FC800L

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
-	2021-11-08	Macky XU	Creation of the document
1.0.0	2021-11-08	Macky XU	Preliminary
1.0.1	2022-04-13	Arrow HUANG	Preliminary: 1. Updated operating temperature.
1.0.2	2022-04-27	Arrow HUANG	Preliminary: 1. Updated operating mode (Table 2, Table 29)
1.0.3	2022-08-22	Arrow HUANG	Preliminary: 1. Update RF characteristics. 2. Update power consumption. 3. Updated WLAN_WAKE pin description and added SDIO interrupt description. 4. Updated evaluation board description and module weights. 5. Added chapter "3.8. RF Antenna Interfaces"

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1 Introduction

This document defines the FC800L and describes its air interfaces and hardware interfaces which are connected with your application.

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.

This device complies with FCC radiation exposure limits set forth for an uncontrolled environment. In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, human proximity to the antenna shall not be less than 20cm (8 inches) during normal operation.

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

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Important Notice to OEM integrators

1. This module is limited to OEM installation ONLY.

2. This module is limited to installation in fixed applications, according to Part 2.1091(b).

3. The separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and different antenna configurations

4. For FCC Part 15.31 (h) and (k): The host manufacturer is responsible for additional testing to verify compliance as a composite system. When testing the host device for compliance with Part

15 Subpart B, the host manufacturer is required to show compliance with Part 15 Subpart B while the transmitter module(s) are installed and operating. The modules should be transmitting and the evaluation should confirm that the module's intentional emissions are compliant (i.e. fundamental and out of band

emissions). The host manufacturer must verify that there are no additional unintentional emissions other than what is permitted in Part 15 Subpart B or emissions are complaint with the transmitter(s) rule(s).

The Grantee will provide guidance to the host manufacturer for Part 15 B requirements if needed.

Important Note notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify to Quectel Wireless Solutions Co., Ltd that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the USI, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

End Product Labeling

When the module is installed in the host device, the FCC/IC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily re-moved. If not, a second label must be placed on the outside of the final device that contains the following text: "Contains FCC ID: XMR202207FC800L"

The FCC ID can be used only when all FCC compliance requirements are met.

Antenna Installation

(1) The antenna must be installed such that 20 cm is maintained between the antenna and users,

(2) The transmitter module may not be co-located with any other transmitter or antenna.

(3) Only antennas of the same type and with equal or less gains as shown below may be used with this module. Other types of antennas and/or higher gain antennas may require additional authorization for operation.

(4) The max allowed antenna gain is WIFI 2.4G/BT 0.52dBi; WIFI 5G 0.66 dBi for external antenna.

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID/IC ID 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/IC authorization.

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.

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.

This device complies with ISED's licence-exempt RSSs. 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.

Le présent appareil est conforme aux CNR d' ISED applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes : (1) le dispositif ne doit pas produire de brouillage préjudiciable, et (2) ce dispositif doit accepter tout brouillage reçu, y compris un brouillage susceptible de provoquer un fonctionnement indésirable.

Radiation Exposure Statement:

This equipment complies with ISED radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm 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 co- location 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-2022FC800L".

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-2022FC800L ".

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.

RSS-247 Section 6.4 (5) (6) (for local area network devices, 5GHz)

The device could automatically discontinue transmission in case of absence of information to transmit, or operational failure.

Note that this is not intended to prohibit transmission of control or signaling information or the use of repetitive codes where required by the technology.

Caution:

i) The device for operation in the band 5150–5250 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems;

ii) where applicable, antenna type(s), antenna models(s), and worst-case tilt angle(s) necessary to remain compliant with the e.i.r.p. elevation mask requirement set forth in section 6.2.2.3 shall be clearly indicated.

L'appareil peut interrompre automatiquement la transmission en cas d'absence d'informations à transmettre ou de panne opérationnelle. Notez que ceci n'est pas destiné à interdire la transmission d'informations de contrôle ou de signalisation ou l'utilisation de codes répétitifs lorsque cela est requis par la technologie.

Avertissement:

i) Le dispositif utilisé dans la bande 5150-5250 MHz est réservé à une utilisation en intérieur afin de réduire le risque de brouillage préjudiciable aux systèmes mobiles par satellite dans le même canal;

ii) lorsqu'il y a lieu, les types d'antennes (s'il y en a plusieurs), les numéros de modèle de l'antenne et les pires angles d'inclinaison nécessaires pour rester conforme à l'exigence de la

p.i.r.e. applicable au masque d'élévation, énoncée à la section 6.2.2.3, doivent être clairement indiqués.

    i. for devices with detachable antenna(s), the maximum antenna gain permitted for devices in the bands 5250-5350 MHz and 5470-5725 MHz shall be such that the equipment still complies with the e.i.r.p. limit

    ii. for devices with detachable antenna(s), the maximum antenna gain permitted for devices in the band 5725-5850 MHz shall be such that the equipment still complies with the e.i.r.p. limits as appropriate;

and

iii. where applicable, antenna type(s), antenna models(s), and worst-case tilt angle(s) necessary to remain compliant with the e.i.r.p. elevation mask requirement set forth in section 6.2.2.3 shall be clearly indicated.

1.1. Special Mark

Table 1: Special Mark

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

2 Product Overview

2.1. General Description

FC800L is a Wi-Fi and Bluetooth module with low power consumption. It is a single-die WLAN (Wireless Local Area Network) and Bluetooth combo solution supporting IEEE 802.11a/b/g/n/ac 2.4/5 GHz WLAN standards and Bluetooth 5.0 standard, which enables seamless integration of WLAN and Bluetooth low energy technologies.

With a low-power SDIO 3.0 interface for WLAN, a UART and a PCM interface for Bluetooth. FC800L can provide WLAN and Bluetooth functions.

2.2. Key Features

The following table describes the key features of FC800L.

Table 2: Key Features

Features	Details
Power Supply	• **VBAT power supply:** Supply voltage range: 2.97–3.63 V Typical supply voltage: 3.3 V • **VDDIO power supply:** Supply voltage range: 1.62–1.98 V Typical supply voltage: 1.8 V
Operating Frequency	• 2.4 GHz WLAN: 2.400–2.4835 GHz • 5 GHz WLAN: 5.15–5.85 GHz • Bluetooth: 2.402–2.480 GHz
Transmission Data Rates	• 802.11b: 1 Mbps, 2 Mbps, 5.5 Mbps, 11 Mbps • 802.11a/g: 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps, 54 Mbps • 802.11n: HT20 (MCS0-7), HT40 (MCS0-7) • 802.11ac: VHT20 (MCS0-8), VHT40 (MCS0-9), VHT80 (MCS0-9)

Transmitting Power	• **2.4 GHz** 802.11b/11 Mbps：16.0 ±2 dBm 802.11g/54 Mbps：15.0 ±2 dBm 802.11n/HT20 MCS7：14 ±2 dBm 802.11n/HT40 MCS7：14 ±2 dBm • **5 GHz** 802.11a/54 Mbps：15 ±3 dBm 802.11n/HT20 MCS7：14 ±3 dBm 802.11n/HT40 MCS7：14 ±3 dBm 802.11ac/VHT20 MCS8：13 ±3 dBm 802.11ac/VHT40 MCS9：12 ±3 dBm 802.11ac/VHT80 MCS9：11 ±3 dBm
Operation Mode	STA
Modulation	CCK, BPSK, QPSK, 16QAM, 64QAM, 256QAM
WLAN Application Interface	SDIO 3.0
Bluetooth Application Interface	UART and PCM
RF Antenna Interfaces	• ANT_WIFI • ANT_BT
Physical Characteristics	• Size: (13 ±0.15) mm × (15 ±0.15) mm × (2.2 ±0.2) mm • Package: LCC • Weight: about 0.8g
Temperature Range	• Operating temperature range: 0 °C to +70 °C [1] • Storage temperature range: -40 °C to +95 °C
RoHS	All hardware components are fully compliant with EU RoHS directive

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[1] Within operating temperature range, the module is IEEE compliant.

2.3. EVB

Quectel supplies an evaluation board (FC800L-M.2) with accessories to control or test the module.

3 Application Interfaces

3.1. General Description

FC800L is equipped with 50 LCC pins. The subsequent chapters will provide a detailed introduction to the following interfaces and pins of the module:

- Power supply
- WLAN application interface
- Bluetooth application interface
- RF antenna interfaces
- Other interfaces

3.2. Pin Assignment
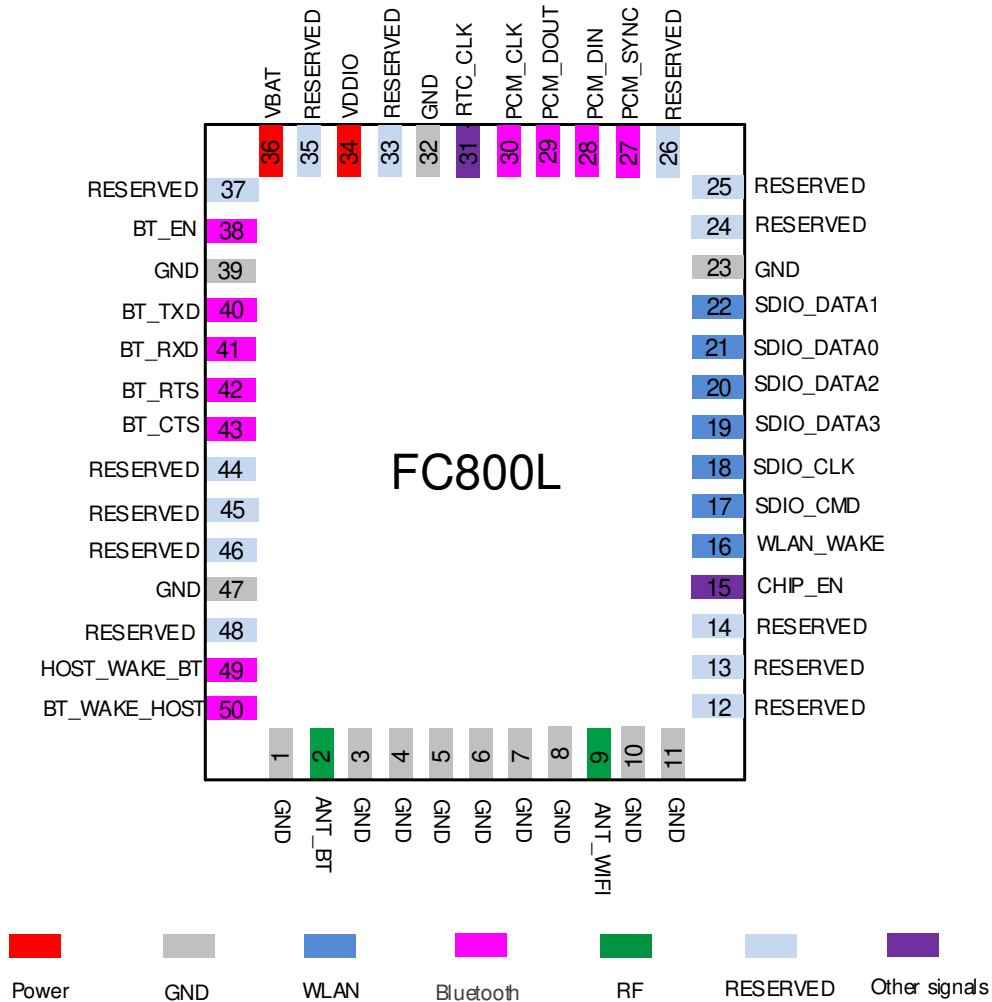
Figure 1: Pin Assignment (Top View)

> **NOTE**
>
> Keep all RESERVED pins open.

3.3. Pin Description

Table 3: I/O Parameters Definition

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

Table 4: Pin Description

Power Supply				
Pin Name	**Pin No.**	**I/O**	**Description**	**Comment**
VBAT	36	PI	Power supply for the module	It must be provided with sufficient current up to 1.2 A.
VDDIO	34	PI	Power supply for module's I/O pins	VDDIO only support 1.8 V
GND	1, 3–8, 10–11, 23, 32, 39, 47			
WLAN Application Interface				
Pin Name	**Pin No.**	**I/O**	**Description**	**Comment**
WLAN_WAKE	16	DO	Wake up the host by WLAN, and SDIO interrupt function	VDDIO power domain
SDIO_CMD	17	DIO	SDIO command	
SDIO_CLK	18	DI	SDIO clock	

SDIO_DATA3	19	DIO	SDIO data bit 3	
SDIO_DATA2	20	DIO	SDIO data bit 2	
SDIO_DATA0	21	DIO	SDIO data bit 0	
SDIO_DATA1	22	DIO	SDIO data bit 1	
Bluetooth Application Interface				
Pin Name	**Pin No.**	**I/O**	**Description**	**Comment**
PCM_SYNC*	27	DI	PCM data frame sync	
PCM_DIN*	28	DI	PCM data input	
PCM_DOUT*	29	DO	PCM data output	VDDIO power domain
PCM_CLK*	30	DI	PCM clock	
BT_EN	38	DI	Bluetooth enable control	Active high. VDDIO power domain
BT_TXD	40	DO	Bluetooth UART transmit	
BT_RXD	41	DI	Bluetooth UART receive	
BT_RTS	42	DO	Bluetooth UART request to send	
BT_CTS	43	DI	Bluetooth UART clear to send	VDDIO power domain
HOST_WAKE_BT*	49	DI	Host wakes up Bluetooth	
BT_WAKE_HOST*	50	DO	Bluetooth wakes up host	
Other Interfaces				
Pin Name	**Pin No.**	**I/O**	**Description**	**Comment**

RTC_CLK	31	DI	External 32.768 kHz clock input	VDDIO power domain
CHIP_EN	15	DI	Module enable pin	Pull up to VDDIO internally through a 4.7 kΩ resistor, high level by default. VDDIO power domain

RF Antenna Interfaces

Pin Name	Pin No.	I/O	Description	Comment
ANT_BT	2	AIO	Bluetooth antenna interface	50 Ω impedance.
ANT_WIFI	9	AIO	Wi-Fi antenna interface	

RESERVED Interfaces

Pin Name	Pin No.	I/O	Description	Comment
RESERVED	12–14, 24–26, 33, 35, 37, 44–46, 48			Keep these pins open.

3.4. Power Supply

The following table shows the power supply pins and ground pins of FC800L.

Table 5: Definition of Power Supply and GND Pins

Pin Name	Pin No.	Description	Min.	Typ.	Max.	Unit
VBAT	36	Power supply for the module	2.97	3.3	3.63	V
VDDIO	34	Power supply for module's I/O pins	1.62	1.8	1.98	V
GND	1, 3–8, 10–11, 23, 32, 39, 47					

FC800L is powered by VBAT and VDDIO, and VBAT is recommended to use a power supply chip with maximum output current more than 1.2 A. The following figure shows the recommended power up timing of FC800L.

Figure 2: Power up Timing

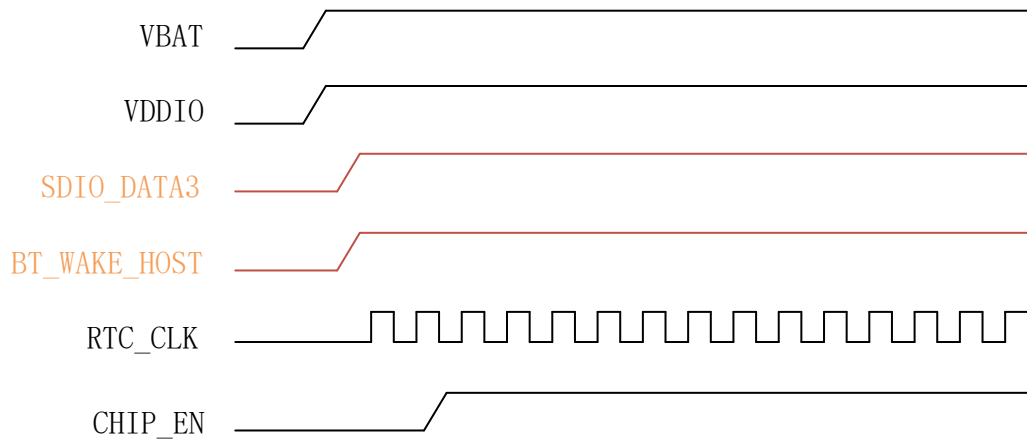**NOTE**

1. VBAT should be up before or at the same time as VDDIO. VDDIO should not be present first or be held high before VBAT is high.
2. RTC_CLK must held stable before CHIP_EN held high.

3.5. WLAN Application Interface

The following figure shows the WLAN application interface connection between FC800L and the host.
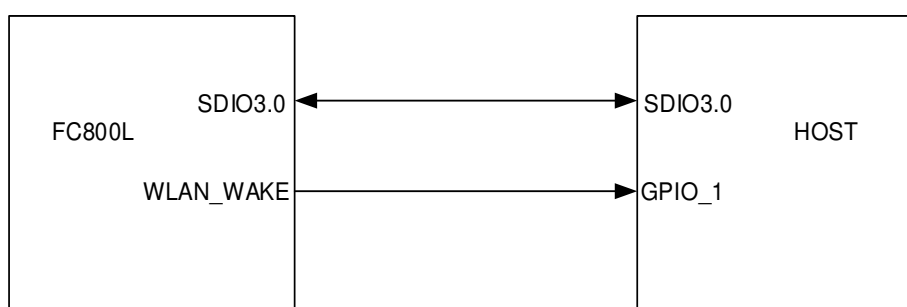
Figure 3: WLAN Application Interface Connection

3.5.1. WLAN_WAKE

WLAN_WAKE is used to wake up the host. And the interrupt function that replaces the regular SDIO D1 interrupt pin.

Table 6: Pin Definition of WLAN_WAKE

Pin Name	Pin No.	I/O	Description	Comment
WLAN_WAKE	16	DO	Wake up the host by WLAN, and SDIO interrupt function	GPIO_1 connected to WLAN_WAKE must be interruptible.

3.5.2. SDIO Interface

The following table shows the pin definition of SDIO interface.

Table 7: Pin Definition of SDIO Interface

Pin Name	Pin No.	I/O	Description	Comment
SDIO_CMD	17	DIO	SDIO command	
SDIO_CLK	18	DI	SDIO clock	
SDIO_DATA3	19	DIO	SDIO data bit 3	
SDIO_DATA2	20	DIO	SDIO data bit 2	VDDIO power domain
SDIO_DATA0	21	DIO	SDIO data bit 0	
SDIO_DATA1	22	DIO	SDIO data bit 1	

The following figure shows the SDIO interface connection between FC800L and host.
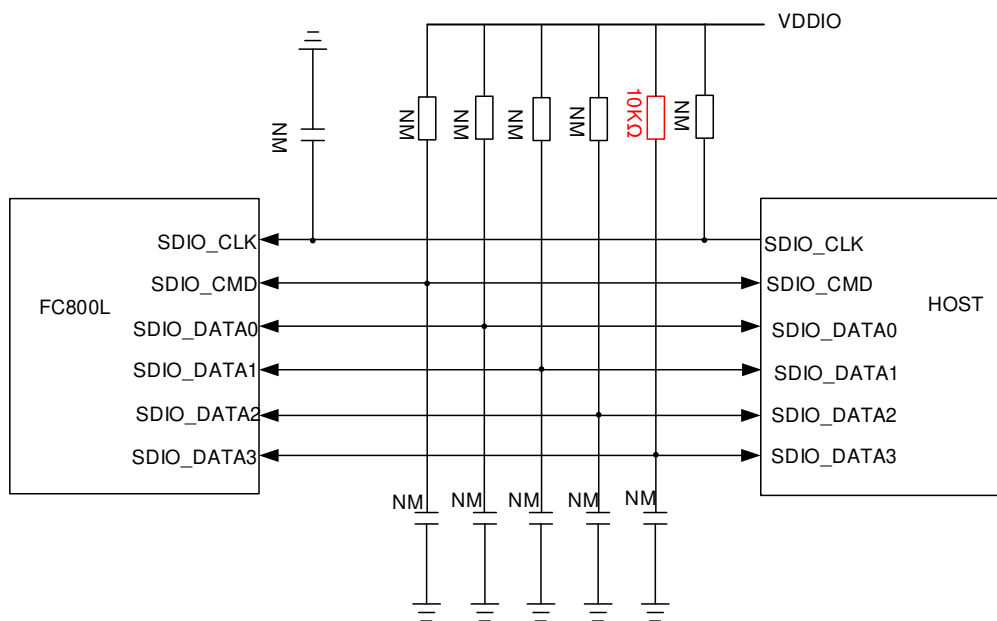
Figure 4: SDIO Interface Connection

To ensure that the interface design complies with the SDIO 3.0 specification, the following principles are recommended to be adopted:

- Route the SDIO traces in inner-layer of the PCB and the impedance is controlled at 50 Ω ±10 %;
- SDIO signals need to be keep away from sensitive signals, such as radio frequency, analog signals, clocks, and DC-DC noise signals;
- The distance between SDIO signals and other signals must be greater than 2 times the trace width, and the busload capacitance must be less than 15 pF.
- SDIO signal traces need to be treated with equal length (the distance between the traces is less than 1 mm). According to the transmission rate, the trace length has the following requirements:

    1) As for SDR104 mode, the recommended bus length is less than 50 mm, the internal trace length of the module is 11.36 mm.
    2) As for other modes, such as DDR50, SDR100, etc., the recommended bus length is less than 150 mm.

3.6. Bluetooth Application Interface

The following figure shows the block diagram of Bluetooth application interface connection between

FC800L and a host.
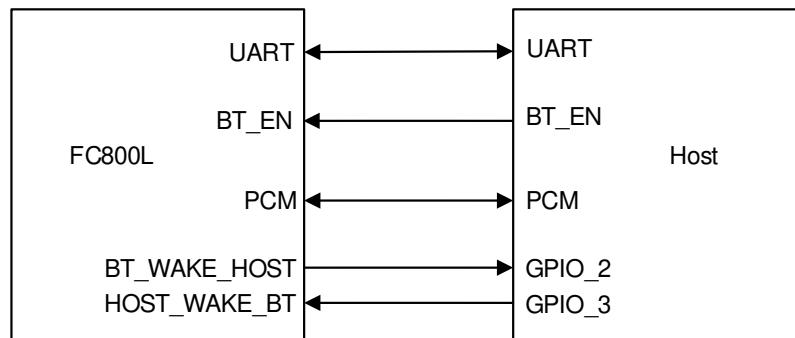
Figure 5: Block Diagram of Bluetooth Application Interface Connection

> **NOTE**
>
> GPIO_2 connected to BT_WAKE_HOST must be interruptible.

3.6.1. BT_EN

BT_EN is used to control the Bluetooth function of FC800L. Bluetooth function will be enabled when BT_EN is at high level.

Table 8: Pin Definition of BT_EN

Pin Name	Pin No.	I/O	Description	Comment
BT_EN	38	DI	Bluetooth enable control	Active high.

3.6.2. UART Interface

FC800L supports an HCI UART as defined in *Bluetooth Core Specification Version 5.0*. The UART supports hardware flow control, and it is used for data transmission with host. It supports up to 4.0 Mbps baud rates.

The following table shows the pin definition of UART interface.

Table 9: Pin Definition of UART Interface

Pin Name	Pin No.	I/O	Description	Comment
BT_TXD	40	DO	Bluetooth UART transmit	VDDIO power domain
BT_RXD	41	DI	Bluetooth UART receive	
BT_RTS	42	DO	Bluetooth UART request to send	
BT_CTS	43	DI	Bluetooth UART clear to send	

The voltage range of the Bluetooth UART interface of FC800L is determined by VDDIO. It is necessary to pay attention to whether the voltage range of host and FC800L Bluetooth UART interface is consistent. If necessary, voltage-level translator shall be added.

The following figure shows a reference design for UART interface connection between FC800L and host.
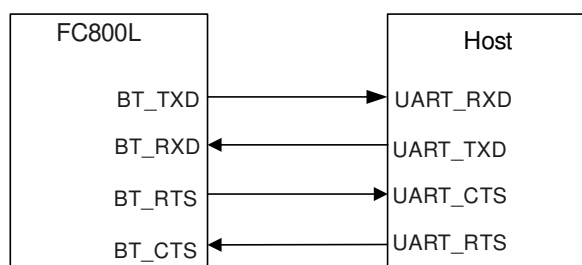
Figure 6: Reference Design for UART Interface Connection

3.6.3. BT_WAKE_HOST* and HOST_WAKE_BT*

Table 10: Pin Definition of BT_WAKEUP_HOST and HOST_WAKEUP_BT

Pin Name	Pin No.	I/O	Description	Comment
HOST_WAKE_BT	49	DI	Host wakes up Bluetooth	VDDIO power domain
BT_WAKE_HOST	50	DO	Bluetooth wakes up host	

3.6.4. PCM Interface*

PCM interface is used for audio over Bluetooth phone. The following table shows the pin definition of PCM interface.

Table 11: Pin Definition of PCM Interface

Pin Name	Pin No.	I/O	Description	Comment
PCM_SYNC	27	DI	PCM data frame sync	VDDIO power domain
PCM_DIN	28	DI	PCM data input	
PCM_DOUT	29	DO	PCM data output	
PCM_CLK	30	DI	PCM clock	

The following figure shows the PCM interface connection between FC800L and the host.
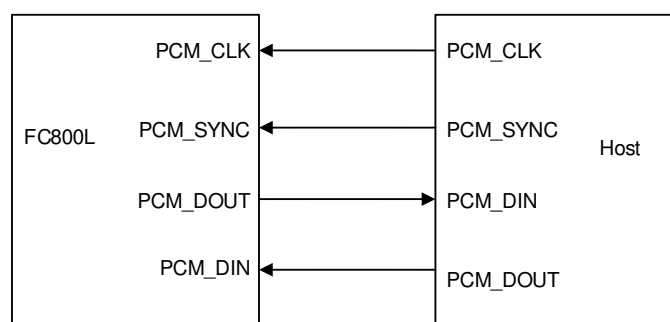
Figure 7: PCM Interface Connection

3.7. Other Interfaces

3.7.1. RTC_CLK

The RTC_CLK 32.768 kHz is used for internal PMU reference clock.

Table 12: Pin Definition of RTC_CLK

Pin Name	Pin No.	I/O	Description	Comment
RTC_CLK	31	DI	External 32.768 kHz clock input	

NOTE

RTC_CLK should surrounded by GND.

3.7.2. CHIP_EN

The module is enabled by CHIP_EN.

Table 13: Pin Definition of CHIP_EN

Pin Name	Pin No.	I/O	Description	Comment
CHIP_EN	15	DI	Module enable pin	Active high. VDDIO power domain

3.8. RF Antenna Interfaces

ANT_BT and ANT_WIFI is the RF antenna pin, and the RF port requires 50 Ω characteristic impedance.

3.8.1. Operating Frequency

The operating frequency of FC800L is shown in the following.

Table 1: Operating Frequency of the Module

Feature	Frequency	Unit
2.4 GHz WLAN	2.400–2.4835	GHz
5 GHz WLAN	5.150–5.850	GHz
Bluetooth	2.402–2.480	GHz

3.8.2. Pin Definition of RF Antenna Interface

Pin definitions of the antenna interface are shown in the following table:

Table 2: Pin Definition of RF Antenna Interfaces

Pin Name	Pin No.	I/O	Description	Comment
ANT_BT	2	AIO	Bluetooth antenna interface	50 Ω impedance
ANT_WIFI	9	AIO	Wi-Fi antenna interface 0	50 Ω impedance

3.8.3. Reference Design of RF Antenna Interfaces

FC800L module provides an RF antenna pin for Wi-Fi & Bluetooth antenna connection. The RF trace in host PCB connected to the module's RF antenna pin should be microstrip line or other types of RF trace, with characteristic impendence close to 50 Ω. FC800L module comes with grounding pins which are next to the antenna pin to give a better grounding.

A reference circuit for the RF antenna interface is shown below. It is recommended to reserve a π-type matching circuit for better RF performance, and ESD protection devices are designed at the same time. Matching components C1, R1, L1~L4 and protection devices D1, D2 should be placed as close as possible to the antenna. Inductors (L1~L4) are not installed by default.
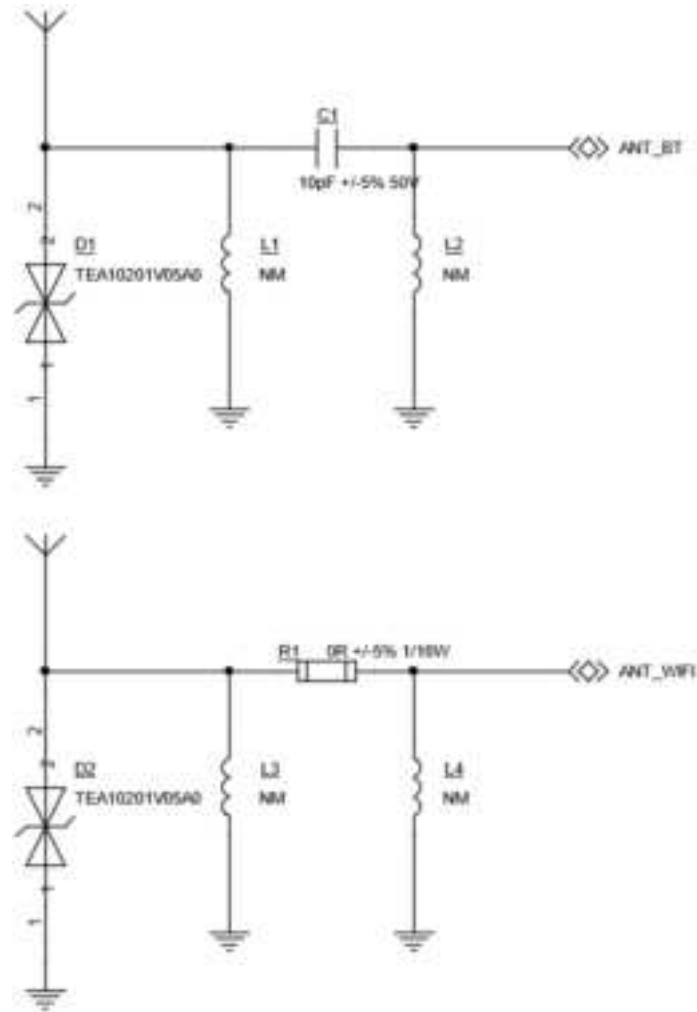
Figure 8: Reference Circuit for RF Antenna Interfaces

3.8.4. Reference Design of RF Layout

For user's PCB, the characteristic impedance of all RF traces should be controlled to 50 Ω. 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 9: Microstrip Design on a 2-layer PCB

Figure 10: Coplanar Waveguide Design on a 2-layer PCB

Figure 11: Coplanar Waveguide Design on a 4-layer PCB (Layer 3 as Reference Ground)
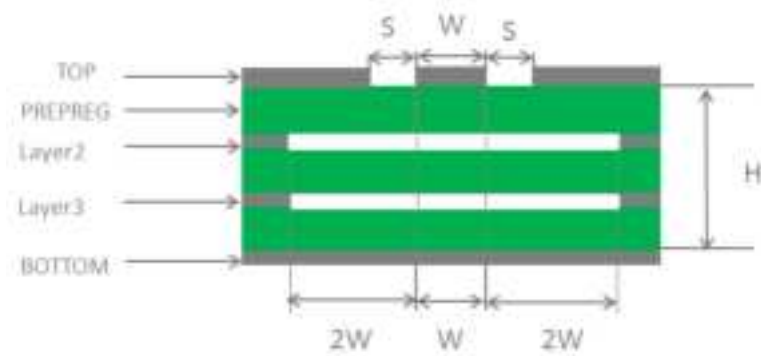
Figure 12: Coplanar Waveguide Design on a 4-layer PCB (Layer 4 as Reference Ground)

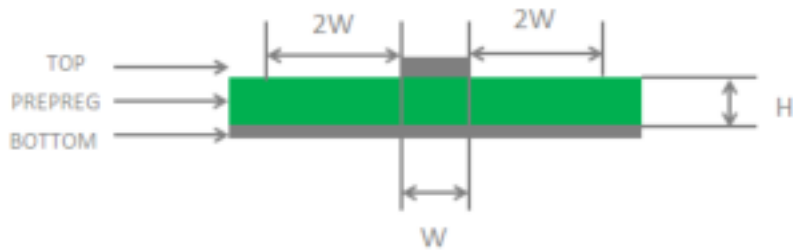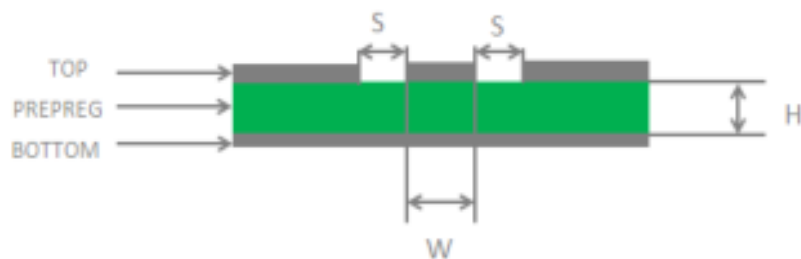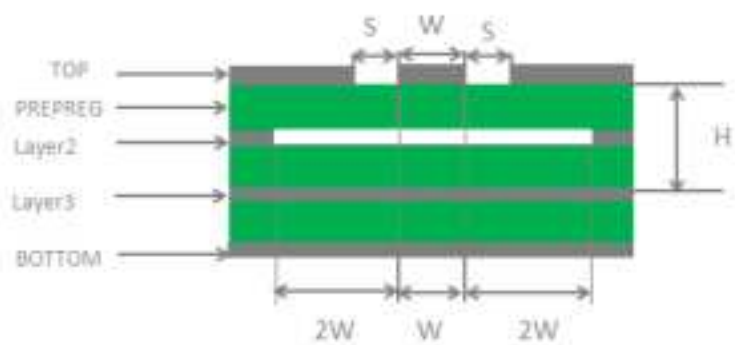In order to ensure RF performance and reliability, the following principles should be complied with in RF layout design:

- 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*

3.8.5. Antenna Requirements

The following tables show the requirements on antenna cables and antennas.

Table 3: Antenna Cable Requirements

Type	Requirements
2.400–2.4835 GHz	Cable insertion loss: <1 dB
5.150–5.850 GHz	Cable insertion loss: <1 dB

Table 4: Antenna Requirements

Type	Requirements
Frequency Range (GHz)	2.400–2.4835 5.150–5.850
VSWR	< 2:1 recommended
Gain (dBi)	Typical 1
Max Input Power (W)	50
Input Impedance (Ω)	50
Polarization Type	Vertical

3.8.6. Recommended RF Connector for Antenna Installation

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

Figure 13: Dimensions of the U.FL-R-SMT Connector (Unit: mm)

U.FL-LP serial connectors listed in the following figure can be used to match the 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 14: Mechanicals of UF.L-LP Connectors (Unit: mm)

The following figure describes the space factor of mated connector
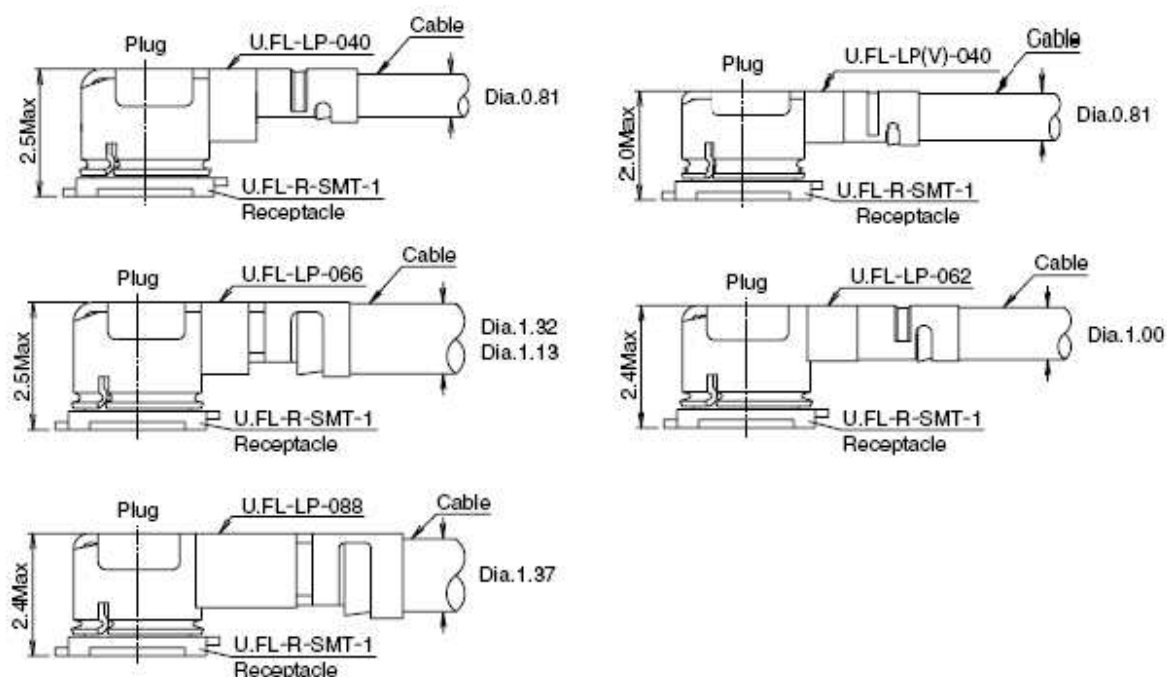
Figure 15: Space Factor of Mated Connector (Unit: mm)

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

4 Reliability, Radio and Electrical Characteristic

4.1. General Description

This chapter mainly introduces the electrical characteristics and radio frequency characteristics of FC800L, the specific content is as follows:

- Absolute maximum ratings
- I/O interface characteristics
- Power consumption
- RF performance
- ESD protection
- Operating and storage temperature

4.2. Electrical Characteristics

Table 5: Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
VBAT	-0.5	3.63	V
VDDIO	-0.5	3.63	V
Digital I/O Input Voltage	-0.5	3.63	V

The following table shows the recommended operating conditions of FC800L module.

Table 6: Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Unit
VBAT	2.97	3.3	3.63	V
VDDIO	1.62	1.8	1.98	V

4.3. I/O Interface Characteristics

The following table shows the general DC electrical characteristics over recommended operating conditions (unless otherwise specified).

Table 7: General DC Electrical Characteristics

Symbol	Parameter	Min.	Max.	Unit
V_{IH}	High-level Input Voltage	0.65 × VDDIO	VDDIO + 0.3	V
V_{IL}	Low-level Input Voltage	-0.3	0.35 × VDDIO	V
V_{OH}	High-level Output Voltage	VDDIO - 0.2	VDDIO + 0.3	V
V_{OL}	Low-level Output Voltage	-0.3	0.2	V

4.4. Current Consumption

Table 8: Current Consumption of the Module (Normal Operation)

Description	Conditions	VBAT (3.3 V)	VDDIO (1.8 V)	Unit
Shutdown	AT+QWIFI=0	TBD	TBD	µA
Idle	AT+QWIFI=1	TBD	TBD	mA
802.11b	TX (2.4 GHz) 1 Mbps	241.50	0.03	mA
	TX (2.4 GHz) 11 Mbps	203.50	0.07	mA
802.11g	TX (2.4 GHz) 6 Mbps	266.50	0.04	mA
	TX (2.4 GHz) 54 Mbps	165.50	0.04	mA
802.11n	TX (2.4 GHz) HT20 MCS0	265.50	0.04	mA
	TX (2.4 GHz) HT20 MCS7	158.00	0.05	mA
	TX (2.4 GHz) HT40 MCS0	261.00	0.04	mA
	TX (2.4 GHz) HT40 MCS7	161.00	0.02	mA
	TX (5 GHz) HT20 MCS0	441.50	0.04	mA
	TX (5 GHz) HT20 MCS7	250.00	0.05	mA
	TX (5 GHz) HT40 MCS0	443.50	0.04	mA
	TX (5 GHz) HT40 MCS7	277.50	0.01	mA
802.11a	TX (5 GHz) 6 Mbps	443.00	0.04	mA
	TX (5 GHz) 54 Mbps	264.50	0.04	mA
802.11ac	TX (5 GHz) VHT20 MCS0	483.00	0.03	mA
	TX (5 GHz) VHT20 MCS8	329.50	0.02	mA
	TX (5 GHz) VHT40 MCS0	448.00	0.04	mA
	TX (5 GHz) VHT40 MCS9	225.00	0.02	mA

TX (5 GHz) VHT80 MCS0	431.50	0.04	mA
TX (5 GHz) VHT80 MCS9	167.50	0.02	mA

4.5. RF Performances

The following tables summarize the transmitting and receiving performances of FC800L.

4.5.1. Wi-Fi Performance

Table 14: Conducted RF Output Power at 2.4 GHz

Standard	Min.	Typ.	Unit
802.11b @ 1 Mbps	14	16	dBm
802.11b @ 11 Mbps	14	16	dBm
802.11g @ 6 Mbps	15	17	dBm
802.11g @ 54 Mbps	13	15	dBm
802.11n, HT20 @ MCS0	15	17	dBm
802.11n, HT20 @ MCS7	12	14	dBm
802.11n, HT40 @ MCS0	14	16	dBm
802.11n, HT40 @ MCS7	12	14	dBm

Table 15: Conducted RF Output Power at 5 GHz

Standard	Min.	Typ.	Unit
802.11a @ 6 Mbps	14	17	dBm
802.11a @ 54 Mbps	12	15	dBm
802.11n, HT20 @ MCS0	14	17	dBm
802.11n, HT20 @ MCS7	11	14	dBm
802.11n, HT40 @ MCS0	13	16	dBm
802.11n, HT40 @ MCS7	11	14	dBm
802.11ac, VHT20 @ MCS0	14	17	dBm

802.11ac, VHT20 @ MCS8	10	13	dBm
802.11ac, VHT40 @ MCS0	13	16	dBm
802.11ac, VHT40 @ MCS9	9	12	dBm
802.11ac, VHT80 @ MCS0	11	14	dBm
802.11ac, VHT80 @ MCS9	8	11	dBm

Table 16: Conducted RF Receiving Sensitivity at 2.4 GHz

Standard	Receiving Sensitivity (Typ.)
802.11b, 1 Mbps	-95.5 dBm
802.11b, 11 Mbps	-87.0 dBm
802.11g, 6 Mbps	-93.0 dBm
802.11g, 54 Mbps	-76.0 dBm
802.11n, HT20, MCS0	-92.5 dBm
802.11n, HT20, MCS7	-74.5 dBm
802.11n, HT40, MCS0	-89.0 dBm
802.11n, HT40, MCS7	-70.5 dBm

Table 17: Conducted RF Receiving Sensitivity at 5 GHz

Standard	Receiving Sensitivity (Typ.)
802.11a, 6 Mbps	-94.0 dBm
802.11a, 54 Mbps	-75.0 dBm
802.11n, HT20, MCS0	-93.0 dBm
802.11n, HT20, MCS7	-75.0 dBm
802.11n, HT40, MCS0	-89.0 dBm
802.11n, HT40, MCS7	-71.0 dBm

802.11ac, VHT20, MCS0	-92.5 dBm
802.11ac, VHT20, MCS8	-69.5 dBm
802.11ac, VHT40, MCS0	-89.0 dBm
802.11ac, VHT40, MCS9	-64.5 dBm
802.11ac, VHT80, MCS0	-84.0 dBm
802.11ac, VHT80, MCS9	-59.0 dBm

4.5.2. Bluetooth Performance

The following table shows the Bluetooth transmitting and receiving performance of FC800L module.

Standard	Transmitting Power	Receiving Sensitivity	Unit
BR	6.8	-90.0	dBm
EDR(π/4-DQPSK)	5.1	-90.5	dBm
EDR(8-DPSK)	5.1	-85.5	dBm
BLE(1M)	6.7	-98.5	dBm
BLE(2M)	6.7	-96.0	dBm
S=2	6.7	-100.5	dBm
S=8	6.7	-103.5	dBm

4.6. Electrostatic Discharge

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 18: Electrostatics Discharge Characteristics (25 °C, 45 % Relative Humidity; Unit: kV)

Tested Interfaces	Contact Discharge	Air Discharge	Unit
VBAT、GND	2	12	kV
ANT_BT、ANT_WIFI	5	10	kV
Other Interfaces	2	2	kV

5 Mechanical Information

This chapter describes the mechanical dimensions of FC800L. All dimensions are measured in millimeter (mm), and the dimensional tolerances are ±0.2 mm unless otherwise specified.
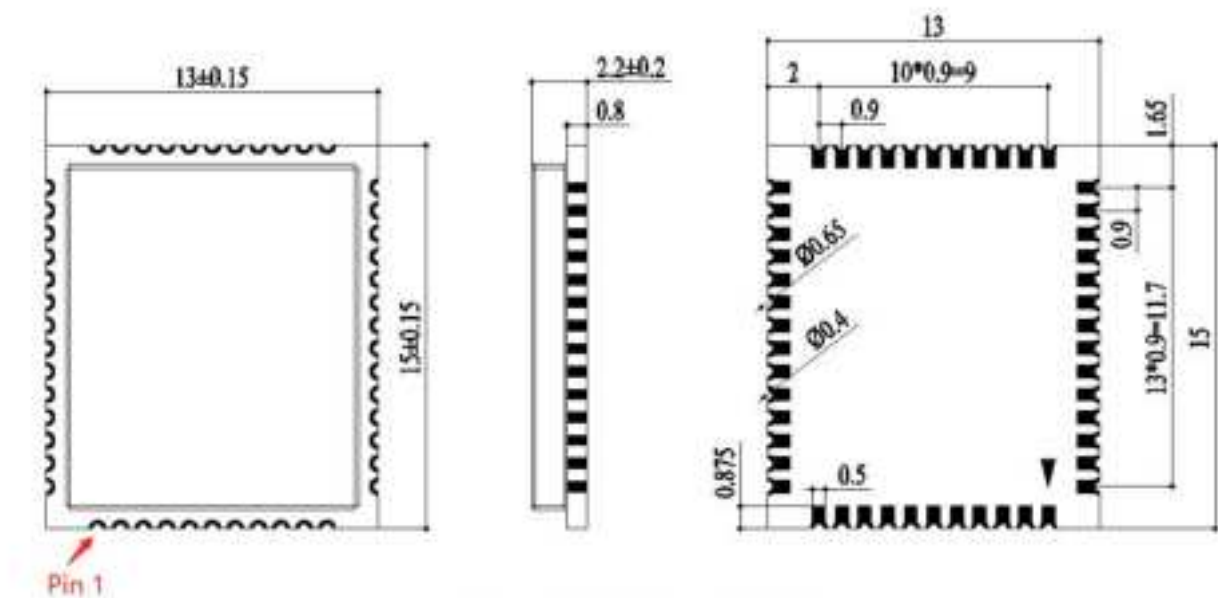
5.1. Mechanical Dimensions

Figure 16: Top and Side Dimensions (Top and Side View)

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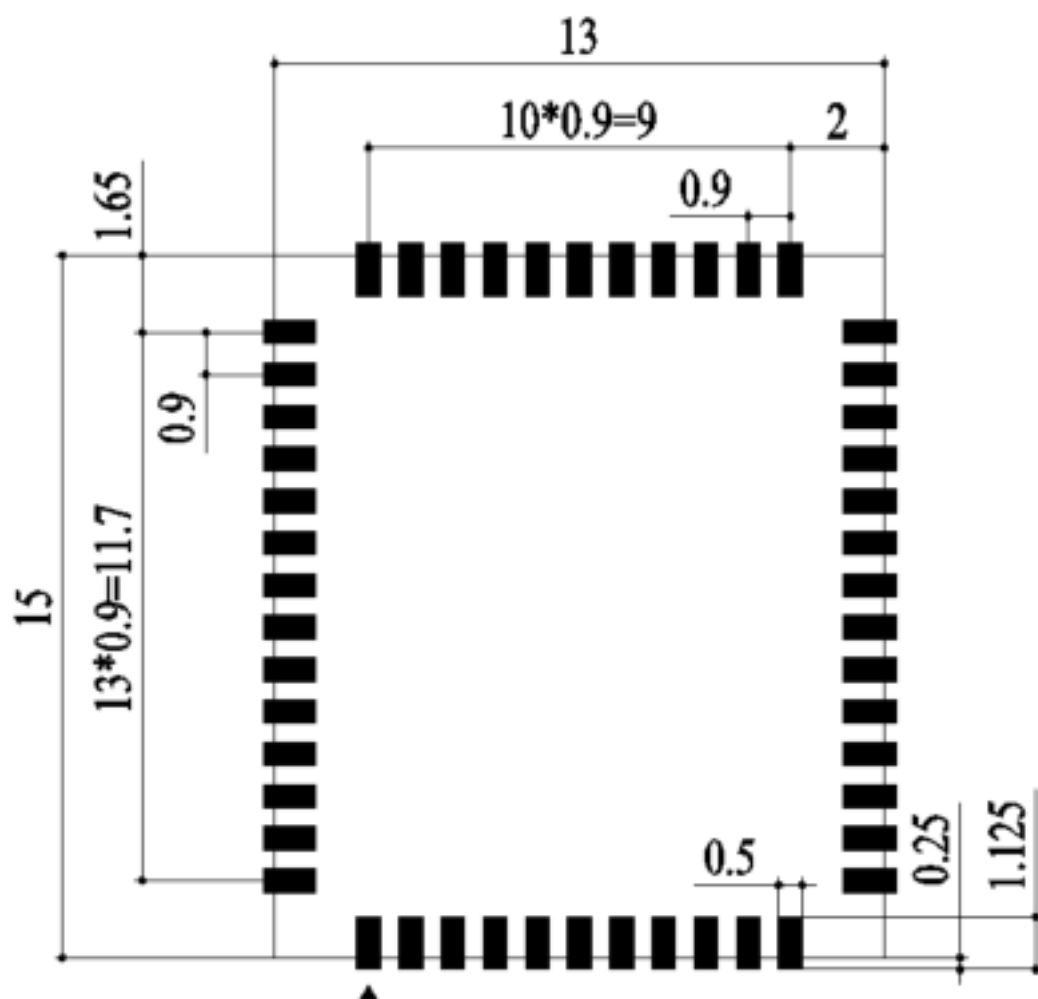
5.2. Recommended Footprint

Figure 17: Recommended Footprint (Top View)

> **NOTE**

1. For easy maintenance of this module, keep at least 3 mm between the module and other components on the motherboard.
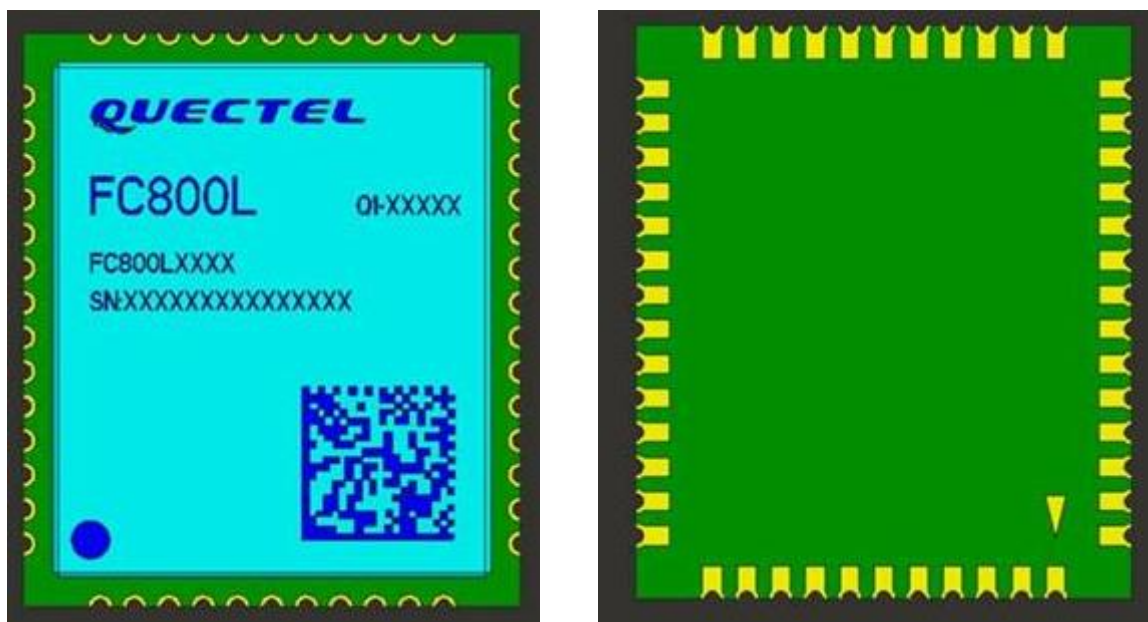2. Keep all RESERVED pins open.

5.3. Top and Bottom Views

Figure 18: 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.

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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. The storage life (in vacuum-sealed packaging) is 12 months in Recommended Storage Condition.

3. The floor life of the module is 168 hours [2] in a plant 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 drying 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 above occurs;
   - 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;
   - All modules must be soldered to PCB within 24 hours after the baking, otherwise they should be put in a dry environment such as in a drying oven.

---

[2] 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.

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. All modules must be soldered to PCB within 24 hours after the baking, otherwise put them in the drying oven. 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 0.13–0.15 mm. For more details, see **document [2]**

The peak 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 strongly recommended that the module should be mounted only after reflow soldering for the other side of PCB has been completed. The recommended reflow soldering thermal profile (lead-free reflow soldering) and related parameters are shown below.
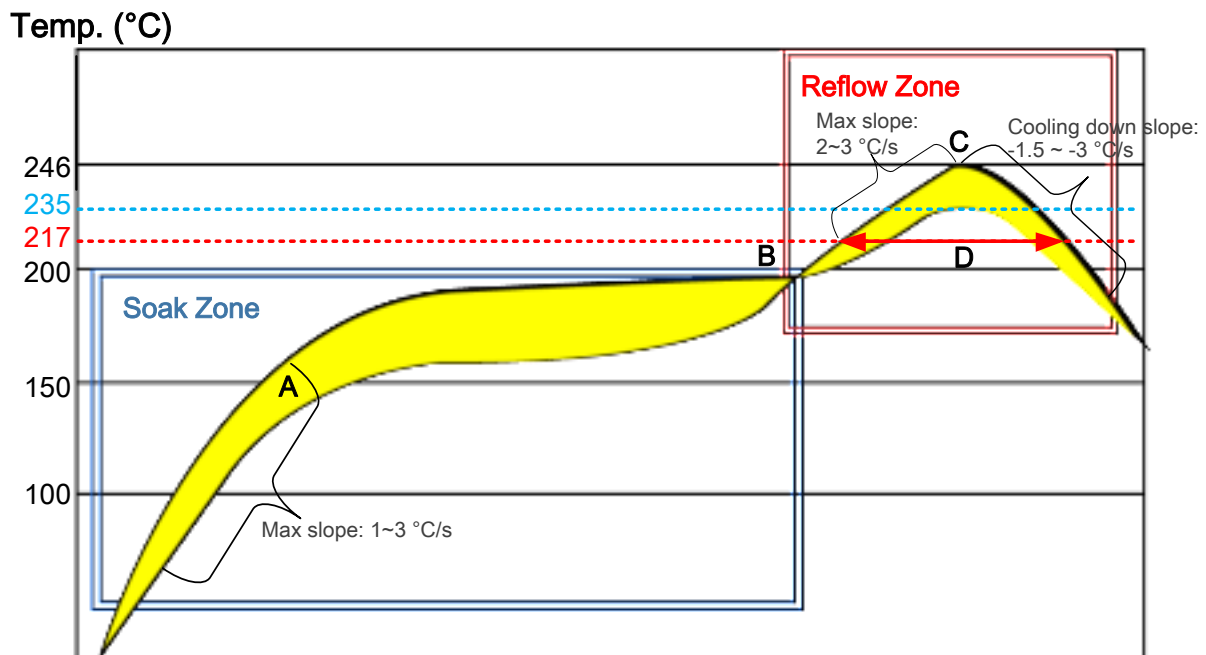
Figure 19: Recommended Reflow Soldering Thermal Profile

Table 19: Recommended Thermal Profile Parameters

Factor	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	2–3 °C/s
Reflow time (D: over 217 °C)	40–70 s
Max temperature	235 °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.

6.3. Packaging Specifications

The module adopts carrier tape packaging and details are as follow:
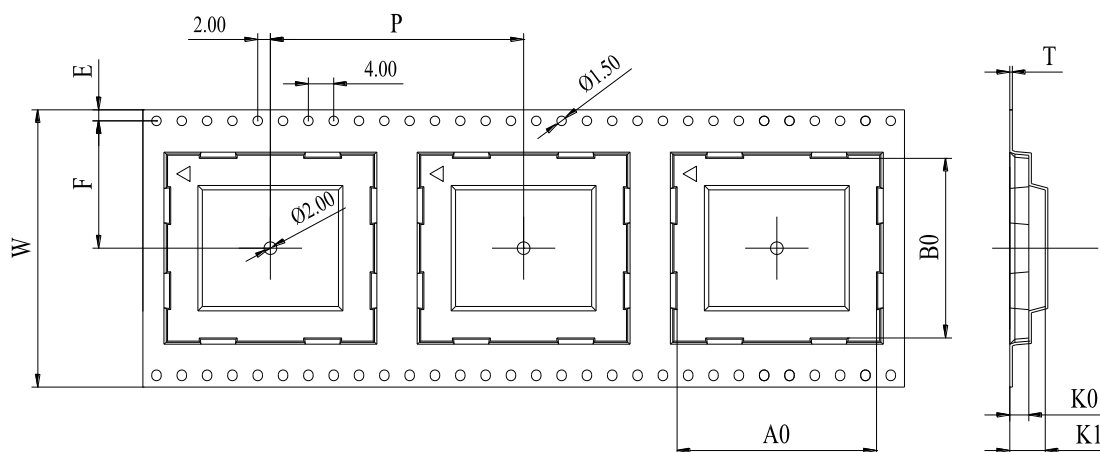
6.3.1. Carrier Tape

Dimension details are as follow:

Figure 20: Carrier Tape Dimension Drawing

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

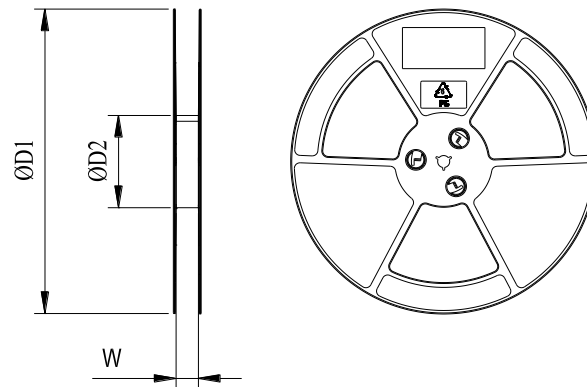| W	P	T	A0	B0	K0	K1	F	E
32	20	0.4	13.4	15.4	2.7	5.4	14.2	1.75

6.3.2. Plastic Reel

Figure 21: **Plastic Reel Dimension Drawing**

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

øD1	øD2	W
330	100	32.5

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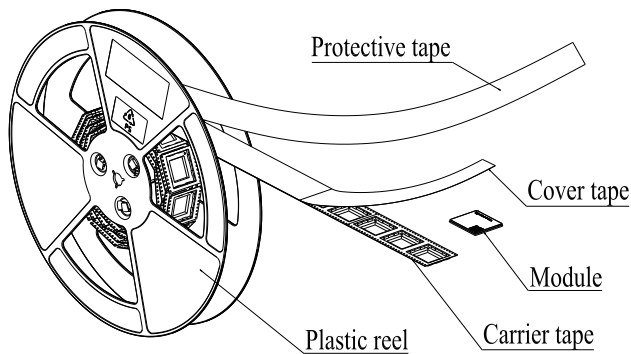
Place the module into the carrier tape and use the cover tape to cover them; then wind the heat-sealed carrier tape to the plastic reel and use the protective tape for protection. One plastic reel can load 500 modules.

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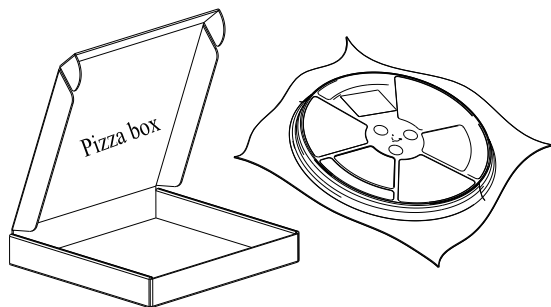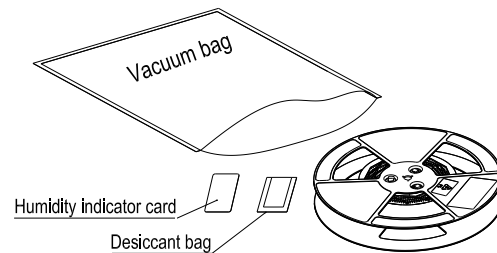
Place the vacuum-packed plastic reel into a pizza box.

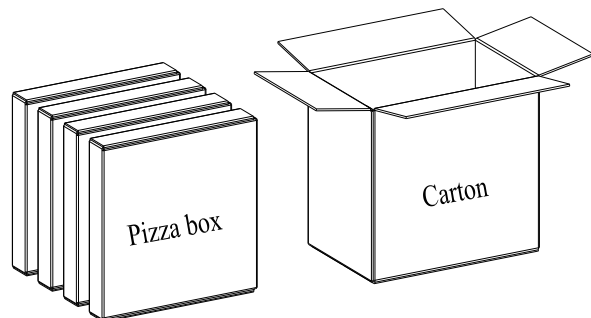Put 4 pizza boxes into 1 carton and seal it. One carton can pack 2000 modules.

Figure 22: **Packaging Process**

7 Appendix References

Table 22: Related Documents

Document Name
[1]   Quectel_UMTS&LTE_EVB_User_Guide
[2]   Quectel_Module_Secondary_SMT_Application_Note

Table 23: Terms and Abbreviations

Abbreviation	Description
BPSK	Binary Phase Shift Keying
BT	Bluetooth
CCK	Complementary Code Keying
CTS	Clear to Send
GND	Ground
HCI	Host Controller Interface
IEEE	Institute of Electrical and Electronics Engineers
I_{IL}	Input Leakage Current
I/O	Input/Output
LNA	Low-Noise Amplifier
LTE	Long Term Evolution
Mbps	Megabits per second
MCS	Modulation and Coding Scheme
PA	Power Amplifier

PCB	Printed Circuit Board
PCM	Pulse Code Modulation
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RoHS	Restriction of Hazardous Substances
RTS	Request to Send
RX	Receive
TBD	To Be Determined
TX	Transmit
UART	Universal Asynchronous Receiver/Transmitter
VHT	Very High Throughput
Wi-Fi	Wireless-Fidelity
WLAN	Wireless Local Area Network