

# FC20 Series

# Hardware Design

**Wi-Fi/BT Module Series**

Rev. FC20\_Series\_Hardware\_Design\_V2.3

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# About the Document

## History

| Revision | Date       | Author                 | Description  |
|----------|------------|------------------------|--|
| 1.0      | 2016-11-02 | Power JIN              | Initial  |
| 1.1      | 2017-12-14 | Power JIN/<br>Kane ZHU | <ol style="list-style-type: none"> <li>1. Updated the chip model into QCA1023.</li> <li>2. Added LTE coexistence function for FC20-N.</li> <li>3. Updated current consumption values in Table 23.</li> <li>4. Updated RF output power values in Table 24 and Table 25.</li> <li>5. Updated RF receiving sensitivity in Table 26 and Table 27.</li> <li>6. Added EC20 R2.1 in the modules that can use in combination with FC20 series module.</li> </ol> |
| 2.0      | 2018-05-17 | Power JIN/<br>Kane ZHU | <ol style="list-style-type: none"> <li>1. Removed all descriptions relating to BT function.</li> <li>2. Removed UART, PCM and BT_EN from Figure 1.</li> <li>3. Changed pins 7, 8, 10, 13~18 into reserved ones.</li> <li>4. Updated bottom dimensions, recommended footprint and recommended stencil.</li> <li>5. Updated the peak reflow temperature and recommended reflow soldering thermal profile in Chapter 6.2.</li> </ol>                        |
| 2.1      | 2018-07-06 | Power JIN/<br>Kane ZHU | <ol style="list-style-type: none"> <li>1. Added a reference design for RF antenna interface in Chapter 3.8.3.</li> <li>2. Updated the recommended thermal profile parameters in Chapter 6.2.</li> <li>3. Updated the frequency range of the modules.</li> </ol>  |
| 2.2      | 2019-05-22 | Power JIN              | <ol style="list-style-type: none"> <li>1. Modified the maximum output current of VDD_3V3 in Table 4 and Chapter 3.4.</li> <li>2. Added the timing between VIO and VDD_3V3 in Figure 4.</li> <li>3. Changed NM_10nF of SDIO interface connection</li> </ol>   |

|     |            |                           |   |
|-----|------------|---------------------------|---|
|     |            |                           | <p>to NM_10pF in Figure 6.</p> <ol style="list-style-type: none"> <li>Added two pull-down resistors in Figure 7.</li> <li>Added Table 26 electrostatic discharge characteristics in Chapter 4.6.</li> <li>Updated the peak reflow temperature and recommended reflow soldering thermal profile in Chapter 6.2.</li> </ol>   |
| 2.3 | 2019-08-16 | Soni RAO/<br>Finley ZHANG | <ol style="list-style-type: none"> <li>Added BT related contents in Table 1, 2, 4, 17 &amp; Chapter 3.6.</li> <li>Operation mode STA and pin WAKE_ON_WIRELESS are fully developed.</li> <li>Updated data rates of FC20 series module in Table 2.</li> <li>Updated functional diagram of FC20 series module in Figure 1.</li> <li>Updated pin 7, 8, 10, 13~18 and 46 from RESERVED to BT function pins in Figure 2 and Table 4.</li> <li>Updated pin descriptions of VDD_3V3 and DBG_TXD in Table 4.</li> <li>Added note for pin SDIO_D2 in Chapter 3.3.</li> <li>Updated reference circuit for RF antenna interface (vehicle applications) in Figure 12.</li> </ol> |

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# 1 Introduction

This document defines the FC20 series module and describes its air interface and hardware interfaces which are connected with the customers' applications.

The document can help customers quickly understand module interface specifications, electrical and mechanical details, as well as other related information of the module. Through using in combination with Quectel EC2x&EG25-G <sup>1)</sup> modules, customers can use FC20 series module to design and set up LTE+Wi-Fi/BT applications easily.

FC20 series module contains two variants: FC20 and FC20-N, which are shown in the following table. Customers can choose a dedicated type based on their requirements.

**Table 1: FC20 Series Products**

| Module | Wi-Fi           | BT*           |
|--------|-----------------|---------------|
| FC20   | 2.4GHz and 5GHz | BT 4.2        |
| FC20-N | 2.4GHz          | Not Supported |

## NOTES

- <sup>1)</sup> EC2x in this document refers to Quectel EC21, EC25, EC20 R2.0 and EC20 R2.1 modules.
- "\*" means under development.

## 1.1 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 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 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 the device offers an Airplane Mode, then it should be enabled prior to boarding an aircraft. Please consult the airline staff for more restrictions on the use of wireless devices on boarding the 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.



The cellular terminal or mobile contains a transmitter and receiver. When it is ON, it receives and transmits radio frequency signals. 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 is a low-power cost-effective Wi-Fi/BT module based on QCA1023, and it consists of two variants (FC20 and FC20-N) as illustrated below.

### FC20

- Supports 1×1 IEEE 802.11a/b/g/n/ac WLAN standards and BT 4.2\*
- Provides a low-power SDIO 3.0 interface for WLAN and UART&PCM interfaces for BT function\*, and also supports LTE/WLAN coexistence

### FC20-N

- Supports 1×1 IEEE 802.11b/g/n WLAN standards
- Provides a low-power SDIO 3.0 interface for WLAN, and also supports LTE/WLAN coexistence

#### NOTE

“\*” means under development.

## 2.2 Key Features

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

**Table 2: Key Features**

| Features     | Description   |
|--------------|---|
| Power Supply | Main supply voltage: 3.3V<br>I/O supply voltage: 1.8V   |
| Data Rates   | <b>FC20:</b> <ul style="list-style-type: none"> <li>● 802.11b: 1Mbps, 2Mbps, 5.5Mbps, 11Mbps</li> </ul> |

|                                  |   |
|----------------------------------|---|
|                                  | <ul style="list-style-type: none"> <li>● 802.11g: 6Mbps, 9Mbps, 12Mbps, 18Mbps, 24Mbps, 36Mbps, 48Mbps, 54Mbps</li> <li>● 802.11n (20MHz): 7.2Mbps, 14.2Mbps, 21.7Mbps, 28.9Mbps, 43.3Mbps, 57.8Mbps, 65Mbps, 72.2Mbps</li> <li>● 802.11n (40MHz): 15Mbps, 30Mbps, 45Mbps, 60Mbps, 90Mbps, 120Mbps, 150Mbps</li> <li>● 802.11a: 6Mbps, 9Mbps, 12Mbps, 18Mbps, 24Mbps, 36Mbps, 48Mbps, 54Mbps</li> <li>● 802.11ac: VHT20 (MCS0~MCS8), VHT40 (MCS0~MCS9), VHT80 (MCS0~MCS9)</li> </ul> <p><b>FC20-N:</b></p> <ul style="list-style-type: none"> <li>● 802.11b: 1Mbps, 2Mbps, 5.5Mbps, 11Mbps</li> <li>● 802.11g: 6Mbps, 9Mbps, 12Mbps, 18Mbps, 24Mbps, 36Mbps, 48Mbps, 54Mbps</li> <li>● 802.11n (20MHz): 7.2Mbps, 14.2Mbps, 21.7Mbps, 28.9Mbps, 43.3Mbps, 57.8Mbps, 65Mbps, 72.2Mbps</li> <li>● 802.11n (40MHz): 15Mbps, 30Mbps, 45Mbps, 60Mbps, 90Mbps, 120Mbps, 150Mbps</li> </ul> |
| Transmitting Power               | <p><b>FC20:</b></p> <ul style="list-style-type: none"> <li>● 802.11b/11Mbps: 17.0±2.5dBm</li> <li>● 802.11g/54Mbps: 15.0±2.5dBm</li> <li>● 802.11n/HT20 MCS7: 14.5±2.5dBm</li> <li>● 802.11a/54Mbps: 12.5±2.5dBm</li> <li>● 802.11ac/VHT20 MCS0: 13.5±2.5dBm</li> </ul> <p><b>FC20-N:</b></p> <ul style="list-style-type: none"> <li>● 802.11b/11Mbps: 17.0±2.5dBm</li> <li>● 802.11g/54Mbps: 15.0±2.5dBm</li> <li>● 802.11n/HT20 MCS7: 14.5±2.5dBm</li> </ul>  |
| WLAN Protocol Features           | <p><b>FC20:</b></p> <ul style="list-style-type: none"> <li>● IEEE 802.11a/b/g/n/ac</li> </ul> <p><b>FC20-N:</b></p> <ul style="list-style-type: none"> <li>● IEEE 802.11b/g/n</li> </ul>  |
| Operation Modes                  | AP, STA   |
| Modulation                       | <p><b>FC20:</b></p> <ul style="list-style-type: none"> <li>● BPSK, QPSK, CCK, 16QAM, 64QAM, 256QAM</li> </ul> <p><b>FC20-N:</b></p> <ul style="list-style-type: none"> <li>● BPSK, QPSK, CCK, 16QAM, 64QAM</li> </ul>   |
| Wireless Connectivity Interfaces | Support a low-power SDIO 3.0 interface for WLAN, and UART&PCM interfaces for BT function* (for FC20 only)   |
| Antenna Interface                | Wi-Fi/BT antenna interface, 50Ω impedance   |
| Physical Characteristics         | <p>Dimensions: (16.6±0.15)mm × (13.0±0.15)mm × (2.1±0.2)mm</p> <p>Package: LCC</p>  |

|                    |  |
|--------------------|--|
|                    | Weight: approx. 0.81g  |
| Temperature Ranges | Operation temperature range: -35°C ~ +75°C <sup>1)</sup><br>Extended temperature range : -40°C ~ +85°C <sup>2)</sup><br>Storage temperature range: -40°C ~ +90°C |
| RoHS               | All hardware components are fully compliant with EU RoHS directive   |

## NOTES

- <sup>1)</sup> Within operation temperature range, the module is IEEE compliant.
- <sup>2)</sup> 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 operation temperature levels, the module will meet IEEE specifications again.
- “\*” means under development.

## 2.3 Functional Diagram

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

- Power supply
- Wireless Connectivity Interfaces
  - WLAN interface
  - BT interface\*
  - Coexistence interface
- Antenna interface
- Other interfaces
  - DBG\_TXD
  - 32KHz\_IN interface

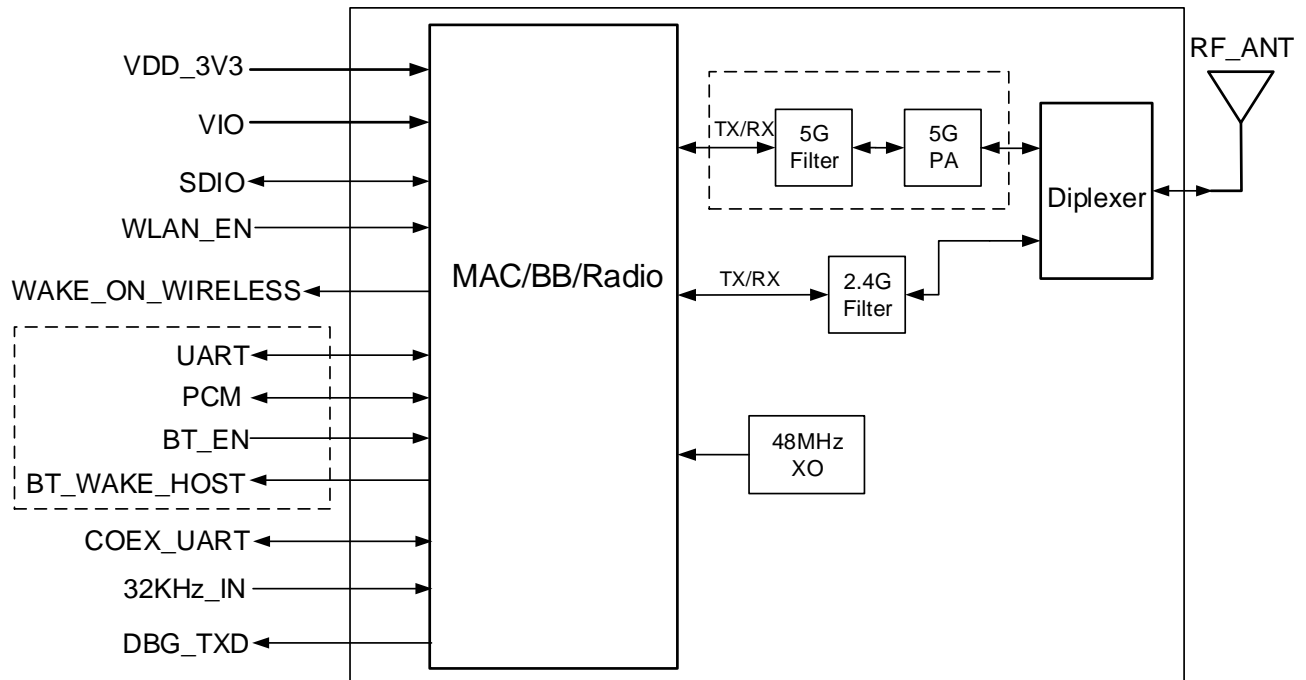


Figure 1: Functional Diagram of FC20 Series Module

#### NOTES

1. Functional parts framed in dotted line are only supported on FC20.
2. "\*" means under development.

## 2.4 Evaluation Board

In order to help customers to develop applications with FC20 series module, Quectel supplies an evaluation board (UMTS&LTE EVB), a RS-232 to USB converter 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 cellular application platform. The subsequent chapters will provide detailed descriptions of the following interfaces:

- Power supply
- Wireless Connectivity Interfaces
  - WLAN interface
  - BT interface\*
  - Coexistence interface
- Antenna interface
- Other interfaces
  - DBG\_TXD interface
  - 32KHz\_IN interface

### NOTE

“\*” means under development.

## 3.2 Pin Assignment

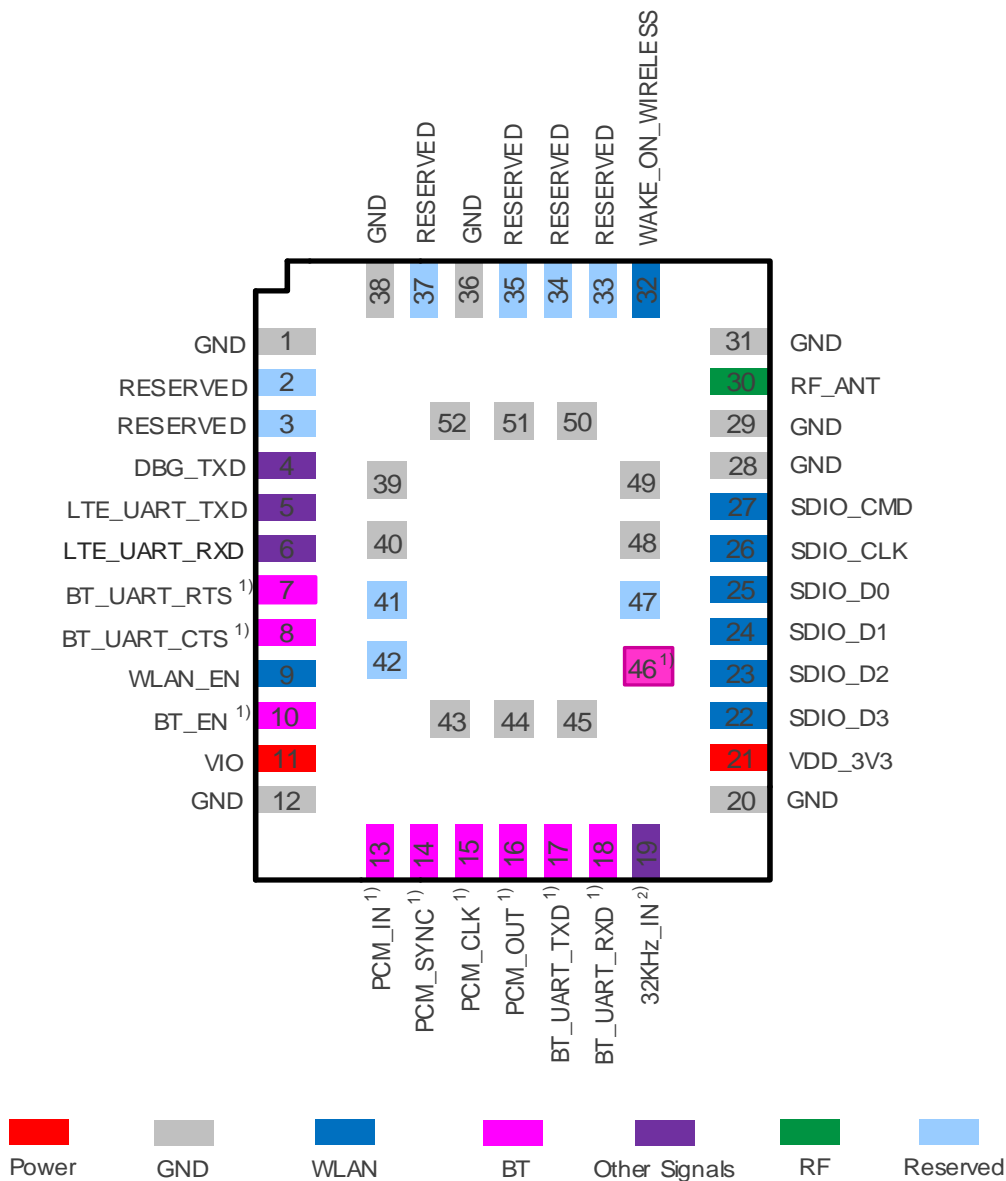


Figure 2: Pin Assignment of FC20 Series Module

### NOTES

1. Please keep all RESERVED pins open.
2. <sup>1)</sup> Pin 7, 8, 10, 13~18 and 46 are BT function pins for FC20 only. FC20-N does not support BT function, thus these pins are reserved on FC20-N. BT function is under development.
3. <sup>2)</sup> 32KHz\_IN is reserved on FC20 series module since the sleep function is under development.



### 3.3 Pin Description

The following tables show the pin definition of FC20 series module.

**Table 3: I/O Parameters Definition**

| Type | Description    |
|------|----------------|
| DI   | Digital input  |
| DO   | Digital output |
| IO   | Bidirectional  |
| PI   | Power input    |

**Table 4: Pin Description of FC20 Series Module**

| Power Supply     |  |     |                                    |   |   |
|------------------|--|-----|------------------------------------|---|---|
| Pin Name         | Pin No.  | I/O | Description                        | DC Characteristics  | Comment   |
| VDD_3V3          | 21   | PI  | Main power supply for module       | V <sub>max</sub> =3.46V<br>V <sub>min</sub> =3.14V<br>V <sub>norm</sub> =3.3V | It must be provided with sufficient current up to 0.6A.                               |
| VIO              | 11   | PI  | Power supply for module's I/O pins | V <sub>max</sub> =1.89V<br>V <sub>min</sub> =1.71V<br>V <sub>norm</sub> =1.8V | It is suggested to be powered by EC2x&EG25-G 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   | OD  | WLAN wake up the host              | V <sub>OLmax</sub> =0.18V<br>V <sub>OHmin</sub> =1.62V                        | 1.8V power domain. Active low. Require external pull-up to 1.8V. If unused, keep this |

|                       |    |    |                       |   |   |
|-----------------------|----|----|-----------------------|---|---|
|                       |    |    |                       |   | pin open.   |
| WLAN_EN               | 9  | DI | WLAN function control | V <sub>IL</sub> min=-0.3V<br>V <sub>IL</sub> max=0.54V<br>V <sub>IH</sub> min=1.26V<br>V <sub>IH</sub> max=2.0V   | 1.8V power domain.<br>Active high.                      |
| SDIO_D3               | 22 | IO | SDIO data bus D3      | V <sub>OL</sub> max=0.18V<br>V <sub>OH</sub> min=1.62V<br>V <sub>IL</sub> min=-0.3V<br>V <sub>IL</sub> max=0.54V<br>V <sub>IH</sub> min=1.26V<br>V <sub>IH</sub> max=2.0V | 1.8V power domain                                       |
| SDIO_D2 <sup>1)</sup> | 23 | IO | SDIO data bus D2      | V <sub>OL</sub> max=0.18V<br>V <sub>OH</sub> min=1.62V<br>V <sub>IL</sub> min=-0.3V<br>V <sub>IL</sub> max=0.54V<br>V <sub>IH</sub> min=1.26V<br>V <sub>IH</sub> max=2.0V | 1.8V power domain.<br>Require external pull-up to 1.8V. |
| SDIO_D1               | 24 | IO | SDIO data bus D1      | V <sub>OL</sub> max=0.18V<br>V <sub>OH</sub> min=1.62V<br>V <sub>IL</sub> min=-0.3V<br>V <sub>IL</sub> max=0.54V<br>V <sub>IH</sub> min=1.26V<br>V <sub>IH</sub> max=2.0V | 1.8V power domain                                       |
| SDIO_D0               | 25 | IO | SDIO data bus D0      | V <sub>OL</sub> max=0.18V<br>V <sub>OH</sub> min=1.62V<br>V <sub>IL</sub> min=-0.3V<br>V <sub>IL</sub> max=0.54V<br>V <sub>IH</sub> min=1.26V<br>V <sub>IH</sub> max=2.0V | 1.8V power domain                                       |
| SDIO_CLK              | 26 | DI | SDIO bus clock        | V <sub>IL</sub> min=-0.3V<br>V <sub>IL</sub> max=0.54V<br>V <sub>IH</sub> min=1.26V<br>V <sub>IH</sub> max=2.0V   | 1.8V power domain                                       |
| SDIO_CMD              | 27 | IO | SDIO bus command      | V <sub>OL</sub> max=0.18V<br>V <sub>OH</sub> min=1.62V<br>V <sub>IL</sub> min=-0.3V<br>V <sub>IL</sub> max=0.54V<br>V <sub>IH</sub> min=1.26V<br>V <sub>IH</sub> max=2.0V | 1.8V power domain                                       |

**BT Interface\* <sup>2)</sup> (For FC20 Only)**

| Pin Name | Pin No. | I/O | Description | DC Characteristics | Comment |
|----------|---------|-----|-------------|--------------------|---------|
|----------|---------|-----|-------------|--------------------|---------|

|              |    |    |  |   |  |
|--------------|----|----|--|---|--|
| BT_EN        | 10 | DI | BT function control                      | $V_{ILmin}=-0.3V$<br>$V_{ILmax}=0.54V$<br>$V_{IHmin}=1.26V$<br>$V_{IHmax}=2.0V$ | 1.8V power domain.<br>Active high.   |
| BT_WAKE_HOST | 46 | OD | BT wake up the host                      | $V_{OLmax}=0.18V$<br>$V_{OHmin}=1.62V$  | 1.8V power domain.<br>Active low.<br>Pulled up internally.<br>If unused, keep this pin open. |
| PCM_IN       | 13 | OD | BT PCM data input                        | $V_{ILmin}=-0.3V$<br>$V_{ILmax}=0.54V$<br>$V_{IHmin}=1.26V$<br>$V_{IHmax}=2.0V$ | 1.8V power domain.<br>Require external pull-up to 1.8V.<br>If unused, keep this pin open.    |
| PCM_SYNC     | 14 | DI | BT PCM data frame synchronization signal | $V_{ILmin}=-0.3V$<br>$V_{ILmax}=0.54V$<br>$V_{IHmin}=1.26V$<br>$V_{IHmax}=2.0V$ | 1.8V power domain.<br>If unused, keep this pin open.   |
| PCM_CLK      | 15 | DI | BT PCM data bit clock                    | $V_{ILmin}=-0.3V$<br>$V_{ILmax}=0.54V$<br>$V_{IHmin}=1.26V$<br>$V_{IHmax}=2.0V$ | 1.8V power domain.<br>If unused, keep this pin open.   |
| PCM_OUT      | 16 | DO | BT PCM data output                       | $V_{OLmax}=0.18V$<br>$V_{OHmin}=1.62V$  | 1.8V power domain.<br>If unused, keep this pin open.   |
| BT_UART_RTS  | 7  | DO | BT UART request to send                  | $V_{OLmax}=0.18V$<br>$V_{OHmin}=1.62V$  | 1.8V power domain.<br>If unused, keep this pin open.   |
| BT_UART_CTS  | 8  | DI | BT UART clear to send                    | $V_{ILmin}=-0.3V$<br>$V_{ILmax}=0.54V$<br>$V_{IHmin}=1.26V$<br>$V_{IHmax}=2.0V$ | 1.8V power domain.<br>If unused, keep this pin open.   |
| BT_UART_TXD  | 17 | DO | BT UART transmit data                    | $V_{OLmax}=0.18V$<br>$V_{OHmin}=1.62V$  | 1.8V power domain.<br>If unused, keep this pin open.   |
| BT_UART_RXD  | 18 | DI | BT UART receive data                     | $V_{ILmin}=-0.3V$<br>$V_{ILmax}=0.54V$<br>$V_{IHmin}=1.26V$<br>$V_{IHmax}=2.0V$ | 1.8V power domain.<br>If unused, keep this pin open.   |

#### Coexistence Interface <sup>3)</sup>

| Pin Name | Pin No. | I/O | Description | DC Characteristics | Comment |
|----------|---------|-----|-------------|--------------------|---------|
|----------|---------|-----|-------------|--------------------|---------|

|              |   |    |                                |   |  |
|--------------|---|----|--------------------------------|---|--|
| LTE_UART_TXD | 5 | DO | LTE/WiFi&BT coexistence signal | $V_{OLmax}=0.18V$<br>$V_{OHmin}=1.62V$  | 1.8V power domain.<br>If unused, keep this pin open. |
| LTE_UART_RXD | 6 | DI | LTE/WiFi&BT coexistence signal | $V_{ILmin}=-0.3V$<br>$V_{ILmax}=0.54V$<br>$V_{IHmin}=1.26V$<br>$V_{IHmax}=2.0V$ | 1.8V power domain.<br>If unused, keep this pin open. |

#### RF Interface

| Pin Name | Pin No. | I/O | Description                | DC Characteristics | Comment        |
|----------|---------|-----|----------------------------|--------------------|----------------|
| RF_ANT   | 30      | IO  | Wi-Fi/BT antenna interface |                    | 50Ω impedance. |

#### Other Interfaces

| Pin Name               | Pin No. | I/O | Description                                   | DC Characteristics  | Comment   |
|------------------------|---------|-----|---|---|---|
| DBG_TXD                | 4       | OD  | Used for software debugging                   | $V_{OLmax}=0.18V$<br>$V_{OHmin}=1.62V$  | 1.8V power domain.<br>Require external pull-up to 1.8V.<br>If unused, keep this pin open. |
| 32KHz_IN <sup>4)</sup> | 19      | DI  | Low power.<br>External 32.768KHz clock input. | $V_{ILmin}=-0.3V$<br>$V_{ILmax}=0.54V$<br>$V_{IHmin}=1.26V$<br>$V_{IHmax}=2.0V$ | 1.8V power domain.<br>If unused, keep this pin open.                                      |

#### RESERVED Pins

| Pin Name | Pin No.                              | I/O | Description | DC Characteristics | Comment               |
|----------|--------------------------------------|-----|-------------|--------------------|-----------------------|
| RESERVED | 2, 3,<br>33~35,<br>37, 41,<br>42, 47 |     | Reserved    |                    | Keep these pins open. |

#### NOTES

- <sup>1)</sup> SDIO\_D2 is a boot strap signal, which must be kept at high level for normal operation during power on.
- <sup>2)</sup> BT interface is only supported on FC20; BT function pins (pin 7, 8, 10, 13~18 and 46) are reserved on FC20-N.
- <sup>3)</sup> FC20 supports both LTE/WLAN coexistence and LTE/BT coexistence\*, while FC20-N only supports LTE/WLAN coexistence.
- <sup>4)</sup> 32KHz\_IN is reserved on FC20 series module since the sleep function is still to be developed.
- "\*" means under development.

### 3.4 Power Supply

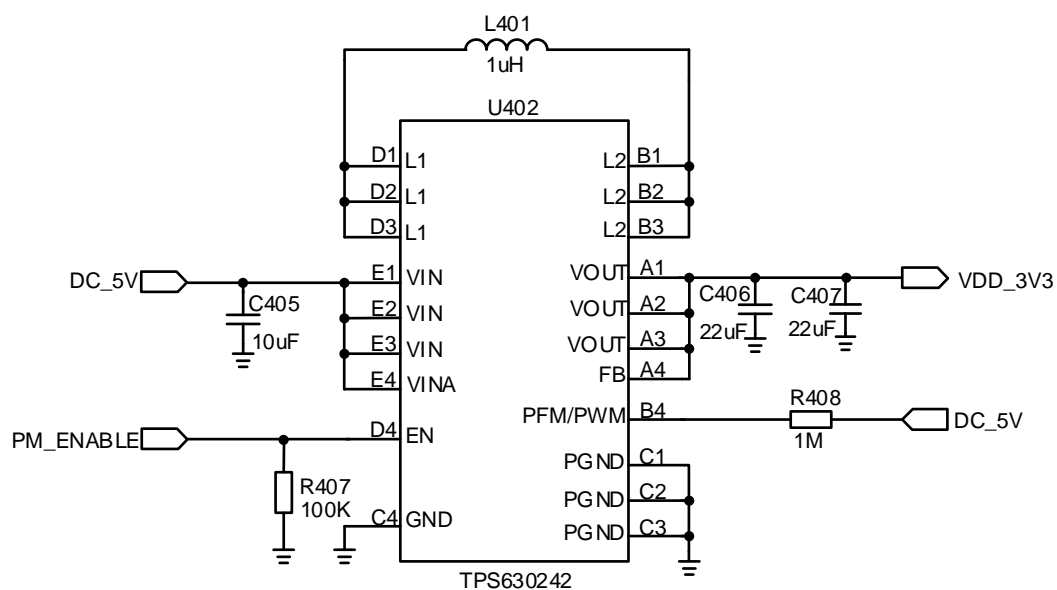
The following table shows the power supply pins and the ground pins of FC20 series. The VIO pin is recommended to be powered by EC2x&EG25-G.

**Table 5: Power Supply Pins and GND Pins**

| Pin Name | Pin No.  | Description                            | Min. | Typ. | Max. | Unit |
|----------|--|--|------|------|------|------|
| VDD_3V3  | 21   | Main power supply for the module       | 3.14 | 3.3  | 3.46 | V    |
| VIO      | 11   | Power supply for the module's I/O pins | 1.71 | 1.8  | 1.89 | V    |
| GND      | 1, 12, 20, 28, 29, 31, 36, 38~40, 43~45, 48~52 | Ground                                 |      |      |      |      |

FC20 series is powered by VDD\_3V3, and it is recommended to use a power supply chip with maximum output current more than 0.6A.

The following figure shows a reference design for VDD\_3V3. Pulling PM\_ENABLE to a high voltage level will enable VDD\_3V3 power output. And this pin should be connected to pin 127 of EC2x&EG25-G. For more details, please refer to **document [2], [3], [4], [5] or [6]**.



**Figure 3: Reference Circuit for VDD\_3V3**

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

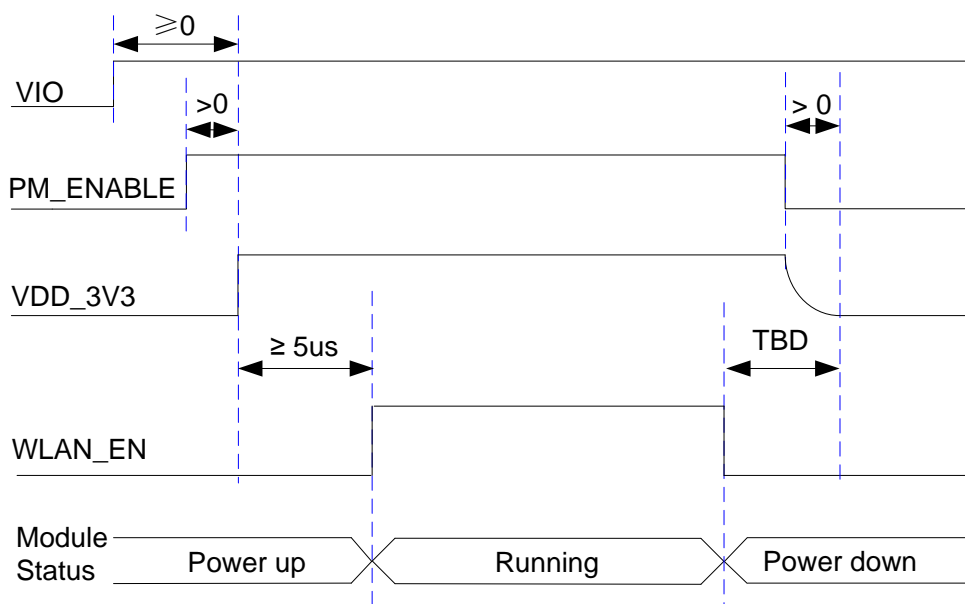


Figure 4: Timing of Turning on/off FC20 Series Module

## 3.5 Wireless Connectivity Interfaces

FC20 series support a low-power SDIO 3.0 interface for WLAN, and UART&PCM interfaces for BT function (for FC20 only).

### 3.5.1 WLAN Interface

The following figure shows the WLAN interface connection between FC20 series and EC2x&EG25-G.

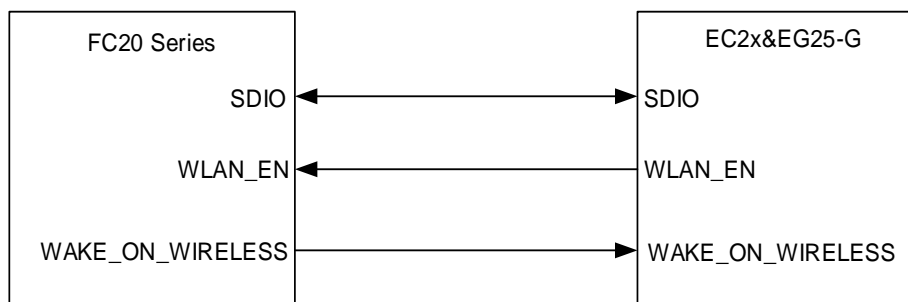


Figure 5: WLAN Interface Connection

### 3.5.1.1 WAKE\_ON\_WIRELESS

WAKE\_ON\_WIRELESS is used to wake up the EC2x&EG25-G module. When the pin is pulled down, EC2x&EG25-G can be woken up.

**Table 6: Pin Definition of WAKE\_ON\_WIRELESS**

| Pin Name         | Pin No. | I/O | Description           | Comment  |
|------------------|---------|-----|-----------------------|--|
| WAKE_ON_WIRELESS | 32      | OD  | WLAN wake up the host | 1.8V power domain.<br>Active low.<br>Require external pull-up to 1.8V.<br>If unused, keep this pin open. |

### 3.5.1.2 WAKE\_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 function control | 1.8V power domain.<br>Active high. |

#### NOTE

WLAN\_EN is a sensitive signal, and thus should be ground-shielded and routed as close as possible to FC20 series module.

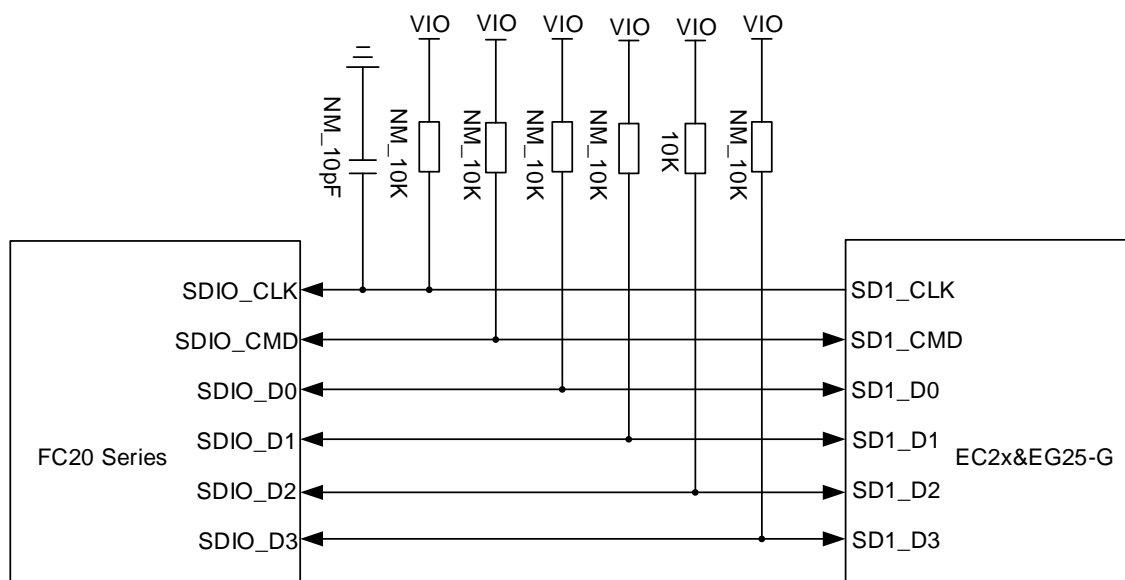
### 3.5.1.3 SDIO Interface

The following table shows the pin definition of SDIO interface.

**Table 8: Pin Definition of SDIO Interface**

| Pin Name | Pin No. | I/O | Description      | Comment   |
|----------|---------|-----|------------------|---|
| SDIO_D3  | 22      | IO  | SDIO data bus D3 | 1.8V power domain.                                      |
| SDIO_D2  | 23      | IO  | SDIO data bus D2 | 1.8V power domain.<br>Require external pull-up to 1.8V. |
| SDIO_D1  | 24      | IO  | SDIO data bus D1 | 1.8V power domain.                                      |
| SDIO_D0  | 25      | IO  | SDIO data bus D0 | 1.8V power domain.                                      |
| SDIO_CLK | 26      | DI  | SDIO bus clock   | 1.8V power domain.                                      |
| SDIO_CMD | 27      | IO  | SDIO bus command | 1.8V power domain.                                      |

The following figure shows the SDIO interface connection between FC20 series and EC2x&EG25-G.



**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 among 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.
- SDIO\_D2 is a boot strap signal, which must be kept at high level for normal operation during power on. 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 trace width.

### 3.5.2 BT Interface\*

The following figure shows the block diagram of BT interface connection between FC20 <sup>1)</sup> and EC2x&EG25-G.

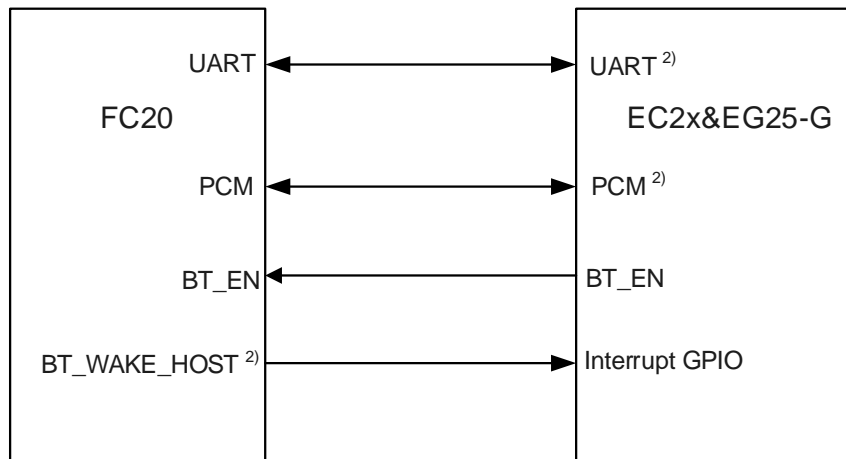


Figure 7: Block Diagram of BT Interface Connection

#### NOTES

- <sup>1)</sup> BT function is only supported on FC20. Please keep BT function pins (pin 7, 8, 10, 13~18 and 46) reserved on FC20-N.
- <sup>2)</sup> UART, PCM and BT\_WAKE\_HOST interfaces of EC2x&EG25-G must be used when BT function is used on FC20.
- “\*” means under development.

#### 3.5.2.1 BT\_EN

BT\_EN is used to control the BT function of FC20. 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  | BT function control | 1.8V power domain.<br>Active high. |

### 3.5.2.2 BT\_WAKE\_HOST

BT\_WAKE\_HOST is used to wake up the EC2x&EG25-G module. When the pin is pulled down, EC2x&EG25-G can be woken up.

**Table 10: Pin Definition of BT\_WAKE\_HOST**

| Pin Name     | Pin No. | I/O | Description         | Comment  |
|--------------|---------|-----|---------------------|--|
| BT_WAKE_HOST | 46      | OD  | BT wake up the host | 1.8V power domain.<br>Active Low.<br>Pulled up internally.<br>If unused, keep this pin open. |

### 3.5.2.3 PCM Interface

FC20 provides a PCM interface for BT application. 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_IN   | 13      | OD  | BT PCM data input                        | 1.8V power domain.<br>Require external pull-up to 1.8V.<br>If unused, keep this pin open. |
| PCM_SYNC | 14      | DI  | BT PCM data frame synchronization signal | 1.8V power domain.<br>If unused, keep these pins open.                                    |
| PCM_CLK  | 15      | DI  | BT PCM data bit clock                    |   |
| PCM_OUT  | 16      | DO  | BT PCM data output                       |   |

The following figure shows a reference design for PCM interface connection between FC20 and EC2x&EG25-G.

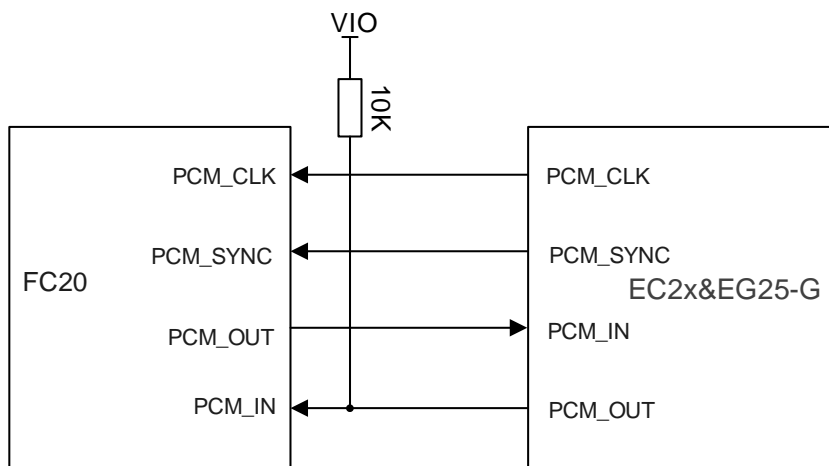


Figure 8: Reference Design for PCM Interface

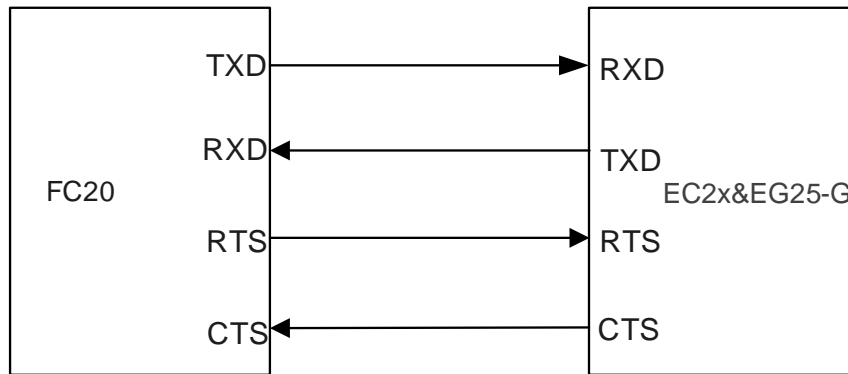
### 3.5.2.4 UART Interface

FC20 provides a dedicated UART interface for BT application. The following table shows the pin definition of UART interface.

Table 12: Pin Definition of UART Interface

| Pin Name    | Pin No. | I/O | Description             | Comment  |
|-------------|---------|-----|-------------------------|--|
| BT_UART_RTS | 7       | DO  | BT UART request to send |  |
| BT_UART_CTS | 8       | DI  | BT UART clear to send   | 1.8V power domain.<br>If unused, keep these pins open. |
| BT_UART_TXD | 17      | DO  | BT UART transmit data   |  |
| BT_UART_RXD | 18      | DI  | BT UART receive data    |  |

The following figure shows a reference design for UART interface connection between FC20 and EC2x&EG25-G.



**Figure 9: Reference Design for UART Interface Connection**

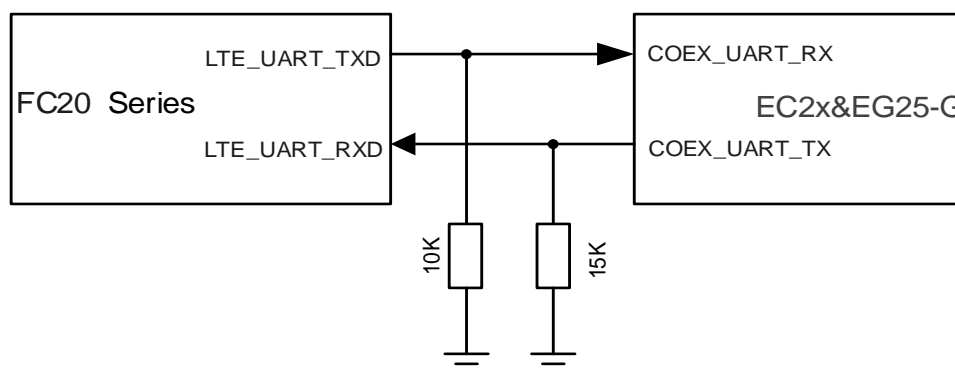
### 3.5.3 Coexistence Interface

The following table shows the pin definition of coexistence interface <sup>1)</sup>.

**Table 13: Pin Definition of Coexistence Interface**

| Pin Name     | Pin No. | I/O | Description                    | Comment                          |
|--------------|---------|-----|--------------------------------|----------------------------------|
| LTE_UART_TXD | 5       | DO  | LTE/WiFi&BT coexistence signal | 1.8V power domain.               |
| LTE_UART_RXD | 6       | DI  | LTE/WiFi&BT coexistence signal | If unused, keep these pins open. |

The following figure shows the coexistence interface connection between FC20 series and EC2x&EG25-G.



**Figure 10: Coexistence Interface Connection**

## NOTES

1. FC20 supports both LTE/WLAN coexistence and LTE/BT coexistence\*; while FC20-N only supports LTE/WLAN coexistence.
2. “\*” means under development.

## 3.6 Other Interfaces

### 3.6.1 DBG\_TXD Interface

DBG\_TXD interface can be used for log output.

**Table 14: Pin Definition of DBG\_TXD Interface**

| Pin Name | Pin No. | I/O | Description                 | Comment   |
|----------|---------|-----|-----------------------------|---|
| DBG_TXD  | 4       | OD  | Used for software debugging | 1.8V power domain.<br>Require external pull-up to 1.8V.<br>If unused, keep this pin open. |

### 3.6.2 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 in sleep mode.

**Table 15: Pin Definition of 32KHz\_IN Interface**

| Pin Name | Pin No. | I/O | Description                                   | Comment  |
|----------|---------|-----|---|--|
| 32KHz_IN | 19      | DI  | Low power.<br>External 32.768KHz clock input. | 1.8V power domain.<br>If unused, keep this pin open. |

## NOTE

32KHz\_IN pin is reserved on FC20 series module since the sleep function is still to be developed.

## 3.7 Antenna Interface

Pin 30 is the RF antenna pad. And the RF port has an impedance of 50Ω.

### 3.7.1 Pin Definition of RF Antenna Interface

Table 16: Pin Definition of RF Antenna Interface

| Pin Name | Pin No. | I/O | Description          | Comment       |
|----------|---------|-----|----------------------|---------------|
| GND      | 28      |     | Ground               |               |
| GND      | 29      |     | Ground               |               |
| RF_ANT   | 30      | IO  | Wi-Fi/BT antenna pad | 50Ω impedance |
| GND      | 31      |     | Ground               |               |

### 3.7.2 Operating Frequency

Table 17: Operating Frequency of FC20-N

| Feature     | Frequency   | Unit |
|-------------|-------------|------|
| 2.4GHz WLAN | 2.412~2.472 | GHz  |

Table 18: Operating Frequency of FC20

| Feature     | Frequency   | Unit |
|-------------|-------------|------|
| 2.4GHz WLAN | 2.412~2.472 | GHz  |
| 5GHz WLAN   | 5.180~5.825 | GHz  |
| BT 4.2*     | 2.402~2.48  | GHz  |

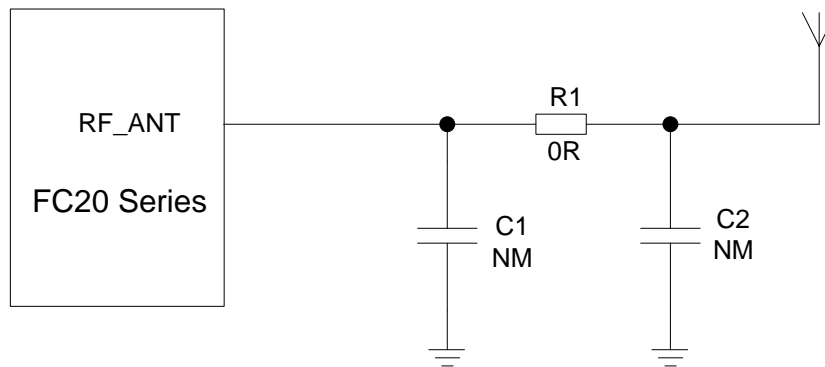
#### NOTE

“\*” means under development.

### 3.7.3 Reference Designs

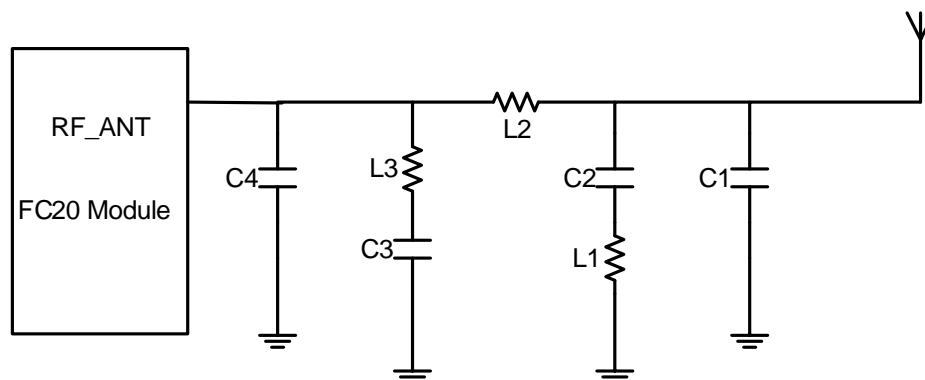
FC20 series module provides an RF antenna pad for Wi-Fi/BT antenna connection. The RF trace in host PCB connected to the module's RF antenna pad should be microstrip line or other types of RF trace, with characteristic impedance close to 50Ω. FC20 series module comes with grounding pads which are next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

A reference circuit for the RF antenna interface is shown below. It is recommended to reserve a  $\pi$ -type matching circuit for better RF performance. The capacitors are not mounted by default.



**Figure 11: Reference Circuit for RF Antenna Interface**

Another type of reference circuit for the RF antenna interface is shown below. It is designed for vehicle applications. It is recommended to reserve two notch filter circuits and a  $\pi$ -type matching circuit for better RF performance. C2/L1 and L3/C3 comprise two notch filter circuits for filtering out interference caused by a particular frequency. When L3/C2/L1/C3 is NC, C1/L2/C4 comprise a  $\pi$ -type matching circuit. Capacitors C1/C2/C3/C4 and inductors L1/L3 are not mounted by default, and L2 is 0Ω by default.



**Figure 12: Reference Circuit for RF Antenna Interface (Vehicle Applications)**

### 3.7.4 Antenna Requirements

The following table shows the requirements on RF antenna.

**Table 19: Antenna Cable Requirements**

| Type              | Requirements              |
|-------------------|---------------------------|
| 2.412GHz~2.472GHz | Cable insertion loss <1dB |
| 5.180GHz~5.825GHz | Cable insertion loss <1dB |

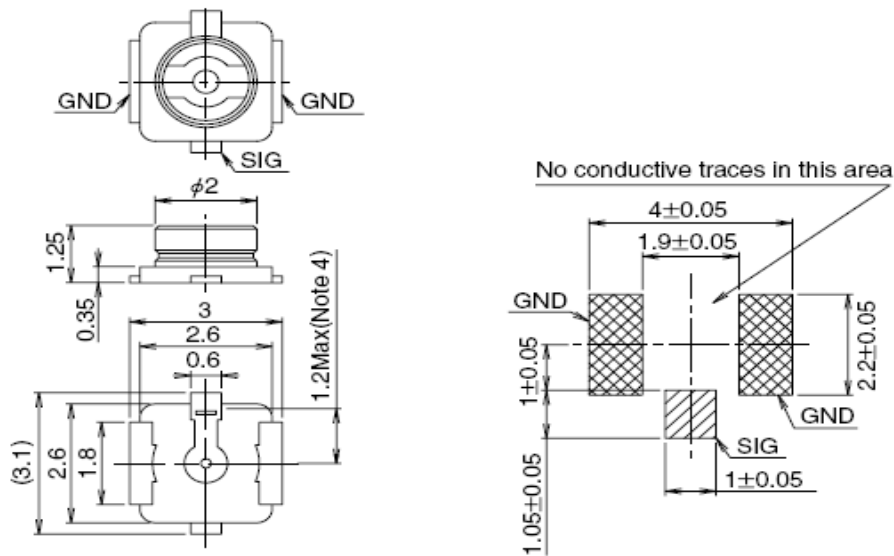
**Table 20: Antenna Requirements**

| Type                         | Requirements                           |
|------------------------------|--|
| Frequency Range              | 2.412GHz~2.472GHz<br>5.180GHz~5.825GHz |
| VSWR                         | < 2:1 recommended                      |
| Gain (dBi)                   | 1 typical                              |
| Max Input Power (W)          | 50                                     |
| Input Impedance ( $\Omega$ ) | 50                                     |
| Polarization Type            | Vertical                               |

### 3.7.5 Recommended RF Connector for Antenna Installation

If RF connector is used for antenna connection, it is recommended to use the 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.

|                  | U.FL-LP-040                  | U.FL-LP-066                                     | U.FL-LP(V)-040               | U.FL-LP-062                | U.FL-LP-088                  |
|------------------|------------------------------|---|------------------------------|----------------------------|------------------------------|
| Part No.         |                              |   |                              |                            |                              |
| Mated Height     | 2.5mm Max.<br>(2.4mm Nom.)   | 2.5mm Max.<br>(2.4mm Nom.)                      | 2.0mm Max.<br>(1.9mm Nom.)   | 2.4mm Max.<br>(2.3mm Nom.) | 2.4mm Max.<br>(2.3mm Nom.)   |
| Applicable cable | Dia. 0.81mm<br>Coaxial cable | Dia. 1.13mm and<br>Dia. 1.32mm<br>Coaxial cable | Dia. 0.81mm<br>Coaxial cable | Dia. 1mm<br>Coaxial cable  | Dia. 1.37mm<br>Coaxial cable |
| Weight (mg)      | 53.7                         | 59.1  | 34.8                         | 45.5                       | 71.7                         |
| RoHS             | YES                          |   |                              |                            |                              |

**Figure 14: Mechanicals of U.FL-LP Connectors**

The following figure describes the space factor of mated connector.

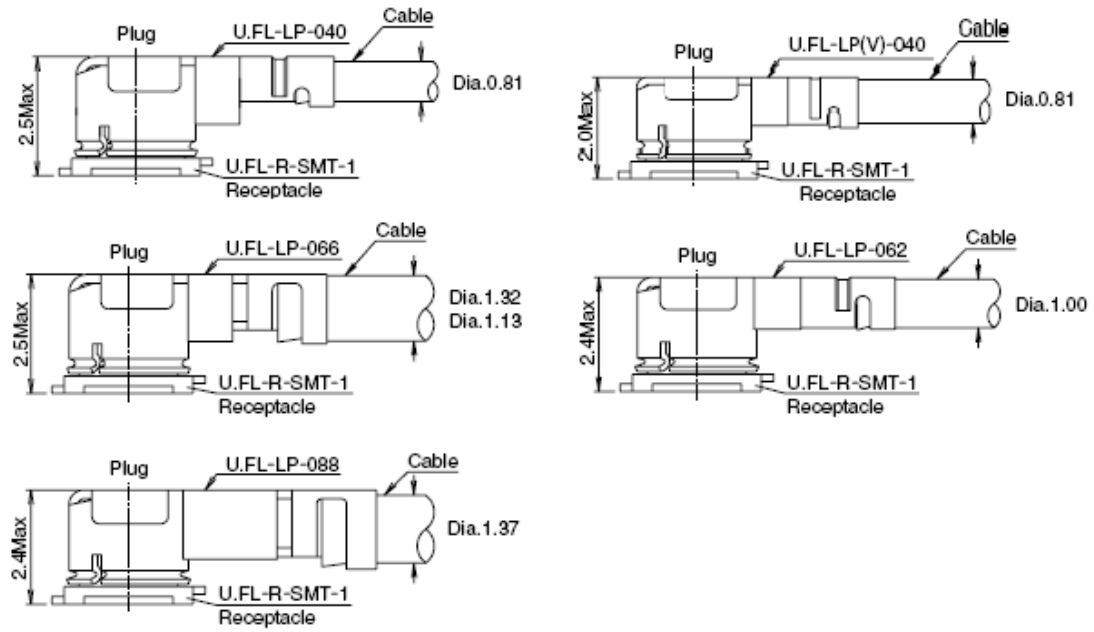


Figure 15: Space Factor of Mated Connector (Unit: mm)

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

# 4 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 21: Absolute Maximum Ratings**

| Parameter                 | Min. | Max.    | Unit |
|---------------------------|------|---------|------|
| VDD_3V3                   | -0.3 | 3.46    | 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 22: 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 23: General DC Electrical Characteristics**

| Symbol          | Parameter                 | Min.    | Max.    | Unit |
|-----------------|---------------------------|---------|---------|------|
| V <sub>IH</sub> | High Level Input Voltage  | 0.7*VIO | VIO+0.2 | V    |
| V <sub>IL</sub> | Low Level Input Voltage   | -0.3    | 0.3*VIO | V    |
| V <sub>OH</sub> | High Level Output Voltage | 0.9*VIO | VIO     | V    |
| V <sub>OL</sub> | Low Level Output Voltage  | 0       | 0.1*VIO | V    |
| I <sub>IL</sub> | Input Leakage Current     | -5      | 5       | μA   |

## 4.4 Current Consumption

**Table 24: Current Consumption of the Module in Low Power Mode**

| Description             | Conditions | I <sub>WLAN_3V3</sub> | I <sub>VIO</sub> | Unit |
|-------------------------|------------|-----------------------|------------------|------|
| OFF State <sup>1)</sup> | AT+QWIFI=0 | 0                     | 554              | μA   |
| Idle <sup>2)</sup>      | AT+QWIFI=1 | 66                    | 6.5              | mA   |

## NOTES

- 1) OFF state: Executing **AT+QWIFI=0** command will make the module enter this state. Under the state, the sleep clock is disabled and no data is saved.
- 2) Idle state: Wi-Fi function enabled via **AT+QWIFI=1**, but without any device connected to the AP.

**Table 25: Current Consumption of the Module**

| Standard | Data Rate             | I <sub>WLAN_3V3</sub> | 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          | 395                   | mA   |
|          | TX HT20 MCS7          | 307                   | mA   |
|          | RX HT20 MCS0          | 78                    | mA   |

|          |                        |     |    |
|----------|------------------------|-----|----|
|          | RX HT20 MCS7           | 78  | mA |
|          | 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 |

## 4.5 RF Performance

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

**Table 26: Conducted RF Output Power at 2.4GHz**

| Standard      | Data Rate | Typ.     | Unit |
|---------------|-----------|----------|------|
| 802.11b       | 1Mbps     | 17.5±2.5 | dBm  |
| 802.11b       | 11Mbps    | 17.0±2.5 | dBm  |
| 802.11g       | 6Mbps     | 16.5±2.5 | dBm  |
| 802.11g       | 54Mbps    | 15.0±2.5 | dBm  |
| 802.11n, HT20 | MCS0      | 15.5±2.5 | dBm  |
| 802.11n, HT20 | MCS7      | 14.5±2.5 | dBm  |

|               |      |          |     |
|---------------|------|----------|-----|
| 802.11n, HT40 | MCS0 | 15.0±2.5 | dBm |
| 802.11n, HT40 | MCS7 | 13.0±2.5 | dBm |

**Table 27: Conducted RF Output Power at 5GHz**

| Standard        | Data Rate | Typ.     | Unit |
|-----------------|-----------|----------|------|
| 802.11a         | 6Mbps     | 14.5±2.5 | dBm  |
| 802.11a         | 54Mbps    | 12.5±2.5 | dBm  |
| 802.11ac, VHT20 | MCS0      | 13.5±2.5 | dBm  |
| 802.11ac, VHT20 | MCS7      | 11.5±2.5 | dBm  |
| 802.11ac, VHT40 | MCS0      | 12.0±2.5 | dBm  |
| 802.11ac, VHT40 | MCS9      | 10.5±2.5 | dBm  |
| 802.11ac, VHT80 | MCS0      | 11.5±2.5 | dBm  |
| 802.11ac, VHT80 | MCS9      | 10.5±2.5 | dBm  |

**Table 28: Conducted RF Receiving Sensitivity at 2.4GHz**

| Standard      | Data Rate | Typ.  | Unit |
|---------------|-----------|-------|------|
| 802.11b       | 1Mbps     | -92   | dBm  |
| 802.11b       | 11Mbps    | -85   | dBm  |
| 802.11g       | 6Mbps     | -88   | dBm  |
| 802.11g       | 54Mbps    | -72   | dBm  |
| 802.11n, HT20 | MCS0      | -88.5 | dBm  |
| 802.11n, HT20 | MCS7      | -70   | dBm  |
| 802.11n, HT40 | MCS0      | -85   | dBm  |
| 802.11n, HT40 | MCS7      | -67   | dBm  |

**Table 29: Conducted RF Receiving Sensitivity at 5GHz**

| Standard        | Data Rate | Typ. | Unit |
|-----------------|-----------|------|------|
| 802.11a         | 6Mbps     | -90  | dBm  |
| 802.11a         | 54Mbps    | -74  | dBm  |
| 802.11ac, VHT20 | MCS0      | -90  | dBm  |
| 802.11ac, VHT20 | MCS7      | -67  | dBm  |
| 802.11ac, VHT40 | MCS0      | -87  | dBm  |
| 802.11ac, VHT40 | MCS9      | -62  | dBm  |
| 802.11ac, VHT80 | MCS0      | -84  | dBm  |
| 802.11ac, VHT80 | MCS9      | -59  | dBm  |

## 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 followed throughout the processing, handling and operation of any application that involves the module.

The following table shows the module's electrostatic discharge characteristics.

**Table 30: Electrostatic Discharge Characteristics (25°C, 45% Relative Humidity)**

| Interface | Contact Discharge | Air Discharge | Unit |
|-----------|-------------------|---------------|------|
| VDD_3V3   | ±3                | ±12           | kV   |
| VIO       | ±3                | ±8            | kV   |
| GND       | ±3                | ±12           | kV   |
| RF        | ±4                | ±12           | kV   |



# 5 Mechanical Dimensions

This chapter describes the mechanical dimensions of FC20 series module. All dimensions are measured in millimeter (mm), and the dimensional tolerances are  $\pm 0.05\text{mm}$  unless otherwise specified.

## 5.1 Mechanical Dimensions of the Module

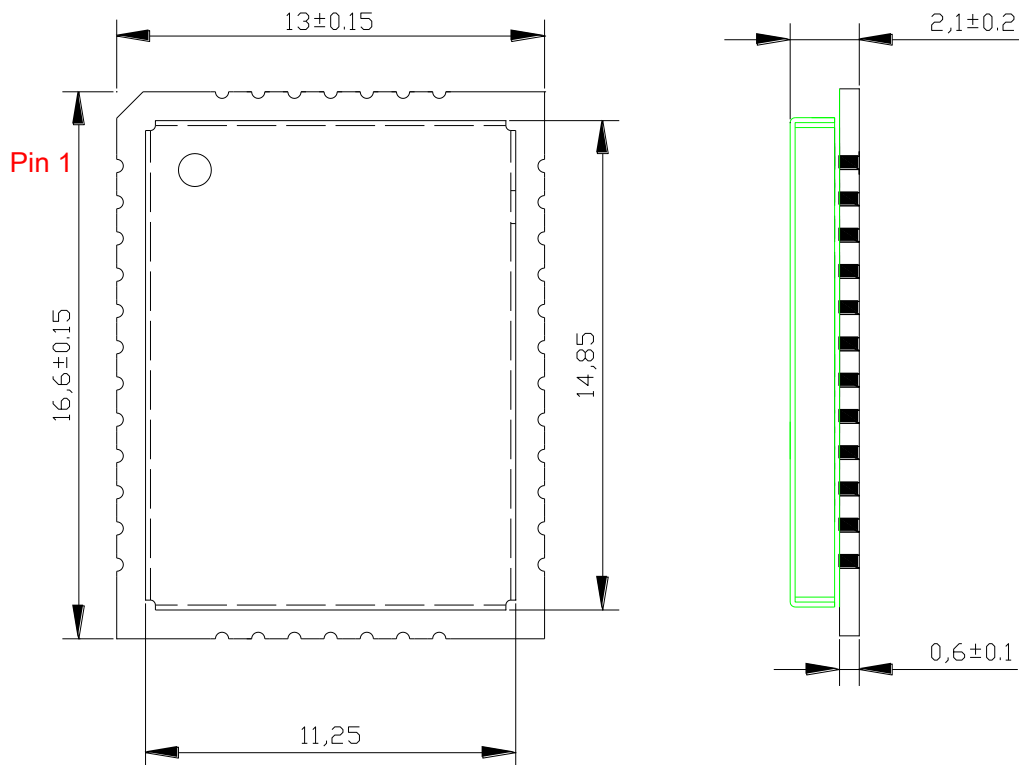
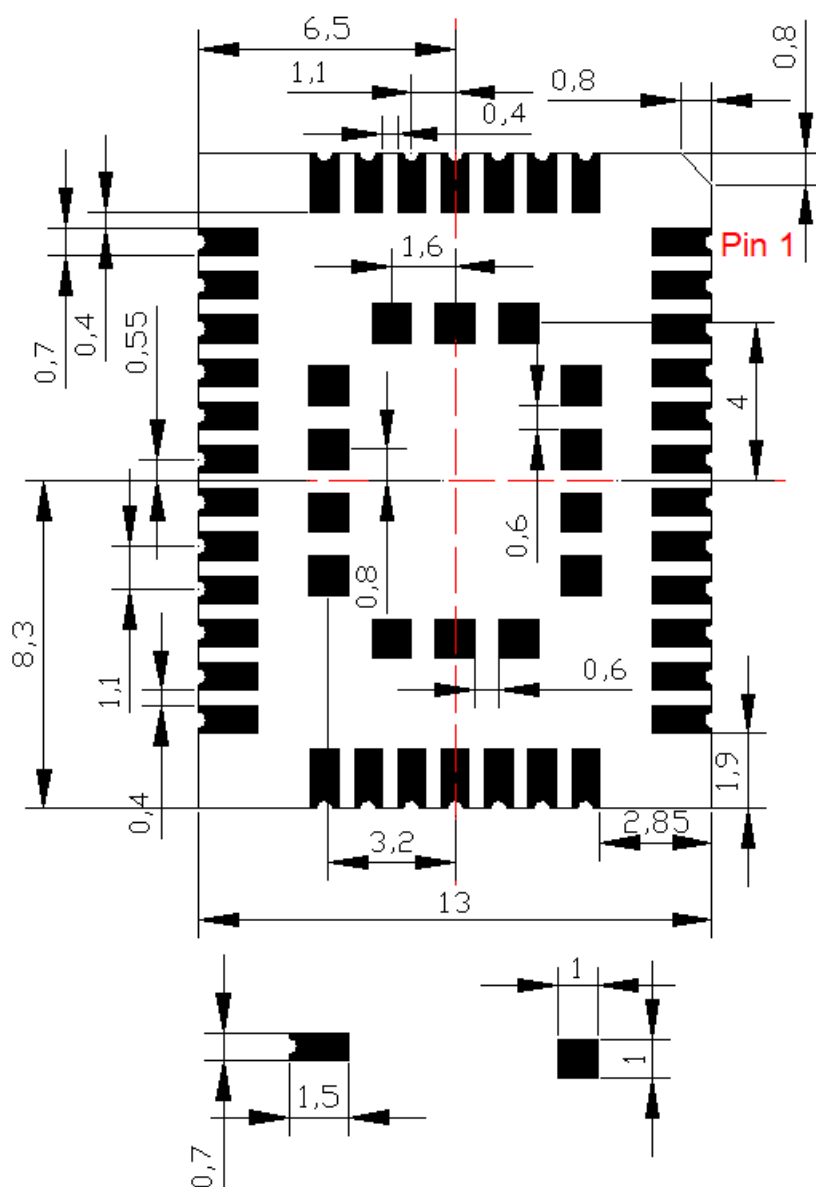


Figure 16: Top and Side Dimensions





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.

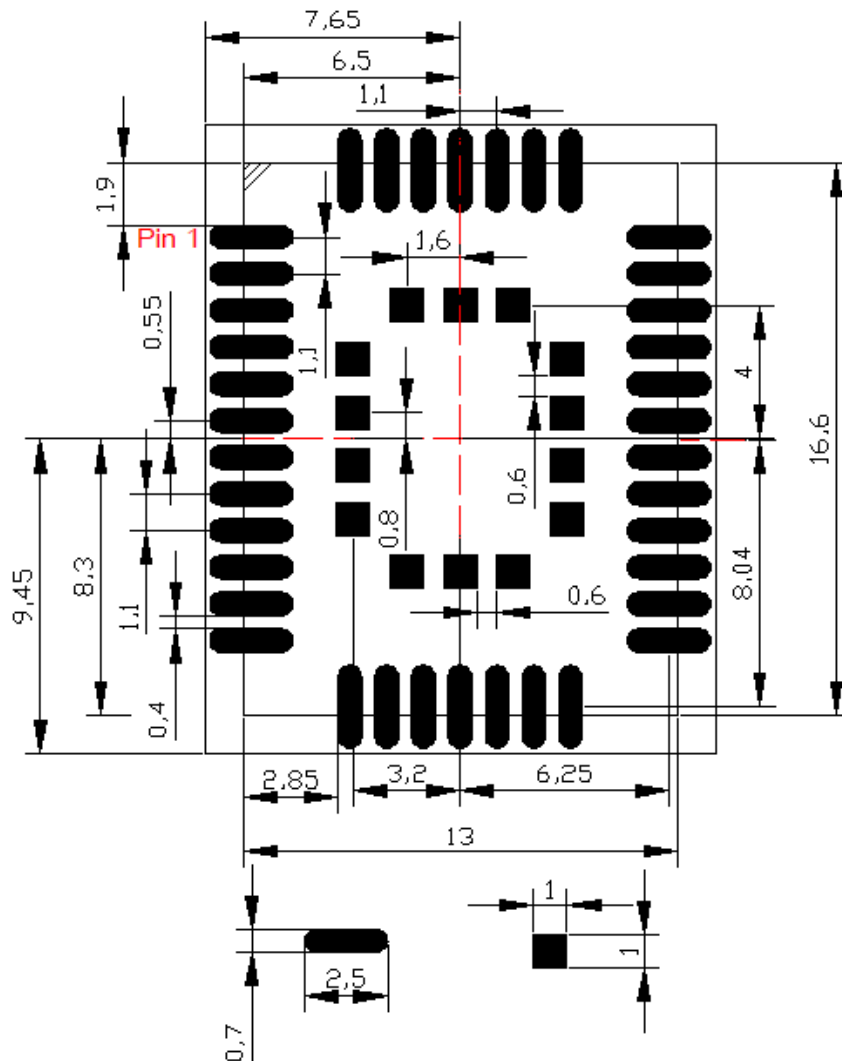


Figure 19: Recommended Stencil Design

#### NOTES

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

### 5.3 Top and Bottom View of the Module



Figure 20: Top View of the Module

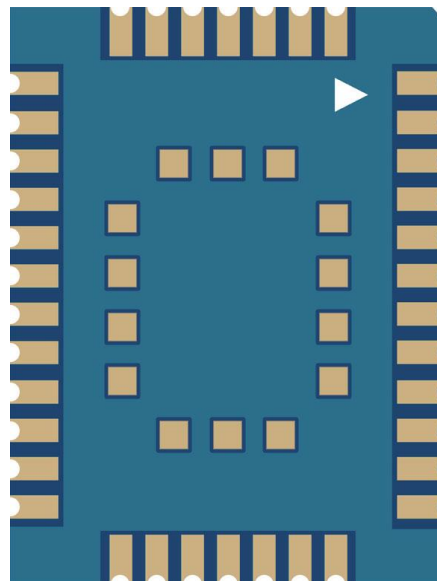


Figure 21: Bottom View of the Module

#### NOTE

These are renderings of FC20 series module. For authentic appearance, 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. It is rated at MSL 3, and its storage restrictions are listed below.

1. Shelf life in the vacuum-sealed bag: 12 months at <40°C/90%RH.
2. After the vacuum-sealed bag is opened, devices that will be subjected to reflow soldering or other high temperature processes must be:
  - Mounted within 168 hours at the factory environment of ≤30°C/60%RH.
  - Stored at <10%RH.
3. Devices require baking before mounting, if any circumstance below occurs.
  - When the ambient temperature is 23°C±5°C and the humidity indication card shows the humidity is >10% before opening the vacuum-sealed bag.
  - Device mounting cannot be finished within 168 hours at factory conditions of ≤30°C/60%RH.
4. If baking is required, devices may be baked for 8 hours at 120°C±5°C.

### NOTE

As the plastic package cannot be subjected to high temperature, it should be removed from devices before high temperature (120°C) baking. If shorter baking time is desired, please refer to *IPC/JEDECJ-STD-033* for baking procedure.

## 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. 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 0.15mm~0.18mm. For more details, please refer to **document [7]**.

It is suggested that the peak reflow temperature is 238°C~245°C, and the absolute maximum reflow temperature is 245°C. To avoid damage to the module caused by repeated heating, it is strongly recommended that the module should be mounted 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.

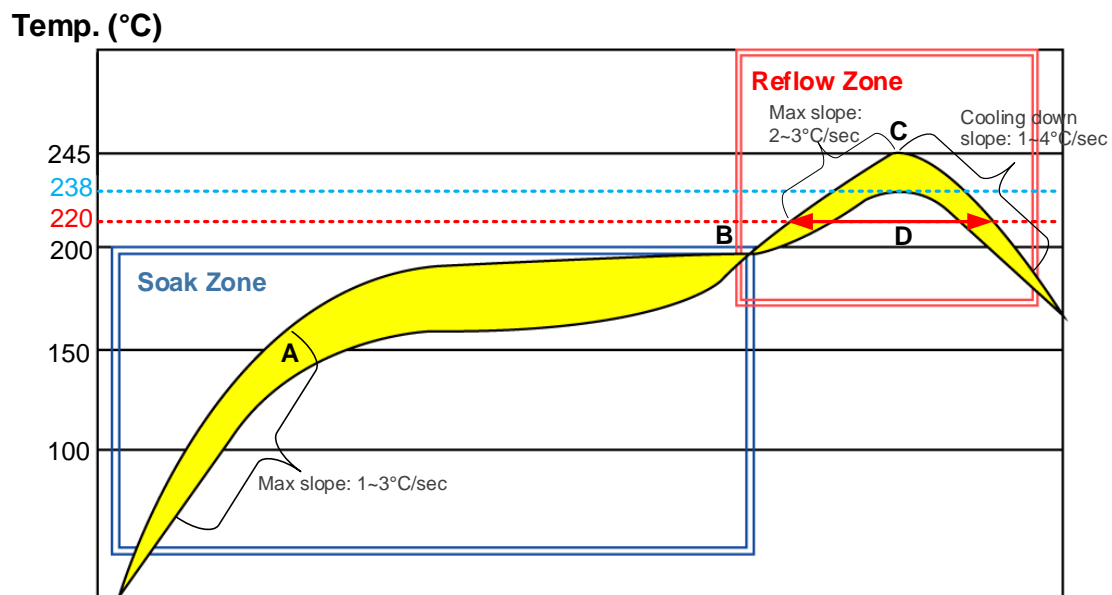


Figure 22: Recommended Reflow Soldering Thermal Profile

Table 31: Recommended Thermal Profile Parameters

| Factor                                       | Recommendation |
|--|----------------|
| <b>Soak Zone</b>                             |                |
| Max slope                                    | 1 to 3°C/sec   |
| Soak time (between A and B: 150°C and 200°C) | 60 to 120 sec  |
| <b>Reflow Zone</b>                           |                |

|                             |              |
|-----------------------------|--------------|
| Max slope                   | 2 to 3°C/sec |
| Reflow time (D: over 220°C) | 40 to 60 sec |
| Max temperature             | 238 to 245°C |
| Cooling down slope          | 1 to 4°C/sec |
| <b>Reflow Cycle</b>         |              |
| Max reflow cycle            | 1            |

**NOTE**

During manufacturing and soldering, or any other processes that may contact the module directly, NEVER wipe the module label with organic solvents, such as acetone, ethyl alcohol, isopropyl alcohol, trichloroethylene, etc. Otherwise, the label information may become unclear.

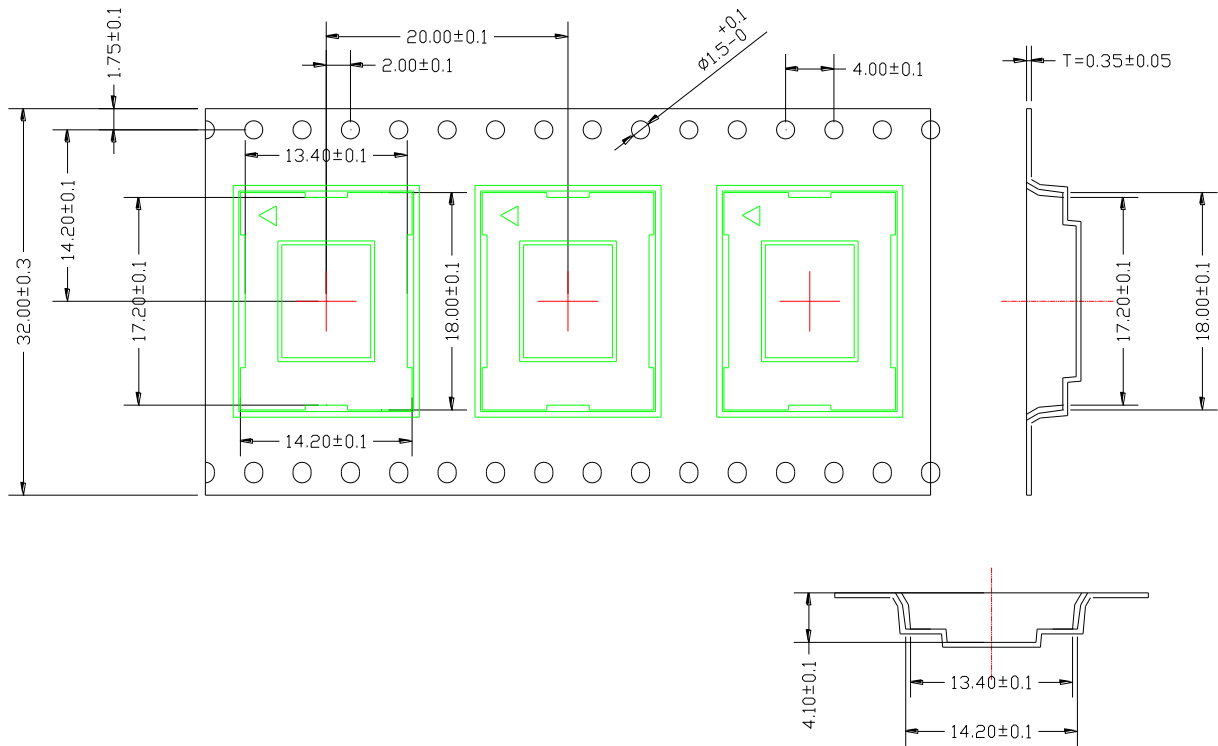
## 6.3 Packaging

FC20 series 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.

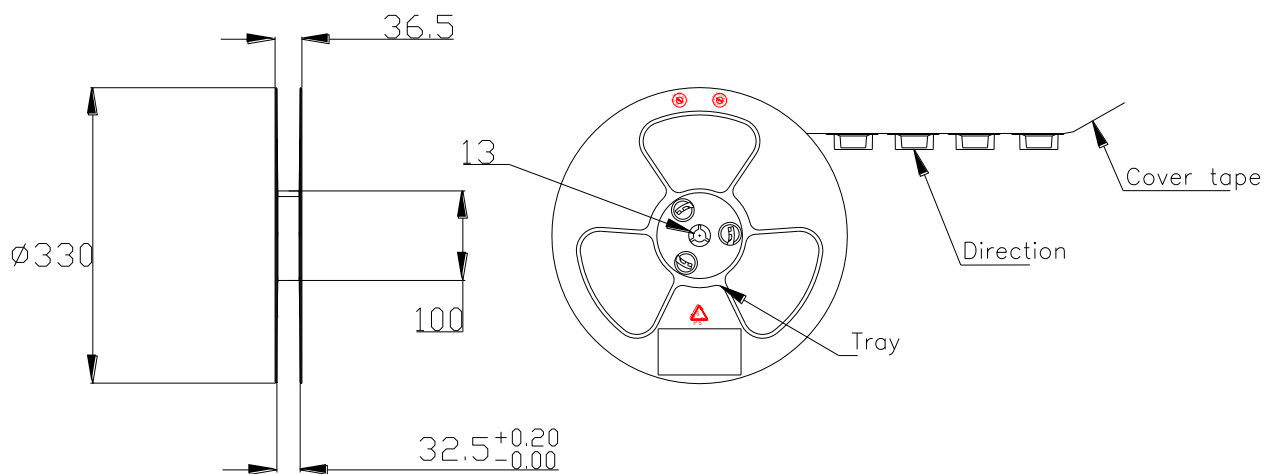
### 6.3.1 Tape and Reel Packaging

FC20 series module is packaged in tape and reel carriers. The figures below show the packaging details, measured in mm.





**Figure 23: Tape Dimensions**



**Figure 24: Reel Dimensions**

**Table 32: Reel Packaging**

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

# 7 Appendix A References

**Table 33: Related Documents**

| SN  | Document Name                           | Remark   |
|-----|---|--|
| [1] | Quectel_UMTS&LTE_EVB_User_Guide         | EVB user guide for Quectel UMTS, LTE and FC20 series modules |
| [2] | Quectel_EC25_Reference_Design           | EC25 reference design  |
| [3] | Quectel_EC21_Reference_Design           | EC21 reference design  |
| [4] | Quectel_EC20_R2.1_Reference_Design      | EC20 R2.1 reference design                                   |
| [5] | Quectel_EC20_R2.0_Reference_Design      | EC20 R2.0 reference design                                   |
| [6] | Quectel_EG25-G_Reference_Design         | EG25-G reference design                                      |
| [7] | Quectel_Module_Secondary_SMT_User_Guide | Module secondary SMT user guide                              |

**Table 34: Terms and Abbreviations**

| Abbreviation | Description                                       |
|--------------|---|
| AP           | Access Point                                      |
| BPSK         | Binary Phase Shift Keying                         |
| BT           | Bluetooth   |
| CCK          | Complementary Code Keying                         |
| ESD          | Electrostatic Discharge                           |
| GND          | Ground  |
| HT           | High Throughput                                   |
| I/O          | Input/Output                                      |
| IEEE         | Institute of Electrical and Electronics Engineers |

|                    |   |
|--------------------|---|
| I <sub>IL</sub>    | Input Leakage Current                   |
| 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                   |
| QAM                | Quadrature Amplitude Modulation         |
| QPSK               | Quadrature Phase Shift Keying           |
| RF                 | Radio Frequency                         |
| RH                 | Relative Humidity                       |
| RoHS               | Restriction of Hazardous Substances     |
| RX                 | Receive Direction                       |
| SDIO               | Secure Digital Input and Output Card    |
| STA                | Station                                 |
| TX                 | Transmitting Direction                  |
| USB                | Universal Serial Bus                    |
| VDD                | Voltage Power for Digital Device        |
| VHT                | Very High Throughput                    |
| V <sub>IHmax</sub> | Maximum Input High Level Voltage Value  |
| V <sub>IHmin</sub> | Minimum Input High Level Voltage Value  |
| V <sub>ILmax</sub> | Maximum Input Low Level Voltage Value   |
| V <sub>ILmin</sub> | Minimum Input Low Level Voltage Value   |
| VIO                | Voltage for Input/Output Port           |
| V <sub>OHmin</sub> | Minimum Output High Level Voltage Value |

---

|                    |  |
|--------------------|--|
| V <sub>OLmax</sub> | Maximum Output Low Level Voltage Value |
| VSWR               | Voltage Standing Wave Ratio            |
| WLAN               | Wireless Local Area Networks           |

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