

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 [Table 1](#) 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
- 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			
	PBAB	GFP	SPP	AT
Type	Code and Binary Image			
Standard Features	Y	Y	Y	Y (Rx mode)
A2DP Source	N	N	N	Y (Tx mode)
PBAB	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

[Table 1](#) 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), 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 51](#) to enable this mode using the Config GUI Tool

- Embedded mode:
 - Obviates the use of host MCU
 - See [Figure 52](#) 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).

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

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 master speaker to one or multiple slave speakers through a modified Bluetooth protocol. Multi-Speaker functionality is implemented using Microchip's IS2083BM device. One (master) speaker can be connected to a Bluetooth-enabled device (such as smartphone, tablet, and laptop). A master/speaker can be connected to a device (phone or tablet) over Bluetooth or AUX-in jack, and re-transmit either of the two audio sources to one or more speakers acting as a slave.

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 master speaker with one or more slave speakers) or in Stereo mode (a left-channel and a right-channel speaker). For more details, refer to ["MSPK Demo Setup"](#) and ["Firmware Capabilities/Features"](#).

Figure 1 illustrates a typical Concert mode application where the master speaker is connected to a Bluetooth-enabled device.

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

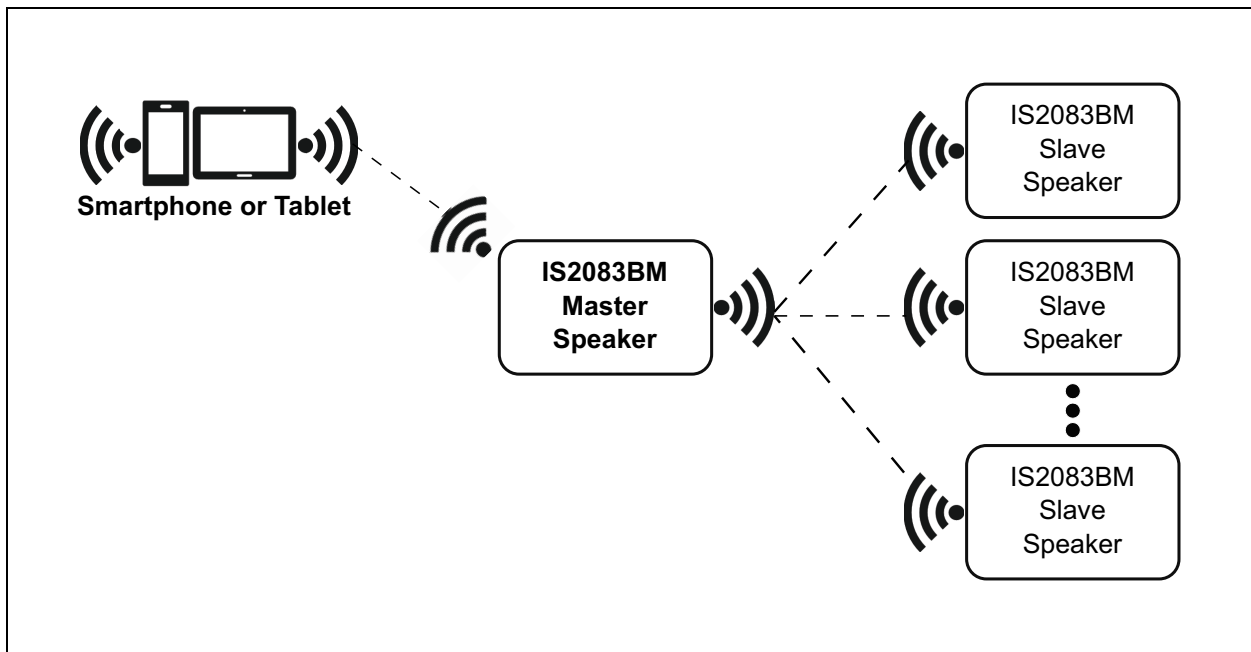


Figure 2 illustrates a typical Concert mode application where the master is connected to a Bluetooth-enabled device through AUX-In.

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

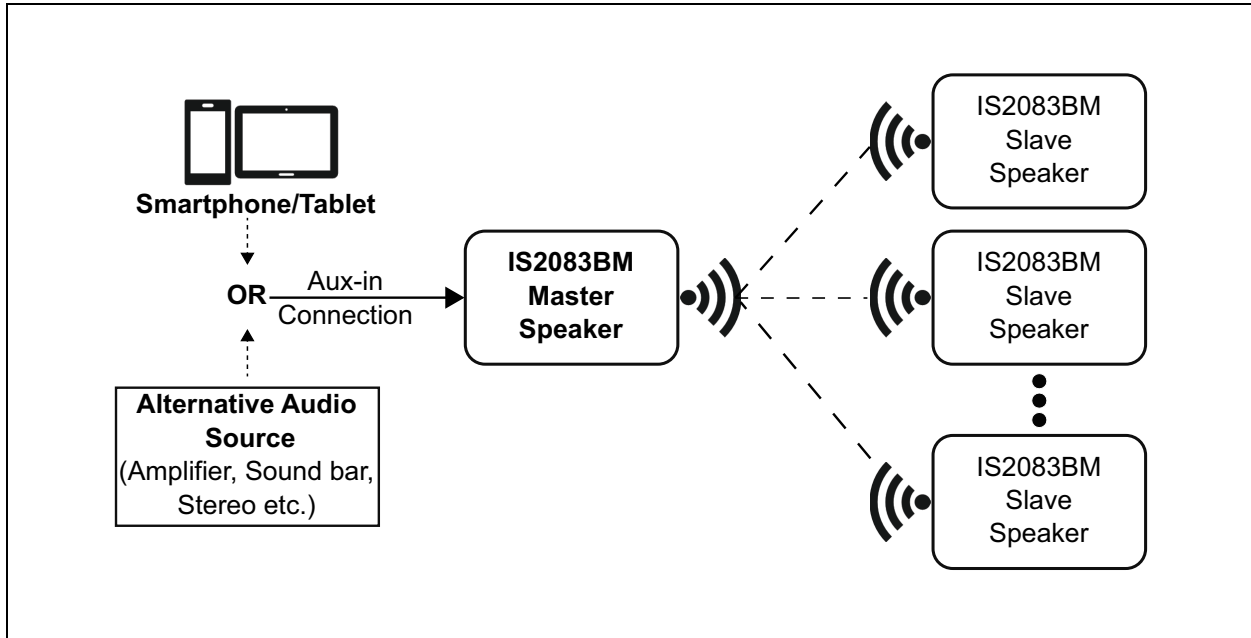


Figure 3 illustrates a typical Stereo mode application where the master is connected to a Bluetooth-enabled device.

FIGURE 3: STEREO MODE: MASTER IS CONNECTED TO BLUETOOTH-ENABLED DEVICE

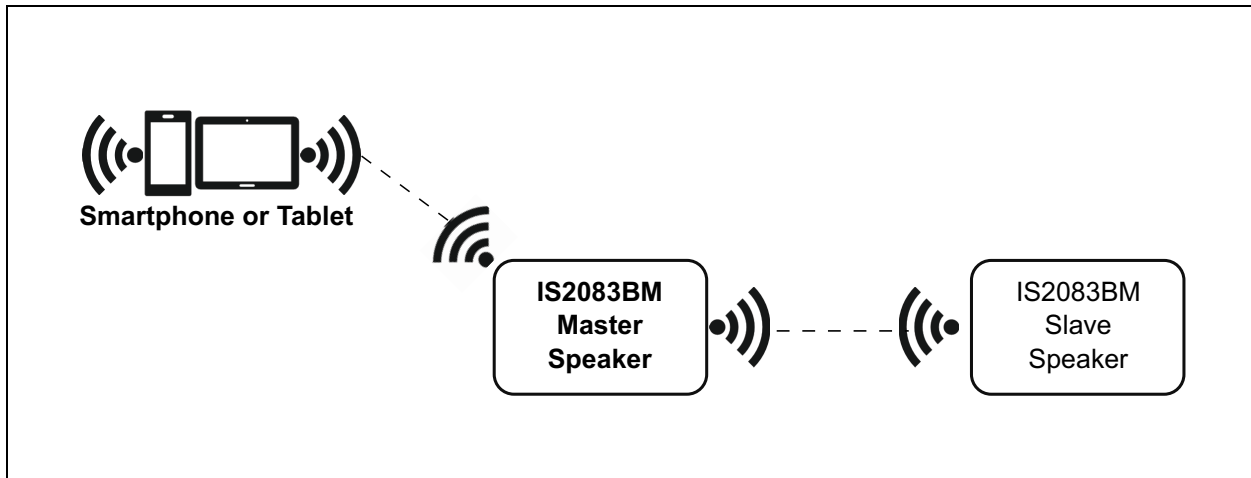
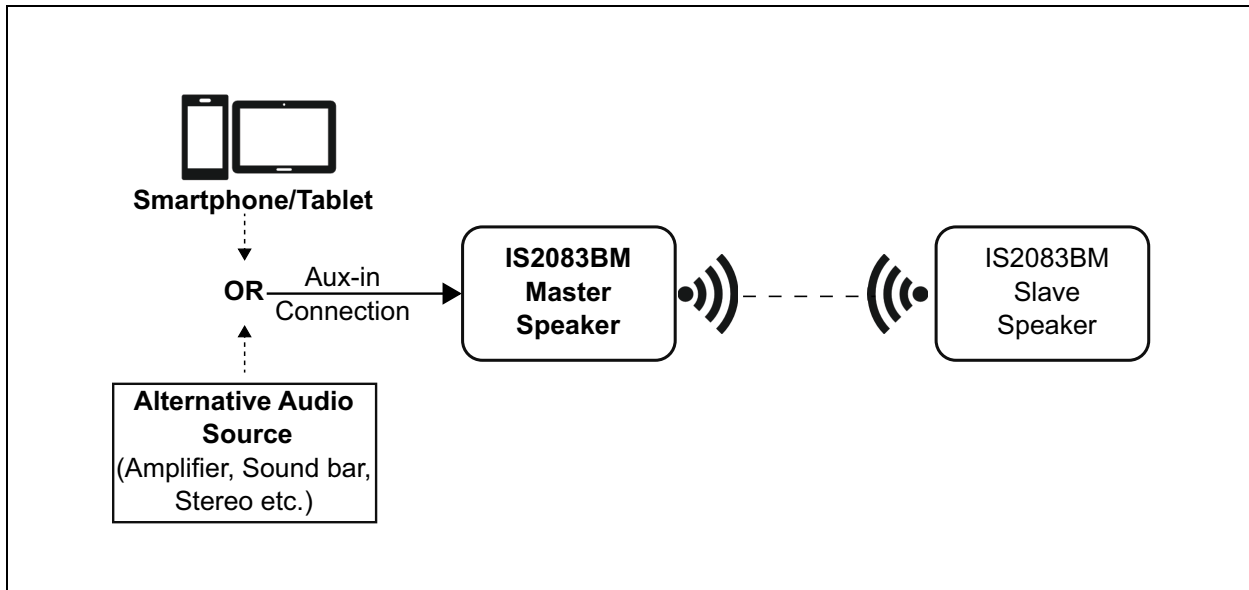


Figure 4 illustrates a typical Stereo mode application where the master is connected to a Bluetooth-enabled device through AUX-In.

FIGURE 4: STEREO MODE: MASTER 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.

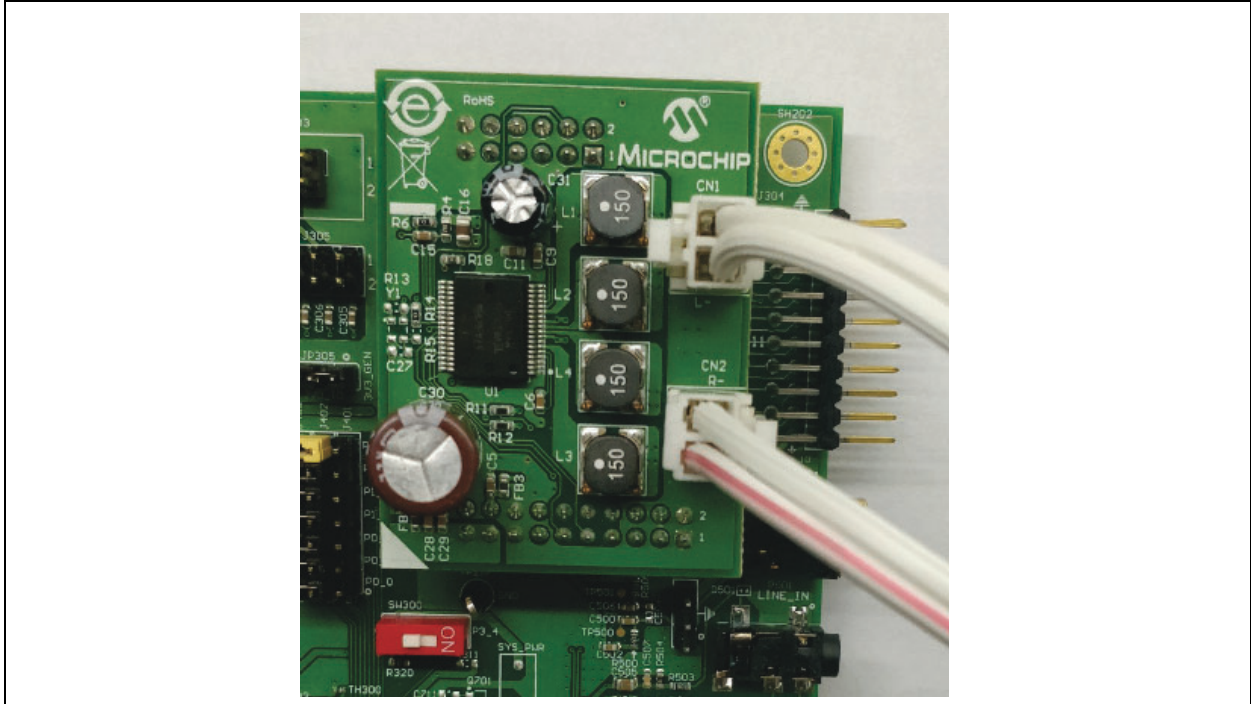
2.2.2 HOST MODE DEMO SETUP

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 5: 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 Long press MFB (SW701)
To enter into Master/Slave mode in Concert mode and to start grouping	Long press VOL UP (SW702)	Long press VOL UP (SW702)
To enter into Master/Slave mode in Stereo mode and to start grouping	Long press VOL DN (SW705)	Long press VOL DN (SW705)
To add a new Slave to the Master 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 Long press MFB (SW701)
To enter Pairing mode	Long press SEL (SW711)	Long press MFB

Note 1: To locate these buttons, refer to [Figure 6](#).

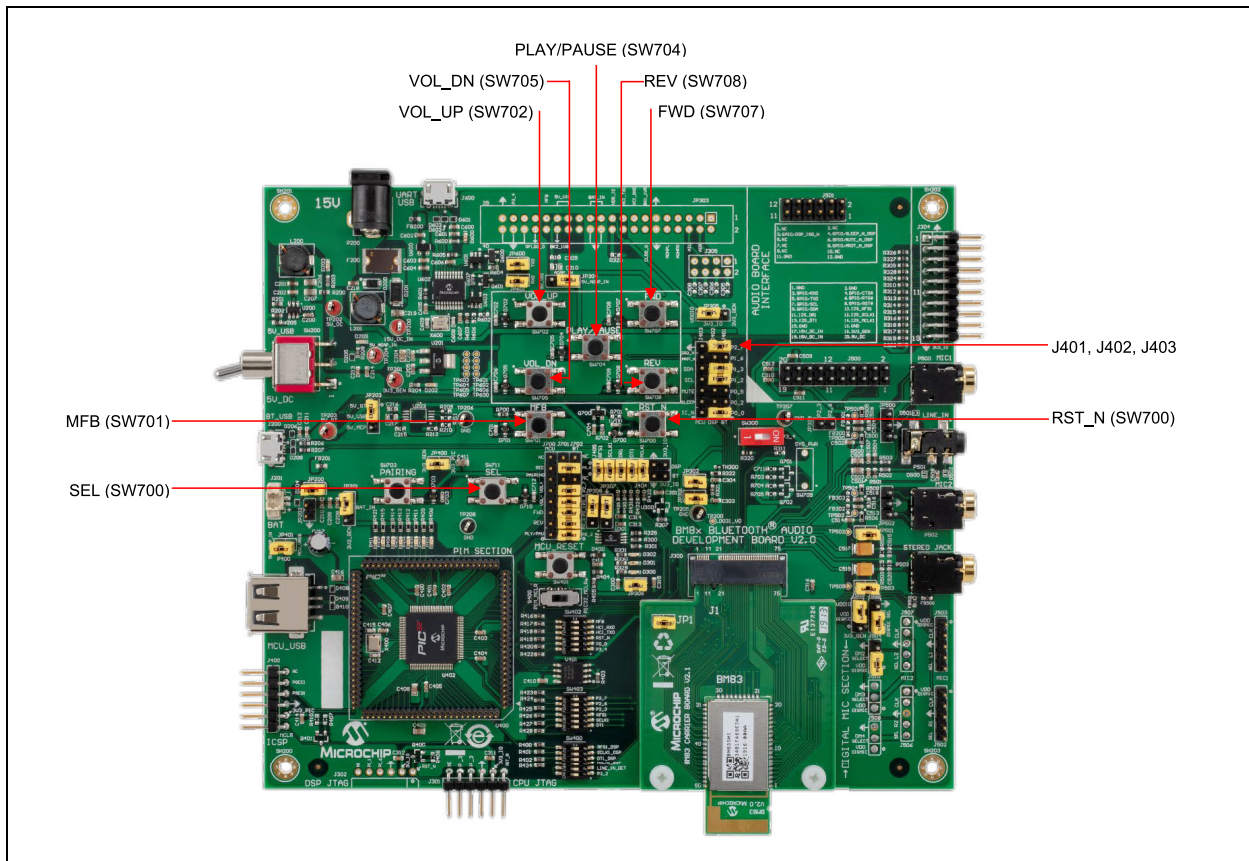
The preceding table shows the default button functionality for Host mode, which is fixed in PIC32 source code. However, the button functionality in the PIC32 code can be changed by changing the command associated with the buttons.

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"](#).

<p>Note: Long press is longer than 3 seconds, Long Long press is longer than 5 seconds, and short press is shorter than 1 second.</p>
--

Figure 6 illustrates the functionality of all the buttons available on the BM83 EVB.

FIGURE 6: 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 slave to the EVB with a flashing Blue LED (D300) as master. The EVB on which VOL UP (SW702) is pressed first is provisioned as master and others are provisioned as slave.

To connect the master with a Bluetooth streaming device, long press the MFB button on the master (flashing Blue LED on the EVB) to enter into Pairing mode. Pair with a Bluetooth-enabled audio streaming device. The flashing Blue LED will become solid Blue on the master EVB once pairing is complete and

connection is established. Now, play music on the audio streaming device to hear a music on master and slave speakers.

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

To play the audio through AUX-In, connect the master (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 master and slave speakers. If Bluetooth audio was playing before inserting the AUX-In, it will pause the Bluetooth audio and AUX-In audio will start playing. When the AUX-In cable is removed, the Bluetooth audio will resume in its previous state.

A long long press MFB on the master device will power-off master and connected slave devices.

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 period. The EVB with a solid Red LED is connected as a slave to the EVB with flashing Blue LED as master. The EVB on which VOL DN (SW705) is pressed first is provisioned as master and the remaining are provisioned as slave.

To connect the master with the Bluetooth streaming device, long press MFB on the master (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 master and slave speakers.

To play the audio through AUX-In, connect the master (flashing/solid Blue LED) with the audio streaming device through AUX-In cable. Play music on an audio streaming device and the audio will be heard on both master and slave speakers. If Bluetooth audio is playing before inserting the AUX-In, it will pause the

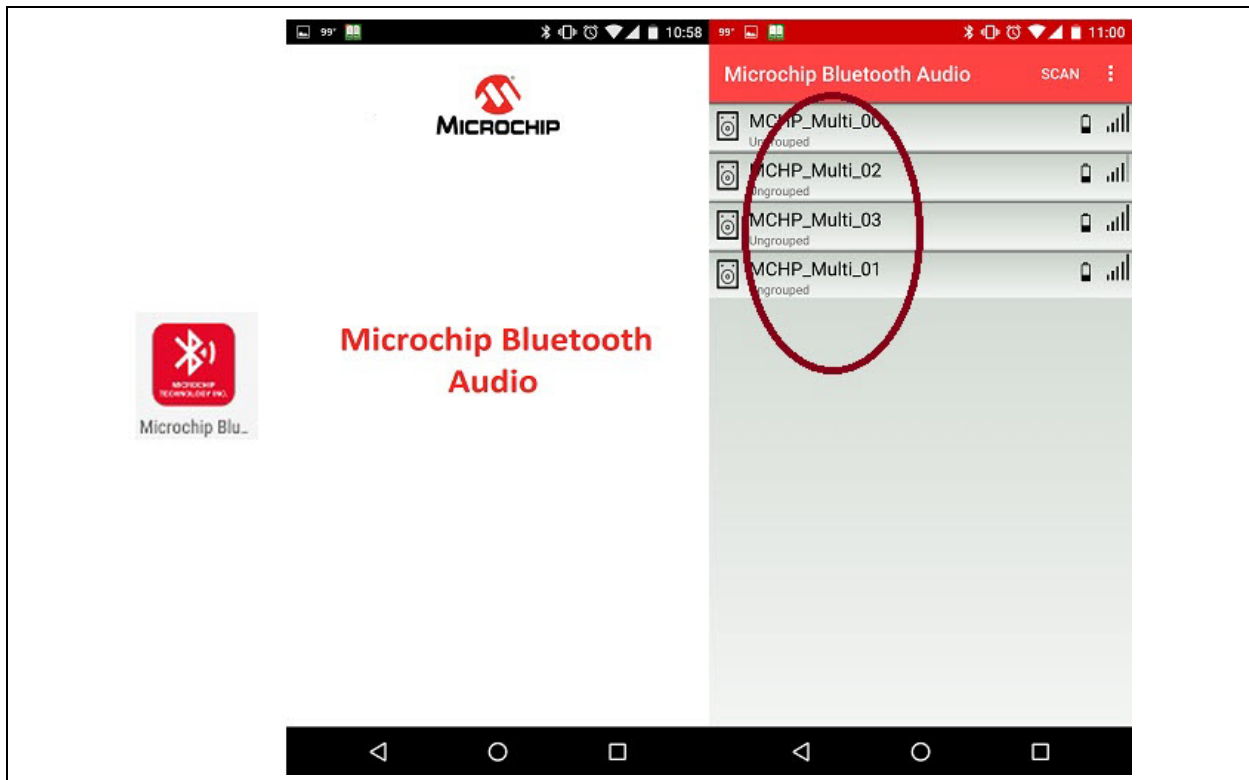
Bluetooth audio and AUX-In audio will start playing. When the AUX-In cable is removed, the Bluetooth audio will resume in its previous state.

A long long press MFB on the master device will power off the master and connected slave device.

2.5 Concert Mode Provisioning Using Microchip Bluetooth Audio App

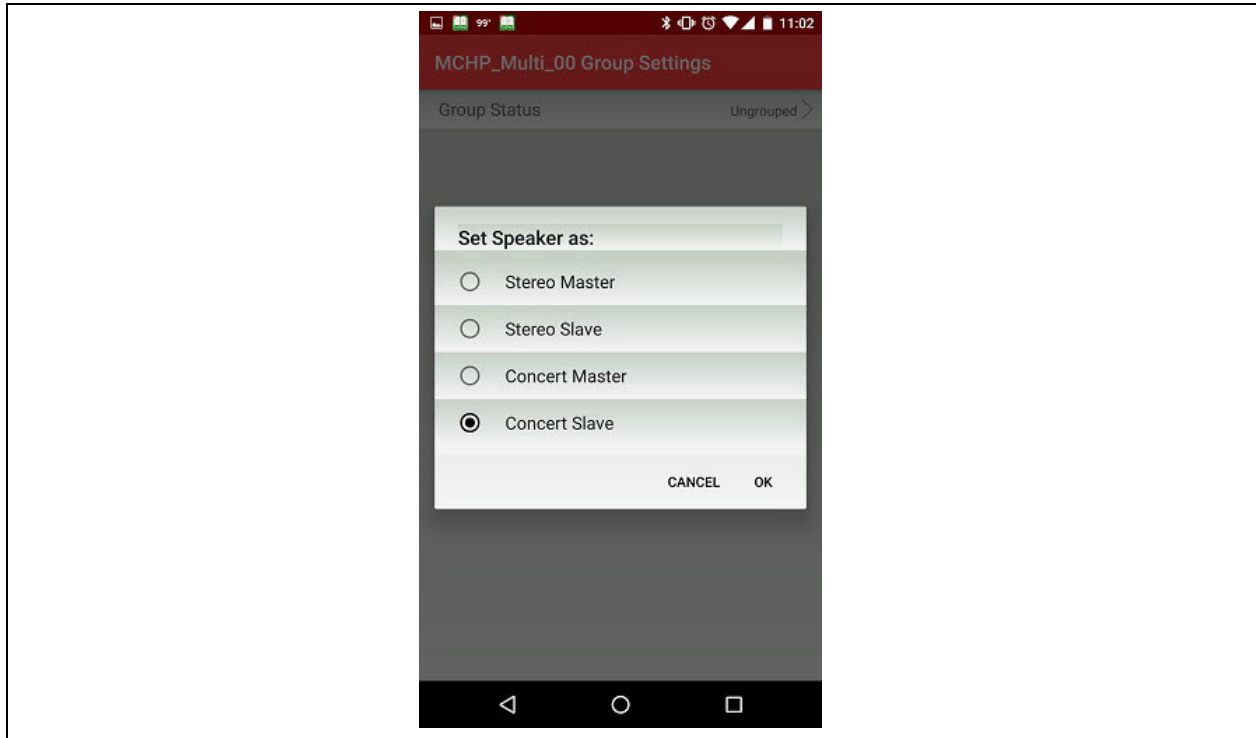
1. Long press MFB on all the BM83 EVBs to power on the EVB and initialize. The Android app can also be used to power on individual BM83 EVB. For more details, refer to [Appendix D: "Android App Power Mode"](#).
2. Open the Microchip Bluetooth Audio Android app on an Android phone. The following screen is displayed, see [Figure 7](#).

FIGURE 7: MICROCHIP BLUETOOTH AUDIO ANDROID APP



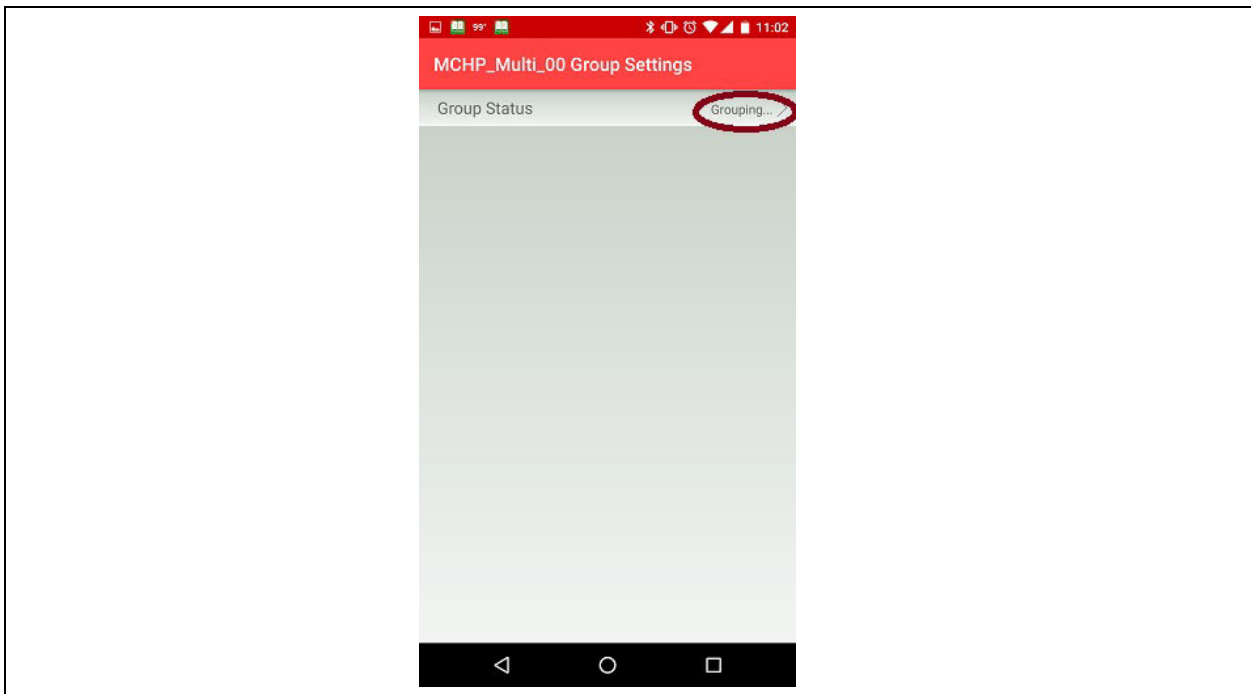
- A list of connectable BLE devices is displayed. Select any one device **MCHP_Multi_x** (see [Figure 7](#)) and assign the role of Master/Slave. In Concert mode, assign one as Master and the others as Slaves. Select **Concert Slave** to assign one of the BM83 EVBs as a slave, see [Figure 8](#).

FIGURE 8: SELECTING OPERATIONAL MODE



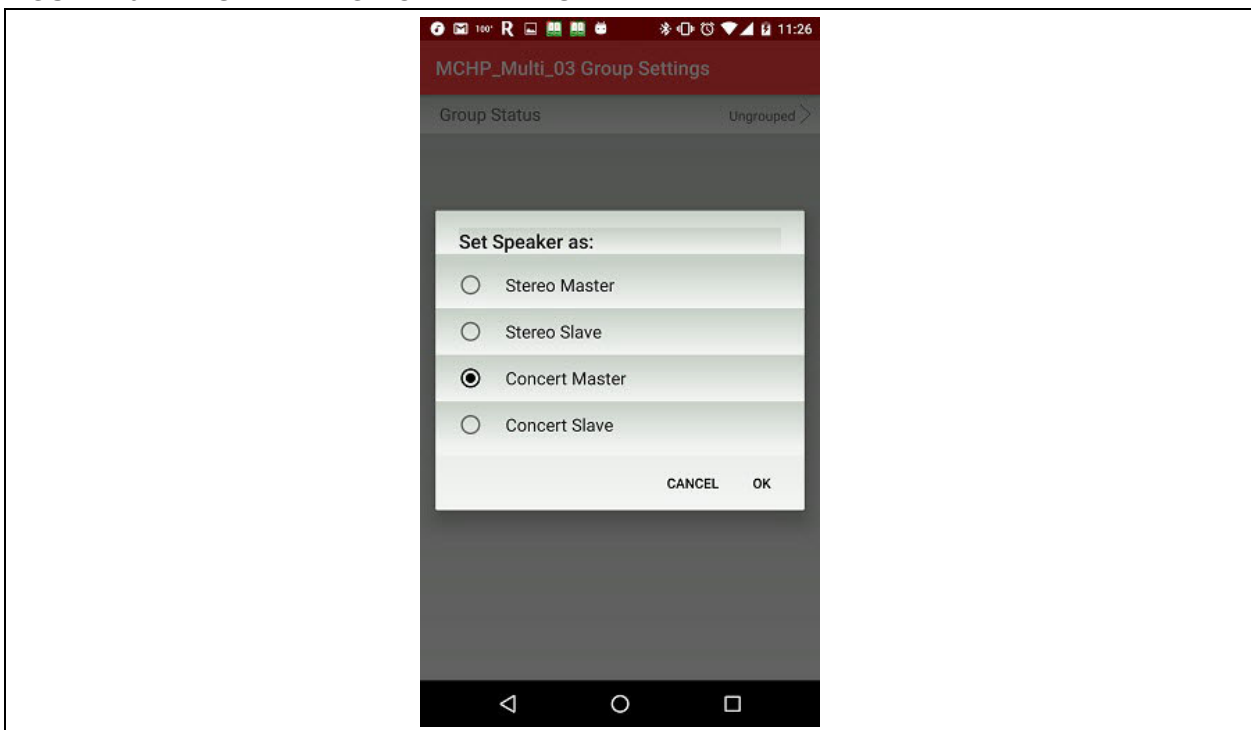
4. When the device is selected as a slave/master, “grouping” is displayed as **Group Status**, see [Figure 9](#). Then the Red LED will start flashing on the BM83 EVB. Repeat this step for the other slave EVBs.

FIGURE 9: GROUPING SLAVE/MASTER



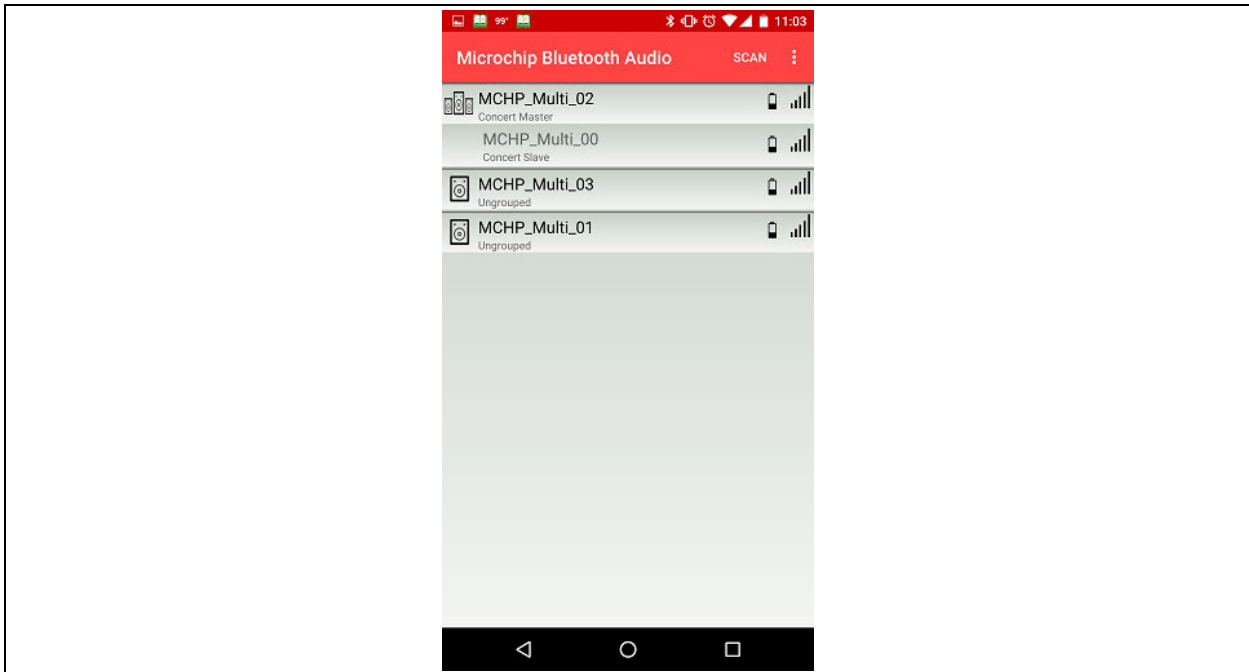
5. Select **Concert Master** to assign one of the BM83 EVB as a master, see [Figure 10](#).

FIGURE 10: SELECTING CONCERT MASTER



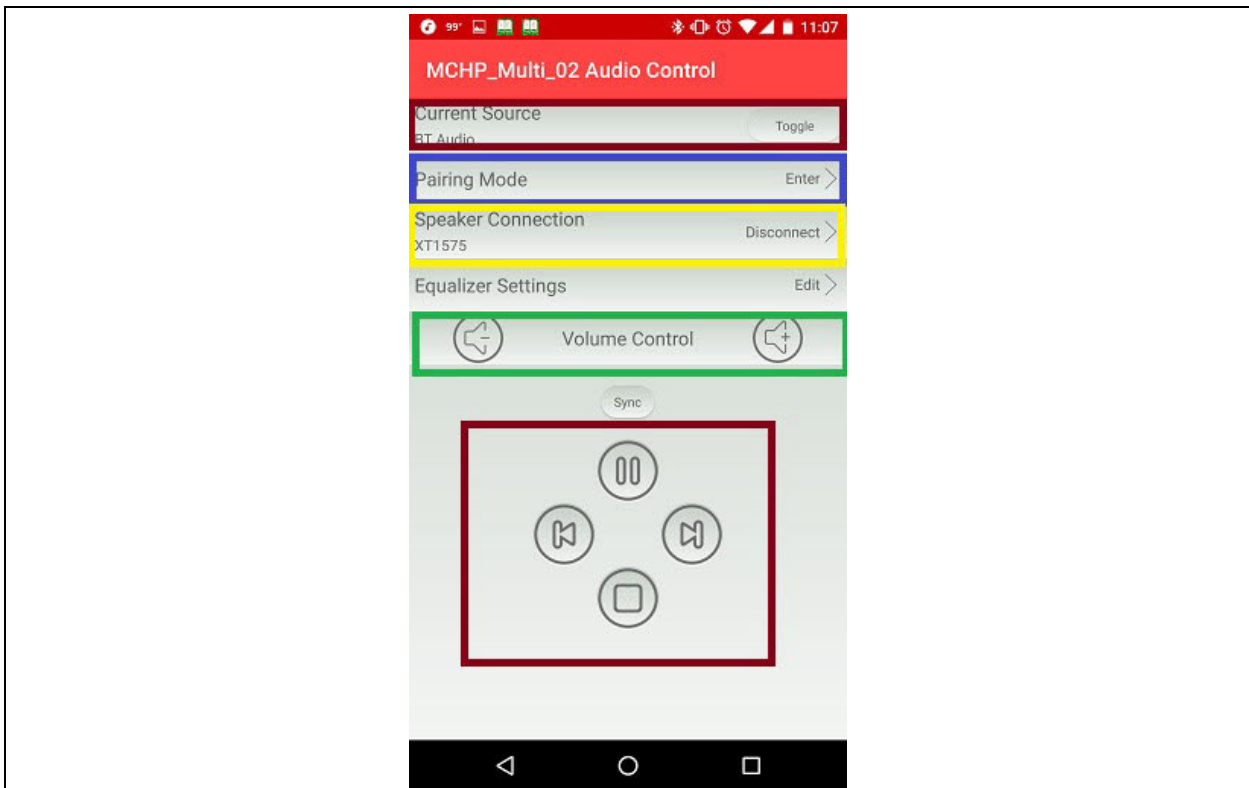
- The “Concert Master” is assigned to a BM83 EVB, see [Figure 11](#).

FIGURE 11: STATUS CONCERT MASTER

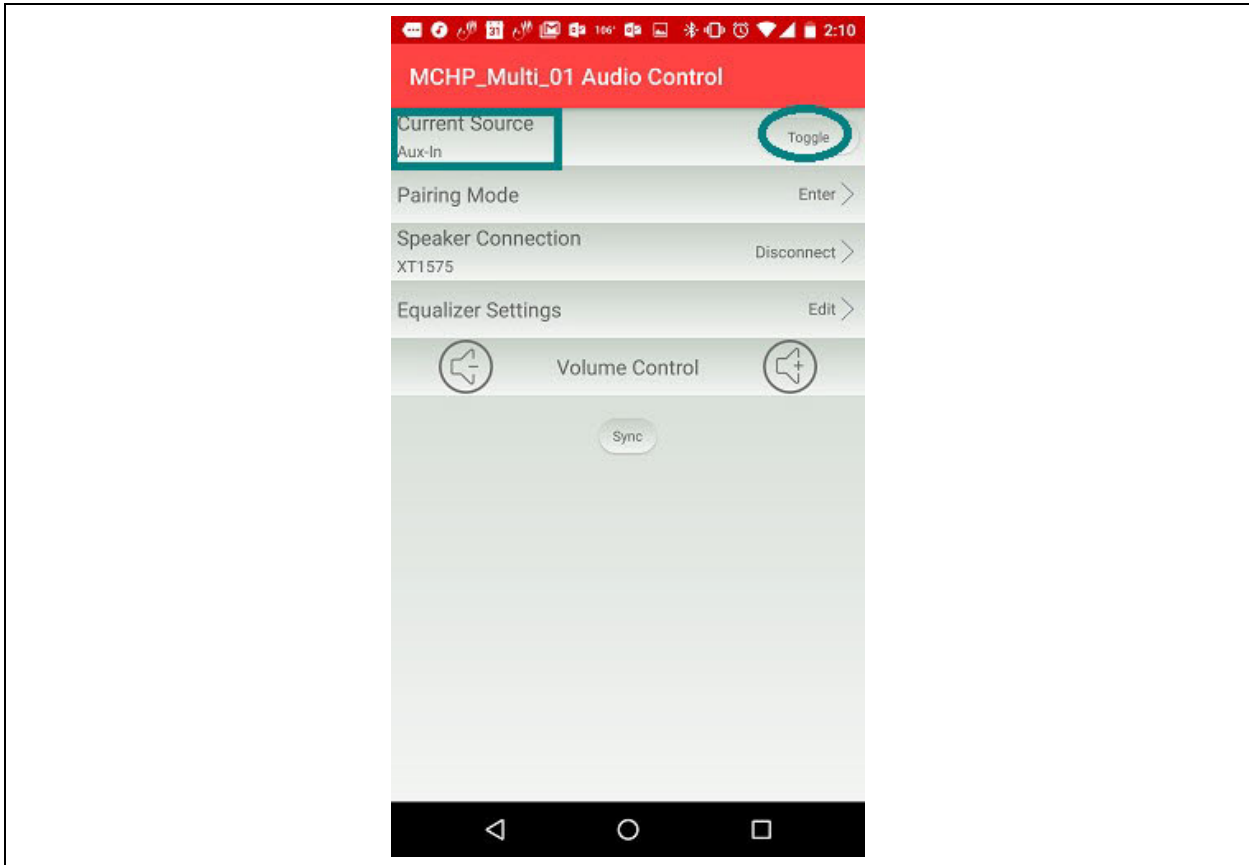


- From the app, click concert master device and then **Audio**, next select **Pairing Mode Enter** to enter Pairing mode, see [Figure 12](#). Select **Speaker Connection Connect** and a list of discoverable Bluetooth devices will be displayed on the Android phone; select the device with name **MCHP_Multi_x** to pair and connect. Now the concert master device audio is connected.

FIGURE 12: AUDIO CONNECTION



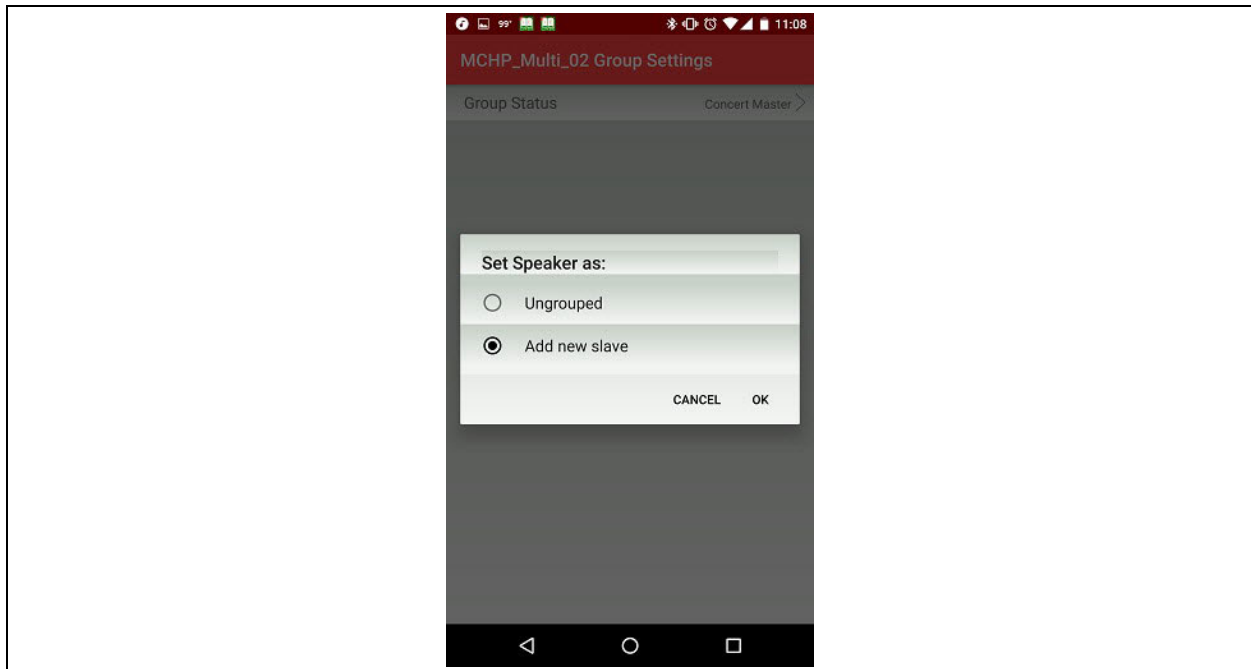
- Control the music from the app through **Music Control**, see [Figure 12](#). Click the **Play** button, and music will play on both master and slave speakers.
- For AUX-In mode, connect an audio streaming device with the master (solid/flashing Blue LED) through an audio AUX-In cable and play music. Music will play on both master and slave speakers.
- To toggle the audio source, click the **Toggle** button on the app, as illustrated in [Figure 13](#).

FIGURE 13: TOGGLE AUDIO SOURCE

2.5.1 ADDING A NEW SLAVE

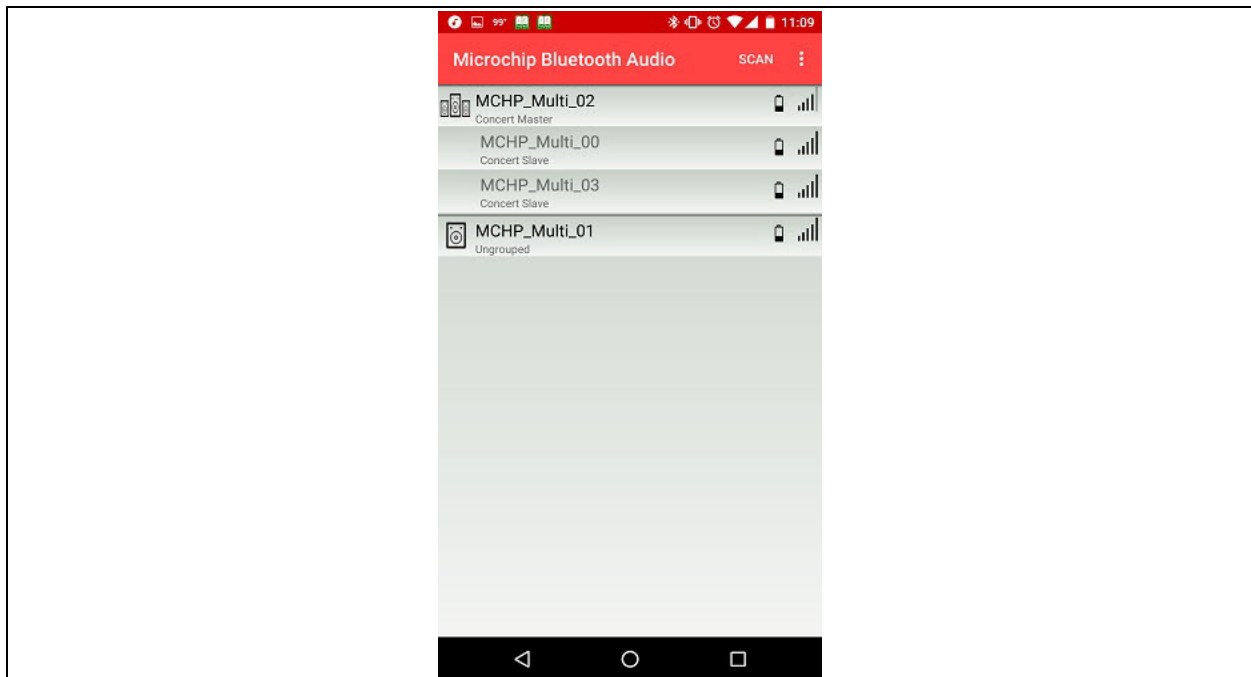
1. From the app, pause the music play. Click the Group **Setting** tab, select **Concert Master**. A small window will pop up. To add a new slave select **Add new slave**, see [Figure 14](#).

FIGURE 14: ADDING A NEW SLAVE



2. Go to Scan mode and click **Scan**. "Waiting for new slave" displays, see [Figure 15](#). Select **Concert Slave** to add as a slave.

FIGURE 15: SCANNING FOR NEW SLAVE



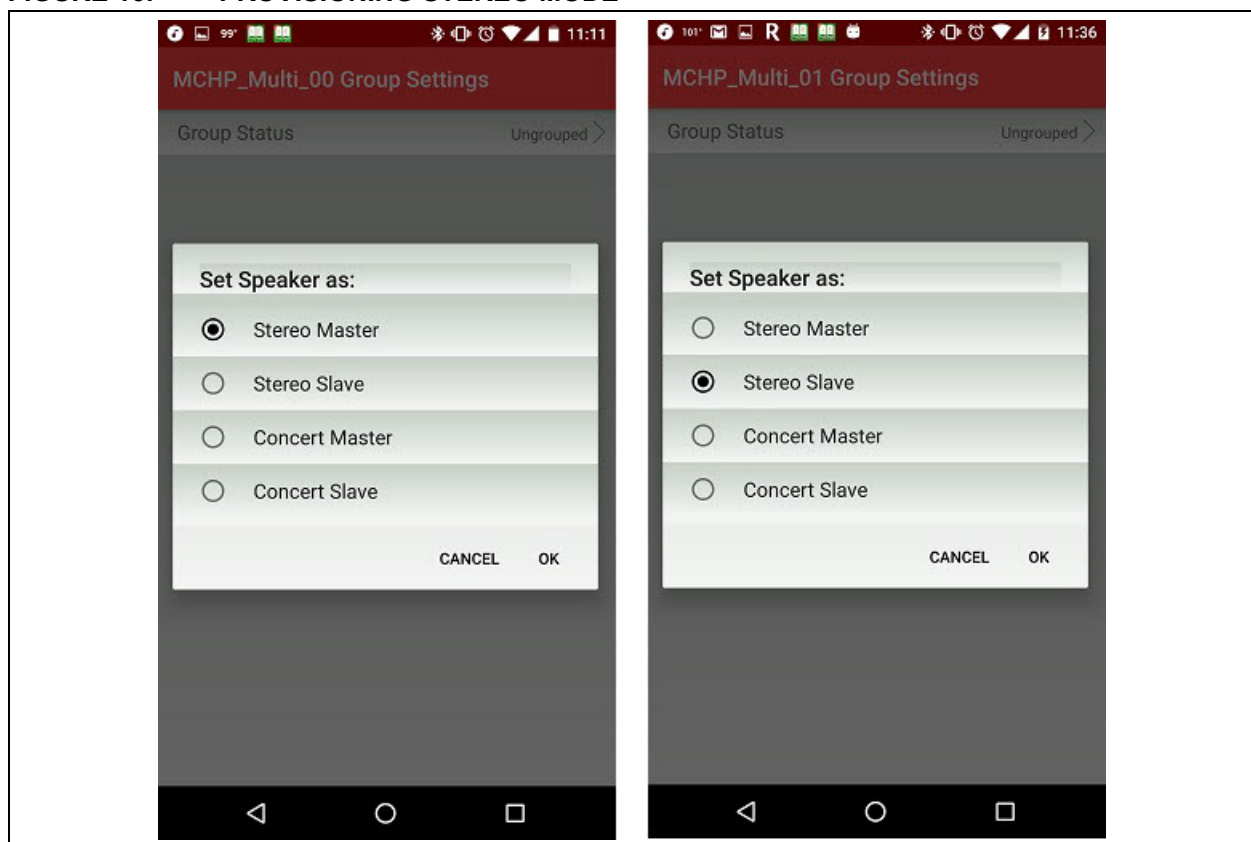
3. A new slave is added to the master. Click **Scan** and select **Concert Master**. Play music from the **Audio** tab (see [Figure 12](#)). Music will be heard on master and slave, including newly added slave.

2.6 Stereo Mode Provisioning Using Microchip Bluetooth Audio Android App

- In Stereo mode, two speakers are used: one as master and another as slave. 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 [Figure 16](#), in place of Concert mode master and Concert mode slave
- in steps 1 through 8 (“[Concert Mode Provisioning Using Microchip Bluetooth Audio App](#)”). The slave will have a solid Red LED and the master will have a flashing/solid Blue LED.
- For AUX-In audio, connect the master (solid/flashing Blue LED) with an audio streaming device through AUX-In cable.
- The AUX-In and the Bluetooth source can be toggled from the app toggle button, as illustrated in [Figure 12](#).

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 16: PROVISIONING STEREO MODE

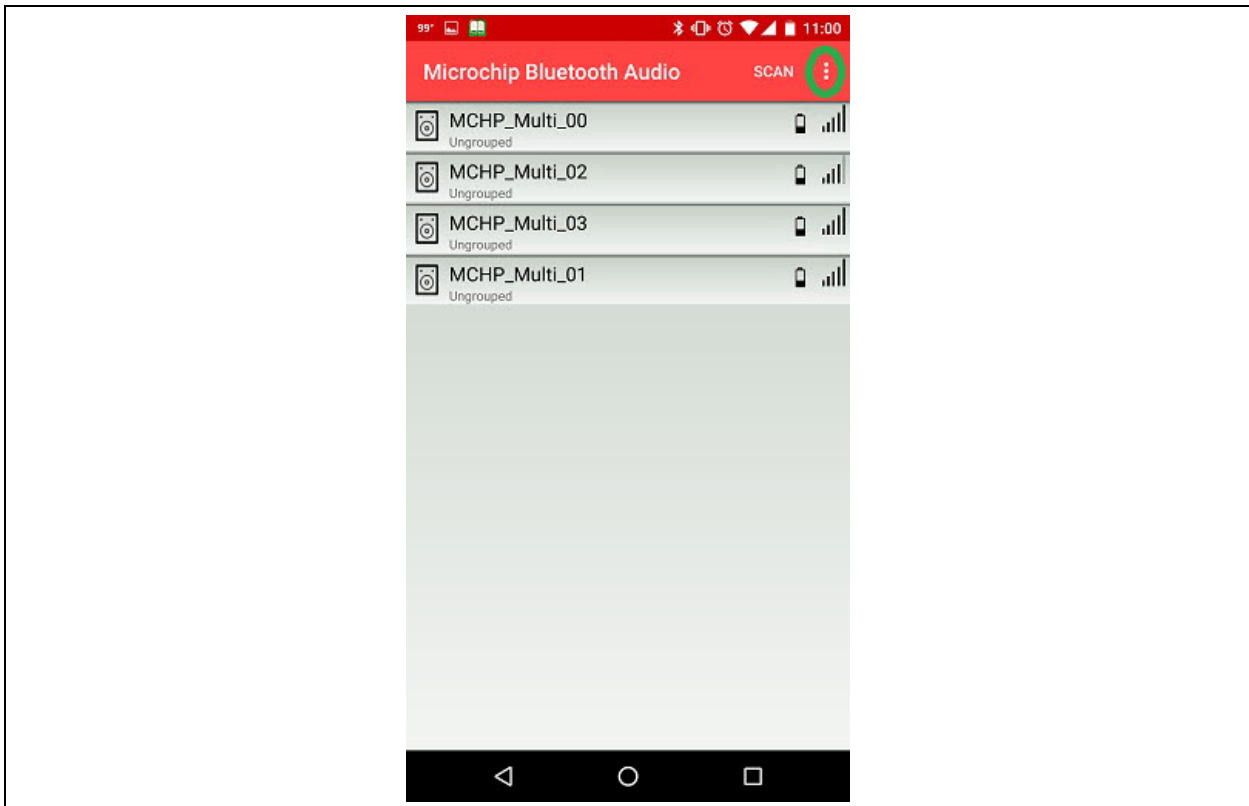


2.6.1 QUICK MASTER/SLAVE SETUP

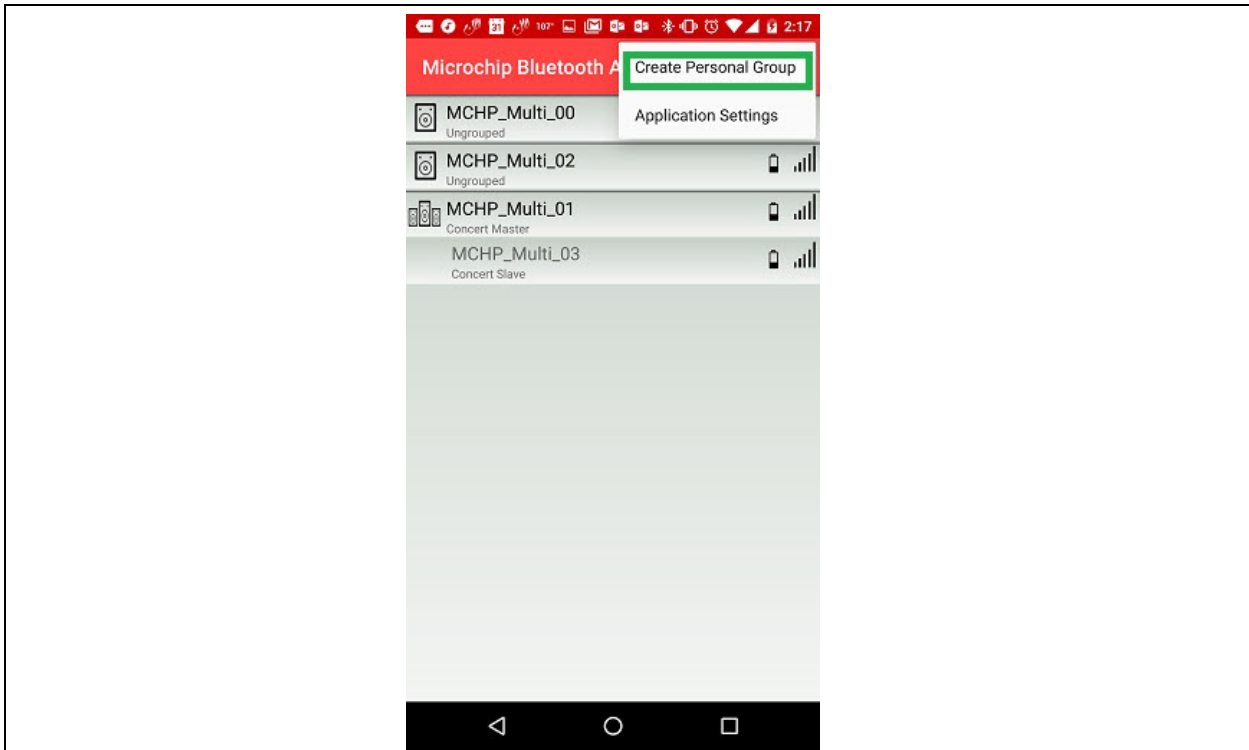
The Microchip Bluetooth Audio app has added a new feature to establish quick master and slave speakers.

1. From the Microchip Bluetooth Audio app, click **Settings**, as illustrated in [Figure 17](#).

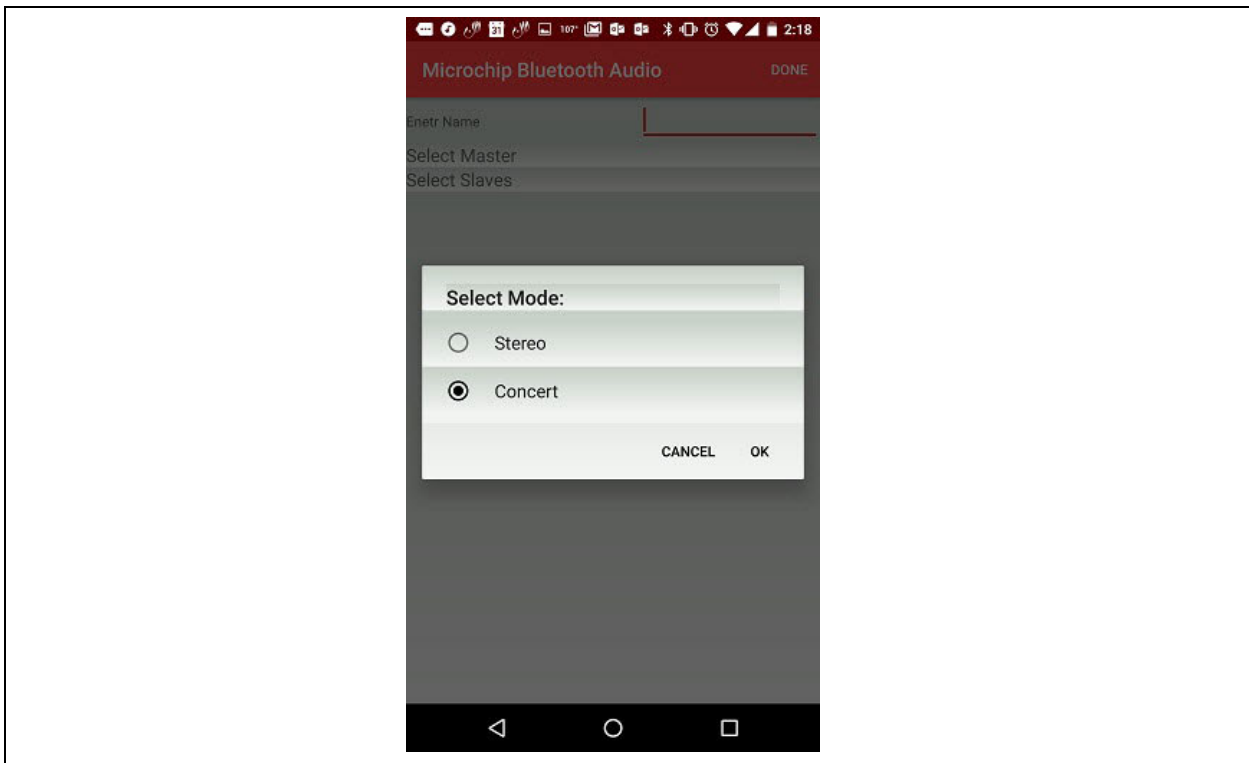
FIGURE 17: QUICK MASTER/SLAVE SETUP



2. Select **Create Personal Group**, as illustrated in [Figure 18](#).

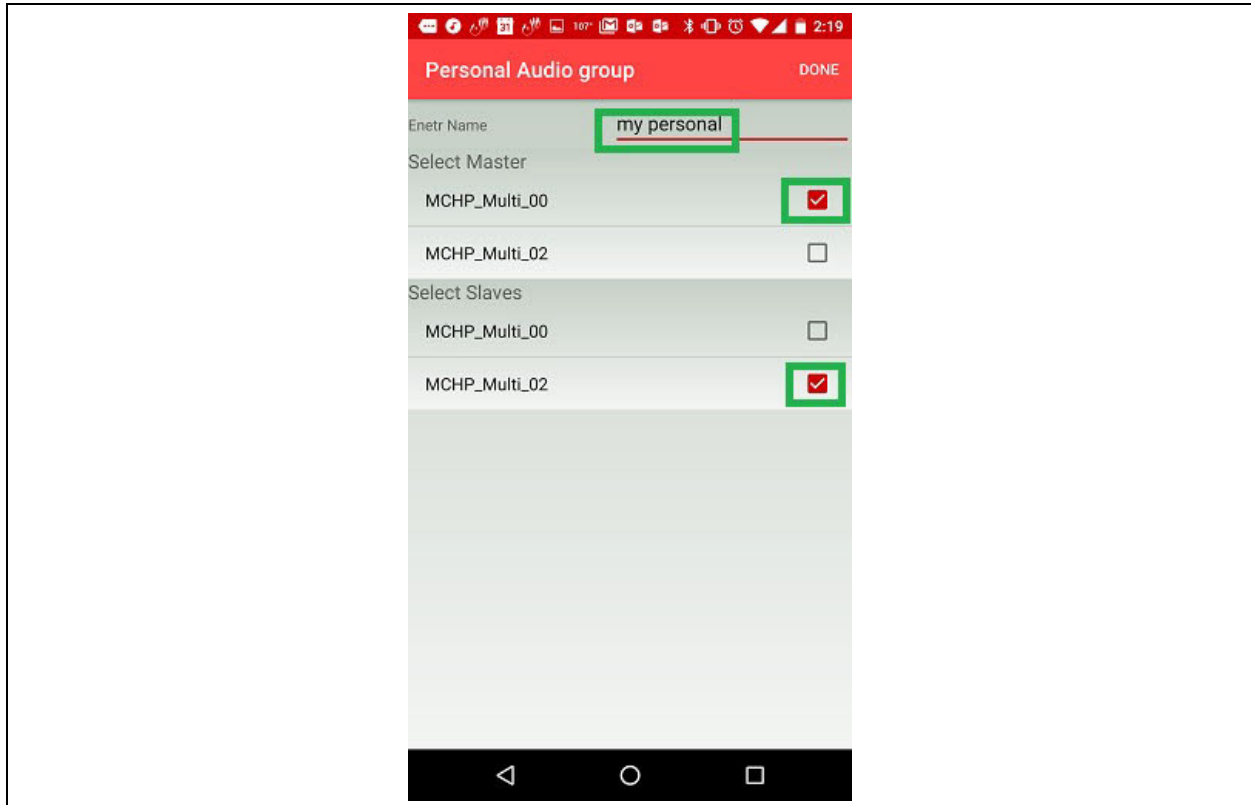
FIGURE 18: CREATING PERSONAL GROUP

3. Select **Stereo/Concert** mode from the pop-up window, as illustrated in [Figure 19](#).

FIGURE 19: SELECTING STEREO/CONCERT MODE

4. After selecting the mode, the Personal Audio group page is displayed. Enter the name (any user-defined) and select master and slave speakers, as illustrated in [Figure 20](#).

FIGURE 20: PERSONAL AUDIO GROUP SETTINGS



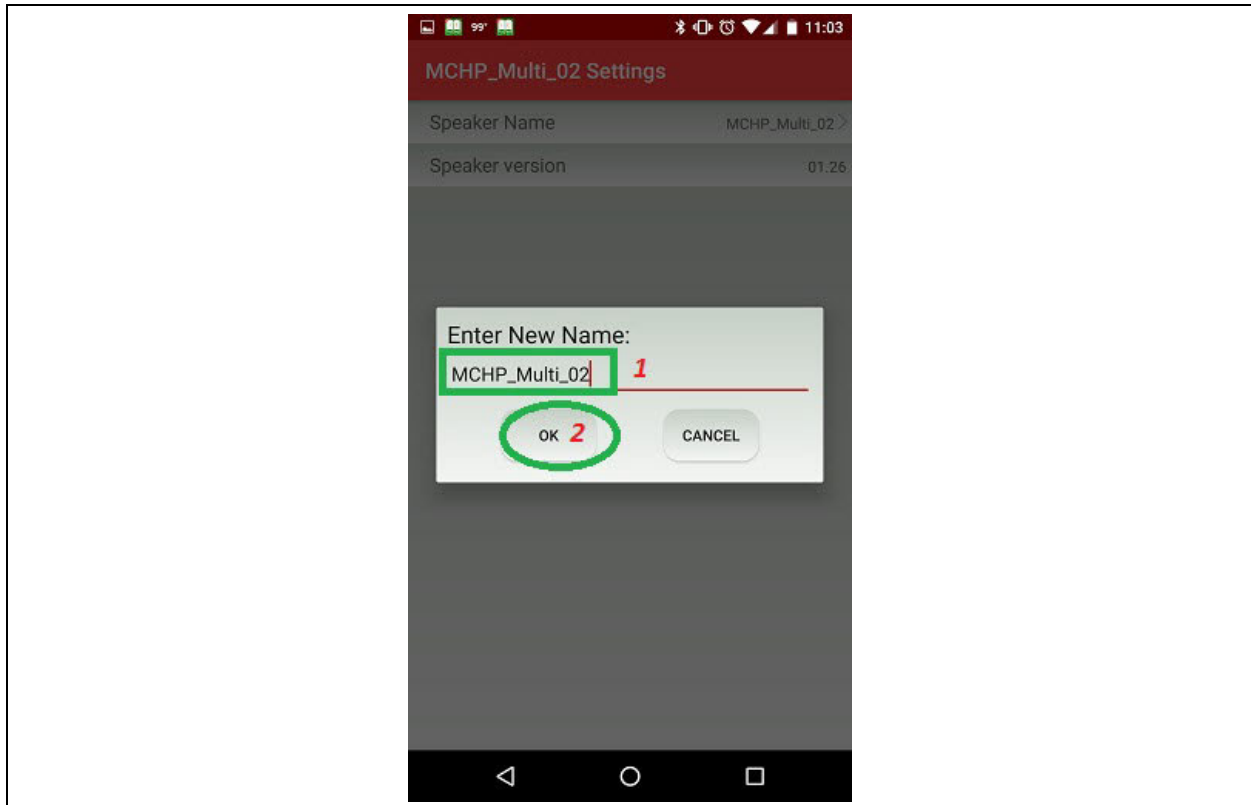
5. Master and slave speakers will be created. To play music, follow step 7 through step 10 from [“Concert Mode Provisioning Using Microchip Bluetooth Audio App”](#).

2.7 Renaming speaker

The speaker name can be changed through the app, as illustrated in [Figure 21](#). 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 long press MFB button in Embedded mode) to store the new speaker name to nonvolatile memory.

FIGURE 21: RENAMING SPEAKER

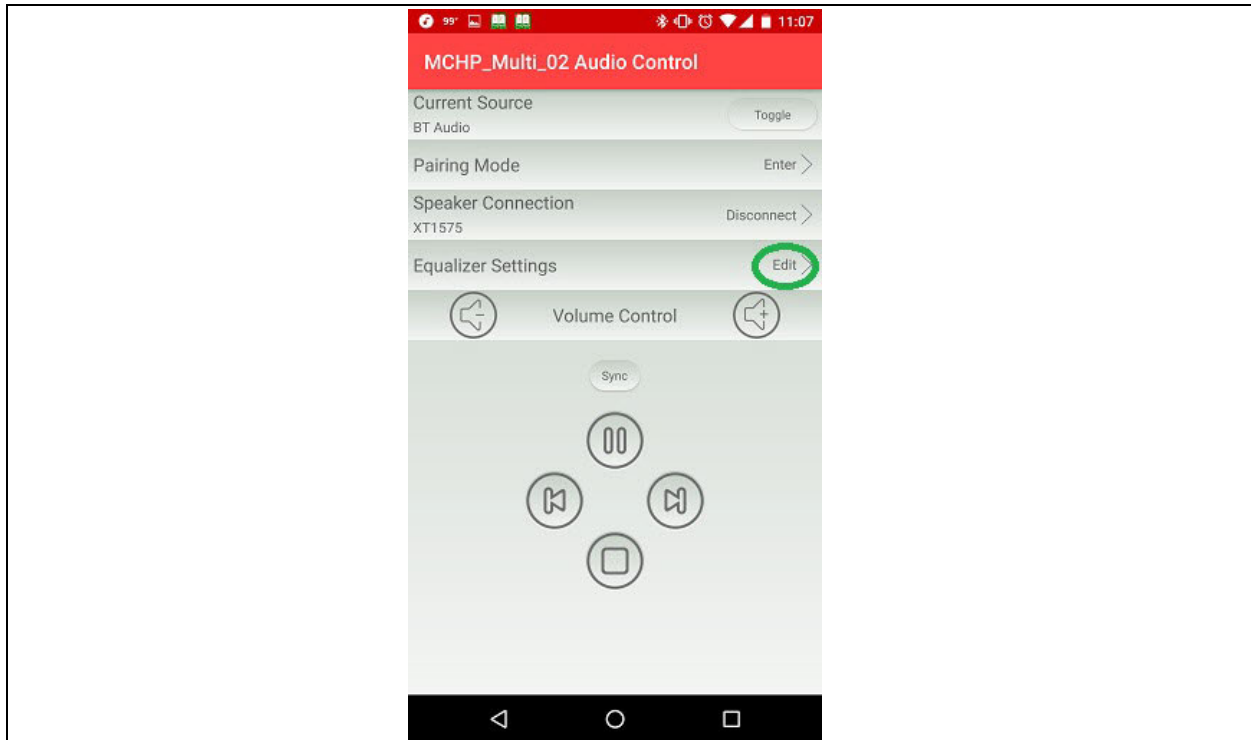


2.8 Equalizer setting

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

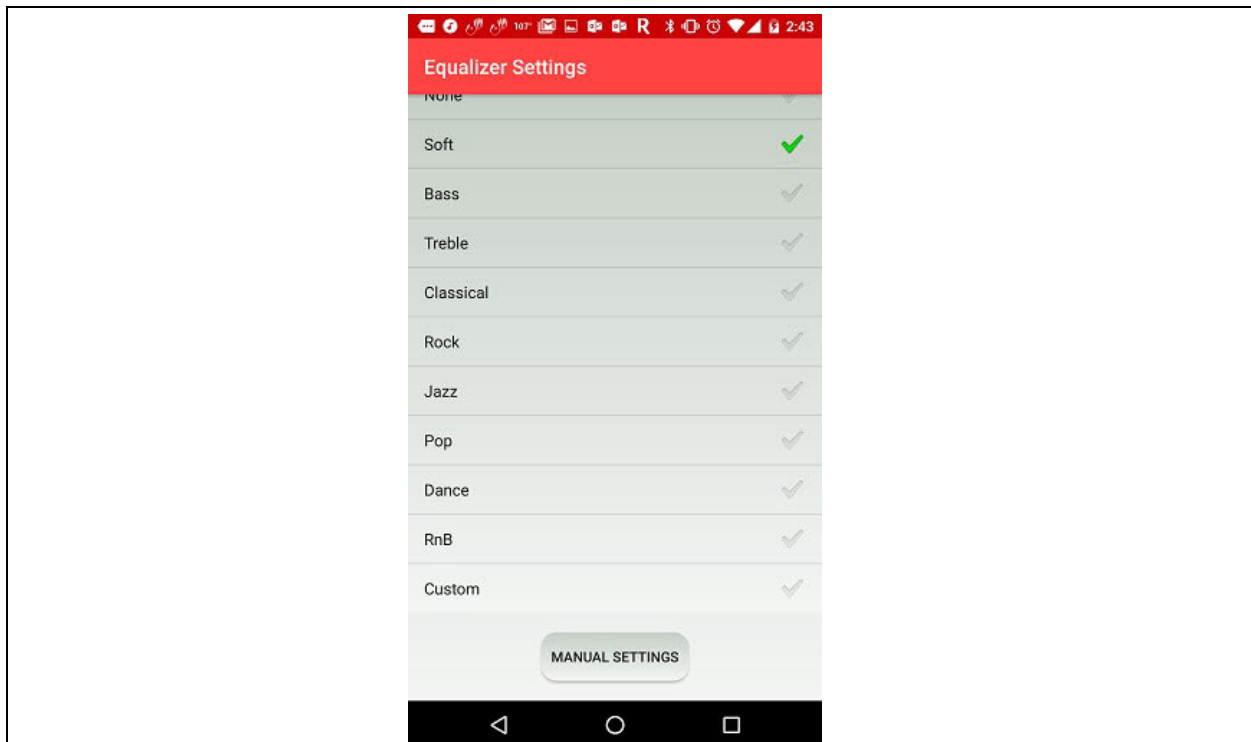
1. Select **Audio > Equalizer Settings > Edit** to edit the equalizer parameters, as illustrated in [Figure 22](#).

FIGURE 22: EDITING EQUALIZER SETTINGS



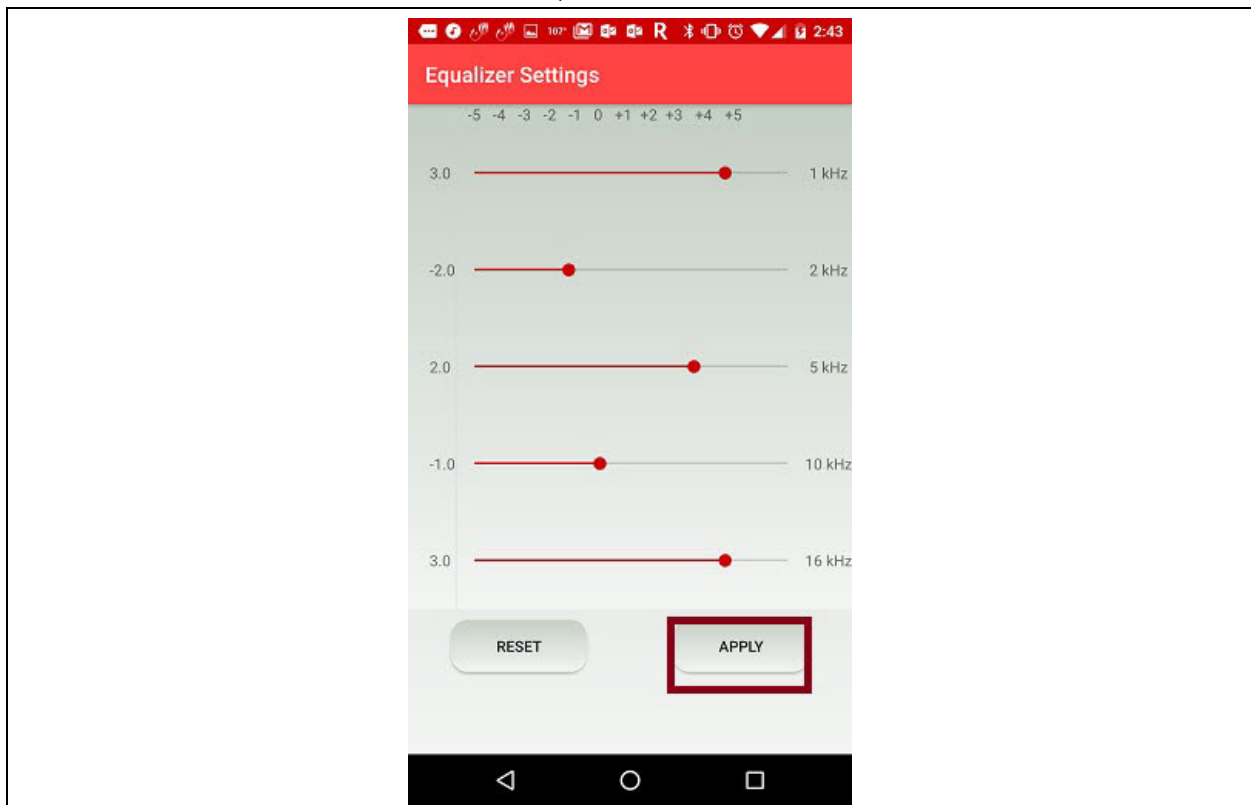
2. Select the standard equalizer parameters from the list, as illustrated in [Figure 23](#).

FIGURE 23: STANDARD EQUALIZER PARAMETERS LIST



3. Select **Manual Settings** to set the equalizer parameters manually, as illustrated in [Figure 24](#).

FIGURE 24: MANUAL SETTINGS OF EQUALIZER PARAMETERS

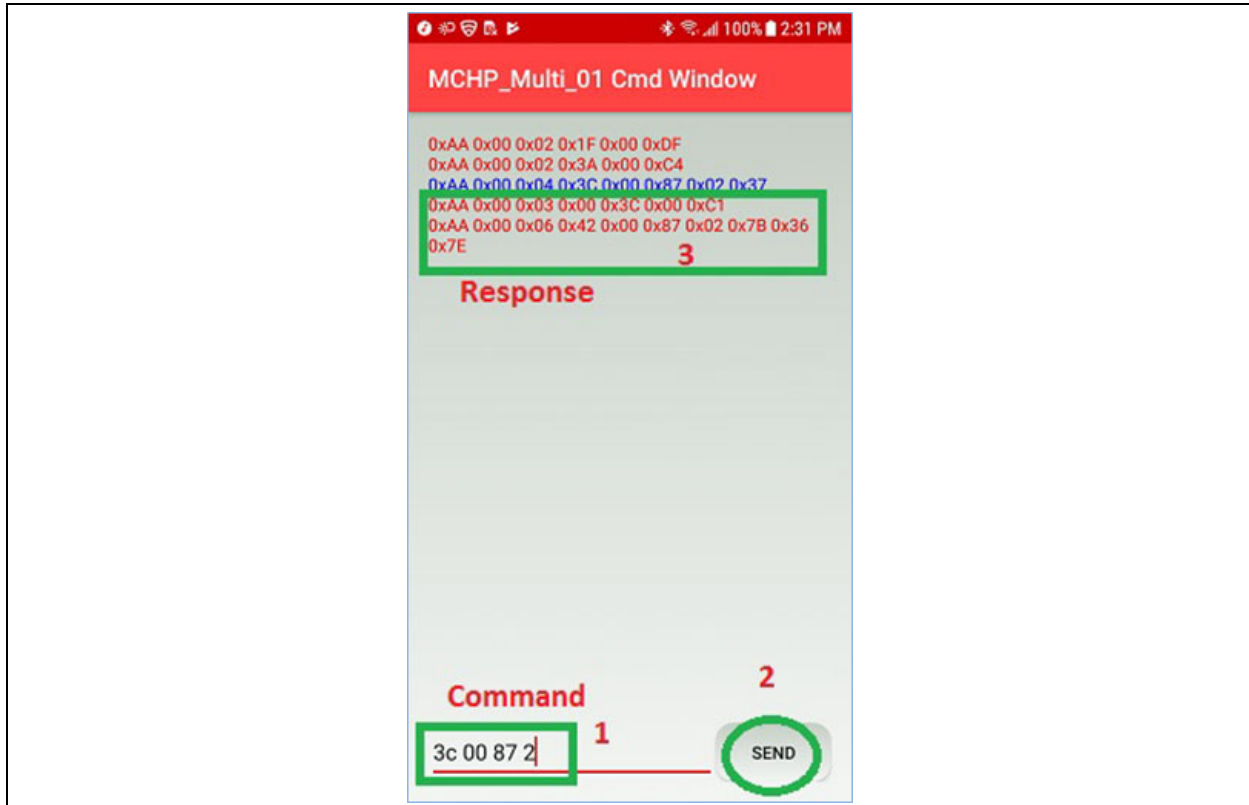


2.9 Command Prompt Feature

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 [Figure 25](#). 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 25: COMMAND PROMPT



2.10 Firmware Capabilities/Features

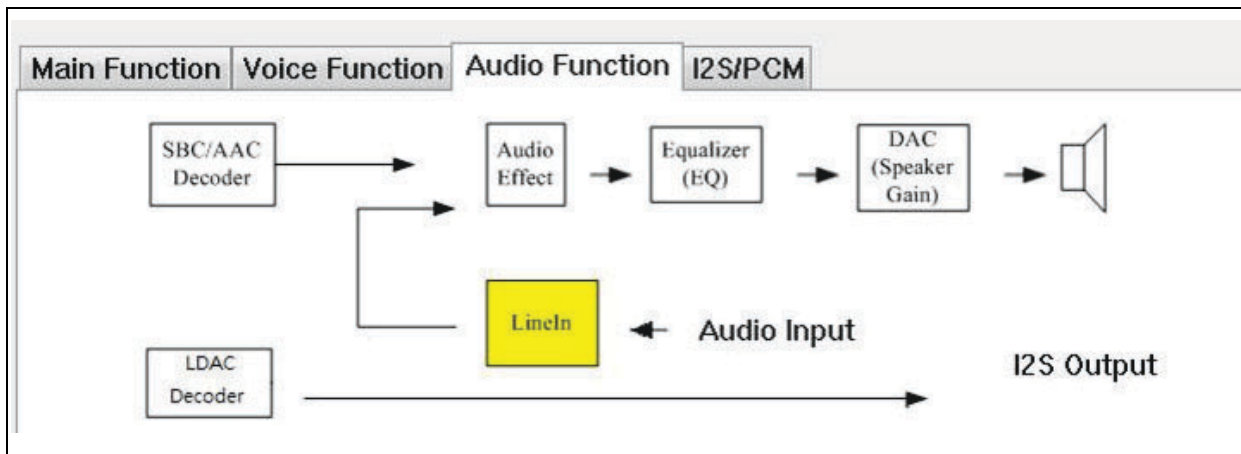
The following features are supported in the MSPK2v1.x firmware:

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 blocks and go directly to the I2S output, as shown in [Figure 26](#). The user cannot change the EQ during LDAC streaming. Therefore, LDAC can not be used with internal CODEC configuration.

FIGURE 26: 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 master and the rest as slaves, connected to the master through Bluetooth. The master 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 slave. There is no guaranteed feedback mechanism between slaves and the master. The button press on the master is communicated to the slave, similarly, the button press on the slave is communicated to master. It follows the same procedure of transmission as a Bluetooth packet received by the master. The AUX-In audio to a slave speaker plays on the slave speaker only. It is not transmitted to the master speaker.

The auto-reconnect feature has been enabled in Concert mode; that is, upon the power cycle of master and slave, they reconnect. For more details, refer to [Appendix K: “Auto Reconnection”](#).

2.12 Stereo Mode

Two speakers are used in Stereo mode. One speaker works as a master and another as a slave connected to the master through Bluetooth. The master speaker is connected to a Bluetooth-enabled streaming device through Bluetooth or through AUX-In cable to an audio streaming device. [Figure 3](#) and [Figure 4](#) illustrate a typical Stereo 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 a high

quality setting and every packet is ACKed by slave. The lost packet or NACKed packet is re-transmitted by the master. The button press is synchronized on both the master and slave, i.e., play, pause, volume, up/down button press on master and slave speaker has similar effect. The AUX-In audio is SBC-encoded with high quality settings by master. It follows the same procedure of transmission as the Bluetooth packet received by the master. The AUX-In audio on the slave speaker plays on the slave speaker and is not transmitted to the master speaker. The auto-reconnect feature has been enabled in Stereo mode; i.e., upon the power cycle of master and slave, 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 13](#).

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 I²S audio output with the following sampling frequency. Find a correct external codec to support I2S with this sampling frequency.

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 non-LDAC bit stream is converted into 48 kHz sampling frequency. The customer can set the sampling frequency of the CODEC @48 kHz during the initialization and it will not change 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 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 a list of common configurable IS2083BM options that can be set by the Config Tool:

- Application: Single speaker, multiple speakers
- Decoding: SBC, AAC, LDAC (no audio effects supported)

Note: Press the power-off button (Short press SEL in Host mode/ Long long press 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 mobile phones. While playing audio from one mobile phone, the other phone audio is paused. The volume of last played mobile

- IS2083BM supplies I2S 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 CODEC is preferred for iOS devices.

2.12.7 AUTO RECONNECT

The Concert/Stereo modes support the auto-reconnect feature, i.e., upon power cycle master and slave reconnects.

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*.

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 apply the same on the BM83 over BLE interface. For more details on this feature, refer to the *BM83 MCHP OTA DSP Tuning Application Note* available in the `\Tools\OTA DSP Tuning` folder.

2.13 MCU and CODEC

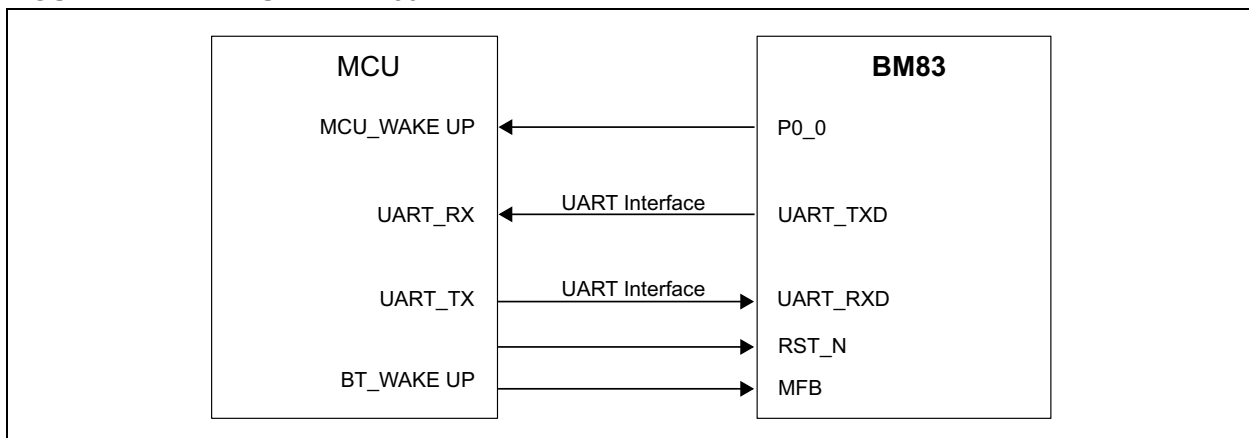
The BM83 EVB contains the BM83 module, PIC32 MCU and an ST codec. However, the PIC32 and ST codec can be replaced by another MCU and codec, but the BM83 module is mandatory.

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. [Figure 27](#) illustrates the minimum connections required by the relevant hardware pins on the BM83 module.

FIGURE 27: 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

3.0 AUDIO TRANSCEIVER SOLUTION

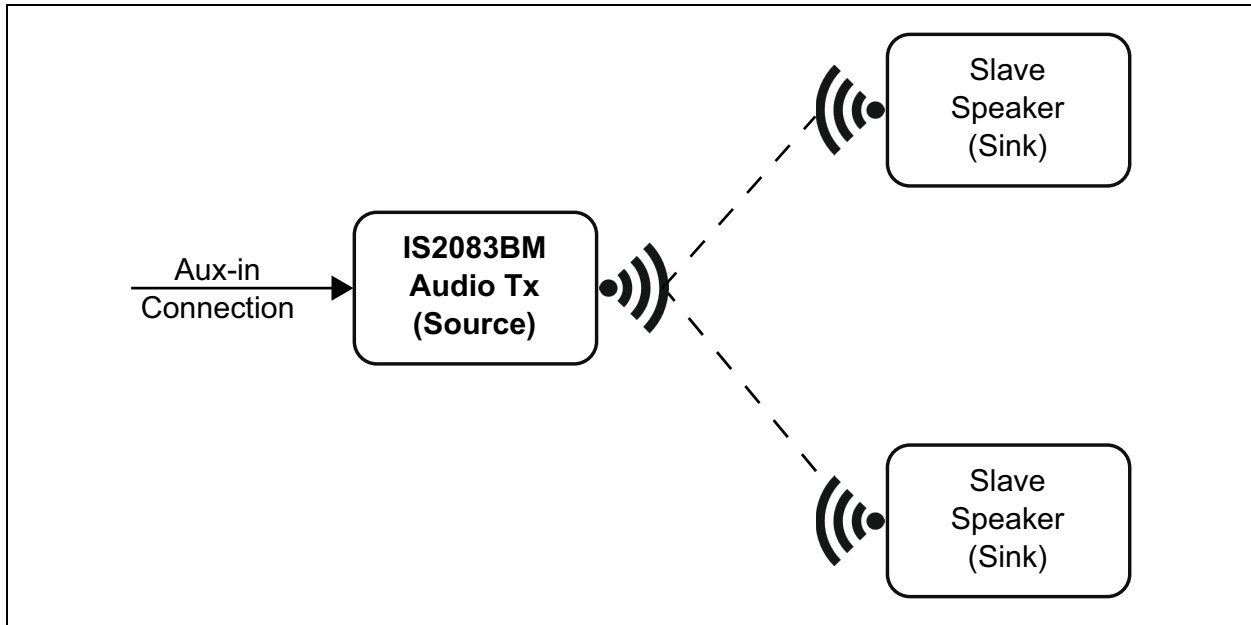
Microchip's Audio Transceiver (AT) solution enables Bluetooth capability in non-Bluetooth Audio-equipment. The AT receives audio inputs through Aux-in or I2S pin and streams the audio up to two Bluetooth paired sink devices.

The AT solution can work as either an A2DP source (where BM83 is the master device) or A2DP/HFP sink (where BM83 is a sink device).

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

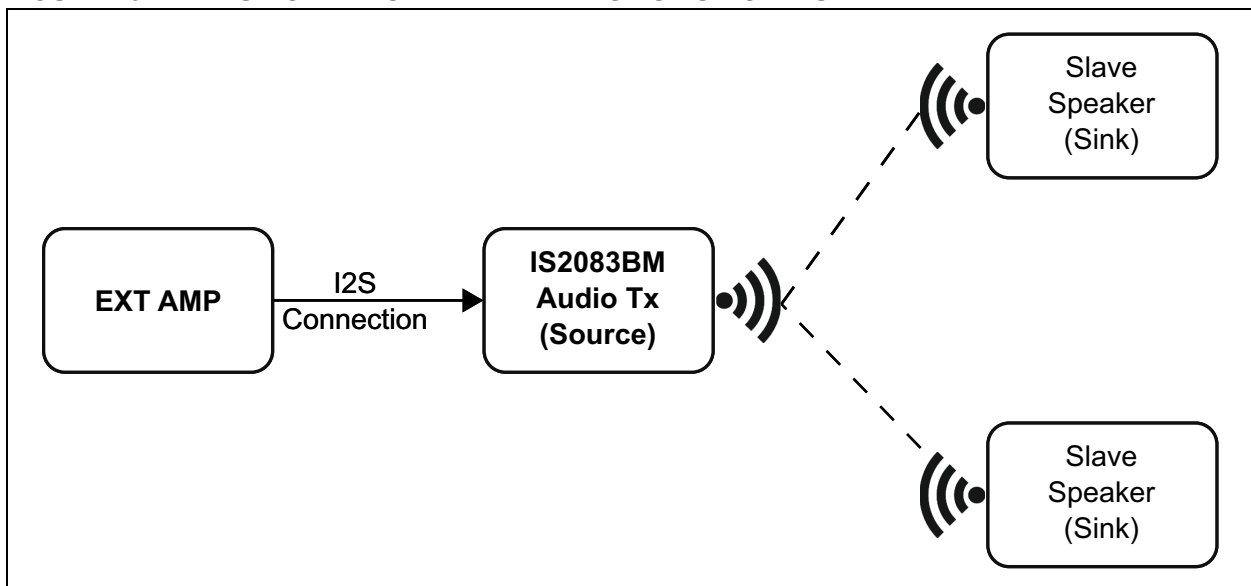
The following figure illustrates a typical example of an audio transmitter taking input from Aux-in and transmitting the signal to two connected sink devices.

FIGURE 28: AUDIO TRANSMITTER WITH AUX-IN AS AUDIO INPUT



The following figure illustrates a typical example of audio transmitter taking I2S as input and transmitting to two connected sink devices.

FIGURE 29: AUDIO TRANSMITTER WITH I2S 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 I2S. Aux-in and I2S 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 I2S 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, I2S 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/I2S, and play and stream out the music through both connected sink devices.

3.2.2 HOST MODE DEMO SETUP

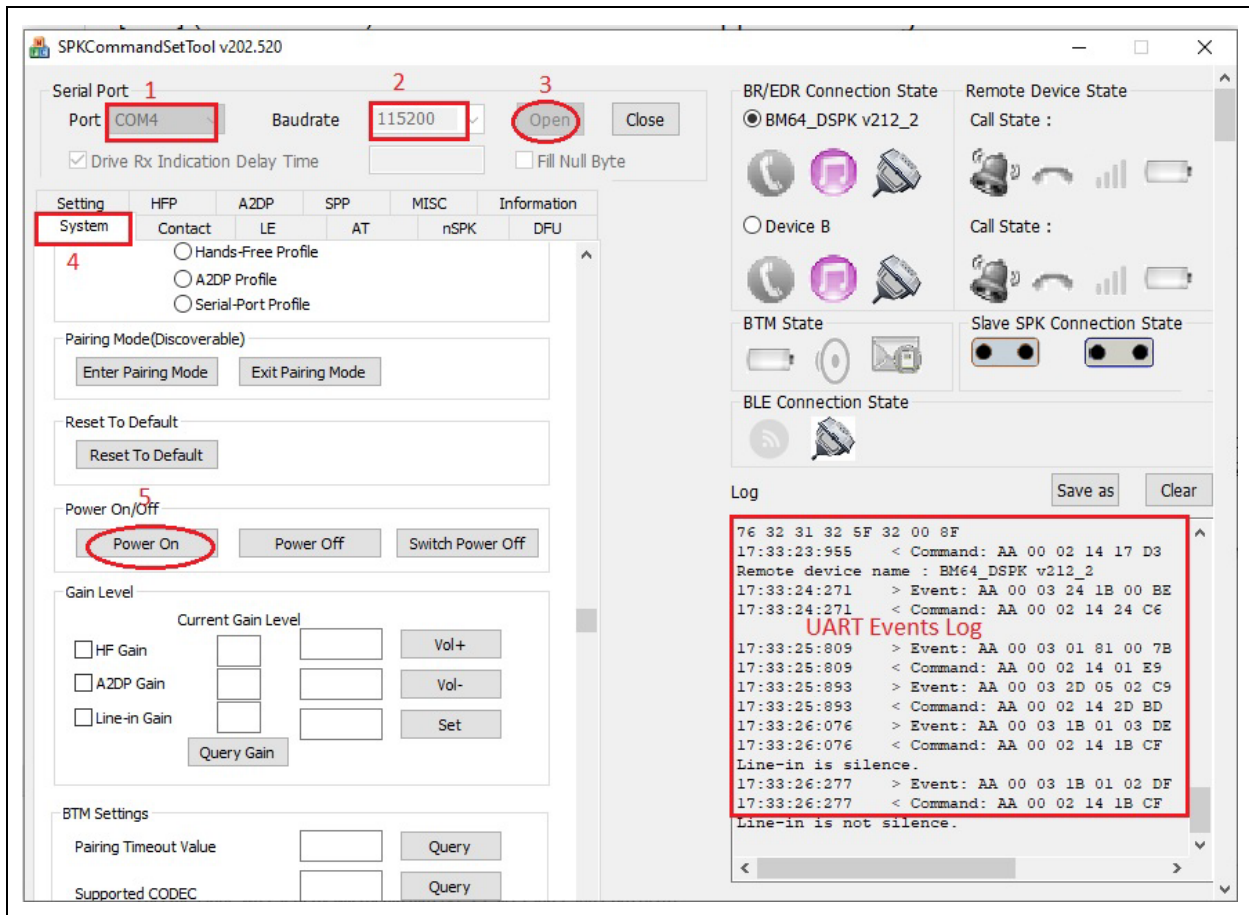
1. Slide SW300 to the ON position to put the BM83 into Test mode.
2. Connect the BM83 EVB with a mini USB and toggle the SW200 switch to the 5V_USB position.
3. Program the AT firmware, DSP firmware, and Config Settings (Host mode) from the BM83 AT package (IS2083 Turnkey v1.x\Software\IS2083 Image\AT 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.

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

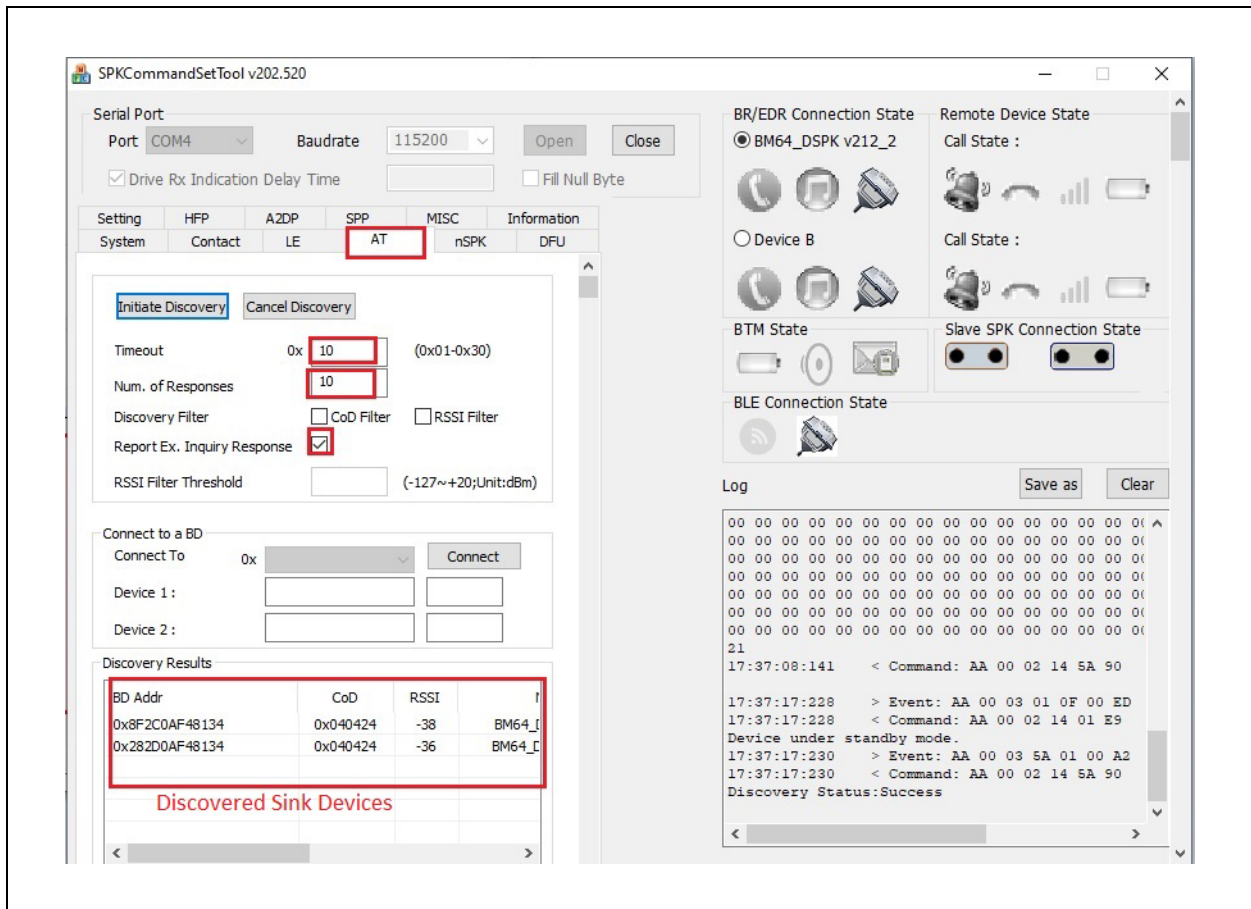
FIGURE 30: SPKCOMMANDSETTOOL GUI



- Go to the **AT** tab, fill out parameters and issue the command as shown in [Figure 31](#).

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

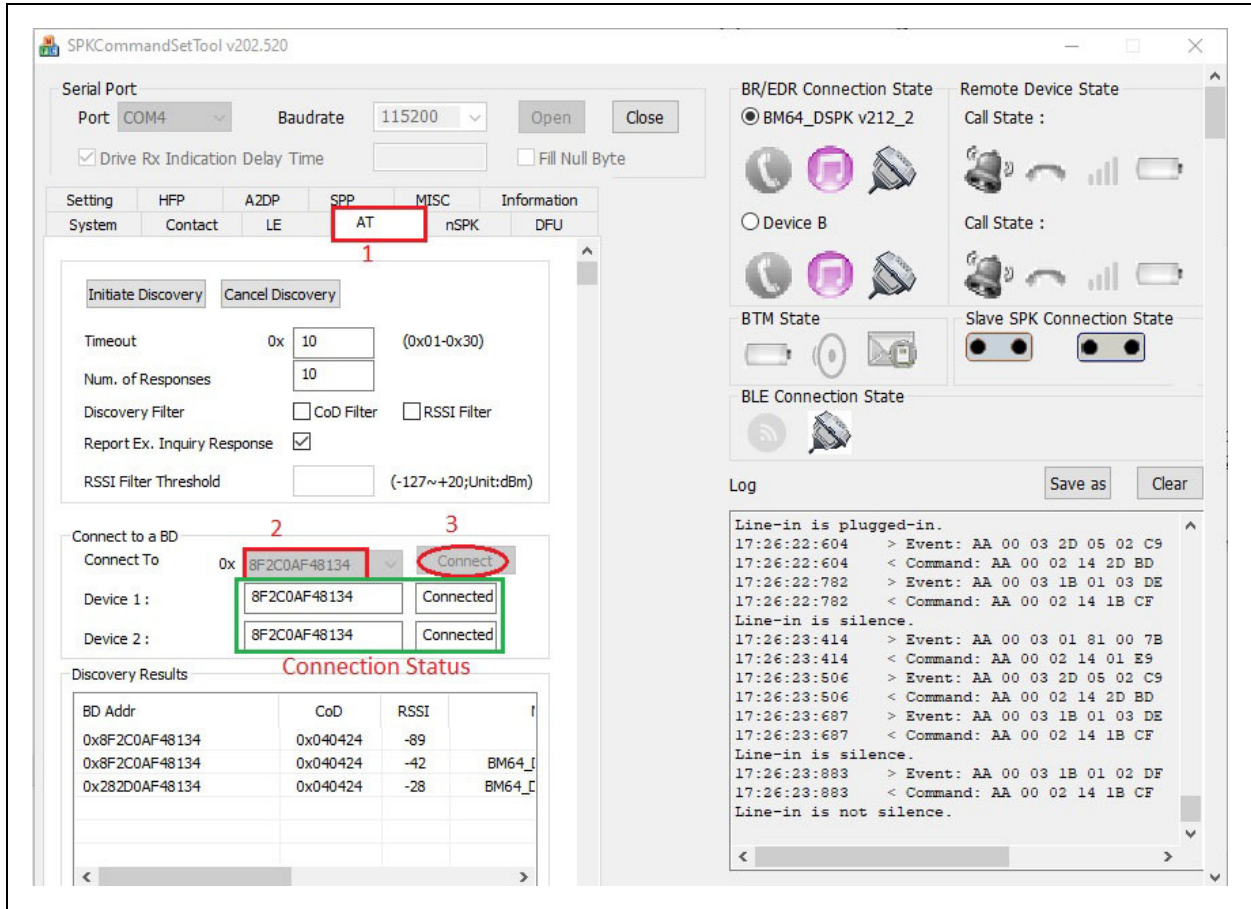
FIGURE 31: AT TAB IN SPKCOMMANDSETTOOL GUI



- 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 32](#).

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

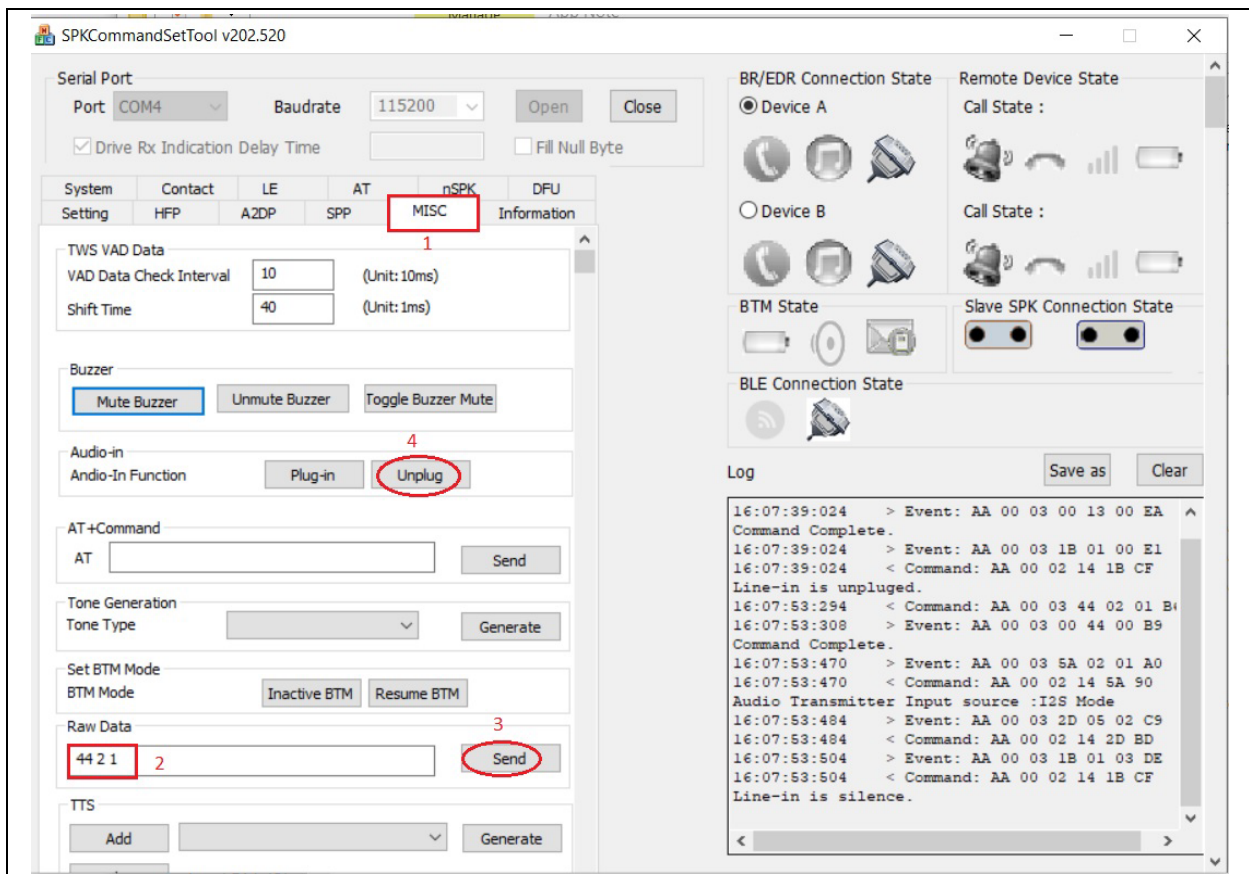
FIGURE 32: CONNECTION STATUS IN AT TAB IN SPKCOMMANDSETTOOL GUI



- Two sink devices have been connected to the BM83 AT as shown in the preceding figure. Connect Aux-in and/or I2S 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 I2S, issue 44 2 1 and 13 1 0 commands as shown in the [Figure 33](#). 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 33: MISC TAB IN SPKCOMMANDSETTOOL GUI



- 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

- Slide SW300 to the ON position to put the BM83 into Test mode.
- Connect the BM83 EVB with a mini USB and toggle the SW200 switch to 5V_USB position.
- 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.

- 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.
- 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.
- 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.
- 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.
- 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

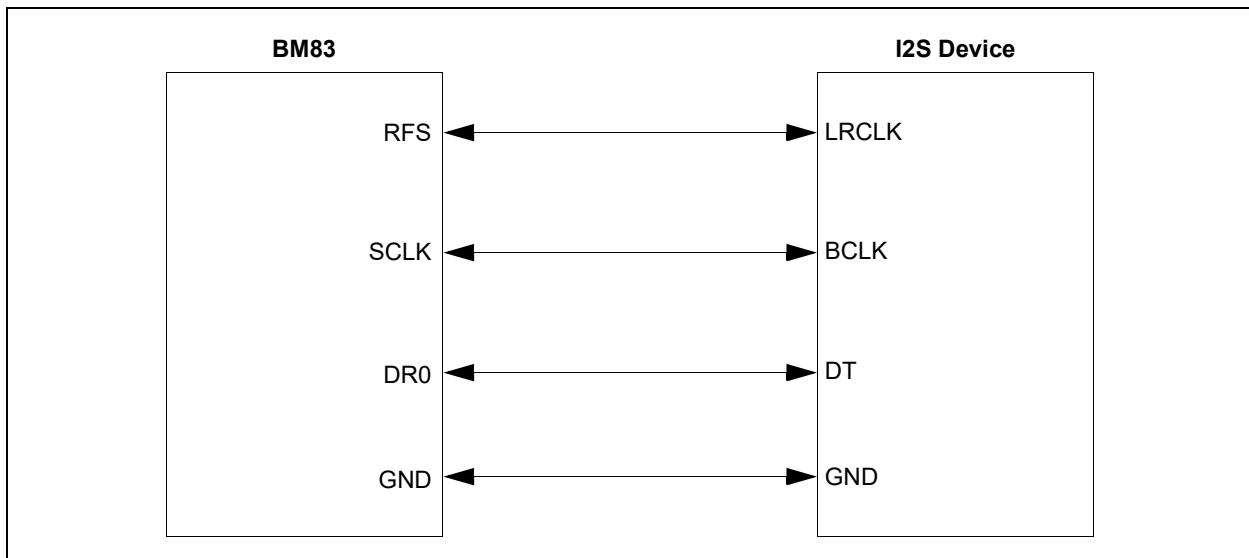
frequency

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 34: 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_SStream(0x44 0x08)

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)

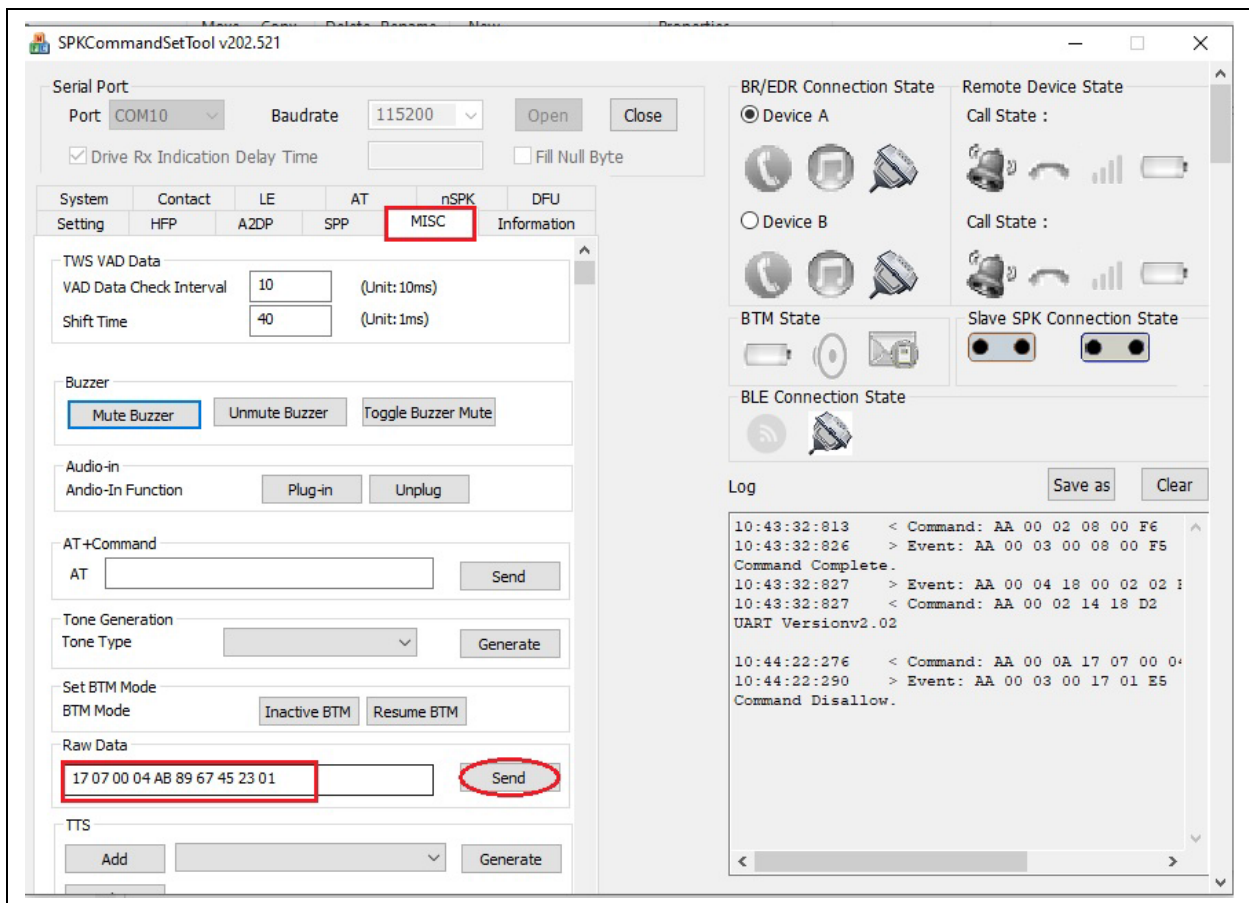
Details of these commands and events are available in *AudioUARTCommandSet_v2 0x.pdf*. This document is part of the BM83 AT package. If the Bluetooth MAC ID of a sink device is known, then a `Profile_Link_Back(0x17)` command with type 7 can be used for establishing a connection. A Bluetooth MAC ID is 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 35: SENDING A RAW DATA THROUGH SPKCOMMANDSETTOOL



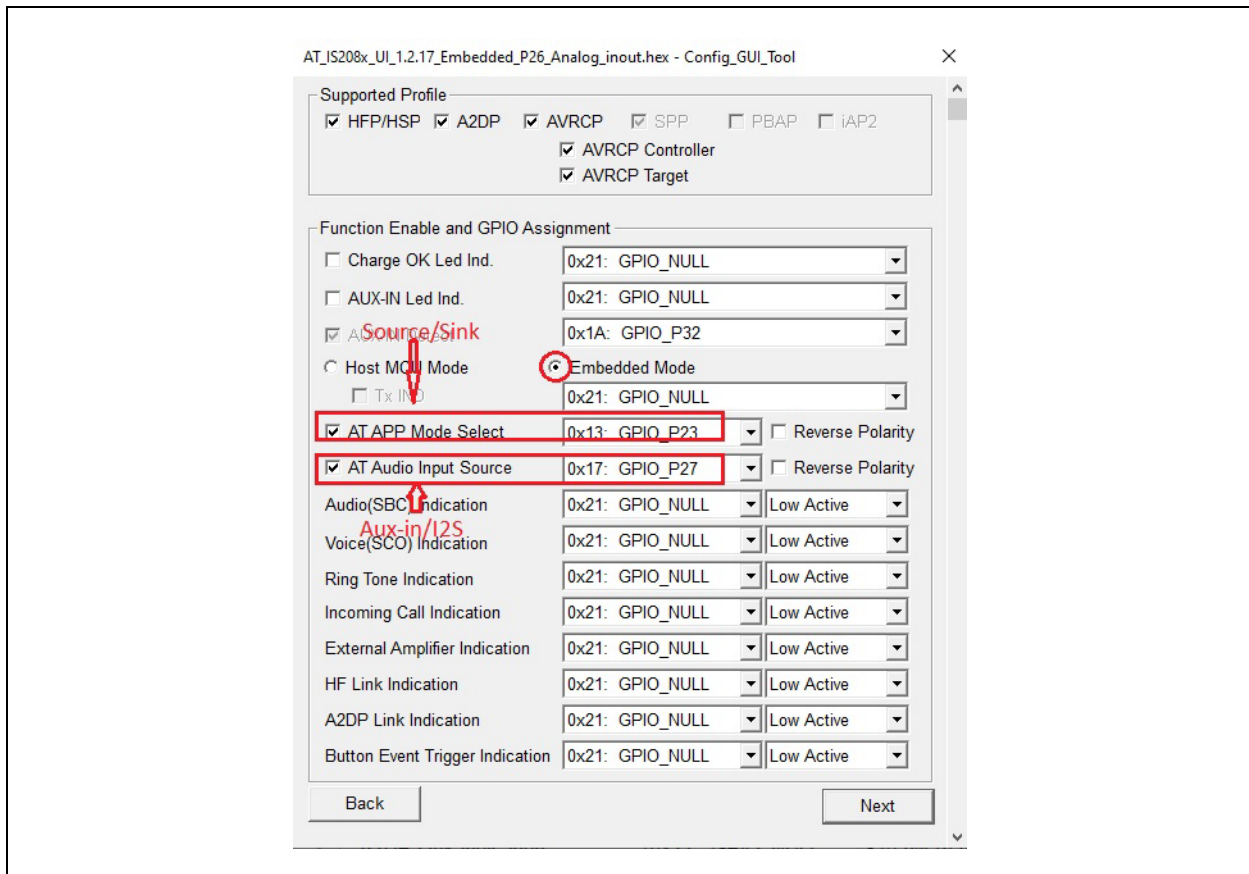
To get the name along with the BT MAC ID of the nearby advertising sink devices, the `Device_Discovery(0x44)` command should include an Extended Inquiry Response (EIR) parameter. If the system has an MCU and display, then the inquiry mode result can also be displayed on the display and a user can choose 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 GPIO in Embedded mode. This GPIO can be configured using Config GUI tool as shown in [Figure 36](#). In Host mode, AT Audio input source should be unchecked and send the `Change_Audio_Source(0x44 2 0/1)` and `13 1 1/0` commands to toggle audio source between Aux-in and I2S.

FIGURE 36: 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 Figure 36. In Host mode, AT APP mode select should be unchecked and the `Change_APP_Mode(0x44 3 0/1)` command needs to be sent to switch between source and sink.

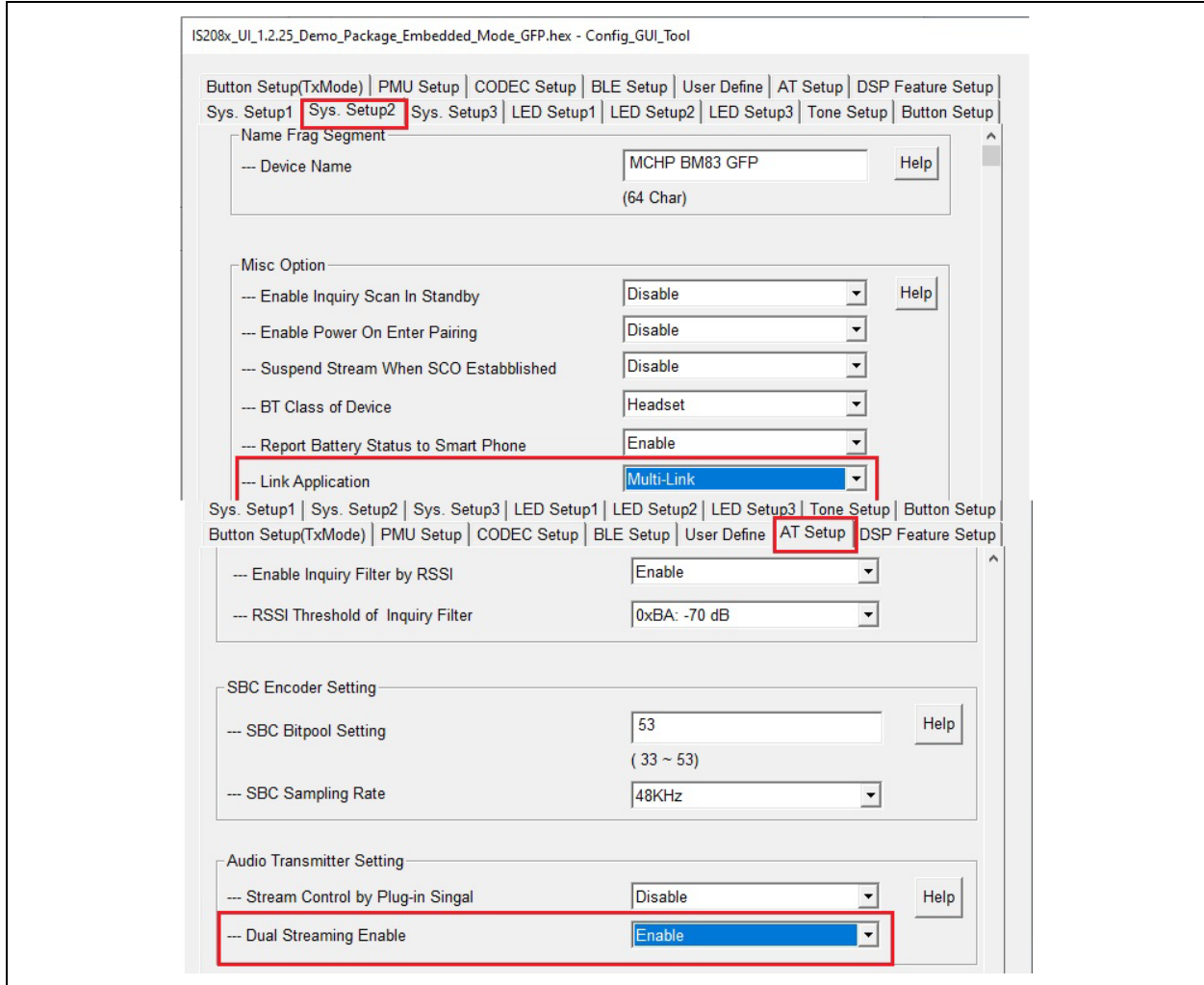
3.8 I2S Sampling Rate Change

The BM83 transmitter can take I2S 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.

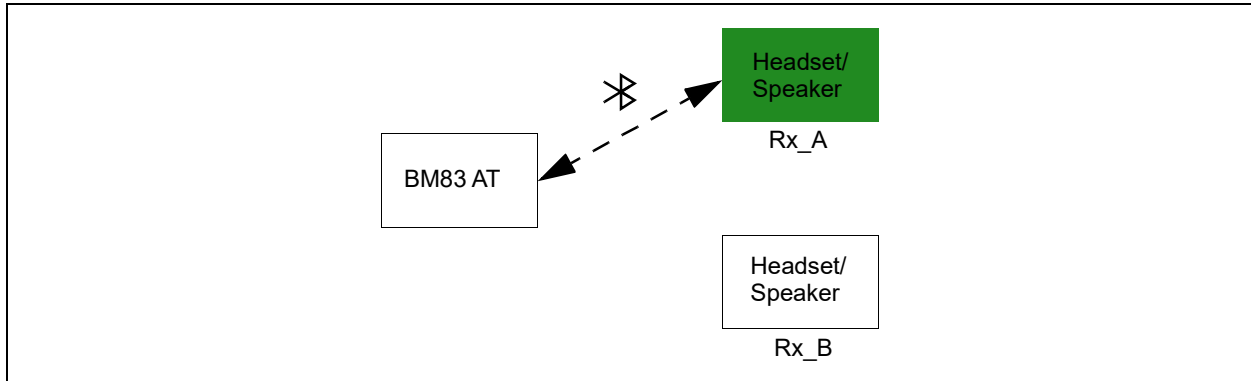
FIGURE 37: ENABLING DUAL STREAMING FEATURE



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

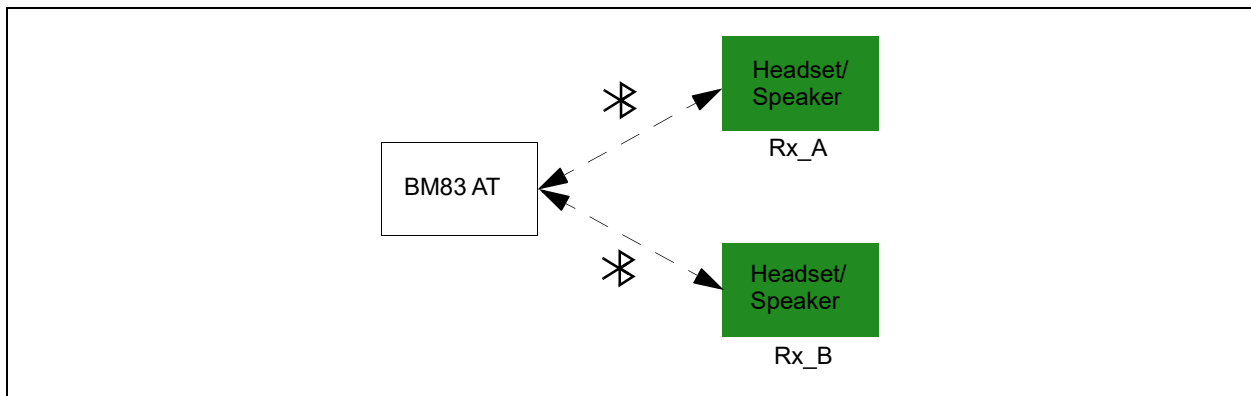
1. Discovery of two Bluetooth audio sink devices as shown in the Host/Embedded mode demo setup.
2. When connection with Rx_A is established, high quality audio will be played on the Rx_A speaker/headset.

FIGURE 38: DEPICTION OF HIGH QUALITY AUDIO STREAMING THROUGH RX_A SINK DEVICE



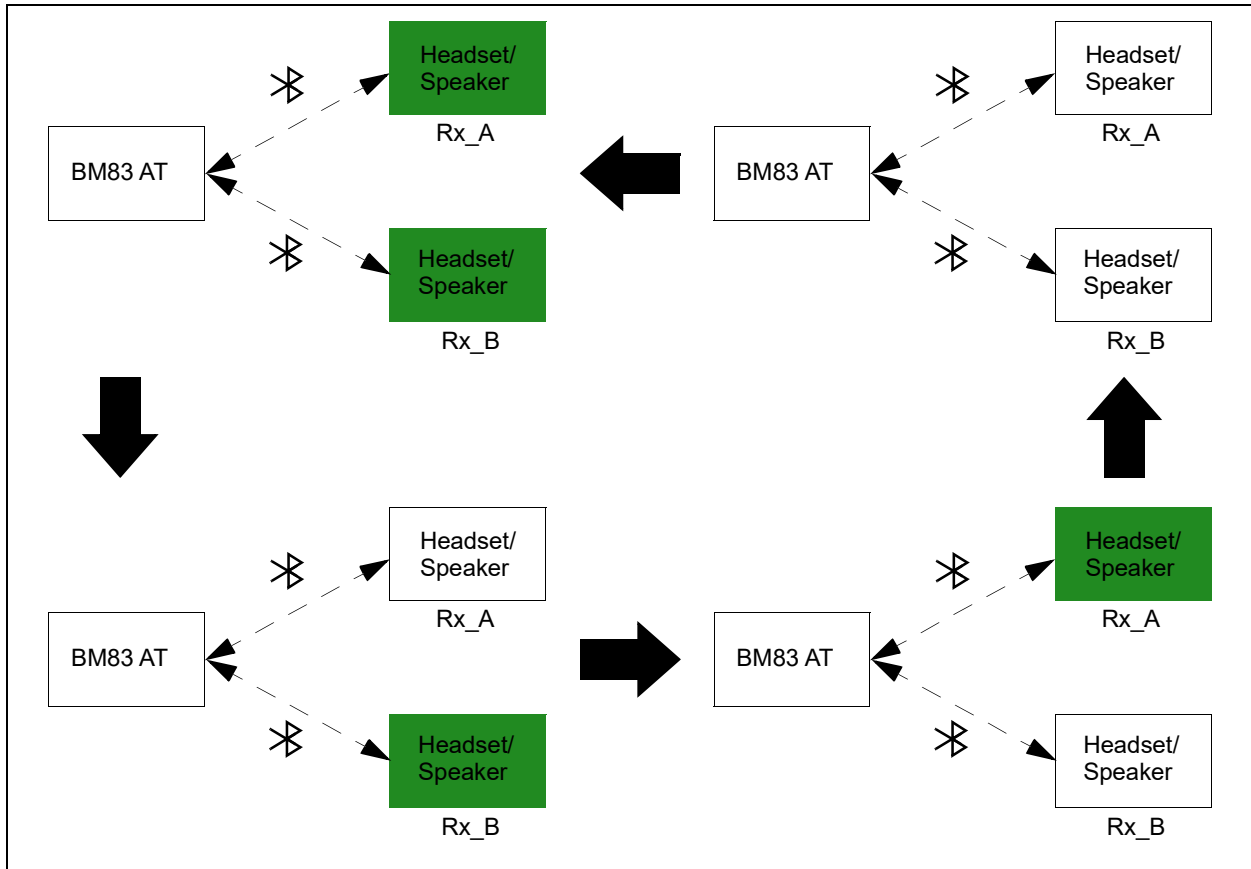
3. When Rx_B establishes a connection, then mid quality audio plays on both Rx_A and Rx_B speakers/headset.

FIGURE 39: DEPICTION OF MID QUALITY AUDIO STREAMING THROUGH RX_A AND RX_B SINK DEVICES



- 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 40: 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.

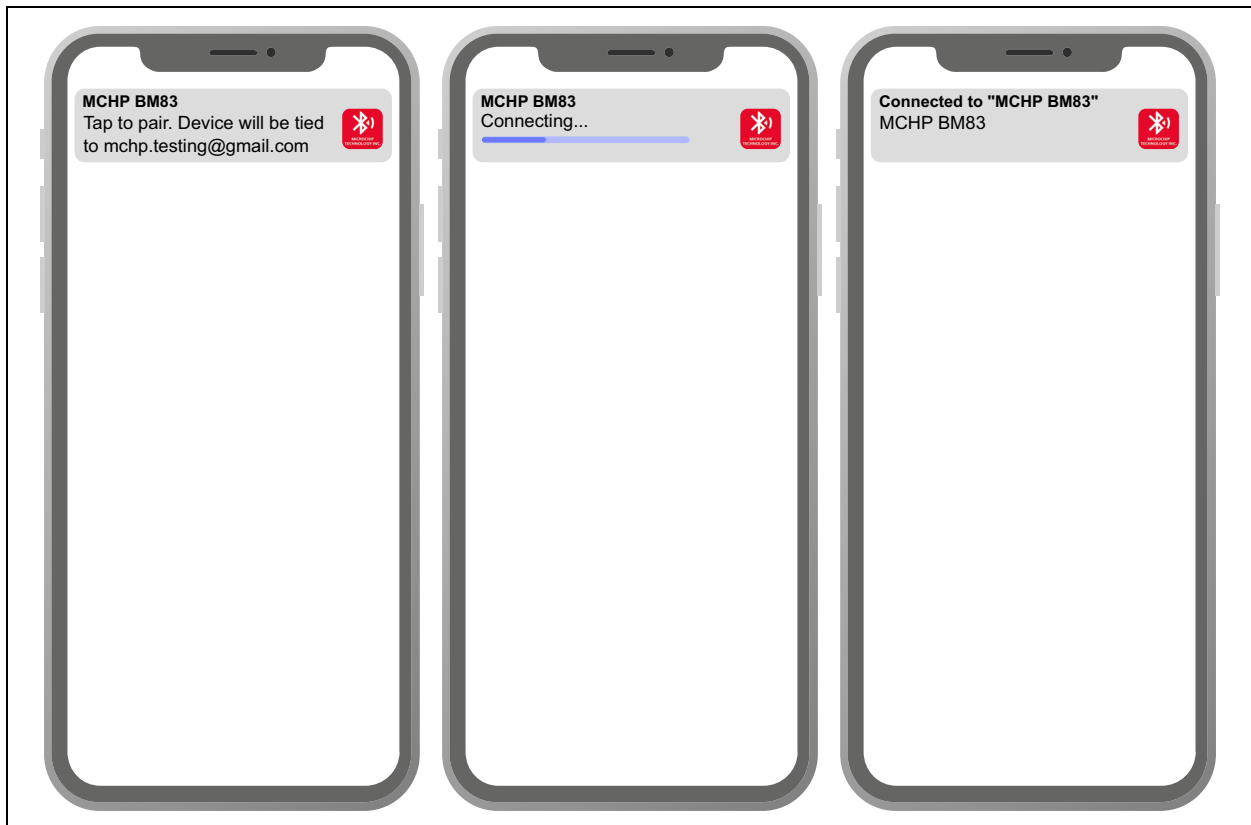
4.1 Demo Setup

- Program the BM83 with GFP firmware, DSP firm-

ware 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 41: 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”](#).

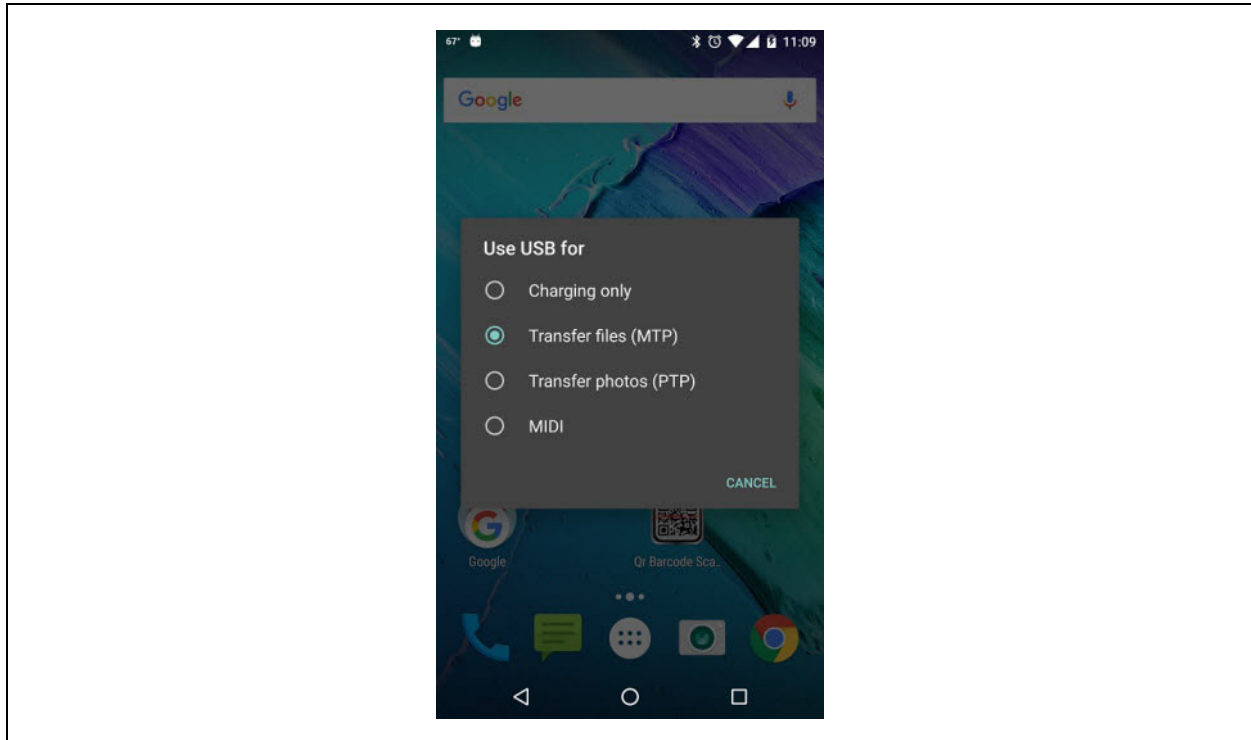
APPENDIX A: ANDROID APP INSTALLATION

To install the application, perform the following steps:

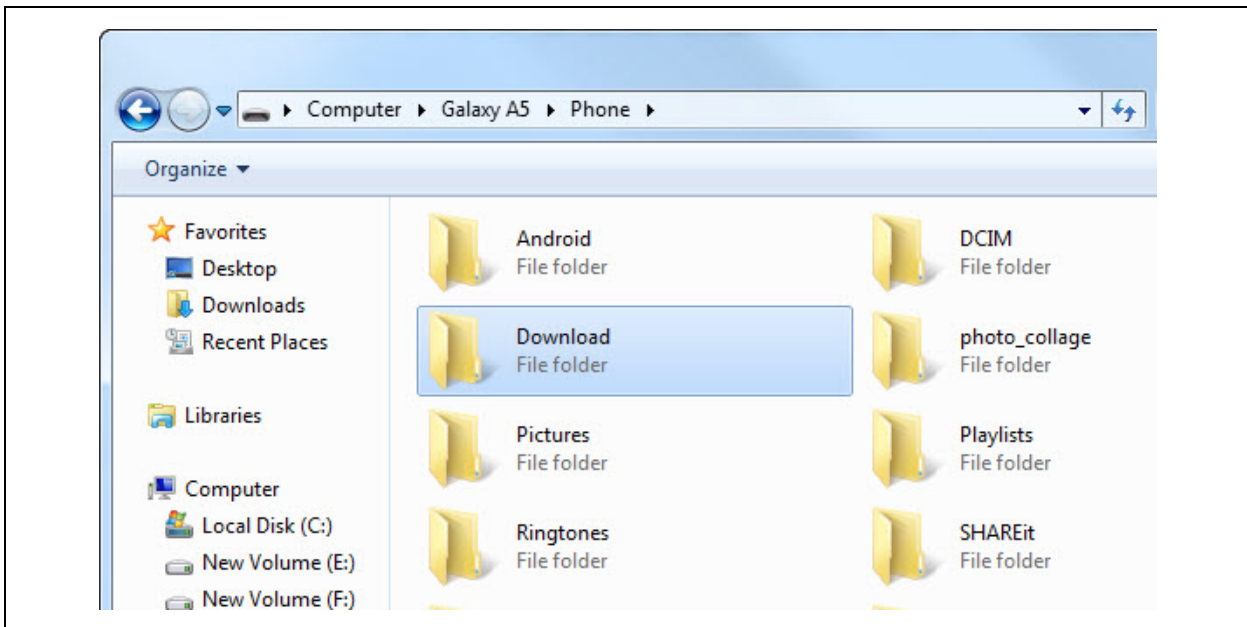
1. Connect the Android phone to the computer using a mini-B USB connector.

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 [Figure 42](#).

FIGURE 42: USB TRANSFER

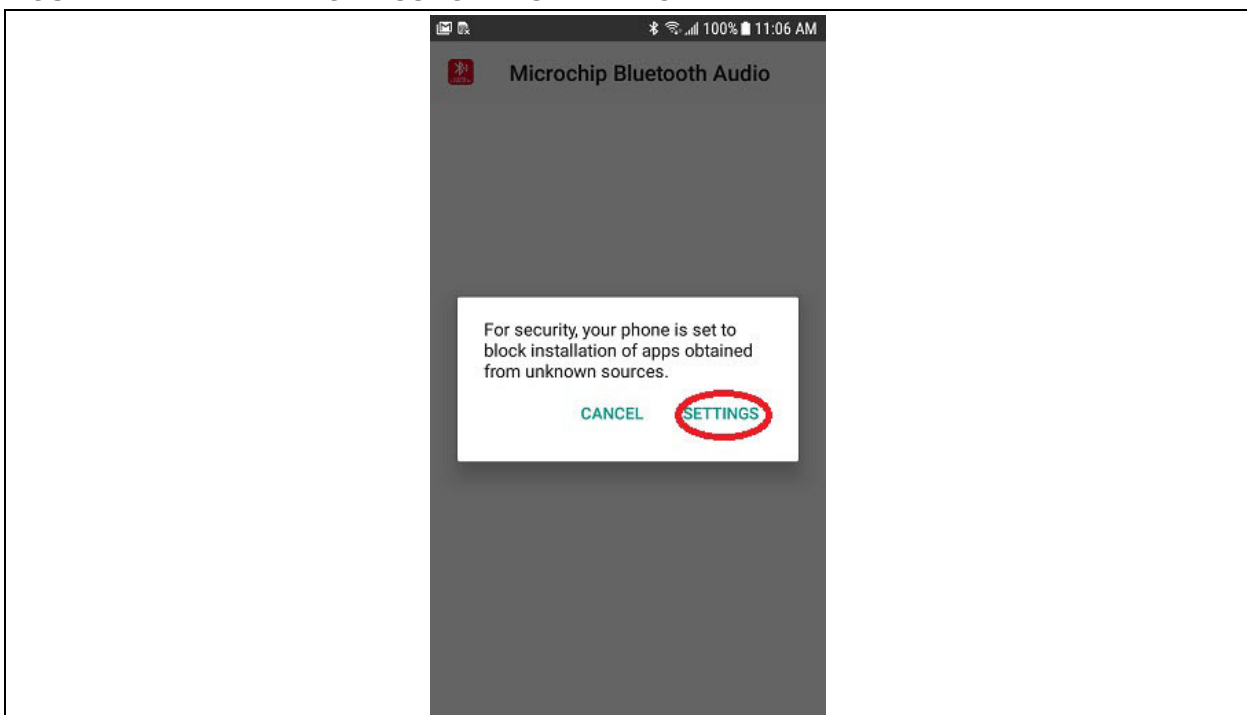


- It is recommended to copy the Microchip Bluetooth Audio Android app to the **Download** folder of the Android mobile device, see [Figure 43](#).

FIGURE 43: DOWNLOAD FOLDER OF THE ANDROID DEVICE

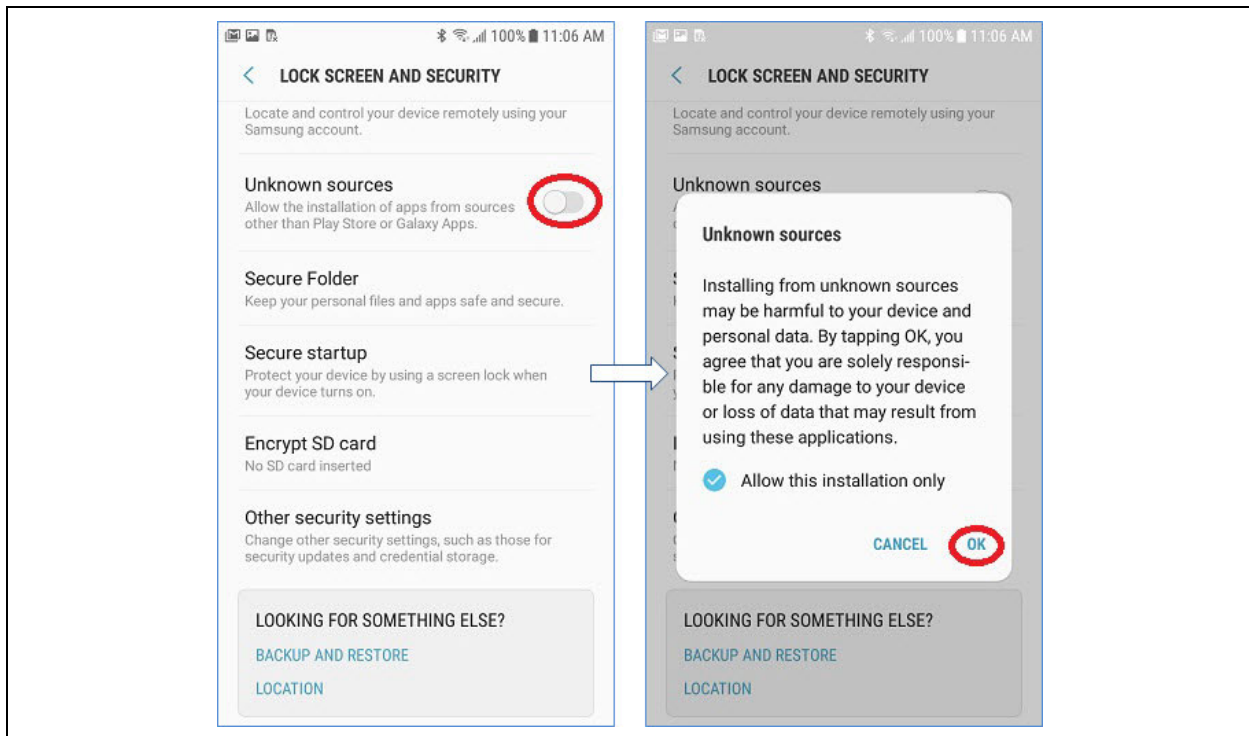
- From the **File Manager** of the mobile device, select *My Files > All Files > Download > MBA3_x_Android.apk*.

After selecting the file, a warning message indicating the installation is blocked is displayed, see [Figure 44](#).

FIGURE 44: WARNING MESSAGE: INSTALL BLOCKED

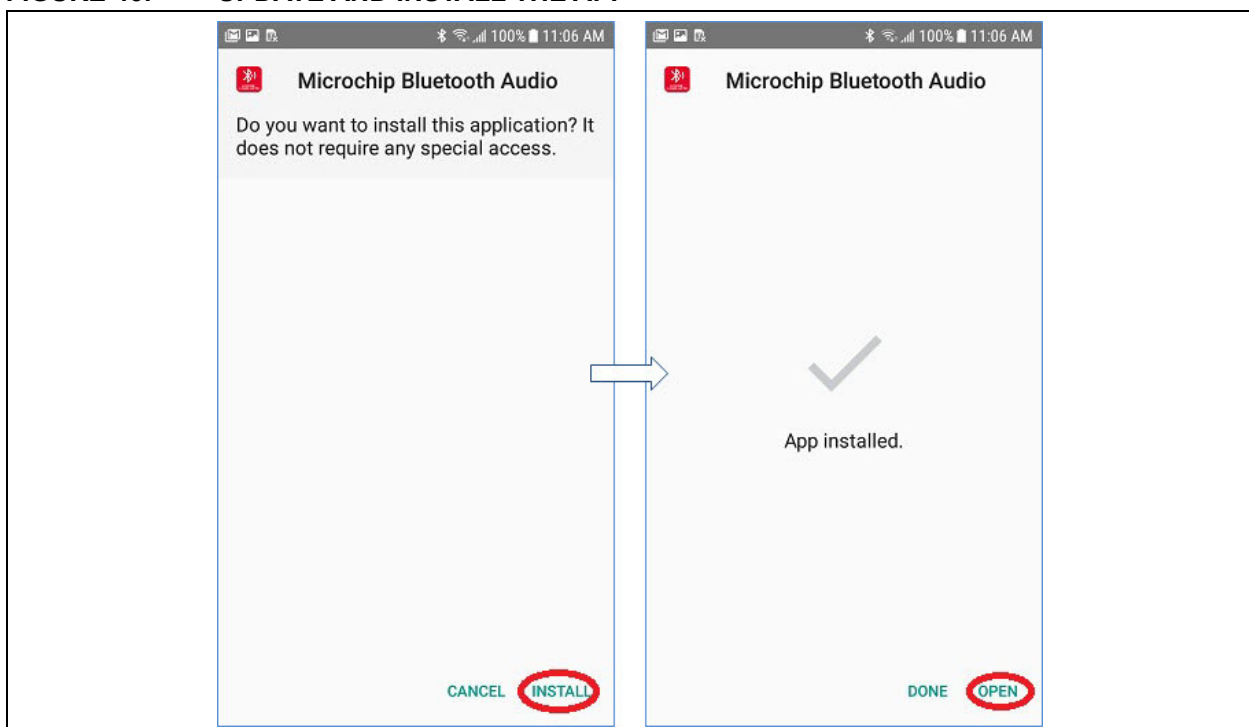
4. Go to **Settings** to open the **Security** screen and enable installations from **Unknown sources**, and then click **OK** to confirm the change, see [Figure 45](#).

FIGURE 45: 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 [Figure 46](#).

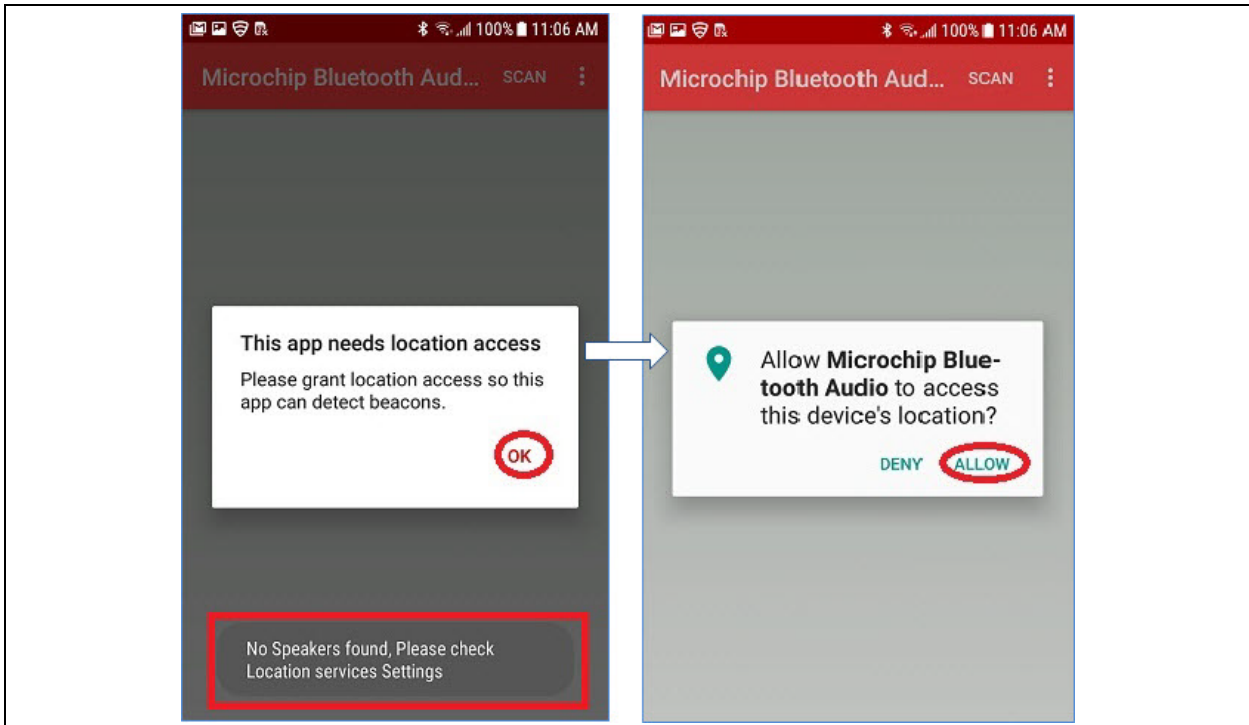
FIGURE 46: UPDATE AND INSTALL THE APP



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 [Figure 47](#).

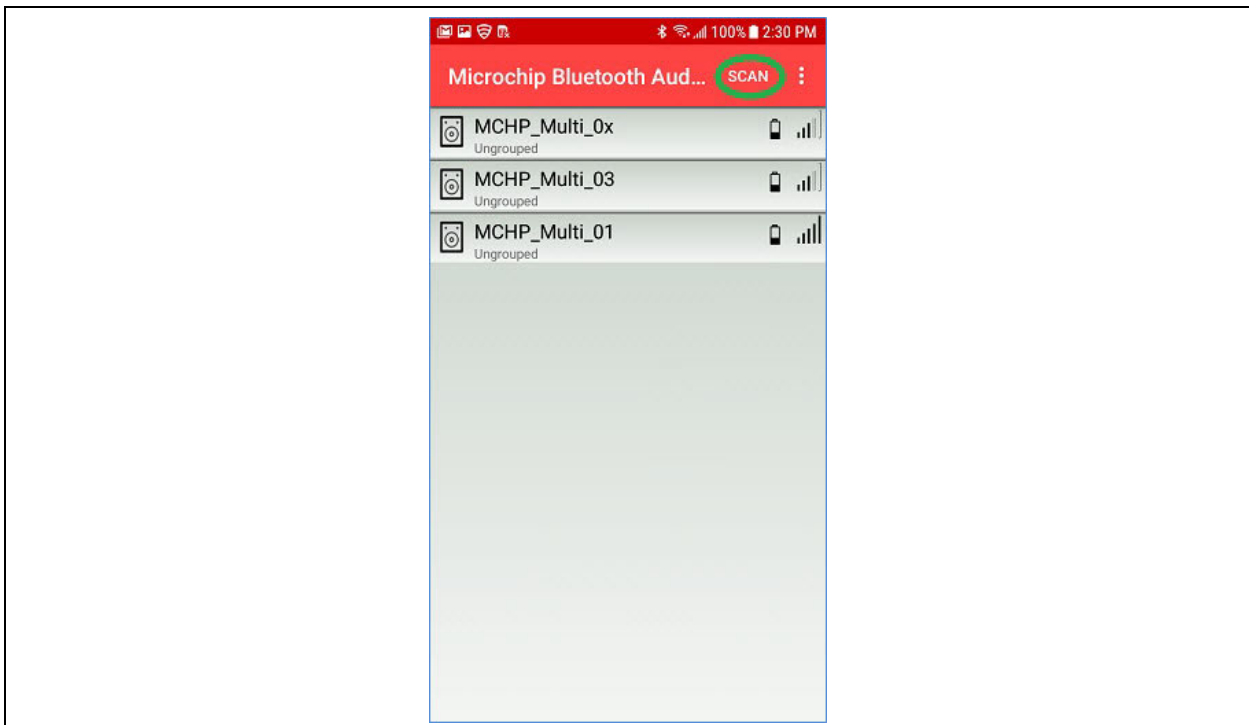
FIGURE 47: LOCATION ACCESS



7. Click **SCAN** to see the list of discoverable

devices nearby, as illustrated in [Figure 48](#).

FIGURE 48: 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.

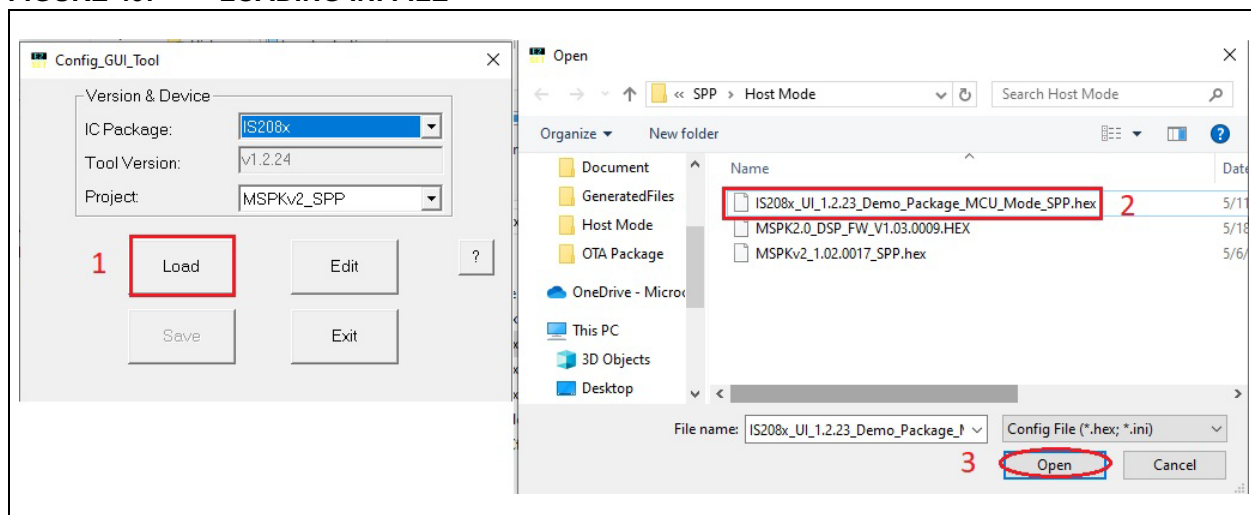
Follow the example procedure below for configuring a BM83 into I²S Master mode with external codec in Embedded/Host mode.

B.1 Customizing UI Parameters

Perform the following steps to customize the UI parameters:

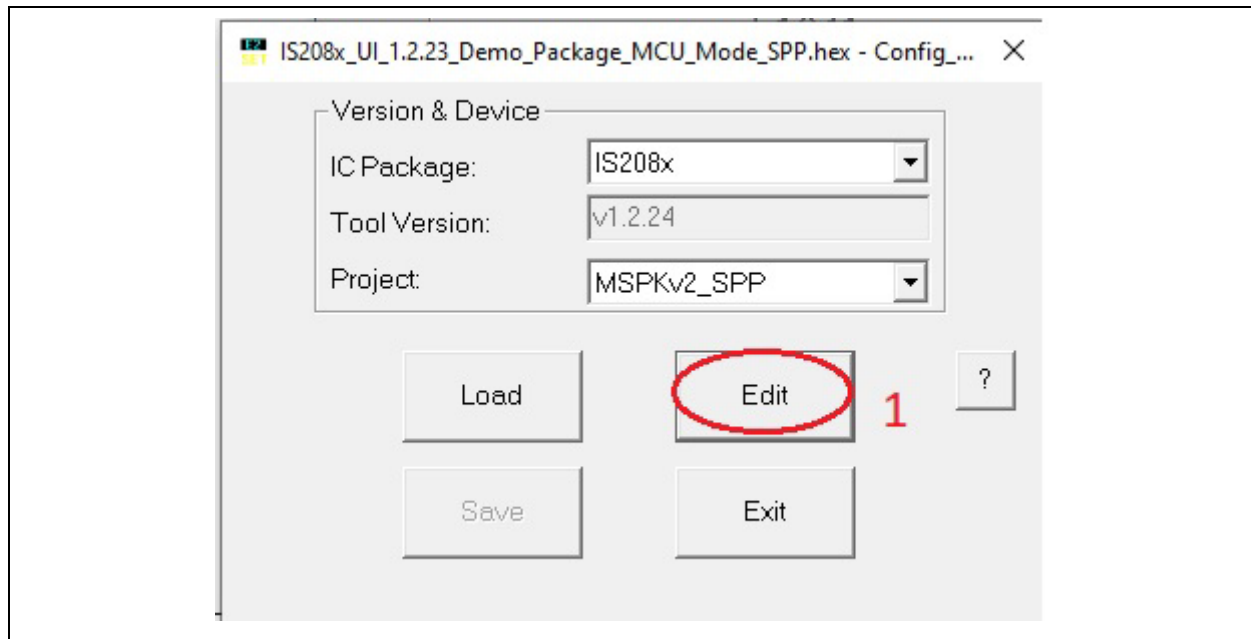
1. Open the Config GUI tool, IS208x_Config_GUI_Tool vx.xx.exe from Tools\Config Tool. Click **Load** to load IS208x_UI_1.2.xy_Demo_Package_MCU_Mode_SPP.hex from the same folder IS2083 Turnkey v1.x\Software\IS2083 Image\MSP-K2v1.y\SPP\Host Mode and then click **Open**, see [Figure 49](#). Every firmware target has customized settings which have been added in the target folder. It is recommended to use these settings for further customization.

FIGURE 49: LOADING INI FILE



- From the Config tool, click **Edit**, see [Figure 50](#).

FIGURE 50: EDIT CONFIG PARAMETERS



3. A window is displayed.
 - a. For Host mode, select "Host MCU Mode" and click Next, see [Figure 51](#).
 - b. For Embedded mode, select "Embedded Mode" and click Next, see [Figure 52](#).

FIGURE 51: MAIN FEATURE SETTINGS - HOST MODE

The screenshot displays the 'MAIN FEATURE SETTINGS - HOST MODE' window. It is divided into two main sections: 'Supported Profile' and 'Function Enable and GPIO Assignment'.

Supported Profile:

- HFP/HSP
- A2DP
- AVRCP
- SPP
- PBAP
- iAP
- AVRCP Controller
- iAP2
- AVRCP Target

Function Enable and GPIO Assignment:

- Charge OK Led Ind. (GPIO: 0x21: GPIO_NULL)
- AUX-IN Led Ind. (GPIO: 0x21: GPIO_NULL)
- AUX-IN Detect (GPIO: 0x1A: GPIO_P32)
- CP Reset (iAP) (GPIO: 0x21: GPIO_NULL)
- Host MCU Mode** (highlighted with a red box)
- Embedded Mode (GPIO: 0x21: GPIO_NULL)
- TX IND
- Audio(SBC) Indication (GPIO: 0x21: GPIO_NULL, Low Active)
- Voice(SCO) Indication (GPIO: 0x21: GPIO_NULL, Low Active)
- Ring Tone Indication (GPIO: 0x21: GPIO_NULL, Low Active)
- Incoming Call Indication (GPIO: 0x21: GPIO_NULL, Low Active)
- External Amplifier Indication (GPIO: 0x21: GPIO_NULL, Low Active)
- HF Link Indication (GPIO: 0x21: GPIO_NULL, Low Active)
- A2DP Link Indication ¹ (GPIO: 0x21: GPIO_NULL, Low Active)
- Button Event Trigger Indication (GPIO: 0x21: GPIO_NULL, Low Active)

At the bottom, there are 'Back' and 'Next' buttons. The 'Next' button is highlighted with a red box, and a red '2' is placed next to it.

FIGURE 52: MAIN FEATURE SETTINGS - EMBEDDED MODE

Supported Profile

HFP/HSP A2DP AVRCP SPP PBAP iAP

AVRCP Controller iAP2

AVRCP Target

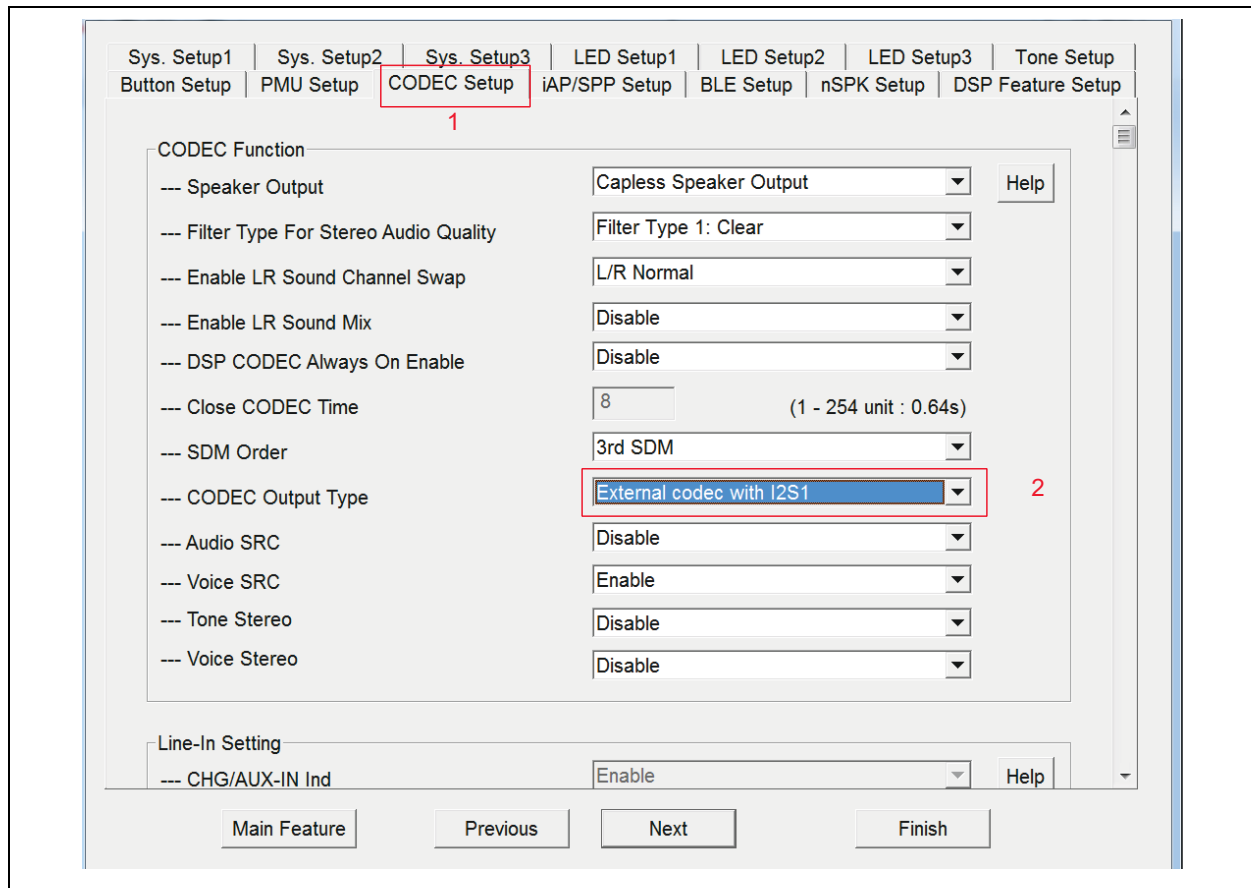
Function Enable and GPIO Assignment

<input type="checkbox"/> Charge OK Led Ind.	0x21: GPIO_NULL
<input type="checkbox"/> AUX-IN Led Ind.	0x21: GPIO_NULL
<input checked="" type="checkbox"/> AUX-IN Detect	0x1A: GPIO_P32
<input type="checkbox"/> CP Reset (iAP)	0x21: GPIO_NULL
<input type="radio"/> Host MCU Mode	<input checked="" type="radio"/> Embedded Mode ¹
<input type="checkbox"/> Tx IND	0x21: GPIO_NULL
Audio(SBC) Indication	0x21: GPIO_NULL Low Active
Voice(SCO) Indication	0x21: GPIO_NULL Low Active
Ring Tone Indication	0x21: GPIO_NULL Low Active
Incoming Call Indication	0x21: GPIO_NULL Low Active
External Amplifier Indication	0x21: GPIO_NULL Low Active
HF Link Indication	0x21: GPIO_NULL Low Active
A2DP Link Indication	0x21: GPIO_NULL Low Active
Button Event Trigger Indication	0x21: GPIO_NULL Low Active

 ²

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.

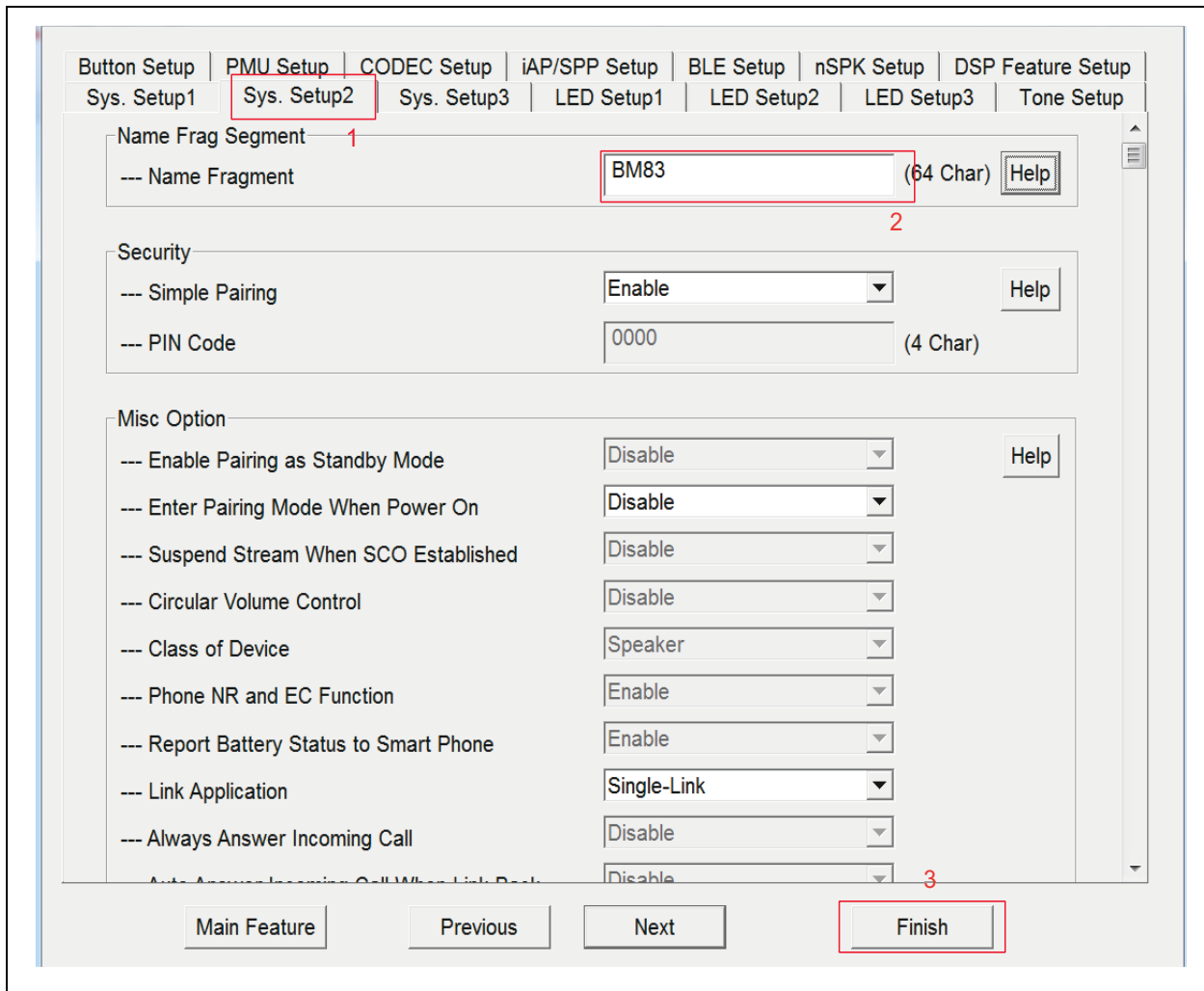
FIGURE 53: CHANGING CODEC OUTPUT TYPE



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"](#).

- Click the **Sys. Setup2** tab to change the speaker name, as illustrated in [Figure 54](#) and then click **Finish**.

FIGURE 54: CHANGING SPEAKER NAME



B.2 Customizing DSP Parameters

- Click **Finish** to open a DSP Tool, see [Figure 55](#).
- Click the I2S/PCM tab and perform the I2S related selection, as illustrated in [Figure 56](#). The Master Clock (MCLK) is the Master clock output provided to an external I2S codec device to use as its system clock. This signal is optional and is not required if the external I2S device provides its own system clock. This signal is not used with the internal audio codec. The BM83 EVB uses ST codec and MCLK to be enabled for this.

Save As window, select the file location, and then click **Save**, see [Figure 58](#).

B.3 Creating *.HEX file

- Save the DSP parameters by clicking **Save**, and then close the DSP window, see [Figure 57](#).
- Click **Exit**, and a window is displayed. From the

FIGURE 55: IS208X DSP CONFIGURATION TOOL

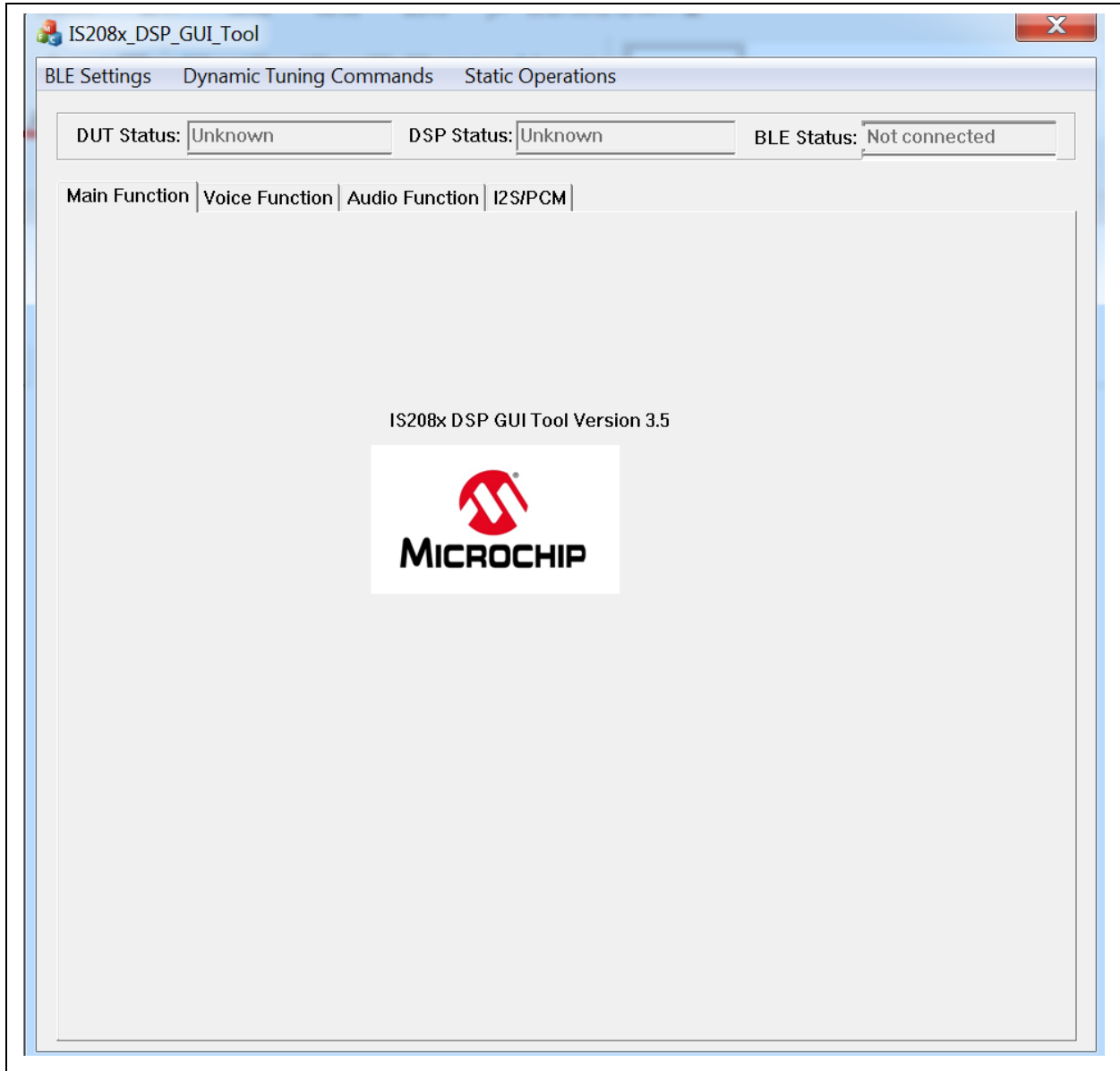


FIGURE 56: IS208X DSP CONFIGURATION TOOL - I2S/PCM MODE SELECTION

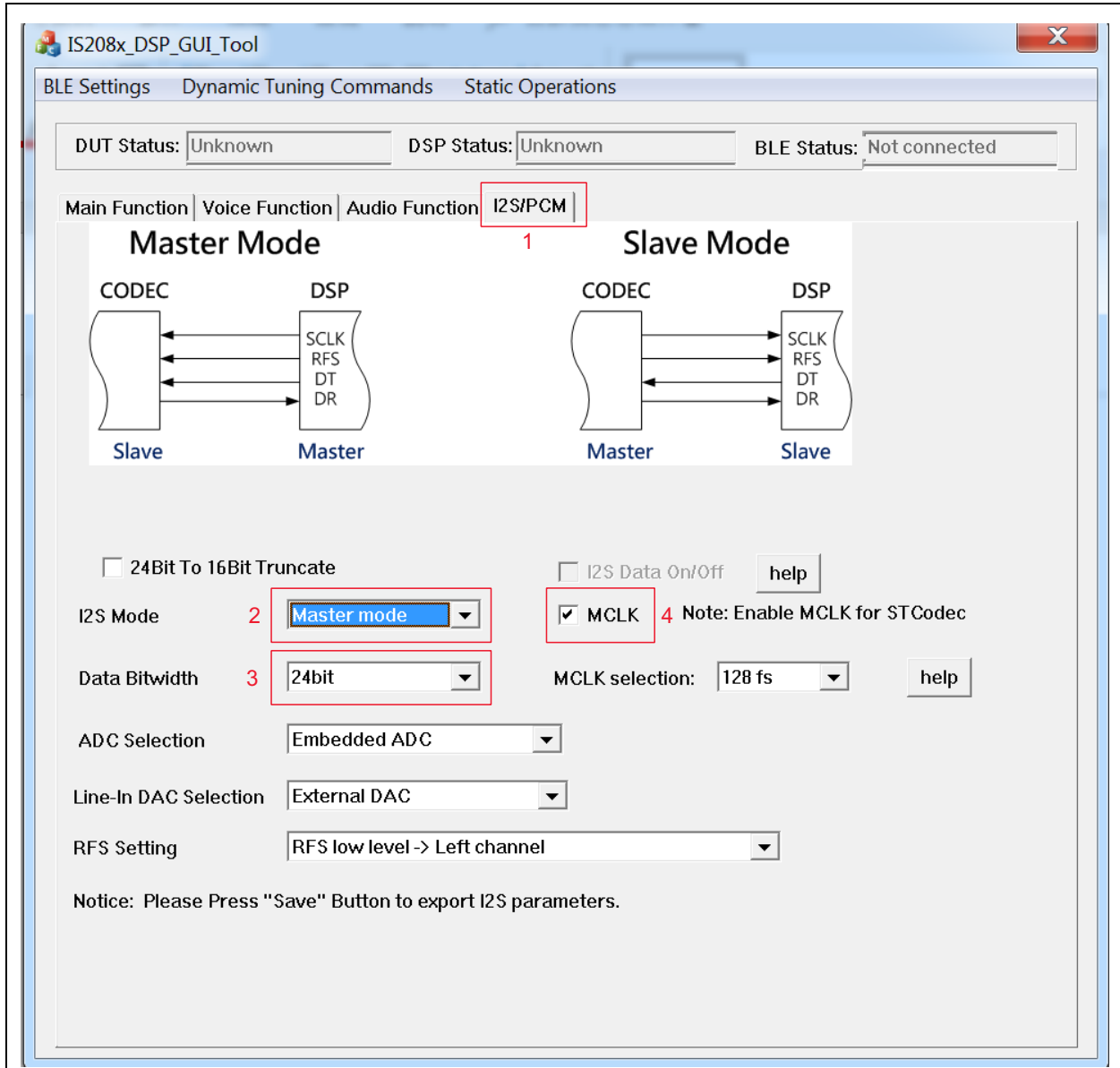


FIGURE 57: SAVING UI PARAMETERS

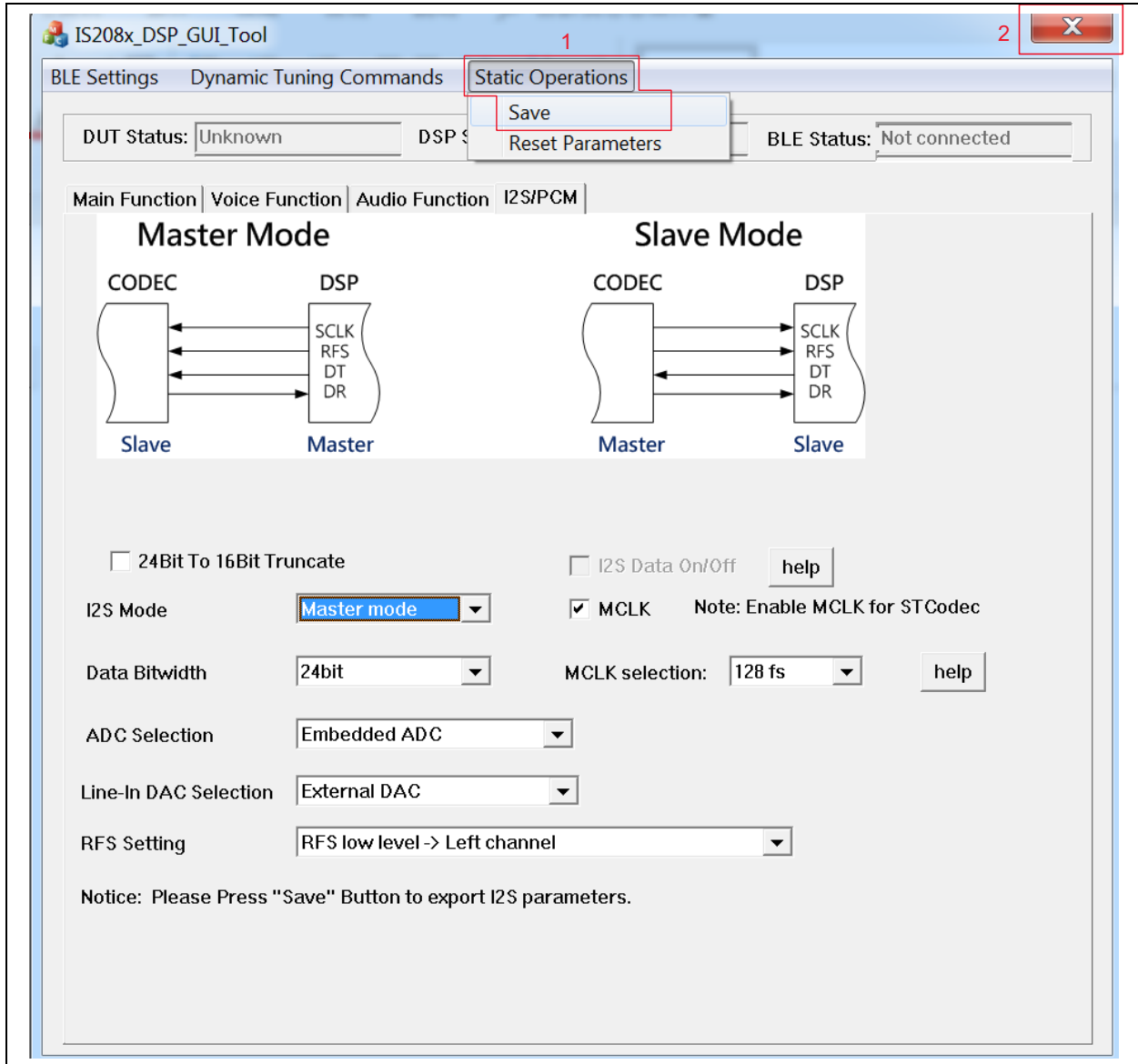
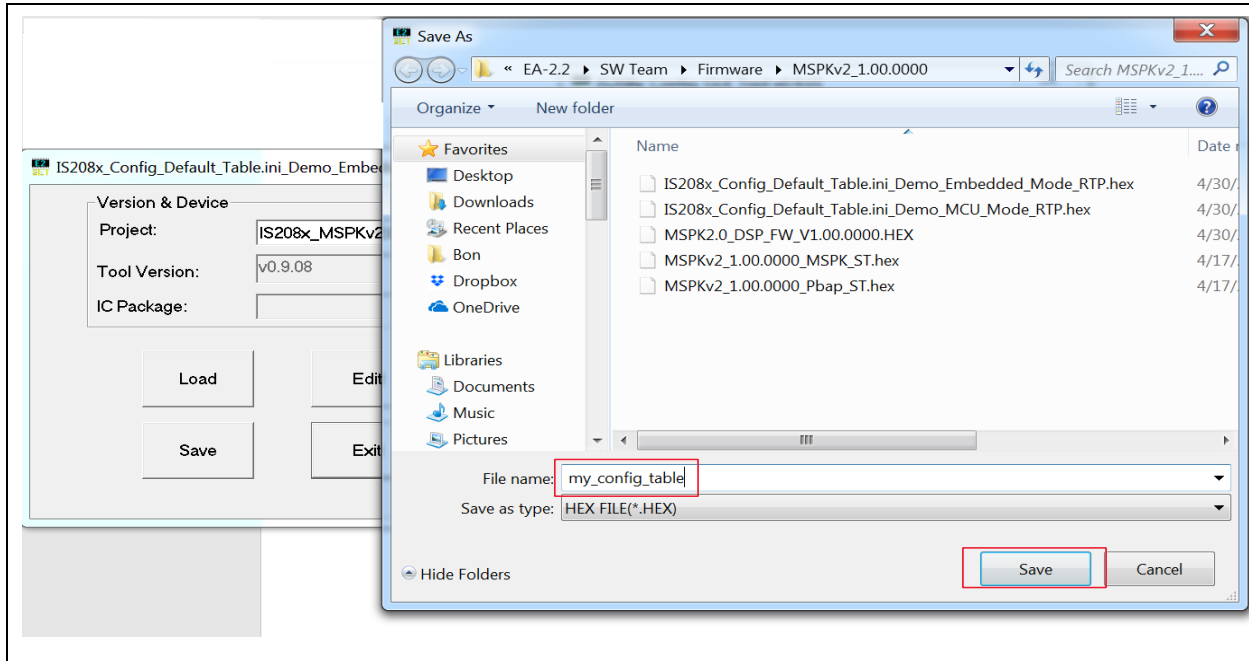


FIGURE 58: SAVING UI PARAMETERS



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)*. It is possible to update only this config file by only selecting this .HEX file in the update process and selecting image number to 1 in the isUpdate tool.

APPENDIX C: CONFIGURING BM83 I²S MASTER/SLAVE MODE AT 48 KHZ

BM83 I²S can be configured into I²S Master and I²S Slave modes. [Appendix B: “Customizing UI and DSP Parameters”](#) describes BM83 configured into I²S Master mode. This section describes BM83 configured into I²S Slave 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 [Figure 59](#). 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. Enable **Tone Stereo** and **Voice Stereo**, as illustrated in [Figure 59](#).

FIGURE 59: CODEC SETUP

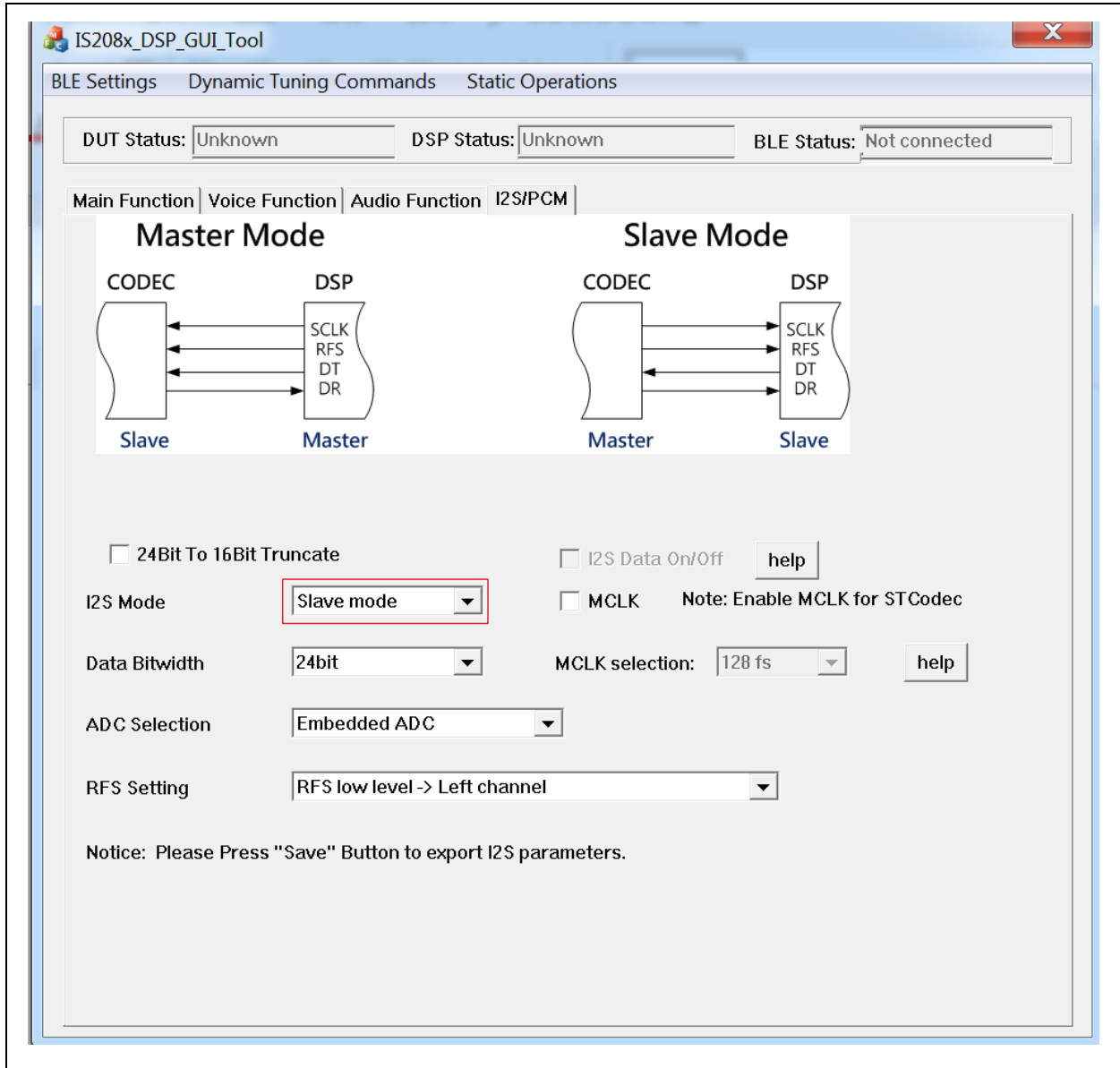
Note 1: If “CODEC Output Type” is selected as Internal codec then audio will be routed to analog speaker out.

- 2:** For BM83 I²S Master mode at 48 kHz, refer to [C.1 “Selecting UI Parameters”](#), [Appendix C: “Configuring BM83 I²S Master/Slave Mode at 48 KHz”](#) and [C.3 “Creating Config *.HEX”](#).

C.2 Selecting DSP Parameters

Perform all the steps from [Appendix C: “Configuring BM83 I2S Master/Slave Mode at 48 KHz”](#). The only difference is to select I²S mode as Slave mode, as illustrated in [Figure 60](#).

FIGURE 60: I²S IN SLAVE MODE



Note: MCLK should not be enabled in I2S in Slave mode.

C.3 Creating Config *.HEX

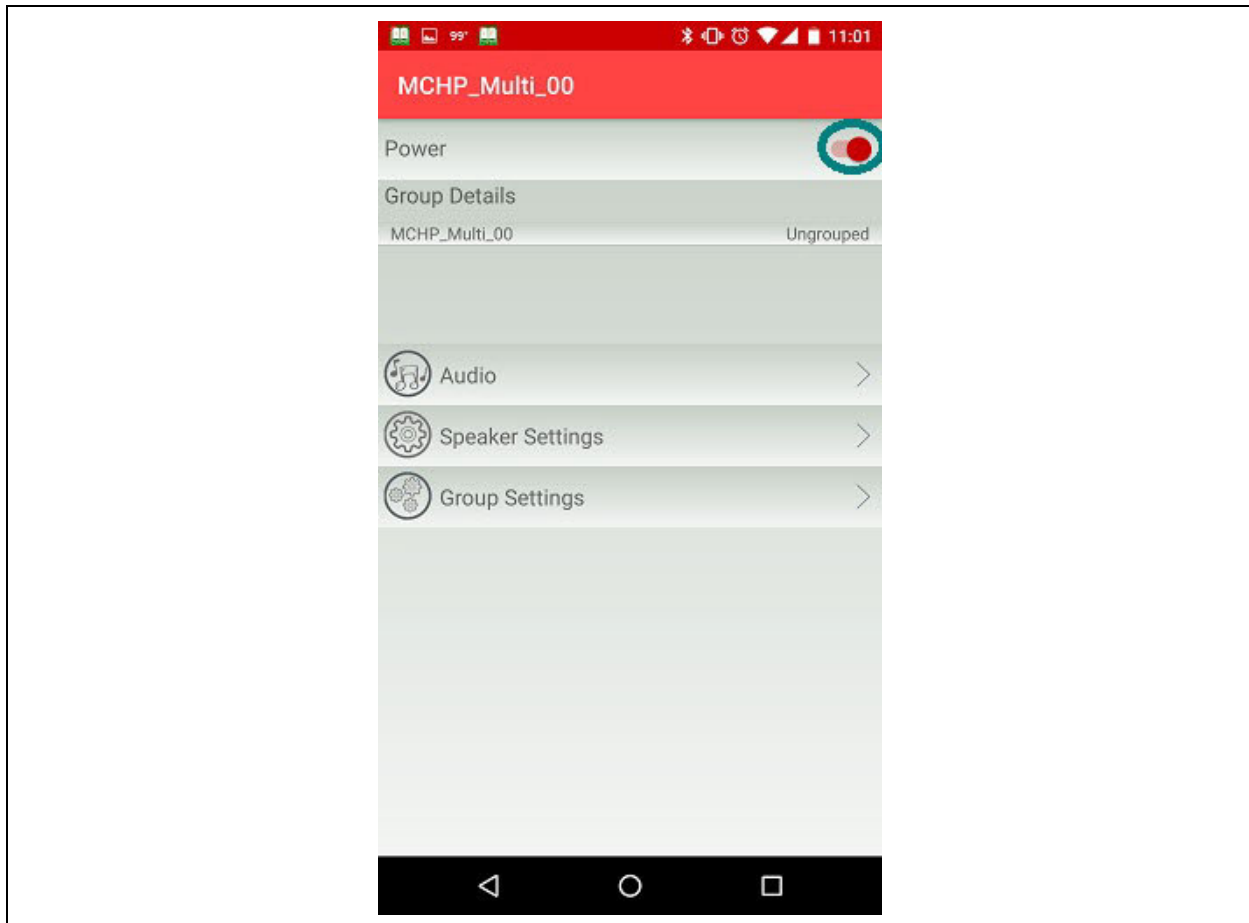
For the procedure to create the *.HEX file, refer to [B.3 “Creating *.HEX file”](#).

APPENDIX D: ANDROID APP POWER MODE

Microchip Bluetooth Audio app can also be used for power on/off for an individual BM83 speaker. Touch **Power** to turn on/off the BM83 speaker, as illustrated in

Figure 61. If the power is turned off on the master speaker then it will switch off master and all the connected slave speakers, similar to the short press SEL in Host mode/long press MFB button in Embedded mode.

FIGURE 61: POWER MODE ON/OFF

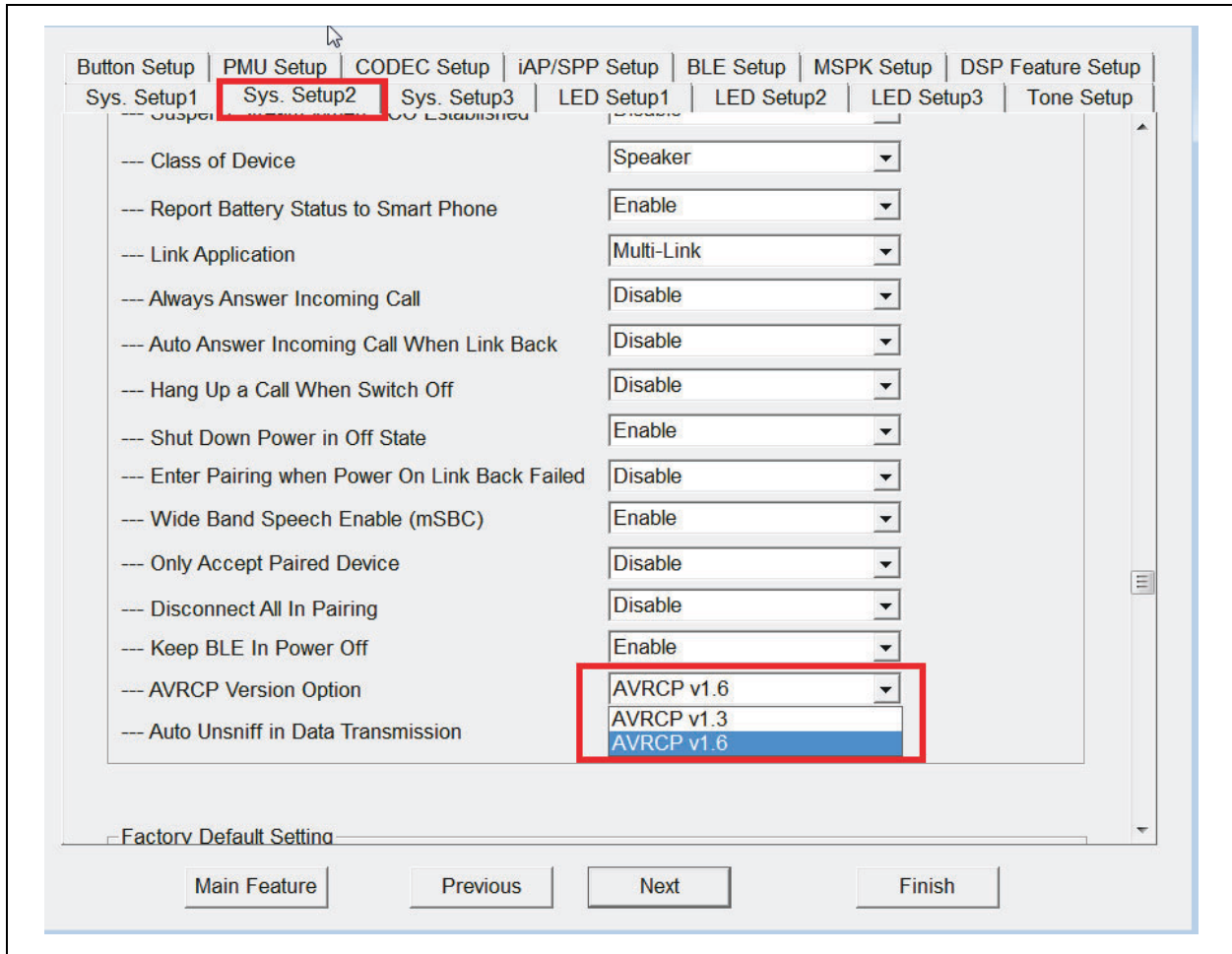


APPENDIX E: AVRCP VERSION

The AVRCP version 1.6/1.3 can be programmed, as illustrated in [Figure 62](#).

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

FIGURE 62: 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 63: ENABLING AAC CODEC

The screenshot displays the 'CODEC Setup' configuration window. The 'CODEC Setup' tab is highlighted with a red box. In the 'CODEC Type Setting' section, the '--- AAC' checkbox is checked and highlighted with a red box, while the '--- SBC' checkbox is also checked but not highlighted. Other settings include 'Line In Indicate Led' (Disable), 'Line In CSB' (Enable), 'Line In Latency' (240), 'Initial Line In SPK Gain' (0x0A), 'Cut Off Amplifier When Mute' (Disable), 'Off Amplifier T0' (0), 'Off Amplifier T1' (0), 'Off Amplifier T2' (0), 'Equalizer Function Enable' (Enable), and 'Initial Equalizer Mode' (OFF). Navigation buttons at the bottom include 'Main Feature', 'Previous', 'Next', and 'Finish'.

Tab	Setting	Value	Unit / Range
CODEC Setup	Line In Indicate Led	Disable	
	Line In CSB	Enable	
	Line In Latency	240	(0 - 240 unit : 1/3ms)
	Initial Line In SPK Gain	0x0A	
Amplifier Control Settings	Cut Off Amplifier When Mute	Disable	
	Off Amplifier T0	0	(0 - 3 unit : 1s)
	Off Amplifier T1	0	(0 : Disable; 1 - 7 unit : 100ms)
	Off Amplifier T2	0	(0 : Disable; 1 - 7 unit : 100ms)
CODEC Type Setting	--- SBC	<input checked="" type="checkbox"/>	
	--- AAC	<input checked="" type="checkbox"/>	
Audio Equalizer Setting	Equalizer Function Enable	Enable	
	Initial Equalizer Mode	OFF	

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 Table 4.

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 even when they are connected to an LDAC speaker.

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:

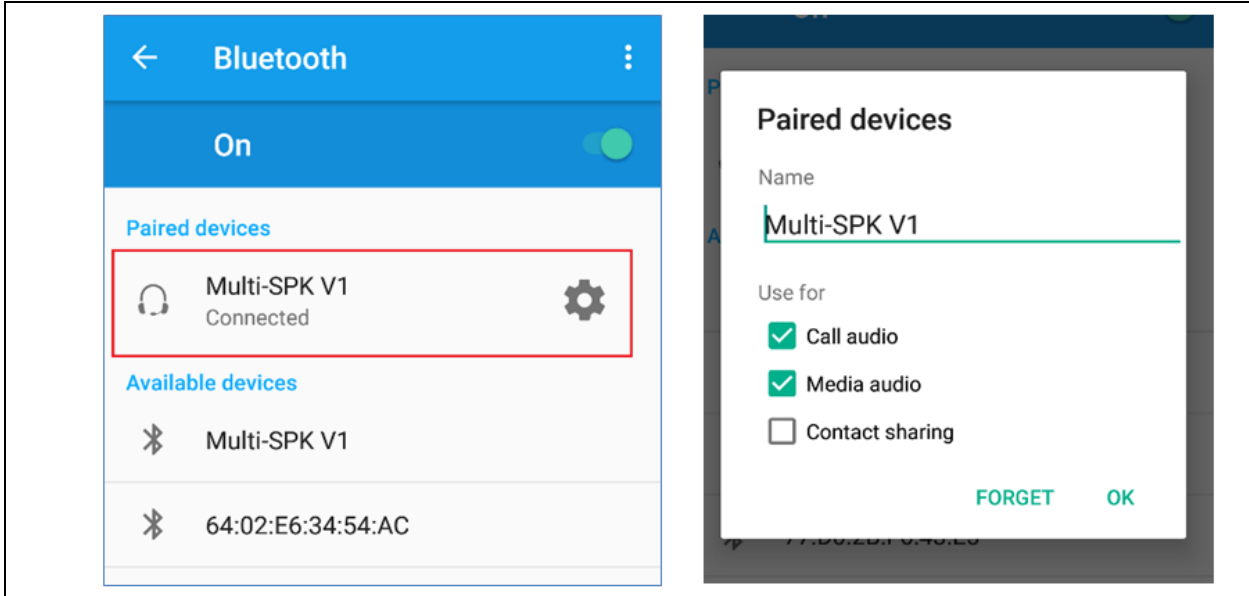
- Quality Priority mode
- Normal mode
- Connection Priority mode

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 [Figure 64](#).

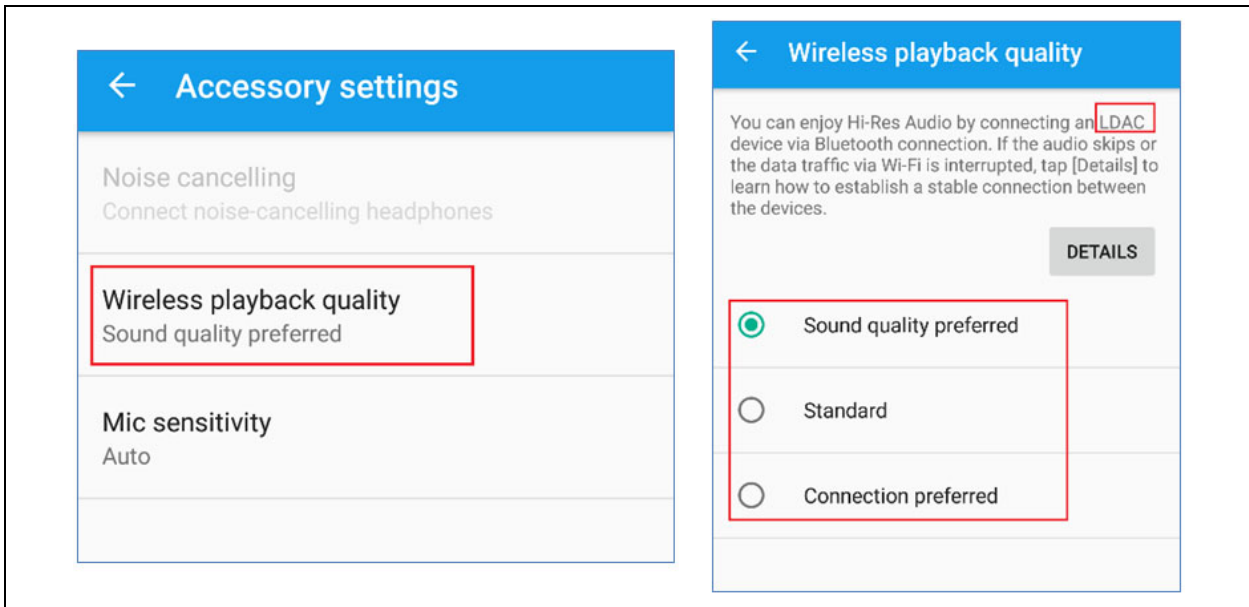
FIGURE 64: BLUETOOTH SETTING PAGE



2. Go to **Settings** > **Sound and Notification** > **Accessory Settings** to select the LDAC quality

selection, as shown in Figure 65.

FIGURE 65: LDAC QUALITY SECTION

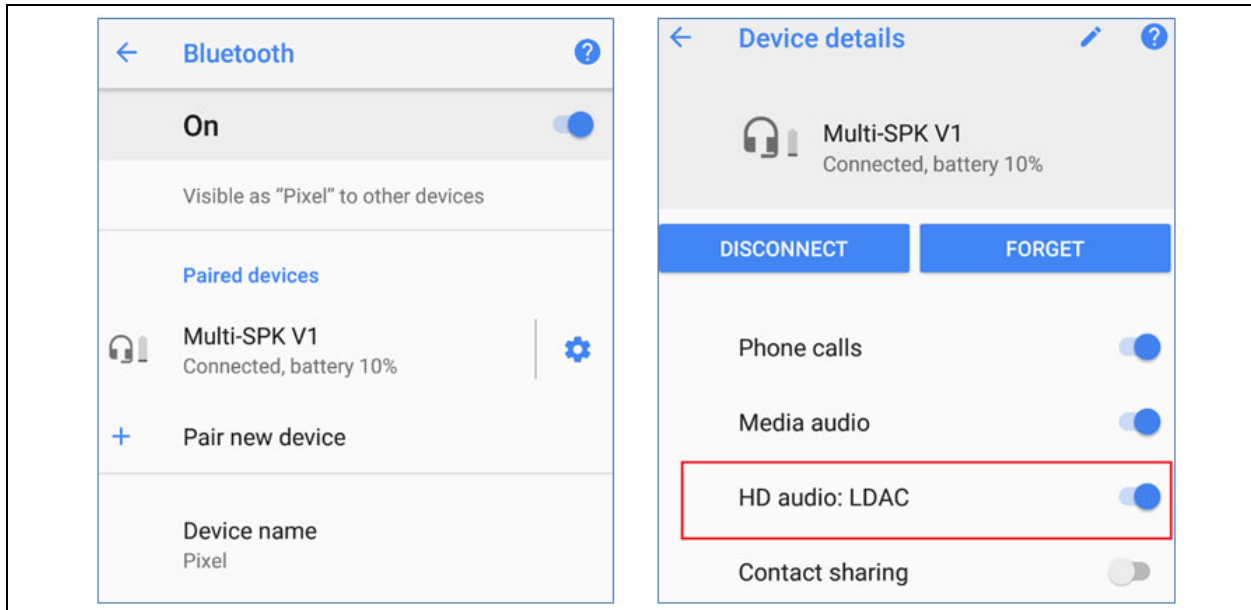


For example, for Google Pixel and Android 8.1:

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 [Figure 66](#).

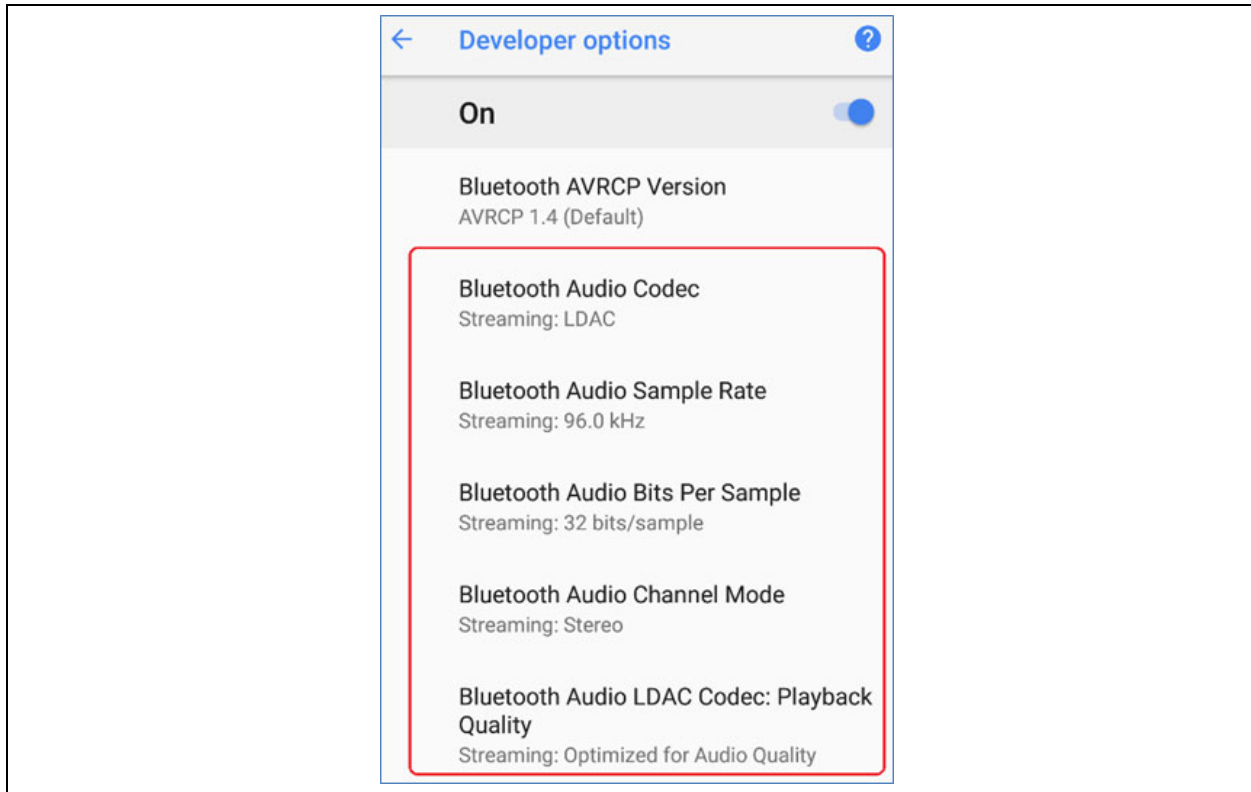
FIGURE 66: BLUETOOTH DEVICE PAGE



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

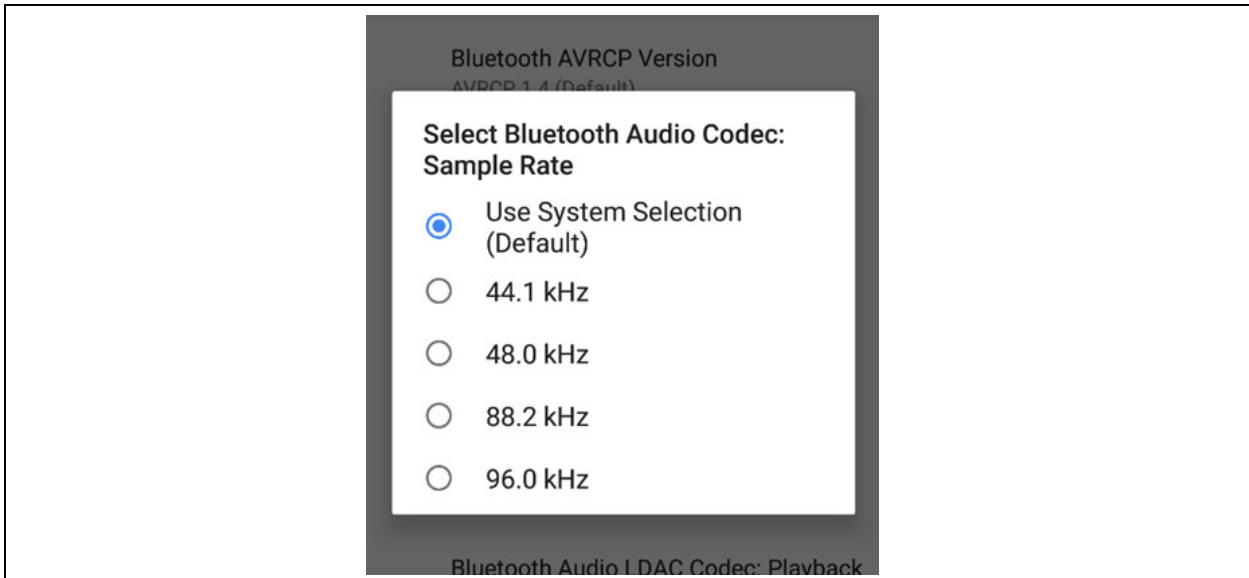
Developer Options, the user can see the Developer Options menu in the phone settings. Within this menu the user will have several Bluetooth audio options, as shown in [Figure 67](#).

FIGURE 67: DEVELOPER OPTIONS



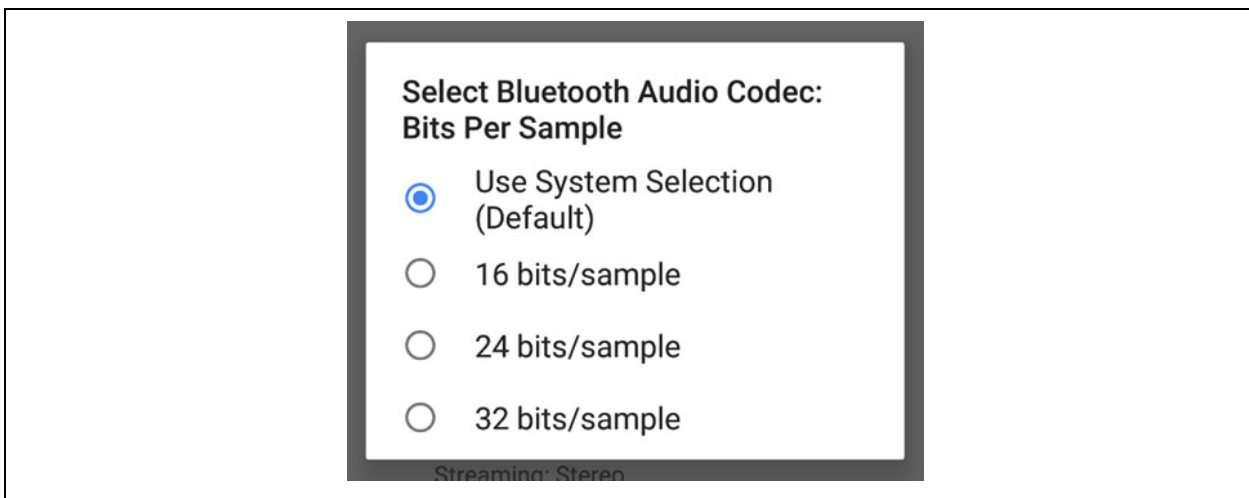
- a) When the user selects **Bluetooth Audio Sample Rate**, a pop-up is displayed for the list of sampling rates, see [Figure 68](#).

FIGURE 68: 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 [Figure 69](#).

FIGURE 69: AUDIO BITS PER SAMPLE

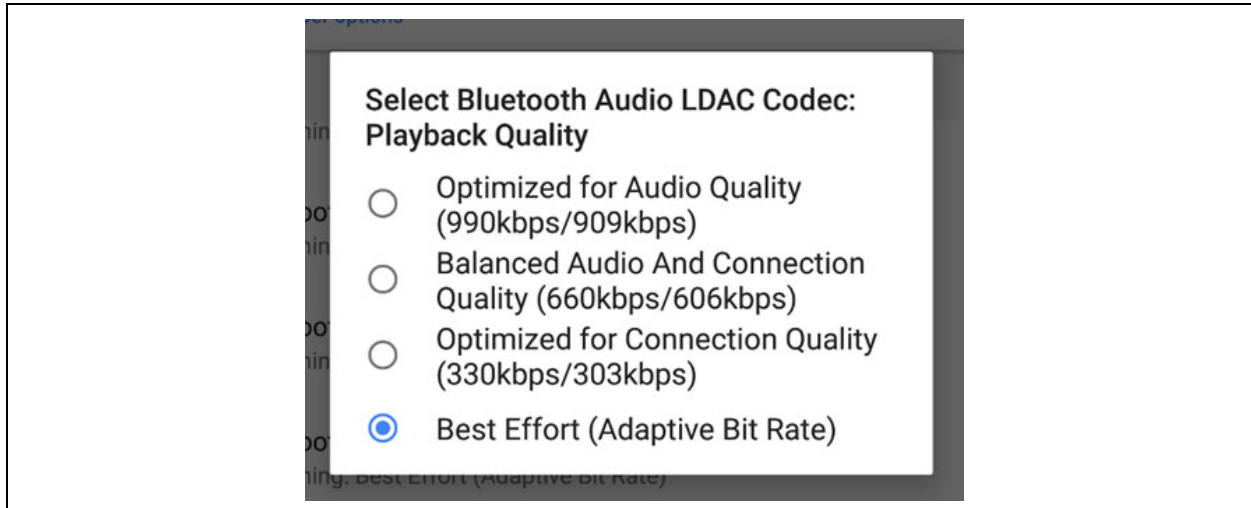


- c) When the user selects **Playback Quality**, a pop-up displays the list of LDAC quality selections, as shown below.

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 70: 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 71: AUX-IN DETECTION

The screenshot shows a configuration window titled "AUX-IN DETECTION". It is divided into several sections:

- Supported Profile:** Contains checkboxes for HFP/HSP, A2DP, AVRCP, SPP, PBAP, and iAP. AVRCP Controller and AVRCP Target are also checked. iAP2 is unchecked.
- Function Enable and GPIO Assignment:** This section lists various functions with checkboxes and dropdown menus for GPIO assignment.
 - Charge OK Led Ind.: Unchecked, 0x21: GPIO_NULL
 - AUX-IN Led Ind.: Unchecked, 0x21: GPIO_NULL
 - AUX-IN Detect:** Checked and highlighted with a red box, 0x1A: GPIO_P32
 - CP Reset (iAP): Unchecked, 0x21: GPIO_NULL
 - Host MCU Mode: Selected (radio button), with Tx IND checked and 0x21: GPIO_NULL assigned.
 - Embedded Mode: Unselected (radio button)
 - Audio(SBC) Indication: 0x21: GPIO_NULL, Low Active
 - Voice(SCO) Indication: 0x21: GPIO_NULL, Low Active
 - Ring Tone Indication: 0x21: GPIO_NULL, Low Active
 - Incoming Call Indication: 0x21: GPIO_NULL, Low Active
 - External Amplifier Indication: 0x21: GPIO_NULL, Low Active
 - HF Link Indication: 0x21: GPIO_NULL, Low Active
 - A2DP Link Indication: 0x21: GPIO_NULL, Low Active
 - Button Event Trigger Indication: 0x21: GPIO_NULL, Low Active

At the bottom of the window, there are "Back" and "Next" buttons.

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 72: BUTTON SETUP

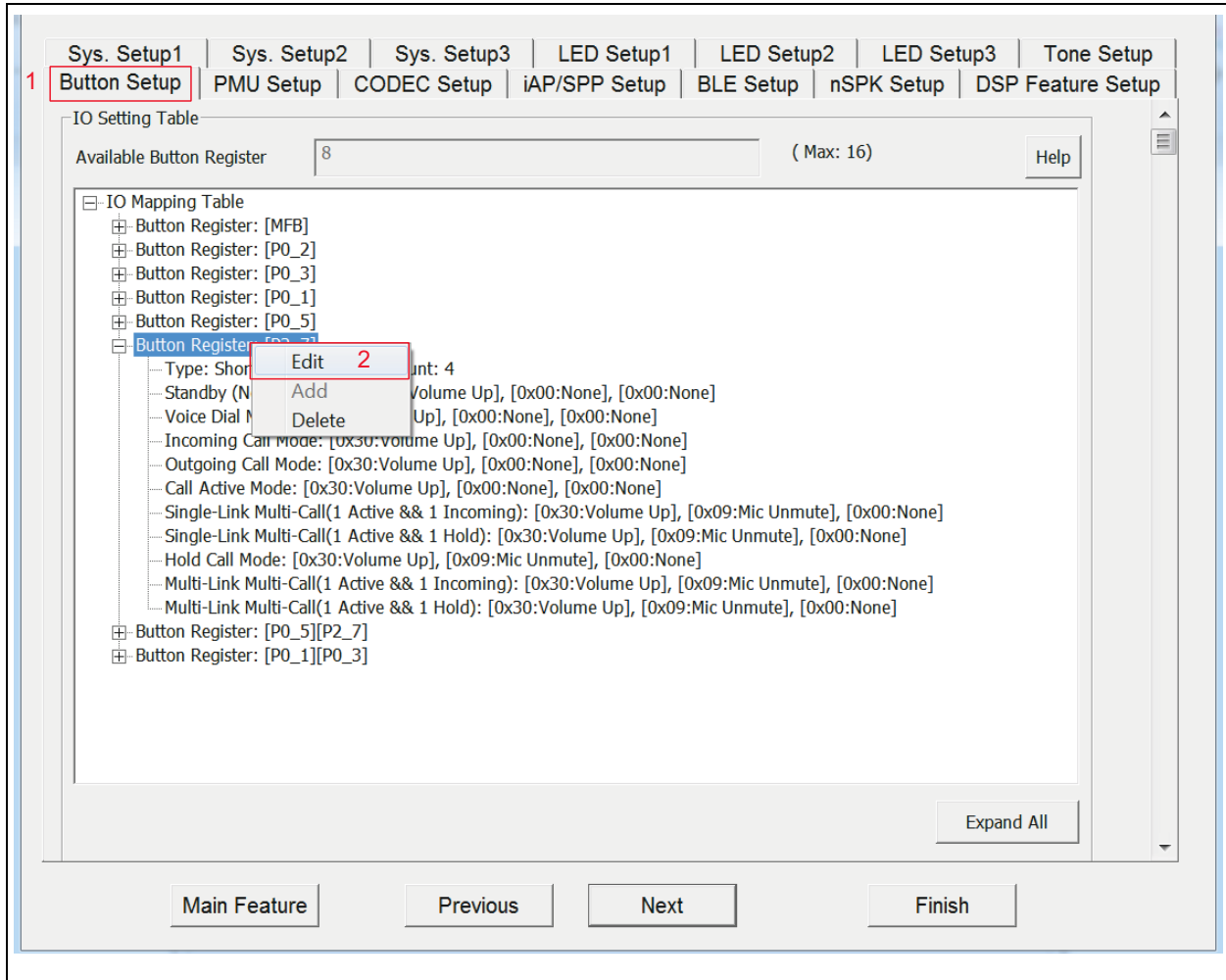


FIGURE 73: BUTTON MAPPING FOR P2_7 IS CONFIGURED FOR VOLUME UP AND CONCERT MODE ENTRY

Button Register
✕

GPIO Assignment

P0_0	<input type="checkbox"/>	P0_1	<input type="checkbox"/>	P0_2	<input type="checkbox"/>	P0_3	<input type="checkbox"/>	P0_4	<input type="checkbox"/>	P0_5	<input type="checkbox"/>	P0_6	<input type="checkbox"/>	P0_7	<input type="checkbox"/>
P1_0	<input type="checkbox"/>	P1_1	<input type="checkbox"/>	P1_2	<input type="checkbox"/>	P1_3	<input type="checkbox"/>	P1_4	<input type="checkbox"/>	P1_5	<input type="checkbox"/>	P1_6	<input type="checkbox"/>	P1_7	<input type="checkbox"/>
P2_0	<input type="checkbox"/>	P2_1	<input type="checkbox"/>	P2_2	<input type="checkbox"/>	P2_3	<input type="checkbox"/>	P2_4	<input type="checkbox"/>	P2_5	<input type="checkbox"/>	P2_6	<input type="checkbox"/>	P2_7	<input checked="" type="checkbox"/>
P3_0	<input type="checkbox"/>	P3_1	<input type="checkbox"/>	P3_2	<input type="checkbox"/>	P3_3	<input type="checkbox"/>	P3_4	<input type="checkbox"/>	P3_5	<input type="checkbox"/>	P3_6	<input type="checkbox"/>	P3_7	<input type="checkbox"/>

MFB

Button Action Setting

--- Press Type 0x01: Short Press ▾

--- Press Time Unit 25 (1~255, Unit: 80ms)

--- Hold Press Count 4 (1~255)

Button Mapping Table

	Short Press	Long Press	Long Long Press
-- Standby (No talk) Mode	0x30 Volume ▾	0xFC One Ke ▾	0x00 None ▾
-- Voice Dial Mode	0x30 Volume ▾	0x00 None ▾	0x00 None ▾
-- Incoming Call Mode	0x30 Volume ▾	0x00 None ▾	0x00 None ▾
-- Outgoing Call Mode	0x30 Volume ▾	0x00 None ▾	0x00 None ▾
-- Call Active Mode	0x30 Volume ▾	0x09 Mic Un ▾	0x00 None ▾
-- Single-Link Multi-Call(1 Active & 1	0x30 Volume ▾	0x09 Mic Un ▾	0x00 None ▾
-- Single-Link Multi-Call(1 Active & 1 Hold)	0x30 Volume ▾	0x09 Mic Un ▾	0x00 None ▾
--- Hold Call Mode	0x30 Volume ▾	0x09 Mic Un ▾	0x00 None ▾
-- Multi-Link Multi-Call(1 Active & 1 Incoming)	0x30 Volume ▾	0x09 Mic Un ▾	0x00 None ▾
-- Multi-Link Multi-Call(1 Active & 1 Hold)	0x30 Volume ▾	0x09 Mic Un ▾	0x00 None ▾

Cancel
OK

FIGURE 74: MFB BUTTON

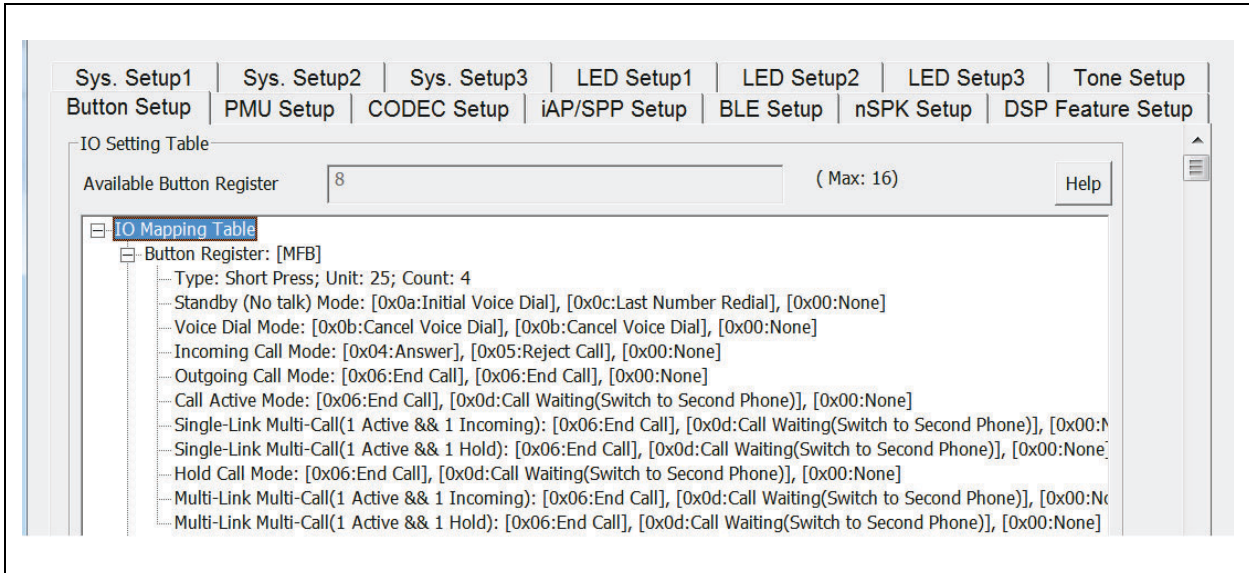


FIGURE 75: GPIO P0_2 IS CONFIGURED FOR PLAY/STOP

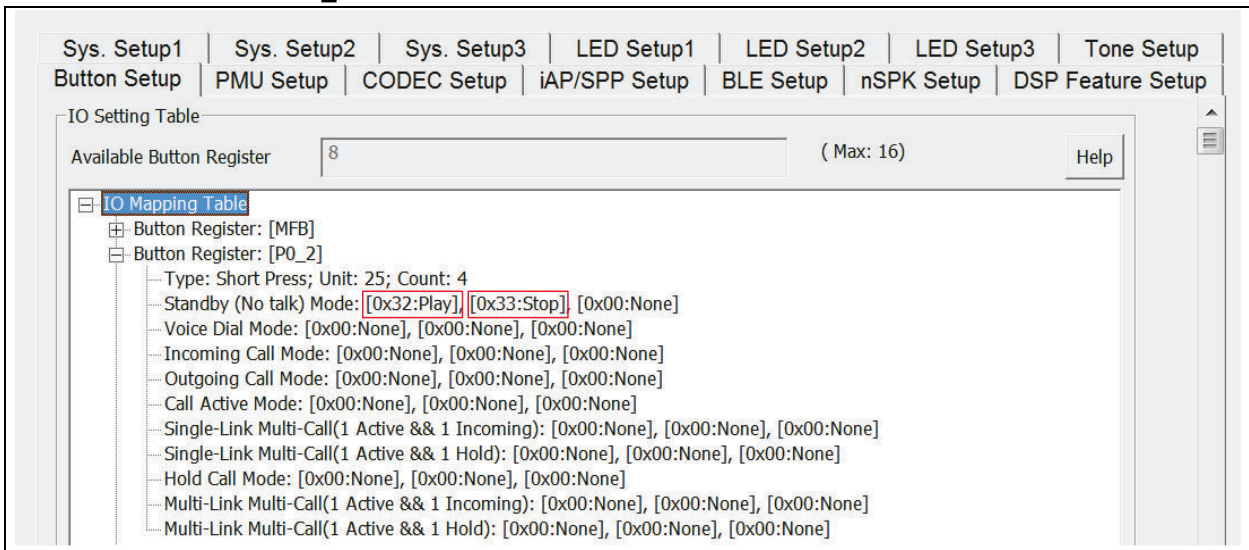


FIGURE 76: GPIO P0_3 IS CONFIGURED FOR BACKWARD/REWIND FUNCTIONALITY

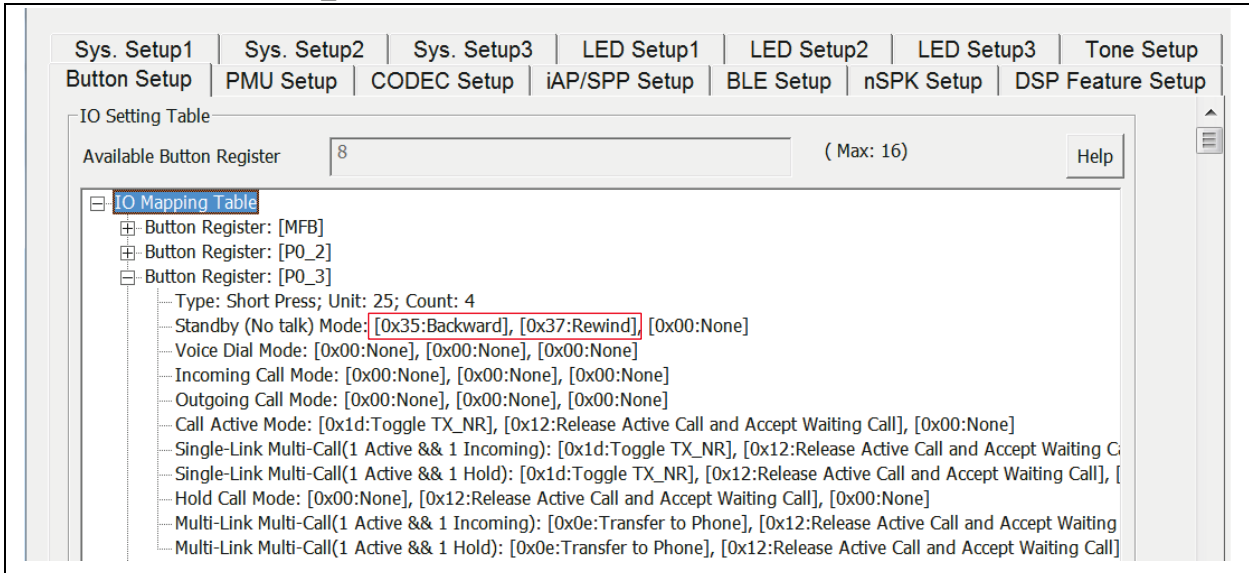


FIGURE 77: GPIO P0_1 IS CONFIGURED FOR FORWARD INITIATION

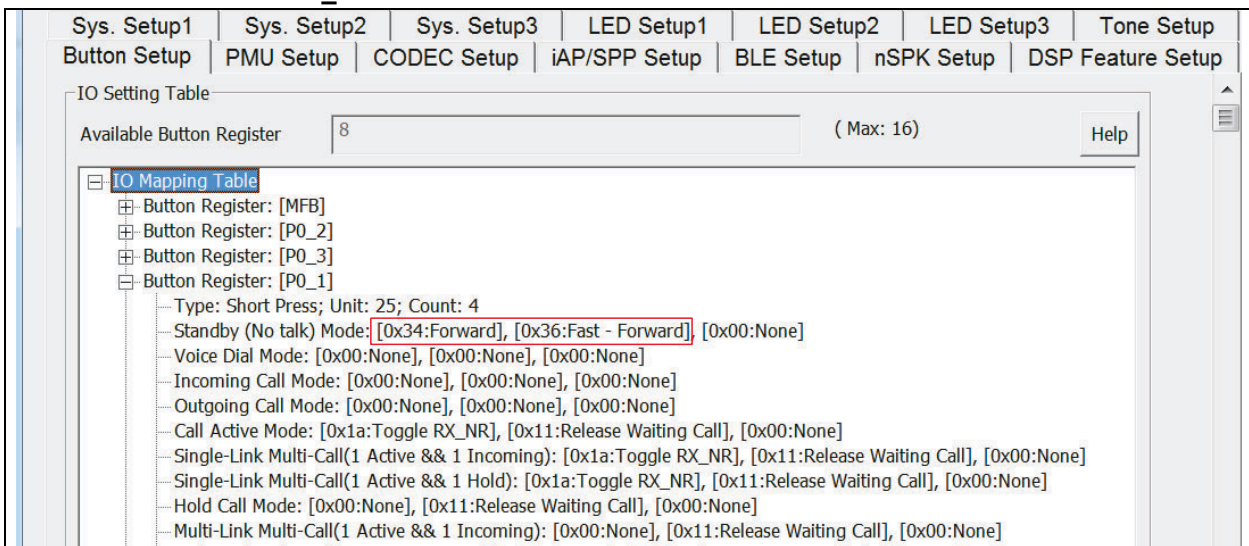


FIGURE 78: GPIO P0_5 IS CONFIGURED FOR VOLUME DOWN AND STEREO MODE ENTRY

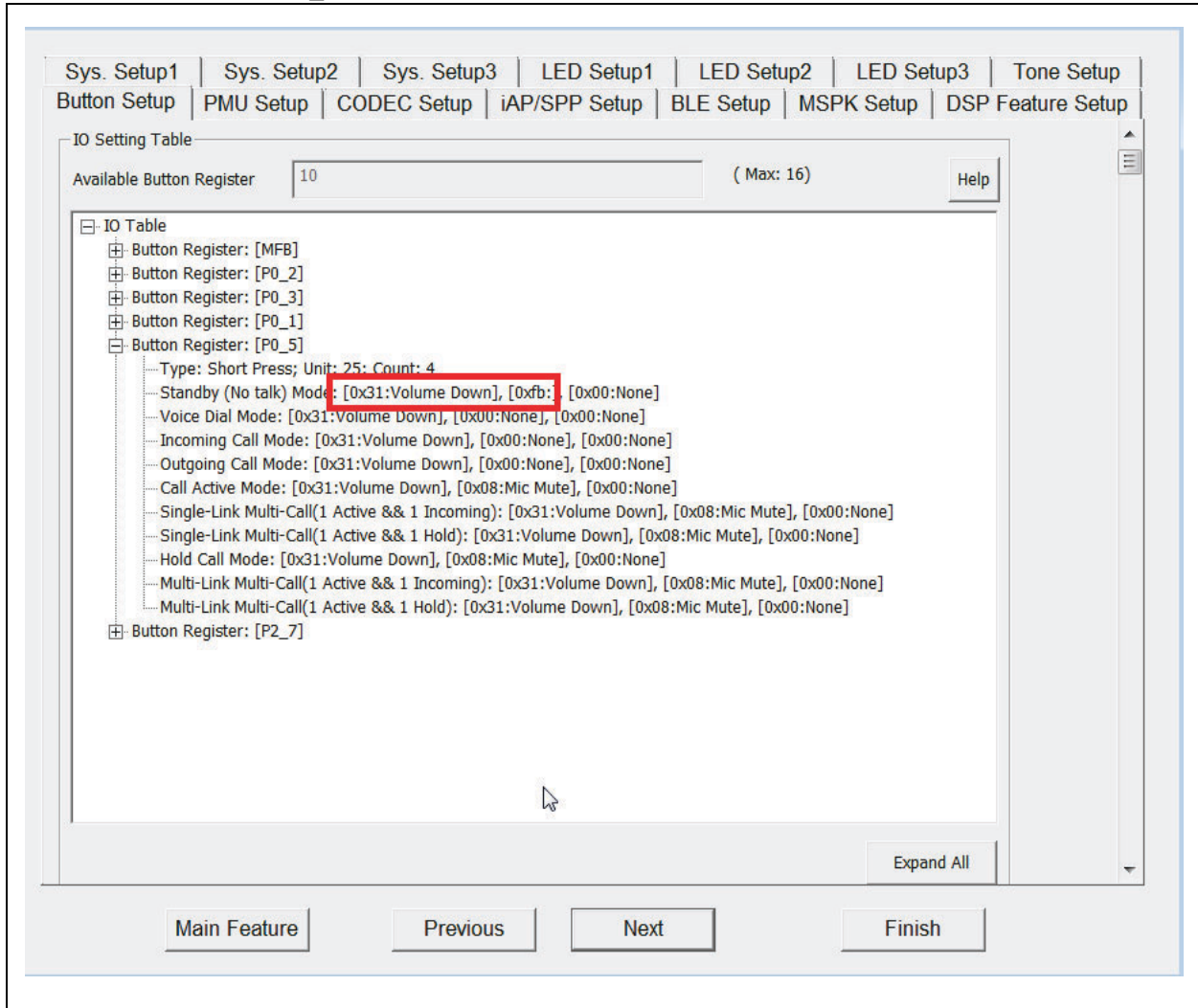
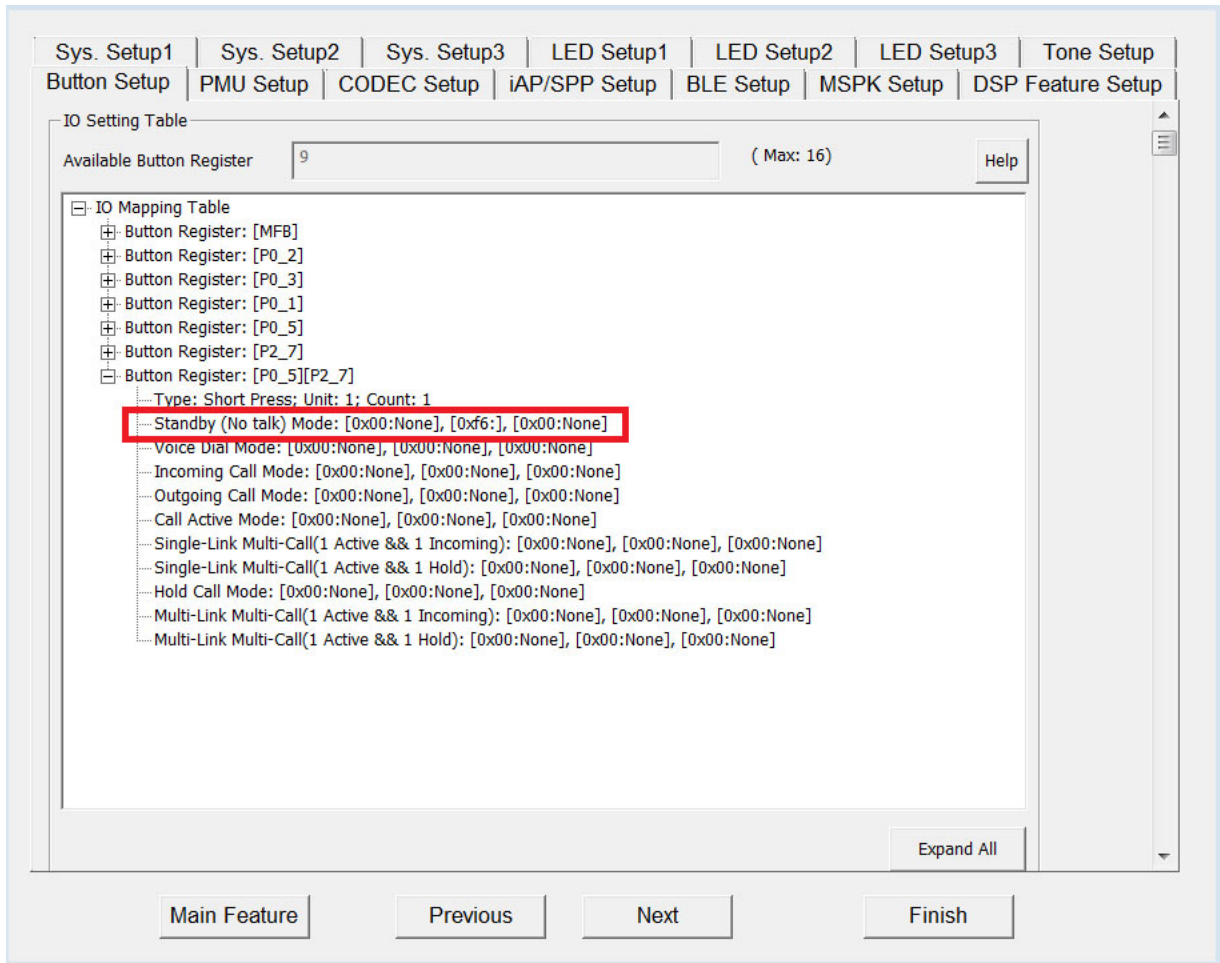


FIGURE 79: GPIO P0_5 AND GPIO P2_7 ARE CONFIGURED FOR ADDING NEW SLAVE IN CONCERT MODE



APPENDIX J: MULTI-LINK

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

FIGURE 80: MULTI-LINK

Button Setup	PMU Setup	CODEC Setup	iAP/SPP Setup	BLE Setup	nSPK Setup	DSP Feature Setup
Sys. Setup1	1 Sys. Setup2	Sys. Setup3	LED Setup1	LED Setup2	LED Setup3	Tone Setup
--- Enter Pairing Mode When Power On				Disable		
--- Suspend Stream When SCO Established				Disable		
--- Circular Volume Control				Disable		
--- Class of Device				Speaker		
--- Phone NR and EC Function				Enable		
--- Report Battery Status to Smart Phone				Enable		
--- Link Application				Multi-Link 2		
--- Always Answer Incoming Call				Disable		
--- Auto Answer Incoming Call When Link Back				Disable		
--- Hang Up a Call When Switch Off				Disable		
--- Shut Down Power in Off State				Enable		
--- Enter Pairing when Power On Link Back Failed				Disable		
--- Wide Band Speech Enable (mSBC)				Enable		
--- Disable Link Back When Remoto No Link Key				Enable		
--- Only Accept Paired Device				Disable		
--- Disconnect All In Pairing				Disable 3		
--- Keep BLE In Power Off				Disable		

Main Feature Previous Next Finish

APPENDIX K: AUTO RECONNECTION

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

FIGURE 81: AUTO RECONNECTION

The screenshot displays the 'MSPK Setup' configuration window. The window title bar includes tabs for 'Sys. Setup1', 'Sys. Setup2', 'Sys. Setup3', 'LED Setup1', 'LED Setup2', 'LED Setup3', and 'Tone Setup'. The 'MSPK Setup' tab is active and highlighted with a red box. Below the tabs, the configuration options are as follows:

- Twin Pairing Duration: 30 (1~255;unit:1s) total : 02 min 30 sec
- Twin Aux. Pairing Duration (For one key operation): 3 (1~255;unit:2s) total : 6.00 sec
- General Twin Mode Group Code: 0x 7B36 (2bytes)
- Stereo Model ID: 0x 0000 (2bytes)
- Recover MSPK Link As Twin Speaker Link Loss (For stereo mode (2-SPK)): Recovery
- Default Multi Speaker Mode: Concert Mode
- Concert Mode Resync: Enable
- Concert Mode Link Status Record: **Enable** (highlighted with a red box)
- ADV Policy in Concert Mode Slave: 0x03: Connectable Advertisi
- ADV Policy in Stereo Slave: 0x03: Connectable Advertisi
- A2DP Latency: 240 (0~255;unit: 1ms)
- Enable AAC Codec in CSB: Enable

At the bottom of the window, there are four buttons: 'Main Feature', 'Previous', 'Next', and 'Finish'.

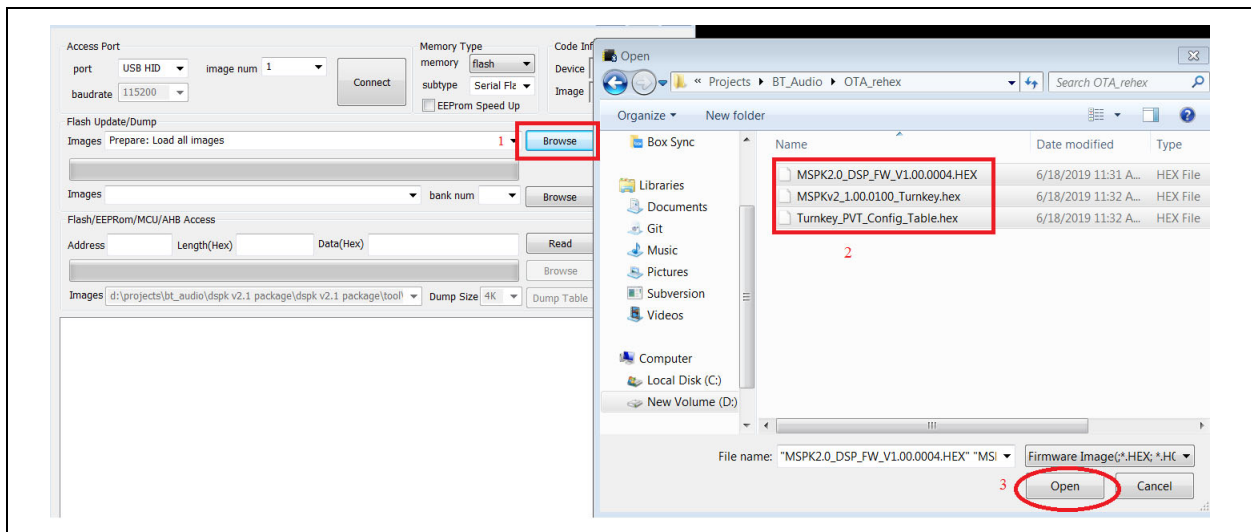
APPENDIX L: DFU- OVER-THE-AIR UPGRADE PROCEDURE

This section details the procedure for how to upgrade IS2083BM firmware using the Microchip Bluetooth Audio mobile app on an Android mobile phone. The MBA app in iOS mobile can also be used for OTA upgrade. This procedure is common for Embedded and Host mode.

1. Rehexing Upgradeable OTA Image - It is possible to upgrade IS2083BM MCU (8051) firmware alone, or IS2083BM MCU firmware, DSP firmware and config image all three together as one rehex image. DSP image can also include the voice prompt. The images need to be rehexed for OTA. Perform the following steps to generate a rehex image from the original image.

a. Open the isUpdate tool from `\Tools\isUpdate Tool`, and browse the MCU image or MCU, DSP, Config images to be upgraded as shown in the following figure.

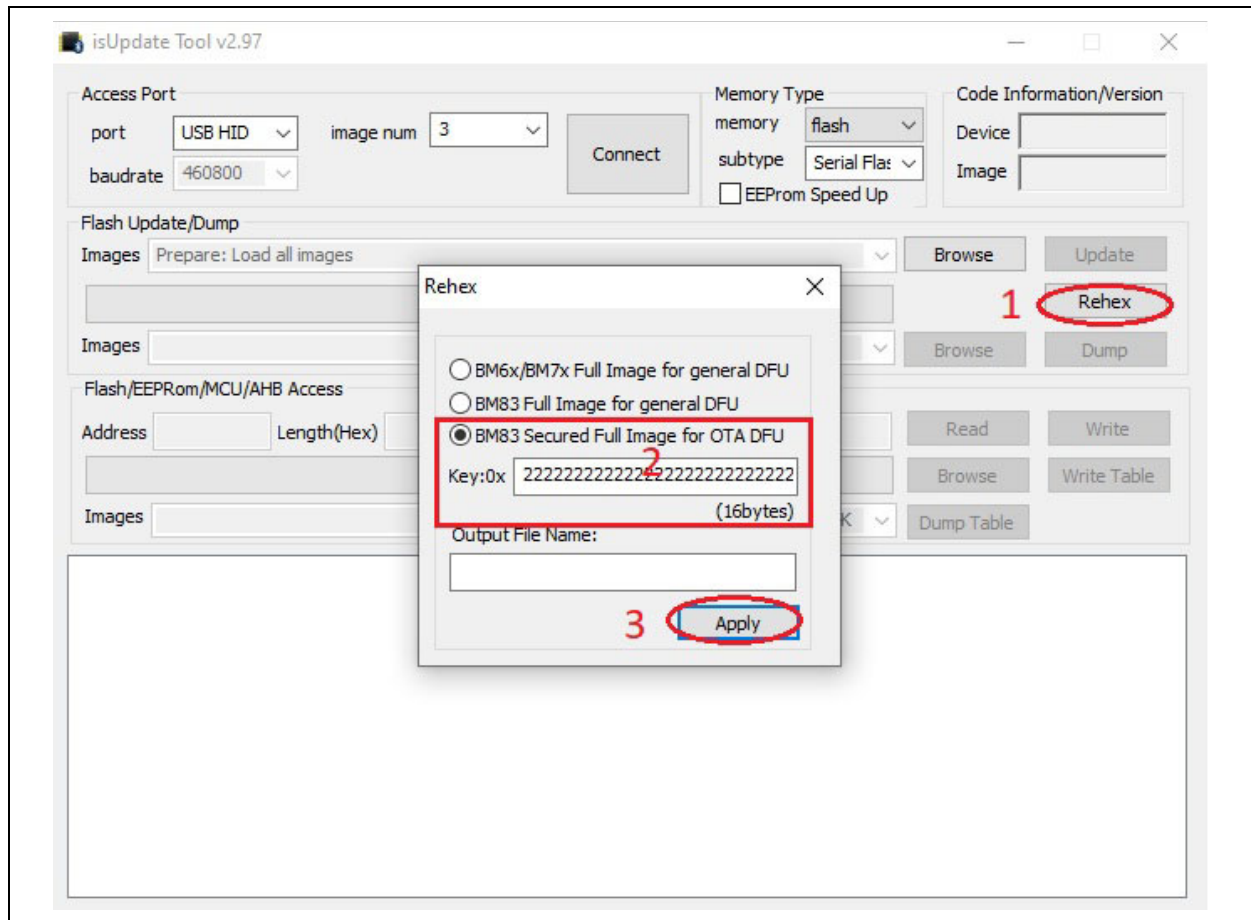
FIGURE 82: OPENING .HEX FILE



b. Click on **Rehex** and select *BM83 OTA DFU Use*.
The Encryption Key for encrypting the OTA image can also be provided in **Key** as shown in the figure below. The upgradeable image is secured using Cipher Feedback Mode (CFB) encryption key while transmitted over BLE link and decrypted with the same key in IS2083BM when it is received. It is required to match the key provided here and key in BM83 firmware. The default Key is already present in **Key**.

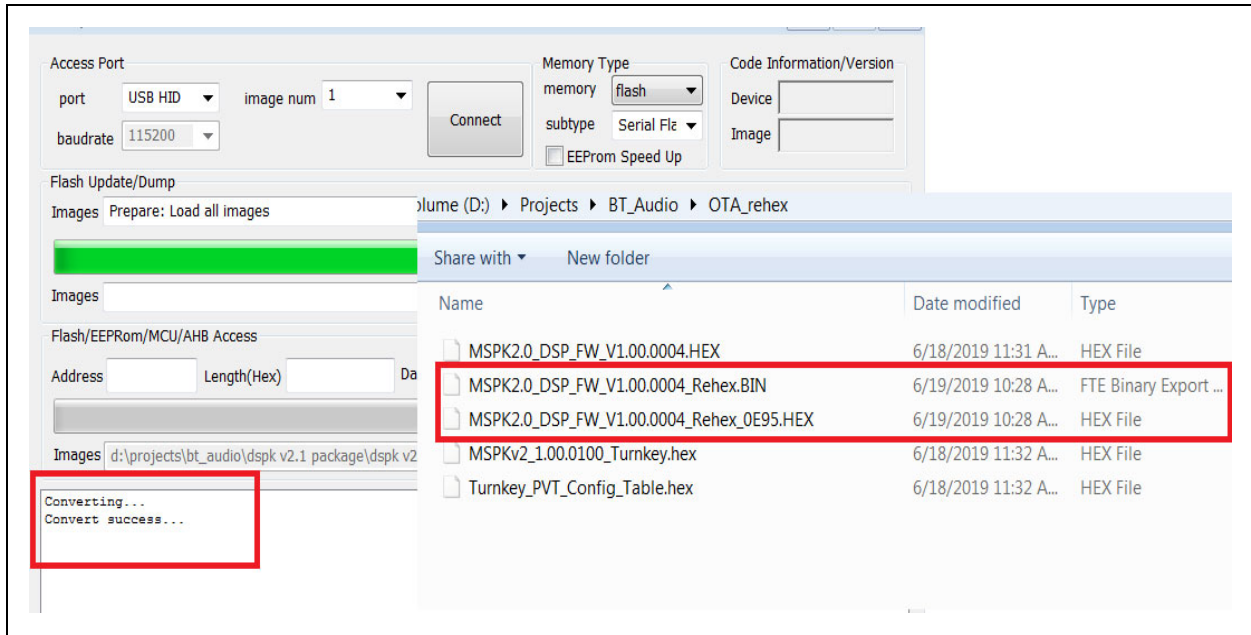
c. Click **Apply** to start rehexing.

FIGURE 83: BM83 OTA DFU USE



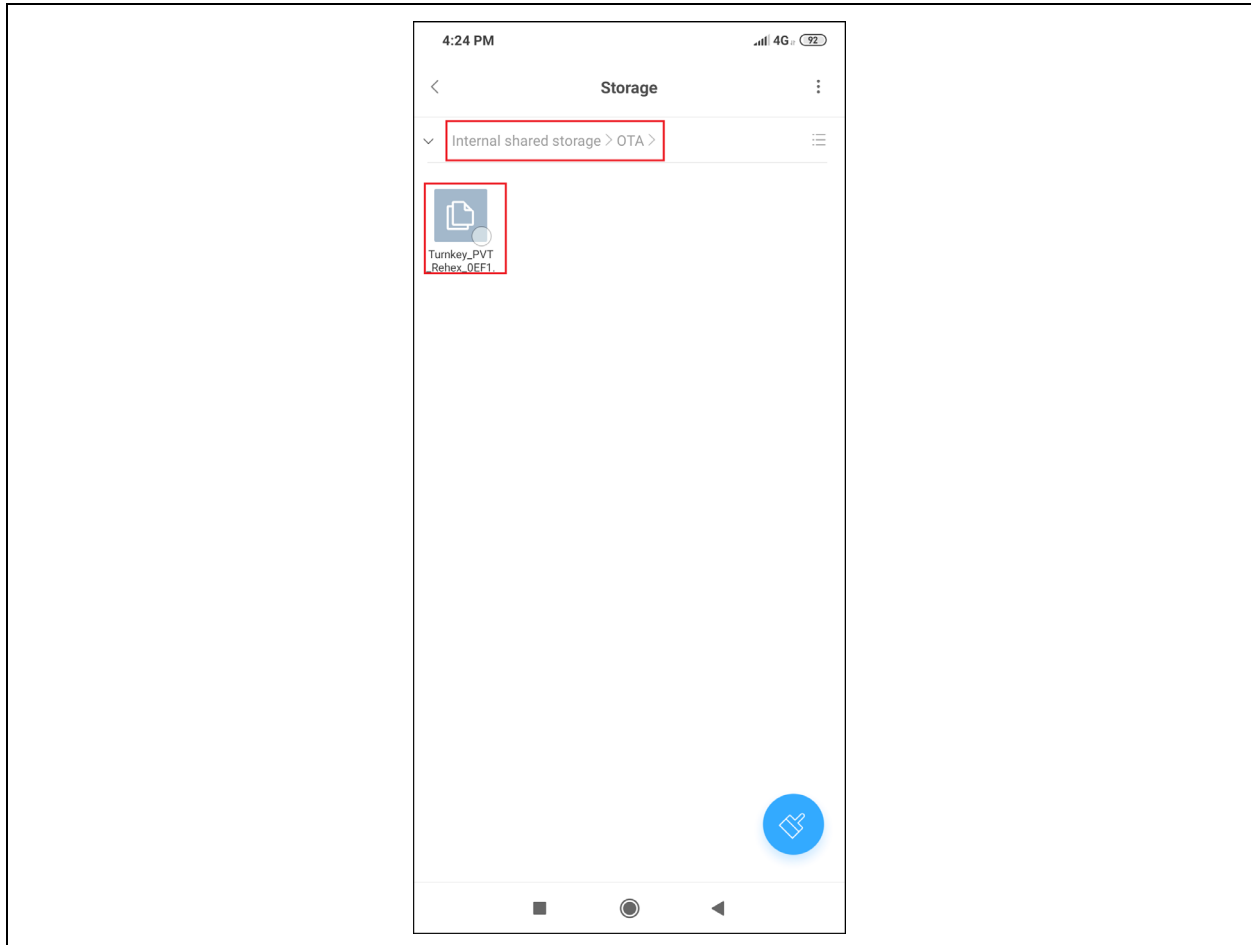
Once it is successfully completed, the rehexed image must be available in the same folder as the original image as shown in the following figure.

FIGURE 84: REHEXED IMAGE FILE



2. Create \OTA folder in the mobile phone internal storage and place the upgradeable image inside the \OTA folder as shown in the following figure. Creating the \OTA folder in internal storage space is needed only for the Android app.

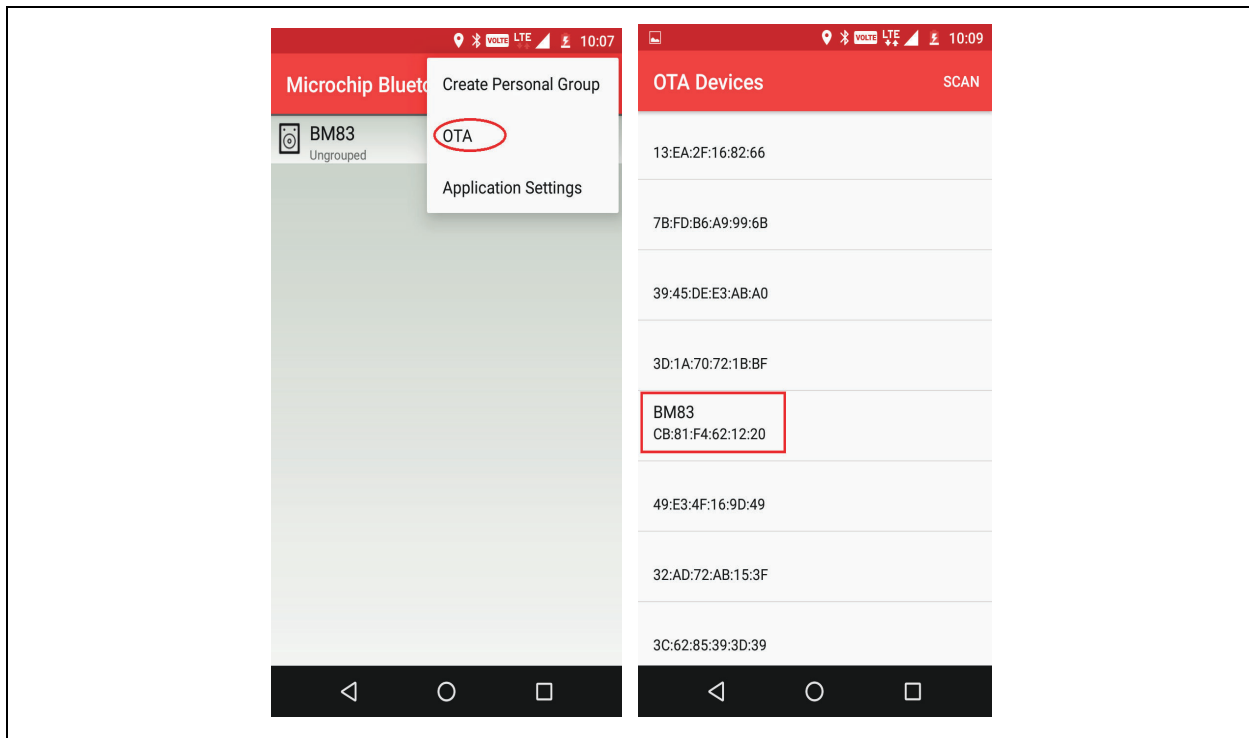
FIGURE 85: ADDING UPGRADEABLE IMAGE IN THE MOBILE PHONE



3. Make sure that IS2083BM is in power-on condition, and open the MBA app.

4. Click on OTA and start scanning the Bluetooth Low Energy devices nearby, as shown below.

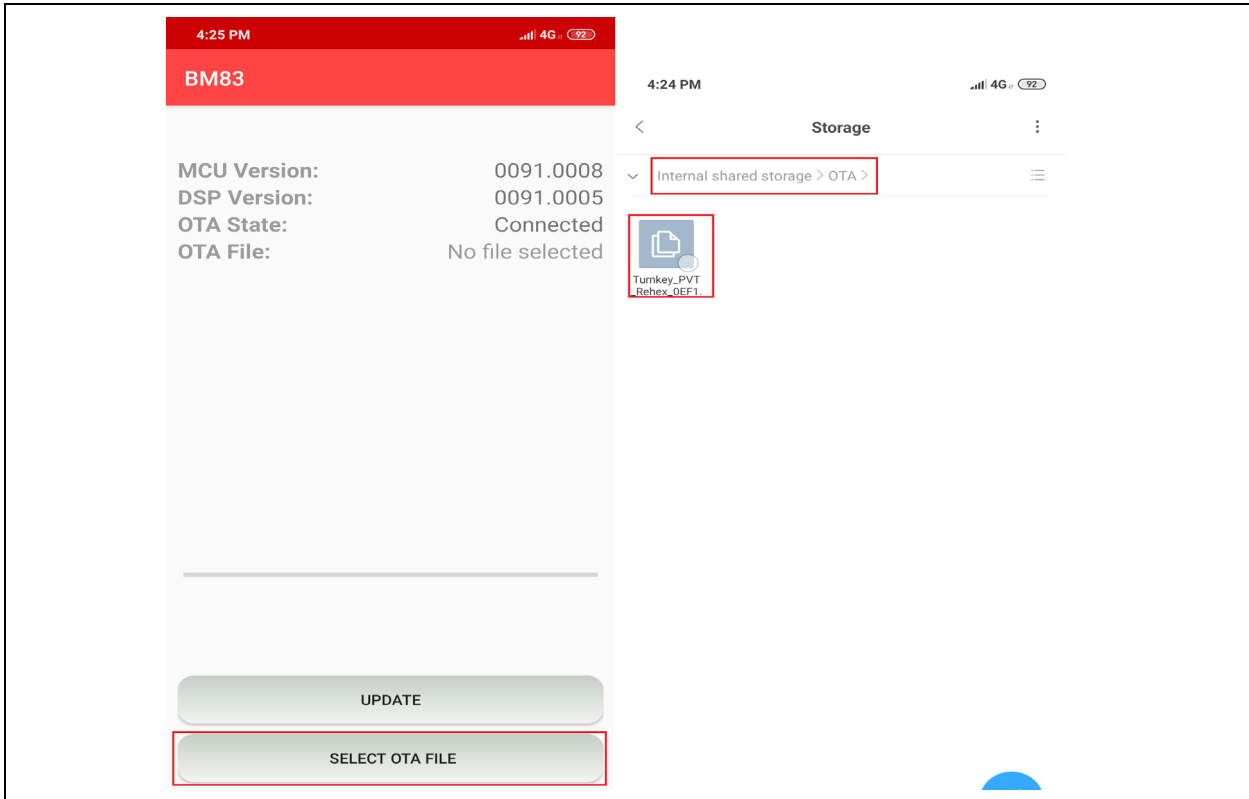
FIGURE 86: SCANNING BLUETOOTH DEVICES USING OTA AND SELECTING BM83



5. Click on the device to be upgradeable from the list of scanned devices, as shown in the preceding figure.

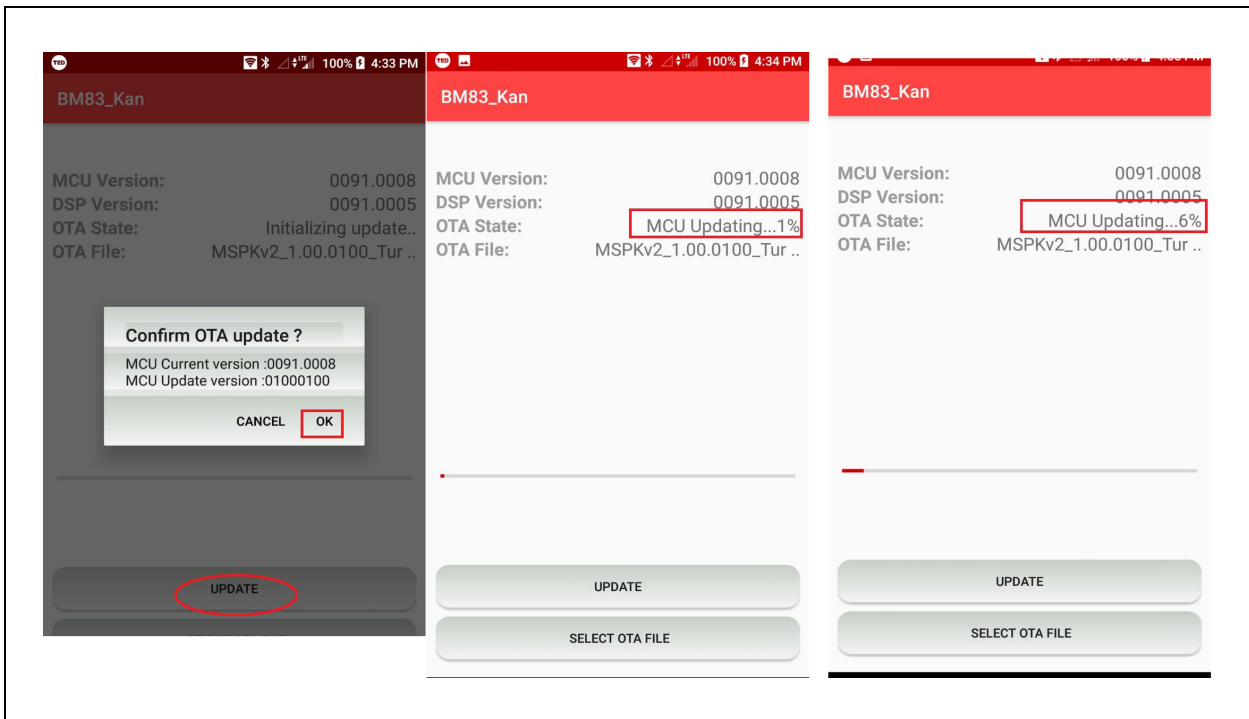
6. Click on **Select OTA File** to select the image from the /OTA folder as shown in the following figure.

FIGURE 87: SELECTING OTA FILE



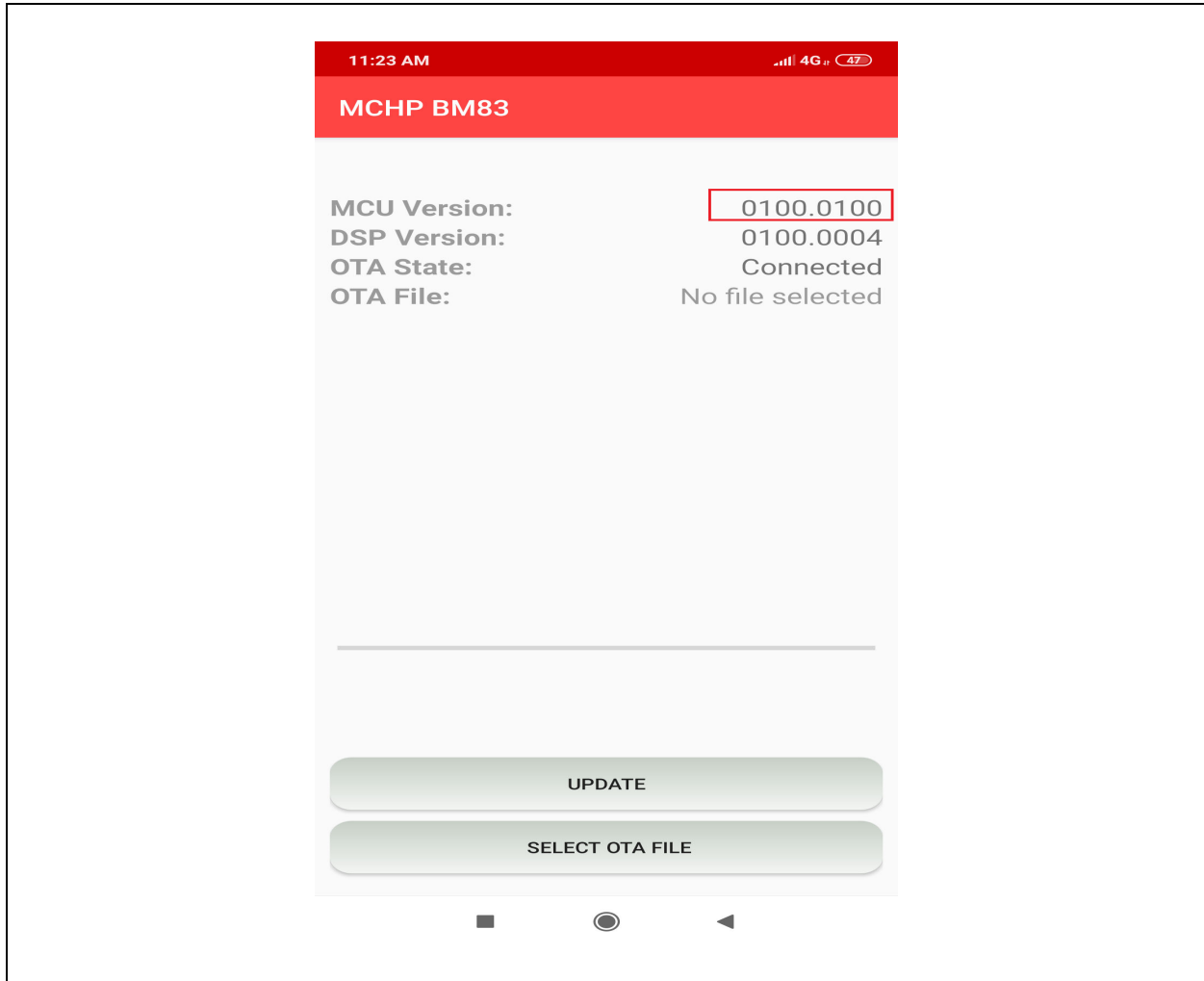
8. Click on **UPDATE** to start the upgrade as shown in the following figure.

FIGURE 88: UPGRADING OTA



9. Once the upgrade is success, the mobile displays the completed message.
10. BM83 automatically restarts while scanning the device and shows the upgraded image version as shown in the following figure.

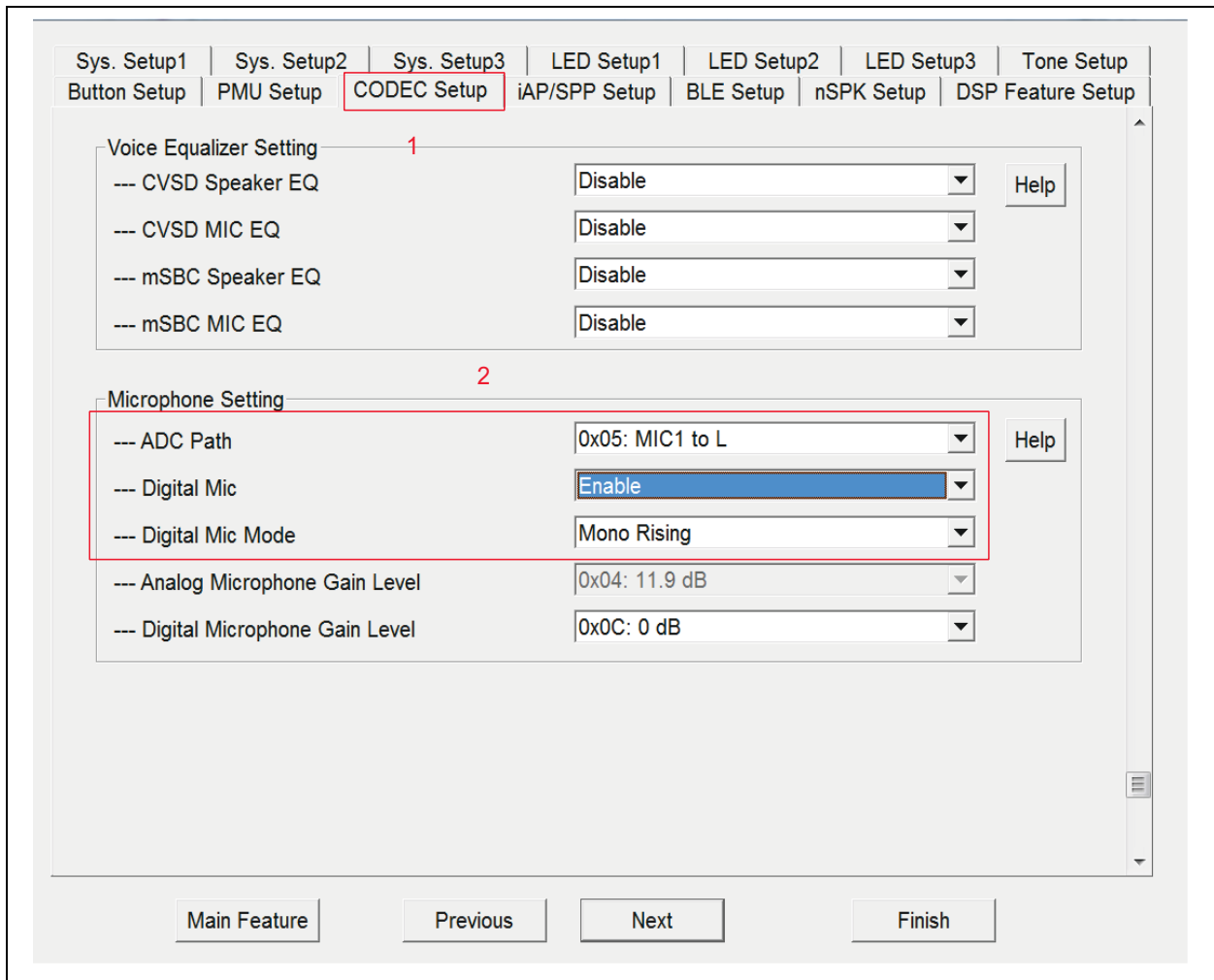
FIGURE 89: UPDATED MCU VERSION



APPENDIX M: ENABLING DIGITAL MIC

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

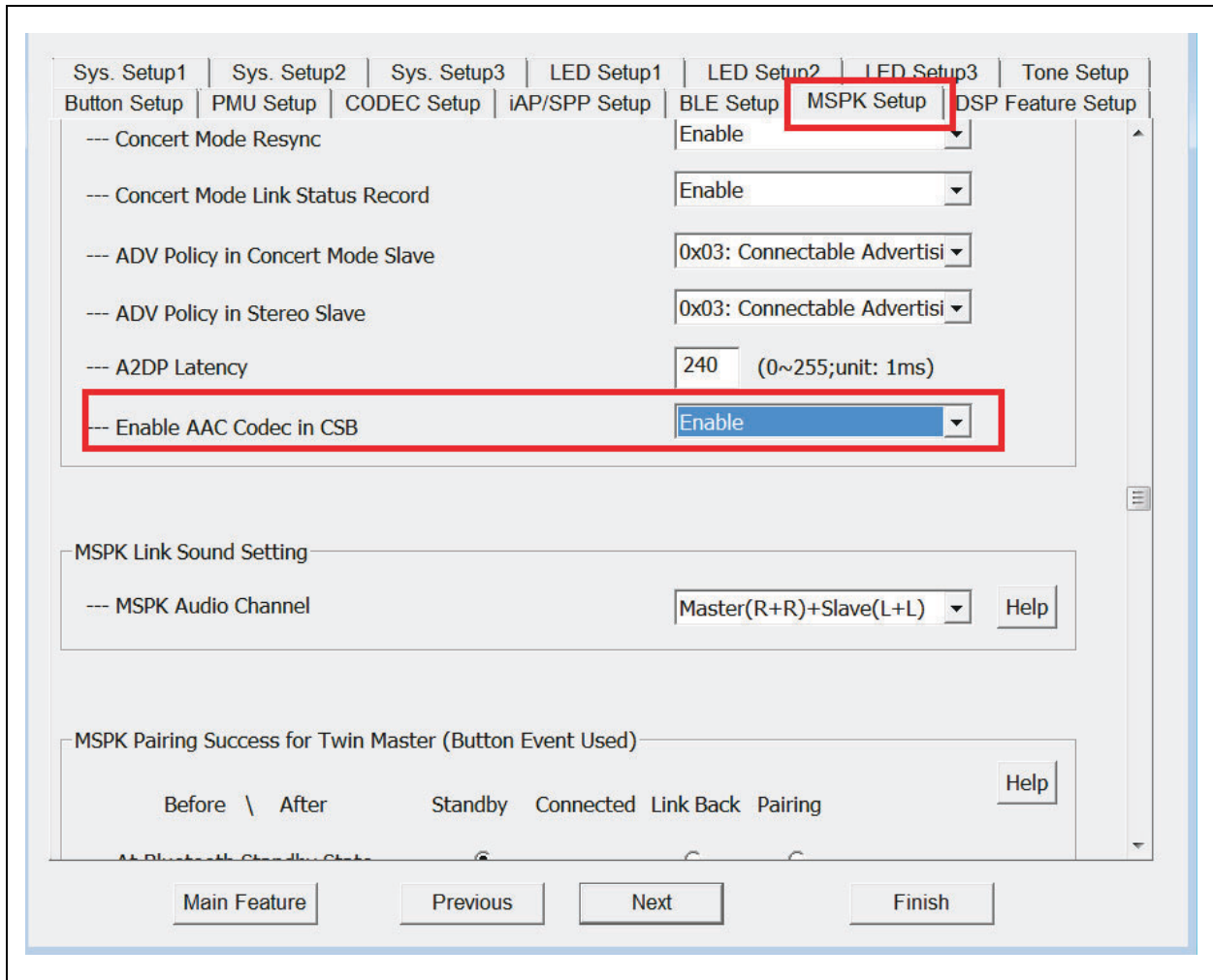
FIGURE 90: ENABLING DIGITAL MIC



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 91: ENABLING AAC ENCODING

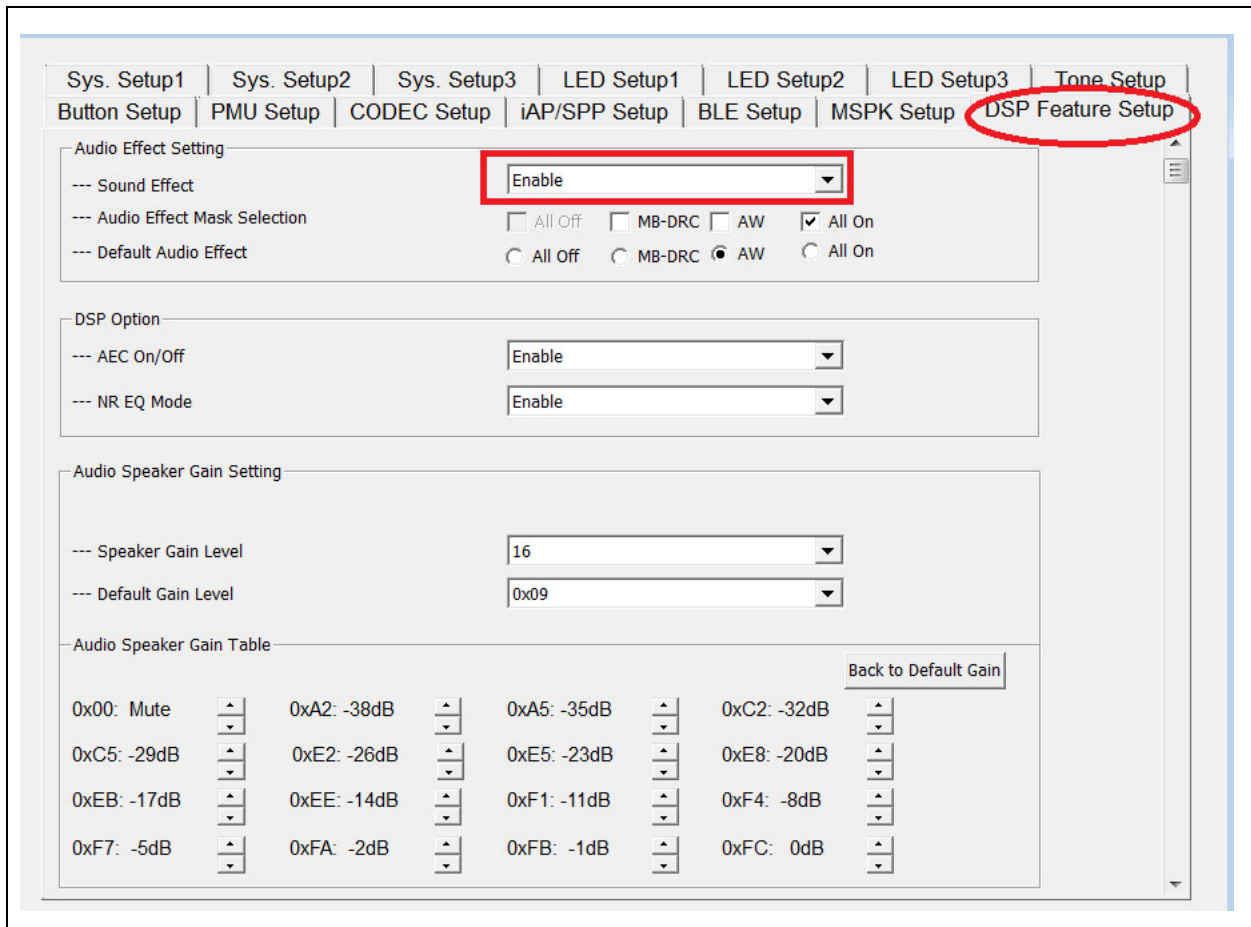


APPENDIX O: ENABLING INTERNAL DSP AUDIO EFFECTS

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.

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

FIGURE 92: 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.

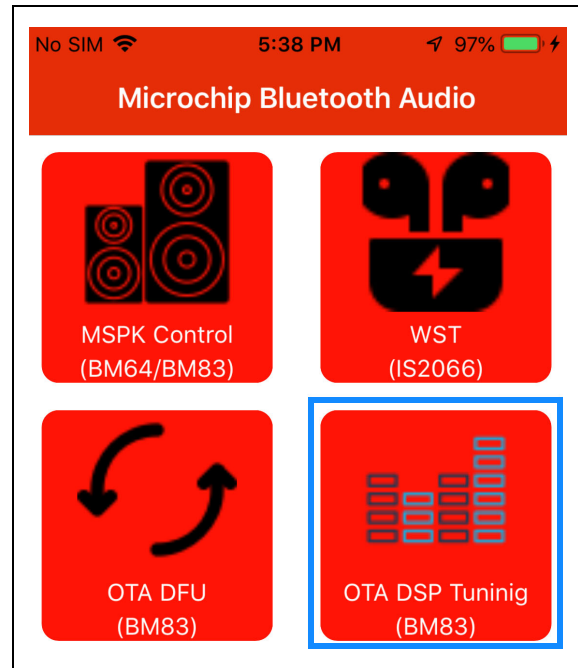
P.1 Audio and Voice Tuning

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 93: OTA DSP TUNING



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

TABLE 4-1: 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: <ul style="list-style-type: none"> - 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.

- 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:

FIGURE 95: DSP/DUT STATUS

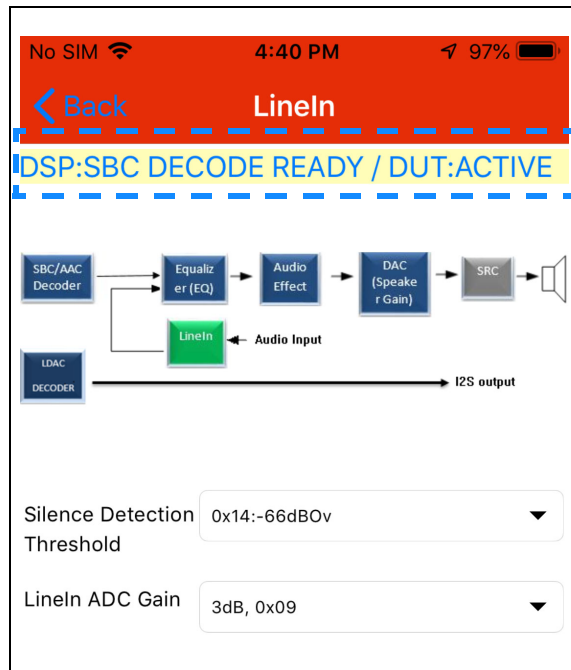


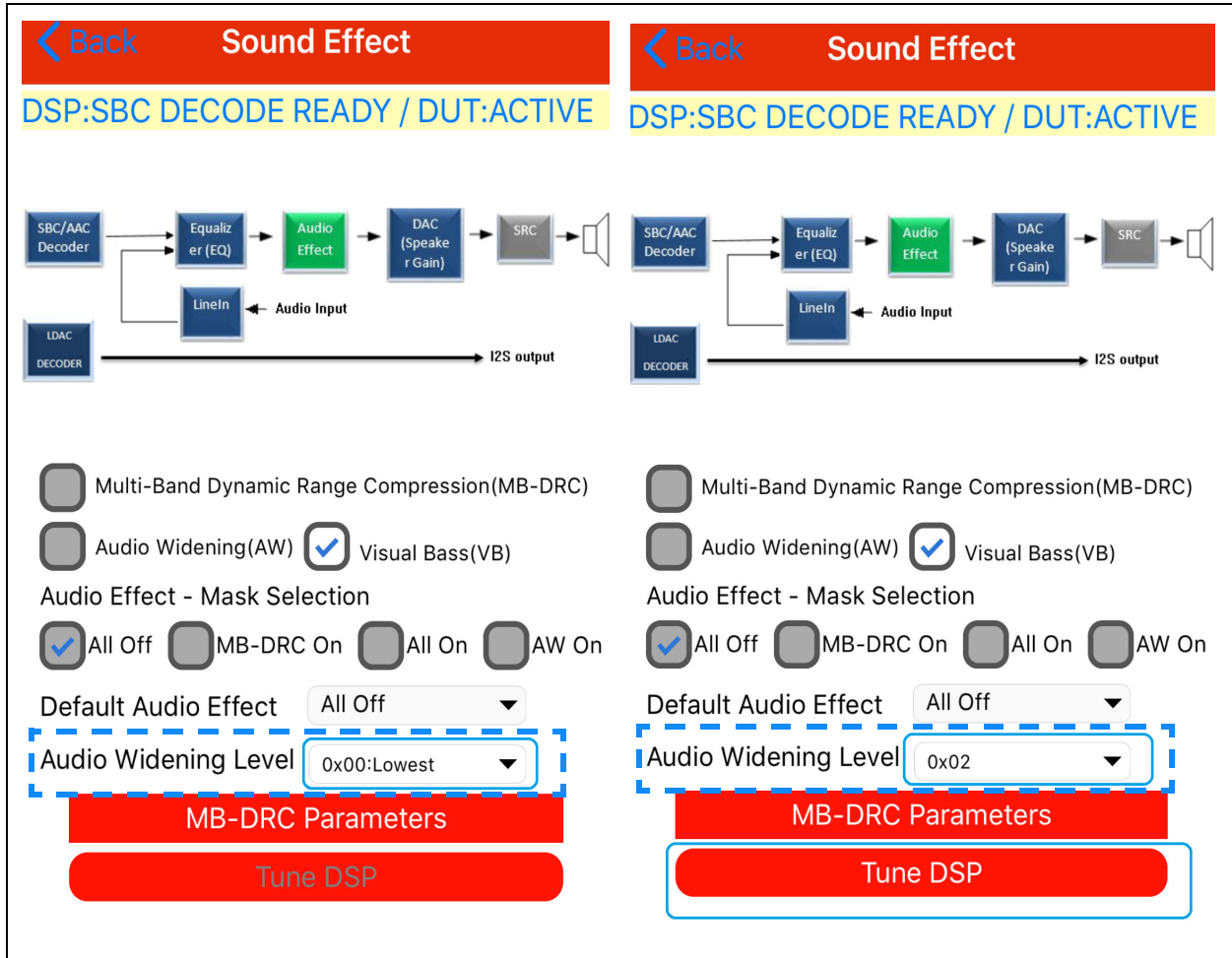
TABLE 4-2: DSP AND DUT STATUS DESCRIPTIONS

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

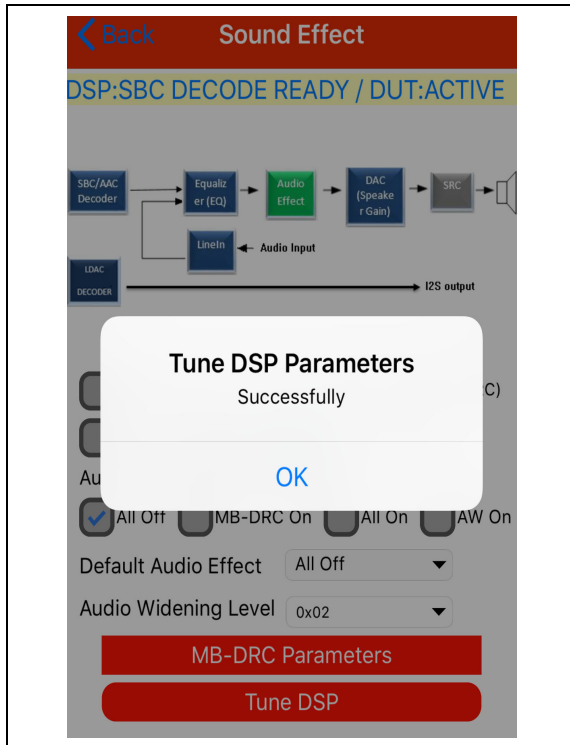
The following images illustrate the GUI pages which allow a user to tune up the audio function parameters. For example, to tune the Audio Widening Level, select the appropriate value for Audio Widening Level and the Tune DSP option will be enabled in order to tune the audio function in real time (see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

FIGURE 96: TUNING A2DP AUDIO WIDENING LEVEL EXAMPLE



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

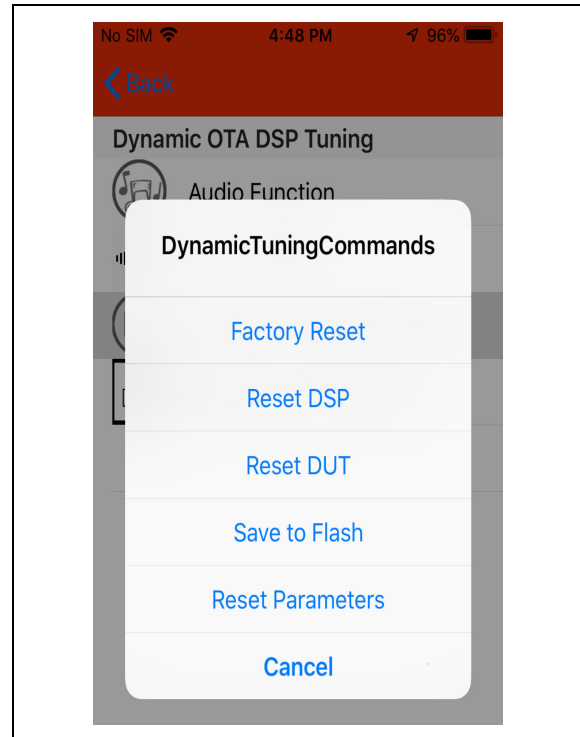
FIGURE 97: STATUS OF SUCCESSFUL TUNING MESSAGE



P.1.2 DYNAMIC TUNING COMMANDS

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

FIGURE 98: 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

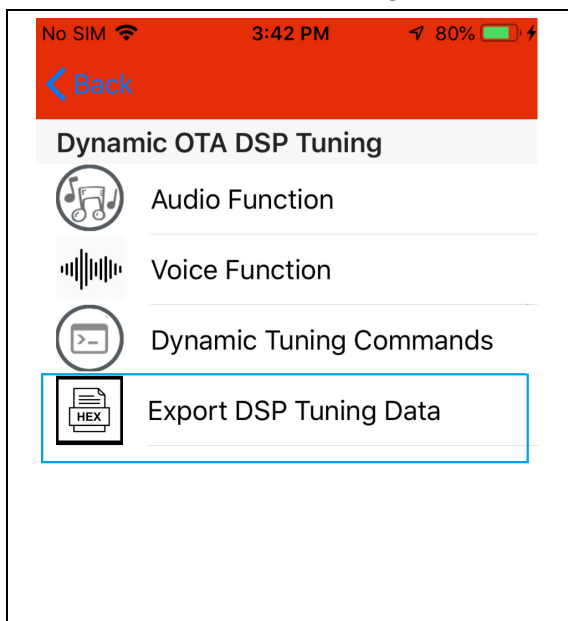
P.1.3 EXPORTING TUNED PARAMETERS

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:

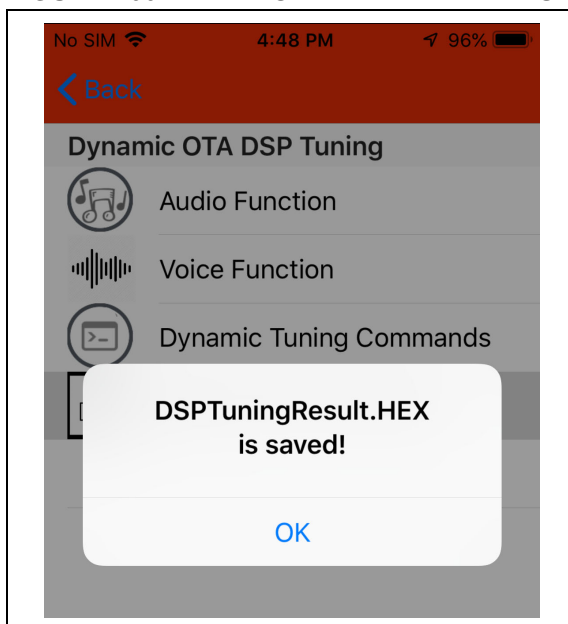
- An exported `DSPTuningResult.HEX` file will be stored in iDevices folder.
- This settings (HEX) file contains audio and voice function parameters only. This settings file can be merged with other HEX files using the Config GUI Tool.

FIGURE 99: EXPORTING DSP PARAMETERS



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

FIGURE 100: EXPORTED PARAMETERS



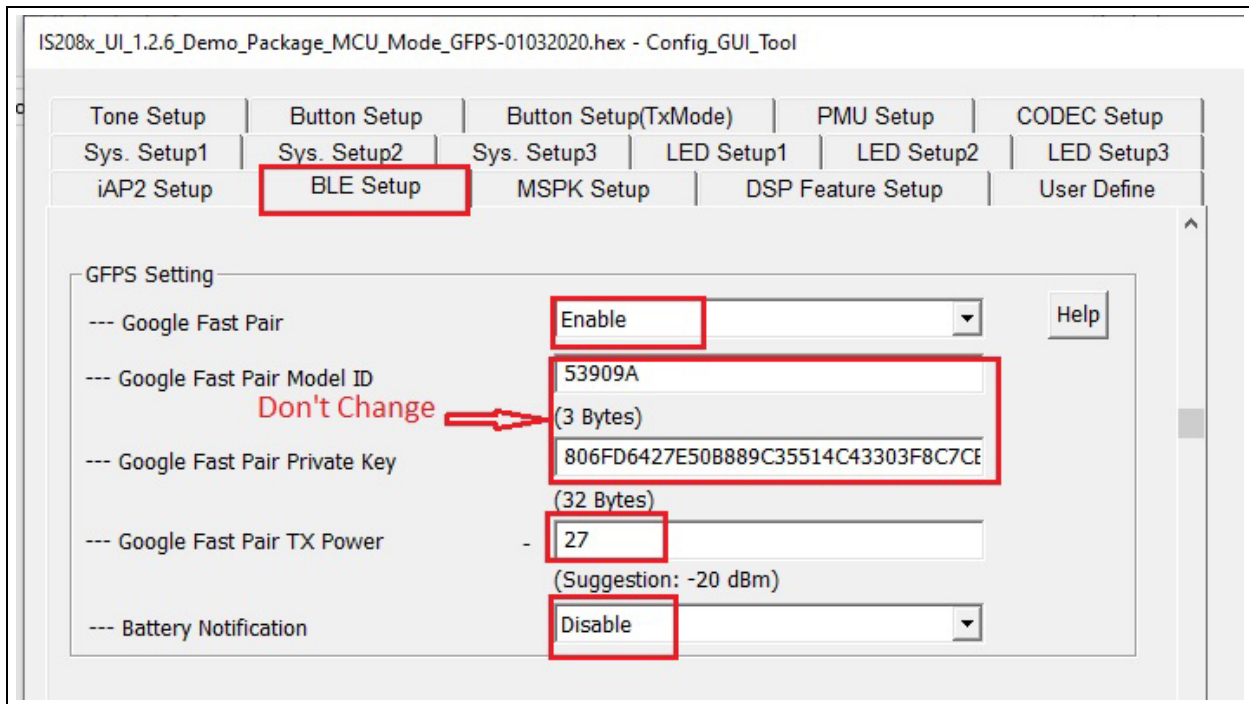
APPENDIX Q: ENABLING GOOGLE FAST PAIRING FEATURES

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.

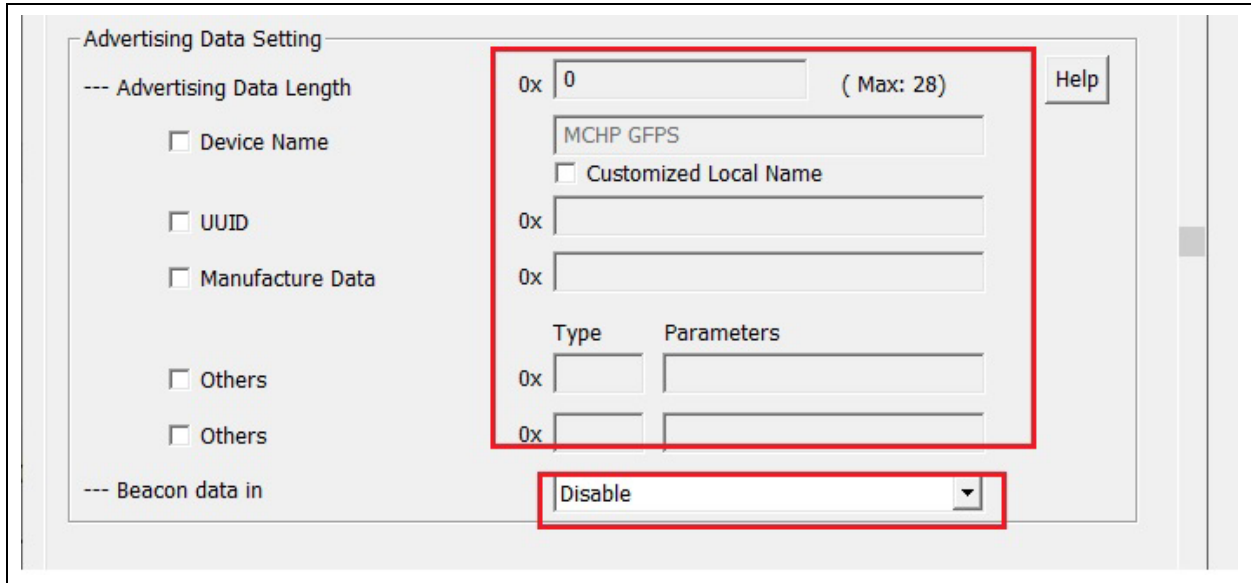
FIGURE 101: ENABLING GFP USING CONFIG GUI TOOL



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

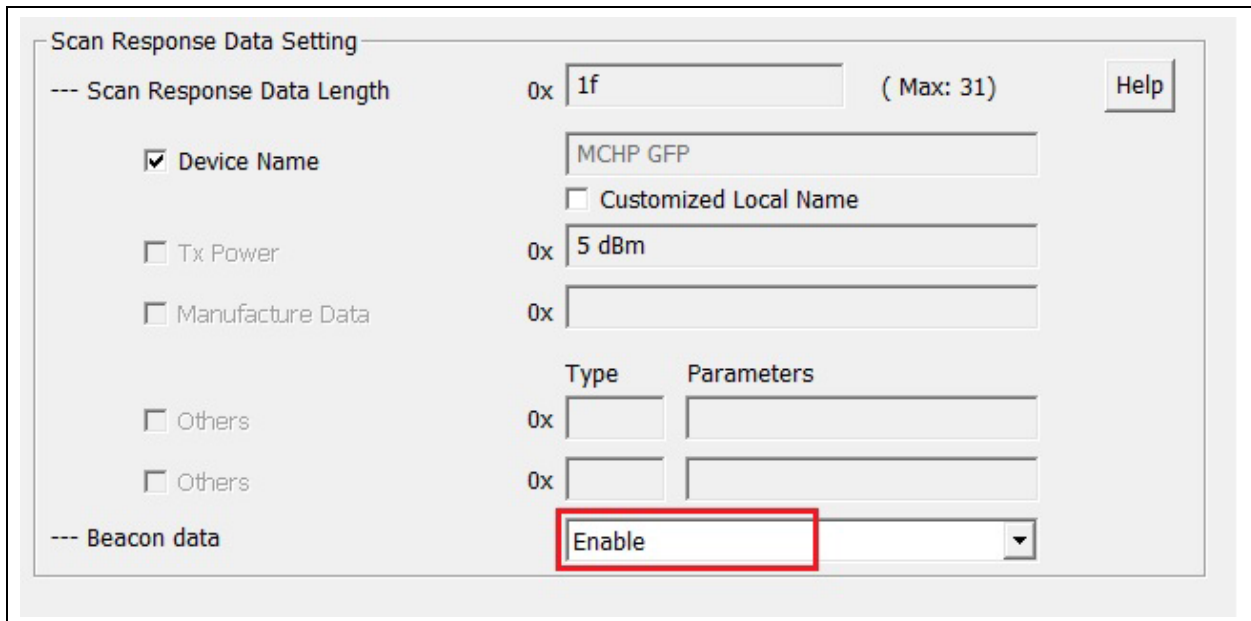
2. The default value of Tx Power is -27 dB and can be changed.
3. Battery level can be Enabled/Disabled.
4. Advertising Data Setting will be greyed out as shown in the following figure.
5. Beacon data can be disabled using the Config GUI Tool as shown in the following figure.

FIGURE 102: 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 103: 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:

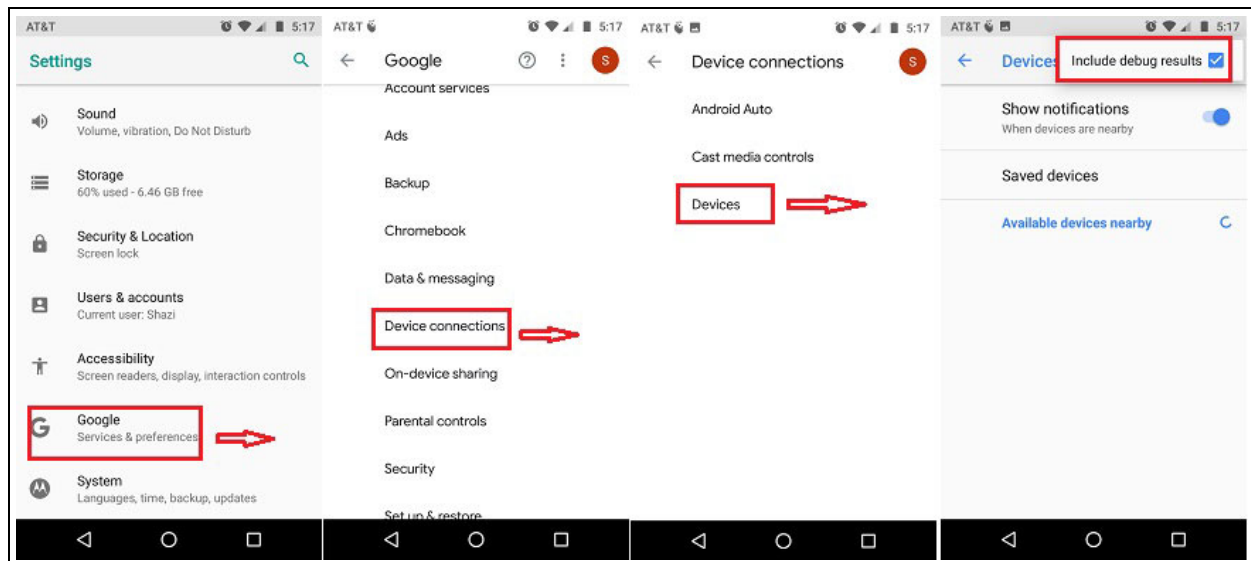
1. The Android phone must be connected to the Internet (Mobile Network/Wi-Fi).

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 104: 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 Slave role in Stereo/Concert mode
 - The connected device number reaches the maximum limit of three devices

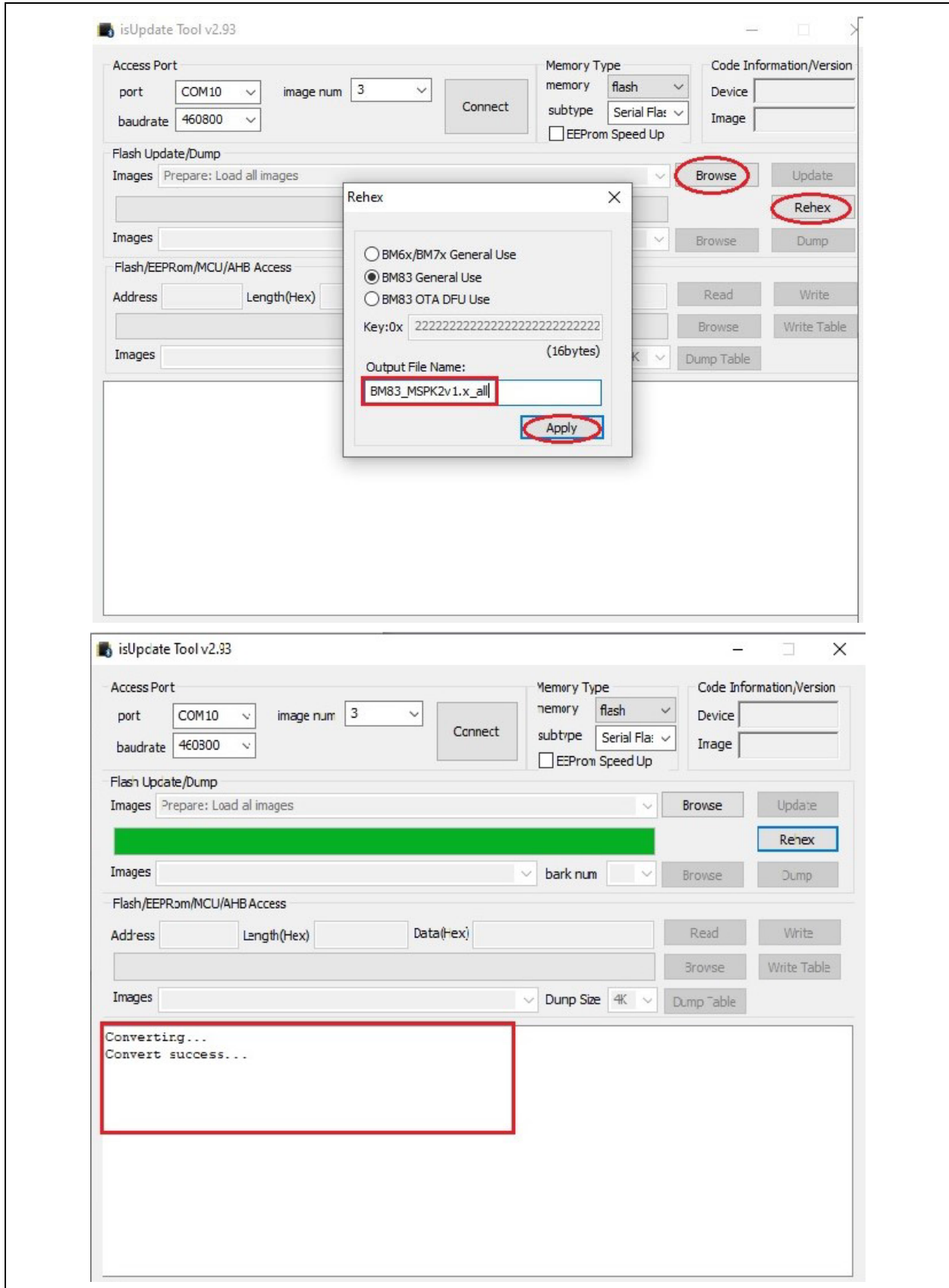
APPENDIX R: MCU DFU

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. Image number should 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.

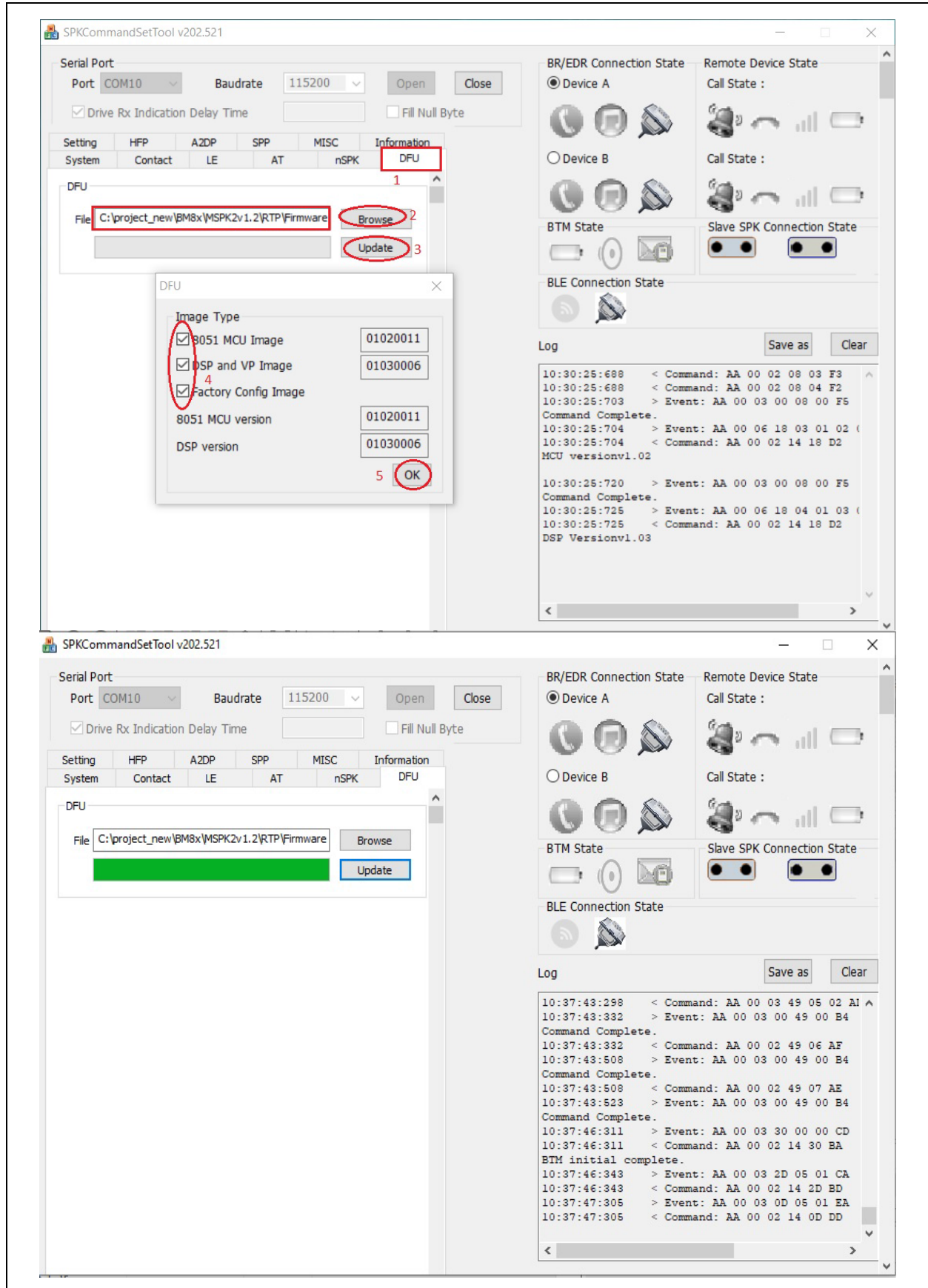
FIGURE 105: CREATING A REHEX FILE BY COMBINING THE IMAGES



R.2 Updating the BM83

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

FIGURE 106: UPDATING BM83



APPENDIX S: REVISION HISTORY

Revision	Date	Section	Description
B	06/2020	Document	<ul style="list-style-type: none"> Minor edits and updates across the document. Updated MSPK version from MSPK V2.x to MSPKv2 1.x.
		<ul style="list-style-type: none"> “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.
		<ul style="list-style-type: none"> 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 the following details of the code protection feature on Microchip devices:

- Microchip products meet the specification contained in their particular Microchip Data Sheet.
- Microchip believes that its family of products is one of the most secure families of its kind on the market today, when used in the intended manner and under normal conditions.
- There are dishonest and possibly illegal methods used to breach the code protection feature. All of these methods, to our knowledge, require using the Microchip products in a manner outside the operating specifications contained in Microchip's Data Sheets. Most likely, the person doing so is engaged in theft of intellectual property.
- Microchip is willing to work with the customer who is concerned about the integrity of their code.
- Neither Microchip nor any other semiconductor manufacturer can guarantee the security of their code. Code protection does not mean that we are guaranteeing the product as “unbreakable.”

Code protection is constantly evolving. We at Microchip are committed to continuously improving the code protection features of our products. Attempts to break Microchip's code protection feature may be a violation of the Digital Millennium Copyright Act. If such acts allow unauthorized access to your software or other copyrighted work, you may have a right to sue for relief under that Act.

Information contained in this publication regarding device applications and the like is provided only for your convenience and may be superseded by updates. It is your responsibility to ensure that your application meets with your specifications. MICROCHIP MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND WHETHER EXPRESS OR IMPLIED, WRITTEN OR ORAL, STATUTORY OR OTHERWISE, RELATED TO THE INFORMATION, INCLUDING BUT NOT LIMITED TO ITS CONDITION, QUALITY, PERFORMANCE, MERCHANTABILITY OR FITNESS FOR PURPOSE. Microchip disclaims all liability arising from this information and its use. Use of Microchip devices in life support and/or safety applications is entirely at the buyer's risk, and the buyer agrees to defend, indemnify and hold harmless Microchip from any and all damages, claims, suits, or expenses resulting from such use. No licenses are conveyed, implicitly or otherwise, under any Microchip intellectual property rights unless otherwise stated.

Trademarks

The Microchip name and logo, the Microchip logo, Adaptec, AnyRate, AVR, AVR logo, AVR Freaks, BesTime, BitCloud, chipKIT, chipKIT logo, CryptoMemory, CryptoRF, dsPIC, FlashFlex, flexPWR, HELDO, IGLoo, JukeBlox, KeeLoq, Klear, LANCheck, LinkMD, maXStylus, maXTouch, MediaLB, megaAVR, Microsemi, Microsemi logo, MOST, MOST logo, MPLAB, OptoLyzer, PackeTime, PIC, picoPower, PICSTART, PIC32 logo, PolarFire, Prochip Designer, QTouch, SAM-BA, SenGenuity, SpyNIC, SST, SST Logo, SuperFlash, Symmetricom, SyncServer, Tachyon, TempTrackr, TimeSource, tinyAVR, UNI/O, Vectron, and XMEGA are registered trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

APT, ClockWorks, The Embedded Control Solutions Company, EtherSynch, FlashTec, Hyper Speed Control, HyperLight Load, IntelliMOS, Libero, motorBench, mTouch, Powermite 3, Precision Edge, ProASIC, ProASIC Plus, ProASIC Plus logo, Quiet-Wire, SmartFusion, SyncWorld, Temux, TimeCesium, TimeHub, TimePictra, TimeProvider, Vite, WinPath, and ZL are registered trademarks of Microchip Technology Incorporated in the U.S.A.

Adjacent Key Suppression, AKS, Analog-for-the-Digital Age, Any Capacitor, AnyIn, AnyOut, BlueSky, BodyCom, CodeGuard, CryptoAuthentication, CryptoAutomotive, CryptoCompanion, CryptoController, dsPICDEM, dsPICDEM.net, Dynamic Average Matching, DAM, ECAN, EtherGREEN, In-Circuit Serial Programming, ICSP, INICnet, Inter-Chip Connectivity, JitterBlocker, KlearNet, KlearNet logo, memBrain, Mindi, MiWi, MPASM, MPF, MPLAB Certified logo, MPLIB, MPLINK, MultiTRAK, NetDetach, Omniscient Code Generation, PICDEM, PICDEM.net, PICKit, PICtail, PowerSmart, PureSilicon, QMatrix, REAL ICE, Ripple Blocker, SAM-ICE, Serial Quad I/O, SMART-I.S., SQI, SuperSwitcher, SuperSwitcher II, Total Endurance, TSHARC, USBCheck, VariSense, ViewSpan, WiperLock, Wireless DNA, and ZENA are trademarks of Microchip Technology Incorporated in the U.S.A. and other countries.

SQTP is a service mark of Microchip Technology Incorporated in the U.S.A.

The Adaptec logo, Frequency on Demand, Silicon Storage Technology, and Symmcom are registered trademarks of Microchip Technology Inc. in other countries.

GestIC is a registered trademark of Microchip Technology Germany II GmbH & Co. KG, a subsidiary of Microchip Technology Inc., in other countries.

All other trademarks mentioned herein are property of their respective companies.

© 2020, Microchip Technology Incorporated, All Rights Reserved.

For information regarding Microchip's Quality Management Systems, please visit www.microchip.com/quality.

ISBN: 978-1-5224-6136-4



MICROCHIP

Worldwide Sales and Service

AMERICAS

Corporate Office
2355 West Chandler Blvd.
Chandler, AZ 85224-6199
Tel: 480-792-7200
Fax: 480-792-7277
Technical Support:
<http://www.microchip.com/support>
Web Address:
www.microchip.com

Atlanta

Duluth, GA
Tel: 678-957-9614
Fax: 678-957-1455

Austin, TX

Tel: 512-257-3370

Boston

Westborough, MA
Tel: 774-760-0087
Fax: 774-760-0088

Chicago

Itasca, IL
Tel: 630-285-0071
Fax: 630-285-0075

Dallas

Addison, TX
Tel: 972-818-7423
Fax: 972-818-2924

Detroit

Novi, MI
Tel: 248-848-4000

Houston, TX

Tel: 281-894-5983

Indianapolis

Noblesville, IN
Tel: 317-773-8323
Fax: 317-773-5453
Tel: 317-536-2380

Los Angeles

Mission Viejo, CA
Tel: 949-462-9523
Fax: 949-462-9608
Tel: 951-273-7800

Raleigh, NC

Tel: 919-844-7510

New York, NY

Tel: 631-435-6000

San Jose, CA

Tel: 408-735-9110
Tel: 408-436-4270

Canada - Toronto

Tel: 905-695-1980
Fax: 905-695-2078

ASIA/PACIFIC

Australia - Sydney
Tel: 61-2-9868-6733

China - Beijing
Tel: 86-10-8569-7000

China - Chengdu
Tel: 86-28-8665-5511

China - Chongqing
Tel: 86-23-8980-9588

China - Dongguan
Tel: 86-769-8702-9880

China - Guangzhou
Tel: 86-20-8755-8029

China - Hangzhou
Tel: 86-571-8792-8115

China - Hong Kong SAR
Tel: 852-2943-5100

China - Nanjing
Tel: 86-25-8473-2460

China - Qingdao
Tel: 86-532-8502-7355

China - Shanghai
Tel: 86-21-3326-8000

China - Shenyang
Tel: 86-24-2334-2829

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

China - Suzhou
Tel: 86-186-6233-1526

China - Wuhan
Tel: 86-27-5980-5300

China - Xian
Tel: 86-29-8833-7252

China - Xiamen
Tel: 86-592-2388138

China - Zhuhai
Tel: 86-756-3210040

ASIA/PACIFIC

India - Bangalore
Tel: 91-80-3090-4444

India - New Delhi
Tel: 91-11-4160-8631

India - Pune
Tel: 91-20-4121-0141

Japan - Osaka
Tel: 81-6-6152-7160

Japan - Tokyo
Tel: 81-3-6880-3770

Korea - Daegu
Tel: 82-53-744-4301

Korea - Seoul
Tel: 82-2-554-7200

Malaysia - Kuala Lumpur
Tel: 60-3-7651-7906

Malaysia - Penang
Tel: 60-4-227-8870

Philippines - Manila
Tel: 63-2-634-9065

Singapore
Tel: 65-6334-8870

Taiwan - Hsin Chu
Tel: 886-3-577-8366

Taiwan - Kaohsiung
Tel: 886-7-213-7830

Taiwan - Taipei
Tel: 886-2-2508-8600

Thailand - Bangkok
Tel: 66-2-694-1351

Vietnam - Ho Chi Minh
Tel: 84-28-5448-2100

EUROPE

Austria - Wels
Tel: 43-7242-2244-39
Fax: 43-7242-2244-393

Denmark - Copenhagen
Tel: 45-4485-5910
Fax: 45-4485-2829

Finland - Espoo
Tel: 358-9-4520-820

France - Paris
Tel: 33-1-69-53-63-20
Fax: 33-1-69-30-90-79

Germany - Garching
Tel: 49-8931-9700

Germany - Haan
Tel: 49-2129-3766400

Germany - Heilbronn
Tel: 49-7131-72400

Germany - Karlsruhe
Tel: 49-721-625370

Germany - Munich
Tel: 49-89-627-144-0
Fax: 49-89-627-144-44

Germany - Rosenheim
Tel: 49-8031-354-560

Israel - Ra'anana
Tel: 972-9-744-7705

Italy - Milan
Tel: 39-0331-742611
Fax: 39-0331-466781

Italy - Padova
Tel: 39-049-7625286

Netherlands - Drunen
Tel: 31-416-690399
Fax: 31-416-690340

Norway - Trondheim
Tel: 47-7288-4388

Poland - Warsaw
Tel: 48-22-3325737

Romania - Bucharest
Tel: 40-21-407-87-50

Spain - Madrid
Tel: 34-91-708-08-90
Fax: 34-91-708-08-91

Sweden - Gothenberg
Tel: 46-31-704-60-40

Sweden - Stockholm
Tel: 46-8-5090-4654

UK - Wokingham
Tel: 44-118-921-5800
Fax: 44-118-921-5820