INTRODUCTION

Microchip’s Multi-Speaker 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 either be connected to a Bluetooth-enabled device (smartphone, tablet, laptop, etc.) 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 Class 1 BM83 modules, 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 (two or more speakers) or in Stereo mode (two speakers). For more details, refer to “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

Modes of Operation

IS2083BM supports two modes of operation:

1. Host Mode

Interfaces with an external microcontroller (MCU) for application-specific system control. The Multi-Speaker (MSPK) solution can reside on this MCU.

2. Embedded Mode

Integrates the MSPK firmware natively on the IS2083BM MCU. Simple system control can be implemented in the IS2083BM MCU by using the SDK. It is a single system solution and no external MCU is needed.
DEMO REQUIREMENTS

**Note:** For a complete list of development support tools, documentation and software downloads, visit [http://www.microchip.com/BM83](http://www.microchip.com/BM83).

**Documentation**
- **BM83 Bluetooth® Audio Development Board User's Guide**
- **IS2083 Bluetooth® Stereo Audio SoC Data Sheet**
- **BM83 Bluetooth® Stereo Audio Module Data Sheet**

**Software Package**

**Host mode**
- **Firmware:** MSPKv2_1.xx.xxxx_Turn-key. (\Software\Firmware Image\BM83 Image\8051 Image)
- **DSP Image:** MSPK2.x_DSP_FW_V1.xx.xxxx (\Software\Firmware Image\BM83 Image\DSP Image)
- **ReHex and Config Tools File:** Demo_Package_MCU_Mode_Rehex.xxxx.hex and IS208x_Config_Default_Table.ini_Demo_Package_MCU_Mode.hex (\Software\Turnkey Package\Host Mode)
- **MCU:** PIC32_BM83_EVB_STCodec_MC-LK_XXXFs_vx.x.x_EVB_2.0.hex (Software\Firmware Image\PIC32 Image)

**Embedded Mode:**
- **Firmware:** MSPKv2_1.xx.xxxx_Turn-key.hex (\Software\Firmware Image\BM83 Image\8051 Image)
- **DSP Image:** MSPK2.x_DSP_FW_V1.xx.xxxx (\Software\Firmware Image\BM83 Image\DSP Image)
- **ReHex and Config Tools File:** Demo_Package_Embedded_Mode_Rehex_0EF3_06282019.hex and IS208x_Config_Demo_Package_Embedded_Mode_xxx.hex (\Software\Turnkey Package\Embedded Mode)

**Hardware**
- **The EVB kit:**
  - BM83 Evaluation Board with BM83 module mounted on BM83 Carrier Board and ST audio daughter card mounted
  - 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

**Tools**
- **isUpdate Tool**
- **Config GUI Tool**
- **MPLAB® Integrated Development Environment (MPLAB X IDE) tool**
- **Microchip Bluetooth Audio (MBA) mobile app**

**Note:** The following demo steps use BM83 EVB with external on-board ST CODEC.
DEMO SETUP

It is mandatory to program the BM83 module with the MSPK V2.x software package. Perform the following procedure to set up the demo.

1. Config File Generation

The Config GUI tool is a configuration tool which enables the user to change the BM83 module parameters, such as device name, enable/disable pairing mode, BLE connection settings, configure the LEDs and enable/disable other functions.

This GUI also enables the user to change the internal DSP-related parameters. Follow the steps mentioned under Appendix B: “Customizing UI and DSP Parameters” to create a config file for external ST CODEC for Embedded or Host mode.

2. Software Update

Copy the Firmware, DSP image, and the configuration image generated in the preceding steps to a folder. Program BM83 with these images as per the procedure in Section 5.2 of the BM83 Bluetooth® Audio Development Board User’s Guide. In the isUpdate tool, image num value is to be put equal to number of images to be programmed on the device. For example, to program firmware, DSP, and configuration images, the image num value must be selected as 3. For Host mode, update PIC32 MCU as per the procedure in Chapter 9 of the BM83 Bluetooth® Audio Development Board User’s Guide.

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

Host Mode:

- Jumper setting for Host mode on BM83 EVB:
  a). Connect on-board audio control buttons to Host MCU (PIC32) as mentioned in the Table 3-7 Host Mode Audio Control Button Header Configurations (J700, J701, and J702) of the BM83 Bluetooth® Audio Development Board User’s Guide.
  b) Ensure the jumpers for IC_N, SLEEP, MUTE, SCL, SDA are connected between J403 and J402 for Host MCU to configure external CODEC. To locate these headers on the BM83 EVB, refer to Figure 6.

- c) Put switch 1 of SW400 to OFF position and switch 2 of SW400 to ON position for AUX-In input detection. This makes the AUX-In detection input connected to Host MCU.
Embedded Mode:

- Jumper setting for Embedded mode on BM83 EVB:
  
  a) Connect on-board audio control buttons to the BM83 module as mentioned in the Table 3-6 Embedded Mode Audio Control Button Header Configurations (J700, J701, and J702) of the BM83 Bluetooth® Audio Development Board User’s Guide.

  b) Ensure the jumper for IC_N, MUTE, SCL, SDA are connected between J401 and J402 for the BM83 module to configure external CODEC. Refer to Figure 6 to locate J401 and J402 headers.

  c) Put switch 1 of SW400 to the ON position and switch 2 of SW400 in OFF position as GPIO P3_2 on BM83 is configured for AUX-In input detection. Refer to Appendix H: “AUX-In Detection”.

4. Power-up

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

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.

6. Provisioning

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

FUNCTIONALITY OF BUTTONS ON BM83 EVB

The BM83 EVB provides various button functionality. The below table provides different button functionality mapping between Host mode and Embedded mode.

### TABLE 1: BM83 EVB BUTTON FUNCTIONALITY

<table>
<thead>
<tr>
<th>Function</th>
<th>Host Mode (1)</th>
<th>Embedded Mode</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power-on and entering into Pairing mode</td>
<td>Short press SEL (SW711)</td>
<td>Long Long press MFB (SW701)</td>
</tr>
<tr>
<td>To enter into Master/Slave mode</td>
<td>Long press VOL UP (SW702)</td>
<td>Long press VOL UP (SW702)</td>
</tr>
<tr>
<td>in Concert mode and to start grouping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>To enter into Master/Slave mode</td>
<td>Long press VOL DN (SW705)</td>
<td>Long press VOL DN (SW705)</td>
</tr>
<tr>
<td>in Stereo mode and to start grouping</td>
<td></td>
<td></td>
</tr>
<tr>
<td>To add a new Slave to the Master</td>
<td>Short double press VOL UP (SW702)</td>
<td>Long press VOL UP and VOL DN buttons at the same time</td>
</tr>
<tr>
<td>in Concert mode</td>
<td></td>
<td></td>
</tr>
<tr>
<td>To power-off</td>
<td>Short press SEL (SW711)</td>
<td>Long Long press MFB (SW701)</td>
</tr>
<tr>
<td>To enter Pairing mode</td>
<td>Long press SEL (SW711)</td>
<td>Long press MFB</td>
</tr>
</tbody>
</table>

Note 1: To locate these switches, 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”.

Note: Long press is longer than 3 seconds, Long press is longer than 5 seconds, and short press is shorter than 1 second.
Figure 6 illustrates the functionality of all the buttons available on the 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.

**Concert Mode**

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 have either solid red or blue LED flashing after a short time period. The EVB with 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 MFB button on master (flashing blue LED on the EVB) to enter into Pairing mode. Pair with 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 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 press MFB on the master device will power-off master and connected slave devices.

**Stereo Mode**

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 red LED will flash on all EVBs. The EVB will have either solid red or flashing blue LED after some time period. The EVB with 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 master (flashing blue LED) to enter into pairing mode. Pair with 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 press MFB on the master device will power-off the master and connected slave device.

**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.
3. 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 other 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**

6. The “Concert Master” is assigned to a BM83 EVB, see Figure 11.

**FIGURE 11: STATUS CONCERT MASTER**
7. From the app, click concert master device and then **Audio**, 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**

8. 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.

9. For AUX-In mode, connect an audio streaming device with the master (solid/flashling blue LED) through audio AUX-In cable and play music. Music will play on both master and slave speakers.

10. To toggle the audio source, click the **Toggle** button on the app, as illustrated in Figure 13.
FIGURE 13: TOGGLE AUDIO SOURCE
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.

STEREO MODE PROVISIONING USING MICROCHIP BLUETOOTH AUDIO ANDROID APP

1. 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 step 1 through step 8 (“Concert Mode Provisioning Using Microchip Bluetooth Audio App”). Slave will have a solid red LED and master will have flashing/solid blue LED.

2. For AUX-In audio, connect master (solid/flash- ing blue LED) with audio streaming device through AUX-In cable.

3. 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
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.
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 name (any user-
defined) and select master and slave speakers, as illustrated in Figure 20.

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”.

FIGURE 20: PERSONAL AUDIO GROUP SETTINGS
RENAMEING 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: RENAMEING SPEAKER**

![Screenshot of app showing speaker settings](image)
EQUALIZER SETTING
The equalizer parameters can be set/changed from the Microchip Bluetooth Audio App.

FIGURE 22: EDITING EQUALIZER SETTINGS

1. Select Audio > Equalizer Settings > Edit to edit the equalizer parameters, as illustrated in Figure 22.
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**
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
**FIRMWARE CAPABILITIES/FEATURES**

The following features are supported in the Multi-Speaker V2.x firmware:

**LDAC™ CODEC**

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”.

**CONCERT MODE**

Two or more speakers are used in Concert mode. One speaker works as master and 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 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”.

**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”.

---

**Note:** By default, LDAC functionality is enabled in the firmware but supported only on IS2083BM-2L2 device.
Simultaneous Bluetooth and AUX-In Audio

Both Concert mode and Stereo mode support simultaneous Bluetooth audio and AUX-In audio. The audio source can be toggled by toggle button on the Microchip Bluetooth Audio app, see Figure 13.

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”.

Audio Output and SRC

MSPK 2.x supports I2S audio output with the following sampling frequency.

<table>
<thead>
<tr>
<th>TABLE 1: SAMPLING FREQUENCY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Audio Output</td>
</tr>
<tr>
<td>LDAC</td>
</tr>
<tr>
<td>Voice prompt / Beep tone</td>
</tr>
<tr>
<td>SCO Mono / Stereo</td>
</tr>
<tr>
<td>AAC / SBC</td>
</tr>
</tbody>
</table>

Find a correct external CODEC to support I2S with the above sampling frequency.

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.

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)
- IS2083BM supplies I2S Master Clock (MCLK) to external CODEC of audio amplifier

The table below illustrates the supported use-cases. Combinations of “YES” and “NO” reflect configuration options. Any setting denoted as “Disable” requires the user to ensure that the feature is not enabled in the Config Tool. Default settings are disabled. Not following these guidelines may result in distorted audio.

<table>
<thead>
<tr>
<th>TABLE 2: SUPPORTED USE-CASES</th>
</tr>
</thead>
<tbody>
<tr>
<td>MCLK</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>Yes</td>
</tr>
<tr>
<td>No</td>
</tr>
<tr>
<td>Yes/No</td>
</tr>
<tr>
<td>Disable</td>
</tr>
</tbody>
</table>
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.

AAC CODEC

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

Auto Reconnect

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

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”.

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.

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”.

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 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.

OTA DSP Tuning

An on-the-fly 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 DSP GUI of the Config UI tool. The 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.

Note 1: Firmware:

- Turnkey Solution: Customer is provided with the BM83 firmware hex images. This firmware has support only for ST CODEC and Master Clock as provided from BM83.
- SDK Solution: Customer is provided with BM83 application source code. Customer has the flexibility to change the CODEC driver, choose internal/external CODEC and Master Clock. SDK has different target projects to provide alternative features in order to reduce the program memory (Refer to the IS2083 SDK User Guide for details on supported features for each project configuration).

2: Application:

- There are two target applications: Multi-Speaker (MSPK) functionality and Single Speaker. SDK firmware and turnkey hex files have different attributes for each.

Note: Press the power-off button (Short press SEL in Host mode/ Long press MFB button in Embedded mode) to store the grouping details to nonvolatile memory. The auto reconnection works only when this is done.
**MCU AND CODEC**

BM83 EVB contains BM83 module, PIC32 MCU and a ST DSP. 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”.

**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.

![MCU AND BM83 EVB INTERFACE](image)

**MCU Commands**

MCU communicates with the BM83 module through UART commands. A summary of the commands is provided in AudioUARTCommandSet_Summary_table.xlsx, and details of the commands are provided in the BM83 Host Device Firmware Development Guide. Both the documents are part of the MSPK V2.X software package.

**MULTI-SPEAKER USER APPLICATION**

- Museum guided tour
- Restaurant
- Outdoor entertainment
- In-home entertainment
- Retail shops
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 28.

FIGURE 28: USB TRANSFER
2. It is recommended to copy the Microchip Bluetooth Audio Android app to the Download folder of the Android mobile device, see Figure 29.

FIGURE 29: DOWNLOAD FOLDER OF THE ANDROID DEVICE

3. 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 30.

FIGURE 30: 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 31.

FIGURE 31: 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 32.

FIGURE 32: 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 33.

**FIGURE 33: LOCATION ACCESS**

7. Click **SCAN** to see the list of discoverable devices nearby, as illustrated in Figure 34.

**FIGURE 34: 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_Config_Default_Table.ini from the same folder path and then click Open, see Figure 35. Demo config file is already generated for Host mode and Embedded mode for BM83 EVB. Instead of loading IS208x_Config_Default_Table.ini file, user can also load the demo config *.hex file from \Software\Turnkey Package\Host Mode\Config Tool Hex, or \Software\Turnkey Package\Embedded Mode\External Codec (Internal Codec) Config Tool Hex, see Figure 36.

FIGURE 35: LOADING INI FILE
FIGURE 36: LOADING .HEX FILE
2. From the Config tool, click **Edit**, see Figure 37.

**FIGURE 37: EDIT CONFIG PARAMETERS**
3. A window is displayed.
   - a. For Host mode, select “Host MCU Mode” and click Next, see Figure 38.
   - b. For Embedded mode, select “Embedded Mode” and click Next, see Figure 39.

**FIGURE 38: MAIN FEATURE SETTINGS - HOST MODE**
FIGURE 39: MAIN FEATURE SETTINGS - EMBEDDED MODE

The main feature settings in embedded mode are as follows:

- **Supported Profile**:
  - HFP/HSP
  - A2DP
  - AVRCP
  - SPP
  - PBAP
  - iAP
  - AVRCP Controller
  - AVRCP Target

- **Function Enable and GPIO Assignment**:
  - Charge OK Led Ind.: 0x21: GPIO_NULL
  - AUX-IN Led Ind.: 0x21: GPIO_NULL
  - AUX-IN Detect: 0x1A: GPIO_P32
  - CP Reset (IAP): 0x21: GPIO_NULL
  - Host MCU Mode: Embedded Mode
  - 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

The diagram shows the settings with the Embedded Mode option highlighted.
4. Click the CODEC Setup tab to select external CODEC in CODEC Output Type. If internal CODEC is needed, then select internal CODEC in CODEC Output Type.

**FIGURE 40: CHANGING CODEC OUTPUT TYPE**

5. This step is needed only for Embedded mode. Configure BM83 GPIO's 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”.

**Note:** BM83EVB_Default_Config_Embedded-Mode.hex file contains the BM83 EVB on-board control buttons configuration. This configuration can be taken as reference.
6. Click the Sys. Setup2 tab to change the speaker name, as illustrated in Figure 41 and then click Finish.

FIGURE 41: CHANGING SPEAKER NAME

B.2 Customizing DSP Parameters

7. Click Finish to open a DSP Tool, see Figure 42.
8. Click the I2S/PCM tab and perform the I2S related selection, as illustrated in Figure 43. 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. BM83 EVB uses ST CODEC and MCLK to be enabled for this.

B.3 Creating *.hex file

9. Save the DSP parameters by clicking Save, and then close the DSP window, see Figure 44.

10. Click Exit, and a window is displayed. From the Save As window, select the file location, and then click Save, see Figure 45.
FIGURE 42: IS208X DSP CONFIGURATION TOOL
FIGURE 43: IS208X DSP CONFIGURATION TOOL - I2S/PCM MODE SELECTION

Notice: Please press "Save" button to export I2S parameters.
FIGURE 44: SAVING UI PARAMETERS

Notice: Please press "Save" button to export I2S 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 (Section 5.2 Firmware Update). It is possible to update only this config file by just 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 46. 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 46.

FIGURE 46: 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”.

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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 47.

FIGURE 47:  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 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 48. 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 48: POWER MODE ON/OFF**
APPENDIX E: AVRCP VERSION

The AVRCP version 1.6/1.3 can be programmed, as illustrated in Figure 49.

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

FIGURE 49: 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 50: ENABLING AAC CODEC
APPENDIX G: LDAC APPLICATION

UNGROUNDED 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.

TABLE 3: TRANSMISSION RATES

<table>
<thead>
<tr>
<th>Mode</th>
<th>Bit Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sound Quality preferred</td>
<td>990 kbps</td>
</tr>
<tr>
<td>Standard</td>
<td>660 kbps</td>
</tr>
<tr>
<td>Connection preferred</td>
<td>330 kbps</td>
</tr>
</tbody>
</table>

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 51.
2. Go to **Settings > Sound and Notification > Accessory Settings** to select the LDAC quality selection, as shown in **Figure 52**.

**FIGURE 51: BLUETOOTH SETTING PAGE**

**FIGURE 52: 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 53.

FIGURE 53: 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 54.

FIGURE 54: DEVELOPER OPTIONS
a) When the user selects Bluetooth Audio Sample Rate, a pop-up is displayed for the list of sampling rates, see Figure 55.

FIGURE 55: 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 56.

FIGURE 56: 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 57: 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 58: AUX-IN DETECTION
APPENDIX I: BUTTON CONFIGURATION

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

FIGURE 59: BUTTON SETUP
FIGURE 60: BUTTON MAPPING FOR P2_7 IS CONFIGURED FOR VOLUME UP AND CONCERT MODE ENTRY
FIGURE 61: MFB BUTTON

FIGURE 62: GPIO P0_2 IS CONFIGURED FOR PLAY/STOP
FIGURE 63: GPIO P0_3 IS CONFIGURED FOR BACKWARD/REWIND FUNCTIONALITY

FIGURE 64: GPIO P0_1 IS CONFIGURED FOR FORWARD INITIATION
FIGURE 65: GPIO P0_5 IS CONFIGURED FOR VOLUME DOWN AND STEREO MODE ENTRY
FIGURE 66: GPIO P0_5 AND GPIO P2_7 ARE CONFIGURED FOR ADDING NEW SLAVE IN CONCERT MODE

<table>
<thead>
<tr>
<th>Available Button Register</th>
<th>(Max: 16)</th>
</tr>
</thead>
</table>

- **ID Mapping Table**
  - **StandBy (No task) Mode**: [0x00:None], [0x00:None], [0x00:None]
  - **Voice Dial Mode**: [0x00:None], [0x00:None], [0x00:None]
  - **Incoming Call Mode**: [0x00:None], [0x00:None], [0x00:None]
  - **Outgoing Call Mode**: [0x00:None], [0x00:None], [0x00:None]
  - **Call Active Mode**: [0x00:None], [0x00:None], [0x00:None]
  - **Single-Link Multi-Call(1 Active & 1 Incoming)**: [0x00:None], [0x00:None], [0x00:None]
  - **Multi-Link Multi-Call(1 Active & 1 Hold)**: [0x00:None], [0x00:None], [0x00:None]

---

Main Feature | Previous | Next | Finish
APPENDIX J: MULTI-LINK

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

FIGURE 67: MULTI-LINK

<table>
<thead>
<tr>
<th>Button Setup</th>
<th>PMU Setup</th>
<th>Codec Setup</th>
<th>iAP/SPP Setup</th>
<th>BLE Setup</th>
<th>nSPK Setup</th>
<th>DSP Feature Setup</th>
</tr>
</thead>
<tbody>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>Enter Pairing Mode When Power On</td>
<td>Disable</td>
<td>Multi-Link</td>
<td>Disable</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
</tr>
<tr>
<td>Suspend Stream When SCO Established</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
</tr>
<tr>
<td>Circular Volume Control</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
</tr>
<tr>
<td>Class of Device</td>
<td>Speaker</td>
<td>Speaker</td>
<td>Speaker</td>
<td>Speaker</td>
<td>Speaker</td>
<td>Speaker</td>
</tr>
<tr>
<td>Phone NR and EC Function</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
</tr>
<tr>
<td>Report Battery Status to Smart Phone</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
</tr>
<tr>
<td>Link Application</td>
<td>Multi-Link</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
</tr>
<tr>
<td>Always Answer Incoming Call</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
</tr>
<tr>
<td>Auto Answer Incoming Call When Link Back</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
</tr>
<tr>
<td>Hang Up a Call When Switch Off</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
</tr>
<tr>
<td>Shut Down Power in Off State</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
</tr>
<tr>
<td>Enter Pairing When Power On Link Back Failed</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
</tr>
<tr>
<td>Wide Band Speech Enable (mSBC)</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
</tr>
<tr>
<td>Disable Link Back When Remote No Link Key</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
<td>Enable</td>
</tr>
<tr>
<td>Only Accept Paired Device</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
</tr>
<tr>
<td>Disconnect All In Pairing</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
</tr>
<tr>
<td>Keep BLE In Power Off</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
<td>Disable</td>
</tr>
</tbody>
</table>

Main Feature  Previous  Next  Finish
APPENDIX K: AUTO RECONNECTION

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

FIGURE 68: AUTO RECONNECTION
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 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 69: OPENING .HEX FILE**

![Opening .HEX File](image-url)
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 70: 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 71: ** REHMXED IMAGE FILE
2. Create \texttt{OTA} folder in the mobile phone internal storage and place the upgradeable image inside the \texttt{OTA} folder as shown in the following figure. Creating the \texttt{OTA} folder in internal storage space is needed only for the Android app.

FIGURE 72: 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 73: 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.
8. Click on **UPDATE** to start the upgrade as shown in the following figure.

**FIGURE 75: 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 76: UPDATED MCU VERSION
BM83/IS208x supports digital MIC. Digital MIC can be enabled as shown in the following figure.

**FIGURE 77: 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 78:  ENABLING AAC ENCODING
APPENDIX O: ENABLING INTERNAL DSP AUDIO EFFECTS

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

FIGURE 79: ENABLING INTERNAL DSP AUDIO EFFECTS
### APPENDIX P: REVISION HISTORY

<table>
<thead>
<tr>
<th>Revision</th>
<th>Date</th>
<th>Section</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>07/2019</td>
<td>Document</td>
<td>Initial release</td>
</tr>
</tbody>
</table>
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.
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