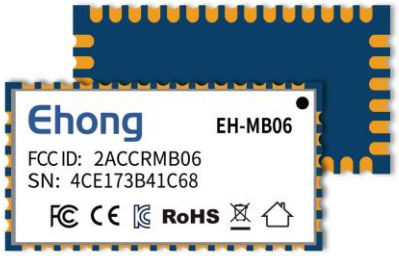
EH-MB06

Audio Module Data Sheet

EH-20211215-DS Rev1.2



EH-MB06

- **Feature**

- Bluetooth® v5.1
- Bluetooth, Bluetooth low energy
- 120Mhz Qualcomm® Kalimba™audio DSPs
- Dual core application subsystem 32 MHz operation
- Flexible QSPI flash programmable platform
- High-performance 24-bit stereo audio interface
- Digital and analog microphone interfaces
- SBC, and AAC audio codecs support
- Serial interfaces: UART, Bit Serializer (I^2C/SPI),USB 2.0
- 256K RAM,32M Flash

- **Application Subsystem**

- Dual core application subsystem 32 MHz operation
- 32-bit Firmware Processor:
- Reserved for system use
- Runs Bluetooth upper stack, profiles, house-keeping code
- 32-bit Developer Processor:Runs developer applications
- Both cores execute code from external flash memory using QSPI clocked at 32MHz
- On-chip caches per core allow for optimized performance and power
- consumption

- **User Interface**

- Send AT command over UART
- Firmware upgrade over USB
- PCM interface (I2S,SPDIF)
- I2C interface(Master)

- **General I/O**

- 13 general purpose I/Os
- 2 analogue I/O
- Three fully configurable LED drivers

- **Single voltage supply: 2.8-4.2V**
- **Small form factor: 23.24 x 11.93 x 2.2mm**
- **Operating temperature range: -40 °C to 85 °C**

Mar 1 2017

VERSION HISTORY

Version	Comment
V1.0	Current consumption added
V1.1	Addition RX and TX
V1.2	Add aptX model

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1. Description

The EH-MB06 is an easy to use Bluetooth module, compliant with Bluetooth v5.1. The module provides complete RF platform in a small form factor.

The module enables electronic devices with wireless connectivity, not requiring any RF experience or expertise for integration into the final product. The module being a certified solution optimizes the time to market of the final application.

The module built-in enhanced Kalimba DSP coprocessor with 120MIPS, supports enhanced audio and DSP Applications (AAC, SBC codec，1-Mic Qualcomm@cVc).Support GATT,A2DP, AVRCP, HSP, HFP,SPP, iAP and PBAP Profiles communication with smart ready devices.

2. Application

- Home entertainment eco-system
  - Smart remote controllers
  - Wired or wireless sound bars
  - Wired or wireless speakers and headphones
  - Bluetooth low energy connectivity to external 3D glasses
- Tablets / PCs / Mobile Connectivity
  - Wired or wireless headphones for music / gaming / multimedia content
  - Wired or wireless speakers
  - Mono Headsets for voice

3. EH-MB06 Product numbering

EH-MB06(C)

A. EH ---------- Company Name (Ehong)

B. MB06 ---------- Module Name

C. C ---------- support aptX

4. Electrical Characteristic

4.1. Recommend operation conditions

Operating Condition	Min	Typical	Max	Unit

Rating	Min		Max	Unit
Storage Temperature	-40		+125	°C
PIO Voltage	-0.4		+3.6	V
AIO Voltage	-0.4		+1.95	V
LED	-0.4		+3.6	V
VDD Voltage	-0.4		+3.6	V
VCHG	-0.4		+7.0	V
USB_DP/USB_DN Voltage	-0.4		+3.6	V
Other Terminal Voltages	VSS-0.4		VDD+0.4	V
Operating Temperature Range	-40	--	+85	°C
PIO Voltage	+1.7	+3.3	+3.6	V
AIO Voltage	+1.7	+1.8	+1.95	V
LED	+1.1	3.7	+3.6	V
VDD Voltage	+2.7	+3.3	+3.6	V
VCHG(a)	+4.75	+5	+5.75	V
RF frequency	2400	2441	24800	MHz

Table 1: Recommended Operating Conditions

4.2. Absolute Maximum Rating

Table 2: Absolute Maximum Rating Recommended Operating Conditions

4.3. Input/output Terminal Characteristics

4.3.1. Digital Terminals

Digital Terminals	Min	Type	Max	Unit

Input Voltage				
V_{IL} input logic level low	-0.4	-	0.4	V
V_{IH} input logic level high	0.7 x VDD	-	VDD + 0.4	V
Tr/Tf	-	-	25	ns
Output Voltage				
V_{OL} output logic level low, I_{OL} = 4.0mA	-	-	0.4	V
V_{OH} output logic level high, I_{OH} = -4.0mA	0.75 X VDD	-	-	V
Tr/Tf	-	-	5	ns
Input and Tristate Currents				
Strong pull-up	-150	-40	-10	µA
Strong pull-down	10	40	150	µA
Weak pull-up	-5	-1.0	-0.33	µA
Weak pull-down	0.33	1.0	5.0	µA
C_I Input Capacitance	1.0	-	5.0	pF

Table 3: Digital Terminal

4.3.2. USB

	Min	Type	Max	Unit
VDD_USB for correct USB operation	3.10	3.30	3.60	V
Input Threshold				
V_{IL} input logic level low	-	-	0.30 x VDD_USB	V
V_{IH} input logic level high	0.70 x VDD_USB	-	-	V
Input Leakage Current				
VSS_DIG < V_{IN} < VDD_USB[a]	-1	1	5	µA
C_I input capacitance	2.5	-	10	pF
Output Voltage Levels to Correctly Terminated USB Cable				
V_{OL} output logic level low	0	-	0.2	V
V_{OH} output logic level high	2.80	-	VDD_USB	V

Table 4: USB Terminal

5. Pinout and Terminal Description

5.1. Pin Configuration

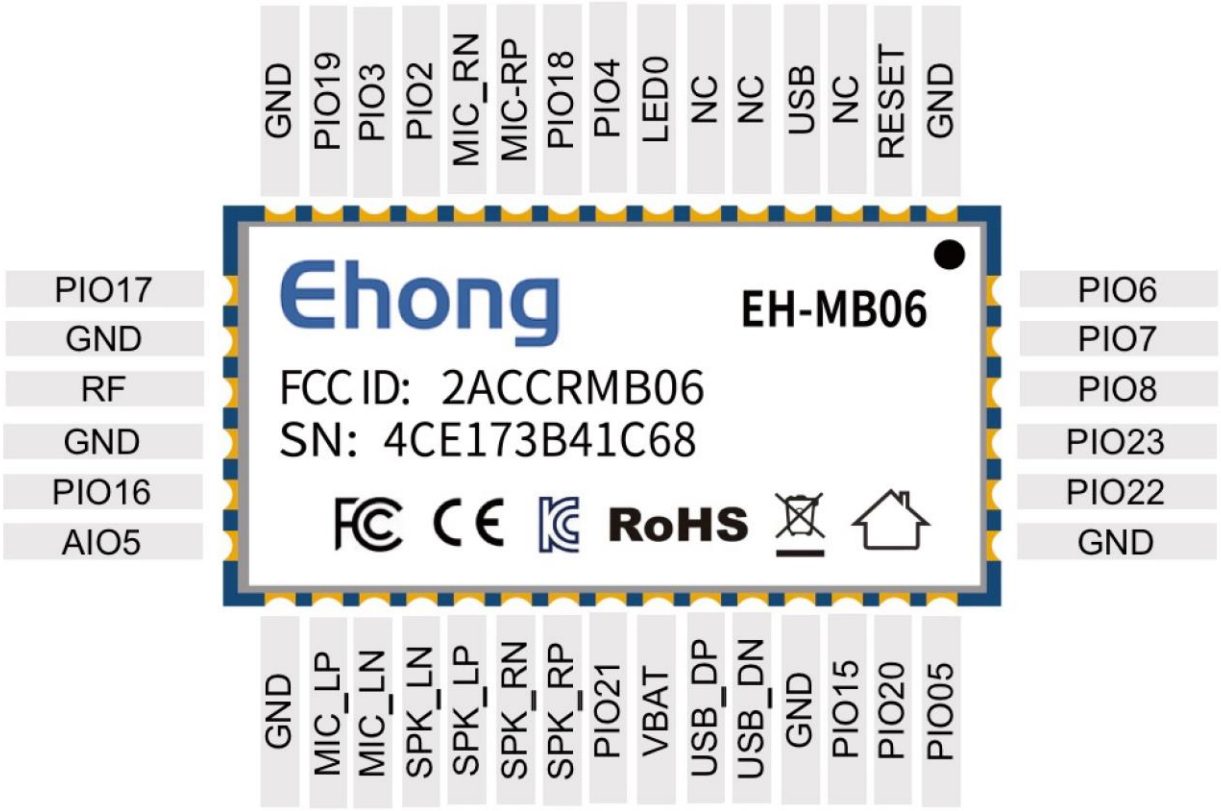

Figure 1：Pinout of EH-MB06

Pin	Symbol	I/O Type	Description
1	GND	Ground	Ground
2	RESETB	CMOS input with weak internal pull-up	Active LOW RESETB, input debounced so must be low for >5ms to cause a RESETB
3	NC		
4	USB_VBUS		Supply to SMPS power switch from charger input.
5	NC		
6	NC		
7	LED0	Analog or digital input/ open drain output.	General-purpose analog/digital input or open drain LED output.
8	PIO4	Digital: Bidirectional with programmable strength internal pull up/pull-down	Programmable I/O line 4. Alternative function: ▪ TBR_MOSI[1]
9	PIO18	Digital: Bidirectional with programmable	Programmable I/O line 18.

		strength internal pull up/pull-down internal pull-down	Alternative function: ■ PCM_DOUT[0]
10	MIC_RP	Analog	Microphone differential 2 input, positive. Alternative function: ■ Differential audio line input right, positive
11	MIC_RN	Analog	Microphone differential 2 input, negative. Alternative function: ■ Differential audio line input right, negative
12	PIO2	Digital: Bidirectional with programmable strength internal pull up/pull-down	Programmable I/O line 2. Alternative function: ■ TBR_MISO[3]
13	PIO3	Digital: Bidirectional with programmable strength internal pull up/pull-down	Programmable I/O line 3. Alternative function: ■ TBR_MISO[2]
14	PIO19	Digital: Bidirectional with programmable strength internal pull up/pull-down	Programmable I/O line 19. Alternative function: ■ PCM_DIN[0]
15	GND		
16	PIO17	Digital: Bidirectional with programmable strength internal pull up/pull-down	Programmable I/O line 17. Alternative function: ■ PCM_SYNC
17	GND		
18	RF	RF	Bluetooth transmit/receive.
19	GND		
20	PIO16	Digital: Bidirectional with programmable strength internal pull up/pull-down	Programmable I/O line 16. Alternative function: ■ PCM_CLK
21	AIO5	Analog or digital input/ open drain output.	General-purpose analog/digital input or open drain LED output.
22	GND		
23	MIC_LP	Analog internal pull-down	Microphone differential 1 input, negative. Alternative function: ■ Differential audio line input left, negative
24	MIC_LN	Analog	Microphone differential 1 input, positive. Alternative function: ■ Differential audio line input left, positive
25	SPK_LN	Analog	Headphone/speaker differential left output, negative. Alternative function: ■ Differential left line output, negative
26	SPK_LP	Analog	Headphone/speaker differential left

			output, positive. Alternative function: ■ Differential left line output, positive
27	SPK_RN	Analog	Headphone/speaker differential right output, negative. Alternative function: ■ Differential right line output, negative
28	SPK_RP	Analog	Headphone/speaker differential right output, positive. Alternative function: ■ Differential right line output, positive
29	PIO21	Digital: Bidirectional with programmable strength internal pull up/pull-down	Programmable I/O line 21. Alternative function: ■ PCM_DOUT[2]
30	VBAT	Supply	Supply to SMPS power switch from battery. +2.7V- +3.6V power input
31	USB_DP	Digital	USB Full Speed device D+ I/O. IEC-61000-4-2 (device level) ESD Protection
32	USB_DN	Digital	USB Full Speed device D- I/O. IEC-61000-4-2 (device level) ESD Protection
33	GND		
34	PIO15	Digital: Bidirectional with programmable strength internal pull up/pull-down	Programmable I/O line 15. Alternative function: ■ MCLK_OUT
35	PIO20	Digital: Bidirectional with programmable strength internal pull up/pull-down	Programmable I/O line 20. Alternative function: ■ PCM_DOUT[1]
36	PIO5	Digital: Bidirectional with programmable strength internal pull up/pull-down	Programmable I/O line 5. Alternative function: ■ TBR_MISO[1]
37	GND	Analogue	Microphone input negative, right
38	22	Digital: Bidirectional with programmable strength internal pull up/pull-down	Programmable I/O line 22. (UART_TX)
39	23	Digital: Bidirectional with programmable strength internal pull up/pull-down	Programmable I/O line 23. (UART_RX)
40	8	Digital: Bidirectional with programmable strength internal pull up/pull-down	Programmable I/O line 8. Alternative function: ■ TBR_CLK
41	7	Digital: Bidirectional with programmable strength internal pull up/pull-down	Programmable I/O line 7. Alternative function: ■ TBR_MISO[0]

42	6	Digital: Bidirectional with programmable strength internal pull up/pull-down	Programmable I/O line 6. Alternative function: ■ TBR_MOSI[0]

Table 5：PIN Terminal Description

6. Physical Interfaces

6.1. Power Supply

- The module DC3.3V power input.
- Power supply pin connection capacitor to chip and pin as far as possible close
- Capacitor decouples power to the chip
- Capacitor prevents noise coupling back to power plane.
-

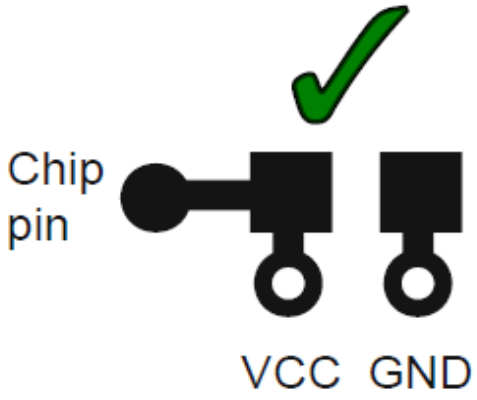

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Figure 2：Power Supply PCB Design

6.2. Reset

The module may be reset from several sources: RESETB pin, power-on reset, a UART break character or via software configured watchdog timer.

The RESETB pin is an active low RESETB and is internally filtered using the internal low frequency clock oscillator. A RESETB will be performed between 1.5 and 4.0ms following RESETB being active. It is recommended that RESETB be applied for a period greater than 5ms.

QSPI_SRAM_CS	Strong PU
QSPI_FLASH_CS	Strong PU
QSPI_SRAM_CLK	Strong PD
QSPI_FLASH_CLK	Strong PD

Table 6: Pin Status on Reset

6.3. PIO

EH-MB06 has a total of 13digital programmable I/O terminals. They are powered from VDD . Their functions depend on firmware running on the device. PIO lines can be configured through software to have either weak or strong pull-ups or pull-downs.

Note:

All PIO lines are configured as inputs with weak pull-downs at reset.

Any of the PIO lines can be configured as interrupt request lines or as wake-up lines from sleep modes.

6.4. AIO

EH-MB06 has 2 analogue I/O terminals. Their functions depend on software. Typically ADC functions can be configured to battery voltage measurement. They can also be used as a digital PIO.

6.5. RF interface

EH-MB06 internet chip antenna and U.fl port choose one of the ways. U.fl port external antenna, impedance is 50 ohm.

6.6. UART

This is a standard UART interface for communicating with other serial devices. The UART interface provides a simple mechanism for communicating with other serial devices using the RS232 protocol.

The UART CTS and RTS signals can be used to implement RS232 hardware flow control where both are active low indicators.

Parameter		Possible Values
Baud Rate	Minimum	1200 baud (≤2%Error)
		9600 baud (≤1%Error)
	Maximum	3M baud (≤1%Error)
Flow Control		RTS/CTS or None
Parity		None, Odd or Even
Number of Stop Bits		1 or 2
Bits per Byte		8

Table 7: Possible UART Settings

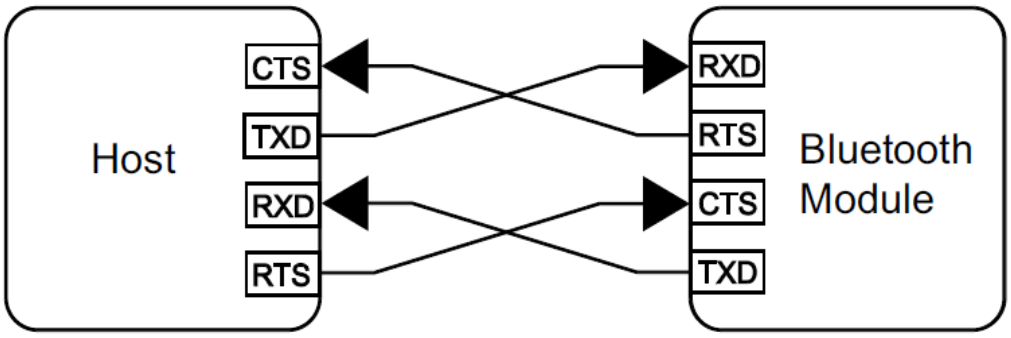


Figure 3：Connection To Host device

6.7. Digital Audio Interfaces

The audio interface circuit consists of:

- ✧ Stereo/Dual-mono audio codec

- ✧ Dual audio inputs and outputs
- ✧ 6 digital MEMS microphone inputs
- ✧ A configurable PCM, I²S or SPDIF interface

Figure 2 outlines the functional blocks of the interface. The codec supports stereo playback and recording of audio signals at multiple sample rates with a resolution of 16-bit. The ADC and the DAC of the codec each contain 2 independent channels. Any ADC or DAC channel can be run at its own independent sample rate.

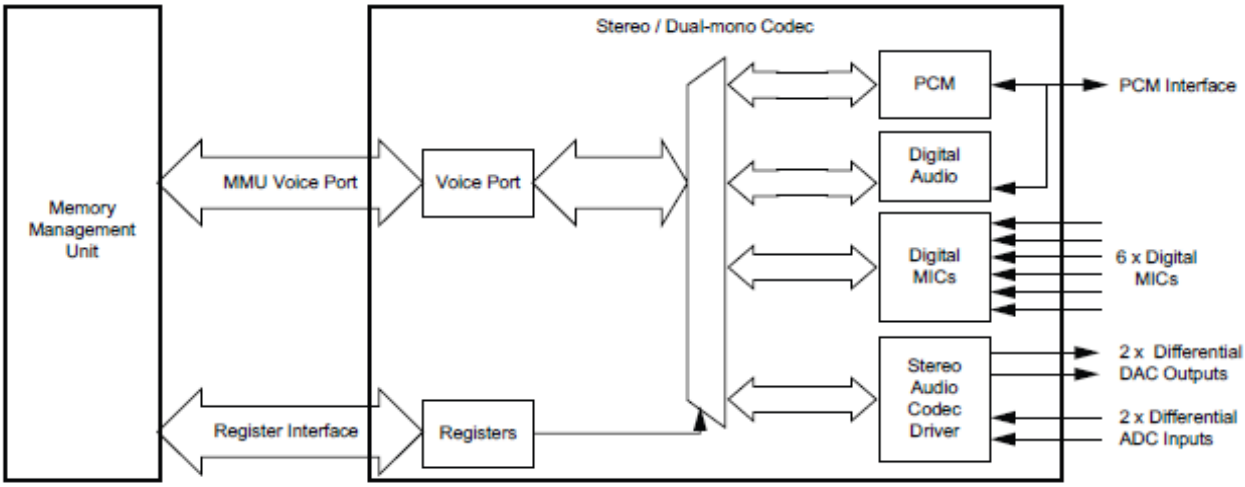


Figure 4 : Audio Interface

The interface for the digital audio bus shares the same pins as the PCM codec interface described in Table 8, which means each of the audio buses are mutually exclusive in their usage. Table 8 lists these alternative functions.

PCM Interface	SPDIF Interface	I²S Interface
PCM_OUT	SPDIF_OUT	SD_OUT
PCM_IN	SPDIF_IN	SD_IN
PCM_SYNC	-	WS
PCM_CLK	-	SCK

Table 8: Alternative Functions of the Digital Audio Bus Interface on the PCM Interface

The audio input circuitry consists of a dual audio input that can be configured to be either single-ended or fully differential and programmed for either microphone or line input. It has an analogue and digital programmable gain stage for optimization of different microphones.
The audio output circuitry consists of a dual differential class A-B output stage.

6.7.1. PCM

The audio pulse code modulation (PCM) interface supports continuous transmission and reception of PCM encoded audio data over Bluetooth.
Hardware on EH-MB06 allows the data to be sent to and received from a SCO connection. Up to three SCO connections can be supported by the PCM interface at any one time.
EH-MB06 can operate as the PCM interface master generating PCM_SYNC and PCM_CLK or as a PCM interface slave accepting externally generated PCM_SYNC and PCM_CLK.
EH-MB06 is compatible with a variety of clock formats, including Long Frame Sync, Short Frame Sync and GCI timing environments.
It supports 13-bit or 16-bit linear, 8-bit u-law or A-law companded sample formats and can receive and transmit on any selection of three of the first four slots following PCM_SYNC.
EH-MB06 interfaces directly to PCM audio devices including the following:

- Qualcomm MSM 3000 series and MSM 5000 series CDMA baseband devices
- OKI MSM7705 four channel A-law and μ-law CODEC
- Motorola MC145481 8-bit A-law and μ-law CODEC
- Motorola MC145483 13-bit linear CODEC
- STW 5093 and 5094 14-bit linear CODECs(8)
- EH-MB06 is also compatible with the Motorola SSI interface

6.7.2. Digital Audio Interface (I2S)

The digital audio interface supports the industry standard formats for I2S, left-justified or right-justified. The interface shares the same pins of the PCM interface as Table 8.

Special firmware is needed if I2S is used. Contact EHong for the special firmware when use I2S as the interface between the module and the host or the codec. The I2S support following formats.

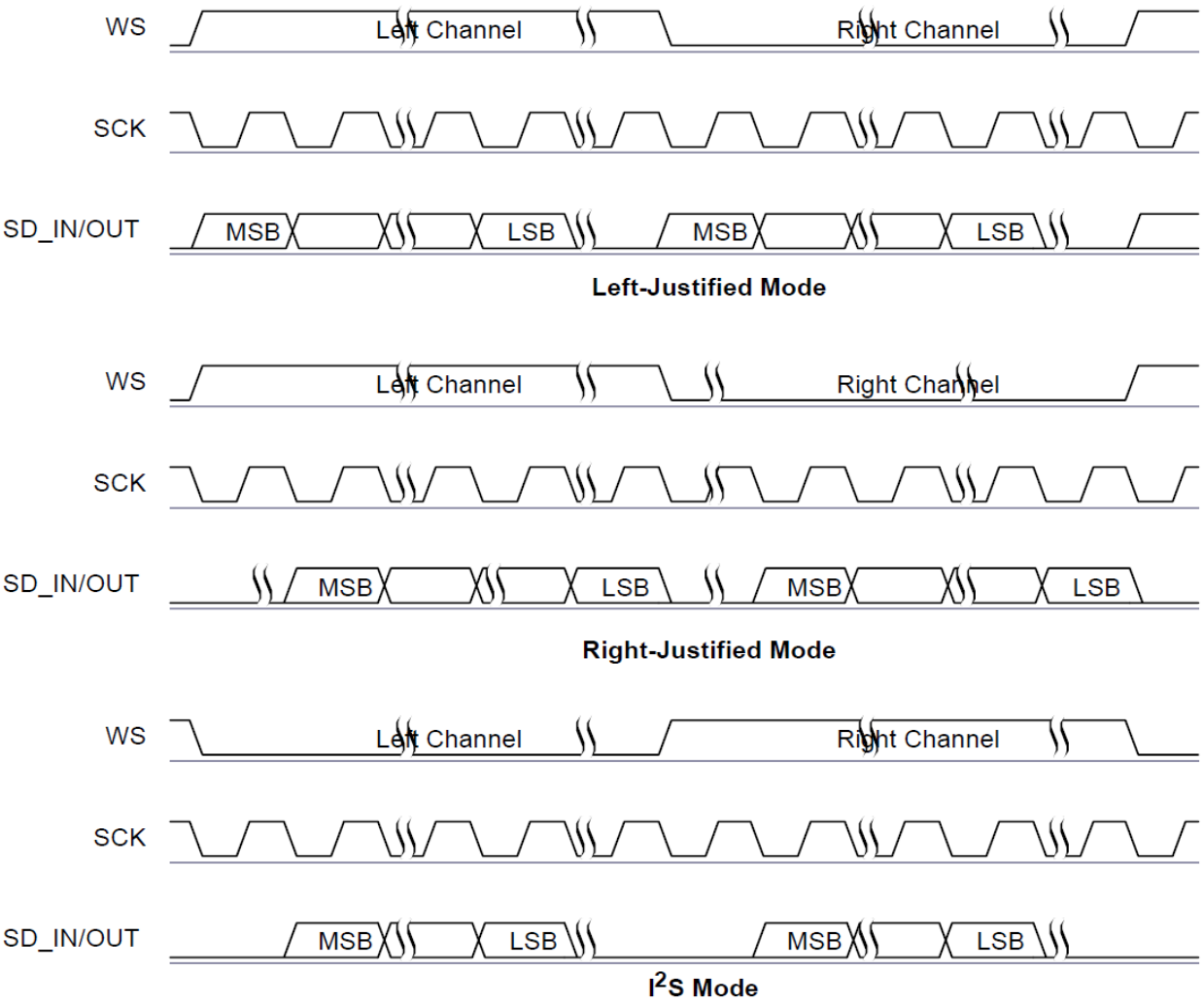


Figure 5 : Digital Audio Interface Modes

Symbol	Parameter	Min	Typical	Max	Unit
-	SCK Frequency	-	-	6.2	MHz
-	WS Frequency	-	-	96	kHz
t_{ch}	SCK high time	80	-	-	ns
t_{cl}	SCK low time	80	-	-	ns
t_{opd}	SCK to SD_OUT delay	-	-	20	ns
t_{ssu}	WS to SCK set up time	20	-	-	ns
t_{sh}	WS to SCK hold time	20	-	-	ns
t_{isu}	SD_IN to SCK set-up time	20	-	-	ns
t_{ih}	SD_IN to SCK hold time	20	-	-	ns

Table 9 : Digital Audio Interface Slave Timing

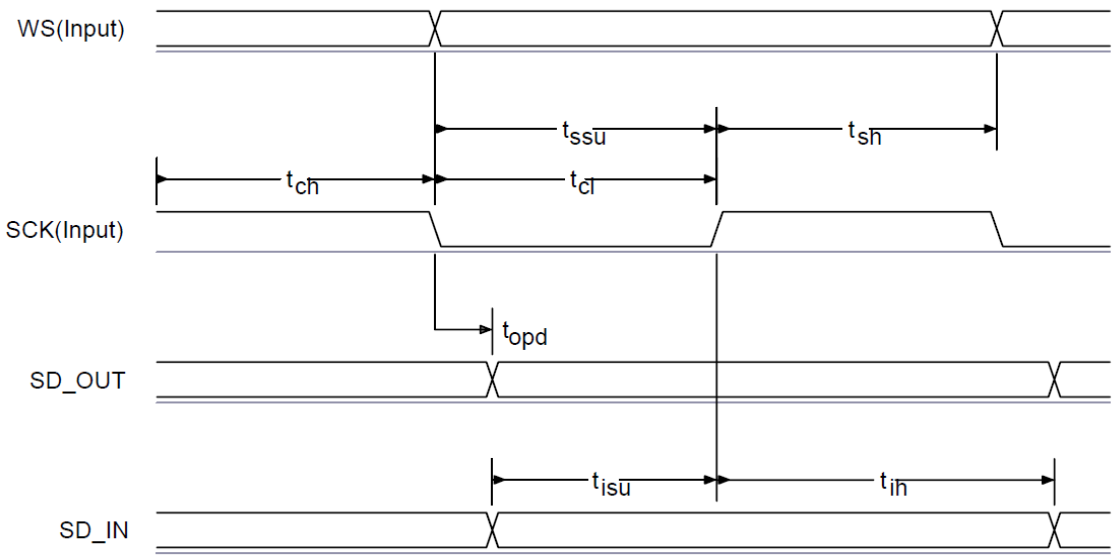


Figure 6 : Digital Audio Interface Slave Timing

Symbol	Parameter	Min	Typical	Max	Unit
-	SCK Frequency	-	-	6.2	MHz
-	WS Frequency	-	-	96	kHz
t_{opd}	SCK to SD_OUT delay	-	-	20	ns
t_{spd}	SCK to WS delay	-	-	20	ns
t_{isu}	SD_IN to SCK set-up time	20	-	-	ns
t_{ih}	SD_IN to SCK hold time	10	-	-	ns

Table 10 : Digital Audio Interface Master Timing

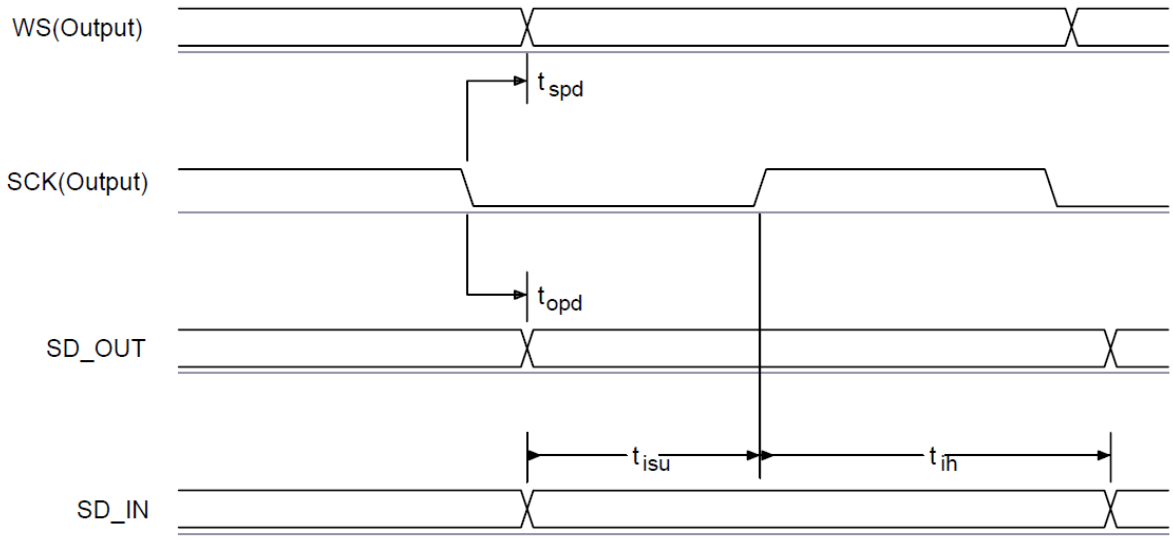


Figure 7 : Digital Audio Interface Master Timing

6.7.3. IEC 60958 Interface (SPDIF)

The IEC 60958 interface is a digital audio interface that uses bi-phase coding to minimise the DC content of the transmitted signal and allows the receiver to decode the clock information from the transmitted signal. The IEC 60958 specification is based on the 2 industry standards:

- AES/EBU
- Sony and Philips interface specification SPDIF

The interface is compatible with IEC 60958-1, IEC 60958-3 and IEC 60958-4.

The SPDIF interface signals are SPDIF_IN and SPDIF_OUT and are shared on the PCM interface pins. The input and output stages of the SPDIF pins can interface to:

- A 75Ω coaxial cable with an RCA connector, see Figure 8.
- An optical link that uses Toslink optical components, see Figure 9.

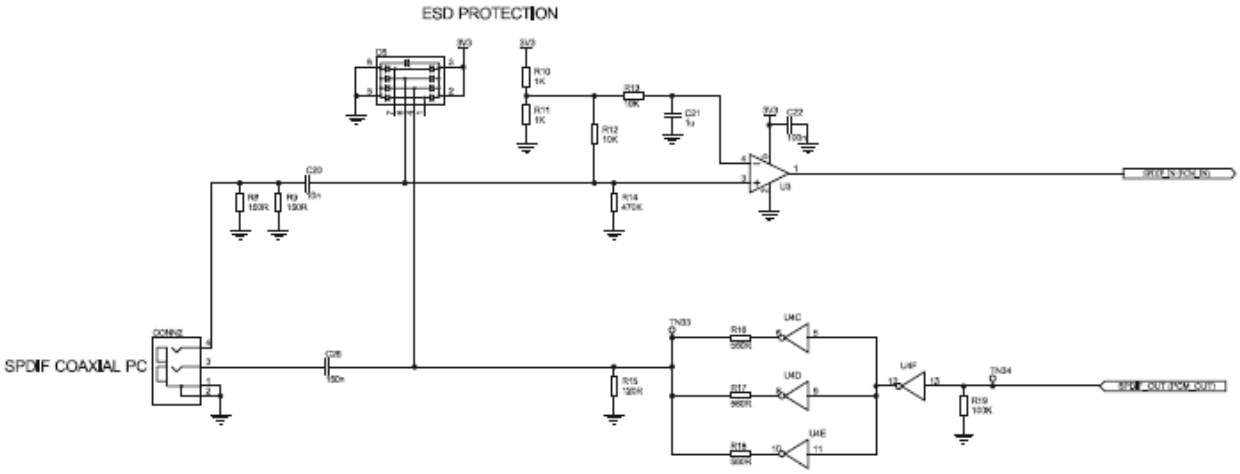


Figure 8: Example Circuit for SPDIF Interface (Co-Axial)

Figure 9: Example Circuit for SPDIF Interface (Optical)

6.8. Microphone input

The module contains 2 independent low-noise microphone bias generators. The microphone bias generators are recommended for biasing electric condensor microphones. Figure 9.6 shows a biasing circuit for microphones with a sensitivity between about -40 to -60dB (0dB = 1V/Pa):

Where:

■ The microphone bias generators derives their power from VBAT or VOUT_3V3 \ and requires no capacitor on its output.

■ The microphone bias generators maintains regulation within the limits 70μA to 2.8mA, supporting a 2mA source typically required by 2 electret condensor microphones. If the microphone sits below these limits, then the microphone output must be pre-loaded with a large value resistor to ground.

■ Biasing resistors R1 and R2 equal 2.2kΩ.

■ The input impedance at MIC_LN, MIC_LP, MIC_RN and MIC_RP is typically 6kΩ.

■ C1, C2, C3 and C4 are 100/150nF if bass roll-off is required to limit wind noise on the microphone.

■ R1 and R2 set the microphone load impedance and are normally around 2.2kΩ.

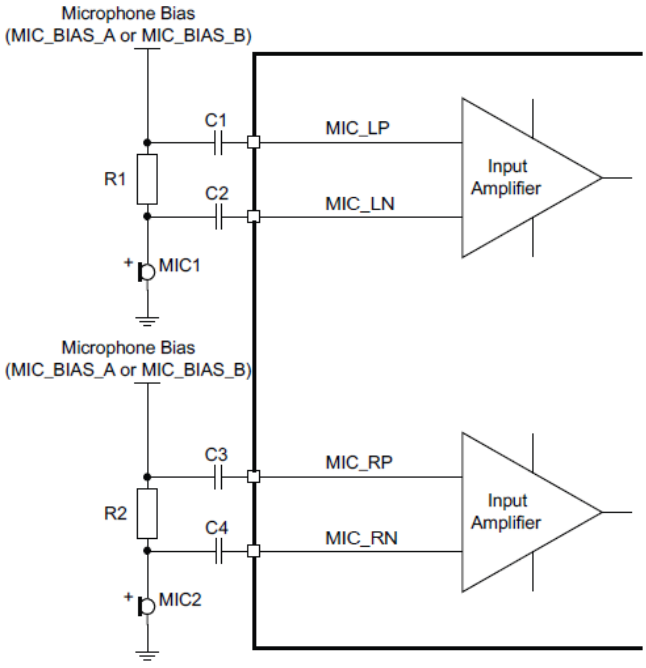


Figure 10: Microphone Biasing (Single Channel Shown)

The microphone bias characteristics include:

- Power supply:
- QCC2032 microphone supply is VBAT (via SMP_VBAT) or VOUT_3V3 (via SMPS_3V3)
- Minimum input voltage = Output voltage + drop-out voltage
- Maximum input voltage is 4.25V
- Drop-out voltage:
- 300mV maximum
- Output voltage:
- 1.8V or 2.6V
- Tolerance 90% to 110%
- Output current:
- 70μA to 2.8mA
- No load capacitor required

6.9. Analog Output stage

The output stage digital circuitry converts the signal from 16-bit per sample, linear PCM of variable sampling frequency to a 2Mbits/s 5-bit multi-bit bit stream, which is fed into the analogue output circuitry.

The output stage circuit is comprised a DAC with gain setting and class AB amplifier. The output is available as a differential signal between SPKR_A_N and SPKR_L_P for the right channel, as Figure 6 shows, and between SPKL_B_N and SPKL_B_P for the left channel.

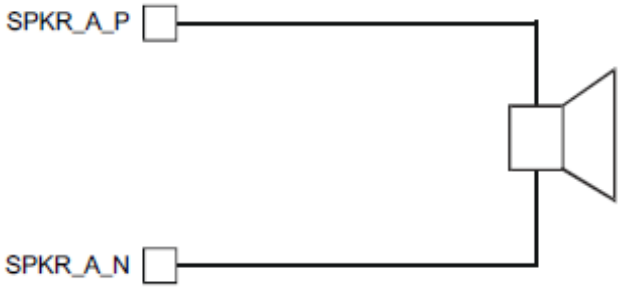


Figure 11: Speaker output

6.10. USB

This is a full speed (12M bits/s) USB interface for communicating with other compatible digital devices. The module acts as a USB peripheral, responding to request from a master host controller, such as a PC.

The USB interface is capable of driving a USB cable directly. No external USB transceiver is required. The device operates as a USB peripheral, responding to requests from a master host controller such as a PC. Both the OHCI and the UHCI standards are supported. The set of USB endpoints implemented can behave as specified in the USB section of the Bluetooth specification v2.1+EDR or alternatively can appear as a set of endpoints appropriate to USB audio devices such as speakers.

The module has an internal USB pull-up resistor. This pulls the USB_DP pin weakly high when module is ready to enumerate. It signals to the USB master that it is a full speed (12Mbit/s) USB device.

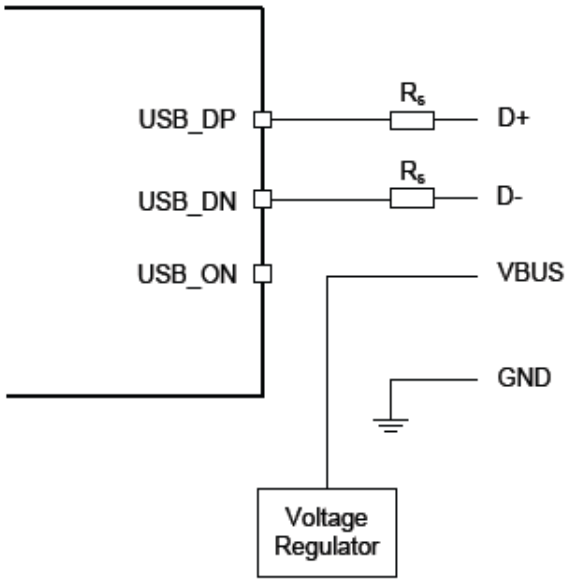


Figure 12: USB Connections

Identifier	Value	Function
R_S	27Ω Nominal	Impedance matching to USB cable

Table 11: USB Interface Component Values

Note:
USB_ON is only used when the firmware need an input to detect if USB is connected and the USB function shall be enabled. In such case it is shared with the module PIO terminals. If detection is not needed (firmware already runs with USB, such as USB DFU or USB CDC), USB_ON is not needed.

7. EH-MB06 Reference Design

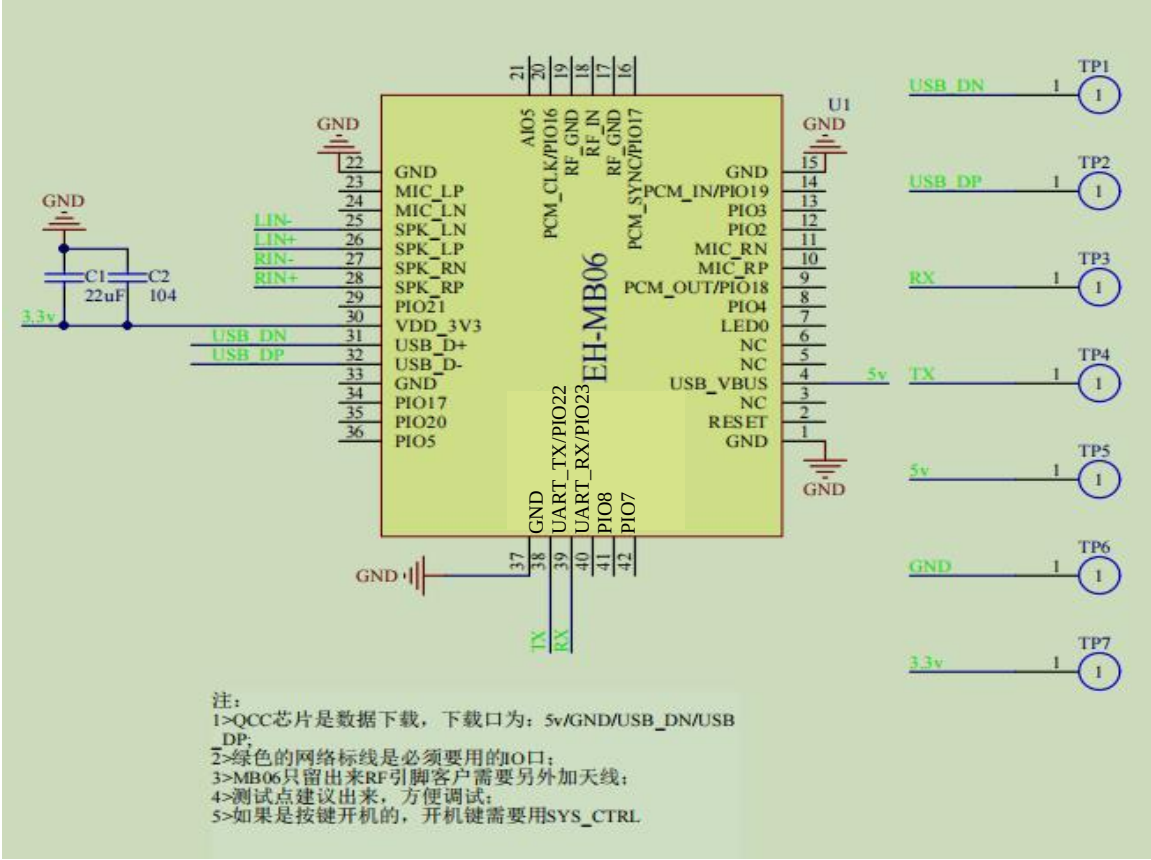


Figure 13: Reference Design

8. Mechanical and PCB Footprint Characteristics

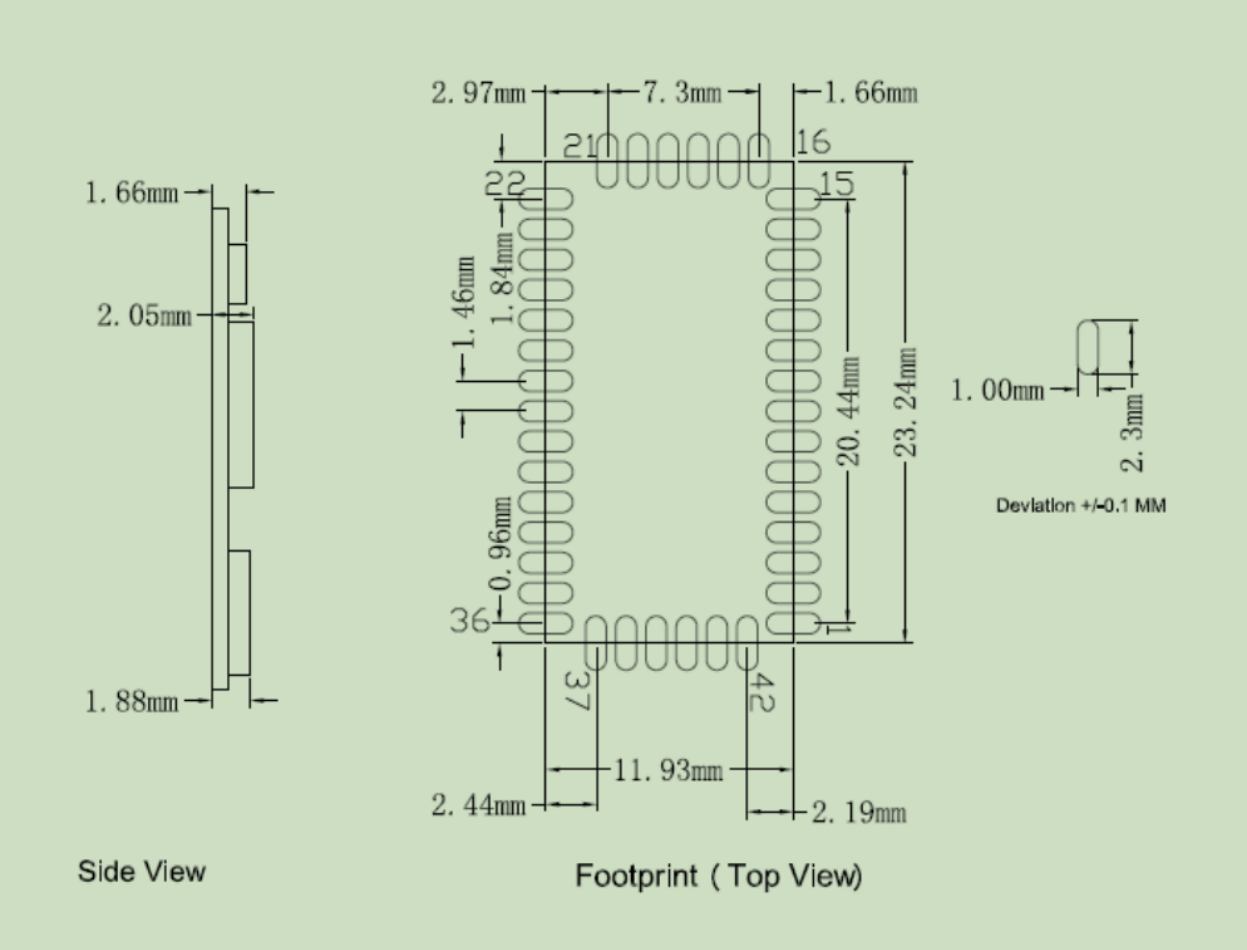


Figure 14: Recommended PCB Mounting Pattern (Unit: mm, Deviation:0.02mm)TOP View

9. RF Layout Guidelines

EH-MB30 RF design to ensure enough clearance area of antenna, area length is 1.6 times of antenna length, area width is 4 times of antenna width, the bigger the better if the space allows. Module antenna clearance area size, as follows.

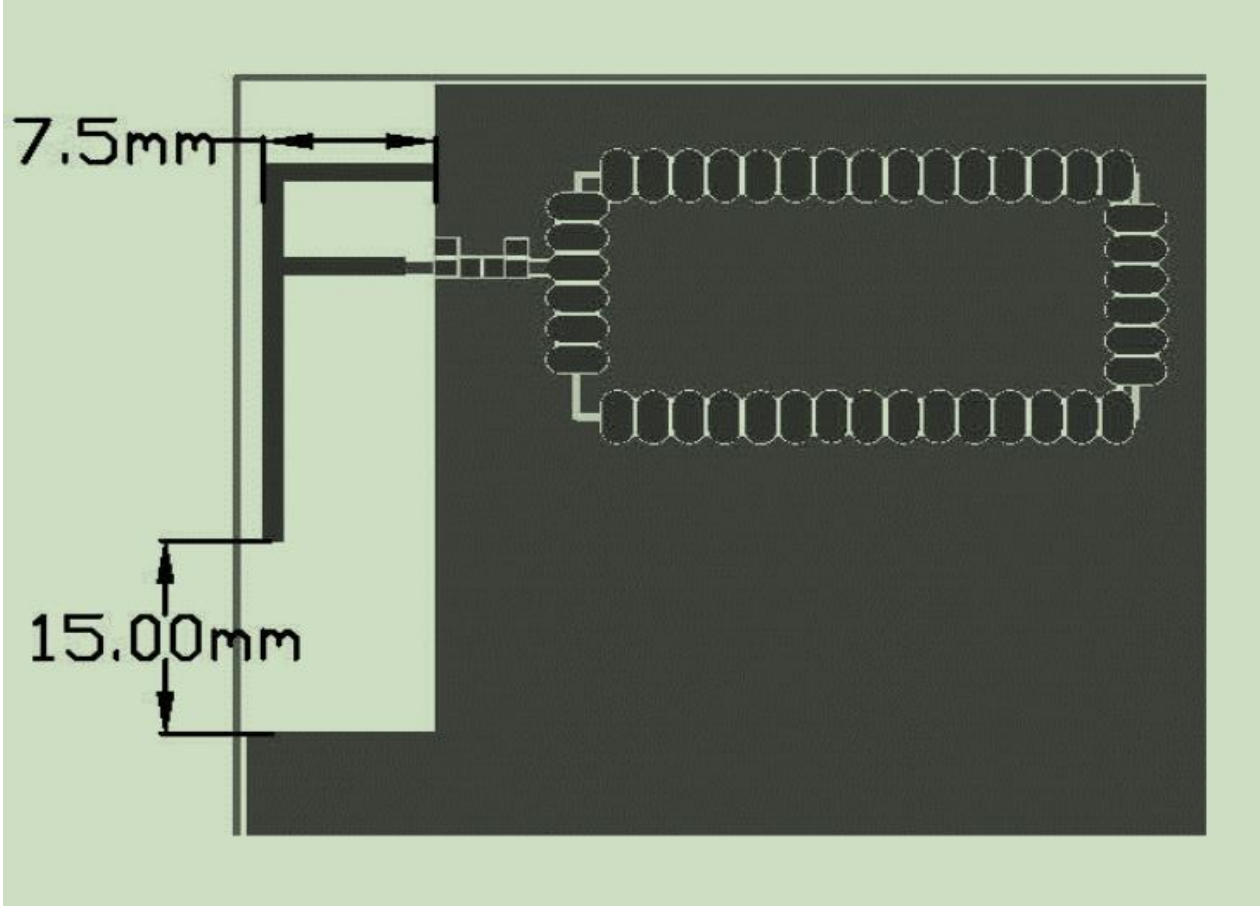


Figure 15: Clearance Area of Antenna

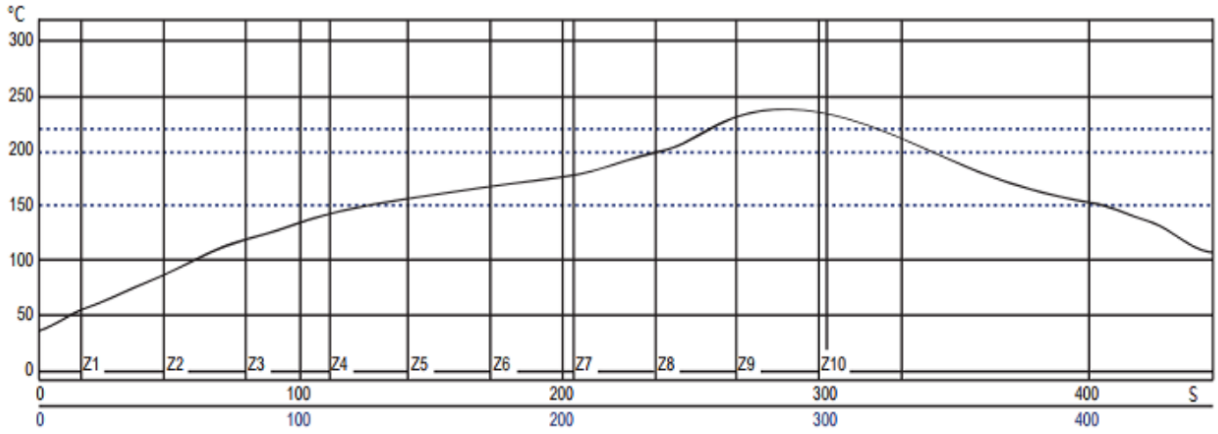
10. Soldering Recommendations

EH-MB30 is compatible with industrial standard reflow profile for Pb-free solders. The reflow profile used is dependent on the thermal mass of the entire populated PCB, heat transfer efficiency of the oven and particular type of solder paste used. Consult the datasheet of particular solder paste for profile configurations.

SMT stencil making requirements

- If Bluetooth module PIN pitch ≥ **0.25mm** and other component PIN pitch ≥ **0.25mm** ,so you choose SMT stencil thickness **1.5mm**。
- If Bluetooth module PIN pitch ≥ **0.25mm** and other component PIN pitch ≤ **0.25mm** ,so you choose SMT Ladder stencil Bluetooth module thickness **1.5mm** other component thickness 1.3mm .
- Solder pad open via ratio **Length 1:1.2**, **width 1:1.**

The EH-MW24 modules can be SMT on the board following the temperature curve graph:



11. Contact Information

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