FCM100D

Hardware Design

Wi-Fi&Bluetooth Module Series

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Safety Information

The following safety precautions must be observed during all phases of operation, such as usage, service or repair of any cellular terminal or mobile incorporating the module. Manufacturers of the cellular 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 cellular 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.
	Cellular 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 emergent help is needed in such conditions, use emergency call if the device supports it. In order to make or receive a call, the cellular 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 cellular 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 cellular terminals. Areas with explosive or potentially explosive atmospheres include fuelling 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
-	2022-07-18	Soni RAO/Michael DU	Creation of the document
1.0	2022-10-24	Kaiven MU	First official release

Contents

Table Index

Figure Index

1 Introduction

This document defines the FCM100D and describes its air interface and hardware interfaces which are connected with your application.

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.

1.1. Special Mark

Table 1: Special Mark

Mark	Definition
*	When an asterisk (*) is used after a function, feature, interface, pin name, AT command, or argument, it indicates that the function, feature, interface, pin name, AT command, or argument is under development and currently not supported, unless otherwise specified.

2 Product Concept

2.1. General Description

FCM100D is a low-power, cost-effective Bluetooth 5.2 and IEEE 802.11b/g/n module, which integrates the hardware and software resources required for Wi-Fi and Bluetooth applications. It can support AP and STA of Wi-Fi connection, and low-power Bluetooth connection. It is very suitable for low-speed applications and data acquisition applications such as home intelligent terminal, industrial application and so on.

FCM100D has a built-in Wi-Fi and Bluetooth ultra-high integration microcontroller, which provides the necessary ability to calculate and stable Wi-Fi and Bluetooth connectivity for IoT data terminals. It includes:

- 120 MHz ARM kernel
- 256 KB RAM
- 2 MB Flash
- Complies with IEEE 802.11b/g/n and Bluetooth 5.2 standards

FCM100D offers 3.3V single power supply with 25 LCC pins , offering a compact size 16mm× 24mm×2.6mm

2.2. Key Features

The following table describes the key features of FCM100D.

Table 2: Key Features

Features	Details
Power Supply	**VBAT Power Supply:** ● Supply voltage range: 3.0–3.6 V ● Typical supply voltage: 3.3 V
Operating Frequency	● Wi-Fi: 2.412–2.484 GHz ● Bluetooth: 2.402–2.480 GHz

Wi-Fi Transmission Data Rates	● 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 (MCS0–MCS7)
Wi-Fi Transmitting Power	**2.4 GHz:** ● 802.11b/11 Mbps: 16 dBm ● 802.11g/54 Mbps: 14 dBm ● 802.11n/HT20 MCS7: 13 dBm
Wi-Fi Protocol Features	IEEE 802.11b/g/n
Wi-Fi Modulation	CCK, BPSK, QPSK,16QAM, 64QAM
Wi-Fi Operation Mode	● AP ● STA
Bluetooth Protocol Feature	GATT
Bluetooth Operation Mode	BLE
Bluetooth Modulation	GFSK
Wireless Application Interfaces	● Main UART: Used for AT command communication, data transmission and firmware upgrade ● Debug UART: Used for the output of partial logs ● SPI*: Supports one SPI interface and master and slave modes
Antenna Interface	● PCB antenna ● IPEX antenna (Optional) ● Wi-Fi/Bluetooth antenna interface (ANT_WIFI/BT), 50 Ω impedance (Optional)
Physical Characteristics	● Package: LCC ● Weight: TBD ● Size: (16.0 ±0.2) mm × (24.0 ±0.2) mm × (2.6 ±0.2) mm
Temperature Range	● Operating temperature range [1]: -40 °C to +85 °C ● Storage temperature range: -45 °C to +95 °C
RoHS	All hardware components are fully compliant with EU RoHS directive

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

2.3. Functional Diagram

The following figure shows a block diagram of FCM100D.

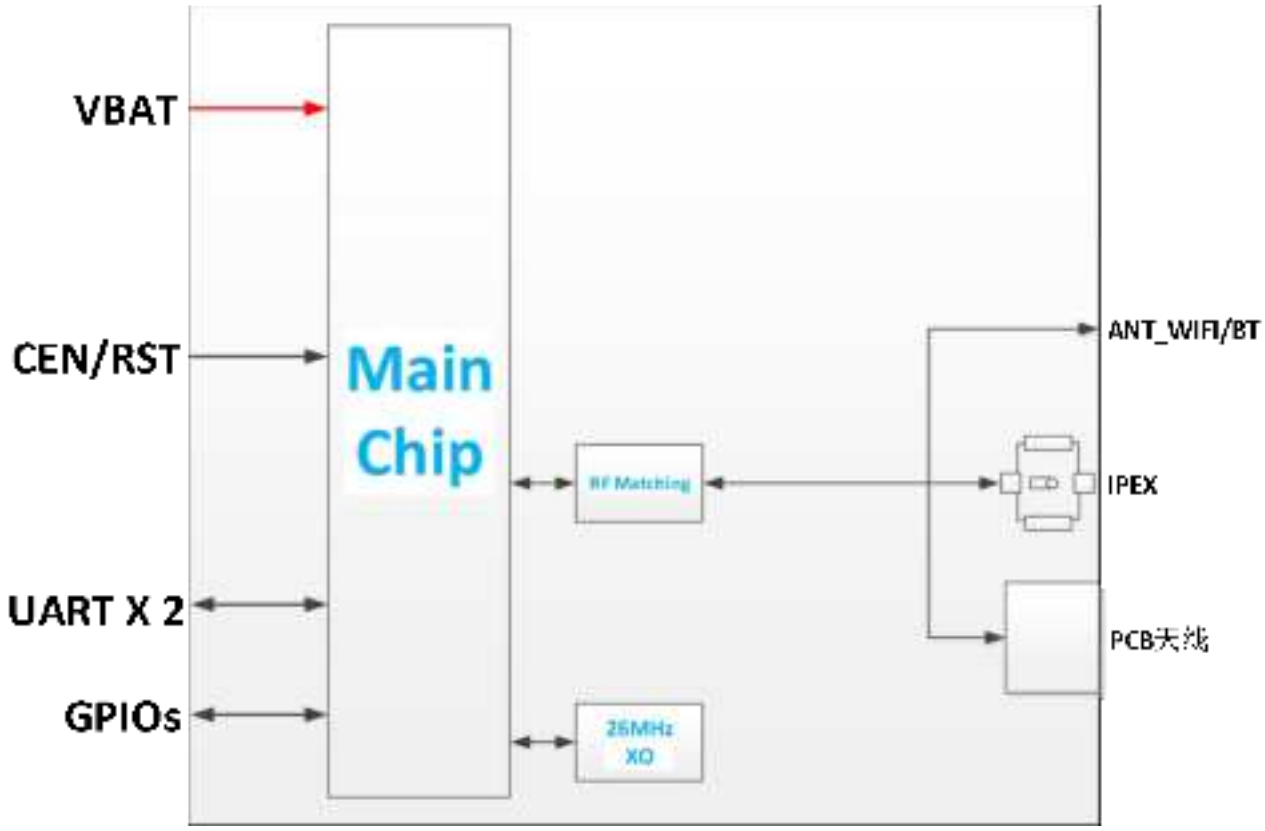


Figure 1: **Functional Diagram**

NOTE

FCM100D supports PCB antenna by default; IPEX antenna and ANT_WIFI/BT are optional.

2.4. EVB

Quectel supplies an evaluation board (FCM100D TE-B) with accessories to control or test the module. For more details, see ***document [1]***.

3 Application Interfaces

3.1. General Description

The FCM100D has 25 LCC pins. The following interfaces are described in detail in subsequent chapters:

- Power supply
- Module reset
- Wireless connectivity interfaces
  - UART interfaces
- GPIO interfaces
- RF antenna interface

3.2. Pin Assignment

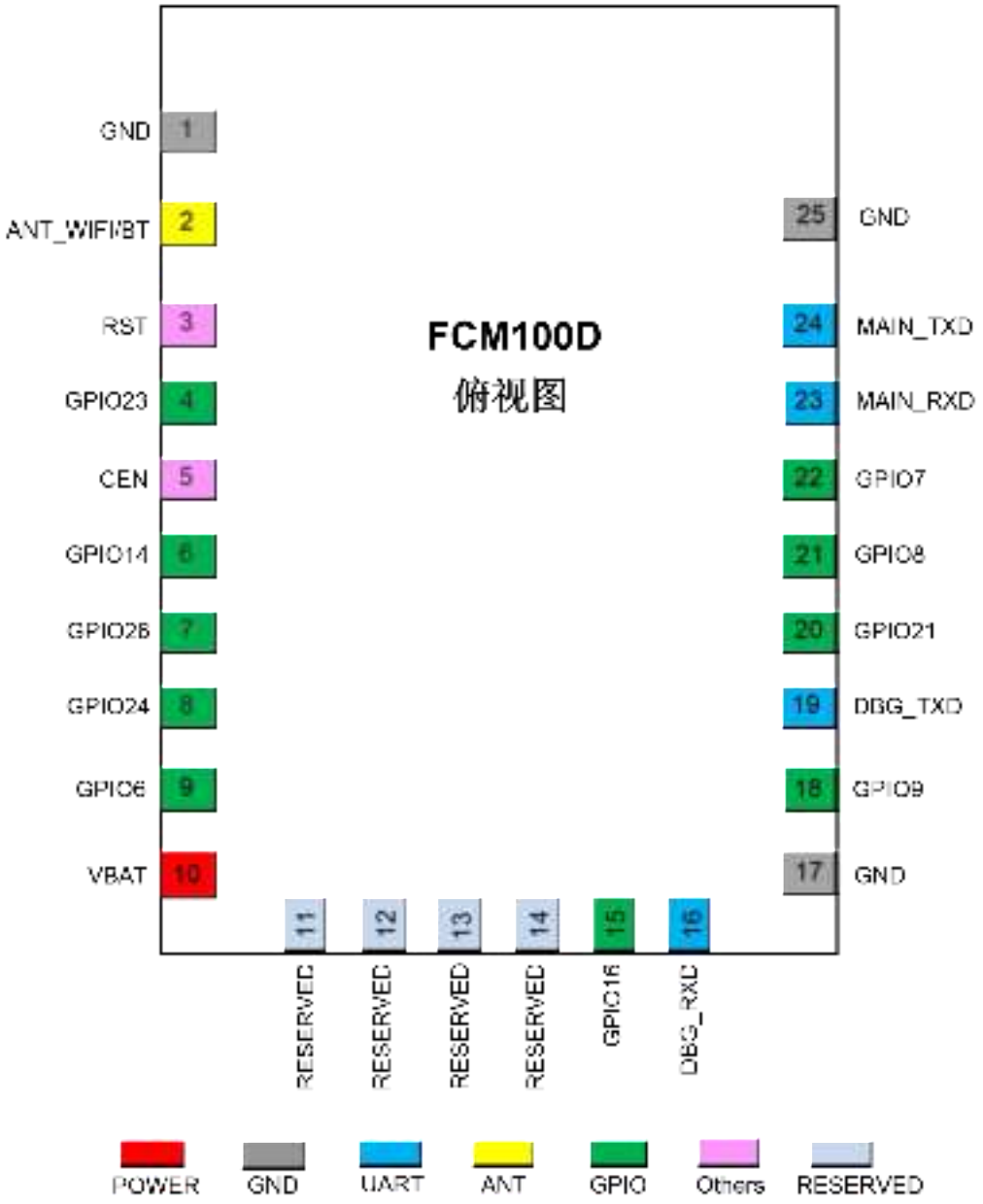


Figure 2: Pin Assignment (Top View)

NOTE

Keep all RESERVED and unused pins open.

3.3. Pin Description

The following tables show the pin description of module.

Table 3: I/O Parameter Description

Type	Description
AIO	Analog Input/Output
DI	Digital Input
DIO	Digital Input/Output
DO	Digital Output
PI	Power Input

Table 4: Pin Description

Power Supply					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
VBAT	10	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 up to 0.3 A.
GND	1, 17, 25				
Reset					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
CEN	5	DI	Enable the module	Vmax = 3.6 V Vmin = 3.0 V Vnom = 3.3 V	Internally pulled up to 3.3 V. Hardware enabling; Compatible with other module designs.
RST	3	DI	Reset the module	Vmax = 3.6 V Vmin = 3.0 V Vnom = 3.3 V	Internally pulled up to 3.3 V. Reset the module

Main UART					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
MAIN_TXD	24	DO	Main UART transmits	3.3 V	
MAIN_RXD	23	DI	Main UART receives		
Debug UART					
DBG_TXD	19	DO	Debug UART transmits	3.3 V	
DBG_RXD	16	DI	Debug UART receives		
GPIO Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
GPIO23	4	DIO	General-purpose input/output	3.3 V	GPIO26/GPIO24/GPIO6/GPIO9/GPIO8/GPIO7 can also be used for PWM; GPIO4/GPIO26/GPIO24/GPIO21 can also be used for ADC.
GPIO14	6	DIO	General-purpose input/output		
GPIO26	7	DIO	General-purpose input/output		
GPIO24	8	DIO	General-purpose input/output		
GPIO6	9	DIO	General-purpose input/output		
GPIO16	15	DIO	General-purpose input/output		
GPIO9	18	DIO	General-purpose input/output		
GPIO21	20	DIO	General-purpose input/output		
GPIO8	21	DIO	General-purpose input/output		
GPIO7	22	DIO	General-purpose input/output		
RF Antenna Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
ANT_WIFI/BT	2	AIO	Wi-Fi/Bluetooth antenna interface		50 Ω impedance.

RESERVED					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
RESERVED	11、12、13、14		RESERVED		Keep it open.

3.4. Power Supply Design

The following table shows the definition of power supply pin and ground pins of FCM100D.

Table 5: Pin Definition of Power Supply and GND Pins

Pin Name	Pin No.	Description	Min.	Typ.	Max.	Unit
VBAT	10	Power supply	3.0	3.3	3.6	V
GND	1, 17, 25	Ground				

FCM100D is powered by VBAT, and it is recommended to use a power supply chip that can provide at least 0.3 A output current. To ensure better power supply performance, it is recommended to parallel 22 μF decoupling capacitor, and 1 μF and 100 nF filter capacitor near the module's VBAT pin. Meanwhile, it is recommended to add a TVS near the VBAT to improve the surge voltage bearing capacity of the module. In principle, the longer the VBAT line is, the wider it should be.

VBAT reference circuit is shown as below:

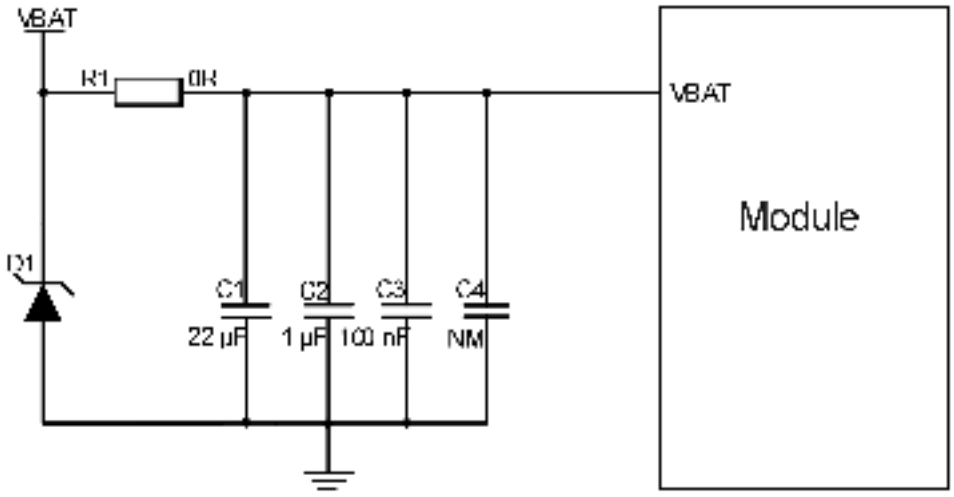


Figure 3: VBAT Reference Circuit

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

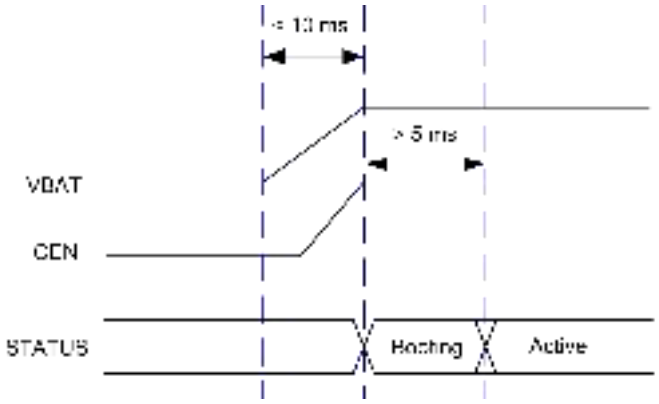


Figure 4: Power-up Timing

Cut off the power supply of VBAT, the module will automatically execute power-off procedure.

3.5. Reset

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

Table 6: Pin Definition of Reset Pin

Pin Name	Pin No.	Description	Comment
RST	3	Reset the module ; Active at low level .	Pulled up to 3.3 V internally.

The reference designs for resetting the module are shown below. An open drain/collector driving circuit or a button can be used to control the RST pin.

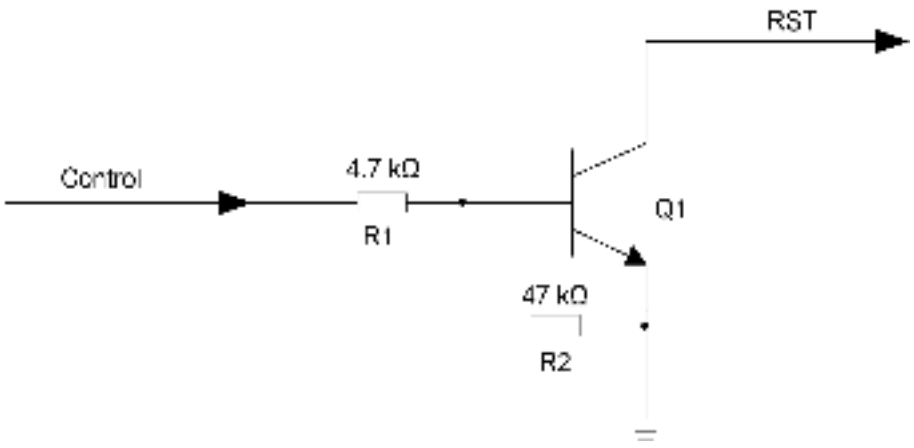


Figure 5: Reference Circuit of CEN by Using Driving Circuit

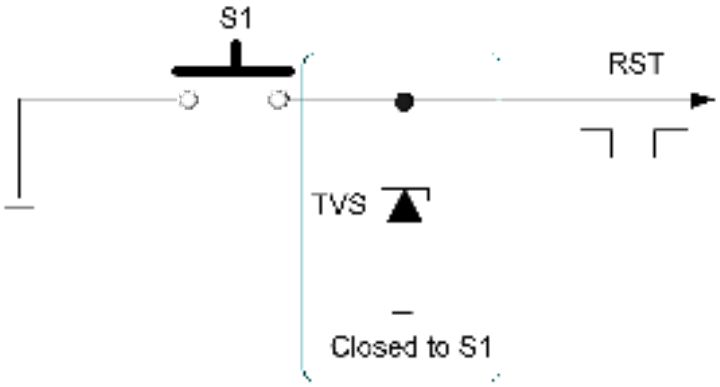


Figure 6: Reference Circuit of CEN by Using Button

The reset scenario is illustrated in the following figure.

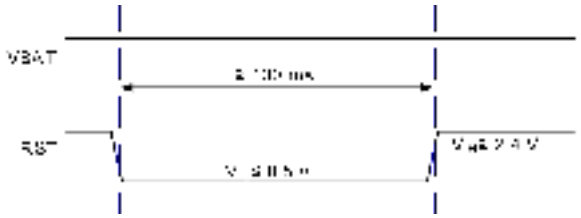


Figure 7: Timing of Resetting the Module

3.6. Wireless Connectivity Interfaces

3.6.1. UART Interfaces

The module provides two UART interfaces: the main UART and the debug UART. The module is used as

DCE (Data Communication Equipment), and is connected in the traditional DCE-DTE (Data Terminal Equipment) mode.

Table 7: Pin Definition of UART Interfaces

Pin Name	Pin No.	I/O	Description
MAIN_TXD	24	DO	Main UART transmits data
MAIN_RXD	23	DI	Main UART receives data
DBG_TXD	19	DO	Debug UART transmits data
DBG_RXD	16	DI	Debug UART receives data

The main UART can be used for AT command communication and data transmission. The default baud rate is 115200 bps, and the maximum baud rate can reach 2 Mbps.

The main UART is also available for firmware upgrade and supports a default baud rate of 921600 bps.

The following is the schematic diagram of the main UART interface connection between DCE and DTE.

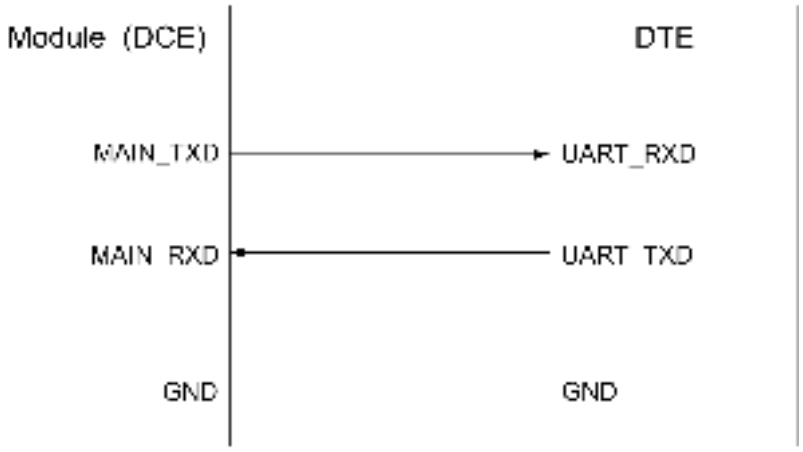


Figure 8: Main UART Connection Diagram

The debug UART interface supports 115200 bps baud rate by default, and is used for the output of partial logs.

The following is a reference design of debug UART.

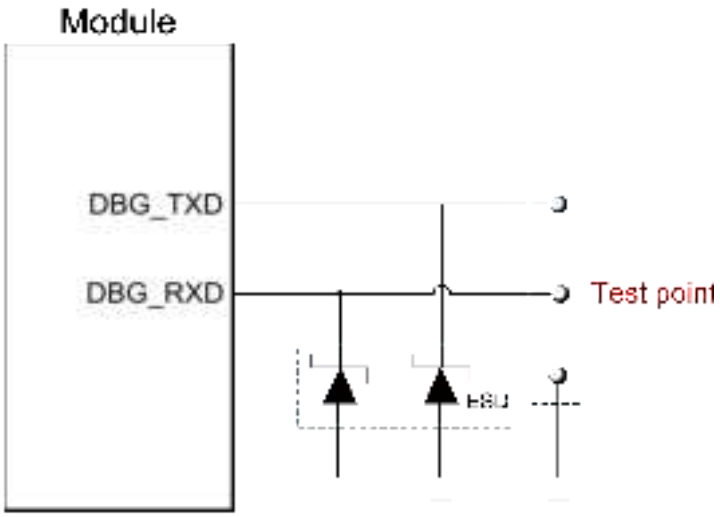


Figure 9: Debug UART Reference Circuit

3.7. GPIO Interfaces

FCM100D provides 10 GPIO interfaces by default. The following table shows the pin description of GPIO.

Table 8: Pin Definition of GPIO Interfaces

Pin Name	Pin No.	I/O	Description	Comment
GPIO23	4	DIO	General-purpose input/output	Wake-up interrupt.
GPIO14	6			
GPIO26	7			
GPIO24	8			
GPIO6	9			
GPIO16	15			
GPIO9	18			
GPIO21	20			
GPIO8	21			
GPIO7	22			

3.8. RF Antenna Interface

FCM100D provides PCB antenna, IPEX connector and ANT_WIFI/BT (stamp hole). The IPEX connector is not mounted on the module when using PCB antenna or ANT_WIFI/BT. FCM100D supports PCB antenna by default; IPEX antenna and ANT_WIFI/BT are optional.

3.8.1. Operating Frequency

The operating frequency of FCM100D is shown in the table below:

Table 9: FCM100D Operating Frequency

Mode	Frequency	Unit
2.4 GHz Wi-Fi	2.412–2.484	GHz
Bluetooth	2.402–2.480	GHz

3.8.2. RF Antenna Pin Description (Optional)

RF Antenna pin description is as below:

Table 10: Antenna Pin Definition

Pin Name	Pin No.	I/O	Description	Comment
ANT_WIFI/BT	2	AIO	Wi-Fi/Bluetooth antenna interface	50 Ω impedance.

The circuit of RF antenna interface is shown below. In order to achieve better RF performance, it is necessary to reserve π matching circuit. Matching components such as R1, C1, C2 should be placed as close to the antenna as possible, C1, C2 are not mounted by default.

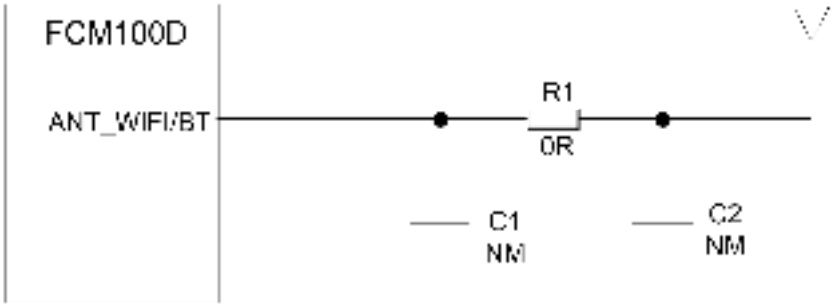


Figure 10: RF Antenna Reference Design

When using the PCB antenna on the module, the module should be placed on the PCB edge of the main board as far as possible. The clearance distance between the PCB antenna and the GND of the main board should be at least 3 mm. At the same time, it is necessary to ensure that the distance between the main board PCB and other metal devices, connectors, PCB vias, wiring, and copper coating is at least 16 mm. All layers of the main board PCB area below the PCB antenna need clearance. For details, please refer to the PCB design of FCM100D TE-B

3.8.2.1. Reference Design of RF Layout (Optional)

The characteristic impedance of all RF traces on your PCB should be controlled at 50 Ω. The impedance of the RF traces is usually determined by the trace width (W), the material's dielectric constant, the height from the reference ground to the signal layer (H), and the spacing between RF traces and grounds (S). The microstrip or coplanar waveguide is typically used in RF layout to control characteristic impedance. The following are reference designs for microstrip or coplanar waveguide transmission lines with different PCB structures.

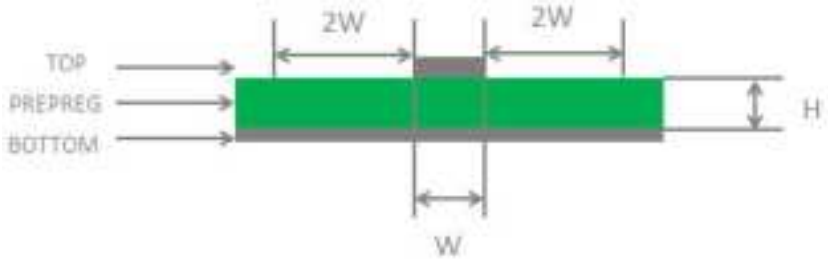


Figure 11: Microstrip Design on a 2-layer PCB

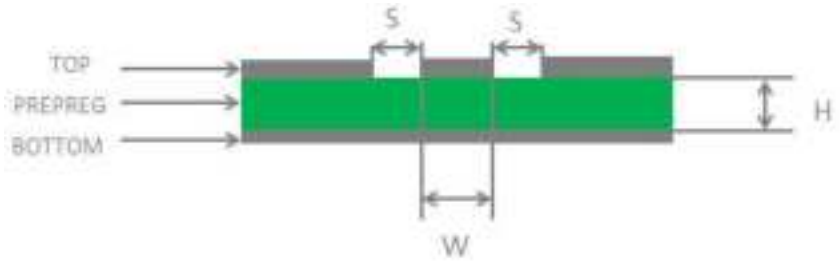


Figure 12: Coplanar Waveguide Design on a 2-layer PCB

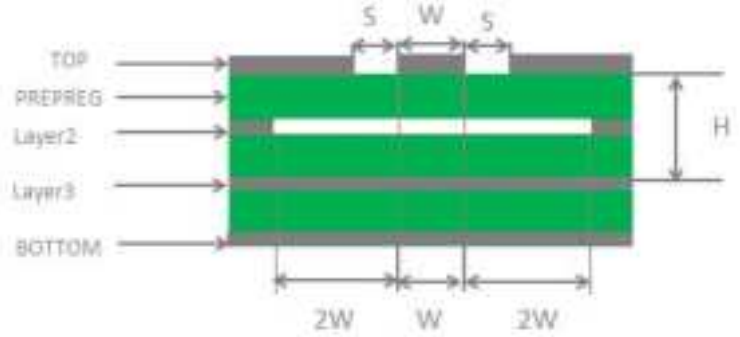


Figure 13: Coplanar Waveguide Design on a 4-layer PCB (Layer 3 as Reference Ground)

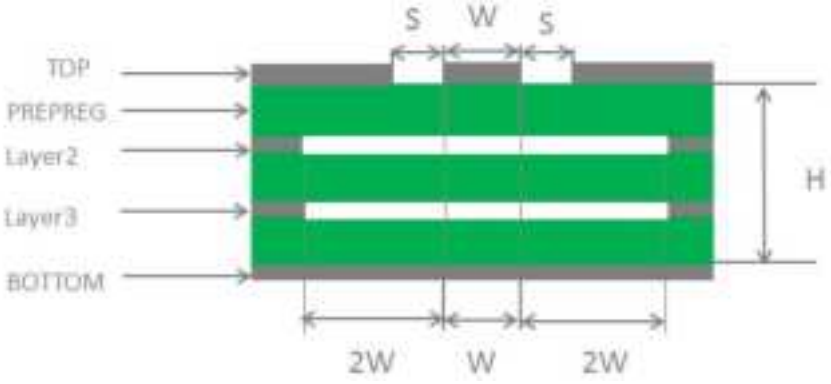


Figure 14: Coplanar Waveguide Design on a 4-layer PCB (Layer 4 as Reference Ground)

To ensure RF performance and reliability, the following principles should be complied with 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 no less than two times the width of RF signal traces (2 × W).
- Keep RF traces away from interference sources, and avoid intersection and paralleling between traces on adjacent layers.

For more details about RF layout, see ***document [2]***.

3.8.3. On Board PCB Antenna

Table 11: On Board PCB Antenna Characteristics

Characters	Min.	Typ.	Max.	Unit
Frequency	2400	-	2500	MHz
Impedance	-	50	-	Ω
VSWR	-	-	3	-
Gain	-	-1.81	-	dBi
Efficiency	-	35 %	-	-

3.8.4. IPEX Connector (Optional)

1:The mechanic size of the IPEX connector (MPN: U.FL-R-SMT-1(80), MHF 1L) provided by the FCM100D is as follows.

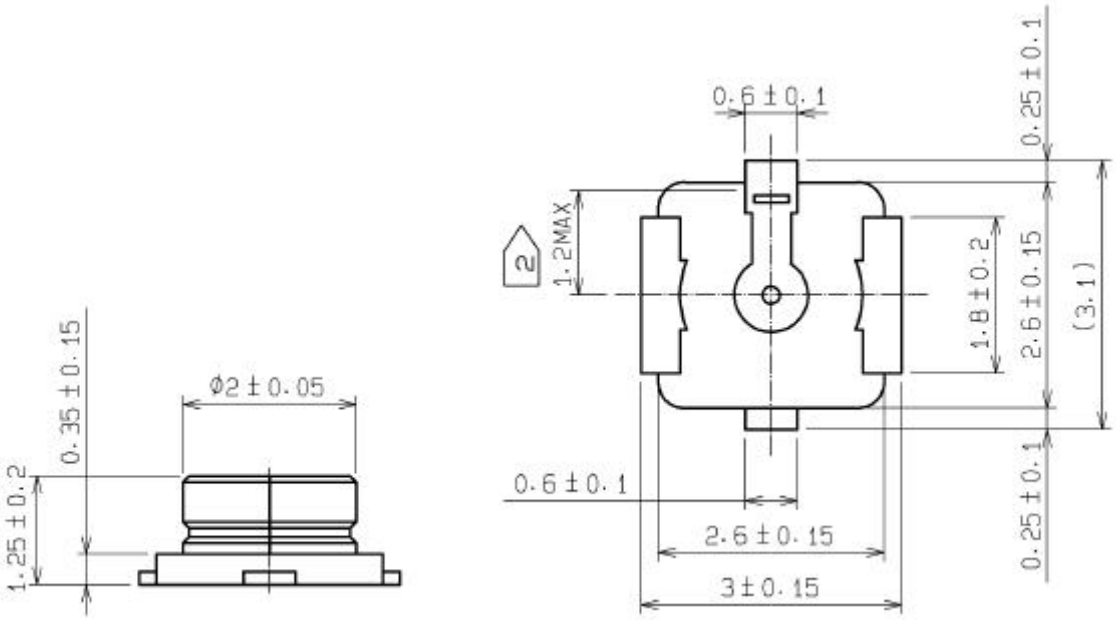


Figure 15: IPEX Connector Size

2：RF Connector recommended to use. U.FL-R-SMT connectors of Hirose have a high priority

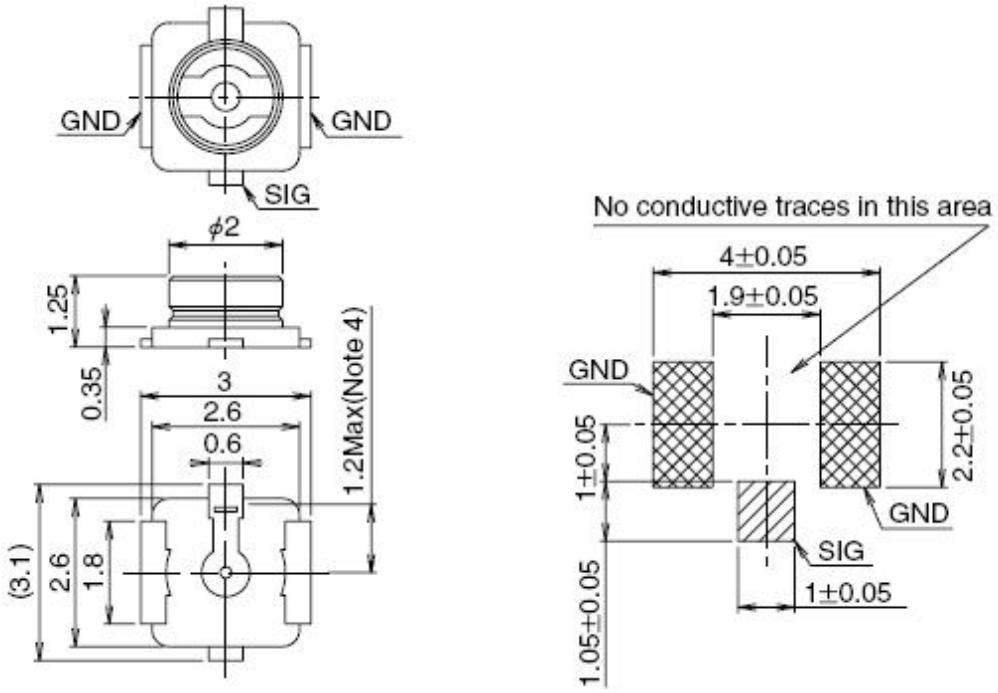


Figure 16: IPEX Connector Size

U. FL-LP series connectors are chosen to match U.FL-R-SMT.

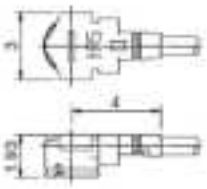
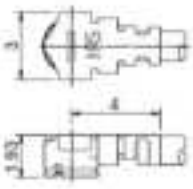
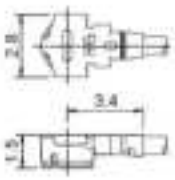
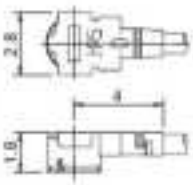
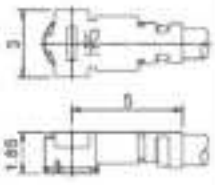
Part No.	U.FL-LP-040	U.FL-LP-066	U.FL-LP(V)-040	U.FL-LP-062	U.FL-LP-088
					
Mated Height	2.5mm Max. (2.4mm Nom.)	2.5mm Max. (2.4mm Nom.)	2.0mm Max. (1.9mm Nom.)	2.4mm Max. (2.3mm Nom.)	2.4mm Max. (2.3mm Nom.)
Applicable cable	Dia. 0.81mm Coaxial cable	Dia. 1.13mm and Dia. 1.32mm Coaxial cable	Dia. 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 17: Plug Size to match IPEX Connector

The image shown below is the size of assembling the two connectors.

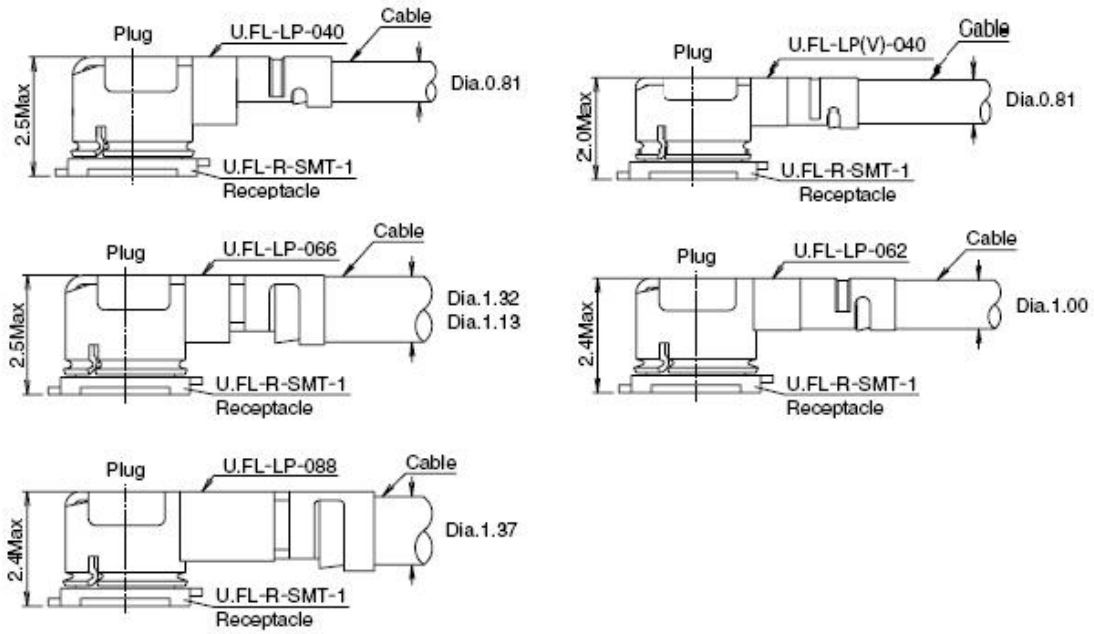


Figure 18: RF Connectors assembling

3.8.5. Antenna Cable and Antenna Requirements

Table 12: Antenna Cable Requirement

Frequency	Requirement
2.412–2.484 GHz	Insertion loss <1 dB

Table 13: Antenna Requirement

Type	Requirement
Frequency	2.412–2.484 GHz
VSWR	< 2
Gain (dBi)	Typ. 1
Max. input power (W)	50
Input impedance (Ω)	50
Polarization type	Vertical

4 Reliability, Radio and Electrical Characteristics

4.1. 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 14: Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
VBAT	-0.3	3.9	V
I/O input voltage	-0.3	3.9	V

4.2. Power Supply Ratings

Table 15: Module Power Supply Ratings

Parameter	Min.	Typ.	Max.	Unit
VBAT	3.0	3.3	3.6	V

4.3. Digital I/O Characteristics

Table 16: Digital I/O Requirements

Parameter	Description	Min.	Max.	Unit
V_{IH}	High Level Input Voltage	0.7 × VBAT	VBAT + 0.2	V
V_{IL}	Low Level Input Voltage	-0.3	0.3 × VBAT	V
V_{OH}	High Level Output Voltage	0.9 × VBAT	VBAT	V
V_{OL}	Low Level Output Voltage	0	0.1 × VBAT	V
I_{iL}	Input Leakage Current	-5	5	μA

4.4. Power Consumption

4.4.1. Power Consumption in Low Power Modes

Table 17: Power Consumption in Low Power Modes

Parameter	Description	Typ.	Unit
Deep sleep mode	**AT+QDEEPSLEEP** can set the module to deep sleep mode. In this case, the serial interfaces stop working and software settings are not saved.	8.6	μA
Standby mode	**AT+QLOWPOWER** can set the module to standby mode. In this case, the serial interfaces stop working but software settings can be saved.	110	μA
Idle state	Neither Wi-Fi nor Bluetooth does any operation.	22.74	mA

4.4.2. Power Consumption in Normal Operating Modes

Table 18: Power Consumption in Normal Operating Modes

Parameter	Description	Typ.	Unit
Wi-Fi Scan	Scan in every 2 s	68.59	mA
Wi-Fi Connected	STA mode is ON, but no STA device is connected	74.52	mA
	SoftAP mode is ON, and 1 STA device is connected	77.11	mA
	SoftAP mode is ON, and 2 STA devices is connected	77.29	mA
	SoftAP mode is ON, but no STA device is connected	77.09	mA
Data Transmission	SoftAP mode data transmission	155.29	mA
	STA mode data transmission	147.81	mA
	SoftAP mode + BLE Server mode data transmission	157.56	mA
	STA mode + BLE Server mode data transmission	149.66	mA
Bluetooth Connected	Receive data as Server	28.41	mA
	Transmit data as Server	28.39	mA
	Receive data as Client	23.68	mA
	Transmit data as Client	23.68	mA
RF Non-signaling Mode	802.11b Tx (2.4 GHz) 1 Mbps	91	mA
	802.11b Tx (2.4 GHz) 11 Mbps	92	mA
	802.11g Tx (2.4 GHz) 6 Mbps	90	mA
	802.11g Tx (2.4 GHz) 54 Mbps	88	mA
	802.11n Tx (2.4 GHz) HT20 MCS0	89	mA
	802.11n Tx (2.4 GHz) HT20 MCS7	88	mA

4.5. RF Performances

4.5.1. Wi-Fi Performances

Table 19: 2.4 GHz Wi-Fi Conducted Output Power

Operating Mode	Rate	Min. (dBm)	Typ. (dBm)
802.11b	1 Mbps	14	16
802.11b	11 Mbps	14	16
802.11g	6 Mbps	13	15
802.11g	54 Mbps	12	14
802.11n, HT20	MCS0	12	14
802.11n, HT20	MCS7	11	13

Table 20: 2.4 GHz Wi-Fi Conducted Receive Sensitivity

Operating Mode	Rate	Typ. (dBm)
802.11b	1 Mbps	-96
802.11b	11 Mbps	-87
802.11g	6 Mbps	-89
802.11g	54 Mbps	-72
802.11n, HT20	MCS0	-89
802.11n, HT20	MCS7	-70

Table 21: 2.4 GHz Wi-Fi OTA TRP Test

Operating Mode	Rate	Typ. (dBm)
802.11b	1 Mbps	15
802.11b	11 Mbps	15
802.11g	6 Mbps	14

802.11g	54 Mbps	13
802.11n, HT20	MCS0	13
802.11n, HT20	MCS7	12

Table 22: 2.4 GHz Wi-Fi OTA TIS

Operating Mode	Rate	Typ. (dBm)
802.11b	1 Mbps	-94
802.11b	11 Mbps	-85
802.11g	6 Mbps	-88
802.11g	54 Mbps	-71
802.11n, HT20	MCS0	-86
802.11n, HT20	MCS7	-66

4.5.2. BLE Performances

Table 23: BLE Conducted Mode Output Power / Receive Sensitivity

Operating Mode	Output Power (Typ.)	Receive Sensitivity (Typ.)	Unit
BLE (1 MHz)	6	-95	dBm

4.6. ESD Protection

Static electricity occurs naturally and it 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 24: ESD Characteristics (Temperature: 25 ºC, Humidity: 45 %)

Tested Interfaces	Contact Discharge	Air Discharge	Unit

VBAT, GND	±4	±8	kV
ANT_WIFI/BT	±4	±8	kV
Other Interfaces	±0.5	±1	kV

4.7. Operating and Storage Temperatures

Table 25: Operating and Storage Temperatures (Unit: ºC)

Parameter	Min.	Typ.	Max.
Operating Temperature Range [2]	-40	+25	+105
Storage Temperature Range	-45	-	+115

[2] Within the operating temperature range, the module's related performance meets IEEE and Bluetooth specifications.

5 Mechanical Information

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

5.1. Mechanical Dimensions

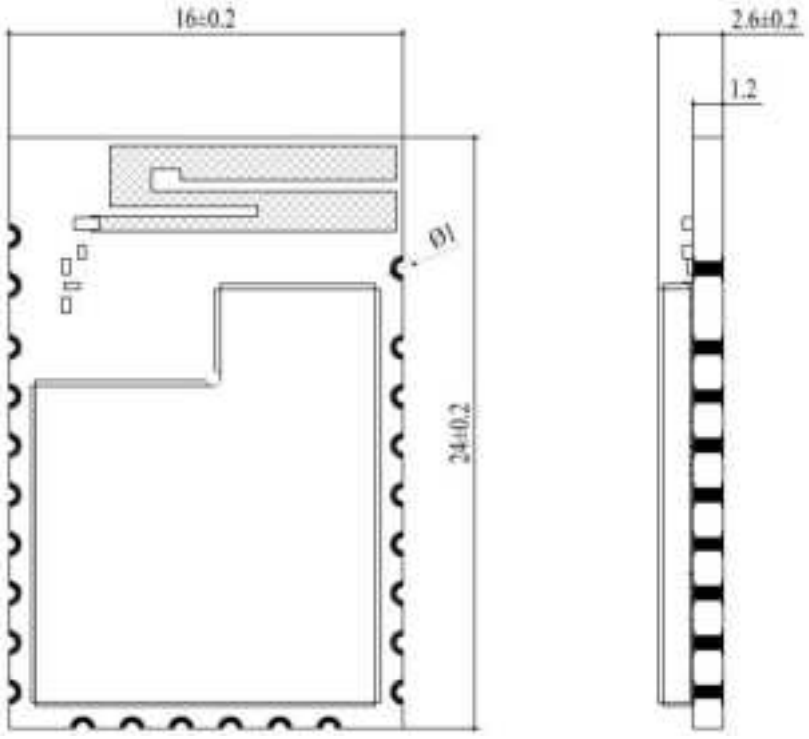


Figure 19: Module Top and Side Dimensions for FCM100D_PCB_Antenna

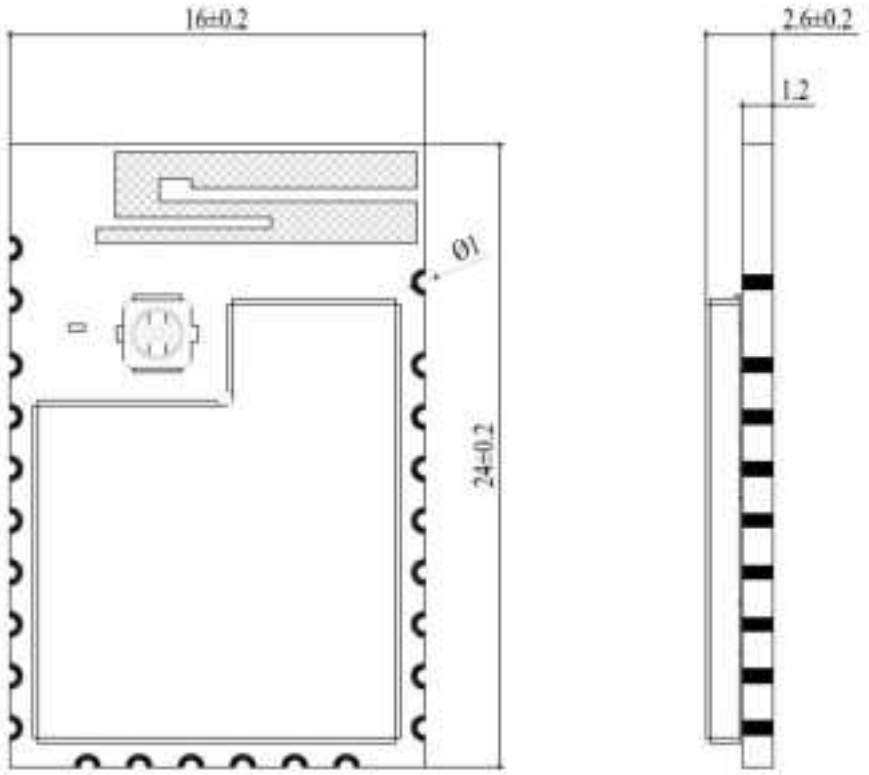


Figure 20: Module Top and Side Dimensions for FCM100D_IPEX

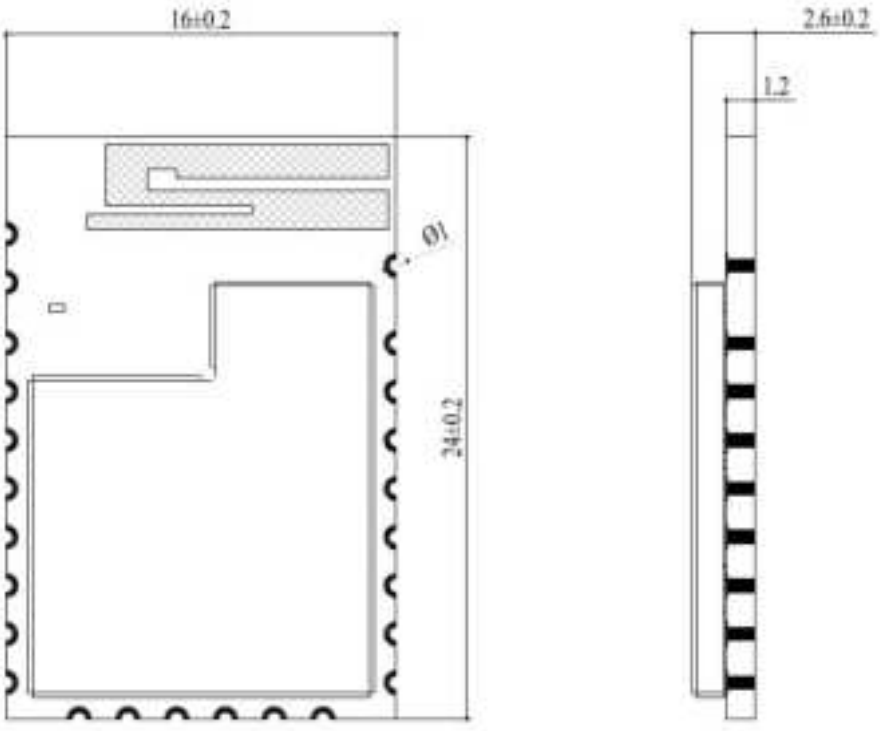


Figure 21: Module Top and Side Dimensions for FCM100D_LCC

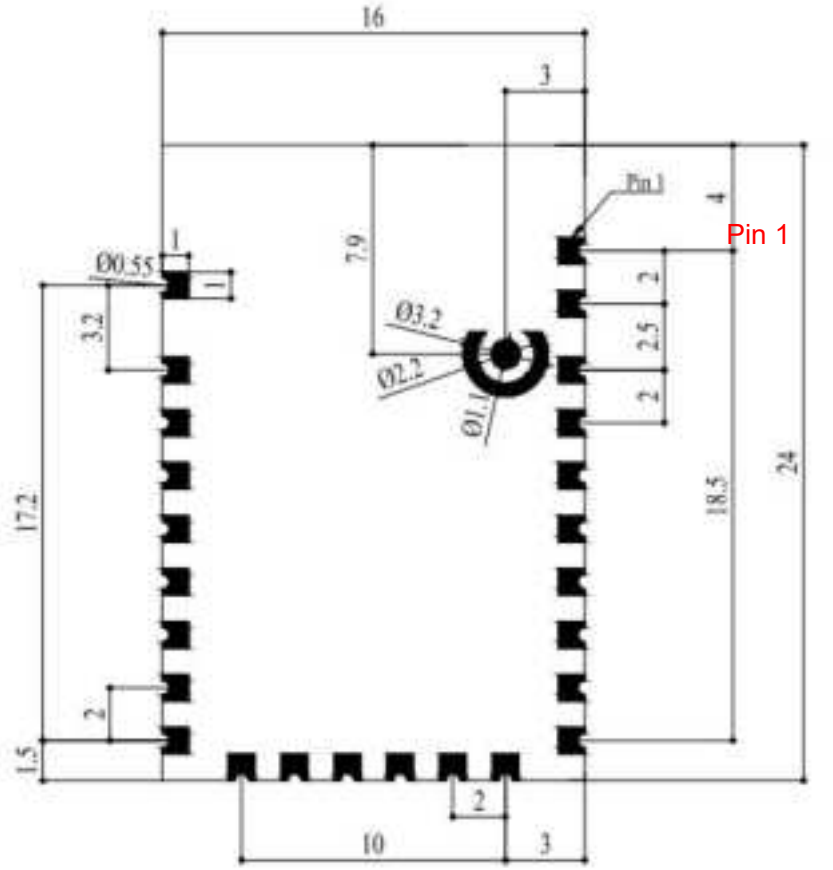


Figure 22: Module Dimension (Bottom View)

NOTE

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

5.2. Recommended Footprint

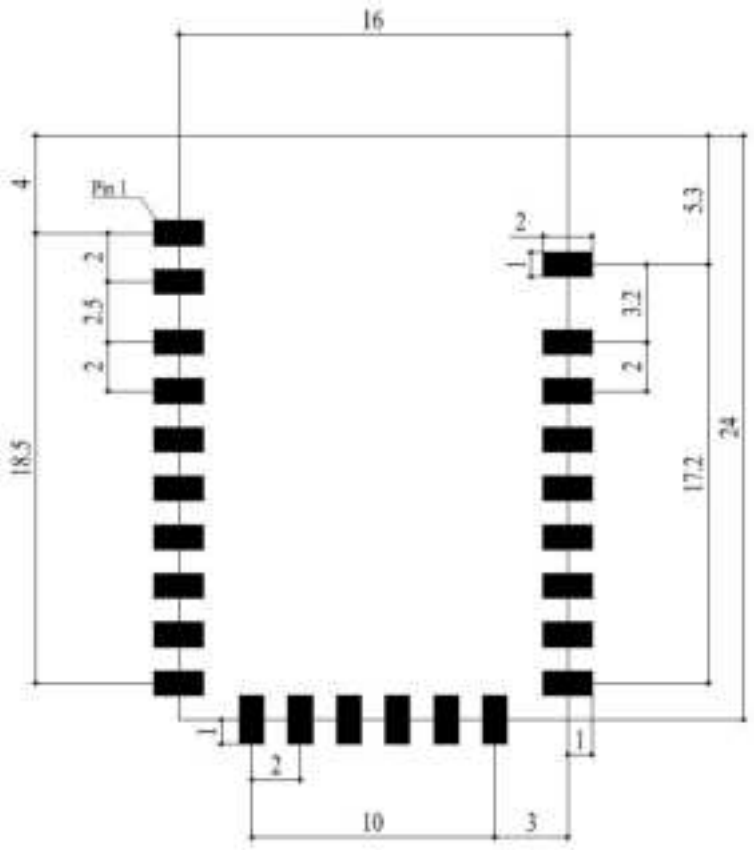


Figure 23: Recommended Footprint (Top View)

NOTE

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

5.3. Top and Bottom Views

Figure 24: Top and Bottom Views of the Module

NOTE

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

6 Storage, Manufacturing and Packaging

6.1. 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 [3] 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.

[3] 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*. And do not remove the packages of tremendous modules if they are not 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.

6.2. Manufacturing and Soldering

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

The recommended reflow temperature should be 238–246 ºC, with 246 ºC as the absolute maximum reflow temperature. To avoid damage to the module caused by repeated heating, it is suggested 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.

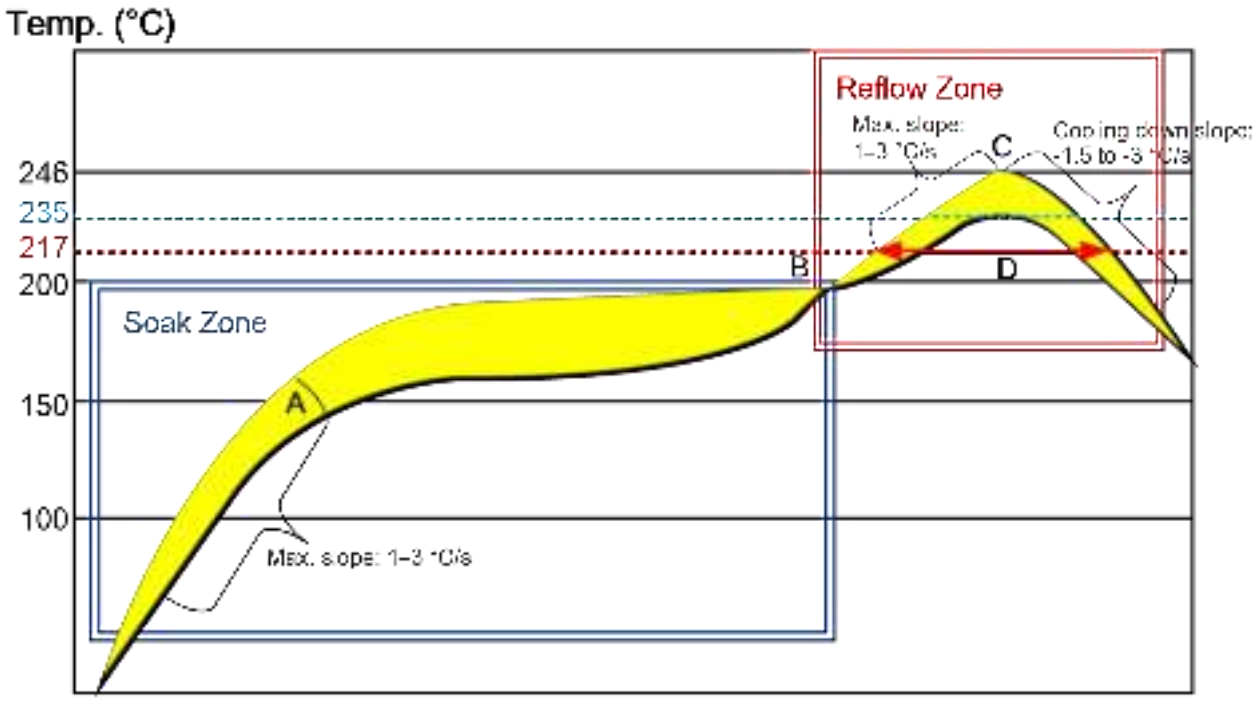


Figure 25: Recommended Reflow Soldering Thermal Profile

Table 26: Recommended Thermal Profile Parameters

Factor	Recommendation
Soak Zone	
Max. slope	1–3 °C/s
Soak time (between A and B: 150 °C and 200 °C)	70–120 s
Reflow Zone	
Max. slope	1–3 °C/s
Reflow time (D: over 217 °C)	40–70 s
Max. temperature	238 °C to 246 °C
Cooling down slope	-1.5 to -3 °C/s
Reflow Cycle	
Max. reflow cycle	1

NOTE

1. 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.
2. 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.
3. 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.
4. Avoid using ultrasonic technology for module cleaning since it can damage crystals inside the module.
5. Due to the complexity of the SMT process, please contact Quectel Technical Support in advance for any situation that you are not sure about, or any process (e.g. selective soldering, ultrasonic soldering) that is not mentioned in ***document [3]***.

6.3. Packaging Specifications

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

6.3.1. Carrier Tape

Dimension details are as follow:

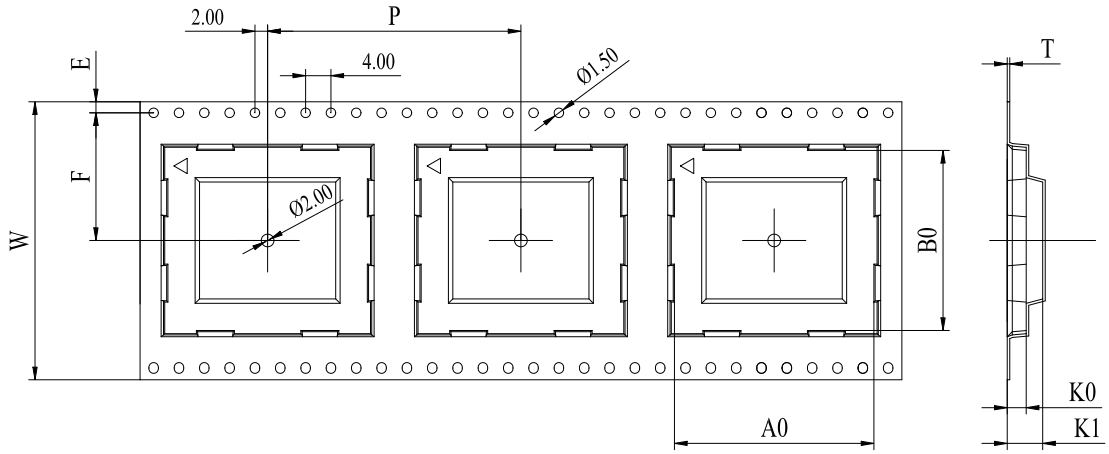


Figure 26: Carrier Tape Dimension Drawing

Table 27: Carrier Tape Dimension Table (Unit: mm)

W	P	T	A0	B0	K0	K1	F	E
44	24	0.4	16.4	24.4	3.1	4.65	20.2	1.75

6.3.2. Plastic Reel

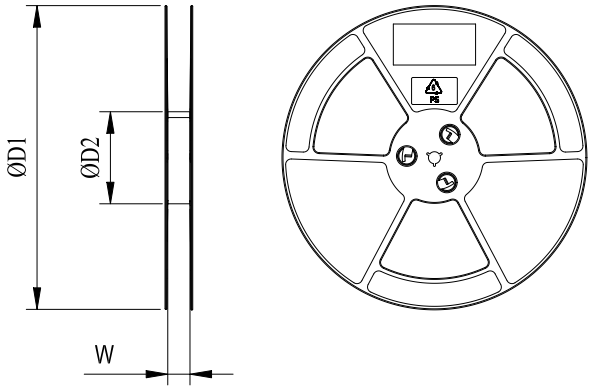
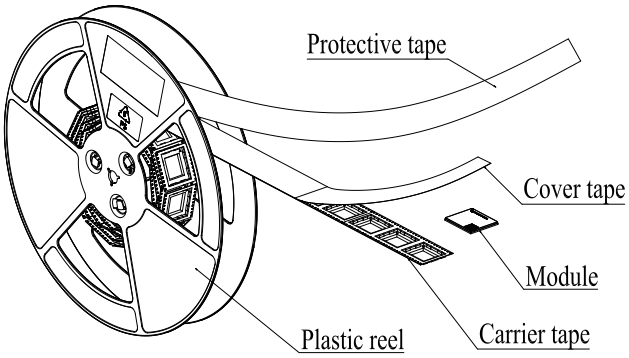


Figure 27: Plastic Reel Dimension Drawing

Table 28: Plastic Reel Dimension Table (Unit: mm)

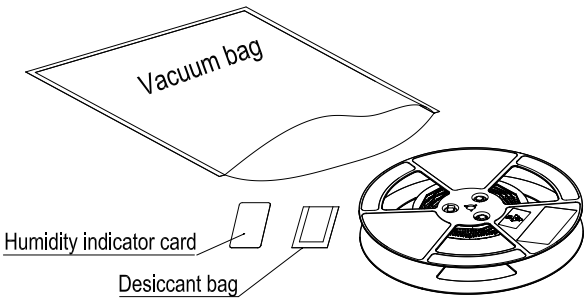
øD1	øD2	W
330	100	44.5

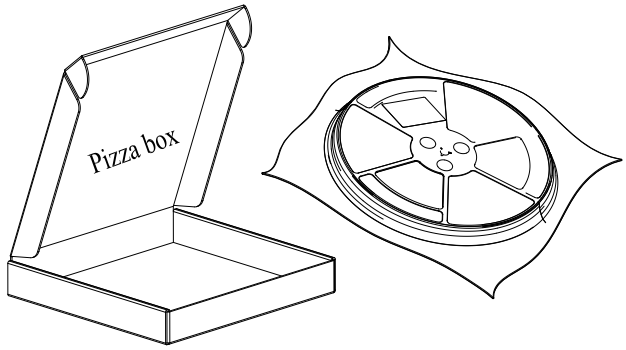
6.3.3. Packaging Process



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 into the pizza box.

Put 4 packaged pizza boxes into 1 carton box and seal it. 1 carton box can pack 2000 modules.

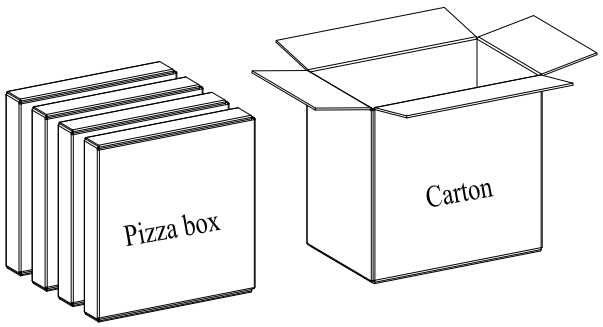


Figure 28: Packaging Process

7 Appendix References

Table 29: Reference Documents

Document Name
[1] Quectel_FCM100D_TE-B_User_Guide
[2] Quectel_RF_LAYOUT_Application_Note
[3] Quectel_Module_SMT_Application_Note

Table 30: Terms and Abbreviations

Abbreviation	Description
AP	Access Point
BLE	Bluetooth Low Energy
BPSK	Binary Phase Shift Keying
CCK	Complementary Code Keying
CTS	Clear To Send
DPSK	Differential Phase Shift Keying
DQPSK	Differential Quadrature Reference Phase Shift Keying
ESD	Electrostatic Discharge
GATT	Generic Attribute Profile
GFSK	Gauss Frequency Shift Keying
GND	Ground
HT	High Throughput
IEEE	Institute of Electrical and Electronics Engineers
I/O	Input/Output
Mbps	Megabits per second

MPN	Manufacturer Part Number
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RH	Relative Humidity
RoHS	Restriction of Hazardous Substances
STA	Station
RTS	Request to Send
RXD	Receive Data (Pin)
SDIO	Secure Digital Input and Output Card
TBD	To Be Determined
TXD	Transmit Data (Pin)
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
VHT	Very High Throughput
V_{IH}max	Maximum High-level Input Voltage
V_{IH}min	Minimum High-level Input Voltage
V_{IL}max	Maximum Low-level Input Voltage
V_{IL}min	Minimum Low-level Input Voltage
V_{OL}max	Maximum Low-level Output Voltage
V_{OH}min	Minimum High-level Output Voltage
Vnom	Normal Voltage Value
VSWR	Voltage Standing Wave Ratio

CE Statement

The minimum distance between the user and/or any bystander and the radiating structure of the transmitter is 20cm.

Hereby, We, Quectel Wireless Solutions Co., Ltd. declares that the radio equipment type BG951A-GL is in compliance with the Directive 2014/53/EU.

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

Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China

https://www.quectel.com.

The device operates with the following frequency bands and transmitting power:

Band	Tx (MHz)	Rx (MHz)	The Maximum (EIRP) Transmitted Power (dBm)
Bluetooth LE	2400 ~ 2483.5	2400 ~ 2483.5	4.97 dBm
Wi-Fi 2.4G	2400 ~ 2483.5	2400 ~ 2483.5	18.25 dBm

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: XMR2022FCM100D.**

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:⩽-1dBi
- ❒ Wi-Fi 2.4G:⩽-1dBi

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: **XMR2022FCM100D**" or "Contains FCC ID: **XMR2022FCM100D**" must be used. The host OEM user manual must also contain clear instructions on how end users can find and/or access the module and the FCC ID.

The final host / module combination may also need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device.

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

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

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

IC Statement

IRSS-GEN

"This device complies with Industry Canada’s licence-exempt RSSs. 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." or "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; 2) l’utilisateur de l’appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d’en compromettre le fonctionnement."

Déclaration sur l'exposition aux rayonnements RF

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.

L'autre utilisé pour l'émetteur doit être installé pour fournir une distance de séparation d'au moins 20 cm de toutes les personnes et ne doit pas être colocalisé ou fonctionner conjointement avec une autre antenne ou un autre émetteur.

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:≤-1dBi
- Wi-Fi 2.4G:≤-1dBi

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-22FCM100D**” or “where: **10224A-22FCM100D** is the module’s certification number”.

Le produit hôte doit être correctement étiqueté pour identifier les modules dans le produit hôte.

L'étiquette de certification d'Innovation, Sciences et Développement économique Canada d'un module doit être clairement visible en tout temps lorsqu'il est installédans le produit hôte; sinon, le produit hôte doit porter une étiquette indiquant le numéro de certification d'Innovation, Sciences et Développement économique Canada pour le module, précédé du mot «Contient» ou d'un libellé semblable exprimant la même signification, comme suit:"Contient IC: 10224A-2021BG951A " ou "où: 10224A-2021BG951A est le numéro de certification du module.