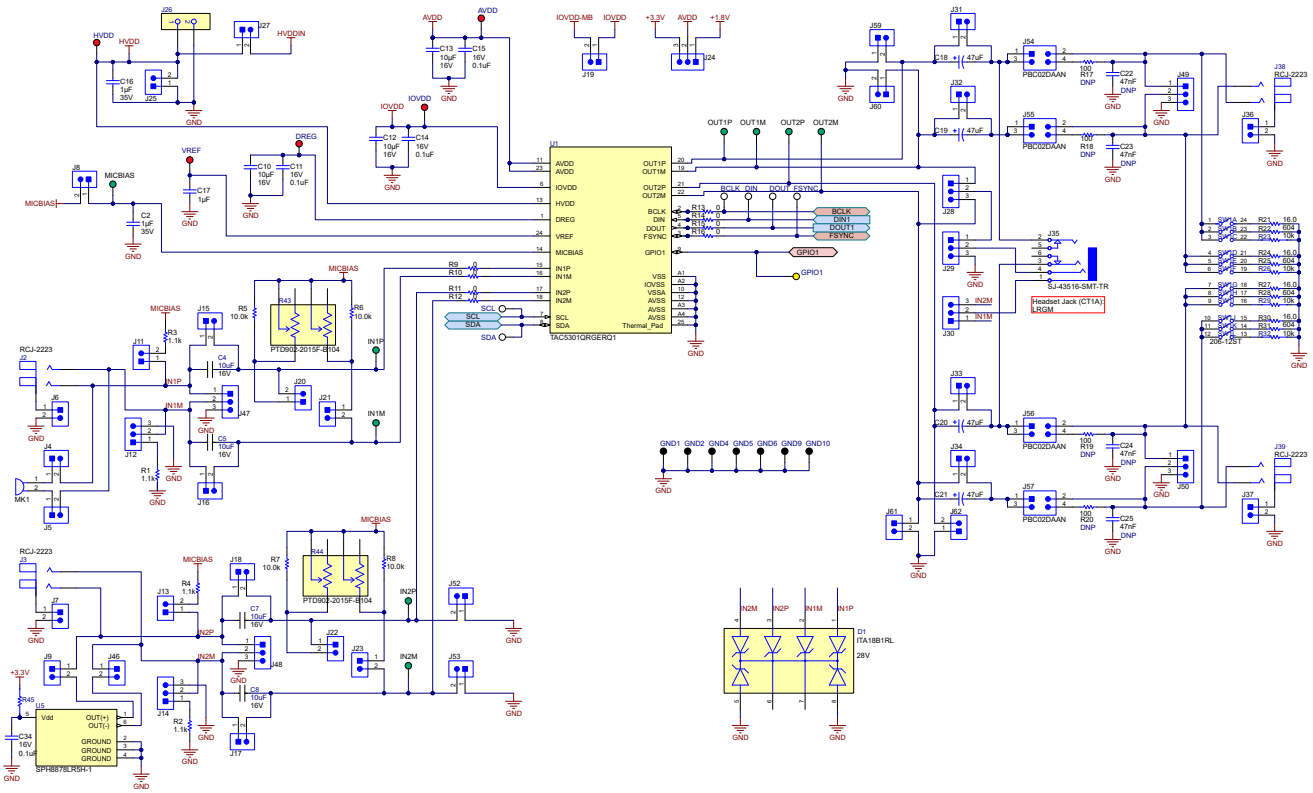


Figure 4-1. TAC5301-Q1 EVM Main DUT Schematic

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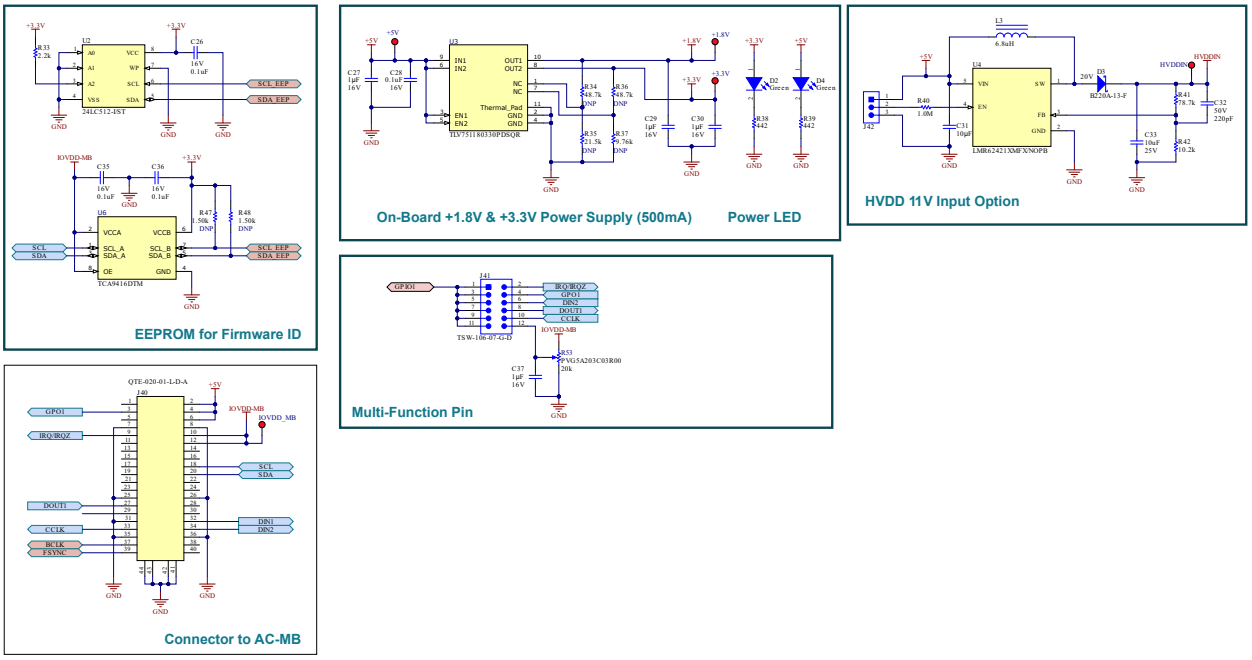


Figure 4-2. TAC5301-Q1 EVM Connectors and Supporting Circuitry Schematic

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4.2 PCB Layouts

TAC5301-Q1 EVM Board Layout

The board layout consists of the top and bottom silkscreen, the top and bottom layer routings, the power planes, the 2 inner layout routings and the ground planes of the TAC5301Q14B4EVM-K.

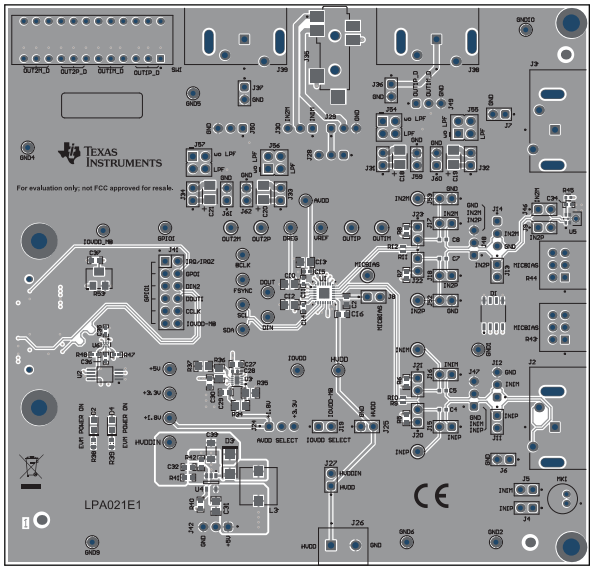


Figure 4-3. TAC5301-Q1 EVM Top Silkscreen

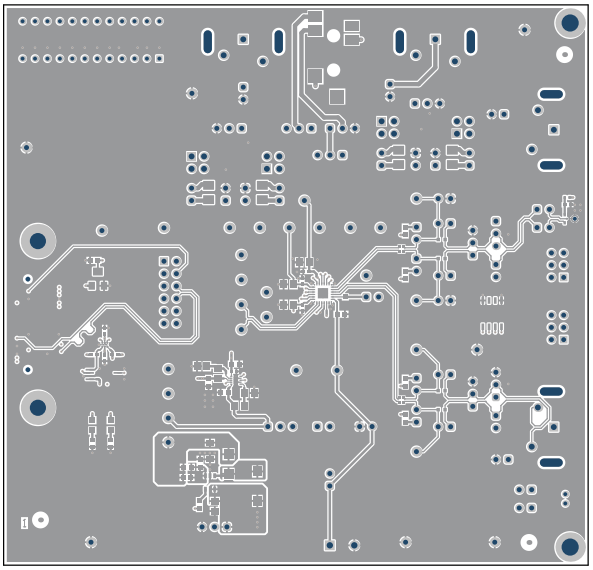


Figure 4-4. TAC5301-Q1 EVM Top Layer

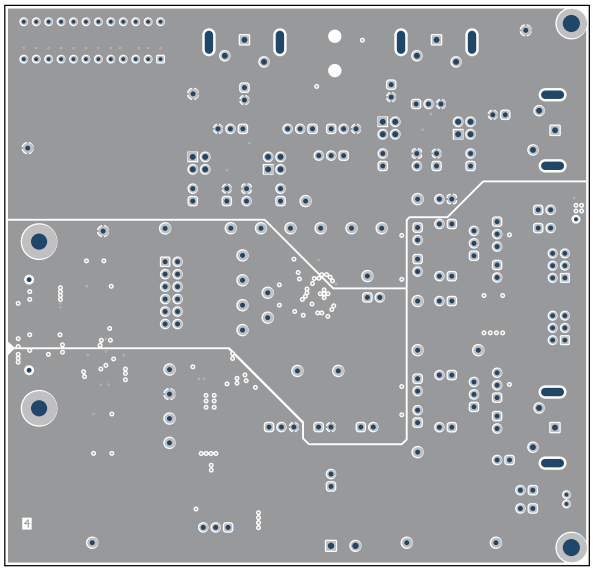


Figure 4-5. TAC5301-Q1 EVM Power Layer 1

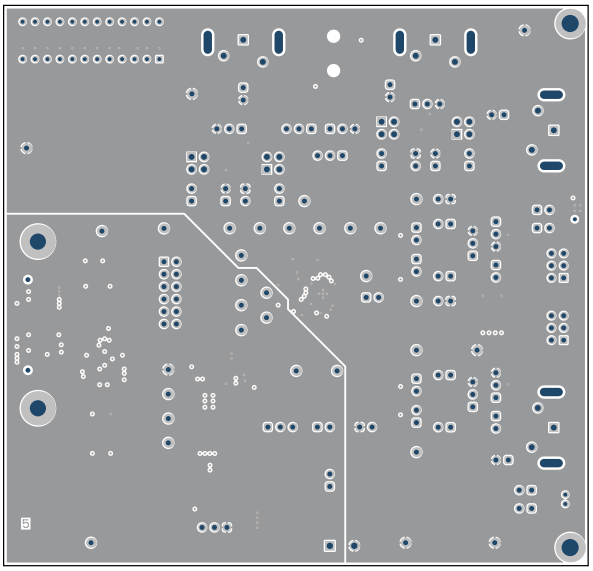


Figure 4-6. TAC5301-Q1 EVM Power Layer 2

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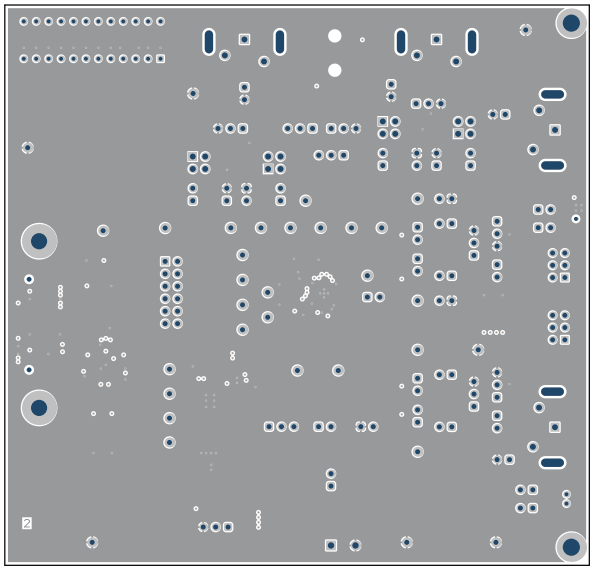


Figure 4-7. TAC5301-Q1 EVM Ground Layer 1

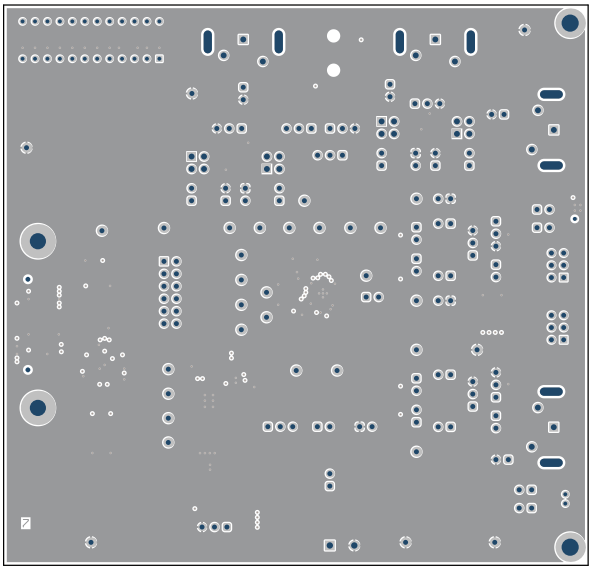


Figure 4-8. TAC5301-Q1 EVM Ground Layer 2

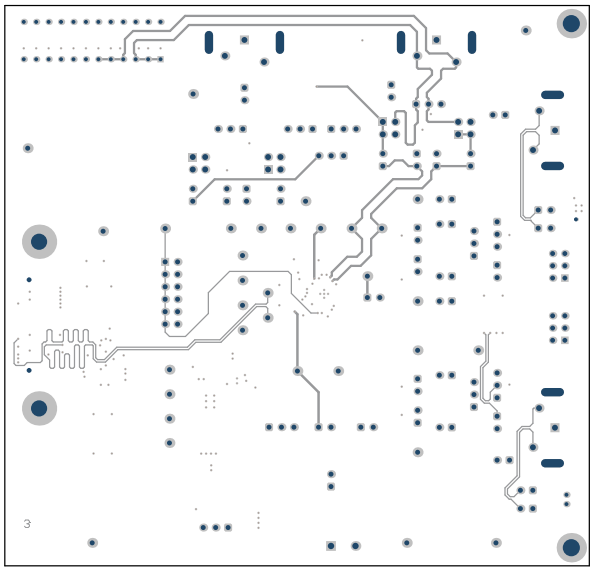


Figure 4-9. TAC5301-Q1 EVM Signal Layer 1

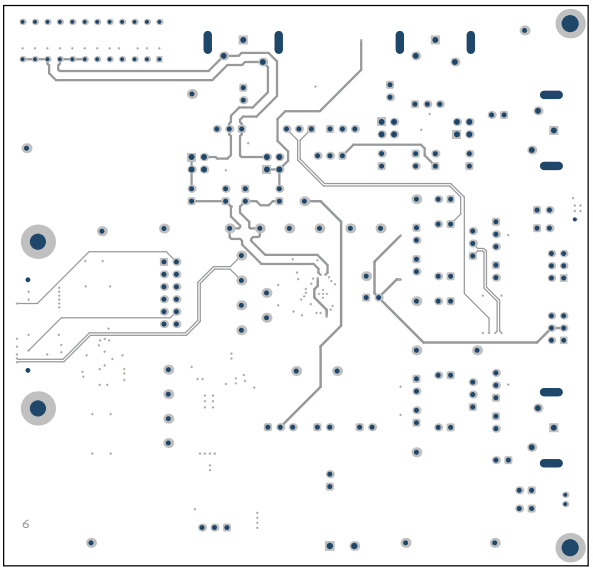


Figure 4-10. TAC5301-Q1 EVM Signal Layer 2

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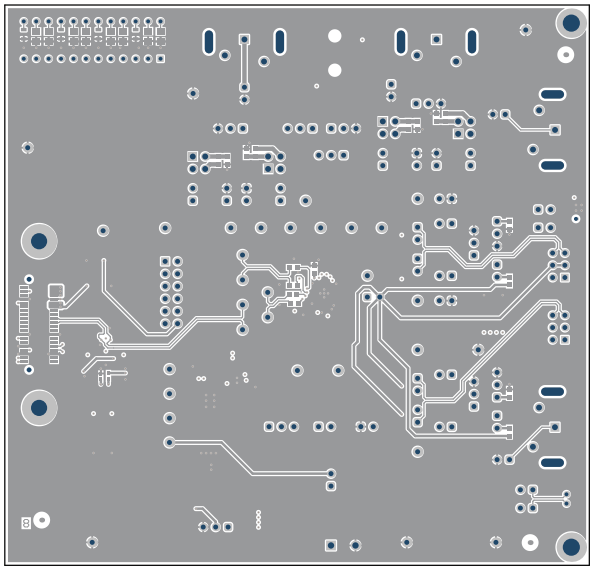


Figure 4-11. TAC5301-Q1 EVM Bottom Layer

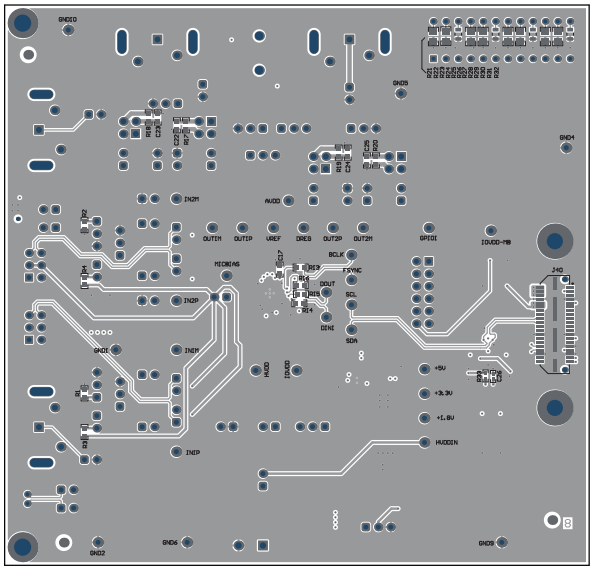


Figure 4-12. TAC5301-Q1 EVM Bottom Silkscreen

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4.3 Bill of Materials (BOM)

Table 4-1. Bill of Materials

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
!PCB	1		Printed Circuit Board		LPA021	Any		
+1.8V, +3.3V, +5V, AVDD, DREG, HVDD, HVDDIN, IOVDD, IOVDD_MB, VREF	10		Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone Electronics		
BCLK, DIN, DOUT, FSYNC, SCL, SDA	6		Test Point, Miniature, White, TH	White Miniature Testpoint	5002	Keystone Electronics		
C2, C16	2	1uF	CAP, CERM, 1uF, 35V, +/- 10%, X7R, 0603	603	C1608X7R1V105K080AC	TDK		
C4, C5, C7, C8	4		CAP CER 10UF 16V X5R 0603	0603 (1608 Metric)	C1608X5R1C106M080AB	TDK Corporation		
C10, C12, C13	3	10uF	CAP, CERM, 10 µF, 16V,+/- 10%, X7R, 0805	805	CL21B106KOQNNNE	Samsung Electro-Mechanics		
C11, C14, C15, C26, C28, C34, C35, C36	8	0.1uF	CAP, CERM, 0.1uF, 16V, +/- 10%, X7R, 0402	402	8.85012E+11	Wurth Elektronik		
C17, C27, C29, C30	4	1uF	CAP, CERM, 1uF, 16V, +/- 10%, X7R, 0603	603	8.85012E+11	Wurth Elektronik		
C18, C19, C20, C21	4	47uF	CAP, TA, 47uF, 10V, +/- 10%, 0.5ohm, SMD	3528-21	TPSB476K010R0500	AVX		
C31	1	10uF	CAP, CERM, 10 µF, V,+/- 10%, X7R, 0805	805	GRM21BR71A106KA73L	MuRata		
C32	1	220pF	CAP, CERM, 220pF, 50V, +/- 5%, C0G/NP0, 0603	603	C0603C221J5GACTU	Kemet		

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Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
C33	1	10uF	CAP, CERM, 10uF, 25V, +/-10%, X7R, 1206	1206	GRM31CR71E106KA12L	MuRata		
D1	1	28V	28V Clamp 25A (8/20µs) Ipp Tvs Diode Surface Mount 8-SOIC	SOIC8	ITA18B1RL	STMicroelectronics		
D2, D4	2	Green	LED, Green, SMD	LED_0805	LTST-C170KGKT	Lite-On		
D3	1	20V	Diode, Schottky, 20V, 2A, SMA	SMA	B220A-13F	Diodes Inc.		
GND1, GND2, GND4, GND5, GND6, GND9, GND10	7		Test Point, Miniature, Black, TH	Black Miniature Testpoint	5001	Keystone Electronics		
GPIO1	1		Test Point, Miniature, Yellow, TH	Yellow Miniature Testpoint	5004	Keystone Electronics		
H1, H2	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		
H3, H4	2		HEX STANDOFF 4-40 NYLON 3/4"	HEX STANDOFF 4-40 NYLON 3/4"	4804	Keystone		
IN1M, IN1P, IN2M, IN2P, MICBIAS, OUT1M, OUT1P, OUT2M, OUT2P	9		Test Point, Miniature, Green, TH	Green Miniature Testpoint	5116	Keystone		

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Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
J2, J3, J38, J39	4		3.20mm ID, 9.00mm OD (RCA) Phono (RCA) Jack Mono Connector Solder	CONN_RCA_DUAL	RCJ-2223	CUI Devices		
J4, J5, J6, J7, J8, J9, J11, J13, J15, J16, J17, J18, J19, J20, J21, J22, J23, J25, J27, J31, J32, J33, J34, J36, J37, J46, J59, J60, J61, J62	30		Header, 100mil, 2x1, Gold, TH	2x1 Header	TSW-102-07 G-S	Samtec		
J12, J14, J24, J28, J29, J30, J42, J47, J48, J49, J50	11		Header, 100mil, 3x1, Gold, TH	3x1 Header	TSW-103-07 G-S	Samtec		
J26	1		TERM BLK 2POS SIDE ENTRY 5MM PCB	HDR2	6.91138E+11	Würth Elektronik		
J35	1		AUDIO JACK 3.5mm 4COND, SMT	AUDIO JACK 3.5mm 4COND, SMT	SJ-43516-SMT-TR	CUI Inc.		
J40	1		Connector, Header, High Speed, 20 pairs, SMT	QTE-020-01X-D-A	QTE-020-01L-D-A	Samtec		
J41	1		Header, 100mil, 6x2, Gold, TH	6x2 Header	TSW-106-07 G-D	Samtec		
J54, J55, J56, J57	4		Header, 2.54mm, 2x2, Gold, TH	Header, 2.54mm, 2x2, TH	PBC02DAAN	Sullins Connector Solutions		
L3	1	6.8uH	Inductor, Shielded Drum Core, Ferrite, 6.8uH, 2.91A, 0.033ohm, SMD	SMD	7447779006	Wurth Elektronik		

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Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650x 0.200 inch	THT-14-423-10	Brady		
MK1	1		Microphone, Condenser, Analog, Omnidirectional, -42DB, TH	6mm DIA	POM-2242P-C33-R	PUI Audio		
R1, R2, R3, R4	4	1.1k	RES, 1.1k, 5%, 0.1W, AEC-Q200 Grade 0, 0603	603	CRCW06031K10JNEA	Vishay-Dale		
R5, R6, R7, R8	4	10.0k	RES, 10.0k, 1%, 0.1W, AEC-Q200 Grade 0, 0603	603	RMCF0603FT10K0	Stackpole Electronics Inc		
R9, R10, R11, R12	4	0	RES, 0, 5%, 0.05W, 0201	201	CRCW02010000Z0ED	Vishay-Dale		
R13, R14, R15, R16	4	0	RES, 0, 0%, 0.25W, AEC-Q200 Grade 0, 0603	603	PMR03EZPJ000	Rohm		
R21, R24, R27, R30	4	16	RES, 16.0, 1%, 0.5W, 0805	805	ERJ-P06F16R0V	Panasonic		
R22, R25, R28, R31	4	604	RES, 604, 1%, 0.125W, AEC-Q200 Grade 0, 0805	805	CRCW0805604RFKEA	Vishay-Dale		
R23, R26, R29, R32	4		RES SMD 10K OHM 5% 0.4W 0805	805	ESR10EZPJ103	Rohm Semiconductor		
R33	1	2.2k	RES, 2.2k, 5%, 0.063W, AEC-Q200 Grade 0, 0402	402	CRCW04022K20JNED	Vishay-Dale		
R38, R39	2	442	RES, 442, 1%, 0.1W, AEC-Q200 Grade 0, 0603	603	CRCW0603442RFKEA	Vishay-Dale		

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Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
R40	1	1.0Meg	RES, 1.0M, 5%, 0.1W, AEC-Q200 Grade 0, 0603	603	CRCW06031M00JNEA	Vishay-Dale		
R41	1	78.7k	RES, 78.7k, 1%, 0.1W, AEC-Q200 Grade 0, 0603	603	CRCW060378K7FKEA	Vishay-Dale		
R42	1	10.2k	RES, 10.2k, 1%, 0.1W, AEC-Q200 Grade 0, 0603	603	CRCW060310K2FKEA	Vishay-Dale		
R43, R44	2	100kΩ	Res POT Carbon Element 100kOhm 20% 1/20W/1/40W PC Pins Thru-Hole	PTH_POT_9MM50_24MM65	PTD902-2015F-B104	Bourns		
R45	1	10k	10k ±5% 0.063W, 1/16W Chip Resistor 0402 (1005 Metric) Moisture Resistant Thick Film	402	RC0402JR-1310KL	Yageo		
R53	1	20k	Trimmer Potentiometer, 20k ohm, 0.25W, SMD	Trimmer, 4.8,3.9x5.1mm	PVG5A203C03R00	Bourns		

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Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
SH1, SH2, SH3, SH4, SH5, SH6, SH7, SH8, SH9, SH10, SH11, SH12, SH13, SH14, SH15, SH16, SH17, SH18, SH19, SH20, SH21, SH22, SH23, SH24, SH25, SH26, SH27, SH28, SH29, SH30, SH31, SH32, SH33, SH34, SH35, SH36, SH37, SH38, SH39, SH40, SH41, SH42, SH43, SH44	44	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec	969102-0000-DA	3M
SW1	1		Dip Switch SPST 12 Position Through Hole Slide (Standard) Actuator 50mA 24VDC	DIP24	206-12ST	CTS		
U1	1		Automotive low-power mono audio codec with 100dB dynamic range ADC, 110dB dynamic range DAC and high-voltage microphone bia	VQFN24	TAC5301QRGERQ1	Texas Instruments		
U2	1		EEPROM, 512KBIT, 400KHZ, 8TSSOP	TSSOP-8	24LC512I/ST	Microchip		

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Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
U3	1		500mA, low-IQ, high-PSRR, dual-channel low-dropout (LDO) voltage regulator 10-WSON -40 to 125	WSON10	TLV751180330PDSQR	Texas Instruments		
U4	1		SIMPLE SWITCHER 2.7V to 5.5V, 2.1A Step-Up Regulator in SOT-23, DBV0005A (SOT-23-5)	DBV0005A	LMR62421XMFX/NOPB	Texas Instruments	LMR62421XMFE/NOPB	Texas Instruments
U5	1		7Hz ~ 36kHz Analog Microphone MEMS (Silicon) 2.3V ~ 3.6V Omnidirectional (-44dB ±0.5dB SPL) Solder Pads	LGA	SPH8878LR5H-1	Knowles		
U6	1		TCA9416DTM X2SON8	X2SON8	TCA9416DTM	Texas Instruments		
C22, C23, C24, C25	0	0.047uF	CAP, CERM, 0.047uF, 50V, +/- 10%, X7R, 0603	603	C1608X7R1H473K080AA	TDK		
C37	0	1uF	CAP, CERM, 1uF, 16V, +/- 10%, X7R, 0603	603	8.85012E+11	Wurth Elektronik		
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A		
J52, J53	0		Header, 100mil, 2x1, Gold, TH	2x1 Header	TSW-102-07G-S	Samtec		
R17, R18, R19, R20	0	100	RES, 100, 1%, 0.1W, 0603	603	RC0603FR-07100RL	Yageo		

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Table 4-1. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
R34, R36	0	48.7k	RES, 48.7k, 1%, 0.125W, AEC-Q200 Grade 0, 0805	805	CRCW080548K7FKEA	Vishay-Dale		
R35	0	21.5k	RES, 21.5k, 1%, 0.125W, AEC-Q200 Grade 0, 0805	805	CRCW080521K5FKEA	Vishay-Dale		
R37	0	9.76k	RES, 9.76k, 1%, 0.125W, AEC-Q200 Grade 0, 0805	805	CRCW080599K76FKEA	Vishay-Dale		
R47, R48	0	1.50k	RES, 1.50k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	402	RMCF0402FT1K50	Stackpole Electronics Inc		

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4.3.1 TAC5301-Q1 EVM Bill of Materials

Table 4-2. Bill of Materials

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
!PCB	1		Printed Circuit Board		LPA021	Any		
+1.8V, +3.3V, +5V, AVDD, DREG, HVDD, HVDDIN, IOVDD, IOVDD_MB, VREF	10		Test Point, Miniature, Red, TH	Red Miniature Testpoint	5000	Keystone Electronics		
BCLK, DIN, DOUT, FSYNC, SCL, SDA	6		Test Point, Miniature, White, TH	White Miniature Testpoint	5002	Keystone Electronics		
C2, C16	2	1uF	CAP, CERM, 1uF, 35V, +/- 10%, X7R, 0603	603	C1608X7R1V105K080AC	TDK		
C4, C5, C7, C8	4		CAP CER 10UF 16V X5R 0603	0603 (1608 Metric)	C1608X5R1C106M080AB	TDK Corporation		
C10, C12, C13	3	10uF	CAP, CERM, 10 µF, 16V,+/- 10%, X7R, 0805	805	CL21B106KOQNNNE	Samsung Electro-Mechanics		
C11, C14, C15, C26, C28, C34, C35, C36	8	0.1uF	CAP, CERM, 0.1uF, 16V, +/- 10%, X7R, 0402	402	8.85012E+11	Wurth Elektronik		
C17, C27, C29, C30	4	1uF	CAP, CERM, 1uF, 16V, +/- 10%, X7R, 0603	603	8.85012E+11	Wurth Elektronik		
C18, C19, C20, C21	4	47uF	CAP, TA, 47uF, 10V, +/- 10%, 0.5ohm, SMD	3528-21	TPSB476K010R0500	AVX		
C31	1	10uF	CAP, CERM, 10 µF, V,+/- 10%, X7R, 0805	805	GRM21BR71A106KA73L	MuRata		
C32	1	220pF	CAP, CERM, 220pF, 50V, +/- 5%, C0G/NP0, 0603	603	C0603C221J5GACTU	Kemet		

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Table 4-2. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
C33	1	10uF	CAP, CERM, 10uF, 25V, +/-10%, X7R, 1206	1206	GRM31CR71E106KA12L	MuRata		
D1	1	28V	28V Clamp 25A (8/20µs) Ipp Tvs Diode Surface Mount 8-SOIC	SOIC8	ITA18B1RL	STMicroelectronics		
D2, D4	2	Green	LED, Green, SMD	LED_0805	LTST-C170KGKT	Lite-On		
D3	1	20V	Diode, Schottky, 20V, 2A, SMA	SMA	B220A-13F	Diodes Inc.		
GND1, GND2, GND4, GND5, GND6, GND9, GND10	7		Test Point, Miniature, Black, TH	Black Miniature Testpoint	5001	Keystone Electronics		
GPIO1	1		Test Point, Miniature, Yellow, TH	Yellow Miniature Testpoint	5004	Keystone Electronics		
H1, H2	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		
H3, H4	2		HEX STANDOFF 4-40 NYLON 3/4"	HEX STANDOFF 4-40 NYLON 3/4"	4804	Keystone		
IN1M, IN1P, IN2M, IN2P, MICBIAS, OUT1M, OUT1P, OUT2M, OUT2P	9		Test Point, Miniature, Green, TH	Green Miniature Testpoint	5116	Keystone		

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Table 4-2. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
J2, J3, J38, J39	4		3.20mm ID, 9.00mm OD (RCA) Phono (RCA) Jack Mono Connector Solder	CONN_RCA_DUAL	RCJ-2223	CUI Devices		
J4, J5, J6, J7, J8, J9, J11, J13, J15, J16, J17, J18, J19, J20, J21, J22, J23, J25, J27, J31, J32, J33, J34, J36, J37, J46, J59, J60, J61, J62	30		Header, 100mil, 2x1, Gold, TH	2x1 Header	TSW-102-07 G-S	Samtec		
J12, J14, J24, J28, J29, J30, J42, J47, J48, J49, J50	11		Header, 100mil, 3x1, Gold, TH	3x1 Header	TSW-103-07 G-S	Samtec		
J26	1		TERM BLK 2POS SIDE ENTRY 5MM PCB	HDR2	6.91138E+11	Würth Elektronik		
J35	1		AUDIO JACK 3.5mm 4COND, SMT	AUDIO JACK 3.5mm 4COND, SMT	SJ-43516-SMT-TR	CUI Inc.		
J40	1		Connector, Header, High Speed, 20 pairs, SMT	QTE-020-01X-D-A	QTE-020-01L-D-A	Samtec		
J41	1		Header, 100mil, 6x2, Gold, TH	6x2 Header	TSW-106-07 G-D	Samtec		
J54, J55, J56, J57	4		Header, 2.54mm, 2x2, Gold, TH	Header, 2.54mm, 2x2, TH	PBC02DAAN	Sullins Connector Solutions		
L3	1	6.8uH	Inductor, Shielded Drum Core, Ferrite, 6.8uH, 2.91A, 0.033ohm, SMD	SMD	7447779006	Wurth Elektronik		

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Table 4-2. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
LBL1	1		Thermal Transfer Printable Labels, 0.650" W x 0.200" H - 10,000 per roll	PCB Label 0.650x 0.200 inch	THT-14-423-10	Brady		
MK1	1		Microphone, Condenser, Analog, Omnidirectional, -42DB, TH	6mm DIA	POM-2242P-C33-R	PUI Audio		
R1, R2, R3, R4	4	1.1k	RES, 1.1k, 5%, 0.1W, AEC-Q200 Grade 0, 0603	603	CRCW06031K10JNEA	Vishay-Dale		
R5, R6, R7, R8	4	10.0k	RES, 10.0k, 1%, 0.1W, AEC-Q200 Grade 0, 0603	603	RMCF0603FT10K0	Stackpole Electronics Inc		
R9, R10, R11, R12	4	0	RES, 0, 5%, 0.05W, 0201	201	CRCW02010000Z0ED	Vishay-Dale		
R13, R14, R15, R16	4	0	RES, 0, 0%, 0.25W, AEC-Q200 Grade 0, 0603	603	PMR03EZPJ000	Rohm		
R21, R24, R27, R30	4	16	RES, 16.0, 1%, 0.5W, 0805	805	ERJ-P06F16R0V	Panasonic		
R22, R25, R28, R31	4	604	RES, 604, 1%, 0.125W, AEC-Q200 Grade 0, 0805	805	CRCW0805604RFKEA	Vishay-Dale		
R23, R26, R29, R32	4		RES SMD 10K OHM 5% 0.4W 0805	805	ESR10EZPJ103	Rohm Semiconductor		
R33	1	2.2k	RES, 2.2k, 5%, 0.063W, AEC-Q200 Grade 0, 0402	402	CRCW04022K20JNED	Vishay-Dale		
R38, R39	2	442	RES, 442, 1%, 0.1W, AEC-Q200 Grade 0, 0603	603	CRCW0603442RFKEA	Vishay-Dale		

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Table 4-2. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
R40	1	1.0Meg	RES, 1.0M, 5%, 0.1W, AEC-Q200 Grade 0, 0603	603	CRCW06031M00JNEA	Vishay-Dale		
R41	1	78.7k	RES, 78.7k, 1%, 0.1W, AEC-Q200 Grade 0, 0603	603	CRCW060378K7FKEA	Vishay-Dale		
R42	1	10.2k	RES, 10.2k, 1%, 0.1W, AEC-Q200 Grade 0, 0603	603	CRCW060310K2FKEA	Vishay-Dale		
R43, R44	2	100kΩ	Res POT Carbon Element 100kOhm 20% 1/20W/1/40W PC Pins Thru-Hole	PTH_POT_9MM50_24MM65	PTD902-2015F-B104	Bourns		
R45	1	10k	10k ±5% 0.063W, 1/16W Chip Resistor 0402 (1005 Metric) Moisture Resistant Thick Film	402	RC0402JR-1310KL	Yageo		
R53	1	20k	Trimmer Potentiometer, 20k ohm, 0.25W, SMD	Trimmer, 4.8,3.9x5.1mm	PVG5A203C03R00	Bourns		

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Table 4-2. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
SH1, SH2, SH3, SH4, SH5, SH6, SH7, SH8, SH9, SH10, SH11, SH12, SH13, SH14, SH15, SH16, SH17, SH18, SH19, SH20, SH21, SH22, SH23, SH24, SH25, SH26, SH27, SH28, SH29, SH30, SH31, SH32, SH33, SH34, SH35, SH36, SH37, SH38, SH39, SH40, SH41, SH42, SH43, SH44	44	1x2	Shunt, 100mil, Gold plated, Black	Shunt	SNT-100-BK-G	Samtec	969102-0000-DA	3M
SW1	1		Dip Switch SPST 12 Position Through Hole Slide (Standard) Actuator 50mA 24VDC	DIP24	206-12ST	CTS		
U1	1		Automotive low-power mono audio codec with 100dB dynamic range ADC, 110dB dynamic range DAC and high-voltage microphone bia	VQFN24	TAC5301QRGERQ1	Texas Instruments		
U2	1		EEPROM, 512KBIT, 400KHZ, 8TSSOP	TSSOP-8	24LC512I/ST	Microchip		

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Table 4-2. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
U3	1		500mA, low-IQ, high-PSRR, dual-channel low-dropout (LDO) voltage regulator 10-WSON -40 to 125	WSON10	TLV751180330PDSQR	Texas Instruments		
U4	1		SIMPLE SWITCHER 2.7V to 5.5V, 2.1A Step-Up Regulator in SOT-23, DBV0005A (SOT-23-5)	DBV0005A	LMR62421XMFX/NOPB	Texas Instruments	LMR62421XMFE/NOPB	Texas Instruments
U5	1		7Hz ~ 36kHz Analog Microphone MEMS (Silicon) 2.3V ~ 3.6V Omnidirectional (-44dB ±0.5dB SPL) Solder Pads	LGA	SPH8878LR5H-1	Knowles		
U6	1		TCA9416DTM X2SON8	X2SON8	TCA9416DTM	Texas Instruments		
C22, C23, C24, C25	0	0.047uF	CAP, CERM, 0.047uF, 50V, +/- 10%, X7R, 0603	603	C1608X7R1H473K080AA	TDK		
C37	0	1uF	CAP, CERM, 1uF, 16V, +/- 10%, X7R, 0603	603	8.85012E+11	Wurth Elektronik		
FID1, FID2, FID3, FID4, FID5, FID6	0		Fiducial mark. There is nothing to buy or mount.	N/A	N/A	N/A		
J52, J53	0		Header, 100mil, 2x1, Gold, TH	2x1 Header	TSW-102-07G-S	Samtec		
R17, R18, R19, R20	0	100	RES, 100, 1%, 0.1W, 0603	603	RC0603FR-07100RL	Yageo		

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Table 4-2. Bill of Materials (continued)

Designator	Quantity	Value	Description	PackageReference	PartNumber	Manufacturer	Alternate PartNumber	Alternate Manufacturer
R34, R36	0	48.7k	RES, 48.7k, 1%, 0.125W, AEC-Q200 Grade 0, 0805	805	CRCW080548K7FKEA	Vishay-Dale		
R35	0	21.5k	RES, 21.5k, 1%, 0.125W, AEC-Q200 Grade 0, 0805	805	CRCW080521K5FKEA	Vishay-Dale		
R37	0	9.76k	RES, 9.76k, 1%, 0.125W, AEC-Q200 Grade 0, 0805	805	CRCW080599K76FKEA	Vishay-Dale		
R47, R48	0	1.50k	RES, 1.50k, 1%, 0.063W, AEC-Q200 Grade 0, 0402	402	RMCF0402FT1K50	Stackpole Electronics Inc		

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5 Additional Information

5.1 Trademarks

PurePath™ is a trademark of Texas Instruments.
All trademarks are the property of their respective owners.

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6 References

Cable Reference

The following are cables that can be used for evaluation with an external audio instrument such as the Audio Precision APx555:

- BNC Male to RCA Male Cable

7 Revision History

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

Changes from Revision * (October 2023) to Revision A (September 2026)	Page
• Updated images throughout document	1

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STANDARD TERMS FOR EVALUATION MODULES

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

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

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

2 *Limited Warranty and Related Remedies/Disclaimers*:

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

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

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

WARNING

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

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

NOTE:

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

3 *Regulatory Notices:*

3.1 *United States*

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

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

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

CAUTION

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

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

FCC Interference Statement for Class A EVM devices

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

FCC Interference Statement for Class B EVM devices

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

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

3.2 *Canada*

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

Concerning EVMs Including Radio Transmitters:

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

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

Concernant les EVMs avec appareils radio:

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

Concerning EVMs Including Detachable Antennas:

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

Concernant les EVMs avec antennes détachables

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

3.3 *Japan*

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

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

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

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

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

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

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

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

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

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西新宿三井ビル

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

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

3.4 *European Union*

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

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

4 *EVM Use Restrictions and Warnings:*

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

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

4.3 *Safety-Related Warnings and Restrictions:*

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