AN3118

IS2083/BM83 Bluetooth® Applications Design Guide

INTRODUCTION

The BM83 module is a flash-based Bluetooth Stereo Audio module built using Microchip's IS2083 SoC. The turnkey solution as mentioned in the table below integrates the Bluetooth stack, profiles, and audio/voice processing to enable Bluetooth audio capability and customize DSP tuning for an end user application.

This application note describes how to implement and use the following solutions using the BM83 module:

- Multi-Speaker (MSPK):
  - Microchip's Wireless Concert Technology (WCT) is a distributed audio solution that synchronizes multiple speakers from one audio source. This is also known as Multi-speaker (MSPK) solution.
- Audio Transceiver (AT):
  - With AT firmware, the BM83 serves as an audio source that transmits A2DP music to standard Bluetooth devices.
- Google Fast Pairing (GFP):
  - Uses Bluetooth Low Energy to discover nearby Android devices, thus eliminating some of the steps in pairing process.

The BM83 supports the following standard features along with other features listed in the following table.

- HFP, A2DP and AVRCP
- Audio Mixer
- Bluetooth Low Energy Transparent Service
- OTA Tuning and OTA DFU
- UART Command for Host MCU
- Microchip Bluetooth Audio (MBA) App Compatibility

The Microchip Bluetooth Audio (MBA) mobile app connects to the BM83 Bluetooth devices to create an audio network, adjust EQ settings, volume control, and perform Over-the-Air (OTA) DSP tuning and firmware upgrade functions.

TABLE 1: FEATURES SUPPORTED BY BM83

Features	Firmware Targets			
	PBAP	GFP	SPP	AT
Type	Code and Binary Image			
Standard Features	Y	Y	Y	Y (RX mode)
A2DP Source	N	N	N	Y (TX mode)
PBAP	Y	N	N	N
iAP2/SPP	N	N	Y	N
MSPK	N	Y	Y	N
AVCRP Browsing	Y	N	Y	N
Google Fast Pair	N	Y	N	N

Legend: Y = Supported, N = Not supported

the table above lists the firmware targets created to support different functionality as memory constraints do not allow all features to be implemented in one firmware image. Each target consists of a firmware image and default configuration settings. The firmware targets are:

- Phone Book Access Profile (PBAP)
- Google Fast Pairing (GFP)
- Serial Port Profile (SPP)
- Audio Transceiver (AT)

The Config GUI Tool is provided along with the BM83 module to optimize the Noise Reduction (NR), Acoustic Echo Cancellation (AEC), Audio Mixer and Equalizer (EQ) Filtering. The BM83 module supports the following modes:

- Host mode (default configuration):
  - Uses the host MCU for advanced system control
  - See Figure 53 to enable this mode using the Config GUI Tool

- Embedded mode:
  - Obviates the use of host MCU
  - See Figure 54 to enable this mode using the Config GUI Tool

The IS2083 Software Development Kit (SDK) provides an opportunity to develop custom code to eliminate the use of an external host (refer to *IS2083 SDK User's Guide* (DS50002894)).

The BM83 supports JTAG for debugging. For details, refer to *IS2083 SDK Debugger User's Guide* (DS50002892).

Note:	For more information on the SDK, SDK User's Guide, and SDK Debugger Guide, contact a Microchip sales representative.

The BM83 firmware consists of:

- 8051 firmware
- DSP firmware
- Config settings

The Config GUI Tool is used to customize parameters. For more details, refer to **Appendix B: "Customizing UI and DSP Parameters"**.

BM83 firmware can be upgraded using one of the following methods:

1. Regular method - BM83 devices are put in Test mode through P3_4 GPIO and using isUpdate Tool, the BM83 image is updated through UART.
2. OTA DFU - BM83 image is updated through MBA app. For more details, refer to **Appendix L: "DFU- Over-The-Air Upgrade Procedure"**.
3. MCU DFU - BM83 image is updated through MCU using DFU command `#0x49`. For more details, refer to **Appendix R: "MCU DFU"**.

1.0 QUICK REFERENCES

Note: For a complete list of development support tools, documentation, and software tools downloads, visit http://www.microchip.com/BM83 or http://www.microchip.com/IS2083.

1.1 Reference Documentation

For additional information, refer to the following documents:

- *BM83 Bluetooth® Audio Development Board User's Guide* (DS50002902)
- *IS2083 Bluetooth® Stereo Audio SoC Data Sheet* (DS70005403)
- *BM83 Bluetooth® Stereo Audio Module Data Sheet* (DS70005402)
- *IS2083 SDK User's Guide*
- *IS2083 SDK Debugger User's Guide*
- *IS2083 isUpdate Tool User's Guide*

1.2 Software Prerequisites

- IS2083 firmware
- Host MCU firmware
- isUpdate tool
- Config GUI tool
- Microchip Bluetooth Audio Application for smartphone

2.0 MULTI-SPEAKER SOLUTION

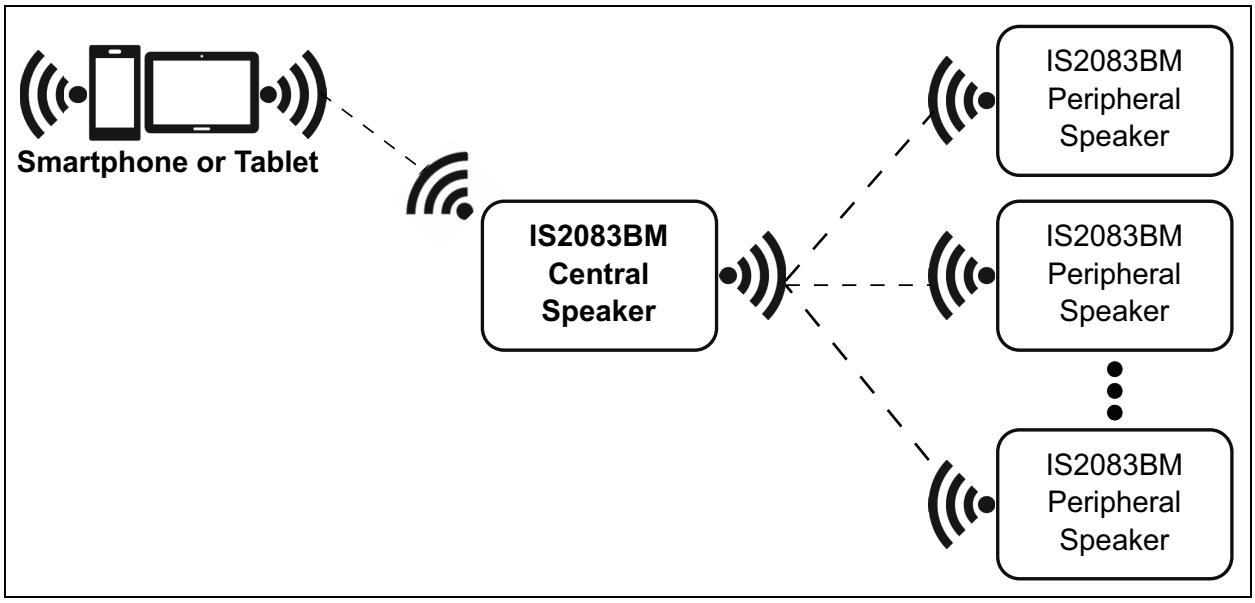
The Multi-Speaker (MSPK) Bluetooth Audio solution utilizes Microchip proprietary technology to connect a central speaker to one or multiple peripheral speakers through a modified Bluetooth protocol. Multi-Speaker functionality is implemented using Microchip's IS2083BM device. A central/speaker can be connected to a device (phone or tablet), over Bluetooth or AUX-in jack or built-in microphone, and re-transmit either of the two audio sources to one or more speakers acting as a peripheral.

Multi-Speaker solutions can be achieved using IS2083BM devices, which allow for extended range. This is a widely used technology for applications such as PA conference systems or wireless audio throughout indoor or outdoor.

Multi-Speaker can be provisioned to Concert mode (one central speaker with one or more peripheral speakers) or in Stereo mode (a left-channel and a right-channel speaker). For more details, refer to **Section 2.2 "MSPK Demo Setup"** and **Section 2.10 "Firmware Capabilities/Features"**.

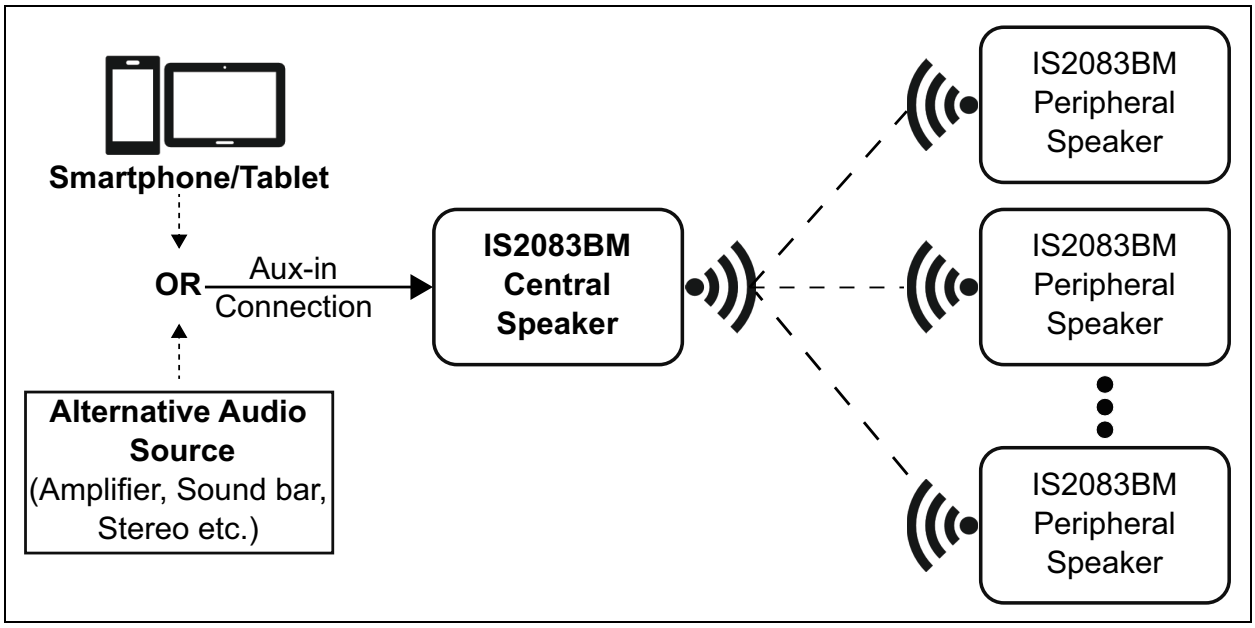
the figure below illustrates a typical Concert mode application where the central is connected to a Bluetooth-enabled device.

FIGURE 1: CONCERT MODE: CENTRAL IS CONNECTED TO BLUETOOTH ENABLED DEVICE OVER BLUETOOTH



the figure below illustrates a typical Concert mode application where the central is connected to a Bluetooth-enabled device through AUX-In.

FIGURE 2: CONCERT MODE: CENTRAL IS CONNECTED TO BLUETOOTH-ENABLED DEVICE THROUGH AUX-IN



the figure below illustrates a typical Concert mode application where the central is connected to a Bluetooth-enabled device through a built-in analog microphone or built-in digital microphone. Refer to **Appendix W: "MIC as Input in MSPK"** for the Config GUI setting.

FIGURE 3: CONCERT MODE: CENTRAL IS CONNECTED TO BLUETOOTH-ENABLED DEVICE THROUGH BUILT-IN ANALOG MICROPHONE OR BUILT-IN DIGITAL MICROPHONE

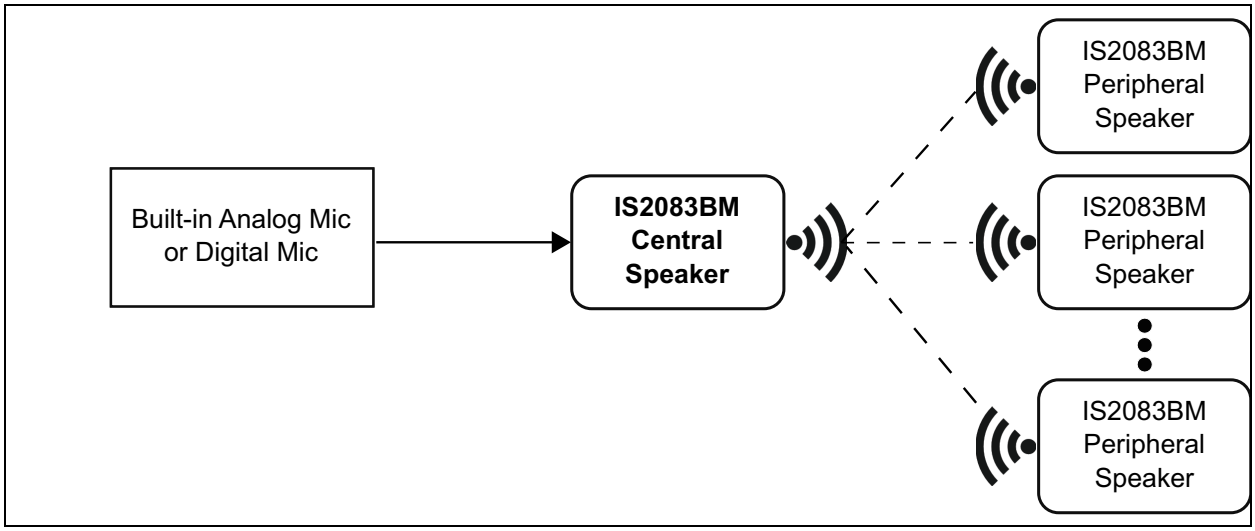
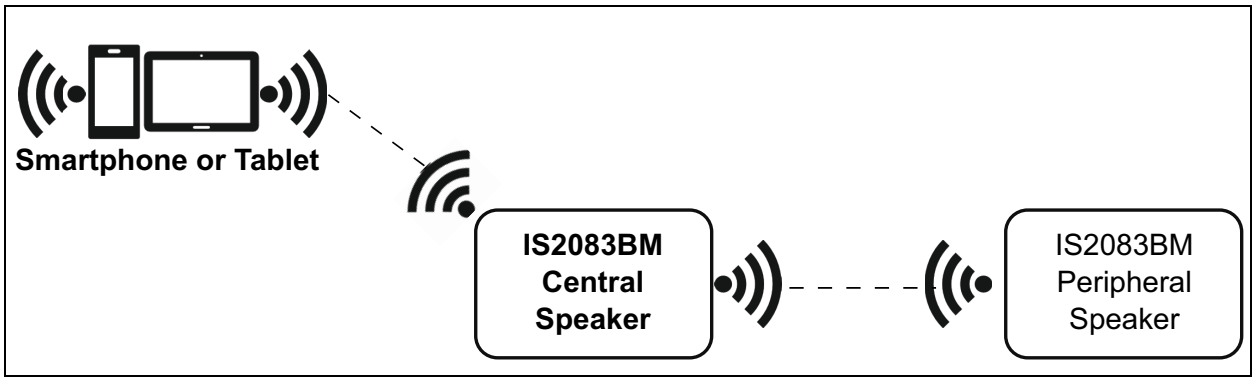


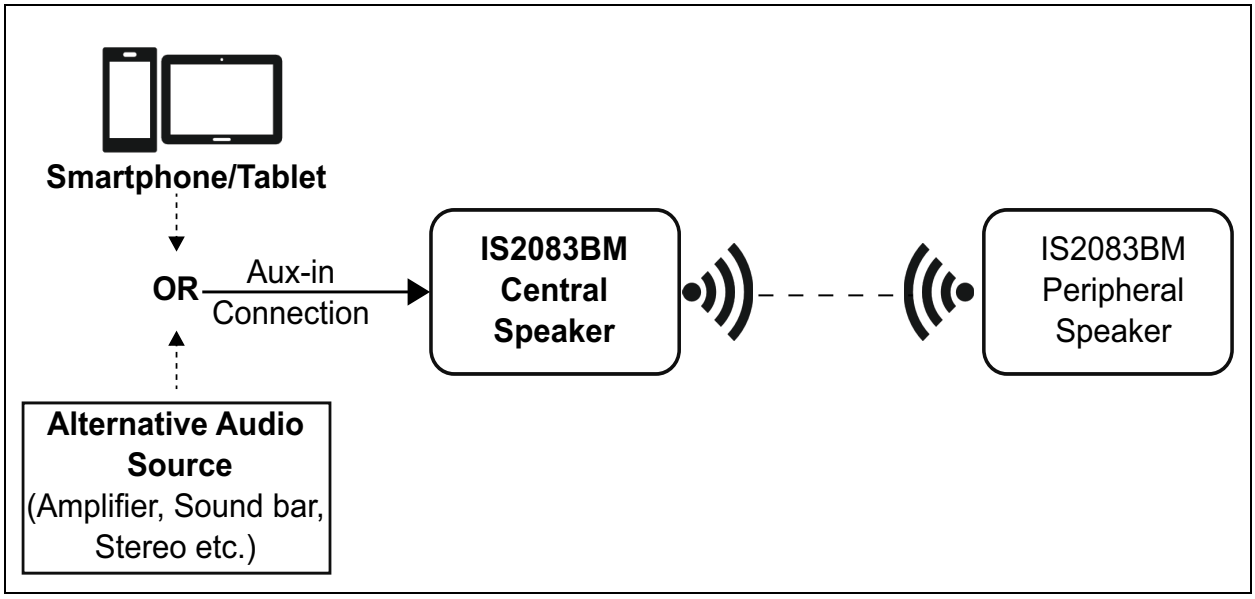
Figure 4 illustrates a typical Stereo mode application where the central is connected to a Bluetooth-enabled device.

FIGURE 4: STEREO MODE: CENTRAL IS CONNECTED TO BLUETOOTH-ENABLED DEVICE



the figure below illustrates a typical Stereo mode application where the central is connected to a Bluetooth-enabled device through AUX-In.

FIGURE 5: STEREO MODE: CENTRAL IS CONNECTED TO BLUETOOTH-ENABLED DEVICE THROUGH AUX-IN



2.1 MSPK Demo Requirements

2.1.1 SOFTWARE REQUIREMENTS

- 8051 firmware
- DSP firmware
- Config settings
- Microchip Bluetooth Audio (MBA) mobile application

2.1.2 HARDWARE REQUIREMENTS

- The BM83 Bluetooth Audio Development Kit (DM164152):
  - BM83 Evaluation Board (BM83 EVB)
  - Type-A to Micro-B USB cable
  - 15V DC power adapter
- Bluetooth-enabled smartphone:
  - Android™ device running Android 6.0 or later version
  - iOS phone
- Speaker, microphone or headset
- MPLAB REAL ICE/MPLAB ICD 3/PICkit™ 3
- Speakers which accept L+/- and R+/- as input

2.1.3 TOOLS

- isUpdate tool
- Config GUI tool
- MPLAB® Integrated Development Environment (MPLAB X IDE) tool
- Microchip Bluetooth Audio (MBA) mobile application

2.2 MSPK Demo Setup

The BM83 module supports following modes of operation in Multi-Speaker solution:

- Embedded mode
- Host mode

2.2.1 EMBEDDED MODE DEMO SETUP

1. Slide SW300 to the ON position to put BM83 into Test mode.
2. Connect the BM83 EVB with a mini USB and toggle SW200 switch to the 5V_USB position.
3. Program the MSPK firmware, DSP firmware, and Config settings (Embedded mode) from the BM83 MSPK2v1.x package (IS2083 Turnkey v1.x\Software\IS2083 Image\MSPK2v1.y\SPP\Embedded Mode) into the BM83 using isUpdate tool. Refer to *BM83 Bluetooth® Audio Development Board User's Guide*, chapter 5. Flash Update for details.

Note:	To program MSPK firmware (image1), DSP firmware (image2), and Config settings (image3), the image num value must be selected as 3 in the isUpdate Tool.

4. Once programming is completed, slide SW300 to position 1 to put device into Application mode. Refer to Table 2 for Embedded mode button functionality. By default, BM83 EVB is preconfigured with Embedded mode settings.
5. Repeat step 1 to step 4 with all other EVBs.

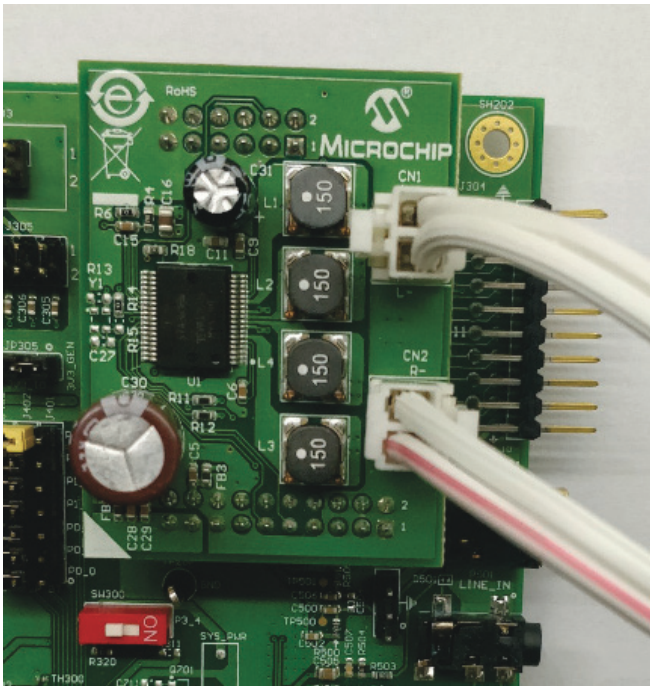
2.2.2 HOST MODE DEMO SETUP

1. Follow steps 1 to step 2 from **Section 2.2.1 "Embedded Mode Demo Setup"** and choose host mode firmware from BM83 MSPK2v2.1 package (IS2083 Turnkey v1.x\Software\IS2083 Image\MSPK2v1.y\SPP\Host Mode) in step 3.
2. Once programming is completed, slide SW300 to position 1 to put the device into Application mode. Refer *BM83 Bluetooth® Audio Development Board User's Guide*, Appendix F: Hardware Setup for Application Demo in Host MCU Mode. Refer to Table 2 for Host mode button functionality.
3. Program PIC32 with the PIC32 hex file provided in the package (\IS2083 Turnkey v1.x\Software\PIC32 Image\MSPK2v1.y). Refer to *BM83 Bluetooth® Audio Development Board User's Guide*, Appendix E: Updating PIC32 MCU Parameters.
4. Repeat steps 1 to 3 with all other EVBs.

2.2.3 CONNECTION

Connect the speakers to R/L+/- on (CN1 and CN2) the BM83 EVB as shown in the following figure.

FIGURE 6: SPEAKERS CONNECTED TO THE AUDIO DAUGHTER CARD



2.2.4 POWER-UP

Connect all the BM83 EVBs to a 15V supply and change the SW200 switch to the 5V_DC position to turn on the system.

2.2.5 INSTALLATION

Install the Microchip Bluetooth Audio app on an Android 6.0 or higher device. Refer to the procedure in **Appendix A: "Android App Installation"** to install the Android application.

The Android version of the Microchip Bluetooth Audio App is available in the Google Play™ Store and the iOS version of the app is available in the Apple iTunes® store.

2.2.6 PROVISIONING

Multi-Speaker can be provisioned to Concert/Stereo mode either through pressing the button on the BM83 EVB or through the Microchip Bluetooth Audio app utilizing BLE UART Transparent mode command.

2.2.7 FUNCTIONALITY OF BUTTONS ON THE BM83 EVB

The BM83 EVB provides various button functionality. The following table provides different button functionality mappings between Host mode and Embedded mode.

TABLE 2: BM83 EVB BUTTONS FUNCTIONALITY

Function	Host Mode (1)	Embedded Mode
Power-on and entering into Pairing mode	Short press SEL (SW711)	Long press for 2.4 seconds MFB (SW701)
To enter into Central/Peripheral mode in Concert mode and to start grouping	Long press for 1 second VOL UP (SW702)	Long press for 2 seconds VOL UP (SW702)
To enter into Central/Peripheral mode in Stereo mode and to start grouping	Long press for 1 second VOL DN (SW705)	Long press for 2 seconds VOL DN (SW705)
To add a new Peripheral to the Central in Concert mode	Short double press VOL UP (SW702)	Long press VOL UP and VOL DN buttons at the same time
To power-off	Short press SEL (SW711)	Long press for 3.2 seconds MFB (SW701)
To enter Pairing mode	Long press SEL (SW711)	Long press MFB

Note 1: To locate these buttons, refer to Figure 7.

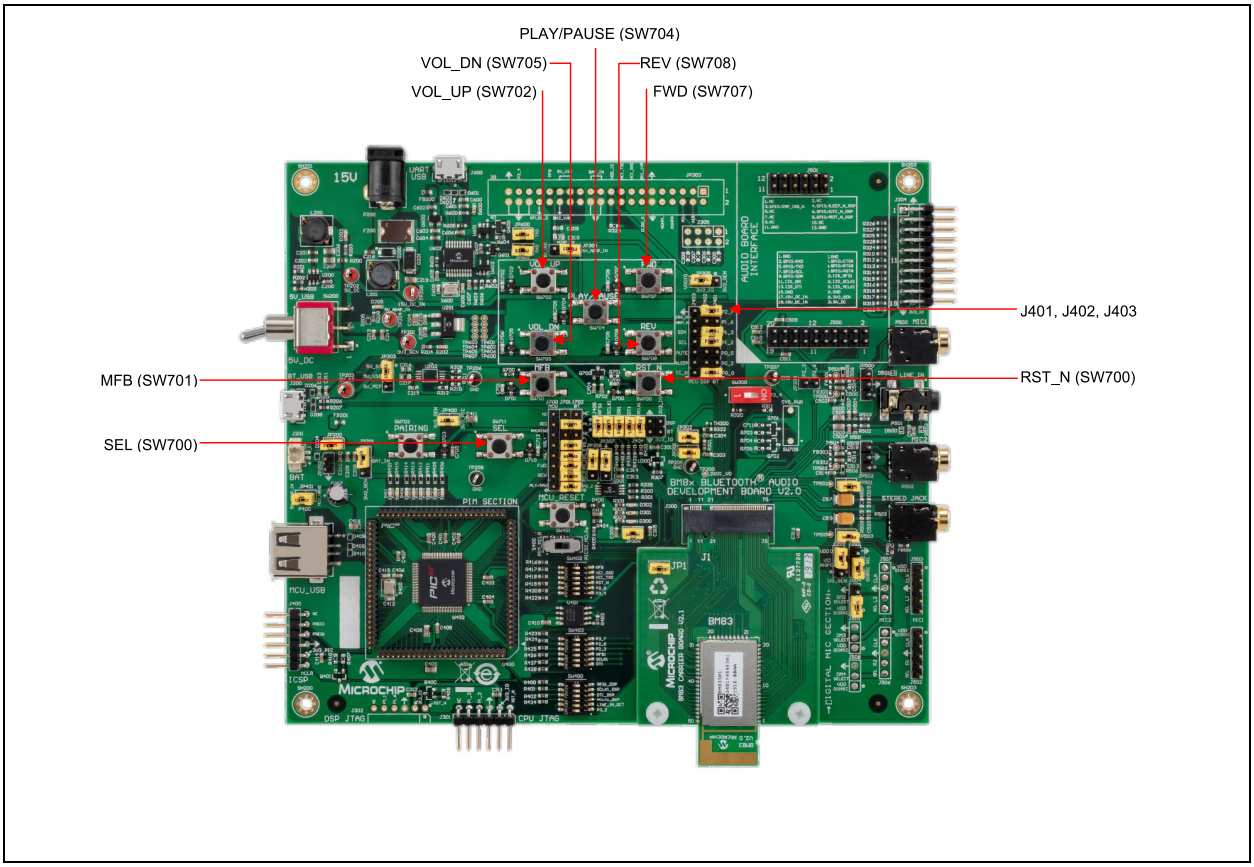
The preceding table shows the default button functionality for Host mode, which is fixed in PIC32 source code. However, the button functionality in the PIC32 code can be changed by changing the command associated with the buttons.

Similarly, button functionality can also be changed in Embedded mode by re-assignment of GPIO in the Config UI tool. Button functionality can be configured using the Config UI tool. Refer to **Appendix I: "Button Configuration"**.

Note: The short press is shorter than 1 second.

the figure below illustrates the functionality of all the buttons available on the BM83 EVB.

FIGURE 7: BM83 EVB



The following demo steps for Concert mode and Stereo mode are based on Embedded mode. The functionality is same for the Host mode as well.

2.3 Concert Mode Demo

Long press MFB on all the BM83 EVBs. This will power-on the EVB and initialization will be done. Observe that the Green LED (D401) turns ON and Blue (D300) and green (D402) LEDs blink. Long press VOL UP (SW702) on all EVBs. The EVB will either have a solid Red or Blue LED flashing after a short time period. The EVB with a solid Red LED (D301) is connected as a peripheral to the EVB with a flashing Blue LED (D300) as the central. The EVB where VOL UP (SW702) is pressed first is provisioned as the central speaker and the others are provisioned as the peripheral speaker.

To connect the central speaker with a Bluetooth streaming device, long press the MFB button on the central (flashing Blue LED) EVB to enter into Pairing mode. Pair with a Bluetooth-enabled audio streaming device. The flashing Blue LED will become solid Blue on the central EVB once pairing is complete and the connection is established. Now, play music on the audio streaming device to hear music on the central and peripheral speakers.

To add a new peripheral speaker, long press the VOL UP and VOL DN buttons at the same time on the central, then long press VOL UP (SW702) on the new speaker. The new speaker will have a solid Red LED indicating that it is added as a peripheral speaker in the group. Music will be heard on the newly added peripheral speakers along with the central and peripheral speakers.

To play the audio through AUX-In, connect the central (flashing/solid Blue LED) with the audio streaming device through the AUX-In cable. Play music on the audio streaming device and the audio will be heard on both the central and peripheral speakers. If Bluetooth audio was playing before inserting the AUX-In, it will pause the Bluetooth audio and the AUX-In audio will start playing. When the AUX-In cable is removed, the Bluetooth audio will resume in its previous state.

A long press MFB on the central EVB will power-off the central and connected peripheral EVB.

2.4 Stereo Mode Demo

Long press MFB on all BM83 EVBs. This will power on the EVB and initialization will be done. Long press VOL DN (SW705) on all EVBs. Initially, the Red LED will flash on all EVBs. The EVB will either have solid Red or flashing Blue LEDs after some time. The EVB with a solid Red LED is connected as a peripheral to the EVB with flashing Blue LED as central. The EVB where VOL DN (SW705) is pressed first is provisioned as the central and the remaining are provisioned as secondaries.

To connect the central with the Bluetooth streaming device, long press MFB on the central (flashing Blue LED) to enter into pairing mode. Pair with a Bluetooth-enabled streaming device. A flashing Blue LED will become solid Blue on the EVB. Now play music on the audio streaming device. Music will be heard on the central and peripheral speakers.

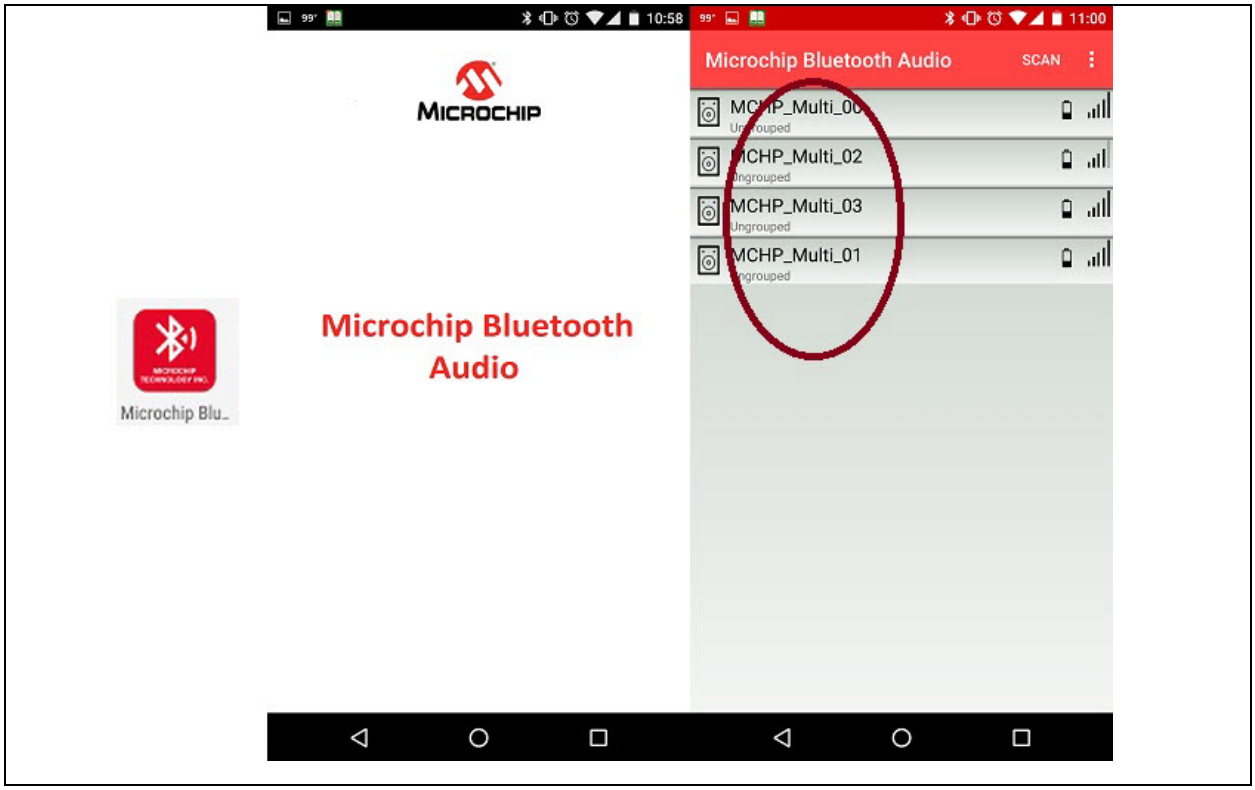
To play the audio through the AUX-In, connect the central (flashing/solid Blue LED) with the audio streaming device through the AUX-In cable. Play music on an audio streaming device and the audio will be heard on both the central and peripheral speakers. If Bluetooth audio is playing before inserting the AUX-In, it will pause the Bluetooth audio and the AUX-In audio will start playing. When the AUX-In cable is removed, the Bluetooth audio will resume in its previous state.

A long press MFB on the central EVB will power off the central and connected peripheral device.

2.5 Concert Mode Provisioning Using Microchip Bluetooth Audio App

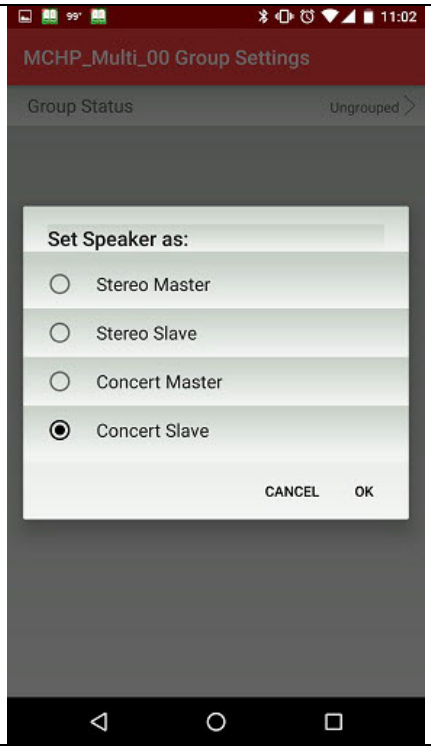
1. Long press MFB on all the BM83 EVBs to power on the EVB and initialize. The Android app can also be used to power on individual BM83 EVB. For more details, refer to **Appendix D: "Android App Power Mode"**.
2. Open the Microchip Bluetooth Audio Android app on an Android phone. The following screen is displayed, see the figure below.

FIGURE 8: MICROCHIP BLUETOOTH AUDIO ANDROID APP



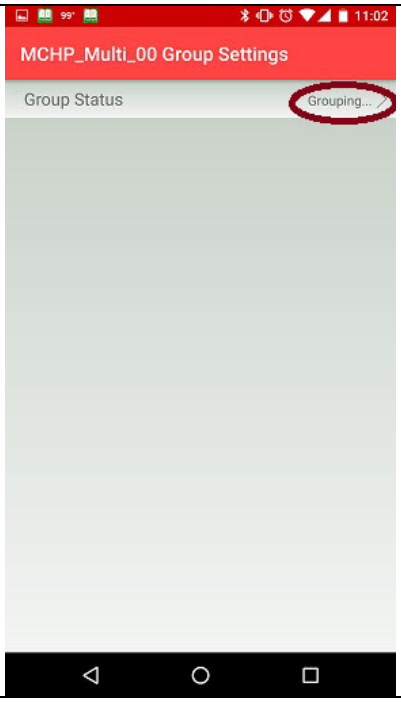
3. A list of connectable BLE devices is displayed. Select any one device **MCHP_Multi_x** (see Figure 8) and assign the role of Central/Peripheral. In Concert mode, assign one as the central and the others as peripheral. Select **Concert Slave** to assign one of the BM83 EVBs as a peripheral (see the figure below).

FIGURE 9: SELECTING OPERATIONAL MODE



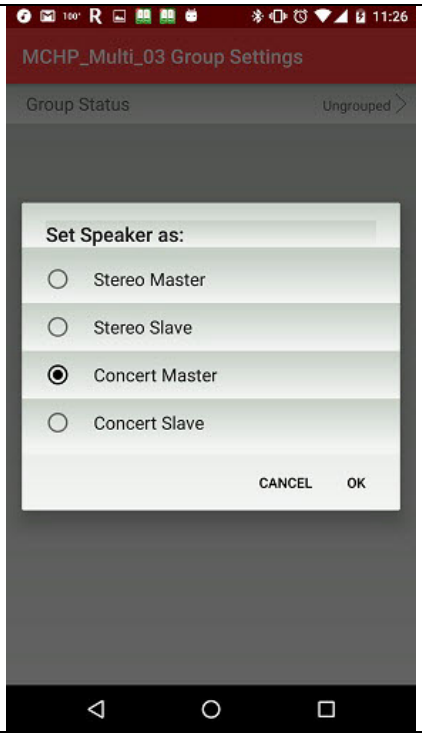
4. When the device is selected as a peripheral/central, “grouping” is displayed as the **Group Status** (see the figure below). Then, the Red LED will start flashing on the BM83 EVB. Repeat this step for the other peripheral.

FIGURE 10: GROUPING PERIPHERAL/CENTRAL



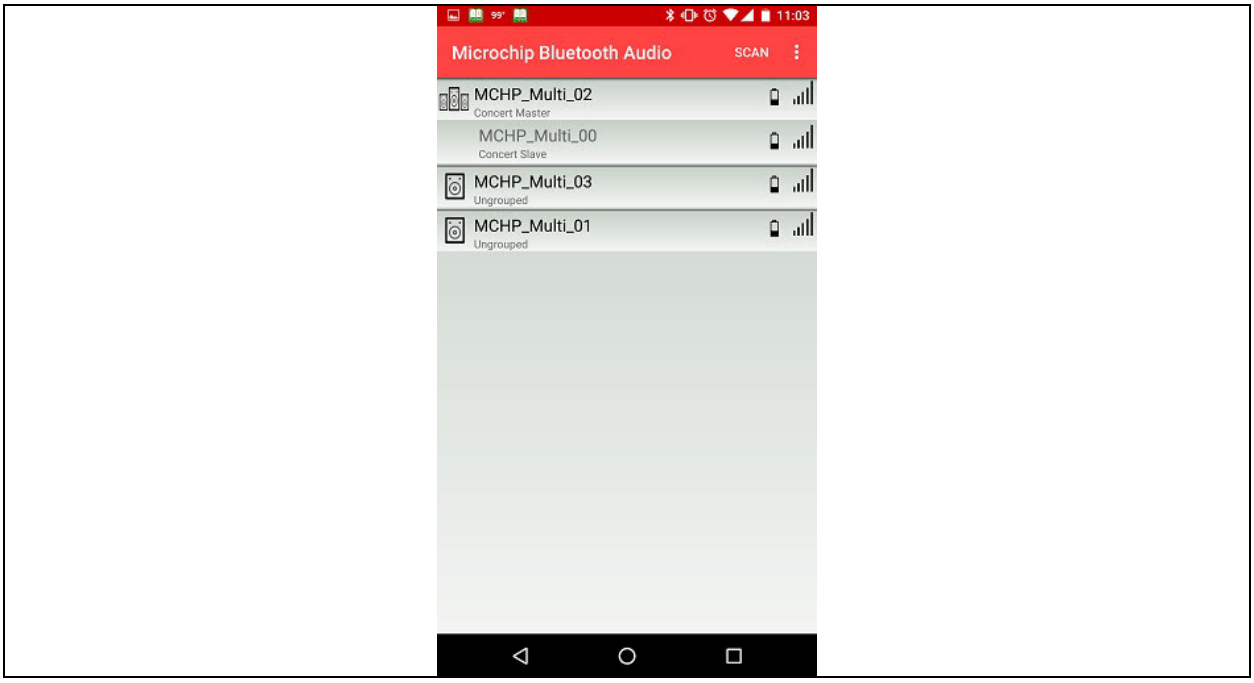
5. Select **Concert Master** to assign one of the BM83 EVB as a central, see the figure below.

FIGURE 11: SELECTING CONCERT CENTRAL



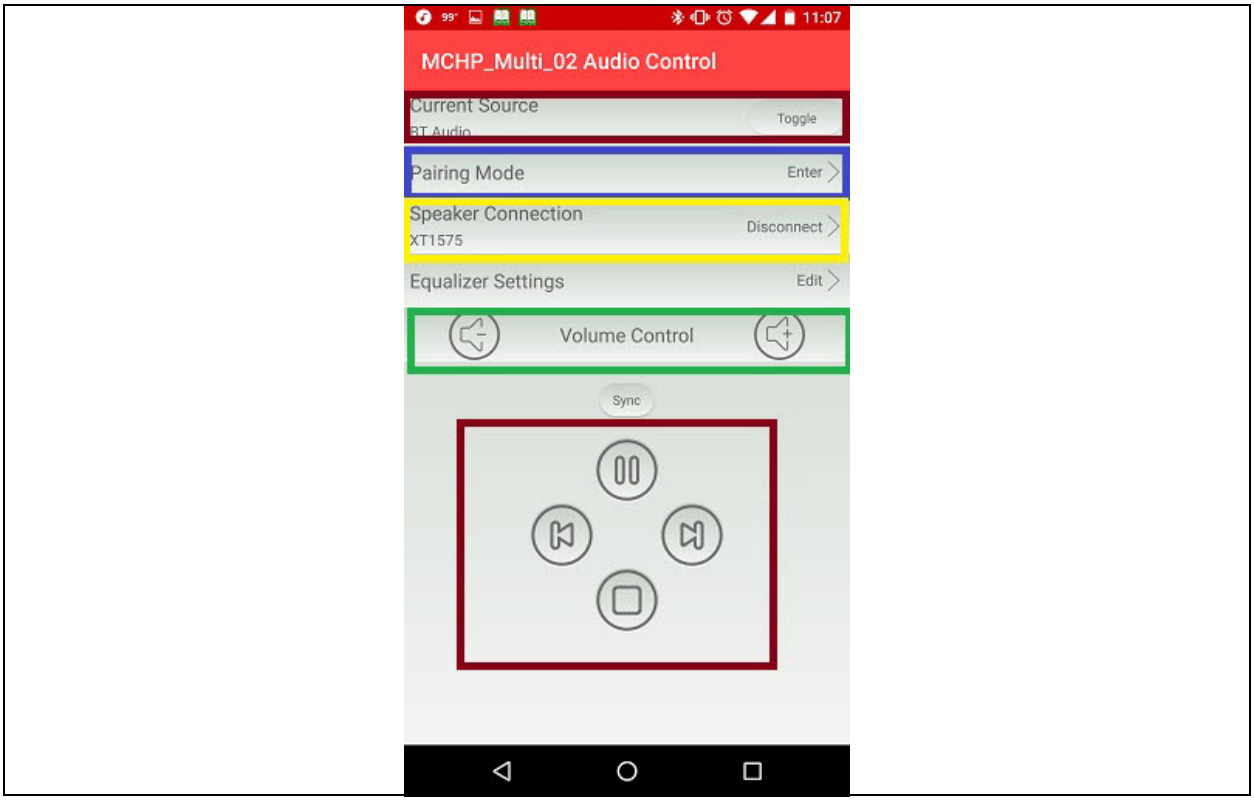
6. The “Concert Master” is assigned to a BM83 EVB, see the figure below.

FIGURE 12: STATUS CONCERT CENTRAL



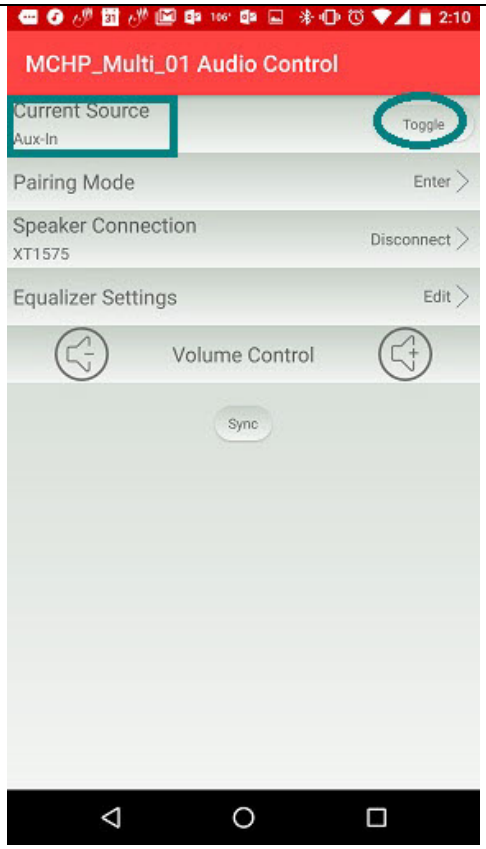
7. From the app, click **Concert Master** device, then **Audio**. Next, select **Pairing Mode Enter** to enter Pairing mode (see the figure below). Select **Speaker Connection Connect** and a list of discoverable Bluetooth devices will be displayed on the Android phone; select the device with the name **MCHP_Multi_x** to pair and connect. Now the concert central device audio is connected.

FIGURE 13: AUDIO CONNECTION



8. Control the music from the app through **Music Control** (see Figure 13). Click the **Play** button and music plays on both the central and peripheral speakers.
9. For AUX-In mode, connect an audio streaming device with the central (solid/flashing Blue LED) through an audio AUX-In cable and play music. Music plays on both the central and peripheral speakers.
10. To toggle the audio source, click the **Toggle** button on the app, as illustrated in the figure below.

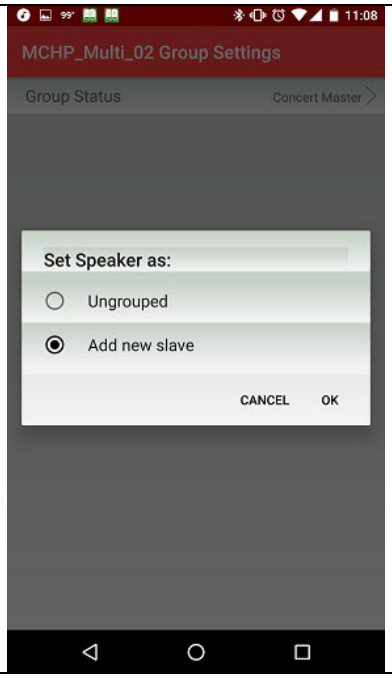
FIGURE 14: TOGGLE AUDIO SOURCE



2.5.1 ADDING A NEW PERIPHERAL

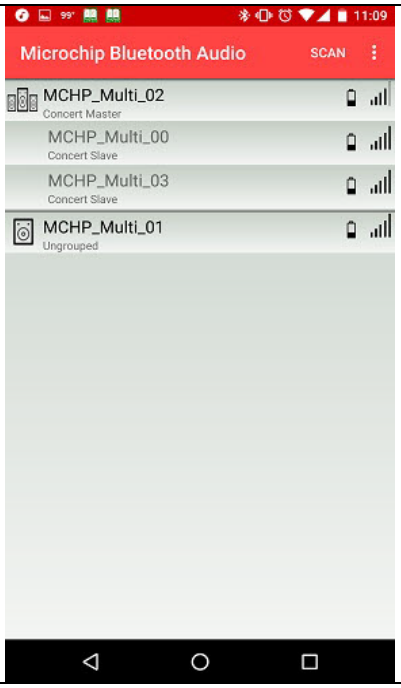
1. From the app, pause the music. Click the Group **Setting** tab, then select **Concert Master**. A small window will pop up. To add a new peripheral, select **Add new slave** (see the figure below).

FIGURE 15: ADDING A NEW PERIPHERAL



2. Go to Scan mode, then click **Scan.** “Waiting for new slave” displays (see the figure below). Select **Concert Slave** to add as a peripheral.

FIGURE 16: SCANNING FOR NEW PERIPHERAL SPEAKERS



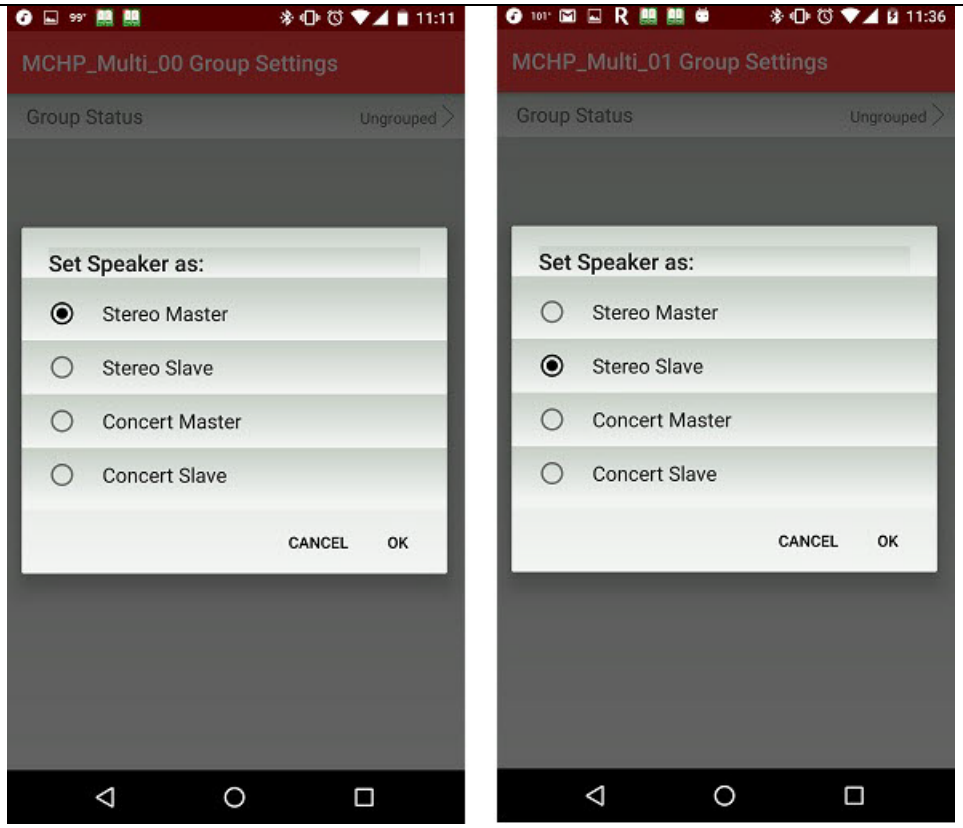
3. A new peripheral speaker is added to the central. Click **Scan**, then select **Concert Master**. Play music from the **Audio** tab (see Figure 13). Music will be heard on the central and peripheral, including the newly added peripheral.

2.6 Stereo Mode Provisioning Using Microchip Bluetooth Audio Android App

1. In Stereo mode, two speakers are used: one as central and another as peripheral. Stereo mode provisioning through the Microchip Bluetooth Audio Android app is similar to Concert mode provisioning. Select **Stereo Master** and **Stereo Slave** from the app (see the figure below) in place of Concert mode central and Concert mode peripheral in steps 1 through 8 (**Section 2.5 "Concert Mode Provisioning Using Microchip Bluetooth Audio App"**). The peripheral will have a solid Red LED and the central will have a flashing/solid Blue LED.
2. For AUX-In audio, connect the central (solid/flashing Blue LED) with an audio streaming device through the AUX-In cable.
3. The AUX-In and the Bluetooth source can be toggled from the app toggle button, as illustrated in Figure 13.

Note: It is not mandatory that the Bluetooth streaming device and provisioning device be the same. Instead, one Android/iOS device can be used for provisioning and another Bluetooth audio device for music play. Provisioning is done through BLE.

FIGURE 17: PROVISIONING STEREO MODE



2.6.1 QUICK CENTRAL/PERIPHERAL SPEAKERS SETUP

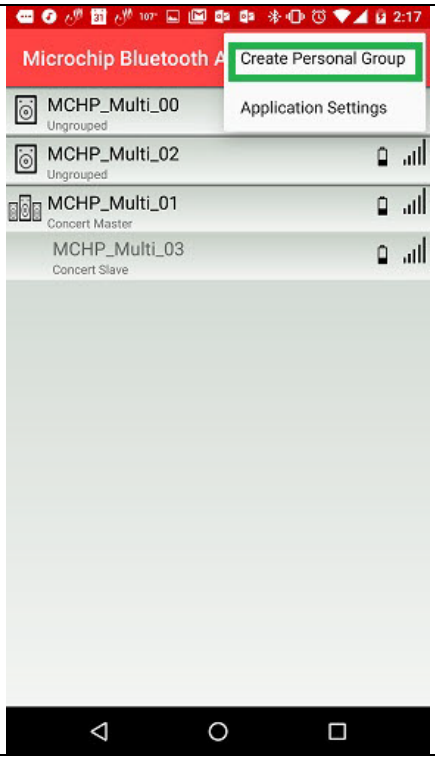
The Microchip Bluetooth Audio app has added a new feature to establish quick central and peripheral speakers.

1. From the Microchip Bluetooth Audio app, click **Settings**, as illustrated in the figure below.

FIGURE 18: QUICK CENTRAL/PERIPHERAL SETUP

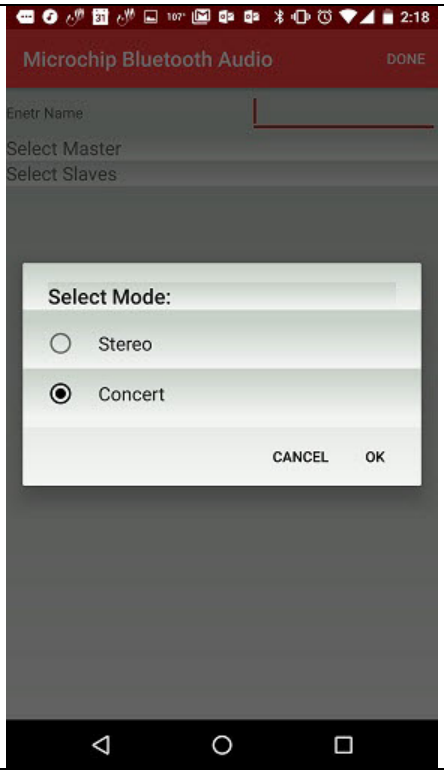
2. Select **Create Personal Group**, as illustrated in the figure below.

FIGURE 19: CREATING PERSONAL GROUP



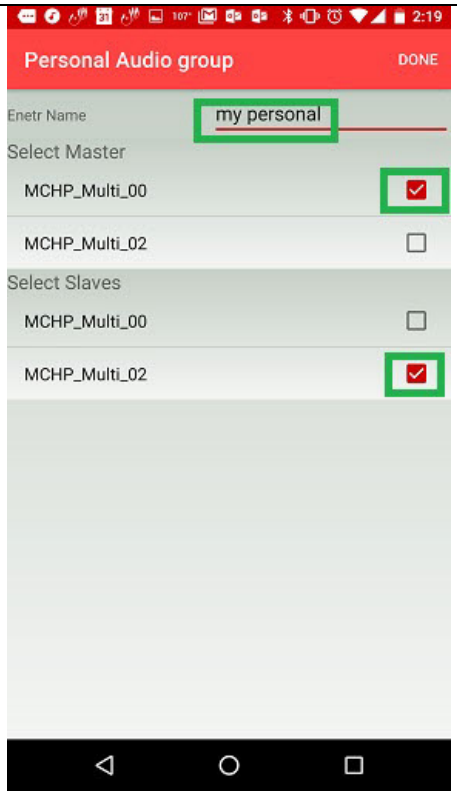
3. Select **Stereo/Concert** mode from the pop-up window, as illustrated in the figure below.

FIGURE 20: SELECTING STEREO/CONCERT MODE



4. After selecting the mode, the Personal Audio group page displays. Enter the name (any user-defined), then select Central and Peripheral speakers, as illustrated in the following figure.

FIGURE 21: PERSONAL AUDIO GROUP SETTINGS



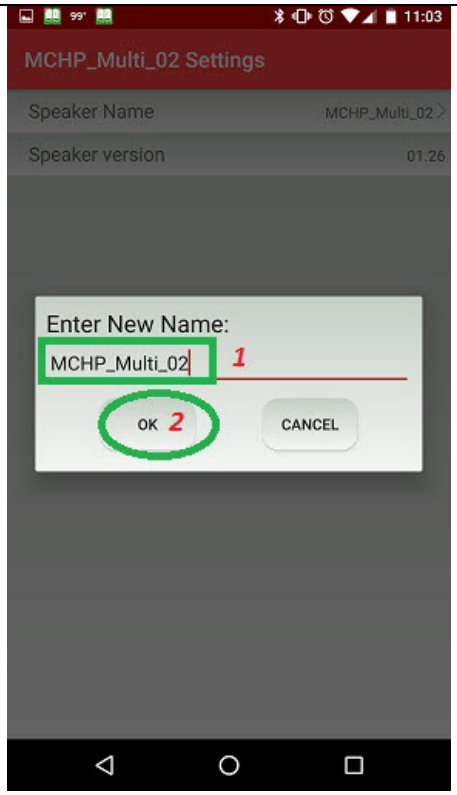
5. Central and Peripheral speakers are created. To play music, follow step 7 through step 10 from **Section 2.5 "Concert Mode Provisioning Using Microchip Bluetooth Audio App"**.

2.7 Renaming speaker

The speaker name can be changed through the app, as illustrated in the figure below. The change in speaker name is permanent, i.e., upon power cycle the new speaker name is retained.

Note: Press the power-off button (Short press SEL in Host mode/long press for 3.2 seconds MFB button in Embedded mode) to store the new speaker name to nonvolatile memory.

FIGURE 22: RENAMING SPEAKER

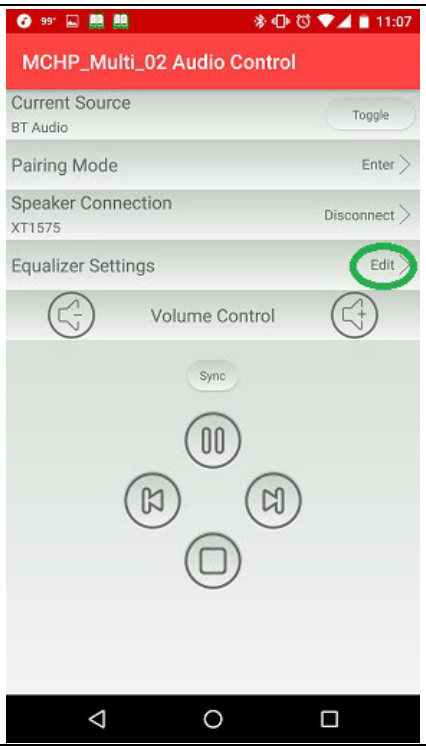


2.8 Equalizer setting

The equalizer parameters can be set/changed from the Microchip Bluetooth Audio App.

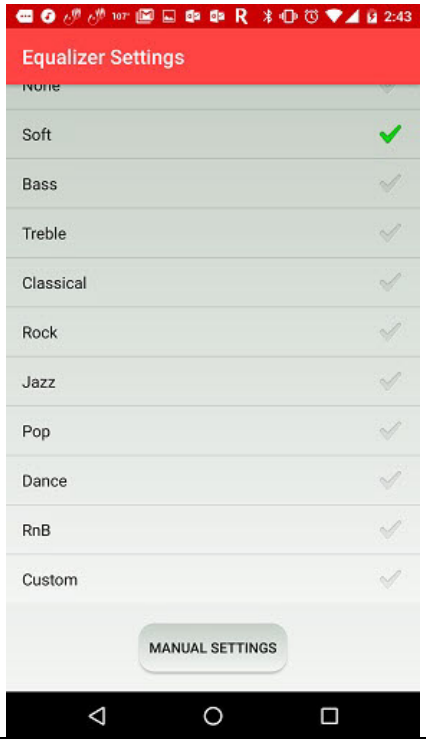
1. Select **Audio > Equalizer Settings > Edit** to edit the equalizer parameters, as illustrated in the figure below.

FIGURE 23: EDITING EQUALIZER SETTINGS



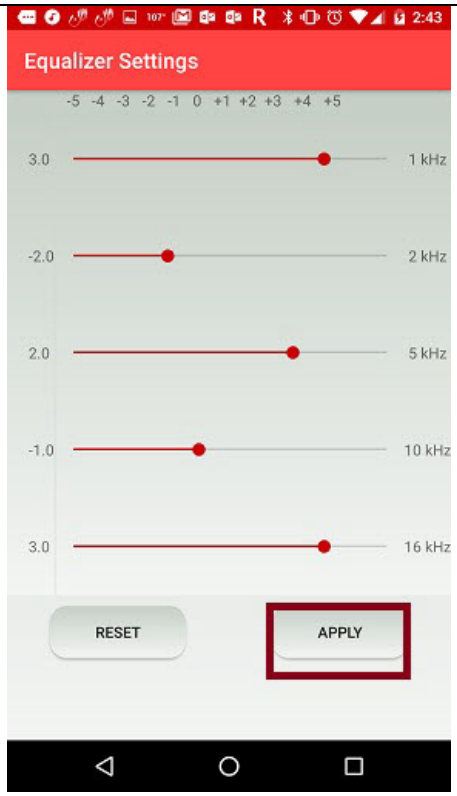
2. Select the standard equalizer parameters from the list, as illustrated in the figure below.

FIGURE 24: STANDARD EQUALIZER PARAMETERS LIST



3. Select **Manual Settings** to set the equalizer parameters manually, as illustrated in the figure below.

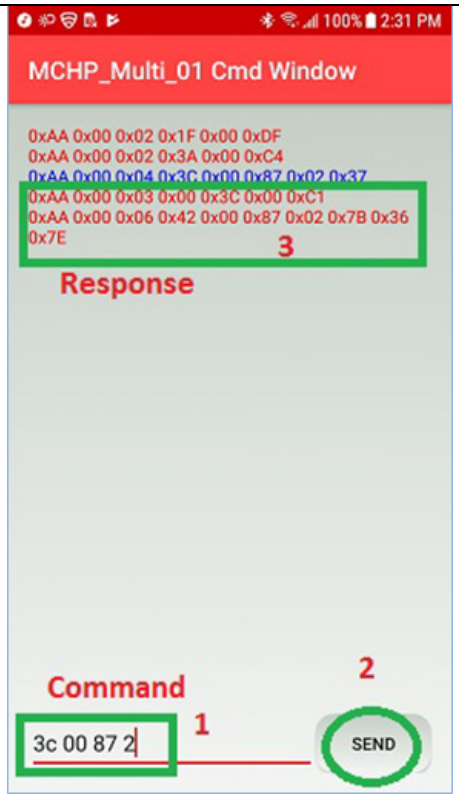
FIGURE 25: MANUAL SETTINGS OF EQUALIZER PARAMETERS



2.9 Command Prompt Feature

The Microchip Bluetooth Audio app provides a command prompt feature. Any command can be sent from this command prompt to a connected BM83 device, as illustrated in the figure below. This feature is used to test the customized command such as lighting control, volume control of particular speaker, zone information extraction and reprogramming, etc.

FIGURE 26: COMMAND PROMPT



2.10 Firmware Capabilities/Features

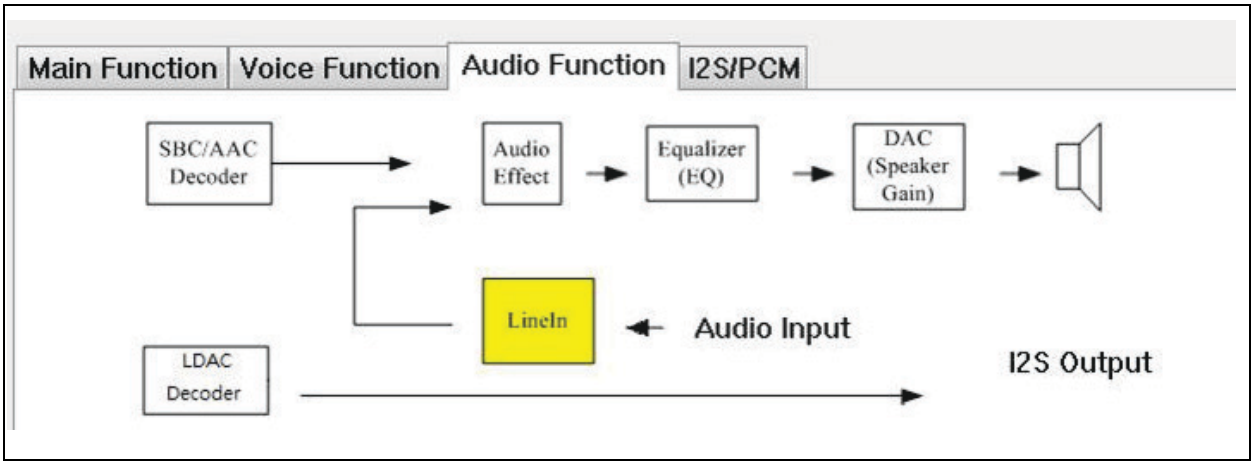
The following features are supported in the `MSPK2v1.x` firmware:

LDAC™ CODEC

Note 1:	The BM83 modules mentioned in this document do not support LDAC functionality.
2:	The IS2083BM-2L2 SoC supports decoding for Sony's LDAC codec. However, a Non-disclosure Agreement (NDA) is required from Sony. For more information, contact a Microchip representative.

The SBC and the AAC audio data will pass through the DSP audio effect and equalizer, but LDAC will bypass the DSP Blocks and go directly to the I^2S output, as shown in Figure 27. The user cannot change the EQ during LDAC streaming. Therefore, LDAC can not be used with internal CODEC configuration.

FIGURE 27: LDAC CODEC



The details of LDAC Application can be found in **Appendix G: "LDAC Application"**.

Note: By default, LDAC functionality is enabled in the firmware but supported only on IS2083BM-2L2 device.

2.11 Concert Mode

Two or more speakers are used in Concert mode. One speaker works as the central and the rest as peripherals, connected to the central through Bluetooth. The central is connected to a Bluetooth-enabled streaming device through Bluetooth (such as a smartphone) or to an AUX-In cable. Figure 1 and Figure 2 illustrate a typical Concert mode application. The audio packets are SBC encoded (it is also possible to use AAC encoded audio packets, refer to **Appendix N: "Enabling AAC encoding in Concert/stereo mode"**) with medium quality setting, and the audio packet is not ACKed by peripherals. There is no guaranteed feedback mechanism between peripherals and the central. The button press on the central is communicated to the peripheral, similarly, the button press on the peripheral is communicated to the central. Central follows the Bluetooth standard to retransmit modified audio packets to the peripherals. The AUX-In audio connected to a peripheral speaker plays on the peripheral speaker only and not transmitted to the central speaker.

The auto-reconnect feature has been enabled in Concert mode; that is, upon the power cycle of the central and peripheral, they reconnect to previous state. For more details, refer to **Appendix K: "Auto Reconnection"**.

The MSPK central and peripheral use an access code so they can connect with each other. A general access code is used to add a new peripheral to a central while a dedicated access code is used to resume the group after the power cycle. The endless grouping mechanism is using one or both access codes to allow the central to add peripherals endlessly. For more details, refer to **Appendix T: "Concert Mode Endless Grouping"**.

2.12 Stereo Mode

Two speakers are used in Stereo mode. One speaker works as a central and another as a peripheral which is connected to the central through Bluetooth. The central speaker is connected to a Bluetooth-enabled streaming device through Bluetooth or through an AUX-In cable to an audio streaming device. Figure 4 and Figure 5 illustrate a typical Stereo mode application. The audio packets are SBC-encoded (AAC Encoded audio packets can be enabled through Config Settings, refer to **Appendix N: "Enabling AAC encoding in Concert/stereo mode"** with a high quality setting and every packet is ACKed by peripheral. The lost packet or NACKed packet is re-transmitted by the central. The button press is synchronized on both the central and peripheral; in other words, play, pause, volume, up/down button press on central and peripheral speaker has a similar effect. The AUX-In audio is SBC-encoded with high quality settings by the central. It follows the same procedure of transmission as the Bluetooth packet received by the central. The AUX-In audio on the peripheral speaker plays on the peripheral speaker and not transmitted to the central speaker. The auto-reconnect feature is enabled in Stereo mode; that is, upon the power cycle of the central and peripheral, they reconnect. For more details, refer to **Appendix K: "Auto Reconnection"**.

2.12.1 TOGGLING BLUETOOTH AND AUX-IN AUDIO

The audio source can be toggled by toggle button on the Microchip Bluetooth Audio app (see Figure 14).

2.12.2 PROGRAMMABLE AVRCP VERSION

Audio/Video Remote Control Profile (AVRCP) version can be programmed to v1.6/v1.3. For more details, refer to **Appendix E: "AVRCP Version"**.

2.12.3 AUDIO OUTPUT AND SRC

MSPK 2.x supports I^2S audio output with the following sampling frequencies configurable through the Config Tool.

TABLE 3: SAMPLING FREQUENCY

Audio Output	Sampling Frequency (kHz)
LDAC	44.1, 48, 88.2, 96
Voice Prompt/Tone	8
HFP/HSP	8, 16
A2DP (SBC, AAC)	44.1, 48

If ASRC and VSRC is enabled in the Config UI tool, then the non-LDAC bit stream is converted to 48 kHz sampling frequency. With ASRC and VSRC enabled in the Configuration, external Codec frequency (I^2S) is required to be set at 48 KHZ during initialization and no change is required during the run time.

2.12.4 AUDIO EFFECTS

The IS2083BM platform offers flexibly for multiple use-cases by providing the option for an application MCU core (via SDK) and a master clock for an external device control (MCLK). In addition, the Config GUI Tool (**Appendix O: "Enabling Internal DSP Audio Effects"**) allows for the following post audio processing effects, which are defaulted to a "disabled" state.

- Multi-band dynamic-range-compression (MB-DRC)
- Equalizer (EQ)
- Audio Widening (AW)

The following is the list of common configurable IS2083BM options that can be set by the Config GUI Tool:

- Application: Single speaker, multiple speakers
- Decoding: SBC, AAC, LDAC (no audio effects supported)
- IS2083BM supplies I^2S Master Clock (MCLK) to the external CODEC of the audio amplifier

2.12.5 VOICE EFFECTS

The voice effects like HPD, DC Remover, NR, AEC/AES, DRC, CNG, AVC, Digital MIC Gain in internal DSP are supported by default for single MIC headset/speaker application. AEC/AES and NR is not supported in dual MIC application.

2.12.6 AAC CODEC

To enable Advanced Audio Coding (AAC) CODEC, refer to **Appendix F: "ENABLE AAC CODEC"**. The AAC is preferred Codec for iOS devices.

2.12.7 AUTO RECONNECT

The Concert/Stereo modes support the auto-reconnect feature, i.e., upon power cycle, the central and peripheral reconnect.

To enable this auto reconnection, refer to **Appendix K: "Auto Reconnection"**.

2.12.8 DFU- OVER-THE-AIR UPGRADE

IS2083BM firmware supports an Over-the-Air upgrade feature to upgrade the firmware on the IS2083BM device using transparent UART interface, refer to **Appendix L: "DFU- Over-The-Air Upgrade Procedure"**.

2.12.9 DFU THROUGH USB

IS2083BM firmware supports device firmware upgrade through on-chip USB interface. It requires both BAT_IN and ADAP_IN power supply to be provided to IS2083BM for the USB DFU to work. The USB plug-in is detected and enumerated only when there is change of ADAP_IN supply from Low to High. Refer to the USB DFU update procedure on BM83 EVB in the *BM83 Bluetooth® Audio Development Board User's Guide*.

Note: Press the power-off button (Short press SEL in Host mode/long press for 3.2 seconds MFB button in Embedded mode) to store the grouping details to nonvolatile memory. The auto reconnection works only when this is done.

2.12.10 VOICE PROMPT AND HANDS FREE PROFILE

Voice prompt and HFP are mono by default and can be enabled in Stereo mode (L and R channel). Refer to **C.1 "Selecting UI Parameters"**.

2.12.11 MULTI-LINK

BM83 supports a max of three A2DP connections at a time. Meaning, the device can get connected to max of three mobile phones without disconnection. Audio can be played from any one of the connected mobile phones. While playing audio from one mobile phone, the other phone audio is paused. This is also called the Break-in mode. The volume of last played mobile

phone is retained in BM83. When replayed, it resumes the volume. Refer to **Appendix J: "Multi-Link"** for enabling this multi-link feature.

After connecting with one mobile phone, long press SEL button in Host mode/long press MFB button in Embedded mode to enable the pairing to connect with another mobile phone.

2.12.12 OTA DSP TUNING

An on-the-fly iOS MBA OTA DSP tuning feature is added to tune the DSP audio parameters and compare the audio performance, without having to reset the DUT.

This feature is added in the iOS MBA App (v1.5.5 or above) and the DSP GUI of the Config UI tool. Refer to **Appendix P: "Using iOS MBA for OTA DSP Tuning"**. Also, the Config GUI tool allows the user to edit the configuration parameters and update in the BM83 over BLE interface.

2.13 MCU and CODEC

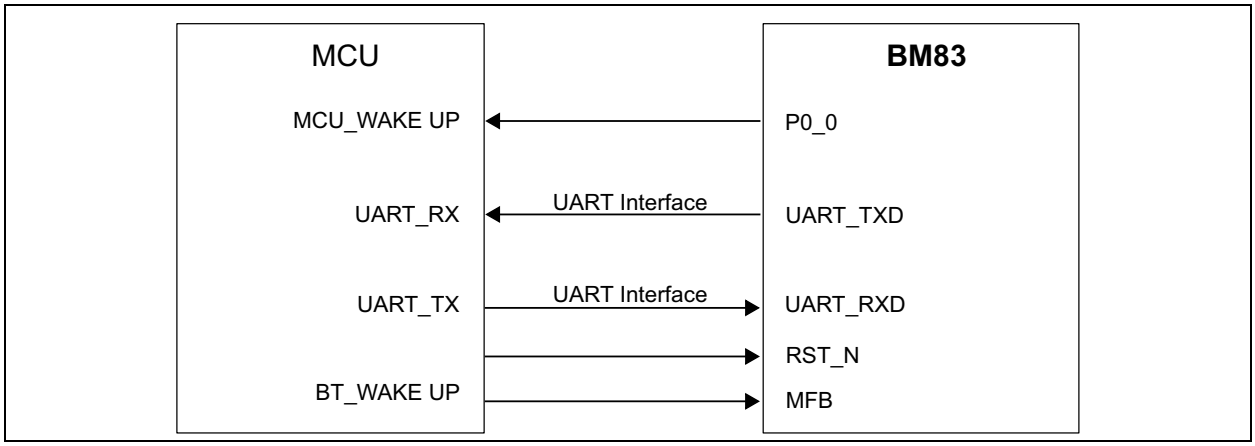
The BM83 EVB contains the BM83 module, the PIC32 MCU and an ST codec. Both the PIC32 and ST codec can be replaced by any MCU and codec.

Note:	44.1K to 48K Audio SRC(ASRC) and 8/16K to 48K Voice SRC(VSRC) are supported in BM83. Therefore, any codec/Class D amplifier can be used. ASRC and VSRC can be selected in Config GUI, refer to **C.1 "Selecting UI Parameters"**.

2.13.1 HOST MCU AND BM83 COMMUNICATION

The MCU communicates with the BM83 module through UART. A minimum set of hardware connections is required to interface MCU to the BM83 module. The figure below illustrates the minimum connections required by the relevant hardware pins on the BM83 module.

FIGURE 28: MCU AND BM83 EVB INTERFACE



2.13.2 MCU COMMANDS

MCU communicates with the BM83 module through UART commands. A summary of the commands is provided in `AudioUARTCommandSet_v2.x.pdf`, and details of the commands are provided in the *BM83 Host Device Firmware Development Guide*. Both documents are part of the `MSPK2v1.x` software package.

2.14 Multi-Speaker User Application

- Museum guided tour
- Restaurant
- Outdoor entertainment
- In-home entertainment
- Retail shops
- Ceiling light speaker

3.0 AUDIO TRANSCEIVER SOLUTION

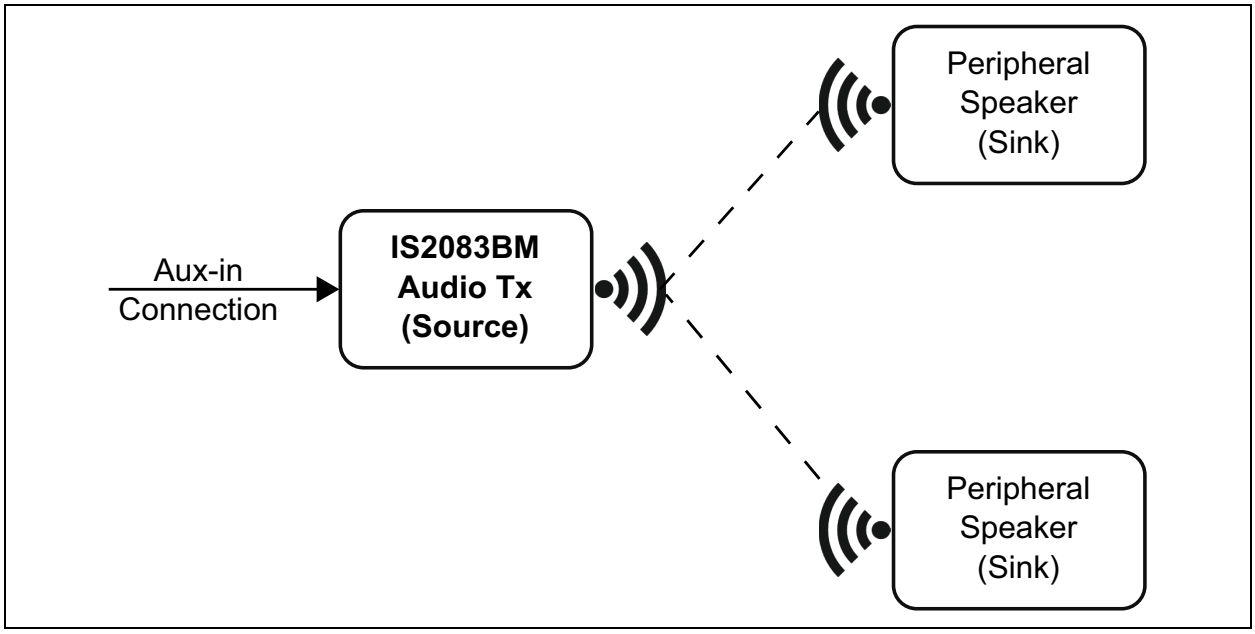
Microchip's Audio Transceiver (AT) solution enables Bluetooth capability in non-Bluetooth Audio-equipment. The AT receives audio inputs through Aux-in or I^2S and streams the audio up to two Bluetooth paired sink devices.

The AT solution can work as either an A2DP source or A2DP/HFP sink.

Note:	HFP source is not supported in the current Microchip Audio Transceiver solution.

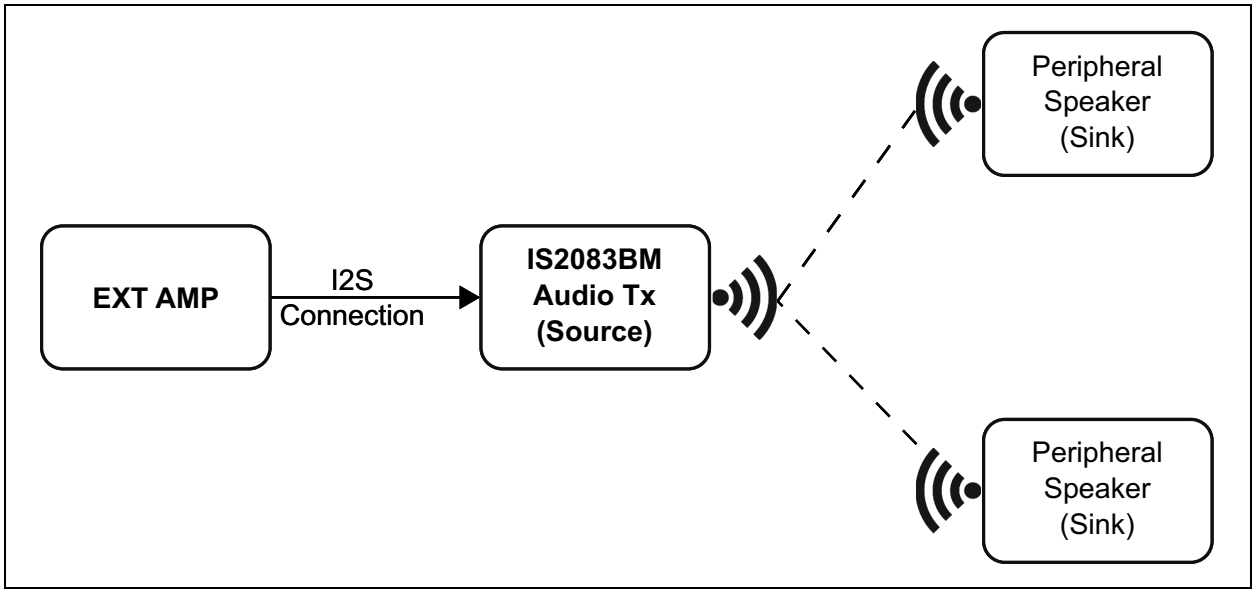
The following figure illustrates a typical example of an audio transmitter taking input from Aux-in and transmitting the signal to two connected sink devices.

FIGURE 29: AUDIO TRANSMITTER WITH AUX-IN AS AUDIO INPUT



The following figure illustrates a typical example of audio transmitter taking I^2S as input and transmitting to two connected sink devices.

FIGURE 30: AUDIO TRANSMITTER WITH I^2S AS AUDIO INPUT



In Embedded mode, the source and sink configuration is controlled by toggling a GPIO. In Host mode, the UART command is used for changing modes of operation. Details of source/sink mode is discussed in **Section 3.5 "A2DP Source Mode"**.

The BM83 audio transceiver can be connected to two sink devices and can take audio input either from Aux-in or from I^2S. Aux-in and I^2S audio inputs are also controlled by toggling GPIO in Embedded mode and by the UART command in Host mode. Details can be found in **Section 3.6 "Audio Input"**.

The BM83 audio transmitter packetizes audio inputs (either from Aux-in or I^2S in), encodes into SBC and transmits to connected sink devices over Bluetooth. Both 44.1 kHz and 48 kHz sampling rates are supported and can be selected by the user (see **Section 3.8 "I^2S Sampling Rate Change"**).

3.1 AT Demo Requirements

3.1.1 SOFTWARE REQUIREMENTS

- 8051 AT firmware
- DSP firmware
- Config settings

3.1.2 HARDWARE REQUIREMENTS

- The EVB kit:
  - BM83 Evaluation Board
  - Type-A to Micro-B USB cable
  - 15V DC power adapter

3.1.3 TOOLS

- isUpdate tool
- Config GUI tool
- SPKCommandSetTool

3.2 AT Demo Setup

Power up the board using the instructions mentioned in the *BM83 Bluetooth® Audio Development Board User's Guide*. The software and tools are available in the BM83 AT package and can be downloaded from www.microchip.com/BM83. The BM83 AT code can work in Embedded and Host mode.

3.2.1 EMBEDDED MODE DEMO SETUP

1. Slide SW300 to the ON position to put BM83 into Test mode.
2. Connect the BM83 EVB with a mini USB and toggle the SW200 switch to the 5V_USB position.
3. Program the AT firmware, DSP firmware, and Config Settings (Embedded mode) from the BM83 AT package (IS2083 Turnkey v1.x\Software\IS2083 Image\AT v1.y\Embedded Mode) into the BM83 using the isUpdate tool. Refer to the *BM83 Bluetooth® Audio Development Board User's Guide*, chapter 5.0 Flash Update for details.

Note:	To program AT firmware (image1), DSP (image2), and configuration (image3), the image num value must be selected as 3.

4. Once programming is completed, slide SW300 to position 1 to put the device into Application mode.
5. Press and hold MFB to put the BM83 in Discovery mode. The Red and Blue LEDs will start flashing alternately to indicate that the BM83 is in Discovery mode.
6. Put a sink device in Pairing mode to pair it with the BM83 (keep the sink device in close proximity to the BM83). Once the sink device is paired with the BM83, the Blue LED will flash periodically.
7. To connect with a second device, power off the connected sink device and follow step 5 and step 6 to connect with the second sink device.
8. Now, power-on the first sink device to connect it with the BM83.
9. Connect the audio source to the Aux-in/I^2S, and play and stream out the music through both connected sink devices.

3.2.2 HOST MODE DEMO SETUP

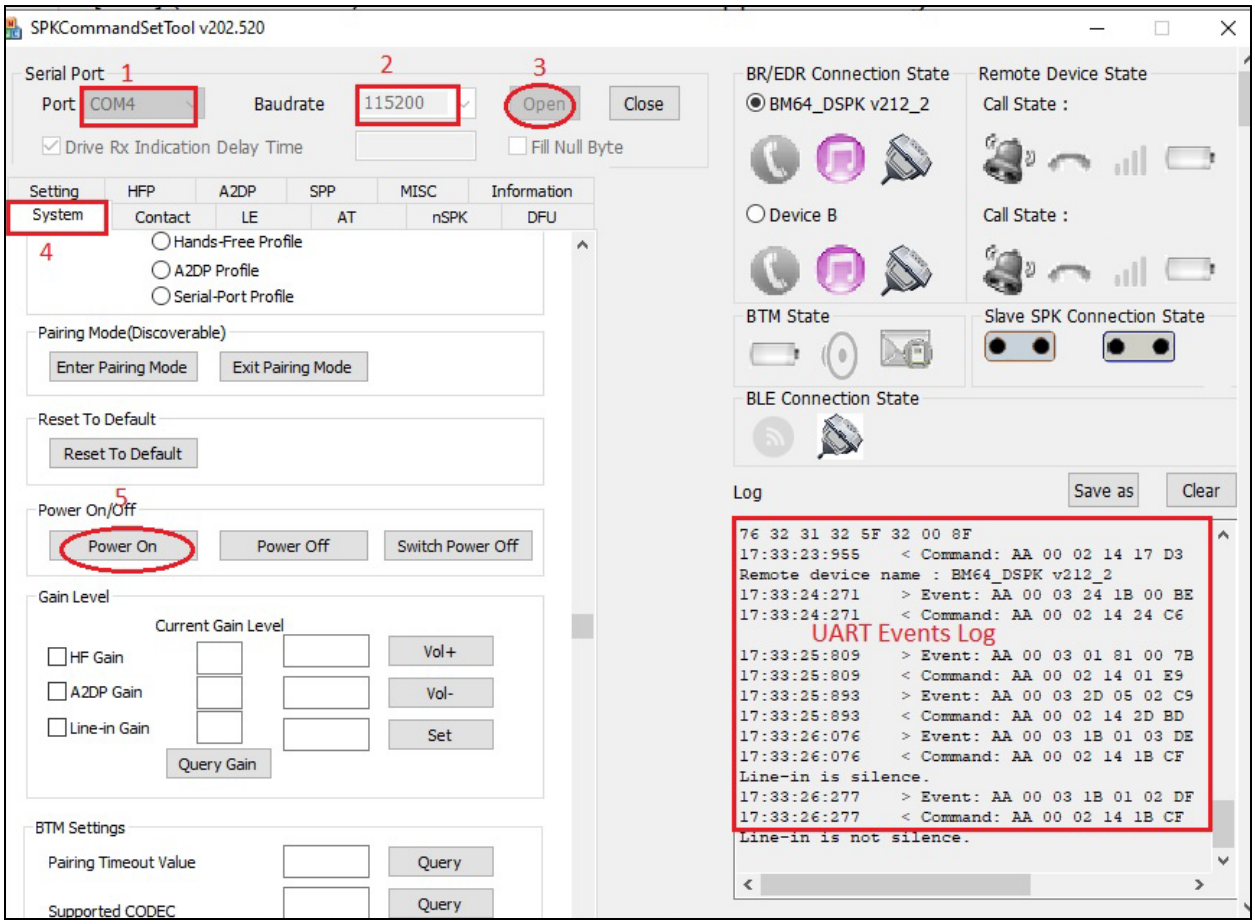
1. Slide SW300 to the ON position to put the BM83 into Test mode.
2. Connect the BM83 EVB with a mini USB and toggle the SW200 switch to the 5V_USB position.
3. Program the AT firmware, DSP firmware, and Config Settings (Host mode) from the BM83 AT package (IS2083 Turnkey v1.x\Software\IS2083 Image\AT v1.y\Host Mode) into the BM83 using the isUpdate tool. Refer to the *BM83 Bluetooth® Audio Development Board User's Guide*, chapter 5.0 Flash Update for details.

Note:	To program AT firmware (image1), DSP (image2), and configuration (image3), the image num value must be selected as 3.

4. Once programming is completed, slide SW300 to position 1 to put device into Application mode.

5. Start SPKCommandSetTool.exe and choose the proper serial port and click on “Open” and “Power On” as shown in the following figure

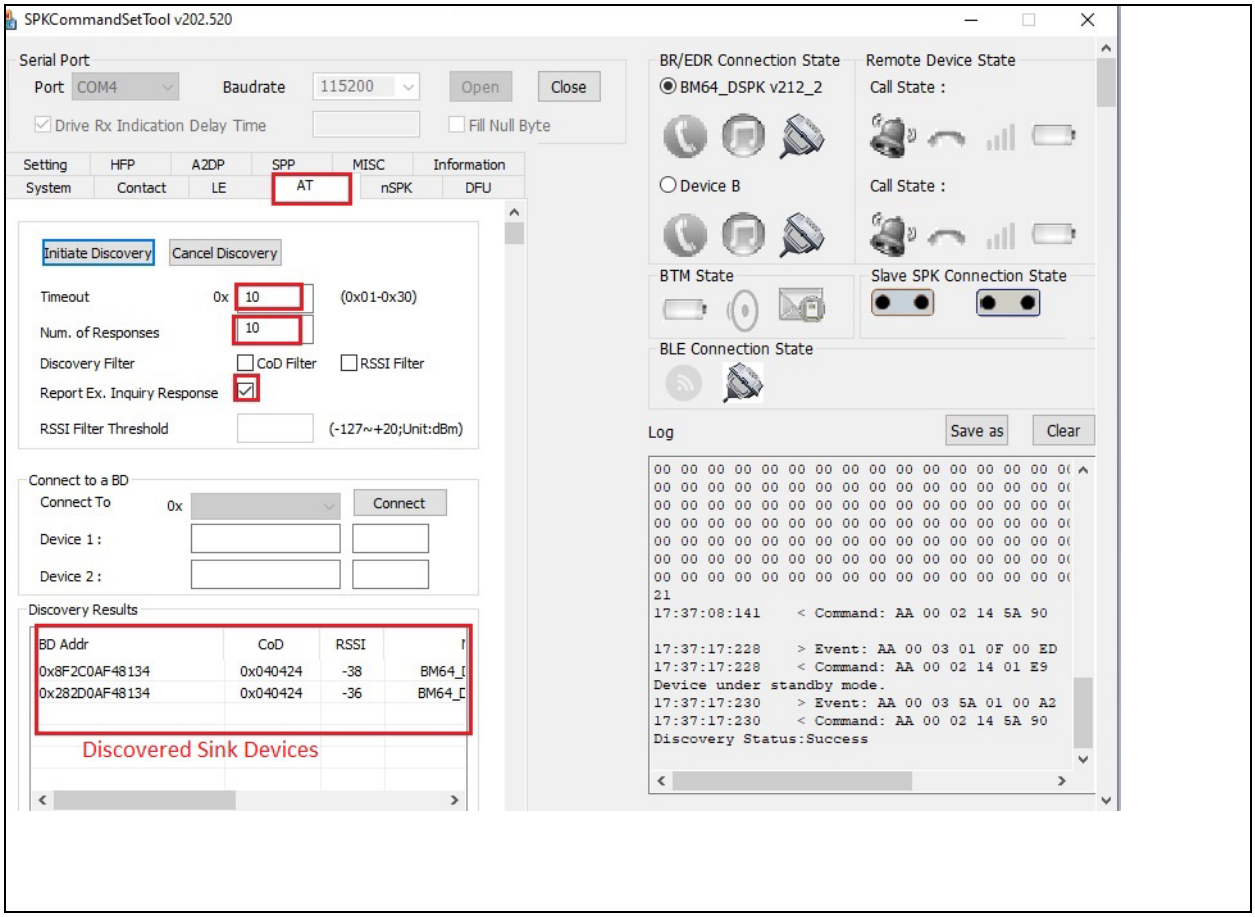
FIGURE 31: SPKCOMMANDSETTOOL GUI



6. Go to the **AT** tab, fill out parameters and issue the command as shown in Figure 32.

Note:	The Inquiry mode command is required to fetch nearby sink devices for pairing.

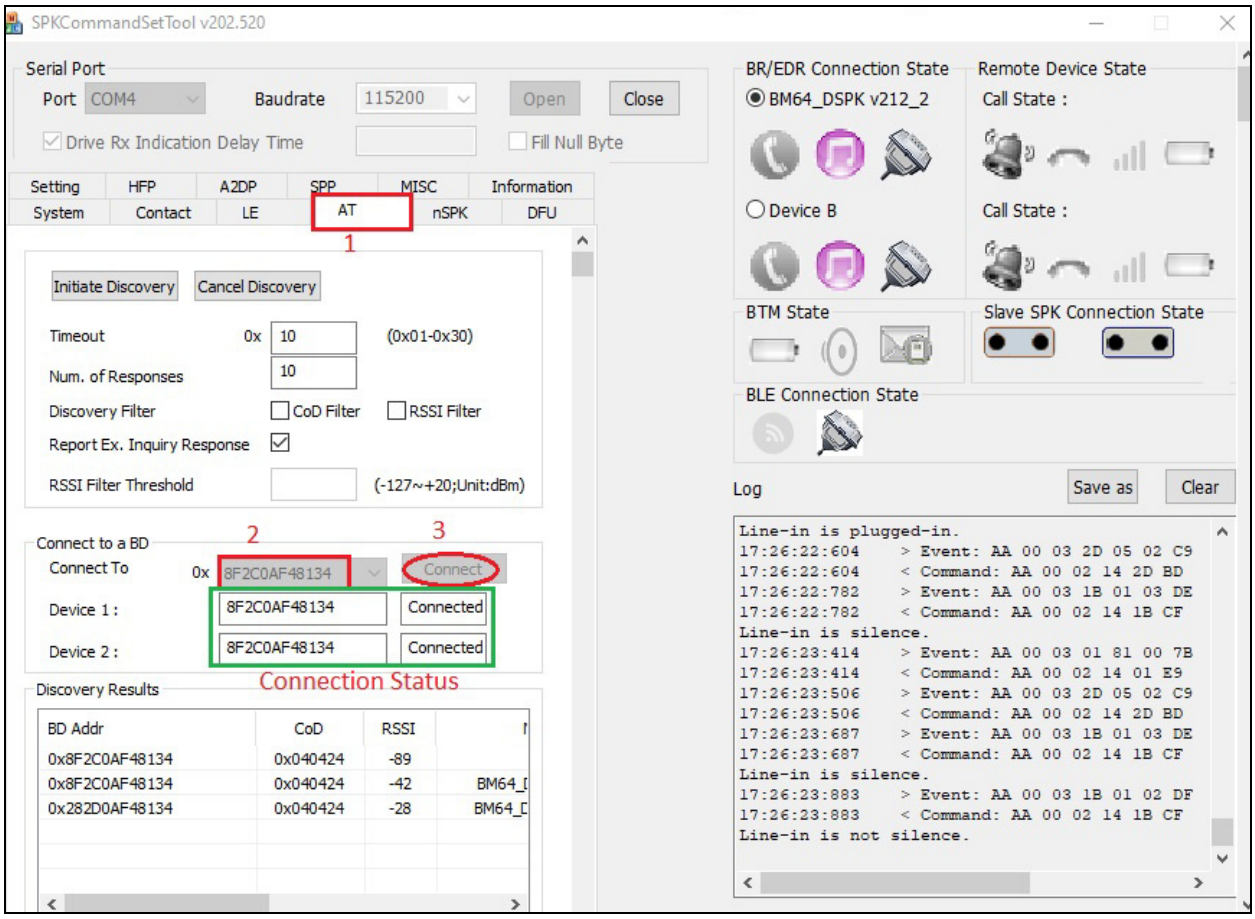
FIGURE 32: AT TAB IN SPKCOMMANDSETTOOL GUI



7. The inquiry result will appear in the inquiry results window as shown in the preceding figure. Now, select a device and issue a connect command as shown in Figure 33.

Note:	Wait for the Inquiry Success event or issue a Cancel Inquiry command before sending a connection command.

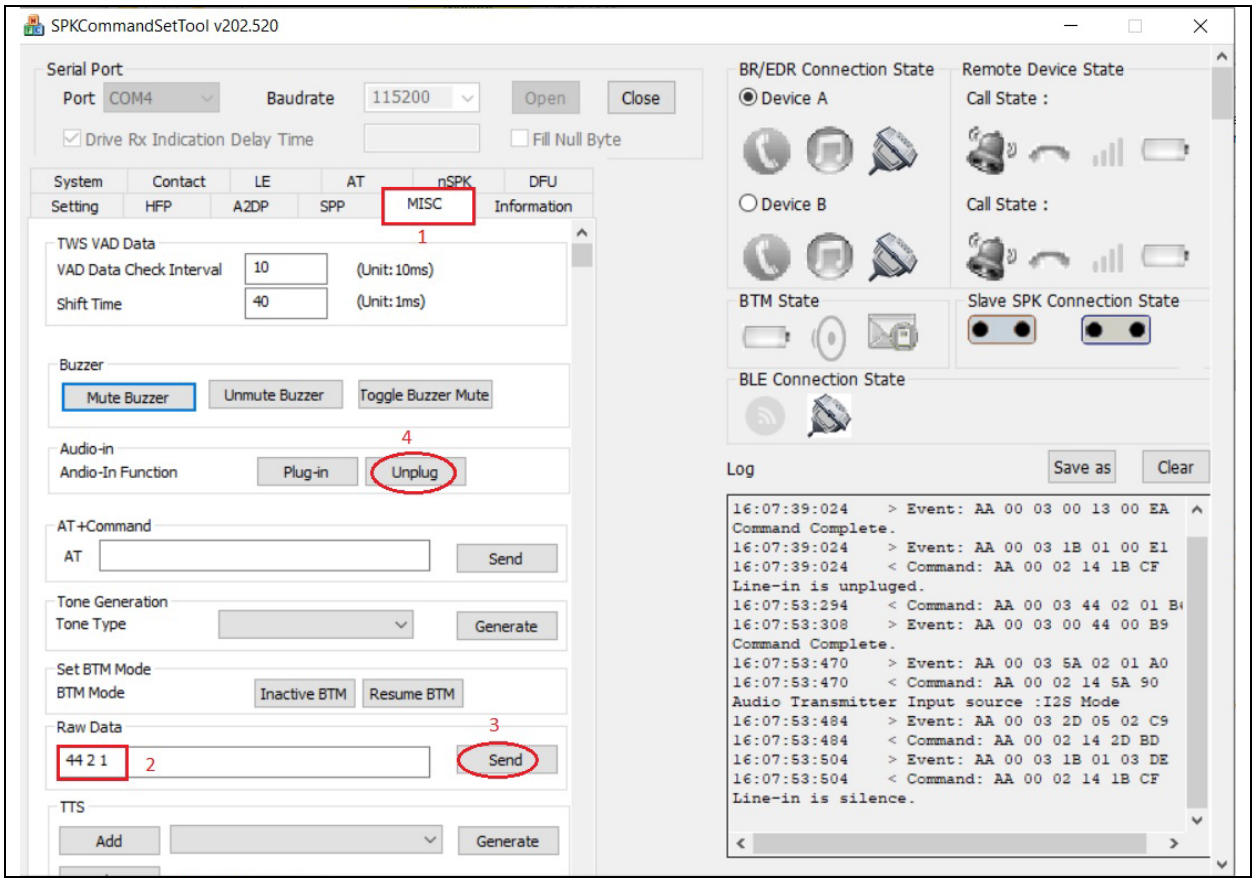
FIGURE 33: CONNECTION STATUS IN AT TAB IN SPKCOMMANDSETTOOL GUI



8. Two sink devices have been connected to the BM83 AT as shown in the preceding figure. Connect Aux-in and/or I^2S input to the BM83, as shown in **Section 3.6 "Audio Input"**. Aux-in is the default input source to the BM83. To switch the input source to I^2S, issue `44 2 1` and `13 1 0` commands as shown in the Figure 34. To switch the input back to Aux-in, issue `44 2 0` and `13 1 1` commands.

Note:	External hosts need to issue 0x44 0x08 0x00 to block the A2DP stream before pairing to a second device. After pairing is complete, issue 0x44 0x08 0x01 to unblock the A2DP stream.

FIGURE 34: MISC TAB IN SPKCOMMANDSETTOOL GUI



9. Once BM83 AT has established a connection with the sink devices, it remembers the previously connected devices. Upon power cycle, it re-establishes the connection with the sink devices. Now the BM83 can be configured into Embedded mode by programming the Embedded mode config setting. The BM83 will operate in Embedded mode where no external host is required.

3.3 Host mode with PIC32

1. Slide SW300 to the ON position to put the BM83 into Test mode.
2. Connect the BM83 EVB with a mini USB and toggle the SW200 switch to 5V_USB position.
3. Program the AT firmware, DSP firmware, and Config Settings (Host mode) from the BM83 AT package (IS2083 Turnkey v1.x\Software\IS2083 Image\AT v1.y\Host Mode) into BM83 using the isUpdate tool. Refer to the *BM83 Bluetooth® Audio Development Board User's Guide*, chapter 5.0 Flash Update for details.

Note: To program the MSPK firmware (image1), DSP (image2), and configuration (image3), the image num value must be selected as 3 in the isUpdate Tool.

4. Once programming is completed, slide SW300 to position 1 to put the device into Application mode and change jumpers to Host mode settings. Refer to the *BM83 Bluetooth® Audio Development Board User's Guide*, Appendix F for Host mode jumper settings.
5. Program the PIC32 with PIC32 AT firmware (IS2083 Turnkey v1.x\Software\PIC32 Image\AT v1.y). Refer to the *BM83 Bluetooth Audio Development Board User's Guide*, Appendix E for details.
6. Press and hold SEL to put the BM83 in Discovery mode. The Blue and Red LEDs will start flashing alternately to indicate that the BM83 is in Discovery mode.
7. Put a sink device in Pairing mode and pair it with the BM83 (keep the sink device in a close proximity to the BM83). Once the sink device is paired with the BM83, the Blue LED will flash periodically.
8. To connect with a second device, power off the

connected sink device and follow step 5 and step 6 to connect with a second sink device.

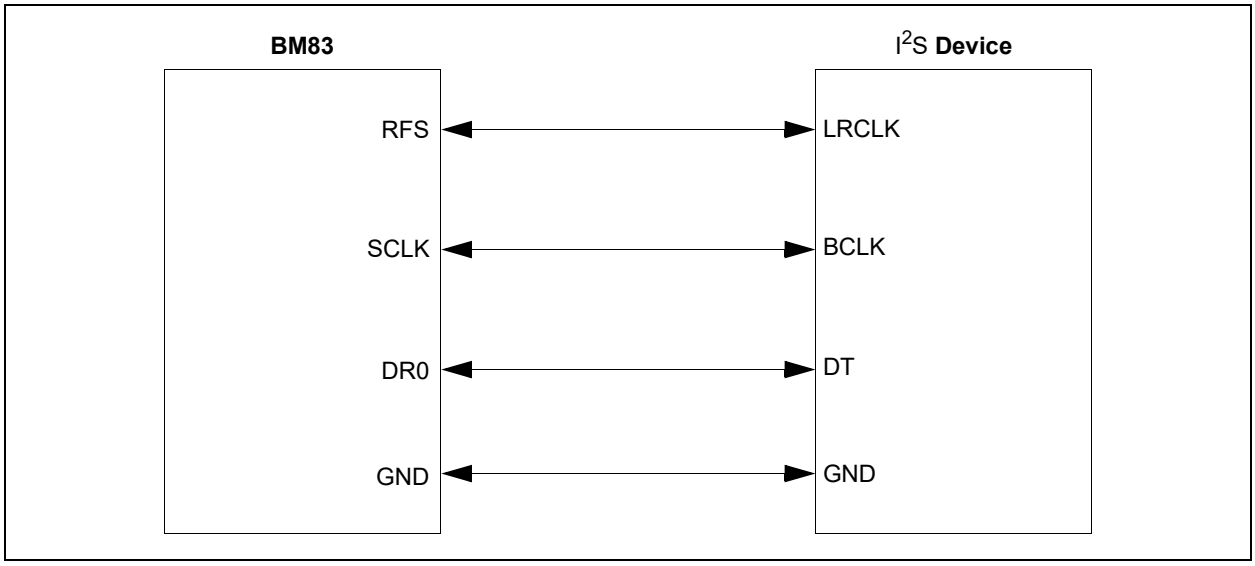
9. Now, power-on the first sink device to connect it with the BM83.
10. Connect an audio source to Aux-in/I²S and play music to stream out the music through both connected sink devices.
11. Double press the Vol- button to Toggle mode (TX/RX)
12. Short press the Rev button to toggle the Audio Source
13. Short press the Fwd button to toggle sampling frequency

3.4 Audio Input to BM83 Source

The BM83 Source mode takes both I²S and Aux-in as inputs. Plug in the Aux-in cable to the BM83 EVB and connect other end to the Aux-in input source (for example, a PC). Audio will be heard on both connected sink devices.

For I²S input, make the connection between the I²S input device and the BM83 as shown in the following figure.

FIGURE 35: CONNECTION BETWEEN BM83 AND I²S DEVICE



Issue commands `44 2 1` and `13 01 00` to switch the audio source to I²S in Host mode. To switch the audio source back to Aux-in, issue commands `44 2 0` and `13 01 01`. In Embedded mode, GPIO toggling is needed to switch the input source between I²S and Aux-in (see **Section 3.6 "Audio Input"**).

3.5 A2DP Source Mode

By programming the BM83 with AT enabled firmware, we can use the BM83 as an A2DP source or sink device. The BM83 can work either as an A2DP source or sink device, but cannot work as source and sink at the same time. By flipping a switch connected to GPIO (configured via Config_GUI_Tool) in Embedded mode, or by sending `Change_APP_Mode(0x44 03 00/01)` UART command in Host mode, the BM83 can work as a source or sink device. The BM83 source can connect to two sink devices at the same time.

Note:	By default, BM83 AT firmware is in A2DP source mode when configured in Host mode and depending on the GPIO state (1: source, 0: sink) in Embedded mode.

Following are the UART commands to facilitate the BM83 transmitter:

- `Device_Discovery(0x44 0x00)`
- `Discovery_Cancel(0x44 0x01)`
- `Change_Audio_Source(0x44 0x02)`
- `Change_APP_Mode(0x44 0x03)`
- `Read_App_Mode(0x44 0x04)`
- `Read_Audio_Input_Source (0x44 0x05)`
- `Change_Audio_In_Sampling_Rate_Cmd (0x44 0x06)`
- `Read_Audio_In_Sampling_Rate_Cmd (0x44,0x07)`
- `Block_Unblock_A2DP_STream(0x44 0x8)`

Following are the UART events for the audio transmitter:

- `Discovery_Response (0x5A 0x00)`
- `Discovery_Complete (0x5A 0x01)`
- `Audio_Input_Source (0x5A 0x02)`
- `Audio_Application_Mode (0x5A 0x03)`
- `Audio-In Sampling Rate(0x5A,0x04)`

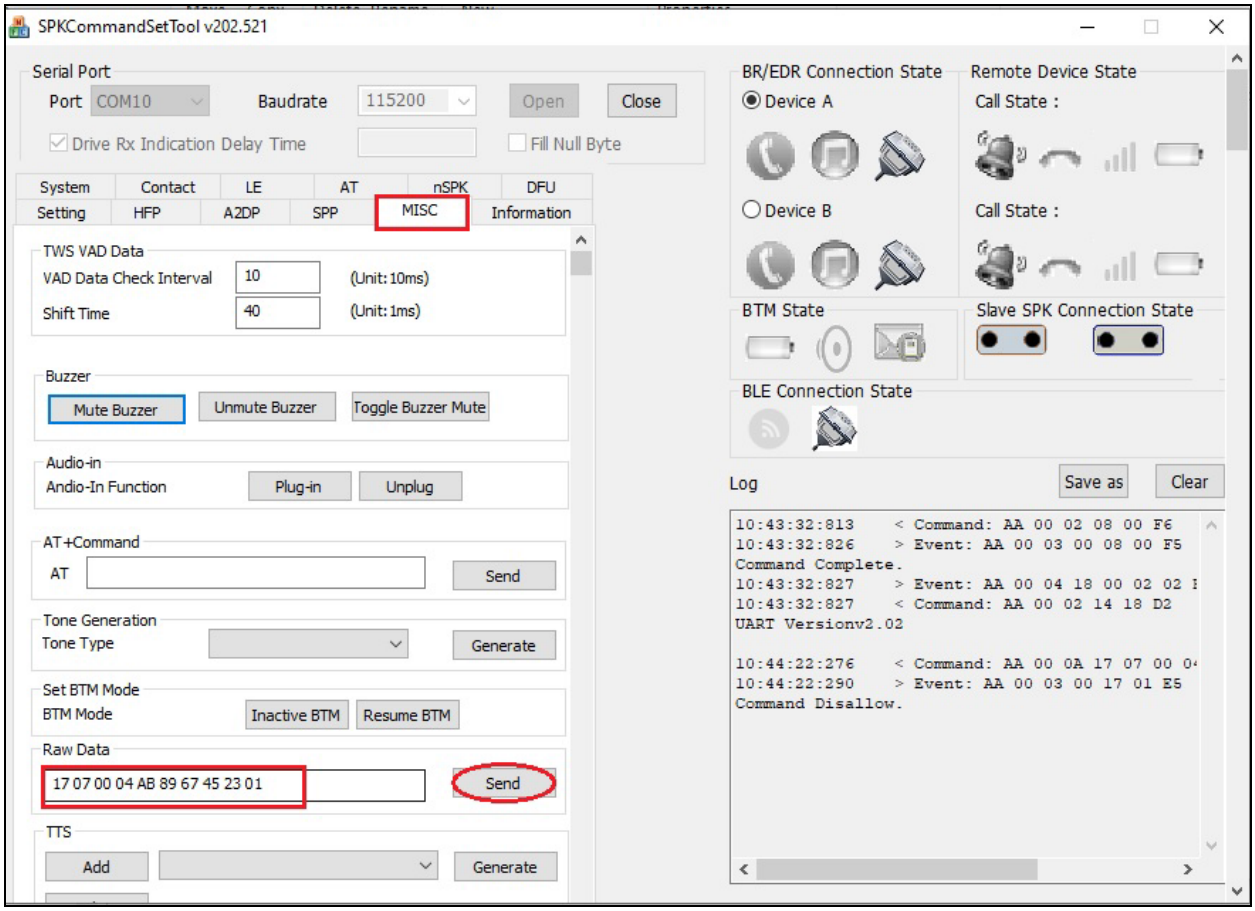
Details of these commands and events are available in *AudioUARTCommandSet_v2 0x.pdf*. This document is part of the BM83 AT package. If the Bluetooth MAC ID of a sink device is known, then a `Profile_Link_Back(0x17)` command with type 7 can be used for establishing a connection. A Bluetooth MAC ID is 6 bytes long and must be in byte reverse order (LSByte first and MSByte last) to be used by this command.

For example, if a BT MAC ID of a sink device is 0x0123456789AB, then the following UART commands can be used from the MCU for establishing connection:

```
17 07 00 04 AB 89 67 45 23 01
```

Note:	The above command does not have prefix and checksum. But, this command can be sent directly as Raw Data from the Spk-CommandSetTool **MISC** tab as shown in the following figure.

FIGURE 36: SENDING A RAW DATA THROUGH SPKCOMMANDSETTOOL

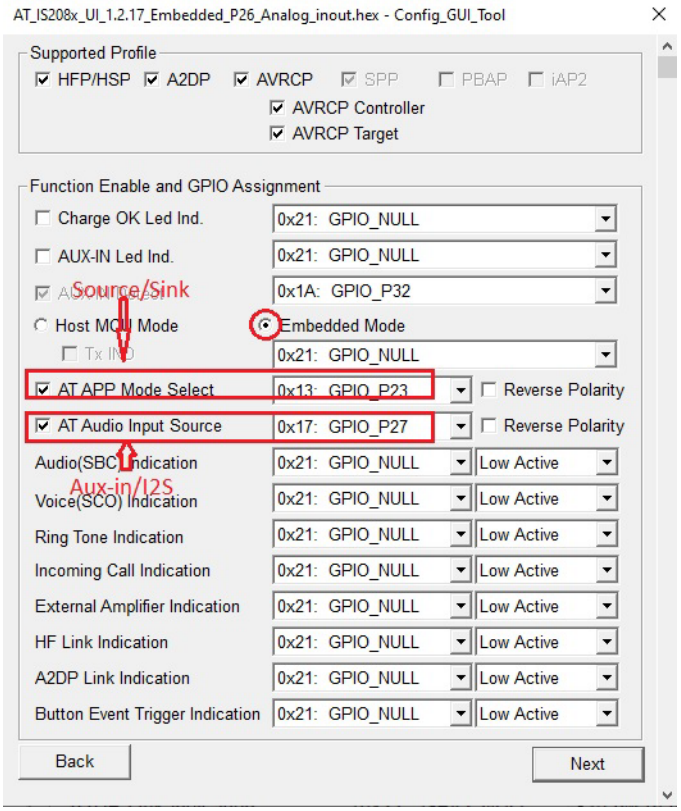


To get the name along with the BT MAC ID of the nearby advertising sink devices, it is recommended that the `Device_Discovery(0x44)` command include an Extended Inquiry Response (EIR) parameter. If the system has an MCU and display, then the inquiry mode result can also be displayed on the display and a user can choose the sink device and establish the connection with the BM83 audio transmitter. Once the Audio transmitter connects with sink devices, link keys are saved in the memory and upon power cycle, can automatically establish connection with the previously connected sink devices or the MCU can read these link keys and issue link back command to establish a connection with previously connected sink devices.

3.6 Audio Input

Audio input can be toggled by flipping a switch connected to the GPIO in Embedded mode. This GPIO can be configured using the Config GUI tool, as shown in the figure below. In Host mode, it is recommended to uncheck the AT Audio input source and to send the `Change_Audio_Source(0x44 2 0/1)` and `13 1 1/0` commands to toggle the audio source between Aux-in and I^2S.

FIGURE 37: SELECTING AN AUDIO INPUT USING CONFIG GUI TOOL



3.7 Mode Select

The BM83 role can be changed from source to sink and vice versa by flipping the switch connected to GPIO in Embedded mode as shown in the figure above. In Host mode, it is recommended that AT APP mode select be unchecked and the `Change_APP_Mode(0x44 3 0/1)` command needs to be sent to switch between source and sink.

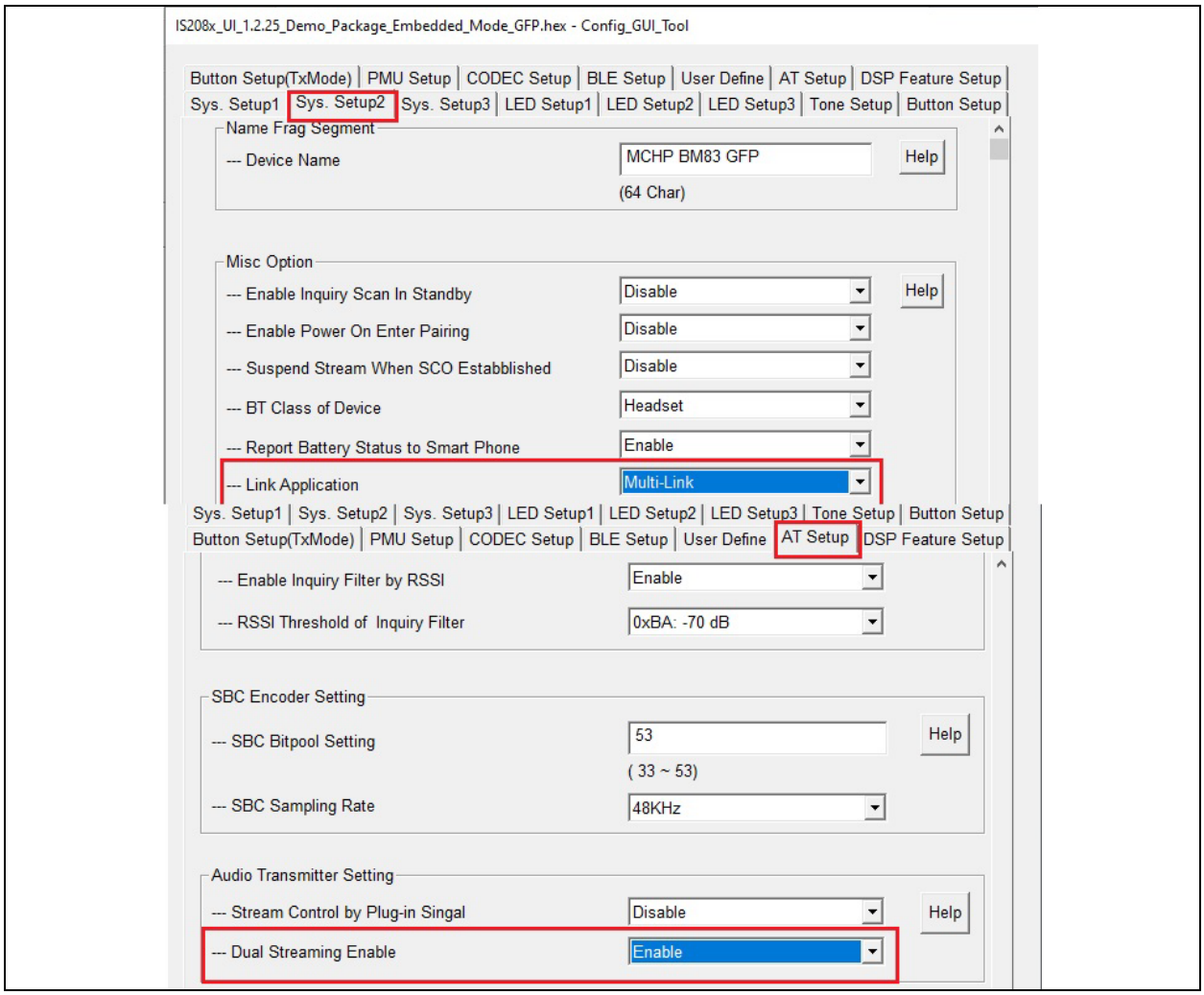
3.8 I^2S Sampling Rate Change

The BM83 transmitter can take I^2S as input. By default, the BM83 transmit audio uses a 48 kHz sampling rate. This sampling frequency can be changed to 44.1 kHz by issuing a `Change_Audio_In_Sampling_Rate_Cmd(44 6 1)` command. The sampling rate can be changed back to 48 kHz by issuing a `44 6 0` command.

3.9 Dual Streaming

The dual streaming feature can be enabled along with multi-link enable in the Config GUI tool as shown in the following figure.

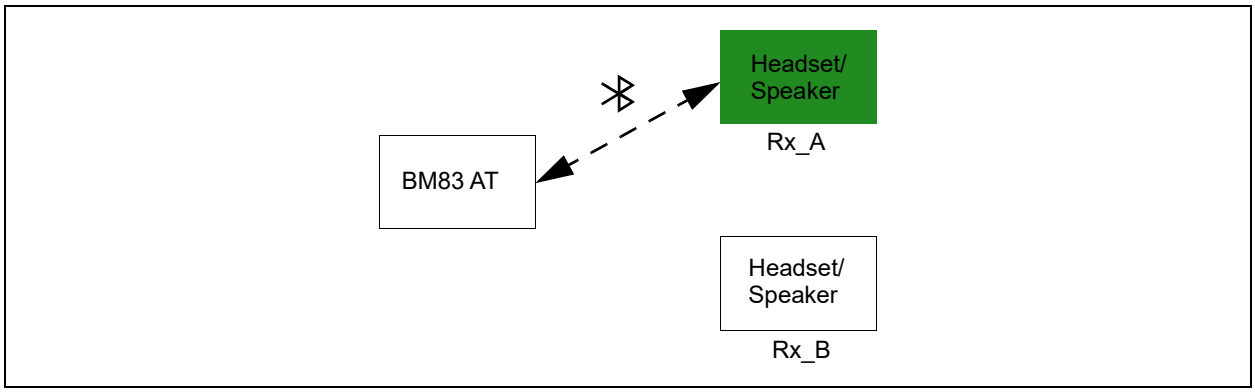
FIGURE 38: ENABLING DUAL STREAMING FEATURE



Once the Dual Stream enable config setting is programmed into the BM83, this feature can be demonstrated as shown below.

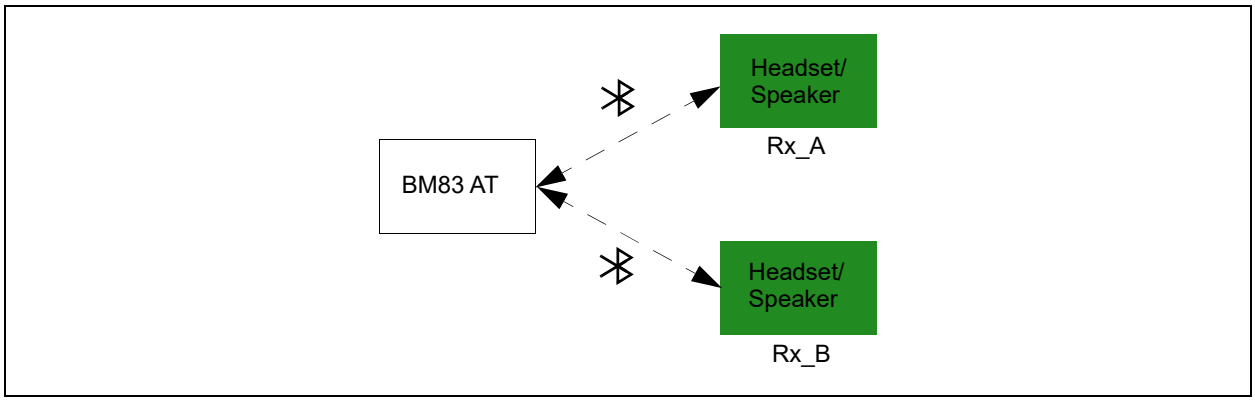
1. Discovery of two Bluetooth audio sink devices as shown in the Host/Embedded mode demo setup.
2. When connection with Rx_A is established, high quality audio will be played on the Rx_A speaker/headset.

FIGURE 39: DEPICTION OF HIGH QUALITY AUDIO STREAMING THROUGH RX_A SINK DEVICE



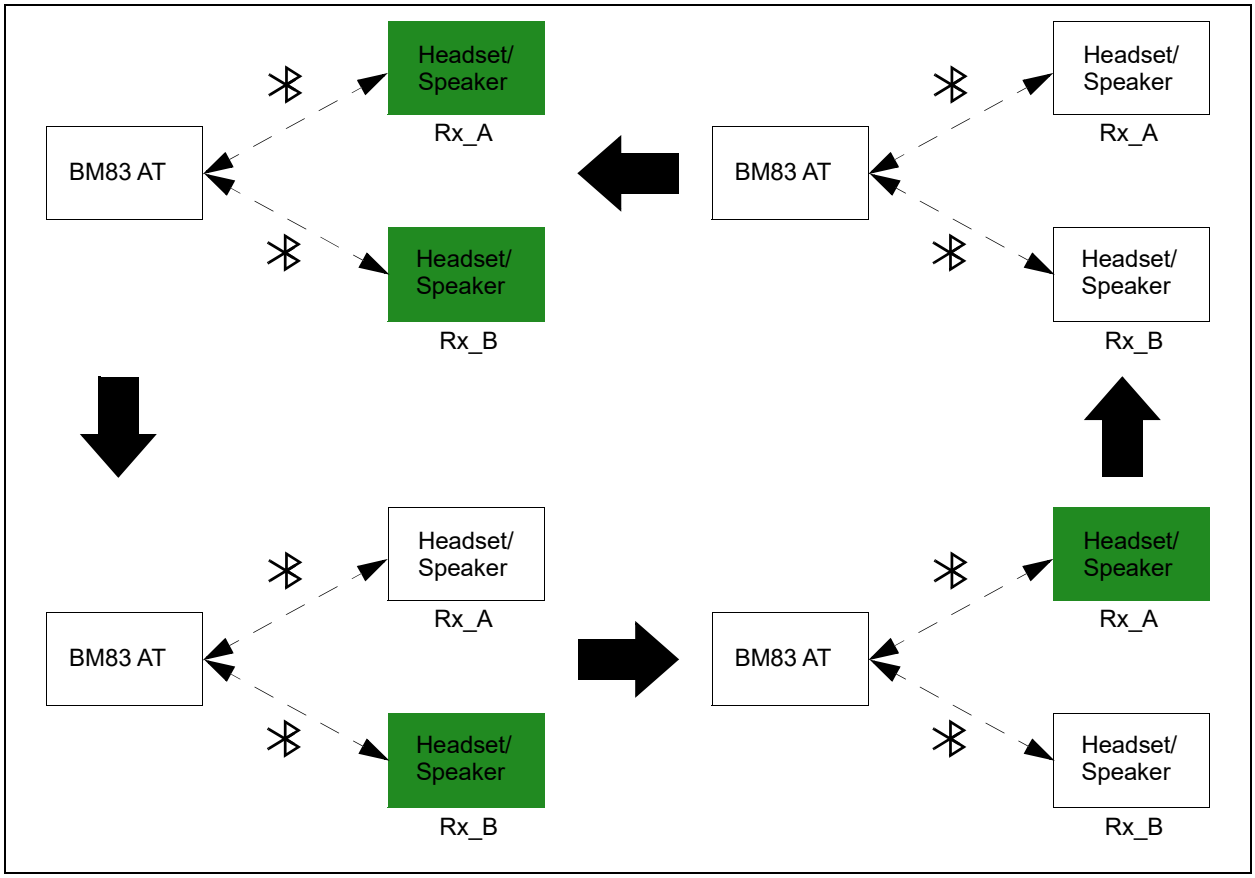
3. When Rx_B establishes a connection, then mid quality audio plays on both Rx_A and Rx_B speakers/headset.

FIGURE 40: DEPICTION OF MID QUALITY AUDIO STREAMING THROUGH RX_A AND RX_B SINK DEVICES



4. By sending a `Toggle Audio Playback (2 0 41)` command repeatedly or short pressing MFB repeatedly, audio will be played on Rx_B, Rx_A, mute Rx_A and Rx_B and then play on both Rx_A and Rx_B and this will continue cyclically (see following figure).

FIGURE 41: AUDIO TOGGLING



4.0 BM83 GOOGLE FAST PAIR

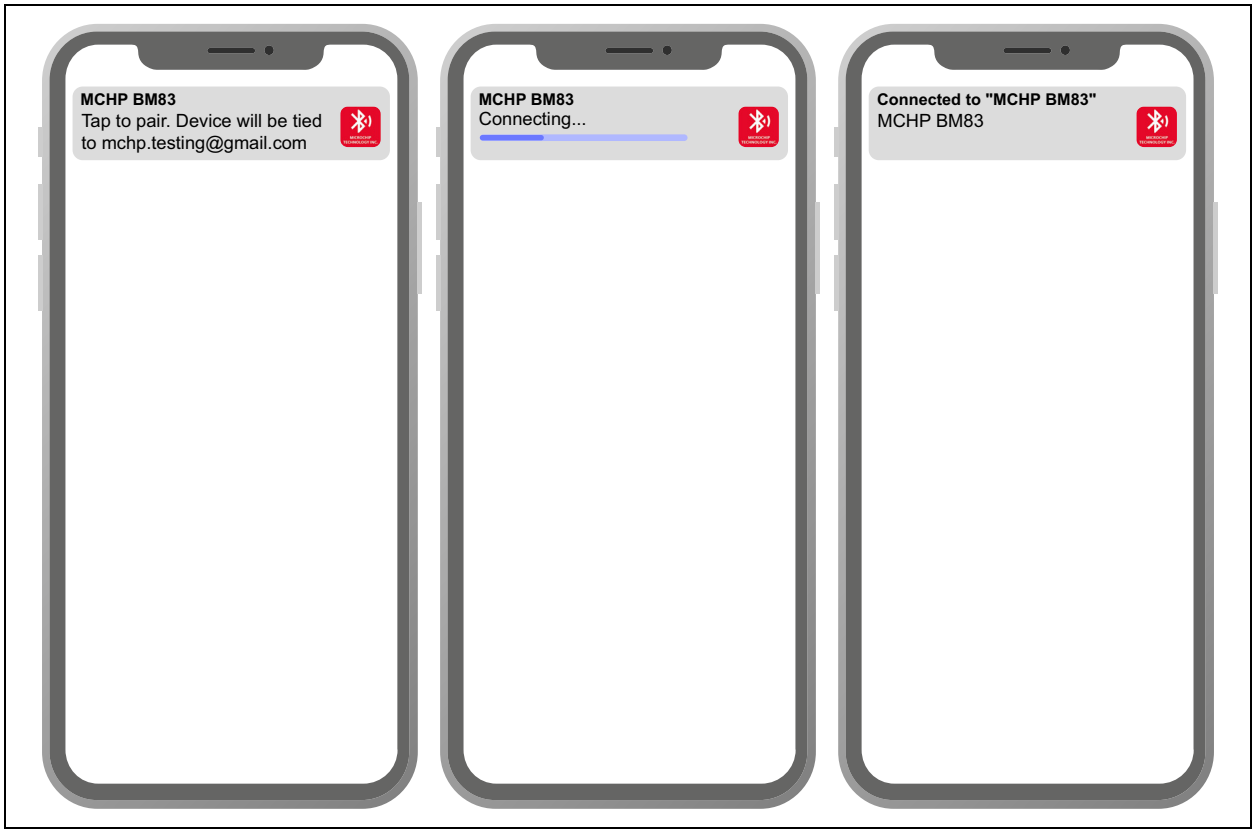
Google Fast Pair (GFP) is a Bluetooth service that uses Bluetooth Low Energy to discover and pair nearby Bluetooth devices without using significant phone battery and requiring minimal user interaction. With GFP, the process of connecting the headphones (or speaker) to a phone for the first time is effortless. With a tap of the acceptance notification, the devices can be connected to an Android mobile phone. In some cases, this may trigger another notification to install a companion app for the devices, if any, which could involve several steps.

Following section describes the setup and connection procedure for the BM83 GFP process.

4.1 Demo Setup

- Program the BM83 with GFP firmware, DSP firmware and GFP config setting (Embedded mode or Host mode: IS2083 Turnkey v1.x\Software\IS2083 Image\MSPK2v1.y\GFP). For Embedded mode demo setup, refer to **Section 2.2.1 “Embedded Mode Demo Setup”** and for Host mode demo setup, refer to **Section 2.2.2 “Host Mode Demo Setup”**.
- Power-up the BM83 EVB and put it in pairing mode (see the button functions in Table 2).
- Enable the Google Fast Pair option in the Android phone (refer to **Q.2 “Enabling GFP on the Android Phone”**).
- Once the notification is enabled and the android phone is within 24 inches of the BM83 device, a message will pop up as shown in the following figure.

FIGURE 42: GFP ENABLING NOTIFICATION IN ANDROID MOBILE



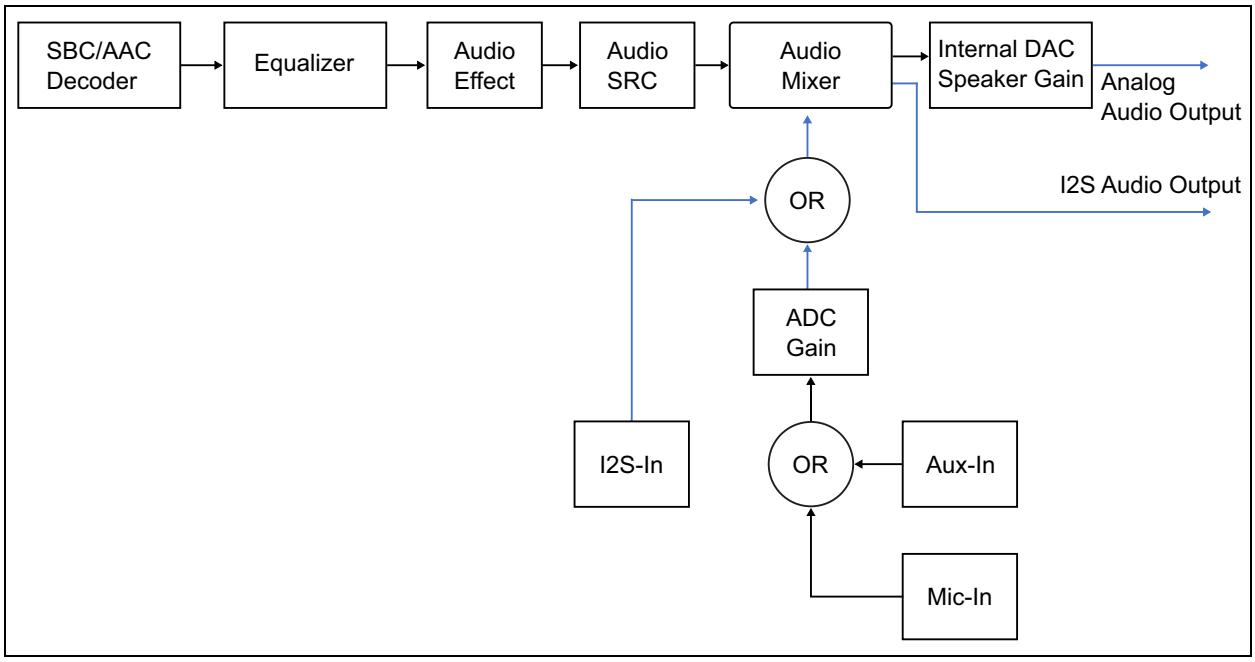
- Once the notification is received, tap on the notification and the BM83 will connect with the Android Phone.
- The GFP config setting can be customized using the Config GUI Tool. For more details, refer to **Q.1 “Enabling GFP in Config GUI Tool”**.

5.0 AUDIO MIXER MODE

During standalone mode (single speaker), the MSPK2 V1.3 software (or later) provides an audio mixer mode to mix A2DP audio (SBC/AAC) with either one of an I^2S-in, Aux-in or Microphone. The audio mixer is not supported for LDAC streaming.

During the mixer mode, the Audio effect and Audio SRC can be enabled for the A2DP audio path. ADC Gain is provided for the Aux-in and Microphone-in while the speaker gain is provided for the analog audio output, as shown in the following figure.

FIGURE 43: AUDIO PATH



To enable this mode, Audio Mixer must be enabled, A2DP must be streaming and audio input source(I^2S/ Aux-in/Mic-in) must be connected to the BM83.

The audio mixer supports 44.1K and 48 KHz audio mixing. If A2DP is sampled at 44.1 KHz, then I^2S/ Microphone must also be 44.1 KHz, and when A2DP is 48 KHz, then I^2S/Microphone must also be 48 KHz. Mismatch in A2DP and I^2S/Microphone sampling frequency is not allowed.

Both the Host mode and the Embedded mode supports audio mixing. For the Host mode, the MMI UART command (0x80: Enable mixer,0x81: disable mixer,0x82: ADC gain UP, 0x83: ADC gain down) is supported. For more details, refer to **Appendix V: "Audio Mixer Settings"** and *AudioUARTCommdnSet_v2.08* (or above).

APPENDIX A: ANDROID APP INSTALLATION

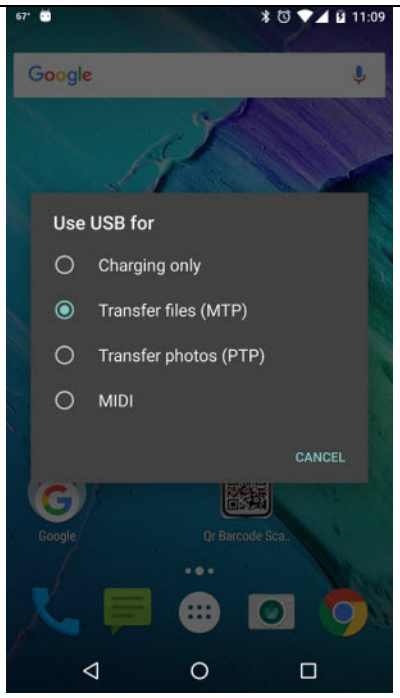
To install the application (*.apk is available), perform the following steps:

1. Connect the Android phone to the computer using a USB connector.

.

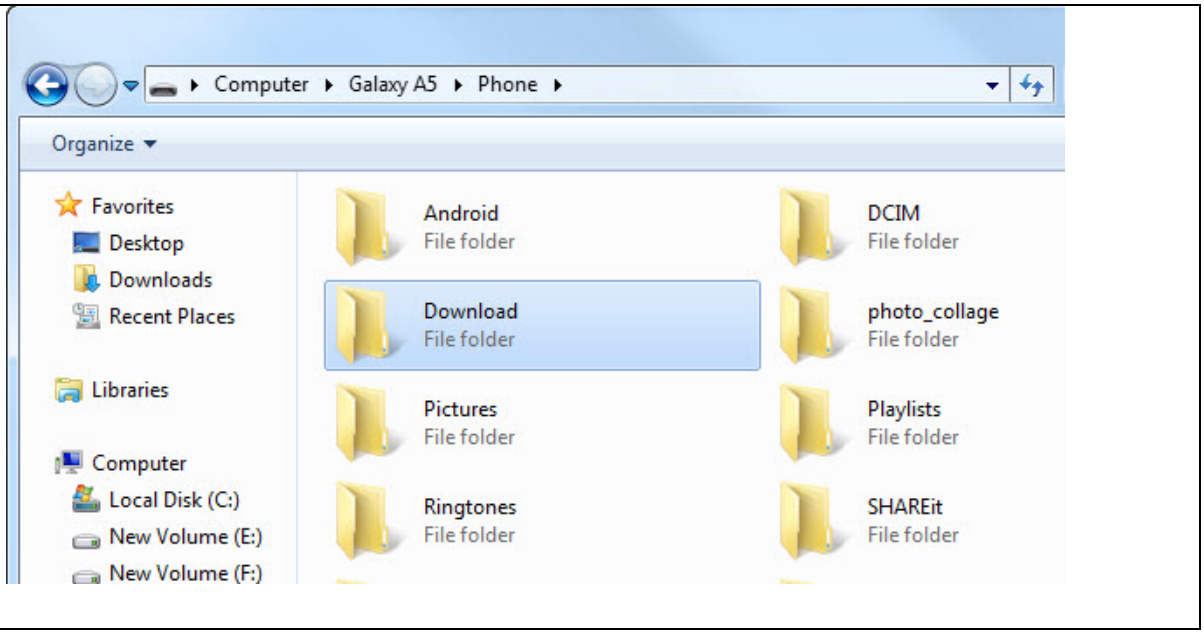
Note: The latest Android version (Android 6.0 and higher) does not show any directory in the phone. Enable “Transfer files” from the phone to access phone memory, as illustrated in the figure below.

FIGURE 44: USB TRANSFER



2. It is recommended to copy the Microchip Bluetooth Audio Android app to the **Download** folder of the Android mobile device, see the figure below.

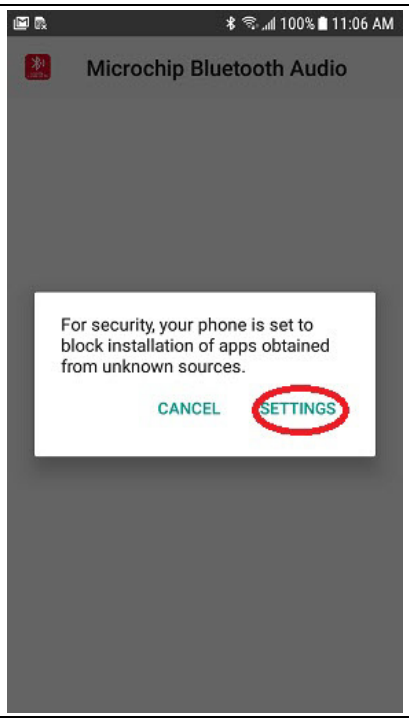
FIGURE 45: DOWNLOAD FOLDER OF THE ANDROID DEVICE



3. From the **File Manager** of the mobile device, select *My Files* > *All Files* > *Download* > *MBA4_x_Android.apk*.

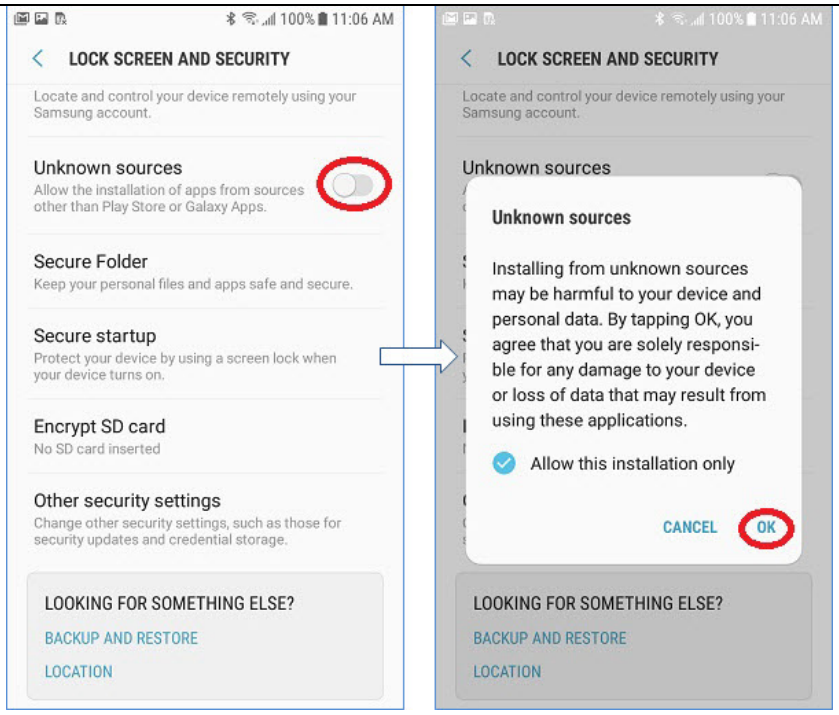
After selecting the file, a warning message indicating the installation is blocked is displayed, see the figure below.

FIGURE 46: WARNING MESSAGE: INSTALL BLOCKED



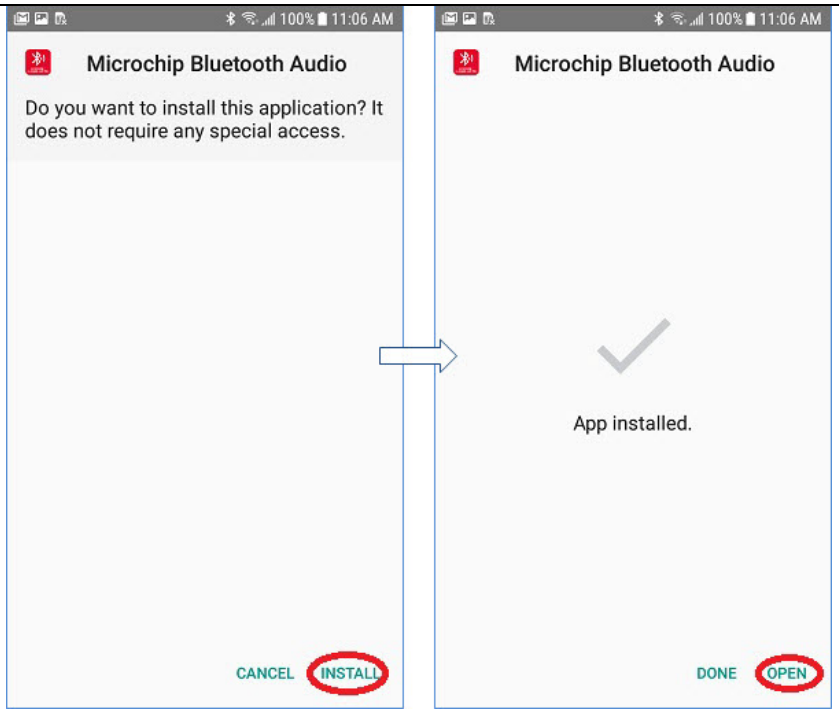
4. Go to **Settings** to open the **Security** screen and enable installations from **Unknown sources**, and then click **OK** to confirm the change, see the figure below.

FIGURE 47: ENABLE INSTALLATION FROM UNKNOWN SOURCES



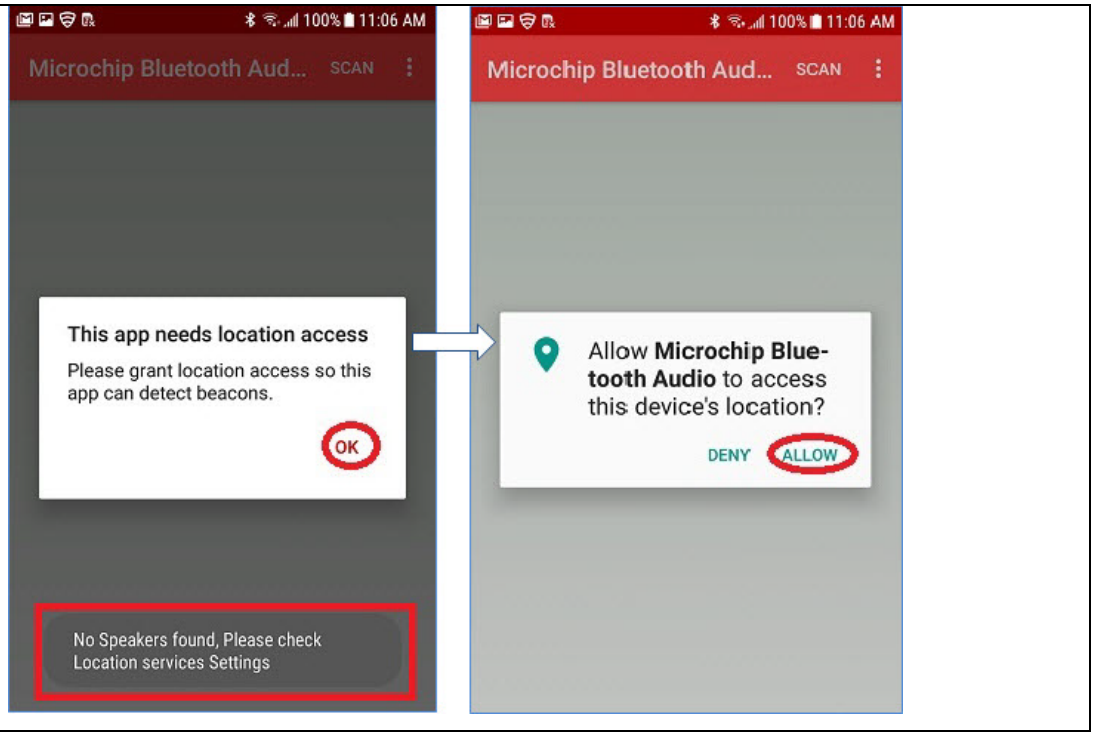
5. A message is displayed requesting whether to install an update to the existing application. Click **Install.** A confirmation screen displays when the application is installed, and then click **Open** to run the application, see the figure below.

FIGURE 48: UPDATE AND INSTALL THE APP



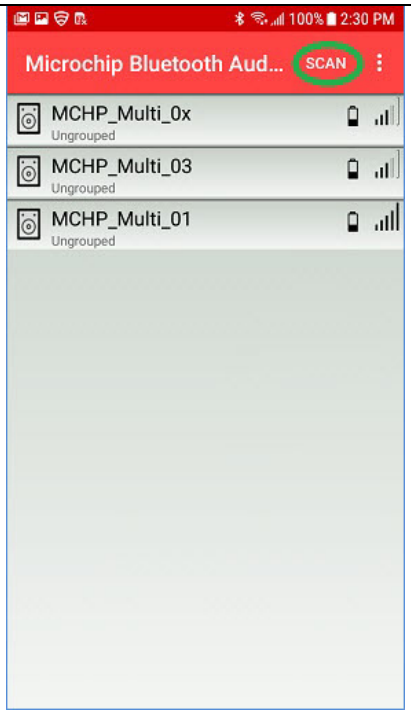
6. The app starts scanning and the timeout is for 30 seconds. A notification is displayed as “This app needs location access”, click **OK** and then select **Allow**, as illustrated in the figure below.

FIGURE 49: LOCATION ACCESS



7. Click **SCAN** to see the list of discoverable devices nearby, as illustrated in the figure below.

FIGURE 50: SCAN FOR DEVICES



APPENDIX B: CUSTOMIZING UI AND DSP PARAMETERS

Note: UI and DSP parameters are merged into one tool called the Config GUI tool.

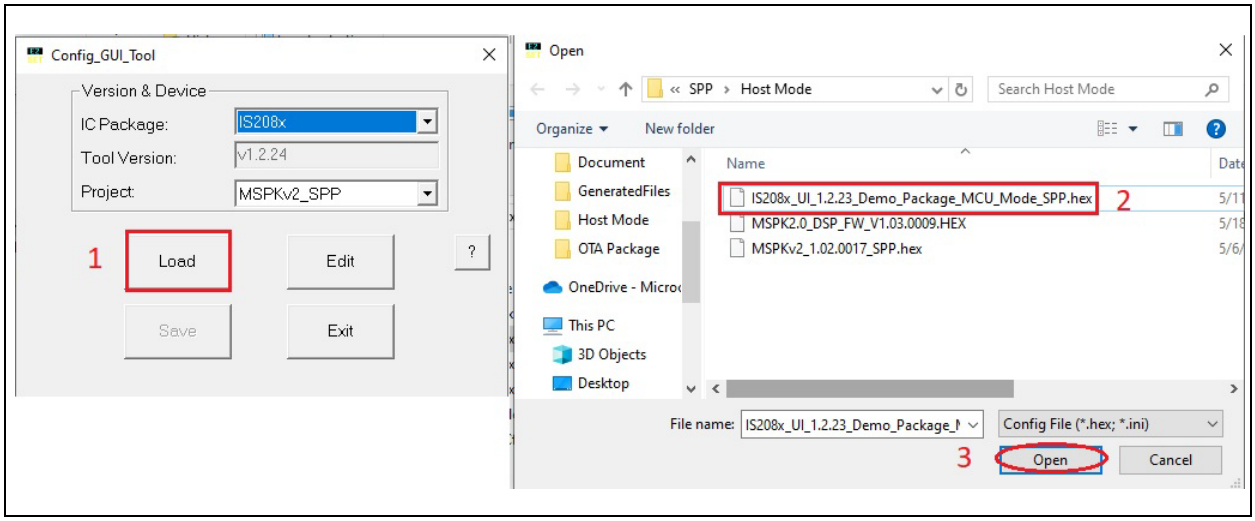
Follow the example procedure below for configuring a BM83 into I^2S Host mode with an external codec in Embedded/Host mode.

B.1 Customizing UI Parameters

Perform the following steps to customize the UI parameters:

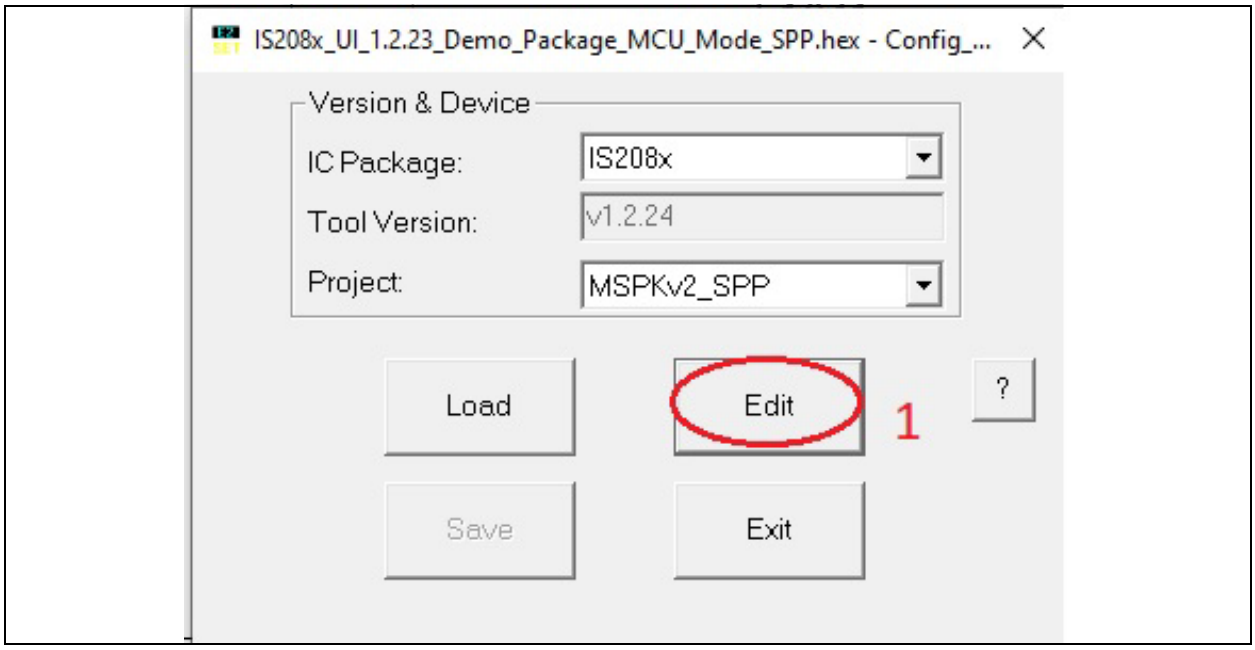
1. Open the Config GUI tool, `IS208x_Config_GUI_Tool vx.xx.exe` from `Tools\Config Tool`. Click **Load** to load `IS208x_UI_1.2.xy_Demo_Package_MCU_Mode_SPP.hex` from the same folder IS2083 Turnkey v1.x\Software\IS2083 Image\MSP-K2v1.y\SPP\Host Mode and then click **Open**, see the figure below. Every firmware target has customized settings which have been added in the target folder. It is recommended to use these settings for further customization.

FIGURE 51: LOADING INI FILE



2. From the Config GUI tool, click **Edit** (see the figure below).

FIGURE 52: EDIT CONFIG PARAMETERS



3. A window is displayed.
   - a. For Host mode, select “Host MCU Mode”, then click Next (see the figure below).
   - b. For Embedded mode, select “Embedded Mode”, then click Next (see Figure 54).

FIGURE 53: MAIN FEATURE SETTINGS - HOST MODE

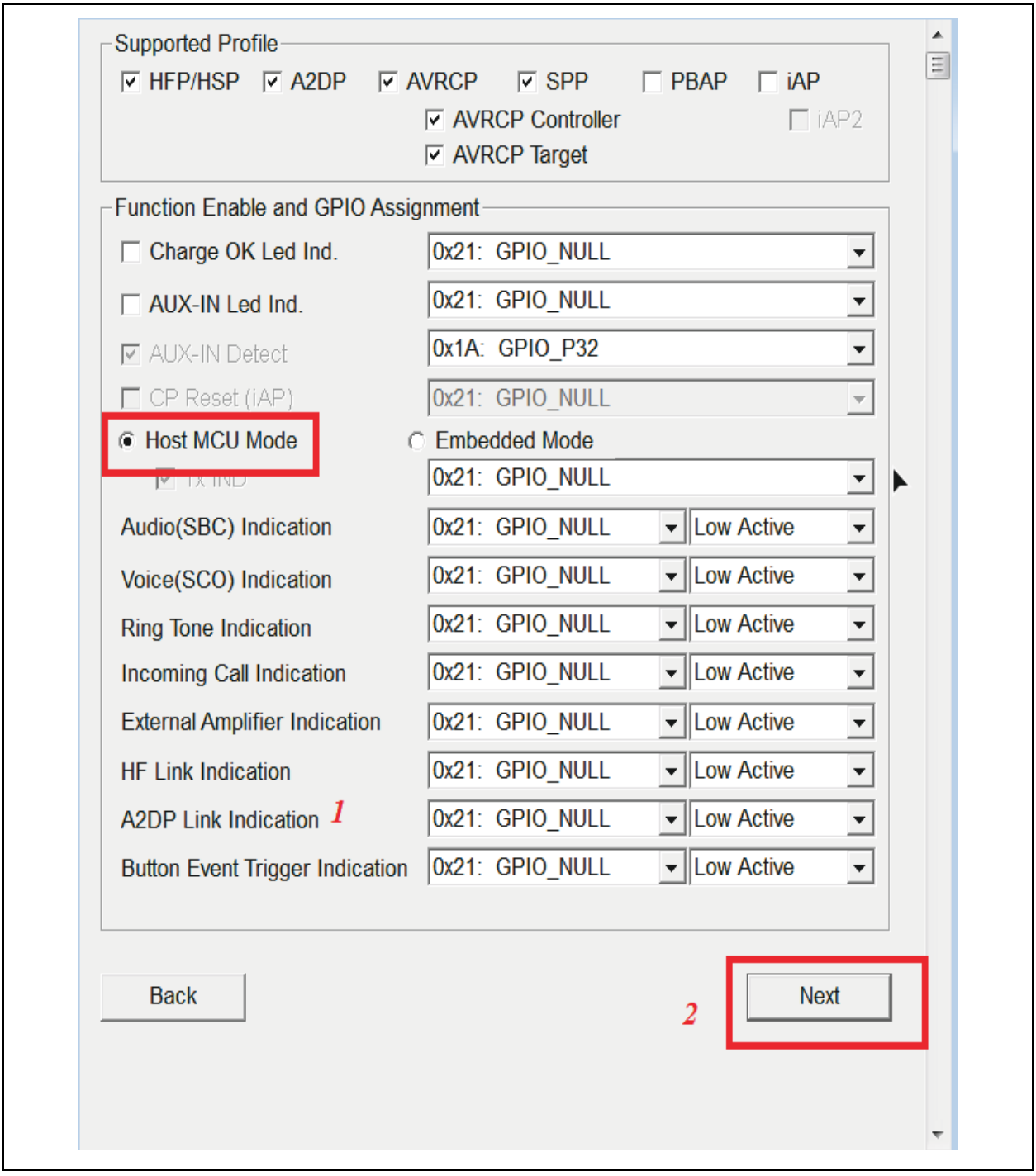
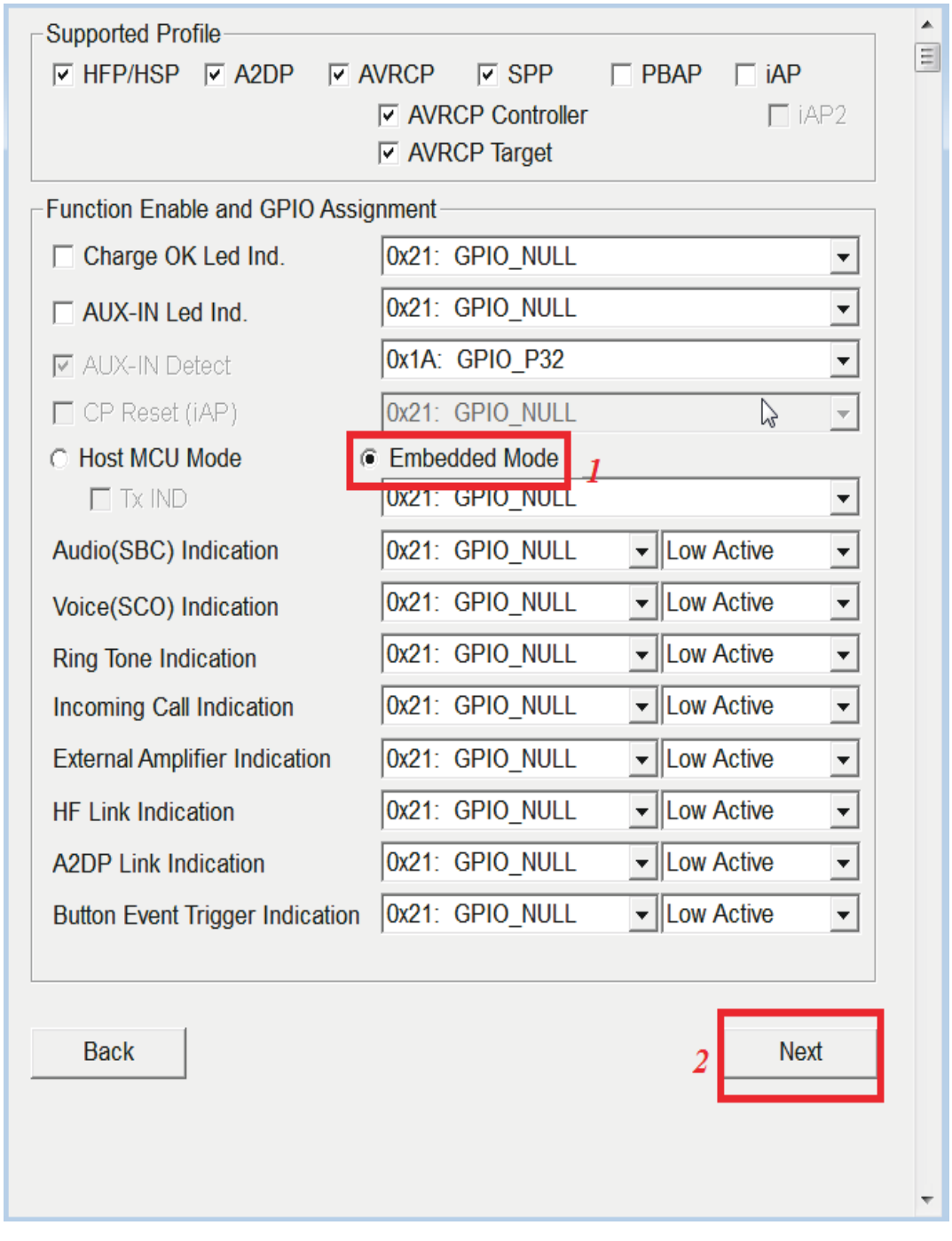
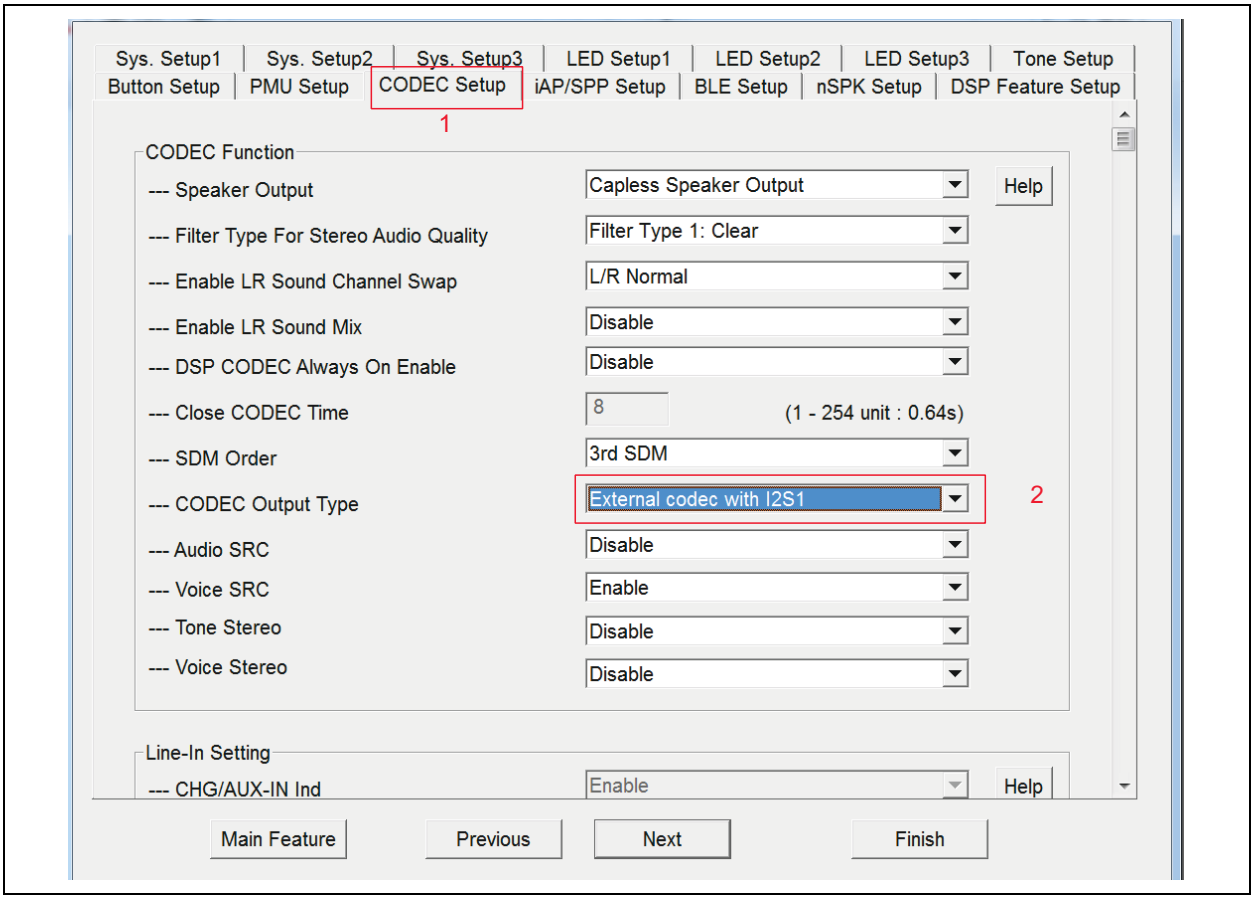


FIGURE 54: MAIN FEATURE SETTINGS - EMBEDDED MODE



4. Click the CODEC Setup tab to select the External codec in CODEC Output Type. If an internal codec is needed, then select Internal codec in CODEC Output Type.

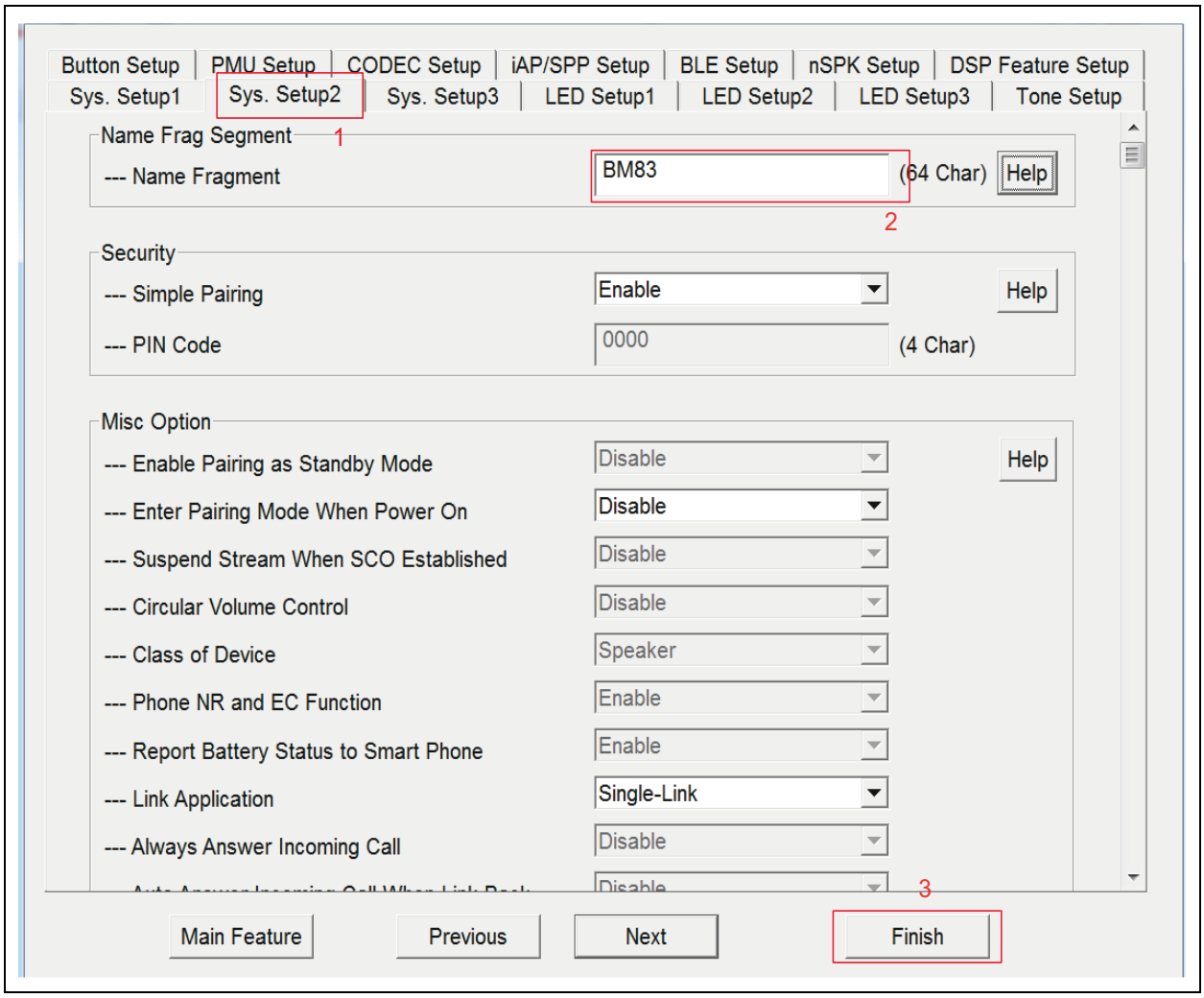
FIGURE 55: CHANGING CODEC OUTPUT TYPE



5. This step is needed only for Embedded mode. Configure BM83 GPIOs to connect with the BM83 EVB on-board buttons and Aux-in input detection as in **Appendix H: "AUX-In Detection"** and **Appendix I: "Button Configuration"**.

6. Click the **Sys. Setup2** tab to change the speaker name, as illustrated in the figure below and then click **Finish**.

FIGURE 56: CHANGING SPEAKER NAME



B.2 Customizing DSP Parameters

7. Click **Finish** to open a DSP Tool (see Figure 57).
8. Click the I^2S/PCM tab and perform the I^2S-related selection, as illustrated in Figure 58. The MCLK is the Master Clock output provided to an external I^2S codec device to use as its system clock. This signal is optional and is not required if the external I^2S device provides its own system clock. The BM83 EVB uses the ST codec and MCLK to be enabled for this.

B.3 Creating *.HEX File

9. Save the DSP parameters by clicking **Save**, then close the DSP window (see Figure 59).
10. Click **Exit**, and a window is displayed. From the Save As window, select the file location, then click **Save** (see Figure 60).

FIGURE 57: IS208X DSP CONFIGURATION TOOL

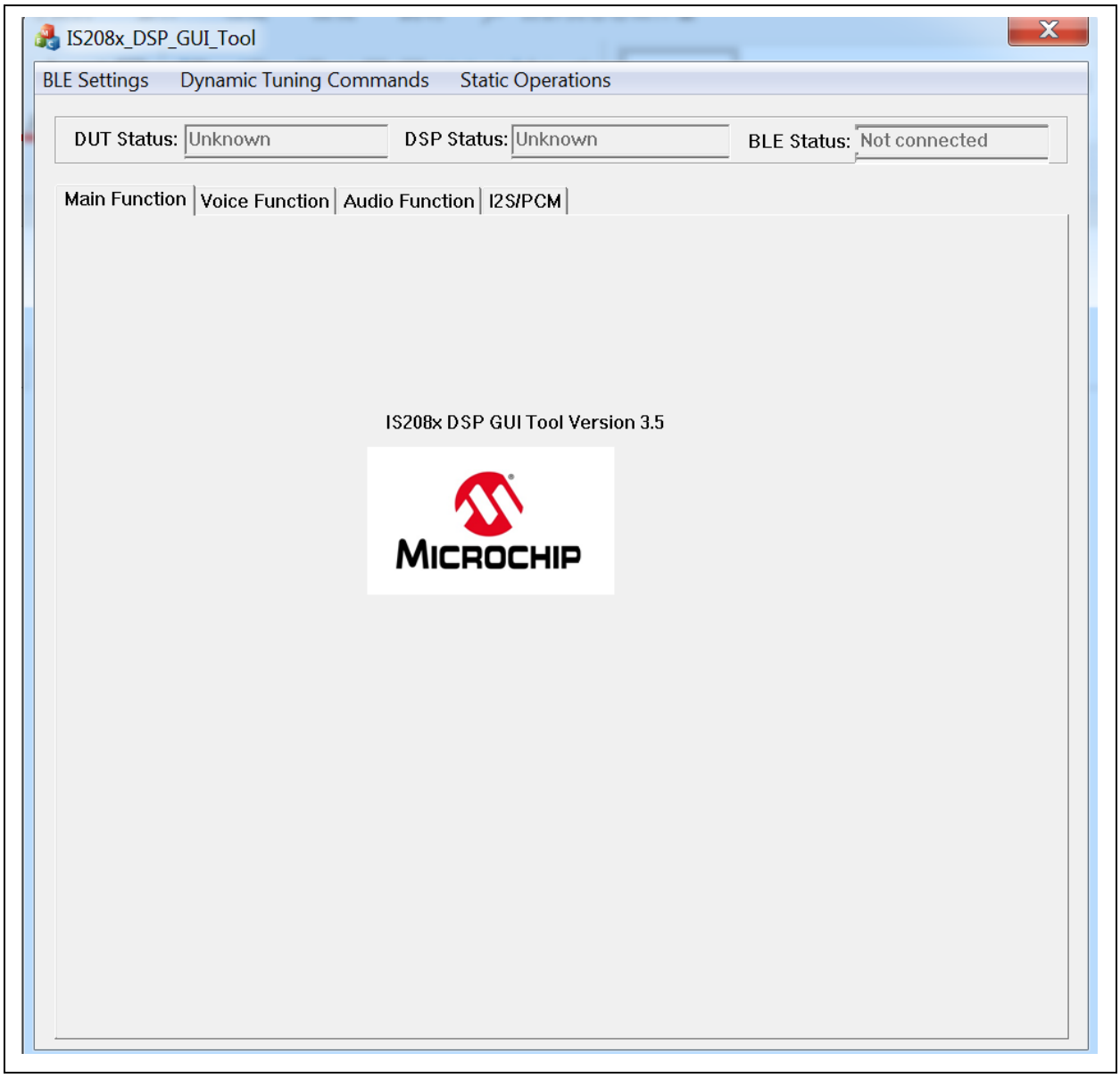
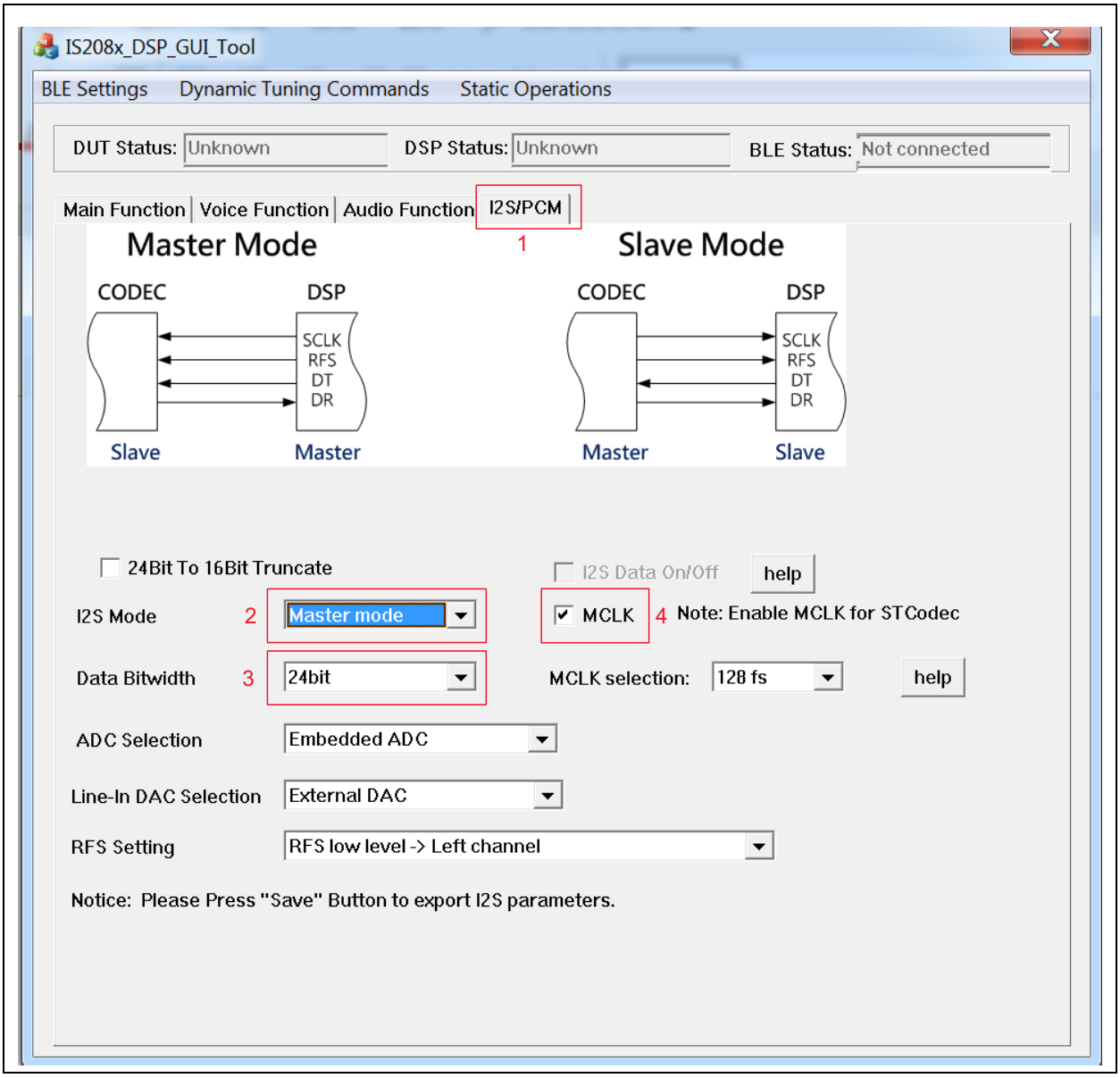


FIGURE 58: IS208X DSP CONFIGURATION TOOL - I²S/PCM MODE SELECTION



Note 1: Configure the I²S for Host mode by selecting "I²S Mode" as *Master mode*, as illustrated in the figure above.

FIGURE 59: SAVING UI PARAMETERS

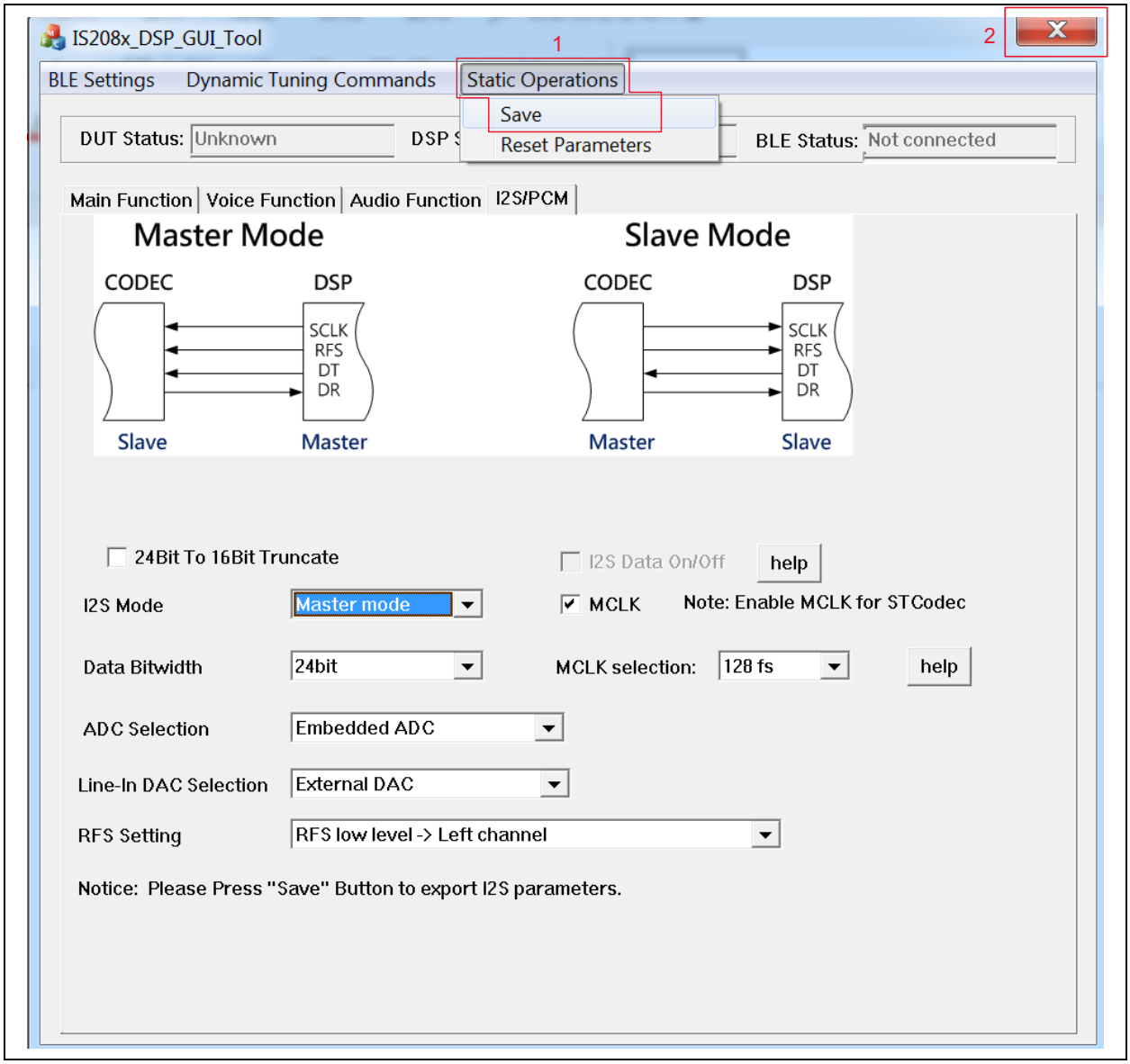
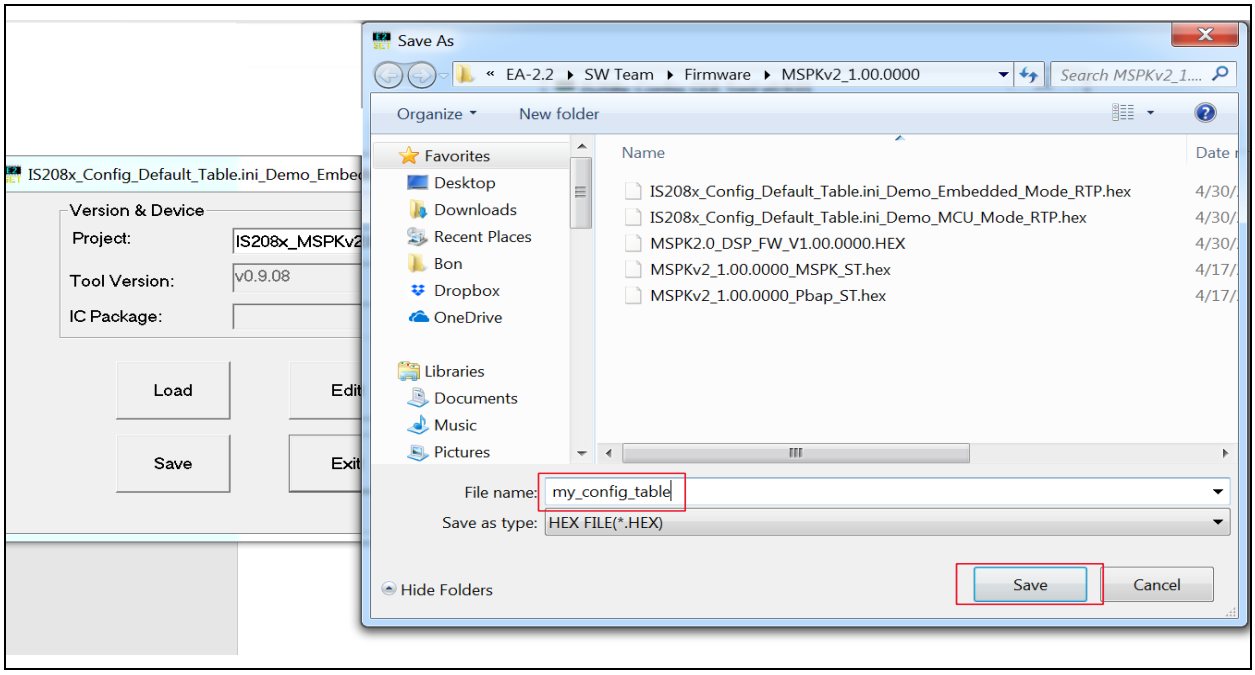


FIGURE 60: SAVING UI PARAMETERS



11. The generated *.HEX can be directly programmed into the BM83 module by following the steps mentioned in the *BM83 Bluetooth® Audio Development Board User's Guide (chapter* 5. Firmware Update). Only the Config file can be updated by selecting this *.hex file and selecting image number to 1 in the isupdate tool.

APPENDIX C: CONFIGURING BM83 I²S HOST/CLIENT MODE AT 48 kHz

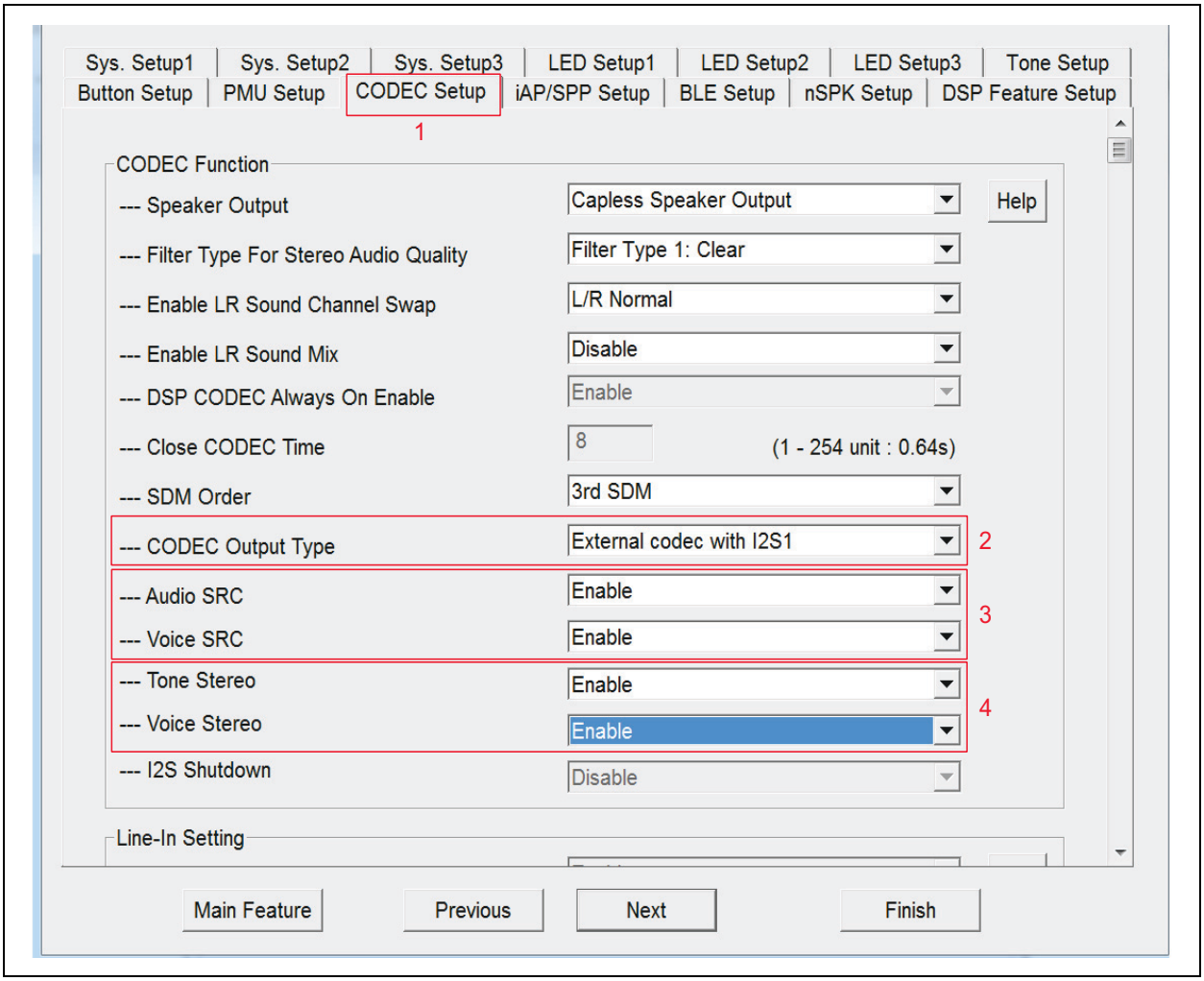
BM83 I²S can be configured into I²S Host and I²S Client modes. **Appendix B: "Customizing UI and DSP Parameters"** describes BM83 configured into I²S Host mode. This section describes BM83 configured into I²S Client mode.

C.1 Selecting UI Parameters

Perform all the steps from **B.1 "Customizing UI Parameters"**. The only difference is enabling Audio SRC and Voice SRC, as illustrated in the figure below. Click the **CODEC Setup** tab, enable **Audio SRC, Voice SRC** and then select "CODEC Output Type" as **External codec**.

Voice Prompt and HFP can be enabled in Stereo mode by enabling **Tone Stereo** and **Voice Stereo**, as illustrated in the figure below.

FIGURE 61: CODEC SETUP



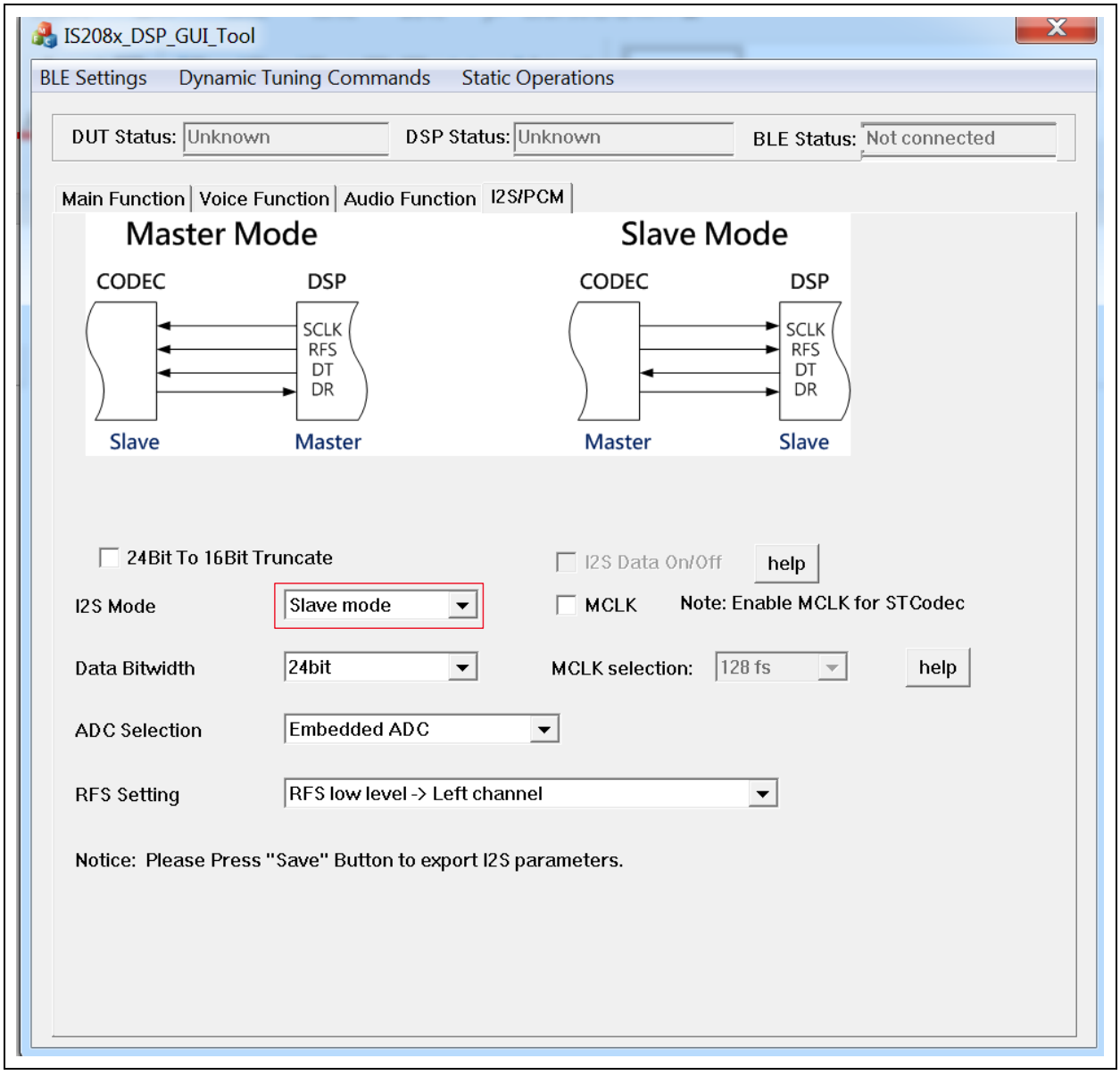
Note 1: If "CODEC Output Type" is selected as Internal codec then audio will be routed to analog speaker out.

2: For BM83 I²S Host mode at 48 kHz, refer to **C.1 "Selecting UI Parameters"** and **C.3 "Creating Config *.HEX"**.

C.2 Selecting DSP Parameters

1. Perform all the steps from **B.2 "Customizing DSP Parameters"**.
2. Select "I²S Mode" as *Slave mode* to configure the I²S for Client mode, as illustrated in the following figure.

FIGURE 62: I²S IN CLIENT MODE



C.3 Creating Config *.HEX

For the procedure to create the `*.HEX` file, refer to **B.3 "Creating *.HEX File"**.

APPENDIX D: ANDROID APP POWER MODE

Microchip Bluetooth Audio app can also be used for power on/off for an individual BM83 speaker. Slide **Power** to turn on/off the BM83 speaker, as illustrated in the figure below. If the power is turned off on the central speaker, it switches off central and all the connected peripheral speakers, similar to the short press SEL in Host mode/long press MFB button in Embedded mode.

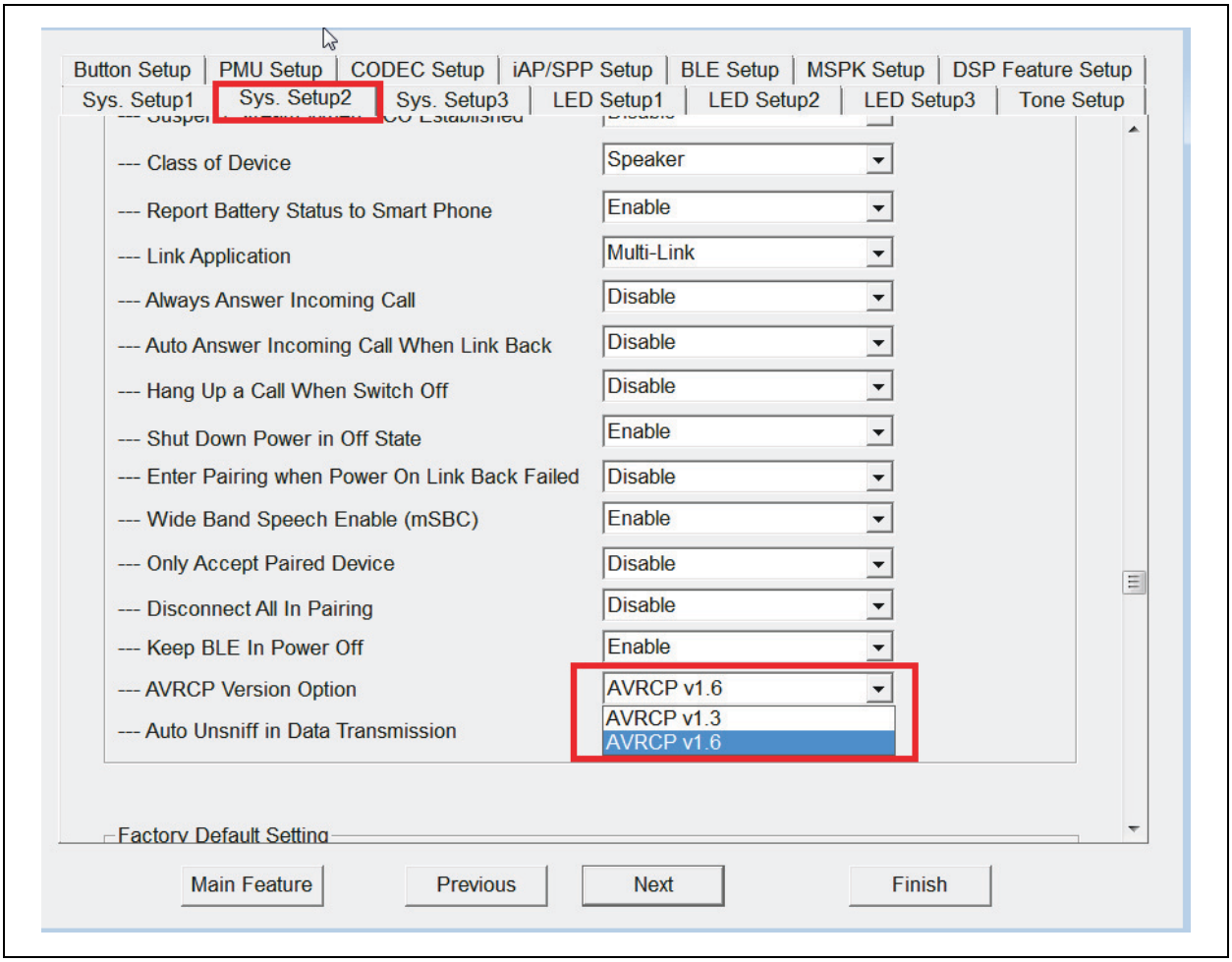
FIGURE 63: POWER MODE ON/OFF

APPENDIX E: AVRCP VERSION

The AVRCP version 1.6/1.3 can be programmed, as illustrated in the figure below.

The volume control is performed on the source in AVRCP v1.3. The absolute volume is sent to sink in AVRCP v1.6.

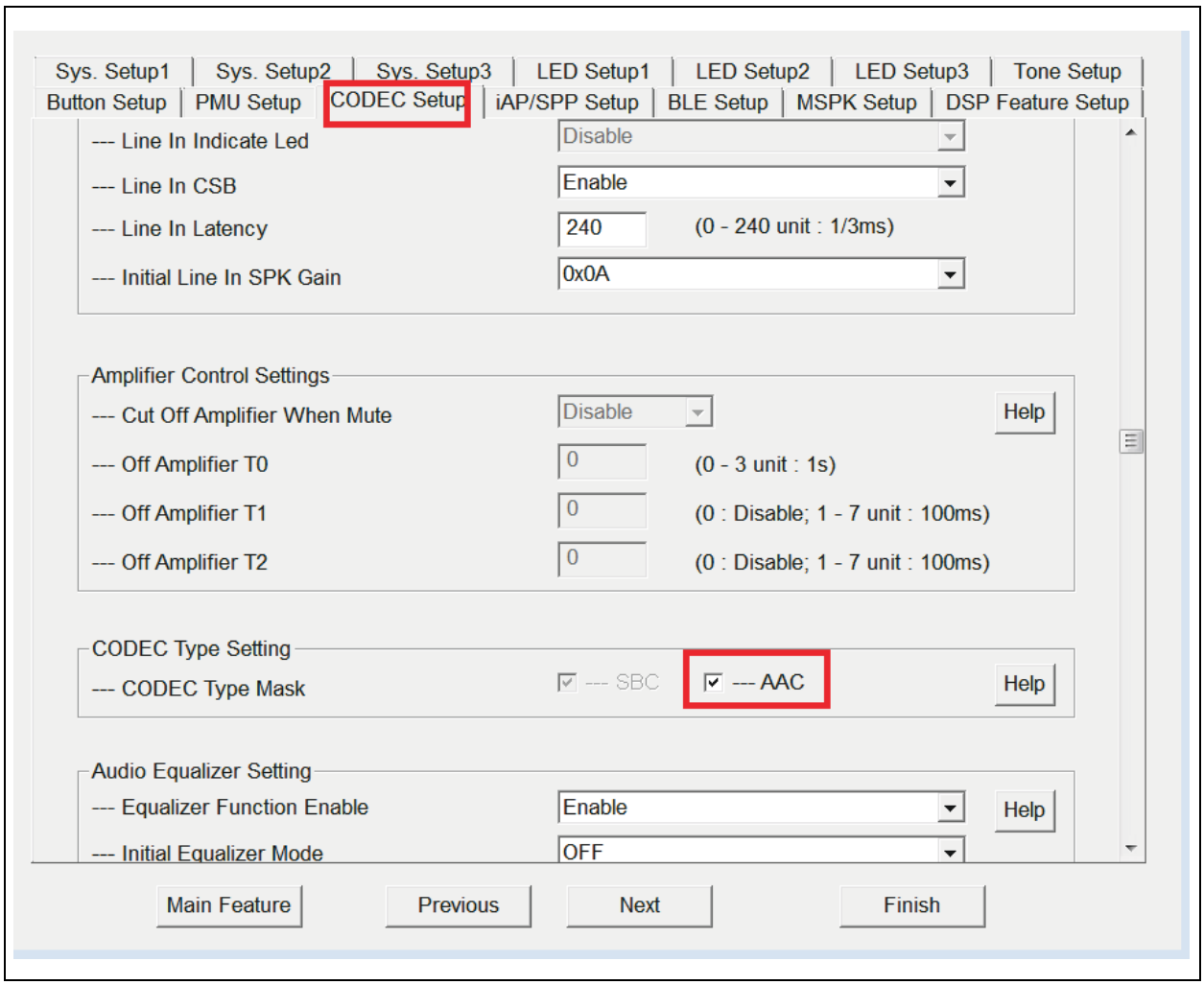
FIGURE 64: SELECTING AVRCP VERSION



APPENDIX F: ENABLE AAC CODEC

AAC CODEC can be enabled or disabled from the **CODEC Setup** tab, as illustrated in the following figure.

FIGURE 65: ENABLING AAC CODEC



APPENDIX G: LDAC APPLICATION

UNGROUPED MODE A2DP PLAYBACK:

LDAC audio CODEC can be used during ungrouped A2DP playback with Sony mobile or Android 8.x devices. On the other hand, SBC CODEC will be used if the speaker is in Stereo mode or Concert mode.

LDAC FORMAT

Microchip utilizes Sony LDAC audio CODEC, which provides high-resolution audio in Ungrouped mode.

LDAC bitrate can be 990 kbps (Quality Priority mode), 660 kbps (Normal mode) and 330 kbps (Connection Priority mode). The user can select the bit rate on the mobile devices and the speaker will automatically support it. Also, the speaker can support 44.1 kHz, 48 kHz, 88.2 kHz and 96 kHz, so the user can decide the sampling rate using the LDAC mobile device.

According to the Sony LDAC web page, https://www.sony.net/Products/LDAC/, modes and bitrate are listed in the table below.

TABLE 4: TRANSMISSION RATES

Mode	Bit Rate
Sound Quality preferred	990 kbps
Standard	660 kbps
Connection preferred	330 kbps

LDAC CERTIFICATION

The branded customer receives an LDAC logo by using the Microchip LDAC test report. The Non-branded customer must collaborate with the Branded customer to apply for the license.

LDAC BLUETOOTH AUDIO STREAMING

Most of the Sony mobiles and Android 8.x mobile devices support LDAC Bluetooth audio streaming.

Mobile phones have their default Bluetooth audio CODEC setting. Some mobile phones may have default SBC or LDAC CODEC.

After pairing and connecting to the ungrouped speaker, the user needs to check whether or not the mobile phone is using LDAC CODEC. The following example shows how to use Sony Xperia® Z5 and Google Pixel™ for LDAC streaming. For more details on the LDAC setup in the mobile phone, refer to the steps below.

Sony mobile devices provide a setting page to select the following LDAC audio quality:

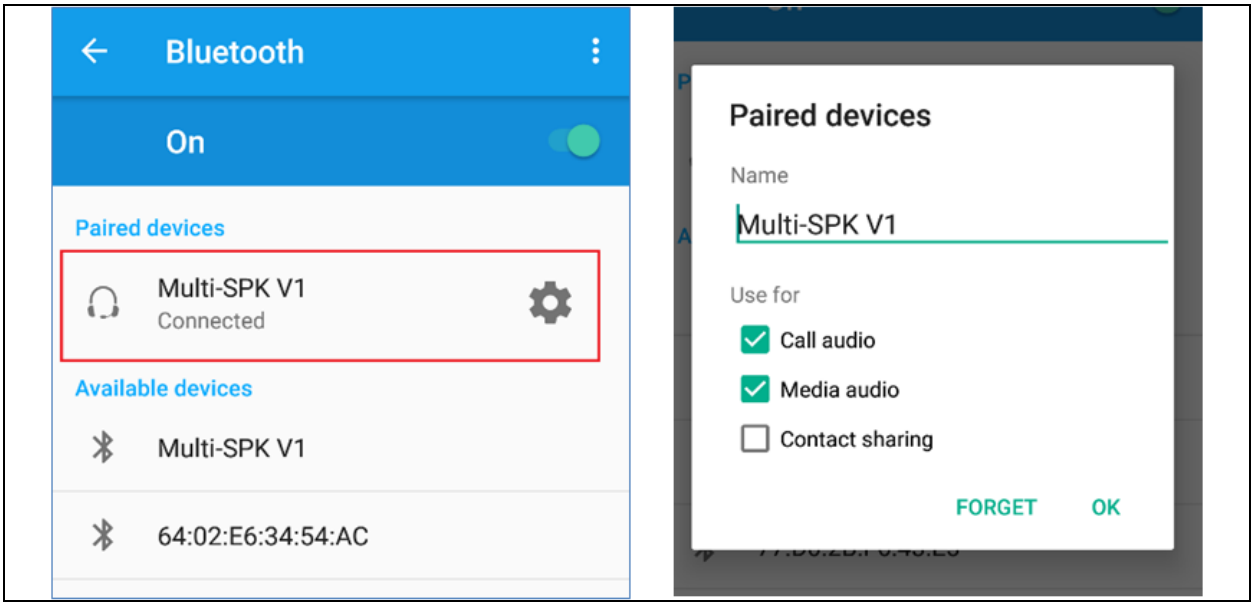
- Quality Priority mode
- Normal mode
- Connection Priority mode

Android 8.x devices may or may not provide a setting page to select LDAC settings.

For example, for Sony Xperia Z5 (E6663) and Android 6.0 devices:

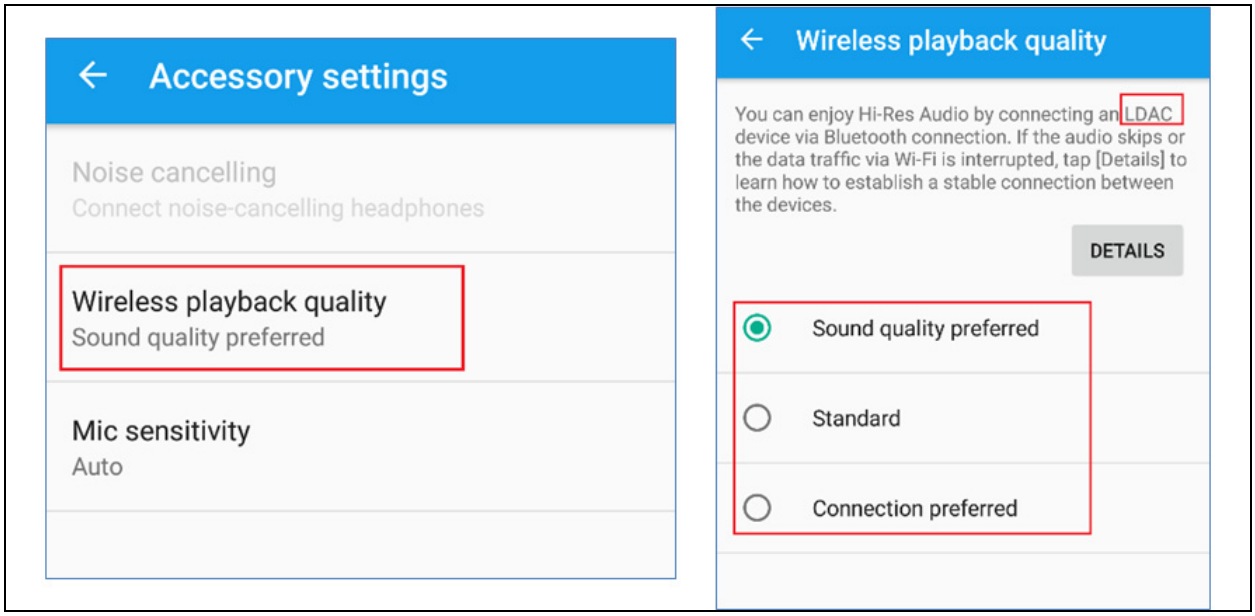
1. When the Android 6.0 mobile device is connected to the speaker, it will not show “LDAC” in the Bluetooth setting page, see the figure below.

FIGURE 66: BLUETOOTH SETTING PAGE



2. Go to **Settings** > **Sound and Notification** > **Accessory Settings** to select the LDAC quality selection, as shown in the figure below.

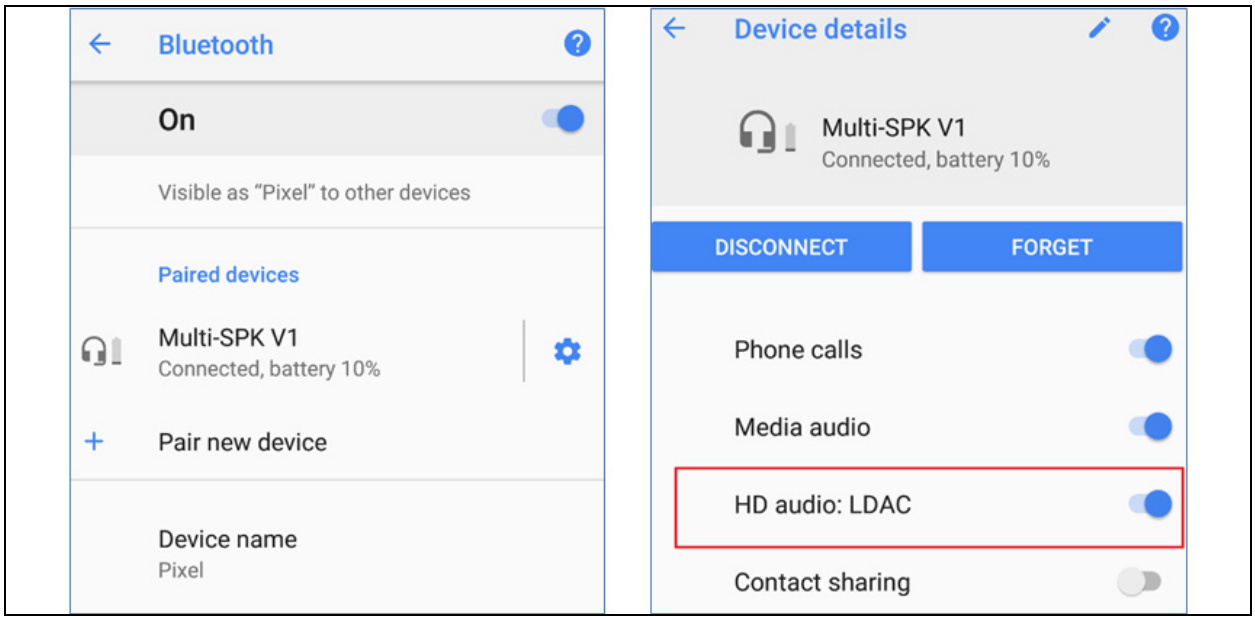
FIGURE 67: LDAC QUALITY SECTION



For example, for Google Pixel and Android 8.1:

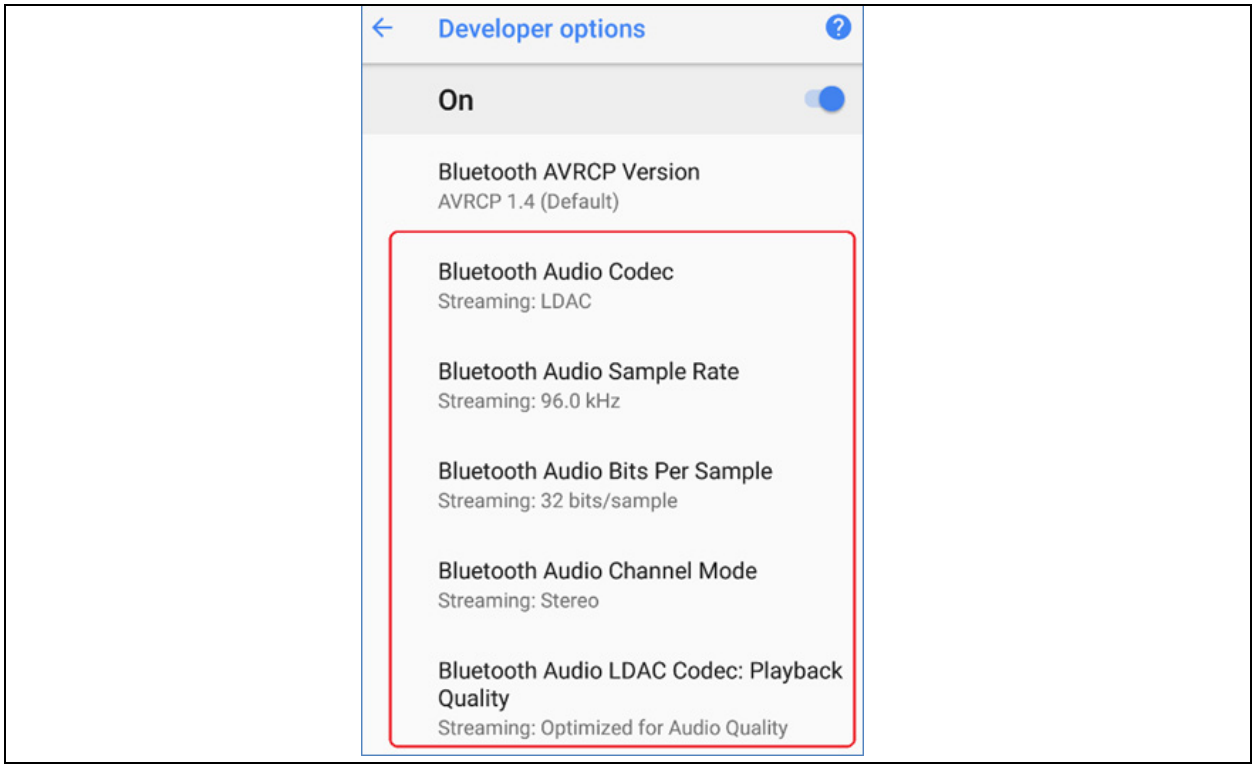
1. When the Android 8.x mobile devices are connected to the speaker, it will show “LDAC” in the Device details of the Bluetooth device page, see the figure below.

FIGURE 68: BLUETOOTH DEVICE PAGE



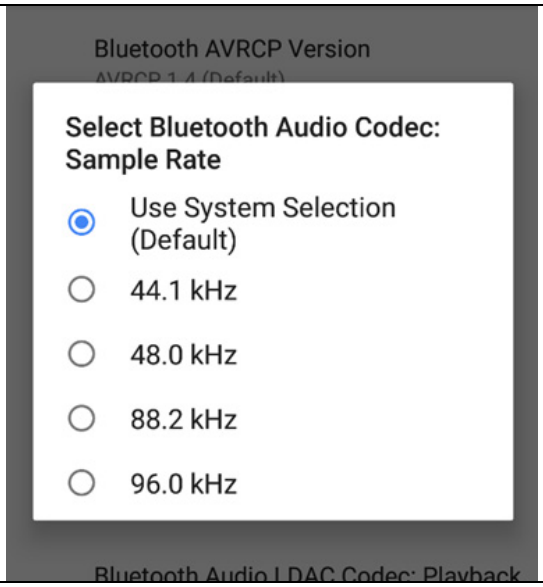
2. If the user needs to test a particular LDAC parameter, they can choose the LDAC options by enabling **Developer Options** on the Android phone. In the Google Pixel phone after enabling **Developer Options**, the user can see the Developer Options menu in the phone settings. Within this menu the user will have several Bluetooth audio options, as shown in the figure below.

FIGURE 69: DEVELOPER OPTIONS



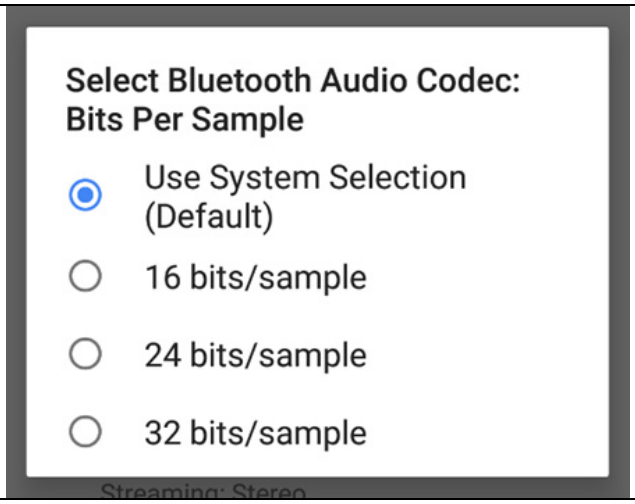
a) When the user selects **Bluetooth Audio Sample Rate**, a pop-up is displayed for the list of sampling rates, see the figure below.

FIGURE 70: AUDIO SAMPLE RATE



b) When the user selects **Bluetooth Audio Bits Per Sample**, a pop-up displays for the list of sample bit-depth, see the figure below.

FIGURE 71: AUDIO BITS PER SAMPLE

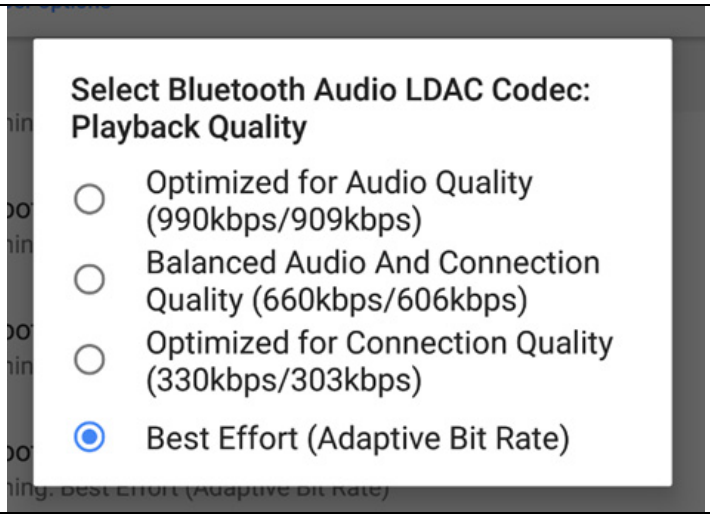


c) When the user selects **Playback Quality**, a pop-up displays the list of LDAC quality selections, as shown below.

This page is similar to the Sony Xperia Z5 device.

Some mobile phones cannot handle the bandwidth when the highest LDAC bit rate is selected. Select **Best Effort** on the mobile phone to adjust the bandwidth with suitable LDAC bit rate.

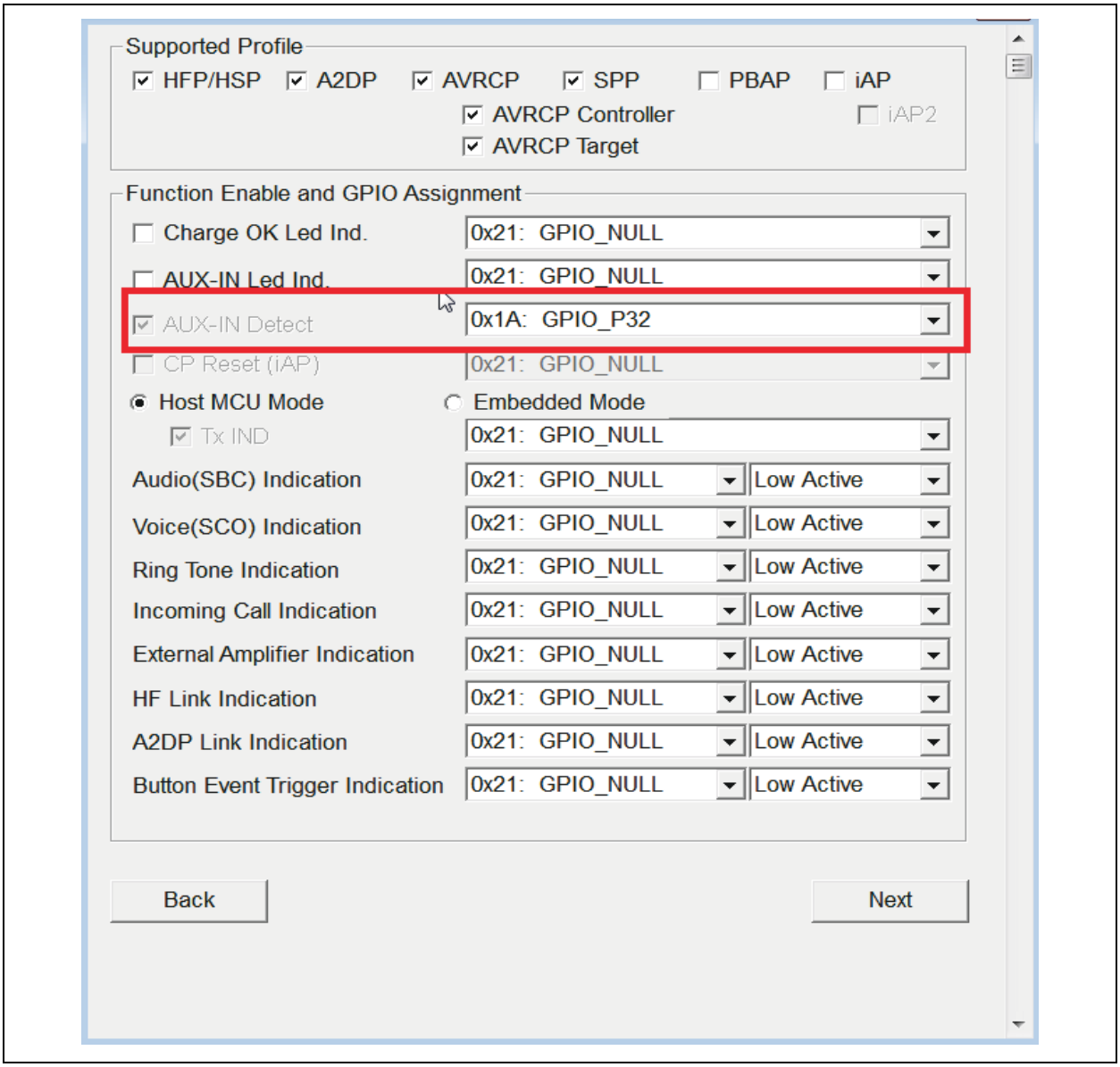
FIGURE 72: PLAYBACK QUALITY



APPENDIX H: AUX-IN DETECTION

Any one of the GPIOs on BM83 can be configured as AUX-In input detector in embedded mode. The below figure shows that P3_2 is configured for AUX-In input detections.

FIGURE 73: AUX-IN DETECTION



APPENDIX I: BUTTON CONFIGURATION

Any one of the GPIO on the BM83 can be configured for button functionalities in Embedded mode. For example, in BM83 EVB VOL UP button is connected to P2_7 pin of BM83. The below figures show P2_7 is configured for dual functionality (Short press for volume up, Long press for Concert Mode entry).

FIGURE 74: BUTTON SETUP

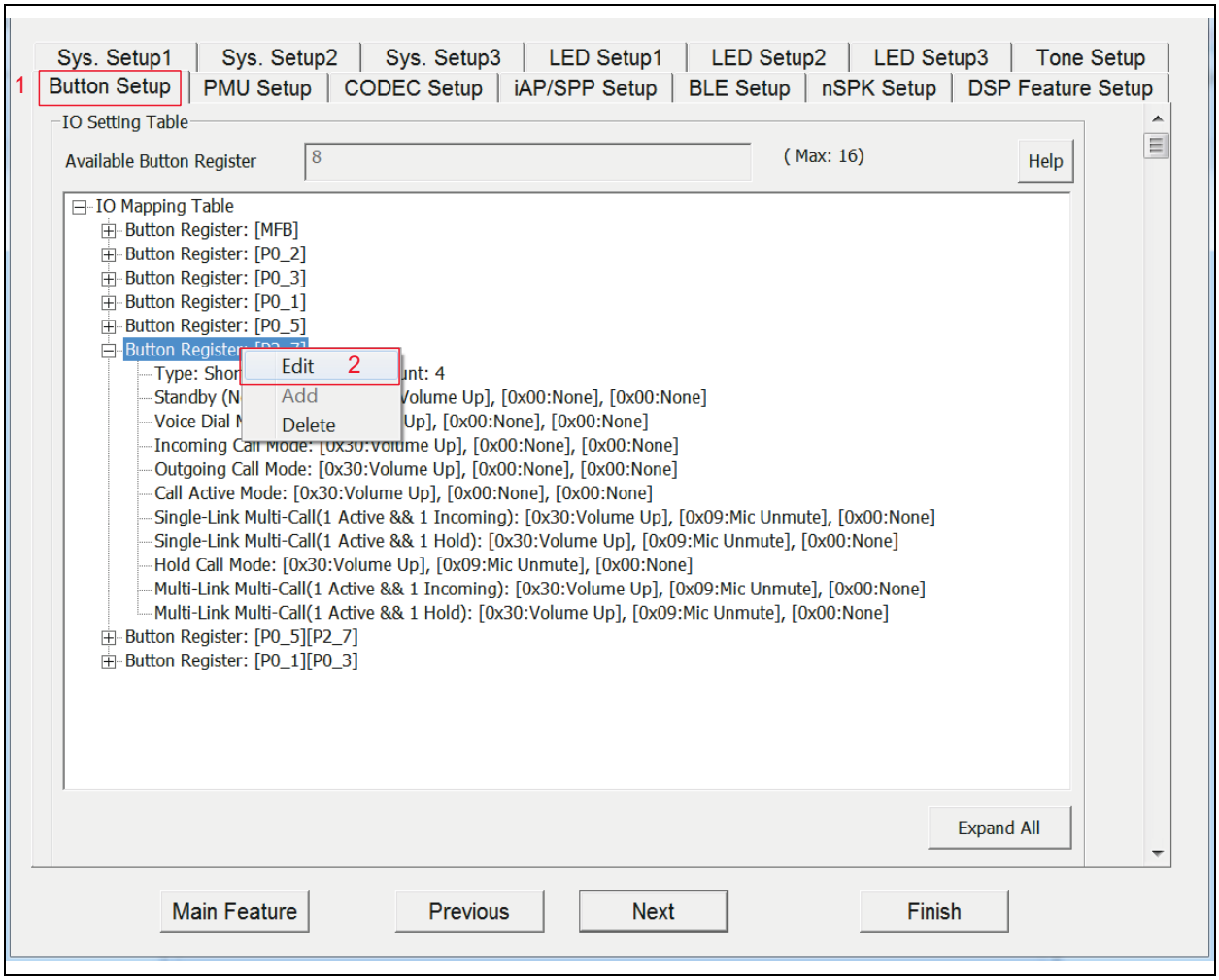


FIGURE 75: BUTTON MAPPING FOR P2_7 IS CONFIGURED FOR VOLUME UP AND CONCERT MODE ENTRY

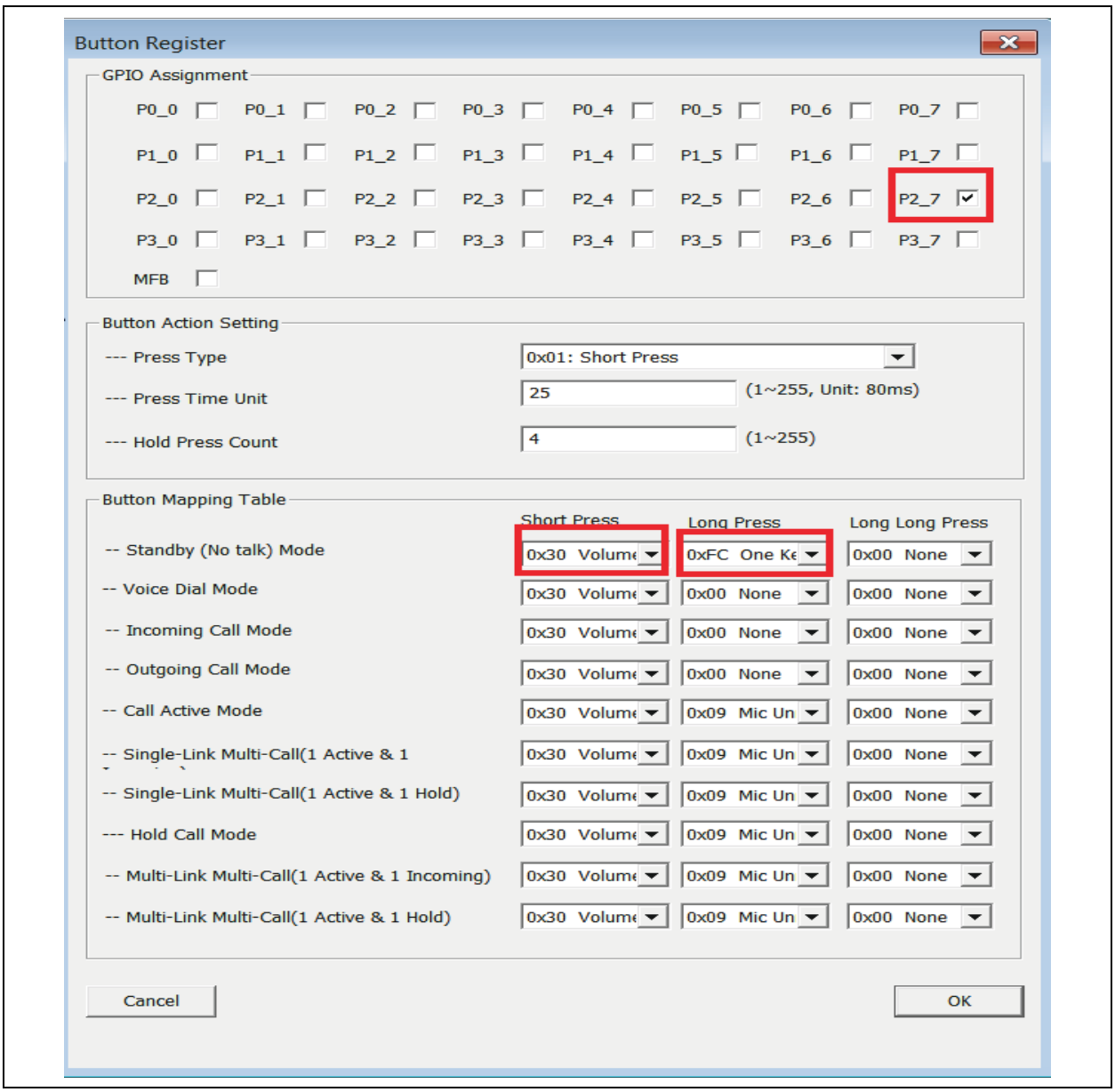


FIGURE 76: MFB BUTTON

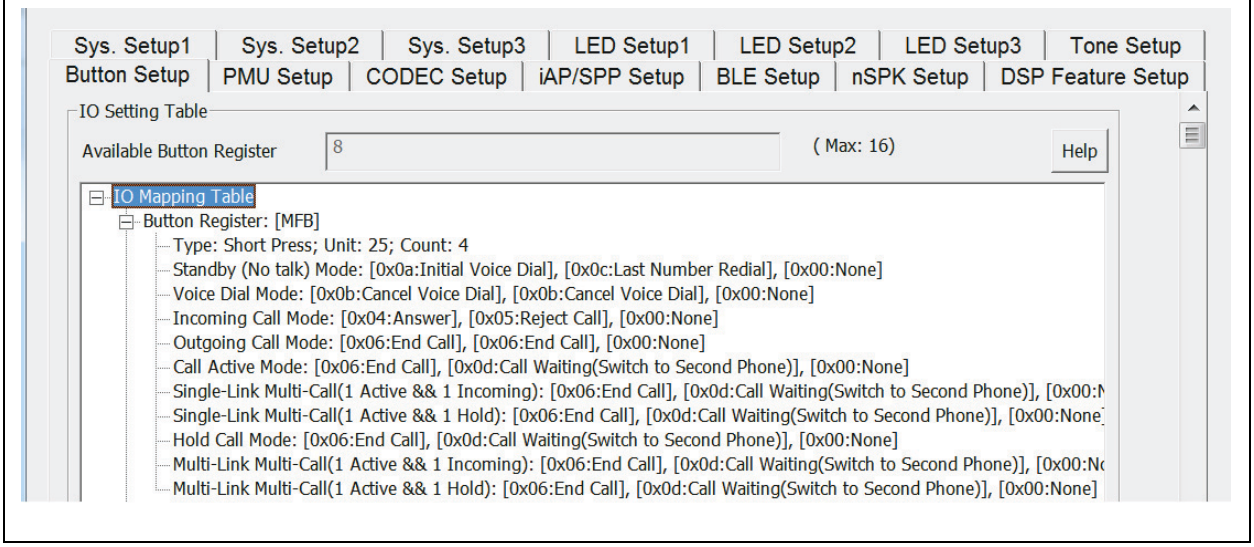


FIGURE 77: GPIO P0_2 IS CONFIGURED FOR PLAY/STOP

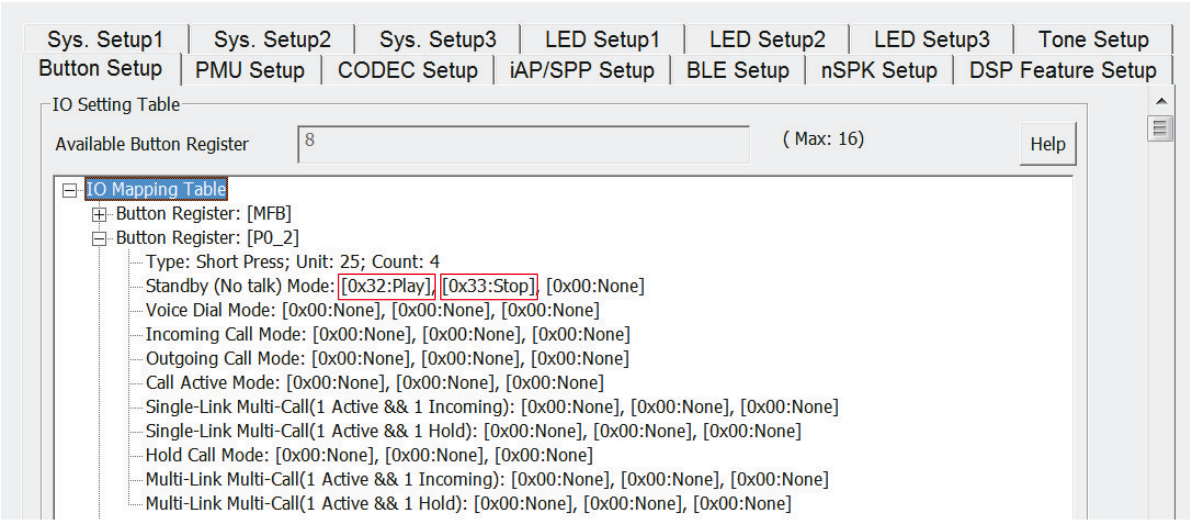


FIGURE 78: GPIO P0_3 IS CONFIGURED FOR BACKWARD/REWIND FUNCTIONALITY

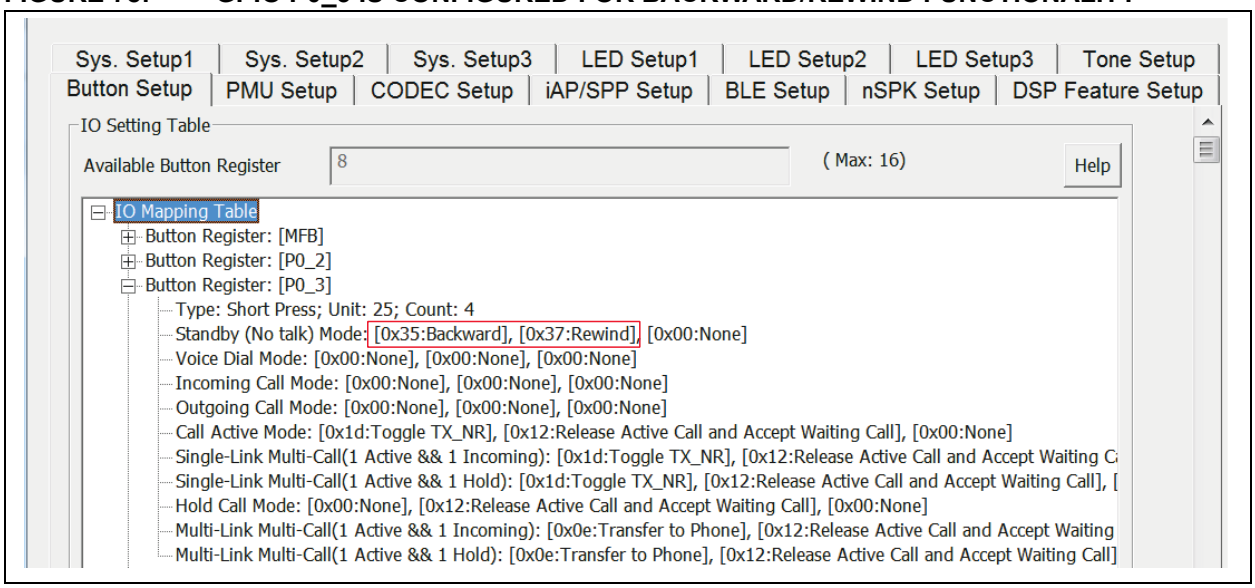


FIGURE 79: GPIO P0_1 IS CONFIGURED FOR FORWARD INITIATION

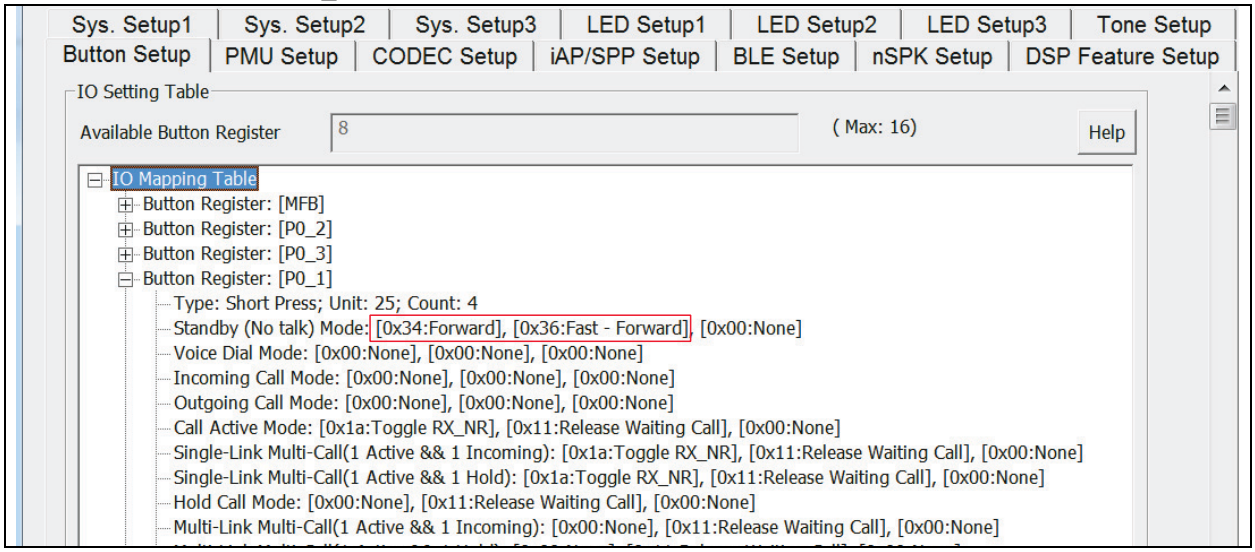


FIGURE 80: GPIO P0_5 IS CONFIGURED FOR VOLUME DOWN AND STEREO MODE ENTRY

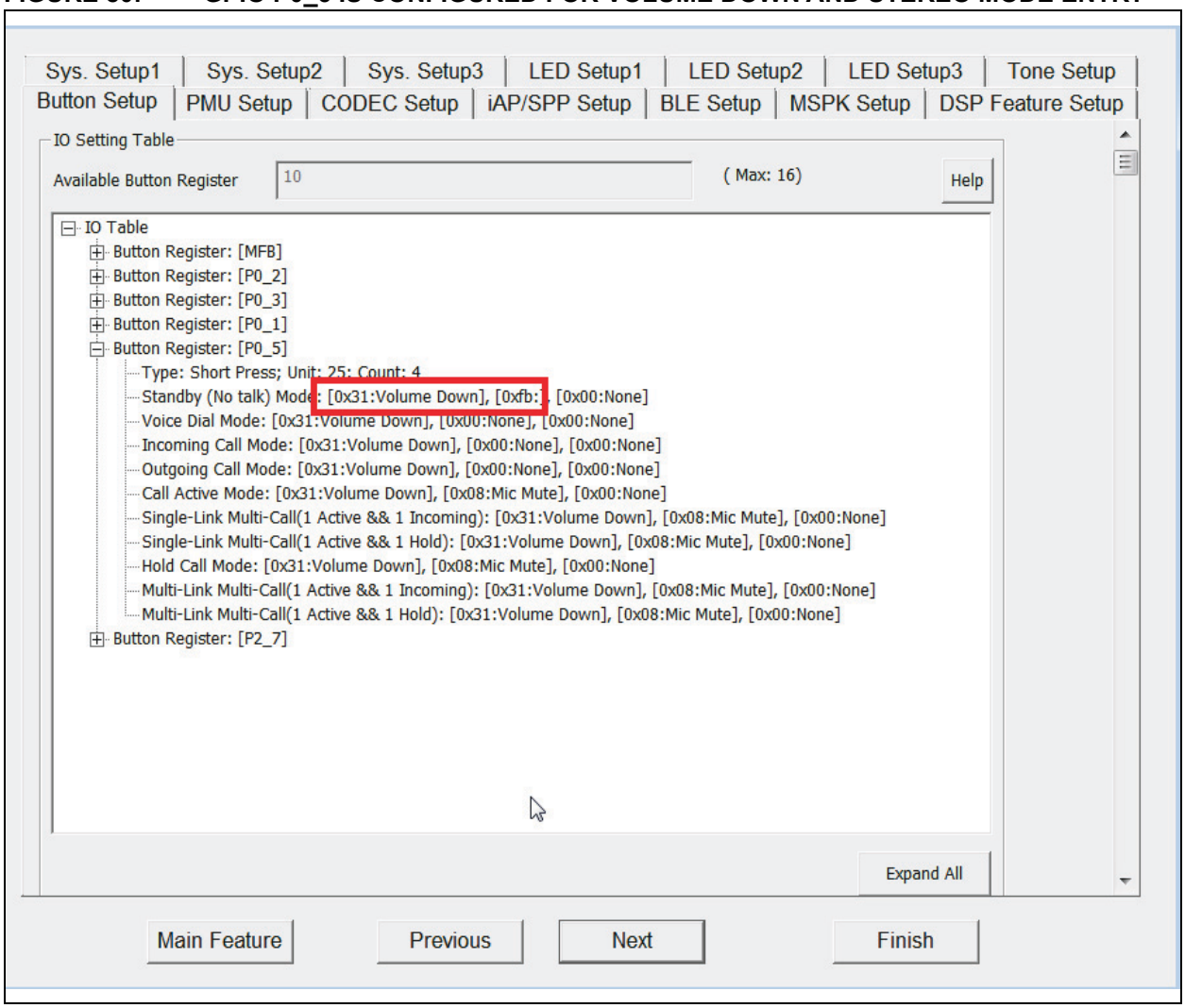
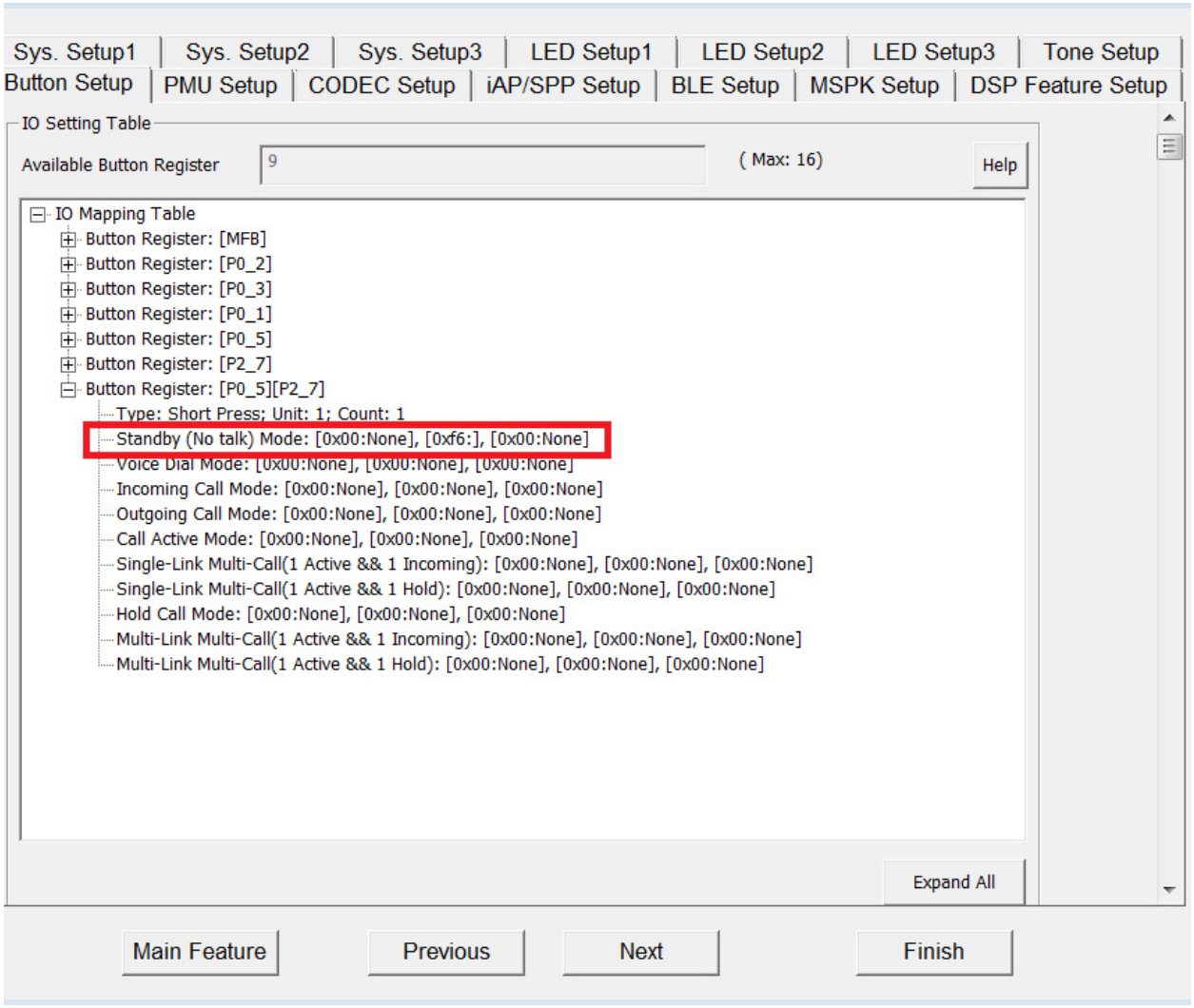


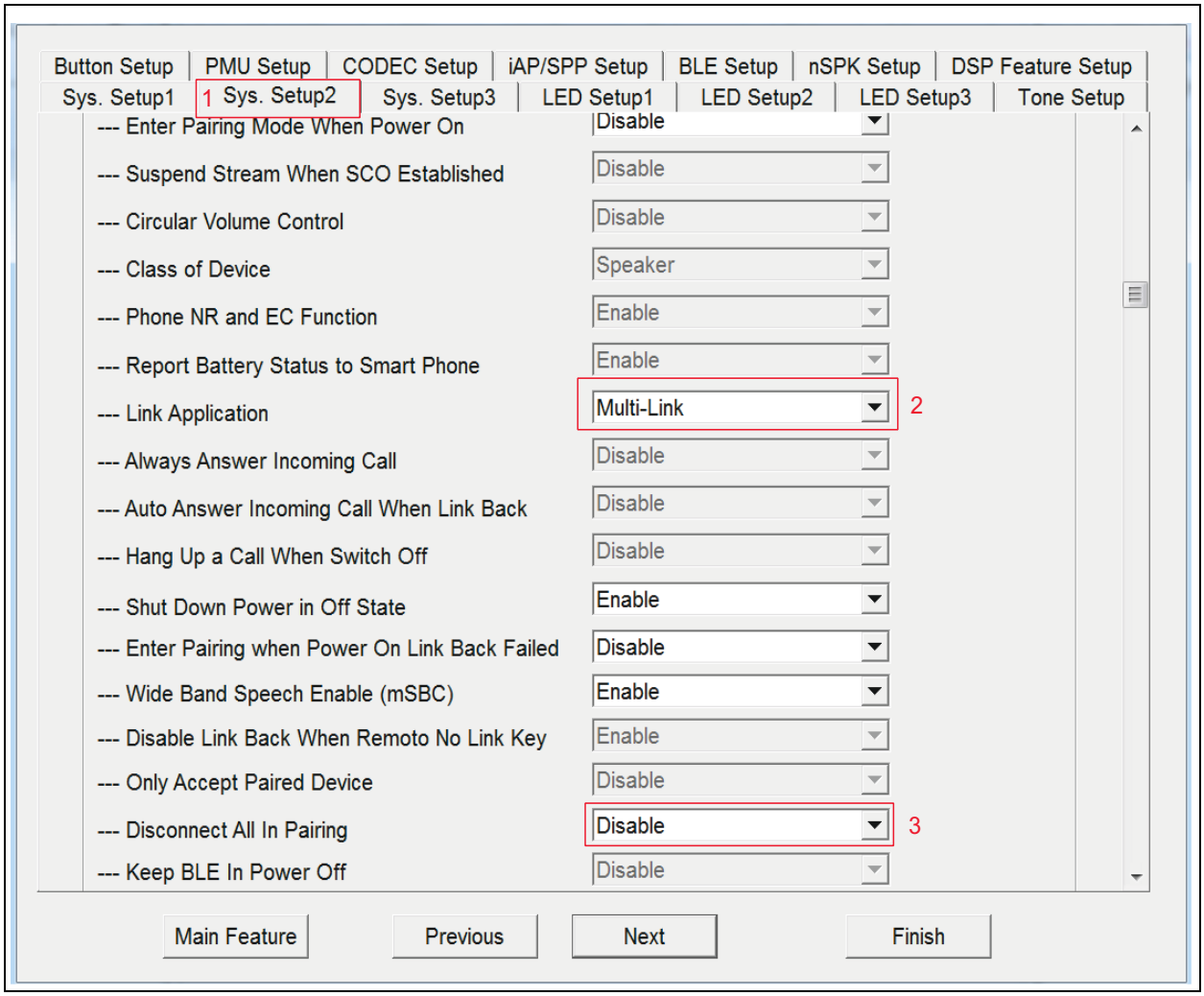
FIGURE 81: GPIO P0_5 AND GPIO P2_7 ARE CONFIGURED FOR ADDING NEW PERIPHERAL IN CONCERT MODE



APPENDIX J: MULTI-LINK

Multi-link feature can be enabled as shown in the following figure.

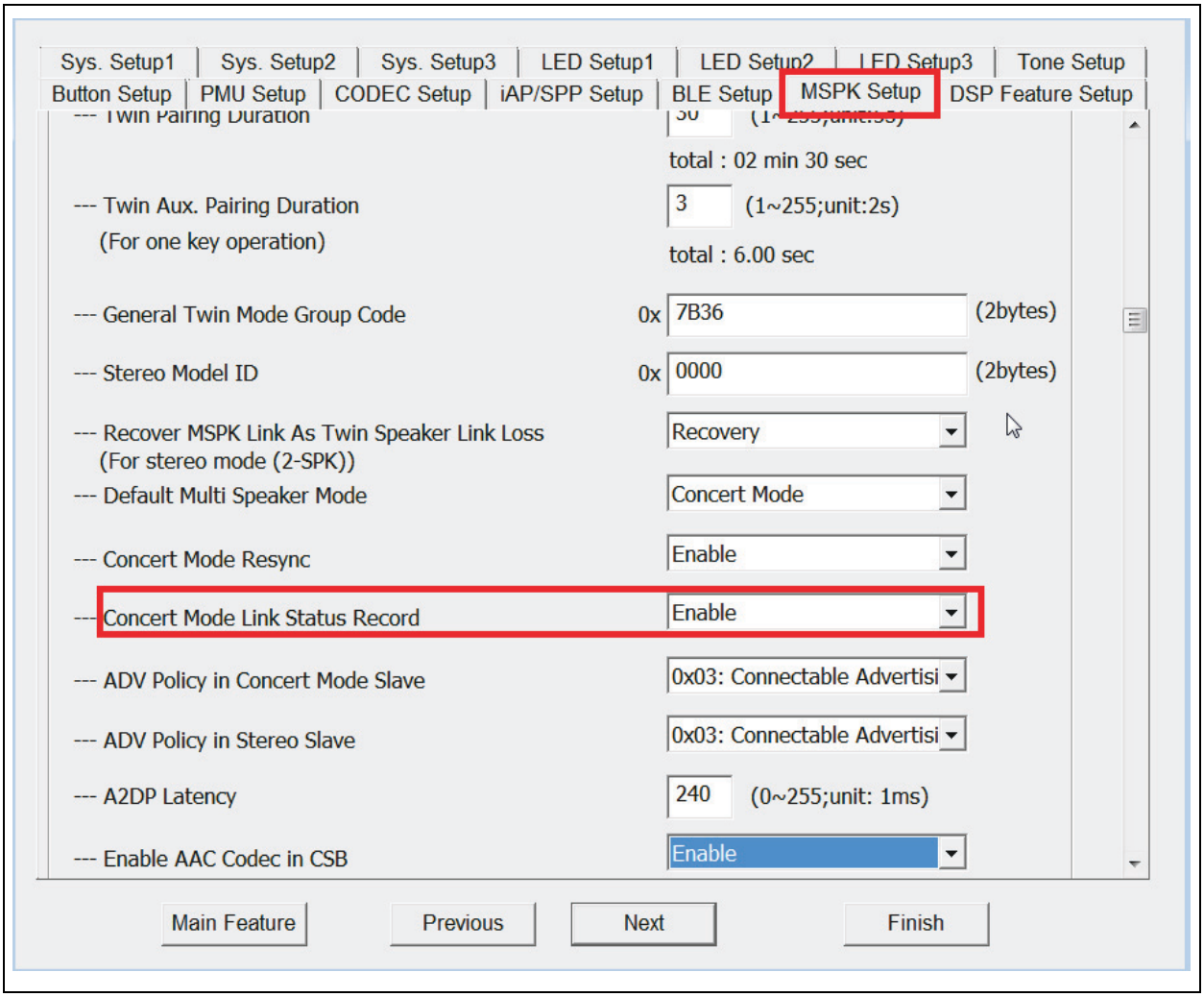
FIGURE 82: MULTI-LINK



APPENDIX K: AUTO RECONNECTION

Auto reconnection feature can be enabled as shown in the following figure.

FIGURE 83: AUTO RECONNECTION



APPENDIX L: DFU- OVER-THE-AIR UPGRADE PROCEDURE

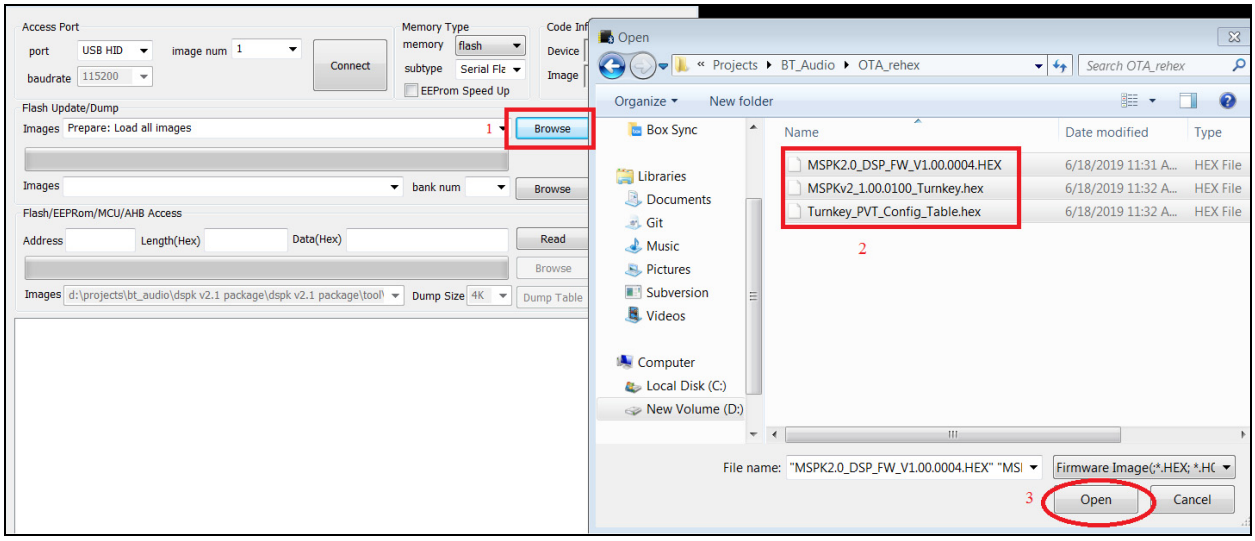
BM83 firmware Over the Air (OTA) upgrade through MBA Android app is discussed in this section. iOS MBA app can also be used and it has similar steps. OTA DFU is supported in both embedded and host mode.

L.1 Rehexing Upgradeable OTA Image

- Here are the steps for rehexings
  - Start isUpdate tool
  - Select 8051, dsp and config settings files as shown in the figure below
  - Click on **Rehex**
  - Select **"BM83 Secured Full Image for OTA DFU"**
  - Leave Key unchanged
  - Give Output File name
  - Click on apply as shown in **Figure 85**

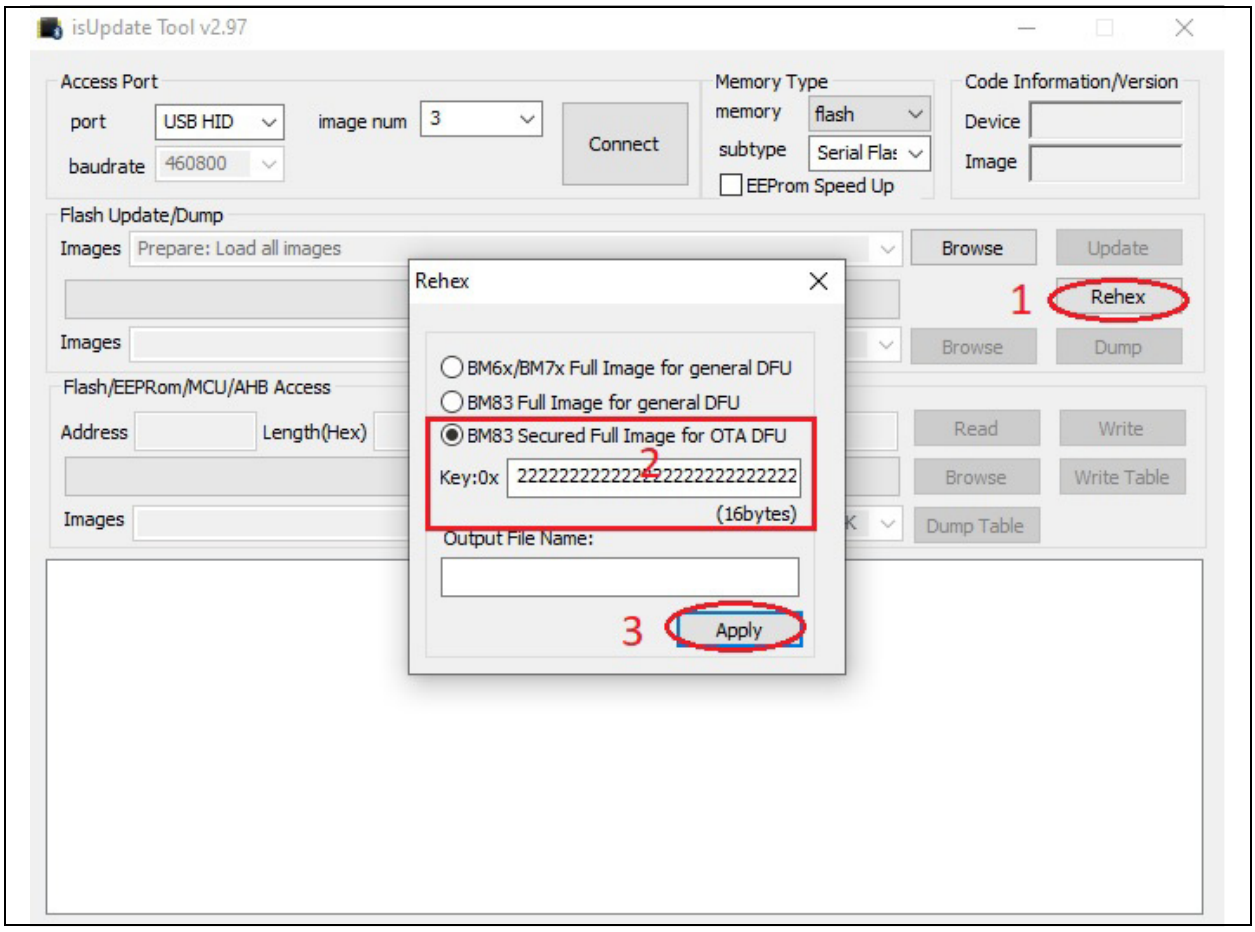
Note: It is recommended that Key be the same as used in Config Settings.

FIGURE 84: OPENING .HEX FILE



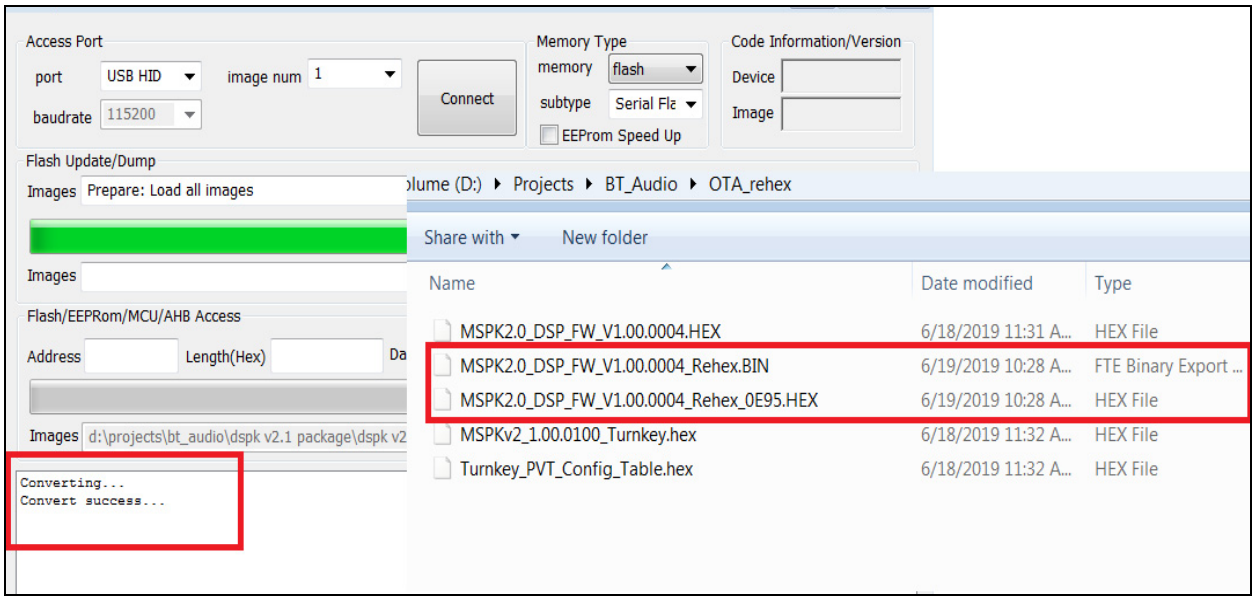
a) Click **Apply** to start rehexing.

FIGURE 85: BM83 OTA DFU USE



Once it is successfully completed, the rehexed image must be available in the same folder as the original image as shown in the following figure.

FIGURE 86: REHEXED IMAGE FILE



L.2 OTA DFU Using Android MBA

1. Install the latest Microchip Bluetooth Audio (MBA) app on the Android device. This app creates /OTA directory in the root of the device.
2. Copy the OTA DFU file created in Appendix L.1 into OTA directory of the Android device.
3. Power On IS2083BM, then start the MBA app.
4. Select BM83 OTA DFU from MBA app as shown in the following figure.
5. Scan Bluetooth devices, then select BLE_BM83SDK.
6. Click on Select OTA File, then select files as shown in Figure 87.

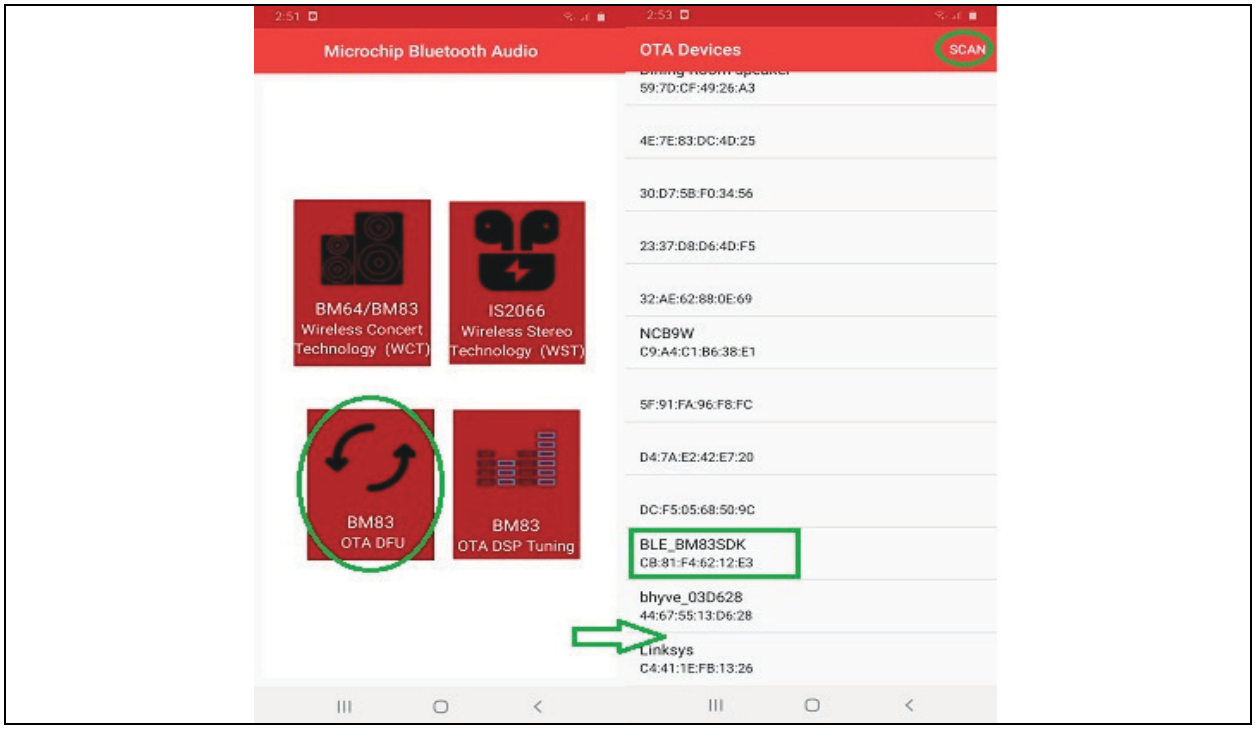
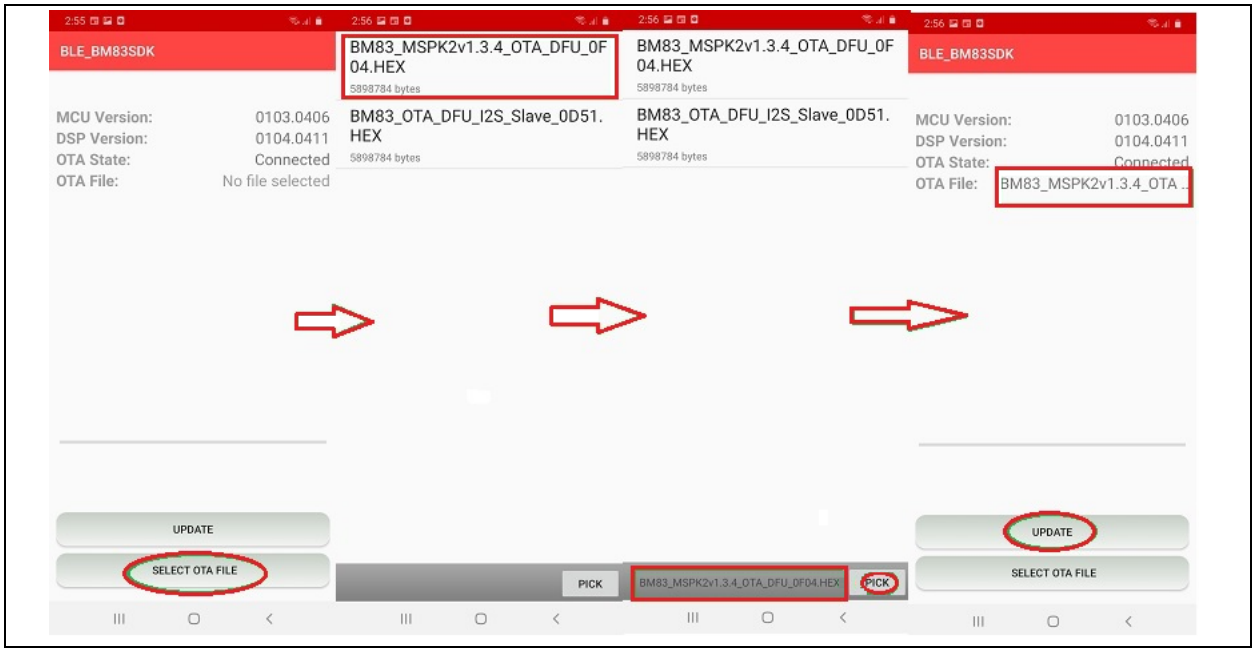
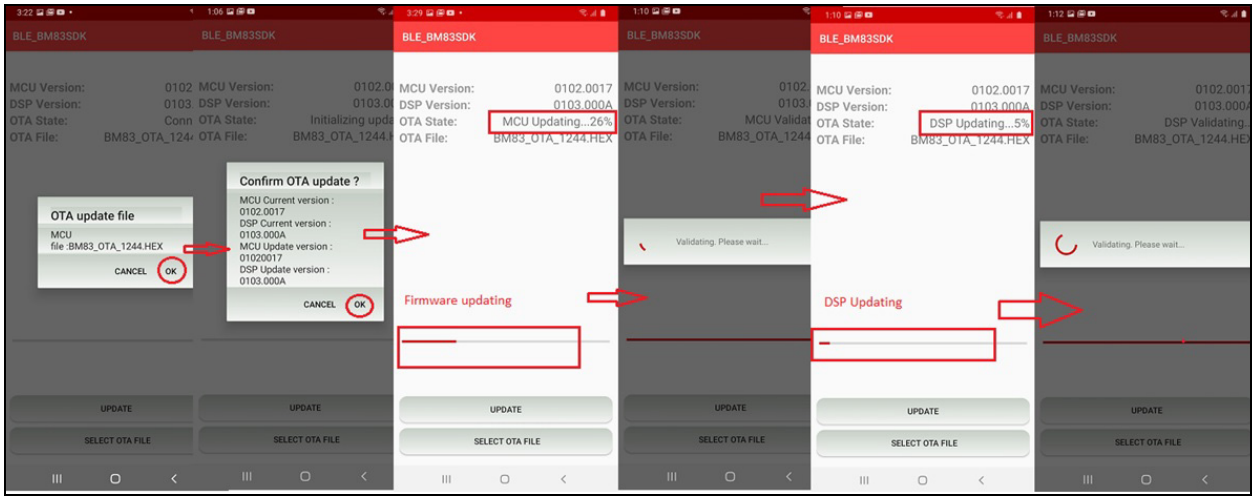


FIGURE 87: SELECTING OTA FILE



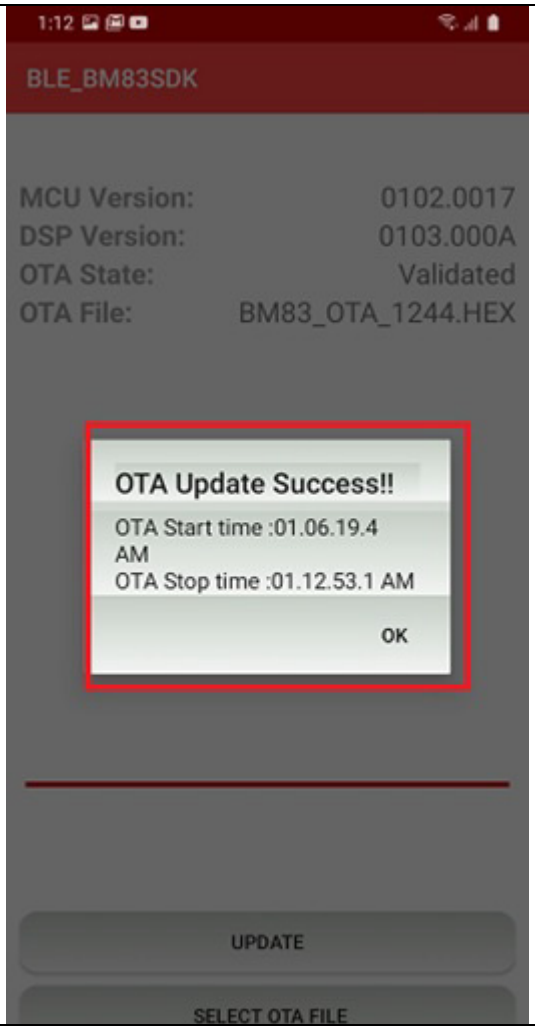
7. Click on **UPDATE** to start the upgrade, as shown in the following figure.

FIGURE 88: UPGRADING OTA



8. Once the upgrade is successful, the mobile displays the completed message.

FIGURE 89: UPDATED MCU VERSION

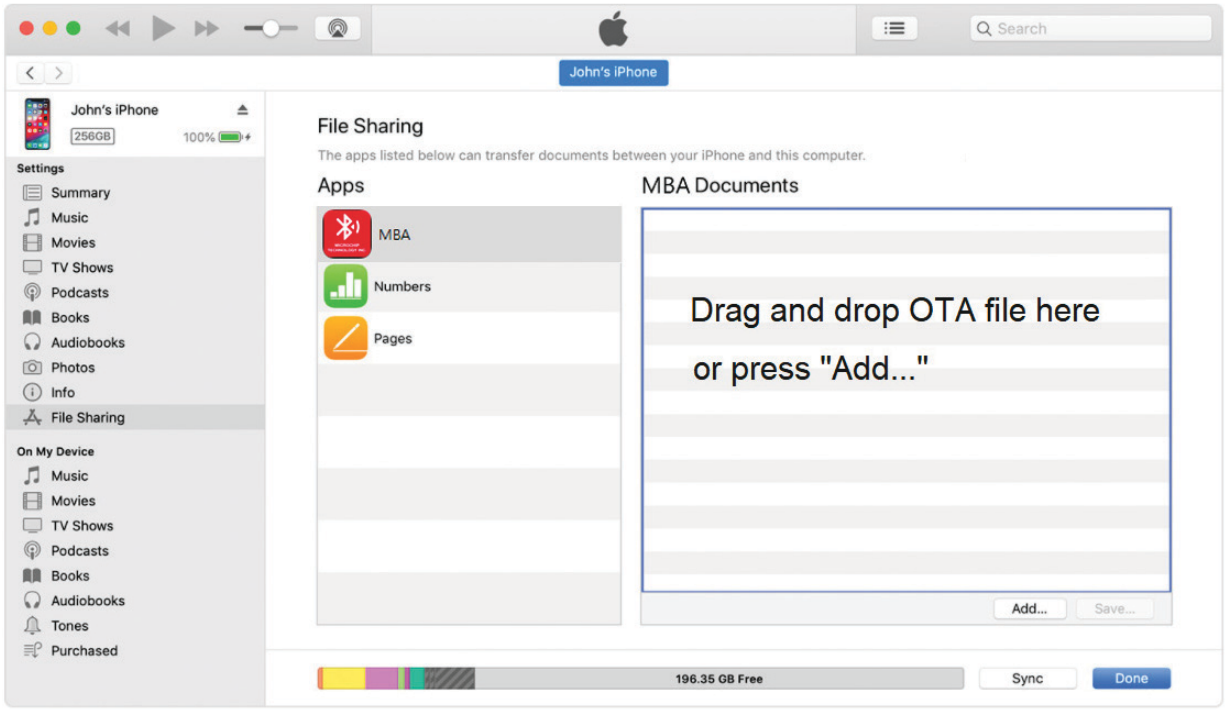


L.3 OTA DFU Using iOS MBA

The MBA iOS App also supports the OTA DFU with a similar procedure. After generating the rehex file using isUpdates tools (**L.1 "Rehexing Upgradeable OTA Image"**), the user can use iTunes to upload the rehex file to iOS.

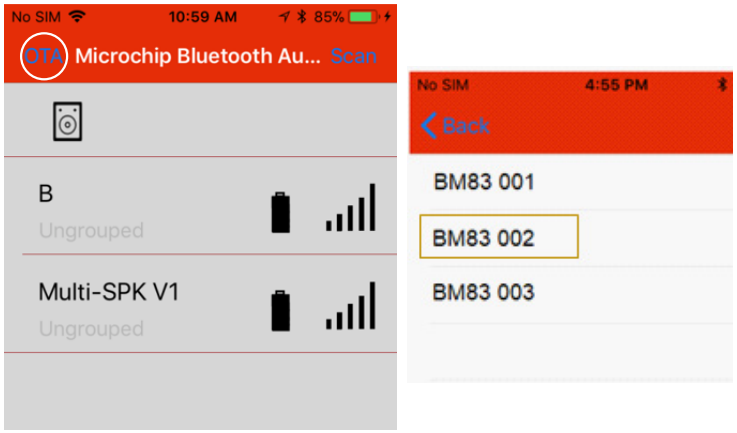
- Open iTunes and perform the following steps:
  - Select the File Sharing section and choose **MBA** in the Apps list.
  - Press **Add…** or drag and drop files from your computer to the "MBA documents" section as described in the following figures.
  - Click **Done** to complete.

FIGURE 90: UPLOADING REHEX FILE TO IPHONE



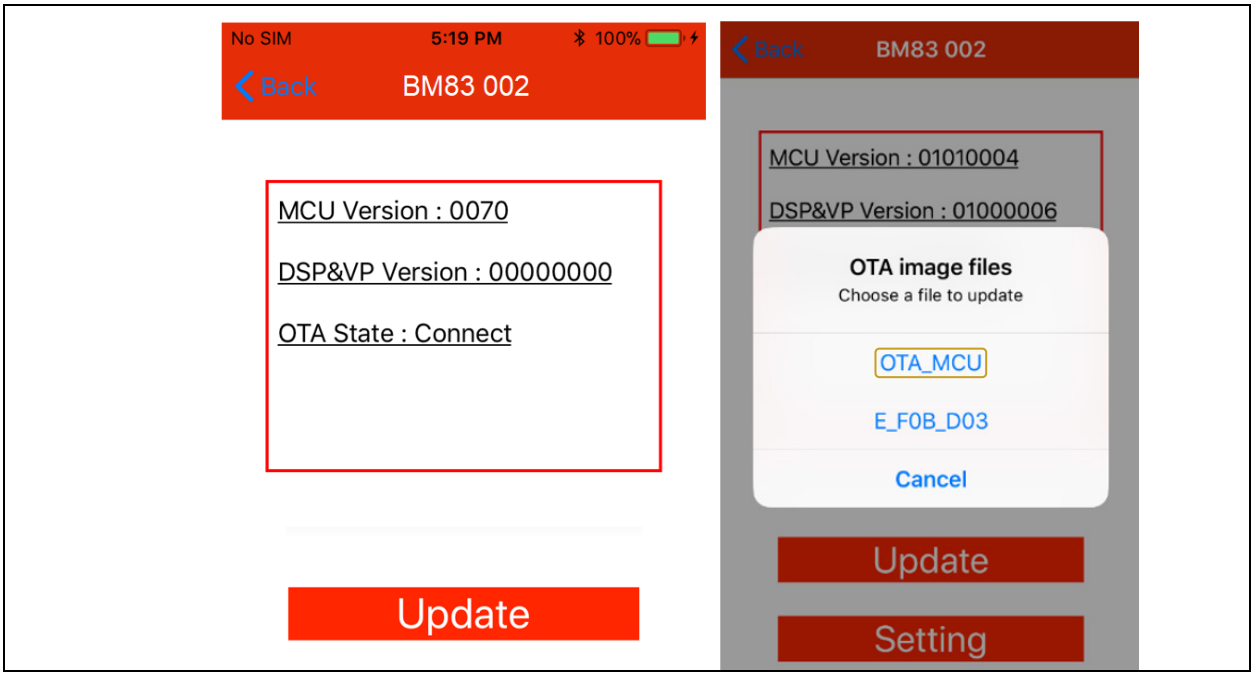
- After launching the iOS MBA application:
  - Press **OTA** on the left-hand corner and it will display a list of available devices.
  - The user can select one of the devices to start the OTA DFU, such as **BM83 002** in the following diagram.
  - The application starts a BLE connection to the devices.

FIGURE 91: OTA DEVICE CONNECTION



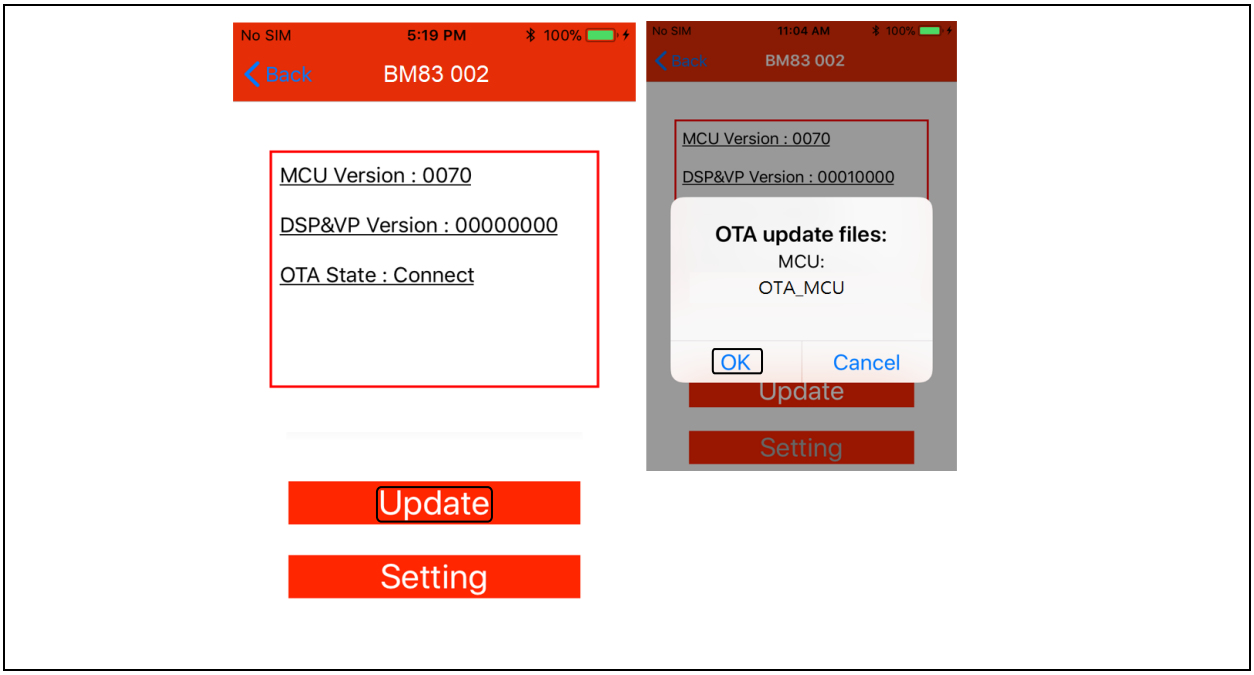
- After connection, it shows the MCU version, DSP & VP version of the connected BM83.
  - The “OTA state” is “Connect”.
  - Clicking **Setting** displays a list of OTA files stored in iOS.

FIGURE 92: OTA DFU FILE SELECTION



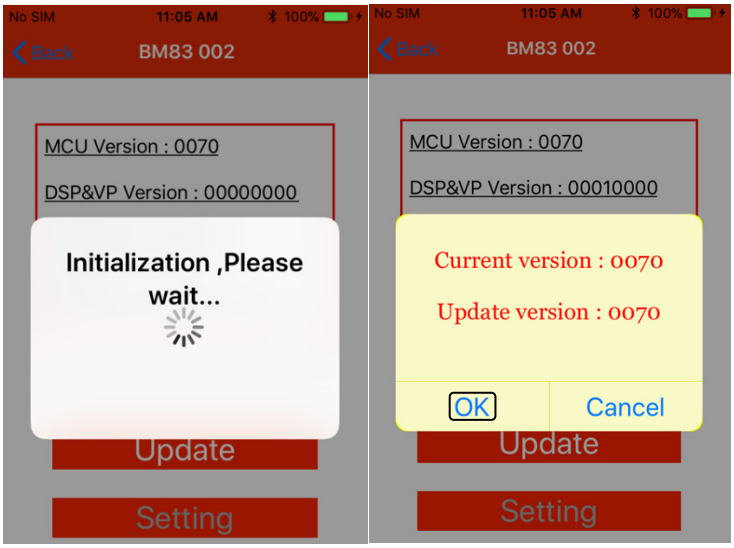
After choosing the files, click **Update**, then click **OK** on the popup to confirm.

FIGURE 93: START OF OTA DFU PROCESS



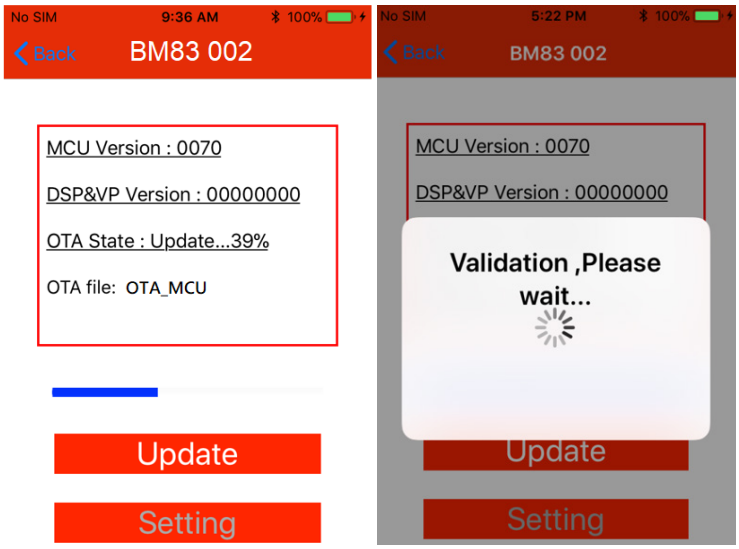
The App starts initialization and displays the software version of the files. The user can compare it with the current version. Press **OK** to start the OTA DFU processes.

FIGURE 94: OTA DFU VERSION COMPARISON



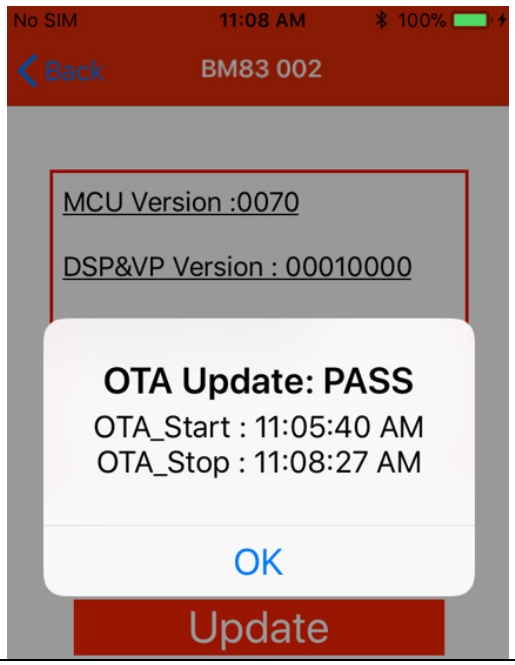
The OTA DFU process starts with a progress bar. The BM83 validates the images after finishing transmission. The App also displays the validation result.

FIGURE 95: OTA DFU UPDATING AND VALIDATING



Finally, BM83 validation is complete. The OTA Update status is Pass and the validation of the OTA DFU completed.

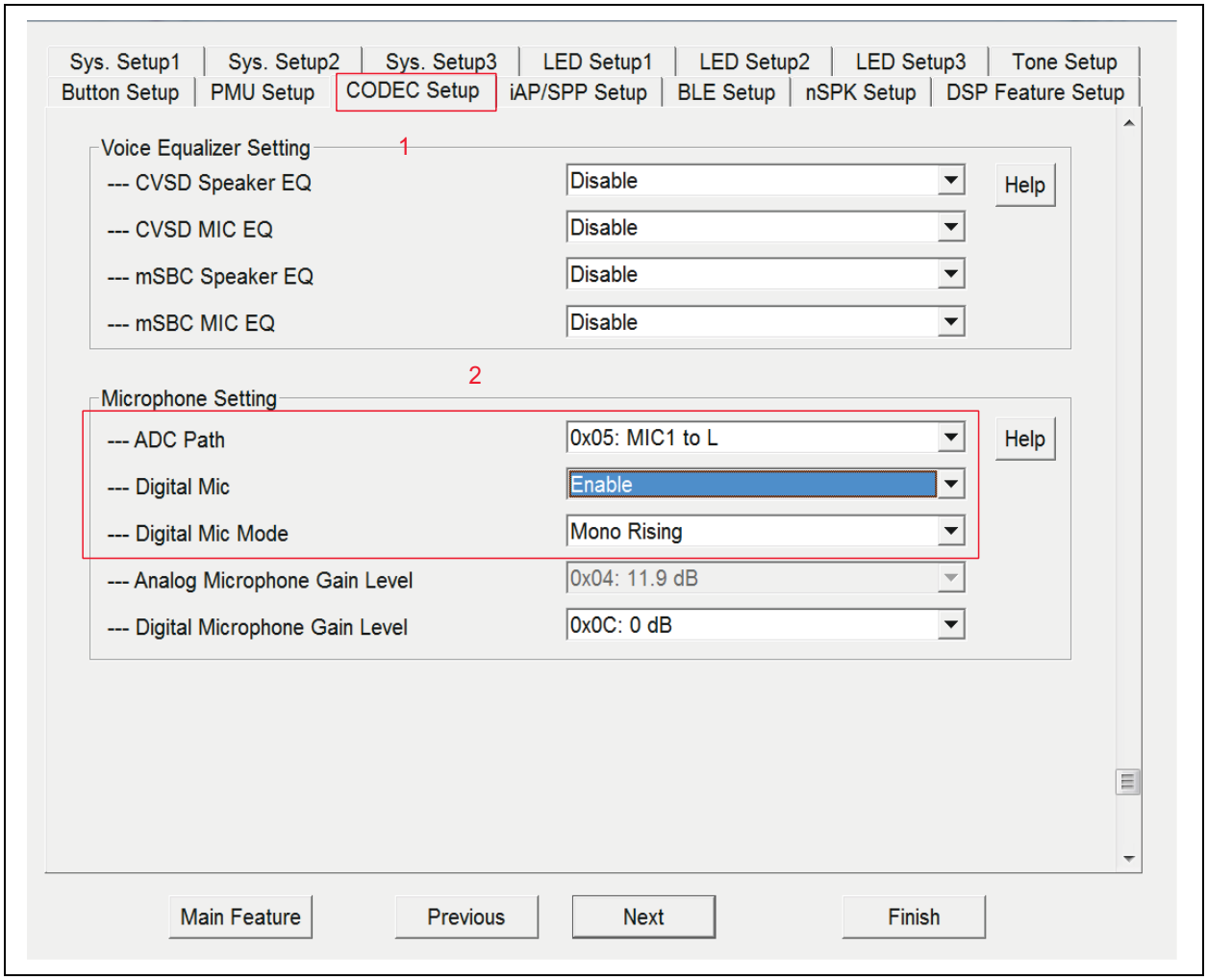
FIGURE 96: OTA DFU COMPLETED



APPENDIX M: ENABLING DIGITAL MIC

BM83/IS208x supports digital MIC. Digital MIC can be enabled as shown in the following figure.

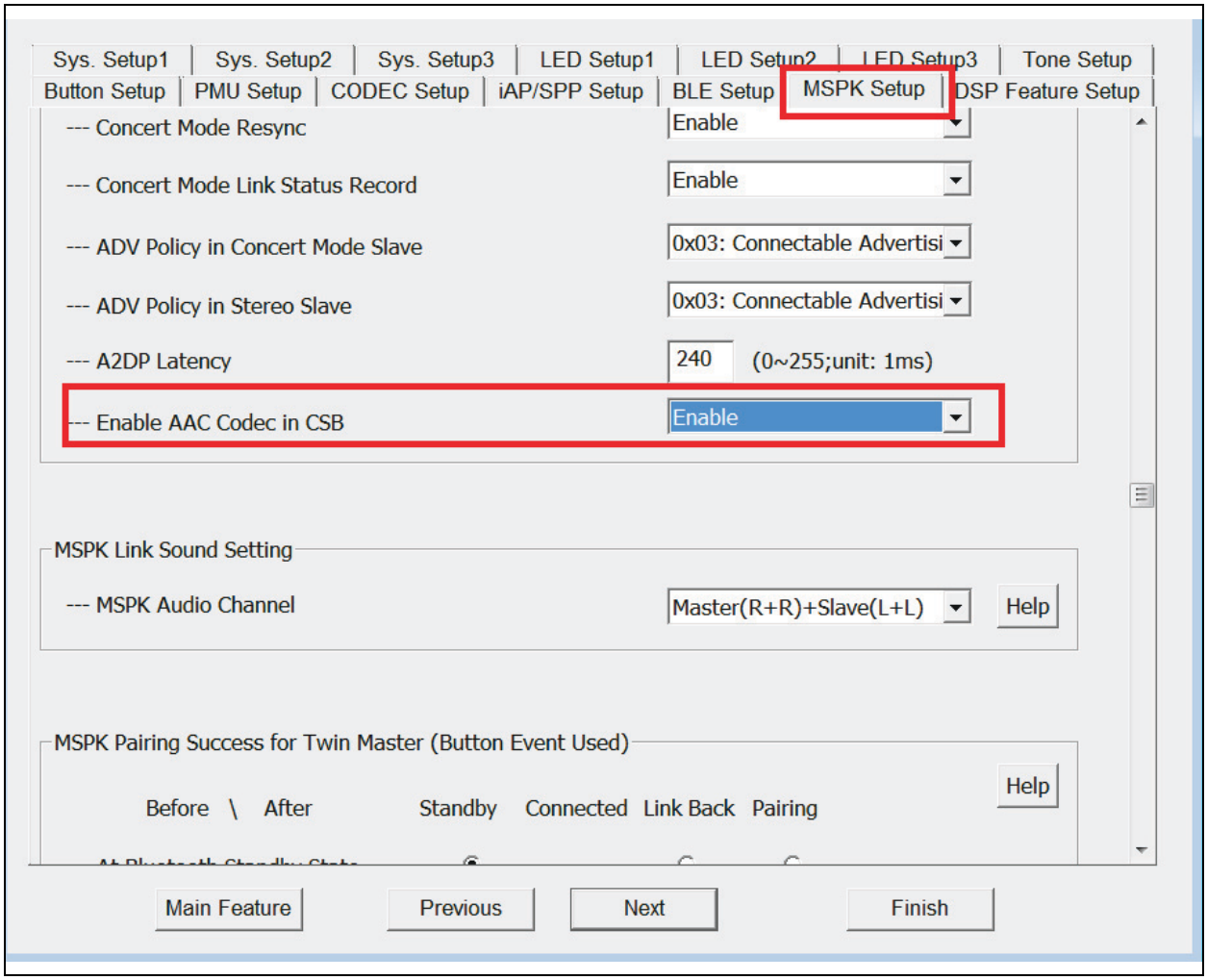
FIGURE 97: ENABLING DIGITAL MIC



APPENDIX N: ENABLING AAC ENCODING IN CONCERT/STEREO MODE

MSPK supports Concert/Stereo mode in SBC encoded audio. AAC encoding is also supported by enabling the feature as shown in the following figure.

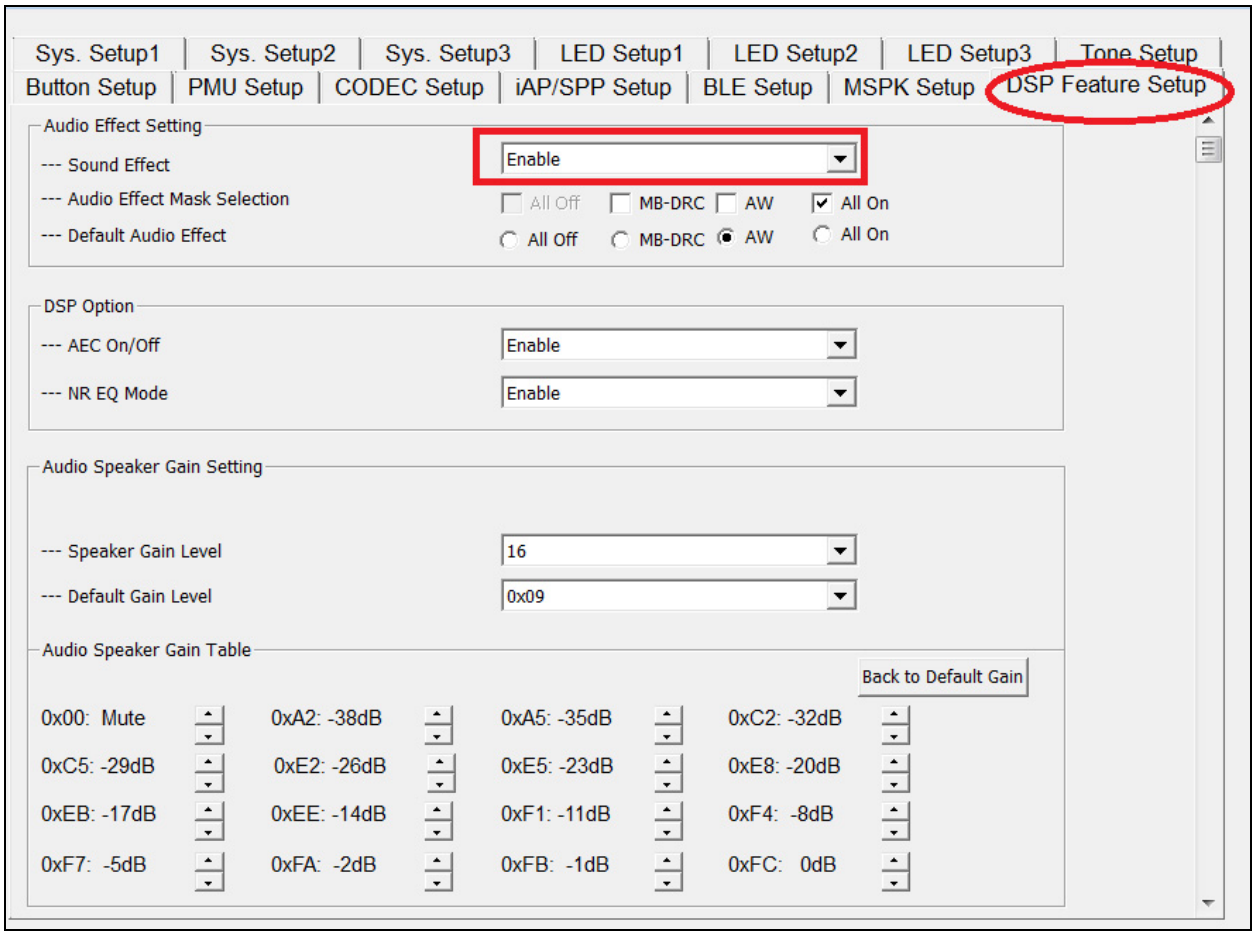
FIGURE 98: ENABLING AAC ENCODING



APPENDIX O: ENABLING INTERNAL DSP AUDIO EFFECTS

Internal DSP audio effects can be enabled as shown in the following figure. The “Audio Effect - Mask Selection” is to select the combinations of audio effects, that can be selected by checkboxes All Off, MB-DRC, AW and All On. “Default Audio Effect” parameter is to select the initial audio effect mode, after the device is power-on.

FIGURE 99: ENABLING INTERNAL DSP AUDIO EFFECTS



APPENDIX P: USING IOS MBA FOR OTA DSP TUNING

An iOS MBA supports OTA DSP tuning through Bluetooth Low Energy from v1.5.5 to configure the DSP parameters of audio and voice path. When the iOS MBA enters DSP tuning, MBA will load the DSP parameters from the connected BM83. During A2DP/ aux-in music playback (audio function), and HFP/HSP (voice function), the user can tune the parameters in real-time basis. Once the audio output performance is tuned, the App can export a HEX file in the Config GUI tool in order to obtain those audio and voice parameters.

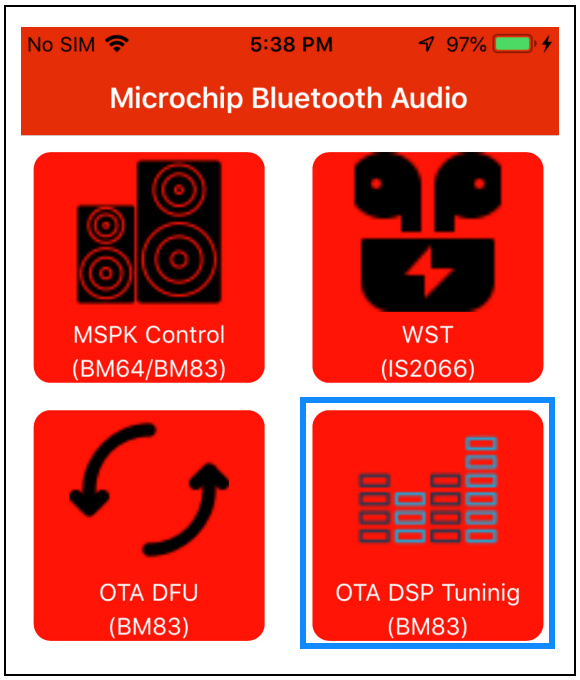
P.1 Audio and Voice Tuning

The user can perform the following steps to access the OTA DSP Tuning:

- Open the Microchip Bluetooth Audio application and tap **OTA DSP Tuning (BM83)** (see the following figure) to find the Bluetooth device, and select the device from the list for tuning.

Note: The IS2083 firmware provides the proprietary Bluetooth Low Energy service for DSP tuning.

FIGURE 100: OTA DSP TUNING



- The following figure shows the functions that are supported by OTA DSP Tuning.

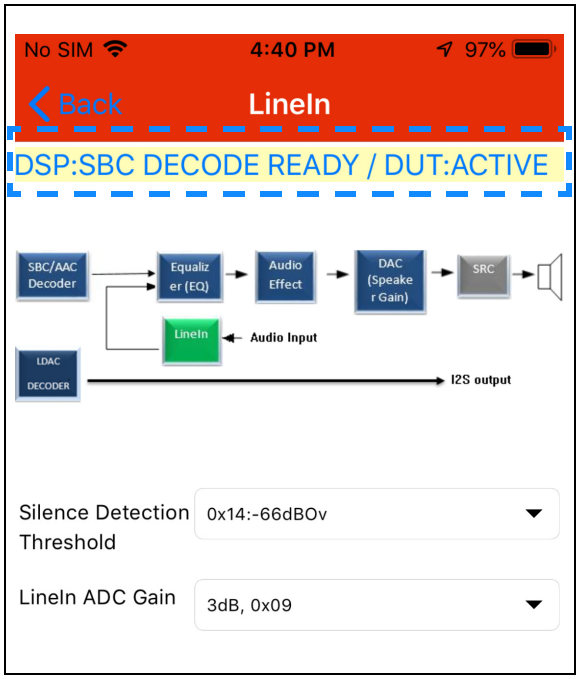
TABLE 5-1: DYNAMIC OTA DSP TUNING FUNCTIONS

Function	Description	Remark
Audio	DSP parameters tuning during A2DP/ Aux-in music playback	Aux-in, sound effect, EQ
Voice	DSP parameters tuning during phone call through HFP	Filter, Noise Reduction, EQ, Mic Gain, Comfort noise, AEC/AES
Dynamic Tuning Commands(1)	Device control: - Factory reset - Reset DSP - Reset DUT - Save to Flash - Reset Parameters	Reset and save commands
Export DSP Tuning Data(1)	Exporting DSP parameters in a file	File can be accessed through iTunes

Note 1: Dynamic Tuning Commands and Export DSP Tuning Data will be available after loading DSP parameters from BM83.

- Tuning is available only in A2DP/Aux-in music playback, or phone call through HPF.
- After entering any of these options, the user can find the status under DSP/DUT.

FIGURE 102: DSP/DUT STATUS



- For example, the preceding figure shows that the DSP status is SBC DECODE READY and DUT is ACTIVE for the selected Bluetooth device. The following table shows the list of DSP and DUT statuses and their descriptions:

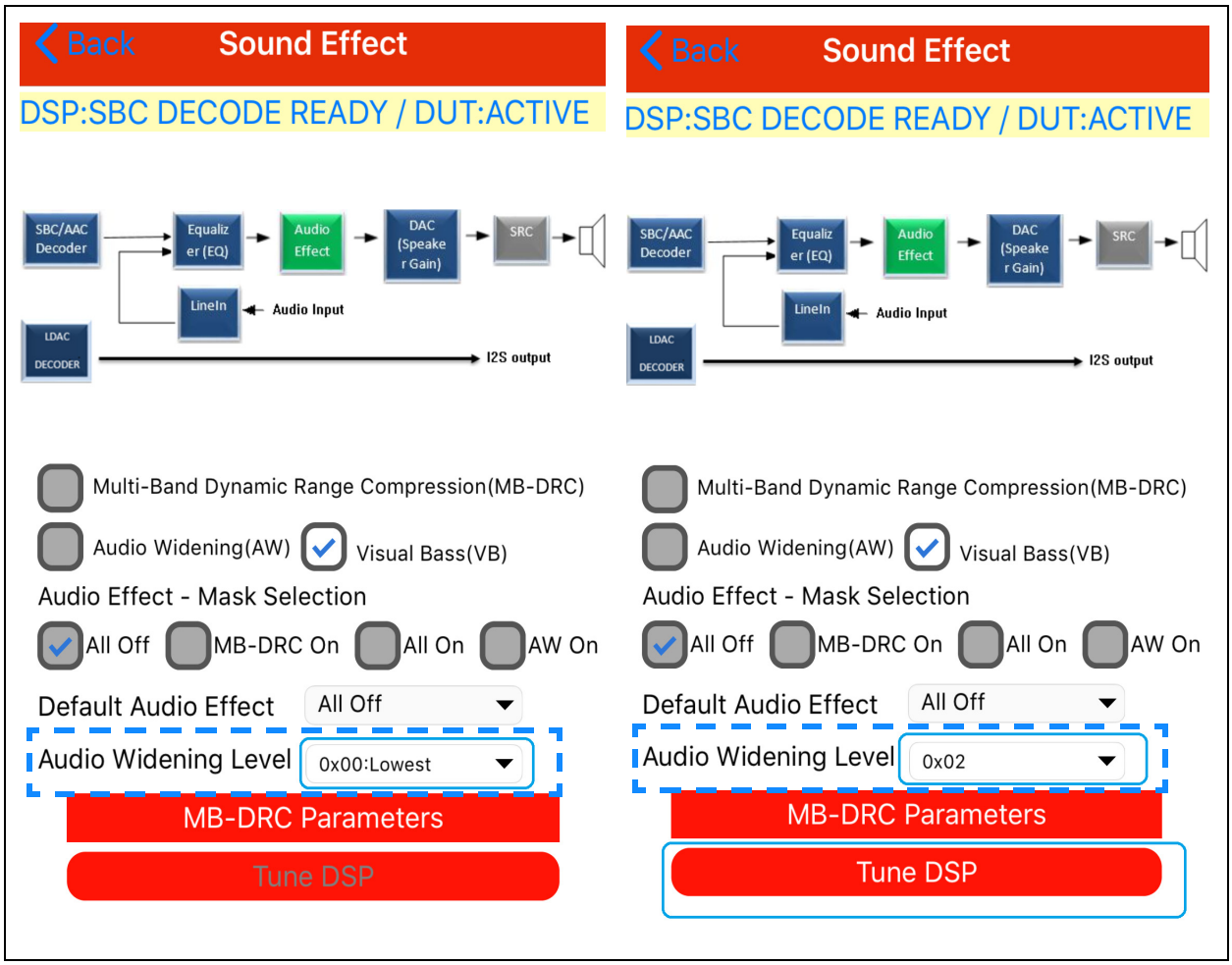
TABLE 5-2: DSP AND DUT STATUS DESCRIPTIONS

Status	Description
DSP Status	
STANDBY	DSP codec is on but idle and in this stage, the parameters cannot be tuned
SBC DECODE READY	A2DP: SBC codec is active for music playback and the audio function can be tuned.
SCO Ready	HFP: SCO link is active for phone call and the voice function can be tuned
DUT Status	
OFF	Power OFF
Standby	Power ON, but in idle
Paging	Power ON, paging the last connected device
Pairing	Power ON, pairing
Active	Power ON, the device is connected

P.1.1 A2DP MUSIC PLAYBACK TUNING

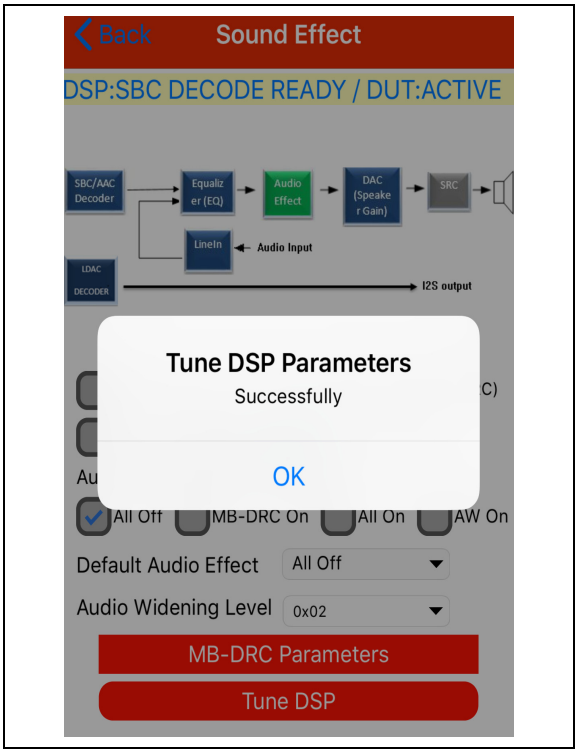
The following images illustrate the GUI pages which allow a user to tune up the audio function parameters. For example, to tune the Audio Widening Level, select the appropriate value for Audio Widening Level and the Tune DSP option will be enabled in order to tune the audio function in real time (see the following figure).

FIGURE 103: TUNING A2DP AUDIO WIDENING LEVEL EXAMPLE



- Upon successful tuning, the message shown in the following figure appears:

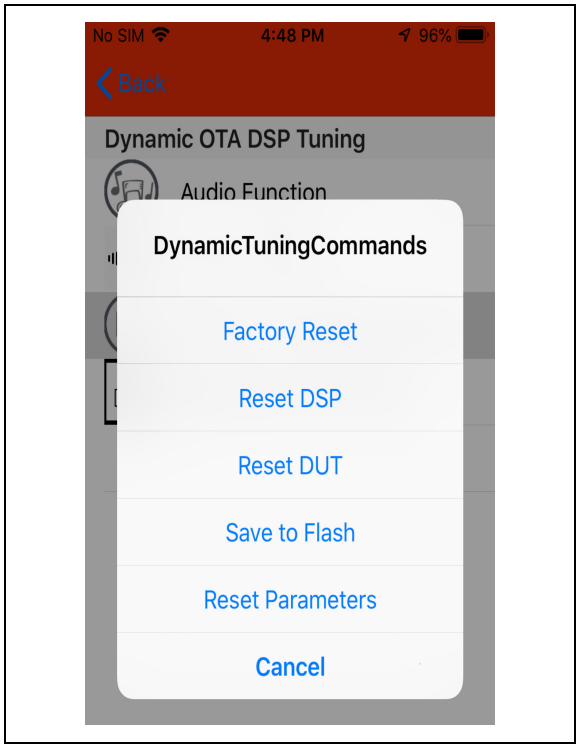
FIGURE 104: STATUS OF SUCCESSFUL TUNING MESSAGE



P.1.2 DYNAMIC TUNING COMMANDS

The following set of commands (see following figure) are used for tuning the parameters effectively:

FIGURE 105: DYNAMIC TUNING COMMANDS



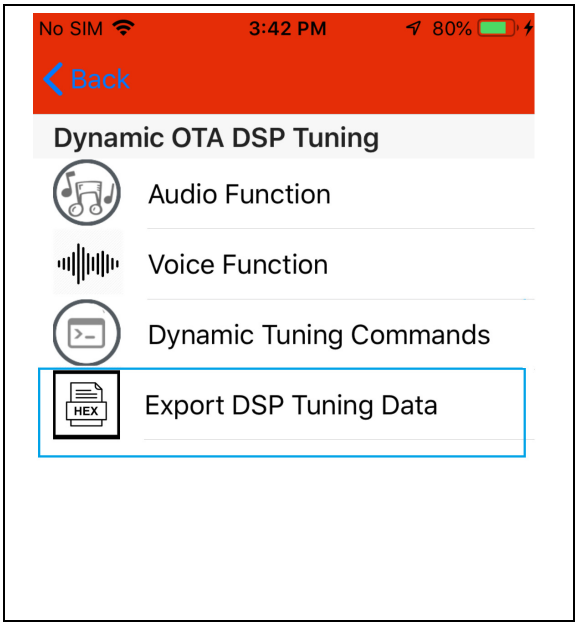
- Reset Parameters
  - Reload the parameters from Flash. All the unsaved parameters will be Reset
- Reset DSP
  - Reset DSP of the IS2083
- Reset DUT
  - Reset IS2083 (8051 and DSP) and all the parameters will be Reset
- Save Parameters to Flash
  - Save the tuned parameters to Flash (runtime section) to in order to bring back the saved parameters after the power cycle
- Restore Factory Default Settings
  - Restore the parameters to factory settings and Reset the IS2083 after restoring the parameters

P.1.3 EXPORTING TUNED PARAMETERS

The MBA application can save all the audio and voice function parameters into a HEX file. This file can be accessed through the Config GUI Tool.

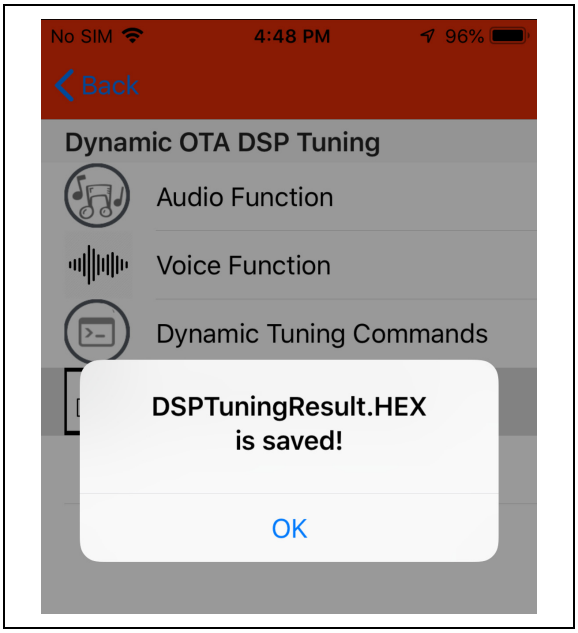
- To export these parameters, tap Export DSP Tuning Data in MBA application under Dynamic OTA DSP Tuning as shown in the following figure:

FIGURE 106: EXPORTING DSP PARAMETERS



- Upon successfully exporting a HEX file, the following message will appear.

FIGURE 107: EXPORTED PARAMETERS



- An exported `DSPTuningResult.HEX` file will be stored in iDevices folder.
- This settings (HEX) file contains audio and voice function parameters only. This settings file can be merged with other HEX files using the Config GUI Tool.

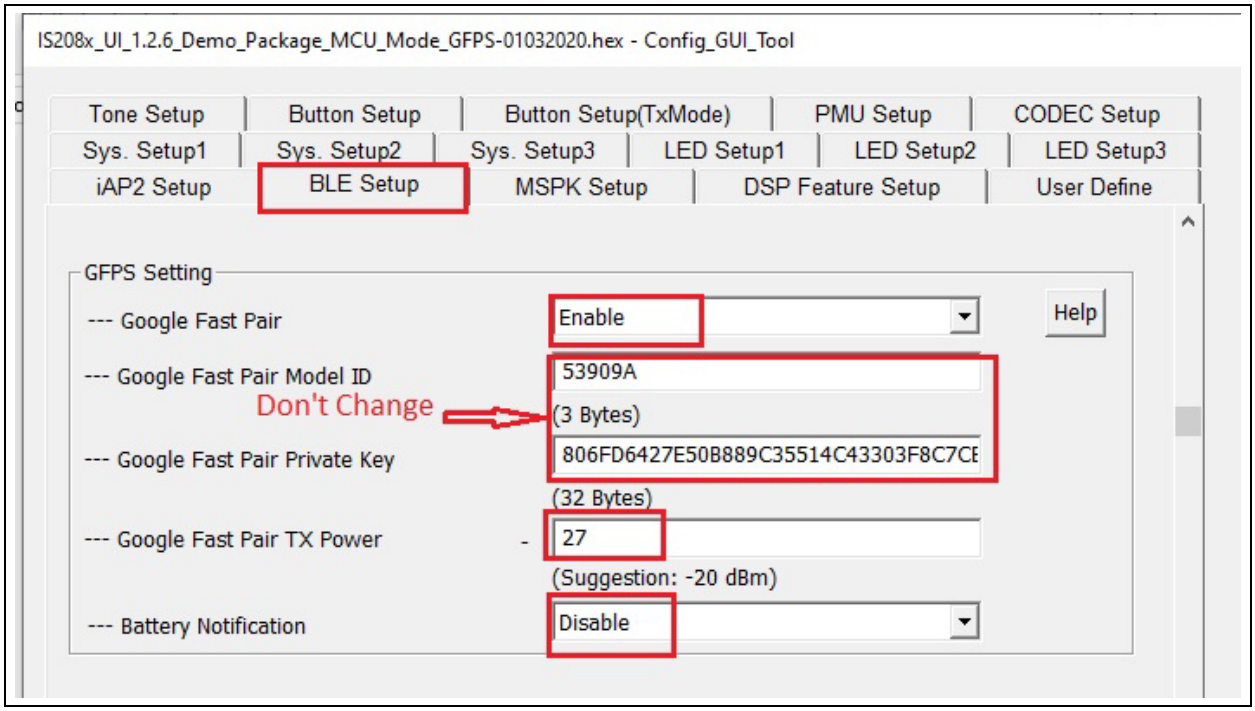
APPENDIX Q: ENABLING GOOGLE FAST PAIRING FEATURES

Q.1 Enabling GFP in Config GUI Tool

To enable Google Fast Pair using the Config GUI Tool:

1. Open the Config GUI Tool and go to the **BLE Setup** tab as shown in the following figure.

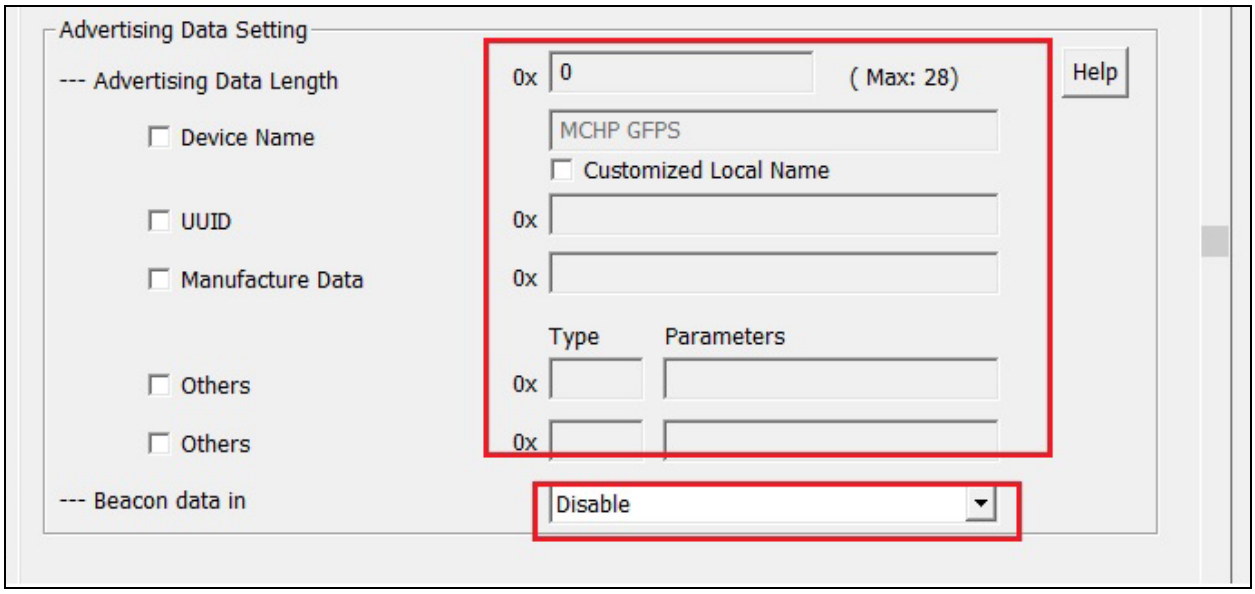
FIGURE 108: ENABLING GFP USING CONFIG GUI TOOL



Note: By default, the Model ID and Private Key are assigned by Google. Thus, DO NOT change these values.

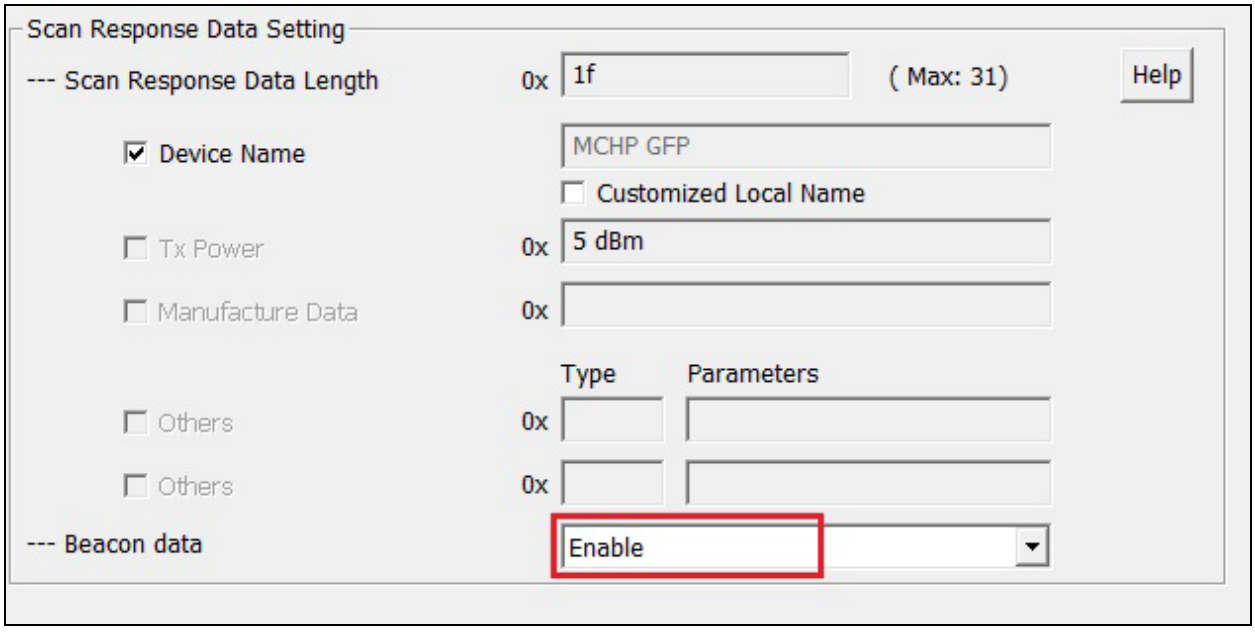
2. The default value of TX Power is -27 dB and can be changed.
3. Battery level can be Enabled/Disabled.
4. Advertising Data Setting will be greyed out as shown in the following figure.
5. Beacon data can be disabled using the Config GUI Tool as shown in the following figure.

FIGURE 109: DISABLING BEACON DATA IN CONFIG GUI TOOL



6. In Scan Response Data Setting:
   - Audio Beacon data can be enabled by default setting for the MBA feature.
   - Device Name must be consistent with the Bluetooth device name and the maximum length is 8 Bytes. The following figure shows the Scan Response Data Setting.

FIGURE 110: SCAN RESPONSE DATA SETTING USING CONFIG GUI TOOL



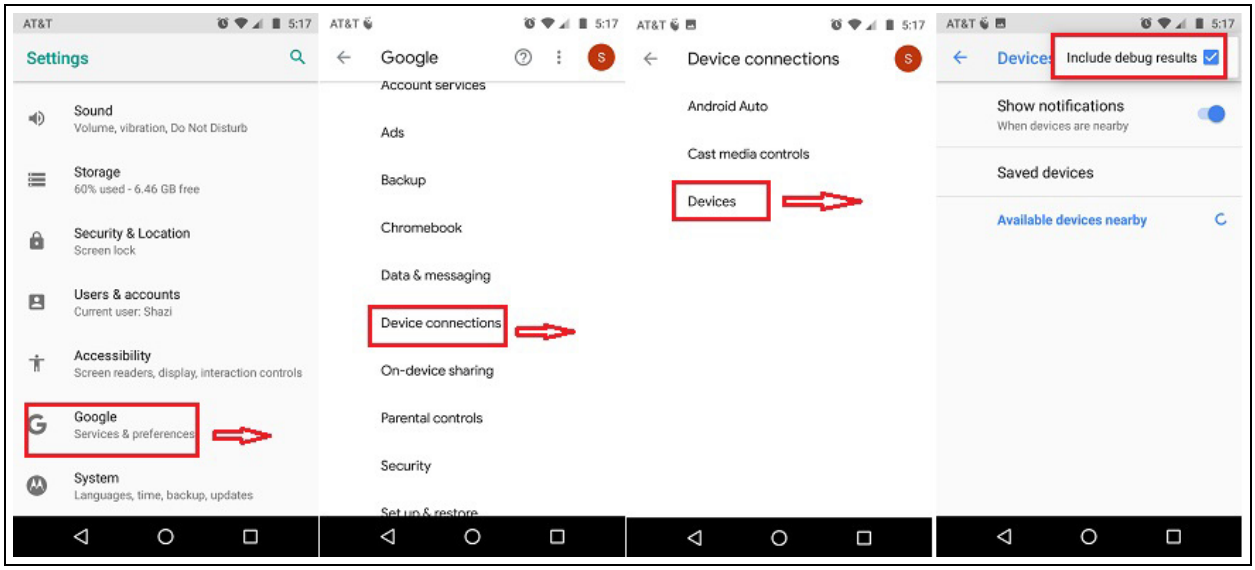
Q.2 Enabling GFP on the Android Phone

To enable the GFP feature on an Android phone:

1. The Android phone must be connected to the Internet (Mobile Network/Wi-Fi).

2. According to the policy mentioned in the Google Fast Pair official website (https://developers.google.com/nearby/fast-pair/help), the model ID of the BM83 registered on Google will be in Debug mode as the BM83 is not an end product. Therefore, it is recommended to enable the “Include debug results” option in the Android phone to enable the Google Fast Pair feature. For more details, refer to https://developers.google.com/nearby/fast-pair/help#debug_model_id.
3. Go to Settings in your Android phone -> Google -> Device Connections -> Devices and then include debug results as shown in the following figure.

FIGURE 111: ENABLING GFP OPTION IN ANDROID PHONE



4. GFP advertising will be deactivated under the below cases:
   - LE is connected
   - Stereo/Concert mode is establishing
   - BM83 is connected as peripheral role in Stereo/Concert mode
   - The connected device number reaches the maximum limit of three devices

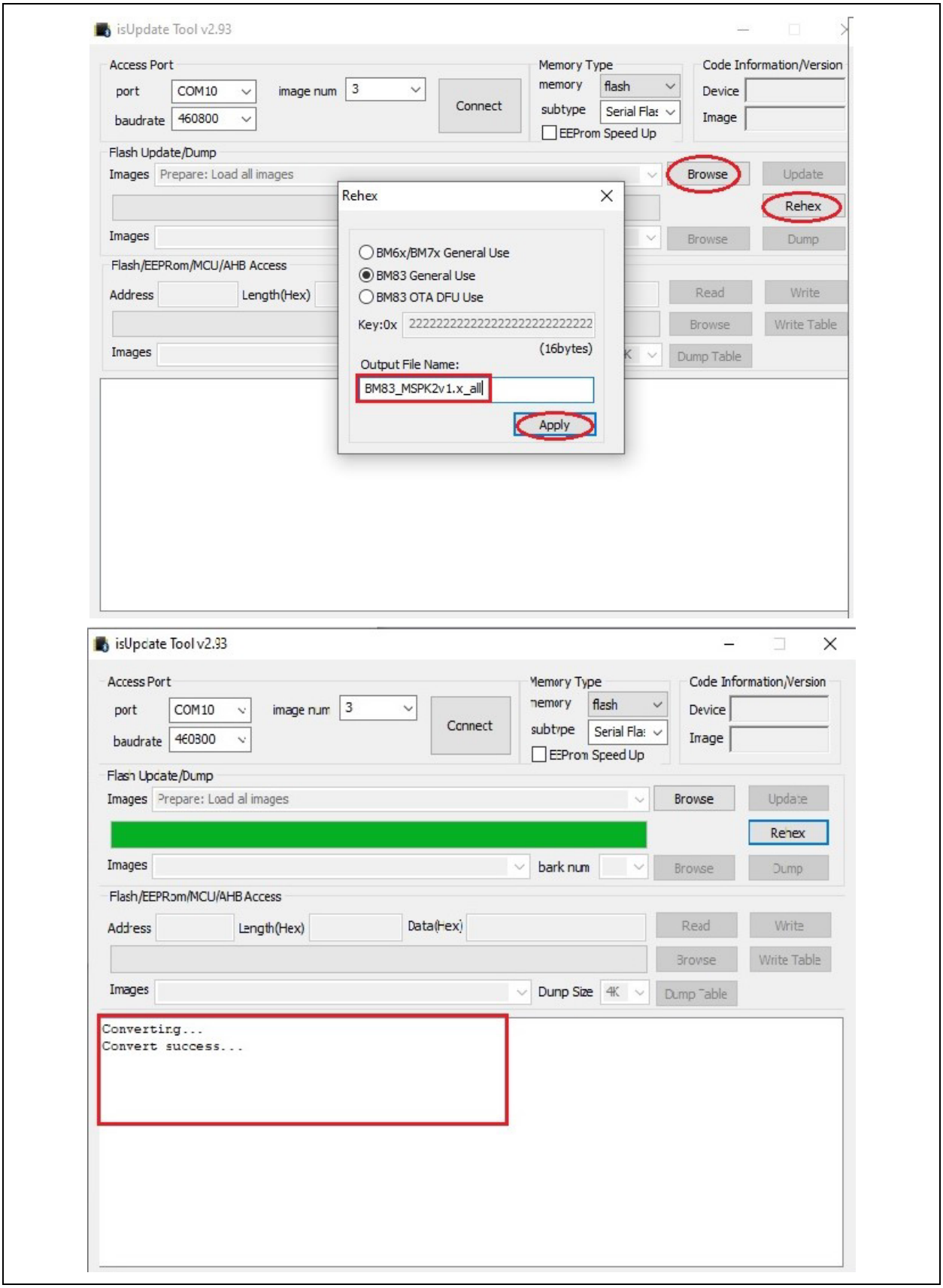
APPENDIX R: MCU DFU

R.1 Rehex BM83

Perform the following steps to rehex the BM83 image using the isUpdate Tool:

1. Start isupdate.exe
2. Click on **Browse** and choose MCU, DSP, and Config settings or any combination of the three. It is recommended that the image number reflect the combination.
3. Click on Rehex and provide the output file name and click on **Apply** as shown the following figure.
   - The green status bar in the following figure indicates the progress of conversion.
4. Once it is combined successfully, a log console will display the `Convert Success` message as shown in the following figure.

FIGURE 112: CREATING A REHEX FILE BY COMBINING THE IMAGES



R.2 Updating the BM83

1. Start the SPKCommandsetTool, then select the appropriate Serial Port and Baudrate, as shown in the Figure 114.
2. Click on the System tab, then click the power on button, as shown in following figure.
3. Click the **DFU** tab.
4. Click the **Browse** button, then select the Rehexed file and click the **Update** button.
5. Select the images in the DFU window, then click on **OK**, as shown in the following figure to update the BM83.
   - The green status bar in the following figure indicates the progress of the update.
6. Once the image is updated in the BM83 Flash, the BM83 will reboot with a new image.

FIGURE 113: SPKCOMMANDSET TOOL

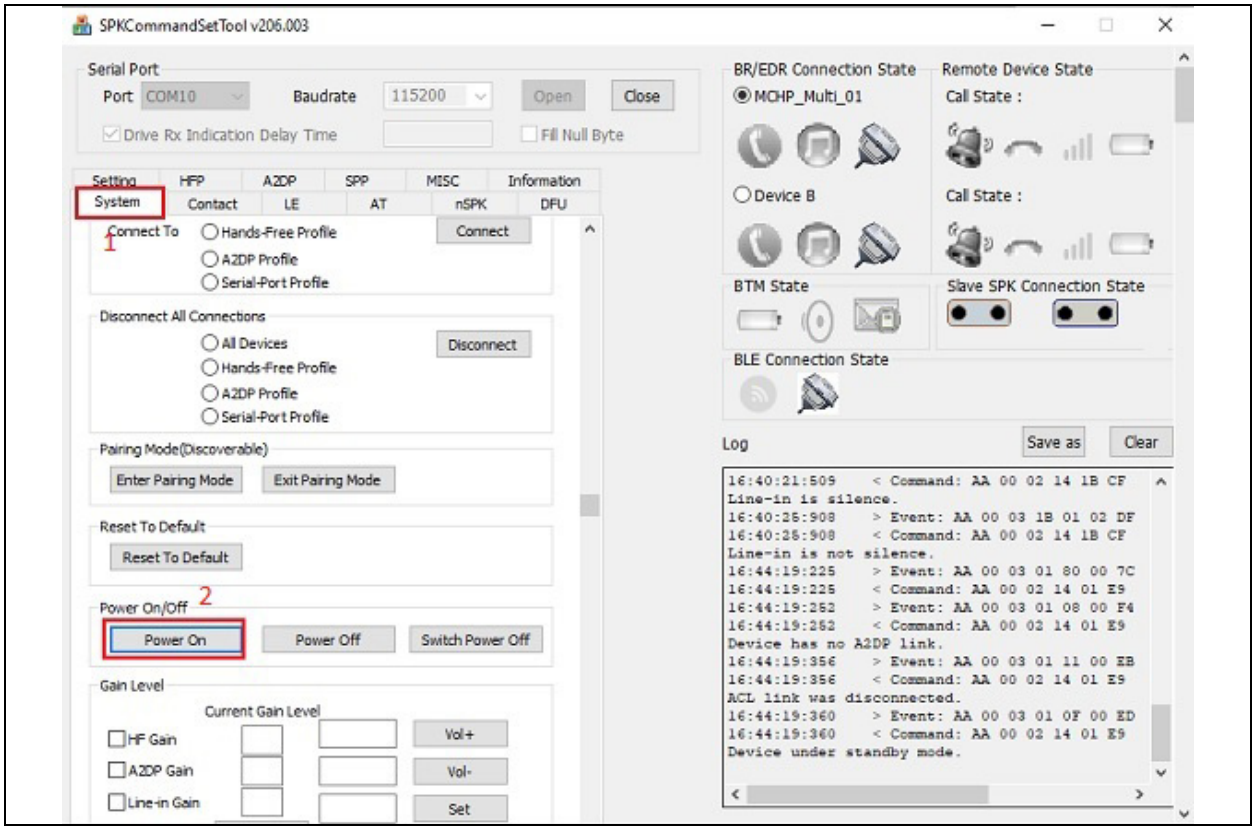
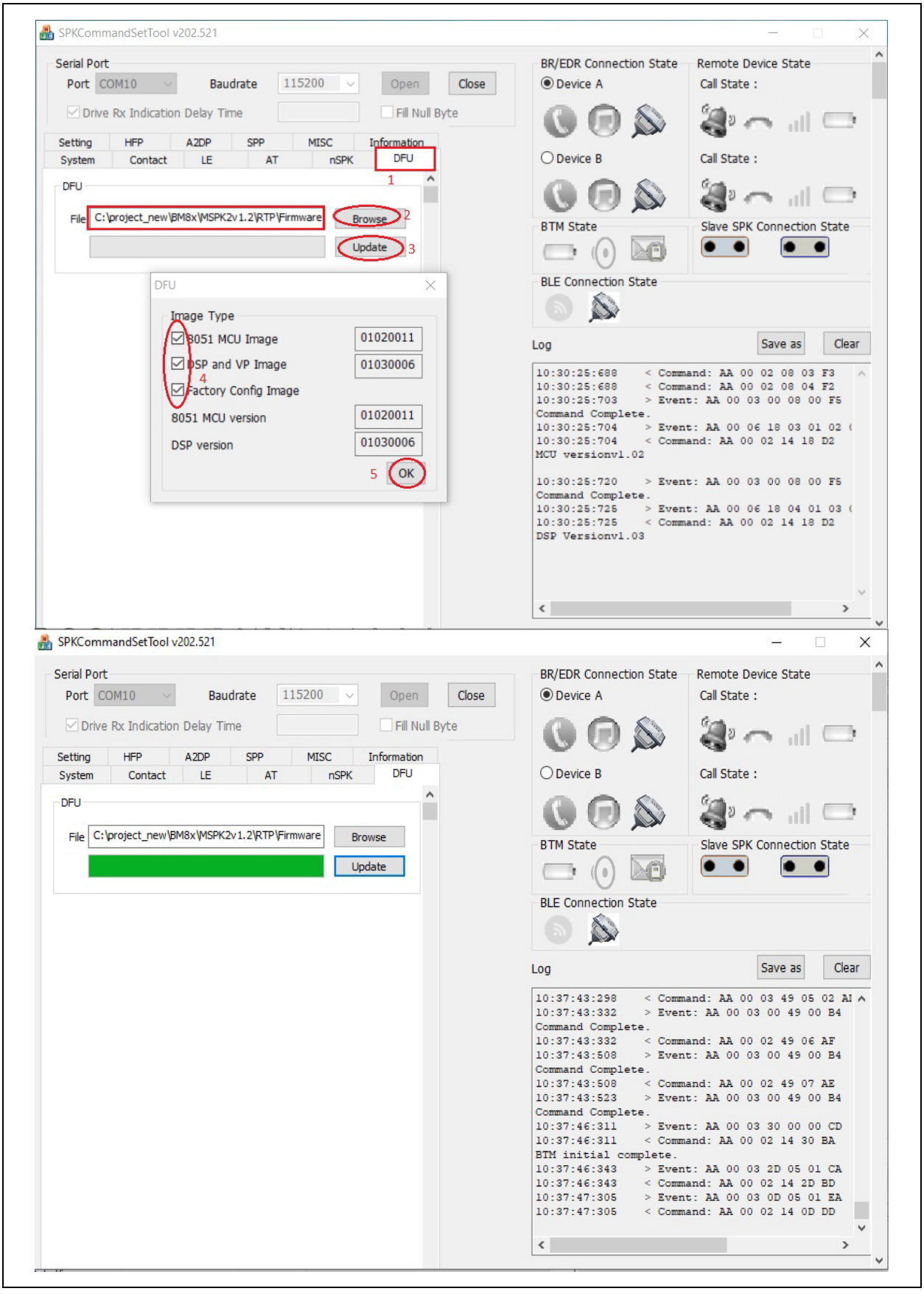


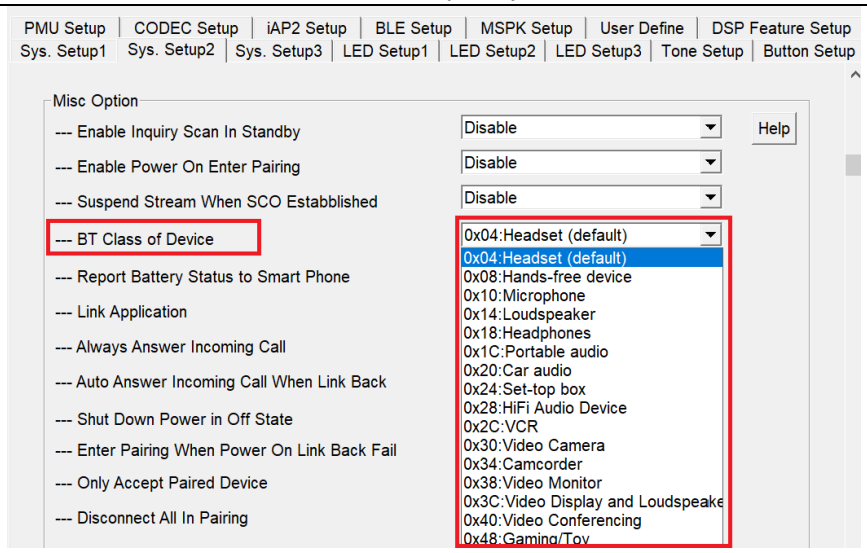
FIGURE 114: UPDATING BM83



APPENDIX S: BLUETOOTH CLASS OF DEVICE

Bluetooth class of device (CoD) can be selected, as shown in the following figure. The user can set the CoD minor bytes for their product. The default is set as “Headset”.

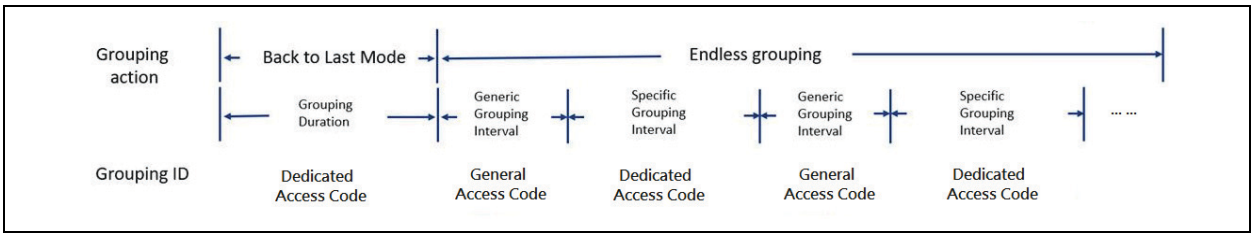
FIGURE 115: BLUETOOTH CLASS OF DEVICE (COD)



APPENDIX T: CONCERT MODE ENDLESS GROUPING

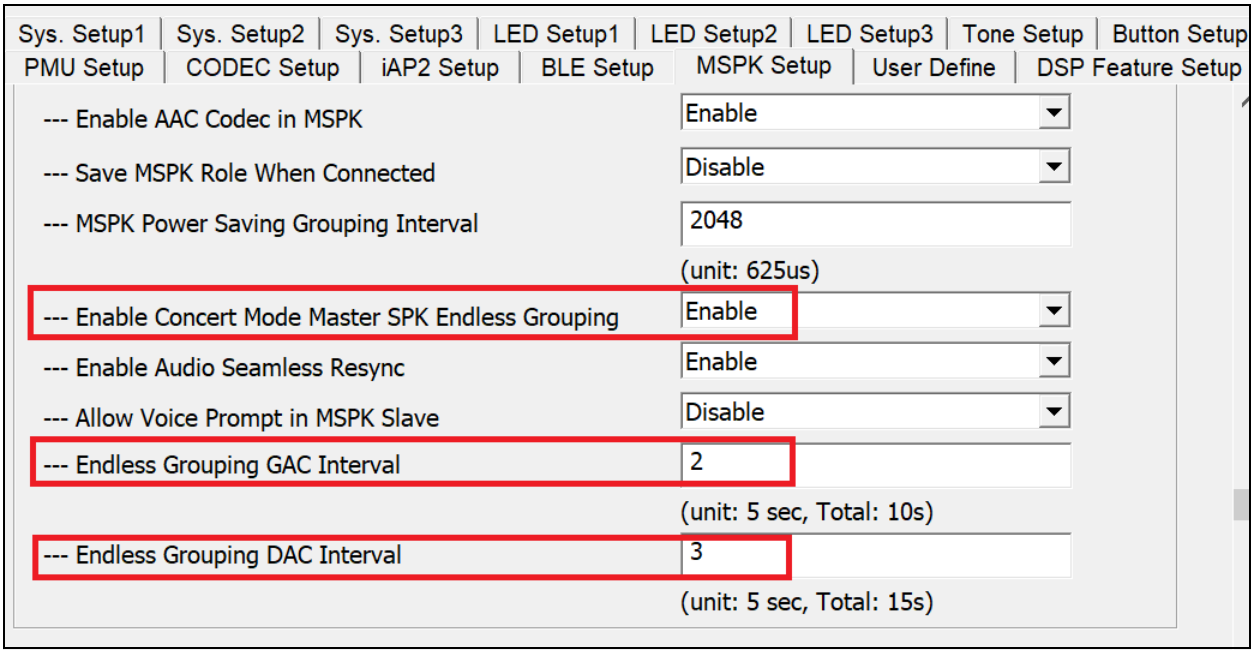
Endless grouping can use GAC (General Access Code) and DAC (Dedicated Access Code) for grouping. After “back to last mode”, the system can undergo endless grouping so the central can connect a new peripheral or previously connected peripheral.

FIGURE 116: CONCERT MODE ENDLESS GROUPING



After enabling the endless grouping, the "Endless Grouping GAC Interval" and "Endless Grouping DAC Interval" can be set as the following figure. The unit of the interval is 5 seconds. For example, if the user sets "2" for the GAC interval and sets "3" for the DAC interval, there will be 10 seconds in the "General grouping interval" and 15 seconds in the "Specific Grouping Interval”.

FIGURE 117: MSPK SETUP WINDOW

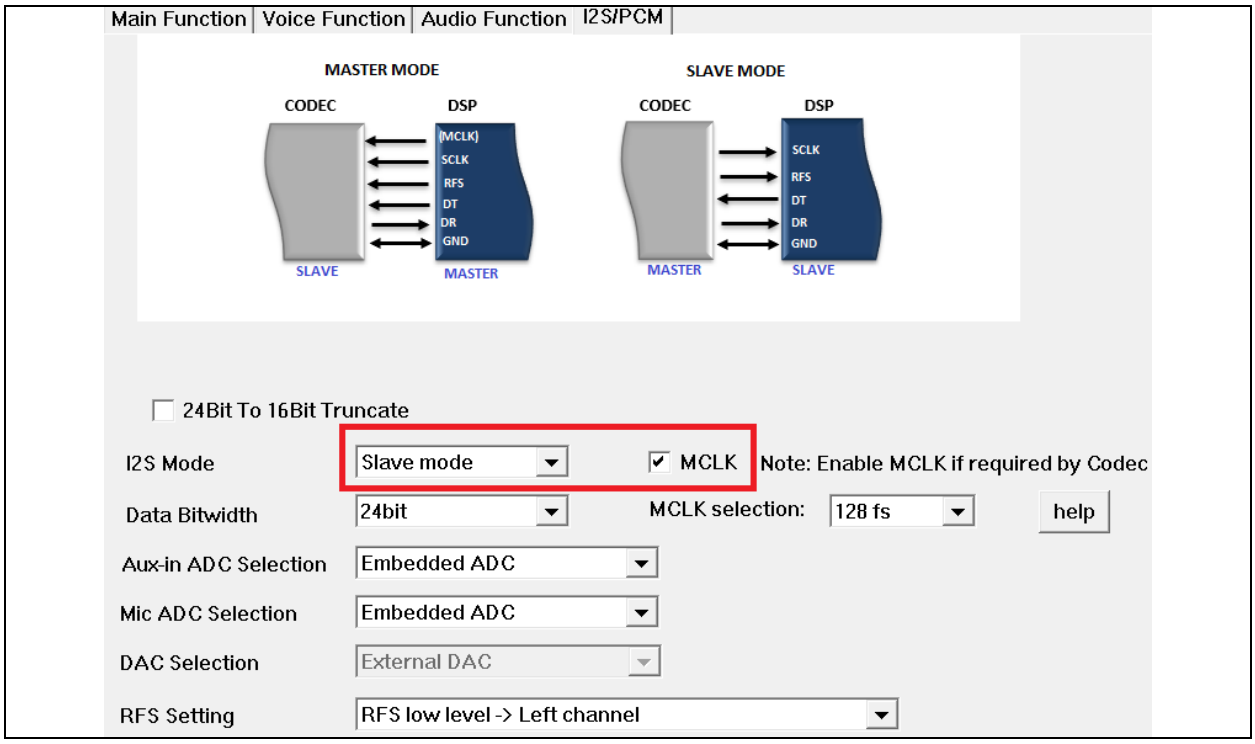


Under Host mode, the UART command 0x4B is used to set up GAC and DAC timing dynamically. The command structure is "0x4B Role GAC-time DAC-time." This command issues grouping action if GAC-time or DAC-time are not all 0. If there is current grouping action from the MMI action command (such as E0/E1/E2/F6), current grouping action will be replaced by 4B grouping action. Furthermore, this command will cancel grouping action if GAC-time and DAC-time are both 0. This command overwrites the endless grouping configuration, which is configured by the Config GUI Tool. For more information, refer to *AudioUARTCommdnSet_v2.08*.

APPENDIX U: I²S CLIENT WITH MCLK

I²S mode can be set to Host or Client mode. I²S MCLK can be enabled both in I²S Host mode and I²S Client mode in the Config GUI tool (see following figure).

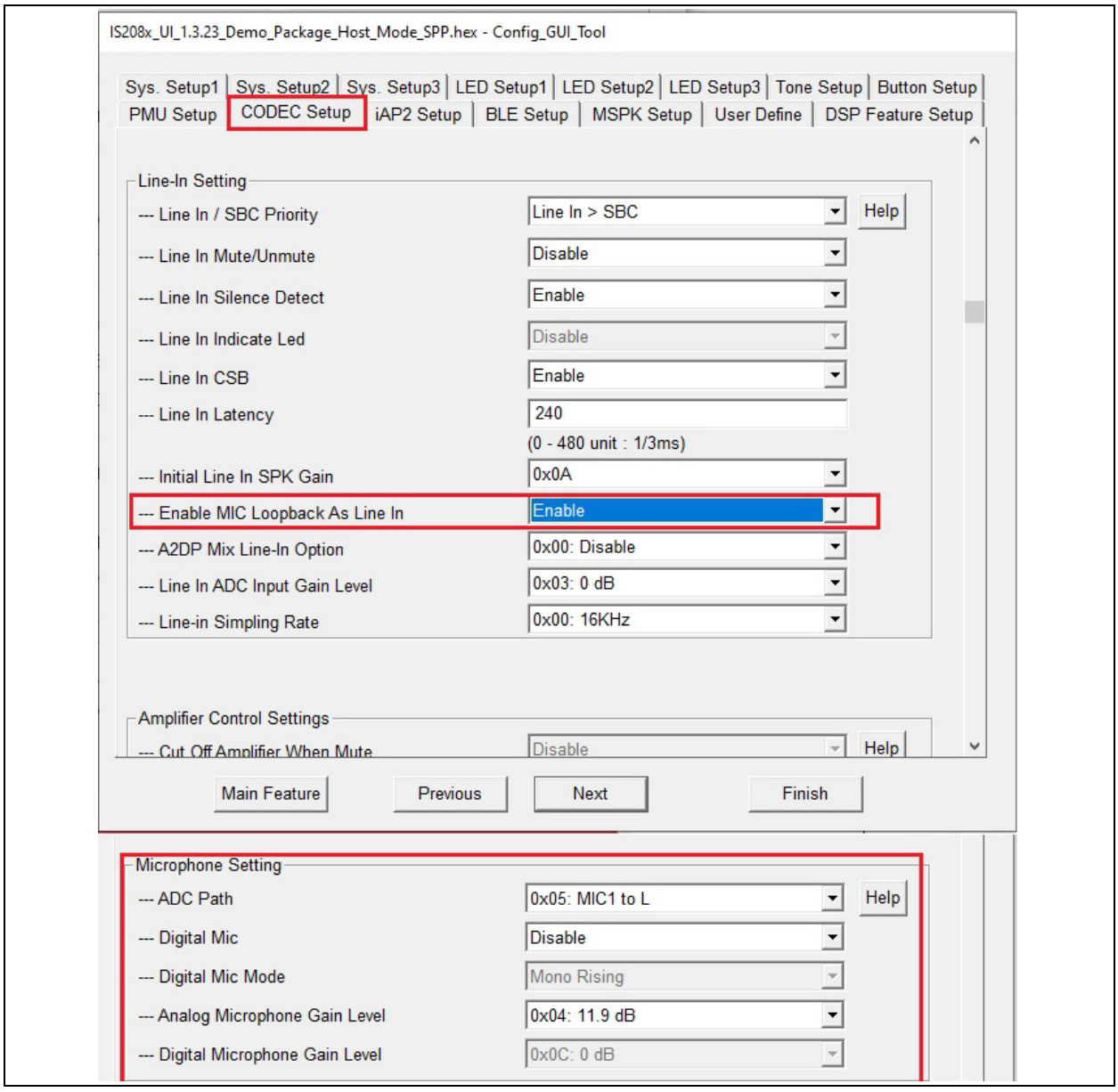
FIGURE 118: I²S CLIENT WITH MCLK



APPENDIX V: AUDIO MIXER SETTINGS

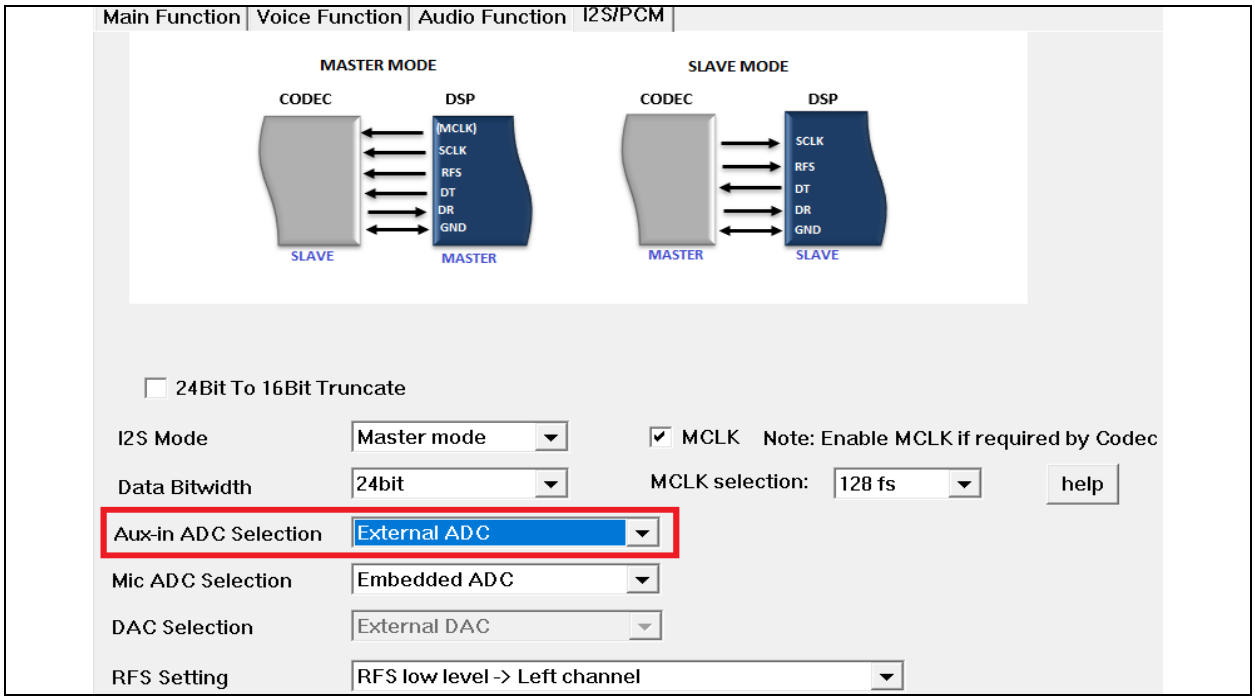
The audio mixer can be enabled, as shown in the following figure. Under “A2DP Mix Line-In Option”, the mixer can either be enabled by a UART command or activated after power-on. It is recommended that the option be “Activated by MMI or Uart Command” for Host mode and “Auto activated after power on” for Embedded mode. By default, the line-in audio source is “aux-in”. Microphone input can be enabled by “Enable MIC Loopback As Line in”. The “Initial Line in SPK Gain” allows for tuning the line-in gain before the audio mixer. Furthermore, “Line-in ADC Input Gain Level” is used to adjust the “ADC gain” block under Audio Mixer mode.

FIGURE 119: LINE-IN SETTING



I^2S-in can be enabled by “Aux-In ADC Selection.”

FIGURE 120: AUX-IN ADC SELECTION

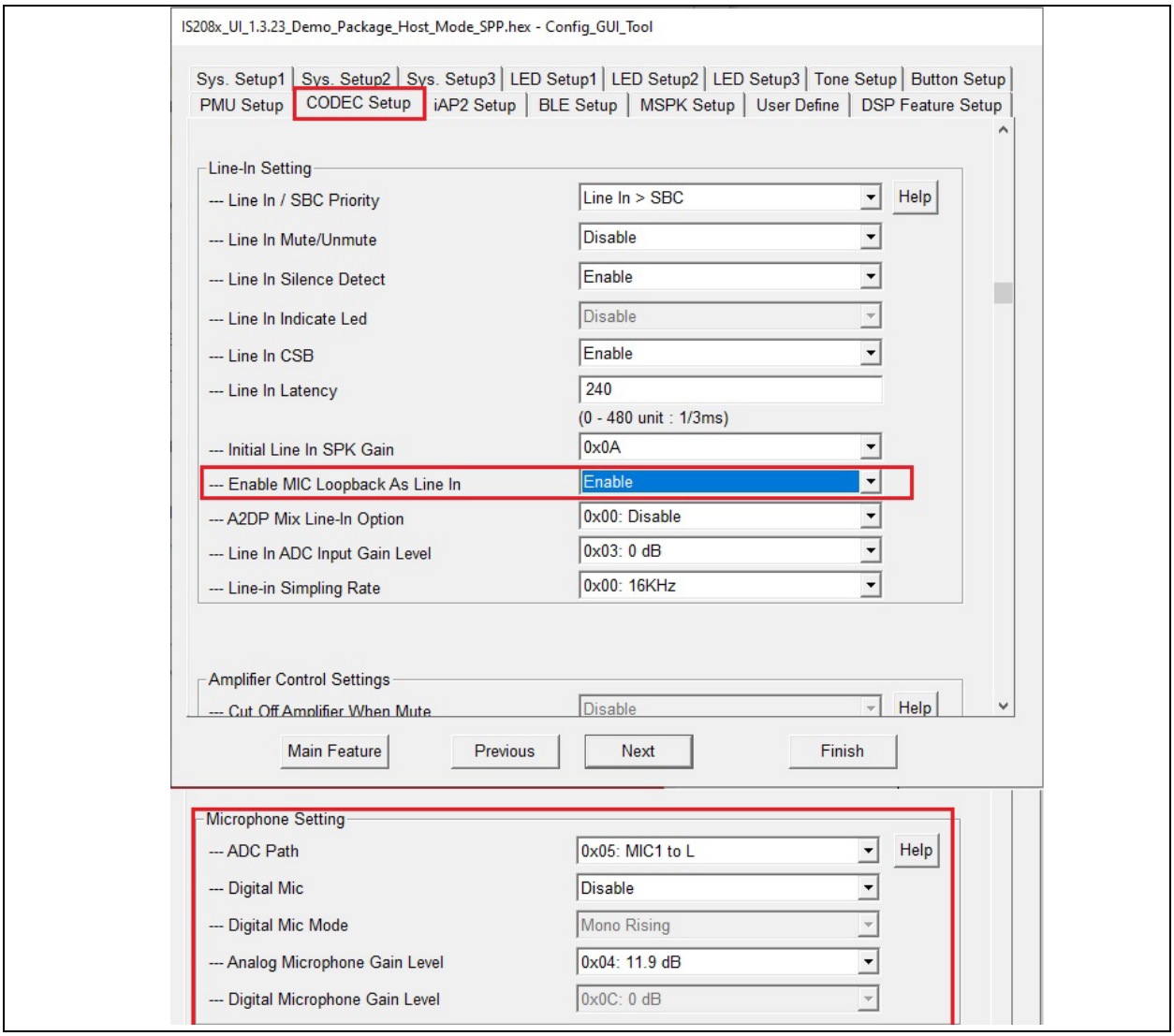


APPENDIX W: MIC AS INPUT IN MSPK

In embedded mode, the user can enable the microphone as line-in input through the following “Enable MIC Loopback As Line-in” settings. The analog mic and digital mic can be selected in Microphone Settings.

Then, the microphone will become the line-in source and aux-in will become inactive. In host mode, after disabling the line-in function by “0x13 0x01 0x00”, The UART command “0x13 0x0F 1/0” can enable or disable “MIC Loopback As Line-in”. Then, use “0x13 0x01 0x01” to enable line-in to use the microphone Loopback function. Then, the microphone can be used during MSPK mode.

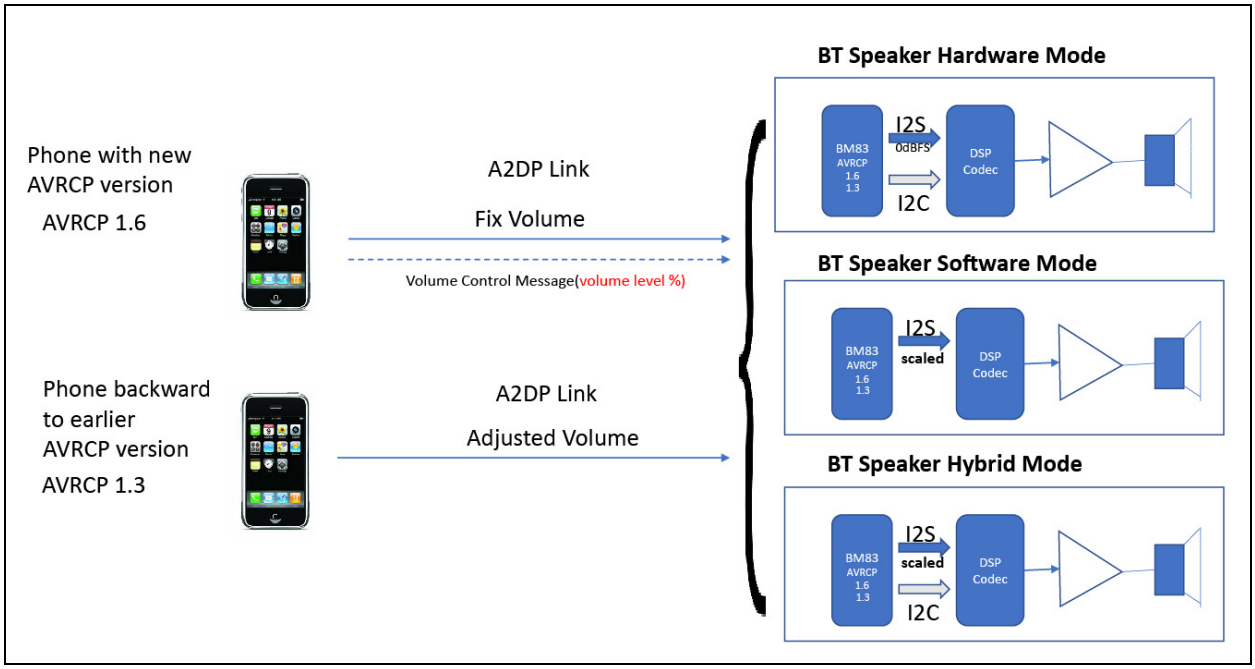
FIGURE 121: CODEC SETUP



APPENDIX X: I²S SCALING

This feature scales I²S output between -20 dB to +20 dB. This feature is only recommended when control over codec gain is not available.

FIGURE 122: I²S SCALING AND HYBRID MODE



Generally, Codec/DSP with I²S interface has I²C to control the volume. Volume change received over the AVRCP command in the gain form or by user action by volume button press, gain needs to be scaled to match to codec/DSP gain and must be written into the codec/DSP using I²C interface.

If Analog output is used, then gain adjustment occurs internally in the BM83/IS2083 for volume AVRCP command and by user volume button press.

I²S scaling is only useful when I²S codec/DSP is used but the user does not have access to I²C. In this case, I²S can be scaled in the BM83/IS2083.This feature can be enabled in the GUI tool as shown in Figure 123, and scaling is performed according to the table shown in Figure 124.

FIGURE 123: I²S SCALING

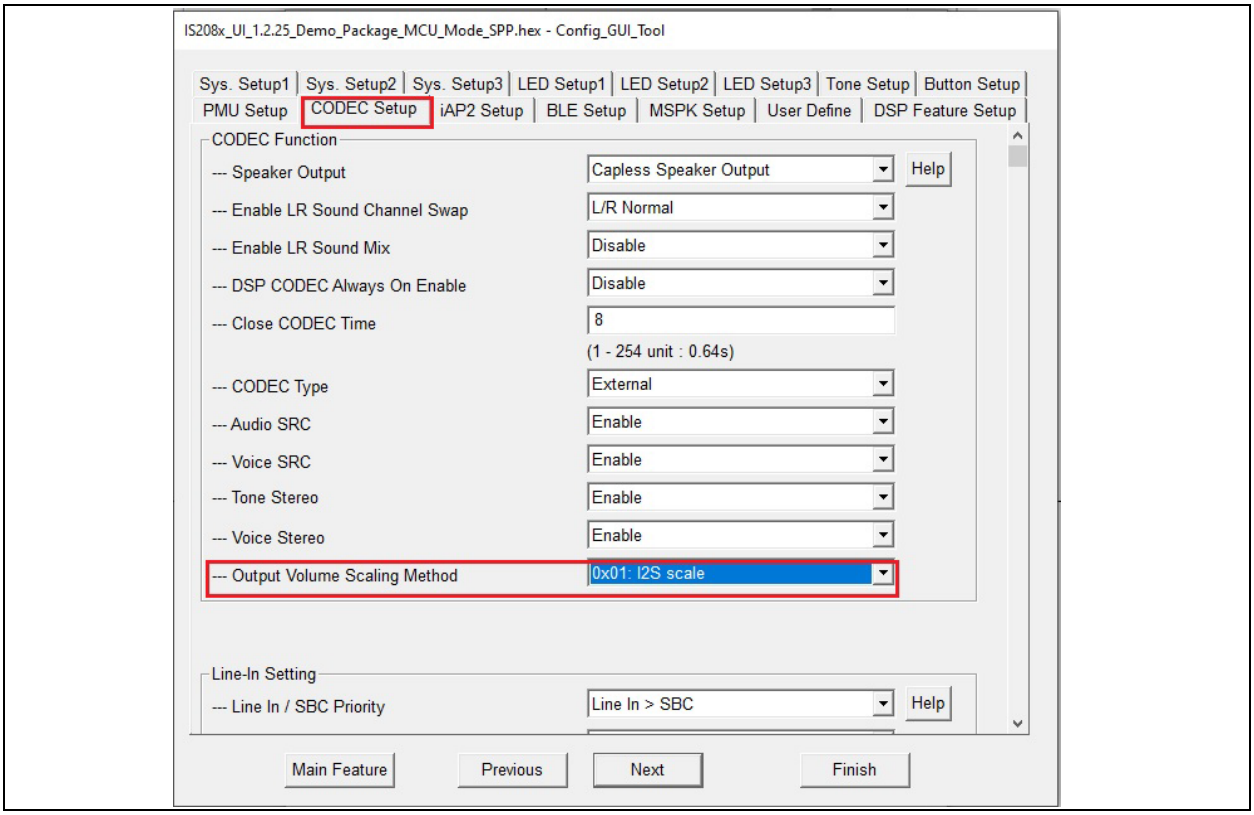
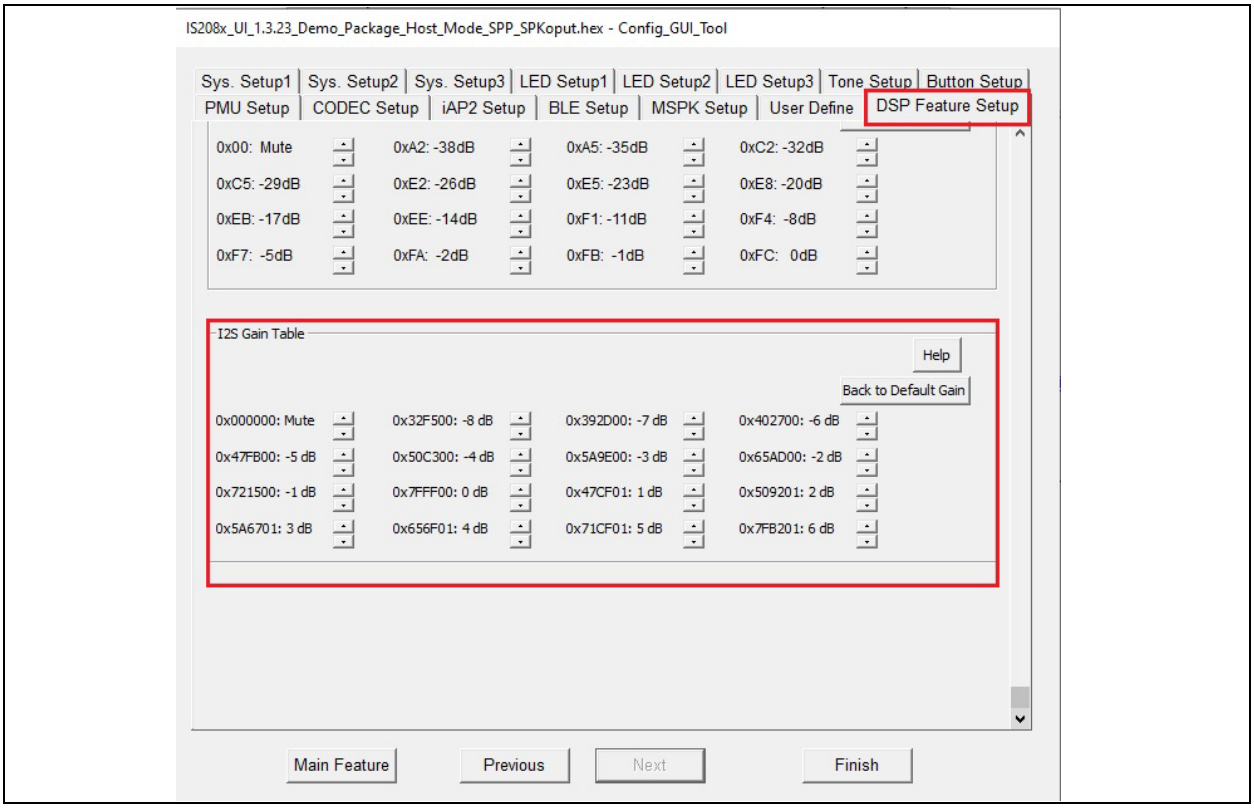


FIGURE 124: I²S GAIN TABLE



APPENDIX Y: AUX-IN AS I²S

Aux-in can be used as Analog/I²S and output as I²S/Analog. All four combinations are possible and can be configured through Config Tools as shown in the following figure. The BM83 module supports 8/16/44.1/48 KHz sampling rates.

FIGURE 125: I²S INOUT - CONFIG GUI TOOL

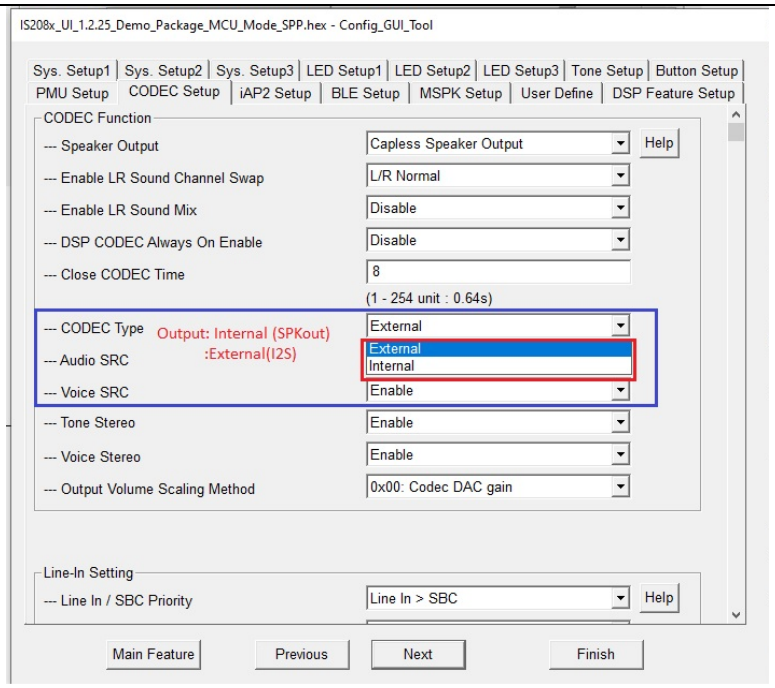
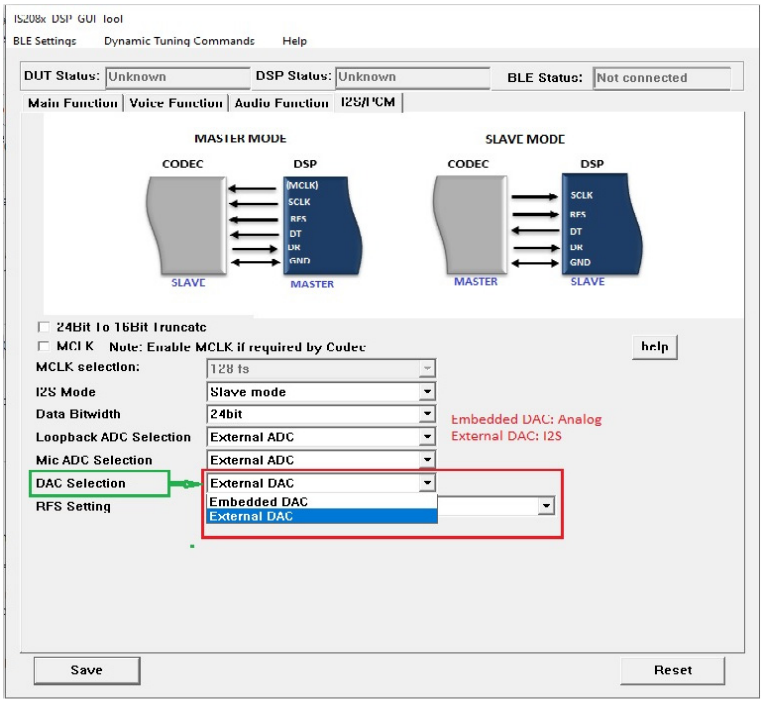


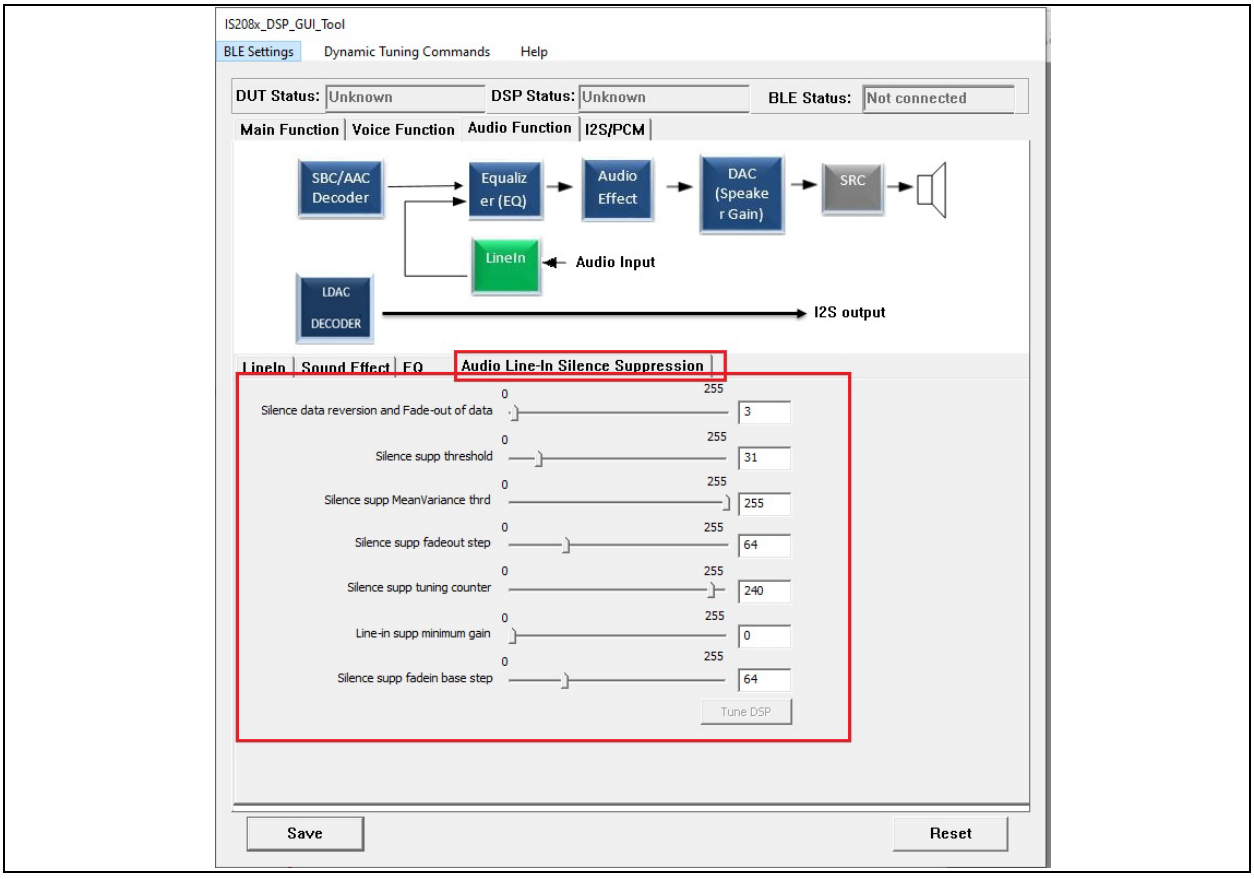
FIGURE 126: I²S INOUT - DSP GUI TOOL



APPENDIX Z: LINE-IN SUPPRESSION

Allows to enable or disable line-in suppression in the Config GUI tools. When it is enabled, the suppression will minimize the background noise, if silence is detected. During silence in the input audio signal, the input audio signal will be faded out until the Line-In suppression minimum gain, as selected in the GUI tool (see following figure).

FIGURE 127: LINE-IN SUPPRESSION



Z.1 Audio Line-In Silence Suppression

For Audio Line-In application, DSP provides Line-In silence suppression function to minimize background noise when silence is detected in the input audio signal. Once silence is detected in the input audio signal, the input audio signal will be faded out by DSP until the fade-out gain reaches Line-In suppression minimum gain.

Z.2 Audio Line-In Silence Suppression Parameters

Z.2.1 SILENCE DATA REVERSION AND FADE-OUT DATA

Enable silence data reversion and fade-in/out data.

Bit 1: Inverse On/Off.

Bit 2: Fade-in/out On/Off.

Z.2.2 SILENCE SUPP THRESHOLD

Silence is detected if the log2 value of the total power of an input audio frame is lower than the silence suppression threshold.

Z.2.3 SILENCE SUPP FADEOUT STEP

Step size for fade-out gain, which controls the amount of each decrement in fade-out gain.

Z.2.4 SILENCE SUPP TUNING COUNTER

When the audio silence is detected, DSP will start counting before DSP starts to perform fade-out on input signal.

Z.2.5 LINE-IN SUPP MINIMUM GAIN

Once silence is detected in the input audio signal, the input audio signal will be faded out by DSP until the fade-out gain reaches Line-In suppression minimum gain.

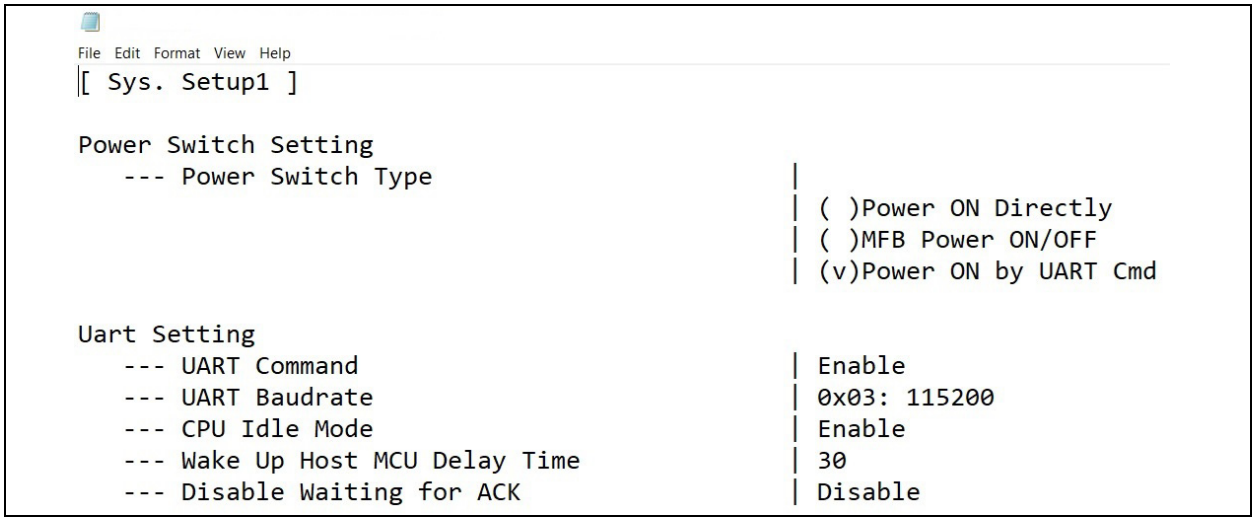
Z.2.6 SILENCE SUPP FADE IN BASE STEP

Step size for fade-in gain, which controls the amount of each increment in fade-in gain.

APPENDIX AA: CONFIG GUI TOOL LOGS

This feature in the Config GUI tool logs all the features selected in the tool. The file is saved in the text file format at the same location and named with the same name of the selected config settings file. This feature is useful for comparison with the previous settings. The file format appears as shown in the following figure.

FIGURE 128: CONFIG GUI TOOL LOG FILE FORMAT



APPENDIX AB: REVISION HISTORY

Revision	Date	Section	Description
D	09/2022	• **Section 2.0 “Multi-speaker Solution”** • **Section 2.10 “Firmware Capabilities/Features”** • **Section 2.11 “Concert Mode”** • **Section 2.12 “Stereo Mode”** • **Section 2.12.3 “Audio Output and SRC”** • **Section 2.12.6 “AAC CODEC”** • **Section 2.12.11 “Multi-link”** • **Section 2.13 “MCU and CODEC”** • **Section 2.14 “Multi-Speaker User Application”** • **Section 5.0 “Audio Mixer Mode”** • **Section Appendix A: “Android App Installation”** • **Section B.3 “Creating *.HEX File”** • **Section Appendix G: “LDAC Application”**	• Updated these sections
		• **Section L.2 “OTA DFU Using Android MBA”**	• Updated Figure 86 and Figure 87
		• **Section Appendix V: “Audio Mixer Settings”**	• Updated Figure 119
		• **Section Appendix W: “MIC as Input in MSPK”**	• Updated Figure 121
		• **Section Appendix X: “I²S Scaling”** • **Section Appendix Y: “Aux-in As I²S”** • **Section Appendix Z: “Line-In Suppression”** • **Section Appendix AA: “Config GUI Tool Logs”**	• Added new appendices

Revision	Date	Section	Description
C	03/2021	• **Section 2.0 “Multi-speaker Solution”**	• Added new figure Figure 3. • Updated with the new terminologies. For more details, see the below note.
		• **Section 3.0 “Audio Transceiver Solution”**	• Updated with the new terminologies. For more details, see the below note.
		• **Section 5.0 “Audio Mixer Mode”**	• Added new chapter
		• **Appendix B: “Customizing UI and DSP Parameters”** • **Appendix C: “Configuring BM83 I2S Host/Client Mode at 48 KHz”** • **Appendix U: “I²S Client With MCLK”**	• Updated with the new terminologies. For more details, see the below note.
		• **Appendix L: “DFU- Over-The-Air Upgrade Procedure”**	• Updated contents
		• **Appendix S: “Bluetooth Class Of Device”** • **Appendix T: “Concert Mode Endless Grouping”** • **Appendix U: “I²S Client With MCLK”** • **Appendix V: “Audio Mixer Settings”** • **Appendix W: “MIC as Input in MSPK”**	• Added new appendices
B	06/2020	Document	• Minor edits and updates across the document. • Updated MSPK version from `MSPK V2.x` to `MSPKv2 1.x.`
		• **“Software Requirements”** • **“OTA DSP Tuning”**	Updated content.
		“BM83 Google Fast Pair”	Added new chapter.
		Appendix B: “Customizing UI and DSP Parameters”	Removed Embedded mode configuration related note.
		• **Appendix P: “Using iOS MBA for OTA DSP Tuning”** • **Appendix Q: “Enabling Google Fast Pairing Features”** • **Appendix R: “MCU DFU”**	Added new appendixes.
A	07/2019	Document	Initial release

Note 1: Microchip is aware that some terminologies used in the technical documents and existing software codes of this product are outdated and unsuitable. This document may use these new terminologies, which may or may not reflect on the source codes, software GUIs, and the documents referenced within this document. The following table shows the relevant terminology changes made in this document

TABLE 5-3: TERMINOLOGY RELATED CHANGES

Old Terminology	New Terminology	
Master speaker	Central Speaker	**Section 2.0 “Multi-speaker Solution”** is updated with the new terminology.
Slave speaker	Peripheral speaker	
Master	Central	
Slave	Peripheral	

TABLE 5-3: TERMINOLOGY RELATED CHANGES

Old Terminology	New Terminology	
Master speaker	Central Speaker	**Section 3.0 "Audio Transceiver Solution"** is updated with the new terminology
Slave Speaker	Peripheral Speaker	
I²S Master	I²S Host	**Appendix B: "Customizing UI and DSP Parameters"**
I²S Slave	I²S Client	
Master	Central	
Slave	Peripheral	
I²S Master	I²S Host	**Appendix C: "Configuring BM83 I2S Host/Client Mode at 48 KHz"**
I²S Slave	I²S Client	
Master	Central	
Slave	Peripheral	
I²S Master	I²S Host	**Appendix U: "I²S Client With MCLK"**
I²S Slave	I²S Client	
Master	Central	
Slave	Peripheral	

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China - Shenzhen
Tel: 86-755-8864-2200

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