FLM163D Hardware Design

Short-Range Module Series

Version: 1.0.0

Date: 2024-06-25

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.
Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China
Tel: +86 21 5108 6236
Email: info@quectel.com

Or our local offices. For more information, please visit:
http://www.quectel.com/support/sales.htm.

For technical support, or to report documentation errors, please visit:
http://www.quectel.com/support/technical.htm.
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.

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
-	2024-06-25	Devin YU/ Casper CHENG	Creation of the document
1.0.0	2023-06-25	Devin YU/ Casper CHENG	Preliminary

Contents

Table Index

Figure Index

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 FLM163D in QuecOpen® solution and describes its air interfaces and hardware interfaces, which are connected with your applications.

With this document, you can quickly understand module interface specifications, electrical and mechanical details, as well as other related information of the module. The document, coupled with application notes and user guides, makes it easy to design and set up mobile applications with the module.

Hereby, Quectel Wireless Solutions Co., Ltd. declares that the radio equipment type FLM163D 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

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.

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

your body.

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.

2 Product Overview

FLM163D is a high-performance MCU Wi-Fi and Bluetooth module supporting IEEE 802.11b/g/n/ax and BLE 5.2 standards. The module provides multiple interfaces including UART, ADC and PWM for various applications.

FLM163D supports secondary development and is manufactured by wave soldering. It includes:

- 320 MHz and 32-bit MCU processor
- Built-in 512 KB SRAM and 4 MB flash

Table 2: Basic Information

FLM163D	
Packaging type	DIP
Pin counts	11
Dimensions	(17.9 ±0.15) mm × (15.0 ±0.15) mm × (2.8 ±0.2) mm
Weight	Approx. 0.83 g

2.1. Key Features

Table 3: Key Features

Basic Information		12 / 43
Protocols and Standards	• Wi-Fi Protocols: IEEE 802.11b/g/n/ax • Bluetooth protocol: BLE 5.2 • All hardware components are fully compliant with EU RoHS directive	
Power Supply	**VBAT Power Supply:** • 3.0–3.6 V • Typ.: 3.3 V	
Temperature Ranges	• Operating temperature [1]: -40 to +85 ℃ • Storage temperature: -45 to +95 ℃	
EVB Kit	FLM163D TE-B [2]	
Antenna/Antenna Interface		
Antenna/ Antenna Interface	• PCB antenna • 50 Ω characteristic impedance	
Application Interface [3]		
Application Interfaces	UART, PWM, ADC	

---

[1] Within the operating temperature range, the module performance meets IEEE and Bluetooth specifications.
[2] For more details about the EVB, see *document [1]*.
[3] For more details about the interfaces, see *Chapters 3.3* and *3.4*.

3 Application Interfaces

3.1. Pin Assignment
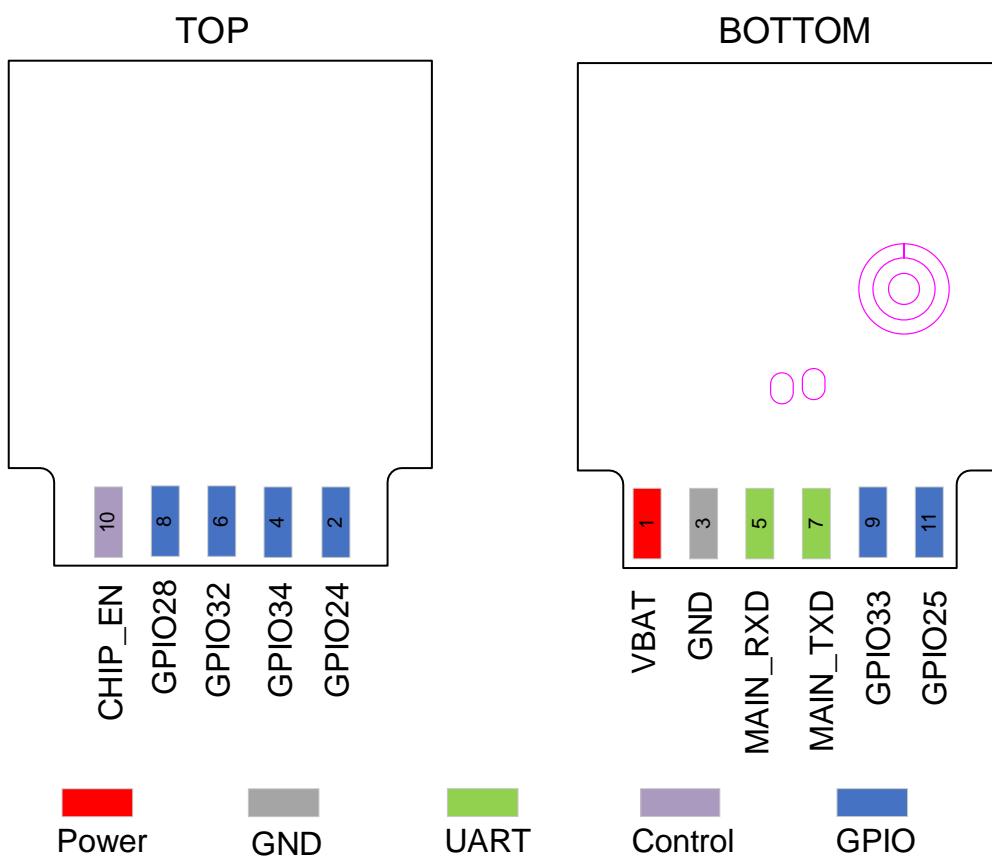
Figure 1: Pin Assignment

> **NOTE**
>
> 1. The module supports 1 UART and 6 GPIO interfaces by default. In the case of multiplexing, it can support PWM and ADC interfaces. For more details, see *Chapters 3.3* and *3.4*.
> 2. The GND pin should be connected to ground.

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	1	PI	Power supply for the module	Vmax = 3.6 V Vmin = 3.0 V Vnom = 3.3 V	It must be provided with sufficient current of at least 0.3 A.
GND	3				
Control Signal					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
CHIP_EN	10	DI	Enable the module (default)	VBAT	Hardware enable. Internally pulled up to 3.3 V. Active high.
		DI	Reset the module		Hardware reset. Internally pulled up to 3.3 V. Active low.
Main UART					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
MAIN_TXD	7	DO	Main UART transmit	VBAT	

Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
MAIN_RXD	5	DI	Main UART receive		

GPIO Interfaces 15 / 43

Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
GPIO24	2	DIO	General-purpose input/output	VBAT	Interrupt wakeup.
GPIO34	4	DIO			
GPIO32	6	DIO			
GPIO28	8	DIO			
GPIO33	9	DIO			
GPIO25	11	DIO			

3.3. GPIO Multiplexing

The module provides 6 GPIO interfaces by default. In the case of multiplexing, it supports up to 8 GPIO interfaces. Pins are defined as follows:

Table 6: GPIO Multiplexing

Pin Name	Pin No.	Alternate Function 0 (GPIO No.)	Alternate Function 1	Alternate Function 2	Alternate Function 3
GPIO24	2	GPIO24	PWM4	32K_CLK_OUT	ADC2
GPIO34	4	GPIO34	PWM8	TS8	-
GPIO32	6	GPIO32	PWM6	TS6	-
GPIO28	8	GPIO28	ADC4	-	-
GPIO33	9	GPIO33	PWM7	TS7	
GPIO25	11	GPIO25	PWM5	ADC1	IRDA
MAIN_RXD	5	GPIO10	-	-	-
MAIN_TXD	7	GPIO11	-	-	-

NOTE

All GPIOs can be configured as interrupt source to interrupt the system in active mode or to wake it up from low power mode. For details, please contact Quectel Technical Support.

3.4. Application Interfaces

3.4.1. UART

The module supports one UART interface: the main UART.

Table 7: Pin Definition of UART

Pin Name	Pin No.	I/O	Description
MAIN_TXD	7	DO	Main UART transmit
MAIN_RXD	5	DI	Main UART receive

The main UART can be used for data transmission. The default baud rate is 115200 bps, and the maximum baud rate is 6 Mbps. The main UART is also available for firmware upgrade, in this case the baud rate is configurable, the default is 921600 bps.

The main UART connection between the module and MCU is illustrated below.
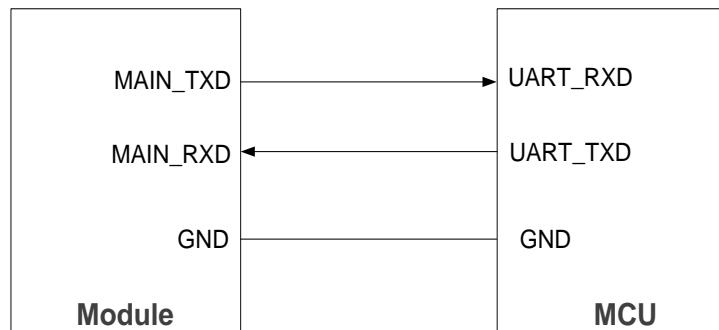
Figure 2: Main UART Connection

3.4.2. PWM Interfaces

In the case of multiplexing, the module supports up to 5 PWM interfaces. Pin description of PWM interfaces are as follows.

Table 8: Pin Definition of PWM Interfaces

Pin Name	Pin No.	Alternate Function	I/O	Description
GPIO24	2	PWM4	DO	PWM4 out
GPIO34	4	PWM8	DO	PWM8 out
GPIO32	6	PWM6	DO	PWM6 out
GPIO33	9	PWM7	DO	PWM7 out
GPIO25	11	PWM5	DO	PWM5 out

3.4.3. ADC Interfaces

In the case of multiplexing, the module supports up to 3 ADC interfaces whose voltage range is 0–2.4 V. To improve ADC accuracy, surround ADC traces with ground.

Table 9: Pin Definition of ADC Interfaces

Pin Name	Pin No.	Alternate Function	I/O	Description
GPIO24	2	ADC2	AI	General-purpose ADC interface
GPIO28	8	ADC4	AI	General-purpose ADC interface
GPIO25	11	ADC1	AI	General-purpose ADC interface

Table 10: ADC Features

Parameter	Min.	Typ.	Max.	Unit
ADC Voltage Range	0	-	2.4	V
ADC Resolution	-	13	-	bit

4 Operating Characteristics

4.1. Power Supply

Power supply pin and ground pin 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	1	PI	Power supply for the module	3.0	3.3	3.6	V
GND	3						

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 sufficient current of at least 0.3 A. 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 protection capacity of the module. In principle, the longer the VBAT trace is, the wider it should be.

VBAT reference design is shown below:
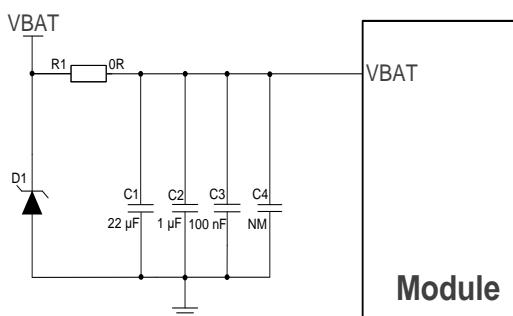
Figure 3: VBAT Reference Design

4.2. Turn On

After the module VBAT is powered on, keep the CHIP_EN at high level to realize the automatic startup of the module.

Table 12: Pin Definition of CHIP_EN

Pin Name	Pin No.	I/O	Description	Comment
CHIP_EN	10	DI	Enable the module	Hardware enable. Internally pulled up to 3.3 V. Active high.

The turn-on timing is shown below:
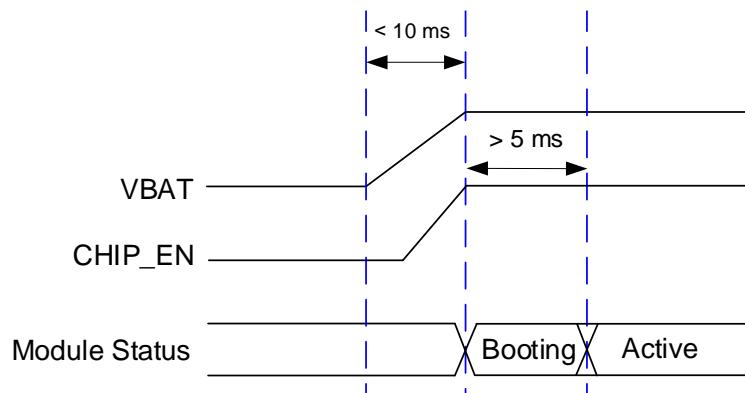

Figure 4: Turn-on Timing

4.3. Reset

Drive CHIP_EN low for at least 100 ms and then release it to reset the module.

Table 13: Pin Definition of CHIP_EN

Pin Name	Pin No.	I/O	Description	Comment
CHIP_EN	10	DI	Reset the module	Hardware reset. Internally pulled up to 3.3 V. Active low.

The reference design for resetting the module is shown below. An open collector driving circuit can be used to control the CHIP_EN pin.
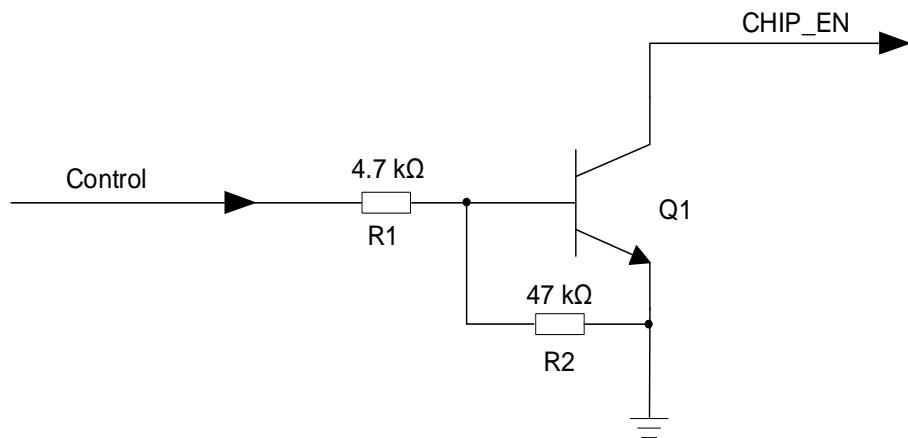
Figure 5: Reference Circuit of CHIP_EN by A Using Driving Circuit

Another way to control the CHIP_EN is by using a button directly. When pressing the button, an electrostatic strike may generate from finger. Therefore, a TVS component shall be placed near the button for ESD protection.
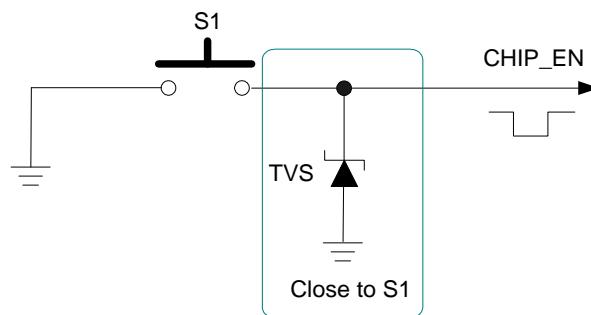
Figure 6: Reference Circuit of CHIP_EN with A Button

The module reset timing is illustrated in the following figure.
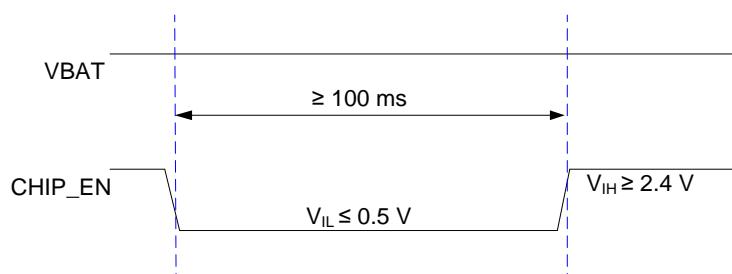
Figure 7: Reset Timing

4.4. Download Mode

Keep the input signal of CHIP_EN at low level during resetting or power-up and the module will enter download mode. In the download mode, the firmware can be download through the main UART. During the hardware design, the CHIP_EN pin of the module is connected to the RTS of the serial port chip, or the CHIP_EN is controlled according to the following waveform, otherwise the download will fail.
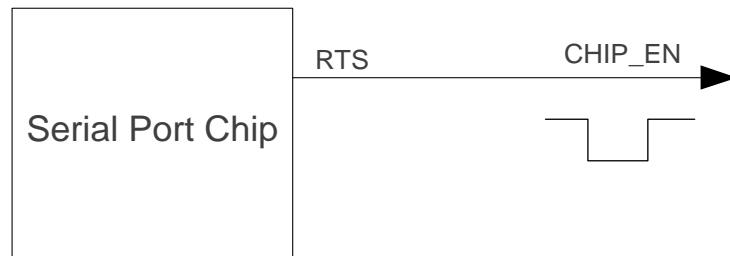
Figure 8: Reference Design for Download Mode

5 RF Performances

5.1. Wi-Fi Performances

Table 14: Wi-Fi Performances

Operating Frequency
2.4 GHz: 2.400–2.4835 GHz

Modulation
BPSK, QPSK, CCK, 16QAM, 64QAM

Operating Mode
● AP ● STA

Encryption Mode
WPA-PSK, WPA2-PSK, WPA3-SAE

Transmission Data Rate
● 802.11b: 1 Mbps, 2 Mbps, 5.5 Mbps, 11 Mbps ● 802.11g: 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps, 54 Mbps ● 802.11n: HT20 (MCS 0–MCS 7) ● 802.11ax: HE20 (MCS 0–MCS 7)

Condition (VBAT = 3.3 V; Temp. 25 °C)		EVM	Typ.; Unit: dBm; Tolerance: ±2 dB	
			Transmitting Power	Receiving Sensitivity
2.4 GHz	802.11b @ 1 Mbps	≤ 35 %	18	-97
	802.11b @ 11 Mbps		18	-88
	802.11g @ 6 Mbps	≤ -5 dB	16	-91
	802.11g @ 54 Mbps	≤ -25 dB	15	-74

802.11n, HT20 @ MCS 0	⩽ -5 dB	15	-90
802.11n, HT20 @ MCS 7	⩽ -27 dB	14	-72
802.11ax, HE20 @ MCS 0	⩽ -5 dB	15	-90
802.11ax, HE20 @ MCS 7	⩽ -27 dB	14	-72

5.2. Bluetooth Performances

Table 15: 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; Tolerance: ±2 dB**	
	Transmitting Power	**Receiving Sensitivity**
BLE (1 Mbps)	10	-95

5.3. RF Antenna Interface

The module supports PCB antenna. The impedance of antenna port is 50 Ω.

5.3.1. PCB Antenna

Table 16: PCB Antenna Specifications

Parameter	Specification

Frequency Range (GHz)	2.400–2.483.5
Input Impedance (Ω)	50
VSWR	⩽ 2
Gain (dBi)	-1.85 (Max.)
Efficiency	30 %

When using the PCB antenna on the module, the module should be placed near the edge of the motherboard. The distance between the PCB antenna and connectors, vias, traces pin headers, ethernet port and any other metal components on the motherboard should be at least 16 mm. All layers in the PCB of the motherboard under the PCB antenna should be designed as a keepout area.
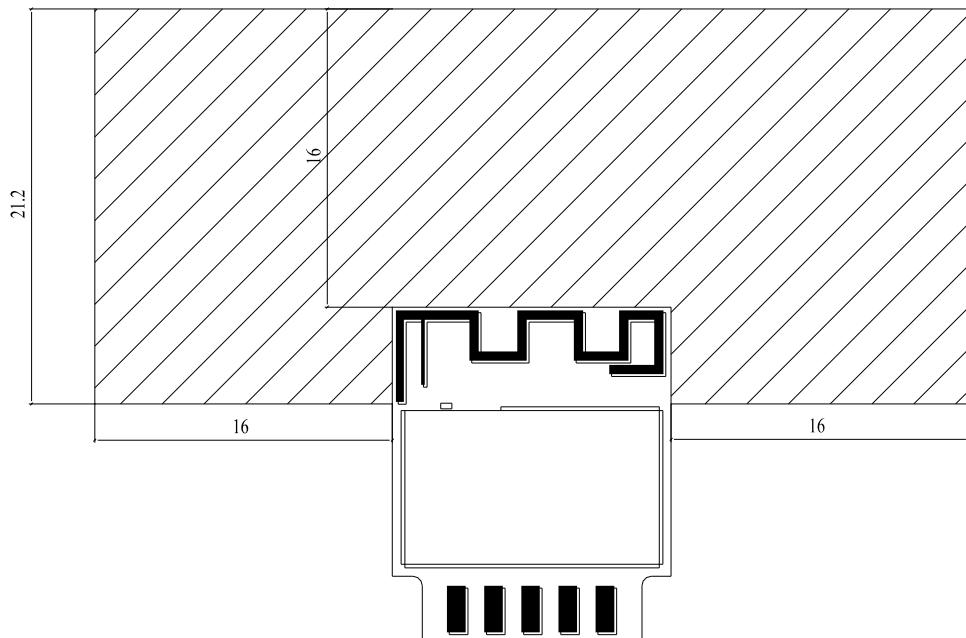
Figure 9: Keepout Area on Motherboard

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 17: Absolute Maximum Ratings (Unit: V)

Parameter	Min.	Max.
VBAT	-0.3	3.9
Voltage at Digital Pins	-0.3	3.9
Voltage at ADC1	0	2.4
Voltage at ADC2	0	2.4
Voltage at ADC4	0	2.4

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.	3.0	3.3	3.6

6.3. Wi-Fi Power Consumption

Table 19: Power Consumption in Non-signaling Mode

Condition (VBAT = 3.3 V; Temp.: 25 °C; Duty Cycle: 99 %)			I_{VBAT} (Typ.)
2.4 GHz	802.11b	Tx 1 Mbps @ 18 dBm	255
		Tx 11 Mbps @ 18 dBm	256
	802.11g	Tx 6 Mbps @ 16 dBm	236
		Tx 54 Mbps @ 15 dBm	233
	802.11n	HT20 Tx MCS 0 @ 15 dBm	234
		HT20 Tx MCS 7 @ 14 dBm	232
	802.11ax	HE20 Tx MCS 0 @ 15 dBm	232
		HE20 Tx MCS 7 @ 14 dBm	233

6.4. Digital I/O Characteristics

Table 20: VBAT I/O Characteristics (Unit: V)

Parameter	Description	Min.	Max.
V_{IH}	High-level input voltage	0.7 × VBAT	VBAT + 0.2
V_{IL}	Low-level input voltage	-0.3	0.3 × VBAT
V_{OH}	High-level output voltage	0.9 × VBAT	VBAT
V_{OL}	Low-level output voltage	0	0.1 × VBAT

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 21: ESD Characteristics (Unit: kV)

Model	Test Result	Standard
Human Body Model (HBM)	±3 (Antenna interface) ±4 (Other interfaces)	*ANSI/ESDA/JEDEC JS-001-2017*
Charged Device Model (CDM)	±1	*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
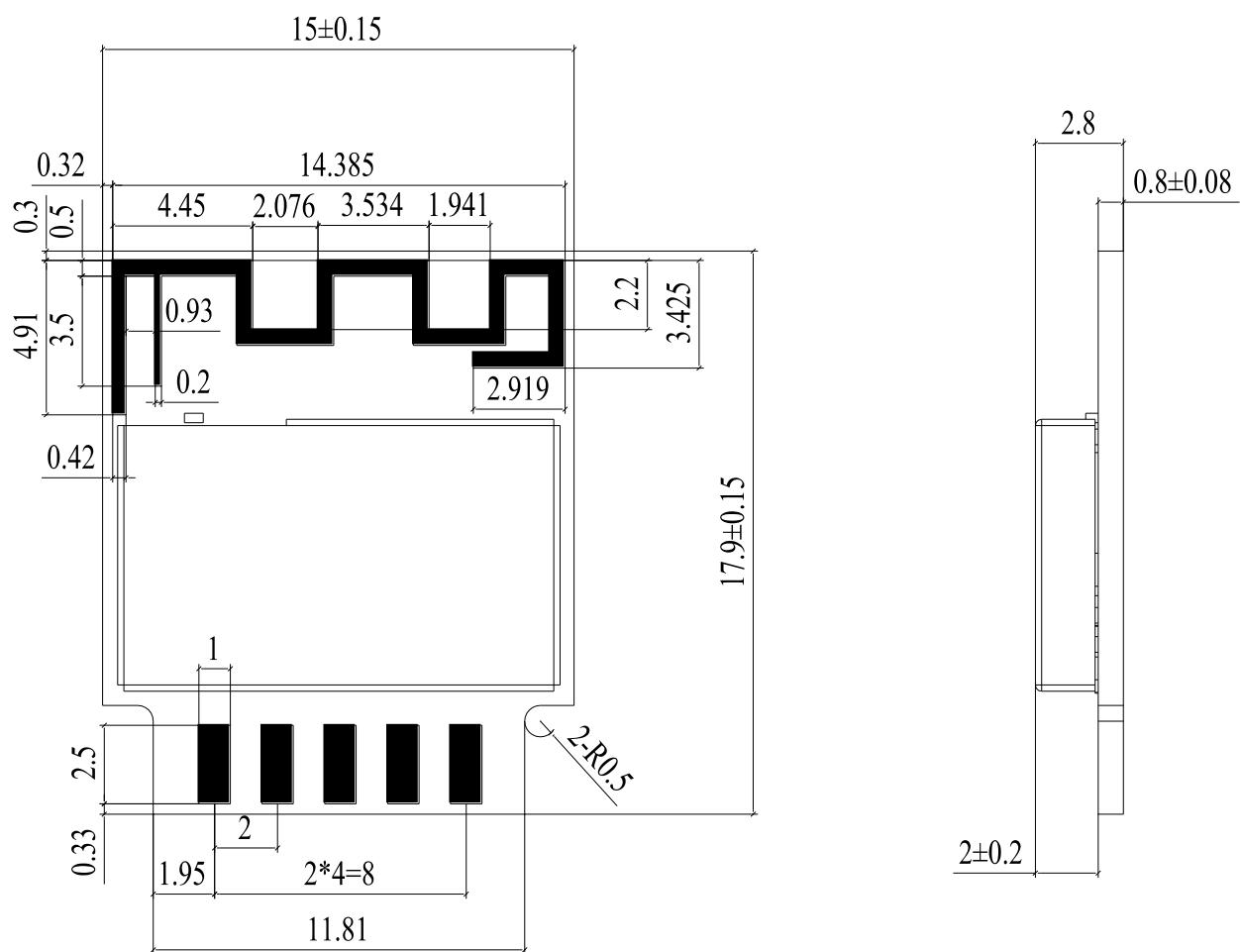
Figure 10: Top and Side Dimensions

Bot
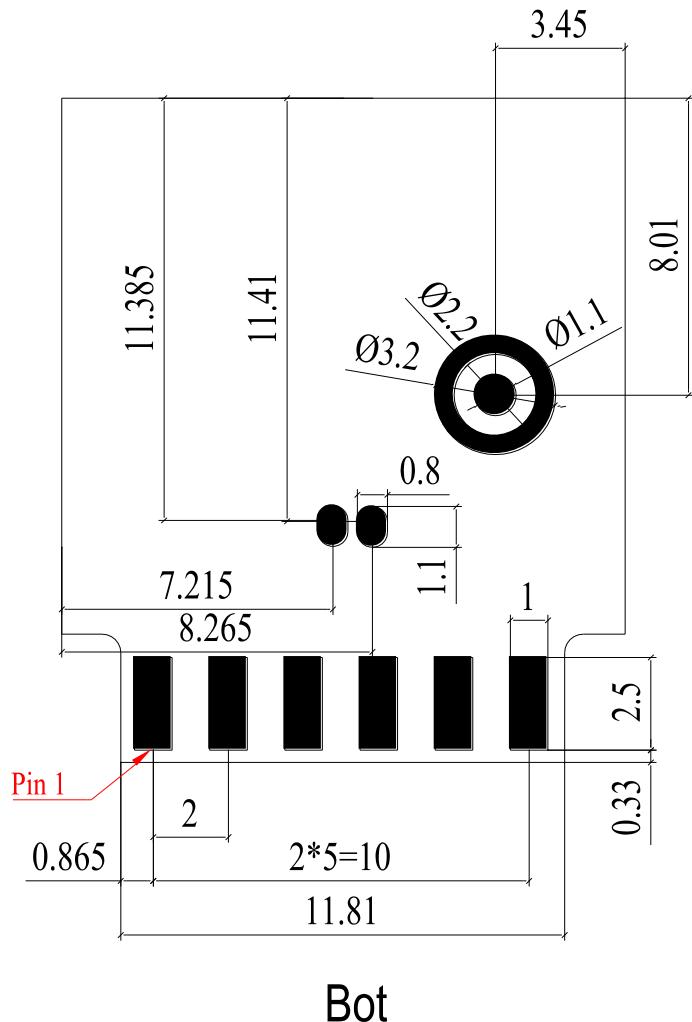
Figure 11: Bottom Dimensions (Bottom View)

> **NOTE**
>
> The package warpage level of the module conforms to the *JEITA ED-7306* standard.

7.2. Recommended Footprint
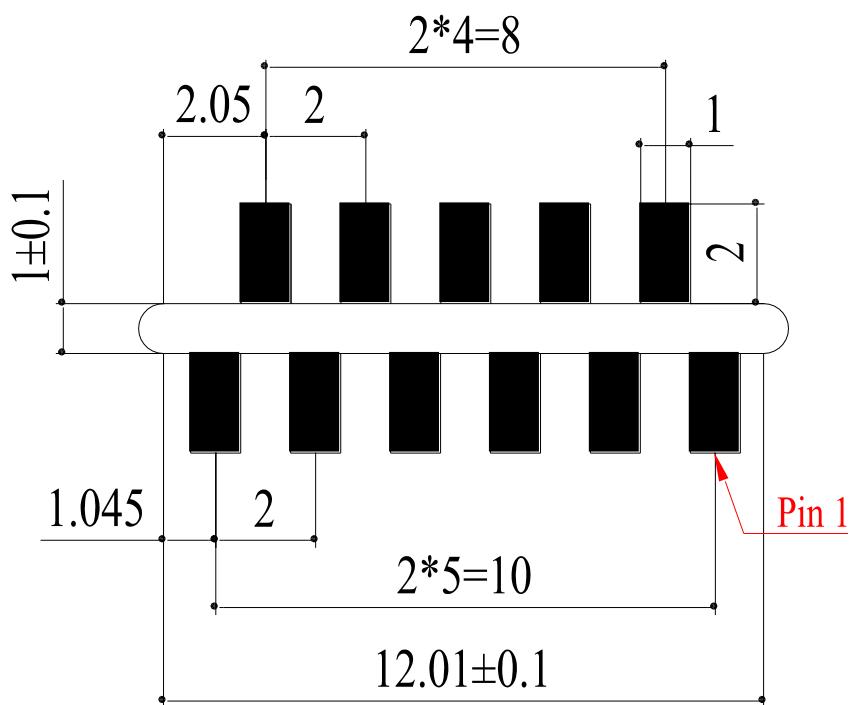
Figure 12: Recommended Footprint

> **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
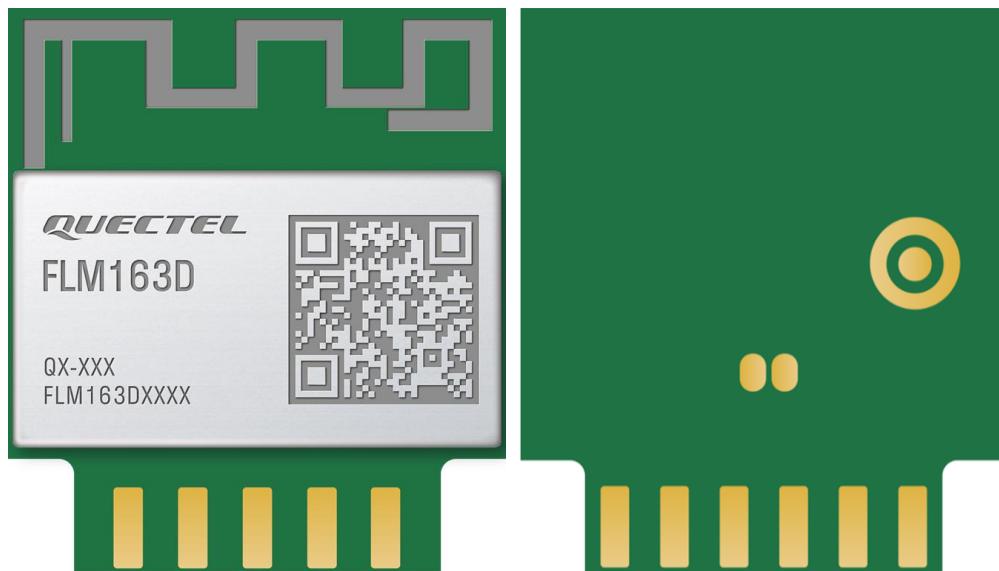
Figure 13: Top and Bottom Views

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.

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

The module is recommended to be soldered with wave-soldering equipment, and manual soldering is applicable only when the wave soldering cannot be used.

8.2.1. Wave Soldering

The recommended peak wave-soldering temperature should be 265 ±5 °C, with 270 ºC as the absolute maximum wave-soldering temperature. The recommended wave-soldering thermal profile (lead-free wave-soldering) and related parameters are shown below.
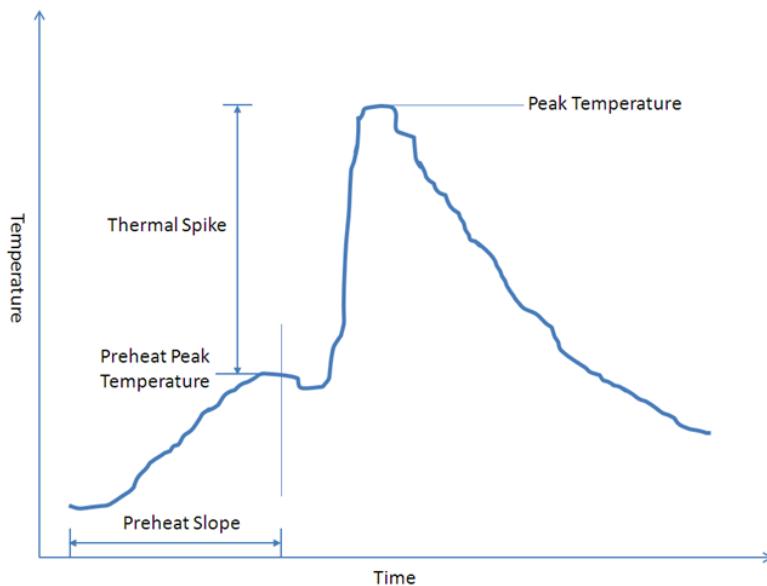

Figure 14: Recommended Lead-free Wave-soldering Thermal Profile

Table 22: Recommended Thermal Profile Parameters

Factor	Recommended Value (Typ.)
Preheat ramp-up slope	1–3 °C/s
Preheat peak temperature (Bottom)	95–145 s
Peak temperature (Bottom)	240–270 °C
Tin immersion time	2–6 s
Tin tab setting temperature	265 ±5 °C
Cool-down slope	< 8 °C/s
Tapping temperature	< 150 °C (Tg)
Chain speed	0.8–1.2 m/min
Orbital elevation	4–6 °

8.2.2. Manual Soldering

Table 23: Recommended Manual-soldering Parameters

Factor	Recommended Value
Soldering temperature	360 ±20 °C
Soldering time	< 3 s/solder joint

NOTE

1. The above profile parameter requirements are for the measured temperature of the 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. 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. For better quality, keep the thermal profile, the amount of flux spraying and the tin slag and copper left over in tin tab in rational levels, and mind the rationality of the opening and the thickness of jigs during production.

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

Carrier tape dimensions are detailed below:
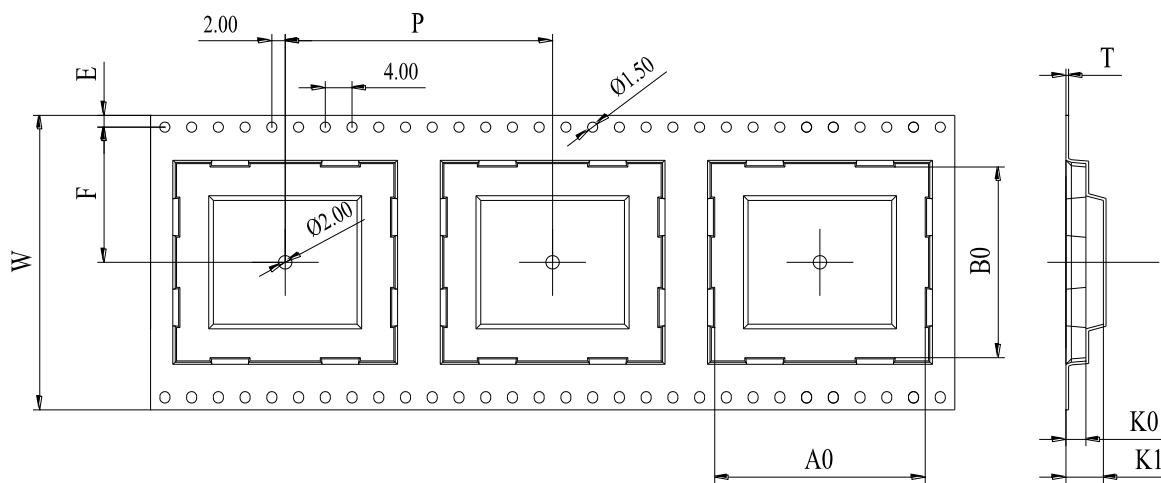

Figure 15: Tape Specifications

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

W	P	T	A0	B0	K0	K1	F	E
44	24	0.4	15.4	18.3	3.3	4.6	20.2	1.75

8.3.2. Plastic Reel
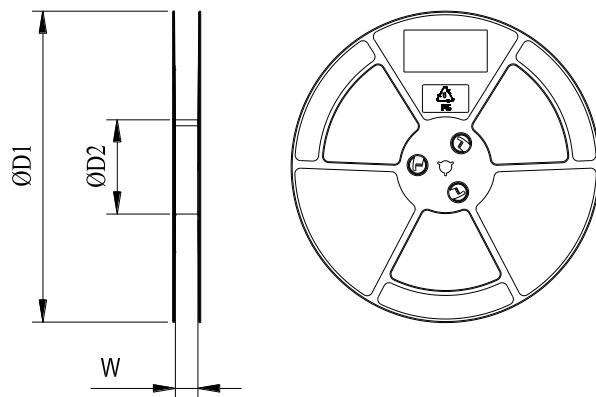
Figure 16: Plastic Reel Dimension Drawing

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

øD1	øD2	W
330	100	44.5

8.3.3. Packaging Process
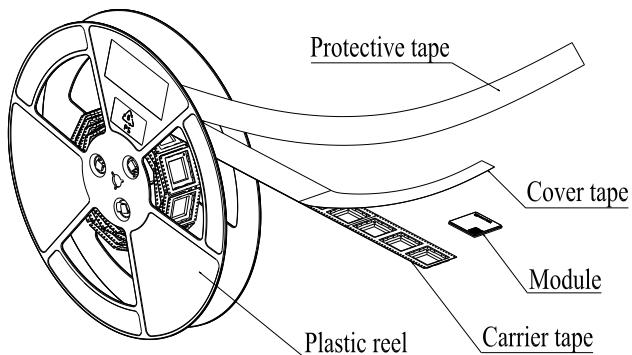
Place the module into the carrier tape and use the cover tape to cover it; then wind the heat-sealed carrier tape to the plastic reel and use the protective tape for protection. 1 plastic reel can load 500 modules.

Place the packaged plastic reel, 1 humidity indicator card and 1 desiccant bag into a vacuum bag, vacuumize it.
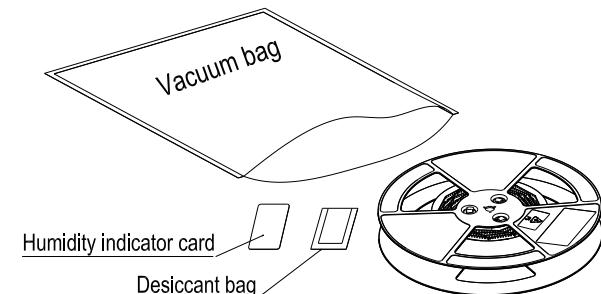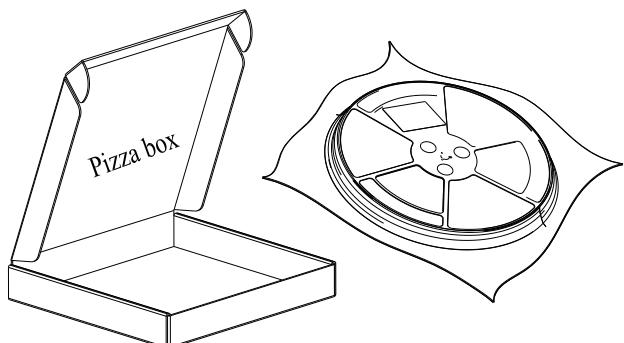
Place the vacuum-packed plastic reel inside the pizza box.

Put 4 packaged pizza boxes into 1 carton box and seal it. 1 carton box can pack 2000 modules.
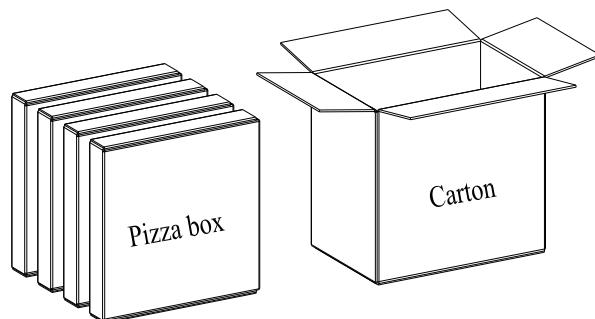
Figure 17: **Packaging Process**

9 Appendix References

Table 26: Reference Document

Document Name
[1]   Quectel_FLM163D_TE-B_User_Guide

Table 27: Terms and Abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
AP	Access Point
BLE	Bluetooth Low Energy
BPSK	Binary Phase Shift Keying
CCK	Complementary Code Keying
CDM	Charged Device Model
DIP	Dual In-line Package
ESD	Electrostatic Discharge
EVM	Error Vector Magnitude
GFSK	Gauss frequency Shift Keying
GND	Ground
GPIO	General-Purpose Input/Output
HBM	Human Body Model
HT	High Throughput
I/O	Input/Output

IEEE	Institute of Electrical and Electronics Engineers
IoT	Internet of Things
Mbps	Million Bits Per Second
MCS	Modulation and Coding Scheme
MCU	Microcontroller Unit
MSL	Moisture Sensitivity Levels
OTA	Over-the-Air
PCB	Printed Circuit Board
PSK	Pre-Shared Key
PWM	Pulse Width Modulation
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RAM	Random Access Memory
RF	Radio Frequency
RoHS	Restriction of Hazardous Substances
RTS	Request To Send
SAE	Simultaneous Authentication of Equals
STA	Station
Tg	Glass Transition Temperature
TVS	Transient Voltage Suppressor
Tx	Transmit
UART	Universal Asynchronous Receiver/Transmitter
V_{IH}	High-level Input Voltage
V_{IL}	Low-level Input Voltage
Vmax	Maximum Voltage
Vmin	Minimum Voltage
Vnom	Nominal Voltage Value

V_{OH}	High-level Output Voltage
V_{OL}	Low-level Output Voltage
VSWR	Voltage Standing Wave Ratio
WPA	Wi-Fi Protected Access

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: XMR2024FLM163D.

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/Wi-Fi 2.4G:≤-1.58dBi

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: XMR2024FLM163D." or "Contains FCC ID: XMR2024FLM163D." 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.

Information on test modes and additional testing requirements

Contact Quectel Wireless Solutions Co., Ltd. will provide stand-alone modular transmitter test mode. Additional testing and certification may be necessary when multiple modules are used in a host.

IC Certification Requirements.

This device contains licence-exempt transmitteris)/receivers) that comply with Innovation, Science and EconomicDevelopment 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/Wi-Fi 2.4G:≤-1.58dBi

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.

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.

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-2024FLM163D" or "where: 10224A-2024FLM163D is the module's certification number".