# BM23 Bluetooth®
# Evaluation Board User's Guide

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**Abbreviations List:**
**AVRCP:** Audio Video Remote Control Profile
**A2DP:** Advanced Audio Distribution Profile
**HFP:** Hands-free Profile
**HSP:** Headset Profile
**NFC:** Near Field Communication
**SPP:** Serial Port Profile

## Preface

| NOTICE TO CUSTOMERS |
| --- |
| All documentation becomes dated, and this manual is no exception. Microchip tools and documentation are constantly evolving to meet customer needs, so some actual dialogs and/or tool descriptions may differ from those in this document. Please refer to our web site (www.microchip.com) to obtain the latest documentation available. |

## INTRODUCTION

This chapter contains general information that will be useful to know before using the BM23. Items discussed in this chapter include:

- Document Layout
- Recommended Reading
- The Microchip Web Site
- Customer Support
- Document Revision History

## DOCUMENT LAYOUT

This user's guide describes how to use the BM23 Bluetooth Evaluation Board. The document is organized as follows:

- Chapter 1. "Overview" – This chapter introduces the BM23 Bluetooth Evaluation Board and provides an overview of various features.
- Chapter 2. "Getting Started" – This chapter describes
  - The hardware components and setup of the BM23 Bluetooth Evaluation Board.
  - The application demonstrations of the BM23 Bluetooth Evaluation Board.
  - Software/Utility Requirements of the BM23 Bluetooth Evaluation Board.
- Appendix A. "BM23 Audio Evaluation Board Schematics" – This appendix includes a schematic of the BM23 Bluetooth Evaluation Board.

### RECOMMENDED READING

This user's guide describes how to use the BM23 Bluetooth Evaluation Board. Other useful documents are listed below. The following Microchip documents are available and recommended as supplemental reference resources:

STEREO Module Data Sheet (BM20/23 Data Sheet)

## MICROCHIP WEBSITE

Microchip provides online support via our web site at http://www.microchip.com. This website is used as a means to make files and information easily available to the customers. Accessible by using your favorite Internet browser, the website contains the following information:

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- General Technical Support – Frequently Asked Questions (FAQs), technical support requests, online discussion groups, Microchip consultant programmer listing
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http://support.microchip.com

## DOCUMENT REVISION HISTORY

Revision A (Aug 2015)

This is the initial released version of this document.

Revision 1.0 : Added details of V4 EVB

# 1 OVERVIEW

## 1.1 INTRODUCTION

This user's guide describes the hardware and software setup for the BM23 Bluetooth® Evaluation Board. This board contains the hardware needed to evaluate the BM23 Bluetooth module. The BM23 module is mounted to an evaluation board that demonstrates the module's key features. The evaluation board contains:

- PIC18 MCU and YAMAHA YDA174 DSP on board
- 12 push buttons to control audio playback
- Status LEDs
- The BM23 supports the following Bluetooth profiles: A2DP, AVRCP, and HFP/HSP
- A2DP stereo audio (Sink mode support for Sub-Band Coding (SBC)),
- AVRCP media player remote control
- HFP/HSP for accepting a phone call support.

For data sheet and other details related to BM23 module, refer to the Microchip website at http://www.microchip.com/bm23.

This chapter discusses the following topics:

- BM23 Evaluation Board Features
- BM23 Evaluation Board Contents and Part Details

## 1.2 BM23 EVALUATION BOARD FEATURES

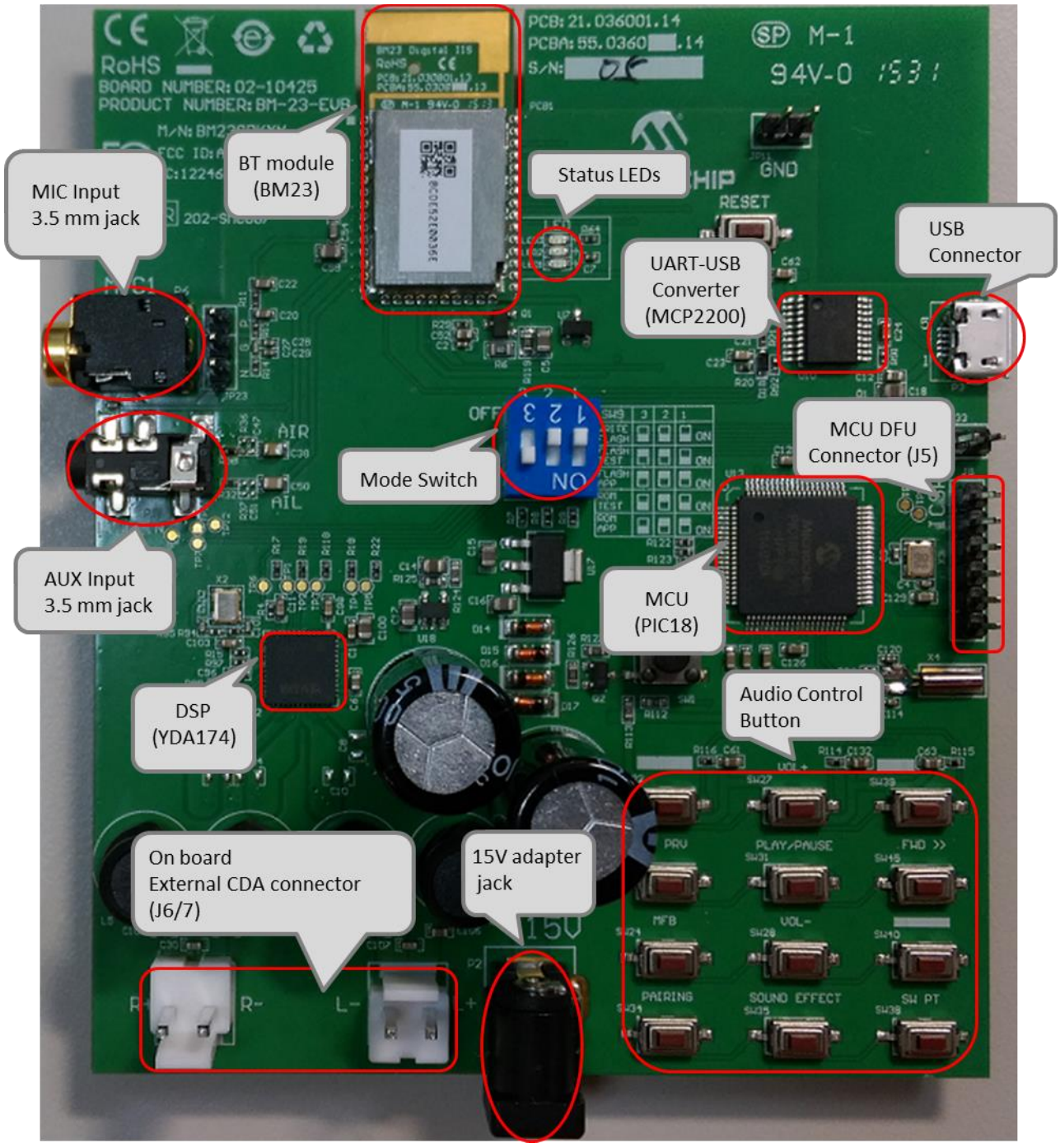
The BM23 Evaluation Board has the following features:

- It includes a Bluetooth module (BM23), MCU (PIC18) and DSP (YDA174) on the board for easy function and feature demonstration.
- BM23 module is a fully qualified Bluetooth version 4.1, fully compatible with Bluetooth version 3.0, 2.0, 1.2.
- Embedded BM23 module with postage-stamp size form factor of 15 x 29 x 2.5 mm (include shielding case)
- Embedded Bluetooth stack profiles: A2DP, AVRCP, and HFP/HSP, Bluetooth SIG certified.
- System gets power from 15V / 3A DC adapter for speaker application.
- Environmentally friendly, RoHS compliant
- Keypad matrix on board and controlled by MCU, easy for playback control (play/pause, Vol Up/Down, forward/rewind, Next/previous track etc.).

## 1.3 BM23 EVALUATION BOARD CONTENTS

BM23 Evaluation Board contains the following components as shown in Figure 1-1 which describes the evaluation board's interfaces and connectors. Table 1-1 describes the various components of the evaluation board.

FIGURE 1-1: BM23 EVALUATION BOARD



MIC (JP23)

1 2 3

| Pin | Description |
|---|---|
| 1 | MIC_P1 |
| 2 | AGND |
| 3 | MIC_N1 |

ICSP (J5)

1 2 3 4 5 6

| Pin | Description |
|---|---|
| 1 | Reset |
| 2 | ICD3 power |
| 3 | GND |
| 4 | PGD |
| 5 | PGC |
| 6 | NC |

TABLE 1-1:BM23 EVALUATION BOARD HARDWARE

| Hardware Component | Description |
|---|---|
| BM23 | Bluetooth® 4.1 Module |
| YDA174 | DSP with internal digital amplifier |
| PIC18F85J10 | 16 bit MCU with 32k byte flash and 2048 bytes SRAM. |
| MCP2200 | UART-USB converter chip |
| Micro USB Connector | USB to UART for EEPROM R/W for BM23. |
| 15V Adapter Jack | Connect to 15V adapter (P2) for main power source of whole system. |
| Amplifier Audio Out | Audio connector (JP6 / 7) from YDA174 |
| Audio In | Audio 3.5 mm jack for Mono microphone input(P6) and AUX input(P8) |
| Status LEDs | Red and Blue LEDs show the pairing/connection status |
| MFB Button | Switch to turn on/off BM23 module (SW24) |
| Play/Pause Button | Button to play or pause the audio playback (SW31) |
| Previous Track Button | Button to skip track backwards (SW23) |
| Next Track Button | Button to skip track forwards(SW45) |
| Volume Up Button | Button to increase volume (SW27) |
| Volume Down Button | Button to decrease volume (SW28) |
| Pairing Button | Button to make BM23 into pairing mode (SW34) |
| Sound Effect Button | Button to change sound effect (SW35) |
| Reset Button | Reset BM23 (SW10); Reset MCU (SW1) |

## 1.4 BM23 EVB KIT CONTENTS

BM23 EVB kit include: BM23 EVB board, 15V adapter, micro USB cable and 2 speaker cables as shown in Figure 1-2.

FIGURE 1-2: BM23 EVB KIT

1) 15V adapter: main power source of the whole system.
2) USB cable: micro USB cable can connect to P3 of BM23 EVB board to do firmware update on BM23.
3) Speaker cable: connect speaker to BM23 EVB J6 and J7.

# 2. Getting Started

## 2.1 INTRODUCTION

This chapter describes how the BM23 Evaluation Board works. Certain hardware and utilities are essential to support the evaluation/development of demo applications. This chapter discusses the following topics:

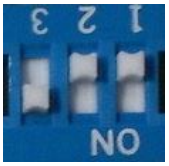
- Hardware Requirements
- Software/Utility Requirements
- Module Configuration

## 2.2 HARDWARE REQUIREMENTS

### 2.2.1 Hardware Setup

To setup the evaluation hardware, perform the following steps:

1. Make sure pin 1 / 2 / 3 of "SW9" in "Off / Off / On" to make system in application mode.




2. Connect the speaker line to the amplifier output connector (J6 / 7).

### 2.2.2 Using Evaluation Board

1. Connect 15V adapter P2.
2. Connect speaker to J6 and J7.
3. Long press MFB button (**SW24**) to turn-on and enter pairing mode. The status LEDs will blink.
4. Press and hold Pairing button (**SW34**). Blue and Red LED will flash alternately. Release the Pairing button. Now the BM23 Evaluation board is discoverable.
5. Turn on Bluetooth device manager on a host device (PC or smartphone), the host device will display a list of discoverable Bluetooth devices. Select the **BM23-002 EVB** and connect with it.
6. If the pairing with the device is successful, BM23 evaluation board is connect to the host device. Once connected, BM23 evaluation board enables Advanced Audio Distribution Profile (A2DP) for audio playback and Audio Video Remote Control Profile (AVRCP) for player control.
7. Play music and the host device and listen the music on the speaker. This will demonstrate A2DP.
8. If host device is cell phone, call you cell phone from another phone. Accept the incoming phone call on your paired and connected cell phone. This will demonstrate HFP.

## 2.3 APPLICATION DEMONSTRATION

### 2.3.1 AUDIO DEMONSTRATION (A2DP)

In this demonstration, user can play an audio stream on both BM23 evaluation boards using a computer or smartphone. The following are the steps to perform the demonstration.

1. Connect BM23 evaluation board to a host device (PC or smartphone) that has an audio source.
2. Connect speakers to BM23 evaluation board J6 / 7.
3. Open the audio source on the host device. Microchip recommends using media player (e.g. Microsoft

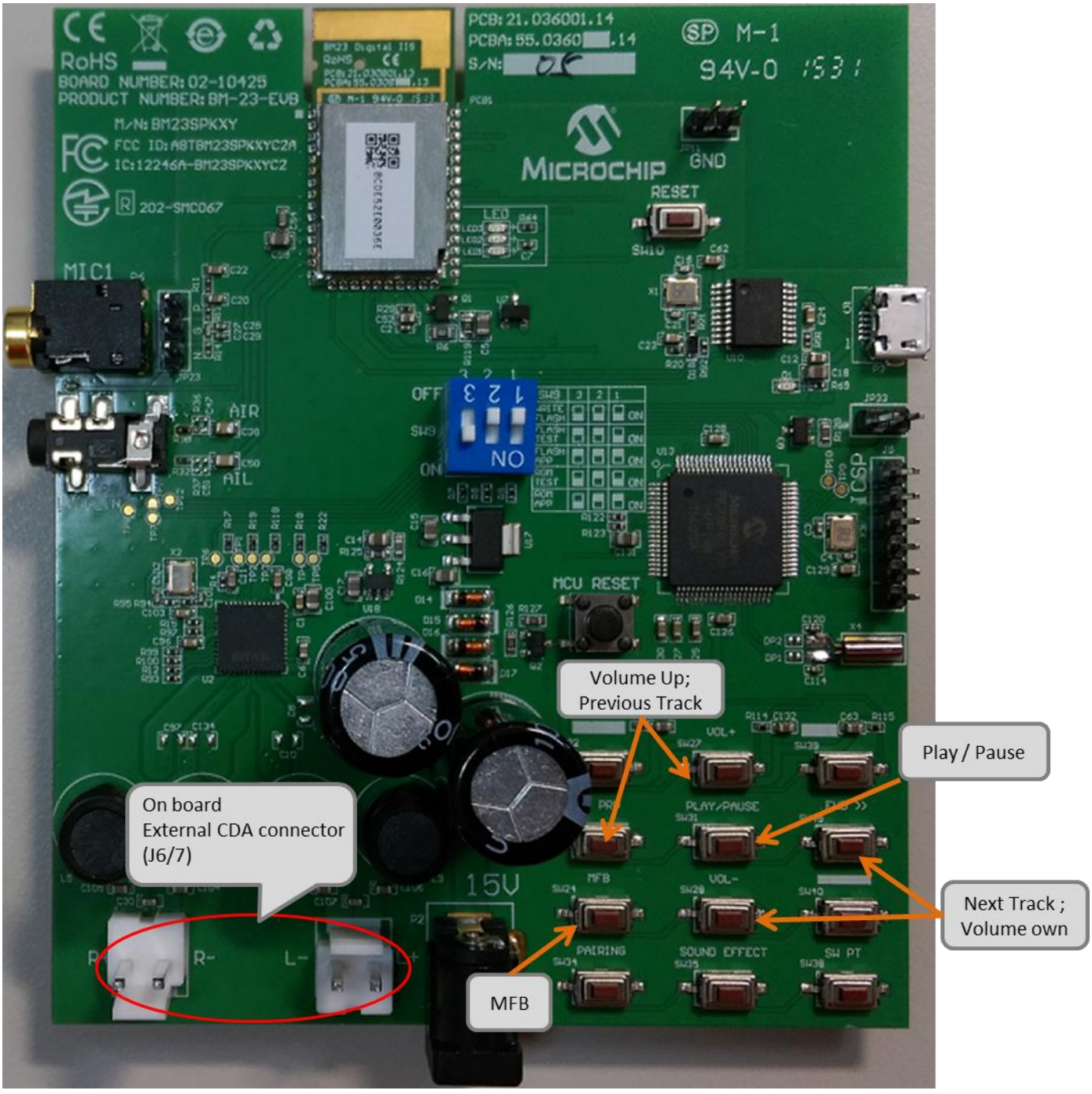
Media Player, iTunes, and Android).

4. Start the audio stream on the media player.

When BM23 evaluation board is connected to an audio source compatible with Bluetooth AVRCP, the following audio control buttons can be used:

- Control the volume of audio output (Vol+ (**SW27**), Vol- (**SW28**)).
- Go to the previous track(**SW23**)
- Go to the next track(**SW45**)
- Start / stop playing the current track (**SW31**).

FIGURE 1-2: BM23 EVALUATION BOARD AUDIO CONTROL BUTTONS



### 2.3.2 HSP/HFP DEMONSTRATION

In this demonstration, user can explore the hands-free profile setting to receive an incoming voice call from a paired smartphone. This demonstration requires a microphone. It would be good to use a PC headset/microphone (with two-plugs). The following are the steps to perform the demonstration.

1. Connect the speakers / microphone to BM23 evaluation board's audio out connector (J6/7) and MIC input (P6) respectively.
2. Connect BM23 evaluation board to a smartphone that supports the A2DP and HFP/HSP Bluetooth profiles.
3. From another one phone, initiate a call to the smartphone that is paired with BM23 evaluation board. The A2DP stream pauses and the ringtone plays on the speakers.
4. Click button "MFB" on BM23 evaluation board to accept the incoming call.
5. Once phone call is terminated, A2DP stream resumes.

## 2.4 SOFTWARE CUSTOMIZATION

User can customized UI and DSP settings according to their requirements. These settings can then be merged along with patch code to create IISC patch file (*.ipf). This patch file then programmed into EEPROM. Process of patch file creation is given below.

Tools needed for customization

**UI Tool**: user can use this tool to create customize Bluetooth behavior like button functionality, Bluetooth name etc.

**DSP Tool**: user can use this tool to modify audio parameter.

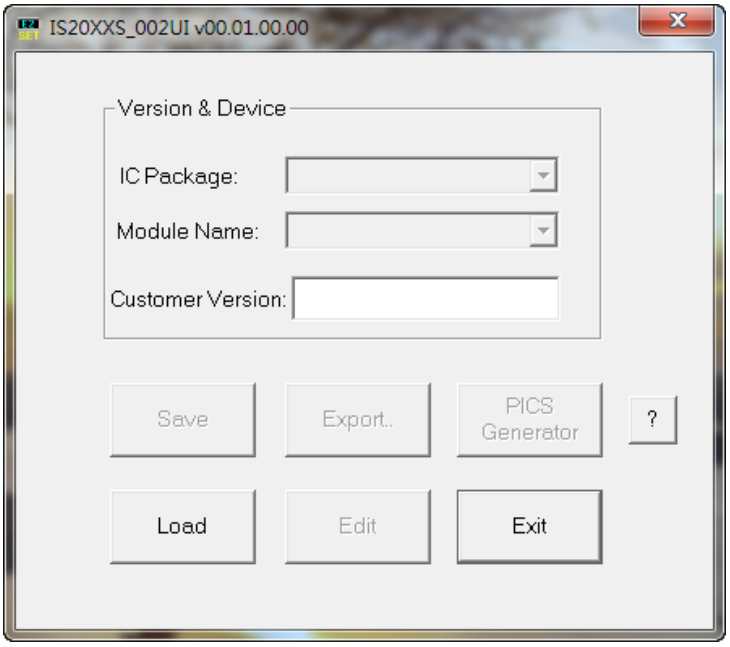
**MPET Tool**: user can use this tool to merge UI, DSP and patch code. Details about Patch code will be provided latter section.

**EEPROM Tool**: user can use this tool to upgrade the merged parameter into EEPROM of BM23.

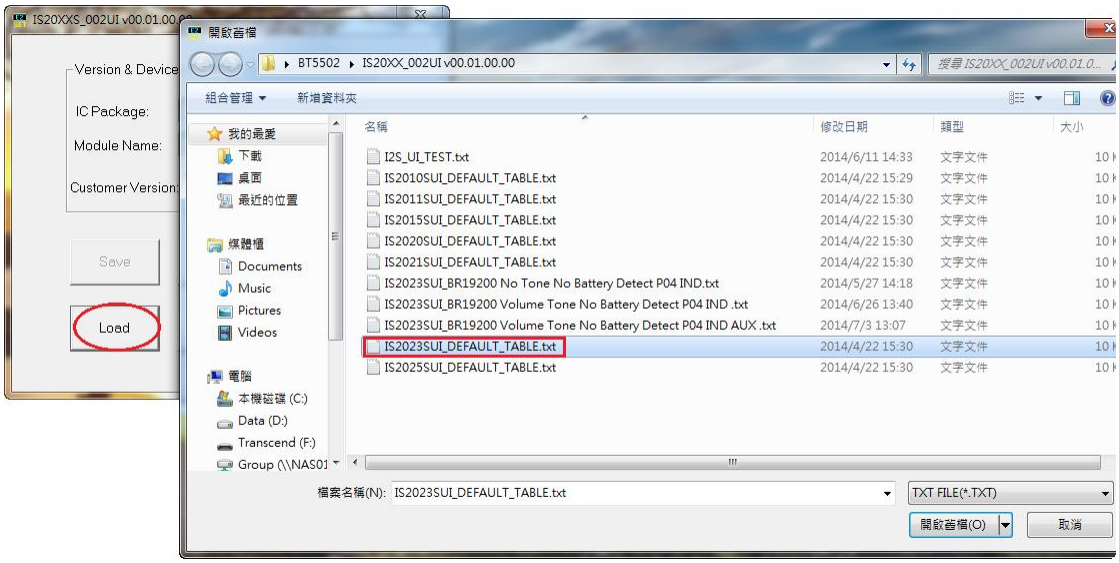
All these tools can be obtained from www.microchip.com/bm23 or through FAE.

### 2.4.1 UI Tool

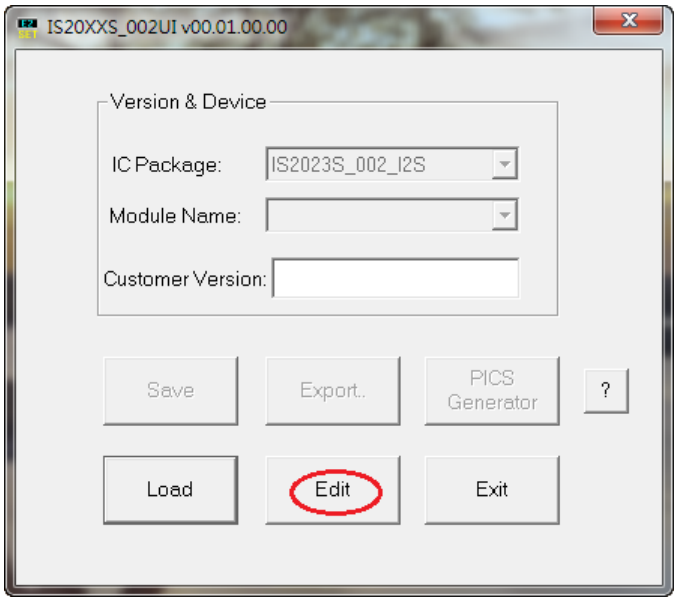
**Step1.** Open UI tool



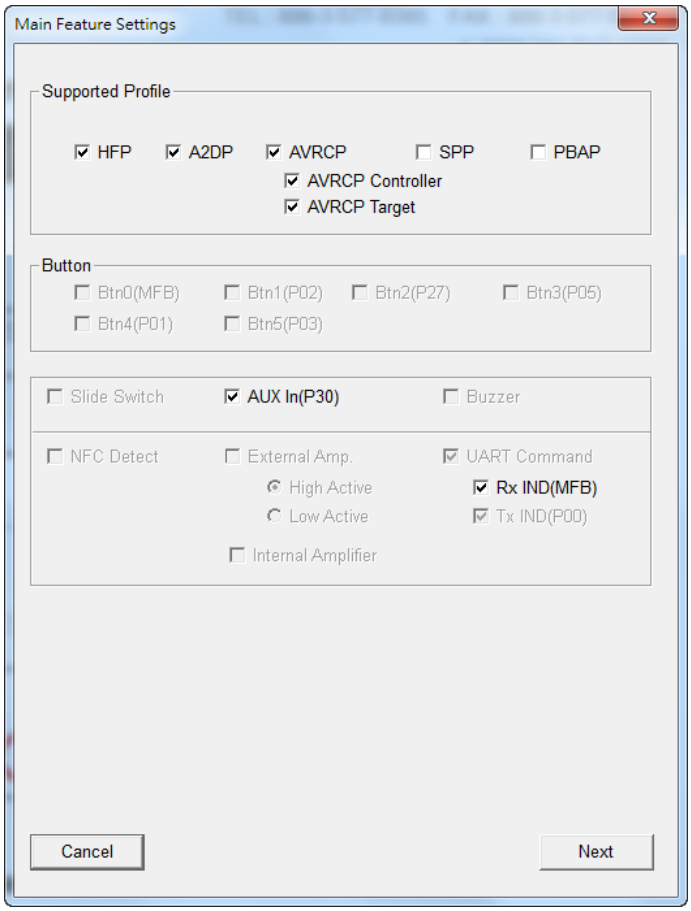
**Step2.** Load appropriate default UI setting (included in UI tool package) or previous saved file.




**Step3.** Click "Edit" to modify the settings.

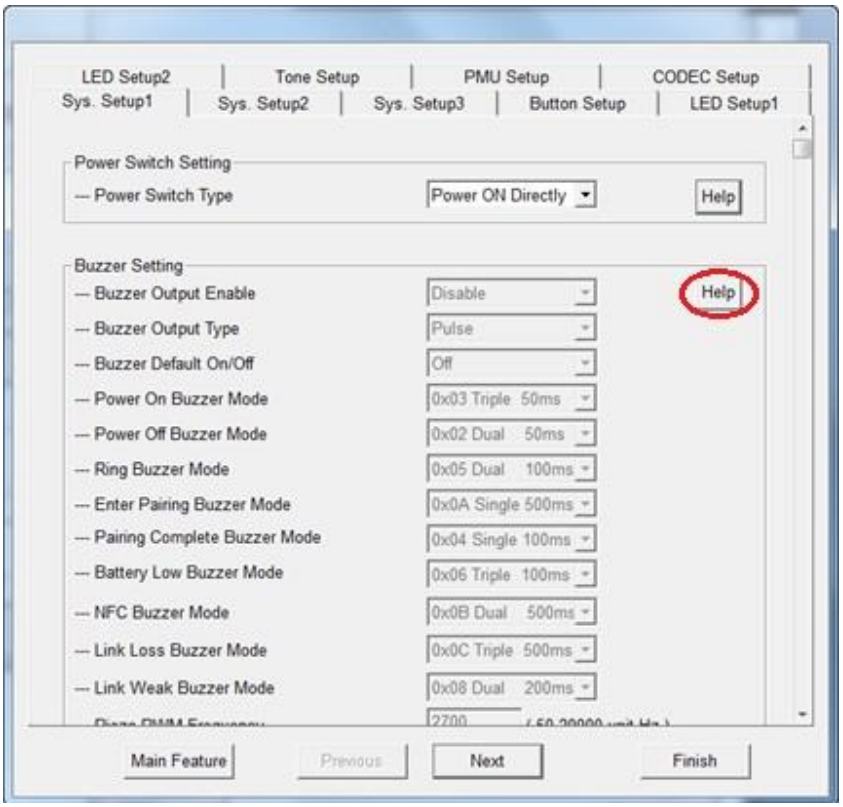


**Step4.** In the main settings, profile can be enabled/disabled by checking/unchecking the box as shown below. Click "Next" for other setting.

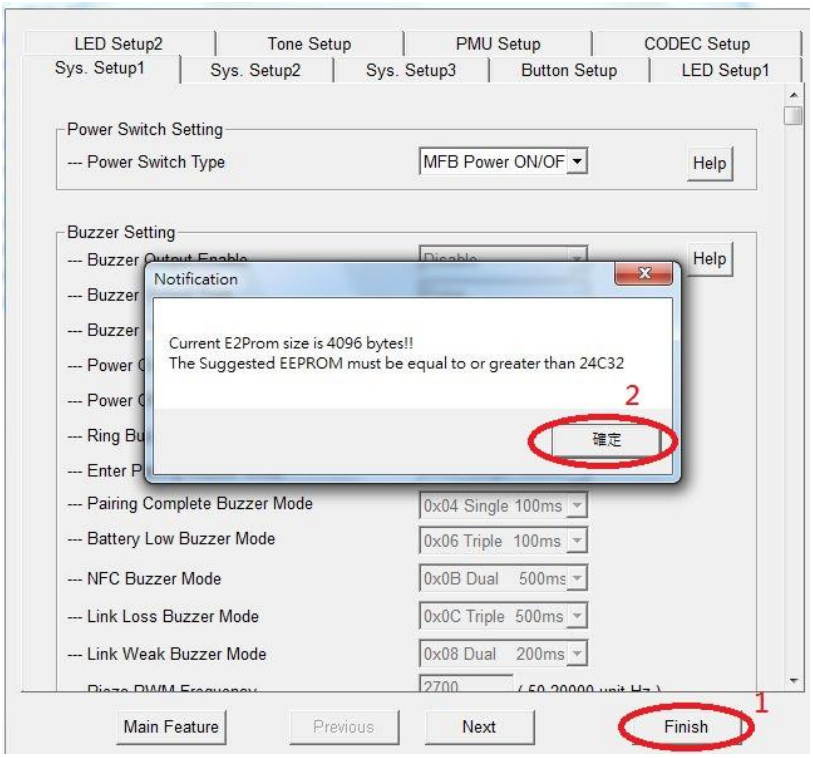


**Step5.** You can do system and functional setting in these pages.

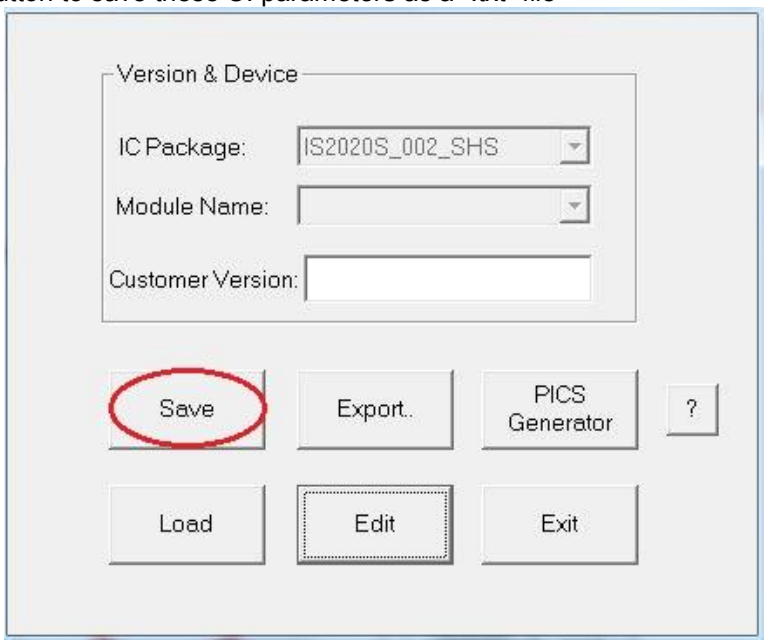
Click "Help" you can get more detail information.




**Step6.** After finish parameter selection, click "Finish" button and a message will remind you check EEPROM size on your system.



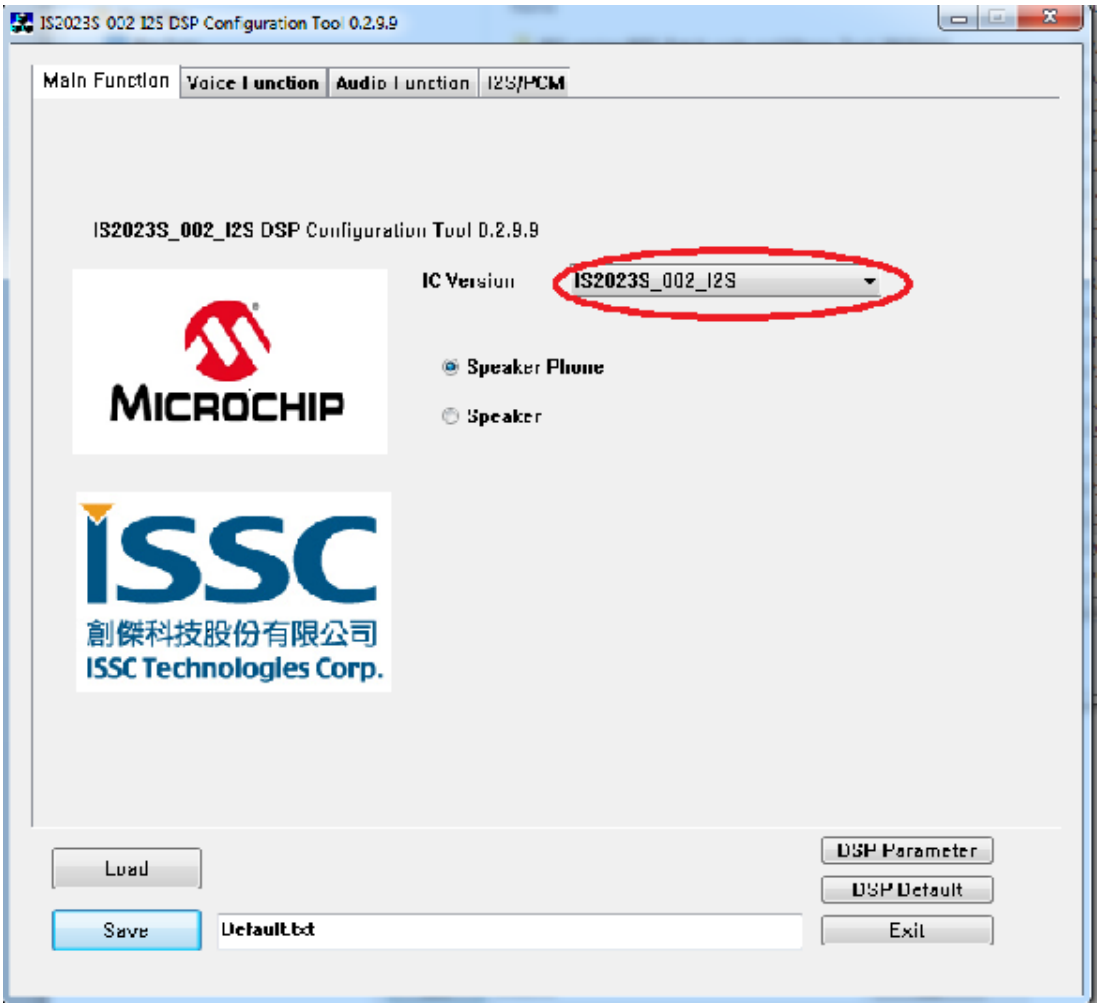
**Step7.** Click "Save" button to save these UI parameters as a ".txt" file



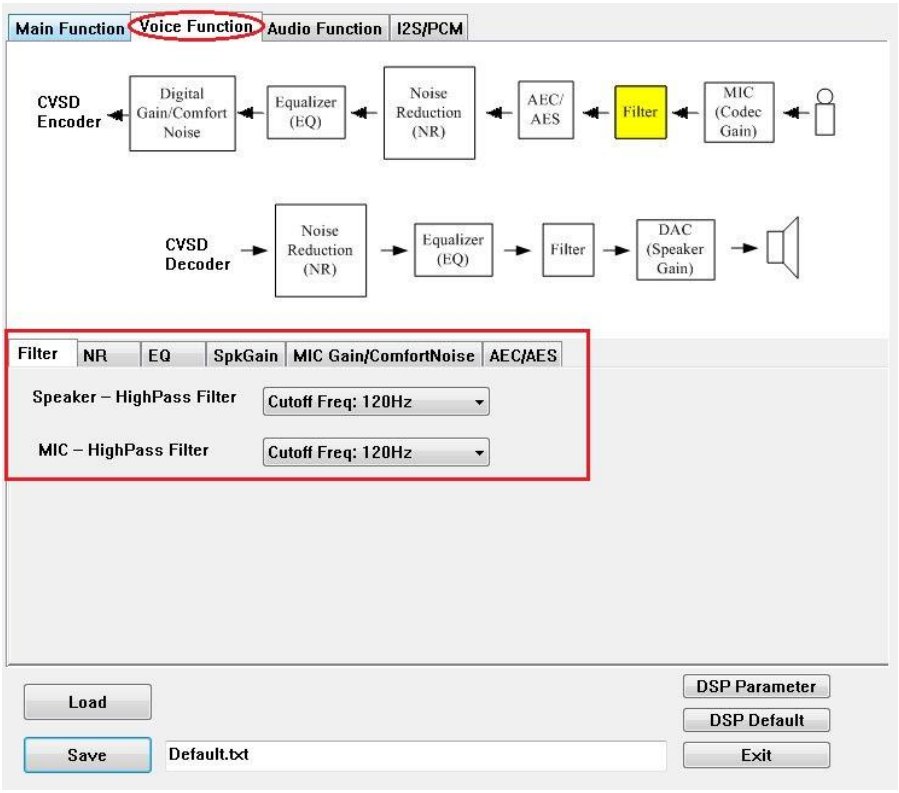
### 2.4.2 DSP TOOL

**Step1.** Open DSP tool

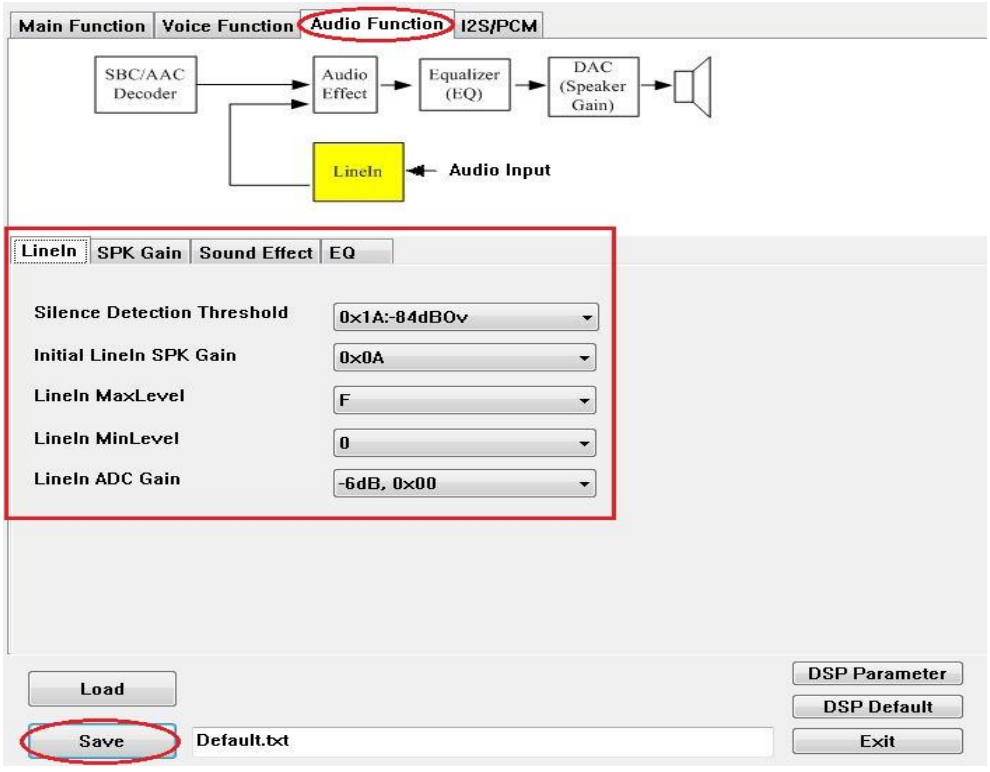
**Step2.** Select IC version "“IS2020_XXX_SHS" (XXX is the version of chip, e.g. IS2023S-002)



**Step3.** You can setup all voice and audio function in these pages.



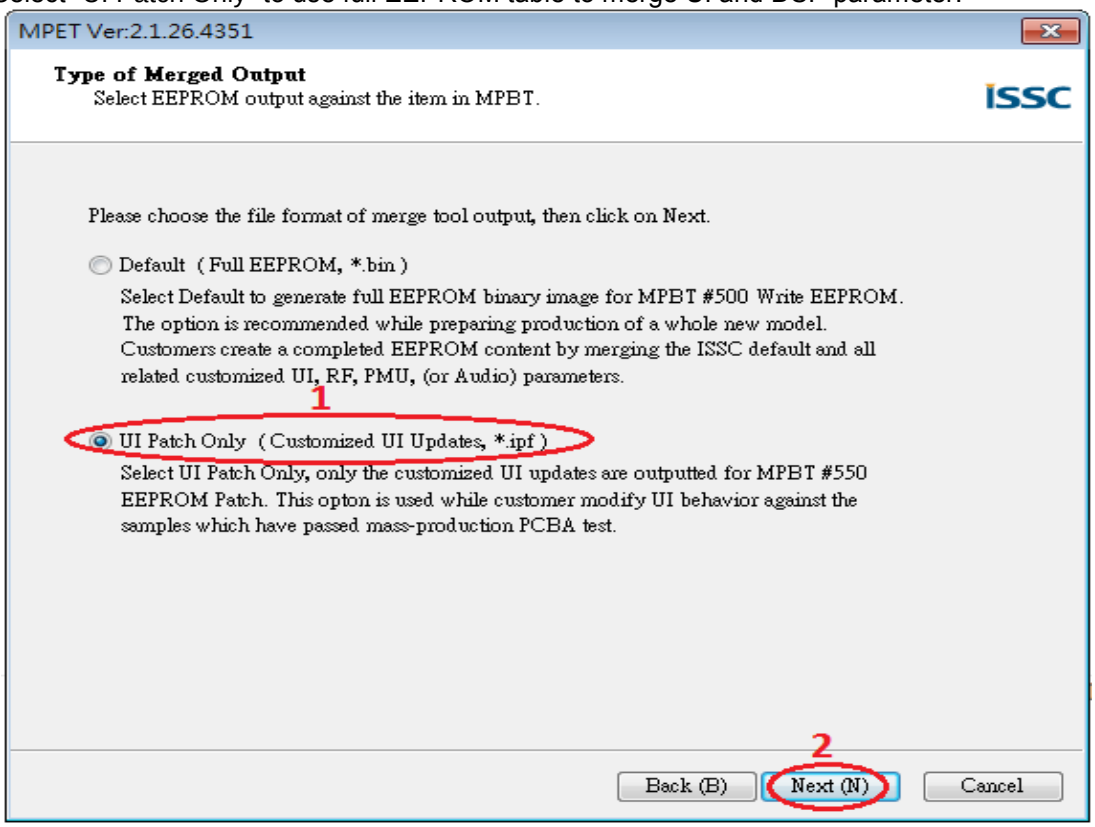

**Step4.** Click "Save" button to save these DSP parameters as a ".txt" file after finish all DSP setting.



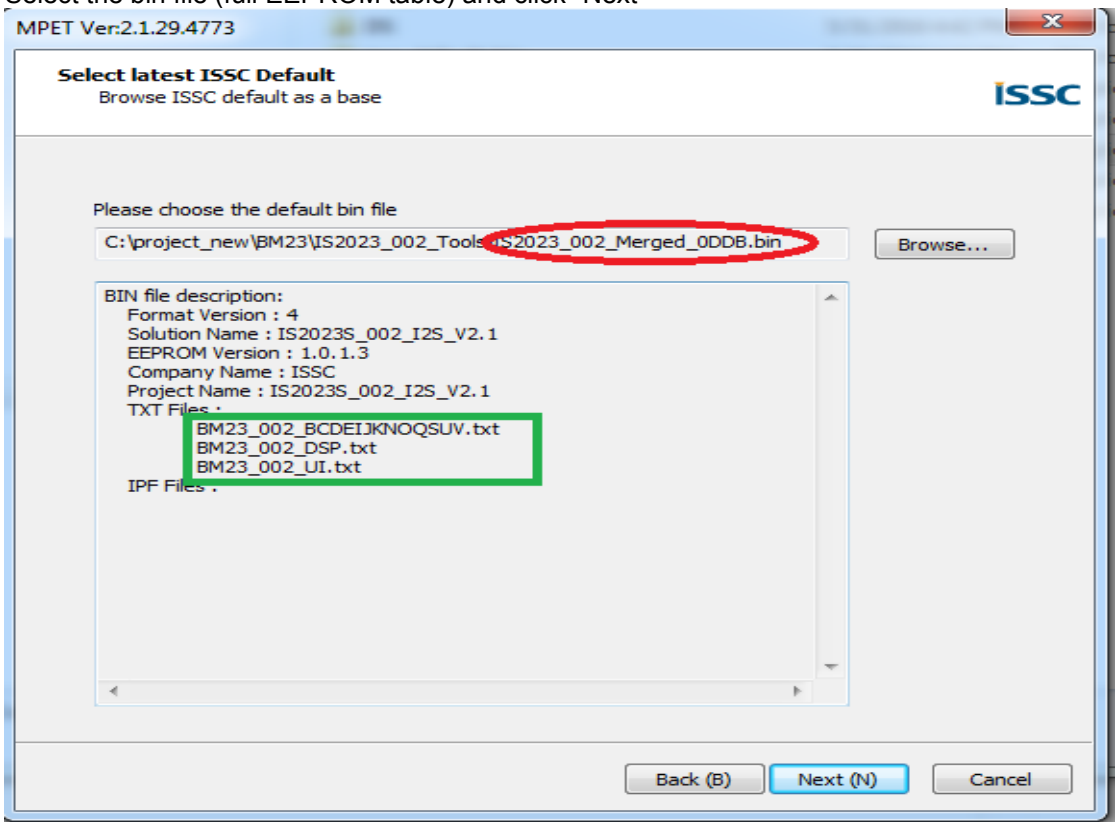
### 2.4.3 MERGE TOOL

**Step1.** Open MPET tool, click "Next" to set up.

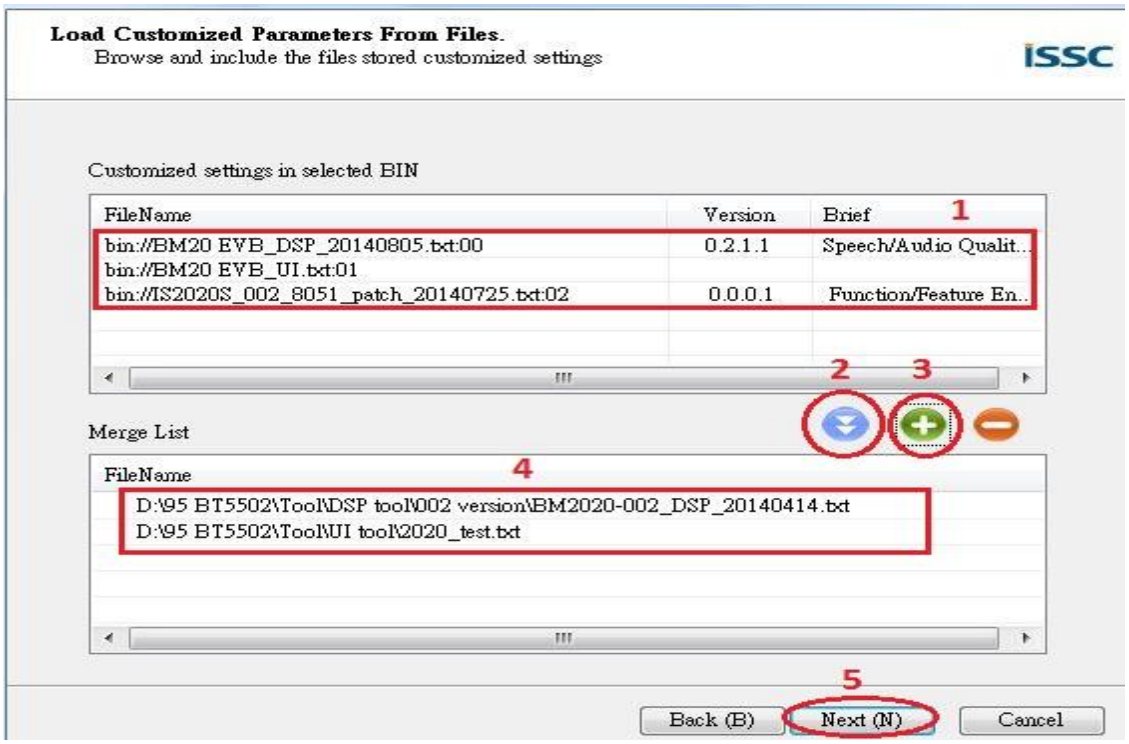
**Step2.** Select "UI Patch Only" to use full EEPROM table to merge UI and DSP parameter.



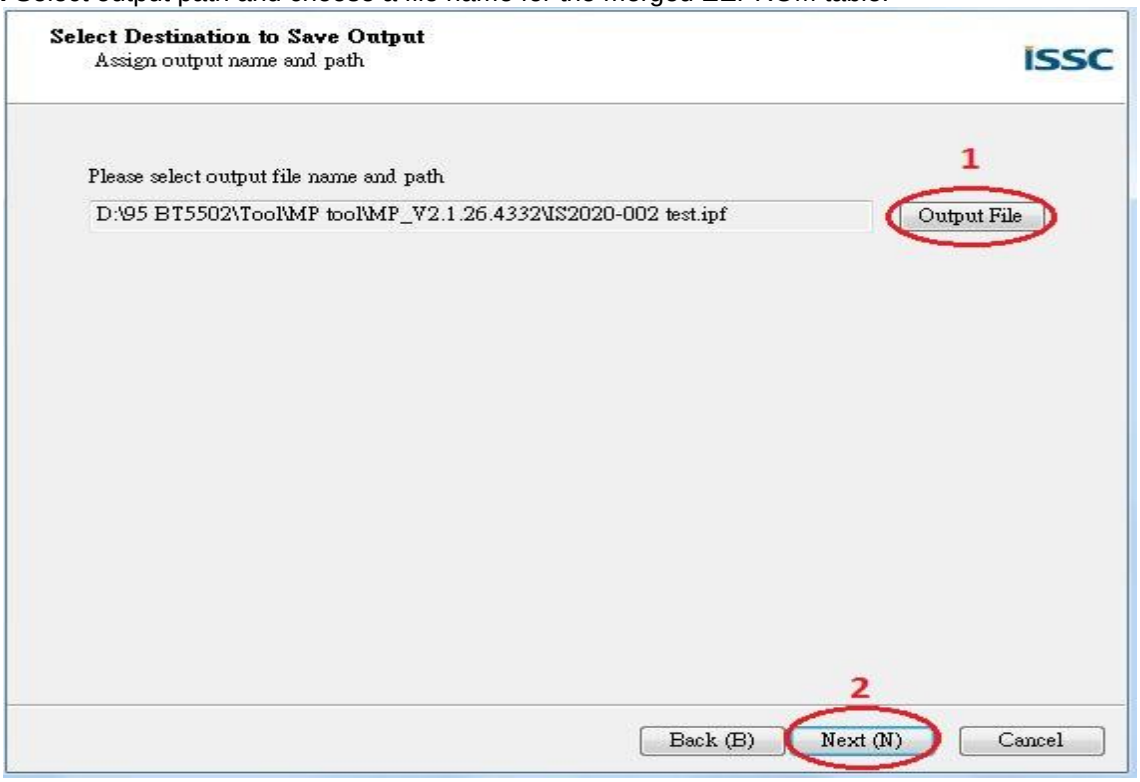
**Step3.** Select the bin file (full EEPROM table) and click "Next"



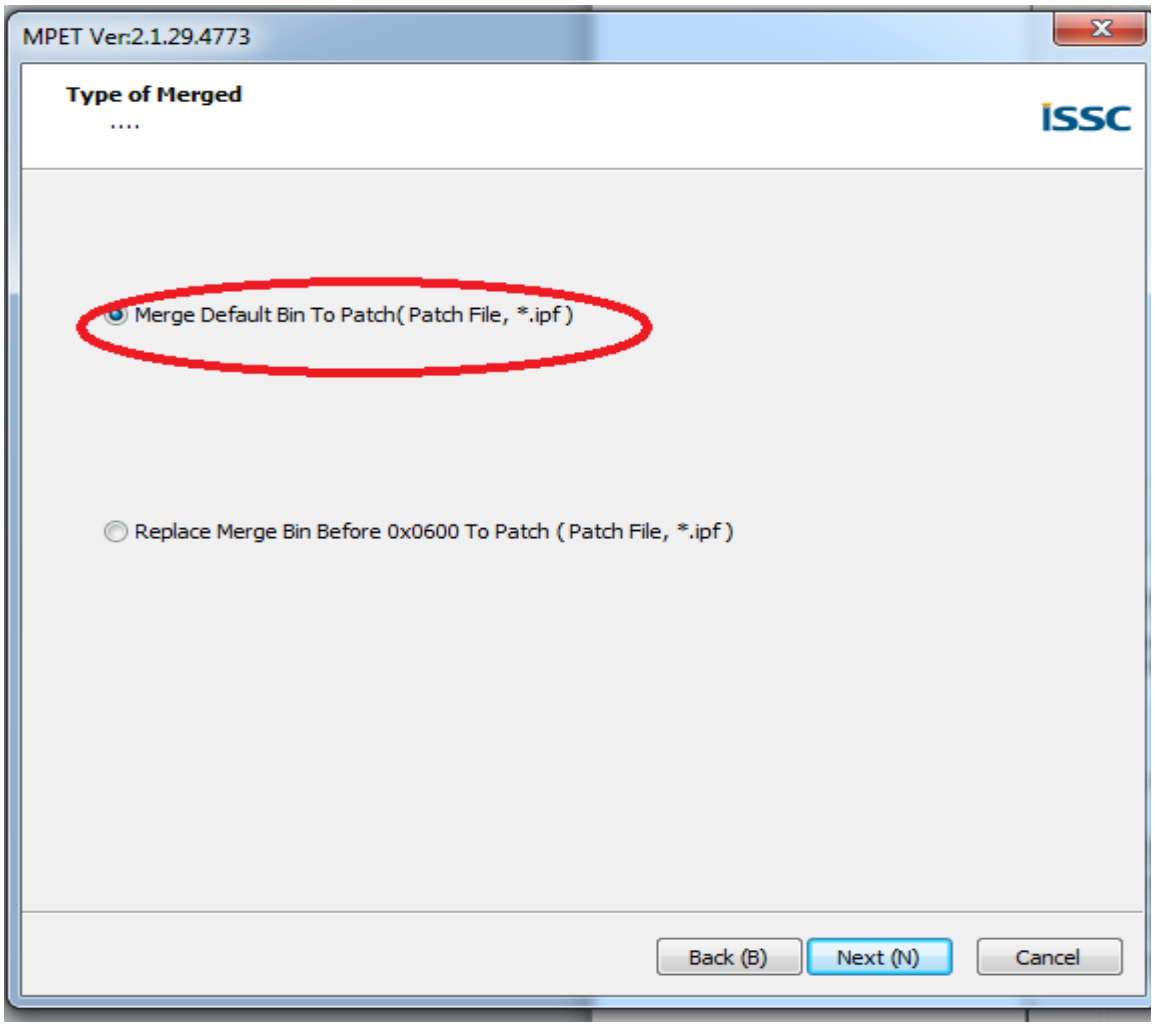

**Step4.** If the bin file includes UI/DSP/patch code, you can see them as shown in the above figure. If you want to keep any one of them in your customization, you can select that and use "pull down" button (**2**) to add them to merge list. For adding customized parameters, you can use add button (+) (**3**) to add new parameters (e.g. UI/DSP parameters), into tool to merge with EEPROM table.



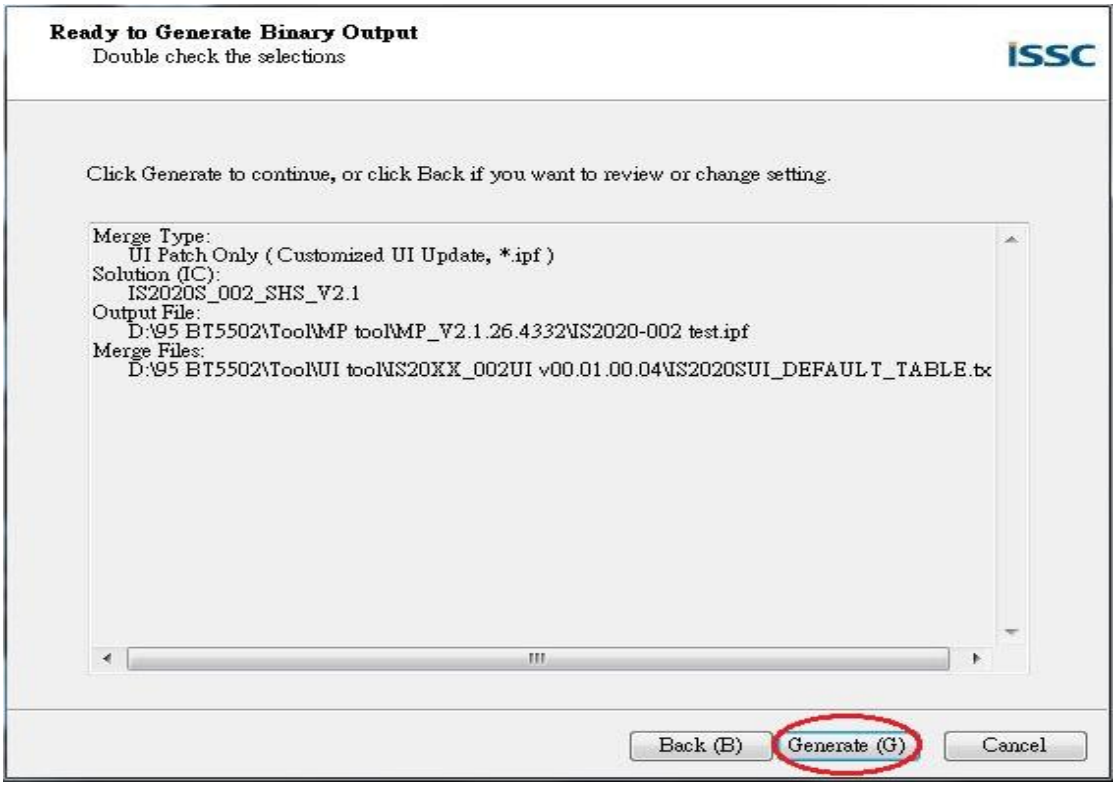
**Step5.** Select output path and choose a file name for the merged EEPROM table.



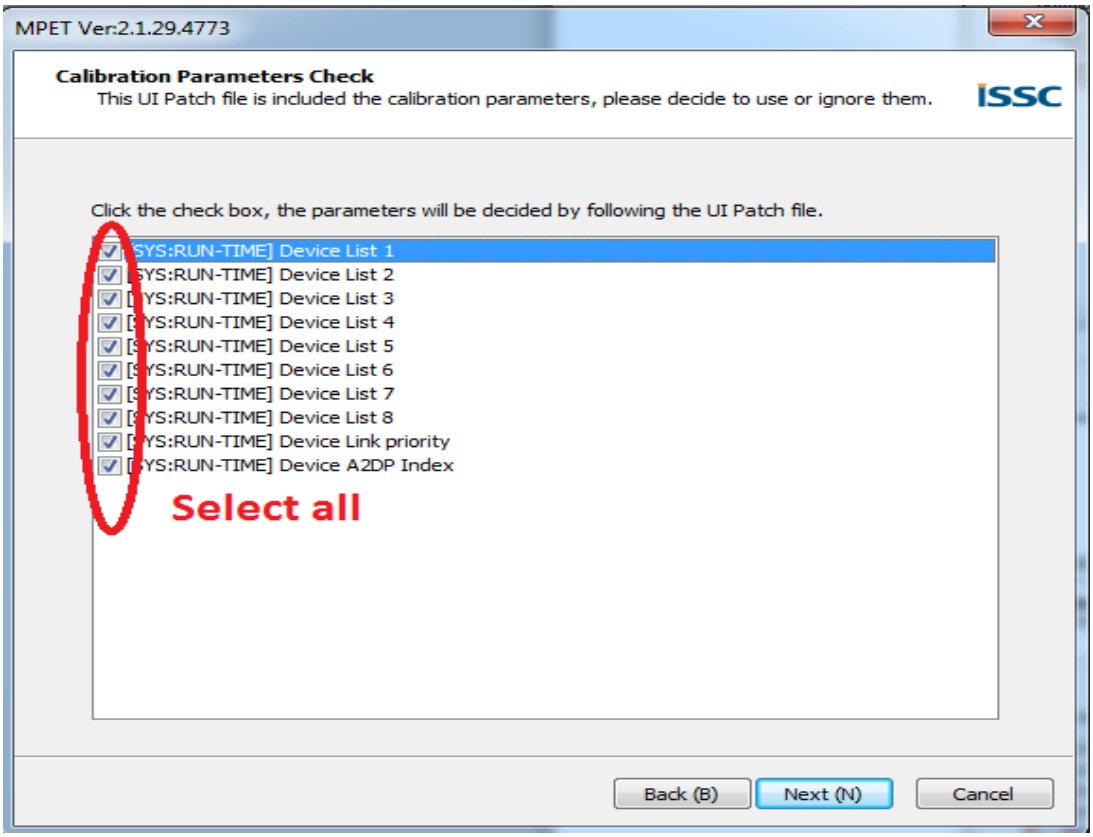
**Step6.** Click "Next" and choose **Merge Default Bin to Patch (Patch File, *.ipf)** as shown in the following picture and then Click "Next". "Generate" button to generate the new EEPROM table.



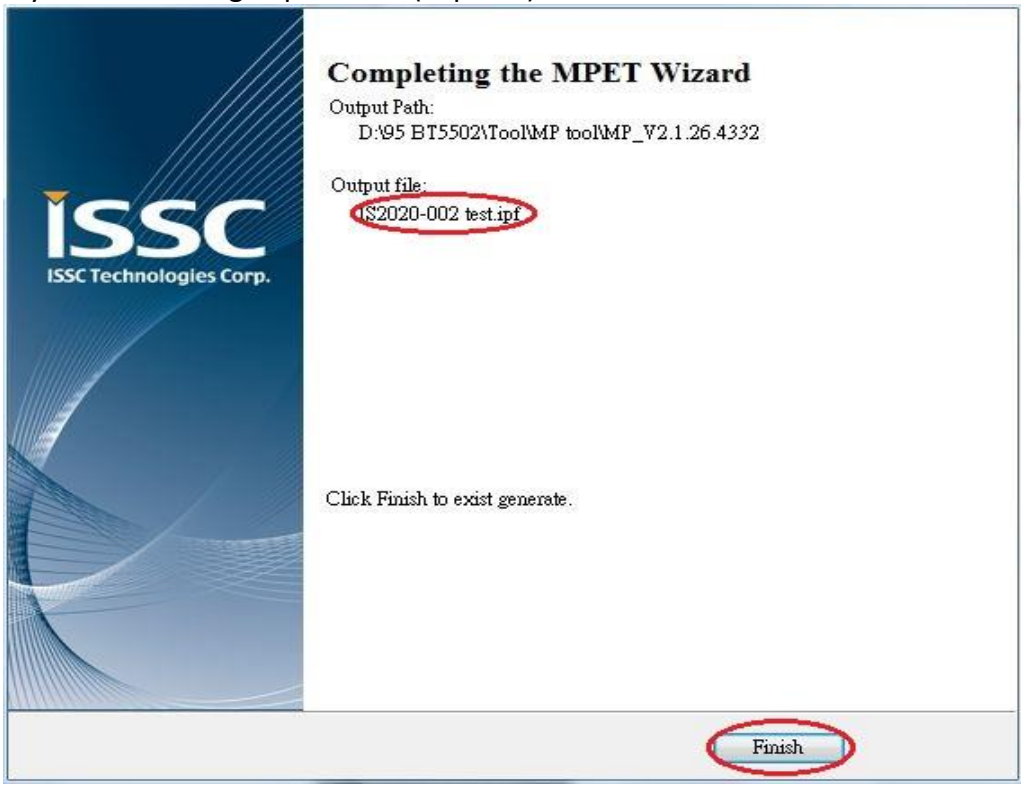
**Step7**. Click Generate button



**Step8.** Select all as shown below and then click Next.

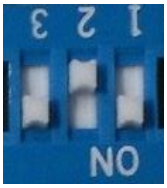



**Step9.** Now you have a merged patch file (*.ipf file).

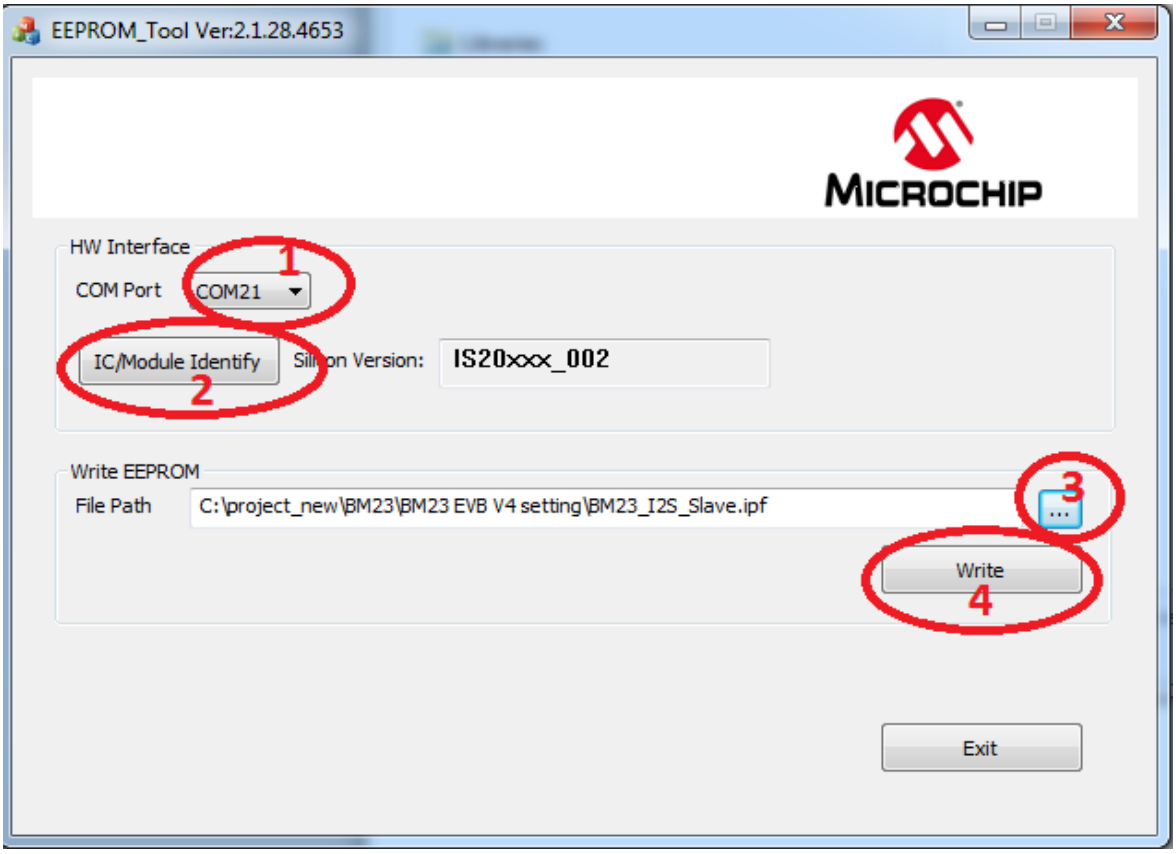


### 2.4.4 EEPROM Parameters Update

**Step1.** Make sure SW9 in "ROM TEST" mode. Mode switch (1/2/3 – on/off/on)



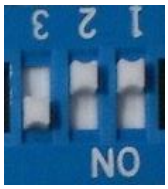

**Step2.** Connect EVB "P1" port and PC by USB cable. **LED1** & **LED2** on EVB will keep lighting.
**Step3.** Run the **E2PROM_tool.exe** program and a window will be come up as below



**Step4**. Specify the **COM** Port (**1**)**.** Click IC/Module (**2**) Identify to know IC version of BM23. This is useful to prevent IC version mismatch.

**Step5.** Press **"Browse"** (**3**) to choose the *.ipf file (created in section 2.4.3) and click **Write**(**4**)

**Step6.** After data update is completed, remove USB cable and make SW9 to "**ROM APP**"(mode Switch 1/2/3 off/off/on) mode and power cycle.

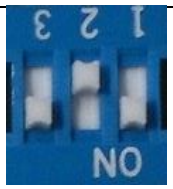
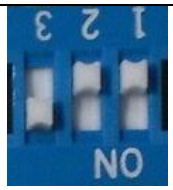



EVB will be using new setting from EEPROM. Follow section 2.0 to see the effect of parameter customization.

## 2.5 MODULE CONFIGURATION

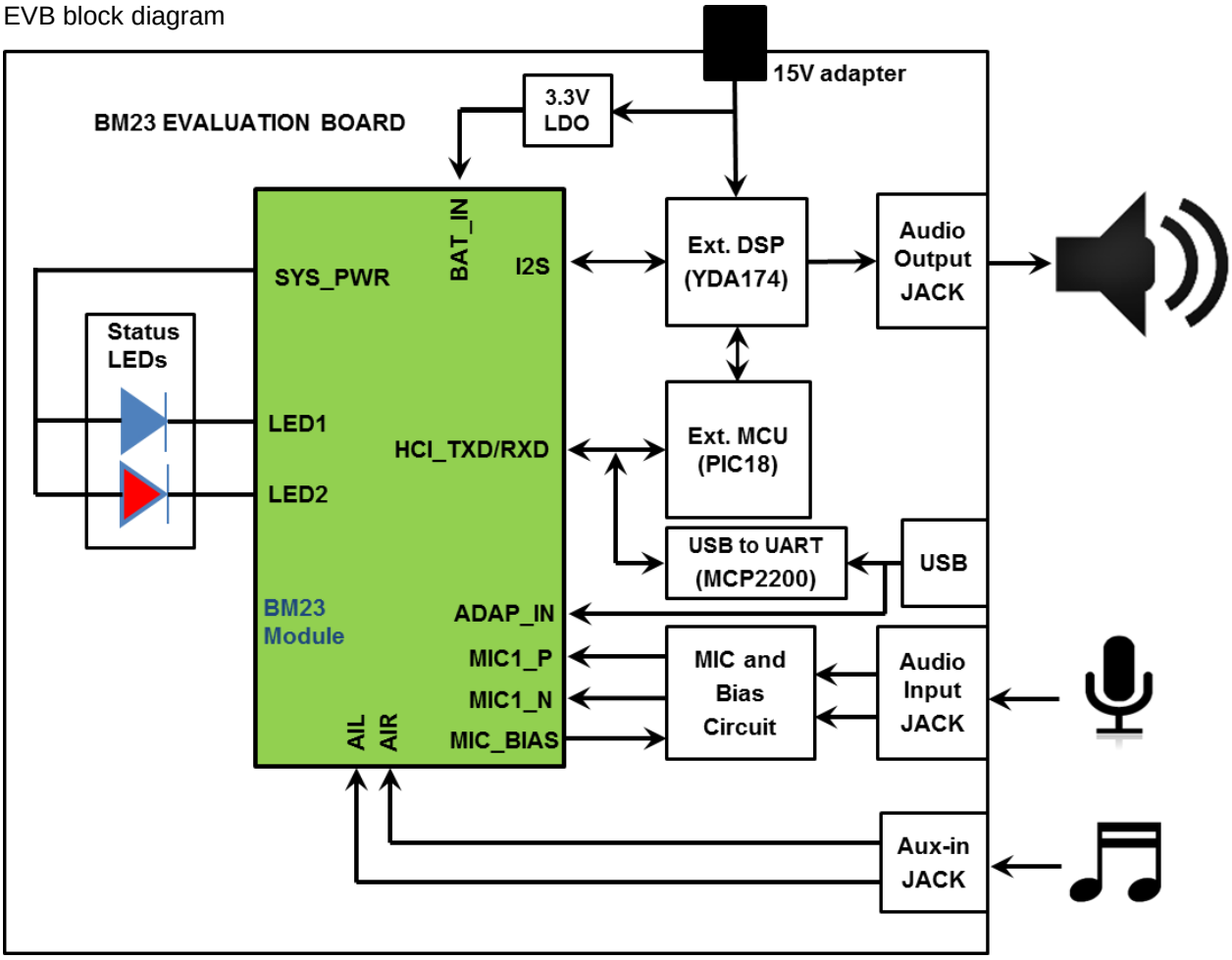
### 2.5.1 Mode Settings

Setting in Mode Switch:

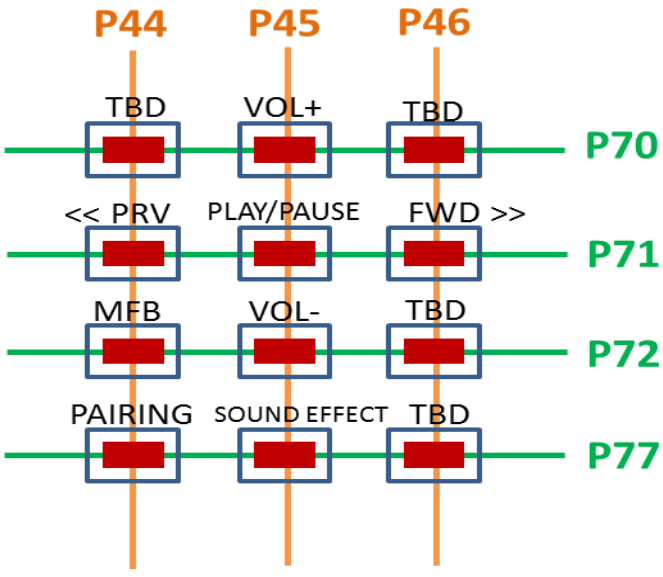
| Mode | SW9 Setting | Switch 9 PIN Definition |
|---|---|---|
| ROM Test Mode |  | 1: ON (P2_0: LOW)<br>2: OFF (P2_4: HIGH)<br>3: ON (EAN: HIGH) |
| Application Mode |  | 1: OFF (P2_0: HIGH)<br>2: OFF (P2_4: HIGH)<br>3: ON (EAN: HIGH) |

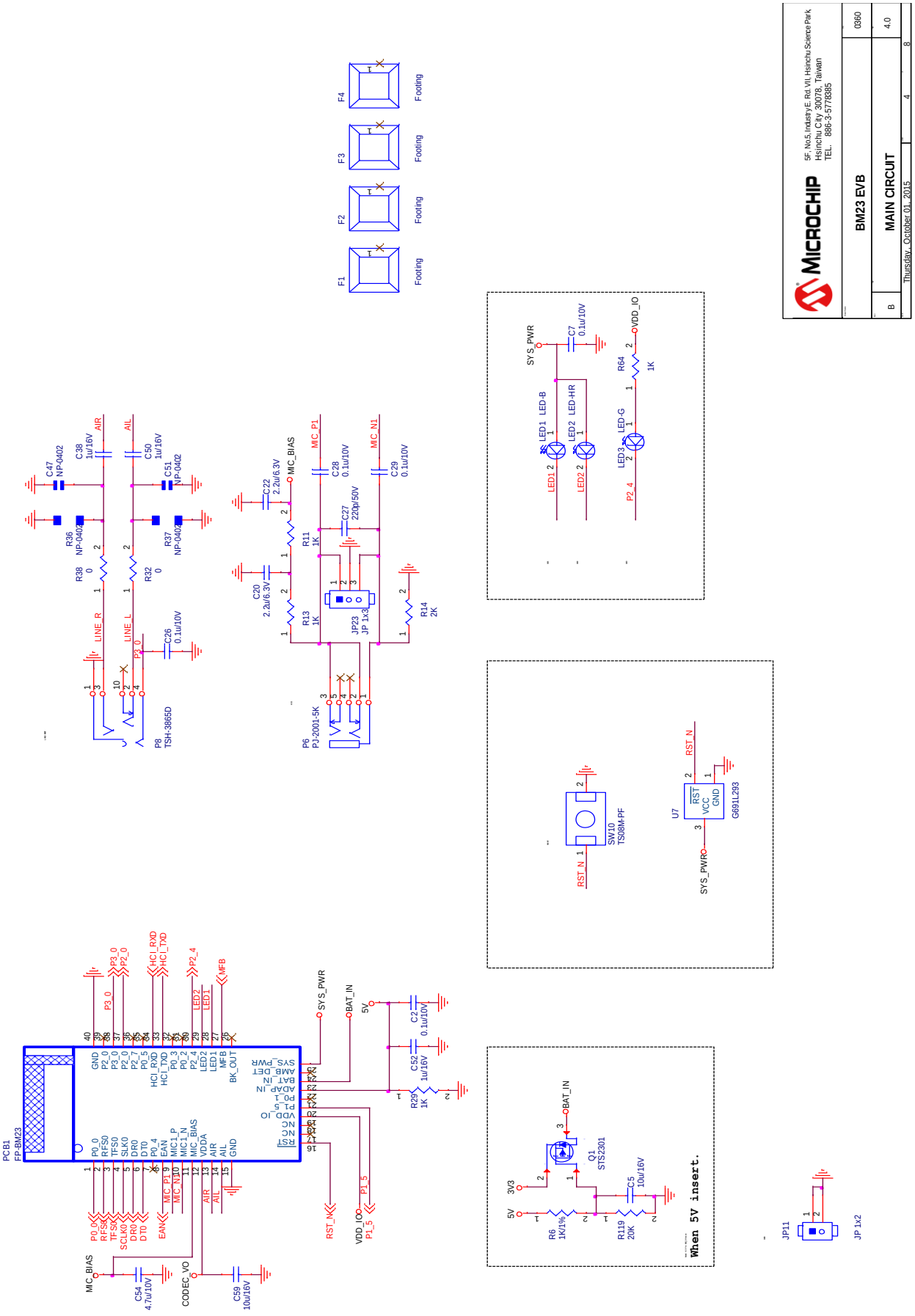
## APPENDIX A. BM23 AUDIO EVALUATION BOARD SCHEMATICS

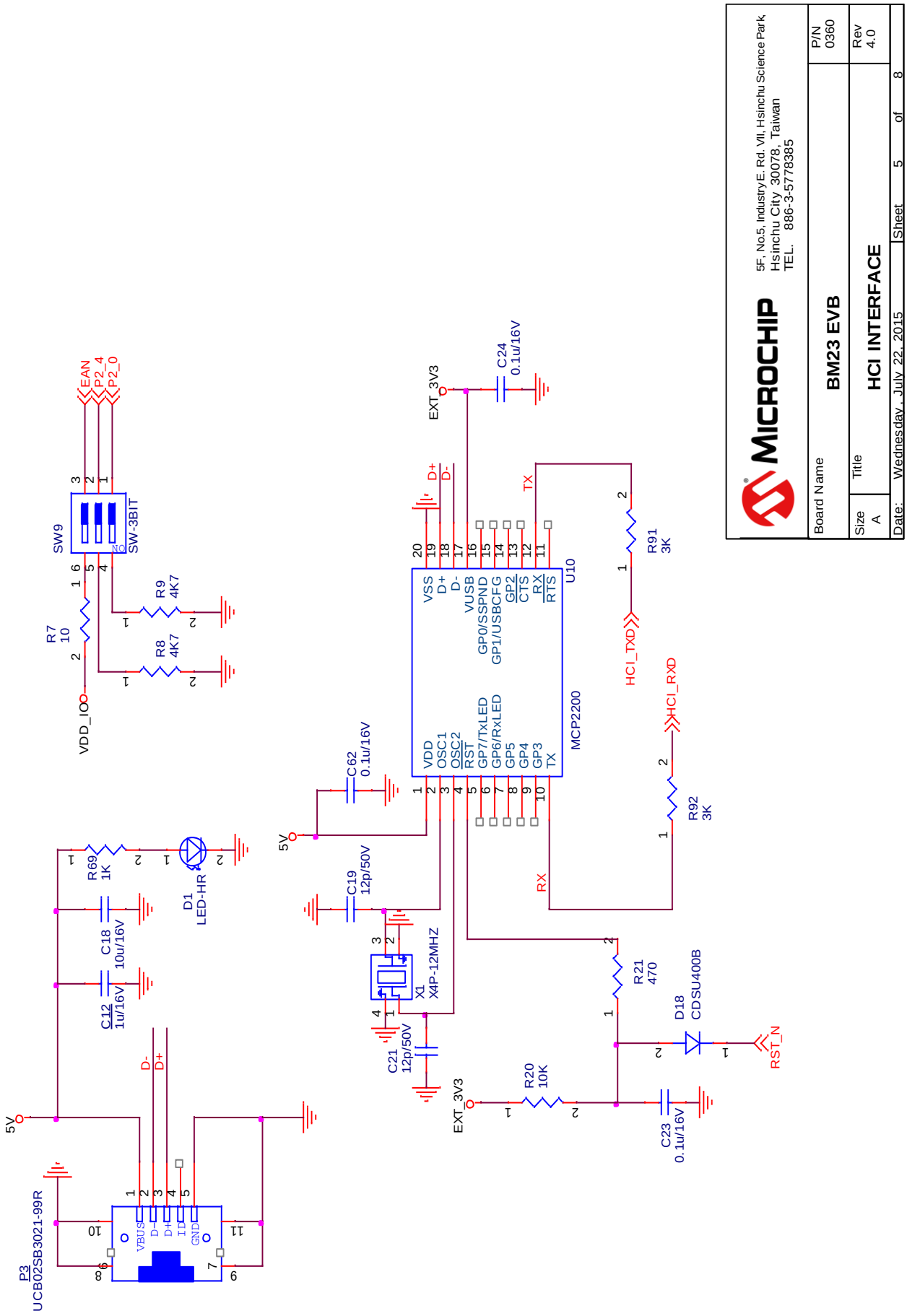
EVB block diagram

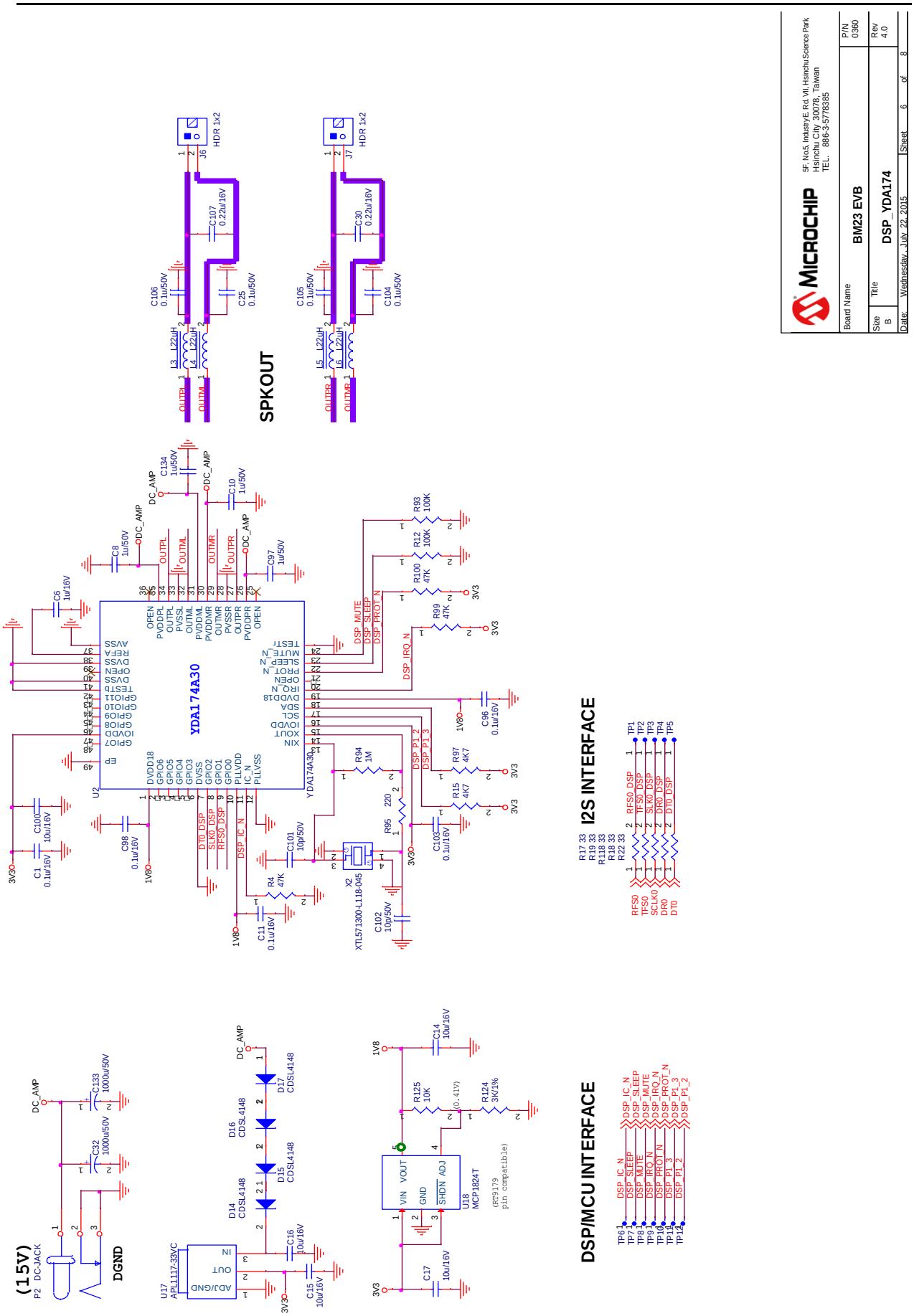


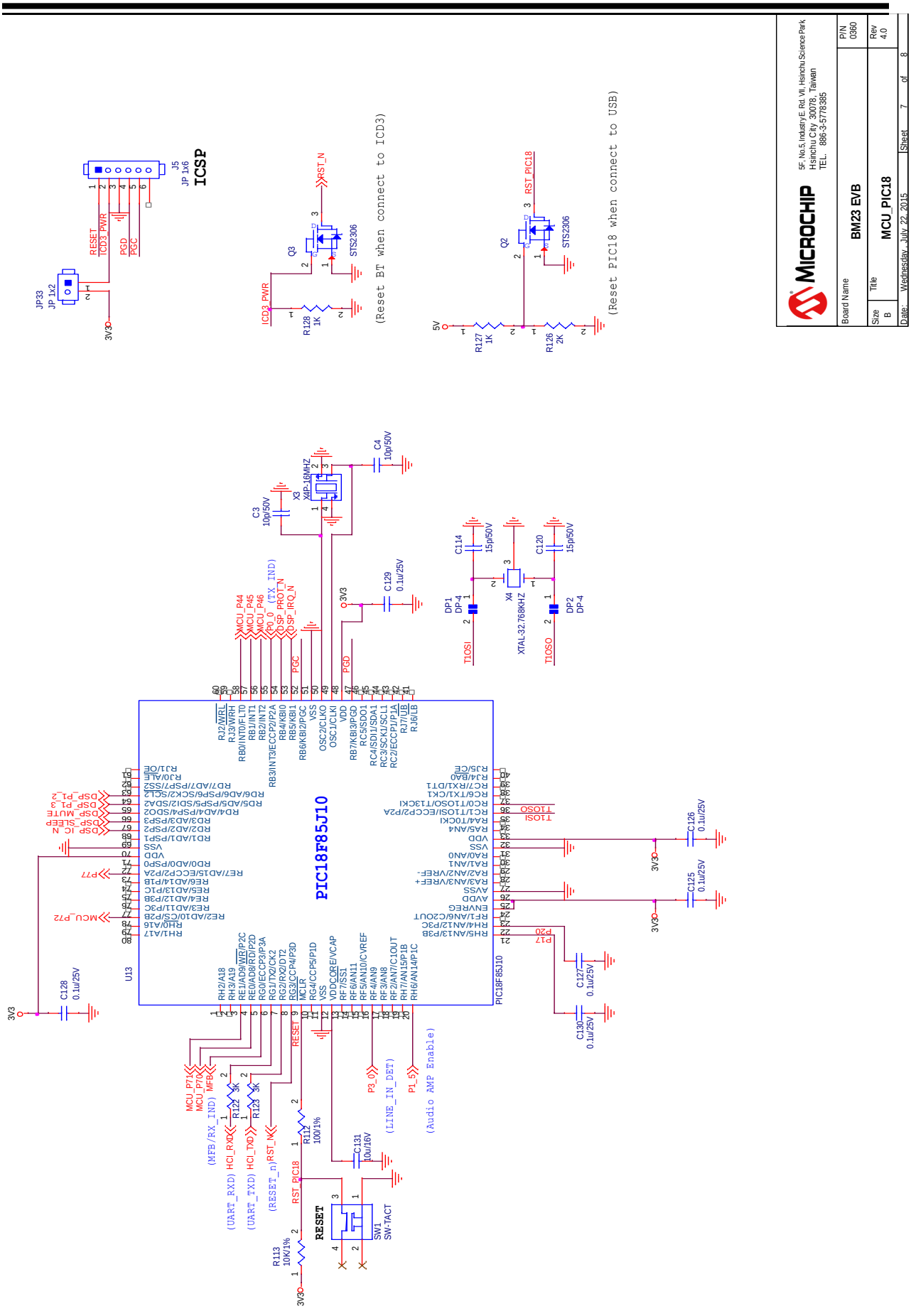

Key Button Matrix:

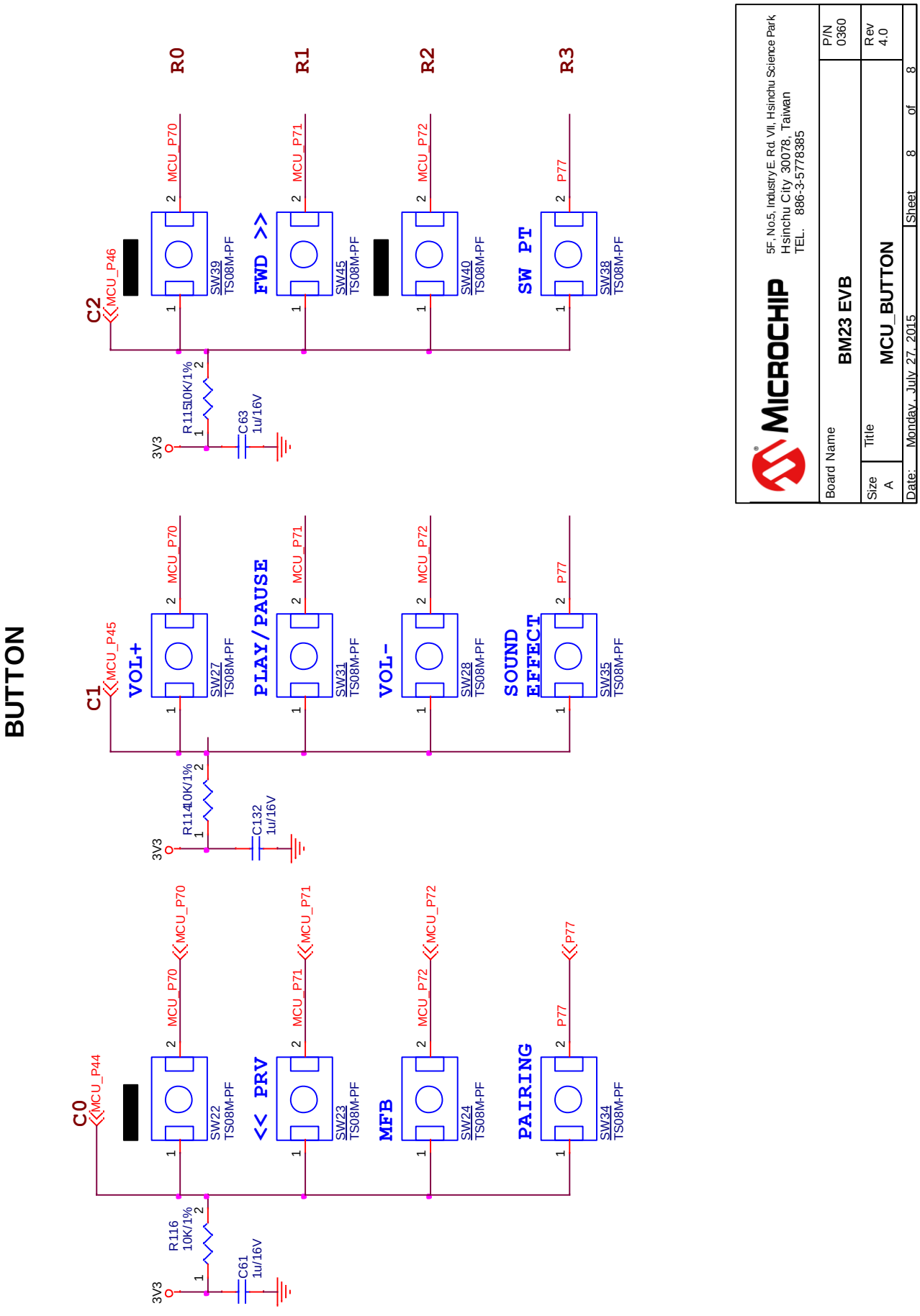



MICROCHIP
5F, No.5, Industry E. Rd. VII, Hsinchu Science Park, Hsinchu City 30078, Taiwan
TEL: 886-3-5778385
BM23 EVB
MAIN CIRCUIT
0360
4.0
B
Thursday, October 01, 2015
When 5V insert.


MICROCHIP
5F, No.5, IndustryE. Rd. VII, Hsinchu Science Park,
Hsinchu City 30078, Taiwan
TEL. 886-3-5778385
Board Name
BM23 EVB
P/N
0360
Size
A
Title
HCI INTERFACE
Rev
4.0
Date:
Wednesday, July 22, 2015
Sheet
5
of
8
SW9
SW-3BIT
R7
10
R9
4K7
R8
4K7
VDD_IO
EAN
P2_4
P2_0
R69
1K
D1
LED-HR
C18
10u/16V
C12
1u/16V
P3
UCB02SB3021-99R
VBUS
D-
D+
ID
GND
5V
C62
0.1u/16V
C19
12p/50V
X1
X4P-12MHZ
C21
12p/50V
EXT_3V3
C24
0.1u/16V
U10
MCP2200
VSS
D+
D-
VUSB
GP0/SSPND
GP1/USBCFG
GP2
CTS
RX
RTS
VDD
OSC1
OSC2
RST
GP7/TxLED
GP6/RxLED
GP5
GP4
GP3
TX
R91
3K
R92
3K
HCI_TXD
HCI_RXD
R21
470
D18
CDSU400B
RST_N
R20
10K
C23
0.1u/16V


MICROCHIP
5F, No5, Industry E. Rd. VII, Hsinchu Science Park
Hsinchu City 30078, Taiwan
TEL: 886-3-5778366
Board Name
BM23 EVB
P/N
0360
Rev
4.0
Size
B
Title
DSP_YDA174
Date: Wednesday, July 22, 2015
Sheet 6 of 8
SPKOUT
HDR 1x2
J6
J7
C106 0.1u/50V
C107 0.22u/16V
C25 0.1u/50V
C105 0.1u/50V
C30 0.22u/16V
C104 0.1u/50V
L3 L22uH
L4 L22uH
L5 L22uH
L6 L22uH
OUTPL
OUTML
OUTPR
OUTMR
YDA174A30
U2
DC_AMP
C134 1u/50V
C10 1u/50V
C8 1u/50V
C97 1u/50V
C6 1u/16V
C1 0.1u/16V
C100 10u/16V
C98 0.1u/16V
C11 0.1u/16V
C101 10p/50V
C102 10p/50V
C103 0.1u/16V
C96 0.1u/16V
R93 100K
R12 100K
R100 47K
R99 47K
R94 1M
R97 4K7
R15 4K7
R95 220
R4 47K
X2
XTL571300-L118-045
3V3
1V8
DSP_MUTE
DSP_SLEEP
DSP_PROT_N
DSP_IRQ_N
DSP_P1_2
DSP_P1_3
I2S INTERFACE
R17 33
R19 33
R118 33
R18 33
R22 33
RFS0_DSP
TFS0_DSP
SCLK0_DSP
DR0_DSP
DT0_DSP
RFS0
TFS0
SCLK0
DR0
DT0
TP1
TP2
TP3
TP4
TP5
DSP/MCU INTERFACE
DSP_IC_N
DSP_SLEEP
DSP_MUTE
DSP_IRQ_N
DSP_PROT_N
DSP_P1_3
DSP_P1_2
TP6
TP7
TP8
TP9
TP10
TP11
TP12
(15V)
P2 DC-JACK
DGND
C133 1000u/50V
C32 1000u/50V
U17
APL1117-33VC
ADJ/GND
OUT
IN
C16 10u/16V
C15 10u/16V
D14 CDSL4148
D15 CDSL4148
D16 CDSL4148
D17 CDSL4148
C14 10u/16V
C17 10u/16V
R125 10K
R124 3K/1%
(0.41V)
U18
MCP1824T
VIN VOUT
GND
SHDN ADJ
(PT5179 pin compatible)


MICROCHIP
5F, No.5, Industry E. Rd. VII, Hsinchu Science Park
Hsinchu City 30078, Taiwan
TEL. 886-3-5778385
Board Name
BM23 EVB
P/N
0360
Size
B
Title
MCU_PIC18
Rev
4.0
Date: Wednesday, July 22, 2015
Sheet 7 of 8
ICSP
J5
JP 1x6
JP33
JP 1x2
RESET
ICD3_PWR
PGD
PGC
3V3
Q3
STS2306
RST_N
R128
1K
(Reset BT when connect to ICD3)
Q2
STS2306
RST_PIC18
R127
1K
R126
2K
(Reset PIC18 when connect to USB)
5V
PIC18F85J10
U13
PIC18F85J10
X3
X4P-16MHZ
C3
10p/50V
C4
10p/50V
C129
0.1u/25V
C114
15p/50V
C120
15p/50V
X4
XTAL-32.768KHZ
DP1
DP-4
DP2
DP-4
T1OSI
T1OSO
C126
0.1u/25V
C125
0.1u/25V
C127
0.1u/25V
C130
0.1u/25V
C128
0.1u/25V
C131
10u/16V
R112
100/1%
R122
3K
R123
3K
R113
10K/1%
SW1
SW-TACT
RESET
(MFB/RX_IND)
(UART_RXD)
(UART_TXD)
(RESET_n)
(LINE_IN_DET)
(Audio AMP Enable)
MCU_P44
MCU_P45
MCU_P46
P0_0 (TX_IND)
DSP_PROT_N
DSP_IRQ_N
DSP_P1_2
DSP_P1_3
DSP_MUTE
DSP_SLEEP
DSP_IC_N
P77
MCU_P72
P17
P20
MCU_P71
MCU_P70
MFB
RST_PIC18


BUTTON
C0
MCU_P44
C1
MCU_P45
C2
MCU_P46
R0
R1
R2
R3
<< PRV
MFB
PAIRING
VOL+
PLAY/PAUSE
VOL-
SOUND EFFECT
FWD >>
SW PT
SW22 TS08M-PF
SW23 TS08M-PF
SW24 TS08M-PF
SW34 TS08M-PF
SW27 TS08M-PF
SW31 TS08M-PF
SW28 TS08M-PF
SW35 TS08M-PF
SW39 TS08M-PF
SW45 TS08M-PF
SW40 TS08M-PF
SW38 TS08M-PF
MCU_P70
MCU_P71
MCU_P72
P77
3V3
R116 10K/1%
R114 10K/1%
R115 10K/1%
C61 1u/16V
C132 1u/16V
C63 1u/16V
MICROCHIP
5F, No.5, Industry E. Rd. VII, Hsinchu Science Park
Hsinchu City 30078, Taiwan
TEL: 886-3-5778385
Board Name
BM23 EVB
P/N 0360
Rev 4.0
Size A
Title
MCU_BUTTON
Date: Monday, July 27, 2015
Sheet 8 of 8

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**Korea - Seoul**
Tel: 82-2-554-7200
Fax: 82-2-558-5932 or
82-2-558-5934

**Malaysia - Kuala Lumpur**
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Fax: 60-3-6201-9859

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Fax: 65-6334-8850

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Fax: 886-3-5770-955

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

**Taiwan - Taipei**
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