EVAL-AD2428WB1BZ A²B Evaluation Board User Guide

Contributed by A²B Applications Team *Rev 1 – October 8, 2019*

Features

- Bus-Powered A²B® Slave Transceiver (AD2428W)
- Stereo Audio Codec/SigmaDSP® (ADAU1761)
- Two Stereo MEMS Microphones
- EEPROM
- LED and Push-Button on GPIO/IRQ
- Test Points for Digital Signals and Analog Inputs

Included Equipment

- 1.8 m Twisted-Pair Cable (CAT5e-Rated, with DuraClik™ Connectors)
- Rubber Feet

Equipment Needed

- Headphone with Cable and 3.5 mm TRS Plug
- Analog Line-Level Audio Source (for example, a Smartphone)
- EVAL-AD2428WD1BZ A²B Master Node Evaluation Board
- Additional A²B Slave Nodes (Optional)
  - EVAL-AD2428WG1BZ
  - EVAL-AD2428WC1BZ

Documents Needed

- Transceiver Data Sheet[1]
- Transceiver Technical Reference[2]
- EVAL-AD2428WB1BZ Hardware Design Files[3]

Software Needed

- SigmaStudio® Rev. 4.4 or later
- Software Distribution for A²B Rev 19.3.0 or later, DLLs

General Description

This evaluation board provides A²B bus-powered slave node functionality for an A²B network, including support for both PDM microphone input and serial audio via an I²S/TDM interface. Bus-powered slave nodes derive power from the bias voltage on the A²B wires.

An audio codec/SigmaDSP (ADAU1761) with stereo analog ADC input and two digital MEMS microphones with PDM output can feed the upstream or downstream slots on the A²B bus while the DAC outputs of the codec/SigmaDSP may use or consume upstream or downstream slots on the A²B bus. The SigmaDSP block allows optional digital pre- or post-processing.

A pushbutton and LED are available for interactive control and response communication over the A²B bus.

The standard 0.1 inch (2.54mm) pin distance, dual-row header (unpopulated) provides direct connectivity to I²S/TDM and ground signals for testing or interfacing to other devices after discovery. All power supplies are easily accessible at surface-mount test points located on the bottom of the board. For the board schematics, assembly/layout files, and bill of materials (BOM), see the EVAL-AD2428WB1BZ Hardware Design Files ZIP archive associated with this EE-note[3].

Evaluation Board Hardware

Figure 1 identifies the important components and connection points on the EVAL-AD2428WB1BZ evaluation board.

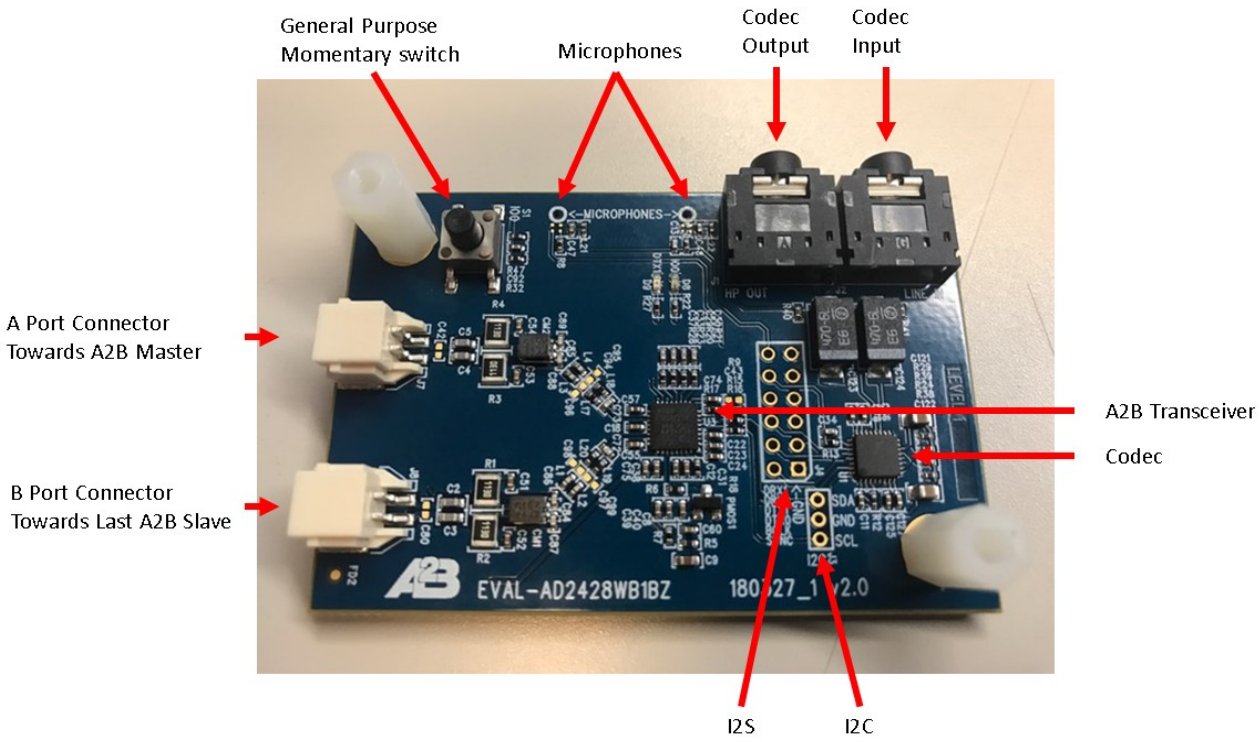

Figure 1. Board Overview

A²B Bus Connections (J7 and J8)

The 2-pin Molex DuraClik connector (J7) allows a single twisted-pair A²B cable to attach to the A-side of the AD2428W transceiver. The opposite end of the A²B cable can attach to the B-side of either the master transceiver or the next slave node transceiver closer to the master node.

The 2-pin Molex DuraClik connector (J8) allows a single twisted-pair A²B cable to attach to the B-side of the AD2428W transceiver. The opposite end of the A²B cable can attach to the A-side of the next slave node transceiver, including the last-in-line slave.

I²C Header (J3)

The unpopulated I²C header (J3) footprint provides access to the I²C interface of the A²B transceiver (SDA, SCL, and GND signals).

Analog Audio Input (J2) and Output (J1) Signals

The EVAL-AD2428WB1BZ evaluation board provides two 3.5mm TRS connectors for stereo, single-ended signals that conform to audio line-levels.

An MP3 player (for example, an iPOD®) or smartphone audio output can directly feed the AC-coupled input (J2) to the ADC of the ADAU1761 SigmaDSP. Non-audio signals with a peak-to-peak swing of less than 2.8V are also supported.

The DAC outputs from the ADAU1761 SigmaDSP can be used to send an analog signal to an external device (J1), with the primary function being driving headphones.

When nothing is plugged into the J1 and J2 jacks, the analog audio output routes to the analog audio input of the ADAU1761 SigmaDSP through switched contacts inside the connectors. This design facilitates analog loop back testing.

Because of the bus bias voltage functionality, the ground of a bus-powered node is not at the same potential as the ground of a locally-powered node. This difference can cause discovery errors if the signal source or destination ground that is connected to the bus-powered node is at the same potential as a locally-powered node in the system. For this reason, only floating signals (such as battery-powered MP3 players and headphones) should be connected to the EVAL-AD2428WB1BZ board.

Microphones

There are two digital MEMS microphones connected directly to the transceiver through PDM.

I²S/TDM Header (J4)

The unpopulated dual-row J4 footprint provides access to the I²S/TDM interface of the A²B transceiver (BCLK, SYNC, DTX0, DTX1, DRX0, and DRX1 signals). It allows connection to other PCBs (either directly or through wires) and permits monitoring of the signals using either a logic analyzer or a digital audio analyzer. One side of the header is connected to ground for improved signal integrity when using shielded or twisted-wire connections.

LEDs (D8 and D9)

D8 and D9 reflect the status of the AD2428W IRQ/IO0 and DTX1/IO4 pins, respectively, when used as GPIO.

Test Points (TP7 – TP12)

The test points are well-marked on the silkscreen of the PCB, providing access to signals and power supplies, as summarized in Table 1. Refer to the schematics to locate the probe points.

Test Point	Provides Access To (A^2B Transceiver Pin, If Applicable)
TP7	AD2428W VOUT1 Output Voltage (PLLVDD/DVDD)
TP8	AD2428W VOUT2 Output Voltage (ATRXVDD/BTRXVDD)
TP9	VBUS Low - Negative Bus Bias Recovered on this Node
TP10	VBUS High - Positive Bus Bias Recovered on this Node
TP11	AD2428W Next Slave Power Sense (SENSE)
TP12	AD2428W Return Current for Next Slave (VSSN)

Table 1. EVAL-AD2428WB1BZ Evaluation Board LED Summary

ADAU1761 SigmaDSP

The non-automotive-qualified ADAU1761 SigmaDSP is functionally equivalent to the obsolete automotive-qualified ADAU1461. This device is also pin-compatible with the automotive-qualified ADAU1361 and ADAU1961 products, which do not include a SigmaDSP processor core for digital audio pre- and post- processing.

Pushbutton (S1)

The AD2428W IRQ/IO0 pin is pulled high to IOVDD such that depressing the pushbutton (S1) can generate an active-low interrupt to the AD2428W transceiver. Configure the IRQ/IO0 pin as an active low GPIO with interrupt capabilities to use this feature.

EEPROM

The default EEPROM content for this board is described in Table 2:

Address	Data	Content
0x0000	0xAB	Configuration Memory Indicator
0x0001	0xAD	Module Vendor ID
0x0002	0x28	Module Product ID
0x0003	0xD2	Module Version ID
0x0004	0x12	RESERVED (Ignore)
0x0005	0x00	Number of Configuration Blocks

Table 2. EEPROM Settings for AD2428W Transceiver

I²C Device Addresses in 7-bit Format

The I²C device address in 7-bit format does not include the read-write (R/W) bit. The schematics tab in the SigmaStudio A²B window uses the 7-bit address representation for configuration, as summarized in Table 3. Both devices are 16-bit addressable and utilize 8-bit data.

Device	7-Bit I²C Device Address
ADAU1761 SigmaDSP with Codec	0x39
24FC256 EEPROM	0x50

Table 3. 7-Bit I²C Device Addresses

Evaluation Board Software Quick Start Procedure

The EVAL-AD2428WB1BZ evaluation board is intended to be connected within an existing A²B system, where at least a master node exists for the on-board AD2428W transceiver to be a slave to on the A²B bus. A host processor on the master node interfaces directly with the A²B master transceiver through which it programs and reads the register spaces of all discovered slave transceivers. This configuration allows a full system initialization at start-up and status monitoring during operation.

The examples furnished with the complementary EVAL-AD2428WD1BZ A²B master evaluation board assume a connection to specific slave boards, as noted in the following sections.

Connection to EVAL-AD2428WD1BZ Master Board

For master board setup instructions, refer to the *EVAL-AD2428WD1BZ A²B Evaluation Board Manual*[4]. Ensure that the master board jumpers are installed in their default positions.

Hardware Setup for a 3-Node A²B System

1. Assemble the example A²B system by connecting the indicated A²B evaluation boards as follows:

   Master (EVAL-AD2428WD1BZ) – Connect the B-side (P2) to the A-side on the slave0 board (J7).
   Slave0 (EVAL-AD2428WC1BZ) – Connect the B-side (J8) to the A-side on the slave1 board (J7).
   Slave1 (EVAL-AD2428WB1BZ)
2. Connect the PC over a USB cable and using the EVAL-ADUSB2EBZ USBi I²C programmer to the SigmaStudio header (P1) on the master board.
3. Connect an audio source to the stereo line input of the slave1 board (J2).
4. Connect headphones to the audio output of the master board (J4).
5. Plug the wall-mount 12V power supply (1.5 A) into an outlet and connect it to the power jack on the master board (P4).

Software Setup and Operation

1. Install the SigmaStudio (Rev. 4.4 or later) and A²B Software for Windows/Baremetal (Rev 19.3.0) software from the EVAL-AD2428WB1BZ product page.
2. Copy the `A2B.dll` and `A2Bstack.dll` driver files from the installation directory (default `C:\Analog Devices\ADI_A2B_Software-Rel19.3.0\GUI\x86_x64`) into the SigmaStudio installation (default

C:\Program Files\Analog Devices\SigmaStudio 4.4). Start SigmaStudio and verify that the A2B.dll file is selected under Tools→AddInsBrowser. Save before exiting.

3. Open the adi_a2b_3NodeSampleDemo.dspproj example project, which is located in the (default) C:\Analog Devices\ADI_A2B_Software-Rel19.3.0\Schematics\BF\A2BSchematics directory. Click the *Link-Compile-Download* icon, as shown in Figure 2.

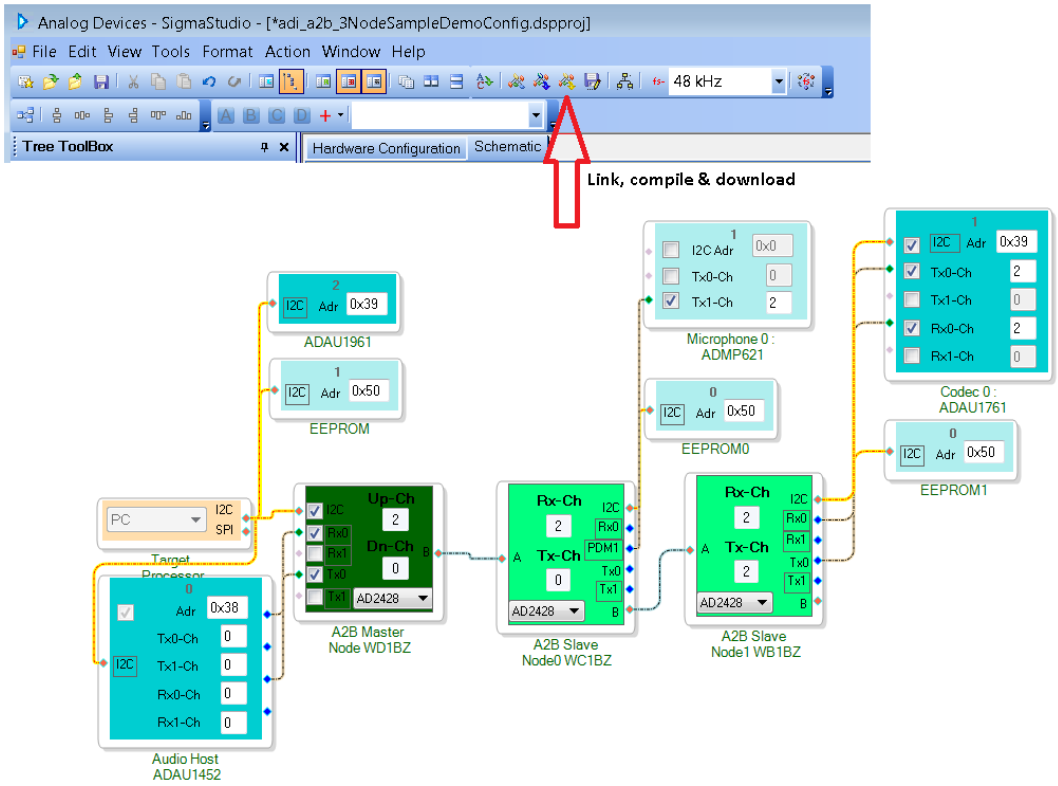

Figure 2. Software Schematic for adi_a2b_3NodeSampleDemoConfig.dspproj A²B Example Project

4. Before running the demo, follow the Hardware Setup for a 3-Node A²B System guidance. The sample demo configuration appears as shown in Figure 2. The audio source connected to the slave1 EVAL-AD2428WB1BZ board plays out of the headphones connected to the master EVAL-AD2428WD1BZ board. The microphone audio from the slave0 EVAL-AD2428WC1BZ board plays out of the slave1 EVAL-AD2428WB1BZ board.

5. Use the configuration settings shown in Figure 3 to properly interface the codec with the A²B transceiver.

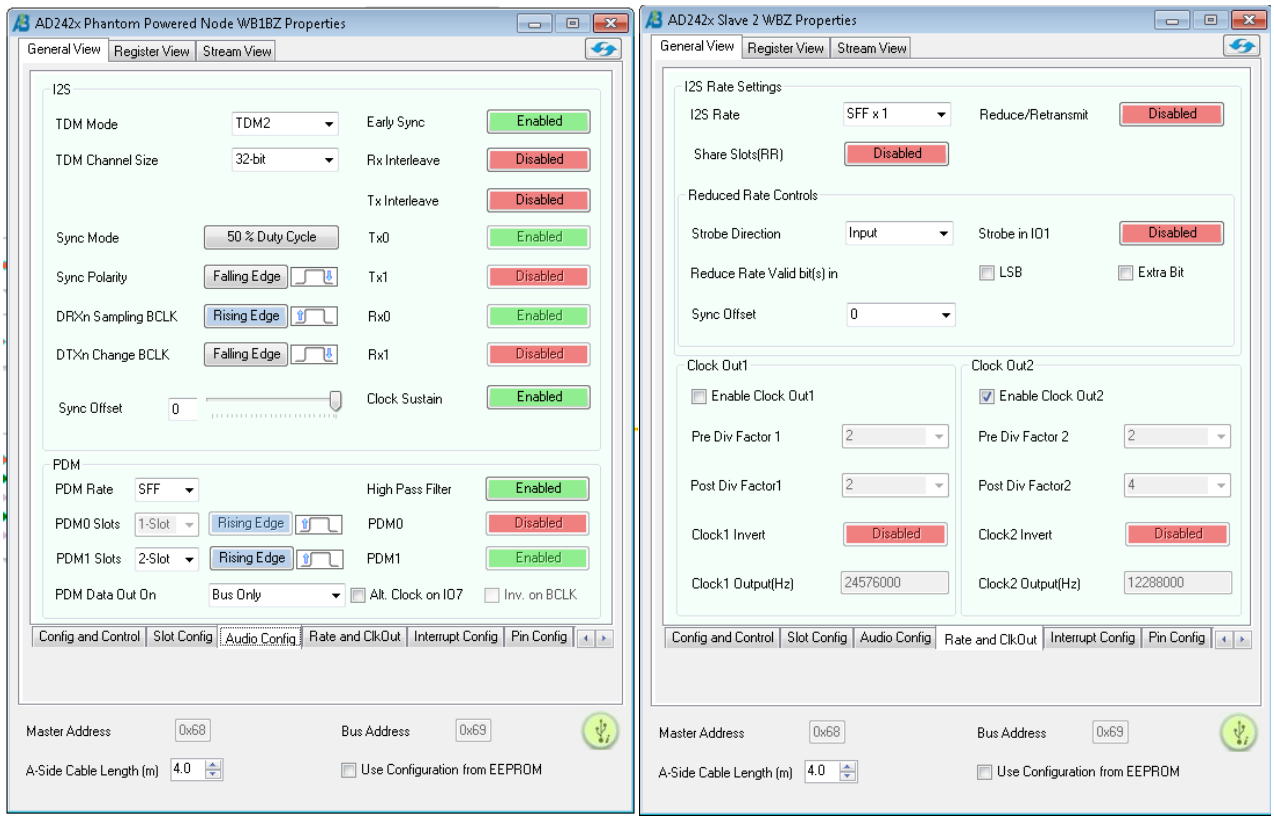

Figure 3. EVAL-AD2428WB1BZ Evaluation Board Example Audio Configuration

Figure 4 shows an example of a downstream data configuration where two slots are consumed from the A^{2}B bus and sent to the local DAC while two additional slots are contributed by the transceiver taking data from the local ADC.

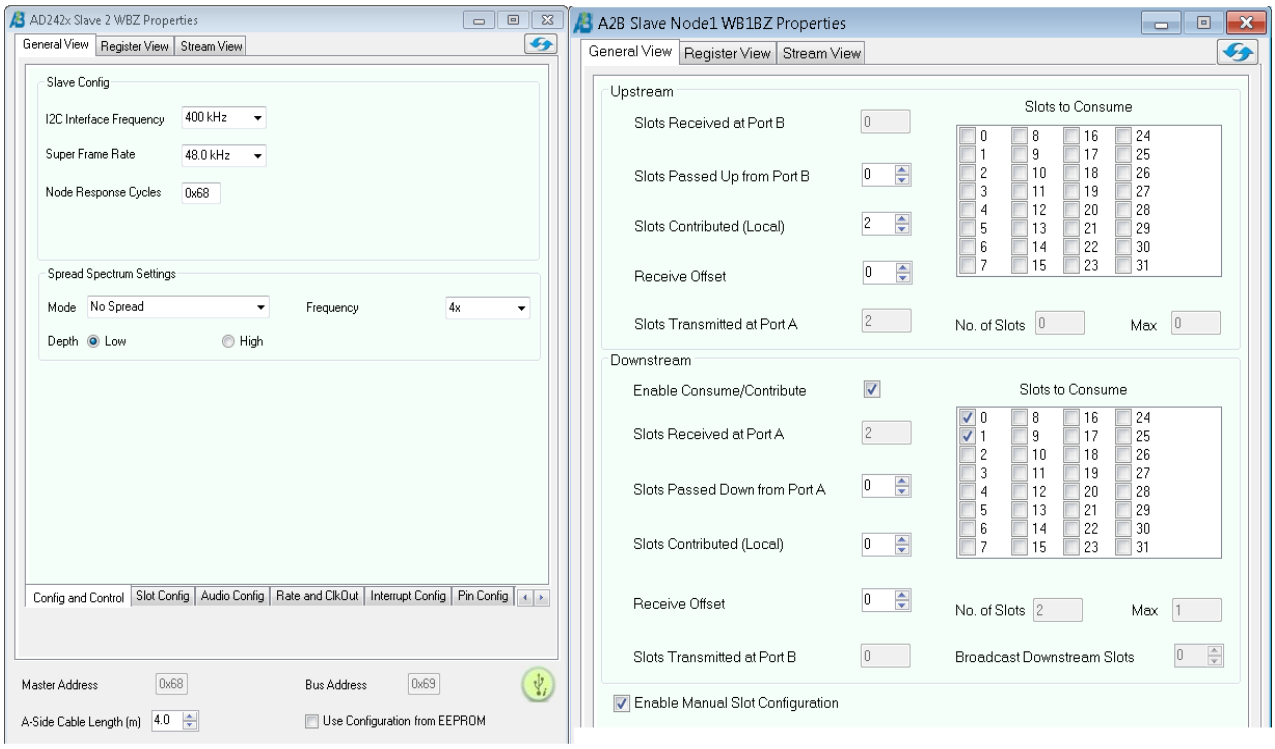

Figure 4. EVAL-AD2428WB1BZ Evaluation Board Example Slot Assignments

6. The ADAU1452 SigmaDSP on the master EVAL-AD2428WD1BZ board supplies the clock (SYNC) to the AD2428W transceiver. For development of customized ADAU1452 audio flows, disable the automatic programming of the ADAU1452 during discovery. Right-click the *ADAU1452* block and select *Peripheral Properties* in the A^{2}B software schematics.
7. To test the PDM microphones on the slave1 EVAL-AD2428WB1BZ board, make the connections shown in Figure 2. Click on *RX1* in the A^{2}B cell to change the input to PDM, as shown in Figure 5.

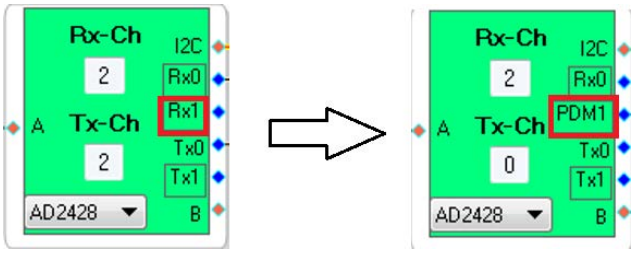

Figure 5. Changing AD2428W Pin Function from DRX1 to PDM1

The headphones connected to the master EVAL-AD2428WD1BZ board can be used to listen to the microphone data coming from the slave1 EVAL-AD2428WB1BZ board.

8. Use the *Stream Config* tab (right-click on Target Processor → Device Properties → Stream Config) to define audio streams across the nodes (Figure 6). The stream assignments configure the upstream and downstream slot settings across the nodes.

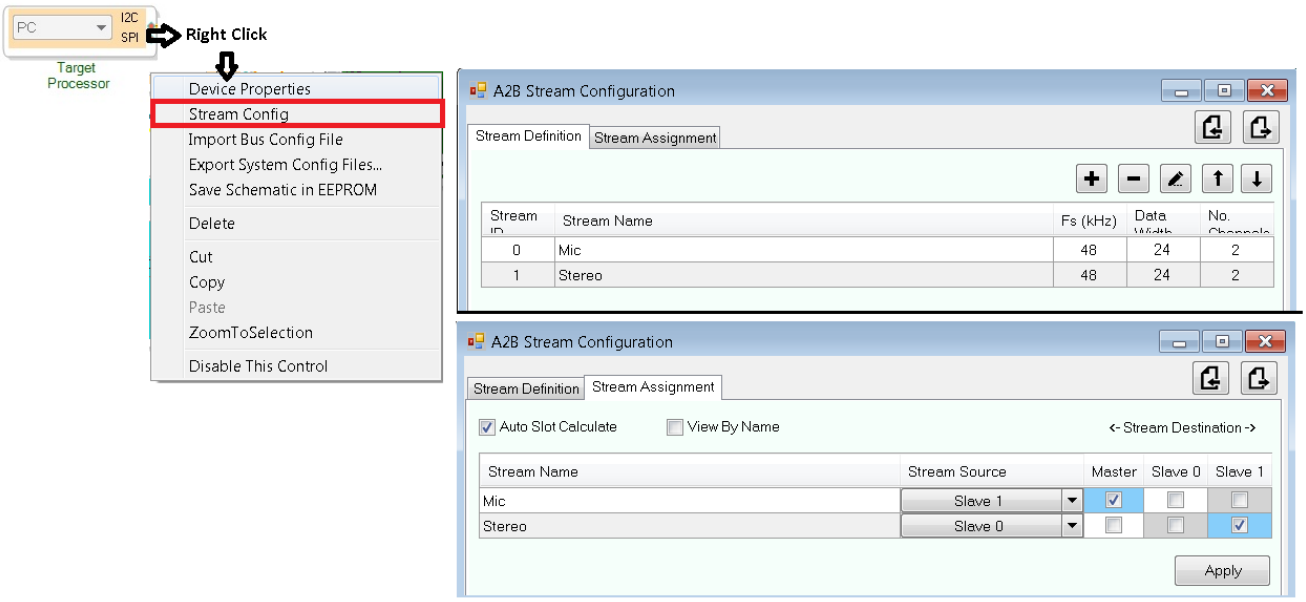

Figure 6: Stream Configuration

Refer to the *Quick Start Guide*[5] from the A²B software distribution for guidance regarding the modification of the software.

References

[1] *AD2820(W)/AD2426(W)/AD2427(W)/AD2428(W)/AD2429(W) Automotive Audio Bus A²B Transceiver Data Sheet.* Rev A, October 2019. Analog Devices, Inc.

[2] *AD2420(W)/6(W)/7(W)/8(W)/9(W) Automotive Audio Bus A²B Transceiver Technical Reference.* Rev 1.1, October 2019. Analog Devices, Inc.

[3] *Associated ZIP File (EE419v01.zip) for EVAL-AD2428WB1BZ A²B Evaluation Board User Guide (EE-419).* October 2019. Analog Devices, Inc.

[4] *EVAL-AD2428WD1BZ A²B Evaluation Board Manual.* Rev 1.1, October 2019. Analog Devices, Inc.

[5] *A²B Quick Start Guide.* Revision 25.0, October 2019. Analog Devices, Inc.

Document History

Revision	Description
Rev 1 – October 17, 2019 *by A²B Applications Team*	Initial Release