FC909A

Hardware Design

Wi-Fi&Bluetooth Module Series

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

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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 shall 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 given 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 shall 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 emergency 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
-	2022-01-13	Macky XU	Creation of the document
1.0.0	2022-01-13	Macky XU	Preliminary

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1 Introduction

This document defines the FC909A and describes its air interfaces and hardware interfaces which are connected with your application.

This document can help you quickly understand module interface specifications, electrical and mechanical details, as well as other related information of the module. Associated with application notes and user guides, you can use FC909A to design and set up applications easily.

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: XMR202207FC909A”

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 0.52 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-2022FC909A”.

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-2022FC909A ".

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.

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

FC909A 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 802.11b/g/n 2.4 GHz WLAN standards and Bluetooth 5.1 standard which enables seamless integration of WLAN and Bluetooth low energy technologies.

With a SDIO 2.0 interface for WLAN, a UART and a PCM interface for Bluetooth, FC909A can provide WLAN and Bluetooth functions.

2.2. Key Features

The following table describes the key features of FC909A.

Table 2: Key Features

Features	Details
Power Supply	● **VBAT power supply:** Supply voltage range: 3.0–4.8 V Typical voltage supply: 3.6 V ● **VDDIO power supply:** Supply voltage range: 1.71–3.63 V Typical voltage supply: 1.8/3.3 V ● **Module buck's typical voltage:** VIN_LDO_OUT/VIN_LDO: 1.35 V
Operating Frequency	● 2.4 GHz WLAN: 2.412–2.462 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 ±1.5 dBm ● 802.11g/54 Mbps: 15 dBm ±1.5 dBm ● 802.11n/HT20 MCS7: 14 dBm ±1.5 dBm
Wi-Fi Operation Mode	● AP ● STA
Wi-Fi Modulation	DSSS, OFDM, DBPSK, DQPSK, CCK, BPSK, QPSK, 16QAM, 64QAM
WLAN Application Interface	SDIO 2.0
Bluetooth Application Interface	UART and PCM
RF Antenna Interfaces	● ANT_WIFI0/BT ● 50 Ω impedance
Physical Characteristics	● Size: (12.0 ±0.15) mm × (12.0 ±0.15) mm × (1.95 ±0.2) mm ● Package: LCC ● Weight: TBD
Temperature Range	● Operating temperature range: -30 °C to +85 °C [1] ● Storage temperature range: -40 °C to +85 °C
RoHS	All hardware components are fully compliant with EU RoHS directive

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

NOTE

FC909A supports internal crystal or external crystal.

2.3. EVB

To help customers to develop applications with FC909A, the evaluation board tools include EVB board (FC909A-M.2 and corresponding TE-A), USB 2.0 data cable, antenna and other external devices used to control and test the module. For details, see ***document [1]***.

3 Application Interfaces

3.1. General Description

FC909A is equipped with 44 LCC pins. The subsequent chapters will provide a detailed introduction to the following function, pins and interfaces of the module:

- Power supply
- WLAN application interfaces
- Bluetooth application interfaces
- RF antenna interfaces
- Other interfaces
  -WLAN_SLP_CLK
  -XTAL_IN/OUT
  -GPIOs

3.2. Pin Description

The following tables show the pin description of FC909A.

Table 3: I/O Parameters Definition

Type	Description
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	9	PI	Power supply for the module	
VDDIO	22	PI	Power supply for module's I/O pins	
VIN_LDO_OUT	21	PO	Internal buck output for the module	
VIN_LDO	23	PI	Internal buck input for the module	
GND	1, 3, 20, 31, 33, 36			
WLAN Application Interface				
Pin Name	**Pin No.**	**I/O**	**Description**	**Comment**
WLAN_EN	12	DI	WLAN function enable control	VDDIO power domain. Active high.
WLAN_WAKE	13	DO	Wake up the host by WLAN	VDDIO power domain.
SDIO_DATA2 [2]	14	DIO	SDIO data bit 2/NC	VDDIO power domain. Supports 1-bit or 4-bit mode.
SDIO_DATA3	15	DIO	SDIO data bit 3/NC	
SDIO_CMD	16	DIO	SDIO command	
SDIO_CLK	17	DI	SDIO clock	
SDIO_DATA0	18	DIO	SDIO data bit 0	
SDIO_DATA1	19	DIO	SDIO data bit 1/IRQ	
Bluetooth Application Interface				
Pin Name	**Pin No.**	**I/O**	**Description**	**Comment**
BT_EN	34	DI	Bluetooth enable control	VDDIO power domain. Active high. If unused, pull it down.

[2] SDIO_DATA2 is the function configuration pin, please select SDIO mode or SPI mode by configuring this pin. See ***chapter 3.5.4*** for details.

HOST_WAKE_BT	6	DI	Host wakes up Bluetooth	VDDIO power domain. If unused, keep them open.
BT_WAKE_HOST	7	DO	Bluetooth wakes up host	
PCM_DOUT	25	DO	PCM data output	
PCM_CLK	26	DI	PCM clock	
PCM_DIN	27	DI	PCM data input	
PCM_SYNC	28	DI	PCM data frame sync	
BT_RTS	41	DO	Bluetooth UART request to send	
BT_TXD	42	DO	Bluetooth UART transmit	
BT_RXD	43	DI	Bluetooth UART receive	
BT_CTS	44	DI	Bluetooth UART clear to send	
RF Antenna Interfaces				
Pin Name	**Pin No.**	**I/O**	**Description**	**Comment**
ANT_WIFI0/BT	2	AIO	Wi-Fi0/Bluetooth antenna interface	50 Ω impedance.
Other Interfaces				
Pin Name	**Pin No.**	**I/O**	**Description**	**Comment**
WLAN_SLP_CLK	24	DI	External 32.768 kHz low power clock input	
XTAL_IN	10	DI	Crystal input	Optional.
XTAL_OUT	11	DO	Crystal output	
GPIO1 [3]	40	DIO	General-purpose input/output	If unused, keep them open.
GPIO2	39	DIO	General-purpose input/output	
RESERVED				
Pin Name	**Pin No.**			**Comment**
RESERVED	4, 5, 8, 29, 30, 32, 35, 37, 38			Keep them open.

[3] JTAG mode can be configured through GPIO1/GPIO2. If you need, please contact Quectel Technical Supports.

NOTE

le supports external crystal or built-in crystal, so XTAL_IN and XTAL_OUT are optional pins.

3.3. Power Supply

3.3.1. Power Supply Pins

Table 5: Pin Definition of Power Supply and GND Pins

Pin Name	Pin No.	Description	Min.	Typ.	Max.	Unit
VBAT	9	Power supply for the module	3.0	3.6	4.8	V
VDDIO	22	Power supply for module's I/O pins	1.71	1.8/3.3	3.63	V
GND	1, 3, 20, 31, 33, 36	Ground				

FC909A is powered by VBAT. It is recommended to use a power chip with a maximum output current of more than 0.5 A. To ensure better power supply performance, it is recommended to parallel 100 μF decoupling capacitors and 1 μF and 100 nF filter capacitors near the input of the module's VBAT. Meanwhile, it is recommended to add a TVS near the VBAT input terminal to prevent surge voltage. In principle, the longer the VBAT traces, the wider the traces.

When paired with LTE modules, it is recommended to use 10 pF and 33 pF for C2/C4.

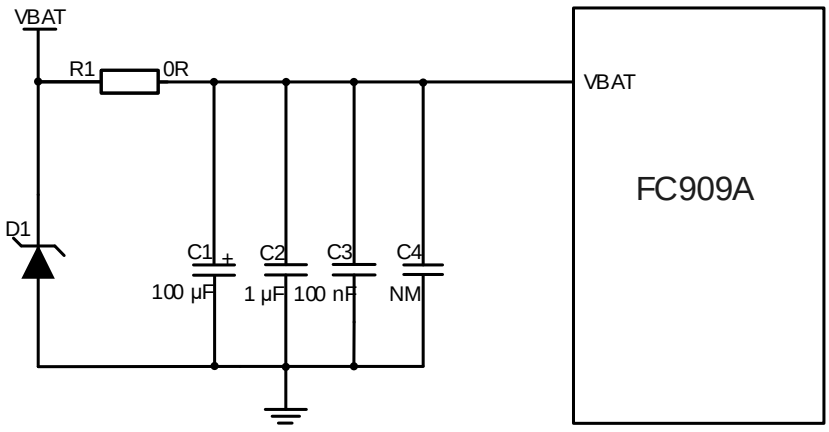


Figure 1: VBAT Circuit Reference Design

The following figure shows the recommended power on/off sequences for the module:

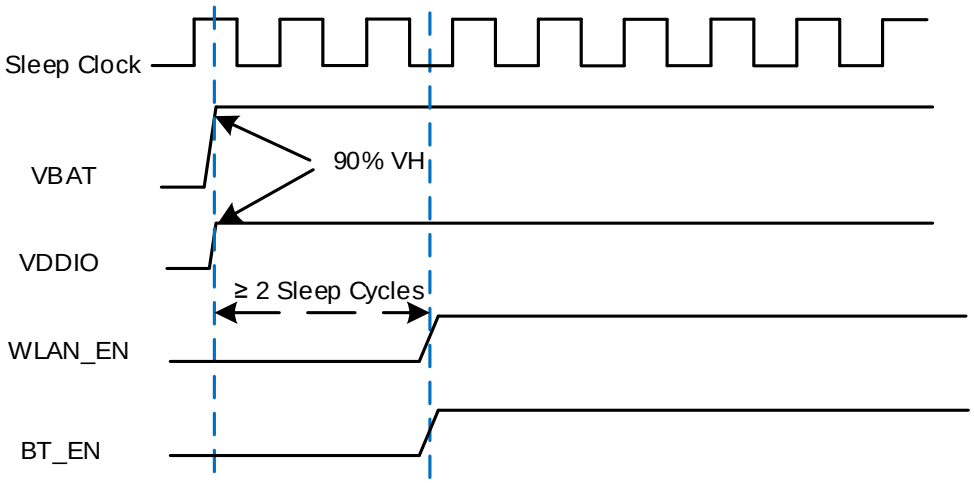


Figure 2: Power On Timing

It is recommended that VBAT shall be powered on no later than VDDIO.

3.3.2. Buck Circuit Pins

Table 6: Definition of Buck Circuit Pins

Pin Name	Pin No.	Description	Min.	Typ.	Max.
VIN_LDO_OUT	21	Internal buck output for the module	-	-	-
VIN_LDO	23	Internal buck input for the module	-	1.35	-
GND	20	Buck circuit dedicated GND pin			

VIN_LDO_OUT/VIN_LDO is the output and input pins of the buck circuit inside the module, and pin 20 is the dedicated GND pin of the buck circuit. Because the buck circuit is prone to high-frequency noise, so please pay attention to it. It is recommended to use 2.2 μH inductors such as TFM201610ALM-2R2MTAA (TDK) and 4.7 μF capacitors to ensure that the traces are as short as possible and the trace width shall not be less than 0.4 mm. At the same time, it is recommended to route the traces away from sensitive signals.

The following is the buck circuit reference circuit and recommended inductance parameter:

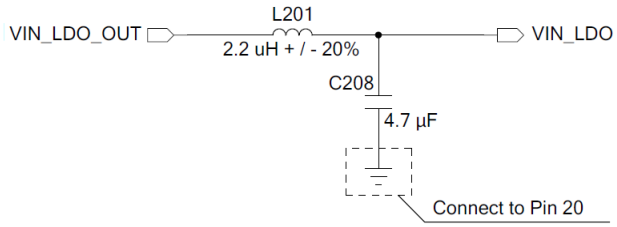


Figure 3: Recommended Reference Design Circuit

Table 7: Recommended Inductance Parameters

Parameter	Recommend	Unit
Inductance	2.2	µH
Tolerance	±20 %	/
DCR	< 0.2	Ω
Rated current (based on temperature rise)	1.15	A

3.4. WLAN Application Interfaces

The following figure shows the WLAN application interfaces connection between FC909A and the host.

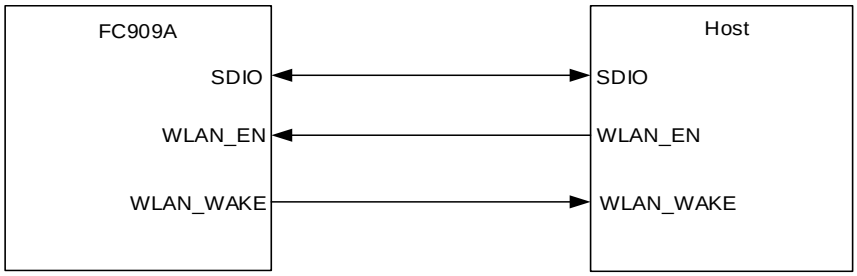


Figure 4: WLAN Application Interfaces Connection

3.4.1. SDIO Interface

FC909A is used for SDIO 2.0 interface, supports 1-bit mode or 4-bit mode (automatic detection when SDIO link). SDIO interface definition is as follows:

Table 8: Pin Definition of SDIO Interface

Pin Name	Pin No.	1-bit Mode	4-bit Mode
SDIO_DATA2	14	NC	SDIO data bit 2
SDIO_DATA3	15	NC	SDIO data bit 3
SDIO_CMD	16	SDIO command	SDIO command
SDIO_CLK	17	SDIO clock	SDIO clock
SDIO_DATA0	18	SDIO data bit 0	SDIO data bit 0
SDIO_DATA1	19	IRQ	SDIO data bit 1

The following figure shows the SDIO interface connection between FC909A and host.

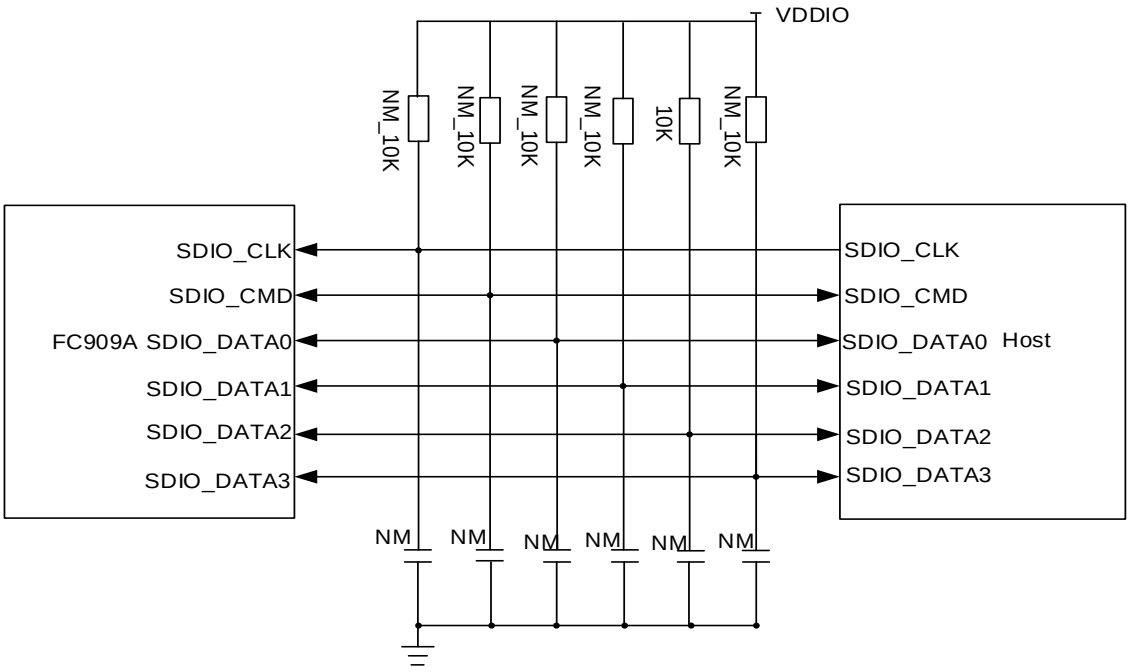


Figure 5: SDIO Interface Connection

To ensure that the interface design complies with the SDIO 2.0 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 kept away from sensitive signals, such as radio frequency, analog signals, clocks, and DC-DC noise signals.
- SDIO_DATA2 requires an external 10 kΩ resistor to be pulled up to VDDIO, and maintains a high level during the process of powering on the FC909A.
- SDIO signal traces need to be treated with equal length (the distance between the traces is less than 1 mm).
- 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.

The maximum length of the internal wiring of the SDIO interface is 5.71 mm.

3.4.2. WLAN_EN

WLAN_EN is used to control the WLAN function of the module. Wi-Fi function will be enabled when WLAN_EN is at high level.

Table 9: Pin Definition of WLAN_EN

Pin Name	Pin No.	I/O	Description	Comment
WLAN_EN	12	DI	Wi-Fi function enable control	VDDIO power domain. Active high.

NOTE

WLAN_EN is the Wi-Fi function enable signal. When wiring, keep it away from sensitive signals such as radio frequency, analog signal, clock, and DC-DC noise signals.

3.4.3. WLAN_WAKE

WLAN_WAKE is used to wake up the host.

Table 10: Pin Definition of WLAN_WAKE

Pin Name	Pin No.	I/O	Description	Comment
WLAN_WAKE	13	DO	Wake up the host by WLAN	VDDIO power domain. If unused, keep it open.

3.4.4. Introduction of WLAN Pin Multiplexing Function

Table 11: Pin Setting Description

SDIO_DATA2	Mode	Note
L	SPI*	Sampling at power-on reset.
H	SDIO	

As shown in the table above, SDIO and SPI* modes can be configured through SDIO_DATA2.

Table 12: Pin Definition of SDIO Interface

Pin Name	Pin No.	SPI Mode	Description
SDIO_DATA2	14	NC	/
SDIO_DATA3	15	CS	Card select
SDIO_CMD	16	DI	Data input
SDIO_CLK	17	SCLK	Clock
SDIO_DATA0	18	DO	Data output
SDIO_DATA1	19	IRQ	Interrupt

3.5. Bluetooth Application Interfaces

The following figure shows the block diagram of Bluetooth application interfaces connection between FC909A and the host.

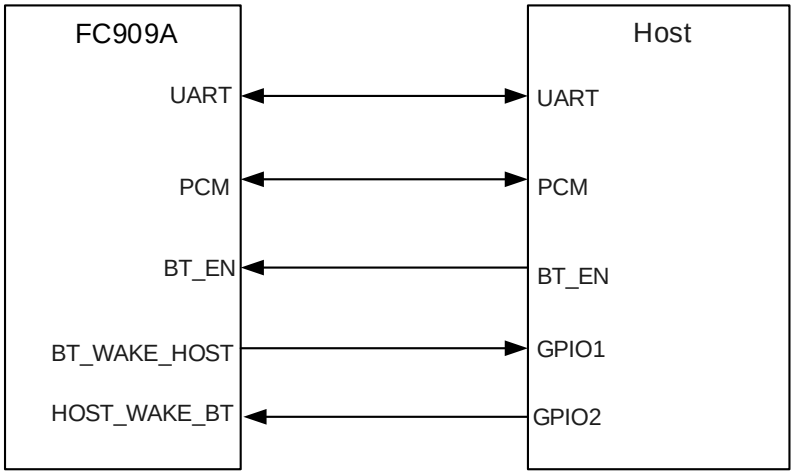


Figure 6: Block Diagram of Bluetooth Application Interfaces Connection

3.5.1. UART

FC909A supports an HCI UART as defined in *Bluetooth Core Specification Version 5.1*. The UART supports hardware flow control, and it is used for data transmission with the host. It supports up to 4.0 Mbps baud rates.

Table 13: Pin Definition of UART

Pin Name	Pin No.	I/O	Description	Comment
BT_RTS	41	DO	Bluetooth UART request to send	VDDIO power domain
BT_TXD	42	DO	Bluetooth UART transmit	
BT_RXD	43	DI	Bluetooth UART receive	
BT_CTS	44	DI	Bluetooth UART clear to send	

The voltage range of the Bluetooth UART of FC909A is determined by VDDIO. It is necessary to pay attention to whether the voltage range of the host and FC909A Bluetooth UART is consistent. If necessary, voltage-level translator shall be adopted.

The following figure shows a reference design for UART connection between FC909A and the host.

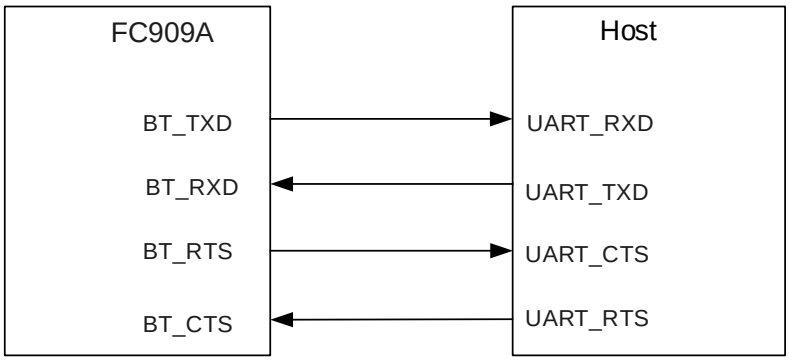


Figure 7: Reference Design for UART Connection

NOTE

When paired with Quectel's LTE modules, it may be their own CTS connected to CTS and RTS connected to RTS. This depends on the input and output directions, so in principle, when connected, the input shall corresponds to the output.

3.5.2. BT_EN

BT_EN is used to control the Bluetooth function of FC909A. Bluetooth function will be enabled when BT_EN is at high level.

Table 14: Pin Definition of BT_EN

Pin Name	Pin No.	I/O	Description	Comment
BT_EN	34	DI	Bluetooth enable control	Active high. If unused, please pull it down. VDDIO power domain.

3.5.3. BT_WAKE_HOST and HOST_WAKE_BT

BT_WAKE_HOST and HOST_WAKE_BT are used to wake up Bluetooth function.

Table 15: Pin Definition of BT_WAKEUP_HOST and HOST_WAKEUP_BT

Pin Name	Pin No.	I/O	Description	Comment
HOST_WAKE_BT	6	DI	Host wakes up Bluetooth function	VDDIO power domain.
BT_WAKE_HOST	7	DO	Bluetooth function wakes up host	

3.5.4. PCM Interface

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

Table 16: Pin Definition of PCM Interface

Pin Name	Pin No.	I/O	Description	Comment
PCM_DOUT	25	DO	PCM data output	VDDIO power domain.
PCM_CLK	26	DI	PCM clock	
PCM_DIN	27	DI	PCM data input	
PCM_SYNC	28	DI	PCM data frame sync	

The following figure shows the PCM interface connection between FC909A and the host.

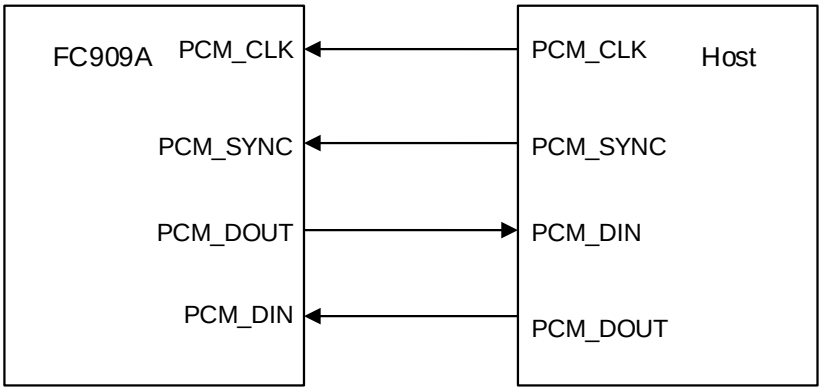


Figure 8: PCM Interface Connection

3.6. Other Interfaces

3.6.1. WLAN_SLP_CLK

The 32.768 kHz sleep clock is used in low power modes, such as IEEE power saving mode and sleep mode. It serves as a timer to determine when to wake up the FC909A to receive signals in various power saving schemes, and to maintain basic logic operations when the module is in sleep mode.

Table 17: Pin Definition of WLAN_SLP_CLK

Pin Name	Pin No.	I/O	Description
WLAN_SLP_CLK	24	DI	External 32.768 kHz low power clock input.

Table 18: Recommended WLAN_SLP_CLK Parameter

Parameter	Value	Unit
Frequency	32.768	kHz
Frequency accuracy	±200	ppm
Duty cycle	30–70	%
Input signal amplitude	200–3300	mV, p-p
Signal type	Square wave or sine wave	-
Input impedance	> 100	kΩ
Crystal load capacitance	< 5	pF
Clock jitter	< 10000	ppm

3.6.2. XTAL_IN/OUT

The XTAL_IN and XTAL_OUT are external crystal pins, and the recommended crystal frequency is 26 MHz. These pins are optional, and the crystal position has been reserved inside the module. The following table is the recommended crystal parameters. It is recommended that customers select the crystal according to the following table and based on their actual needs:

Table 19: XTAL_IN/OUT Parameter Definition

Parameter	Min	Typ.	Max	Unit
Frequency	-	26	-	MHz
load capacitance	-	12	-	pF
ESR	-	60	-	Ω
Drive level	200	-	-	μW
Frequency tolerance Initial + over temperature	-20	-	20	ppm

3.6.3. GPIOs

GPIO1/GPIO2 are function configuration pins, which can be used to enter JTAG mode. If you need, please contact Quectel Technical Supports.

Table 20: Pin Definition of GPIOs

Pin Name	Pin No.	I/O	Description	Comment
GPIO1	40	DIO	General-purpose input/output	VDDIO power domain.
GPIO2	39	DIO	General-purpose input/output	

4 RF Antenna Interfaces

4.1. RF Antenna

Pin 2 is the RF antenna pin, And the RF port has an impedance of 50 Ω.

4.1.1. Antenna Interface & Frequency Bands

The pin definition is shown below:

Table 21: Pin Definition of RF Antenna Interfaces

Pin Name	Pin No.	I/O	Description	Comment
ANT_WIFI0/BT	2	AIO	Wi-Fi0/Bluetooth antenna interface	50 Ω impedance.

Table 22: FC909A Operating Frequency

Feature	Frequency	Unit
2.4 GHz Wi-Fi	2.412–2.462	GHz
Bluetooth	2.402–2.480	GHz

4.1.2. Reference Design

FC909A 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 shall be microstrip line or other types of RF trace, with characteristic impendence close to 50 Ω. FC909A comes with grounding pins which are next to the antenna pin in order to give a better grounding.

A reference circuit for the RF antenna interface is shown below. It is recommended to reserve a LC and Π-type matching circuit for better RF performance, and it is also recommended to reserve an ESD protection component. Matching components such as C1, R1, C2, L1, C3 and the protection component

D1 shall be placed as close to the antenna as possible. The NM in the figure below is not attached by default.

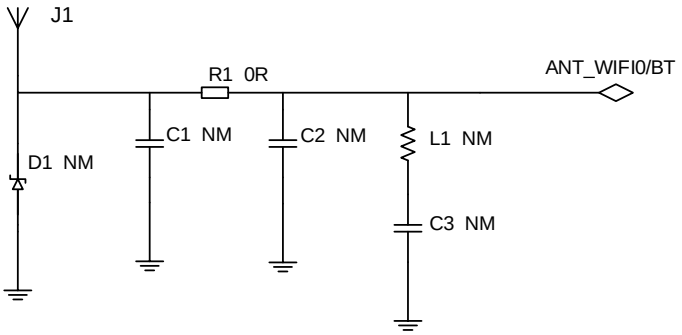


Figure 9: Reference Circuit for RF Antenna Interface

4.2. Reference Design of RF Routing

For user's PCB, the characteristic impedance of all RF traces shall 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.

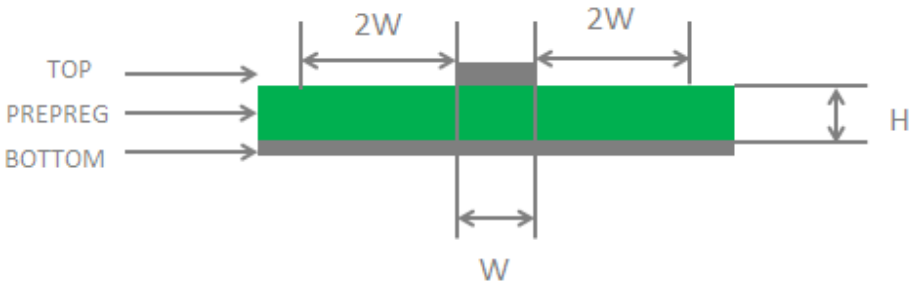


Figure 10: Microstrip Design on a 2-layer PCB

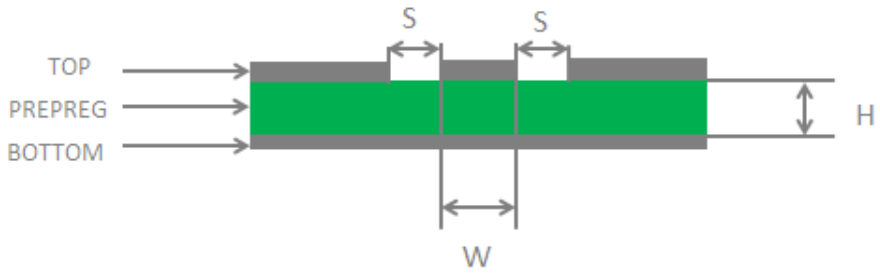


Figure 11: Coplanar Waveguide Design on a 2-layer PCB

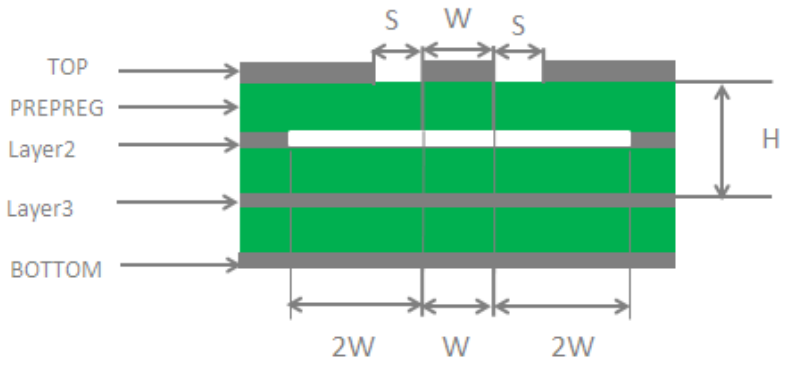


Figure 12: Coplanar Waveguide Design on a 4-layer PCB (Layer 3 as Reference Ground)

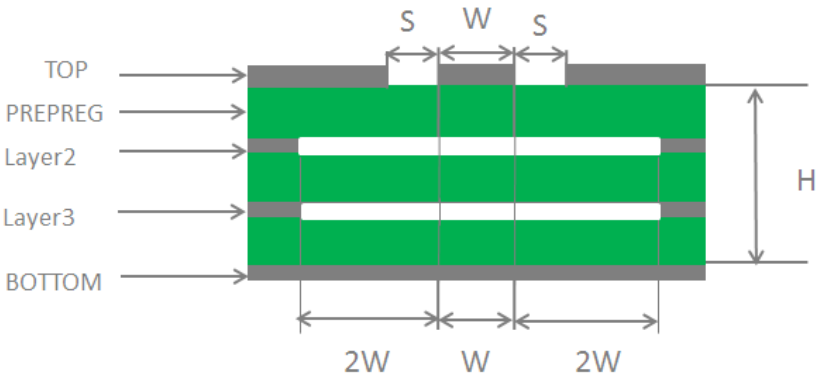


Figure 13: Coplanar Waveguide Design on a 4-layer PCB (Layer 4 as Reference Ground)

To ensure RF performance and reliability, the following principles shall be complied with 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.
- 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, ground vias around RF traces and the reference ground improves RF performance. The distance between the ground vias and RF traces should be more 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]***.

4.3. Requirements for Antenna Design

The following table shows the requirements on RF antenna.

Table 23: Antenna Cable Requirements

Type	Requirements
2.412–2.484 GHz	Cable insertion loss < 1 dB

Table 24: Antenna requirements

Type	Requirements
Frequency Range	2.412–2.484 GHz
VSWR	< 2
Gain (dBi)	Typ. 1
Max Input Power (W)	50
Input Impedance (Ω)	50
Polarization Type	Vertical

4.4. RF Connector Recommendation

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

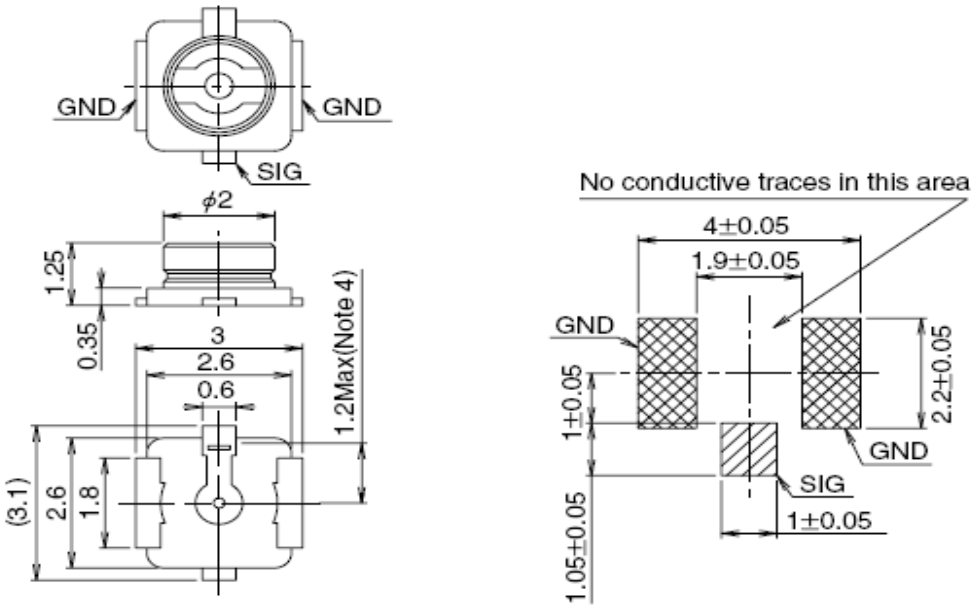


Figure 14: Dimensions of the U.FL-R-SMT Connector (Unit: mm)

U.FL-LP serial connectors listed in the following figure can be used to match the U.FL-R-SMT.

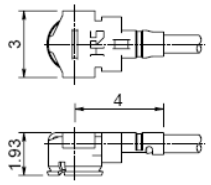
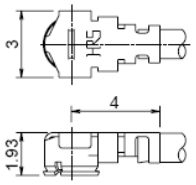
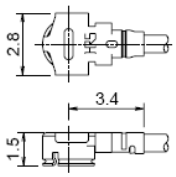
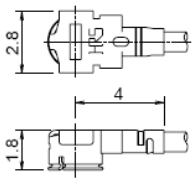
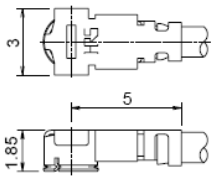
Part No.	U.FL-LP-040	U.FL-LP-066	U.FL-LP(V)-040	U.FL-LP-062	U.FL-LP-088
					
Mated Height	2.5mm Max. (2.4mm Nom.)	2.5mm Max. (2.4mm Nom.)	2.0mm Max. (1.9mm Nom.)	2.4mm Max. (2.3mm Nom.)	2.4mm Max. (2.3mm Nom.)
Applicable cable	Dia. 0.81mm Coaxial cable	Dia. 1.13mm and Dia. 1.32mm Coaxial cable	Dia. 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 15: Mechanicals of U.FL-LP Connectors

The following figure describes the space factor of mated connector.

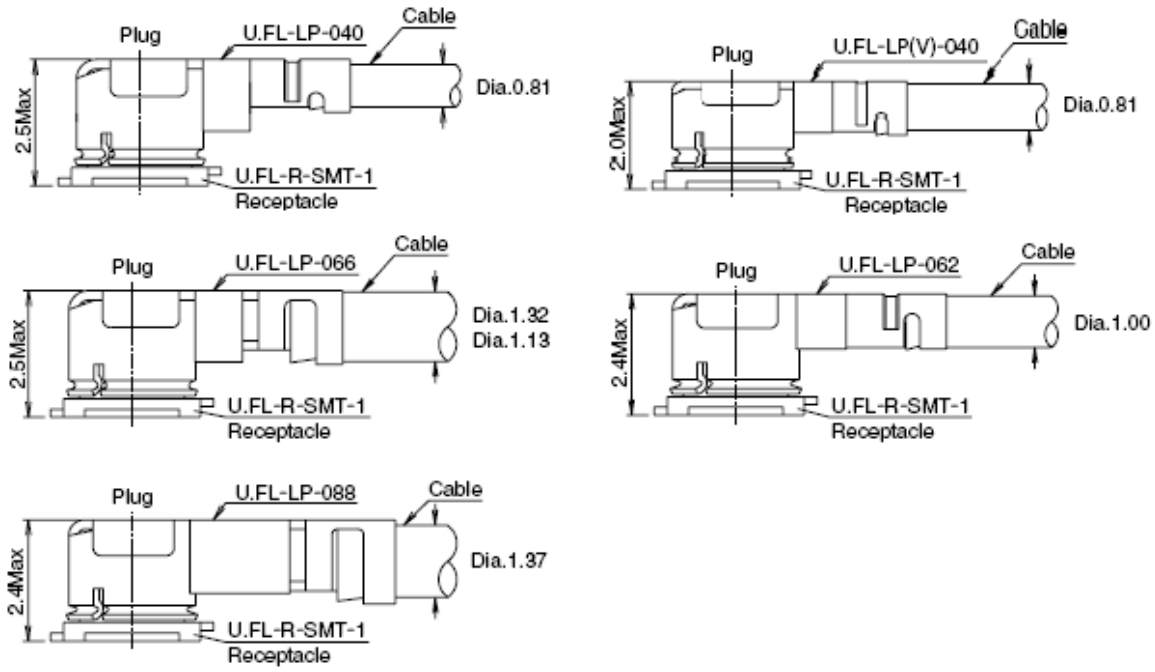


Figure 16: Space Factor of Mated Connector (Unit: mm)

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

5 Electrical Characteristics & Reliability

5.1. Electrical Characteristics

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

Table 25: Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
VBAT	-0.3	5.5	V
Digital I/O Input Voltage	-0.3	3.9	V

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

Table 26: Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Unit
VBAT	3.0	3.6	4.8	V
VDDIO	1.71	1.8/3.3	3.63	V

5.2. I/O Interface Characteristics

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

Table 27: General DC Electrical Characteristics for 1.8 V Domain

Symbol	Parameter	Min.	Max.	Unit
V_{IH}	High-level Input Voltage	0.65 × VDDIO	-	V
V_{IL}	Low-level Input Voltage	-	0.35 × VDDIO	V
V_{OH}	High-level Output Voltage	VDDIO - 0.45	-	V
V_{OL}	Low-level Output Voltage	-	0.45	V

Table 28: General DC Electrical Characteristics for 3.3 V Domain

Symbol	Parameter	Min.	Max.	Unit
V_{IH}	High-level Input Voltage	2	-	V
V_{IL}	Low-level Input Voltage	-	0.8	V
V_{OH}	High-level Output Voltage	VDDIO - 0.4	-	V
V_{OL}	Low-level Output Voltage	-	0.4	V

5.3. Power Consumption

Table 29: Current Consumption of the Module (Normal Operation)

Description	Conditions	VBAT (3.3 V)	VDDIO (1.8 V)	Unit
802.11b	TX 1 Mbps @ 16 dBm	300	0.6	mA
	TX 11 Mbps @ 16 dBm	280	0.6	mA
802.11g	TX 6 Mbps @ 15 dBm	270	0.6	mA

	TX 54 Mbps @15 dBm	200	0.6	mA
802.11n (HT20)	TX MCS0 @ 14 dBm	260	0.6	mA
	TX MCS7 @ 14 dBm	190	0.6	mA

5.4. RF Performance

The following tables summarize the transmitting and receiving performances of FC909A.

5.4.1. Wi-Fi Performance

Table 30: Conducted RF Output Power at 2.4 GHz Wi-Fi

Description	Min.	Typ.	Unit
802.11b @ 1 Mbps	15.8	16	dBm
802.11b @ 11 Mbps	15.9	16	dBm
802.11g @ 6 Mbps	15.3	15	dBm
802.11g @ 54 Mbps	15.2	15	dBm
802.11n, HT20 @ MCS0	14.4	14	dBm
802.11n, HT20 @ MCS7	14.2	14	dBm

Table 31: Conducted RF Receiving Sensitivity at 2.4 GHz Wi-Fi

Description	Receiving Sensitivity (Typ.)	Unit
802.11b @ 1 Mbps	-94	dBm
802.11b @ 11 Mbps	-87	dBm
802.11g @ 6 Mbps	-89	dBm
802.11g @ 54 Mbps	-74	dBm
802.11n, HT20 @ MCS0	-89	dBm

802.11n, HT20 @ MCS7	-71	dBm

5.4.2. BLE Performance

Table 32: BLE Transmitting and Receiving Performance

Description	Transmitting Power (Typ.)	Receiving Sensitivity (Typ.)	Unit
BR	9	-88	dBm
EDR (π/4-DQPSK)	8	-90	dBm
EDR (8DPSK)	8	-84	dBm
BLE	8	-90	dBm

5.5. ESD Protection

The module is not protected against electrostatics discharge (ESD) in general. Consequently, it is subject to ESD handling precautions that typically apply to ESD sensitive components. Proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates the module, for example, ESD protection should be added at the interface of circuit design and the points that are vulnerable to electrostatic discharge damage or influence; anti-static gloves should be worn during production, etc.

ESD characteristics of the module's pins are as follows:

Table 33: Electrostatic Discharge Characteristics (25 ºC, 45 % Relative Humidity)

Tested Interfaces	Contact Discharge	Air Discharge	Unit
VBAT/GND	TBD	TBD	kV
ANT_WIFI0/BT	TBD	TBD	kV
Other Interfaces	TBD	TBD	kV

6 Mechanical Information

This chapter describes the mechanical dimensions of FC905A. All dimensions are measured in millimeter (mm), and the dimensional tolerances are ±0.2 mm unless otherwise specified.

6.1. Mechanical Dimensions

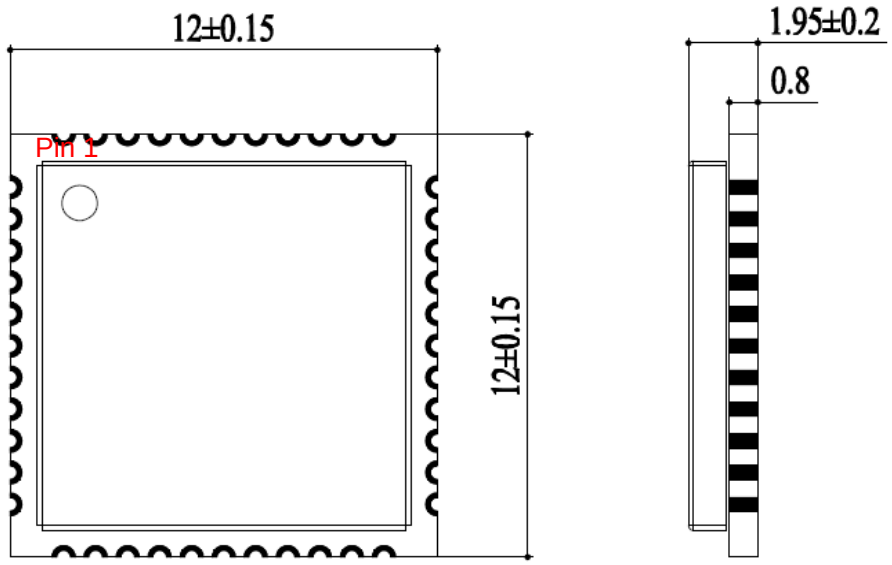


Figure 17: Top and Side Dimensions

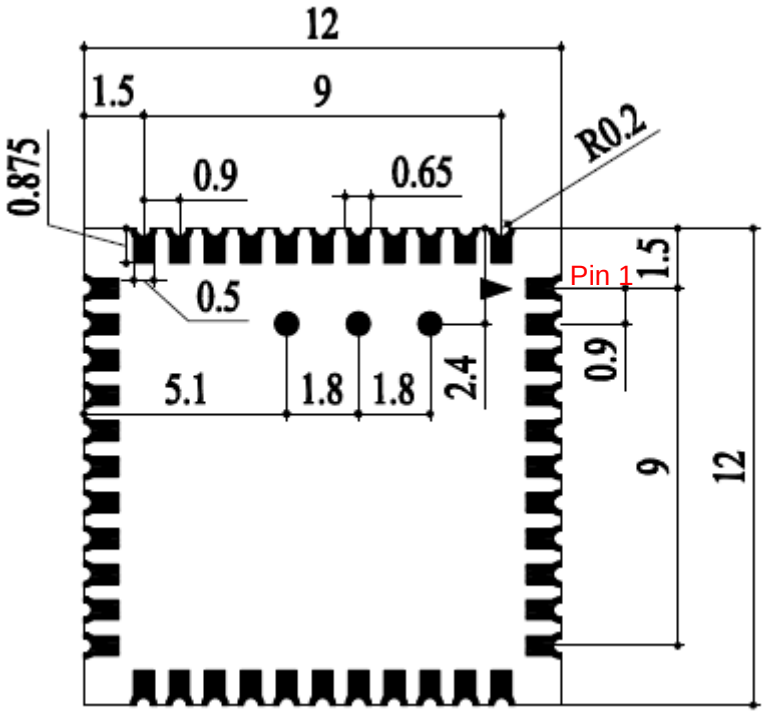


Figure 18: Bottom Dimension

NOTE

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

6.2. Recommended Footprint

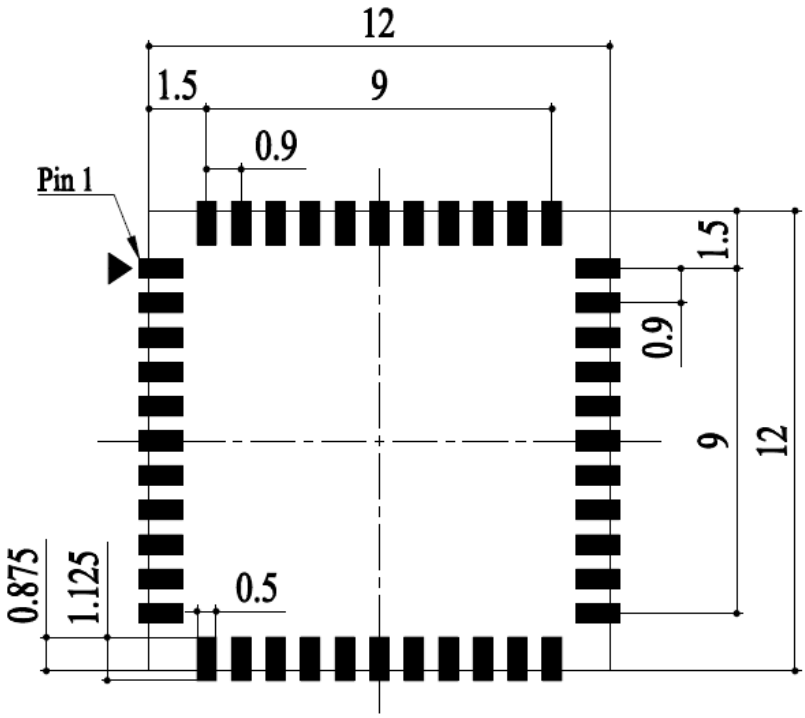


Figure 19: Recommended Footprint (Top View)

NOTE

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

6.3. Top and Bottom Views

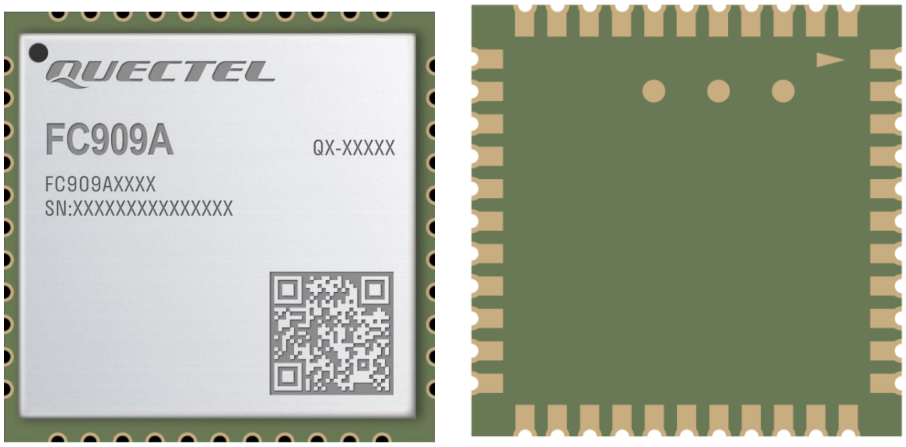


Figure 20: Top and Bottom Views of FC909A

NOTE

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

7 Storage, Manufacturing & Packaging

7.1. 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 shall be 23 ±5 °C and the relative humidity shall 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 [4] 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 24 hours. Otherwise, the module shall be stored in an environment where the relative humidity is less than 10 % (e.g. a drying cabinet).

4. The module shall 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 shall follow the requirements below:

   - The module shall be baked for 8 hours at 120 ±5 °C;
   - All modules must be soldered to PCB within 24 hours after the baking, otherwise they shall be put in a dry environment such as in a drying oven.

[4] This floor life is only applicable when the environment conforms to *IPC/JEDEC J-STD-033*. It is recommended to start the solder reflow process within 24 hours after the package is removed if the temperature and moisture do not conform to, or are not sure to conform to *IPC/JEDEC J-STD-033*. 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. 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.

7.2. 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. The force on the squeegee shall be adjusted properly to produce a clean stencil surface on a single pass. To ensure the module soldering quality, the thickness of stencil for the module is recommended to be 0.15–0.18mm. For more details, see ***document [3]***.

The peak reflow temperature shall be 235–246 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 shall 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.

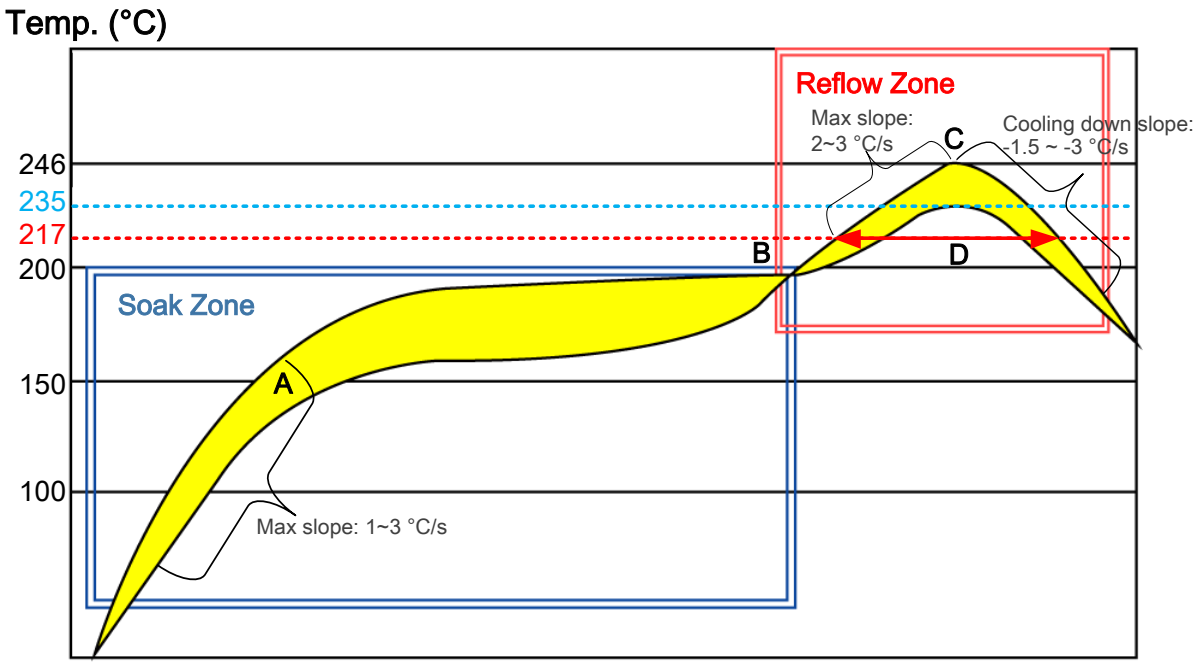


Figure 21: Recommended Reflow Soldering Thermal Profile

Table 34: 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	235–246 °C
Cooling down slope	-1.5– -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 Supports 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]***.

7.3. Packaging Specifications

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

7.3.1. Carrier Tape

Dimension details are as follow:

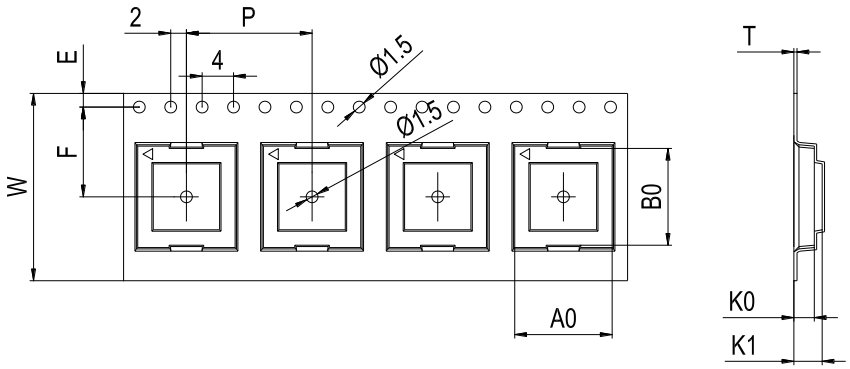


Figure 22: Carrier Tape Dimension Drawing

Table 35: Carrier Tape Dimension Table (Unit: mm)

W	P	T	A0	B0	K0	K1	F	E
24	16	0.35	12.4	12.4	2.6	3.6	11.5	1.75

7.3.2. Plastic Reel

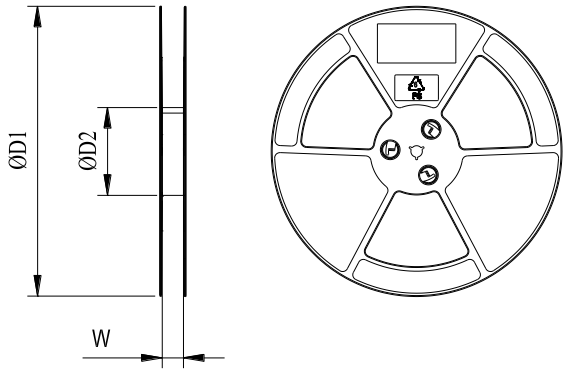
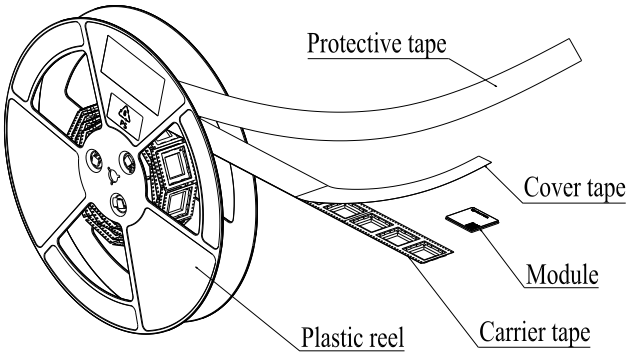


Figure 23: Plastic Reel Dimension Drawing

Table 36: Plastic Reel Dimension Table (Unit: mm)

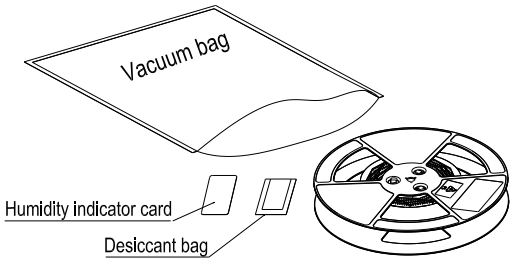
øD1	øD2	W
330	100	24.5

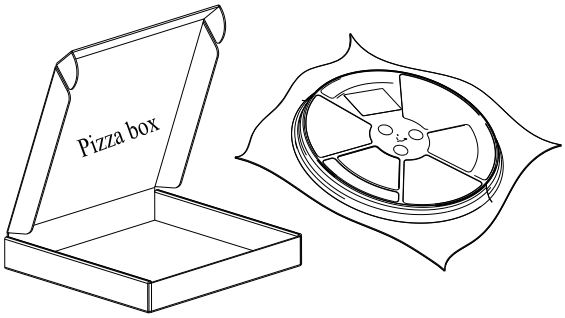
7.3.3. Packaging Process



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, humidity indicator card and 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 and seal it. 1 carton can pack 2000 modules.

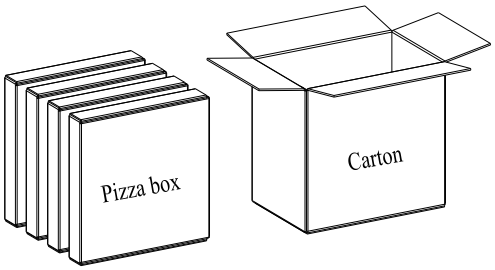


Figure 24: **Packaging Process**

8 Appendix References

Table 37: Related Documents

SN	Document Name
[1]	Quectel_UMTS&LTE_EVB_User_Guide
[2]	Quectel_RF_Layout_Application_Note
[3]	Quectel_Module_Secondary_SMT_Application_Note

Table 38: Terms and Abbreviations

Abbreviation	Description
AP	Access Point
BLE	Bluetooth Low Energy
BPSK	Binary Phase Shift Keying
BT	Bluetooth
CCK	Complementary Code Keying
CTS	Clear To Send
DQPSK	Differential Quadrature Reference Phase Shift Keying
GATT	Generic Attribute Profile
GND	Ground
HT	High Throughput
IEEE	Institute of Electrical and Electronics Engineers
I/O	Input/Output

Mbps	Million Bits Per Second
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RoHS	Restriction of Hazardous Substances
STA	Spike-triggered average
RTS	Request to Send
RXD	Receive Data
TBD	To Be Determined
TXD	Transmit Data
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial Bus
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
VSWR	Voltage Standing Wave Ratio