FC20 Series

Hardware Design

Wi-Fi&BT Module Series

Rev. FC20_Series_Hardware_Design_V1.0

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About the Document

History

Revision	Date	Author	Description
1.0	2016-11-02	Power JIN	Initial

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1 Introduction

This document defines the FC20 series module and describes its hardware interface which is connected with the customer's application as well as its air interface.

The document can help customers quickly understand module interface specifications, as well as the electrical and mechanical details. Associated with application note and user guide, customers can use FC20 series module to design and set up mobile applications easily.

FC20 series module contains two variants: FC20 and FC20-N. Customers can choose the dedicated type basing on their requirements. The following table shows the entire models of FC20 series.

Table 1: FC20 Series Products

Module	Wi-Fi	BT
FC20	2.4GHz and 5GHz	4.1
FC20-N	2.4GHz	Not Supported

1.1. Safety Information

The following safety precautions must be observed during all phases of the operation, such as usage, service or repair of any cellular terminal or mobile incorporating FC20 series module. Manufacturers of the cellular terminal should send the following safety information to users and operating personnel, and incorporate these guidelines into all manuals supplied with the product. If not so, Quectel assumes no liability for the customer's 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. You must comply with laws and regulations restricting the use of wireless devices while driving.

	Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it is switched off. The operation of wireless appliances in an aircraft is forbidden, so as to prevent interference with communication systems. Consult the airline staff about the use of wireless devices on boarding the aircraft, if your device offers an Airplane Mode which must be enabled prior to boarding an aircraft.
	Switch off your wireless device when in hospitals, clinics or other health care facilities. These requests are desinged to prevent possible interference with sensitive medical equipment.
	Cellular terminals or mobiles operating over radio frequency signal and cellular network cannot be guaranteed to connect in all conditions, for example no mobile fee or with an invalid SIM card. While you are in this condition and need emergent help, please remember using emergency call. In order to make or receive a call, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength.
	Your cellular terminal or mobile contains a transmitter and receiver. When it is ON, it receives and transmits radio frequency energy. RF interference can occur if it is used close to TV set, radio, computer or other electric equipment.
	In locations with potentially explosive atmospheres, obey all posted signs to turn off wireless devices such as your phone or other cellular terminals. Areas with potentially explosive atmospheres include fuelling areas, below decks on boats, fuel or chemical transfer or storage facilities, areas where the air contains chemicals or particles such as grain, dust or metal powders, etc.

2 Product Concept

2.1. General Description

FC20 series module is a low-power and low-cost wireless module based on QCA9377-3.

FC20 module supports 1×1 IEEE 802.11 a/b/g/n/ac WLAN standards and BT 4.1, enabling seamless integration of WLAN/BT and low-energy technology. FC20 supports a low-power SDIO 3.0 interface for WLAN and a UART/PCM interface for BT, and also supports LTE-WLAN coexistence and LTE-BT coexistence. The BT function of FC20 is under development.

FC20-N module only supports 1×1 IEEE 802.11 b/g/n WLAN standards.

2.2. Key Features

The following table describes the detailed features of FC20 series module.

Table 2: Key Features

Features	Implementation
Power Supply	Main supply voltage: 3.3V IO supply voltage: 1.8V
Transmission Data	FC20: 802.11b: 1, 2, 5.5, 11Mbps 802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps 802.11n: 6.5, 13, 19.5, 26, 39, 52, 58.5, 65Mbps 802.11a: 6, 9, 12, 18, 24, 36, 48, 54Mbps 802.11ac: VHT20 (MCS0-8), VHT40 (MCS0-9), VHT80 (MCS0-9)
	FC20-N: 802.11b: 1, 2, 5.5, 11Mbps 802.11g: 6, 9, 12, 18, 24, 36, 48, 54Mbps 802.11n: 6.5, 13, 19.5, 26, 39, 52, 58.5, 65Mbps
Transmitting Power	FC20: 802.11b/11Mbps: 17dBm 802.11g/54Mbps: 15dBm 802.11n/HT20 MCS7: 14dBm

	802.11a/54Mbps: 13dBm 802.11ac/VHT20 MCS0: 13.5dBm
	FC20-N: 802.11b/11Mbps: 17dBm 802.11g/54Mbps: 15dBm 802.11n/HT20 MCS7: 14dBm
Protocol Features	FC20: IEEE 802.11a/b/g/n/ac
	FC20-N: IEEE 802.11b/g/n
Operator Mode	AP
	STA*
Modulation	FC20: BPSK, QPSK, CCK, 16QAM, 64QAM, 256QAM
	FC20-N: BPSK, QPSK, CCK, 16QAM, 64QAM
WLAN Interface	SDIO 3.0
BT Interface	FC20: UART and PCM
Antenna Interface	Wi-Fi & BT antenna, 50Ω
Physical Characteristics	Size: 16.6±0.15 × 13±0.15 × 2.1±0.2mm Interface: LCC+LGA Weight: about 0.81g
Temperature Range	Operating temperature range: -35°C~+75°C [1)] Extended temperature range : -40°C~+85°C [2)]
RoHS	All hardware components are fully compliant with EU RoHS directive

NOTES

1. [1)] Within operation temperature range, the module is IEEE compliant.
2. [2)] Within extended temperature range, the module remains the ability for data transmission. There is no unrecoverable malfunction. There are also no effects on radio spectrum and no harm to radio network. Only one or more parameters like P_{out} might reduce in their value and exceed the specified tolerances. When the temperature returns to the normal operating temperature levels, the module will meet IEEE compliant again.

2.3. Functional Diagram

The following figure shows a block diagram of FC20 series module and illustrates the major functional parts.

- Power supply
- SDIO
- PCM and UART
- RF antenna

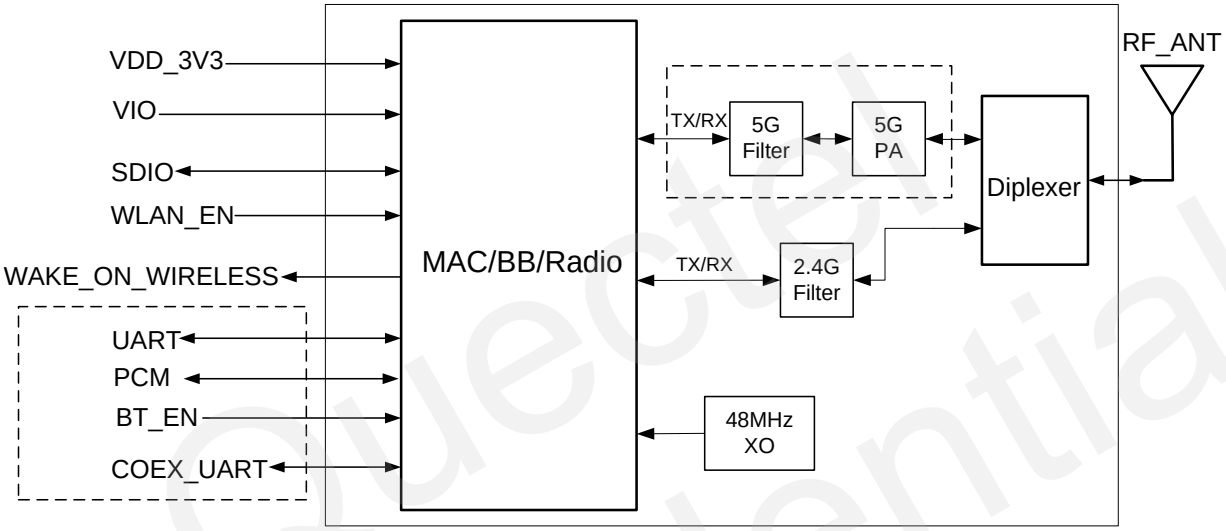


Figure 1: Functional Diagram of FC20 Series Module

NOTE

The functions in dotted line are only supported by FC20. Please keep these pins open in FC20-N.

2.4. Evaluation Board

In order to help customers to develop applications with FC20 series module, Quectel supplies an evaluation board (EVB), a RS-232 to USB cable, a USB data cable, a power adapter, 4 antennas and other peripherals to control or test the module. For details, please refer to ***document [1]***.

3 Application Interfaces

3.1. General Description

FC20 series module is equipped with 38 LCC pads and 14 LGA pads that can be connected to the cellular application platform. Sub-interfaces included in these pads are described in details in following chapters:

- Power supply
- WLAN interface
- BT interface
- Coexistence interface
- Antenna interface

3.2. Pin Assignment

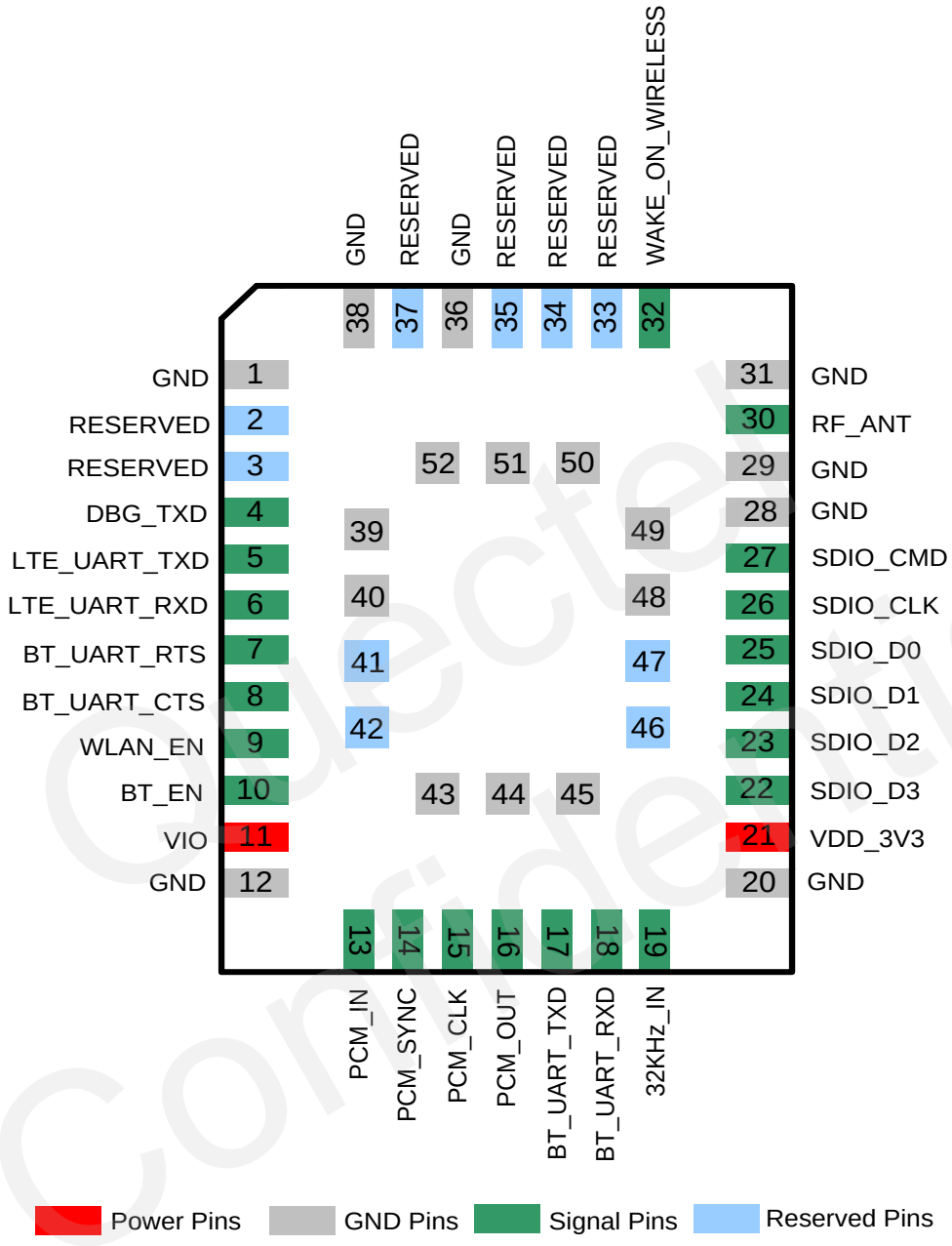


Figure 2: Pin Assignment of FC20 Series Module

NOTE

Please keep all RESERVED pins open.

3.3. Pin Description

The following tables show the pin definition of FC20 series.

Table 3: I/O Parameters Definition

Type	Description
IO	Bidirectional input/output
DI	Digital input
DO	Digital output
PI	Power input

Table 4: Pin Description

Power Supply					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
VDD_3V3	21	PI	Main power supply for module	Vmax=3.46V Vmin=3.14V Vnorm=3.3V	It must be able to provide sufficient current up to 0.9A.
VIO	11	PI	Power supply for module IO pin	Vmax=1.89V Vmin=1.71V Vnorm=1.8V	It is powered by EC20 R2.0/EC21/EC25 module.
GND	1, 12, 20, 28, 29, 31, 36, 38~40, 43~45, 48~52		Ground		
WLAN Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
WAKE_ON_WIRELESS	32	DO	Wake up host	V_{OL}max=0.18V V_{OH}min=1.62V	1.8V power domain. Active low. If unused, keep this pin open.
WLAN_EN	9	DI	WLAN enabled	V_{IL}min=-0.3V V_{IL}max=0.54V	1.8V power domain. Active high.

				V_{IH}min=1.26V V_{IH}max=2.0V	
SDIO_D3	22	IO	SDIO data pin bit 3	V_{OL}max=0.18V V_{OH}min=1.62V V_{IL}min=-0.3V V_{IL}max=0.54V V_{IH}min=1.26V V_{IH}max=2.0V	1.8V power domain
SDIO_D2	23	IO	SDIO data pin bit 2	V_{OL}max=0.18V V_{OH}min=1.62V V_{IL}min=-0.3V V_{IL}max=0.54V V_{IH}min=1.26V V_{IH}max=2.0V	1.8V power domain. Require external pull-up to 1.8V.
SDIO_D1	24	IO	SDIO data pin bit 1	V_{OL}max=0.18V V_{OH}min=1.62V V_{IL}min=-0.3V V_{IL}max=0.54V V_{IH}min=1.26V V_{IH}max=2.0V	1.8V power domain
SDIO_D0	25	IO	SDIO data pin bit 0	V_{OL}max=0.18V V_{OH}min=1.62V V_{IL}min=-0.3V V_{IL}max=0.54V V_{IH}min=1.26V V_{IH}max=2.0V	1.8V power domain
SDIO_CLK	26	DI	SDIO clock	V_{IL}min=-0.3V V_{IL}max=0.54V V_{IH}min=1.26V V_{IH}max=2.0V	1.8V power domain
SDIO_CMD	27	IO	SDIO command	V_{OL}max=0.18V V_{OH}min=1.62V V_{IL}min=-0.3V V_{IL}max=0.54V V_{IH}min=1.26V V_{IH}max=2.0V	1.8V power domain
BT Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
BT_EN	10	DI	Bluetooth enabled	V_{IL}min=-0.3V V_{IL}max=0.54V V_{IH}min=1.26V V_{IH}max=2.0V	1.8V power domain. Active high.

PCM_IN	13	DI	Bluetooth PCM data input	V_{IL}min=-0.3V V_{IL}max=0.54V V_{IH}min=1.26V V_{IH}max=2.0V	1.8V power domain. If unused, keep this pin open.
PCM_SYNC	14	DI	Bluetooth PCM data frame sync signal	V_{IL}min=-0.3V V_{IL}max=0.54V V_{IH}min=1.26V V_{IH}max=2.0V	1.8V power domain. If unused, keep this pin open.
PCM_CLK	15	DI	Bluetooth PCM clock	V_{IL}min=-0.3V V_{IL}max=0.54V V_{IH}min=1.26V V_{IH}max=2.0V	1.8V power domain. If unused, keep this pin open.
PCM_OUT	16	DO	Bluetooth PCM data output	V_{OL}max=0.18V V_{OH}min=1.62V	1.8V power domain. If unused, keep this pin open.
BT_UART_RTS	7	DO	Request to send	V_{OL}max=0.18V V_{OH}min=1.62V	1.8V power domain. If unused, keep this pin open.
BT_UART_CTS	8	DI	Clear to send	V_{IL}min=-0.3V V_{IL}max=0.54V V_{IH}min=1.26V V_{IH}max=2.0V	1.8V power domain. If unused, keep this pin open.
BT_UART_TXD	17	DO	Bluetooth transmits data	V_{OL}max=0.18V V_{OH}min=1.62V	1.8V power domain. If unused, keep this pin open.
BT_UART_RXD	18	DI	Bluetooth receives data	V_{IL}min=-0.3V V_{IL}max=0.54V V_{IH}min=1.26V V_{IH}max=2.0V	1.8V power domain. If unused, keep this pin open.
Coexistence Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
LTE_UART_TXD	5	DO	LTE coexistence signal	V_{OL}max=0.18V V_{OH}min=1.62V	1.8V power domain. If unused, keep this pin open.
LTE_UART_RXD	6	DI	LTE coexistence signal	V_{IL}min=-0.3V V_{IL}max=0.54V V_{IH}min=1.26V V_{IH}max=2.0V	1.8V power domain. If unused, keep this pin open.
RF Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**

RF_ANT	30	IO	WLAN and BT antenna	50Ω impedance.	
Other Pins					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
DBG_TXD	4	DO	Software debugging	V_{OL}max=0.18V V_{OH}min=1.62V	1.8V power domain. If unused, keep this pin open.
32KHz_IN	19	DI	Low power. External 32.768KHz clock input is required in sleep mode.	V_{IL}min=-0.3V V_{IL}max=0.54V V_{IH}min=1.26V V_{IH}max=2.0V	1.8V power domain. If unused, keep this pin open.
RESERVED Pins					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristics**	**Comment**
RESERVED	2, 3, 33~35, 37, 41, 42, 46, 47		Reserved		Keep these pins unconnected.

NOTE

FC20-N module does not support BT interface and coexistence interface.

3.4. Power Supply

The following table shows the power supply pins and the ground pins of FC20 series. The VIO is powered by EC20 R2.0/EC21/EC25.

Table 5: Power Supply Pins and GND Pins

Pin Name	Pin No.	Description	Min.	Typ.	Max.	Unit
VDD_3V3	21	Main power supply for module	3.14	3.3	3.46	V
VIO	11	Power supply for module IO	1.71	1.8	1.89	V
GND	1, 12, 20,	Ground				

	28, 29, 31, 36, 38~40, 43~45, 48~52

FC20 series is powered by VDD_3V3, and it is recommended to use power supply chip whose maximum output current is more than 1.2A.

The following figure shows a reference design for VDD_3V3, which is controlled by PM_ENABLE. And PM_ENABLE should be connected to pin 127 of EC20 R2.0/EC21/EC25. For more details, please refer to ***document [2]***, ***[3]*** or ***[4]***.

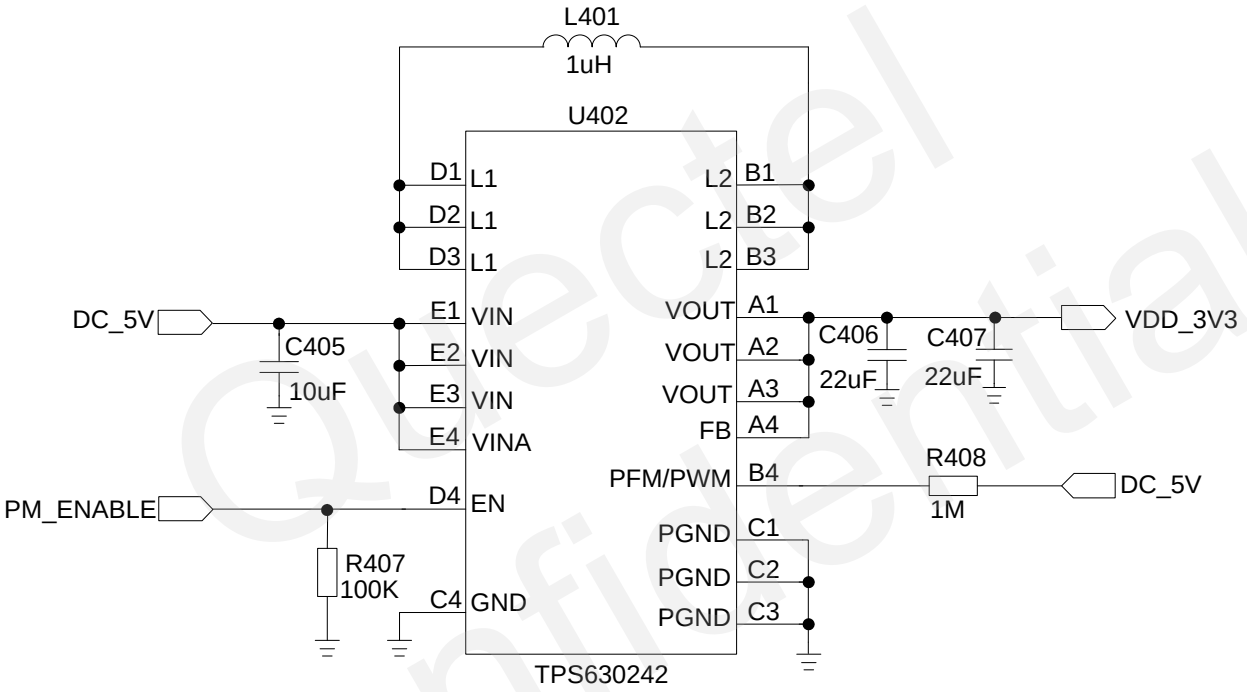


Figure 3: Reference Circuit for VDD_3V3

The following figure shows the recommended power on/off sequences for FC20 series.

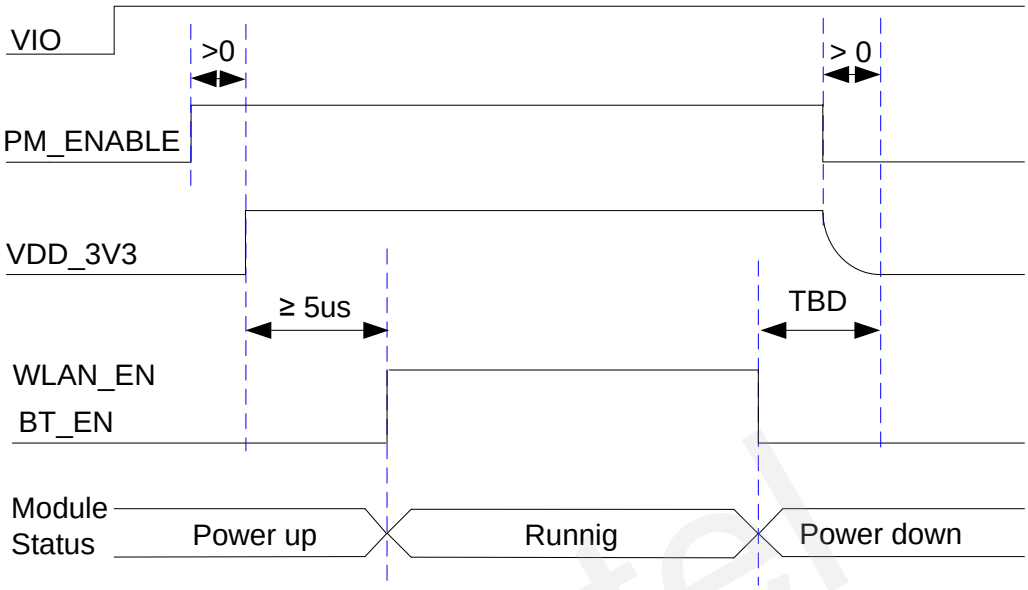


Figure 4: Timing of Power ON/OFF the FC20 Series Module

Execute AT command **AT+QWIFI=1** to open VDD_3V3 and WLAN.

3.5. WLAN Interface

The following figure shows the WLAN interface connection between FC20 series and EC20 R2.0/EC21/EC25.

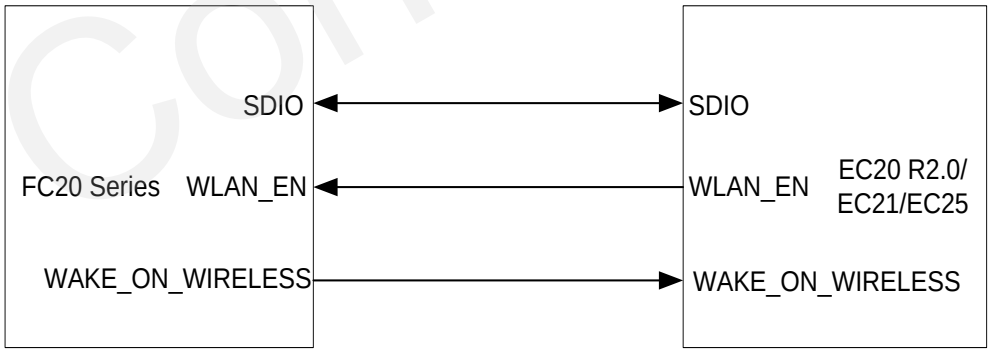


Figure 5: WLAN Interface Connection

3.5.1. WAKE_ON_WIRELESS Interface

WAKE_ON_WIRELESS interface is used to wake up the EC20 R2.0/EC21/EC25. When WAKE_ON_WIRELESS is pulled down, EC20 R2.0/EC21/EC25 can be woken up.

Table 6: Pin Definition of WAKE_ON_WIRELESS

Pin Name	Pin No.	I/O	Description	Comment
WAKE_ON_WIRELESS	32	DO	Wake up host	Active low. If unused, keep this pin open.

3.5.2. WLAN_EN

WLAN_EN is used to control the WLAN function of FC20 series. When WLAN_EN is at high level voltage, WLAN function will be enabled.

Table 7: Pin Definition of WLAN_EN

Pin Name	Pin No.	I/O	Description	Comment
WLAN_EN	9	DI	WLAN enabled	Active high

NOTE

WLAN_EN is a sensitive signal, which should be guarded by ground and routed as close as possible to FC20 series module.

3.5.3. SDIO Interface

The following table shows the pin definition of the SDIO interface of FC20 series.

Table 8: Pin Definition of the SDIO Interface

Pin Name	Pin No.	I/O	Description	Comment
SDIO_D3	22	IO	SDIO data pin bit 3	1.8V power domain
SDIO_D2	23	IO	SDIO data pin bit 2	1.8V power domain. Require external pull-up to

				1.8V.
SDIO_D1	24	IO	SDIO data pin bit 1	1.8V power domain
SDIO_D0	25	IO	SDIO data pin bit 0	1.8V power domain
SDIO_CLK	26	DI	SDIO clock	1.8V power domain
SDIO_CMD	27	IO	SDIO command	1.8V power domain

The following figure shows the SDIO interface connection between FC20 series and EC20 R2.0/EC21/EC25.

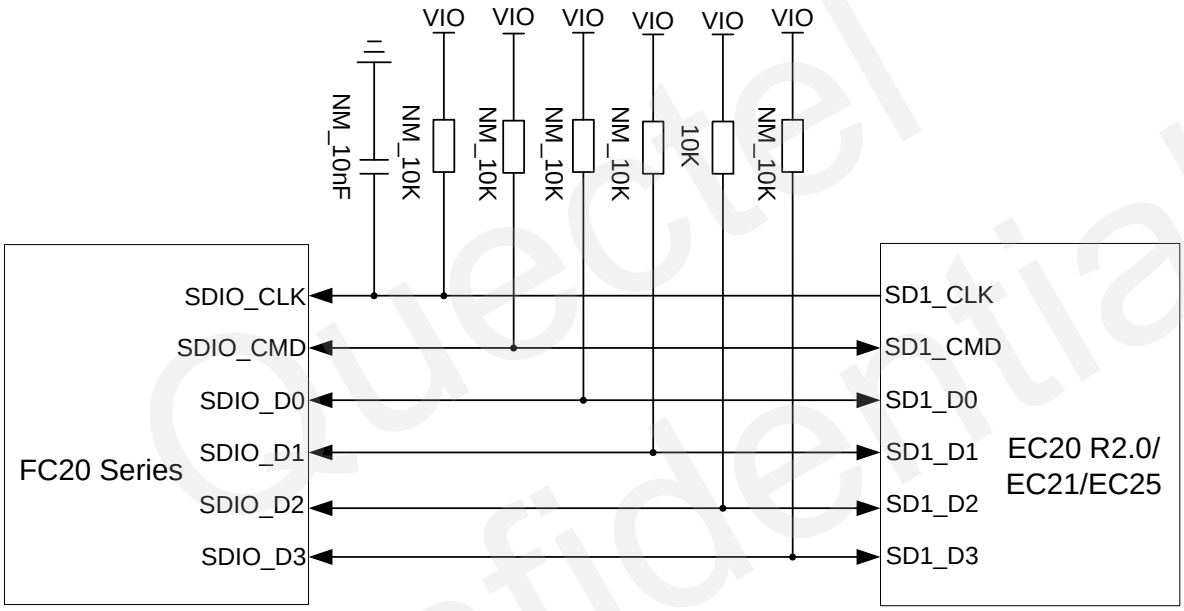


Figure 6: SDIO Interface Connection

In order to ensure the performance of SDIO, please comply with the following principles:

- SDIO signals are very high-speed signals. Please prevent crosstalk between them and other sensitive signals.
- Keep SDIO traces as parallel as possible in the same layer. Make sure SDIO lines are guarded by ground vias and not crossed.
- Do not route SDIO signal traces under crystals, oscillators, magnetic devices and RF signal traces.
- The pull-up resistor on SDIO_D2 line must be mounted.
- Keep SDIO traces as short as possible with equal length, and impedance control as 50Ω.
- The spacing to all other signals is greater than 2 times of the line width.

3.6. BT Interface

BT function is only supported by FC20. Please keep these pins open in FC20-N.

The following figure shows the block diagram of BT interface connection between FC20 and EC20 R2.0/EC21/EC25.

If BT interface of FC20 module is used, the UART and PCM interfaces of EC20 R2.0/EC21/EC25 must be used.

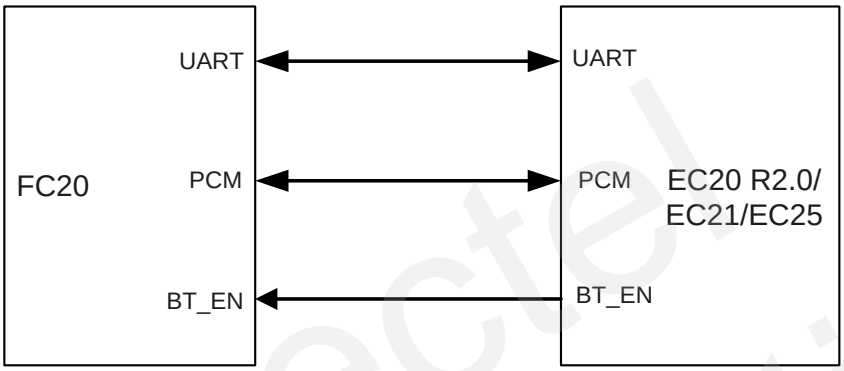


Figure 7: Block Diagram of BT Interface Connection

3.6.1. BT_EN

BT_EN is used to control the BT function of FC20 module. When BT_EN is at high level voltage, BT function will be enabled.

Table 9: Pin Definition of BT_EN

Pin Name	Pin No.	I/O	Description	Comment
BT_EN	10	DI	Bluetooth enabled	Active high

3.6.2. PCM Interface

The following table shows the pin definition of PCM interface.

Table 10: Pin Definition of PCM Interface

Pin Name	Pin No.	I/O	Description	Comment
PCM_IN	13	DI	PCM data input	1.8V power domain
PCM_SYNC	14	IO	PCM data frame sync signal	1.8V power domain
PCM_CLK	15	IO	PCM data bit clock	1.8V power domain
PCM_OUT	16	DO	PCM data output	1.8V power domain

The following figure shows the reference design for PCM interface.

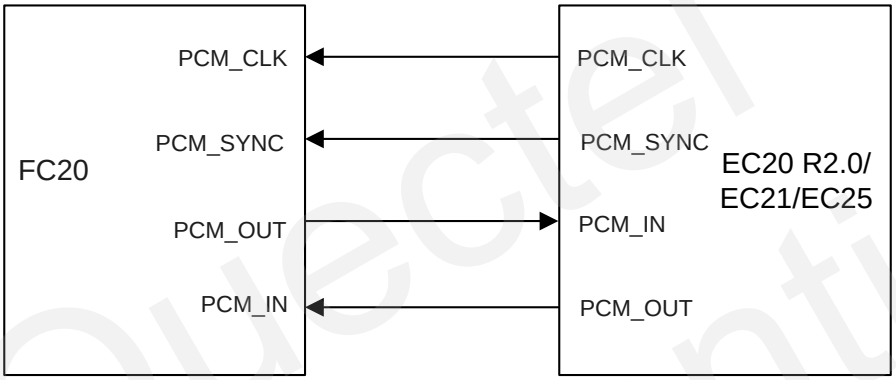


Figure 8: Reference Design for PCM Interface

3.6.3. UART Interface

The following table shows the pin definition of UART interface.

Table 11: Pin Definition of UART Interface

Pin Name	Pin No.	I/O	Description	Comment
BT_UART_RTS	7	DO	Request to send	1.8V power domain
BT_UART_CTS	8	DI	Clear to send	1.8V power domain
BT_UART_TXD	17	DO	Bluetooth transmits data	1.8V power domain
BT_UART_RXD	18	DI	Bluetooth receives data	1.8V power domain

The following figure shows the reference design for UART interface connection between FC20 and EC20 R2.0/EC21/EC25.

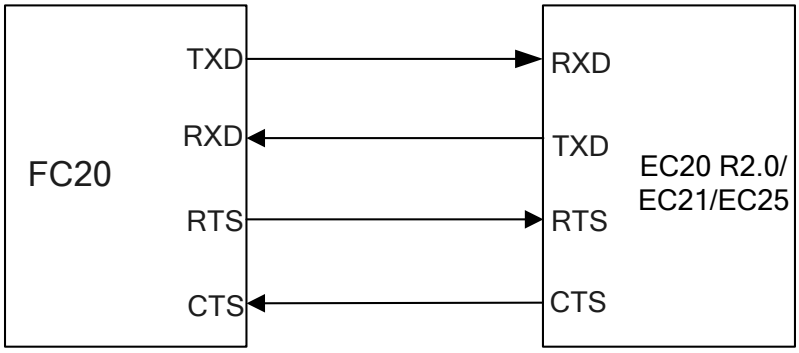


Figure 9: Reference Design for UART Interface Connection

3.7. Coexistence Interface

Coexistence function is only supported by FC20. Please keep these pins open in FC20-N.

The following table shows the pin definition of FC20's coexistence interface.

Table 12: Pin Definition of Coexistence Interface

Pin Name	Pin No.	I/O	Description	Comment
LTE_UART_TXD	5	DO	LTE coexistence signal	If unused, keep this pin open.
LTE_UART_RXD	6	DI	LTE coexistence signal	If unused, keep this pin open.

FC20 module supports LTE-WLAN coexistence and LTE-BT coexistence. The following figure shows the coexistence interface connection between FC20 and EC20 R2.0/EC21/EC25.

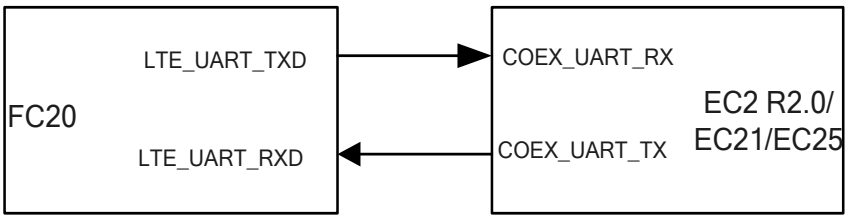


Figure 10: Coexistence Interface Connection

NOTE

LTE-BT coexistence function is under development.

3.8. Other Interfaces

3.8.1. DBG_TXD Interface

DBG_TXD interface can be used for log output.

Table 13: Pin Definition of DBG_TXD Interface

Pin Name	Pin No.	I/O	Description	Comment
DBG_TXD	4	DO	Software debugging	If unused, keep this pin open.

3.8.2. 32KHz_IN Interface

The 32KHz clock is used in low power mode such as IEEE power saving mode and sleep mode. It serves as a timer to determine when to wake up FC20 series module to receive beacons in various power saving schemes, and to maintain basic logic operations when in sleep mode. The sleep clock signal is transferred from EC20 R2.0/EC21/EC25 module.

Table 14: Pin Definition of 32KHz_IN Interface

Pin Name	Pin No.	I/O	Description	Comment
32KHz_IN	19	DI	Low power. External 32.768KHz clock input is required in sleep mode.	If unused, keep this pin open.

3.9. Antenna Interface

The pin 30 is the RF antenna pad. And the RF interface has an impedance of 50Ω.

3.9.1. Pin Definition of the RF Antenna

Table 15: Pin Definition of the RF Antenna

Pin Name	Pin No.	I/O	Description	Comment
GND	28		Ground	
GND	29		Ground	
RF_ANT	30	IO	RF antenna pad	50Ω impedance
GND	31		Ground	

3.9.2. Operating Frequency

Table 16: Operating Frequency of the Module

Feature	Frequency	Unit
WLAN-2.4GHz	2.412~2.484	GHz
WLAN-5GHz	4.9~5.925	GHz
BT	2.402~2.48	GHz

3.9.3. Reference Design

FC20 series module provides an RF antenna pad for antenna connection. The RF trace in host PCB connected to the module's RF antenna pad should be microstrip line or other types of RF trace, whose characteristic impendence should be close to 50Ω. FC20 series module comes with grounding pads which are next to the antenna pad in order to give a better grounding.

The RF external circuit is recommended as following figure. And a π-type matching circuit should be reserved for better RF performance. The capacitors are not mounted by default.

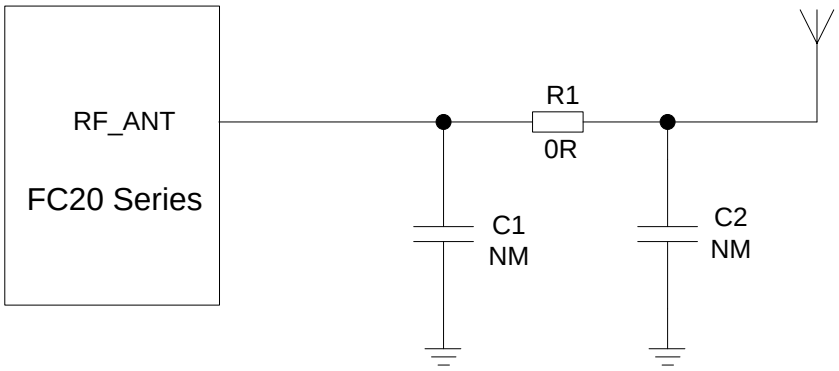


Figure 11: Reference Circuit for RF Antenna Interface

3.9.4. Antenna Requirements

The following table shows the requirements on RF antenna.

Table 17: Antenna Cable Requirements

Type	Requirements
2.412~2.484GHz	Cable insertion loss <1dB
4.9~5.925GHz	Cable insertion loss <1dB

Table 18: Antenna Requirements

Type	Requirements
Frequency Range	2.412~2.484GHz 4.9~5.925GHz
VSWR	<2:1 recommended
Gain (dBi)	1 typical
Max Input Power (W)	50
Input Impedance (Ω)	50
Polarization Type	Vertical

3.9.5. Install the Antenna with RF Connector

The following figure is the antenna installation with RF connector provided by HIROSE. The recommended RF connector is UF.L-R-SMT.

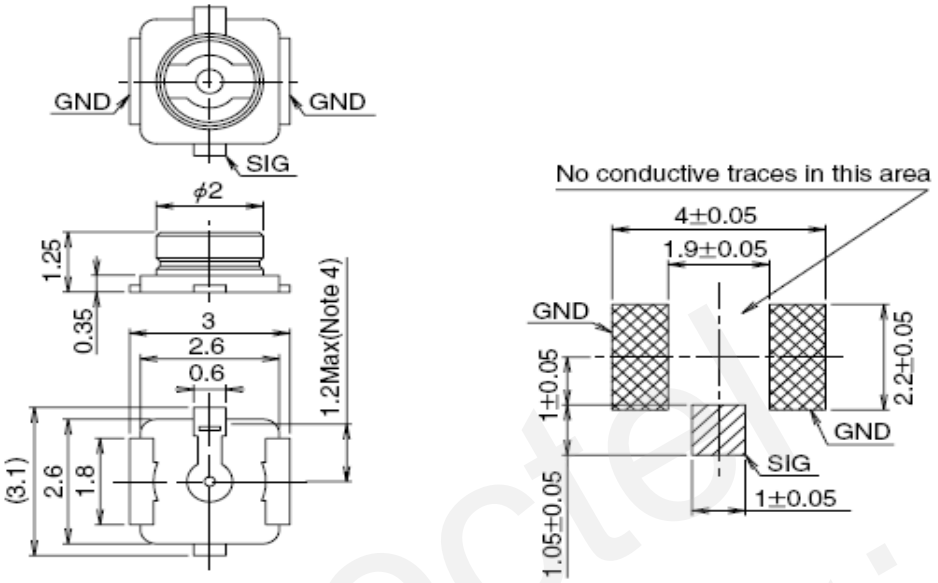


Figure 12: Dimensions of the UF.L-R-SMT Connector (Unit: mm)

Customers can use U.FL-LP serial connector listed in the following figure to match the UF.L-R-SMT.

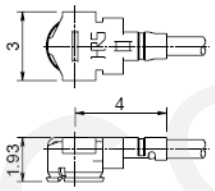
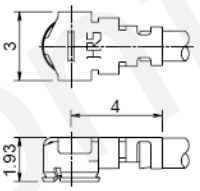
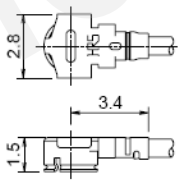
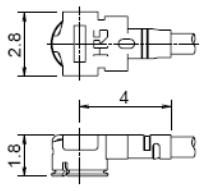
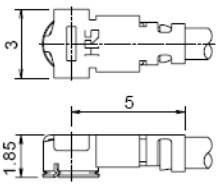
Part No.	U.FL-LP-040	U.FL-LP-066	U.FL-LP(V)-040	U.FL-LP-062	U.FL-LP-088
					
Mated Height	2.5mm Max. (2.4mm Nom.)	2.5mm Max. (2.4mm Nom.)	2.0mm Max. (1.9mm Nom.)	2.4mm Max. (2.3mm Nom.)	2.4mm Max. (2.3mm Nom.)
Applicable cable	Dia. 0.81mm Coaxial cable	Dia. 1.13mm and Dia. 1.32mm Coaxial cable	Dia. 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 13: Mechanicals of UF.L-LP Connectors (Unit: mm)

The following figure describes the space factor of mated connector

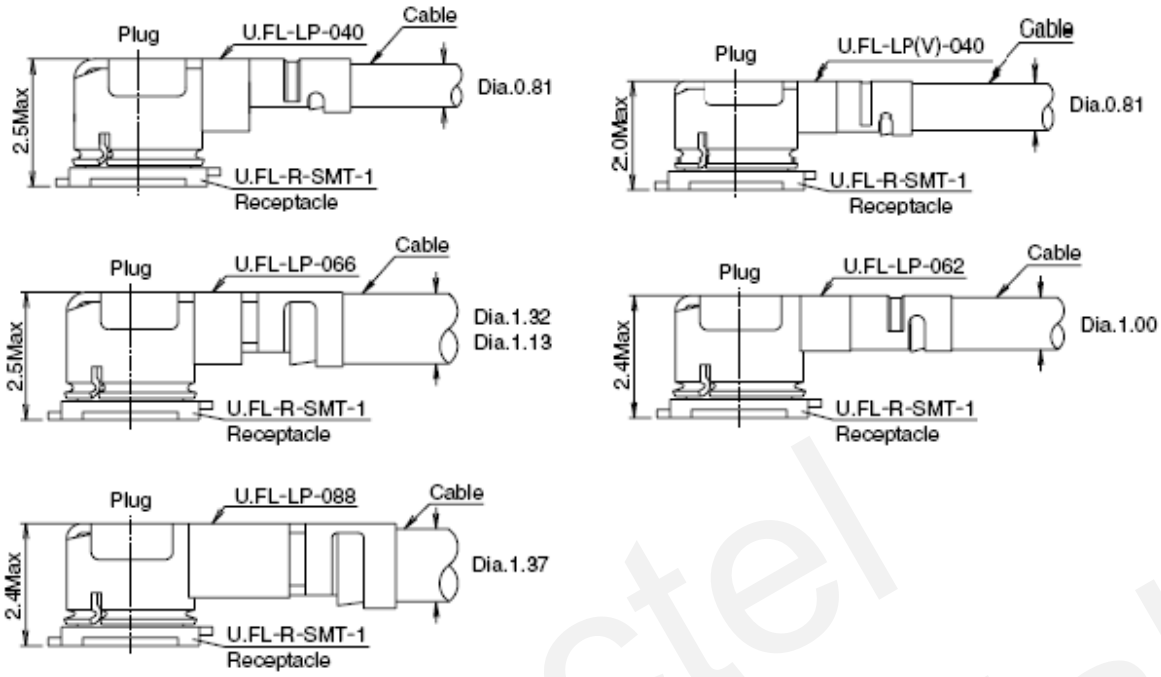


Figure 14: Space Factor of Mated Connector (Unit: mm)

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

4 Electrical, Reliability and Radio Characteristics

4.1. General Description

This chapter mainly introduces the electrical and the radio frequency characteristics of FC20 series module, which are listed in detail in the following chapters:

- Electrical characteristics
- I/O interface characteristics
- Current consumption
- RF performance
- Electrostatic discharge

4.2. Electrical Characteristics

The following table shows the absolute maximum ratings.

Table 19: Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
VDD_3V3	-0.3	4.0	V
VIO	-0.3	1.89	V
Digital I/O input voltage	-0.3	VIO+0.2	V

The following table shows the recommended operating conditions for FC20 series module.

Table 20: Recommended Operating Conditions

Parameter	Min.	Typ.	Max.	Unit
VDD_3V3	3.14	3.3	3.46	V
VIO	1.71	1.8	1.89	V

4.3. I/O Interface Characteristics

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

Table 21: General DC Electrical Characteristics

Symbol	Parameter	Min.	Max.	Unit
V_{IH}	High Level Input Voltage	0.7*VIO	VIO+0.2	V
V_{IL}	Low Level Input Voltage	-0.3	0.3*VIO	V
V_{OH}	High Level Output Voltage	0.9*VIO	VIO	V
V_{OL}	Low Level Output Voltage	0	0.1*VIO	V
I_{IL}	Input Leakage Current	-5	5	uA

4.4. Current Consumption

The values of current consumption are shown as below.

Table 22: Current Consumption of the Module in Low Power Mode

Description	Conditions	I_{WLAN_3V3}	I_{VIO}	Unit
OFF State	**AT+QWIFI=0**	0	554	uA

Description	Conditions	I_{WLAN_3V3}	I_{VIO}	Unit
Idle	**AT+QWIFI=1**	66	6.5	mA

Table 23: Current Consumption of the Module

Description	Conditions	I_{WLAN_3V3}	Unit
802.11b	TX 1Mbps @17.5dBm	370	mA
	TX 11Mbps @17.2dBm	357	mA
	RX 1Mbps	48	mA
	RX 11Mbps	49	mA
802.11g	TX 6Mbps @16dBm	328	mA
	TX 54Mbps @14.8dBm	245	mA
	RX 6Mbps	49	mA
	RX 54Mbps	50	mA
802.11n	TX HT20-MCS0 @15.8dBm	322	mA
	TX HT20-MCS7 @13.5dBm	234	mA
	TX HT40-MCS0 @14.5dBm	291	mA
	TX HT40-MCS7 @12.5dBm	194	mA
	RX HT20-MCS0	49	mA
	RX HT20-MCS7	50	mA
	RX HT40-MCS0	54	mA
	RX HT40-MCS7	52	mA
802.11a	TX HT20 MCS0 @dBm	TBD	mA
	TX HT20 MCS7 @dBm	TBD	mA
	RX HT20 MCS0	TBD	mA
	RX HT20 MCS7	TBD	mA

Description	Conditions	I_{WLAN_3V3}	Unit
	TX VHT20 MCS0 @13.2dBm	378	mA
	TX VHT20 MCS8 @12.5dBm	289	mA
	TX VHT40 MCS0 @13.5dBm	372	mA
	TX VHT40 MCS9 @10.5dBm	244	mA
	TX VHT80 MCS0 @13dBm	355	mA
	TX VHT80 MCS9 @10dBm	220	mA
802.11ac	RX VHT20 MCS0	78	mA
	RX VHT20 MCS8	78	mA
	RX VHT40 MCS0	85	mA
	RX VHT40 MCS9	84	mA
	RX VHT80 MCS8	92	mA
	RX VHT80 MCS9	91	mA

NOTE

OFF state: Execute **AT+QWIFI=0** to bring the module to this state. Under the state, the sleep clock is disabled and no data is saved.

4.5. RF Performance

The following tables summarize the transmitter and receiver characteristics of FC20 series.

Table 24: Conducted RF Output Power at 2.4GHz

Frequency	Min.	Typ.	Unit
802.11b @1Mbps	16.8	17.5	dBm
802.11b @11Mbps	16.5	17	dBm

802.11g @6Mbps	15	15.5	dBm
802.11g @54Mbps	14.5	15	dBm
802.11n, HT20 @MCS0	15	15.5	dBm
802.11n, HT20 @MCS7	13.5	14	dBm

Table 25: Conducted RF Output Power at 5GHz

Frequency	Min.	Typ.	Unit
802.11a @6Mbps	13	13.5	dBm
802.11a @54Mbps	12.5	13	dBm
802.11ac, HT20 @MCS0	13	13.5	dBm
802.11ac, HT20 @MCS7	12.5	13	dBm
802.11ac, HT40 @MCS0	13	13.5	dBm
802.11ac, HT40 @MCS7	10.5	11	dBm
802.11ac, HT80 @MCS0	13	13.5	dBm
802.11ac, HT80 @MCS7	10	10.5	dBm

Table 26: Conducted RF Receiving Sensitivity at 2.4GHz

Frequency	Receive Sensitivity (Typ.)
802.11b, 1Mbps	TBD
802.11b, 11 Mbps	-85
802.11g, 6Mbps	TBD
802.11g, 54Mbps	-73
802.11n, HT20, MCS0	TBD
802.11n, HT20, MCS7	-70
802.11n, HT40, MCS0	TBD

802.11n, HT40, MCS7	-68

Table 27: Conducted RF Receiving Sensitivity at 5GHz

Frequency	Receive Sensitivity (Typ.)
802.11a, 6Mbps	TBD
802.11a, 54Mbps	-68
802.11ac,VHT20, MCS0	TBD
802.11ac,VHT20, MCS8	-68
802.11ac, VHT40, MCS0	TBD
802.11ac, VHT40, MCS9	-62
802.11ac, VHT80, MCS0	TBD
802.11ac, VHT80, MCS9	-57

4.6. Electrostatic Discharge

The module is not protected against Electrostatic 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.

5 Mechanical Dimensions

This chapter describes the mechanical dimensions of FC20 series module.

5.1. Mechanical Dimensions of the Module

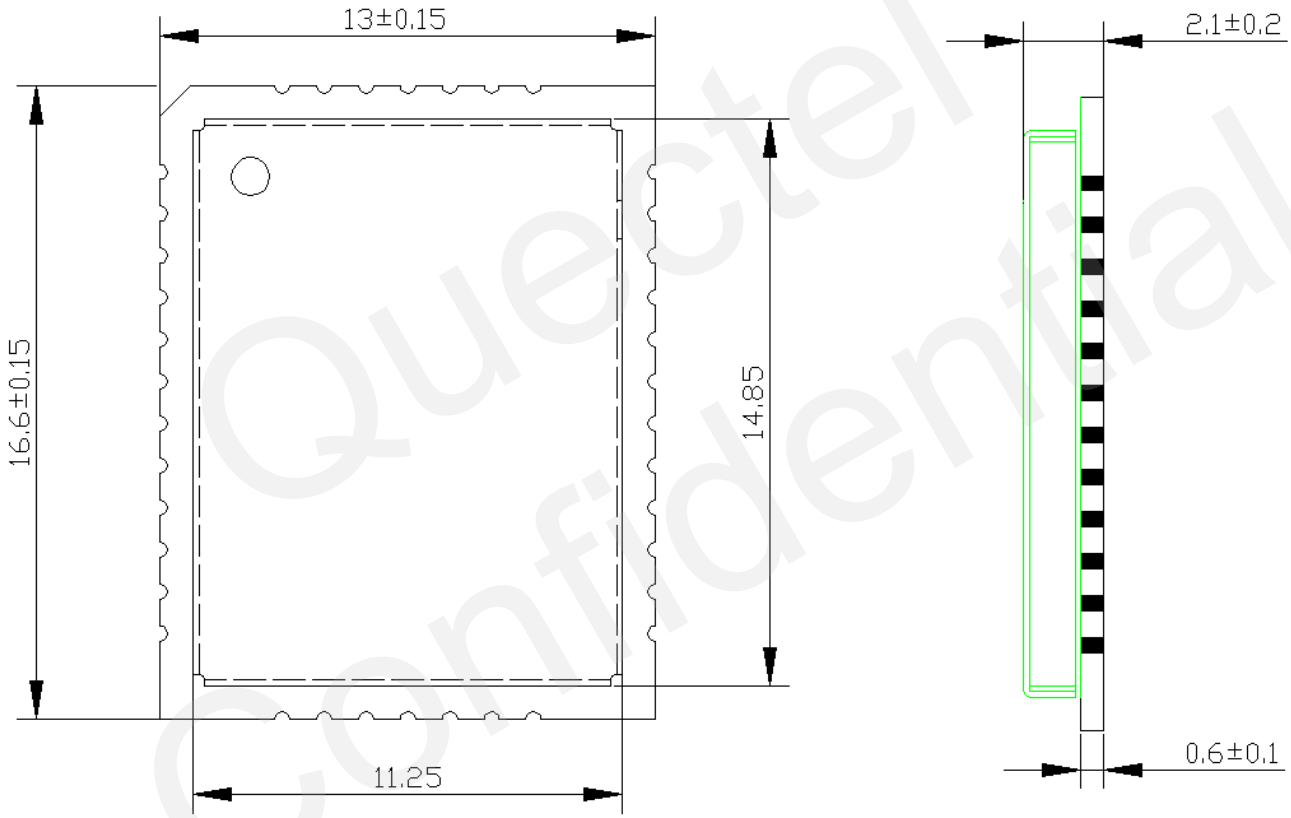


Figure 15: FC20 Top and Side Dimensions (Unit: mm)

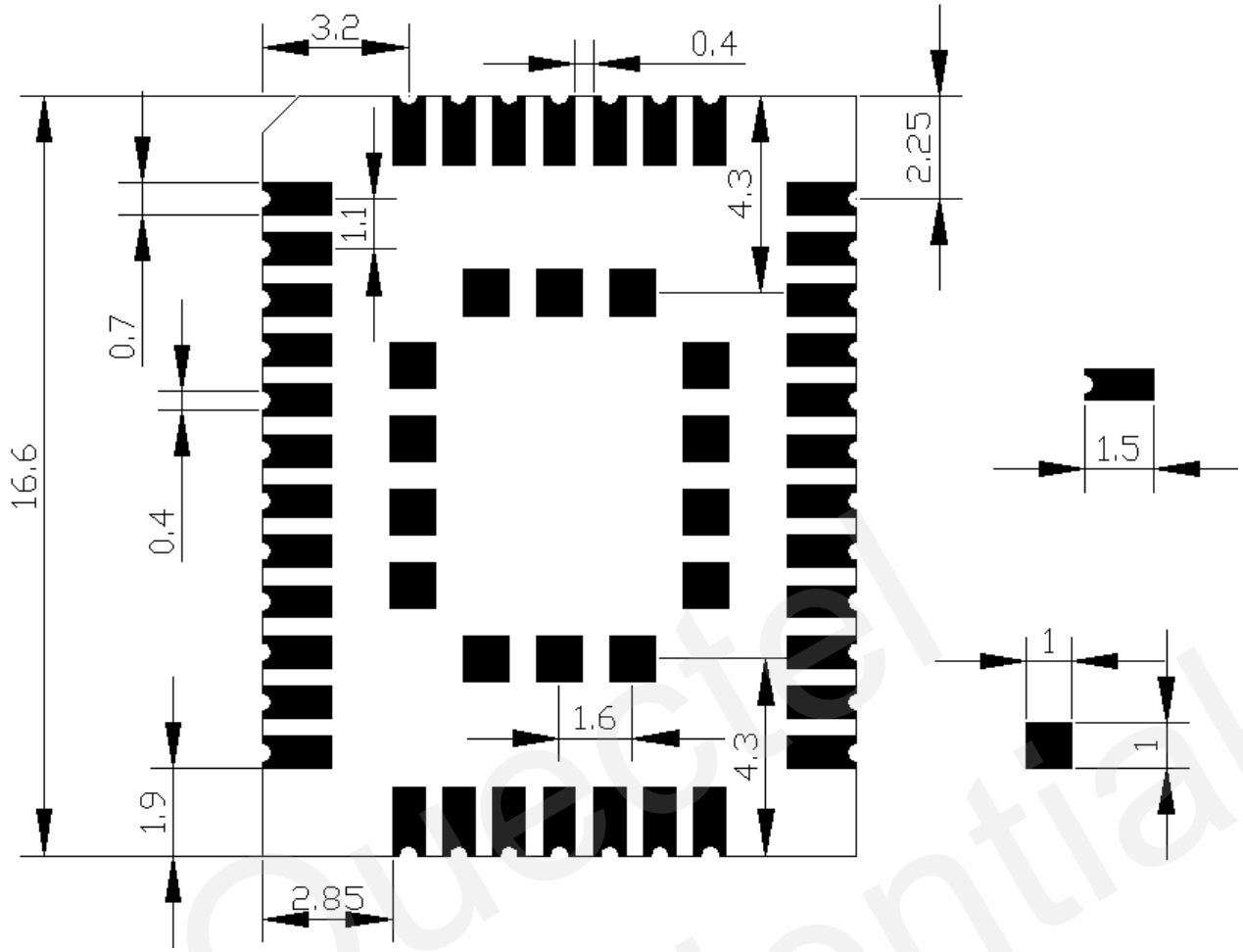


Figure 16: FC20 Bottom Dimensions (Unit: mm)

5.2. Recommended Footprint and Stencil

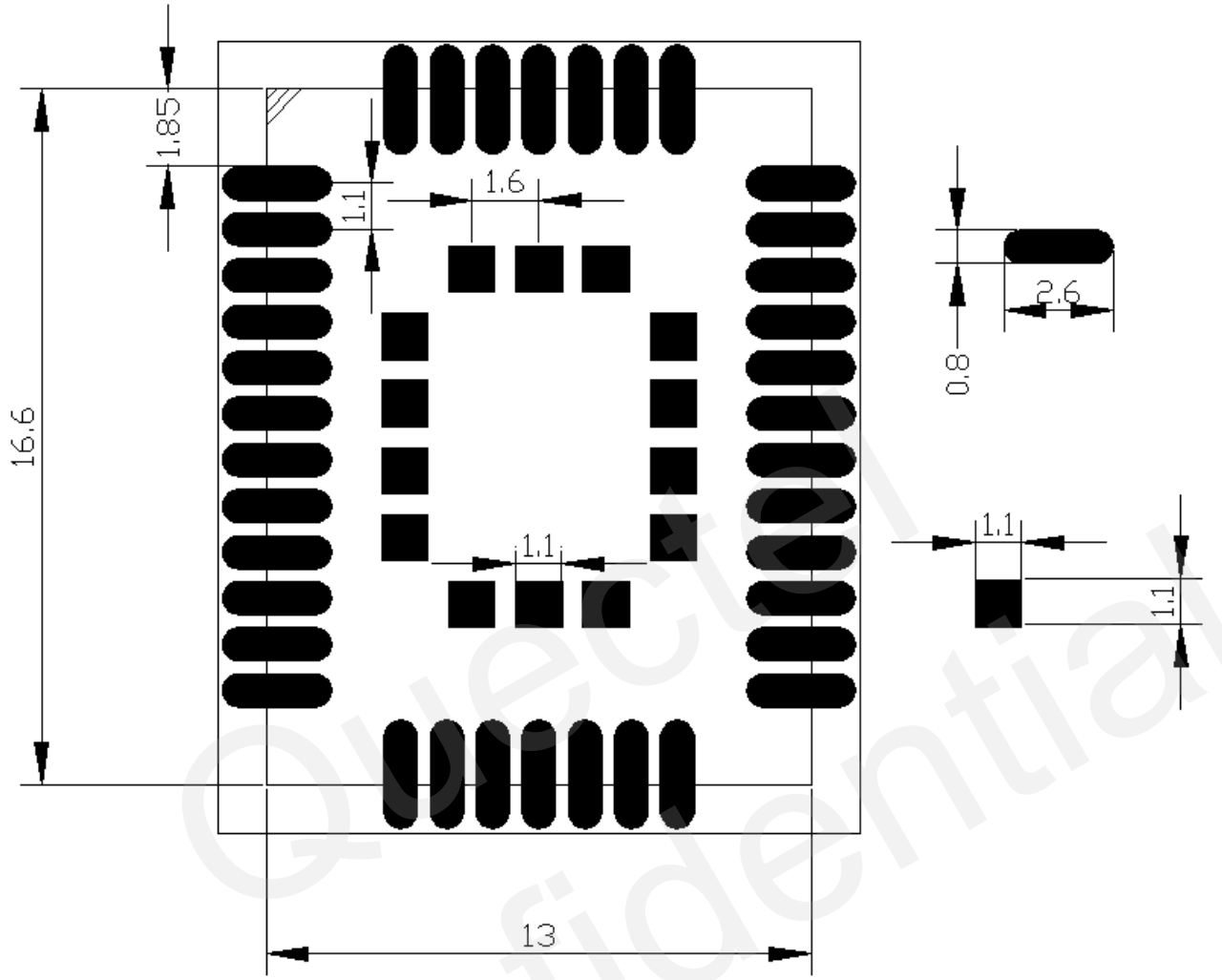


Figure 17: Recommended Footprint (Unit: mm)

The recommended stencil design for FC20 series is shown as below. To ensure the module soldering quality, the thickness of stencil for the module is recommended to be 0.18mm.

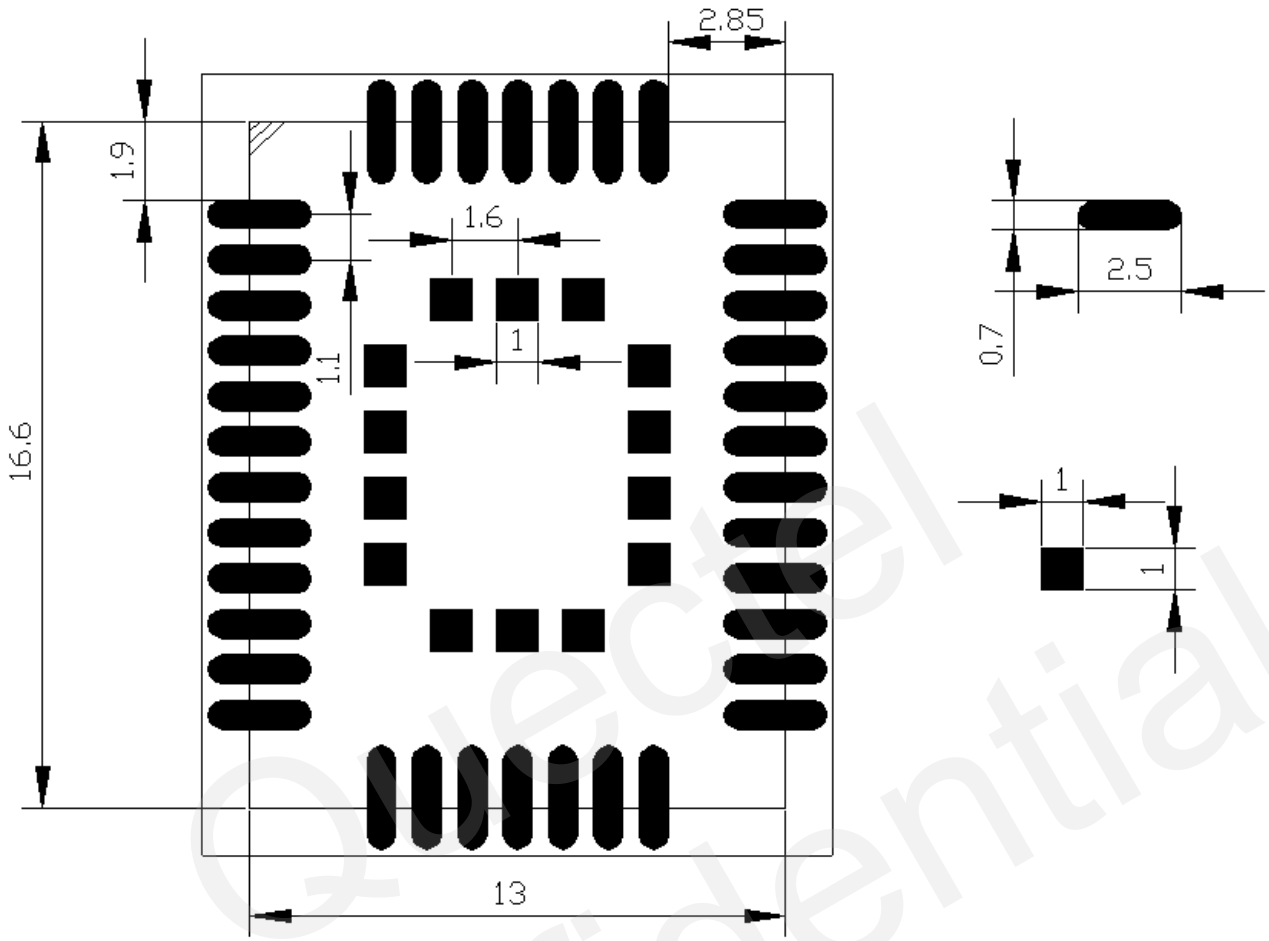


Figure 18: Recommended Stencil (Unit: mm)

NOTES

1. For easy maintenance of the module, please keep about 3mm between the module and other components in host PCB.
2. Keep the RESERVED pins unconnected.

5.3. Top and Bottom View of the Module

Figure 19: Top View of the Module

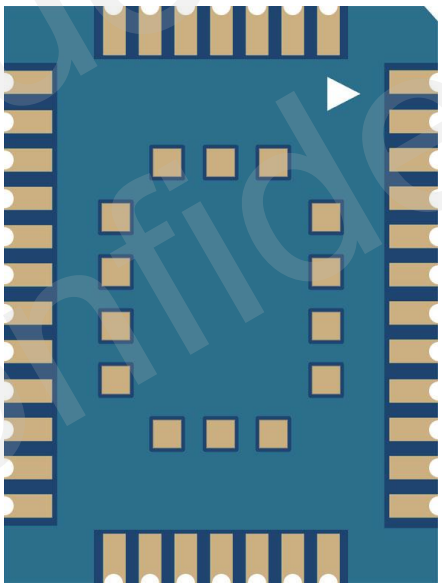


Figure 20: Bottom View of the Module

NOTE

These are design effect drawings of FC20 series module. For more accurate pictures, please refer to the module that you get from Quectel.

6 Storage, Manufacturing and Packaging

6.1. Storage

FC20 series module is stored in a vacuum-sealed bag. The storage restrictions are shown as below.

1. Shelf life in the vacuum-sealed bag: 12 months at <40ºC and <90% RH.

2. After the vacuum-sealed bag is opened, devices that need to be mounted directly must be:

- Mounted within 72 hours at the factory environment of ≤30ºC and <60%RH.
- Stored at <10% RH.

3. Devices require baking before mounting, if any circumstance below occurs.

- When the ambient temperature is 23ºC±5ºC and the humidity indication card shows the humidity is >10% before opening the vacuum-sealed bag.
- Device mounting cannot be finished within 72 hours when the ambient temperature is <30ºC and the humidity is <60%.
- Stored at >10% RH.

4. If baking is required, devices should be baked for 48 hours at 125ºC±5ºC.

NOTE

As the plastic package cannot be subjected to high temperature, it should be removed from devices before high temperature (125ºC) baking. If shorter baking time is desired, please refer to *IPC/JEDECJ-STD-033* for baking procedure.

6.2. 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 should be adjusted properly so as 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 0.18mm. For more details, please refer to ***document [5]***.

It is suggested that the peak reflow temperature is from 235ºC to 245ºC (for SnAg3.0Cu0.5 alloy). The absolute maximum reflow temperature is 260ºC. To avoid damage to the module caused by repeated heating, it is suggested that the module should be mounted after reflow soldering for the other side of PCB has been completed. Recommended reflow soldering thermal profile is shown below:

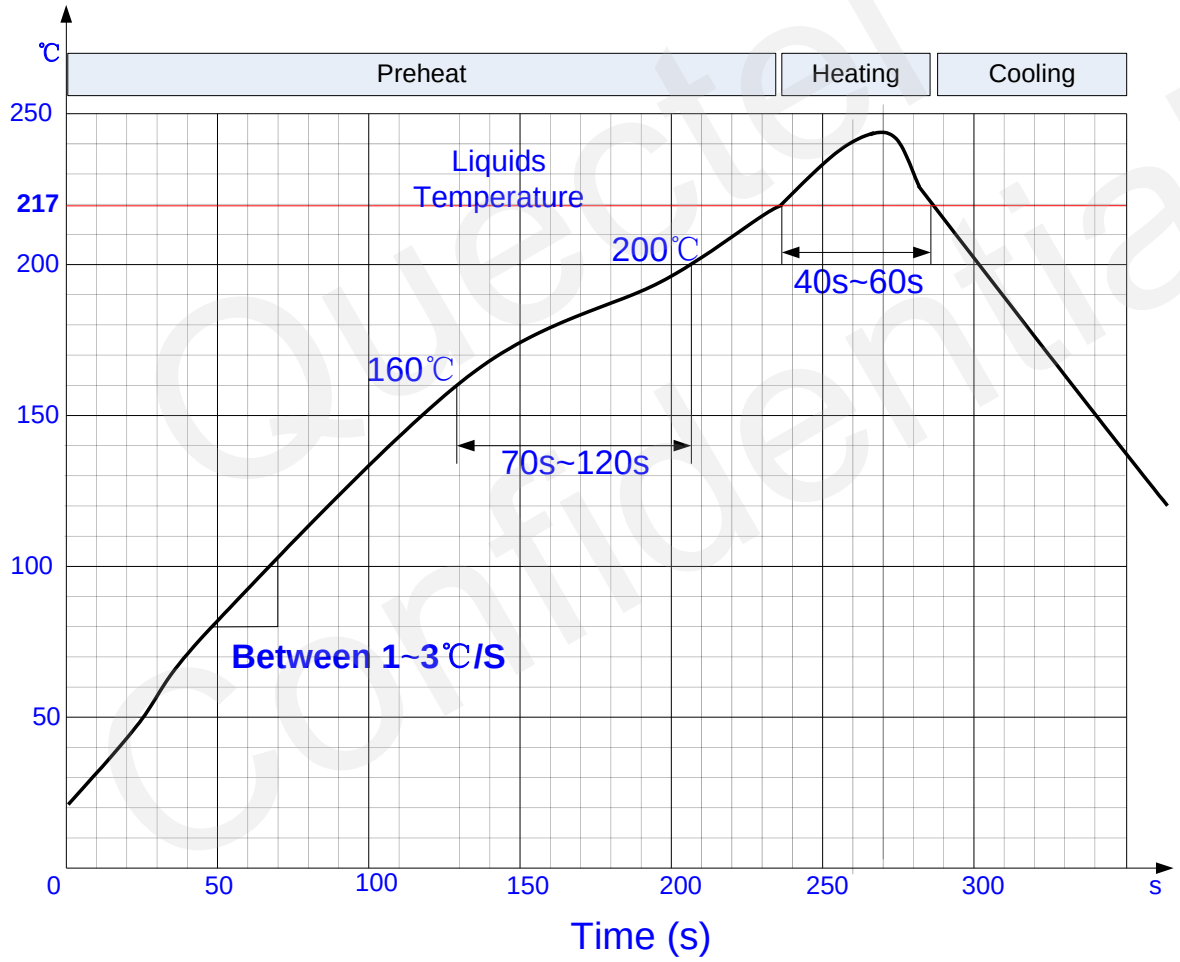


Figure 21: Reflow Soldering Thermal Profile

6.3. Packaging

FC20 module is packaged in a vacuum-sealed bag which is ESD protected. The bag should not be opened until the devices are ready to be soldered onto the application.

6.3.1. Tape and Reel Packaging

FC20 is packaged in tape and reel carriers. The figures below show the packaging details.

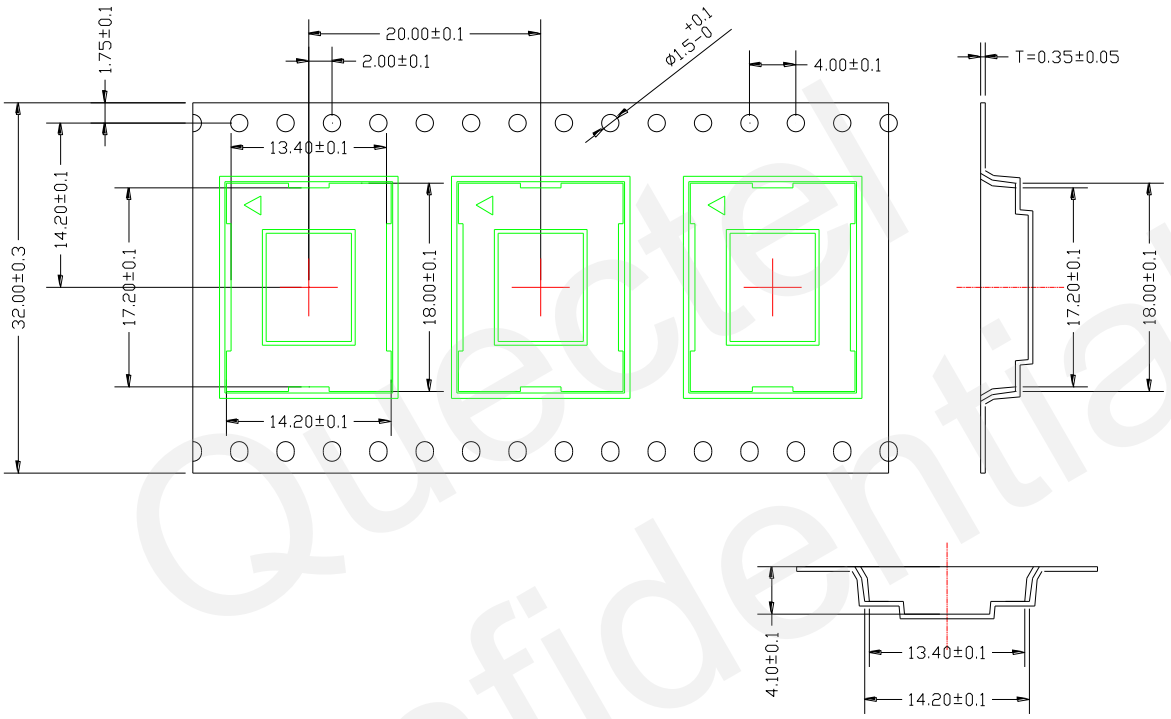


Figure 22: Tape Dimensions (Unit: mm)

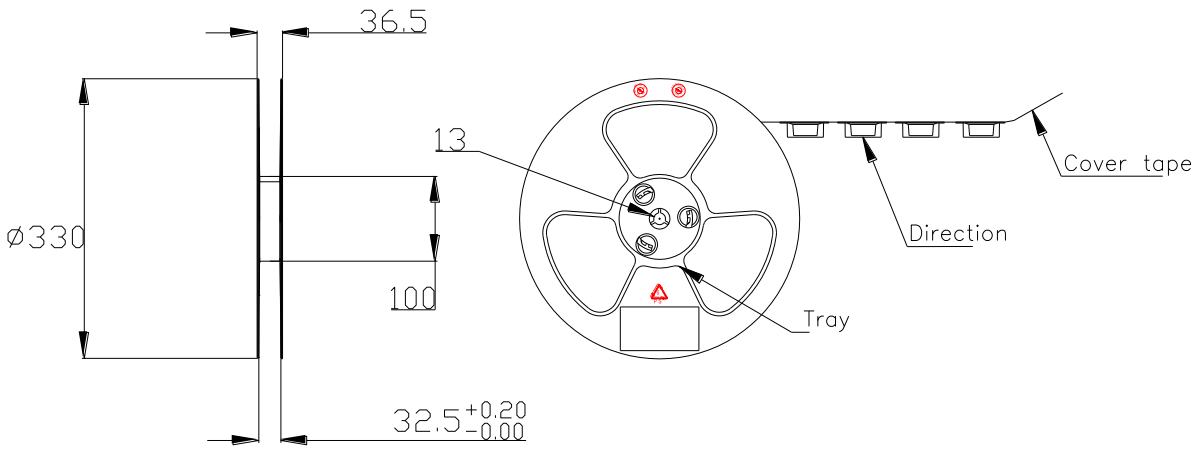


Figure 23: Reel Dimensions (Unit: mm)

Table 28: Reel Packaging

Model Name	MOQ for MP	Minimum Package: 250pcs	Minimum Package × 4=1000pcs
FC20/FC20-N	250pcs	Size: 370mm × 350mm × 56mm N.W: 0.203kg G.W: 0.945kg	Size: 380mm × 250mm × 365mm N.W: 0.81kg G.W: 4.33kg

7 Appendix A References

Table 29: Related Documents

SN	Document Name	Remark
[1]	Quectel_FC20_EVB_User_Guide	FC20 EVB user guide
[2]	Quectel_EC25_Reference_Design	EC25 reference design
[3]	Quectel_EC21_Reference_Design	EC21 reference design
[4]	Quectel_EC20_R2.0_Reference_Design	EC20 R2.0 reference design
[5]	Quectel_Module_Secondary_SMT_User_Guide	Module secondary SMT user guide

Table 30: Terms and Abbreviations

Abbreviation	Description
AP	Access Point
BPSK	Binary Phase Shift Keying
BT	Bluetooth
CCK	Complementary Code Keying
CTS	Clear To Send
ESD	Electrostatic Discharge
GND	Ground
HT	High Throughput
IEEE	Institute of Electrical and Electronics Engineers
I_{IL}	Input Leakage Current
I/O	Input/Output

LTE	Long Term Evolution
Mbps	Million Bits Per Second
MCS	Modulation and Coding Scheme
MOQ	Minimum Order Quantity
MP	Manufacture Product
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RF	Radio Frequency
RH	Relative Humidity
RoHS	Restriction of Hazardous Substances
RTS	Request To Send
RX	Receive Direction
SDIO	Secure Digital Input and Output Card
TBD	To Be Determined
TX	Transmitting Direction
UART	Universal Asynchronous Receiver Transmitter
USB	Universal Serial Bus
VDD	Voltage Power for Digital Device
VHT	Very High Throughput
V_{IH}max	Maximum Input High Level Voltage Value
V_{IH}min	Minimum Input High Level Voltage Value
V_{IL}max	Maximum Input Low Level Voltage Value
V_{IL}min	Minimum Input Low Level Voltage Value

VIO	Voltage for Input/Output Port
V_{OL}max	Maximum Output Low Level Voltage Value
V_{OH}min	Minimum Output High Level Voltage Value
VSWR	Voltage Standing Wave Ratio
Wi-Fi	Wireless-Fidelity
WLAN	Wireless Local Area Networks