

KCM233S Hardware Design

Short-Range Products

Version: 1.0.0

Date: 2025-11-21

Status: Preliminary



At Quectel, our aim is to provide timely and comprehensive services to our customers. If you require any assistance, please contact our headquarters:

Quectel Wireless Solutions Co., Ltd.

No. 8 Waipojing Road, Sijing Town, Songjiang District, Shanghai 201601, China

Tel: +86 21 5108 6236

Email: info@quectel.com

Or our local offices. For more information, please visit:

<https://www.quectel.com/contact/>.

For technical support, or to report documentation errors, please visit:

<https://www.quectel.com/tech-support/>.

Or email us at: support@quectel.com.

Legal Notices

We offer information as a service to you. The provided information is based on your requirements and we make every effort to ensure its quality. You agree that you are responsible for using independent analysis and evaluation in designing intended products, and we provide reference designs for illustrative purposes only. Before using any hardware, software or service guided by this document, please read this notice carefully. Even though we employ commercially reasonable efforts to provide the best possible experience, you hereby acknowledge and agree that this document and related services hereunder are provided to you on an “as available” basis. We may revise or restate this document from time to time at our sole discretion without any prior notice to you.

Use and Disclosure Restrictions

License Agreements

Documents and information provided by us shall be kept confidential, unless specific permission is granted. They shall not be accessed or used for any purpose except as expressly provided herein.

Copyright

Our and third-party products hereunder may contain copyrighted material. Such copyrighted material shall not be copied, reproduced, distributed, merged, published, translated, or modified without prior written consent. We and the third party have exclusive rights over copyrighted material. No license shall be granted or conveyed under any patents, copyrights, trademarks, or service mark rights. To avoid ambiguities, purchasing in any form cannot be deemed as granting a license other than the normal non-exclusive, royalty-free license to use the material. We reserve the right to take legal action for noncompliance with abovementioned requirements, unauthorized use, or other illegal or malicious use of the material.

Trademarks

Except as otherwise set forth herein, nothing in this document shall be construed as conferring any rights to use any trademark, trade name or name, abbreviation, or counterfeit product thereof owned by Quectel or any third party in advertising, publicity, or other aspects.

Third-Party Rights

This document may refer to hardware, software and/or documentation owned by one or more third parties ("third-party materials"). Use of such third-party materials shall be governed by all restrictions and obligations applicable thereto.

We make no warranty or representation, either express or implied, regarding the third-party materials, including but not limited to any implied or statutory, warranties of merchantability or fitness for a particular purpose, quiet enjoyment, system integration, information accuracy, and non-infringement of any third-party intellectual property rights with regard to the licensed technology or use thereof. Nothing herein constitutes a representation or warranty by us to either develop, enhance, modify, distribute, market, sell, offer for sale, or otherwise maintain production of any our products or any other hardware, software, device, tool, information, or product. We moreover disclaim any and all warranties arising from the course of dealing or usage of trade.

Privacy Policy

To implement module functionality, certain device data are uploaded to Quectel's or third-party's servers, including carriers, chipset suppliers or customer-designated servers. Quectel, strictly abiding by the relevant laws and regulations, shall retain, use, disclose or otherwise process relevant data for the purpose of performing the service only or as permitted by applicable laws. Before data interaction with third parties, please be informed of their privacy and data security policy.

Disclaimer

- a) We acknowledge no liability for any injury or damage arising from the reliance upon the information.
- b) We shall bear no liability resulting from any inaccuracies or omissions, or from the use of the information contained herein.
- c) While we have made every effort to ensure that the functions and features under development are free from errors, it is possible that they could contain errors, inaccuracies, and omissions. Unless otherwise provided by valid agreement, we make no warranties of any kind, either implied or express, and exclude all liability for any loss or damage suffered in connection with the use of features and functions under development, to the maximum extent permitted by law, regardless of whether such loss or damage may have been foreseeable.
- d) We are not responsible for the accessibility, safety, accuracy, availability, legality, or completeness of information, advertising, commercial offers, products, services, and materials on third-party websites and third-party resources.

Copyright © Quectel Wireless Solutions Co., Ltd. 2025. All rights reserved.

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.



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.



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
-	2025-11-21	Waller Wang/	Creation of the document
1.0.0	2025-11-21	Waller Wang/	Preliminary

Contents

Safety Information.....	3
About the Document.....	4
Contents.....	5
Table Index.....	7
Figure Index.....	8
1 Introduction	9
1.1. Special Mark	9
2 Product Overview.....	10
2.1. Key Features.....	11
3 Application Interfaces	12
3.1. Pin Assignment	12
3.2. Pin Definitions	13
3.3. GPIO Multiplexing	16
3.4. Application Interfaces.....	19
3.4.1. SWD Interface	19
3.4.2. USART Interface	20
3.4.3. EUSART Interface.....	23
3.4.4. I2C* Interfaces.....	23
3.4.5. ADC* Interface	24
3.4.6. DAC* Interface	24
3.4.7. ACMP* Interface	24
3.4.8. KEYSKAN* Interface.....	25
3.4.9. GPIO Interfaces.....	25
4 Operating Characteristics	26
4.1. Power Supply Interface.....	26
4.1.1. Reference Design for Power Supply.....	26
4.2. Reset.....	27
5 RF Specifications	29
5.1. Bluetooth Performances	29
5.2. 802.15.4 Performances.....	30
5.3. Antenna/Antenna Interfaces	30
5.3.1. Pin Antenna Interface (ANT_15.4/BT)	31
5.3.1.1. Reference Design.....	31
5.3.1.2. RF Routing Guidelines	32
5.3.1.3. RF Connector Recommendation	33
5.3.2. KCM233S RF Coaxial Connector	35
5.3.2.1. Receptacle Specifications	35

5.3.2.2.	Antenna Connector Installation.....	36
5.3.2.3.	Recommended RF Connector Installation.....	38
5.3.2.4.	Recommended Manufacturers of RF Connector and Cable	39
5.3.3.	Requirements for Antenna Design.....	40
6	Electrical Characteristics and Reliability	41
6.1.	Absolute Maximum Ratings	41
6.2.	Power Supply Ratings.....	41
6.3.	Power Consumption.....	42
6.3.1.	Bluetooth Power Consumption	42
6.3.2.	802.15.4 Power Consumption.....	42
6.4.	Digital I/O Characteristics	43
6.5.	ESD Protection.....	43
7	Mechanical Information.....	44
7.1.	Mechanical Dimensions	44
7.2.	Recommended Footprint	46
7.3.	Top and Bottom Views.....	47
8	Storage and Packaging	48
8.1.	Storage Conditions.....	48
8.2.	Manufacturing and Soldering.....	49
8.3.	Packaging Specification.....	51
8.3.1.	Carrier Tape	51
8.3.2.	Plastic Reel	52
8.3.3.	Mounting Direction	52
8.3.4.	Packaging Process	53
9	Appendix References	54

Table Index

Table 1: Special Mark.....	9
Table 2: Basic Information	10
Table 3: Key Features.....	11
Table 4: Parameter Definition	13
Table 5: Pin Description	13
Table 6: GPIO Multiplexing (Digital Pins).....	16
Table 7: GPIO Multiplexing (Analog Pins)	18
Table 8: Pin Description of SWD Interface	19
Table 9: USART Interface Synchronous/Asynchronous Mode.....	21
Table 10: Pin Description of Power Supply and GND Pins	26
Table 11: Pin Description of RESET_N	27
Table 12: Bluetooth Performances	29
Table 13: 802.15.4 Performances.....	30
Table 14: KCM233S ANT_15.4/BT1& ANT_15.4/BT2 Pin Description.....	31
Table 15: Major Specifications of the RF Connector	36
Table 17: Requirements for Antenna Design.....	40
Table 18: Absolute Maximum Ratings (Unit: V).....	41
Table 19: Module Power Supply Ratings (Unit: V)	41
Table 20: Bluetooth Consumption in Non-signaling Mode (Unit: mA)	42
Table 21: 802.15.4 Consumption (Unit: mA)	42
Table 22: VBAT I/O Characteristics (Unit: V).....	43
Table 23: Electrostatic Discharge Characteristics (Unit: kV)	43
Table 24: Recommended Thermal Profile Parameters	50
Table 25: KCM233S Carrier Tape Dimension Table (Unit: mm)	51
Table 27: Plastic Reel Dimension Table (Unit: mm)	52
Table 28: Reference Documents	54
Table 29: Terms and Abbreviations	54

Figure Index

Figure 2: KCM233S Pin Assignment (Top View).....	12
Figure 4: SWD Interface Connection	20
Figure 5: USART Interface Functional Diagram	20
Figure 6: UART Interface Connection.....	21
Figure 7: SPI Interface Connection (Master Mode)	22
Figure 8: SPI Interface Connection (Slave Mode)	22
Figure 9: I2S Interface Connection	22
Figure 10: RS-485 Interface Connection	23
Figure 11: Reference Design of Power Supply.....	27
Figure 12: Reference Circuit for RESET_N with a Button	28
Figure 13: Reset Timing.....	28
Figure 14: RF Antenna Reference Design.....	31
Figure 15: Microstrip Design on a 2-layer PCB	32
Figure 16: Coplanar Waveguide Design on a 2-layer PCB	32
Figure 17: Coplanar Waveguide Design on a 4-layer PCB (Layer 3 as Reference Ground).....	33
Figure 18: Coplanar Waveguide Design on a 4-layer PCB (Layer 4 as Reference Ground).....	33
Figure 19: Dimensions of the Receptacle (Unit: mm).....	34
Figure 20: Specifications of Mated Plugs.....	34
Figure 21: Space Factor of Mated Connectors (Unit: mm).....	35
Figure 22: Dimensions of the Receptacle (Unit: mm).....	36
Figure 23: Dimensions of Mated Plugs (Ø 0.81 mm/Ø 1.13 mm Coaxial Cables) (Unit: mm).....	37
Figure 24: Space Factor of Mated Connectors (Ø 0.81 mm Coaxial Cables) (Unit: mm)	37
Figure 25: Space Factor of Mated Connectors (Ø 1.13 mm Coaxial Cables) (Unit: mm)	38
Figure 26: Plug in a Coaxial Cable Plug	38
Figure 27: Pull out a Coaxial Cable Plug	39
Figure 28: Install the Coaxial Cable Plug with Jig.....	39
Figure 31: KCM233S Top and Side Dimensions.....	44
Figure 32: KCM233S Bottom Dimensions (Bottom View)	45
Figure 35: KCM233S Recommended Footprint.....	46
Figure 36: KCM233S Top and Bottom Views (Pin Antenna Interface).....	47
Figure 37: KCM233S Top and Bottom Views (RF Coaxial Connector).....	47
Figure 39: Recommended Reflow Soldering Thermal Profile	49
Figure 40: Carrier Tape Dimension Drawing (Unit: mm)	51
Figure 41: Plastic Reel Dimension Drawing.....	52
Figure 42: Mounting Direction	52
Figure 43: Packaging Process	53

1 Introduction

This document defines KCM233S series in Open solution ¹ 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.

1.1. Special Mark

Table 1: Special Mark

Mark	Definition
*	Unless otherwise specified, an asterisk (*) after a function, feature, interface, pin name, command, argument, and so on indicates that it is under development and currently not supported; and the asterisk (*) after a model indicates that the model sample is currently unavailable.

¹ For the details of the Open solution, please refer to the **document [1]**.

2 Product Overview

KCM233S series is a low-power, cost-effective MCU Thread, Zigbee and BLE module supporting IEEE 802.15.4 and BLE 6.0 protocols. It integrates a highly configurable wireless transceiver. The module has 2 UART and 1 SWD interfaces by default. In the case of multiplexing, it supports interfaces including USART, EUSART, I2C*, ADC*, DAC*, ACMP* and KEYSKAN*.

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

- Embedded 32-bit ARM Cortex-M33 processor with a frequency of up to 78 MHz
- Built-in 256 KB RAM and 1536 KB/2.5 MB/3.5 MB flash options
- Flexible and efficient power consumption management
- Support Matter and BLE mesh network
- Support for OTA (Over-the-Air Technology)
- Support for secondary development

Table 2: Basic Information

KCM233S Series	
Packaging type	LCC
Pin counts	50
Dimensions	(18 +0.3/-0.15) mm × (18 +0.3/-0.15) mm × (2.4 ±0.2) mm
Weight	approx. 1.25g

2.1. Key Features

Table 3: Key Features

Basic Information	
Protocols and Standard	● Zigbee/Thread protocol: IEEE 802.15.4 ● Bluetooth protocol: BLE 6.0 ● All hardware components are fully compliant with EU RoHS directive
Supply Voltage	VBAT Power Supply: ● 1.71–3.8 V ● Typ.: 3.3 V
Temperature Ranges	● Normal operating temperature ²: -40 °C to +105 °C ● Storage temperature: -45 °C to +115 °C
TE-B Kit	KCM233S-TE-B ³
Antenna/Antenna Interfaces ⁴	
KCM233S	● Pin antenna interface (ANT_15.4/BT) ● RF coaxial connector ● 50 Ω characteristic impedance
Application Interfaces ⁵	
Application Interfaces	SWD, USART, EUSART, I2C*, ADC*, DAC*, ACMP* and KEYSKAN*

² Within the normal operating temperature range, the module's indicators comply with 802.15.4 and Bluetooth specification requirements.

³ Quectel supplies an evaluation board (KCM233S-TE-B) with accessories to develop and test the module.

⁴ KCM233S is provided with one of the two antenna interface designs. For more details, contact Quectel Technical Support.

3 Application Interfaces

3.1. Pin Assignment

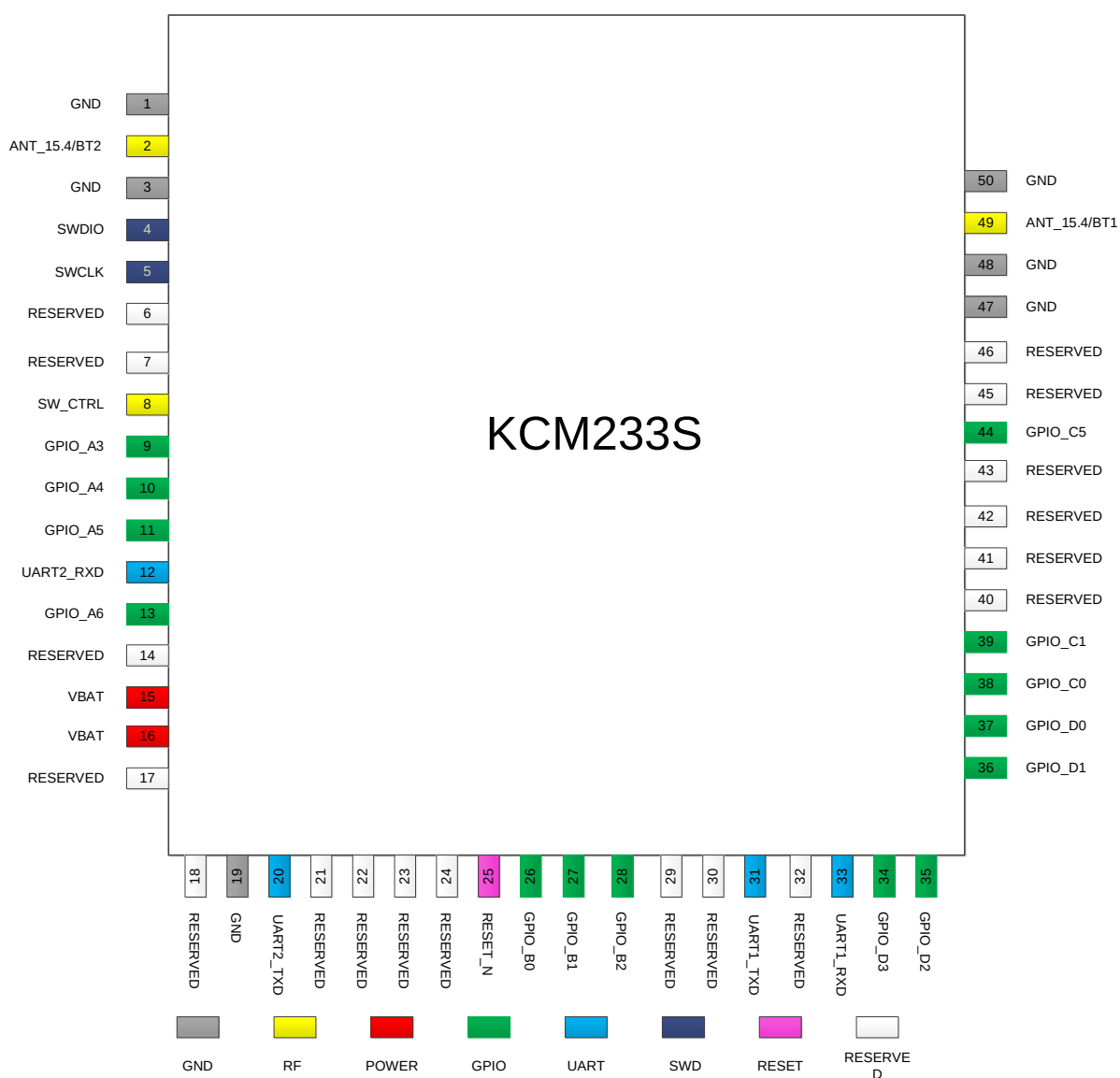


Figure 1: KCM233S Pin Assignment (Top View)

NOTE

1. Keep all RESERVED and unused pins unconnected.
2. All GND pins should be connected to ground.
3. Ensure that there is no current sink on the module's pins before the module turns on.
4. The module supports 2 UART, 1 SWD and 14 GPIO interfaces by default. In the case of multiplexing, it supports interfaces including USART, EUSART, I2C*, ADC*, DAC*, ACMP* and KEYSCAN*. For more details, see **Chapter 3.3** and **Chapter 3.4**.
5. For the chip pin names corresponding to the module pin names, see **document [1]**.

3.2. Pin Definitions

Table 4: Parameter Definition

Parameter	Description
AIO	Analog Input/Output
DI	Digital Input
DO	Digital Output
DIO	Digital Input/Output
PI	Power Input
PU	Pull Up
Hi-Z	High Impedance

DC characteristics include power domain and rated current.

Table 5: Pin Description

Power Supply and GND Pins						
Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristics	Comment
VBAT	15、16	PI	-	Power supply for the module	Vmin = 1.71 V Vnom = 3.3 V	It is recommended to provide a current

					Vmax = 3.8 V	of at least 250 mA.
GND	1, 3, 19, 47, 48, 50					Connect these pins to ground.

Reset

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristics	Comment
RESET_N	25	DI	PU	Reset the module	1.8 V	Hardware reset. Internally pulled up to 1.8 V. Active low.

UART Interfaces

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristics	Comment
UART1_TXD	31	DO	Hi-Z	UART1 transmit	VBAT	
UART1_RXD	33	DI	Hi-Z	UART1 receive		
UART2_TXD	20	DO	Hi-Z	UART2 transmit		
UART2_RXD	12	DI	Hi-Z	UART2 receive		

SWD Interface

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristics	Comment
SWDIO	4	DIO	Hi-Z	Serial wire data input/output	VBAT	Used for program downloading. Enabled after power-up. Internally pulled up to VBAT.
SWCLK	5	DI	Hi-Z	Serial wire data clock		Used for program downloading. Enabled after power-up. Internally pulled down to GND.

GPIO Interfaces

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristics	Comment
GPIO_A3	9	DIO	Hi-Z	General-purpose input/output	VBAT	GPIO pins can be configured as interrupt sources capable of triggering asynchronous interrupts in EM0 and EM1 modes.
GPIO_A4	10	DIO	Hi-Z	General-purpose input/output		
GPIO_A5	11	DIO	Hi-Z	General-purpose input/output		
GPIO_A6	13	DIO	Hi-Z	General-purpose input/output		
GPIO_B0	26	DIO	Hi-Z	General-purpose input/output		
GPIO_B1	27	DIO	Hi-Z	General-purpose input/output		
GPIO_B2	28	DIO	Hi-Z	General-purpose input/output		
GPIO_C0	38	DIO	Hi-Z	General-purpose input/output		
GPIO_C1	39	DIO	Hi-Z	General-purpose input/output		
GPIO_C5	44	DIO	Hi-Z	General-purpose input/output		
GPIO_D0	37	DIO	Hi-Z	General-purpose input/output		
GPIO_D1	36	DIO	Hi-Z	General-purpose input/output		
GPIO_D2	35	DIO	Hi-Z	General-purpose input/output		
GPIO_D3	34	DIO	Hi-Z	General-purpose input/output		

KCM233S RF Antenna Interface

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristics	Comment
ANT_15.4/BT 1	49	AIO	-	802.15.4/Bluetooth antenna interface		50 Ω characteristic impedance.
ANT_15.4/BT 2	2	AIO	-	802.15.4/Bluetooth antenna interface		

SW_CTRL	8	DO	Hi-Z	ANT_15.4/BT1 and ANT_15.4/BT2 antenna switching control
Reserved Pin				
Pin Name	Pin No.			Comment
RESERVED	6, 7, 14, 17, 18, 21, 22, 23, 24, 29, 30,32, 40, 41, 42, 43, 45, 46			Keep these pins open.

NOTE

1. To reduce the probability of module damage and extend module service life, do not power up and down frequently.
2. EM0 mode is the normal operating mode (Active mode); EM1 is the sleep mode.

3.3. GPIO Multiplexing

The module supports 2 UART, 1 SWD and 14 GPIO interfaces by default. In the case of multiplexing, it supports interfaces including USART, EUSART, I2C*, ADC*, DAC*, ACMP* and KEYSKAN*. Pins are defined as follows:

Table 6: GPIO Multiplexing (Digital Pins)

Multiplexing Function	GPIO Interface			
	SWCLK, SWDIO, SW_CTRL, UART2_TXD, UART2_RXD, GPIO_A3~A6	UART1_TXD, UART1_RXD, GPIO_B0~B2	GPIO_C0~C1 GPIO_C5	GPIO_D0~D3
ACMP0_DOUT	√	√	√	√
ACMP1_DOUT	√	√	√	√
EUSART0_CS	√	√	-	-
EUSART0_CTS	√	√	-	-

EUSART0_RTS	√	√	-	-
EUSART0_RXD	√	√	-	-
EUSART0_SCLK	√	√	-	-
EUSART0_TXD	√	√	-	-
EUSART1_CS	√	√	√	√
EUSART1_CTS	√	√	√	√
EUSART1_RTS	√	√	√	√
EUSART1_RXD	√	√	√	√
EUSART1_SCLK	√	√	√	√
EUSART1_TXD	√	√	√	√
I2C0_SCL	√	√	√	√
I2C0_SDA	√	√	√	√
I2C1_SCL	-	-	√	√
I2C1_SDA	-	-	√	√
KEYSCAN_COL_OUT0	√	√	√	√
KEYSCAN_COL_OUT1	√	√	√	√
KEYSCAN_COL_OUT2	√	√	√	√
KEYSCAN_COL_OUT3	√	√	√	√
KEYSCAN_COL_OUT4	√	√	√	√
KEYSCAN_COL_OUT5	√	√	√	√
KEYSCAN_COL_OUT6	√	√	√	√
KEYSCAN_COL_OUT7	√	√	√	√
KEYSCAN_ROW_SENSE0	√	√	-	-
KEYSCAN_ROW_SENSE1	√	√	-	-
KEYSCAN_ROW_SENSE2	√	√	-	-
KEYSCAN_ROW_SENSE3	√	√	-	-

KEYSCAN_ROW_SENSE4	√	√	-	-
KEYSCAN_ROW_SENSE5	√	√	-	-
USART0_CLK	√	√	√	√
USART0_CS	√	√	√	√
USART0_CTS	√	√	√	√
USART0_RTS	√	√	√	√
USART0_RXD	√	√	√	√
USART0_TXD	√	√	√	√

Table 7: GPIO Multiplexing (Analog Pins)

Multiplexing Function	SWCLK, SWDIO, SW_CTRL, UART2_TXD, UART2_RXD, GPIO_A3~A6	UART1_TXD, UART1_RXD, GPIO_B0~B2	GPIO_C0~C1 GPIO_C5	GPIO_D0~D3
ACMP0	√	√	√	√
ACMP1	√	√	√	√
ADC0	√	√	√	√
DAC0	√	√	√	√
DAC1	√	√	√	√

NOTE

1. All GPIO pins are selectable as interrupts in EM0 and EM1 modes.
2. SWCLK, SWDIO, SW_CTRL, UART2_TXD, UART2_RXD, GPIO_A3~A6, UART1_TXD, UART1_RXD, GPIO_B0~B2 pins are selectable as interrupts in EM2 and EM3 modes.

3. GPIO_A5, GPIO_B1, UART1_TXD, GPIO_C0, GPIO_C5 and GPIO_D2 are available for wake-up function in EM4 mode.
4. EM2 is deep sleep mode, EM3 is stop mode, and EM4 is shutoff mode.
5. After the module is powered off, all of its GPIOs must be driven low. Otherwise, the current leakage may make the module enter an abnormal state.
6. The maximum number of application interfaces multiplexed through GPIOs isn't available simultaneously. For the maximum number of different application interfaces that the module can support, see **Chapter 3.4**.

3.4. Application Interfaces

3.4.1. SWD Interface

The module supports a 2-pin SWD interface, the pin descriptions are shown in the table below.

Table 8: Pin Description of SWD Interface

Pin Name	Pin No.	I/O	Description	Comment
SWDIO	4	DIO	Serial wire data input/output	Used for program downloading. Enabled after power-up. Internally pulled up to VBAT.
SWCLK	5	DI	Serial wire data clock	Used for program downloading. Enabled after power-up. Internally pulled down to GND.

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

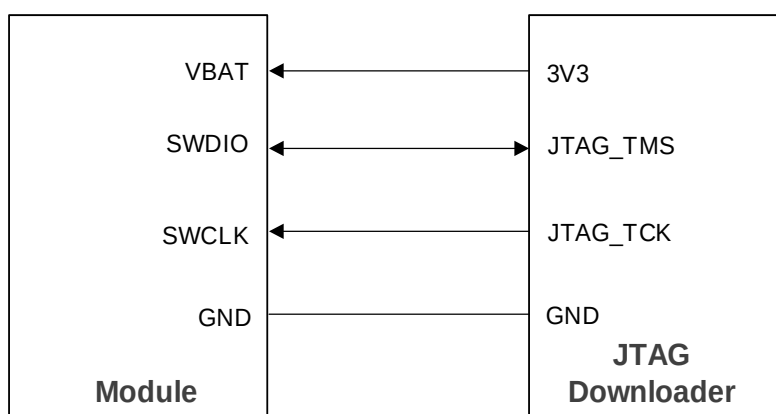


Figure 2: SWD Interface Connection

3.4.2. USART Interface

In the case of multiplexing, the module supports 1 USART interface. See **Table 6** for more details. The USART interface supports the following applications:

- UART (supporting full-duplex asynchronous communication and hardware flow control)
- RS-485/RS-232 serial communication interfaces
- SPI
- MicroWire: Simplified SPI protocol
- 3-wire: Reduced-pin serial interface
- ISO 7816 Smart-Cards: Smart card interface
- IrDA: Infrared communication interface
- I2S audio interface

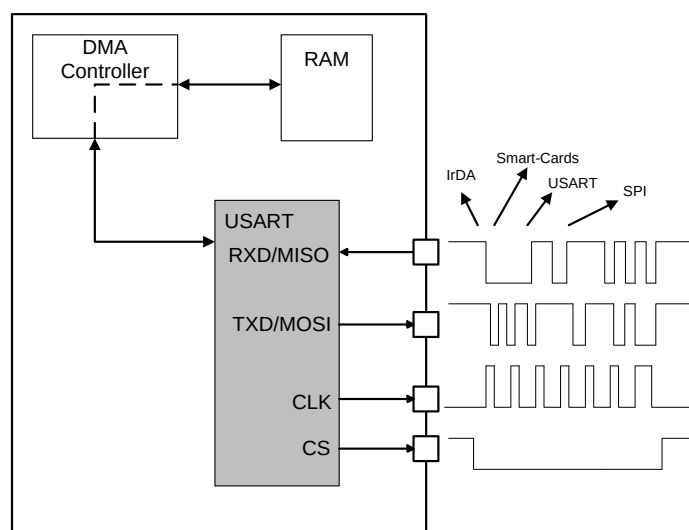


Figure 3: USART Interface Functional Diagram

The USART interfaces operate in either asynchronous or synchronous mode:

- In synchronous mode, the clock signal is provided by the bus master and transmitted synchronously with the data signals. Both master and slave devices must follow the same clock frequency for data transfer. The synchronous communication mode is compatible with the SPI bus protocol standard.
- In asynchronous mode, the clock signal is not synchronized with data transmission. The USART receiver must autonomously recover clock information from the data stream to determine sampling points. Data frames in asynchronous mode require additional synchronization bits (e.g., start/stop bits) to ensure correct sampling.

Asynchronous or synchronous mode can be selected by configuring SYNC in USART register. For

specific configuration methods, please consult Quectel Technical Support. The mode options with supported protocols are listed below:

Table 9: USART Interface Synchronous/Asynchronous Mode

SYNC	Communication Mode	Protocol
0	Asynchronous	UART, RS-232, RS-485 (with external driver), IrDA, ISO 7816 Smart-Cards
1	Synchronous	I2S, SPI, MicroWire, 3-wire

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

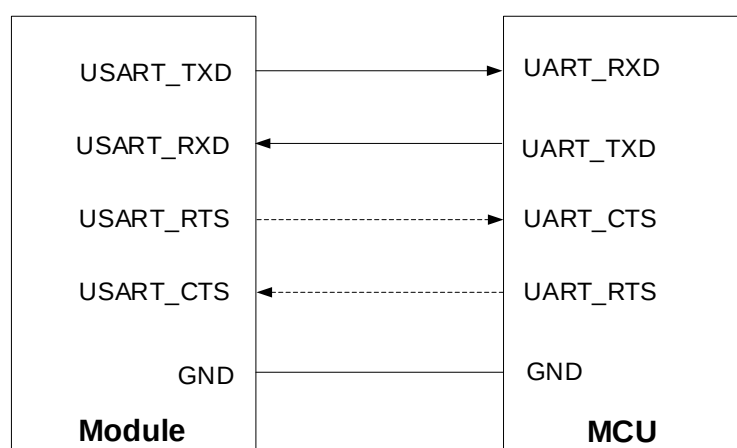


Figure 4: UART Interface Connection

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

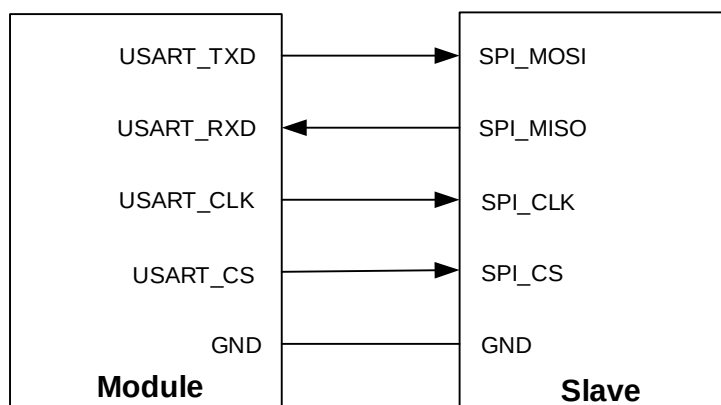


Figure 5: SPI Interface Connection (Master Mode)

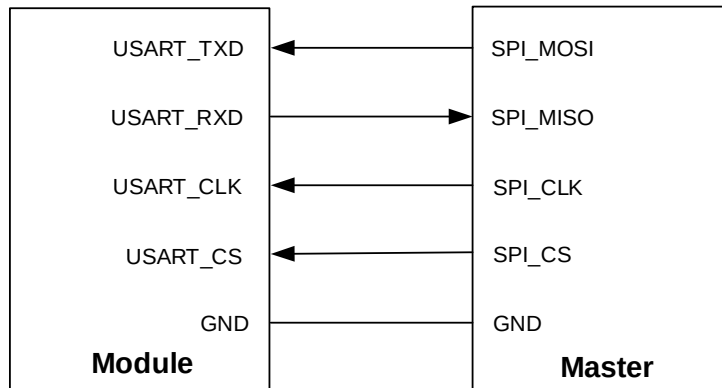


Figure 6: SPI Interface Connection (Slave Mode)

NOTE

When the module operates as an SPI slave device, the TXD and RXD functions of the USART interface can be swapped via software configuration to align with SPI protocol signal flow:

- The original USART_TXD (mapped as SPI_MOSI) receives data from the master device.
- The original USART_RXD (mapped as SPI_MISO) transmits data to the master device.

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

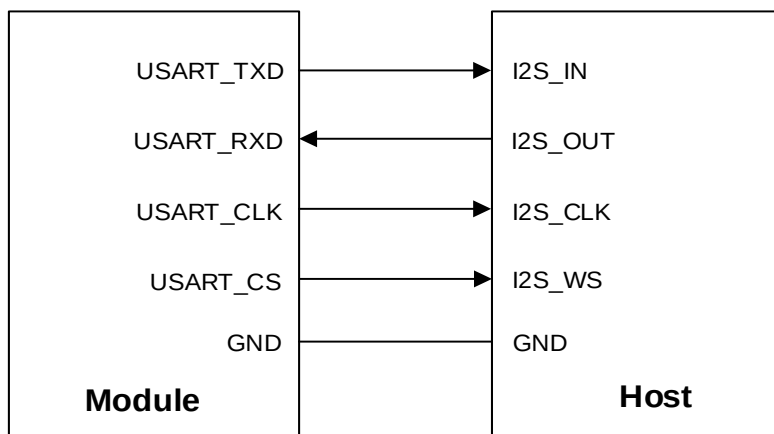


Figure 7: I2S Interface Connection

The following figure shows the USART Interface connection between the module and the host when used as RS-485 application.

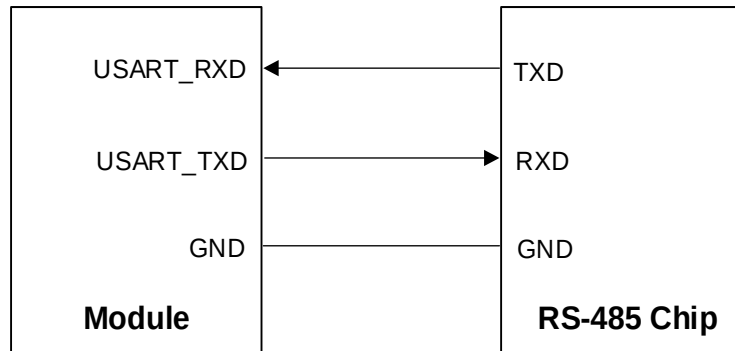


Figure 8: RS-485 Interface Connection

3.4.3. EUSART Interface

In the case of multiplexing, the module supports 2 EUSART interfaces: EUSART0 and EUSART1. See **Table 6** for more details. The EUSART interfaces support the following applications:

- UART (supporting full duplex asynchronous communication with hardware flow control)
- RS-485/RS-232 serial communication interfaces
- IrDA: Infrared communication interface
- High-speed SPI
- DALI

EUSART0 may be used in a low-energy mode and operate in EM2. A 32.768 kHz clock source allows full duplex UART communication up to 9600 baud. EUSART0 can act as a SPI secondary device in EM2 and EM3, and wake the system when data is received from an external bus controller.

3.4.4. I2C* Interfaces

In the case of multiplexing, the module can provide two I2C interfaces, both supporting master-slave mode and multi-master communication. The interface supports standard mode (100 kbps), fast mode (400 kbps) and fast mode + (1 Mbps), and also complies with slave device arbitration and timeout for compatibility with the SMBus system. Automatic identification of slave device addresses is supported in EM0–EM3 power modes. Details of the interface multiplexing are shown in **Table 6**.

Both the I2C interfaces are open-drain. The maximum value of the pull-up resistor (R_p) can be calculated by the maximal rise-time (T_r) for the given bus speed and the estimated bus capacitance (C_b) as shown below:

$$R_p = T_r / (0.8473 \times C_b)$$

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

3.4.5. ADC* Interface

In the case of multiplexing, the module supports one ADC interface, see **Table 7** for more details. The ADC interface is a hybrid architecture combining techniques from both SAR and Delta-Sigma style converters. Flexible controls allow finetuned performance and speed to meet the needs of a wide variety of applications. Hardware oversampling reduces system-level noise over multiple front-end samples. It includes integrated voltage reference options. Inputs are selectable from a wide range of sources, including pins configurable as either single-ended or differential.

The ADC interface supports three operational speed and performance:

- Normal Mode (all devices): Flexible speed and performance, 12–16 bits output resolution
 - 11.7 bits ENOB performance at 1 Msps (OSR = 2)
 - 14.3 bits ENOB performance at 76.9 ksps (OSR = 32)
- High Speed Mode (select devices): Doubles output speed of Normal mode with similar performance, 12–16 bits output resolution
 - 11.7 bits ENOB performance at 2 Msps (OSR = 2)
 - 14.3 bits ENOB performance at 153.8 ksps (OSR = 32)
- High Accuracy Mode (select devices): Optimized for low-rate, high performance applications, with 20 bit output resolution
 - 16 bits ENOB performance at 3.8 ksps (OSR = 256)
 - 15 bits ENOB performance at 15.3 ksps (OSR = 64)

3.4.6. DAC* Interface

In the case of multiplexing, the module supports two DAC interfaces, see **Table 7** for more details. The DAC interface can convert a digital value to an analog output voltage. It is a fully differential, 500 ksps, 12-bit converter. It may be used for a number of different applications such as sensor interfaces or sound output. It can generate high-resolution analog signals while the MCU is operating at low frequencies and with low total power consumption. Using DMA and a timer, it can be used to generate waveforms without any CPU intervention. It is available in all energy modes down to and including EM3.

3.4.7. ACMP* Interface

In the case of multiplexing, the module supports two ACMP interfaces, see **Table 7** for more details. The ACMP interface 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.

3.4.8. KEYSCAN* Interface

In the case of multiplexing, the module supports one KEYSCAN interface, see **Table 6** for more details. The low-energy KEYSCAN interface can scan up to a 6 x 8 matrix of keyboard switches. The KEYSCAN peripheral contains logic for debounce and settling time, allowing it to scan through the switch matrix autonomously in EM0 and EM1, and interrupt the processor when a key press is detected. A wake-on-keypress feature is also supported, allowing for the detection of any key press down to EM3.

3.4.9. GPIO Interfaces

In the case of multiplexing, the module supports up to 21 GPIO interfaces, see **Table 6** and **Table 7** for more details. Each GPIO pin can be individually configured as either an output or input. More advanced configurations including open-drain, open-source, and glitch-filtering can be configured for each individual GPIO pin. The GPIO pins can be overridden by peripheral connections, like SPI communication. Each peripheral connection can be routed to several GPIO pins on the device. The input value of a GPIO pin can be routed through the Peripheral Reflex System to other peripherals. The GPIO subsystem supports asynchronous external pin interrupts.

4 Operating Characteristics

4.1. Power Supply Interface

Table 10: Pin Description of Power Supply and GND Pins

Pin Name	Pin No.	I/O	Description	Min.	Typ.	Max.	Unit
VBAT	15、16	PI	Power supply for the module	1.71	3.3	3.8	V
GND	1, 3, 19, 47, 48, 50						

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 provides at least 250 mA to ensure sufficient current. For better power supply performance, it is recommended to parallel a 22 μ F decoupling capacitor, and two filter capacitors (1 μ F and 100 nF) near the module's VBAT pin. C4 is reserved for debugging and not mounted by default. In addition, to avoid the ripple and surge and to ensure the stability of the power supplies to the module, add a high-power rated TVS component at the front end of the power supplies. If TVS is not added, surges on the input power supplies may cause damage to the module. In principle, the longer the VBAT trace is, the wider it should be.

VBAT reference circuit is shown below:

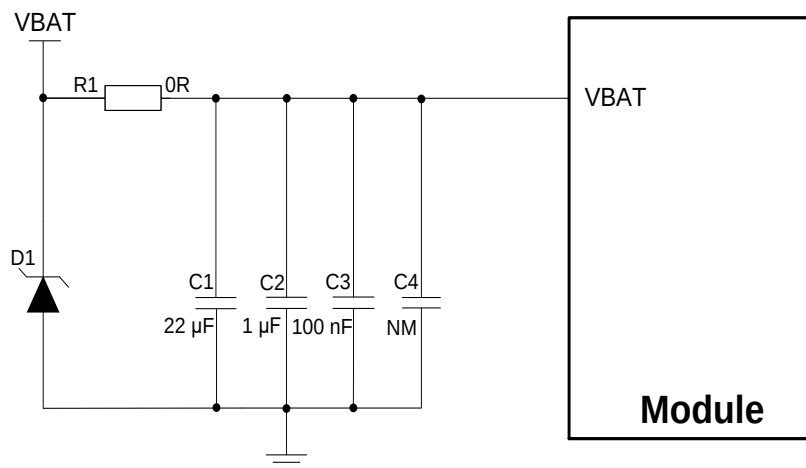


Figure 9: Reference Design of Power Supply

4.2. Reset

Drive the RESET_N low for at least 100 ns and then release it to reset the module. In order to avoid module restart due to abnormal interference, it is recommended to route the trace as short as possible and surround it with ground.

Table 11: Pin Description of RESET_N

Pin Name	Pin No.	I/O	Description	Comment
RESET_N	25	DI	Reset the module	Hardware reset. Internally pulled up to 1.8 V. Active low.

The reference design for resetting the module is shown below. Press 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 and a 100 nF capacitor to avoid jittering.

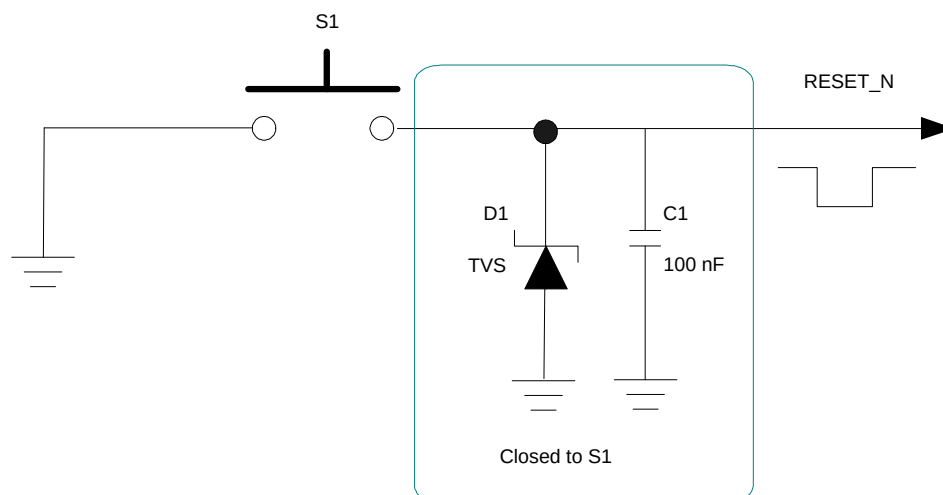


Figure 10: Reference Circuit for RESET_N with a Button

The module reset timing is illustrated in the following figure.

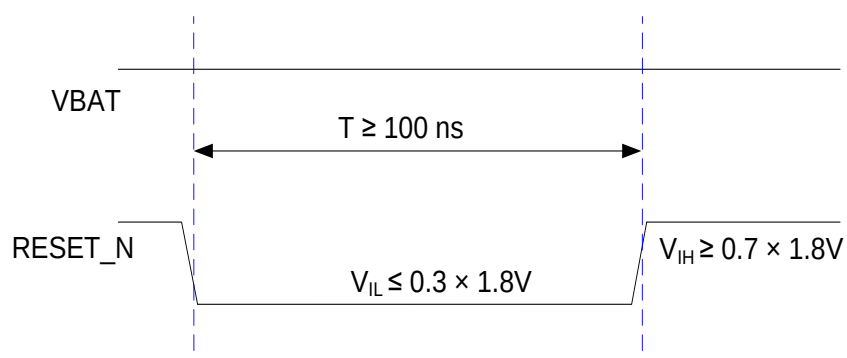


Figure 11: Reset Timing

NOTE

RESET_N is internally pulled up with a 44 kΩ resistor.

5 RF Specifications

5.1. Bluetooth Performances

Table 12: Bluetooth Performances

Operating Frequency		
2.400–2.4835 GHz		
Modulation		
GFSK		
Operating Mode		
BLE		
Condition (VBAT = 3.3 V; Temp. 25 °C)	Typ.; Unit: dBm	
	Transmit Power	Receiver Sensitivity (Tolerance: ±2 dB)
BLE (1 Mbps)	≤ 10	-98.5
BLE (2 Mbps)	≤ 10	-94
BLE (S = 2)	≤ 10	-100.5
BLE (S = 8)	≤ 10	-105.5

5.2. 802.15.4 Performances

Table 13: 802.15.4 Performances

Operating Frequency		
2.400–2.4835 GHz		
Modulation		
OQPSK		
Operating Mode		
Zigbee or Thread		
Condition (VBAT = 3.3 V; Temp. 25 °C)	Typ.; Unit: dBm	
	Transmit Power	Receiver Sensitivity (Tolerance: ± 2 dB)
CH11 (2405 MHz)	≤ 10	-106
CH18 (2440 MHz)	≤ 10	-105
CH26 (2480 MHz)	≤ 10	-104

5.3. Antenna/Antenna Interfaces

Appropriate antenna type and design should be used with matched antenna parameters according to specific application. It is required to perform a comprehensive functional test for the RF design before mass production of terminal products. The entire content of this chapter is provided for illustration only. Analysis, evaluation and determination are still necessary when designing target products.

KCM233S is provided with one of the two antenna interface designs: pin antenna interface ANT_15.4/BT and RF coaxial connector. The RF coaxial connector is not soldered when the module is designed with ANT_15.4/BT 1antenna interface. The impedance of antenna port is 50 Ω .

5.3.1. Pin Antenna Interface (ANT_15.4/BT) ⁶

Table 14: KCM233S ANT_15.4/BT1& ANT_15.4/BT2 Pin Description

Pin Name	Pin No.	I/O	Description	Comment
ANT_15.4/BT1	49	AIO	802.15.4/Bluetooth antenna interface	50 Ω characteristic impedance.
ANT_15.4/BT2	2	AIO	802.15.4/Bluetooth antenna interface	50 Ω characteristic impedance.

5.3.1.1. Reference Design

The circuit of pin antenna interface is shown below. For better RF performance, it is recommended to reserve a dual L-type circuit and add an ESD protection component. The reserved matching components (R1, C1, C2, and D1) should be placed as close to the antenna as possible and should be mounted or not based on the actual situation. By default, C1, C2, and D1 are not mounted, and only a 0 Ω resistor is mounted at R1.

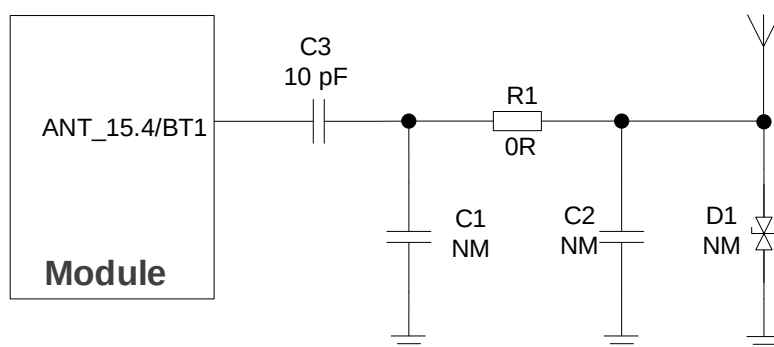


Figure 12: RF Antenna Reference Design

NOTE

- It is recommended to reserve an ESD protection component for the antenna interface and the junction capacitance should not exceed 0.05 pF.
- Notes on C3:
 - If there is DC power at the antenna port, place a capacitor on C3 to prevent short circuit to ground. The capacitance value is recommended to be 10 pF, which can be adjusted according to the debugging results.
 - If there is no DC power in the peripheral design:

⁶ KCM233S is provided with one of the two antenna interface designs. For more details, contact Quectel Technical Support.

- a) Do not reserve C3.
- b) If C3 has already been reserved, it should be mounted with a component, and it is recommended to use a $0\ \Omega$ resistor. You can also match the component according to the debugging results.

5.3.1.2. RF Routing Guidelines

For user's PCB, the characteristic impedance of all RF traces should be controlled to $50\ \Omega$. The impedance of the RF traces is usually determined by the trace width (W), the materials' dielectric constant, the height from the reference ground to the signal layer (H), and the spacing between RF traces and grounds (S). Microstrip or coplanar waveguide is typically used in RF layout to control characteristic impedance. The following are reference designs of microstrip or coplanar waveguide with different PCB structures.

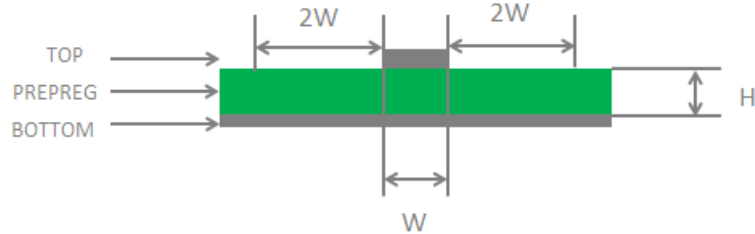


Figure 13: Microstrip Design on a 2-layer PCB

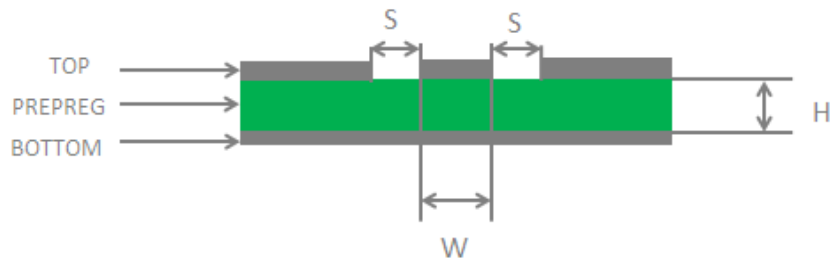


Figure 14: Coplanar Waveguide Design on a 2-layer PCB

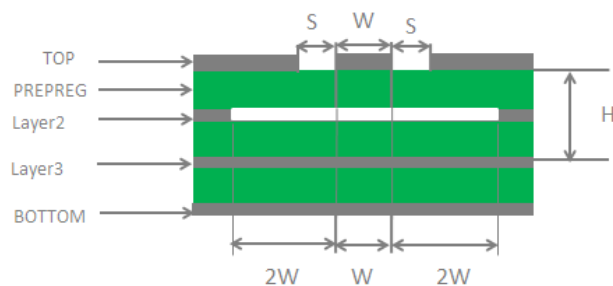


Figure 15: Coplanar Waveguide Design on a 4-layer PCB (Layer 3 as Reference Ground)

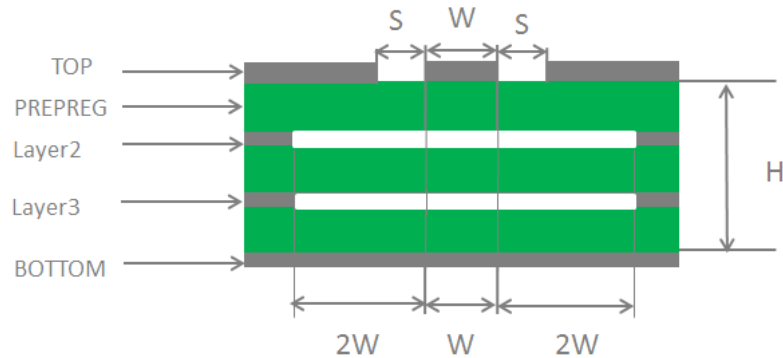


Figure 16: Coplanar Waveguide Design on a 4-layer PCB (Layer 4 as Reference Ground)

To ensure RF performance and reliability, follow the principles below in RF layout design:

- Use an impedance simulation tool to accurately control the characteristic impedance of RF traces to 50 Ω .
- The GND pins adjacent to RF pins should not be designed as thermal relief pads, and should be fully connected to ground.
- The distance between the RF pins and the RF connector should be as short as possible and all the right-angle traces should be changed to curved ones. The recommended trace angle is 135°.
- There should be clearance under the signal pin of the antenna connector or solder joint.
- The reference ground of RF traces should be complete. Meanwhile, adding some ground vias around RF traces and the reference ground could help to improve RF performance. The distance between the ground vias and RF traces should be at least twice the width of RF signal traces ($2 \times W$).
- Keep RF traces away from interference sources (such as DC-DC, (U)SIM/USB/SDIO high frequency digital signals, display signals, and clock signals), and avoid intersection and paralleling between traces on adjacent layers.

For more details about RF layout, see **document [3]**.

5.3.1.3. RF Connector Recommendation

If RF connector is used for antenna connection, it is recommended to use the U.FL-R-SMT connector provided by Hirose.

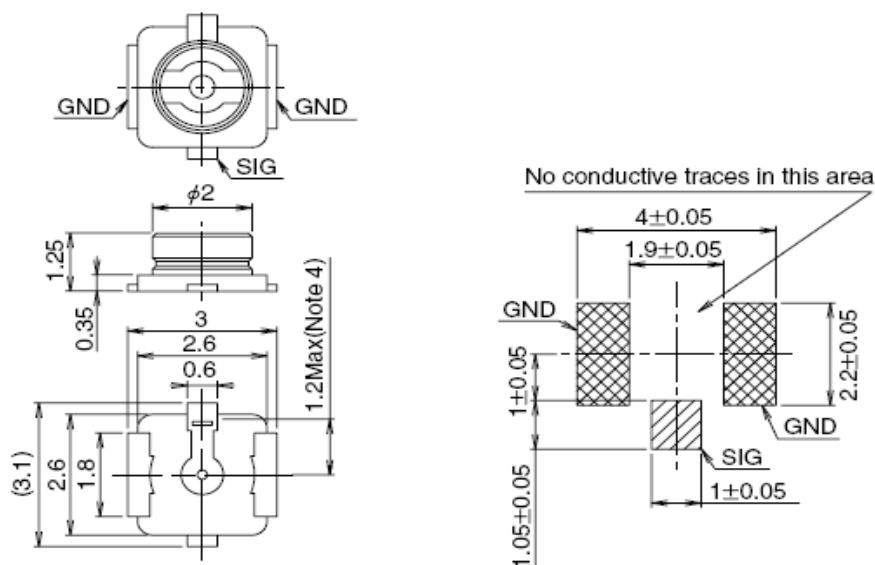


Figure 17: Dimensions of the Receptacle (Unit: mm)

U.FL-LP series mated plugs listed in the following figure can be used to match the U.FL-R-SMT connector.

	U.FL-LP-040	U.FL-LP-066	U.FL-LP(V)-040	U.FL-LP-062	U.FL-LP-088
Part No.					
Mated Height	2.5mm Max. (2.4mm Nom.)	2.5mm Max. (2.4mm Nom.)	2.0mm Max. (1.9mm Nom.)	2.4mm Max. (2.3mm Nom.)	2.4mm Max. (2.3mm Nom.)
Applicable cable	Dia. 0.81mm Coaxial cable	Dia. 1.13mm and Dia. 1.32mm Coaxial cable	Dia. 0.81mm Coaxial cable	Dia. 1mm Coaxial cable	Dia. 1.37mm Coaxial cable
Weight (mg)	53.7	59.1	34.8	45.5	71.7
RoHS	YES				

Figure 18: Specifications of Mated Plugs

The following figure describes the space factor of mated connectors.

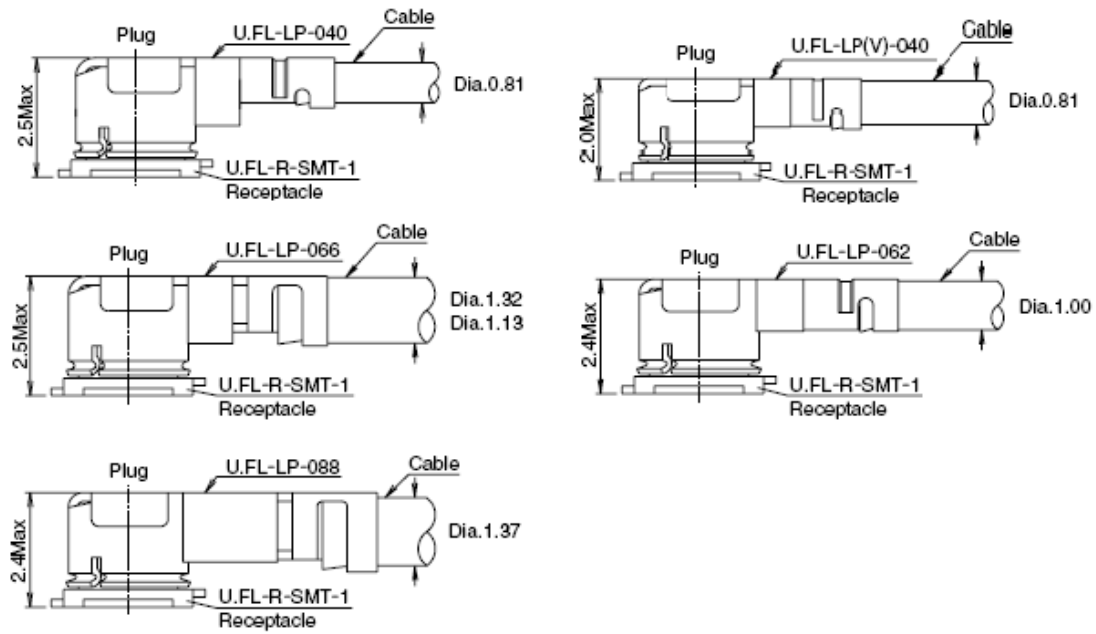


Figure 19: Space Factor of Mated Connectors (Unit: mm)

For more details, please visit <http://www.hirose.com>.

5.3.2. KCM233S RF Coaxial Connector ⁷

5.3.2.1. Receptacle Specifications

The mechanical dimensions of the receptacle supported by the module are as follows.

⁷ KCM233S is provided with one of the two antenna interface designs. For more details, contact Quectel Technical Support.

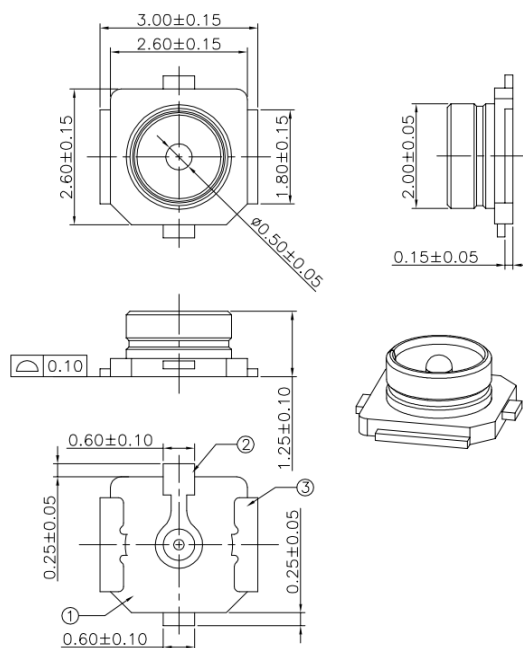


Figure 20: Dimensions of the Receptacle (Unit: mm)

Table 15: Major Specifications of the RF Connector

Item	Specification
Nominal Frequency Range	DC to 6 GHz
Nominal Impedance	50 Ω
Temperature Rating	-40 °C to +105 °C
Voltage Standing Wave Ratio (VSWR)	Meet the requirements of: Max. 1.3 (DC–3 GHz) Max. 1.45 (3–6 GHz)

5.3.2.2. Antenna Connector Installation

The receptacle mounted on the module accepts two types of mated plugs that will meet a maximum height of 2.0 mm using a $\varnothing$ 0.81 mm coaxial cable or a maximum height of 2.2 mm utilizing a $\varnothing$ 1.13 mm coaxial cable.

The following figure shows the dimensions of mated plugs using $\varnothing$ 0.81 mm/ $\varnothing$ 1.13 mm coaxial cables.

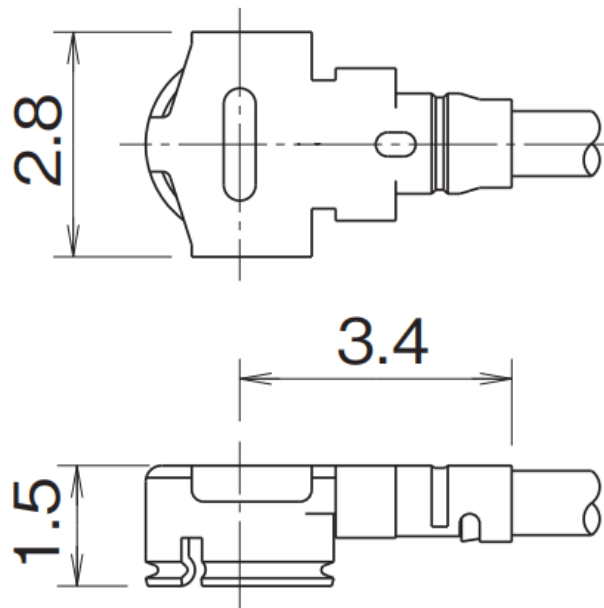


Figure 21: Dimensions of Mated Plugs (Ø 0.81 mm/Ø 1.13 mm Coaxial Cables) (Unit: mm)

The following figure illustrates the connection between the receptacle on the module and the mated plug using a Ø 0.81 mm coaxial cable.

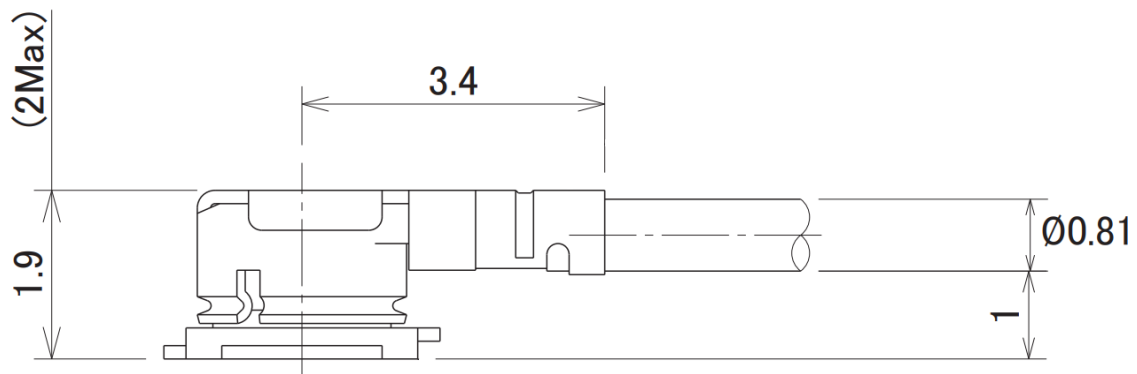


Figure 22: Space Factor of Mated Connectors (Ø 0.81 mm Coaxial Cables) (Unit: mm)

The following figure illustrates the connection between the receptacle mounted on the module and the mated plug using a Ø 1.13 mm coaxial cable.

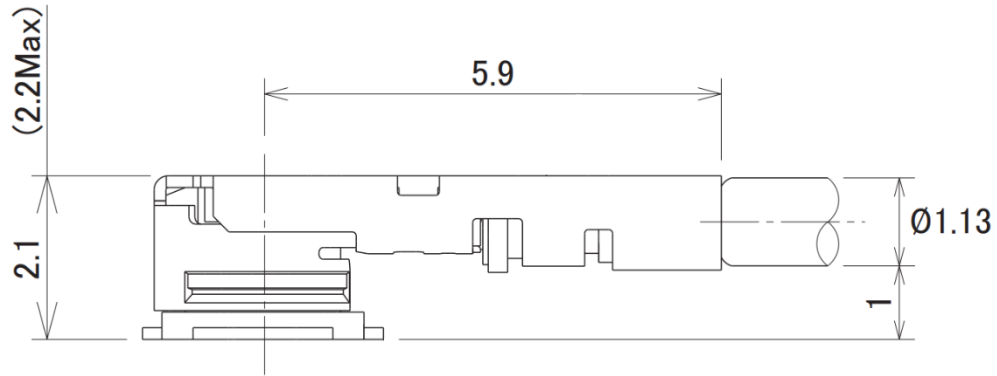


Figure 23: Space Factor of Mated Connectors (Ø 1.13 mm Coaxial Cables) (Unit: mm)

5.3.2.3. Recommended RF Connector Installation

The pictures for plugging in a coaxial cable plug is shown below, $\theta = 90^\circ$ is acceptable, while $\theta \neq 90^\circ$ is not.

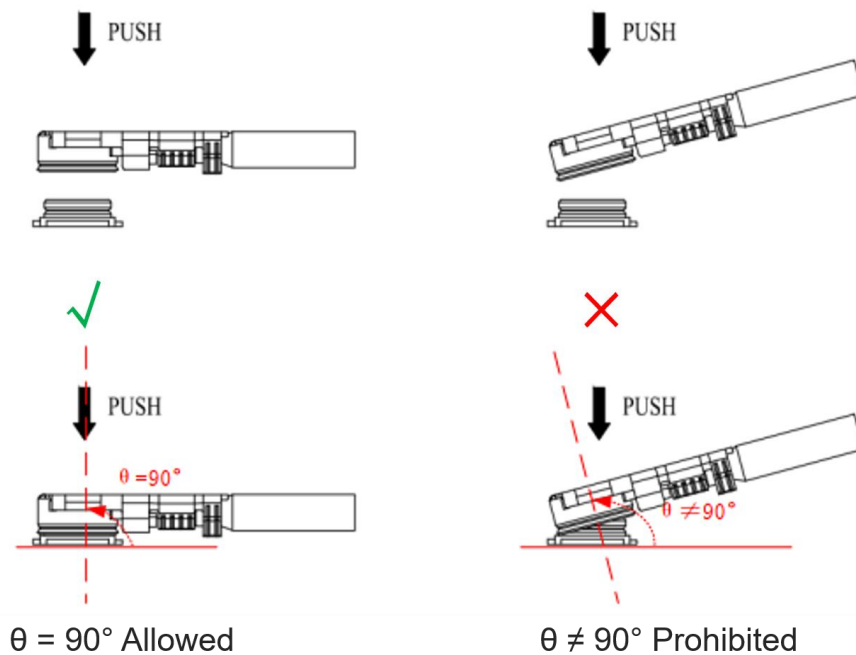


Figure 24: Plug in a Coaxial Cable Plug

The pictures of pulling out the coaxial cable plug is shown below, $\theta = 90^\circ$ is acceptable, while $\theta \neq 90^\circ$ is not.

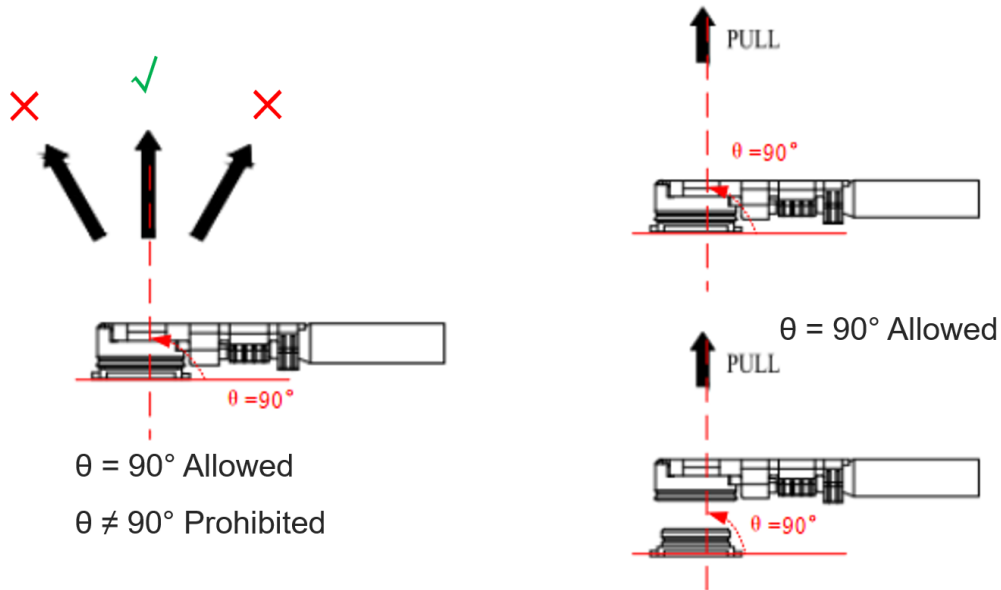


Figure 25: Pull out a Coaxial Cable Plug

The pictures of installing the coaxial cable plug with a jig is shown below, $\theta = 90^\circ$ is acceptable, while $\theta \neq 90^\circ$ is not.

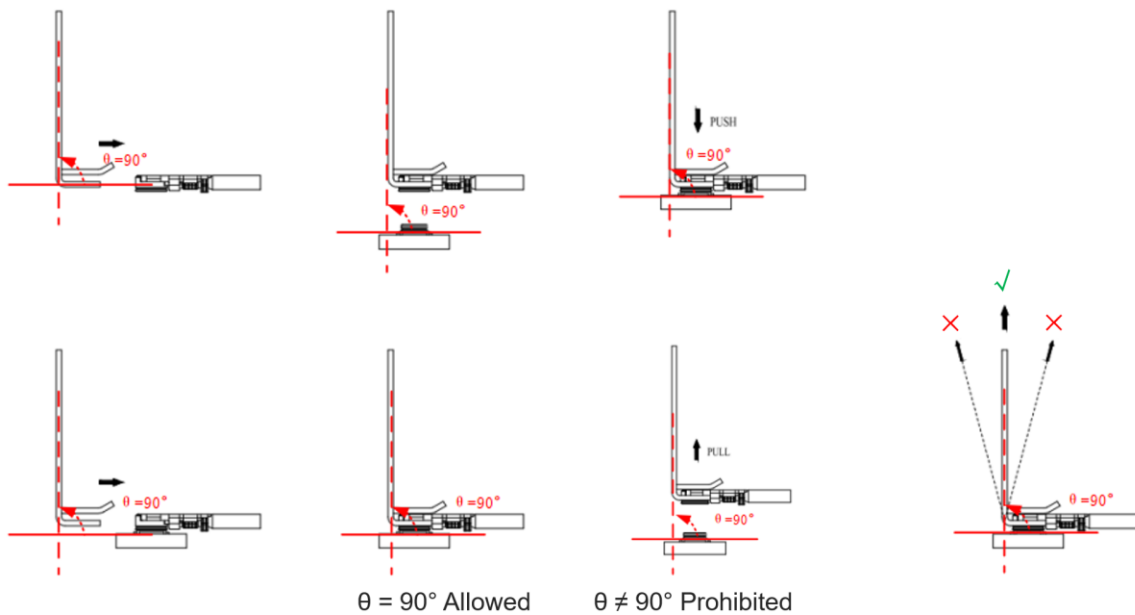


Figure 26: Install the Coaxial Cable Plug with Jig

5.3.2.4. Recommended Manufacturers of RF Connector and Cable

RF connectors and cables by I-PEX are recommended. For more details, visit <https://www.i-pex.com>.

5.3.3. Requirements for Antenna Design

Table 16: Requirements for Antenna Design

Parameter	Requirements
Frequency Range (GHz)	2.4 GHz: 2.400–2.4835 GHz
Pin Antenna Interface, RF Coaxial Connector	● VSWR: ≤ 2 (Typ.) ● Gain: 0.2 dBi (max.) ● Max. Input Power: 50 W ● Input Impedance: 50 Ω ● Vertical polarization ● Cable Insertion Loss: < 1 dB

6 Electrical Characteristics and Reliability

6.1. Absolute Maximum Ratings

Table 17: Absolute Maximum Ratings (Unit: V)

Parameter	Min.	Max.
VBAT	-0.3	3.8
Voltage at Digital Pins	-0.3	4.1

NOTE

Exceeding the conditions of use as shown above may cause permanent damage to the module.

6.2. Power Supply Ratings

Table 18: 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. Power Consumption

Test conditions for module power consumption are as follows:

- Ambient temperature 25 °C
- Typical power domain
- 50 Ω impedance

The following power consumption data are the typical values for your reference only. Actual values may vary among different modules due to differences in internal components, software versions and test ambient temperatures. For more details, please contact Quectel Technical Support.

6.3.1. Bluetooth Power Consumption

Table 19: Bluetooth Consumption in Non-signaling Mode (Unit: mA)

Mode	Typ.	Max.
BLE 1 Mbps @ Tx 8 dBm	10.31	12.29
BLE 2 Mbps @ Tx 8 dBm	6.58	8.50
BLE (S = 2) @ Tx 8 dBm	9.22	14.37
BLE (S = 8) @ Tx 8 dBm	12.3	15.09

6.3.2. 802.15.4 Power Consumption

Table 20: 802.15.4 Consumption (Unit: mA)

Mode	Typ.	Max.
2405 MHz @ 10 dBm	20.06	23.36
2440 MHz @ 10 dBm	19.66	22.72
2480 MHz @ 10 dBm	19.29	22.30

6.4. Digital I/O Characteristics

Table 21: VBAT I/O Characteristics (Unit: V)

Parameter	Description	Min.	Max.
V_{IH}	High-level input voltage	$0.7 \times V_{BAT}$	-
V_{IL}	Low-level input voltage	-	$0.3 \times V_{BAT}$
V_{OH}	High-level output voltage	$0.8 \times V_{BAT}$	-
V_{OL}	Low-level output voltage	-	$0.2 \times V_{BAT}$

NOTE

$V_{BAT} = 3.3 \text{ V}$.

6.5. 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 22: Electrostatic Discharge Characteristics (Unit: kV)

Model	Test Result	Standard
Human Body Model (HBM)	± 2.5	ANSI/ESDA/JEDEC JS-001-2017
Charged Device Model (CDM)	± 0.75	ANSI/ESDA/JEDEC JS-002-2018

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

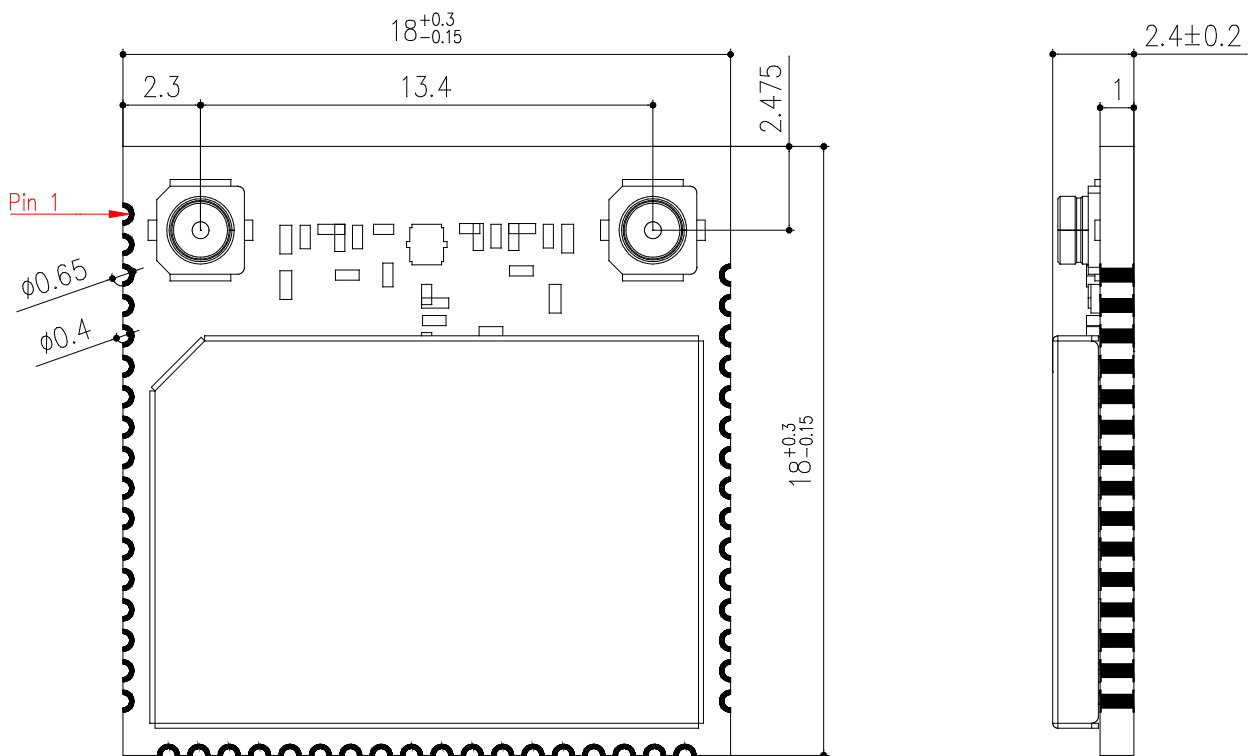


Figure 27: KCM233S Top and Side Dimensions

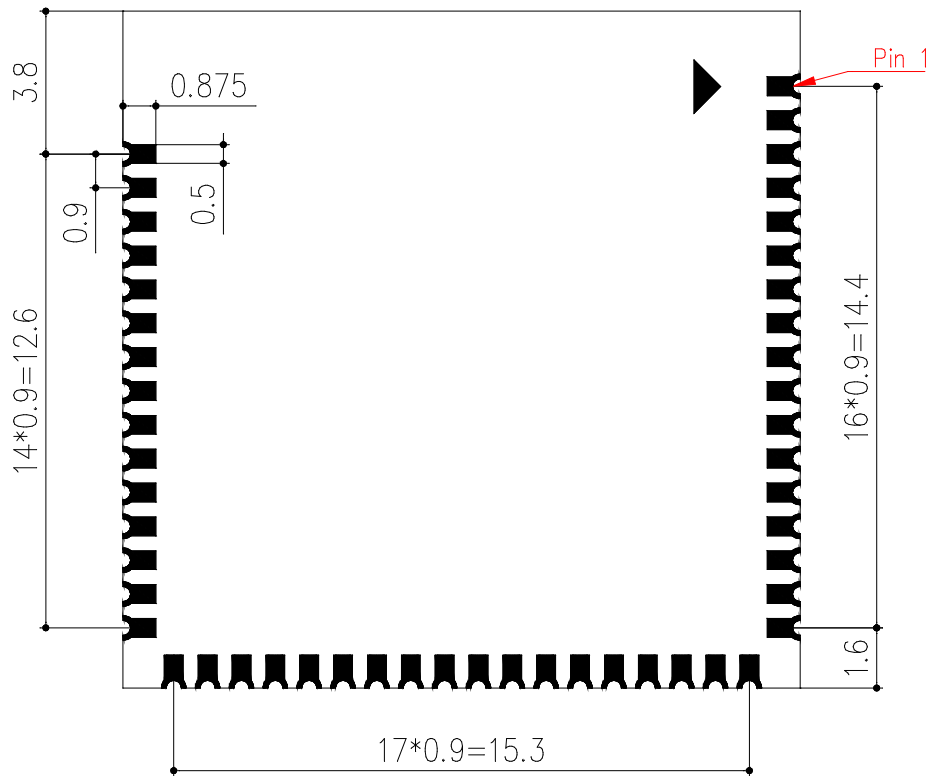


Figure 28: KCM233S Bottom Dimensions (Bottom View)

NOTE

The module's coplanarity standard: ≤ 0.13 mm.

7.2. Recommended Footprint

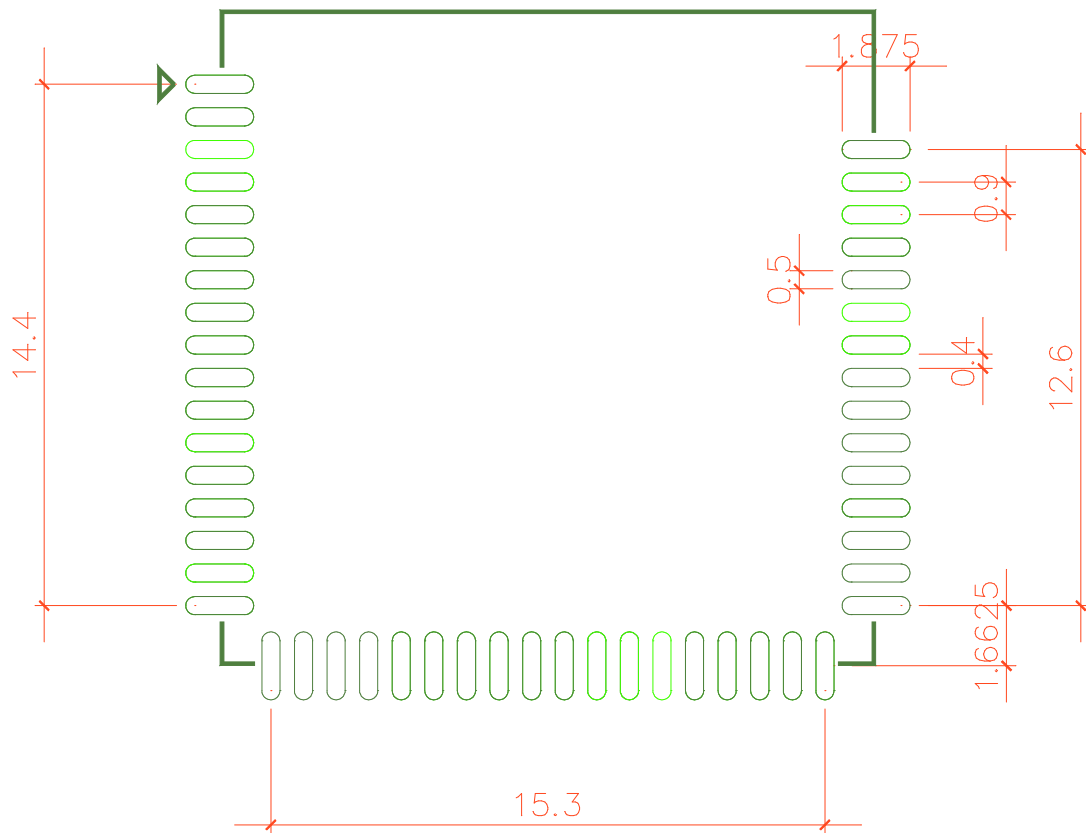


Figure 29: KCM233S Recommended Footprint

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

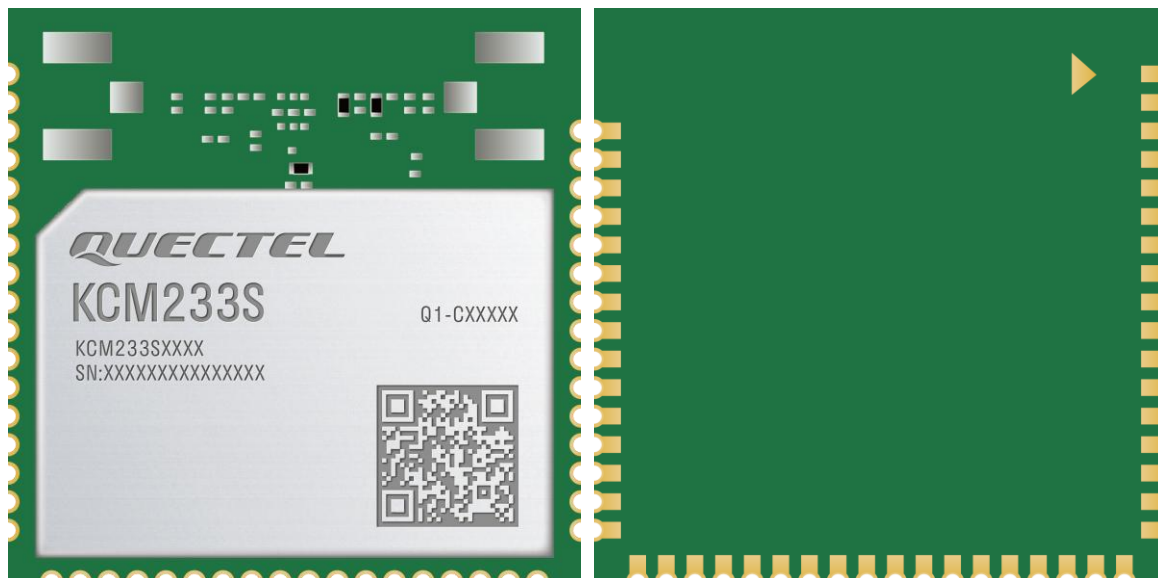


Figure 30: KCM233S Top and Bottom Views (Pin Antenna Interface)

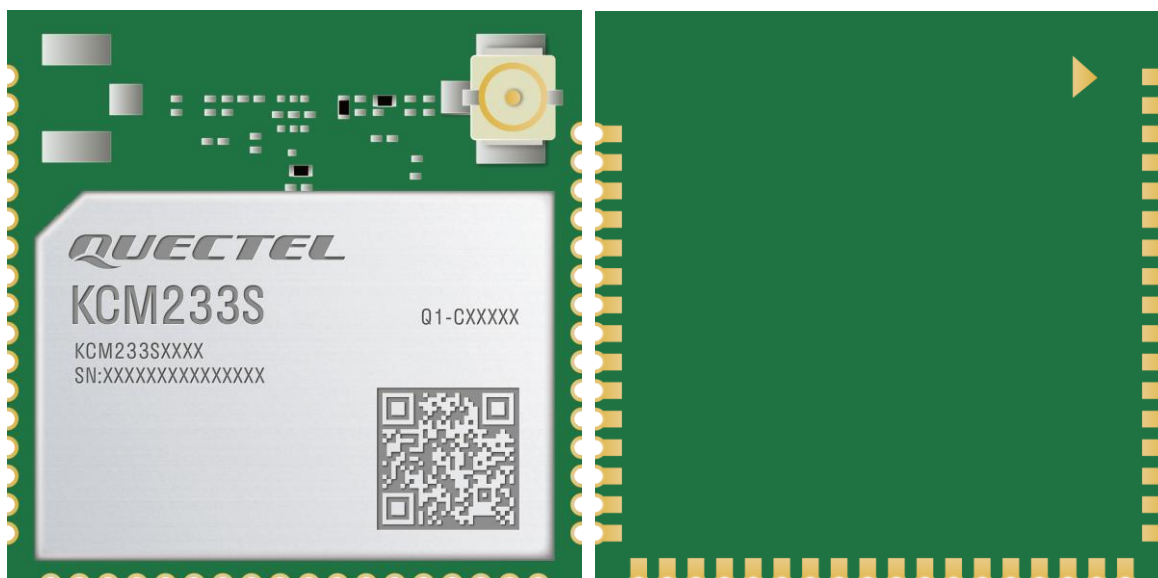


Figure 31: KCM233S Top and Bottom Views (RF Coaxial Connector)

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 ⁸ 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 24 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.

⁸ 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 [4]**.

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.

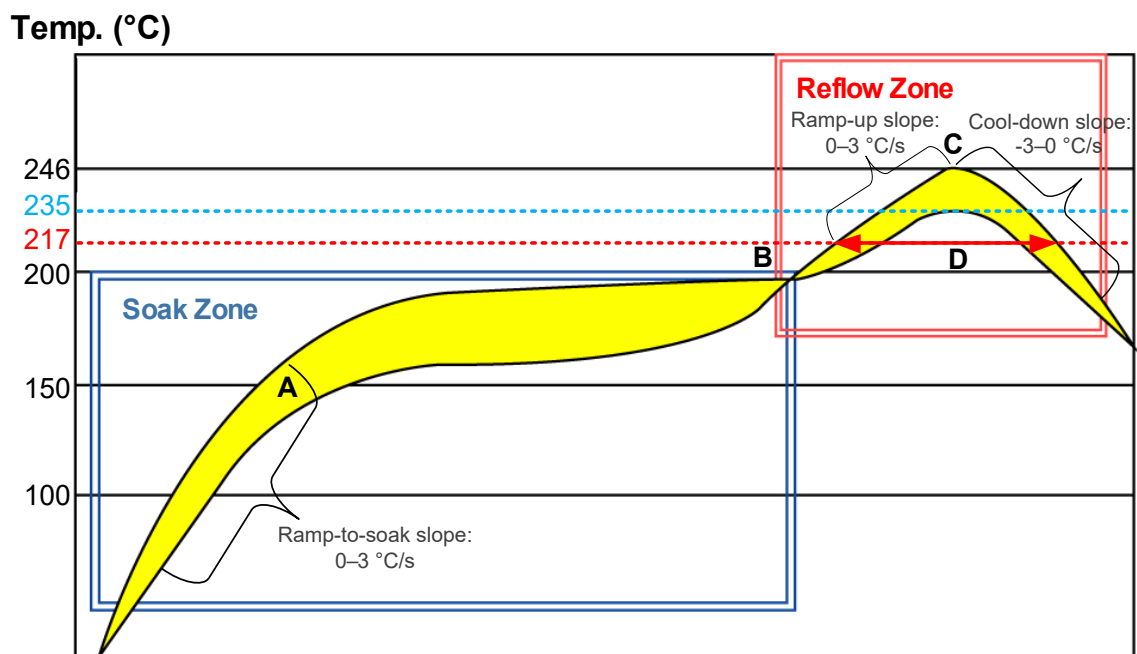


Figure 32: Recommended Reflow Soldering Thermal Profile

Table 23: 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. Avoid using materials that contain mercury (Hg), such as adhesives, for module processing, even if the materials are RoHS compliant and their mercury content is below 1000 ppm (0.1 %).
7. Corrosive gases may corrode the electronic components inside the module, affecting their reliability and performance, and potentially leading to a shortened service life that fails to meet the designed lifespan. Therefore, do not store or use unprotected modules in environments containing corrosive gases such as hydrogen sulfide, sulfur dioxide, chlorine, and ammonia.
8. 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 [5]*.

8.3. Packaging Specification

This chapter outlines the key packaging parameters and processes. All figures below are for reference purposes only, as the actual appearance and structure of packaging materials may vary in delivery.

The modules are packed in a tape and reel packaging as specified in the sub-chapters below.

8.3.1. Carrier Tape

Carrier tape dimensions are illustrated in the following figure and table:

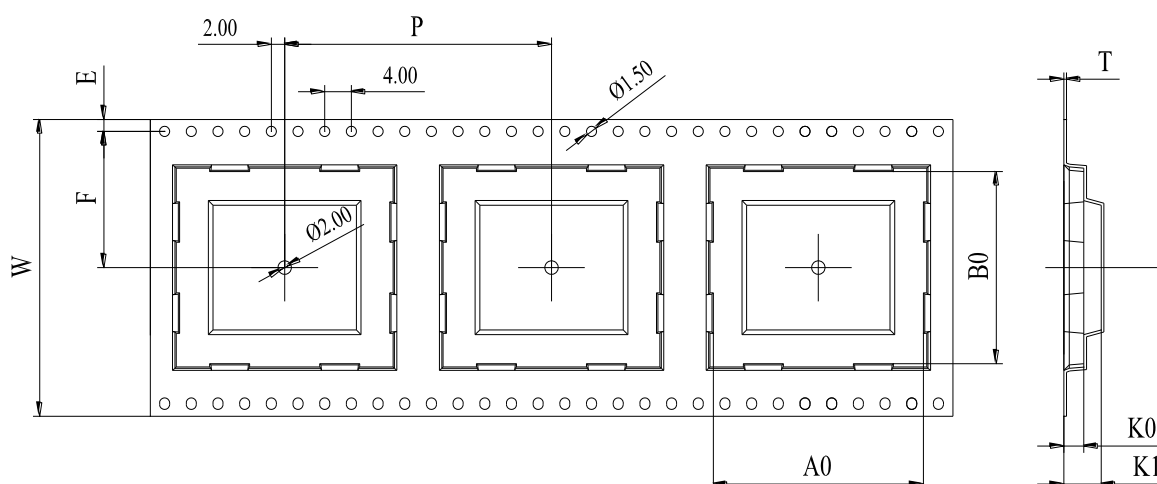


Figure 33: Carrier Tape Dimension Drawing (Unit: mm)

Table 24: KCM233S Carrier Tape Dimension Table (Unit: mm)

W	P	T	A0	B0	K0	K1	F	E
44	28	0.4	18.4	18.4	2.9	4	20.2	1.75

8.3.2. Plastic Reel

Plastic reel dimensions are illustrated in the following figure and table:

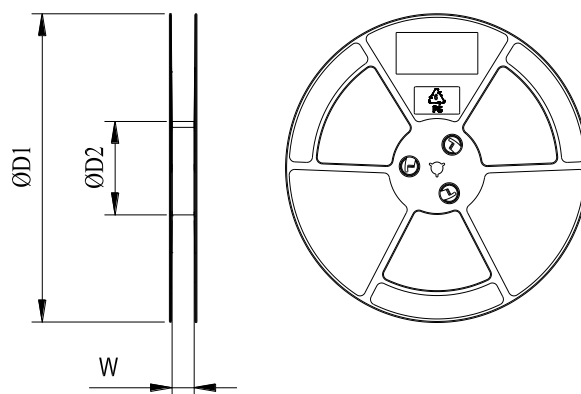


Figure 34: Plastic Reel Dimension Drawing

Table 25: Plastic Reel Dimension Table (Unit: mm)

ØD1	ØD2	W
330	100	44.5

8.3.3. Mounting Direction

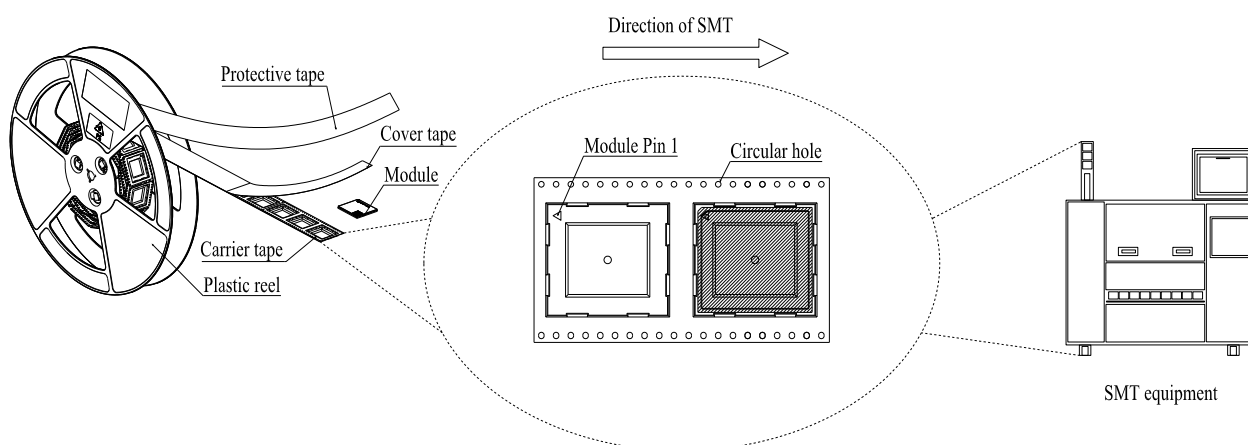
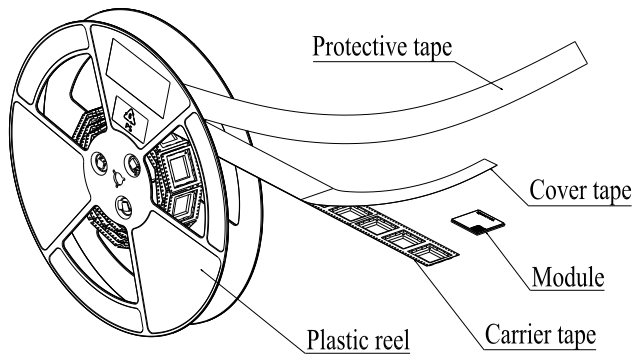


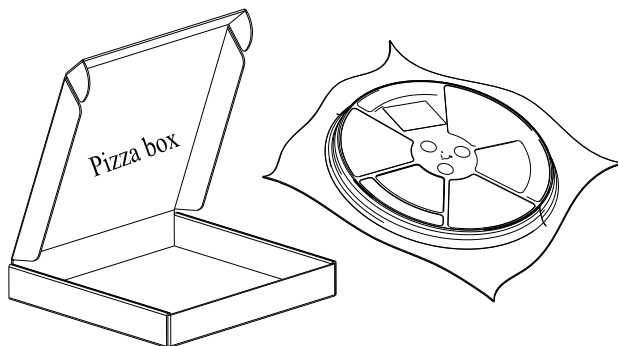
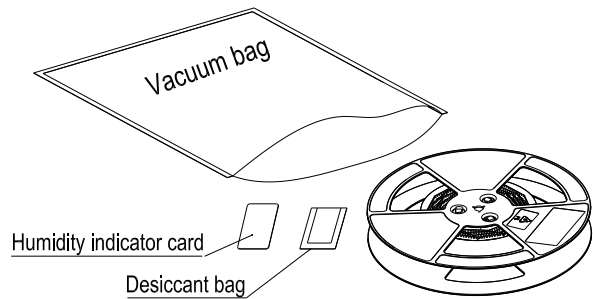
Figure 35: Mounting Direction

8.3.4. Packaging Process



Place the modules onto the carrier tape cavity and cover them securely with cover tape. Wind the heat-sealed carrier tape onto a plastic reel and apply a protective tape for additional protection. 1 plastic reel can pack 500 modules.

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



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

Place the 4 packaged pizza boxes into 1 carton and seal it. 1 carton can pack 2000 modules.

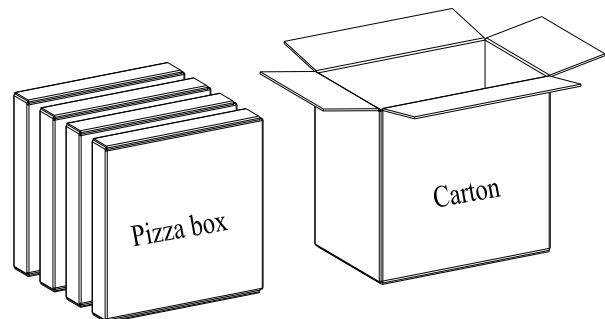


Figure 36: Packaging Process

9 Appendix References

Table 26: Reference Documents

Document Name
[1] Quectel_KCM233S_Open(SDK)_Quick_Start_Guide
[2] Quectel_KCM233S_TE-B_User_Guide
[3] Quectel_RF_Layout_Application_Note
[4] Quectel_Module_Stencil_Design_Requirements
[5] Quectel_Module_SMT_Application_Note

Table 27: Terms and Abbreviations

Abbreviation	Description
ACMP	Analog Comparator
ADC	Incremental Analog to Digital Converter
ANT	Antenna
ARM	Advanced RISC Machine
ASR	Successive Approximation Register
BLE	Bluetooth Low Energy
CDM	Charged Device Model
CPU	Central Processing Unit
DAC	Digital to Analog Converter
DALI	Digital Addressable Lighting Interface

DC	Direct Current
DMA	Direct Memory Access
EM	Energy Mode
ENOB	Effective Number of Bits
ESD	Electrostatic Discharge
EUSART	Enhanced Universal Synchronous Asynchronous Receiver Transmitter
GFSK	Gauss frequency Shift Keying
GND	Ground
GPIO	General-Purpose Input/Output
HBM	Human Body Mode
I2C	Inter-Integrated Circuit
I2S	Inter-IC Sound
I/O	Input/Output
IrDA	Infra-red Data Association
LGA	Land Grid Array
Mbps	Million Bits Per Second
MCU	Microcontroller Unit
MISO	Master In Slave Out
MOSI	Master Out Slave In
OQPSK	Orthogonal Quaternary Phase Shift Keying
OSR	Oversampling Ratio
OTA	Over-the-Air Technology
PCB	Printed Circuit Board
RAM	Random Access Memory
RF	Radio Frequency

RoHS	Restriction of Hazardous Substances
RXD	Receive Data
SDIO	Secure Digital Input and Output
SMBus	System Management Bus
SMD	Surface Mount Device
SPI	Serial Peripheral Interface
SWD	Serial Wire Debug
TVS	Transient Voltage Suppressor
Tx	Transmit
TXD	Transmit Data
UART	Universal Asynchronous Receiver/Transmitter
USART	Universal Synchronous/Asynchronous Receiver/ Transmitter
USB	Universal Serial Bus
(U)SIM	(Universal) Subscriber Identity Module
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
XO	Crystal Oscillator

FCC Statement

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help

The device must not be co-located or operating in conjunction with any other antenna or transmitter. 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.

FCC Radiation Exposure Statement

This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

Does not comply with the use restrictions of the product:

Portable devices used close with human's body (within 20cm), Like Cell phone, Notebook etc.

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

2.2 List of applicable FCC rules

FCC Part 15 Subpart C 15.247

2.3 Specific operational use conditions

The module can be used for mobile applications with a maximum 0.2 dBi antenna. The host manufacturer installing this module into their product must ensure that the final product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation. The host manufacturer has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as shown in this manual.

2.4 Limited module procedures

Not applicable. The module is a Single module and complies with the requirement of FCC Part 15.212.

2.5 Trace antenna designs

Not applicable. The module has its own antenna, and doesn't need a host's printed board micro strip trace antenna etc.

2.6 RF exposure considerations

The module must be installed in the host equipment such that at least 20cm is maintained between the antenna and user's body; and if RF exposure statement or module layout is changed, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID or new application. The FCC ID of the module cannot be used on the final product. In these circumstances, the host manufacturer will be responsible for reevaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

2.7 Antennas

Antenna Specification are as follows:

Type: External Antenna

Gain: 2.4G:0.2dBi;

This device is intended only for host manufacturers under the following conditions: The transmitter module may not be co-located with any other transmitter or antenna; The module shall be only used with the internal antenna(s) that has been originally tested and certified with this module. The antenna must be either permanently attached or employ a "unique" antenna coupler.

As long as the conditions above are met, further transmitter test will not be required. However, the host manufacturer is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc).

2.8 Label and compliance information

Host product manufacturers need to provide a physical or e-label stating "Contains FCC ID: XMR2025KCM233S" with their finished product.

2.9 Information on test modes and additional testing requirements

Host manufacturer must perform test of radiated & conducted emission and spurious emission, etc. according to the actual test modes for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product. Only when all

the test results of test modes comply with FCC requirements, then the end product can be sold legally.

2.10 Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is only FCC authorized for FCC Part 15 Subpart C 15.247 and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Federal Communication Commission Statement (FCC, U S)

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules These limits are designed to provide reasonable protection against harmful interference in a residential installation This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications However, there is no guarantee that interference will not occur in a particular installation If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna
- Increase the separation between the equipment and receiver
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected
- Consult the dealer or an experienced radio/TV technician for help

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.

FCC Caution:

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

IMPORTANT NOTES

Co-location warning:

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

OEM integration instructions:

This device is intended only for OEM integrators under the following conditions:

The transmitter module may not be co-located with any other transmitter or antenna The module shall be only used with the external antenna(s) that has been originally tested and certified with this module.

As long as the conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

Validity of using the module certification:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End product labeling:

The final end product must be labeled in a visible area with the following: "Contains Transmitter Module **FCC ID: XMR2025KCM233S**"

Information that must be placed in the end user manual:

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as shown in this manual.

IC**Industry Canada Statement**

This device complies with Industry Canada's licence-exempt RSS. Operation is subject to the following two conditions:

- (1) This device may not cause interference; and
- (2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

- (1) l'appareil ne doit pas produire de brouillage, et
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement."

Radiation Exposure Statement

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body.

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements ISED établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

This device is intended only for OEM integrators under the following conditions: (For module device use)

- 1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- 2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes: (Pour utilisation de dispositif module)

- 1) L'antenne doit être installée de telle sorte qu'une distance de 20 cm est respectée entre l'antenne et les utilisateurs, et
- 2) Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

Tant que les 2 conditions ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

IMPORTANT NOTE:

In the event that these conditions can not be met (for example certain laptop configurations or colocation with another transmitter), then the Canada authorization is no longer considered valid and the IC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate Canada authorization.

NOTE IMPORTANTE:

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains IC:10224A-2025KCM233S".

Plaque signalétique du produit final

Ce module émetteur est autorisé uniquement pour une utilisation dans un dispositif où l'antenne peut être installée de telle sorte qu'une distance de 20cm peut être maintenue entre l'antenne et les utilisateurs. Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 10224A-2025KCM233S".

Manual Information To the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.

Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.

This radio transmitter 【IC: 10224A-2025KCM233S】 has been approved by Innovation, science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

Ce émetteur radio 【IC : 10224A-2025KCM233S】 a été approuvé par Innovation, Science et Economic Development Canada pour fonctionner avec les types d'antennes énumérés ci - dessous, avec le gain maximal autorisé indiqué. Les types d'antennes non inclus dans cette liste ayant un gain supérieur au gain maximal indiqué pour tout type énuméré sont strictement interdits pour une utilisation avec cet appareil.

Antennas

Antenna Specification are as follows:

Type: External Antenna

Gain: 2.4G:0.2dBi;

