

HCM010S Hardware Design

Bluetooth Module Series

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Safety Information

The following safety precautions must be observed during all phases of operation, such as usage, service or repair of any terminal or mobile incorporating the module. Manufacturers of the terminal should notify users and operating personnel of the following safety information by incorporating these guidelines into all manuals of the product. Otherwise, Quectel assumes no liability for customers' failure to comply with these precautions.



Full attention must be paid to driving at all times in order to reduce the risk of an accident. Using a mobile while driving (even with a handsfree kit) causes distraction and can lead to an accident. Please comply with laws and regulations restricting the use of wireless devices while driving.



Switch off the terminal or mobile before boarding an aircraft. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. If there is an Airplane Mode, it should be enabled prior to boarding an aircraft. Please consult the airline staff for more restrictions on the use of wireless devices on an aircraft.



Wireless devices may cause interference on sensitive medical equipment, so please be aware of the restrictions on the use of wireless devices when in hospitals, clinics or other healthcare facilities.



Terminals or mobiles operating over radio signal and cellular network cannot be guaranteed to connect in certain conditions, such as when the mobile bill is unpaid or the (U)SIM card is invalid. When emergency help is needed in such conditions, use emergency call if the device supports it. In order to make or receive a call, the terminal or mobile must be switched on in a service area with adequate cellular signal strength. In an emergency, the device with emergency call function cannot be used as the only contact method considering network connection cannot be guaranteed under all circumstances.



The terminal or mobile contains a transceiver. When it is ON, it receives and transmits radio frequency signals. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment.



In locations with explosive or potentially explosive atmospheres, obey all posted signs and turn off wireless devices such as mobile phone or other terminals. Areas with explosive or potentially explosive atmospheres include fueling areas, below decks on boats, fuel or chemical transfer or storage facilities, and areas where the air contains chemicals or particles such as grain, dust or metal powders.

About the Document

Revision History

Version	Date	Author	Description
-	2023-09-18	Luke Fu	Creation of the document
1.0.0	2023-09-18	Luke Fu	Preliminary

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1 Introduction

QuecOpen® is a solution where the module acts as the main processor. Constant transition and evolution of both the communication technology and the market highlight its merits. It can help you to:

- Realize embedded applications' quick development and shorten product R&D cycle
- Simplify circuit and hardware structure design to reduce engineering costs
- Miniaturize products
- Reduce product power consumption
- Apply OTA technology
- Enhance product competitiveness and price-performance ratio

This document defines HCM010S in QuecOpen® solution and describes its hardware interfaces and air interfaces, which are connected with your applications. The document provides a quick insight into interface specifications, RF performance, electrical and mechanical specifications, as well as other related information of the module.

Hereby, Quectel Wireless Solutions Co., Ltd. declares that the radio equipment type HCM010S is in compliance with Directive 2014/53/EU.

The full text of the EU declaration of conformity is available at the following internet address:

<http://www.quectel.com/support/technical.htm>

The device could be used with a separation distance of 20cm to the human body.

Disposal of old electrical appliances



The European directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE), requires that old household electrical appliances must not be disposed of in the normal unsorted municipal waste stream. Old appliances must be collected separately in order to optimize the recovery and recycling of the materials they contain, and reduce the impact on human health and the environment.

The crossed out "wheeled bin" symbol on the product reminds you of your obligation, that when you dispose of the appliance, it must be separately collected.

Consumers should contact their local authority or retailer for information concerning the correct disposal of their old appliance.

1.1. Special Marks

Table 1: Special Marks

Mark	Definition
*	Unless otherwise specified, when an asterisk (*) is used after a function, feature, interface, pin name, AT command, argument, and so on, it indicates that the function, feature, interface, pin, AT command, argument, and so on, is under development and currently not supported; and the asterisk (*) after a model indicates that the sample of the model is currently unavailable.
[...]	Brackets ([...]) used after a pin enclosing a range of numbers indicate all pins of the same type. For example, SDIO_DATA[0:3] refers to all four SDIO pins: SDIO_DATA0, SDIO_DATA1, SDIO_DATA2, and SDIO_DATA3.

2 Product Overview

HCM010S is a low-power and high performance MCU Bluetooth module, it supports BLE 5.4 protocol and Bluetooth Mesh. The module, featuring built-in 2.4 GHz Balun, integrates tunable crystal loading capacitors and PA with maximum transmitting power up to 20 dBm. It supports multiple interfaces such as USART, SWD, JTAG, I2C, ACMP, IADC and for various applications.

It is an SMD module with compact packaging. The general features of the module are as follows:

- Embedded 32-bit ARM Cortex-M33 processor with a frequency of up to 80 MHz
- 64 KB RAM memory and 768 KB Flash
- Flexible and efficient power management
- Supporting Peripheral Reflex System (PRS) for autonomous inter-peripheral signaling
- Supporting OTA (Over-The-Air Upgrade)
- Supporting secondary development

Table 2: Basic Information

HCM010S	
Packaging type	LCC
Pin counts	25
Dimensions	(20 ±0.2) mm × (15.6 ±0.2) mm × (2.35 ±0.2) mm
Weight	Approx. 1.14 g

2.1. Key Features

Table 3: Key Features

Basic Information	
Protocols and Standards	<ul style="list-style-type: none"> ● Bluetooth protocol: BLE 5.4 ● All hardware components are fully compliant with EU RoHS directive
Power Supply	VBAT Power Supply: <ul style="list-style-type: none"> ● 1.71–3.8 V ● Typ.: 3.3 V
Temperature Ranges	<ul style="list-style-type: none"> ● Operating temperature ¹: -40 to +105 °C ● Storage temperature: -45 to +115 °C
EVB Kit	HCM010S-TE-B ²
Antenna/Antenna Interface	
Antenna/Antenna Interfaces	<ul style="list-style-type: none"> ● PCB antenna ● 50 Ω characteristic impedance
Application Interface ³	
Application Interfaces	USART, SWD, JTAG, I2C, ACMP, IADC

¹ Within the operating temperature range, the module's related performance meets Bluetooth specifications.

² For more details about the EVB, see **document [1]**.

³ For more details about the interfaces, see **Chapter 0** and **Chapter 3.4**.

3 Application Interfaces

3.1. Pin Assignment

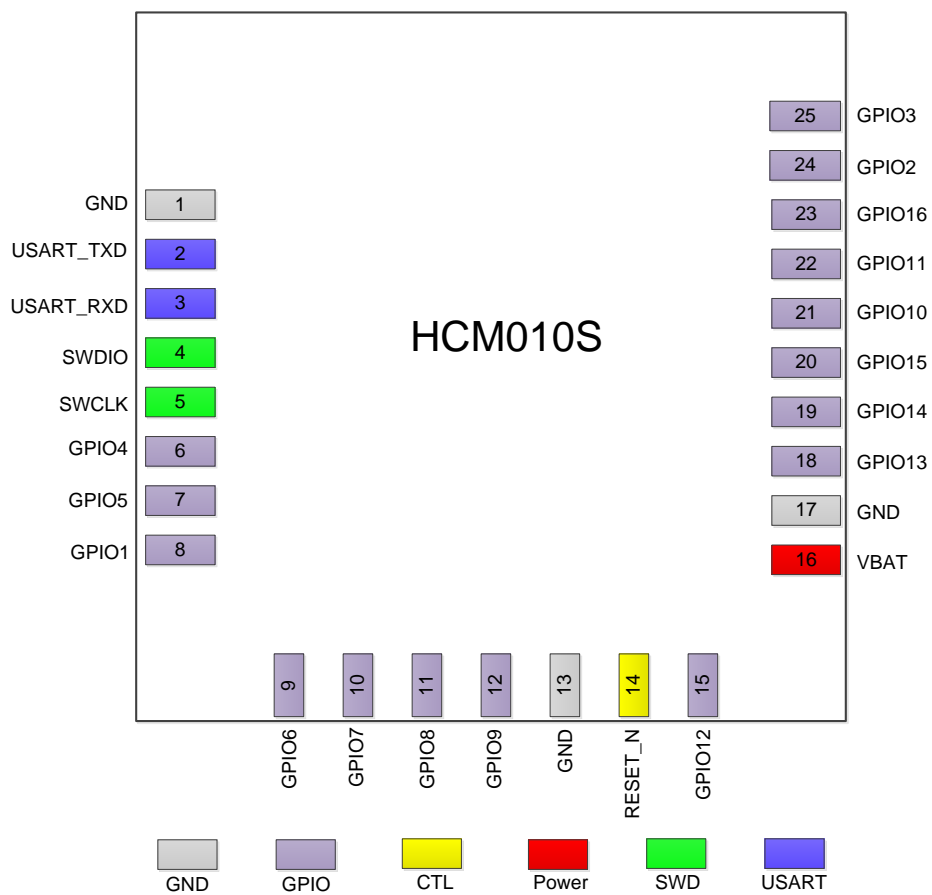


Figure 1: Pin Assignment (Top View)

NOTE

1. Keep all unused pins unconnected.
2. All GND pins should be connected to ground.
3. The module provides 16 GPIO interfaces by default. In the case of multiplexing it supports interfaces including USART, SWD, JTAG, I2C, ACMP, IADC. For more details, see **Chapter 3.3**

and *Chapter 3.4*.

3.2. Pin Description

Table 4: Parameter Description

Parameter	Description
DI	Digital Input
DO	Digital Output
DIO	Digital Input/Output
PI	Power Input

DC characteristics include power domain and rated current.

Table 5: Pin Description

Power Supply					
Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
VBAT	16	PI	Power supply for the module	V _{max} = 3.8 V V _{min} = 1.71 V V _{nom} = 3.3 V	It must be provided with sufficient current of more than 0.3 A.
GND	1, 13, 17				
Reset					
Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
RESET_N	14	DI	Reset the module	VBAT	Hardware reset. Internally pulled up to VBAT. Active low.
USART					
Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment

USART_TX D	2	DO	USART transmit	VBAT	Used for debugging.
USART_RX D	3	DI	USART receive		
SWD Interface					
Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
SWDIO	4	DIO	Serial data input/ output	VBAT	Used for program downloading.
SWCLK	5	DI	Serial clock input		
GPIO Interfaces					
Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
GPIO4	6	DIO	General-purpose input/output	VBAT	The GPIO subsystem supports asynchronous external pin interrupts.
GPIO5	7	DIO	General-purpose input/output		
GPIO1	8	DIO	General-purpose input/output		
GPIO6	9	DIO	General-purpose input/output		
GPIO7	10	DIO	General-purpose input/output		
GPIO8	11	DIO	General-purpose input/output		
GPIO9	12	DIO	General-purpose input/output		
GPIO12	15	DIO	General-purpose input/output		
GPIO13	18	DIO	General-purpose input/output		
GPIO14	19	DIO	General-purpose input/output		
GPIO15	20	DIO	General-purpose input/output		
GPIO10	21	DIO	General-purpose input/output		
GPIO11	22	DIO	General-purpose input/output		

GPIO16	23	DIO	General-purpose input/output
GPIO2	24	DIO	General-purpose input/output
GPIO3	25	DIO	General-purpose input/output

3.3. GPIO Multiplexing

The module provides 16 GPIO interfaces by default, and can support up to 20 GPIO interfaces in the case of multiplexing. Pins are defined as follows:

Table 6: GPIO Multiplexing (Digital Pins)

Multiplexing Function	GPIO Interface			
	USART_TXD, USART_RXD, SWDIO, SWCLK, GPIO1~3	GPIO4~5	GPIO6~11	GPIO12~16
ACMP0_DIGOUT	√	√	√	√
ACMP1_DIGOUT	√	√	√	√
CMU_CLKIN0	-	-	√	√
CMU_CLKOUT0	-	-	√	√
CMU_CLKOUT1	-	-	√	√
CMU_CLKOUT2	√	√	-	-
FRC_DCLK	-	-	√	√
FRC_DFRAME	-	-	√	√
FRC_DOUT	-	-	√	√
I2C0_SCL	√	√	√	√
I2C0_SDA	√	√	√	√
I2C1_SCL	-	-	√	√
I2C1_SDA	-	-	√	√
LETIMER0_OUT0	√	√	-	-

LETIMER0_OUT1	√	√	-	-
MODEM_ANT0	√	√	√	√
MODEM_ANT1	√	√	√	√
MODEM_DCLK	√	√	-	-
MODEM_DIN	√	√	-	-
MODEM_DOUT	√	√	-	-
PRS_ASYNCH0	√	√	-	-
PRS_ASYNCH1	√	√	-	-
PRS_ASYNCH10	-	-	√	√
PRS_ASYNCH11	-	-	√	√
PRS_ASYNCH2	√	√	-	-
PRS_ASYNCH3	√	√	-	-
PRS_ASYNCH4	√	√	-	-
PRS_ASYNCH5	√	√	-	-
PRS_ASYNCH6	-	-	√	√
PRS_ASYNCH7	-	-	√	√
PRS_ASYNCH8	-	-	√	√
PRS_ASYNCH9	-	-	√	√
PRS_SYNCH0	√	√	√	√
PRS_SYNCH1	√	√	√	√
PRS_SYNCH2	√	√	√	√
PRS_SYNCH3	√	√	√	√
TIMER0_CC0	√	√	√	√
TIMER0_CC1	√	√	√	√
TIMER0_CC2	√	√	√	√
TIMER0_CDTI0	√	√	√	√

TIMER0_CDTI1	√	√	√	√
TIMER0_CDTI2	√	√	√	√
TIMER1_CC0	√	√	√	√
TIMER1_CC1	√	√	√	√
TIMER1_CC2	√	√	√	√
TIMER1_CDTI0	√	√	√	√
TIMER1_CDTI1	√	√	√	√
TIMER1_CDTI2	√	√	√	√
TIMER2_CC0	√	√	-	-
TIMER2_CC1	√	√	-	-
TIMER2_CC2	√	√	-	-
TIMER2_CDTI0	√	√	-	-
TIMER2_CDTI1	√	√	-	-
TIMER2_CDTI2	√	√	-	-
TIMER3_CC0	-	-	√	√
TIMER3_CC1	-	-	√	√
TIMER3_CC2	-	-	√	√
TIMER3_CDTI0	-	-	√	√
TIMER3_CDTI1	-	-	√	√
TIMER3_CDTI2	-	-	√	√
USART0_CLK	√	√	√	√
USART0_CS	√	√	√	√
USART0_CTS	√	√	√	√
USART0_RTS	√	√	√	√
USART0_RXD	√	√	√	√
USART0_TXD	√	√	√	√

USART1_CLK	√	√	-	-
USART1_CS	√	√	-	-
USART1_CTS	√	√	-	-
USART1_RTS	√	√	-	-
USART1_RXD	√	√	-	-
USART1_TXD	√	√	-	-
USART2_CLK	-	-	√	√
USART2_CS	-	-	√	√
USART2_CTS	-	-	√	√
USART2_RTS	-	-	√	√
USART2_RXD	-	-	√	√
USART2_TXD	-	-	√	√

Table 7: GPIO Multiplexing (Analog Pins)

Interface	Signal	USART_TXD, USART_RXD, SWDIO, SWCLK, GPIO1–3		GPIO4–5		GPIO6–11		GPIO12–16	
		EVEN	ODD	EVEN	ODD	EVEN	ODD	EVEN	ODD
ACMP0	ana_neg	√	√	√	√	√	√	√	√
	ana_pos	√	√	√	√	√	√	√	√
ACMP1	ana_neg	√	√	√	√	√	√	√	√
	ana_pos	√	√	√	√	√	√	√	√
IADC0	ana_neg	√	√	√	√	√	√	√	√
	ana_pos	√	√	√	√	√	√	√	√

Notes:

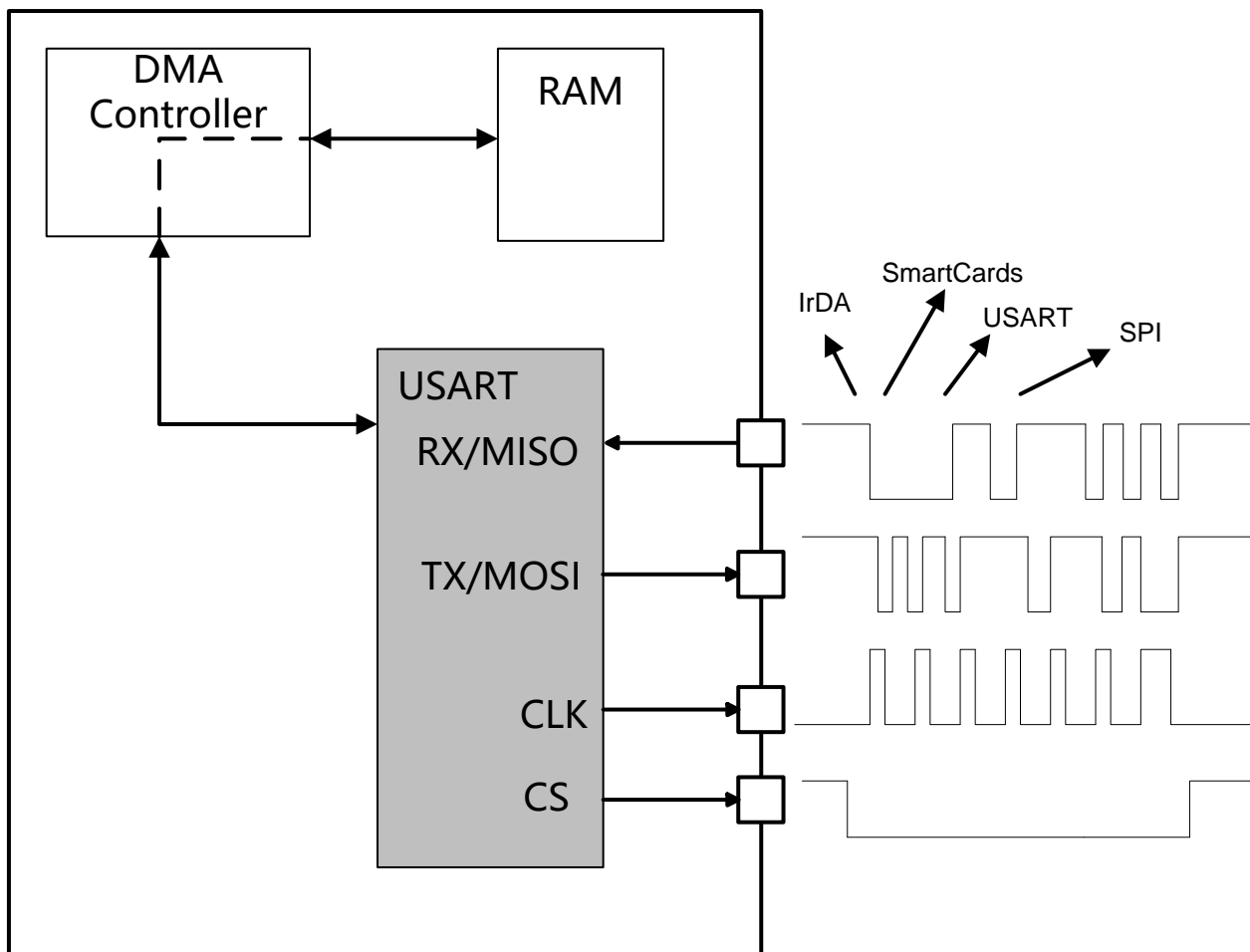
1. USART_TXD、USART_RXD、SWDIO、SWCLK、GPIO1~5 pins are EM2 capable;
2. These pins may be used by Low-Energy peripherals in EM2/3 and may also be used as EM2/3 pin wake-ups.
3. GPIO6-GPIO16 pins are latched/retained in their current state when entering EM2 until EM2 exit upon which internal peripherals could once again drive those pads.
4. GPIO8 GPIO11 GPIO4 USART_TXD and GPIO15 pins also have EM4 wake functionality.

3.4. Application Interfaces

3.4.1. USARTs

The Universal Synchronous/Asynchronous Receiver/Transmitter is a flexible serial I/O module. It supports full duplex asynchronous UART communication with hardware flow control as well as RS-485, SPI, MicroWire and 3-wire. It can also interface with devices supporting:

- Smart-Cards (ISO7816)
- IrDA
- I2S



The USART operates in either asynchronous or synchronous mode:

In synchronous mode, a separate clock signal generated by the bus master is transmitted with the data. Both the master and slave transmit data according to this clock. The synchronous communication mode is compatible with the SPI Bus standard.

In asynchronous mode, no separate clock signal is transmitted with the data on the bus. The USART receiver thus has to determine where to sample the data on the bus from the actual data. To make it possible, additional synchronization bits are added to the data when operating in asynchronous mode.

Asynchronous or synchronous mode can be selected by configuring SYNC in register (USARTn_CTRL). The options are listed with supported protocols are listed below:

Table 8: USART Synchronous/Asynchronous Mode

SYNC	Communication Mode	Protocol
0	Asynchronous	RS-232, RS-485 (w/external driver), IrDA, ISO 7816
1	Synchronous	SPI, MicroWire, 3-wire

USART can be used as UART for AT command communication, data transmission. In such case, it supports self-configurable baud rate with default baud rate of 115200 bps. The USART connection between the module and MCU is illustrated below (The dotted lines are optional as required).

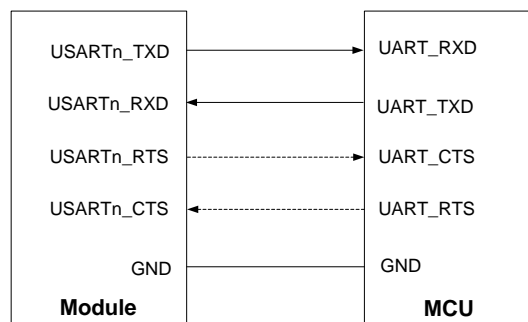


Figure 2: UART Connection

The USART can be used as debug UART for outputting partial logs with debugging tools and supports 115200 bps baud rate by default. The following is a reference design for debug USART used as debug UART.

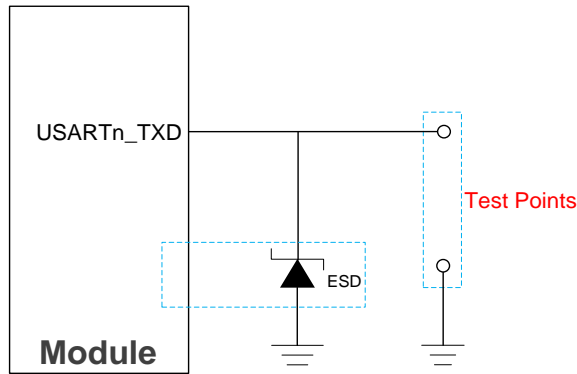


Figure 3: Debug UART Reference Circuit

The following figure shows the USART connection between the module and the host when used as SPI.

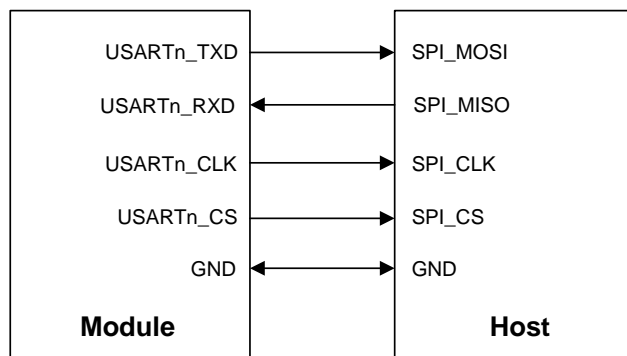


Figure 4: SPI Connection

The following figure shows the USART connection between the module and the host when used as I2S.

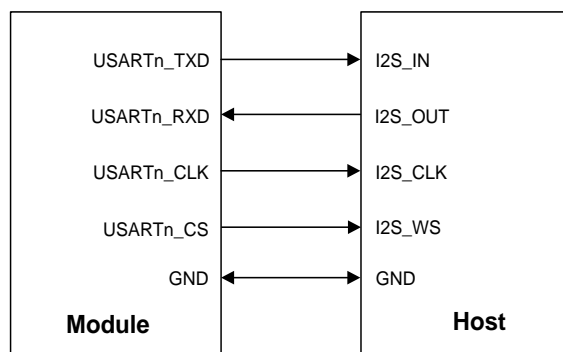


Figure 5: I2S Connection

The following figure shows the USART connection between the module and the host when used as RS485.

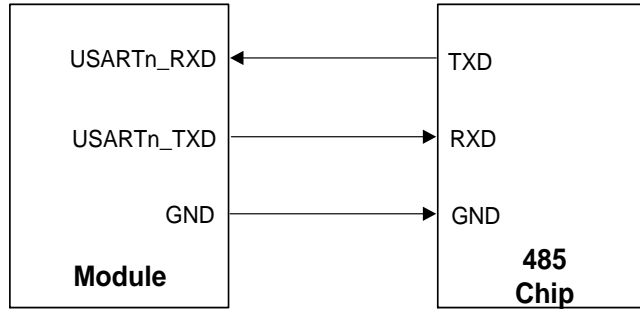


Figure 6: RS485 Connection

3.4.2. SWD Interface

The module supports 1 SWD interface which can be multiplexed as JTAG interface. It is recommended to select the debugging interface for firmware upgrade and debugging based on the actual hardware design. The pin definitions of SWD interface are shown in the table below.

Table 9: Pin Definition of SWD Interface

Pin Name	Pin No.	I/O	Description	Comment
SWDIO	4	DIO	Serial data input/output	Enabled after power-up and has a built-in pull-up.
SWCLK	5	DI	Serial clock input	Enabled after power-up and has a built-in pull-down.

The SWD interface supports online program writing and the common connection of SWD interface is shown below.

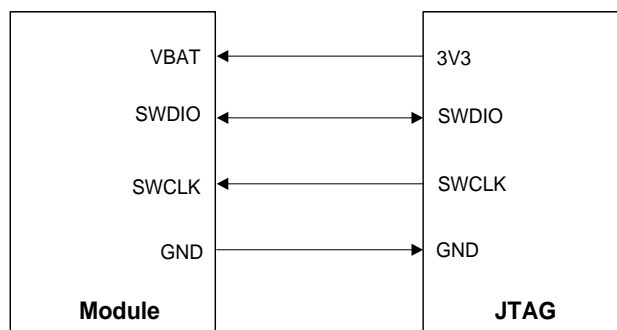


Figure 7: SWD Interface Connection

In the case of multiplexing, the module supports JTAG interface. The JTAG function can only be enabled after power-down resetting to return debugging configuration when necessary. The pin definitions of JTAG interface are shown in the table below.

Table 10: Pin Definition of JTAG Interface

Pin Name	Pin No.	Multiplexing Function	I/O	Description	Comment
SWDIO	4	JTAG_TMS	DIO	JTAG test mode select	Enabled after power-up and has a built-in pull-up.
SWCLK	5	JTAG_TCK	DI	JTAG test clock	Enabled after power-up and has a built-in pull-down
GPIO2	24	JTAG_TDO	DO	JTAG test data output	remains in high-Z state until the first valid JTAG command is received.
GPIO3	25	JTAG_TDI	DI	JTAG test data input	remains in high-Z state until the first valid JTAG command is received. Once enabled, the pin has a built-in pull-up.

The JTAG interface supports debugging and program writing and the common connection of JTAG interface is shown below.

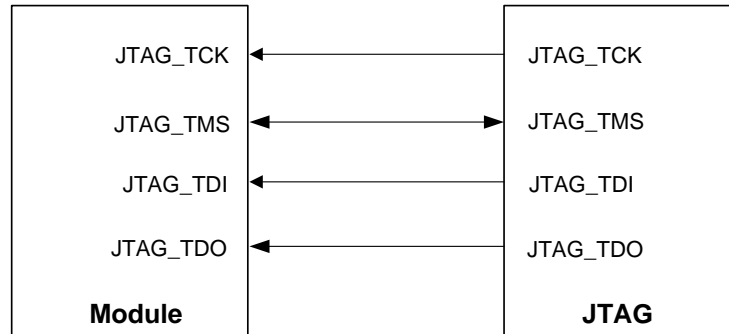


Figure 8: JTAG Interface Connection

Upon disabling the debug pins, the device can no longer be accessed by a debugger. A reset will set the debug pins back to their enabled default state. The register (GPIO_DBGROUPEPEN) can only be updated when the debugger is disconnected from the system. Any attempts to modify GPIO_DBGROUPEPEN when the debugger is connected will not occur. Keep at least 3 s before running the program to disable the debug pins.

3.4.3. I2C Interfaces

In the case of multiplexing, the module supports up to 2 I2C interfaces capable of acting as both a

master and a slave and supports multi-master buses. Standard-mode(100kbps), fast-mode(400kbps) and fast-mode plus (1Mbps) speeds are supported, Slave arbitration and timeouts are also provided to allow implementation of an SMBus compliant system. The interface provided to software by the I2C module allows precise control of the transmission process and highly automated transfers. Automatic recognition of slave addresses is provided in all energy modes (except EM4).

Both the bus lines are open-drain. The maximum value of the pull-up resistor can be calculated as a function of the maximal rise-time t_r for the given bus speed, and the estimated bus capacitance C_b as shown:

$$R_p(\max) = t_r / (0.8473 \times C_b).$$

The maximal rise times for 100 kHz, 400 kHz and 1 MHz I2C are 1 μ s, 300 ns and 120 ns respectively.

3.4.4. ACMP Interface

The ACMP is used to compare the voltage of two analog inputs, with a digital output indicating which input voltage is higher. Inputs are selected from among internal references and external pins. The tradeoff between response time and current consumption is configurable by software. Two 6-bit reference dividers allow for a wide range of internally-programmable reference sources. The ACMP can also be used to monitor the supply voltage. An interrupt can be generated when the supply falls below or rises above the programmable threshold.

The key features of ACMP interface are as follows:

- Internal and external input selections:
 - External I/O ports
 - Internal 1.25 V bandgap reference voltage with programmable divider
 - Internal 2.5 V bandgap reference voltage with programmable divider
 - VBAT reference voltage
- VBAT voltage supply monitoring
- Selectable response time
- Operational in EM0 to EM3
- Asynchronous interrupt generation on selectable edges
- Configurable output state when inactive
- Comparator output available on PRS

The ACMP interface can be multiplexed with GPIOs. See **Table 7** for more details of the multiplexing functions. When a differential connection is being used, positive inputs are restricted to the EVEN pins and negative inputs are restricted to the ODD pins. When a single ended connection is being used, positive input is available on all pins.

3.4.5. IADC Interfaces

The module supports IADC interfaces multiplexed with GPIOs, and see **Table 7** for more details. IADC is a hybrid architecture combining techniques from both SAR and Delta-Sigma style converters with a resolution of 12 bits when operating at one million samples per second (1 Msps). The flexible incremental architecture uses oversampling to allow applications to trade speed for higher resolution.

The key features of ACMP interface are as follows:

- Flexible oversampled architecture allows for tradeoffs between speed and resolution:
 - 1 Msps with oversampling ratio = 2
 - 555 ksps with oversampling ratio = 4
- Internal and external conversion trigger sources
 - Immediate (software triggered)
 - Local IADC timer
 - External TIMER module (synchronous with output/PWM generation)
 - General PRS hardware signal
- Integrated pre-scaler for conversion clock generation
- Can be run during EM2 and EM3, waking up the system on interrupts as needed
- Selectable reference sources
 - 1.21 V internal reference
 - External precision reference
- Support for offset and gain calibration
- Programmable input gain: 0.5x, 1x, 2x, 3x, or 4x
- Flexible output formatting
- Programmable single channel conversion
- Autonomous multi-channel scan
- Multiple interrupt resources

3.4.6. GPIO Interfaces

In the case of multiplexing, the module supports up to 20 GPIO interfaces which can all be individually configured as either an output or input. More advanced configurations like open-drain, open-source, and glitch filtering can be configured for each individual GPIO pin. After a reset, both input and output are disabled for all pins on the device, except for the Serial Wire Debug pins. Peripheral resources, like Timer PWM outputs or USART RX/TX can be routed to the GPIO pins as desired by the user. Finally, the input value of a pin can be routed through the Peripheral Reflex System to other peripherals or used to trigger an external interrupt.

4 Operating Characteristics

4.1. Power Supply

Power supply pin and ground pins of the module are defined in the following table.

Table 11: Pin Definition of Power Supply and GND Pins

Pin Name	Pin No.	I/O	Description	Min.	Typ.	Max.	Unit
VBAT	16	PI	Power supply for the module	1.71	3.3	3.8	V
GND	1, 13, 17						

4.1.1. Reference Design for Power Supply

The module is powered by VBAT, and it is recommended to use a power supply chip that can provide more than 0.3 A output current. For better power supply performance, it is recommended to parallel a 22 μF decoupling capacitor, and two filter capacitors (1 μF and 100 nF) near the module's VBAT pin. C4 is reserved for debugging and not mounted by default. In addition, it is recommended to add a TVS near the VBAT to improve the surge voltage bearing capacity of the module. In principle, the longer the VBAT trace is, the wider it should be.

VBAT reference circuit is shown below:

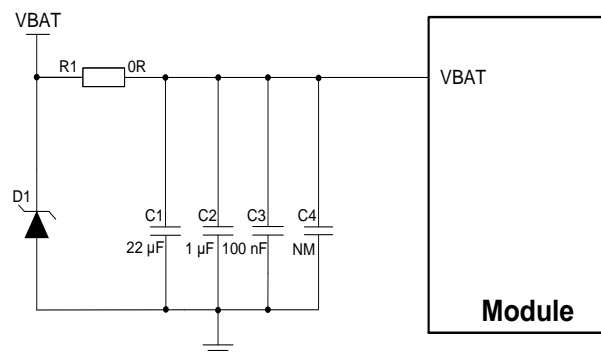


Figure 9: VBAT Reference Circuit

4.2. Turn On

The module can automatically start up after the VBAT is powered on.

The turn-on timing is shown below:

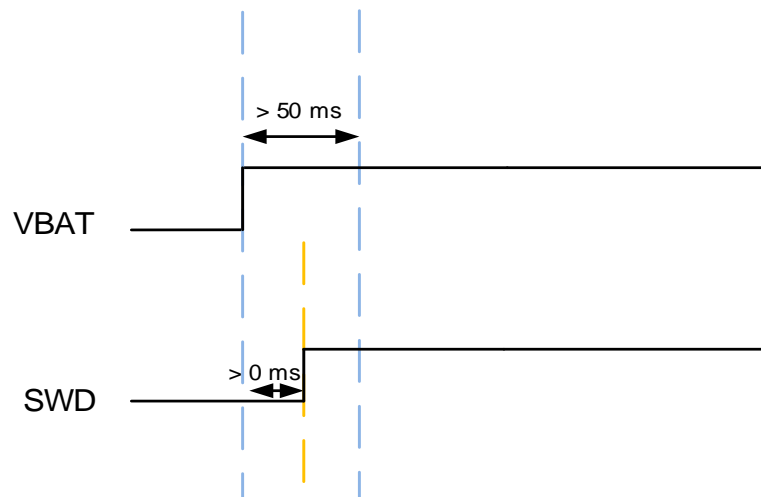


Figure 10: Turn-on Timing

4.3. Reset

Pull the RESET_N up for at least 50 ms and then release it to reset the module.

Table 12: Pin Definition of RESET_N

Pin Name	Pin No.	I/O	Description	Comment
RESET_N	14	DI	Reset the module	Hardware reset. Internally pulled up to VBAT. Active high.

The reference design for resetting the module is shown below. Pull up the button directly to realize the resetting of the module. At the same time, it is recommended to place a TVS near the button for ESD protection.

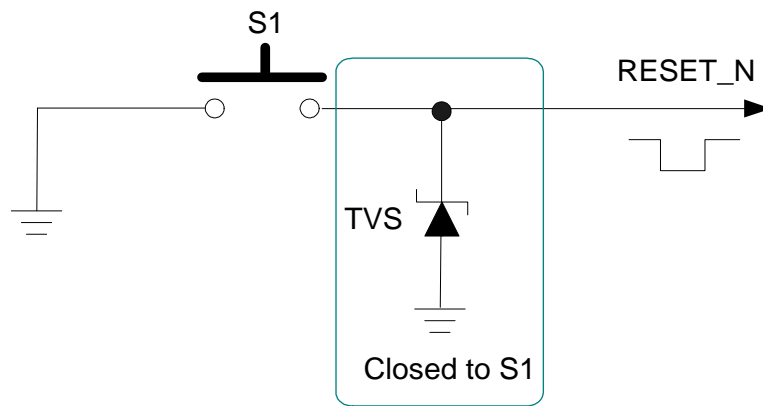


Figure 11: Reference Circuit of RESET with a Button

The module reset timing is illustrated in the following figure.

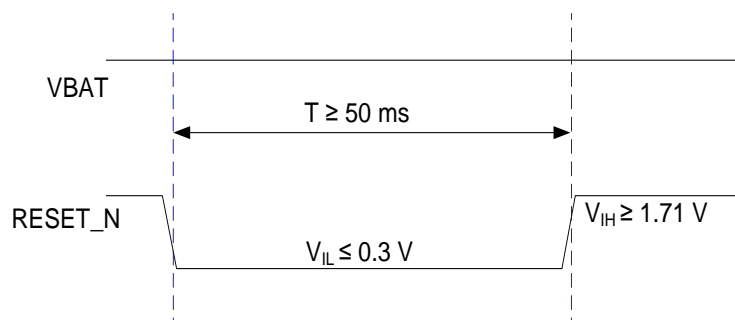


Figure 12: Reset Timing

5 RF Performances

5.1. Bluetooth Performances

Table 13: Bluetooth Performances

Operating Frequency		
2.400–2.4835 GHz		
Modulation		
GFSK		
Operating Mode		
BLE		
Condition (VBAT = 3.3 V; Temp. 25°C)	Transmitting Power (Typ.)	Receiving Sensitivity (Typ.)
BLE (1 Mbps)	≤ 20 dBm	-97.5 dBm ±2 dB
BLE (2 Mbps)	≤ 20 dBm	-94.5 dBm ±2 dB
BLE (125 Kbps)	≤ 20 dBm	-105 dBm ±2 dB
BLE (500 Kbps)	≤ 20 dBm	-100.5 dBm ±2 dB

5.2. Antenna Interface

The module is provided PCB antenna.

Table 14: PCB Antenna Specifications

Parameter	Specification
-----------	---------------

Frequency Range (GHz)	2.400–2.500
Input Impedance (Ω)	50
VSWR	≤ 2
Gain (dBi)	-1.8 (Max.)
Efficiency	34 %(Average)

When using the PCB antenna, the module should be placed on the edge of the motherboard. The PCB antenna should be at least 16 mm away from the vias, traces, copper pour area, and other components on the motherboard, including connectors, ethernet ports and any metal components. On the motherboard, all PCB layers under the PCB antenna should be designed as a keep-out area.

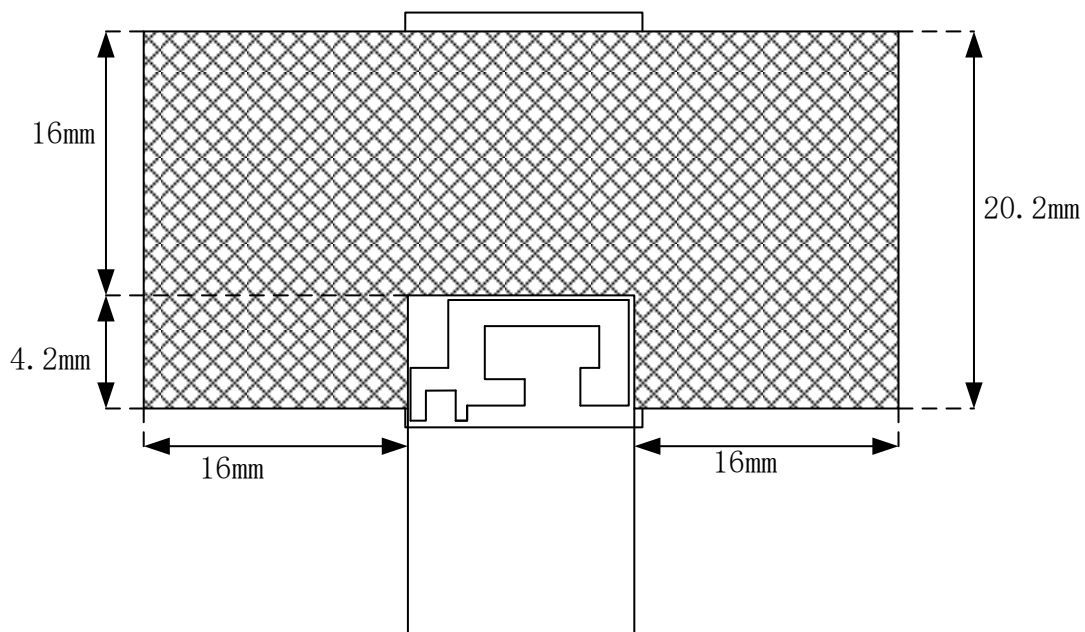


Figure 13: Keep-out Area on Motherboard

During PCB design, do not route traces across the RF test point at the bottom of the module to ensure the module performance.

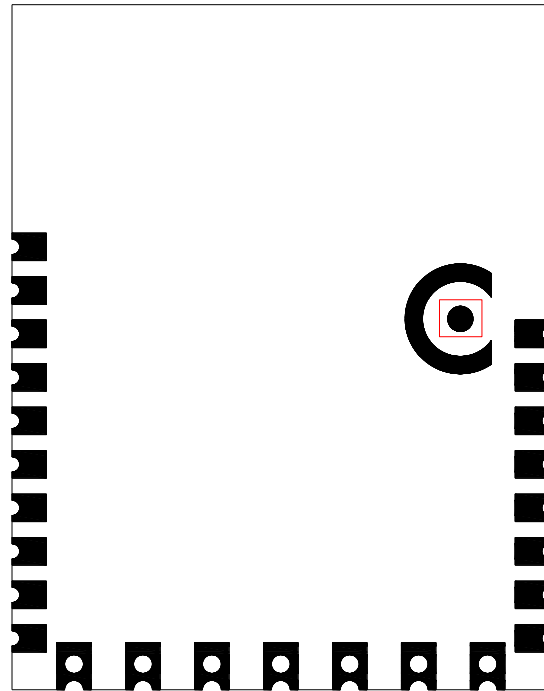


Figure 14: Prohibited Area for Routing

6 Electrical Characteristics & Reliability

6.1. Absolute Maximum Ratings

Absolute maximum ratings for power supply and voltage on digital and analog pins of the module are listed in the following table.

Table 15: Absolute Maximum Ratings (Unit: V)

Parameter	Min.	Max.
VBAT	-0.3	3.8
Voltage at Digital Pins	-0.3	4.1
Voltage at ADC[0:3]	0	3.8

6.2. Power Supply Ratings

Table 16: Module Power Supply Ratings (Unit: V)

Parameter	Description	Condition	Min.	Typ.	Max.
VBAT	Power supply for the module	The actual input voltages must be kept between the minimum and maximum values.	1.71	3.3	3.8

6.3. Digital I/O Characteristics

Table 17: VBAT I/O Characteristics (Unit: V)

Parameter	Description	Min.	Max.
V_{IH}	High-level input voltage	$0.7 \times V_{BAT}$	V_{BAT}
V_{IL}	Low-level input voltage	-0.3	$0.3 \times V_{BAT}$
V_{OH}	High-level output voltage	$0.9 \times V_{BAT}$	V_{BAT}
V_{OL}	Low-level output voltage	0	$0.1 \times V_{BAT}$

6.4. ESD Protection

Static electricity occurs naturally and may damage the module. Therefore, applying proper ESD countermeasures and handling methods is imperative. For example, wear anti-static gloves during the development, production, assembly and testing of the module; add ESD protection components to the ESD sensitive interfaces and points in the product design.

Table 18: ESD Characteristics (Unit: kV)

Model	Test Result	Standard
Human Body Model (HBM)	± 2.5	<i>ANSI/ESDA/JEDEC JS-001-2017</i>
Charged Device Model (CDM)	± 1	<i>ANSI/ESDA/JEDEC JS-002-2018</i>

7 Mechanical Information

This chapter describes the mechanical dimensions of the module. All dimensions are measured in millimeters (mm), and the dimensional tolerances are ± 0.2 mm unless otherwise specified.

7.1. Mechanical Dimensions

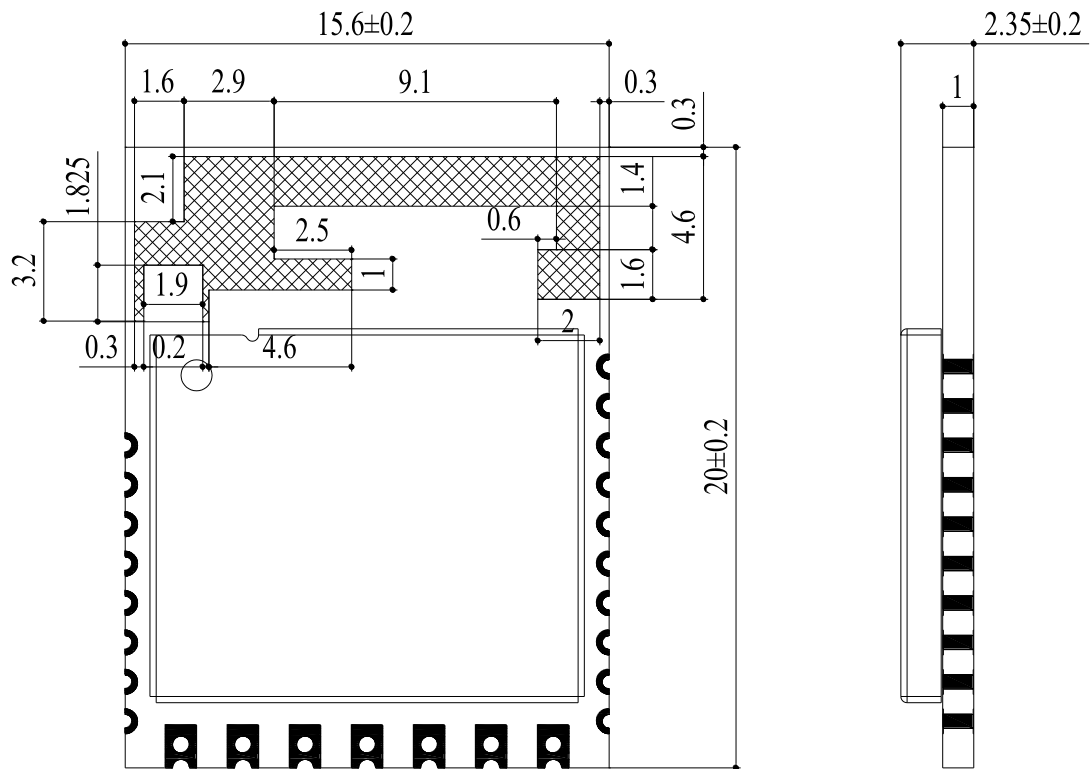


Figure 15: Top and Side Dimensions

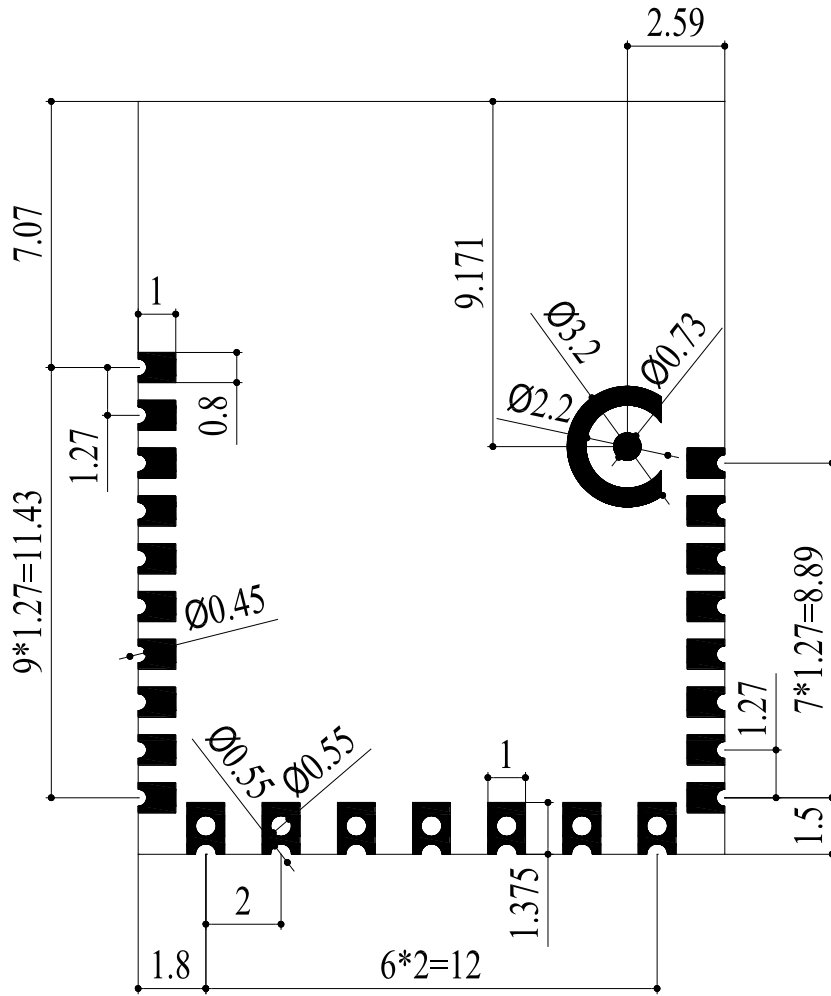


Figure 16: Bottom Dimensions (Bottom View)

NOTE

The package warpage level of the module refers to the JEITA ED-7306 standard.

7.2. Recommended Footprint

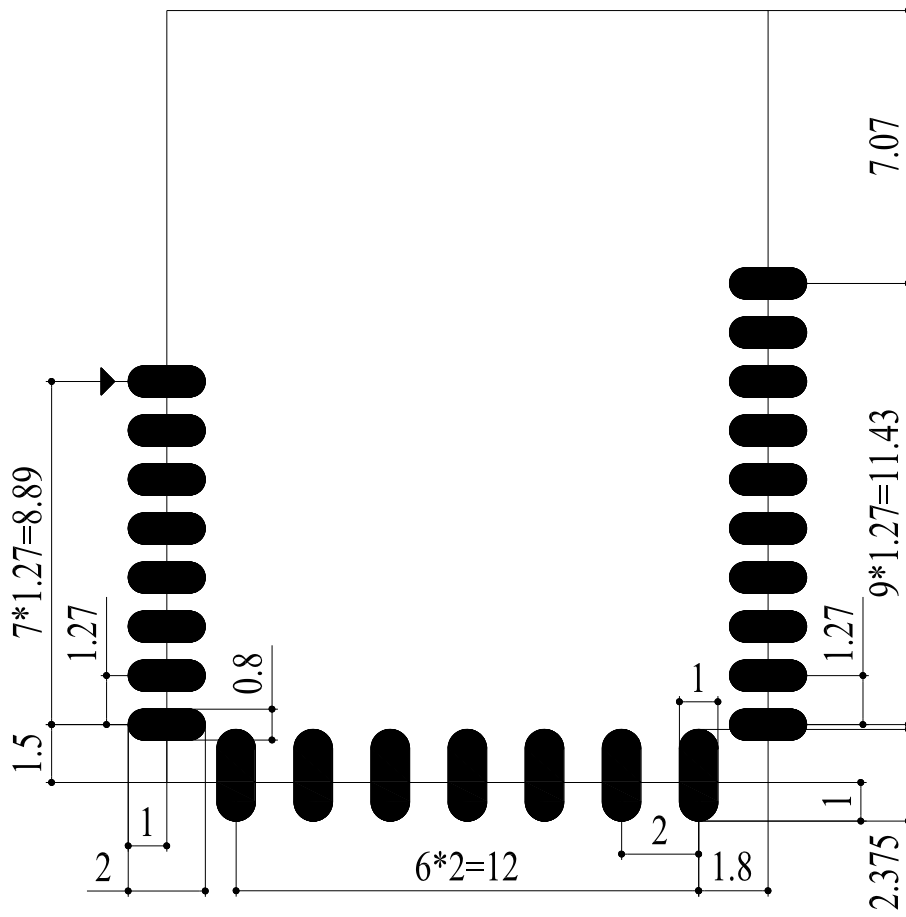


Figure 17: Recommended Footprint

NOTE

Keep at least 3 mm between the module and other components on the motherboard to improve soldering quality and maintenance convenience.

7.3. Top and Bottom Views

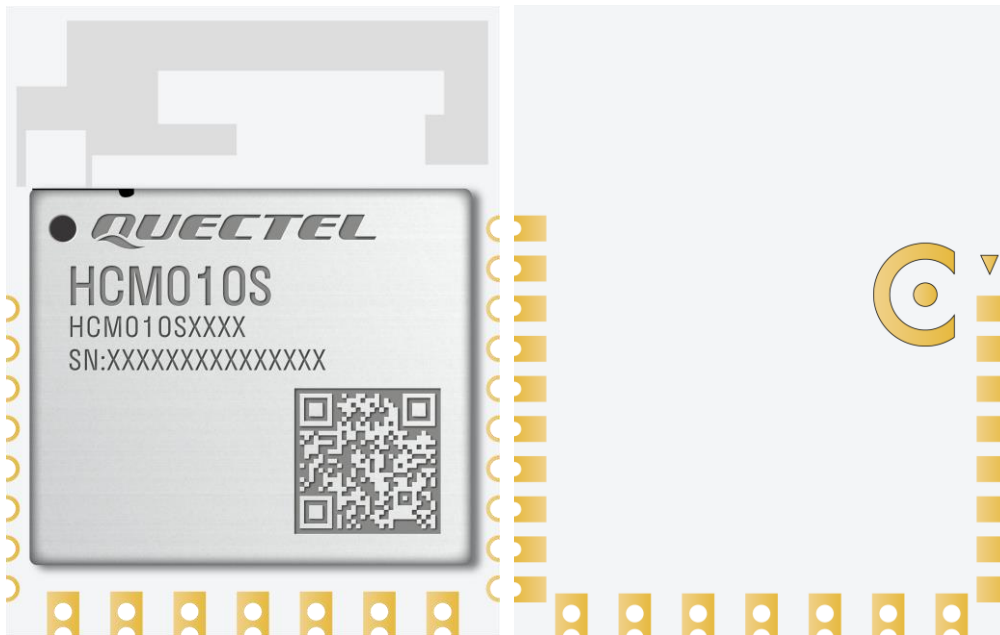


Figure 18: Top and Bottom Views

NOTE

Images above are for illustrative purposes only and may differ from the actual module. For authentic appearance and label, please refer to the module received from Quectel.

8 Storage and Packaging

8.1. Storage Conditions

The module is provided with vacuum-sealed packaging. MSL of the module is rated as 3. The storage requirements are shown below.

1. Recommended Storage Condition: the temperature should be 23 ± 5 °C and the relative humidity should be 35–60 %.
2. Shelf life (in a vacuum-sealed packaging): 12 months in Recommended Storage Condition.
3. Floor life: 168 hours ⁴ in a factory where the temperature is 23 ± 5 °C and relative humidity is below 60 %. After the vacuum-sealed packaging is removed, the module must be processed in reflow soldering or other high-temperature operations within 168 hours. Otherwise, the module should be stored in an environment where the relative humidity is less than 10 % (e.g., a dry cabinet).
4. The module should be pre-baked to avoid blistering, cracks and inner-layer separation in PCB under the following circumstances:
 - The module is not stored in Recommended Storage Condition;
 - Violation of the third requirement mentioned above;
 - Vacuum-sealed packaging is broken, or the packaging has been removed for over 24 hours;
 - Before module repairing.
5. If needed, the pre-baking should follow the requirements below:
 - The module should be baked for 8 hours at 120 ± 5 °C;
 - The module must be soldered to PCB within 24 hours after the baking, otherwise it should be put in a dry environment such as in a dry cabinet.

⁴ This floor life is only applicable when the environment conforms to *IPC/JEDEC J-STD-033*. It is recommended to start the solder reflow process within 24 hours after the package is removed if the temperature and moisture do not conform to, or are not sure to conform to *IPC/JEDEC J-STD-033*. Do not unpack the modules in large quantities until they are ready for soldering.

NOTE

1. To avoid blistering, layer separation and other soldering issues, extended exposure of the module to the air is forbidden.
2. Take out the module from the package and put it on high-temperature-resistant fixtures before baking. If shorter baking time is desired, see *IPC/JEDEC J-STD-033* for the baking procedure.
3. Pay attention to ESD protection, such as wearing anti-static gloves, when touching the modules.

8.2. Manufacturing and Soldering

Push the squeegee to apply the solder paste on the surface of stencil, thus making the paste fill the stencil openings and then penetrate to the PCB. Apply proper force on the squeegee to produce a clean stencil surface on a single pass. To guarantee module soldering quality, the thickness of stencil for the module is recommended to be 0.15–0.18 mm. For more details, see **document [3]**.

The recommended peak reflow temperature should be 235–246 °C, with 246 °C as the absolute maximum reflow temperature. To avoid damage to the module caused by repeated heating, it is recommended that the module should be mounted only after reflow soldering for the other side of PCB has been completed. The recommended reflow soldering thermal profile (lead-free reflow soldering) and related parameters are shown below.

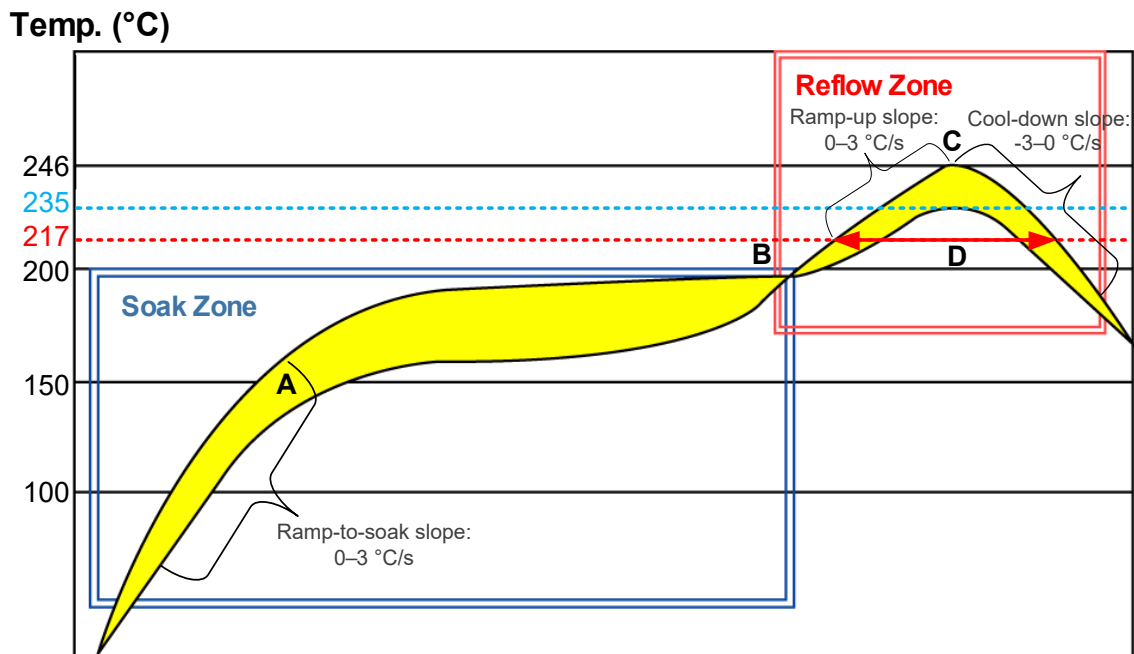


Figure 19: Recommended Reflow Soldering Thermal Profile

Table 19: Recommended Thermal Profile Parameters

Factor	Recommended Value
Soak Zone	
Ramp-to-soak slope	0–3 °C/s
Soak time (between A and B: 150 °C and 200 °C)	70–120 s
Reflow Zone	
Ramp-up slope	0–3 °C/s
Reflow time (D: over 217 °C)	40–70 s
Max. temperature	235–246 °C
Cool-down slope	-3–0 °C/s
Reflow Cycle	
Max. reflow cycle	1

NOTE

1. The above profile parameter requirements are for the measured temperature of solder joints. Both the hottest and coldest spots of solder joints on the PCB should meet the above requirements.
2. During manufacturing and soldering, or any other processes that may contact the module directly, NEVER wipe the module’s shielding can with organic solvents, such as acetone, ethyl alcohol, isopropyl alcohol, trichloroethylene, etc. Otherwise, the shielding can may become rusted.
3. The shielding can for the module is made of Cupro-Nickel base material. It is tested that after 12 hours’ Neutral Salt Spray test, the laser engraved label information on the shielding can is still clearly identifiable and the QR code is still readable, although white rust may be found.
4. If a conformal coating is necessary for the module, do NOT use any coating material that may chemically react with the PCB or shielding cover, and prevent the coating material from flowing into the module.
5. Avoid using ultrasonic technology for module cleaning since it can damage crystals inside the module.
6. Due to the complexity of the SMT process, please contact Quectel Technical Support in advance for any situation that you are not sure about, or any process (e.g. selective soldering, ultrasonic soldering) that is not mentioned in **document [3]**.

8.3. Packaging Specifications

This chapter describes only the key parameters and process of packaging. All figures below are for reference only. The appearance and structure of the packaging materials are subject to the actual delivery.

The module adopts carrier tape packaging and details are as follow:

8.3.1. Carrier Tape

Dimension details are as follow:

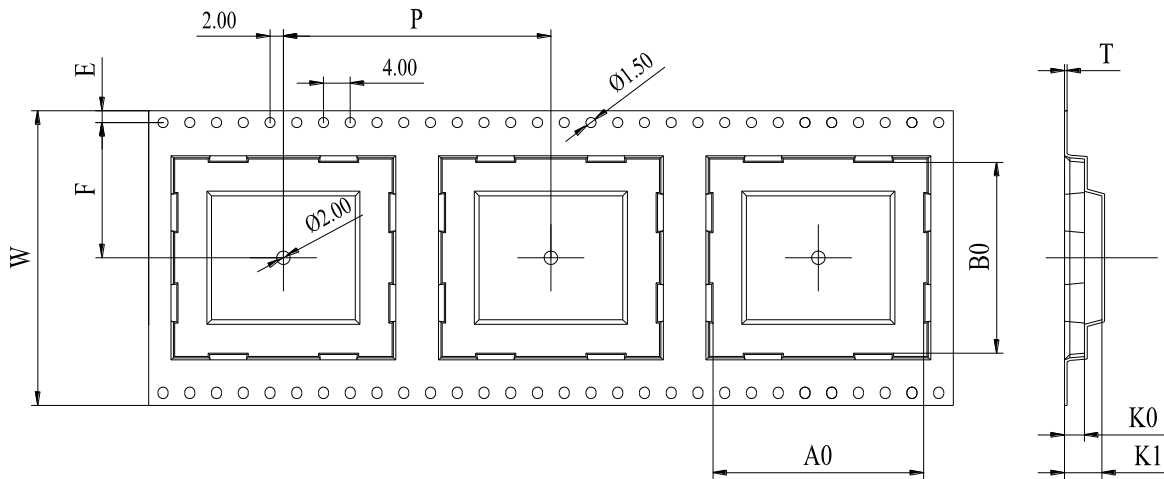


Figure 20: Tape Specifications

Table 20: Carrier Tape Dimension Table (Unit: mm)

W	P	T	A0	B0	K0	K1	F	E
44	24	0.4	16	20.4	2.85	3.4	20.2	1.75

8.3.2. Plastic Reel

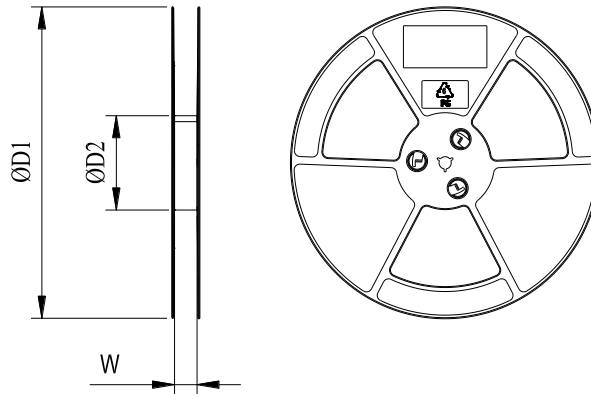


Figure 21: Plastic Reel Dimension Drawing

Table 21: Plastic Reel Dimension Table (Unit: mm)

ØD1	ØD2	W
380	100	44.5

8.3.3. Mounting Direction

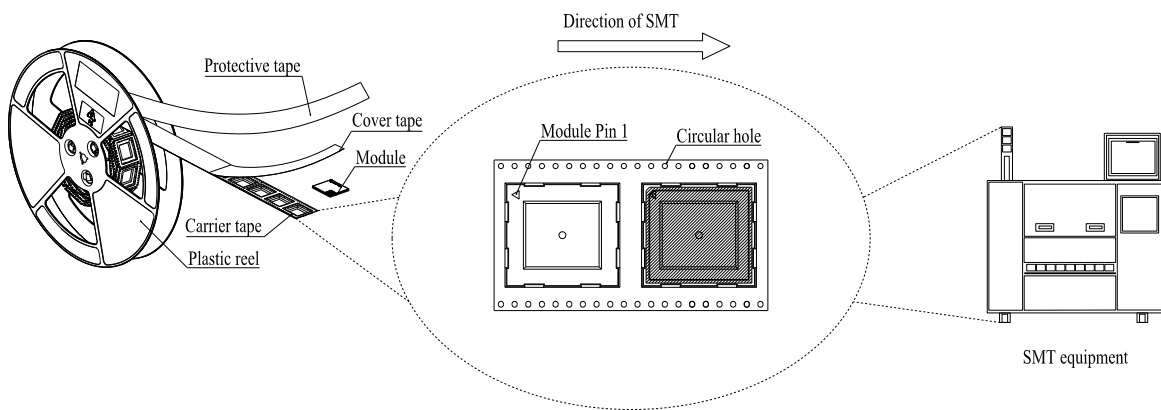
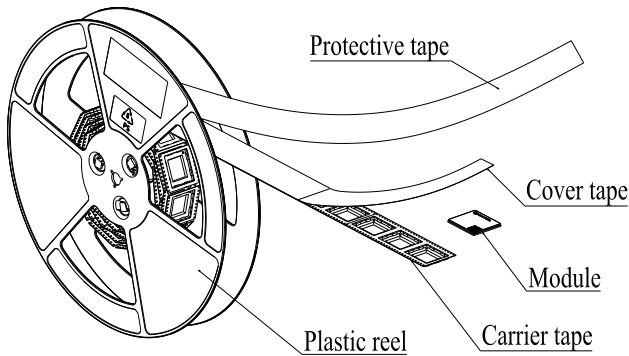


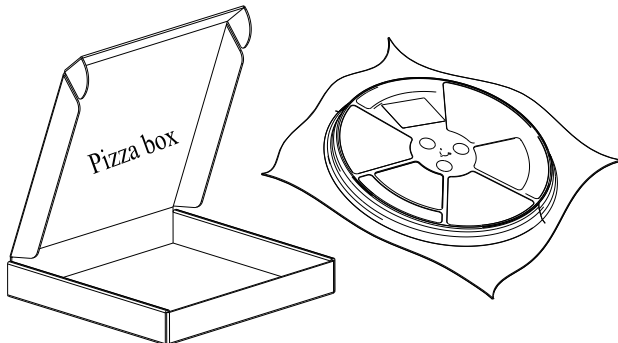
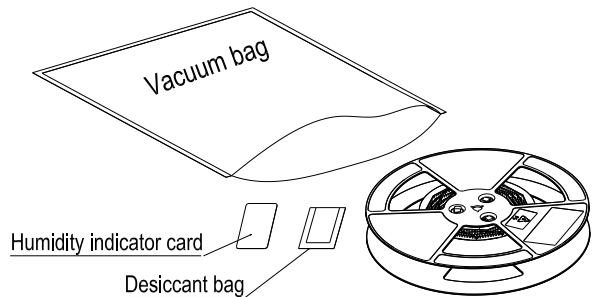
Figure 22: Mounting Direction

8.3.4. Packaging Process



Place the module into the carrier tape and use the cover tape to cover it; then wind the heat-sealed carrier tape to the plastic reel and use the protective tape for protection. 1 plastic reel can load 1000 modules.

Place the packaged plastic reel, 1 humidity indicator card and 1 desiccant bag into a vacuum bag, vacuumize it.



Place the vacuum-packed plastic reel into the pizza box.

Put 4 packaged pizza boxes into 1 carton box and seal it. 1 carton box can pack 4000 modules.

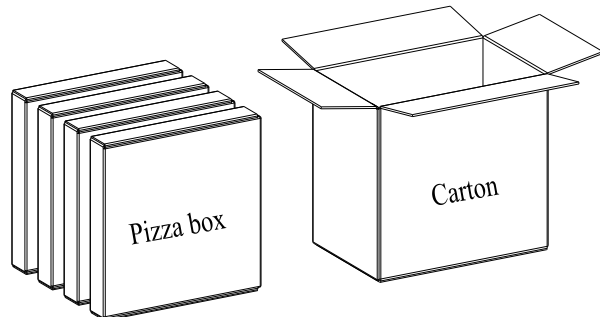


Figure 23: Packaging Process

9 Appendix References

Table 22: Reference Documents

Document Name
[1] Quectel_HCM010S_TE-B_User_Guide
[2] Quectel_RF_Layout_Application_Note
[3] Quectel_Module_SMT_Application_Note

Table 23: Terms and Abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
AMBA	Advanced Microcontroller Bus Architecture
APB	Advanced Peripheral Bus
ARM	Advanced RISC Machine
BLE	Bluetooth Low Energy
DAC	Digital-to-Analog Converter
DMA	Direct Memory Access
DSP	Digital Signal Processor
ESD	Electrostatic Discharge
EM	Energy Mode
EVB	Evaluation Board
FRC	Frame Controller

GFSK	Gauss frequency Shift Keying
GND	Ground
GPIO	General-Purpose Input/Output
I/O	Input/Output
I2C	Inter-Integrated Circuit
I2S	Inter-IC Sound
LCC	Leadless Chip Carrier (package)
LDO	Low-dropout Regulator
LED	Light Emitting Diode
Mbps	Million Bits Per Second
MCU	Microcontroller Unit
OTA	Over-The-Air
PCB	Printed Circuit Board
PRS	Peripheral Reflex System
PWM	Pulse Width Modulation
RF	Radio Frequency
RoHS	Restriction of Hazardous Substances
SPI	Serial Peripheral Interface
SRAM	Static Random-Access Memory
SWD	Serial Wire Debug
TBD	To Be Determined
TVS	Transient Voltage Suppressor
UART	Universal Asynchronous Receiver/Transmitter
V _{IH}	High-level Input Voltage
V _{IL}	Low-level Input Voltage

V _{max}	Maximum Voltage
V _{min}	Minimum Voltage
V _{nom}	Nominal Voltage
V _{OH}	High-level Output Voltage
V _{OL}	Low-level Output Voltage
VSWR	Voltage Standing Wave Ratio

FCC Certification Requirements.

According to the definition of mobile and fixed device is described in Part 2.1091(b), this device is a mobile device.

And the following conditions must be met:

1. This Modular Approval is limited to OEM installation for mobile and fixed applications only. The antenna installation and operating configurations of this transmitter, including any applicable source-based time- averaging duty factor, antenna gain and cable loss must satisfy MPE categorical Exclusion Requirements of 2.1091.

2. The EUT is a mobile device; maintain at least a 20 cm separation between the EUT and the user' s body and must not transmit simultaneously with any other antenna or transmitter.

3.A label with the following statements must be attached to the host end product: This device contains FCC ID: XMR2023HCM010S.

4.To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation, maximum antenna gain (including cable loss) must not exceed:

□ Bluetooth LE: ≤ -1.8 dBi

5. This module must not transmit simultaneously with any other antenna or transmitter

6. The host end product must include a user manual that clearly defines operating requirements and conditions that must be observed to ensure compliance with current FCC RF exposure guidelines.

For portable devices, in addition to the conditions 3 through 6 described above, a separate approval is required to satisfy the SAR requirements of FCC Part 2.1093

If the device is used for other equipment that separate approval is required for all other operating configurations, including portable configurations with respect to 2.1093 and different antenna configurations.

For this device, OEM integrators must be provided with labeling instructions of finished products. Please refer to KDB784748 D01 v07, section 8. Page 6/7 last two paragraphs:

A certified modular has the option to use a permanently affixed label, or an electronic label. For a permanently affixed label, the module must be labeled with an FCC ID - Section 2.926 (see 2.2 Certification (labeling requirements) above). The OEM manual must provide clear instructions explaining to the OEM the labeling requirements, options and

OEM user manual instructions that are required (see next paragraph).

For a host using a certified modular with a standard fixed label, if (1) the module' s FCC ID is not visible when installed in the host, or (2) if the host is marketed so that end users do not have straightforward commonly used methods for access to remove the module so that the FCC ID of the module is visible; then an additional permanent label referring to the enclosed module: "Contains Transmitter Module FCC ID: XMR2023HCM010S." or "Contains FCC ID: XMR2023HCM010S." must be used. The host OEM user manual must also contain clear instructions on how end users can find and/or access the module and the FCC ID.

The final host / module combination may also need to be evaluated against the FCC Part 15B criteria for

unintentional radiators in order to be properly authorized for operation as a Part 15 digital device.

The user's manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. In cases where the manual is provided only in a form other than paper, such as on a computer disk or over the Internet, the information required by this section may be included in the manual in that alternative form, provided the user can reasonably be expected to have the capability to access information in that form.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

IC Certification Requirements.

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

1. This device may not cause interference.
2. This device must accept any interference, including interference that may cause undesired operation of the device.

To comply with IC regulations limiting both maximum RF output power and human exposure to RF radiation, maximum antenna gain (including cable loss) must not exceed:

□ Bluetooth LE: ≤ -1.8 dBi

The host product shall be properly labelled to identify the modules within the host product.

The Innovation, Science and Economic Development Canada certification label of a module shall be clearly visible at all times when installed in the host product; otherwise, the host product must be labeled to display the Innovation, Science and Economic Development Canada certification number for the module, preceded by the word "Contains" or similar wording expressing the same meaning, as follows:

"Contains IC: 10224A-2023HCM010S" or "where: 10224A-2023HCM010S is the module's certification number".

This equipment complies with ISED radiation exposure limits set forth for an uncontrolled environment. To comply with RSS-102 RF Exposure compliance requirements, this grant is applicable to only Mobile Configurations. The antennas used for the transmitter must be installed to provide a separation distance of at least 20cm from all persons and must not be co-located or operating in conjunction with any other antenna or transmitter.

L'appareil contient un émetteur / récepteur exempté de licence conforme au CNR exempté de licence d'innovation, sciences et développement économique Canada. Les opérations sont soumises aux deux conditions suivantes:

1. Cet appareil peut ne pas causer d'interférence.

L'appareil doit accepter toute interférence, y compris celles qui peuvent entraîner un fonctionnement indésirable de l'appareil.