

**Research & Vehicle Technology**

**“Infotainment Systems Product Development”**

**Feature – Digital A2B Audio Bus**

*Strawman for A2B SPSS for Phoenix Audio system.*

**Infotainment Subsystem Part Specific Specification (SPSS)**

Version 1.4

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# FRD-REQ-407092/A-Architectural Design

## Interface Requirements

### HW/SWR-REQ-407093/A-GPIO Signals

The module shall implement all General Purpose IO signal lines (GPIO) that are necessary for proper functionality as defined in the ADI *AD242x Data Sheet* or in the ADI *AD243x Data Sheet* – latest revision at time of sourcing. The logic values the GPIOs are set to shall be provided by Ford core engineering. The suppliers shall provide Ford with all intended uses of the ‘virtual GPIO’ registers.

See Analog Devices *AD242x Data Sheet* and *AD242x Programming Reference Manual,* or the *AD232x Data Sheet* and *AD243x Programming Reference Manual,* (dependent on supplier design) for pins on A2B micro for GPIO I/O.

#### HW/SWR-REQ-416431/B-Design guidelines for GPIO pins

The following charts identify the virtual GPIO (or GPIO Over Distance) pins each module shall use.

* “Direct Micro Connect” (or D/C) lines are used for outputs.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| AD2433 PIN | Pin Name | Alternative Function | Harman PAC Usage | Harman DSP AMP B&O 6 Usage | Harman DSP AMP B&O 10 Usage | Harman DSP AMP Revel 10 Usage | Harman DSP AMP Revel 24 Usage | GPIO Feature |
| 5 | SIO0 | PDM0 GPIO0 |  |  |  |  |  |  |
| 6 | SIO1 | PDW1 GPIO1 |  |  |  |  |  |  |
| 7 | SIO2 | ASPISS SPISSEL1 GPIO2 |  |  |  |  |  |  |
| 12 | SIO3 | GPIO3 |  |  |  |  |  |  |
| 13 | SIO4 | GPIO0 |  |  |  |  |  |  |
| 14 | GPIO7 | RRSTRB PDMCLK | IOD7DAT (GPIO7) (D/C) | IOD7DAT (GPIO7) (D/C) | IOD7DAT (GPIO7) (D/C) | IOD7DAT (GPIO7) (D/C) | IOD7DAT (GPIO7) (D/C) | Clip Detect |
| 15 | SDA | GPIO6 |  |  |  |  |  |  |
| 16 | SCL | GPIO5 |  |  |  |  |  |  |
| 17 | MISO | PWM1 GPIO5 |  |  |  |  |  |  |
| 18 | MOSI | PWM2 GPIO6 |  |  |  |  |  |  |
| 19 | SCK | PWM3 GPIO0 |  |  |  |  |  |  |
| 22 | ADR1 | SPISS SPISSEL0 PWMOE CLKOUT GPIO4 |  |  |  |  |  |  |
| 23 | ADR2 | MCLK ASPISS SPISSEL2 CLKOUT GPIO4 |  |  |  |  |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| AD2433 PIN | Pin Name | Alternate Function | PDC Usage | Visteon D245 Usage | China DuerOS Usage | GPIO Feature |
| 5 | SIO0 | PDM0 GPIO0 |  |  |  |  |
| 6 | SIO1 | PDW1 GPIO1 |  |  |  |  |
| 7 | SIO2 | ASPISS SPISSEL1 GPIO2 |  |  |  |  |
| 12 | SIO3 | GPIO3 |  |  |  |  |
| 13 | SIO4 | GPIO0 |  |  |  |  |
| 14 | GPIO7 | RRSTRB PDMCLK | N/C | IOD7DAT (GPIO7) (D/C) | IOD7DAT (GPIO7) (D/C) | Clip Detect |
| 15 | SDA | GPIO6 |  |  |  |  |
| 16 | SCL | GPIO5 |  |  |  |  |
| 17 | MISO | PWM1 GPIO5 |  |  |  |  |
| 18 | MOSI | PWM2 GPIO6 |  |  |  |  |
| 19 | SCK | PWM3 GPIO0 |  |  |  |  |
| 22 | ADR1 | SPISS SPISSEL0 PWMOE CLKOUT GPIO4 |  |  |  |  |
| 23 | ADR2 | MCLK ASPISS SPISSEL2 CLKOUT GPIO4 |  |  |  |  |

#### HW/SWR-REQ-407094/A-GPIO0

This GPIO shall be used as a ‘Virtual GPIO’ as defined in the ADI *AD242x Data Sheet*, or in the ADI *AD243x Data Sheet.* The usage for this virtual GPIO is to be node specific and shall be defined in the *Phoenix Audio Peripheral Command and Control API Specification*.

**Message Type**: GPIO

|  |  |  |  |
| --- | --- | --- | --- |
| **Signal Name** | **Literals** | **Value** | **Description** |
| IO0 | Single Digit of Virtual GPIO - Logic ‘0’ | 0x0 | this is when IO0 is not asserted |
| Single Digit of Virtual GPIO - Logic ‘1’ | 0x1 | this is when IO0 is asserted |

#### HW/SWR-REQ-407095/A-GPIO1

This GPIO shall be used as a ‘Virtual GPIO’ as defined in the ADI *AD242x Data Sheet*, or in the ADI *AD243x Data Sheet.* The usage for this virtual GPIO is to be node specific and shall be defined in the *Phoenix Audio Peripheral Command and Control API Specification*.

**Message Type**: GPIO

|  |  |  |  |
| --- | --- | --- | --- |
| **Signal Name** | **Literals** | **Value** | **Description** |
| IO1 | Single Digit of Virtual GPIO - Logic ‘0’ | 0x0 | this is when IO1 is not asserted |
| Single Digit of Virtual GPIO - Logic ‘1’ | 0x1 | this is when IO1 is asserted |

#### HW/SWR-REQ-407096/A-GPIO2

This GPIO shall be used as a ‘Virtual GPIO’ as defined in the ADI *AD242x Data Sheet*, or in the ADI *AD243x Data Sheet.* The usage for this virtual GPIO is to be node specific and shall be defined in the *Phoenix Audio Peripheral Command and Control API Specification*.

**Message Type**: GPIO

|  |  |  |  |
| --- | --- | --- | --- |
| **Signal Name** | **Literals** | **Value** | **Description** |
| IO2 | Single Digit of Virtual GPIO - Logic ‘0’ | 0x0 | this is when IO2 is not asserted |
| Single Digit of Virtual GPIO - Logic ‘1’ | 0x1 | this is when IO2 is asserted |

#### HW/SWR-REQ-407097/A-GPIO3

This GPIO shall be used as a ‘Virtual GPIO’ as defined in the ADI *AD242x Data Sheet*, or in the ADI *AD243x Data Sheet.* The usage for this virtual GPIO is to be node specific and shall be defined in the *Phoenix Audio Peripheral Command and Control API Specification*.

**Message Type**: GPIO

|  |  |  |  |
| --- | --- | --- | --- |
| **Signal Name** | **Literals** | **Value** | **Description** |
| IO3 | Single Digit of Virtual GPIO - Logic ‘0’ | 0x0 | this is when IO3 is not asserted |
| Single Digit of Virtual GPIO - Logic ‘1’ | 0x1 | this is when IO3 is asserted |

#### HW/SWR-REQ-407098/A-GPIO4

This GPIO shall be used as a ‘Virtual GPIO’ as defined in the ADI *AD242x Data Sheet*, or in the ADI *AD243x Data Sheet.* The usage for this virtual GPIO is to be node specific and shall be defined in the *Phoenix Audio Peripheral Command and Control API Specification*.

**Message Type**: GPIO

|  |  |  |  |
| --- | --- | --- | --- |
| **Signal Name** | **Literals** | **Value** | **Description** |
| IO4 | Single Digit of Virtual GPIO - Logic ‘0’ | 0x0 | this is when IO4 is not asserted |
| Single Digit of Virtual GPIO - Logic ‘1’ | 0x1 | this is when IO4 is asserted |

#### HW/SWR-REQ-407099/A-GPIO5

This GPIO shall be used as a ‘Virtual GPIO’ as defined in the ADI *AD242x Data Sheet*, or in the ADI *AD243x Data Sheet.* The usage for this virtual GPIO is to be node specific and shall be defined in the *Phoenix Audio Peripheral Command and Control API Specification*.

**Message Type**: GPIO

|  |  |  |  |
| --- | --- | --- | --- |
| **Signal Name** | **Literals** | **Value** | **Description** |
| IO5 | Single Digit of Virtual GPIO - Logic ‘0’ | 0x0 | this is when IO5 is not asserted |
| Single Digit of Virtual GPIO - Logic ‘1’ | 0x1 | this is when IO5 is asserted |

#### HW/SWR-REQ-407100/A-GPIO6

This GPIO shall be used as a ‘Virtual GPIO’ as defined in the ADI *AD242x Data Sheet*, or in the ADI *AD243x Data Sheet.* The usage for this virtual GPIO is to be node specific and shall be defined in the *Phoenix Audio Peripheral Command and Control API Specification*.

**Message Type**: GPIO

|  |  |  |  |
| --- | --- | --- | --- |
| **Signal Name** | **Literals** | **Value** | **Description** |
| IO6 | Single Digit of Virtual GPIO - Logic ‘0’ | 0x0 | this is when IO6 is not asserted |
| Single Digit of Virtual GPIO - Logic ‘1’ | 0x1 | this is when IO6 is asserted |

#### HW/SWR-REQ-407101/A-GPIO7

This GPIO shall be used as a ‘GPIO Over Distance’ (or Hardwire GPIO) as defined in the ADI *AD242x Data Sheet*, or the ADI *AD243x Data Sheet.* The usage for this hardwire GPIO is to be reserved for audio clip detect events*.* The Main node shall directly connect the A2B IC GPIO7 pin to an Input pin on the DSP/Micro for real time processing. Amplifier Sub node shall directly connect the A2B IC GPIO7 pin to its internal clip detect circuit for real time processing. All other Sub nodes shall not use the ‘GPIO Over Distance’ feature for GPIO7.

**Message Type**: GPIO

A2B Audio Server asserts IO7 to tell the A2B Audio Client that a clip detect event has occurred.

|  |  |  |  |
| --- | --- | --- | --- |
| **Signal Name** | **Literals** | **Value** | **Description** |
| IO7 | No Clip Detect | 0x0 | this is when IO7 is not asserted |
| Clip Detect asserted | 0x1 | this is when IO7 is asserted |

### HW/SWR-REQ-407102/A-I2C Signals

“IRQ” shall be connected to allow interrupts to be processed.

#### HW/SWR-REQ-407103/A-I2C Command and Control

If the supplier chooses to use I2C, the supplier shall implement the I2C protocol and message set as defined in Phoenix Audio Peripheral Command and Control API Specification. This document defines the I2C and SPI communication protocol used to provide command and control using the A2B I2C/SPI backchannel.

### HW/SWR-REQ-407189/A-SPI Signals

#### HW/SWR-REQ-407190/A-SPI Command and Control

If the supplier chooses to use SPI, the supplier shall implement the SPI protocol and message set as defined in Phoenix Audio Peripheral Command and Control API Specification. This document defines the I2C and SPI communication protocol used to provide command and control using the A2B I2C/SPI backchannel.

### HW/SWR-REQ-407104/A-Clock Signals

#### HW/SWR-REQ-407105/A-Clock Signal Syncronization to A2B Streams

All Microphone signals and ‘Loopback’ signals on the A2B bus shall utilize the A2B Clock Pulse for analog to digital conversion, for transmission on the A2B bus, and for any intermediate/post processing of these signals.

### SWR-REQ-434538/A-A2B Mailbox

#### SWR-REQ-434539/A-A2B Mailbox

The two mailboxes contained on the A2B Transceiver shall be configured as follows:

* MBOX0 shall be configured for Receiving messages
* MBOX1 shall be configured for Sending messages

The above configurations shall be made on both the Main Node and all Sub Nodes.

The A2B mailbox process shall follow the ADI process for sending and receiving messages and shall utilize the interrupt process defined in the *AD243x A2B Transceiver Programming Reference* manual.

## SWR-REQ-407106/A-Audio Client

The Audio Client is responsible for producing and transmitting the audio.

## SWR-REQ-407107/A-Audio Server

The Audio Server is responsible for receiving and sending the audio to speakers.

## A2B Audio Stream ID assignments

### SWR-REQ-407108/B-A2B Downstream Stream IDs

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Stream Identifier** | **Audio Management SPSS** | **Stream Name** | **Sample Rate** | **Data Size** | **Slots Used** |
| Stream ID 1 |  | PAC Tuner Audio | 48 KHz | 24 bit | 1 |
| Stream ID 2 |  | PAC Tuner Audio | 48 KHz | 24 bit | 1 |
| Stream ID 3 |  | Android Audio Loopback | 48 KHz | 24 bit | 1 |
| Stream ID 4 |  | Android Audio Loopback | 48 KHz | 24 bit | 1 |
| Stream ID 5 |  | Android Audio Loopback | 48 KHz | 24 bit | 1 |
| Stream ID 6 |  | Android Audio Loopback | 48 KHz | 24 bit | 1 |
| Stream ID 7 |  | Premium Audio (Stereo) | 48 KHz | 24 bit | 1 |
| Stream ID 8 |  | Premium Audio (Stereo) | 48 KHz | 24 bit | 1 |
| Stream ID 9 |  | Premium Audio (Stereo) | 48 KHz | 24 bit | 1 |
| Stream ID 10 |  | Premium Audio (Stereo) | 48 KHz | 24 bit | 1 |
| Stream ID 11 |  | PAC Mic Input | 48 KHz | 24 bit | 1 |
| Stream ID 12 |  | PAC Mic Input | 48 KHz | 24 bit | 1 |
| Stream ID 13 |  | PAC Mic Input | 48 KHz | 24 bit | 1 |
| Stream ID 14 |  | PAC Mic Input | 48 KHz | 24 bit | 1 |
| Stream ID 15 |  | PAC Mic Input | 48 KHz | 24 bit | 1 |
| Stream ID 16 |  | PAC Mic Input | 48 KHz | 24 bit | 1 |
| Stream ID 17 | BT\_Zone2 | BT Audio Channels | 48 KHz | 24 bit | 1 |
| Stream ID 18 | BT\_Zone3 | BT Audio Channels | 48 KHz | 24 bit | 1 |
| Stream ID 19 | BT\_Zone4 | BT Audio Channels | 48 KHz | 24 bit | 1 |
| Stream ID 20 | BT\_Zone5 | BT Audio Channels | 48 KHz | 24 bit | 1 |
| Stream ID 21 |  | ICC LS-Channels | 48 KHz | 24 bit | 1 |
| Stream ID 22 |  | ICC LS-Channels | 48 KHz | 24 bit | 1 |
| Stream ID 23 |  | ICC LS-Channels | 48 KHz | 24 bit | 1 |
| Stream ID 24 |  | ICC LS-Channels | 48 KHz | 24 bit | 1 |

### SWR-REQ-407109/C-A2B Upstream Stream IDs

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Stream Identifier** | **Audio Management SPSS** | **Stream Name** | **Sample Rate** | **Data Size** | **Slots Used** |
| Stream ID 50 | A2B\_ID1 | PDC Main Cabin Audio - Left PDC MSS Driver Audio Mono/Phone | 48 KHz | 24 bit | 1 |
| Stream ID 51 | A2B\_ID1 | PDC Main Cabin Audio - Right | 48 KHz | 24 bit | 1 |
| Stream ID 52 | A2B\_ID4 | PDC Captains Announcement | 48 KHz | 24 bit | 1 |
| Stream ID 53 | A2B\_ID2 | PDC Phone - Receive Path | 48 KHz | 24 bit | 1 |
| Stream ID 57 |  | PDC AVAS Front/Rear | 48 KHz | 24 bit | 1 |
| Stream ID 58 | A2B\_ID3 | PDC Chime/Prompt Bus (RF) | 48 KHz | 24 bit | 1 |
| Stream ID 59 | A2B\_ID3 | PDC Chime/Prompt Bus (LF) | 48 KHz | 24 bit | 1 |
| Stream ID 60 | A2B\_ID3 | PDC Chime/Prompt Bus (RR) | 48 KHz | 24 bit | 1 |
| Stream ID 61 | A2B\_ID3 | PDC Chime/Prompt Bus (LR) | 48 KHz | 24 bit | 1 |
| Stream ID 62 |  | ANC (LF +ESE +EVSE) | 48 KHz | 24 bit | 1 |
| Stream ID 63 |  | ANC (RF +ESE +EVSE) | 48 KHz | 24 bit | 1 |
| Stream ID 64 |  | ANC (RR +ESE +EVSE) | 48 KHz | 24 bit | 1 |
| Stream ID 65 |  | ANC (LR +ESE +EVSE) | 48 KHz | 24 bit | 1 |
| Stream ID 66 |  | ANC (CF +ESE +EVSE) | 48 KHz | 24 bit | 1 |
| Stream ID 67 |  | ANC (Sub +ESE +EVSE) | 48 KHz | 24 bit | 1 |
| Stream ID 68 | A2B\_ID6 | PDC Aux Source MSS Zone 2 | 48 KHz | 24 bit | 1 |
| Stream ID 69 | A2B\_ID7 | PDC Aux Source MSS Zone 3-6 | 48 KHz | 24 bit | 1 |
| Stream ID 70 | A2B\_ID8 | PDC MSS Target Prompt Driver | 48 KHz | 24 bit | 1 |
| Stream ID 71 |  | PDC Target Prompt MSS Zone 2-6 | 48 KHz | 24 bit | 1 |
| Stream ID 72 |  | PAC Speaker Channels | 48 KHz | 24 bit | 1 |
| Stream ID 73 |  | PAC Speaker Channels | 48 KHz | 24 bit | 1 |
| Stream ID 74 |  | PAC Speaker Channels | 48 KHz | 24 bit | 1 |
| Stream ID 75 |  | PAC Speaker Channels | 48 KHz | 24 bit | 1 |
| Stream ID 76 |  | PAC Speaker Channels | 48 KHz | 24 bit | 1 |
| Stream ID 77 |  | PAC Speaker Channels | 48 KHz | 24 bit | 1 |
| Stream ID 78 |  | ICC Reference Channels | 48 KHz | 24 bit | 1 |
| Stream ID 79 |  | ICC Reference Channels | 48 KHz | 24 bit | 1 |
| Stream ID 80 |  | SSE Reference Channels | 48 KHz | 24 bit | 1 |
| Stream ID 81 |  | SSE Reference Channels | 48 KHz | 24 bit | 1 |
| Stream ID 82 |  | SSE Reference Channels | 48 KHz | 24 bit | 1 |
| Stream ID 83 |  | SSE Reference Channels | 48 KHz | 24 bit | 1 |
| Stream ID 84 |  | A2B Microphone Output | 48 KHz | 24 bit | 1 |
| Stream ID 85 |  | A2B Microphone Output | 48 KHz | 24 bit | 1 |
| Stream ID 86 |  | A2B Microphone Output | 48 KHz | 24 bit | 1 |
| Stream ID 87 |  | A2B Microphone Output | 48 KHz | 24 bit | 1 |
| Stream ID 88 | A2B\_ID5 | PDC Exterior Audio | 48 KHz | 24 bit | 1 |
| Stream ID 89 |  | Ext Voice Call Audio | 48 KHz | 24 bit | 1 |
| Stream ID 90 |  | A2B Microphone Output | 48 KHz | 24 bit | 1 |
| Stream ID 91 |  | A2B Microphone Output | 48 KHz | 24 bit | 1 |
| Stream ID 92 |  | A2B Microphone Output | 48 KHz | 24 bit | 1 |
| Stream ID 93 |  | A2B Microphone Output | 48 KHz | 24 bit | 1 |
| Stream ID 94 |  | PDC Aux Source MSS Zone 2 | 48 KHz | 24 bit | 1 |
| Stream ID 95 |  | PDC Aux Source MSS Zone 3 | 48 KHz | 24 bit | 1 |
| Stream ID 96 |  | PDC Aux Source MSS Zone 4 | 48 KHz | 24 bit | 1 |

## A2B Architectures

### SWR-REQ-407110/C-A2B Architectures

The following are the planned multimedia system architectures. These architectures shall be managed via Ford End-Of-Line diagnostic configuration.

The actual order of A2B Slots being sent on the A2B bus shall be contained in the Sigma Studio’s “.dspproj” file created for each architecture.

#### SWR-REQ-407111/C-Phoenix Audio with 2 Nodes - Arch 1 - NonB (PAC 1, 2, 3, 4, & 5)



#### SWR-REQ-407112/B-Phoenix Audio with 3 Nodes - Arch 2 - NonB (PAC 1, 2, 3, 4, & 5)



#### SWR-REQ-407114/C-Phoenix Audio with 3 Nodes - Arch 4 - Branded (PAC 1, 2, 3, 4, & 5)



#### SWR-REQ-407115/B-Phoenix Audio with 2 Nodes - Arch 7 - DuerOS - Subwoofer\_Base



#### SWR-REQ-410563/C-Phoenix Audio with 2 Nodes - Arch 8 - DuerOS - w/o ICC



#### SWR-REQ-416752/C-Phoenix Audio with 3 Nodes - Arch 9 - DuerOS - w/ ICC



# FRD-REQ-407128/C-General Requirements

## SWR-REQ-407129/B-A2B ADI Stack Software

It is recommended that the A2B Main supplier shall integrate the *ADI A2B Software Stack* “ADI\_A2B\_Software\_Rel19.0.0” or later on their µC/DSP to interface with the A2B Main IC and network. The supplier shall reference and comply with the latest version of ADI’s *A2B Stack User Guide* revision 6.0 or later as part of the release package.

## HW/SWR-REQ-423177/D-A2B Digital Audio Bus Start-Up - Two Node

The A2B Digital Audio Bus shall initialize and become active & functional when the CAN bus is active. Reference “Analog Devices A2B Link Implementation Specification” for details and A2B start-up times.

The A2BBroadcastState message shall be sent via the A2B I2C backchannel as a broadcast message to all subnodes.

The A2BStreamReportStatus message shall be sent via the A2B I2C backchannel to the PAC mailbox.

The A2B Node IDs shall be determined per SWR-REQ-407134-Generic A2B Node ID Discovery Process Flow just after the initial *A2BBroadcastState()* message is sent.

All modules shall send muted data over A2B (ex: volume step 0) while the A2B digital audio bus is active and the modules are not ready to play audio (i.e. in greater than 1000ms from when the CAN Bus starts up).

### HW/SWR-REQ-423178/A-Module settings prior to A2B Bus configuration

At A2B bus start-up, the virtual GPIO (or GPIO over Distance) registers and hardwired GPIOs (Direct Micro Connect) shall initialize to all zero’s. The Main node and Sub nodes shall be initially set to the following values prior to receiving any A2B I2C Mailbox messages:

- A2B Bus is assumed to be not configured

- All PAC Speakers are Muted

- All A2B audio streams are sending Muted or digital zero content

### HW/SWR-REQ-423179/B-A2BBroadcastState Configuration usage

The receipt of the Initial A2BBroadcastState message by all Sub Nodes shall be an indication that the A2B bus has been fully configured.

The A2B Main Node (PAC) shall transmit the A2BBroadcastState message with the following values after the A2B Initialization has been completed.

* Bit 0: Muted
* Bit 1: AudioNotSent
* Bit 2: A2B Node Request

The PAC shall then execute *SWR-REQ-407134-Generic A2B Node ID Discovery Process Flow* to determine what nodes are connected in the A2B Bus.

### HW/SWR-REQ-423180/B-A2BBroadcastState (Default to Muted & AudioNotSent) signals usage

The A2B Main Node (PAC) shall assert A2BBroadcastState signals to:

* Bit 0: ‘Muted’
* Bit 1: “AudioNotSent’
* Bit 2: ‘Default’

when the following two conditions are true:

* the A2B bus is initialized and fully configured, and the PAC speakers have been Muted.

Once the PAC asserts A2BBroadcastState signal to

* Bit 0: ‘Muted’
* Bit 1: ‘AudioNotSent’
* Bit 2: ‘Default’

all A2B Audio Streams shall all be in the ‘Muted’ state, ie: transmitting all digital zeros.

### HW/SWR-REQ-423182/E-A2BBroadcastStates (Muted to Unmuted AND AudioNotSent to AudioSent) signal usage

For Non-AVAS Systems:

The PAC shall start the unmute process once the following conditions are met:

* {the 700 to 1100ms timer from HS-CAN Bus startup has finished.} [AND]
* [{HMIAudioNode = On} [AND/OR]
* {Power\_Up\_Chime\_Modules = Active} [AND/OR]

For AVAS Systems:

The PAC shall start the unmute process once the following conditions are met:

* {the 700 to 1100ms timer from HS-CAN Bus startup has finished.} [AND]
* [{HMIAudioNode = On} [AND/OR]
* {Power\_Up\_Chime\_Modules = Active} [AND/OR]
* {Ignition\_Status = RUN}]

For all Systems:

The PAC shall only unmute in a pop free manner at a vehicle level. The overriding requirement is that there shall be no audible pops or clicks from any speakers during any START event.

Within 150ms of receiving the above CAN messages, the PAC shall transmit the A2BBroadcastState() signal with the following states:

* Bit 0: ‘Muted” to “Un-Muted”
* Bit 1: “AudioNotSent” to “AudioSent”
* Bit 2: “Default” to “Default”

After the PAC assert A2BBroadcastState signal to:

* Bit 0: “Un-Muted”
* Bit 1: “AudioSent”
* Bit 2: “Default”

the PAC shall keep the A2BBroadcastState signal states unchanging as long as HMIAudioMode = ON or Power\_Up\_Chime\_Modules = ON unless an error condition occurs (such as a reset of the A2B digital audio bus).

Note: Crank is not considered an error condition and so the A2BBroadcastState signal is not used for Crank muting/unmuting. Ex. If the A2BBroadcastState signal to “UnMuted” before crank and infotainment system is ON then the PAC would keep the A2BBroadcastState signal to “UnMuted” during crank.

Once the PAC asserts A2BBroadcastState signal to

* Bit 0: ‘UnMuted’
* Bit 1: ‘AudioSent’
* Bit 2: “Default’

all A2B Audio Streams content shall be transmitting to the speakers.

If an EVCM is present, the PAC external speakers may unmute faster than what is defined in this document. The timing for this unmute event is contained in the EVCM spec.

### HW/SWR-REQ-423184/B-A2BBroadcastState (Heartbeat) signal usage

The A2B Main Node (PAC) shall transmit the following A2BBroadcastState signals at a periodic rate of 1000ms.:

* Bit 0: ‘UnMuted’
* Bit 1: ‘AudioSent’
* Bit 2: “Default’

The PAC shall monitor the A2B I2C Sub Node Read responses of each heartbeat signal. If a node fails to provide a Sub Node Read Response, then the PAC shall implement *SWR-REQ-434357-Missing Mailbox Message.*

If the A2B Main Node (PAC)’s internal amplifier is muted after the A2BBroadcastState signals ‘UnMuted’ & ‘AudioSent’ & “Default’ has been sent, then the PAC shall immediately transmit A2BBroadcastState signals of:

* Bit 0: ‘Muted’
* Bit 1: ‘AudioNotSent’
* Bit 2: ‘Default’

Once the nodes receive this message, the nodes shall immediately implement “HW/SWR-REQ-423187-Sequence Diagram (Shutdown of PAC, and PDC)”.

If the A2B Main Node (PAC) receives A2BStreamReportStatus signal of ‘AudioNotSent’, then the PAC shall immediately transmit A2BBroadcastState signals of:

* Bit 0: ‘Muted’
* Bit 1: ‘AudioNotSent’
* Bit 2: ‘Default’

Once the nodes receive this message, the nodes shall immediately implement “HW/SWR-REQ-423187-Sequence Diagram (Shutdown of PAC, and PDC)”.

If the PAC requires to Mute itself, it shall respond by sending A2BBroadcastState signals of:

* Bit 0: “Muted”
* Bit 1: “AudioNotSent”
* Bit 2: “Default”

to all Sub-Nodes and report the appropriate Infotainment Diagnostic DTCs. Once the conditions recover and the PAC is able to unmute, the PAC shall implement the sequence defined in the second half of *HW/SWR-REQ-423185-Sequence Diagram (Startup of PAC, and PDC)*, after the 1000ms timer is finished.

### HW/SWR-REQ-423185/E-Sequence Diagram (Startup of PAC, and PDC for Non-AVAS Systems)



### HW/SWR-REQ-474557/A-Sequence Diagram(Startup of PAC, and PDC for AVAS Systems)



## HW/SWR-REQ-423186/B-A2B Digital Audio Bus Shut-Down - Two Node

### HW/SWR-REQ-423222/D-A2B Shutdown Sequence signals usage

The infotainment system shall follow the shutdown process called out in the Station Management SPSS.

For Non-AVAS Systems:

When the following HS-CAN conditions are met:

* {HMIAudioMode changes from ON to OFF/Load Shed} [AND]
* {Power\_Up\_Chime\_Modules changes from Active to Inactive} [AND]

For AVAS Systems:

When the following HS-CAN conditions are met:

* {HMIAudioMode changes from ON to OFF/Load Shed} [AND]
* {Power\_Up\_Chime\_Modules changes from Active to Inactive} [AND]
* {Ignition\_Status != RUN/START}

For all Systems:

Then:

1. Within 30ms the PAC (if PAC have speakers) shall gracefully mute its speaker outputs.

2. The PAC shall transmit A2BBroadcastState with signals ‘Muted’ & ‘AudioSent’.

3. The PDC shall transmit A2BStreamReportStatus with signal ‘AudioNotSent’.

4. Within 100ms the PAC shall transmit A2BBroadcastState with signals ‘Muted’ & ‘AudioNotSent’.

5. Immediately all A2B Audio Streams shall send a muted signal, ie: transmitting all digital zeros.

The exact timing of the muting of the speakers may need to be adjusted to provide pop free functionality at a vehicle level. The overriding requirement is that there shall be no audible pops or clicks from any speakers during any START event.

If the above HS-CAN signals change prior to full HS-CAN Bus shutdown, then the conditions listed in *HW/SWR-REQ-423185-Sequence Diagram (Startup of PAC, and PDC)* after the 1000ms timer shall be evaluated.

* If met, then the A2BBroadcastStat() message will be sent and the SubNodes confirmed to be present.
  + If the SubNodes are present, then implement *HW/SWR-REQ-423185-Sequence Diagram (Startup of PAC, and PDC)* from the point where the CAN messages are received just below the grey line.
  + If the SubNodes are not present, then implement *HW/SWR-REQ-423185-Sequence Diagram (Startup of PAC, and PDC)* from the start of the A2B Initialization step.
* If not met, then finish the HS-CAN Bus shutdown process called out in the Station Management SPSS.

Note: If an EVCM is present, the PAC muting strategy for the EVCM external speakers shall follow the Power Mode SPSS process.

### HW/SWR-REQ-423187/E-Sequence Diagram (Shutdown of PAC, and PDC for Non-AVAS Systems)



### HW/SWR-REQ-474558/A-Sequence Diagram (Shutdown of PAC, and PDC for AVAS Systems)



## HW/SWR-REQ-423107/D-A2B Digital Audio Bus Start-Up - Three Node

The A2B Digital Audio Bus shall initialize and become active & functional when the CAN bus is active. Reference “Analog Devices A2B Link Implementation Specification” for details and A2B start-up times.

The A2BBroadcastState message shall be sent via the A2B I2C backchannel as a broadcast message to all subnodes.

The A2B Node IDs shall be determined per SWR-REQ-407134-Generic A2B Node ID Discovery Process Flow just after the initial *A2BBroadcastState()* message is sent.

The AMPSpeakerOutputStatus message shall be sent via the A2B I2C backchannel to the PAC mailbox.

The A2BStreamReportStatus message shall be sent via the A2B I2C backchannel to the PAC mailbox.

All modules shall send muted data over A2B (ex: volume step 0) while the A2B digital audio bus is active and the modules are not ready to play audio (i.e. in greater than 1000ms from when the CAN Bus starts up).

### HW/SWR-REQ-423109/A-Module settings prior to A2B Bus configuration

At A2B bus start-up, the virtual GPIO (or GPIO over Distance) registers and hardwired GPIOs (Direct Micro Connect) shall initialize to all zero’s. The Main node and Sub nodes shall be initially set to the following values prior to receiving any A2B I2C Mailbox messages:

- A2B Bus is assumed to be not configured

- All PAC and AMP Speakers are Muted

- All A2B audio streams are sending Muted or digital zero content

### HW/SWR-REQ-423111/B-A2BBroadcastState Configuration usage

The receipt of the Initial A2BBroadcastState message by all Sub Nodes shall be an indication that the A2B bus has been fully configured.

The A2B Main Node (PAC) shall transmit the A2BBroadcastState message with the following values after the A2B Initialization has been completed.

* Bit 0: Muted
* Bit 1: AudioNotSent
* Bit 2: A2B Node Request

The PAC shall then execute *SWR-REQ-407134-Generic A2B Node ID Discovery Process Flow* to determine what nodes are connected in the A2B Bus.

### HW/SWR-REQ-423112/A-AMPSpeakerOutputStatus (Default to Muted) signal usage

The AMP shall assert AMPSpeakerOutputStatus signal to “Muted” when:

- the A2B bus is initialized and configured, and the AMP speakers have been Muted.

### HW/SWR-REQ-423114/B-A2BBroadcastState (Default to Muted & AudioNotSent) signals usage

The A2B Main Node (PAC) shall assert A2BBroadcastState signals to:

* Bit 0: ‘Muted’
* Bit 1: ‘AudioNotSent’
* Bit 2: ‘Default’

when the following two conditions are true:

* the A2B bus is initialized and fully configured, and the PAC speakers have been Muted.
* the AMP has asserted the *AMPSpeakerOutputStatus* signal to “Muted”.

Once the PAC asserts A2BBroadcastState signal to:

* Bit 0: ‘Muted’
* Bit 1: ‘AudioNotSent’
* Bit 2: ‘Default’

all A2B Audio Streams shall all be in the ‘Muted’ state, ie: transmitting all digital zeros.

### HW/SWR-REQ-423220/E-AmplifierEnableState (Default to Enabled) signal usage

For Non-AVAS systems:

The PAC shall start the unmute process once the following conditions are met:

• {the 1000ms timer from HS-CAN Bus startup has finished.} [AND]

• {HMIAudioNode = On} [AND/OR]

• {Power\_Up\_Chime\_Modules = Active} [AND/OR]

For AVAS Systems:

The PAC shall start the unmute process once the following conditions are met:

• {the 1000ms timer from HS-CAN Bus startup has finished.} [AND]

• {HMIAudioNode = On} [AND/OR]

• {Power\_Up\_Chime\_Modules = Active} [AND/OR]

• {Ignition\_Status = RUN}

For all Systems:

The A2B Main Node (PAC) shall change the AMPEnableState signal from “Default” to “Enabled” within 15 msec of the above conditions being met.).

The PAC shall only unmute in a pop free manner at a vehicle level.

The AMP shall only unmute in a pop free manner at a vehicle level after the assertion of the AMPEnableState signal to “Enabled” to allow for proper audio biasing.

The exact timing of the unmuting of the speakers may need to be adjusted to provide pop free functionality at a vehicle level. The overriding requirement is that there shall be no audible pops or clicks from any speakers during any START event.

### HW/SWR-REQ-423115/D-AMPSpeakerOutputStatus (Muted to Un-Muted) signal usage

The AMP shall change the AMPSpeakerOutputStatus signal from “Muted” to “UnMuted” within 150ms of the receipt of the AMPEnableSet with a signal of “Enabled” when the following conditions are met:

- the AMP is ready to receive audio (ex. AMP has unmuted its internal amplifier IC’s for the AMP speakers and can receive audio without producing pops), the AMP is ready to transmit audio (ex. can transmit audio to the PAC without producing pops), and the A2B bus is initialized

Note: Crank is not considered an error condition and so the AMPSpeakerOutputStatus interface is not used for Crank muting/unmuting. Ex. If AMPSpeakerOutputStatus is asserted to “UnMuted” before crank and infotainment system is ON then the AMP would keep AMPSpeakerOutputStatus asserted to “UnMuted” during crank.

After the AMP asserts AMPSpeakerOutputStatus to “UnMuted” the AMP shall keep AMPSpeakerOutputStatus at “UnMuted” whenever A2BBroadcastState heartbeat message is received, unless an error condition occurs (such as a reset of the A2B digital audio bus). It shall also keep it’s internal amplifier IC in a ‘pop-free’ state.

### HW/SWR-REQ-423116/D-A2BBroadcastState (Muted to Un-Muted & AudioNotSent to AudioSent) signal usage

The PAC shall assert the A2BBroadcastState signal as follows:

* Bit 0: “Muted” to “UnMuted”
* Bit 1: ‘AudioNotSent’ to ‘AudioSent’
* Bit 2: ‘Default’ to ‘Default’

once the following condition is met:

* AMPSpeakerOutputStatus signal is “UnMuted’

After the PAC asserts A2BBroadcastState signals to:

* Bit 0: ‘UnMuted’
* Bit 1: ‘AudioSent’
* Bit 2: ‘Default’

all nodes shall remain Un-Muted unless an error condition occurs (such as a reset of the A2B digital audio bus).

After the PAC asserts A2BBroadcastState signals to:

* Bit 0: ‘UnMuted’
* Bit 1: ‘AudioSent’
* Bit 2: ‘Default’

the PAC shall keep the A2BBroadcastState signal states unchanging as long as HMIAudioMode = ON or Power\_Up\_Chime\_Modules = ON unless an error condition occurs (such as a reset of the A2B digital audio bus). It shall also keep it’s internal amplifier IC in a ‘pop-free’ state.

Note: Crank is not considered an error condition and so the A2BBroadcastState message interface is not used for Crank muting/unmuting. Ex. If A2BBroadcastState message is asserted to “UnMuted” before crank and infotainment system is ON then the PAC would keep it asserted to “UnMuted” during crank.

If an EVCM is present, the PAC external speakers may unmute faster than what is defined in this document. The timing for this unmute event is contained in the EVCM spec.

### HW/SWR-REQ-423137/B-A2BBroadcastState (Heartbeat) signal usage

The A2B Main Node (PAC) shall transmit the following A2BBroadcastState signals at a periodic rate of 1000ms:

* Bit 0: ‘UnMuted’
* Bit 1: ‘AudioSent’
* Bit 2: ‘Default’

The PAC shall monitor the A2B I2C Sub Node Read responses of each heartbeat signal. If a node fails to provide a Sub Node Read Response, then the PAC shall implement *SWR-REQ-434357-Missing Mailbox Message*.

If the PDC requires to stop sending A2B Audio streams, it shall send A2BStreamReportStatus asserted to ‘AudioNotSent’, then the A2B Main Node (PAC) shall respond by sending A2BBroadcastState signals of:

* Bit 0: ‘Muted’
* Bit 1: ‘AudioNotSent’
* Bit 2: ‘Default’

to all Sub-Nodes and report the appropriate Infotainment Diagnostic DTCs. Once the conditions recover and the PDC is able to send A2B Audio Streams again, the PDC shall send A2BStreamReportStatus asserted to ‘AudioSent’ and the PAC shall implement the sequence defined in the second half of *HW/SWR-REQ-423185-Sequence Diagram (Startup of PAC, and PDC)*, after the 1000ms timer is finished.

If the AMP requires to Mute itself, it shall send AMPSpeakerOutputStatus asserted to “Muted”, and the A2B Main Node (PAC) shall respond by sending A2BBroadcastState signals of:

* Bit 0: “Muted”
* Bit 1: ‘AudioNotSent’
* Bit 2: ‘Default’

to all Sub-Nodes and report the appropriate Infotainment Diagnostic DTCs. Once the conditions recover and the AMP is able to unmute again, the AMP shall send AMPSpeakerOutputStatus asserted to “Unmuted” and the PAC shall implement the sequence defined in the second half of *HW/SWR-REQ-423185-Sequence Diagram (Startup of PAC, and PDC)*, after the 1000ms timer is finished.

If the PAC requires to Mute itself, it shall respond by sending A2BBroadcastState signals of:

* Bit 0: “Muted”
* Bit 1: ‘AudioNotSent’
* Bit 2: ‘Default’

to all Sub-Nodes and report the appropriate Infotainment Diagnostic DTCs. Once the conditions recover and the PAC is able to unmute again, the PAC shall implement the sequence defined in the second half of *HW/SWR-REQ-423185-Sequence Diagram (Startup of PAC, and PDC)*, after the 1000ms timer is finished.

### HW/SWR-REQ-423138/E-Sequence Diagram (Startup of PAC, AMP, and PDC for Non-AVAS Systems)



### HW/SWR-REQ-474560/A-Sequence Diagram (Startup of PAC, AMP, and PDC for AVAS Systems)



## HW/SWR-REQ-423139/C-A2B Digital Audio Bus Shut-Down - Three Node

### HW/SWR-REQ-423224/D-A2B Shutdown Sequence signals usage

The infotainment system shall follow the shutdown process called out in the Station Management SPSS.

For Non-AVAS Systems:

When the following HS-CAN conditions are met:

* {HMIAudioMode changes from ON to OFF/Load Shed} [AND]
* {Power\_Up\_Chime\_Modules changes from Active to Inactive} [AND]

For AVAS Systems:

When the following HS-CAN conditions are met:

* {HMIAudioMode changes from ON to OFF/Load Shed} [AND]
* {Power\_Up\_Chime\_Modules changes from Active to Inactive} [AND]
* {Ignition\_Status != RUN/START}

For all Systems:

then:

1. Within 15ms the PAC shall transmit AmpEnableSet with signal “Disabled”.
2. Within 30ms of transmitting the signal “Disabled”, the PAC (if PAC have speakers) shall gracefully mute its speaker outputs.
3. Within 30ms of receiving the signal “Disabled”, the AMP shall gracefully mute its speaker outputs.
4. After 30ms of transmitting the signal “Disabled”, the PAC shall transmit A2BBroadcastState with signals:
   * Bit 0: ‘Muted’
   * Bit 1: ‘AudioSent’
   * Bit 2: “Default’
5. Then the PDC shall transmit A2BStreamReportStatus with signal ‘AudioNotSent’.
6. Within 100ms of the initial conditions being met the PAC shall transmit A2BBroadcastState with signals:
   * Bit 0: ‘Muted’
   * Bit 1: ‘AudioNotSent’
   * Bit 2: ‘Default’
7. Then all A2B Audio Streams shall send a muted signal, ie: transmitting all digital zeros.

The exact timing of the unmuting of the speakers may need to be adjusted to provide pop free functionality at a vehicle level. The overriding requirement is that there shall be no audible pops or clicks from any speakers during any START event.

Note: If an EVCM is present, the PAC muting strategy for the EVCM external speakers shall follow the Power Mode SPSS process.

### HW/SWR-REQ-423140/E-Sequence Diagram (Shutdown of PAC, AMP, and PDC for Non-AVAS Systems))



### HW/SWR-REQ-474577/A-Sequence Diagram (Shutdown of PAC, AMP, and PDC for AVAS Systems)



## HW/SWR-REQ-455497/A-A2B Digital Audio Bus - Cold Crank Mute - Three Node

### HW/SWR-REQ-455517/A-A2B Cold Crank Sequence Signal Usage

This requirement applies only to architectures with an amplifier that is not on the HS-CAN bus. Architectures with an amplifier that is on the HS-CAN bus shall implement the mute on cold crank feature as outlined in *ALERT-SR-REQ-052682/K-Chime Requests while the infotainment system is muted during a cold crank*.

When the PAC receives the following HS\_CAN signals:

{Timer Finished}

[&]

{HMIAudioMode = ON}

[&]

{Power\_Up\_Chime\_Modules = Active}

[&]

{PwPckTq\_D\_Stat = StrtInPrg\_TqNotAvail

[Or]

IGN\_St = START / CRANK}

the PAC shall transmit the AMPDirectMute() with the following values:

* Bit 0: AudioMute

The audio output at the AMP and PAC speaker output pins shall be muted within 30ms, as per *STMGNTv2-SR-REQ-014670-Crank Audio Muting*. Once the AMP has muted the audio at the output pins, the AMP shall transmit *AMPSpeakerOutputStatus()* with a value of “Muted” to the PAC.

The audio output at the AMP and PAC speaker output pins shall remain muted until 1000ms AFTER the PAC receives the following HS\_CAN signals, as per *STMGNTv2-SR-REQ-014670-Crank Audio Muting* :

{Timer Finished}

[&]

{HMIAudioMode = ON}

[&]

{Power\_Up\_Chime\_Modules = Active}

[&]

{PwPckTq\_D\_Stat != StrtInPrg\_TqNotAvail

[AND]

IGN\_St != START / CRANK}

the PAC shall transmit the AMPDirectMute() with the following values:

* Bit 0: AudioUnMuted

Once the AMP audio output is unmuted, the AMP shall transmit *AMPSpeakerOutputStatus()* with a value of “UnMuted” to the PAC. Immediately after “UnMuted” is sent, any content intended to be heard that is on the A2B bus will be heard on the appropriate speaker(s).

### HW/SWR-REQ-455537/A-Sequence Diagram (Cold Crank Mute of PAC, AMP)



## A2B Discovery Configuration

### SWR-REQ-407130/A-Initial A2B Discovery Precursors - Main Node

The A2B Main node shall:

* Utilize the latest version of ADI Sigma Studio software (or equivalent) at the time of sourcing, minimum revision of 3.15.
* Perform a runtime discovery of the A2B devices connected to the network as specified in the “*Analog Devices A2B Link Implementation Specification*”.
* Implement the latest version of ADI A2B Software Stack (or equivalent) at time of sourcing, minimum revision of 17.0.0.
* Follow the ‘Simple Discovery Flow’ as defined in Sigma Studio.
* Enable the A2B Bus Monitor Mode feature by enabling the ‘ENDSNIFF’ (0x20) bit on the Main DATCTL register. This bit shall be configurable On/Off.

### SWR-REQ-407131/A-Initial A2B Discovery Precursors - Sub Node

The A2B Sub node shall:

* Store a unique identifier in the modules memory. If the module has no Microprocessor (ie: a Sub I2C device), a EEPROM with minimum of 256 bytes shall be implemented. The EEPROM shall be set to an I2C address of 0xA0.The Main Node shall directly access the EEPROM to read the Node Identifier.
* Utilize the latest version of ADI Sigma Studio software (or equivalent) at the time of sourcing, minimum revision of 3.15.
* Utilize Sigma Studio (or equivalent) to identify the register settings required for the proper operation of their node on the A2B bus, and send the verified exported ‘NCF.xml’ node configuration file to Ford Core Multimedia Engineer.
* Implement the ‘Custom Node Identifier’ field within the ‘NCF.xml’ file. The ‘Custom Node Identifier’ values shall be as follows:

### SWR-REQ-407132/B-Table of Custom Node Identifiers

|  |  |  |  |
| --- | --- | --- | --- |
| **Sub Node** | **Custom Node Identifier** | | |
| **Type** | **Location that Node ID is at** | **Node Value** |
| **Type** |
| D245 2 Channel Amp | Mailbox | Defined in ‘NCF.xml’ file | 0x01 |
| D425 4 Channel Amp | Mailbox | Defined in ‘NCF.xml’ file | 0x02 |
| B&O Amp – 6 Channel | Mailbox | Defined in ‘NCF.xml’ file | 0x83 |
| B&O Amp – 10 Channel | Mailbox | Defined in ‘NCF.xml’ file | 0x84 |
| Revel Amp – 12 Channel | Mailbox | Defined in ‘NCF.xml’ file | 0x85 |
| Revel Amp – 24 Channel | Mailbox | Defined in ‘NCF.xml’ file | 0x86 |
| Phoenix Domain Controller | Mailbox | Defined in ‘NCF.xml’ file | 0x07 |
| A2B Microphone | I2C Device | Defined in ‘NCF.xml’ file | 0x08 |

* Allow the A2B Main node to set up all Sub node A2B register values.
* The node variant shall be made available using a separate A2B I2C/SPI message.
* The A2B Node ID Discovery Process is not part of the initial A2B Bus Discovery Process. It is done after the A2B bus is fully discovered and configured.

Note: It is permitted to have two identical sub nodes in the same vehicle A2B bus configuration file setup with the same custom node identifier information. The two sub node’s hardware and software MUST be completely identical for this to be true.

### SWR-REQ-407133/B-Generic A2B Sub Node Discovery Process

This flow chart describes Custom Node ID Authentication process during discovery of an A2B sub node.



The ‘Node Discovery Process’ follows the ‘Simple Discovery Flow’ as described in ‘AD242x A2B Transceiver Programming Reference Manual’ or the ‘AD243x A2B Transceiver Programming Reference Manual’.

### SWR-REQ-407134/A-Generic A2B Node ID Discovery Process Flow

This flow chart describes the process of determining the Node IDs for the current nodes used in a given vehicle. The Node IDs for these amplifiers are listed in *SWR-REQ-407132-Table of Custom Node Identifiers*.



### SWR-REQ-407135/A-Generic A2B Software Update Process

The software update process over A2B is not currently supported.

## SWR-REQ-407139/A-A2B B&A Plant EOL configuration

The A2B main node shall have a configuration that allows each possible bus configuration to be selectable.

## Error Handling

### SWR-REQ-407140/B-Loss of Communication with Main Node A2B IC

When the Main Node identifies I2C/SPI communication loss due to loss of Audio Clock, Loss of Power to the A2B IC, or loss of Main Node A2B register configurations, then the Main Node shall:

* perform a periodic rediscovery of the internal A2B IC every 1 second
* set the appropriate DTC per the Infotainment Diagnostics Specification.

When the above condition occurs, the Main Node shall also do the following:

* perform a soft mute of the Audio server(s)
* set the signal InfotainmentAudio.St = ErrorState\_NoAudio
* set Chime\_Supported = Not Supported returning chime control back to the Cluster.

Note1: reference the Clock and Reset Timing table in the *AD242x Data Sheet* or the *AD243x Data Sheet* specification for details on clock and reset parameters. The flags TNSCFR and TNSYNCR are defined in the *AD242x Data Sheet* or the *AD243x Data Sheet* specification.

Note2: reference the *Analog Devices A2B Data link Implementation Specification* for clock reset details.

Some occurrences of when the clock signal is considered lost:

- When the A2B Sub chip (ex A2B chip in DSP AMP) detects loss of Main A2B clock signal for TNSCFR then the clock is considered lost. If there is any contradiction between the SPSS definition of A2B Sub chip clock lost and the *Analog Devices A2B Data link Implementation Specification* definition of Sub chip clock lost, then the *Analog Devices A2B Data link Implementation Specification* shall take precedent.

OR

- Additional instances and details for when the clock is considered lost reference *AD242x Data Sheet* or the *AD243x Data Sheet* specification and the *Analog Devices A2B Data link Implementation Specification.*

### SWR-REQ-407141/B-Line Fault Handling Process

The Main node shall utilize the ‘line fault diagnostics’ feature with ‘fault localization’ to monitor the A2B bus for faults, and to identify localized fault types (short to ground, short to battery, shorted together, or lines reversed). The retry strategy for identified faults shall be to attempt to rediscover the A2B bus every 500ms until the fault condition is no longer present.

This digital interface shall adhere with the standard Ford diagnostics “*IDS Spec*” and must be capable to detect and survive indefinite short circuits (Zsc < 350[mΩ]) to ground or battery. Once a short circuit occurs and is removed, the output shall return to its normal state as stated in *Analog Devices A2B Data link Implementation Specification*.

If the line fault diagnostics feature has detected an A2B Bus fault as listed above for 5 seconds or more while the infotainment system is on (HMIAudioMode = ON) or while chimes is active (Power\_Up\_Chime\_Modules = Active) then the A2B Main node shall take the following actions:

* The A2B Main node shall set Chime\_Supported = Not Supported returning chime control back to the Cluster.
* The A2B Main node shall change the InfotainmentAudio.St signal from “NormalOperation” to “ErrorState\_NoAudio”.
* The A2B Main Node shall set a DTC as defined in the Infotainment Diagnostics Specification.

A2B digital audio bus recovers:

* When the A2B bus recovers, it shall follow the normal A2B audio start-up process.
* The A2B Main node shall set the signal InfotainmentAudio.St = NormalOperation

### SWR-REQ-407142/A-Loss of Communication with Amplifier Sub Node

While the infotainment system is in normal operation:

* Power\_Up\_Chime\_Modules = Active and/or HMIAudioMode = ON

If either the Audio Client or the Audio Server detects they are unable to transmit/receive/amplify chime content due to any reason for more than 5 seconds, then:

- The Audio Server shall notify the A2B Main node that chimes are not supported.

- The A2B Main node shall set Chime\_Supported = Not Supported returning chime control back to the Cluster.

- The A2B Main node shall change the InfotainmentAudio.St signal from “NormalOperation” to “ErrorState\_NoAudio”.

### SWR-REQ-407143/B-Retrying handling at A2B bus initialization

See *Analog Devices A2B Data link Implementation Specification* for retry handling due to line faults. If initial A2B Bus discovery does not match the architecture chosen in the IDS Configuration, then the Main Node shall retry the A2B Bus Node discovery process every 100ms endlessly until the architecture matches the IDS configuration. The Main Node shall set a Diagnostic DTC of “Misconfiguration” after 800ms.

### SWR-REQ-407144/A-Wrong Configuration at EOL

See *Analog Devices A2B Data link Implementation Specification* for A2B EOL error configuration handling.

The A2B Main node shall set the appropriate diagnostics error code (see *Infotainment Diagnostics Specification)*.

The A2B Main Node shall record the ‘alternate’ matching configuration in a Diagnostic DID.

### SWR-REQ-407146/A-Data Error Handling Process

The Main node shall monitor the A2B communication for the following data bit errors:

* Header Count Error (HDCNTERR)
* Data Decode Error (DDERR)
* (CRCERR)
* Parity Errors (DPERR)
* Bit Errors (BECOVF)
* (SRFERR)
* SRFCRCERR (sub node only)

The Main Node shall adhere with Ford diagnostics *Infotainment Diagnostics Specification* with respect to A2B Bit Error faults.

### SWR-REQ-407147/A-Sub Node Power Loss Fault Handling Process

If the Sub node’s A2B transceiver unexpectedly shuts down, the Sub node shall record that the event occurred in non-volatile memory. Once the Sub node’s A2B transceiver starts responding again, the Sub node shall return to its normal state and wait to be rediscovered.

### SWR-REQ-434357/C-Missing Mailbox Message

If the Main Node does not receive the initial ‘Sub Node Read’ interrupt within 1000ms of sending out a A2B mailbox message, the Main Node shall set an A2B Bus Diagnostic Fault and resend the A2B mailbox message. The A2B mailbox message shall be re-sent every 1000ms until a “Sub Node Read” is received. If after the fifth time the Main Node does not receive the “Sub Node Read” interrupt, the Main Node shall set a DTC code for A2B Bus Inoperative and not use the A2B Bus.

If the Main Node does not receive an expected initial Sub Node mailbox message within 1200ms of sending out the triggering Main Node mailbox message, the Main Node shall set an A2B Bus Diagnostic Fault and resend the A2B mailbox message. The Main Node A2B mailbox message shall be re-sent every 1000ms until the expected initial Sub Node mailbox message is received. If after the fifth time the Main Node does not receive the expected initial Sub Node mailbox message, the Main Node shall set a DTC code for A2B Bus Inoperative and not use the A2B Bus.

This requirement applies to A2B mailbox messages of varying lengths. For A2B mailbox messages of 4 bytes or less, it applies to the whole message received as one group of data. For A2B mailbox messages of more than 4 bytes in length, it applies to the ‘Sub Node Read’ of the first set of 4 bytes.

## Audio Content Management

### SWR-REQ-407148/A-Audio Server side Initialized

The Audio Server shall not process any Audio content received on any A2B stream until the receiving circuitry has stabilized. (ie: the A2B audio content shall be ignored until the amplifiers are stabilized and pop-free)

### SWR-REQ-407149/A-Audio Client side Initialized

The Audio Client shall transmit full mute on all A2B Audio Streams until the transmitting circuitry has stabilized. (ie: the A2B Tuner Audio stream shall send audio content of ‘full mute’ until the tuner circuitry is fully initialized and stable)

### SWR-REQ-407150/A-Audio Client side De-Allocated

The Audio Client shall transmit full mute on all A2B Audio Streams not in use. (ie: A2B Streams ‘PAC Speaker Channels’ shall transmit full mute when the Audio HMI is turned off by the customer, and no other audio source is playing such as a phone call or Navigation prompt.)

This supersedes SPSS requirement “AUMGNT-GREQ-220856-Muting and Unmuting of Audio Resource Server Line Level signal to the external DSP AMP for source changes” which is for when there is not a digital audio bus connection.

### SWR-REQ-407151/A-Audio Server side Audio Quality

The Audio Server shall play audio:

* Without any distortions caused by the Digital Audio Transport signal.
* With no choppy data from digital audio data getting buffered.
* With the latencies from when the audio signal leaves the Audio Client until the audio is output from the Audio Server being no worse than if analog signals were used.
* With the audio quality being as good or better than analog:
  + S/N ratio (ex. can’t hear digital noise, clock jitter when there is no volume or low volume)
  + Non-corrupted data
  + Digital Bit Stream for test signal looks better than analog signal test signal

## HR-REQ-407152/B-Audio Performance during a Start-Stop Event

The A2B bus shall be independent of any Start-Stop event. It shall continue to function during a ‘warm crank’ event per *SWR-REQ-348828-Audio Server side Audio Quality*.

## SWR-REQ-407153/A-Audio Performance during a Thermal Reduction Event

The A2B bus shall be independent of any Thermal Reduction event. It shall continue to function during a Thermal Reduction event per *SWR-REQ-348828-Audio Server side Audio Quality*.

## SWR-REQ-348828/A-Audio Server side Audio Quality

The Audio Server shall play audio:

* Without any distortions caused by the Digital Audio Transport signal.
* With no choppy data from digital audio data getting buffered.
* With the latencies from when the audio signal leaves the Audio Client until the audio is output from the Audio Server being no worse than if analog signals were used.
* With the audio quality being as good or better than analog:
  + S/N ratio (ex. can’t hear digital noise, clock jitter when there is no volume or low volume)
  + Non-corrupted data
  + Digital Bit Stream for test signal looks better than analog signal test signal

# FRD-REQ-407154/A-Functional Definition

## A2B Use Cases

### Sub Node Discovery Use Cases

#### UC-REQ-407155/A-Generic A2B Bus Configuration Process

|  |  |
| --- | --- |
| **Actors** | A2B Main Node, Multiple A2B Sub Nodes |
| **Pre-conditions** | * Sub modules are connected on the A2B bus * Main node has been configured for A2B node order. |
| **Scenario Description** | * Main node reads Diagnostic Configuration and identifies appropriate sequence of Sub nodes on A2B bus * A2B Node Discovery process performed * Sequence of A2B nodes identified matches configuration. * A2B register settings are sent to all nodes for EOL configured bus structure |
| **Post-conditions** | A2B bus discovery complete. |
| **List of Exception Use Cases** | 1. Sub node sequence from Node Discovery Process does not match EOL configuration.   Action: Set DTC for A2B bus misconfiguration |
| **Interfaces** |  |

#### UC-REQ-407157/B-A2B Node ID Discovery Process for Mailbox I2C/SPI Communication

|  |  |
| --- | --- |
| **Actors** | Main Node, Multiple A2B Sub Nodes |
| **Pre-conditions** | * Main node is present on the A2B bus * Sub modules are interconnected on the A2B bus in specific order * Sub node with I2C microcontroller is the next node to be discovered |
| **Scenario Description** | Main node requests Sub Node ID |
| **Post-conditions** | Main node reads Sub node’s mailbox for Sub Node ID |
| **List of Exception Use Cases** | 1. Sub Node ID is not placed in Sub node’s mailbox.   Action: Main node re-requests Sub node’s Node ID.   1. Main node is unable to read Sub node’s mailbox.   Action: Main node re-requests Sub node’s Node ID.   1. Sub Node ID is the wrong Node ID.   Action: Set DTC for A2B bus cannot be configured |
| **Interfaces** |  |

#### UC-REQ-407158/A-A2B Sub Node Discovery Process for Direct Chip to Chip I2C/SPI Communication

|  |  |
| --- | --- |
| **Actors** | Main Node, Multiple A2B Sub Nodes |
| **Pre-conditions** | * The Main node is on the A2B bus * Sub modules are interconnected on the A2B bus in specific order * Sub Node Discovery process underway, and I2C/SPI Sub node is the next node to be discovered |
| **Scenario Description** | Main node requests Sub Node ID |
| **Post-conditions** | Main node reads Sub node’s EEPROM chip address for Sub Node ID |
| **List of Exception Use Cases** | 1. Sub Node ID is not contained in Sub node’s EEPROM.   Action: Set DTC for A2B bus cannot be configured.   1. Main node is unable to read Sub node’s EEPROM chip.   Action: Set DTC for A2B bus cannot be configured.   1. Incorrect Node ID contained in Sub node’s EEPROM chip.   Action: Set DTC for A2B bus cannot be configured. |
| **Interfaces** |  |

### Generic A2B Process Use Cases

#### UC-REQ-407161/A-A2B Bus B&A Plant EOL Configuration

|  |  |
| --- | --- |
| **Actors** | Main Node, Multiple A2B Sub Nodes |
| **Pre-conditions** | * Vehicle fully assembled * All DTCs related to the Main Node and all Sub Nodes have been corrected |
| **Scenario Description** | Ford Body and Assembly plant configures the vehicle according to the Diagnostics database |
| **Post-conditions** | Main Node is properly configured per the diagnostic database. |
| **List of Exception Use Cases** | 1. Vehicle is configured correctly per the diagnostic database, but the configuration does not match the actual vehicle architecture. Main Node fails to self-discover A2B node as configured.   Action: See SWR-REQ-407144. |
| **Interfaces** |  |

#### UC-REQ-407162/A-Clip Detect (GPIO) Process

|  |  |
| --- | --- |
| **Actors** | Main Node, Multiple A2B Sub Nodes |
| **Pre-conditions** | * Bus is fully discovered, fully configured, fully software updated. * Audio is being transmitted on A2B bus to amplifier. * Clipping/distortion occurring in the amplifier * Audio is choppy and distorted |
| **Scenario Description** | * Amplifier sends clip detect signal over A2B bus via GPIO 7 * Audio server reduces Digital Audio output to acceptable level |
| **Post-conditions** | * System volume is lowered * Audio is clear and not distorted |
| **List of Exception Use Cases** | 1. Main Node ignores the GPIO7 clip detect signal for a period of time. This causes heavy audio distortion.   Action: Main Node closely reacts to the GPIO7 clip detect signals.   1. Main Node does not clear the GPIO7 register after read. This allows further clip evens to be ignored, and keeps the audio volume reduced until the GPIO is cleared.   Action: Main Node clears the GPIO7 register after every read. |
| **Interfaces** |  |

#### UC-REQ-407163/A-Amplifier Enable (I2C/SPI) (Turn On)

|  |  |
| --- | --- |
| **Actors** | Main Node, Multiple A2B Sub Nodes |
| **Pre-conditions** | * Bus is fully discovered, fully configured, fully software updated. * Amplifier has not been enabled yet. |
| **Scenario Description** | * Main node’s algorithm determines amplifier shall be enabled. * Main node sends activation I2C/SPI signal through A2B bus to amplifier indicating power on |
| **Post-conditions** | Amplifier is enabled |
| **List of Exception Use Cases** | 1. I2C/SPI signal for amplifier enable is not sent out, which causes the Amplifier to not turn on.   Action: Main Node sends out I2C/SPI signal for amplifier enable. |
| **Interfaces** |  |

#### UC-REQ-407164/A-Amplifier Enable (I2C/SPI) (Turn Off)

|  |  |
| --- | --- |
| **Actors** | Main Node, Multiple A2B Sub Nodes |
| **Pre-conditions** | * Bus is fully discovered, fully configured, fully software updated. * Amplifier has been enabled. |
| **Scenario Description** | * Main node’s algorithm determines amplifier shall be disabled. * Main node sends deactivation I2C/SPI signal through A2B bus to amplifier indicating disabled |
| **Post-conditions** | Amplifier is disabled |
| **List of Exception Use Cases** | 1. The I2C/SPI signal is not sent out, which causes the Amplifier to never turn off.   Action: Main Node sends out I2C/SPI signal for amplifier disable. |
| **Interfaces** |  |

#### UC-REQ-407165/A-A2B Mailbox Communication Process (I2C/SPI Main node to I2C/SPI Sub node)

|  |  |
| --- | --- |
| **Actors** | Main Node, Multiple A2B Sub Nodes |
| **Pre-conditions** | * The Main node present on the A2B bus * Sub modules are interconnected on the A2B bus in specific order * Sub Node Discovery Process completed |
| **Scenario Description** | Main node or Sub node initiates I2C/SPI Mailbox Communication |
| **Post-conditions** | Main node or Sub node reads I2C/SPI Mailbox for content |
| **List of Exception Use Cases** | Sender   1. I2C/SPI Mailbox message not read at receiving end (sender not able to send more messages until cleared)   Action: Sending end waits for (TBD)ms before initiating missing message protocol.   1. Sender interrupted while sending I2C/SPI message. Receiver sees this as an incomplete message.   Action: Sender resends transmission.   1. I2C/SPI message successfully sent, but receiver not act on signal sent in a way that affects the sender. (ex: A2B Main node requests preset values, but sender does not send them).   Action: Sender resends signal after (TBD)ms.  Receiver   1. I2C Mailbox read triggered, but I2C/SPI Mailbox content not found   Action: Clear I2C/SPI mailbox and wait for next request   1. I2C/SPI Mailbox read triggered, but I2C/SPI Mailbox content not match known signals   Action: Clear I2C/SPI mailbox and wait for next request   1. I2C/SPI Mailbox read triggered, but receiver not able to read I2C/SPI Mailbox within (TBD)ms.   Action: Request sender to re-send message.   1. Partial signal content found in receiving I2C/SPI Mailbox (multiple command message where complete message not sent). Receiving end times out on waiting for message to complete.   Action: Receiving end waits for (TBD)ms before initiating missing message protocol.   1. Too much signal content found in receiving I2C/SPI Mailbox (multiple command message where not receive ‘end of message’ when expected)   Action: Receiving end requests a retransmission of signal.   1. I2C/SPI Mailbox message not read at receiving end (sender not able to send more messages until cleared)   Action: Receiving end reads and clears I2C/SPI Mailbox ‘quickly’.   1. I2C/SPI Mailbox message read but not cleared   Action: Receiving end clears I2C/SPI Mailbox. |
| **Interfaces** |  |

#### UC-REQ-407166/A-A2B Direct I2C Chip to Chip Communication Process (I2C Main node to I2C Sub node)

|  |  |
| --- | --- |
| **Actors** | Main Node, Multiple A2B Sub Nodes |
| **Pre-conditions** | * The Main node present on the A2B bus * Sub modules are interconnected on the A2B bus in specific order * Sub Node Discovery process completed |
| **Scenario Description** | Main node sends/receives I2C/SPI commands directly to Sub Node ICs |
| **Post-conditions** | Sub node reacts to Main Node I2C/SPI message |
| **List of Exception Use Cases** | 1. Sub Node ID does not have IC that message is directed to.   Action: Sub node ignores I2C/SPI message.   1. Main Node I2C/SPI command not able to be performed.   Action: Sub node ignores I2C/SPI message.   1. Main Node I2C/SPI command request sent before the Sub Node can finish prior command request.   Action: If capable, Sub Node executes command when prior command finishes processing. If not capable, Sub Node ignores I2C/SPI message. |
| **Interfaces** |  |

### Generic A2B Downstream Use Cases

#### UC-REQ-407168/A-Generic Streaming Audio

|  |  |
| --- | --- |
| **Actors** | Main Node, Multiple A2B Sub Nodes |
| **Pre-conditions** | * The infotainment system is powered ON. * No Audio being sent over the A2B bus between the Audio Source Module/Audio Signal Generator and the AMP. * All the speakers are connected to the AMP |
| **Scenario Description** | Audio is transmitted digitally via the A2B bus. |
| **Post-conditions** | * The AMP is playing audio without distortion * There is no choppy data from digital audio data getting buffered * The latencies from when audio signal leaves the Audio Source Module until audio is produced by the AMP are no worse than if analog signals sent to the AMP. * The Audio quality is as good or better than analog * S/N ratio (ex. can’t hear digital noise, clock jitter when there is no volume or low volume) * Non-corrupted data * Digital Bit Stream for test signal looks better than analog signal test signal |
| **List of Exception Use Cases** | 1. Cannot produce any audio for 5 seconds or more   Action: See *Infotainment Diagnostic Specification*   1. Loss of Clock. (Customer perceives no audio)   Action: See SWR-REQ-407140   1. Data Error Rate handling. (Customer perceives high level of noise in all audio modes.)   Action: See SWR-REQ-407146   1. Bit Error Fault Handling (Customer perceives audio with random dropouts in all audio modes.)   Action: See SWR-REQ-407146   1. Audio is transmitted at the wrong gain level. (Customer perceives different audio modes as having different volume levels.)   Action: Analysis and Correction of matching gain levels between all audio modes.   1. Digitized Audio is transmitted over the A2B bus with poor S/N ratios (Customers perceives high level of noise in a specific audio mode.)   Action: Analysis and Correction of gain structures within the DSP coding. |
| **Interfaces** |  |

#### UC-REQ-407176/A-Tuner Audio

|  |  |
| --- | --- |
| **Actors** | Main Node, Multiple A2B Sub Nodes |
| **Pre-conditions** | * The infotainment system is powered ON. * No Tuner Audio being sent over A2B between the Tuner and the Sub Node. * The audio mode is set for AM, FM-analog, FM-HD, or DAB * All the speakers are connected to the Speaker Outputs |
| **Scenario Description** | Tuner sends Tuner Audio content over A2B |
| **Post-conditions** | * The Audio Player is playing AM, FM-analog, FM-HD, or DAB content without distortion * There is no choppy data from A2B audio streams getting buffered * The AM, FM-analog, FM-HD, or DAB audio quality is as good or better than analog * S/N ratio (ex. can’t hear digital noise, clock jitter when there is no volume or low volume) * Non-corrupted data |
| **List of Exception Use Cases** | 1. Tuner Audio is transmitted at the wrong gain level   Action: Analysis and Correction of gain levels.   1. Tuner Audio is transmitted with excessive Data Error Rate (Customer perceives high level of noise during Tuner Audio event)   Action: See SWR-REQ-407146   1. Tuner Audio is transmitted with excessive Bit Error (Customer perceives audio with random dropouts during Tuner Audio event)   Action: See SWR-REQ-407146   1. Tuner Audio is transmitted with poor S/N ratios (Customers perceives high level of noise while Tuner Audio is present.)   Action: Analysis and Correction of gain structures within the DSP coding. |
| **Interfaces** |  |

#### UC-REQ-407174/A-Microphone Audio

|  |  |
| --- | --- |
| **Actors** | Main Node, Multiple A2B Sub Nodes |
| **Pre-conditions** | * The infotainment system is powered ON. * No Microphone Audio is being sent over A2B between the Audio Client and the Audio Server. * All the speakers are connected to the Speaker Output pins. * Phone call is initiated |
| **Scenario Description** | Microphone Audio is transmitted digitally via the A2B bus. |
| **Post-conditions** | * The Main Node is Transmitting Microphone Audio via Bluetooth to the phone without distortion * There is no choppy data from digital audio data getting buffered * The A2B Microphone Audio quality is as good as or better than the hardware microphone performance. * S/N ratio (ex. can’t hear digital noise, clock jitter when there is no volume or low volume) * Non-corrupted data * Digital Bit Stream for test signal looks better than analog microphone test signal |
| **List of Exception Use Cases** | 1. Microphone Audio is transmitted at the wrong gain level   Action: Analysis and Correction of gain levels.   1. Microphone Audio is transmitted with excessive Data Error Rate (Customer perceives high level of noise during Microphone Audio event)   Action: See SWR-REQ-407146   1. Microphone Audio is transmitted with excessive Bit Error (Customer perceives audio with random dropouts during Microphone Audio event)   Action: See SWR-REQ-407146   1. Microphone Audio is transmitted with poor S/N ratios (Customers perceives high level of noise while Microphone Audio is present.)   Action: Analysis and Correction of gain structures within the DSP coding. |
| **Interfaces** |  |

#### UC-REQ-407175/A-Generic A2B Image Streaming Process

|  |  |
| --- | --- |
| **Actors** | Main Node, Multiple A2B Sub Nodes |
| **Pre-conditions** | * The infotainment system is powered ON. * The audio mode is set for FM-HD. * A station is tuned to that broadcasts image content. |
| **Scenario Description** | Tuner received image files from the broadcaster is packetized and sent to the Main Node for reassembly and display |
| **Post-conditions** | Image received is displayed |
| **List of Exception Use Cases** | 1. Image is partially received by Tuner from the broadcaster (ie: incomplete image)   Action: Image is not displayed.   1. Image is partially received by the Sub Node from the Tuner (ie: incomplete image)   Action: Image is not displayed.   1. Image transmitted over the air by broadcaster is improperly packetized (broadcaster level packetization) (ie: incomplete image)   Action: Image is not displayed.   1. Image transmitted over A2B by Tuner is improperly packetized (Tuner level packetization) (ie: incomplete image)   Action: Image is not displayed.   1. Image is corrupted as received by the Sub Node (ie: corrupted image)   Action: Image is not displayed.   1. Image is larger/smaller than specified (ie: wrong size image)   Action: Image is not displayed.   1. Start of file (FIRST signal) not sent by the Tuner or received by the Sub node (ie: Tuner sends data without notifying Sub node.)   Action: Image is not displayed.   1. Additional Packets (ONGOING signal) not sent by the Tuner or received by the Sub node (ie: Tuner sends data without the ‘ONGOING’ status.)   Action: Sub node times out waiting for ‘LAST’ message. Image is not displayed.   1. End of file (LAST signal) not sent by the Tuner or received by the Sub node (ie: Tuner ends sending data without first sending the ‘LAST’ status)   Action: Sub node times out waiting for ‘LAST’ message. Image is not displayed.   1. Last broadcaster packet not received by the Sub node   Action: Sub node times out waiting for the last broadcaster packet – waits for 300 seconds – and does not display image.   1. Broadcaster links image to incorrect HD sub-band.   Action: Sub node displays image as broadcast. |
| **Interfaces** |  |

#### UC-REQ-407167/A-Generic A2B Software Update Process

|  |  |
| --- | --- |
| **Actors** | Main Node, Multiple A2B Sub Nodes |
| **Pre-conditions** | A2B bus is discovered, nodes have been identified and bus is configured for use |
| **Scenario Description** | * Main node determines a software update is needed for a Sub node on the A2B bus, and sends software update file via A2B to identified Sub node * Main node identifies additional Sub nodes that need software updates, and sends software update file to each additional Sub node that needs software update. |
| **Post-conditions** | All Identified Sub nodes’ software is updated |
| **List of Exception Use Cases** | 1. Sub Node software level is the same as the software loaded in the Main Node.   Action: Sub Node software is not updated.   1. Sub Node software level is newer than the software loaded in the Main Node.   Action: Sub Node software is not updated. |
| **Interfaces** |  |

### Generic A2B Upstream Use Cases

#### UC-REQ-407177/A-Generic Streaming Audio

|  |  |
| --- | --- |
| **Actors** | Main Node, Multiple A2B Sub Nodes |
| **Pre-conditions** | * The infotainment system is powered ON. * No Audio being sent over the DAT audio line between the Audio Client and the Audio Server. * All the speakers are connected to the Speaker Output lines |
| **Scenario Description** | Audio is transmitted digitally via the A2B bus. |
| **Post-conditions** | * The Audio Player is playing audio without distortion * There is no choppy data from A2B Audio stream getting buffered * The latencies from when audio signal leaves the Audio Source Module until audio is produced by the Audio Player are no worse than if analog signals sent to the Audio Player. * The Audio quality is as good or better than analog * S/N ratio (ex. can’t hear digital noise, clock jitter when there is no volume or low volume) * Non-corrupted data * Digital Bit Stream for test signal looks better than analog signal test signal |
| **List of Exception Use Cases** | 1. Audio is transmitted at the wrong gain level   Action: Analysis and Correction of gain levels.   1. Audio is transmitted with excessive Data Error Rate (Customer perceives high level of noise during Audio event)   Action: See SWR-REQ-407146   1. Audio is transmitted with excessive Bit Error (Customer perceives audio with random dropouts during Audio event)   Action: See SWR-REQ-407146   1. Audio is transmitted with poor S/N ratios (Customers perceives high level of noise while Audio is present.)   Action: Analysis and Correction of gain structures within the DSP coding. |
| **Interfaces** |  |

#### UC-REQ-407172/A-Phone Audio

|  |  |
| --- | --- |
| **Actors** | Main Node, Multiple A2B Sub Nodes |
| **Pre-conditions** | * The infotainment system is powered ON. * No Phone Audio is being sent over A2B between the Audio Client and the Audio Server. * All the speakers are connected to the Speaker Output Pins. |
| **Scenario Description** | Phone Audio is transmitted digitally via the A2B bus. |
| **Post-conditions** | * The Audio Player is playing Phone Audio without distortion * There is no choppy data from A2B Audio streams getting buffered * The latencies from when audio signal leaves the Audio Source Module until audio is produced by the Audio Player are no worse than if analog signals sent to the Audio Player. * The Phone Audio quality is as good or better than analog * S/N ratio (ex. can’t hear digital noise, clock jitter when there is no volume or low volume) * Non-corrupted data * Digital Bit Stream for test signal looks better than analog signal test signal |
| **List of Exception Use Cases** | 1. Phone Audio is transmitted at the wrong gain level   Action: Analysis and Correction of gain levels.   1. Phone Audio is transmitted with excessive Data Error Rate (Customer perceives high level of noise during Phone Audio event)   Action: See SWR-REQ-407146   1. Phone Audio is transmitted with excessive Bit Error (Customer perceives audio with random dropouts during Phone Audio event)   Action: See SWR-REQ-407146   1. Phone Audio is transmitted with poor S/N ratios (Customers perceives high level of noise while Phone Audio is present.)   Action: Analysis and Correction of gain structures within the DSP coding. |
| **Interfaces** |  |

#### UC-REQ-407170/A-Active Noise Cancellation

|  |  |
| --- | --- |
| **Actors** | Main Node, Multiple A2B Sub Nodes |
| **Pre-conditions** | * No Chimes are playing. * There is no active audio source on Stereo Stream 1 & 2 (Press power OFF button so have an empty audio stack). * ANC is not active (ANC/ESE A2B streams not producing audio). * Prompts are not active (Prompts and Target Prompts 1 & 2 not producing audio). * The Chime Generator and Chime Audio Source are powered up for supporting chimes. * The Vehicle engine is OFF while ignition is in Accessory or Run (Infotainment System power ON with no audio). * All the speakers are connected to the AMP |
| **Scenario Description** | * The vehicle engine is started * Active Noise Cancellation audio signals are sent to the applicable speakers |
| **Post-conditions** | * The AMP looks at the applicable A2B Audio Streams for the data it received and produces the ANC audio out of the applicable speakers * There is no choppy data from digital audio data getting buffered * The latencies from when audio signal leaves the Audio Source Module / Audio Signal Generator until audio is produced by the AMP are no worse than if analog signals sent to the AMP. * The Audio quality is as good or better than analog * S/N ratio (ex. can’t hear digital noise, clock jitter when there is no volume or low volume) * Non-corrupted data * Digital Bit Stream for test signal looks better than analog signal test signal |
| **List of Exception Use Cases** | 1. ANC is transmitted at the wrong gain level   Action: Analysis and Correction of gain levels.   1. ANC is transmitted with excessive Data Error Rate (Customer perceives high level of noise during chime event)   Action: See SWR-REQ-407146   1. ANC is transmitted with excessive Bit Error (Customer perceives audio with random dropouts during chime event)   Action: See SWR-REQ-407146   1. ANC is transmitted with poor S/N ratios (Customers perceives high level of noise while ANC is present.)   Action: Analysis and Correction of gain structures within the DSP coding.   1. ANC is transmitted with excessive latencies. (Customer perceives excessive/unexpected noise while ANC is present.)   Action: Analysis and Correction of ANC Microphone signal path to reduce latencies. |
| **Interfaces** |  |

## HW/SWR-REQ-412263/A-Diagnostic Configuration for A2B Stream Content

## Amplifier Sub Node Functionality

### SWR-REQ-407179/A-Clip Detect (IO7) PCB connections

The A2B Sub nodes that have internal amplifiers shall have the amplifier IC clip detect pins hooked directly up to the A2B IC’s ‘GPIO7’ pin with minimal added components.

The A2B Main node shall directly connect the A2B IC’s ‘GPIO7’ pin to a logic circuit that can read it’s state, with minimal added components.

The ‘system transmission’ time from “the clip pulse out of the A2B Sub node’s internal amplifier” to the A2B Main node’s A2B IC’s ‘GPIO7’ pin shall be less than 60 microseconds.

### SWR-REQ-407180/A-Amplifier Enable (AE) I2C command and control message

The A2B Main node shall send the Amplifier Enable (AE) I2C command and control message according to the A2B Amplifier Module SPSS and per *Phoenix Audio Peripheral Command and Control API Specification*.

## Digital Stream Gain Settings

### SWR-REQ-407181/B-Digital Stream Gain Settings

The values in the following tables shall be measured using an A2B Bus Analysis tool that measures values in the A2B digital domain. The ‘muted’ digital value for the audio content transmitted on the A2B bus shall be all zeros (0x000000). The number system used on the A2B Bus shall be using a 2's complement representation.

#### SWR-REQ-407182/C-A2B Downstream Audio Signal Characteristics

Table: A2B Downstream Audio Signal Characteristics

|  |  | **Value** | | |  |
| --- | --- | --- | --- | --- | --- |
| **Symbol** | **Parameter** | **Min** | **Target** | **Max** | **Unit** |
| Stream ID 1 | PAC Tuner Audio  Input: 1kHz 0dB Tone (Peak),  Per AMFM-HR-REQ-407530-FM Test Setup |  |  | -2 | dBfs (Peak) |
| Stream ID 2 | PAC Tuner Audio  Input: 1kHz 0dB Tone (Peak),  Per AMFM-HR-REQ-407530-FM Test Setup |  |  | -2 | dBfs (Peak) |
| Stream ID 3 | Android Audio Loopback  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 4 | Android Audio Loopback  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 5 | Android Audio Loopback  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 6 | Android Audio Loopback  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 7 | Premium Audio (Stereo)  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 8 | Premium Audio (Stereo)  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 9 | Premium Audio (Stereo)  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 10 | Premium Audio (Stereo)  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 11 | PAC Mic Input  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 12 | PAC Mic Input  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 13 | PAC Mic Input  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 14 | PAC Mic Input  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 15 | PAC Mic Input  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 16 | PAC Mic Input  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 17 | BT Audio Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 18 | BT Audio Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 19 | BT Audio Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 20 | BT Audio Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 21 | ICC LS-Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 22 | ICC LS-Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 23 | ICC LS-Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 24 | ICC LS-Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |

#### SWR-REQ-407183/D-A2B Upstream Audio Signal Characteristics

Table: A2B Upstream Audio Signal Characteristics

|  |  | **Value** | | |  |
| --- | --- | --- | --- | --- | --- |
| **Symbol** | **Parameter** | **Min** | **Target** | **Max** | **Unit** |
| Stream ID 50 | PDC Main Cabin Audio - Left PDC MSS Driver Audio Mono/Phone  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 51 | PDC Main Cabin Audio - Right  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 52 | Captains Announcement  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 53 | Phone - Receive Path  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 57 | PDC AVAS Front/Rear  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 58 | Chime/Prompt Bus  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 59 | Chime/Prompt Bus  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 60 | Chime/Prompt Bus  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 61 | Chime/Prompt Bus  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 62 | ANC (+ESE +EVSE) (ANC 1)  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 63 | ANC (+ESE +EVSE) (ANC 2)  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 64 | ANC (+ESE +EVSE) (ANC 3)  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 65 | ANC (+ESE +EVSE) (ANC 4)  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 66 | ANC (+ESE +EVSE) (ANC 5)  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 67 | ANC (+ESE +EVSE) (ANC 6)  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 68 | PDC Aux Source MSS Zone 2  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 69 | PDC Aux Source MSS Zone 3-6  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 70 | PDC Target Prompt Driver  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 71 | PDC Target Prompt MSS Zone 2-6  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 72 | PAC Speaker Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 73 | PAC Speaker Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 74 | PAC Speaker Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 75 | PAC Speaker Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 76 | PAC Speaker Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 77 | PAC Speaker Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 78 | ICC Reference Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 79 | ICC Reference Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 80 | SSE Reference Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 81 | SSE Reference Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 82 | SSE Reference Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 83 | SSE Reference Channels  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 84 | A2B Microphone Output  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 85 | A2B Microphone Output  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 86 | A2B Microphone Output  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 87 | A2B Microphone Output  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 88 | Exterior Audio  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 89 | Ext Voice Call Audio  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 90 | A2B Microphone Output  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 91 | A2B Microphone Output  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 92 | A2B Microphone Output  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 93 | A2B Microphone Output  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 94 | PDC Aux Source MSS Zone 2  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 95 | PDC Aux Source MSS Zone 3  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |
| Stream ID 96 | PDC Aux Source MSS Zone 4  Input: 1kHz, 0 dB tone (Peak) |  |  | -2 | dBfs (Peak) |

## Software Update File Structure

### SWR-REQ-407184/A-Sub Node Software Update File Structure

The software update process over A2B is not currently supported.

# FRD-REQ-407185/A-Appendix A

## SWR-REQ-407186/B-Reference Documents

The requirements of the documents listed in the reference tables below, of the latest revision level, form a part of this Engineering Specification.

**All referenced requirements below shall be met.**

|  |  |  |  |
| --- | --- | --- | --- |
| **Document Title** | **Document** | **Date** | **Ver.** |
| **A2B SYSTEMS REQUIREMENTS** | | | |
|  |  |  |  |
| AD243x Sp0 Datasheet | AD243x Sp0 Datasheet.pdf | April 2021 | Sp0 |
| AD243x A2B Transceiver Programming Reference | AD243x\_A2B\_Transceiver\_Programming\_Reference\_ Rev1.0 \_March\_2021.pdf | March2021 | 1.0 |
| AD243x High Power Reference Schematics | AD243x\_High\_Power\_Reference\_Schematics\_CFG-4\_NFET-NFET\_Rev1.1\_27November2020.pdf | 11/27/2020 | 1.1 |
| AD243x Medium Power Reference Schematics | AD243x\_Medium\_Power\_Reference\_Schematics\_CFG-4\_NFET-NFET\_Rev1.2\_30November2020.pdf | 11/30/2020 | 1.2 |
| AD243x Tuner Reference Schematics | AD243x\_Tuner\_Reference\_Schematics\_\_Rev1.1\_27November2020.pdf | 11/27/2020 | 1.1 |
| AD2426W/AD2427W/AD2428W-TRM | AD2426W-AD2427W-AD2428W-TRM-Rev-1.0.pdf | Nov 2018 | 1.0 |
| AD2431/2432/2433/2435 Data Sheets | AD2431\_2432\_2433\_2435\_PrD\_datasheet.pdf | July 2020 | PrD |
| AD2431/AD2432/AD2433/AD2435 Anomaly List | AD2431\_AD2432\_AD2433\_AD2435 Anomaly List for Revision(s) 1.0, 1.1 (Rev B).pdf | 2020/09/29 | B |
| AD2433 Standard Power (2.5W) Reference Schematics | AD2433\_StandardPower(2.5W)\_Reference\_Schematics\_Rev1.1\_2020\_11\_27.pdf | 11/27/2020 | 1.1 |
| ADI A2B Stack UserGuide | ADI A2B Stack UserGuide\_V6.0\_2018-06-06.pdf | 06/06/2018 | 6.0 |
| Analog Devices A2B Hardware Review | Analog Devices A2B Hardware Review 000603.501 AG\_2021-04-28.docx | 2021/04/28 | AG |
| Analog Devices A2B Data link Implementation Specification | Analog Devices A2B Link Implementation Specification ver 2.1\_2021-04-28.docx | 2021/04/28 | 2.1 |
| Analog Devices A2B Data Link and Physical Layer Specification | Analog Devices A2B Physical Layer Specification 000603.501 AG\_2021-04-28.docx | 2021/04/28 | AG |
| AD2433 Reference Schematic | AD2433\_StandardPower(2.5W)\_Reference\_Schematics\_Rev1.1\_2020\_11\_27.pdf | 2020-11-27 | 1.1 |
| A2B Peripheral CAC API Spec |  |  |  |

# FRD-REQ-407187/A-Revision History

## SWR-REQ-407188/E-Revision History

|  |  |  |  |
| --- | --- | --- | --- |
| **Date** | **Version** | **Notes** | |
| July 30, 2021 | 1.0 | Initial Release |  |
| September 9, 2021 | 1.1 | SWR-REQ-407108/B-A2B Downstream Stream IDs | 2021-09-09 DWALUS: Updated Audio Management SPSS values. |
|  |  | SWR-REQ-407109/B-A2B Upstream Stream IDs | 2021-09-09 DWALUS: Updated Audio Management SPSS values. |
|  |  | SWR-REQ-407110/B-A2B Architectures | 2021-09-07 DWALUS: Included statement of where actual order of TDM streams can be found. |
|  |  | SWR-REQ-407111/B-Phoenix Audio with 2 Nodes - Non-Branded (PAC 1, 2, 3, 4, & 5) | 2021-09-09 DWALUS: No Change. |
|  |  | HW/SWR-REQ-423177/B-A2B Digital Audio Bus Start-Up - Two Node | 2021-09-09 DWALUS: Updated timing to match Sequence Diagram. Also replaced can message startup with timer startup. |
|  |  | HW/SWR-REQ-423181/B-A2BBroadcastState (Muted to Un-Muted & AudioNotSent) signal usage | 2021-09-09 DWALUS: Updated timing to match Sequence Diagram. Also replaced can message startup with timer startup. |
|  |  | HW/SWR-REQ-423182/B-A2BStreamReportStatus (AudioNotSent to AudioSent) signal usage | 2021-09-09 DWALUS: Updated timing to match Sequence Diagram. Also replaced can message startup with timer startup. |
|  |  | HW/SWR-REQ-423185/B-Sequence Diagram (Startup of PAC, and PDC) | 2021-09-09 DWALUS: Updated timing. Also replaced can message startup with timer startup. |
|  |  | HW/SWR-REQ-423187/B-Sequence Diagram (Shutdown of PAC, and PDC) | 2021-09-09 DWALUS: Updated timing. Also replaced can message startup with timer startup. |
|  |  | HW/SWR-REQ-423107/B-A2B Digital Audio Bus Start-Up - Three Node | 2021-09-09 DWALUS: Updated timing to match Sequence Diagram. Also replaced can message startup with timer startup. |
|  |  | HW/SWR-REQ-423220/B-AmplifierEnableState (Default to Enabled) signal usage | 2021-09-09 DWALUS: Updated timing to match Sequence Diagram. Also replaced can message startup with timer startup. |
|  |  | HW/SWR-REQ-423115/B-AMPSpeakerOutputStatus (Muted to Un-Muted) signal usage | 2021-09-09 DWALUS: Updated timing to match Sequence Diagram. Also replaced can message startup with timer startup. |
|  |  | HW/SWR-REQ-423116/B-A2BBroadcastState (Muted to Un-Muted & AudioNotSent) signal usage | 2021-09-09 DWALUS: Updated timing to match Sequence Diagram. Also replaced can message startup with timer startup. |
|  |  | HW/SWR-REQ-423117/B-A2BStreamReportStatus (AudioNotSent to AudioSent) signal usage | 2021-09-09 DWALUS: Updated timing to match Sequence Diagram. Also replaced can message startup with timer startup. |
|  |  | HW/SWR-REQ-423138/B-Sequence Diagram (Startup of PAC, AMP, and PDC) | 2021-09-09 DWALUS: Updated timing. Also replaced can message startup with timer startup. |
|  |  | HW/SWR-REQ-423140/B-Sequence Diagram (Shutdown of PAC, AMP, and PDC) | 2021-09-09 DWALUS: Updated timing. Also replaced can message startup with timer startup. |
|  |  | STR-851565/B-A2B Discovery Configuration | 2021-09-09 DWALUS: Revised to allow changes to section. |
|  |  | SWR-REQ-407133/B-Generic A2B Sub Node Discovery Process | 2021-09-09 DWALUS: Removed Node ID Discovery from this process step. |
|  |  | SWR-REQ-407134/A-Generic A2B Node ID Discovery Process Flow | 2021-09-09 DWALUS: Initial Release. |
|  |  | SWR-REQ-407140/B-Loss of Communication with Main Node A2B IC | 2021-09-07 DWALUS: Expanded chimes error condition reportout to include all times the A2B bus is lost. |
|  |  | SWR-REQ-407141/B-Line Fault Handling Process | 2021-09-08 DWALUS: Removed references to 'client'. |
|  |  | SWR-REQ-434357/B-Missing Mailbox Message | 2021-09-07 DWALUS: Expanded 5 re-tries to infinite retrys since this is just rechecking for 'A2B read reciept' from subnode. |
|  |  | HR-REQ-407152/B-Audio Performance during a Start-Stop Event | 2021-09-08 DWALUS: Changed requirement type from "SWR" to "HR". |
|  |  | SWR-REQ-407188/B-Revision History | 2021-09-09 DWALUS: Added revisions for latest release. |
| October 18, 2021 | 1.2 | SWR-REQ-407114/B-Phoenix Audio with 3 Nodes - Branded (PAC 1, 2, 3, 4, & 5) | 2021-10-11 DWALUS: Updated image to show all B&O and Revel amps possible. |
|  |  | SWR-REQ-416750/B-Phoenix Audio with 3 Nodes - Branded (PAC 6, 7, & 8) | 2021-10-11 DWALUS: Updated image to show all B&O and Revel amps possible. Removed Ext Phone Audio from PDC to PAC and added Phone Audio PDC to AMP. |
|  |  | SWR-REQ-410563/B-Phoenix Audio with 2 Nodes - DuerOS - w/o ICC and w/o MSS | 2021-10-11 DWALUS: Updated image to show all B&O and Revel amps possible. |
|  |  | SWR-REQ-416752/B-Phoenix Audio with 3 Nodes - DuerOS - w/ ICC and w/o MSS | 2021-10-11 DWALUS: Updated image to show all B&O and Revel amps possible. |
|  |  | FRD-REQ-407128/B-General Requirements | 2021-10-11 DWALUS: Revised to allow changes to section |
|  |  | HW/SWR-REQ-423177/C-A2B Digital Audio Bus Start-Up - Two Node | 2021-10-05 DWALUS: Revised to allow changes to section. |
|  |  | HW/SWR-REQ-423179/B-A2BBroadcastState Configuration usage | 2021-10-05 DWALUS: Added the Node ID software process to this requirement. |
|  |  | HW/SWR-REQ-423180/B-A2BBroadcastState (Default to Muted & AudioNotSent) signals usage | 2021-10-07 DWALUS: Update to reflect Bit 0 - Bit 2. |
|  |  | HW/SWR-REQ-423182/C-A2BBroadcastStates (Muted to Unmuted AND AudioNotSent to AudioSent) signal usage | 2021-10-05 DWALUS: Merged HW/SWR-REQ-423181 and HW/SWR-REQ-423182 and HW/SWR-REQ-42183 into a single requirement. |
|  |  | HW/SWR-REQ-423184/B-A2BBroadcastState (Heartbeat) signal usage | 2021-10-05 DWALUS: Updated the A2BBroadcastState signal to include Bit 2. Changed "Audio Shutdown Procedure" to indicate "HW/SWR-REQ-423187-Sequence Diagram (Shutdown of PAC, and PDC)". |
|  |  | HW/SWR-REQ-423185/C-Sequence Diagram (Startup of PAC, and PDC) | 2021-10-05 DWALUS: Updated sequence diagram to include corrected HS-CAN Messages. |
|  |  | HW/SWR-REQ-423222/B-A2B Shutdown Sequence signals usage | 2021-10-05 DWALUS: Updated HS-CAN signals to reflect what is on the Sequence Diagram. Better described the re-start process. |
|  |  | HW/SWR-REQ-423187/C-Sequence Diagram (Shutdown of PAC, and PDC) | 2021-10-05 DWALUS: Updated sequence diagram to include corrected HS-CAN Messages. |
|  |  | HW/SWR-REQ-423107/C-A2B Digital Audio Bus Start-Up - Three Node | 2021-10-07 DWALUS: Revised to allow changes to section. |
|  |  | HW/SWR-REQ-423111/B-A2BBroadcastState Configuration usage | 2021-10-07 DWALUS: Cleaned up the logic and identified broadcast signal bits. |
|  |  | HW/SWR-REQ-423114/B-A2BBroadcastState (Default to Muted & AudioNotSent) signals usage | 2021-10-07 DWALUS: Cleaned up the logic and identified broadcast signal bits. |
|  |  | HW/SWR-REQ-423220/C-AmplifierEnableState (Default to Enabled) signal usage | 2021-10-07 DWALUS: Cleaned up the logic and identified broadcast signal bits. |
|  |  | HW/SWR-REQ-423115/C-AMPSpeakerOutputStatus (Muted to Un-Muted) signal usage | 2021-10-07 DWALUS: Cleaned up the logic and identified broadcast signal bits. |
|  |  | HW/SWR-REQ-423116/C-A2BBroadcastState (Muted to Un-Muted & AudioNotSent to AudioSent) signal usage | 2021-10-05 DWALUS: Merged HW/SWR-REQ-423116 and HW/SWR-REQ-423117 and HW/SWR-REQ-42118 into a single requirement. |
|  |  | HW/SWR-REQ-423137/B-A2BBroadcastState (Heartbeat) signal usage | 2021-10-07 DWALUS: Cleaned up the heartbeat logic and clarified error conditions. |
|  |  | HW/SWR-REQ-423138/C-Sequence Diagram (Startup of PAC, AMP, and PDC) | 2021-10-05 DWALUS: Updated sequence diagram to include corrected HS-CAN Messages. |
|  |  | HW/SWR-REQ-423139/B-A2B Digital Audio Bus Shut-Down - Three Node | 2021-10-07 DWALUS: Revised to allow changes to section. |
|  |  | HW/SWR-REQ-423224/B-A2B Shutdown Sequence signals usage | 2021-10-07 DWALUS: Cleaned up logic and clarified the bit used in the A2BBroadcastState message. |
|  |  | HW/SWR-REQ-423140/C-Sequence Diagram (Shutdown of PAC, AMP, and PDC) | 2021-10-05 DWALUS: Updated sequence diagram to include corrected HS-CAN Messages. |
|  |  | HW/SWR-REQ-455497/A-A2B Digital Audio Bus - Cold Crank Mute - Three Node | 2021-10-11 DWALUS: Initial Release |
|  |  | HW/SWR-REQ-455517/A-A2B Cold Crank Sequence Signal Usage | 2021-10-11 DWALUS: Initial Release |
|  |  | HW/SWR-REQ-455537/A-Sequence Diagram (Cold Crank Mute of PAC, AMP) | 2021-10-11 DWALUS: Initial Release |
|  |  | SWR-REQ-407132/B-Table of Custom Node Identifiers | 2021-09-13 DWALUS: Added statement that the Node ID process is post initial discovery process. |
|  |  | SWR-REQ-407143/B-Retrying handling at A2B bus initialization | 2021-10-18 DWALUS: Added retry strategy for initial self discovery failures. |
|  |  | UC-REQ-407157/B-A2B Node ID Discovery Process for Mailbox I2C/SPI Communication | 2021-09-13 DWALUS: Removed reference to discovery process. |
|  |  | SWR-REQ-407182/B-A2B Downstream Audio Signal Characteristics | 2021-10-15 DWALUS: Updated table with values to set gains. |
|  |  | SWR-REQ-407183/B-A2B Upstream Audio Signal Characteristics | 2021-10-15 DWALUS: Updated table with values to set gains. |
|  |  | SWR-REQ-407186/B-Reference Documents | 2021-10-18 DWALUS: Remove duplicate and outdated reference. Corrected title of API spec. |
|  |  | SWR-REQ-407188/C-Revision History | 2021-10-18 DWALUS: Revised to add revisions to table. |
| December 9, 2021 | 1.3 | SWR-REQ-407109/C-A2B Upstream Stream IDs | 2021-11-02 DWALUS: Added labels for ANC streams. 2021-12-08 DWALUS: Added Aux Zone 2, 3, & 4 |
|  |  | SWR-REQ-416751/B-Phoenix Audio with 3 Nodes - Branded (PAC 9, 10, & 11) | 2021-12-08 DWALUS: Dropped from 4 BT to 3 BT, added MSS Zones 2, 3, 4 |
|  |  | SWR-REQ-416753/B-Phoenix Audio with 3 Nodes - DuerOS - w/ ICC and w/ MSS (PAC 9, 10, & 11) | 2021-12-08 DWALUS: Dropped from 4 BT to 3 BT, added MSS Zones 2, 3, 4 |
|  |  | FRD-REQ-407128/C-General Requirements | 2021-12-09 DWALUS: Revised to allow changes to section. |
|  |  | HW/SWR-REQ-423182/D-A2BBroadcastStates (Muted to Unmuted AND AudioNotSent to AudioSent) signal usage | 2021-12-08 DWALUS: Updated the process to match the agreed upon sequence diagram. |
|  |  | HW/SWR-REQ-423185/D-Sequence Diagram (Startup of PAC, and PDC) | 2021-12-08 DWALUS: Splitting the initialization into sub pieces. |
|  |  | HW/SWR-REQ-423222/C-A2B Shutdown Sequence signals usage | 2021-12-09 DWALUS: Updated CAN messages used to trigger event. |
|  |  | HW/SWR-REQ-423187/D-Sequence Diagram (Shutdown of PAC, and PDC) | 2021-12-08 DWALUS: Updated the can messages that trigger the event. |
|  |  | HW/SWR-REQ-423220/D-AmplifierEnableState (Default to Enabled) signal usage | 2021-12-08 DWALUS: Updated CAN messages used to trigger event. |
|  |  | HW/SWR-REQ-423115/D-AMPSpeakerOutputStatus (Muted to Un-Muted) signal usage | 2021-12-08 DWALUS: Corrected the 300ms requirement to match the sequence diagram |
|  |  | HW/SWR-REQ-423116/D-A2BBroadcastState (Muted to Un-Muted & AudioNotSent to AudioSent) signal usage | 2021-12-09 DWALUS: Revised the conditions to match the sequence diagram. |
|  |  | HW/SWR-REQ-423138/D-Sequence Diagram (Startup of PAC, AMP, and PDC) | 2021-12-08 DWALUS: Splitting the initialization into sub pieces. |
|  |  | HW/SWR-REQ-423224/C-A2B Shutdown Sequence signals usage | 2021-12-09 DWALUS: Corrected the initial CAN signals to match the sequence diagram. |
|  |  | HW/SWR-REQ-423140/D-Sequence Diagram (Shutdown of PAC, AMP, and PDC) | 2021-12-08 DWALUS: Updated the can messages that triggers this process. |
|  |  | SWR-REQ-407181/B-Digital Stream Gain Settings | 2021-11-30 DWALUS: Updated number system used. |
|  |  | SWR-REQ-407183/C-A2B Upstream Audio Signal Characteristics | 2021-12-09 DWALUS: Corrected ANC gain settings per Jim H. Added the three new A2B streams. |
|  |  | SWR-REQ-407188/D-Revision History | 2021-12-09 DWALUS: Revised to add revision history notes. |
| February 07, 2022 | 1.4 | HW/SWR-REQ-416431/B-Design guidelines for GPIO pins | 2022-01-14 DWALUS: Removed Visteon PAC |
|  |  | SWR-REQ-407110/C-A2B Architectures | 2022-01-24 DWALUS: Revised to allow changes to section |
|  |  | SWR-REQ-407111/C-Phoenix Audio with 2 Nodes - Arch 1 - NonB (PAC 1, 2, 3, 4, & 5) | 2022-01-24 DWALUS: Updated name and picture to include architecture number. |
|  |  | SWR-REQ-407112/B-Phoenix Audio with 3 Nodes - Arch 2 - NonB (PAC 1, 2, 3, 4, & 5) | 2022-01-24 DWALUS: Updated name and picture to include architecture number. |
|  |  | SWR-REQ-407113/B-Phoenix Audio with 2 Nodes - Arch 3 - NonB (PAC M) | 2022-01-24 DWALUS: Updated name and picture to include architecture number. |
|  |  | SWR-REQ-407114/C-Phoenix Audio with 3 Nodes - Arch 4 - Branded (PAC 1, 2, 3, 4, & 5) | 2022-01-24 DWALUS: Updated name and picture to include architecture number. |
|  |  | SWR-REQ-407115/B-Phoenix Audio with 2 Nodes - Arch 7 - DuerOS - Subwoofer\_Base | 2022-01-24 DWALUS: Updated name and picture to include architecture number. |
|  |  | SWR-REQ-410563/C-Phoenix Audio with 2 Nodes - Arch 8 - DuerOS - w/o ICC | 2022-01-24 DWALUS: Updated name and picture to include architecture number. |
|  |  | SWR-REQ-416752/C-Phoenix Audio with 3 Nodes - Arch 9 - DuerOS - w/ ICC | 2022-01-24 DWALUS: Updated name and picture to include architecture number. |
|  |  | HW/SWR-REQ-423177/D-A2B Digital Audio Bus Start-Up - Two Node | 2022-01-18 DWALUS: Revised to allow changes to section. |
|  |  | HW/SWR-REQ-423182/E-A2BBroadcastStates (Muted to Unmuted AND AudioNotSent to AudioSent) signal usage | 2022-01-18: Revised and split to show difference between AVAS and Non-AVAS systems. |
|  |  | HW/SWR-REQ-423185/E-Sequence Diagram (Startup of PAC, and PDC for Non-AVAS Systems) | 2022-01-18: Revised and split to show difference between AVAS and Non-AVAS systems. |
|  |  | HW/SWR-REQ-474557/A-Sequence Diagram(Startup of PAC, and PDC for AVAS Systems) | 2022-01-18: Revised and split to show difference between AVAS and Non-AVAS systems. |
|  |  | HW/SWR-REQ-423186/B-A2B Digital Audio Bus Shut-Down - Two Node | 2022-01-18 DWALUS: Revised to allow changes to section. |
|  |  | HW/SWR-REQ-423222/D-A2B Shutdown Sequence signals usage | 2022-01-18: Revised and split to show difference between AVAS and Non-AVAS systems. |
|  |  | HW/SWR-REQ-423187/E-Sequence Diagram (Shutdown of PAC, and PDC for Non-AVAS Systems) | 2022-01-18: Revised and split to show difference between AVAS and Non-AVAS systems. |
|  |  | HW/SWR-REQ-474558/A-Sequence Diagram (Shutdown of PAC, and PDC for AVAS Systems) | 2022-01-18: Revised and split to show difference between AVAS and Non-AVAS systems. |
|  |  | HW/SWR-REQ-423107/D-A2B Digital Audio Bus Start-Up - Three Node | 2022-01-18 DWALUS: Revised to allow changes to section. |
|  |  | HW/SWR-REQ-423220/E-AmplifierEnableState (Default to Enabled) signal usage | 2022-01-18: Revised and split to show difference between AVAS and Non-AVAS systems. |
|  |  | HW/SWR-REQ-423138/E-Sequence Diagram (Startup of PAC, AMP, and PDC for Non-AVAS Systems) | 2022-01-18: Revised and split to show difference between AVAS and Non-AVAS systems. |
|  |  | HW/SWR-REQ-474560/A-Sequence Diagram (Startup of PAC, AMP, and PDC for AVAS Systems) | 2022-01-18: Revised and split to show difference between AVAS and Non-AVAS systems. |
|  |  | HW/SWR-REQ-423139/C-A2B Digital Audio Bus Shut-Down - Three Node | 2022-01-18 DWALUS: Revised to allow changes to section. |
|  |  | HW/SWR-REQ-423224/D-A2B Shutdown Sequence signals usage | 2022-01-18: Revised and split to show difference between AVAS and Non-AVAS systems. |
|  |  | HW/SWR-REQ-423140/E-Sequence Diagram (Shutdown of PAC, AMP, and PDC for Non-AVAS Systems)) | 2022-01-18: Revised and split to show difference between AVAS and Non-AVAS systems. |
|  |  | HW/SWR-REQ-474577/A-Sequence Diagram (Shutdown of PAC, AMP, and PDC for AVAS Systems) | 2022-01-18: Revised and split to show difference between AVAS and Non-AVAS systems.Se |
|  |  | SWR-REQ-434357/C-Missing Mailbox Message | 2022-01-13 DWALUS: Updated to include multiframe messages. |
|  |  | STR-851574/B-Digital Stream Gain Settings | 2022-01-24 DWALUS: Removed TBD from name |
|  |  | SWR-REQ-407182/C-A2B Downstream Audio Signal Characteristics | 2022-02-07 DWALUS: Added (Peak) to all inputs and outputs |
|  |  | SWR-REQ-407183/D-A2B Upstream Audio Signal Characteristics | 2022-02-07 DWALUS: Added (Peak) to all inputs and outputs |
|  |  | SWR-REQ-407188/E-Revision History | 2022-01-24 DWALUS: Updated Revision History |
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