Total Phase A^{2}B Bus Monitor User Manual

This document describes the A^{2}B Bus Monitor web software applications, the A^{2}B Adapter Board, and how to use both.

The A^{2}B Bus Monitor Application is an application for the Promira Serial Platform® that provides the ability to passively monitor a system using Analog Devices' Automotive Audio Bus (A^{2}B).

By attaching the A^{2}B Adapter Board in-line between A^{2}B nodes, the A^{2}B monitor can non-intrusively sniff A^{2}B data on the line, giving users a real-time view into A^{2}B traffic on the bus. A^{2}B superframes are decoded and disassembled into I2S/TDM audio data and I2C control data for easy debugging. Additionally, full reporting on Interrupts and GPIO handshakes are correlated into the data capture.

TOTAL
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Supported products:

PROMIRA

A^{2}B Bus Monitor
User Manual v1.10.000

May 01, 2018

1 General Overview

1.1 Revision History

Always read the CHANGES.txt file included in the Promira Serial Platform update package for more details

1.1.1 Release 1.10

- Added support for uninterrupted capture even when the bus being monitored goes through re-discovery and re-initialization.

- Added visual indication of A2B monitor board LOCK status

- Added collapsed rows of back-back frames that have the same information in the bus transaction view

1.1.2 Release 1.00

Version 1.00 - This is the first release of the A^{2}B Bus Monitor.

1.2 General Description

The A^{2}B Bus Monitor Application is an application for the Promira Serial Platform$^®$ that provides the ability to passively monitor a system using Analog Devices' Automotive Audio Bus (A^{2}B).
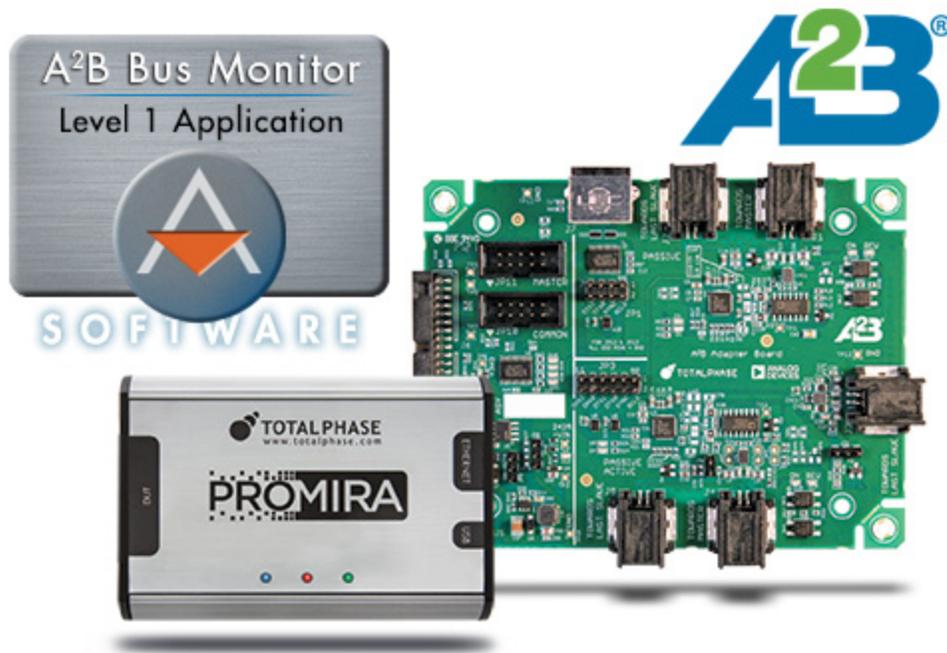
This document describes the A^{2}B Bus Monitor web software applications, the A^{2}B Adapter Board and how to use both.

1.3 A^{2}B Background

The Automotive Audio Bus (A^{2}B) is a two-wire interface developed by Analog Devices with a single master and multiple downstream slaves.
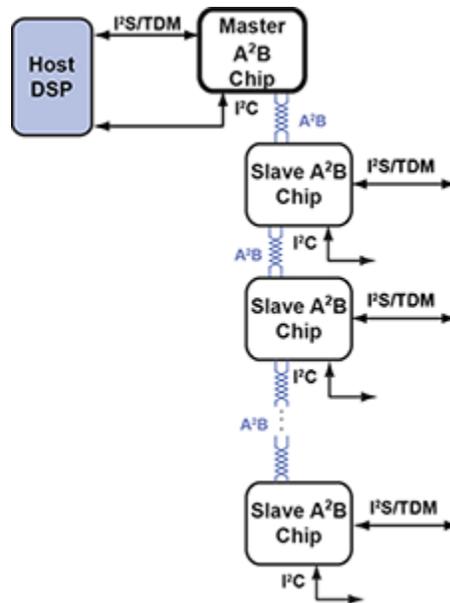
Figure 2 : A^{2}B Communication Systems Block Diagram.
Image courtesy of Analog Devices, Inc.

For more detailed information about A^{2}B, please refer to the documentation from Analog Devices.

2 Device Specifications

2.1 Software Specifications

2.1.1 Compatibility

The A^{2}B Bus Monitor Application currently supports the following browsers and operating systems:

Table 1 : OS/Browser Compatibility

Platform	Google Chrome	Mozilla Firefox	Apple Safari
Windows 7	X	X	
Windows 10	X	X	
Mac OS X 10.11+	X	X	X
Linux (Ubuntu 14.04+)	X	X	
iOS 10+ (iPad/iPhone)	X	X	X
Android 6 (tablet/phone)	X	X	

At this time, the following browsers are not supported:

- Internet Explorer

- Microsoft Edge

2.1.2 Desktop

The graphical web interface requires a standards compliant HTML5 web browser such as Google Chrome or Safari. The performance of the application will depend on the resources available to the web browser. If the RAM available is insufficient, the application may become unstable. All data is stored in volatile memory, so if the browser crashes, all data will be lost.

2.1.3 Mobile

The graphical web interface has a responsive design, which will adapt to smaller screens. For the best user experience, it is recommended that the A^{2}B Bus Monitor application be accessed from a laptop or desktop. Devices that are hardware constrained or have a smaller screen may be provide a sub-optimal experience. In the case of very small screens, such as smart phones, not all functionality may be available.

Please note that web audio performance on iOS devices is not very responsive. It can take over 15 seconds for audio to play after an audio channel is selected. The cause of this issue appears to be in the core iOS and affects all browsers.

2.2 Hardware Specifications

The A^{2}B Adapter Board is designed to provide two independent A^{2}B modules.
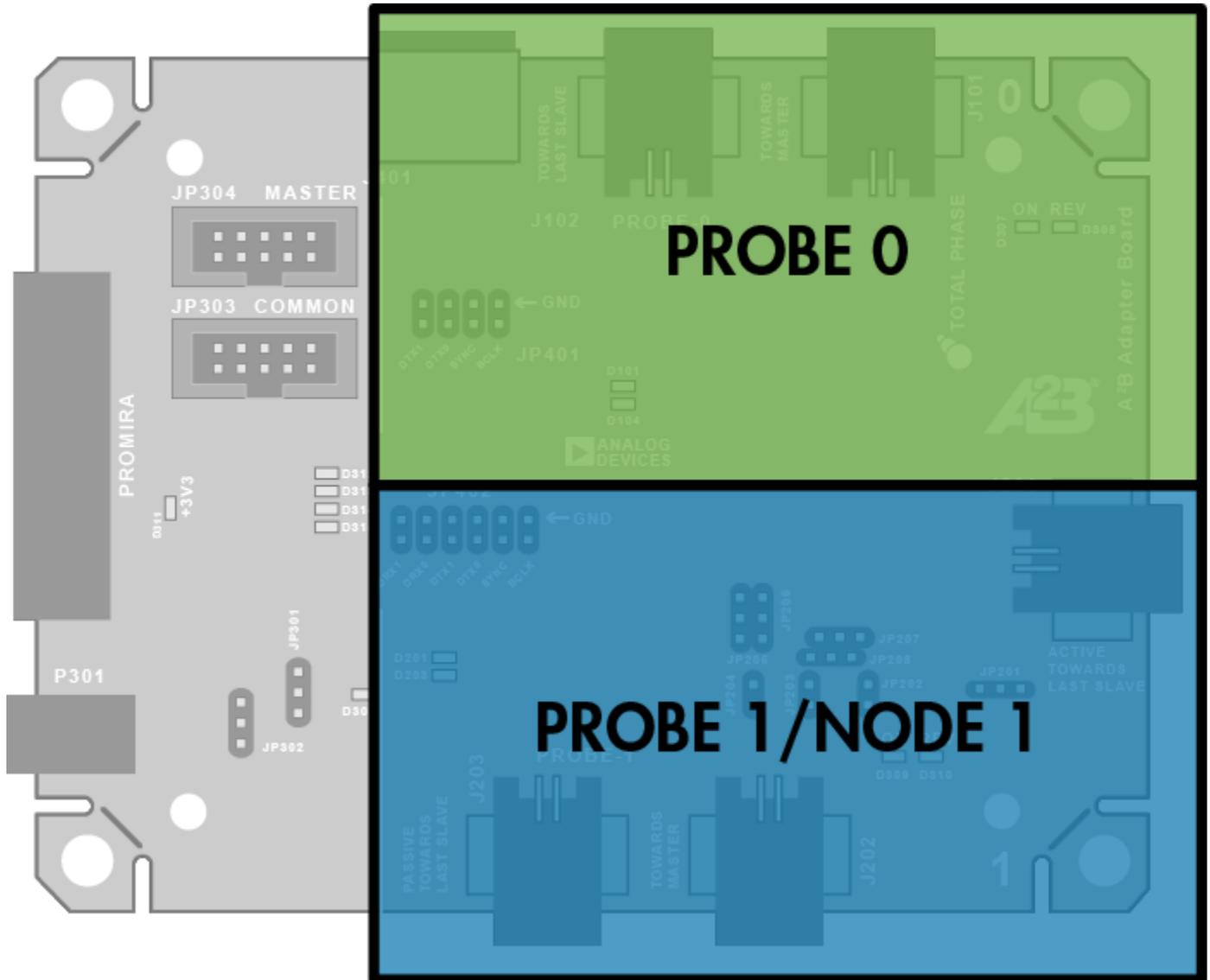
Figure 3 : Organization of the A^{2}B Adapter Board. The top part of the board is dedicated to Probe 0 and the bottom part is dedicated to Probe 1/Node 1. In the initial release, only Probe 0 is supported. In the future, support for both passive monitoring and active simulation will be added to Probe 1.

The Probe 0 module is capable of non-intrusively monitoring an A^{2}B bus. In a future release, Probe 1/Node 1 will become available as a second monitoring interface to allow monitor of 2 A^{2}B links simultaneously. Additionally, Probe 1/Node 1 will also be able to provide active simulation of an A^{2}B Node.

2.2.1 Physical Specifications

- DC Characteristics: Power Consumption: 900 mA @ 5 V with Promira platform

- Dimensions: W x L x D: 122 x 96 x 20 mm (4.80 x 3.78 x 0.79 in)

- Weight: 65 g (2.3 oz)

• Operating Temperature: $10° - 35°$ C ($50° - 95°$ F), non-condensing

2.2.2 Hardware Connectors and LED Indicators
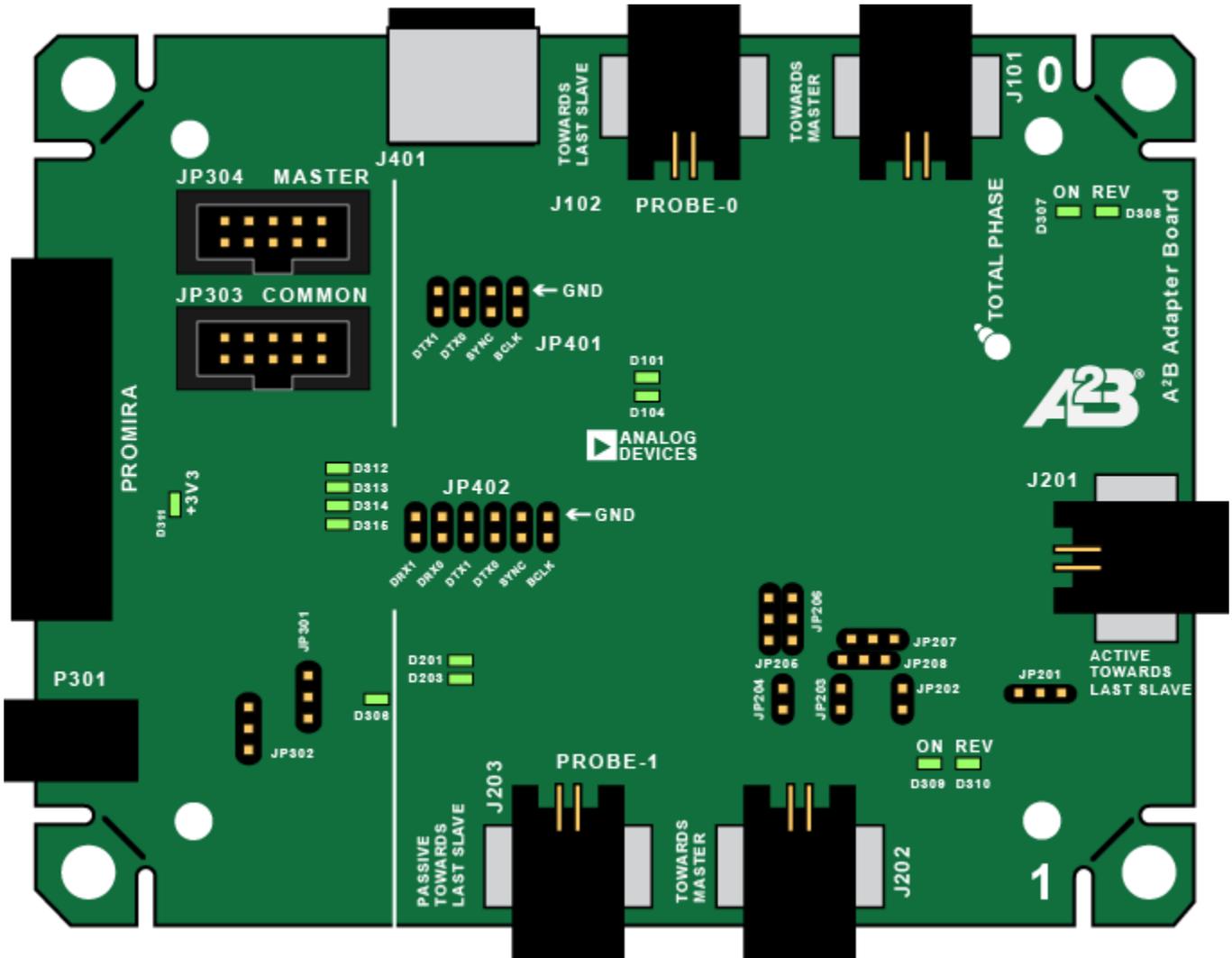
Figure 4 : Connectors and LEDs on the A^{2}B Adapter Board
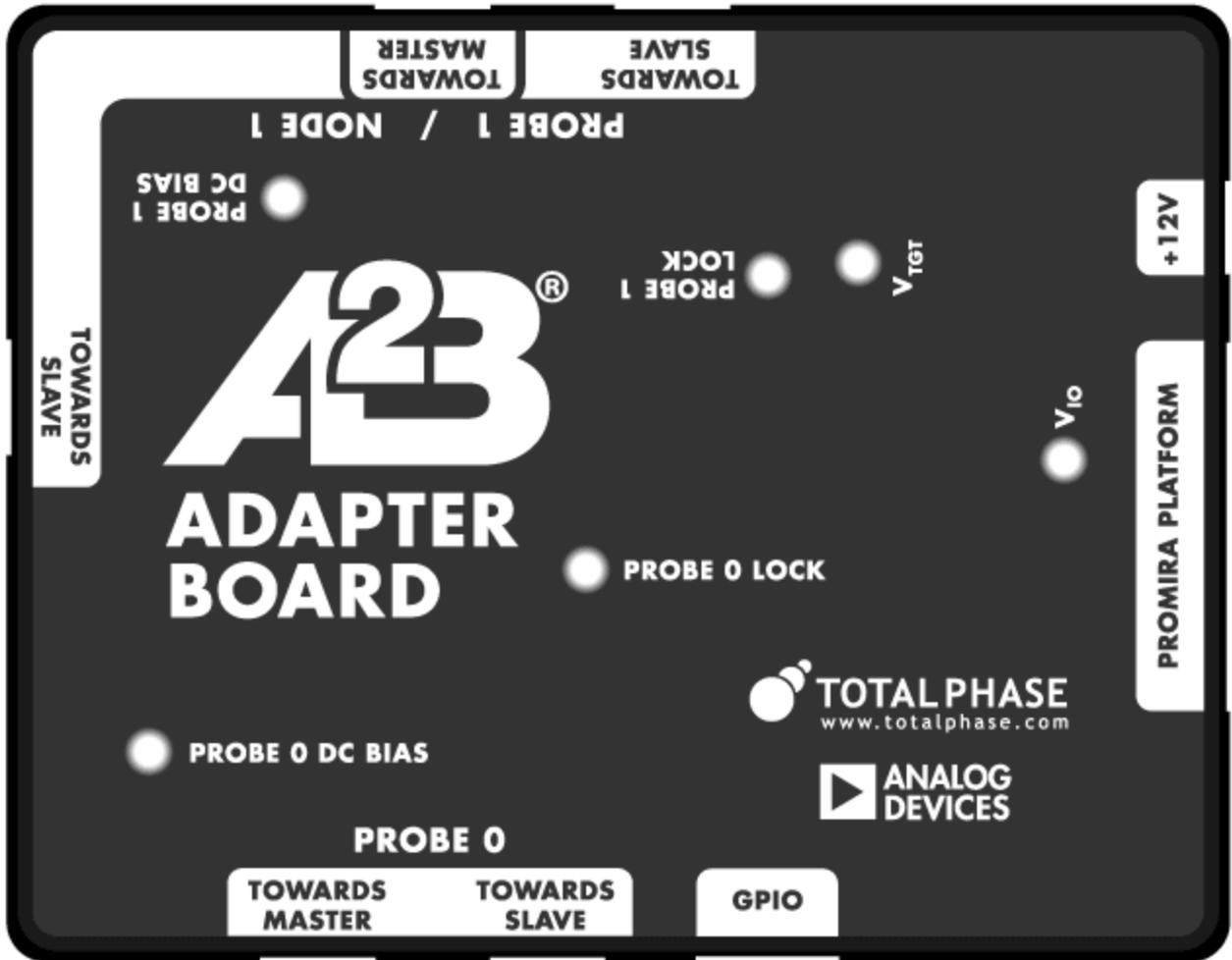
Figure 5 : Connectors and LEDs on the A^{2}B Adapter Board Enclosure

Table 2 : Connector Description

Connector	Enclosure	Purpose
Promira (J301)	Promira Platform	Connects to Promira platform via included 40mm 34-pin ribbon cable. The Promira Serial Adapter provides all the command and control functions of the A^{2}B Bus Monitor application. The application will not work if a Promira platform is not connected.

Towards Master (J101) and Towards Last Slave (J102)	Probe 0 - Towards Master and Towards Last Slave	Probe 0 Passive Mode Both of these ports are cross-connected. Using the included cables, Probe 0 of the A^{2}B Bus Monitor can be connected in-line between two A^{2}B Nodes as shown in Figure 6. Only one of these ports needs to be connected, so it is possible to use a "T-cable" to monitor a link between two nodes (Figure 7).
Probe0 I2S Output (JP401)	N/A	Probe 0 I2S audio output header. I2S data can be sent to a hardware analyzer from this header. The top pin of each pair provides GND.
Towards Master (J202) and Passive Towards Last Slave (J203)	Probe 1 / Node 1 - Towards Master and Towards Slave (Top)	Probe 1 Passive Mode (Future Functionality) In the future, a second probe port will be available to monitor a second A^{2}B link simultaneously.
Probe1 I2S Output (JP402)	N/A	Probe 1 I2S audio output header (Future Functionality). I2S data can be sent to a hardware analyzer from this header. The top pin of each pair provides GND.
Active Towards Last Slave (J201)	Probe 1 / Node 1 - Towards Slave (Left)	Probe 1 Active Mode (Future Functionality) In the future, Probe 1 can also be used to simulate an A^{2}B node. When used in this mode, Probe 1 will need to be attached to an A^{2}B bus via ports J4 (A) and J3 (B).
GPIO (J401)	GPIO	GPIO (Future Functionality) In the future, the A^{2}B Bus Monitor will be able to use this port to synchronize with other bus monitors in order to provide the ability to cross-correlate with other protocol analyzers.

Table 3 : LED Function and Description

LED	Enclosure	Purpose and Meaning
D311 and D308	V$_{IO}$ and V$_{TGT}$	LEDs are both green when the A^{2}B Adapter Board is properly powered by the Promira platform
ON (D307)	Probe 0 DC Bias (Green)	LED is green when Probe 0 detects 'forward bias' bus power, differential cable orientation is correct.
REV (D308)	Probe 0 DC Bias (Red)	LED is red when Probe 0 detects 'reverse bias' bus power, differential cable orientation is incorrect
D104	Probe 0 Lock	LED is on when Probe 0 has locked on to the A^{2}B link under analysis
ON (D309)	Probe 1 DC Bias (Green)	LED is green when Probe 1/Node 1 detects 'forward bias' bus power, differential cable orientation is correct.

REV (D310)	Probe 1 DC Bias (Red)	LED is red when Probe 1/Node 1 detects 'reverse bias' bus power, differential cable orientation is incorrect
D203	Probe 1 Lock	LED is on when Probe 1 has locked on to the A^{2}B link under analysis

2.2.3 Pin Orientation

The pin orientation of the differential signals is important. The following table provides the pinouts for each of the Mini50 connectors. Please be sure to connect the correct signal to the correct pin.

Table 4 : Pin Orientation

Connector	Pin 1	Pin 2
J101	N (-)	P (+)
J102	P (+)	N (-)
J201	P (+)	N (-)
J202	N (-)	P (+)
J203	P (+)	N (-)

2.3 Connecting to an A^{2}B Bus

The A^{2}B Adapter Board is designed to have two different probe ports. They are referred to as Probe 0 and Probe 1. In the initial release, only Probe 0 will be functional. In future releases, passive monitoring support will be added to Probe 1 and eventually active simulation capabilities as well.

Each probe port has two Mini50 connectors. The design allows the A^{2}B Bus Monitor to be connected in-line between nodes of interest. There are two possible ways of inserting the A^{2}B Bus Monitor to Probe 0 as shown by the following figures.
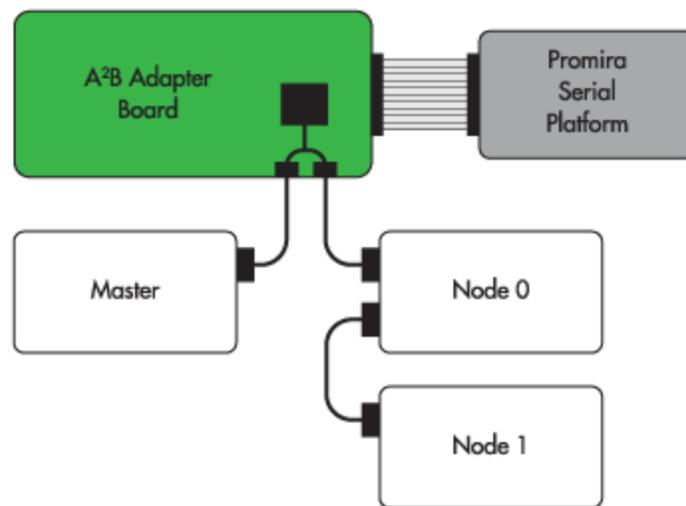
Figure 6 : The A^{2}B Bus Monitor is inserted between the
Master Node and Node 0 by using 2 cables

In the preceding figure, the cable that normally connects the Master Node to Node 0 has been replaced with two cables. These cables allow the A^{2}B Bus Monitor to be placed in-line on the link of interest. To support this style of connection, the included A^{2}B cables must be terminated with compatible plugs for the system under test.

Also note that it is important to swap the pins in order to ensure the correct polarity of the differential signals. This means that Pin 1 at the Master B port should be connected to Pin 2 at the Bus Monitor port J5 and vice versa. The second cable will have swapped pins as well resulting in the correct polarity at Node 0.

Alternatively, it is also possible to connect to the link of interest by modifying an existing cable and splicing into the A^{2}B signals. This creates a "T"-cable which can be connected to the A port of the A^{2}B Adapter Board.
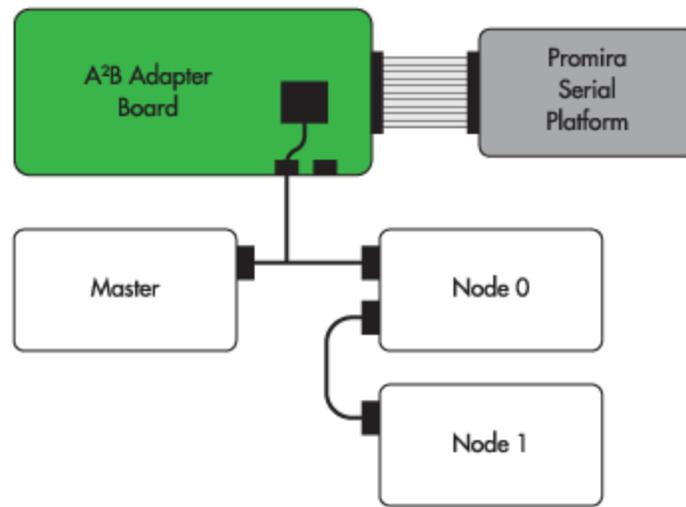
Figure 7 : The A^{2}B Bus Monitor is inserted between the
Master Node and Node 0 by using a single "T"-cable

Please note, when probing an A^{2}B link, it is advisable to use as short a cable as possible
to the A^{2}B Adapter Board in order to minimally affect the signal integrity of the A^{2}B data
stream. If the A^{2}B cables reduce the quality of the signal, it may result in the introduction
of additional errors.

3 Promira Serial Platform Overview

The Promira Serial Platform is a multi-purpose test platform. Total Phase separately licenses many other applications for other types of test and development. This includes Host Adapter and Analysis applications for I2C, SPI, eSPI, etc. The A^{2}B Bus Monitor Applications are just a few possibilities for the platform. Details about the Promira Serial Platform are included in the separate Promira Serial Platform System User (http://www.totalphase.com/support/articles/204227283). A brief overview of essential usage details is included here.

3.1 Basic Connectivity

The basic interface to the Promira Serial Platform is via USB or Ethernet. In either case, the USB micro-B interface is used for power (see below). Communication between the end user platform and the Promira is via TCP/IP over Ethernet-over-USB or via TCP/IP over Ethernet. The Ethernet over USB connection is established using the RNDIS or ECM protocol. In this case, the Promira will act as a DHCP server, provide an IP address t your PC/Mac in the 10.0.0.0/24 range.

When using the physical Ethernet connection, the Promira platform can use a static IP address or act as a DHCP client, depending on network requirements. It is most convenient to use the Promira Utility (http://www.totalphase.com/products/promira-update-utility) software to discover the address that was assigned. The utility software can connect to the Promira via USB or Ethernet connection. The Promira Utility software can also be used to configure a static IP address for the Promira platform (and therefore the A^{2}B Bus Monitor).

3.2 Powering the Promira and A^{2}B Bus Monitor

In the case where an Ethernet connection is used, it is necessary to power the Promira platform (and the A^{2}B Bus Monitor) via a USB power adapter with a Micro-B cable. It is essential that this is a high-quality power supply, capable of supplying a minimum of 5V at 1A of current, and with all relevant safety certifications. If a power adapter does not provide enough power, the Promira platform and the A^{2}B Adapter Board may not have enough power to operate properly and thus cannot ensure valid testing.

After the Promira platform is configured, the A^{2}B Bus Monitor Application is simply accessed via HTTP from an HTML5-compatible web browser. Please consult the Quick Start Guide at the end of this manual or on our website at Quick Start Guide (https://

www.totalphase.com/support/articles/115001154813-A2B-Bus-Monitor-Quick-Start-Guide).

3.3 Update Process

The full update sequence is:

1. Start the Promira Utility (v1.35 or later available at Download) and use it put the Promira in firmware update mode:

   a. Click the Promira button.

   b. Find your Promira device in the list. If it doesn't appear yet, wait a little while for it to finish booting and enumerating, then click the button to refresh the list.

   c. Select the Promira which was found, and click OK.

   d. Click the Update License/Firmware button.

2. Copy the new firmware (.pmu file) to the Promira's disk. Typically your PC will notify you that a new disk has been detected, and give you the option to browse it. You may need to manually navigate to it using Finder or Explorer.

3. Eject the USB disk

4. Power-cycle the Promira the firmware will be automatically updated, which will take about a minute to complete, during which time the LEDs will blink blue.

5. Wait for the right-most LED to illuminate green, then login to the A^{2}B Bus Monitor.

4 User Interface Overview

The A^{2}B Bus Monitor application is accessed via an HTML5 web browser, connecting to the server application hosted on the Promira platform.

Features:

- **Multi-user:** Multiple users can simultaneously access, view, and control the A^{2}B Bus Monitor.

- **Role-level access:** Different roles are available to limit access to the various features.

- **Responsive design:** Single web interface is compatible with mobile browsers, tablets, and PCs.

- **Bus Data View:** all I2C, GPIO, and IRQ events are displayed in a single table with microsecond resolution. When possible, bus data is parsed to show human readable data fields.

- **Node Topology View:** a simple tree view of all nodes that are discovered in an A^{2}B system that is based on captured data.

- **Audio Channel View:** all downstream and upstream audio channel levels are displayed simultaneously during a capture. There is a buffer on the device which can store audio data.

All captured data is stored in volatile memory and are cleared if the power is cycled. Bus data can be exported as a CSV file and audio data (up to 15 seconds) can be exported as a multi-channel WAV file.

4.1 Login
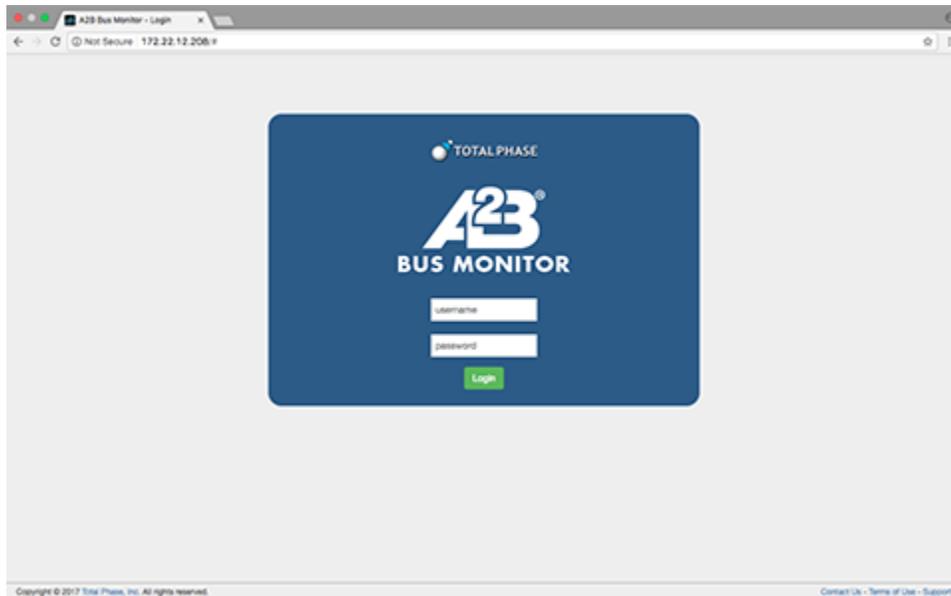
Figure 8 : A²B Bus Monitor Application Login Page

The login screen functions as expected. The user should enter their username and password and click "Login" to access the system. If an incorrect username or password is entered, an error message will appear.

By default, the A²B Bus Monitor includes an "admin" user (password: "promira"). It is highly recommended that this password be changed upon first usage. If the username or password is forgotten, it is possible to do a system reset to reset the admin user password. Please note that a System Reset will reset all parameters and configuration. These parameters and settings are not recoverable.

For more information about creating and managing users, please see the User Management section.

For more information about resetting the A²B Bus Monitor, please see the System Reset section.

4.2 General

After logging in, the user will be presented with the main interface. At the top of the page, there is a Menu button on the left and a Capture buttons on the right.
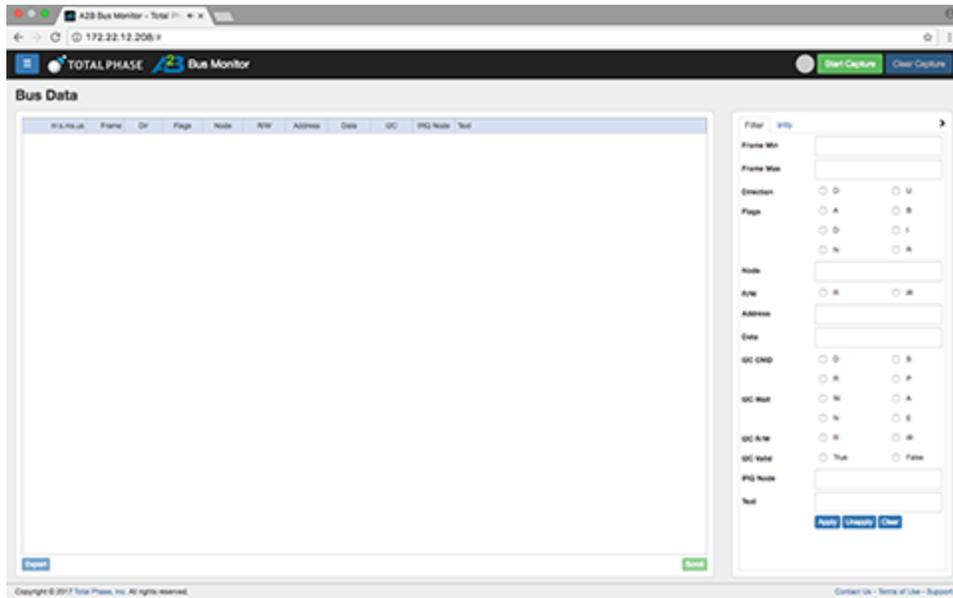
Figure 9 : A^{2}B Bus Monitor Application Initial Page

4.2.1 Menu

All functional areas of the A^{2}B Bus Monitor can be accessed via the menu. Click on the menu button to toggle the appearance of the menu. The menu button can be clicked again to hide the menu.

4.2.2 Start/Stop Capture

The start/stop capture button is used to start and stop an A^{2}B capture. Some functionality is only available when the capture is active and some functionality is only available when the capture is stopped.

When a capture is not active, a green "Start Capture" button will appear. If a capture is active, a red "Stop Capture" button will appear. To start or stop a capture, simply click the button. The state of the button will change to reflect the new status of the A^{2}B Bus Monitor.

Please note that is very important that the capture must be started before there is data on the A^{2}B bus. Otherwise, the behavior of the A^{2}B Bus Monitor will be erratic and unpredictable.

4.2.3 A^{2}B Bus Status Indicator

To the left of the Start/Stop Capture button is the A^{2}B bus status indicator. This indicator will be a pulsing green if the A^{2}B Bus Monitor has successfully locked on to the A^{2}B bus.

4.2.4 Clear Capture

The "Clear Capture" button is used to delete all data that has been captured. This button is only available when the capture is stopped and there is data to clear. It is not possible to clear a capture while it is running.

4.3 Bus Data View

The Bus Data view provides a historical record of all A^{2}B bus data captured. This view has two major components: the transaction table on the left and tools on the right. Currently the tools consist of the filtering tools and transaction details.
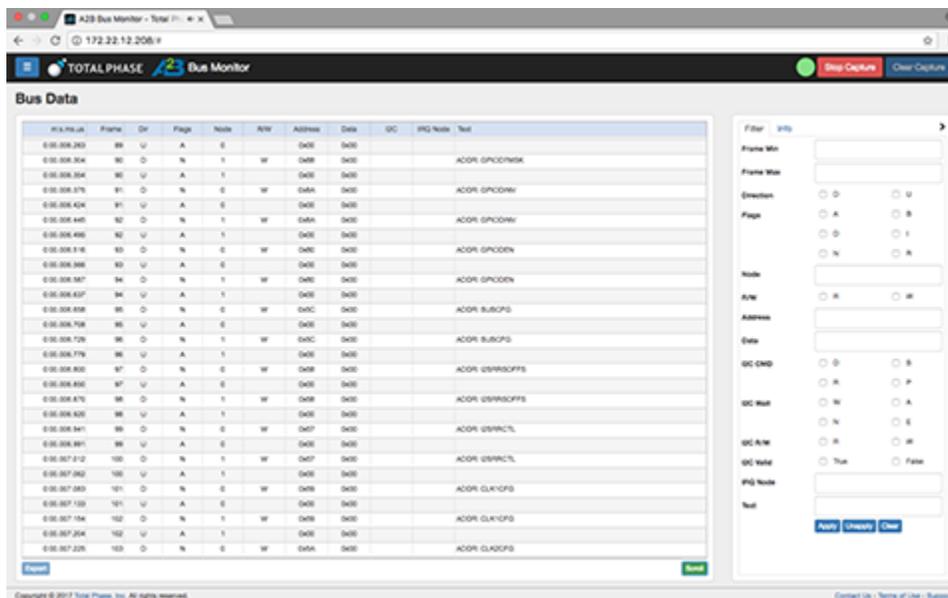
Figure 10 : *Bus Data View during a capture*

4.3.1 Transaction Table

The Transaction Table lists all the A^{2}B frames that have been captured. Each row contains either a Synchronization Control Frame (SCF) header or Synchronization Response Frame (SRF) header. This means that each superframe will have two rows. The data is separated into the following columns:

Table 5 : Transaction Table Columns

Column Name	Description
m:s.ms.us	Timestamp relative to the start of the capture. Each frame has a 64-bit timestamp.

Frame	Relative frame number from the start of the capture. The frame number is incremented by 1 for each frame captured on the A^{2}B bus.
Dir	Downstream or Upstream. Downstream indicates that the row data is for an SCF and Upstream indicates that the row data is for an SRF.

Flags	Indicates information about the row
	
	        Downstream (SCF), the possible values are:
	        N: Normal
	        B: Broadcast
	        D: Discovery
	
	        Upstream (SRF), the possible values are:
	        A: ACK
	        N: NACK
	        R: Repeat
	        I: IRQ

Node	Node number
R/W	Downstream Only, Read or Write
Address	A^{2}B Register address
Data	A^{2}B Data at specific register address

I2C	This column encodes information about I2C communication on the A^{2}B bus. There are 4 letters in this column.
	
	        The first letter provides information about the I2C Start/Stop command. The possible values are:
	        D: Data
	        S: Start
	        R: Repeat Start
	        P: Stop
	
	        The second letter provides information about the I2C Command Status. The possible values are:
	        W: Wait
	        A: ACK
	        N: NACK
	        E: Error
	
	        The third letter indicates if the I2C command was a read or write command.
	
	        The fourth letter indicates if the I2C data was valid.

IRQ Node	Node that issued an Interrupt
Text	Text summary of the row data (if available).

As new data is captured, new rows are added to the bottom of the table.

Collapsed Packets

In order to condense the data stream, if a particular packet is repeated multiple times, it will be collapsed into a single row with summary information that indicates the summarized frames and the number of times the packet was repeated.

4.3.2 Scroll

The Scroll button at the bottom of the table controls the scrolling function of the table. When the scroll button is green, the table will scroll as new data is added to the table. When the scroll button is red, the table will remain at its current location, even if new data is added. This feature can be turned on or off by clicking the button.

When the user highlights a row of data in the table, the scrolling feature will automatically stop so that the row of interest does not scroll out of view. The scrolling feature can be restored by clicking the Scroll button again.

4.3.3 Export

Data export is only possible when a capture is stopped. Data in the transaction table can be exported to a CSV file by clicking the Export button. If a filter is active, only the filtered data will be exported. The exported CSV file will have a filename: a2b_data_[ts].csv where [ts] is a timestamp of when the export was created. This naming convention prevents exported data from being accidentally over-written.

Please note that due to limitations in Safari, the CSV file will be saved as "Unknown."

4.3.4 Clear Data

Clearing data is only possible when a capture is stopped. Clear Data will delete all data in memory (including the Node Topology data and Audio Buffer data) and reset all filters. When the Clear Data button is clicked, a confirmation dialog will appear to confirm that the user wants to continue with the action.

4.3.5 Right Sidebar

The sidebar on the right provides two additional tools: Transaction Details and Filters. These tools are tabs in the sidebar.

Please note that on devices with small screens, the right sidebar is not available due to the limited screen space. A device with a larger screen is recommended for full functionality.

Transaction Details

Figure 11 *: Transaction Details*

When a row is selected in the transaction table, its information is displayed in more detail in the Info tab. This is useful in the case of large data payloads. The Transaction Details view will show the entirety of the payload.

Filtering
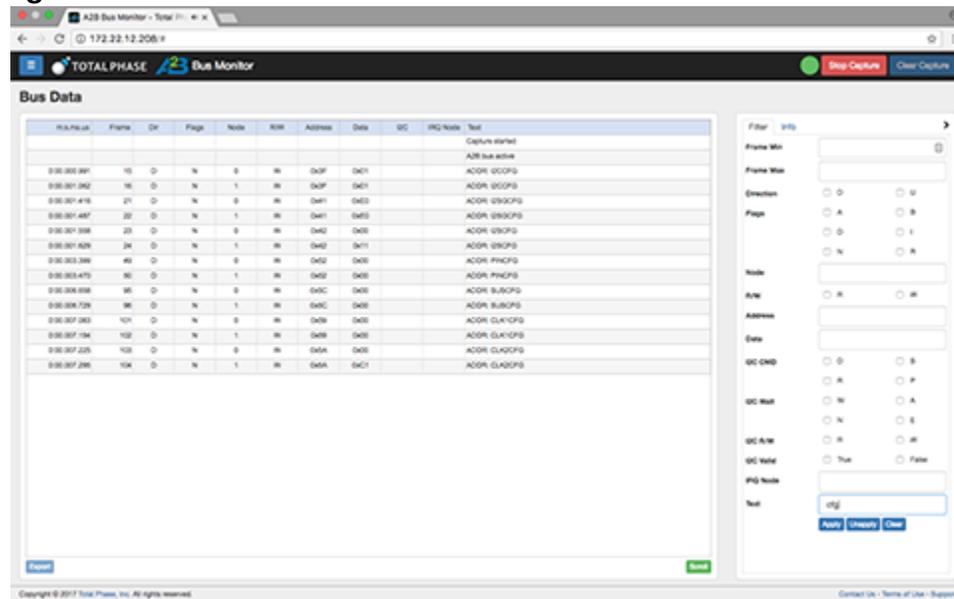
Figure 12 : *Bus Data View with data being filtered for data == 0x02*

The Filter tab provides a filtering view. The filter is a non-destructive filter that will present only matching data in the Transaction Table. There are a number of parameters which can be used to filter the data and they are combined with a logical AND meaning that all filter parameters must be met in order for the data to appear in the Transaction Table.

In the case of Node, Address, and Data, multiple entries can be entered, separated by a space. For example, if the user desires to see all rows for address 2, 30, and 63, the user would enter "2 30 63" in the Address field. The data entered can be in decimal or hexadecimal, which means that "0x02 0x1e 0x3f" would work as well.

To apply the filters, hit Enter in the filter form or click the "Apply Filter" button.

To clear the filters, click the "Clear Filter" button.

4.4 Node Topology View

The Node Topology View provides a view into the most current configuration settings seen by the A²B Bus Monitor, organized by node. The Node Topology View consists of two major components: the Node list and the Node Register table.
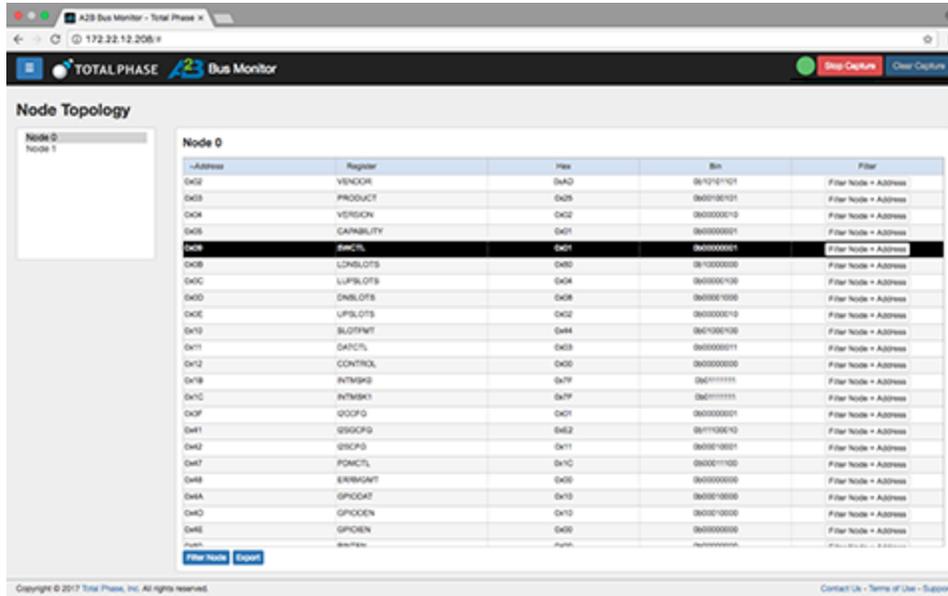
Figure 13 : Node Topology View displaying the registers for
Node 0

4.4.1 Node List

All nodes that have been detected during the capture will be included in the list.

At the bottom of the list is a "Clear Data" button. This function is only available when a capture is stopped. When clicked, all data will be deleted, including bus transaction data and audio data. When clicked, a confirmation dialog will appear to confirm that the user wants to delete all data.

4.4.2 Node Register Table

The Node Register Table displays all captured node configurations for the selected node. Each row represents the data last written or read to a specific register address. The data is separated into the following columns:

Table 6 : Node Register Table Columns

Column Name	Description
Address	The register address in hexadecimal
Register	The register name, as listed in the ADI A^{2}B Transceiver Programming Reference
Hex	The register data in hexadecimal
Bin	The register data in binary

Filter	The "Filter Node + Address" button can be used to filter the Bus Data table with the node number and register address of the row. When this button is clicked, the view will change to the Bus Data view and all rows that match the selected node and register address will be displayed. This provides the user with a history of all read and writes to that node's specific address during the capture.

Note: if the A^{2}B bus lock is lost, the node topology data will be reset once lock is reacquired.

4.4.3 Filter Node

Besides filtering on a combination of Node and address, it is also possible to filter only on node. When clicking on the "Filter Node" button, the view will change to the Bus Data view and all rows that match the selected node will be displayed. This provides the user with a history of transactions specific to the selected node. This feature is available during a capture.

4.4.4 Export

Data in the node register table can be exported to a CSV file by clicking the Export button. The exported CSV file will have a filename: a2b_node[#]_[ts].csv where [#] is the node number and [ts] is a timestamp of when the export was created. This naming convention prevents exported data from being accidentally over-written. This feature is only available after a capture is stopped.

Please note that due to limitations in Safari, the CSV file will be saved as "Unknown."

4.5 Audio Channel View

The Audio Channel View provides an instantaneous view of all audio levels of all audio channels on the A^{2}B link under analysis. This view has three major components: the downstream audio channels, the upstream audio channels, and the informational sidebar. The information sidebar provides a time-domain view, a frequency domain view, and information about the I2S configuration on the A^{2}B link.
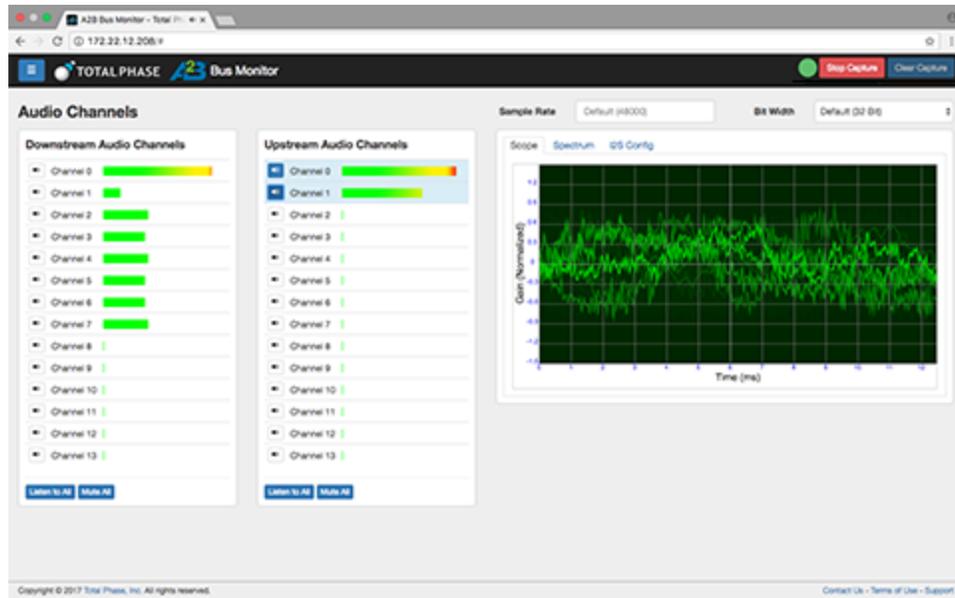
Figure 14 : Audio Channels View with downstream and
upstream audio levels

4.5.1 Audio Settings

The audio settings of the monitored audio data must be configured for it to appear
properly in the A^{2}B Bus Monitor Application. Audio sample rates of 48 kHz and 44.1 kHz
and bit widths of 8-bit, 16-bit, 24-bit, and 32-bit are supported. By default, the audio
sample rate is set to 48 kHz and the bit width of the audio data is set to 24-bit. The audio
settings are applicable to both the downstream and upstream audio channels.

The audio settings can only be changed when audio is not playing. To enable the form
elements to change the audio settings during a capture, simply mute all audio channels.

4.5.2 Downstream and Upstream Audio Channels

These two views functional identically for the downstream and upstream audio data
respectively. Fourteen channels of audio data will be available in each direction. When a
capture is active, any energy detected in any of the audio stream will be displayed as the
dbFS levels. In the case where there is absolute silence, the dbFS level will be 0 (the
equivalent of -90 dbFS).

Each channel is displayed as a separate row in these views. The button at the left of the
row will select the row. While a capture is active, selecting a row will cause its audio to
be included in the live mix audio mix and have its data appear in the oscilloscope and
spectrum view. While a capture is stopped, selecting a row will include that channel
when exporting a WAV file.

Listen to All

This button is only available when a capture is active. When clicked, this button selects all channels and adds them to the audio mix, the oscilloscope view and the spectrum view.

Mute All

This button is only available when a capture is active. When clicked, this button deselects all channels and removes them from the audio mix, the oscilloscope view and the FFT view.

Select All

This button is only available when a capture is inactive. When clicked, this button selects all channels for saving to a WAV file.

Unselect All

This button is only available when a capture is inactive. When clicked, this button deselects all channels for saving to a WAV file.

Save

This button is only available when a capture is inactive. When clicked, this button will generate a WAV file of all the selected channels. The amount of audio data available will depend on the length of the capture, with a maximum of 15 seconds. Please note, WAV files are to be used for debugging purposes only and are not for distribution.

Please note that due to limitations in Safari, the WAV file will be saved as "Unknown."

4.5.3 Right Sidebar

The information sidebar provides a tabbed interface to additional data views: Oscilloscope, FFT, and I2S Configuration information.

Please note that on devices with small screens, the right sidebar is not available due to the limited screen space. A device with a larger screen is recommended for full functionality.

Oscilloscope
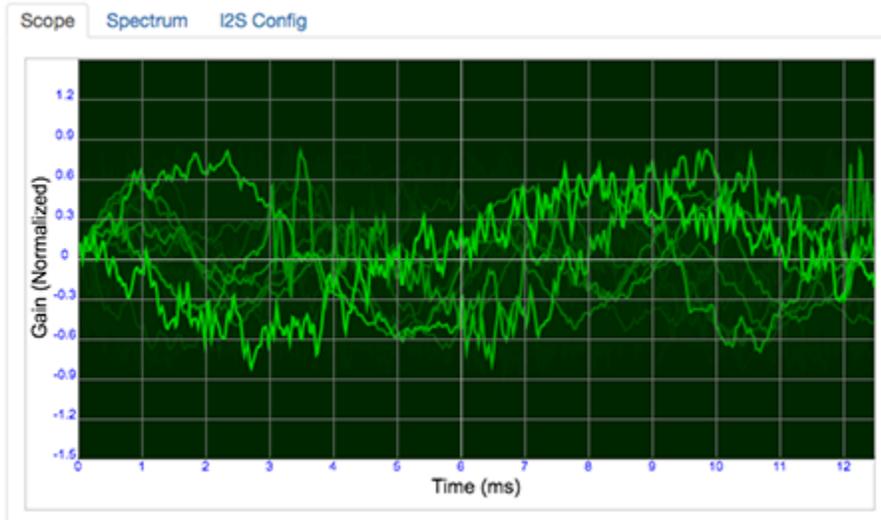
Figure 15 : *Oscilloscope tool*

The oscilloscope view provides a simple time-domain view of the currently playing audio mix, displaying the normalized audio amplitude over time. All selected channels are included in this view. Please note that this view is only for basic audio analysis. For detailed audio analysis, it is recommended that the audio be imported into a dedicated audio analysis software.

FFT Spectrum
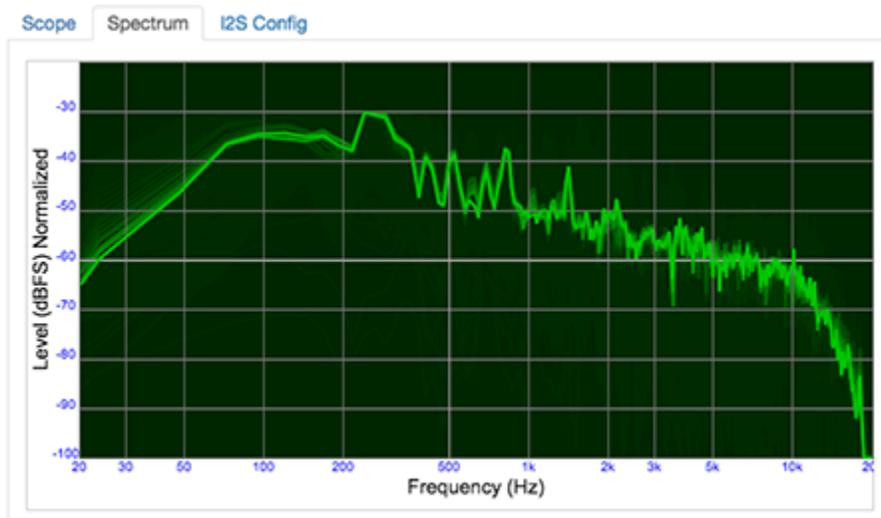
Figure 16 : *FFT Spectrum tool*

The FFT view provides a simple frequency-domain view of the currently playing audio mix, displaying audio signal amplitude versus frequency. All selected channels are included in this view. Please note that this view is only for basic audio analysis. For detailed audio analysis, it is recommended that the audio be imported into a dedicated audio analysis software.

I2S Configuration

Figure 17 : I2S Global Configuration Information

The I2S Configuration view provides information about the I2S data streams. This information is generated from the I2S global configuration register. The I2S configuration information displayed is:

Table 7 : I2S Configuration

Configuration	Description
TDM Mode	TDM2, TDM4, TDM8, TDM12, TDM16, TDM20, TDM24, or TDM32
TDM Slot Size	16-bit or 32-bit slot sizes
Alternating Sync	Drive the SYNC pin for 1 cycle or alternating cycles
Early Sync	Change SYNC pin in the same cycle or previous cycle
Invert Sync	Rising or Falling edge of SYNC pin at the start of the audio frame

4.6 User Management

The A^{2}B Bus Monitor Application includes a user management system. Only authorized users can remotely access the application. The User Management page consists of two major sections: the User list and the User Information section.
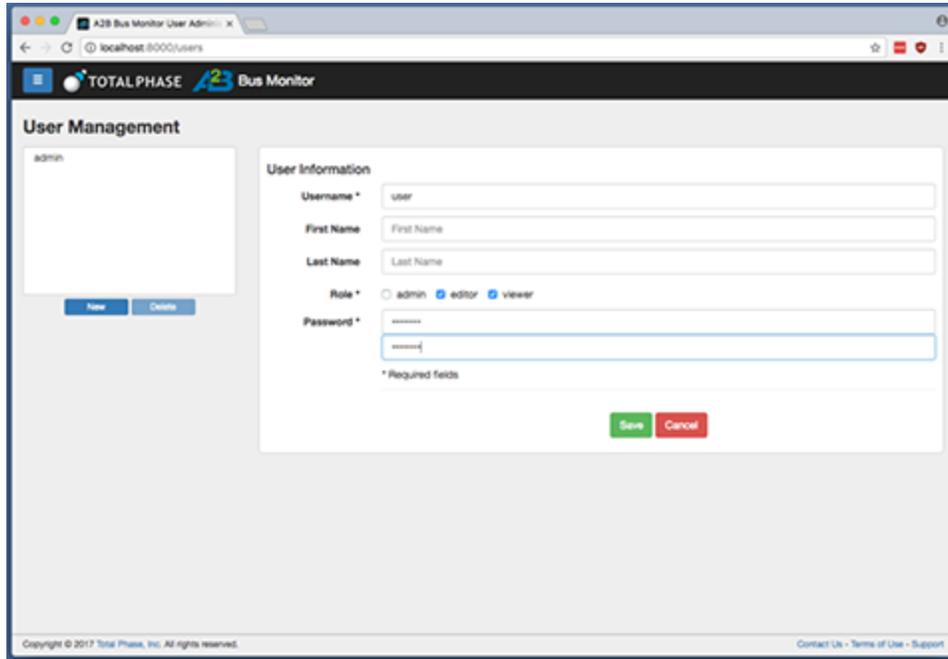
Figure 18 : *User Management System*

4.6.1 User List

All users that are on the A^{2}B Bus Monitor are listed in the user view. Users are local to the specific A^{2}B Bus Monitor Application and are not shared globally. To select a user, simply click on the username. The user's information will appear in the User Information when selected.

By default, every A^{2}B Bus Monitor is pre-loaded with an admin user (password: promira). It is recommended that the password be changed for this user when first using the A^{2}B Bus Monitor.

4.6.2 User Information

The user information appears in this section. By default this form is disabled, but when a user is selected or a new user is created, the form is activated and available to receive entry. Only the username, role and password fields are required. The First Name and Last Name fields are optional.

Roles

There are three user roles that are built into the A^{2}B Bus Monitor Application: admin, editor, and viewer. These roles are not mutually exclusive, so any user can have one or more roles on the device. Currently there is no difference between the access levels in the web interface, but this may change in the future.

4.6.3 Create User

To create a user, simply click on the New button. This will activate the form in the User Information section. All fields with an asterisk (*) are required. Usernames must be unique and once created, usernames cannot be changed. If there are any problems with the entry, an error message will appear when trying to save the user information. Clicking on the Cancel button will disable the form and clear all information entered.

Please note that there is no way to recover a user's password. If a user forgets their password, the only option will be to have the administrator change the password. If the administrator's password is forgotten, the only way to regain access to the system is to do a System Reset.

4.6.4 Modify User

To modify an existing user, simply select the specific username in the User List. The User Information section will activate and display the information for the selected user, excluding their current password. Changes made to this user can be saved by clicking on the Save button. If there are any problems with the entry, an error message will appear when trying to save the user information. Clicking on the Cancel button will disable the form and clear all newly entered information, defaulting to the previously saved user information.

4.6.5 Delete User

To delete an existing user, simply select the specific username in the User List and click Delete. There is no confirmation dialog box when deleting a user.

4.7 Configuration

The Configuration system provides information about the A^{2}B Bus Monitor and allows the management of the available configurable parameters.
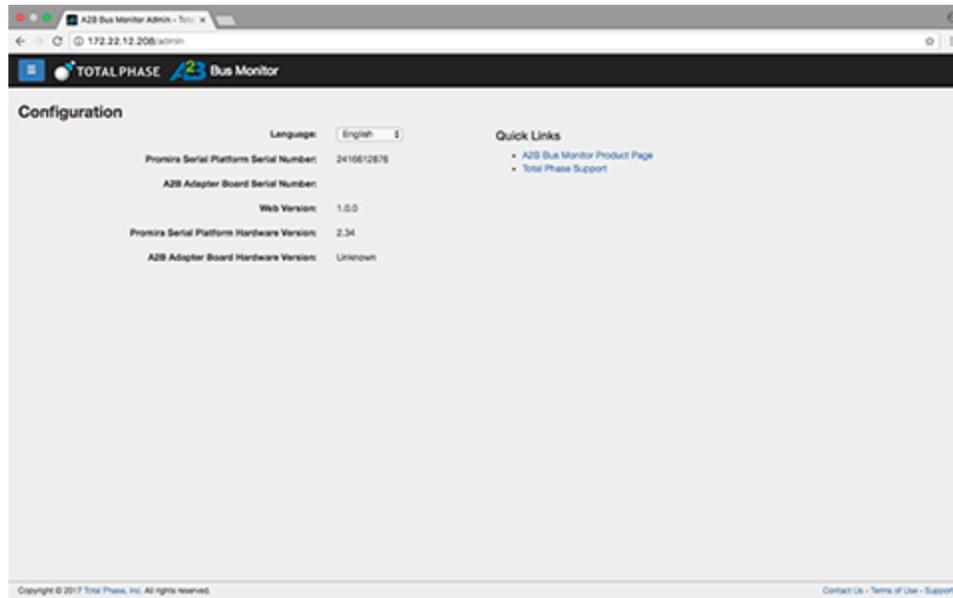
Figure 19 *: Configuration Page*

4.7.1 Language Setting

The A^{2}B Bus Monitor Application's interface language can be changed on the fly. Currently the following interface languages are supported:

- Chinese (Simplified)

- Chinese (Traditional)

- English

- French

- German

- Japanese

- Korean

4.7.2 Serial Numbers

The serial numbers for the Promira Serial Platform and the A^{2}B Adapter Board are displayed.

4.7.3 Versions

The versions of the Hardware, Firmware, and Web Software are displayed.

4.7.4 Support

Quick links to Total Phase support resources are provided for quick access.

5 Notes and Limitations

There are some important limitations in the capabilities of A^{2}B Bus Monitor.

5.1 A^{2}B Capture Limitations

Due to limitations in the architecture of the A^{2}B Bus Monitor there are a number of issues to keep in mind when capturing A^{2}B data.

5.1.1 Capture must be started before Discovery

The A^{2}B Bus Monitor capture must be started before the Discovery and Initialization of the A^{2}B bus. The A^{2}B Bus Monitor must be actively capturing data on the A^{2}B bus so that it can lock on to the signal. The implication of this limitation is that the A^{2}B Bus Monitor cannot be attached to an A^{2}B bus after the bus has been discovered and initialized.

In the event that the lock to the A^{2}B bus is lost, the A^{2}B Bus Monitor will attempt to recover the lock. When lock is lost, the A^{2}B bus indicator will turn gray. Once lock is reacquired, the indicator will turn green.

When A^{2}B bus lock is lost, it is possible that the saved audio stream from the capture will have a glitch at the point lock was lost.

5.1.2 Sigma Studio and Phantom-Powered device discovery

If Analog Devices' Sigma Studio platform is being used to bring up an A^{2}B system, it is recommended that an extra delay be added between when the commands are sent to the configure a phantom-powered A^{2}B node and when Discovery is started. By default, the Discovery process can be too fast and would prevent the A^{2}B Bus Monitor from locking on to the A^{2}B signal.

5.1.3 Wire Polarity

When connecting the A^{2}B Adapter Board in-line to an A^{2}B system, the polarity of the pins is important. The pin polarity should be flipped at each connector. Meaning that pin 1 of the preceding node should be connected to pin 2 of the A^{2}B Adapter Board and vice versa. The output connector of the A^{2}B Adapter Board should also be flipped when

connecting to the following node. The REV LED (D14) will be red if the polarity is incorrect. In this case, please swap the pins in the connector and try again.

5.2 Enable Audio Output

In order for the A^{2}B Bus Monitor to be able to capture the I2S/TDM audio data on the A^{2}B bus, the A^{2}B Master must be configured to enable audio output. The instructions for how to enable audio output must be requested from Analog Devices as this is a security feature to prevent unauthorized access to the audio data.

5.3 Frame Data Errors

It is important to note that the A^{2}B Bus Monitor is only a protocol analyzer. It is not able to provide any information about the electrical characteristics of the A^{2}B bus. While the A^{2}B Bus Monitor is a non-intrusive bus monitor, there are limitations to the errors that it is able to capture on the A^{2}B link under analysis.

The A^{2}B Bus Monitor captures protocol level information only. If there is a problem in the physical layer below the PHY layer, data communication errors that are seen by either node may not necessarily be captured. The best indicator of bus errors would be determining if the data is being retransmitted between nodes.

5.4 Capture Depth and Error Aggregation

The A^{2}B Bus Monitor has a finite amount of memory that can limit the amount of data captured. The memory buffer in the A^{2}B monitor operates as a circular buffer. As long as the A^{2}B monitor is connected to a web browser that is downloading the A^{2}B bus data, data will be saved unless the web browser runs out of memory. For very long captures, it is recommended that a script is used to write bus data directly to disk.

To help maximize the available memory buffer space, SCF or SRF that have errors are aggregated into a single row that provides a count of all errors that were collapsed into that row.

While the bus data is stored in a circular buffer until it downloaded by a web browser, the node topology information is stored in its entirety. The last state of the node registers is always available.

5.5 Discovery and Initialization

A^{2}B bus lock must occur before the A^{2}B Bus Monitor can capture data. A direct consequence of this architecture is that it is not possible to capture "Discovery" frames. Only "Normal" and "Broadcast" frames can be captured, which means the captured bus data will consist of A^{2}B Synchronization Control Frames (SCF) and Synchronization Response Frames (SRF). SCF and SRF encode A^{2}B register read/write. Additionally,

embedded within the SCF and SRF may be I2C (upstream and downstream), GPIO over Distance (upstream and downstream), and Interrupt events (downstream only).

This means that it is not possible to see the actual Discovery process on the A^{2}B bus for which the nodes are trying to lock on to the A^{2}B bus. However, it is possible to capture the Initialization frames.

For the most complete capture of Initialization data, it is recommended to connect the A^{2}B Bus Monitor between the A^{2}B Master Node and the first A^{2}B Slave Node. This will allow the bus monitor to see any initialization data for all nodes. If the bus monitor is placed further down the chain, it will not see the interaction between upstream nodes and the master node.

5.6 A^{2}B System Debug Support

A^{2}B has a built-in system diagnostic function to identify line faults and other error conditions. This system is only accessible via the Host and is not visible in the A^{2}B communication.

5.7 Web Performance

The Promira Serial Platform services all requests. If the device receives too many requests at the same time, the performance of the software can be negatively affected. If you experience reduced performance, it is recommended that you limit the number of users concurrently accessing the software.

5.8 A^{2}B Data Capture Buffer

There is a limited amount of memory in the Promira Serial Platform available for storing A^{2}B data. Due to this limitation, a circular buffer exists in the device, which limits the amount of A^{2}B data that can be stored before the data is overwritten. In order to ensure that no data is lost, it is recommended to retrieve data from the device on a regular basis. This can be accomplished via the web interface or the API. If joining a session mid-capture, it is possible that the earliest data may have been overwritten and no longer available for download and analysis.

5.9 Audio Channels

The A^{2}B Bus Monitor uses TDM16 to capture audio data. Two channels of audio are repurposed for other functions, reducing the total number of audio channels to 14.

Due to bandwidth constraints, the A^{2}B Bus Monitor is limited to a maximum of 32 simultaneous audio channels for streaming audio, across all web client sessions. Should the maximum number of channels be exceeded, an error message will appear when a user tries to stream additional audio.

5.10 I2S/TDM Output

The A^{2}B Adapter Board has the capability of outputting I2S/TDM data on connector JP1 and JP3. The I2S/TDM audio output setting is global so if the A^{2}B Bus Monitor is configured for TDM16, then the I2S data output on these connectors will also be in TDM16. This is important when outputting audio to third-party audio analyzers, like the Audio Precision APx525. Please verify that the hardware audio analyzers are able to support TDM16. If the I2S data is misconfigured, the audio data will not appear as expected in the audio analyzer.

It is important to note that the A^{2}B Bus Monitor captures downstream and upstream audio simultaneously. Downstream audio is output on the DTX0 pin and the upstream audio is output on the DTX1 pin. The audio data is not interleaved. Each pin will output I2S/TDM at the configured TDM Mode, meaning that if the A^{2}B Bus Monitor is configured to output TDM16, then the downstream audio and the upstream audio will both be sent as TDM16. Due to this architecture, the I2S output data does not follow the "traditional" I2S convention. Therefore it is important to configure the hardware analyzer correctly in order to see the expected audio data.

In the case of the Audio Precision family of analyzers, the following settings are recommended.
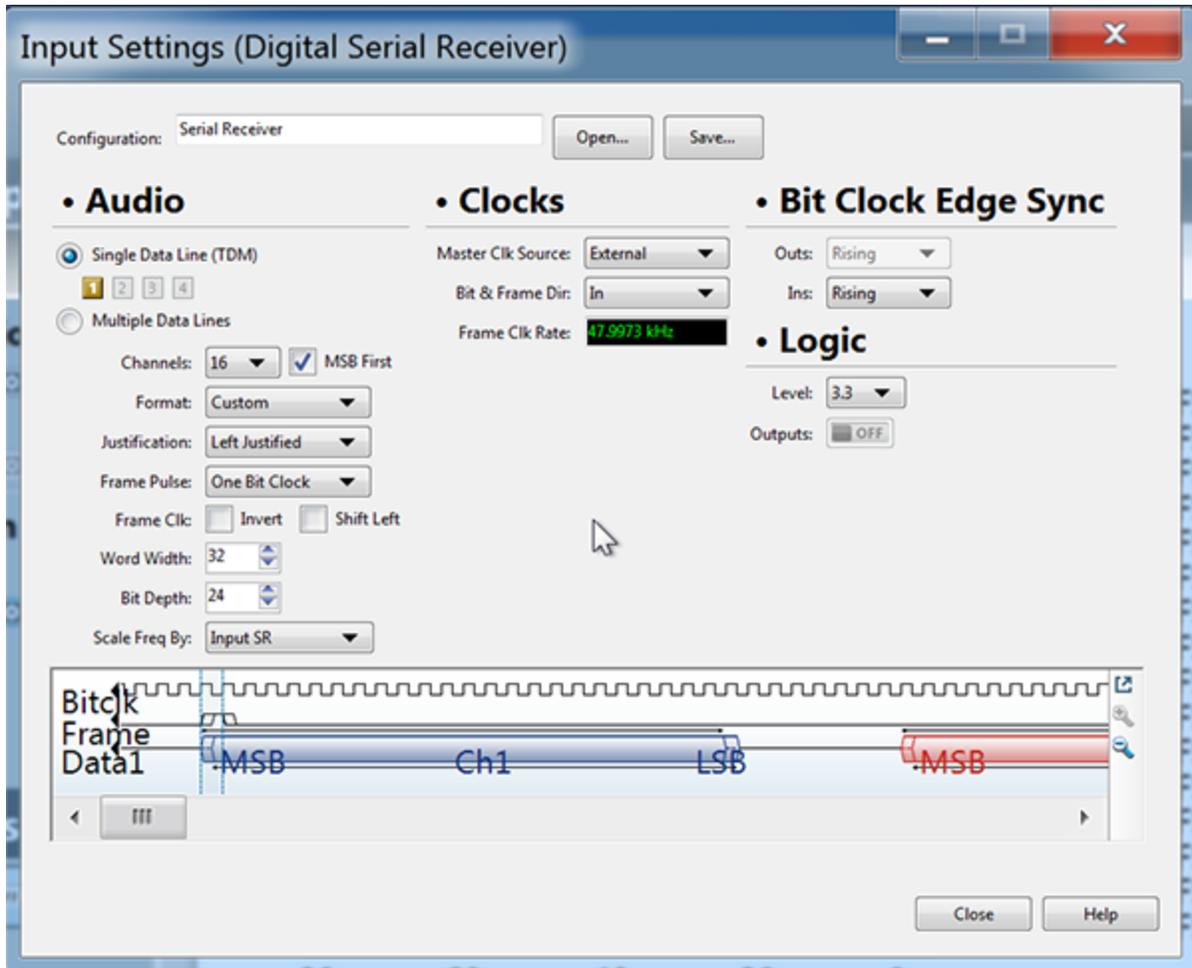
Figure 20 : Audio Precision Digital Input Recommended Settings.
Image courtesy of Audio Precision, Inc.

Table 8 : Audio Precision Digital Input Recommended Settings

Setting	Configuration
Single/Multiple	"Single Data Line (TDM)"
Channels	"16"
MSB First	Checked
Format	"Custom"
Frame Pulse	"One Bit Clock"
Frame Clk	none
Word Width	"32"
Bit Depth	The bit depth will depend on the I2S data under analysis.

Scale Freq By	"Input SR"
Master Clk Source	"External"
Bit & Frame Dir	"In"
Ins	"Rising"
level	"3.3"

5.11 Audio Recording Buffer

The A^{2}B Bus Monitor offers just under 15 seconds of audio buffer via the web application. If a longer recording is desired, it is recommended to use either the I2S Hardware output or to stream the audio data directly to disk using the A^{2}B Bus Monitor API.

6 API

The A^{2}B Bus Monitor includes a web-socket based, event driven API. The API provides access to all the underlying functionality of all aspects of the A^{2}B Bus Monitor. System wide functions can be accessed directly via the API, such as managing Users. A^{2}B specific functions can also be accessed via the API.

The API documentation is self-contained and the latest documentation is available directly from the device. The documentation can be viewed at http://[PROMIRA_IP]/api.

Sample code that makes use of the API can be found on the Total Phase website.

7 System Reset

A system reset will return an A^{2}B Bus Monitor to its factory default setting. All configuration settings, users, and sessions will be lost. A system reset requires a Reset PMU file, which can be requested from Total Phase Support.

8 Appendix A: Quick Start Guide

The simplest way to interface with the A^{2}B Bus Monitor Application is via the USB connection, which is described here:

1. 1) Connect the A^{2}B Adapter Board to the Promira platform, using the 40mm 34-pin connector and the provided cable as shown below.
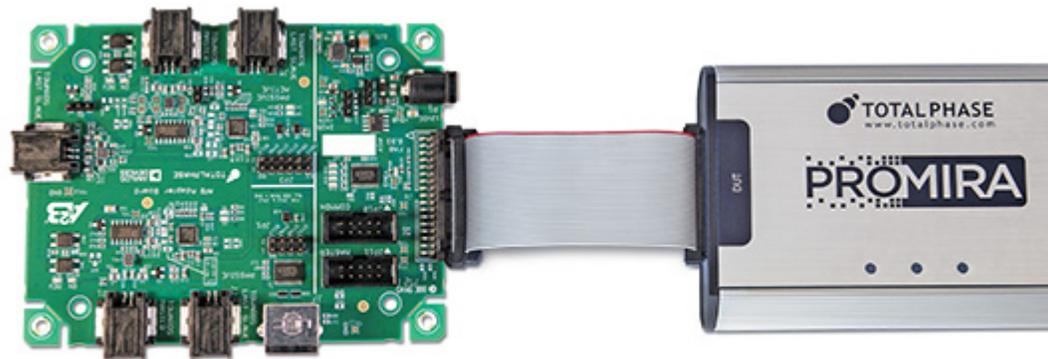
2. Connect the Promira platform to your PC using a USB Standard-A to Micro-B cable.

3. Follow the instructions in Section 5.2 – Connectivity of the Promira platform system user manual to configure Ethernet over USB interface.

4. Download and unzip the latest version of Promira Utility for your OS. (?)

5. Start the Promira Utility and use it to connect to your Promira by clicking the Promira button in the upper-left corner of the utility window.

   a. Click the ⬚Promira⬚ Promira button.
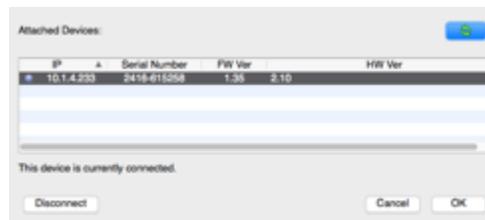
   b. Find your Promira device in the list.

   If it doesn't appear yet, wait a little while for it to finish booting and enumerating, then click the 🔄 button to refresh the list.

    c. Select the Promira device which was found, and click OK.

6. In order to start the A^{2}B Bus Monitor application on the Promira platform you must enable it as the "Auto Start App:" by clicking on the pulldown.

    a. Choose "com.totalphase.promana_a2b" in the list, and click Apply.

    b. Note the IP address shown in the window. This is the address of the device that you will need below in the process.

    c. Power-cycle the Promira by unplugging the USB cable, and plugging it back in.

    d. Wait for the Promira platform's right LED to go from RED to BLUE and finally to GREEN.

7. Open a web browser, and navigate to the IP address: http://[PROMIRA_IP_ADDRESS]/

8. Login using the default credentials, Username: `admin` and Password: `promira`.

9. Connect to the A^{2}B bus of interest. It is recommended that the A^{2}B should be monitored between the master node and the first slave node. Please refer to figures 6 and 7.

10. Click the Start Capture button to start the A^{2}B capture.

11. Start the A^{2}B system of interest. Note: the A^{2}B Bus Monitor capture must be started before Discovery happens on the A2B bus under analysis.

12. Watch the A^{2}B traffic and listen to audio data as it is captured on the bus.

9 Legal / Contact

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