

FC30R Hardware Design

Wi-Fi Module Series

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Safety Information

The following safety precautions must be observed during all phases of operation, such as usage, service or repair of any terminal or mobile incorporating the module. Manufacturers of the terminal should notify users and operating personnel of the following safety information by incorporating these guidelines into all manuals of the product. Otherwise, Quectel assumes no liability for customers' failure to comply with these precautions.



Full attention must be paid to driving at all times in order to reduce the risk of an accident. Using a mobile while driving (even with a handsfree kit) causes distraction and can lead to an accident. Please comply with laws and regulations restricting the use of wireless devices while driving.



Switch off the terminal or mobile before boarding an aircraft. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. If there is an Airplane Mode, it should be enabled prior to boarding an aircraft. Please consult the airline staff for more restrictions on the use of wireless devices on an aircraft.



Wireless devices may cause interference on sensitive medical equipment, so please be aware of the restrictions on the use of wireless devices when in hospitals, clinics or other healthcare facilities.



Terminals or mobiles operating over radio signal and cellular network cannot be guaranteed to connect in certain conditions, such as when the mobile bill is unpaid or the (U)SIM card is invalid. When emergency help is needed in such conditions, use emergency call if the device supports it. In order to make or receive a call, the terminal or mobile must be switched on in a service area with adequate cellular signal strength. In an emergency, the device with emergency call function cannot be used as the only contact method considering network connection cannot be guaranteed under all circumstances.



The terminal or mobile contains a transceiver. When it is ON, it receives and transmits radio frequency signals. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment.



In locations with explosive or potentially explosive atmospheres, obey all posted signs and turn off wireless devices such as mobile phone or other terminals. Areas with explosive or potentially explosive atmospheres include fueling areas, below decks on boats, fuel or chemical transfer or storage facilities, and areas where the air contains chemicals or particles such as grain, dust or metal powders.

About the Document

Revision History

| Version | Date | Author | Description |
|---------|------------|-----------------------------|--|
| - | 2019-06-05 | Elinor WANG/ Lucas HUANG | Creation of the document |
| 1.0 | 2021-05-13 | Elinor WANG/ Lucas HUANG | First official release |
| 1.1 | 2023-02-24 | Shinnie XU | <ol style="list-style-type: none"> Deleted the applicable module FC31R. Updated the timing of power-up and power-down (Figure 4). Updated the top and bottom views of the module (Figure 19). Updated the recommended ramp-to-soak, ramp-up, and cool-down slopes (Chapter 6.2). Updated the carrier tape dimensions (Chapter 6.3.1). Added module mounting direction (Chapter 6.3.3). |
| 1.2 | 2023-06-16 | Shinnie XU | Added the Wi-Fi encryption mode (Table 2). |
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1 Introduction

This document defines the FC30R module and describes its air interface and hardware interfaces which are connected with your applications.

With this document, you can quickly understand module interface specifications, electrical and mechanical details, as well as other related information of the module. The module can be used in combination with LTE Standard EC21 series and EC25 series modules or other application processors (IMX6, IMX8, etc.). You can use FC30R to design and set up LTE + Wi-Fi applications easily.

NOTE

As for EC21 series and EC25 series modules, please contact Quectel Technical Support for details.

1.1. Special Marks

Table 1: Special Marks

| Mark | Definition |
|-------|---|
| * | Unless otherwise specified, when an asterisk (*) is used after a function, feature, interface, pin name, AT command, argument, and so on, it indicates that the function, feature, interface, pin, AT command, argument, and so on, is under development and currently not supported; and the asterisk (*) after a model indicates that the sample of the model is currently unavailable. |
| [...] | Brackets ([...]) used after a pin enclosing a range of numbers indicate all pins of the same type. For example, SDIO_DATA[0:3] refers to all four SDIO pins: SDIO_DATA0, SDIO_DATA1, SDIO_DATA2, and SDIO_DATA3. |

2 Product Overview

2.1. General Description

FC30R is a cost-effective 2.4 GHz Wi-Fi module with low power consumption. It is a single-die Wi-Fi module supporting IEEE 802.11b/g/n Wi-Fi standards and provides an SDIO 3.0 interface.

2.2. Key Features

Table 2: Key Features

| Features | Description |
|-------------------------|--|
| Power Supply | <ul style="list-style-type: none"> ● VDD_3V3 power supply: 3.0–3.6 V, Typ. 3.3 V ● SDIO power supply: 1.75–1.89 V, Typ. 1.8 V 3.0–3.6 V, Typ. 3.3 V |
| Transmission Data Rates | <ul style="list-style-type: none"> ● 802.11b: 1 Mbps, 2 Mbps, 5.5 Mbps, 11 Mbps ● 802.11g: 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps, 54 Mbps ● 802.11n: HT20 (MCS 0–MCS 7) ● 802.11n: HT40 (MCS 0–MCS 7) |
| Transmitting Power | <ul style="list-style-type: none"> ● 802.11b @ 11 Mbps: 16 dBm \pm2.5 dB ● 802.11g @ 54 Mbps: 14 dBm \pm2.5 dB ● 802.11n @ HT20 MCS 7: 13 dBm \pm2.5 dB ● 802.11n @ HT40 MCS 7: 13 dBm \pm2.5 dB |
| Wi-Fi Encryption Mode | WPA3 |
| Wi-Fi Protocols | IEEE 802.11b/g/n |
| Operation Modes | <ul style="list-style-type: none"> ● AP ● STA |

| | |
|-----------------------------|---|
| Modulations | DBPSK, DQPSK, BPSK, QPSK, CCK, 16QAM, 64QAM |
| Wi-Fi Application Interface | SDIO 3.0 |
| Antenna Interface | <ul style="list-style-type: none"> ● Wi-Fi antenna interface ● 50 Ω characteristic impedance |
| Physical Characteristics | <ul style="list-style-type: none"> ● Size: (12.0 ±0.15) mm × (12.0 ±0.15) mm × (2.1 ±0.2) mm ● Package: LCC ● Weight: approx.0.58 g |
| Temperature Ranges | <ul style="list-style-type: none"> ● Operating temperature range ¹: -30 °C to +85 °C ● Storage temperature range: -40 °C to +90 °C |
| RoHS | All hardware components are fully compliant with EU RoHS directive |

2.3. EVB Kit

To help you develop applications with FC30R, Quectel supplies an evaluation board (UMTS<E EVB), a RS-232 to USB cable, a USB data cable, antennas and other peripherals to develop and test the modules. For details, see **document [1]**.

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

3 Application Interfaces

3.1. General Description

FC30R is equipped with 22 LCC pins and 12 LGA pins that can be connected to application platforms. The subsequent chapters will provide a detailed introduction on the following module interfaces:

- Power supply
- Wi-Fi application interfaces
- RF antenna interface

3.2. Pin Assignment

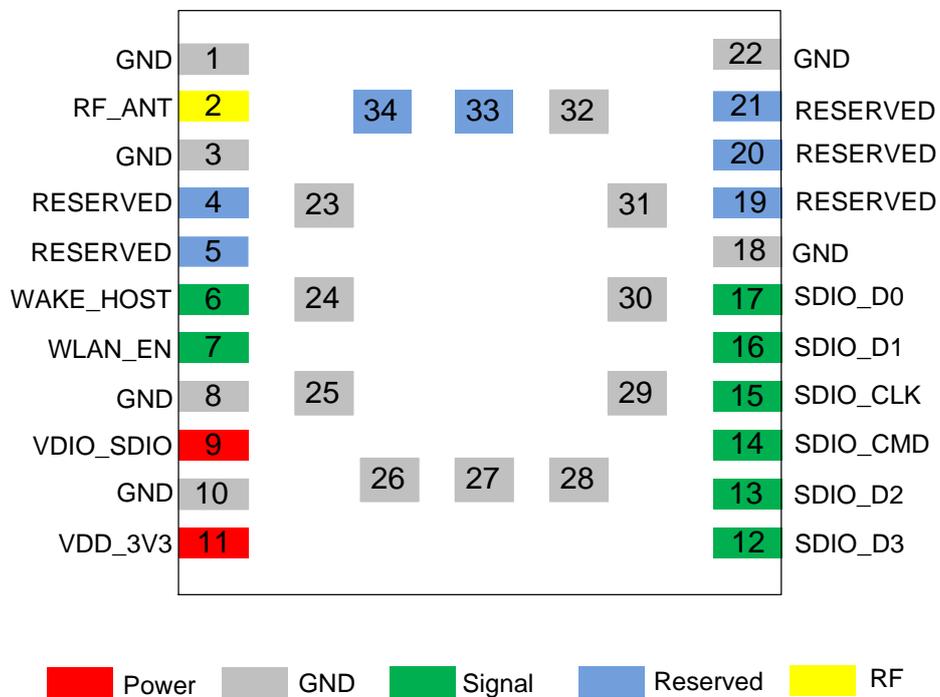


Figure 1: Pin Assignment (Top View)

NOTE

1. Keep all RESERVED and unused pins open.
2. All GND pins should be connected to ground.

3.3. Pin Description

Table 3: I/O Parameter Definition

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

Table 4: Pin Description

| Power Supply | | | | |
|-----------------------------|------------------------|-----|----------------------------------|--|
| Pin Name | Pin No. | I/O | Description | Comment |
| VDD_3V3 | 11 | PI | Main power supply for the module | The power supply current is recommended to be greater than 0.5 A. 3.3 V power domain. |
| VDIO_SDIO | 9 | PI | Power supply for SDIO interface | The power supply current is recommended to be greater than 10 mA. 1.8/3.3 V power domain. |
| GND | 1, 3, 8, 10, 18, 22–32 | | | |
| Wi-Fi Application Interface | | | | |
| Pin Name | Pin No. | I/O | Description | Comment |
| WAKE_HOST* | 6 | DO | Wakes up the host | 3.3 V power domain. |

| | | | | |
|----------|----|-----|-------------------------------|---|
| | | | | Active low. If unused, keep this pin open. |
| WLAN_EN | 7 | DI | Wi-Fi function enable control | 3.3 V power domain. Active high. |
| SDIO_D3 | 12 | DIO | SDIO data bit 3 | |
| SDIO_D2 | 13 | DIO | SDIO data bit 2 | |
| SDIO_D1 | 16 | DIO | SDIO data bit 1 | |
| SDIO_D0 | 17 | DIO | SDIO data bit 0 | 1.8/3.3 V power domain. |
| SDIO_CLK | 15 | DI | SDIO clock | |
| SDIO_CMD | 14 | DIO | SDIO command | |

RF Antenna Interface

| Pin Name | Pin No. | I/O | Description | Comment |
|----------|---------|-----|-------------------------|--------------------------------|
| RF_ANT | 2 | AIO | Wi-Fi antenna interface | 50 Ω characteristic impedance. |

RESERVED Pins

| Pin Name | Pin No. | Comment |
|----------|---------------------|-----------------------|
| RESERVED | 4, 5, 19–21, 33, 34 | Keep these pins open. |

3.4. Power Supply

The following table shows the power supply pins and the ground pins of FC30R. The VDIO_SDIO should be powered up later than VDD_3V3.

Table 5: Power Supply and GND Pins

| Pin Name | Pin No. | Description | Min. | Typ. | Max. | Unit |
|-----------|------------------------|-------------------------------------|------|---------|------|------|
| VDD_3V3 | 11 | Main power supply for the module | 3.0 | 3.3 | 3.6 | V |
| VDIO_SDIO | 9 | Power supply for the SDIO interface | 1.75 | 1.8/3.3 | 3.6 | V |
| GND | 1, 3, 8, 10, 18, 22–32 | | | | | |

The power-up and power-down timing is illustrated in the following figure.

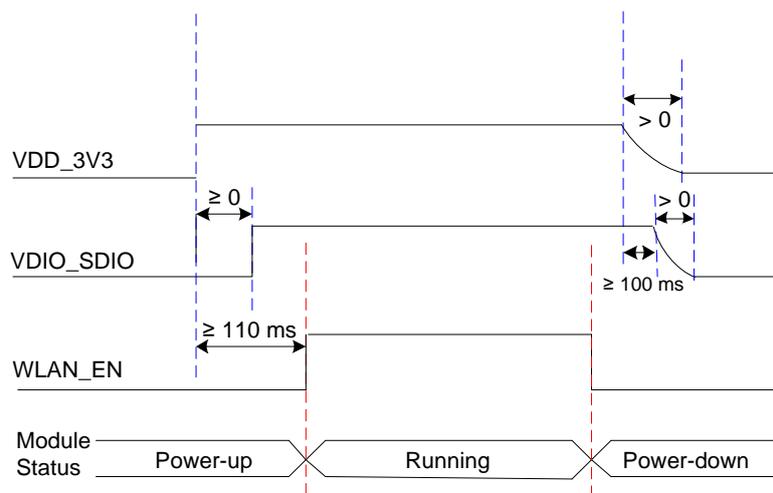


Figure 2: Power-up and Power-down Timing

NOTE

After pulling down WLAN_EN, it is recommended to pull down VDIO_SDIO at least 100 ms after pulling down VDD_3V3, although it can be pulled down at the same time as VDD_3V3.

3.5. Wi-Fi Application Interfaces

The following figure shows the Wi-Fi application interface connection between FC30R and the host.

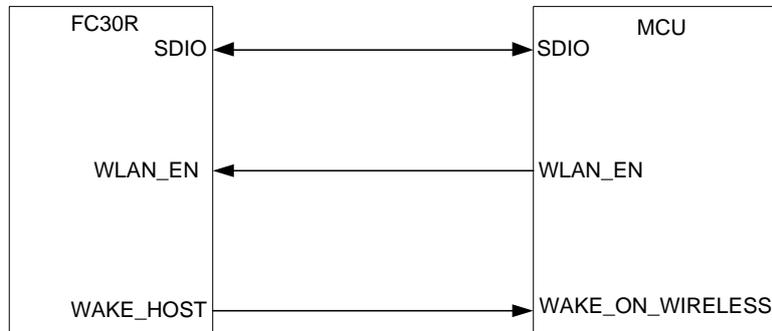


Figure 3: Wi-Fi Application Interface Connection

3.5.1. WAKE_HOST*

WAKE_HOST is used to wake up the host. When the pin is pulled down, host can be woken up.

Table 6: Pin Definition of WAKE_HOST

| Pin Name | Pin No. | I/O | Description | Comment |
|-----------|---------|-----|------------------|--|
| WAKE_HOST | 6 | DO | Wake up the host | 3.3 V power domain. Active low. If unused, keep this pin open. |

3.5.2. WLAN_EN

WLAN_EN is used to control the Wi-Fi function of FC30R. When WLAN_EN is at high level, Wi-Fi function will be enabled.

Table 7: Pin Definition of WLAN_EN

| Pin Name | Pin No. | I/O | Description | Comment |
|----------|---------|-----|-------------------------------|-------------------------------------|
| WLAN_EN | 7 | DI | Wi-Fi function enable control | 3.3 V power domain. Active high. |

NOTE

WLAN_EN is a sensitive signal, and thus should be ground-shielded.

3.5.3. SDIO Interface

- Connected to the host as Wi-Fi application interface.
- Supports high speed modes SDR50, SDR25, etc.; 80 MHz @ 1.8 V maximum clock frequency.
- SDIO 3.0 compliant.

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 | 12 | DIO | SDIO data bit 3 | |
| SDIO_D2 | 13 | DIO | SDIO data bit 2 | |
| SDIO_D1 | 16 | DIO | SDIO data bit 1 | 1.8/3.3 V power domain |
| SDIO_D0 | 17 | DIO | SDIO data bit 0 | |
| SDIO_CLK | 15 | DI | SDIO clock | |
| SDIO_CMD | 14 | DIO | SDIO command | |

The following figure shows the SDIO interface connection between FC30R and the host.

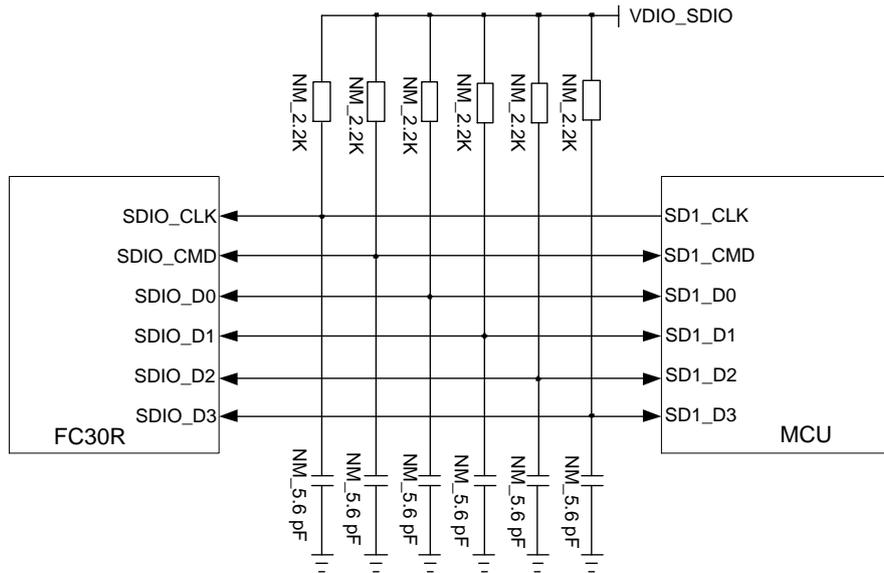


Figure 4: SDIO Interface Connection

To ensure the performance of SDIO, please comply with the following principles:

- Surround the SDIO differential traces with ground on that layer and with ground planes above and below.
- The traces should avoid branching, and the impedance is controlled at $50 \Omega \pm 10 \%$.
- Keep SDIO signals far away from other sensitive circuits/signals such as RF circuits and analog signals, as well as noisy signals such as clock signals and DC-DC signals.
- SDIO_CLK and SDIO_D[0:3]/SDIO_CMD need to be equal in length (the difference is less than 1 mm). The highest transmission mode of SDIO is SDR50 and the maximum clock frequency is 80 MHz. It is recommended that the total trace length should be less than 150 mm (the maximum internal trace length of the module should be 8.1 mm).
- Ground shielding is needed between SDIO_CLK signal and SDIO_D[0:3]/SDIO_CMD signals.

3.6. RF Antenna Interface

3.6.1. Pin Definition of RF Antenna Interface

Table 9: Pin Definition of RF Antenna Interface

| Pin Name | Pin No. | I/O | Description | Comment |
|----------|---------|-----|-------------------------|---------------------------------------|
| RF_ANT | 2 | AIO | Wi-Fi antenna interface | 50 Ω characteristic impedance. |

3.6.2. Operating Frequencies

Table 10: Operating Frequencies (Unit: GHz)

| Feature | Frequency Range |
|---------------|-----------------|
| 2.4 GHz Wi-Fi | 2.400–2.4835 |

3.6.3. RF Antenna Reference Design

A reference circuit for the RF antenna interface is shown below. It is recommended to reserve a π -type matching circuit for better RF performance. The matching components (C1, C2, and R1) should be placed as close to the antenna as possible. The capacitors (C1, C2) are not mounted by default.

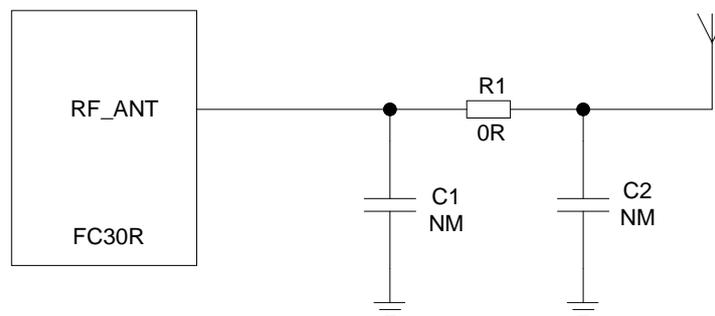


Figure 5: Reference Circuit for RF Antenna Interface

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 π -type matching circuit for better RF performance. C2, L1 and C3, L3 comprise two notch filter circuits respectively for filtering out interference caused by a particular frequency. When L3, C3, L1 and C2 are not mounted, C1, R1 and C4 comprise a π -type matching circuit. Capacitors C1, C2, C3 and C4 and inductors L1 and L3 are not mounted by default, and R1 is 0 Ω by default.

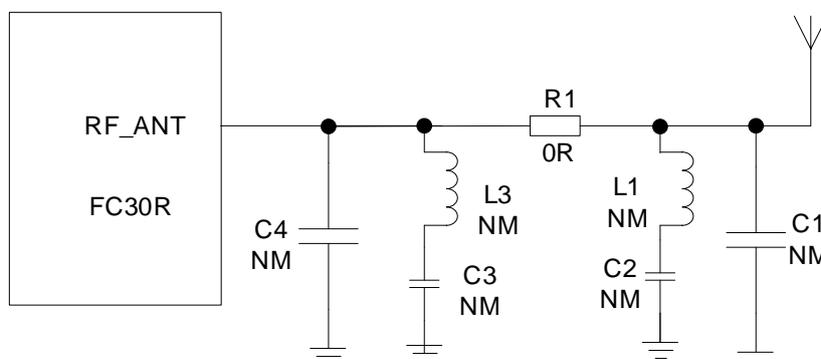


Figure 6: Reference Circuit for RF Antenna Interface (Vehicle Applications)

3.6.4. RF Routing Guidelines

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

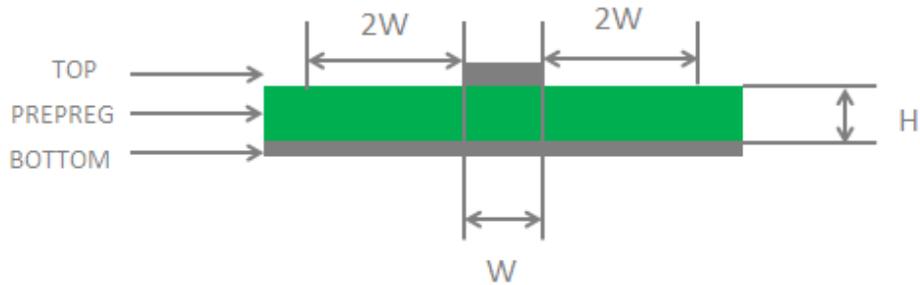


Figure 7: Microstrip Line Design on a 2-layer PCB

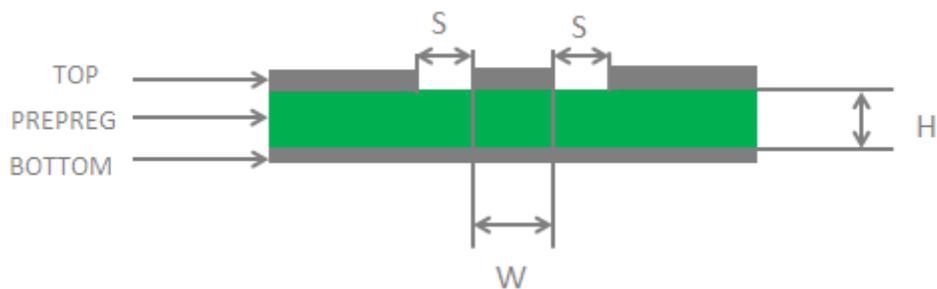


Figure 8: Coplanar Waveguide Line Design on a 2-layer PCB

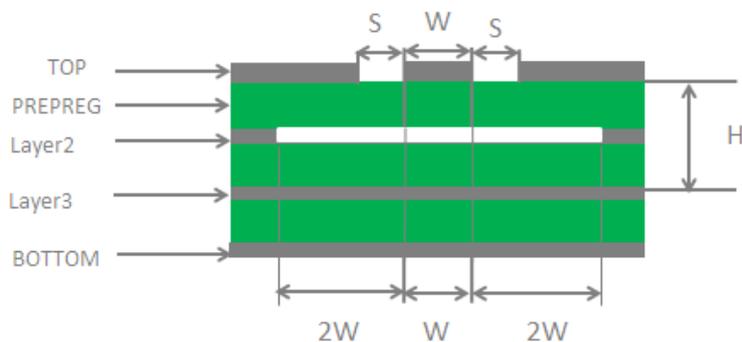


Figure 9: Coplanar Waveguide Line Design on a 4-layer PCB (Layer 3 as Reference Ground)

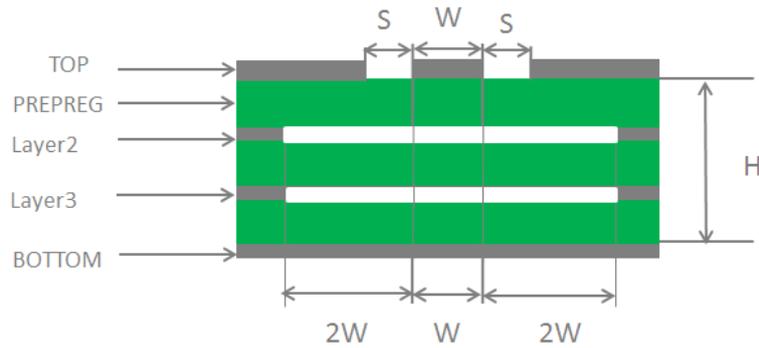


Figure 10: Coplanar Waveguide Line Design on a 4-layer PCB (Layer 4 as Reference Ground)

To ensure RF performance and reliability, follow the principles below in RF layout design:

- Use an impedance simulation tool to accurately control the characteristic impedance of RF traces to 50 Ω.
- The GND pins adjacent to RF pins should not be designed as thermal relief pads, and should be fully connected to ground.
- The distance between the RF pins and the RF connector should be as short as possible and all the right-angle traces should be changed to curved ones. The recommended trace angle is 135°.
- There should be clearance under the signal pin of the antenna connector or solder joint.
- The reference ground of RF traces should be complete. Meanwhile, adding some ground vias around RF traces and the reference ground could help to improve RF performance. The distance between the ground vias and RF traces should be not less than twice the width of RF signal traces ($2 \times W$).
- Keep RF traces away from interference sources, and avoid intersection and paralleling between traces on adjacent layers.

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

3.6.5. Antenna Design Requirements

The following table shows the requirements on RF antenna.

Table 11: Antenna Requirements

| Type | Requirements |
|-----------------------|--|
| Frequency Range (GHz) | 2.400–2.4835 (Cable insertion loss < 1 dB) |
| VSWR | ≤ 2 (recommended) |
| Gain (dBi) | 1 (Typ.) |

| | |
|------------------------------|----------|
| Max. Input Power (W) | 50 |
| Input Impedance (Ω) | 50 |
| Polarization Type | Vertical |

3.6.6. RF Connector Recommendation

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

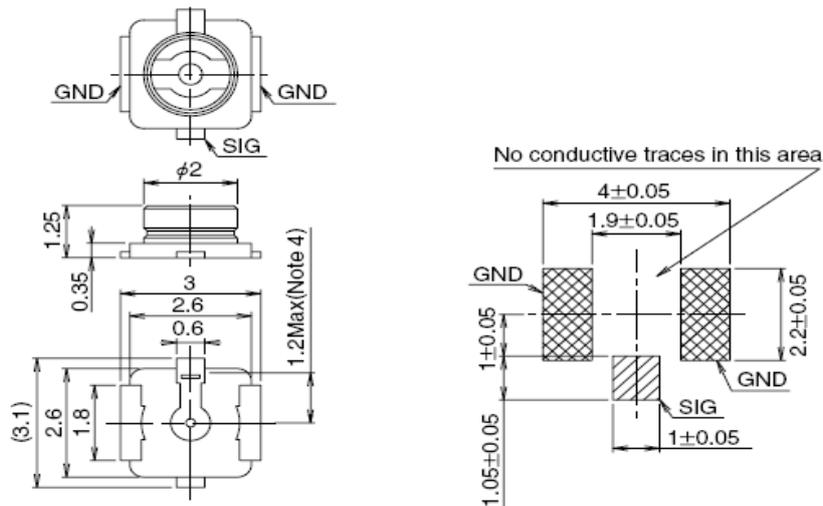


Figure 11: Dimensions of the Receptacle (Unit: mm)

U.FL-LP series mated plugs listed in the following figure can be used to match the U.FL-R-SMT connector.

| 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 12: Specifications of Mated Plugs

The following figure describes the space factor of mated connectors.

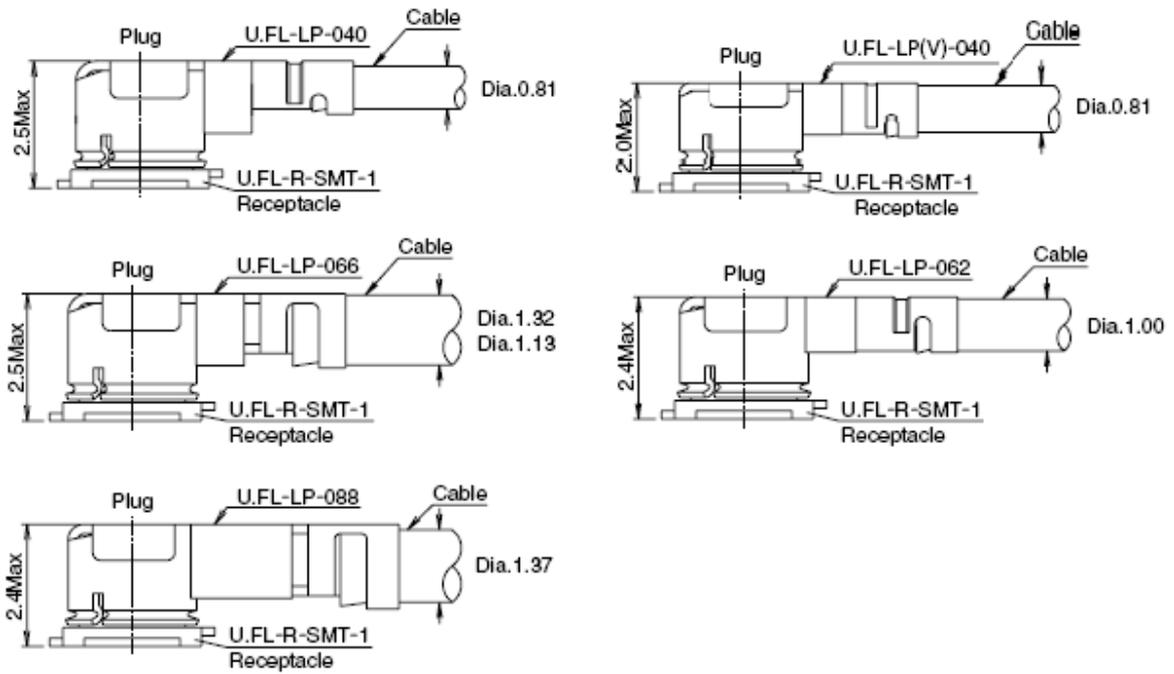


Figure 13: Space Factor of Mated Connectors (Unit: mm)

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

4 Electrical Characteristics & Reliability

4.1. Absolute Maximum Ratings

Table 12: Absolute Maximum Ratings (Unit: V)

| Parameter | Min. | Max. |
|-----------|------|------|
| VDD_3V3 | 0 | 3.6 |
| VDIO_SDIO | 0 | 3.6 |

4.2. Power Supply Ratings

Table 13: Module Power Supply Ratings (Unit: V)

| Parameter | Min. | Typ. | Max. |
|-----------|------|------|------|
| VDD_3V3 | 3.0 | 3.3 | 3.6 |
| VDIO_SDIO | 1.75 | 1.8 | 1.89 |
| VDIO_SDIO | 3.0 | 3.3 | 3.6 |

4.3. Digital I/O Characteristics

Table 14: I/O Requirements (3.3 V Power Domain; Unit: V)

| Parameter | Description | Min. | Max. |
|-----------|---------------------------|------|------|
| V_{IH} | High-level Input Voltage | 2.0 | 3.6 |
| V_{IL} | Low-level Input Voltage | 0 | 0.9 |
| V_{OH} | High-level Output Voltage | 2.97 | 3.3 |
| V_{OL} | Low-level Output Voltage | 0 | 0.33 |

Table 15: I/O Requirements (1.8 V Power Domain; Unit: V)

| Parameter | Description | Min. | Max. |
|-----------|---------------------------|------|------|
| V_{IH} | High-level Input Voltage | 1.26 | 2.0 |
| V_{IL} | Low-level Input Voltage | 0.3 | 0.54 |
| V_{OH} | High-level Output Voltage | 1.62 | 1.8 |
| V_{OL} | Low-level Output Voltage | 0 | 0.18 |

4.4. Power Consumption

The following tables show the power consumption of FC30R in different modes.

Table 16: Power Consumption in Low Power Modes

| Description | Condition | I _{VDD_3V3} (Typ.) | I _{VDIO_SDIO} (Typ.) | Unit |
|------------------------|------------|-----------------------------|-------------------------------|------|
| OFF State ² | AT+QWIFI=0 | 31 | 1 | μA |
| Idle ³ | AT+QWIFI=1 | 60 | 2 | mA |

Table 17: Power Consumption of the Module (Unit: mA)

| Standard | Data Rate | I _{VDD_3V3} |
|----------|------------------------|----------------------|
| 802.11b | Tx 1 Mbps @16 dBm | 251.35 |
| | Tx 11 Mbps @16 dBm | 232.10 |
| | Rx 1 Mbps | 57.24 |
| | Rx 11 Mbps | 58.42 |
| 802.11g | Tx 6 Mbps @ 16 dBm | 241.20 |
| | Tx 54 Mbps @ 14 dBm | 171.97 |
| | Rx 6 Mbps | 59.93 |
| | Rx 54 Mbps | 59.99 |
| 802.11n | Tx HT20 MCS 0 @ 15 dBm | 233.19 |
| | Tx HT20 MCS 7 @ 13 dBm | 166.27 |
| | Tx HT40 MCS 0 @ 14 dBm | 220.40 |
| | Tx HT40 MCS 7 @ 13 dBm | 141.99 |
| | Rx HT20 MCS 0 | 59.93 |

² OFF state: Wi-Fi function disabled via **AT+QWIFI=0** or other methods. Under this state, the sleep clock is disabled and no data is saved.

³ Idle state: Wi-Fi function enabled via **AT+QWIFI=1** or other methods without any device connected to the AP. For more information about AT command, see **document [5]**.

| | |
|---------------|-------|
| Rx HT20 MCS 7 | 59.85 |
| Rx HT40 MCS 0 | 64.28 |
| Rx HT40 MCS 7 | 64.57 |

4.5. RF Performance

The following tables summarize the transmitting and receiving characteristics of FC30R.

4.5.1. Conducted RF Output Power

Table 18: Conducted RF Output Power at 2.4 GHz

| Standard | Data Rate | Typ. |
|----------------|-----------|---------------------|
| 802.11b | 1 Mbps | 16 dBm \pm 2.5 dB |
| 802.11b | 11 Mbps | 16 dBm \pm 2.5 dB |
| 802.11g | 6 Mbps | 16 dBm \pm 2.5 dB |
| 802.11g | 54 Mbps | 14 dBm \pm 2.5 dB |
| 802.11n (HT20) | MCS 0 | 15 dBm \pm 2.5 dB |
| 802.11n (HT20) | MCS 7 | 13 dBm \pm 2.5 dB |
| 802.11n (HT40) | MCS 0 | 15 dBm \pm 2.5 dB |
| 802.11n (HT40) | MCS 7 | 13 dBm \pm 2.5 dB |

4.5.2. Conducted RF Receiving Sensitivity

Table 19: Conducted RF Receiving Sensitivity at 2.4 GHz

| Standard | Data Rate | Typ. |
|----------------|-----------|---------|
| 802.11b | 1 Mbps | -93 dBm |
| 802.11b | 11 Mbps | -86 dBm |
| 802.11g | 6 Mbps | -87 dBm |
| 802.11g | 54 Mbps | -70 dBm |
| 802.11n (HT20) | MCS 0 | -87 dBm |
| 802.11n (HT20) | MCS 7 | -68 dBm |
| 802.11n (HT40) | MCS 0 | -84 dBm |
| 802.11n (HT40) | MCS 7 | -64 dBm |

4.6. ESD Protection

Static electricity occurs naturally and it may damage the module. Therefore, applying proper ESD countermeasures and handling methods is imperative. For example, wear anti-static gloves during the development, production, assembly and testing of the module; add ESD protection components to the ESD sensitive interfaces and points in the product design.

Table 20: ESD Characteristics (Unit: kV)

| Model | Test Result | Standard |
|----------------------------|-------------|------------------------|
| Human Body Model (HBM) | ±1 | ESDA/JEDEC JS-001-2017 |
| Charged Device Model (CDM) | ±0.35 | ESDA/JEDEC JS-002-2018 |

5 Mechanical Dimensions

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

5.1. Mechanical Dimensions

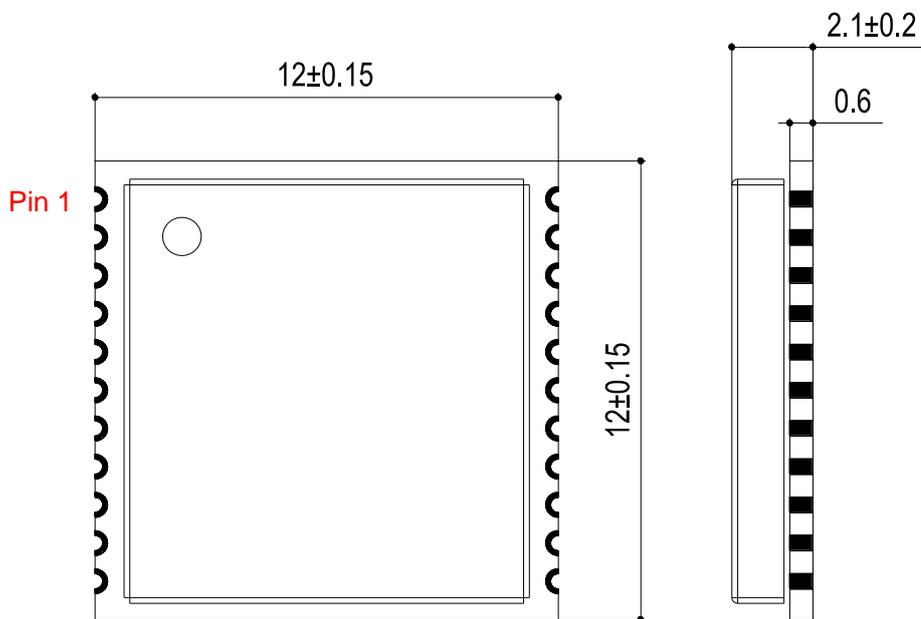


Figure 14: Top and Side Dimensions

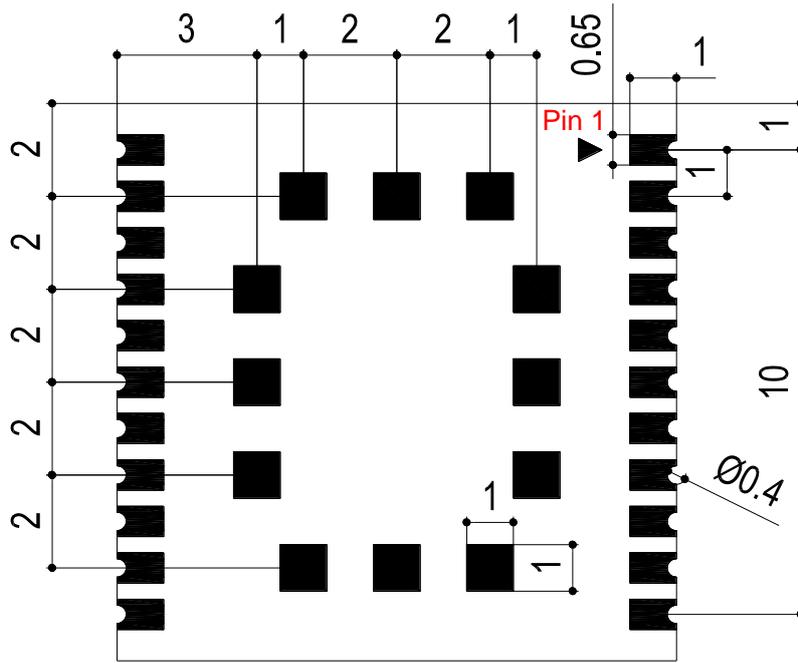


Figure 15: Bottom Dimensions (Bottom View)

NOTE

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

5.2. Recommended Footprint

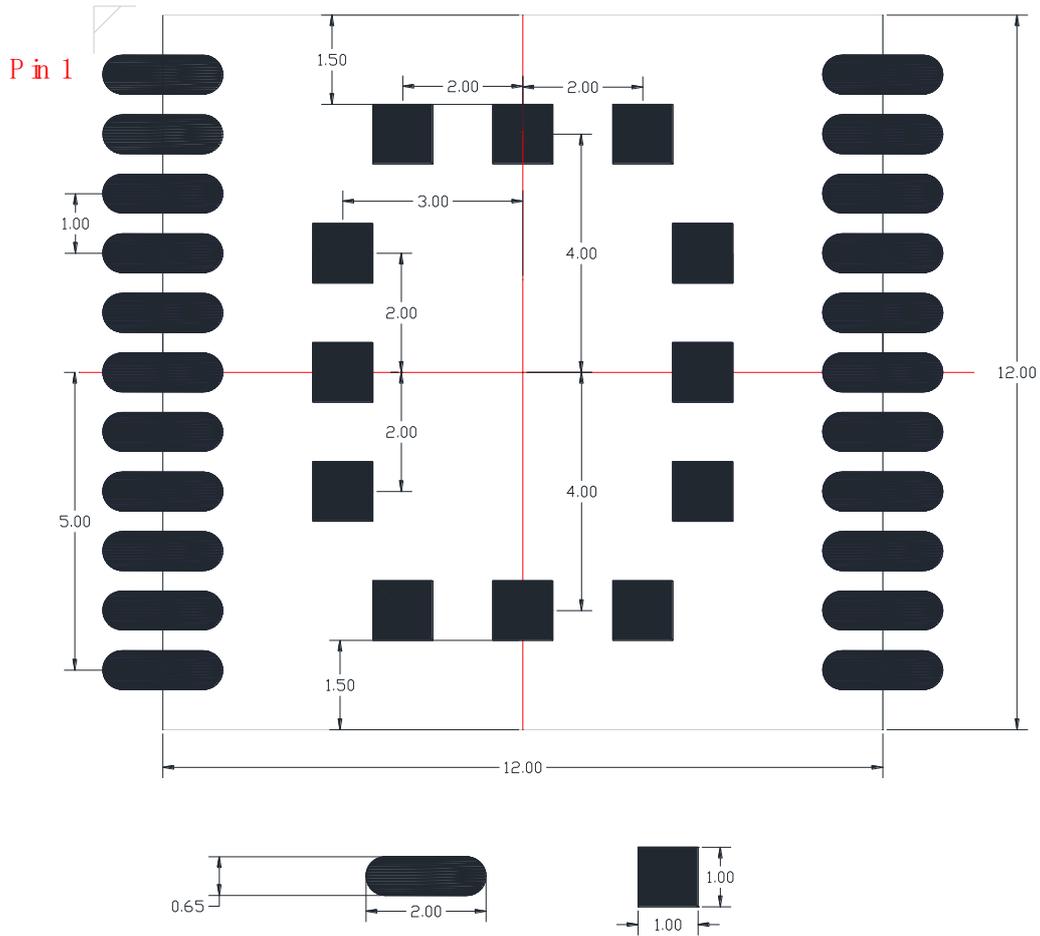


Figure 16: Recommended Footprint

NOTE

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

5.3. Top and Bottom Views of the Modules

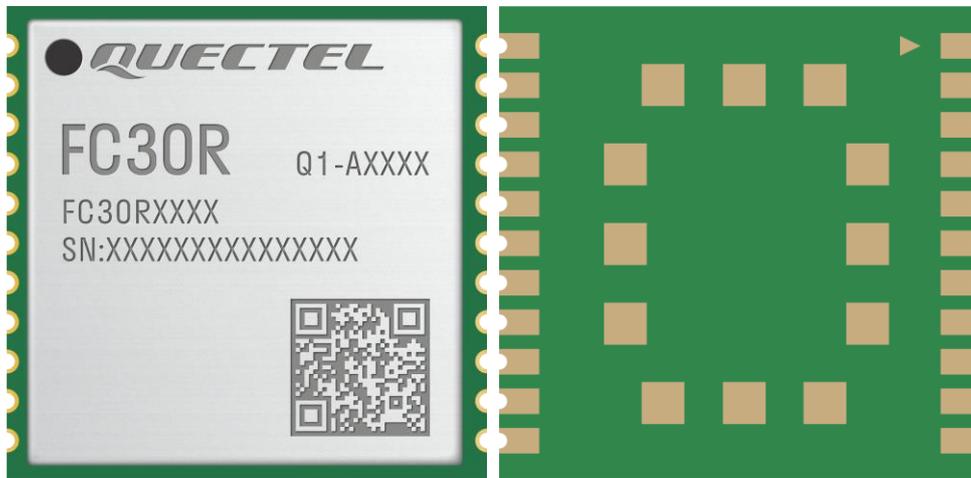


Figure 17: Top and Bottom Views

NOTE

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

6 Storage, Manufacturing & Packaging

6.1. Storage Condition

The module is provided with vacuum-sealed packaging. MSL of the module is rated as 3. The storage requirements are shown below.

1. Recommended Storage Condition: The temperature should be 23 ± 5 °C and the relative humidity should be 35–60 %.
2. Shelf life (in a vacuum-sealed packaging): 12 months in Recommended Storage Condition.
3. Floor life: 168 hours ⁴ in a factory where the temperature is 23 ± 5 °C and relative humidity is below 60 %. After the vacuum-sealed packaging is removed, the module must be processed in reflow soldering or other high-temperature operations within 168 hours. Otherwise, the module should be stored in an environment where the relative humidity is less than 10 % (e.g., a dry cabinet).
4. The module should be pre-baked to avoid blistering, cracks and inner-layer separation in PCB under the following circumstances:
 - The module is not stored in Recommended Storage Condition;
 - Violation of the third requirement mentioned above;
 - Vacuum-sealed packaging is broken, or the packaging has been removed for over 24 hours;
 - Before module repairing.
5. If needed, the pre-baking should follow the requirements below:
 - The module should be baked for 8 hours at 120 ± 5 °C;
 - The module must be soldered to PCB within 24 hours after the baking, otherwise it should be put in a dry environment such as in a drying cabinet.

⁴ This floor life is only applicable when the environment conforms to *IPC/JEDEC J-STD-033*. It is recommended to start the solder reflow process within 24 hours after the package is removed if the temperature and moisture do not conform to, or are not sure to conform to *IPC/JEDEC J-STD-033*. Do not unpack the modules in large quantities until they are ready for soldering.

NOTE

1. To avoid blistering, layer separation and other soldering issues, extended exposure of the module to the air is forbidden.
2. Take out the module from the package and put it on high-temperature-resistant fixtures before baking. If shorter baking time is desired, see *IPC/JEDEC J-STD-033* for the baking procedure.
3. Pay attention to ESD protection, such as wearing anti-static gloves, when touching the modules.

6.2. Manufacturing and Soldering

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

The recommended peak reflow temperature should be 235–246 °C, with 246 °C as the absolute maximum reflow temperature. To avoid damage to the module caused by repeated heating, it is recommended that the module should be mounted only after reflow soldering for the other side of PCB has been completed. The recommended reflow soldering thermal profile (lead-free reflow soldering) and related parameters are shown below.

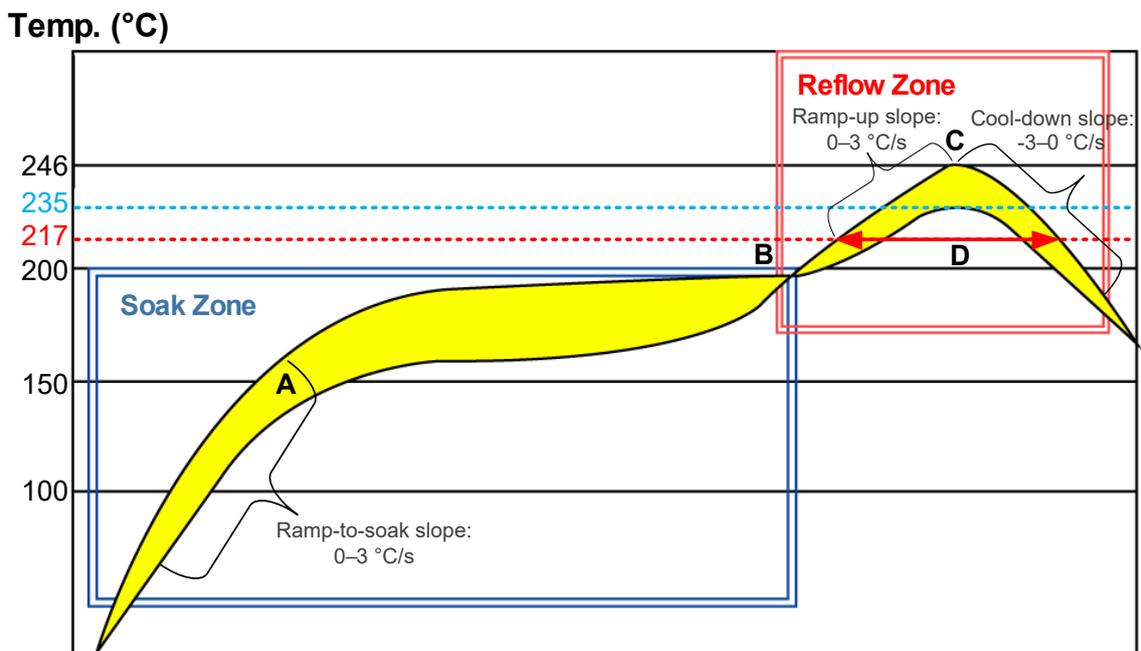


Figure 18: Recommended Reflow Soldering Thermal Profile

Table 21: Recommended Thermal Profile Parameters

| Factor | Recommended Value |
|--|-------------------|
| Soak Zone | |
| Ramp-to-soak slope | 0–3 °C/s |
| Soak time (between A and B: 150 °C and 200 °C) | 70–120 s |
| Reflow Zone | |
| Ramp-up slope | 0–3 °C/s |
| Reflow time (D: over 217 °C) | 40–70 s |
| Max. temperature | 235–246 °C |
| Cool-down slope | -3–0 °C/s |
| Reflow Cycle | |
| Max. reflow cycle | 1 |

NOTE

1. The above profile parameter requirements are for the measured temperature of the solder joints. Both the hottest and coldest spots of solder joints on the PCB should meet the above requirements.
2. During manufacturing and soldering, or any other processes that may contact the module directly, NEVER wipe the module’s shielding can with organic solvents, such as acetone, ethyl alcohol, isopropyl alcohol, trichloroethylene, etc. Otherwise, the shielding can may become rusted.
3. The shielding can for the module is made of Cupro-Nickel base material. It is tested that after 12 hours’ Neutral Salt Spray test, the laser engraved label information on the shielding can is still clearly identifiable and the QR code is still readable, although white rust may be found.
4. If a conformal coating is necessary for the module, do NOT use any coating material that may chemically react with the PCB or shielding cover, and prevent the coating material from flowing into the module.
5. Avoid using ultrasonic technology for module cleaning since it can damage crystals inside the module.
6. Due to the complexity of the SMT process, please contact Quectel Technical Support in advance for any situation that you are not sure about, or any process (e.g. selective soldering, ultrasonic soldering) that is not mentioned in **document [3]**.

6.3. Packaging Specification

This chapter describes only the key parameters and process of packaging. All figures below are for reference only. The appearance and structure of the packaging materials are subject to the actual delivery.

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

6.3.1. Carrier Tape

Dimension details are as follow:

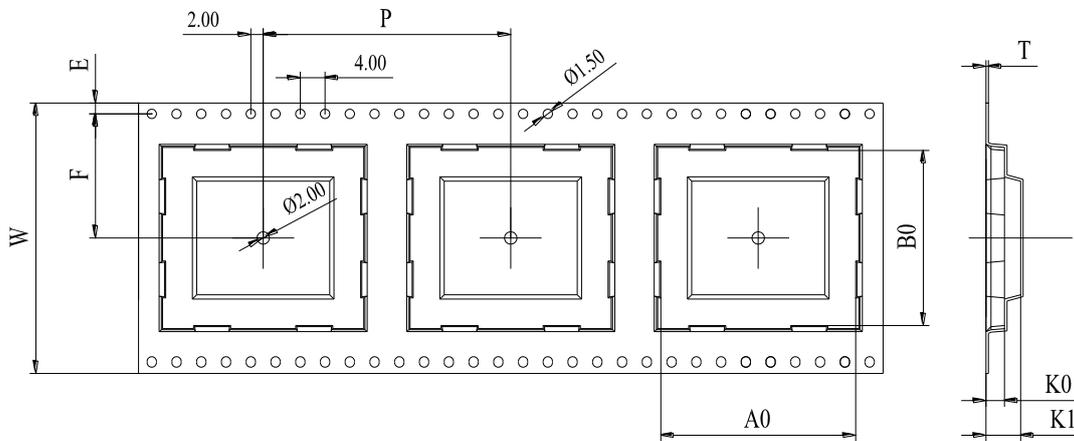


Figure 19: Carrier Tape Dimension Drawing

Table 22: Carrier Tape Dimension Table (Unit: mm)

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

6.3.2. Plastic Reel

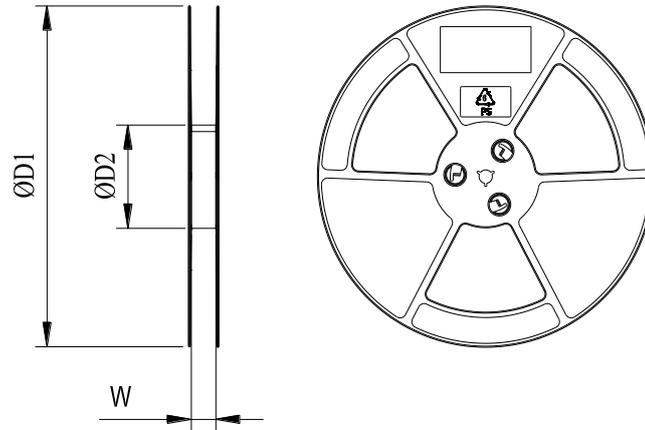


Figure 20: Plastic Reel Dimension Drawing

Table 23: Plastic Reel Dimension Table (Unit: mm)

| øD1 | øD2 | W |
|-----|-----|------|
| 330 | 100 | 24.5 |

6.3.3. Mounting Direction

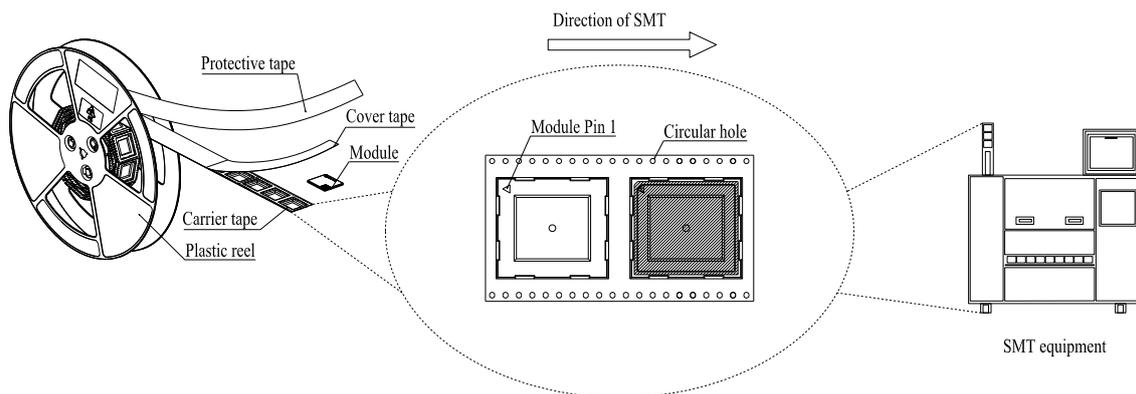
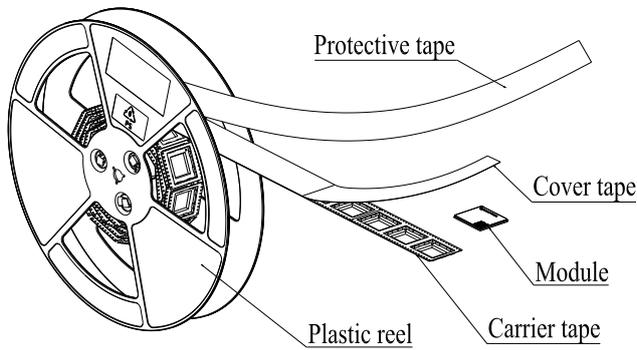


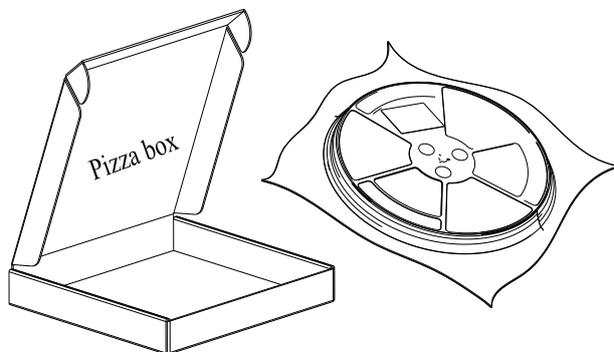
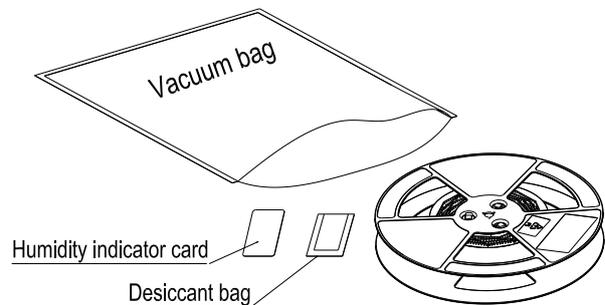
Figure 21: Mounting Direction

6.3.4. Packaging Process



Place the module into the carrier tape and use the cover tape to cover it; then wind the heat-sealed carrier tape to the plastic reel and use the protective tape for protection. 1 plastic reel can load 500 modules.

Place the packaged plastic reel, 1 humidity indicator card and 1 desiccant bag into a vacuum bag, vacuumize it.



Place the vacuum-packed plastic reel into the pizza box.

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

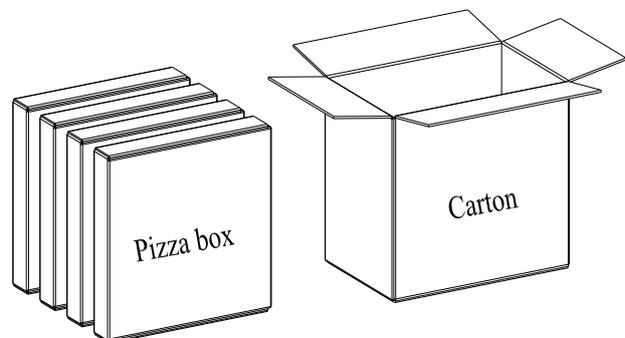


Figure 22: Packaging Process

7 Appendix References

Table 24: Related Documents

| Document Name |
|---|
| [1] Quectel_UMTS<E_EVB_User_Guide |
| [2] Quectel_RF_Layout_Application_Note |
| [3] Quectel_Module_SMT_Application_Note |
| [4] Quectel_FC30R_Reference_Design |
| [5] Quectel_EC2x_Series&EG25-G_Wi-Fi_Application_Note |

Table 25: Terms and Abbreviations

| Abbreviation | Description |
|--------------|---|
| AP | Access Point |
| BPSK | Binary Phase Shift Keying |
| CCK | Complementary Code Keying |
| DBPSK | Differential Binary Phase Shift Keying |
| DQPSK | Differential Quadrature Phase Shift Keying |
| ESD | Electrostatic Discharge |
| EVB | Evaluation Board |
| GND | Ground |
| HT | High Throughput |
| IEEE | Institute of Electrical and Electronics Engineers |
| I/O | Input/Output |

| | |
|------|--|
| LCC | Leadless Chip Carrier (package) |
| LGA | Land Grid Array |
| LTE | Long Term Evolution |
| Mbps | Million Bits Per Second |
| MCS | Modulation and Coding Scheme |
| MSL | Moisture Sensitivity Levels |
| PCB | Printed Circuit Board |
| QAM | Quadrature Amplitude Modulation |
| QPSK | Quadrature Phase Shift Keying |
| RF | Radio Frequency |
| RoHS | Restriction of Hazardous Substances |
| Rx | Receive |
| SDIO | Secure Digital Input and Output Card |
| SDR | Single Date Rate |
| STA | Station |
| Tx | Transmit |
| UMTS | Universal Mobile Telecommunications System |
| USB | Universal Serial Bus |
| VHT | Very High Throughput |
| WPA3 | Wi-Fi Protected Access 3 |
| VSWR | Voltage Standing Wave Ratio |

Important Notice to OEM integrators

1. This module is limited to OEM installation ONLY.
2. This module is limited to installation in mobile or fixed applications, according to Part 2.1091(b).
3. The separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and different antenna configurations
4. For FCC Part 15.31 (h) and (k): The host manufacturer is responsible for additional testing to verify compliance as a composite system. When testing the host device for compliance with Part 15 Subpart B, the host manufacturer is required to show compliance with Part 15 Subpart B while the transmitter module(s) are installed and operating. The modules should be transmitting and the evaluation should confirm that the module's intentional emissions are compliant (i.e. fundamental and out of band emissions). The host manufacturer must verify that there are no additional unintentional emissions other than what is permitted in Part 15 Subpart B or emissions are complaint with the transmitter(s) rule(s). The Grantee will provide guidance to the host manufacturer for Part 15 B requirements if needed.

Important Note

notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify to Quectel that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the USI, or the host manufacturer can take responsibility through the change in FCC ID (XMR2023FC30R) procedure followed by a Class II permissive change application.

End Product Labeling

When the module is installed in the host device, the FCC/IC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily re-moved. If not, a second label must be placed on the outside of the final device that contains the following text: “Contains FCC ID: XMR2023FC30R”

“Contains IC: 10224A-2023FC30R “

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

Antenna Installation

- (1) The antenna must be installed such that 20 cm is maintained between the antenna and users,
- (2) The transmitter module may not be co-located with any other transmitter or antenna.
- (3) Only antennas of the same type and with equal or less gains as shown below may be used with this module. Other types of antennas and/or higher gain antennas may require additional authorization for operation.

| Antenna type | 2.4GHz band | | 5.2GHz band | | 5.3GHz band | | 5.5GHz band | | 5.8GHz band | |
|--------------|-------------|------|-------------|------|-------------|------|-------------|------|-------------|------|
| | Peak (dBi) | Gain |
| Dipole | -0.3 | | / | | / | | / | | / | |

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC/IC authorization is no longer considered valid and the FCC ID/IC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC/IC authorization.

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

Federal Communication Commission Interference Statement

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

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

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

List of applicable FCC rules

This module has been tested and found to comply with 15.247 and 15.407 requirements for Modular Approval.

The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also

contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

This device is intended only for OEM integrators under the following conditions: (For module device use)

- 1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- 2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Radiation Exposure Statement

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body.

IC

Industry Canada Statement

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:

- (1) This device may not cause interference; and
- (2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

- (1) l'appareil ne doit pas produire de brouillage, et
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement."

Radiation Exposure Statement

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body.

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements ISED établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

This device is intended only for OEM integrators under the following conditions: (For module device use)

- 1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- 2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes: (Pour utilisation de dispositif module)

- 1) L'antenne doit être installée de telle sorte qu'une distance de 20 cm est respectée entre l'antenne et les utilisateurs, et

2) Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

Tant que les 2 conditions ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

IMPORTANT NOTE:

In the event that these conditions can not be met (for example certain laptop configurations or colocation with another transmitter), then the Canada authorization is no longer considered valid and the IC ID can not be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate Canada authorization.

NOTE IMPORTANTE:

Dans le cas où ces conditions ne peuvent être satisfaites (par exemple pour certaines configurations d'ordinateur portable ou de certaines co-localisation avec un autre émetteur), l'autorisation du Canada n'est plus considéré comme valide et l'ID IC ne peut pas être utilisé sur le produit final. Dans ces circonstances, l'intégrateur OEM sera chargé de réévaluer le produit final (y compris l'émetteur) et l'obtention d'une autorisation distincte au Canada.

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains IC:10224A-2023FC30R".

Plaque signalétique du produit final

Ce module émetteur est autorisé uniquement pour une utilisation dans un dispositif où l'antenne peut être installée de telle sorte qu'une distance de 20cm peut être maintenue entre l'antenne et les utilisateurs. Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 10224A-2023FC30R".

Manual Information To the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à

la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.

Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.