# CC660D-LS

# Hardware Design

**Satellite Communication Module Series**

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| | |
|---|---|
|  | 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 fuelling areas, below decks on boats, fuel or chemical transfer or storage facilities, and areas where the air contains chemicals or particles such as grain, dust or metal powders. |

# About the Document

## Revision History

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|---|---|---|---|
| - | 2023-07-04 | Ryan LIU/ Frances WU/ Porter WU | Creation of the document |
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# 1 Introduction

This document defines CC660D-LS and describes its air interfaces 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 document, coupled with application notes and user guides, makes it easy to design and set up mobile applications with the module.

## 1.1. Special Mark

**Table 1: Special Mark**

| Mark | Definition |
|---|---|
| * | Unless otherwise specified, when an asterisk (*) is used after a function, feature, interface, pin name, AT command, or argument, and so on, it indicates that the function, feature, interface, pin, AT command, or 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. |

# 2 Product Overview

The module is a high-performance satellite module with low power consumption. It is designed to communicate with infrastructures of mobile network operators through IoT-NTN radio protocols as specified in 3GPP Rel-17.

The module is an SMD module with small size and compact packaging, which is engineered to meet most of the demands of IoT applications.

**Table 2: Basic Information**

| CC660D-LS | |
|---|---|
| Packaging type | LCC + LGA |
| Pin counts | 58 |
| Dimensions | (17.7 ±0.15) mm × (15.8 ±0.15) mm × (2.0 ±0.2) mm |
| Weight | approx.1.2 g |

## 2.1. Frequency Bands and Functions

Designed with power saving technique, the module consumes an ultra-low current of 3.4 μA in deep sleep.

**Table 3: Frequency Bands and Functions**

| | CC660D-LS |
|---|---|
| IoT-NTN | L-Band (B255)/S-Band (B256/B23) |

## 2.2. Key Features

**Table 4: Key Features**

| Category | Description |
|---|---|
| Supply Voltage | ● 2.2–3.6 V<br>● Typ.: 3.3 V |
| Power Saving | Typical power consumption in deep sleep mode: 3.4[1] μA |
| SMS | ● Text and PDU mode<br>● Point-to-point MO and MT |
| USIM Interface | 1.8 V and 3.0 V |
| UART | **Main UART:**<br>● Use: AT command communication and data transmission<br>– Baud rate: up to 115200 bps<br>● Use: firmware upgrade<br>– Baud rate: 921600 bps by default<br>**Debug UART:**<br>● Use: software debugging<br>– Baud rate: 921600 bps<br>**Auxiliary UART:**<br>● Used: software debugging<br>– Baud rate: 921600 bps |
| USB Interface | The USB interface of this module conforms to USB 1.1 specifications and supports full-speed (12 Mbps) mode. |
| AT Commands | ● Complies with the AT commands defined in *3GPP TS 27.007* and *3GPP TS 27.005*<br>● Complies with Quectel enhanced AT commands |
| Antenna Interface | 50 Ω characteristic impedance |
| Transmitting Power | 23 dBm ±2 dB |
| Internet Protocol Features | The module complies with IPv4/UDP*/NIDD/SMP*/DNS* |
| Data Transmission Features | **IoT-NTN** [1]**:**<br>● Single-tone with 15/3.75 kHz subcarrier:<br>– UL: 5.8 kbps (15 kHz)/2.7kbps (3.75 kHz)<br>● Multi-tone with 15 kHz subcarrier:<br>– DL: 8.3 kbps<br>– UL: 8.6 kbps |

[1] Reference data provided by the baseband chip platform.

| | |
|---|---|
| Real Time Clock | The module supports RTC function |
| OTDOA* | Complies with 3GPP Rel-14 specification |
| E-CID* | Complies with 3GPP Rel-14 specification |
| Temperature Ranges | ● Normal operating temperature [2]: -35 °C to +75 °C<br>● Extended operating temperature [3]: -40 °C to +85 °C<br>● Storage temperature: -40 °C to +90 °C |
| Firmware Upgrade | ● Main UART<br>● DFOTA* |
| RoHS | All hardware components are fully compliant with EU RoHS directive |

## 2.3. Functional Diagram

The functional diagram illustrates the following major functional parts:

- Power management
- Baseband part
- Flash
- Radio frequency part
- Peripheral interfaces

[2] Within this range, the module's indicators comply with 3GPP specification requirements.
[3] Within this range, the module retains the ability to establish and maintain functions such as SMS, without any unrecoverable malfunction. Radio spectrum and radio network remain uninfluenced, whereas the value of one or more parameters, such as $P_{out}$, may decrease and fall below the range of the 3GPP specified tolerances. When the temperature returns to the normal operating temperature range, the module's indicators will comply with 3GPP specification requirements again.

## 2.4. Pin Assignment

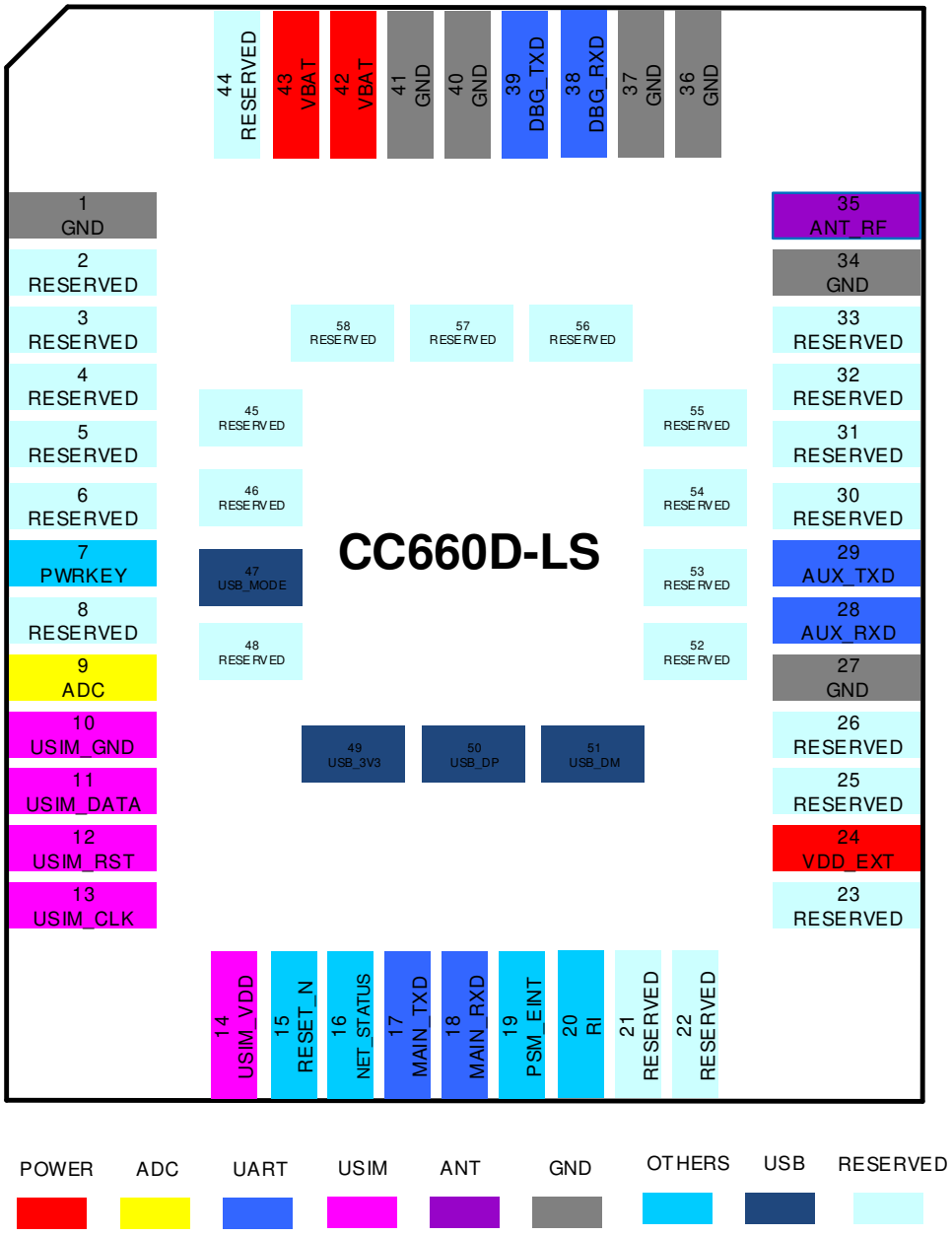



**Figure 1: Pin Assignment (Top View)**

**NOTE**

Keep all RESERVED pins and unused pins unconnected.

## 2.5. Pin Description

**Table 5: Parameter Definition**

| Parameter | Description |
|---|---|
| AI | Analog Input |
| AIO | Analog Input/Output |
| DI | Digital Input |
| DO | Digital Output |
| DIO | Digital Input/Output |
| PI | Power Input |
| PO | Power Output |

DC characteristics include power domain and rate current.

**Table 6: Pin Description**

| **Power Supply** | | | | | |
|---|---|---|---|---|---|
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristic** | **Comment** |
| VBAT | 42, 43 | PI | Power supply for the module | Vmax = 3.6 V<br>Vmin = 2.2 V<br>Vnom = 3.3 V | |
| VDD_EXT | 24 | PO | 1.8 V output power supply | Vmax = 1.94 V<br>Vmin = 1.66 V<br>Vnom = 1.8 V | It is intended to supply power for the module's pull-up circuits, and is not recommended to be used as the power supply for external circuits.<br>VDD_EXT has no voltage output in deep sleep mode.<br>A test point is recommended to be reserved. |

| | | | | | |
|---|---|---|---|---|---|
| GND | 1, 27, 34, 36, 37, 40, 41 | | | | |
| **Turn On/Reset** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristic** | **Comment** |
| PWRKEY | 7 | DI | Turn on the module | VBAT | Active low.<br>A test point is recommended to be reserved. |
| RESET_N | 15 | DI | Reset the module | VBAT | Active low.<br>A test point is recommended to be reserved if unused. |
| **Indication Interface*** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristic** | **Comment** |
| NET_STATUS | 16 | DO | Indicate the module's network activity status | VDD_EXT | If unused, keep this pin open. |
| RI | 20 | DO | Ring indication | VDD_EXT | |
| **USIM Interface** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristic** | **Comment** |
| USIM_GND | 10 | - | Specified ground for USIM card | - | |
| USIM_DATA | 11 | DIO | USIM card data | USIM_VDD | |
| USIM_RST | 12 | DO | USIM card reset | USIM_VDD | |
| USIM_CLK | 13 | DO | USIM card clock | USIM_VDD | |
| USIM_VDD | 14 | PO | USIM card power supply | Low-voltage:<br>Vmin = 1.66 V<br>Vnom = 1.8 V<br>Vmax = 1.94 V<br><br>High-voltage:<br>Vmin = 2.76 V<br>Vnom = 3.0 V<br>Vmax = 3.24 V | Supply current: about 60 mA. |
| **Auxiliary UART** | | | | | |

| Pin Name | Pin No. | I/O | Description | DC Characteristic | Comment |
|---|---|---|---|---|---|
| AUX_RXD | 28 | DI | Auxiliary UART receive | VDD_EXT | If unused, keep these pins open. Test points are recommended to be reserved. |
| AUX_TXD | 29 | DO | Auxiliary UART transmit | VDD_EXT | |
| **Main UART** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristic** | **Comment** |
| MAIN_TXD | 17 | DO | Main UART transmit | VDD_EXT | Test points are recommended to be reserved. |
| MAIN_RXD | 18 | DI | Main UART receive | VDD_EXT | |
| **Debug UART** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristic** | **Comment** |
| DBG_RXD | 38 | DI | Debug UART receive | VDD_EXT | If unused, keep these pins open. Test points must be reserved. |
| DBG_TXD | 39 | DO | Debug UART transmit | VDD_EXT | |
| **RF Antenna Interface** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristic** | **Comment** |
| ANT_RF | 35 | AIO | RF antenna interface | | 50 Ω characteristic impedance |
| **ADC Interface** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristic** | **Comment** |
| ADC | 9 | AI | General-purpose ADC interface | Voltage range: 0–1.4 V | If unused, keep this pin open. |
| **USB Interface** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristic** | **Comment** |
| USB_MODE | 47 | DI | Pull down the pin to achieve USB download mode | | A test point is recommended to be reserved if unused. |
| USB_3V3 | 49 | PI | USB power supply | Vmin = 2.97 V<br>Vnom = 3.3 V<br>Vmax = 3.6 V | A test point is recommended to be reserved if unused. |

| | | | | | |
|---|---|---|---|---|---|
| USB_DP | 50 | AIO | USB differential data (+) | | Conform to USB 1.1 specification. Request 90 Ω differential impedance. Test points must be reserved. |
| USB_DM | 51 | AIO | USB differential data (-) | | |
| **Other Interface** | | | | | |
| **Pin Name** | **Pin No.** | **I/O** | **Description** | **DC Characteristic** | **Comment** |
| PSM_EINT | 19 | DI | Wake up the module from PSM | VBAT | Active on falling edge. |
| **Reserved Pins** | | | | | |
| **Pin Name** | **Pin No.** | | | | |
| RESERVED | 2–6, 8, 21–23, 25, 26, 30–33, 44–46, 48, 52–58 | | | | |

**NOTE**

Keep all reserved and unused pins unconnected.

## 2.6. TE-B Kit

Quectel supplies a CC660D-LS TE-B with accessories to develop and test the module.

# 3 Operating Characteristics

## 3.1. Operating Modes

**Table 7: Operating Mode Overview**

| Device | Mode | Description |
|---|---|---|
| AP | Active | AP handles tasks, for example, AT command communication. |
| | Idle | When all tasks are suspended, AP will enter Idle mode. |
| Modem | Connected | The module is connected to the network and supports data transmission. The modem can switch to PSM or DRX/eDRX mode. |
| | DRX/eDRX | Modem is in Idle mode, and downlink data can be received during PTW only. The modem can switch to PSM or Connected mode. |
| | PSM | The modem is disconnected from the eNodeB and cannot receive any downlink data. The modem can switch to Connected mode. |

| Device | Mode | Precondition | Description |
|---|---|---|---|
| Module | Active | ● AP is in Active mode<br>● Modem is in Connected mode or the PTW of DRX/eDRX mode. | All services and functions work normally with the maximum power consumption. |
| | Light Sleep | ● AP is in Idle mode<br>● Modem is in PTW of DRX/eDRX mode. | AP suspends tasks, modem does not receive downlink data or only receives it in paging window, and power consumption is greatly reduced to μA level. |
| | Deep Sleep | ● AP is in Idle mode.<br>● Modem is in PSM or eDRX mode. | CPU powers down and only the internal RTC keeps working. Meanwhile, VDD_EXT keeps outputting power, and the I/O pin status remains constant. In this mode, the power consumption minimizes to about 3.4 μA. |

## 3.2. Power Saving Modes

### 3.2.1. Light Sleep Mode

In Light Sleep mode, UART does not work. On the falling edge of PSM_EINT or by sending AT commands to the module via UART can the module be awakened.

### 3.2.2. Deep Sleep Mode

The module consumes extremely low current in Deep Sleep mode (typical value: 3.4 μA). The main purpose of Deep Sleep is to reduce the power consumption of the module and prolong the power supply duration of the battery. In this mode, UART does not work. The following figure shows the power consumption of the module in different modes:

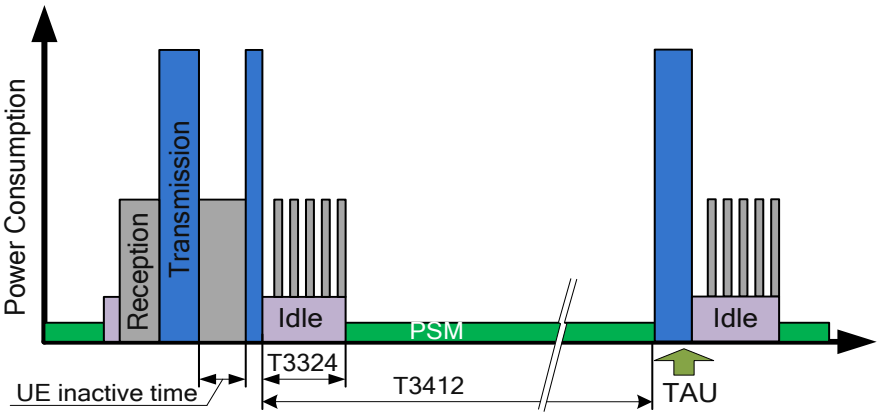



**Figure 2: Module Power Consumption in Deep Sleep Mode**

The procedure of the module entering PSM is as follows:

The modem requests to enable PSM with an ATTACH REQUEST or TAU REQUEST message during ATTACH or TAU (Tracking Area Update) procedure. Then the network accepts the request and provides an active time value (T3324) to the module and the mobile reachable timer starts. When the modem enters the idle state, it will then initiate T3324 timer. When the T3324 timer expires, the modem enters PSM. When all tasks from AP are in the suspended state, the AP will enter the Idle mode and the module will automatically enter the Deep Sleep mode.

When the module is in Deep Sleep mode, the following methods or conditions will wake up the module:

- After the TAU timer expires.
- Pulling down PSM_EINT (falling edge).

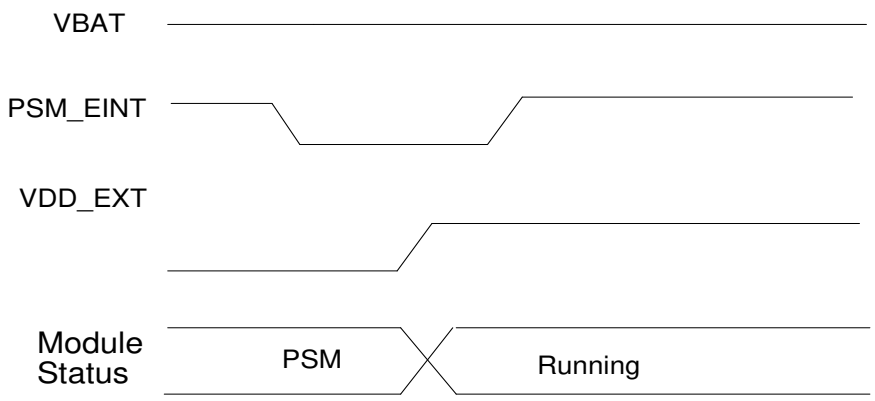



**Figure 3: Timing of Waking Up the Module from Deep Sleep Mode**

## 3.3. Power Supply

### 3.3.1. Power Supply Interface

The module provides two VBAT pins dedicated to connecting with the external power supply:

**Table 8: VBAT and GND Pins**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| VBAT | 42, 43 | PI | Power supply for the module | |
| VDD_EXT | 24 | PO | 1.8 V output power supply | It is intended to supply power for the module's pull-up circuits, and is not recommended to be used as the power supply for external circuits.<br>VDD_EXT has no voltage output in deep sleep mode.<br>A test point is recommended to be reserved. |
| GND | 1, 27, 34, 36, 37, 40, 41 | | | |

### 3.3.2. Reference Design for Power Supply

Power design for the module is essential. It is recommended to use a low quiescent current power source with an output capacity of at least 1.5 A to regulate the power supply for the module. Meanwhile,

Lithium-thionyl chloride (Li-SOCl2) batteries or Lithium manganese oxide (LiMn2O4) batteries can also be used as the power source.

### 3.3.3. Requirements for Voltage Stability

The power supply range of the module is from 2.2 V to 3.6 V. Ensure the input voltage never drops below 2.2 V.

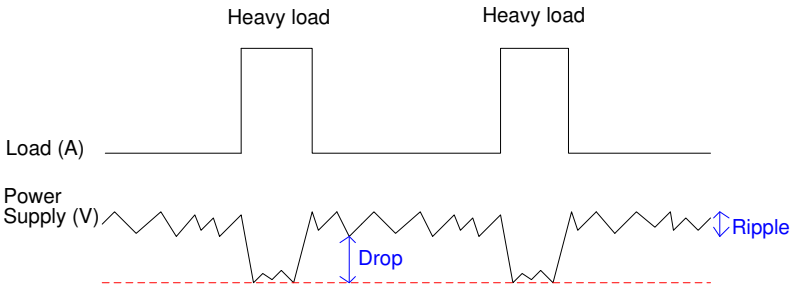



**Figure 4: Power Supply Limits During Heavy Load**

For better performance, it is recommended to place a 220 µF tantalum capacitor with low ESR and three ceramic capacitors (100 nF, 100 pF and 22 pF) near the VBAT pins. Also, it is recommended to add a TVS component on the VBAT trace (near VBAT pins) to improve surge voltage withstanding capability. As per design rules, the width of VBAT trace is recommended to be wider than 1.5 mm, and the longer the trace is, the wider it should be.

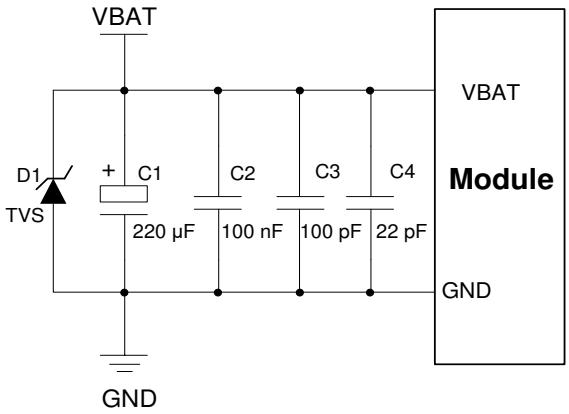



**Figure 5: Reference Design of Power Supply**

## 3.4. Turn On

**Table 9: Pin Description of PWRKEY**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| PWRKEY | 7 | DI | Turn on the module | Active low.<br>A test point is recommended to be reserved. |

When the module is in turn off state, it can be turned on by driving PWRKEY low for at least 500 ms. It is recommended to use an open drain/collector driver to control the PWRKEY.

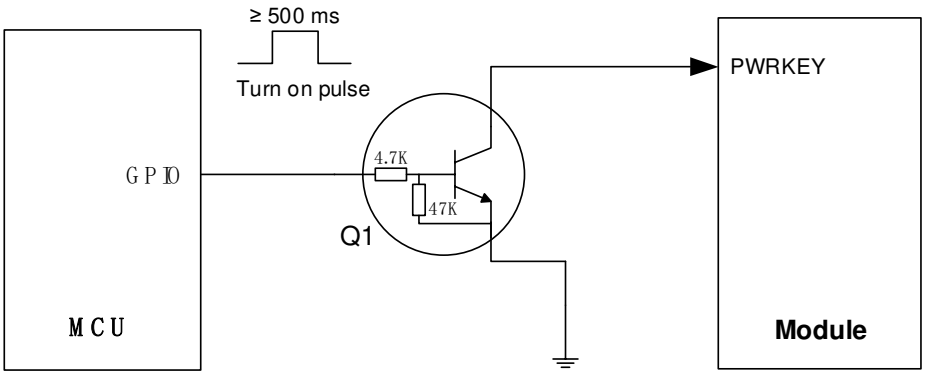



**Figure 6: Reference Design of Turn On with Driving Circuit**

Another way to control the PWRKEY is using a keystroke directly. When pressing the keystroke, an electrostatic strike may be generated from finger. Therefore, you should place a TVS component near the keystroke for ESD protection.

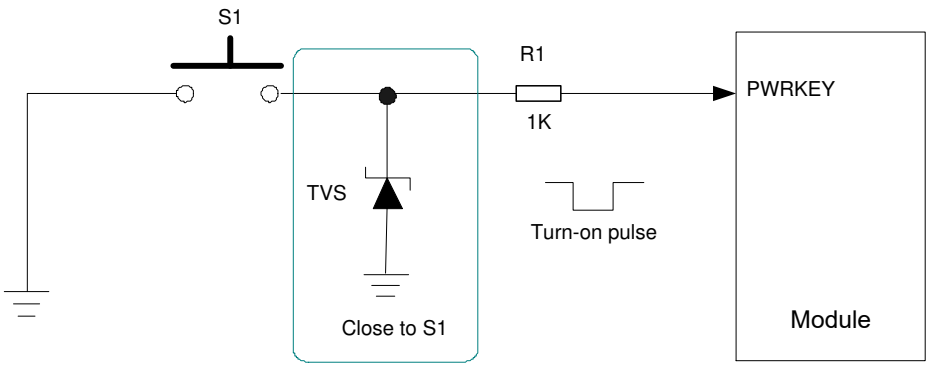



**Figure 7: Reference Design of Turn On with Keystroke**

After the module VBAT is powered up, keep RESET_N high and the module can be turned on by driving

PWRKEY low for at least 500 ms.

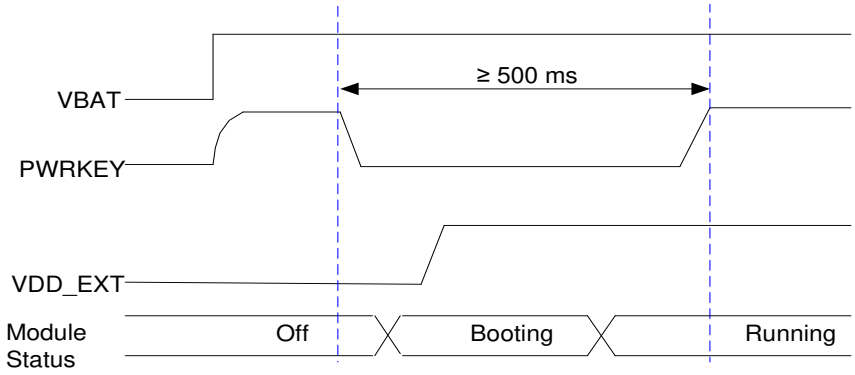



**Figure 8: Timing of Turn On with PWRKEY**

**NOTE**

1. After VBAT is powered up, RESET_N and PWRKEY will automatically rise to high level due to internal pull-up.
2. PWRKEY cannot be pulled down all the time, otherwise the module will not be able to enter deep sleep mode.

## 3.5. Turn Off

The module can be turned off through the following methods:

- Cutting off VBAT power supply. The module will turn off automatically when VBAT drops below 2.2 V.
- Executing **AT+QPOWD=0**.

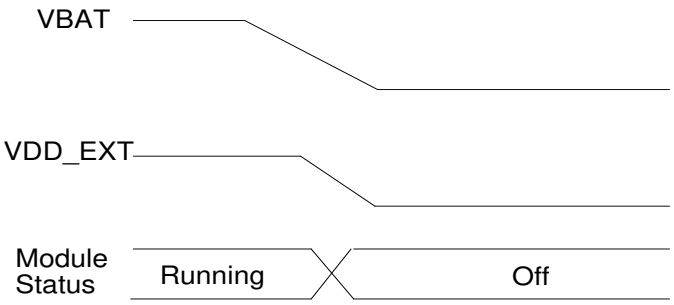



**Figure 9: Timing of Turn Off (by Cutting Off VBAT)**

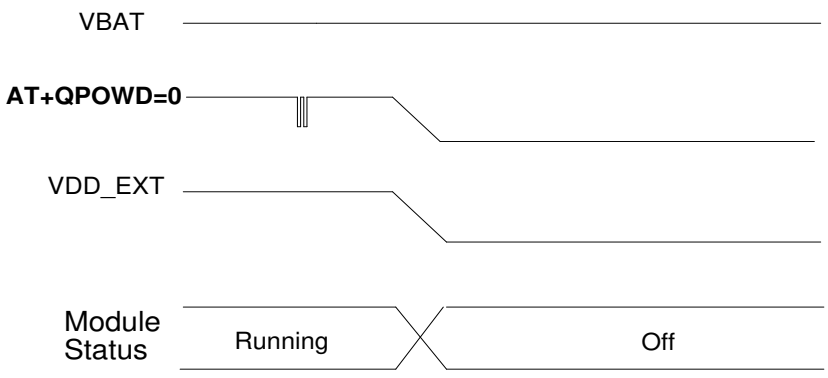



**Figure 10: Timing of Turn Off (by Executing AT Command)**

**NOTE**

For more details about the AT command, see *Quectel_CC660D-LS_AT_Commands_Manual*.

## 3.6. Reset

The module can be reset though the following methods:

- Hardware reset: driving RESET_N low for at least 100 ms.
- Executing **AT+QRST=1**.

**Table 10: Pin Description of RESET_N**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| RESET_N | 15 | DI | Reset the module | Active low.<br>A test point is recommended to be reserved if unused. |

You can use an open drain/collector driver or a button to control RESET_N.

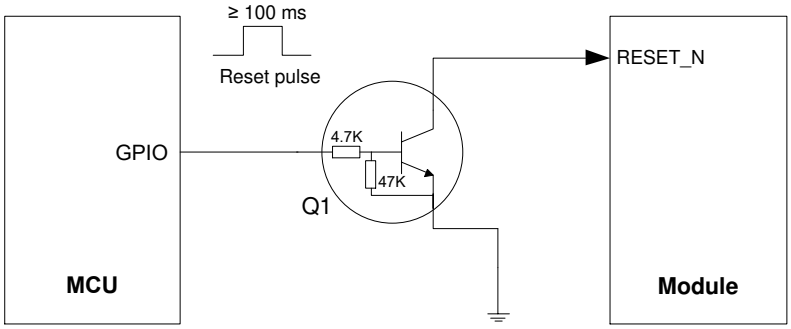



**Figure 11: Reference Design of Reset with Driving Circuit**

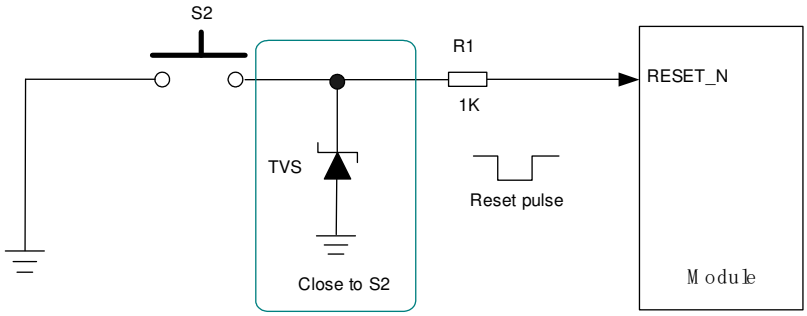



**Figure 12: Reference Design of Reset with Button**

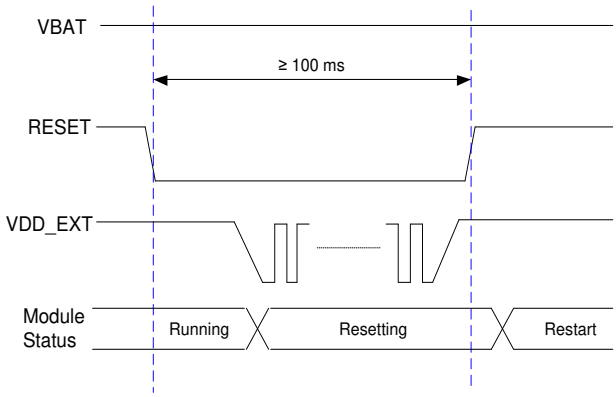



**Figure 13: Timing of Reset**

**NOTE**

Ensure the capacitance on PWRKEY and RESET_N is not more than 10 nF.

# 4 Application Interfaces

## 4.1. USIM Interface

The module provides one USIM interface. The USIM card is powered by the USIM_VDD inside the module. Both 1.8 V and 3.0 V USIM cards are supported. When the input voltage of the USIM_VDD is below 3 V, only 1.8 V USIM card is supported.

**Table 11: Pin Description of USIM Interface**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| USIM_GND | 10 | - | Specified ground for USIM card | |
| USIM_DATA | 11 | DIO | USIM card data | USIM_VDD power domain. |
| USIM_RST | 12 | DO | USIM card reset | |
| USIM_CLK | 13 | DO | USIM card clock | |
| USIM_VDD | 14 | PO | USIM card power supply | Supply current: about 60 mA. |

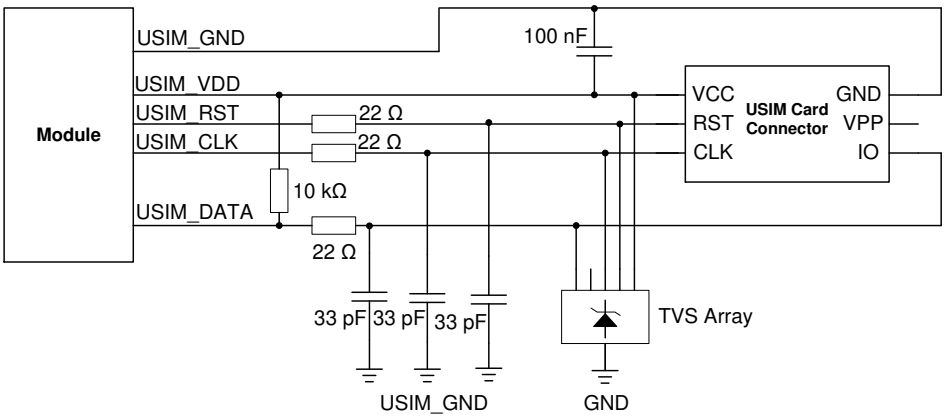



**Figure 14: Reference Design of USIM Interface with a 6-pin USIM Card Connector**

**NOTE**

If your PCB board has a complete ground plane, connect USIM_GND directly to the main GND. Otherwise, USIM_GND keeps the connection as shown above, and the shorter the USIM_GND trace is, the better.

For more information about USIM card connector, please visit http://www.amphenol.com and http://www.molex.com.

To ensure the performance, you should follow the principles below in the USIM circuit design:

- Place the USIM card connector close to the module. Keep the trace length less than 200 mm if possible.
- Route USIM card at the inner-layer of the PCB, and surround the traces with ground on that layer and ground planes above and below. For signal traces, provide clearance from power supply traces, crystal-oscillators, magnetic devices, sensitive signals like RF signals, analog signals, and noise signals generated by clock, DC-DC, etc.
- Ensure the trace between the USIM card connector and the module is short and wide. Keep the trace width of ground and USIM_VDD at least 0.5 mm to maintain the same electric potential.
- To avoid cross-talk between USIM_DATA and USIM_CLK, keep the traces away from each other and shield them with ground surrounded.
- The module's USIM peripheral devices should be placed close to the USIM card connector. Place the ESD protection component as close to the USIM card connector as possible and the ESD protection components you choose shall have a parasitic capacitance of not more than 15 pF. You can visit http://www.onsemi.com to choose the proper ESD protection components. Ensure the USIM card signal traces from the USIM card connector go through the ESD protection component before reaching the module. The 22 Ω resistors should be connected in series between the module and the USIM card connector to suppress EMI such as spurious transmission and to enhance the ESD protection.
- Add 33 pF capacitors in parallel on USIM_DATA, USIM_CLK and USIM_RST signal traces to filter out RF interference. If the trace of USIM interface is too long or there is an interference source nearby, it is recommended to add a pull-up resistor near the card connector.

## 4.2. UART

The module provides three UARTs.

**Table 12: Pin Description of UART**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| MAIN_TXD | 17 | DO | Main UART transmit | Test points are recommended to be reserved. |
| MAIN_RXD | 18 | DI | Main UART receive | |
| DBG_RXD | 38 | DI | Debug UART receive | If unused, keep these pins open. Test points must be reserved. |
| DBG_TXD | 39 | DO | Debug UART transmit | |
| AUX_RXD | 28 | DI | Auxiliary UART receive | If unused, keep these pins open. Test points are recommended to be reserved. |
| AUX_TXD | 29 | DO | Auxiliary UART transmit | |

### 4.2.1. Main UART

The main UART supports AT command communication, data transmission and firmware upgrade.

- By default, the module is in auto-baud mode. and it supports automatic baud rates not exceeding 115200 bps. When powering on the module, the MCU has to send **AT** commands consecutively to synchronize the baud rate with the module. When **OK** is returned, it indicates the baud rate has been synchronized successfully. When the module is woken up from deep sleep or idle mode, the baud rate synchronized during start-up will be used directly.
- When the port is used for firmware upgrade, the baud rate is 921600 bps by default.

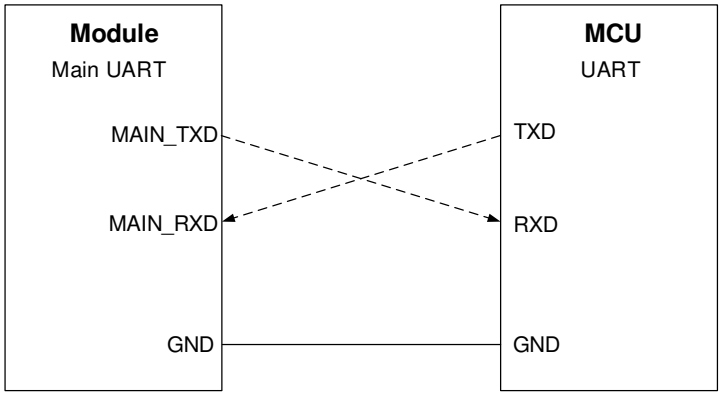



**Figure 15: Block Diagram of Main UART Connection**

### 4.2.2. Debug UART

Through debug tools, the debug UART can be used to view log information for software debugging, and the baud rate is 921600 bps.

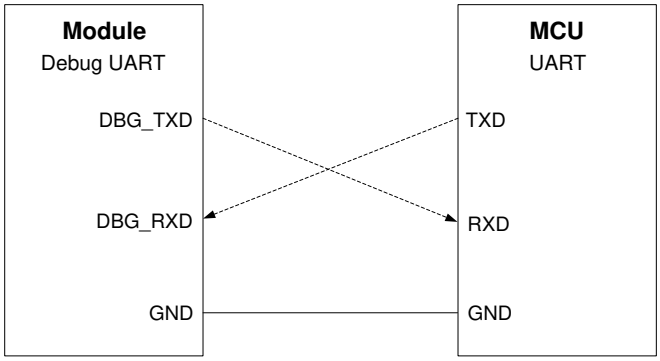



**Figure 16: Block Diagram of Debug UART Connection**

### 4.2.3. Auxiliary UART

You can use auxiliary UART to view the underlying log for software debugging via debugging tools. Its default baud rate is 921600 bps.

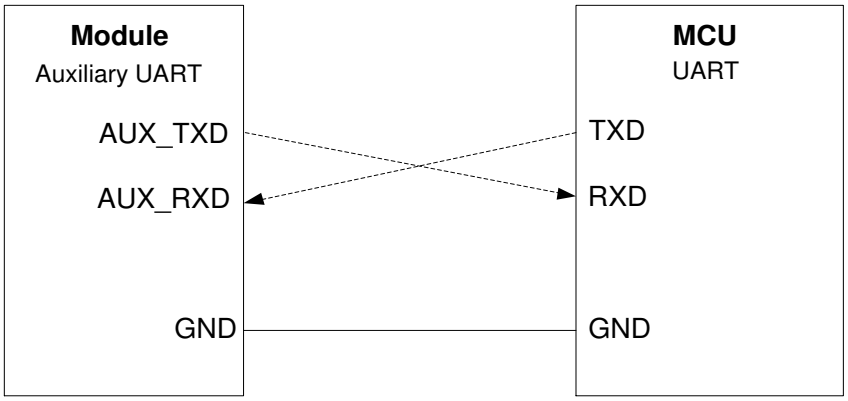



**Figure 17: Block Diagram of Auxiliary UART Connection**

### 4.2.4. UART Application

The module provides 1.8 V UART. A voltage-level translator should be used if the application is equipped with a 3.3 V UART or other voltage UART. The following figure shows a reference design.

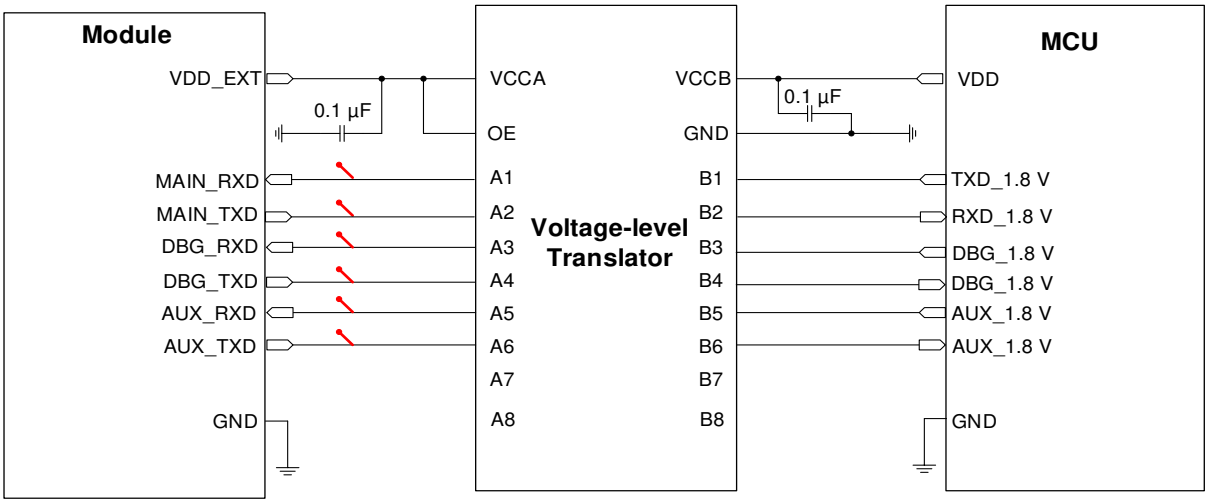



**Figure 18: Reference Design of UART with Voltage-level Translator**

Another example of level-shifting circuit is shown as below. For the design of input/output circuits in dotted lines, see that shown in solid lines, but pay attention to the direction of the connection.

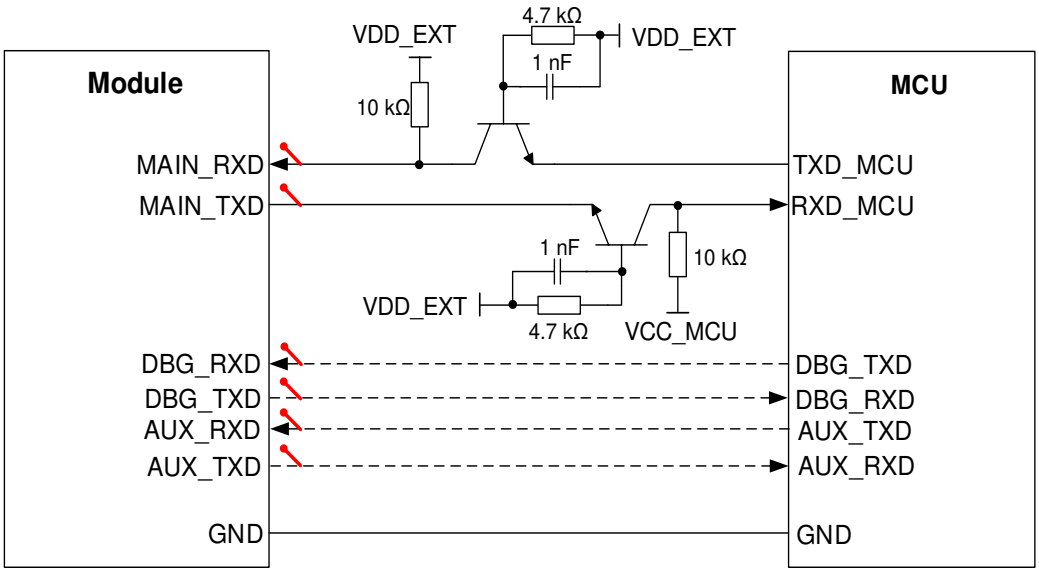



**Figure 19: Reference Design of UART with Transistor Level-shifting Circuit**

The following circuit shows a reference design for the communication between the module and a PC with a standard RS-232 voltage-level translator. Ensure the I/O voltage of voltage-level translator which is connected to the module is 1.8 V:

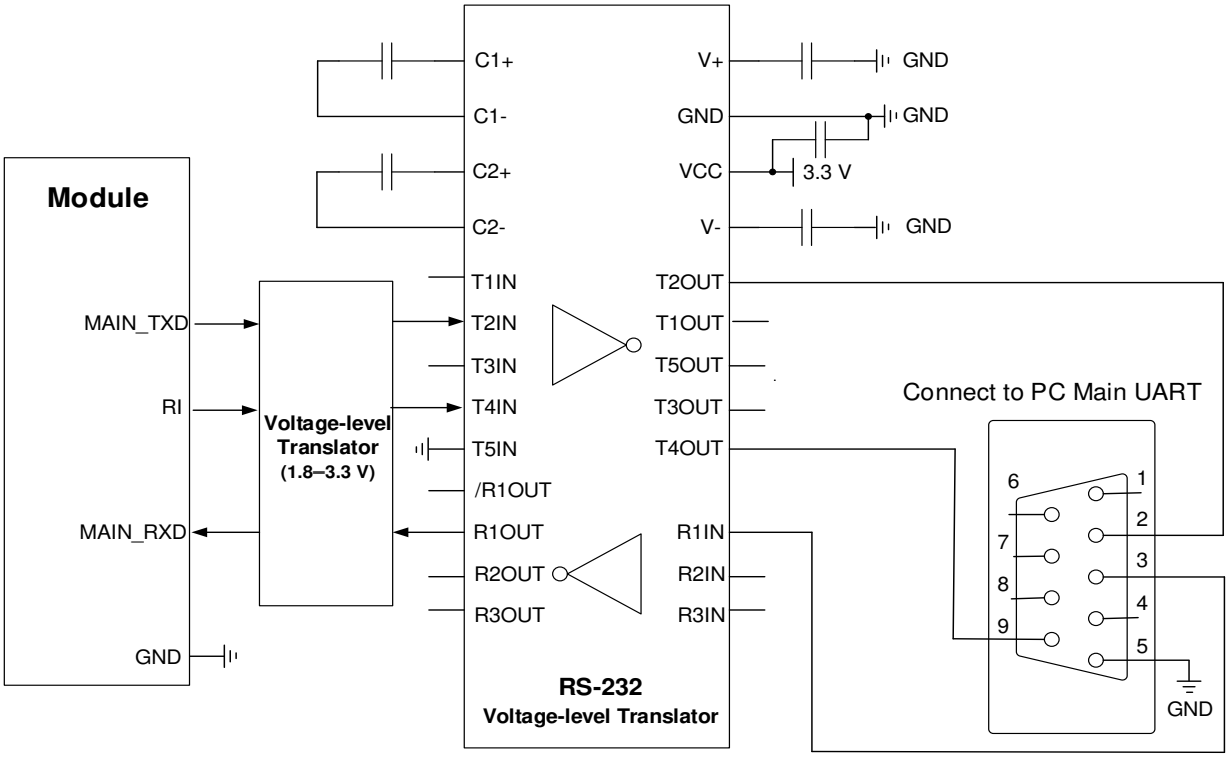



**Figure 20: Reference Design of UART with RS-232 Voltage-level Translator**

Visit vendors' websites to select a suitable RS-232 voltage-level translator, such as: http://www.exar.com and http://www.maximintegrated.com.

**NOTE**

1. Transistor level-shifting circuit above is not suitable for applications with baud rates exceeding 460 kbps.
2. " " represents test points of UART. It is recommended to reserve the test points of VBAT and RESET_N for convenient firmware upgrade and software debugging when necessary.

## 4.3. USB Interface

The USB interface of this module conforms to USB 1.1 specifications and supports full-speed (12 Mbps) mode. The interface can be used for debugging and upgrading, and supports USB serial driver under Windows operating system.

**Table 13: Pin Description of USB Interface**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| USB_MODE | 47 | DI | Pull down the pin to achieve USB download mode | A test point is recommended to be reserved if unused. |
| USB_3V3 | 49 | PI | USB power supply | A test point is recommended to be reserved if unused. |
| USB_DP | 50 | AIO | USB differential data (+) | Conform to USB 1.1 specification. Request 90 Ω differential impedance. Test points must be reserved. |
| USB_DM | 51 | AIO | USB differential data (-) | |

The following is a reference design of USB interface:

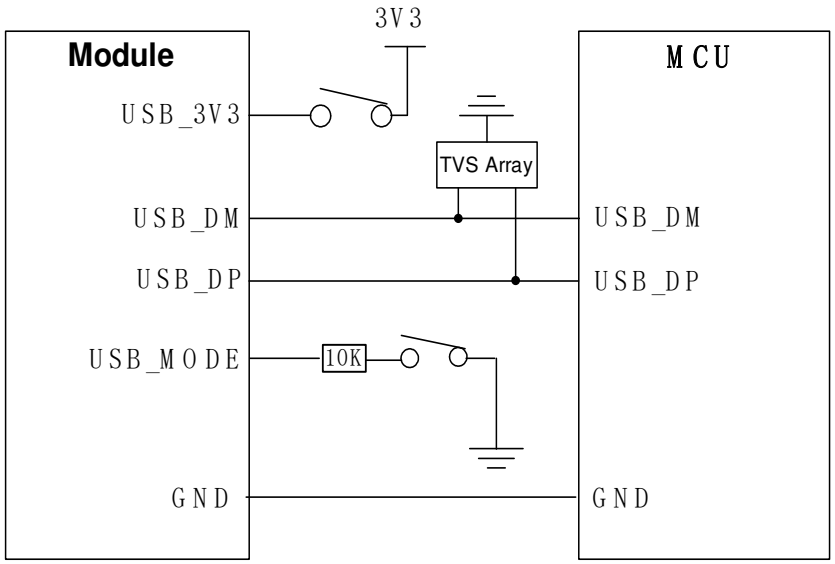



**Figure 21: USB Interface Reference Design**

In the circuit design of USB interface, to ensure the performance of USB, the following principles are suggested in the circuit design:

- It is important to route the USB signal traces as differential pairs with ground surrounded. The impedance of USB differential trace is 90 Ω.
- Route USB differential traces at the inner-layer of the PCB, and surround the traces with ground on that layer and ground planes above and below. For signal traces, provide clearance from power supply traces, crystal-oscillators, magnetic devices, sensitive signals like RF signals, analog signals, and noise signals generated by clock, DC-DC, etc.
- Pay attention to the impact caused by stray capacitance of the ESD protection component on USB interface. Typically, the ESD protection component should be placed close to USB interface and its stray capacitance should be less than 3 pF.

**NOTE**

1. When using USB function of the module, an external 3.3 V power supply should be provided.
2. Pull down the USB_MODE to GND through a 10 kΩ resistor before turning on the module, and the module will enter the USB download function immediately; If the USB_MODE is not connected, the module will enter the normal boot mode after turning on.
3. When the USB interface is used for log capturing, the module will not be able to enter deep sleep mode.

## 4.4. ADC Interface

The module provides one ADC interface to read the voltage value. The interface is available in Active and Idle modes.

The resolution of ADC can reach up to 10 bits.

**Table 14: Pin Description of ADC Interface**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| ADC | 9 | AI | General-purpose ADC interface | If unused, keep this pin open. |

## 4.5. Indication Signal*

**Table 15: Pin Description of Indication Signal**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| NET_STATUS | 16 | DO | Indicate the module's network activity status | If unused, keep this pin open. |
| RI | 20 | DO | Ring indication | |

### 4.5.1. Network Status Indication

NET_STATUS can be used to indicate the network status of the module. This function is disabled by default and NET_STATUS outputs low level voltage. The function can be enabled by **AT+QLEDMODE=1**. For more details about the AT command, see *Quectel_CC660D-LS_AT_Commands_Manual*.

**Table 16: Network Status Indication Pin Level and Module Network Status**

| NET_STATUS Level Status | Module Network Status |
|---|---|
| 64 ms high level (LED on)/800 ms low (LED off) | Network searching |
| 64 ms high level (LED on)/2000 ms low (LED off) | Network connected |

| | |
|---|---|
| Always low (LED off) | Other status |

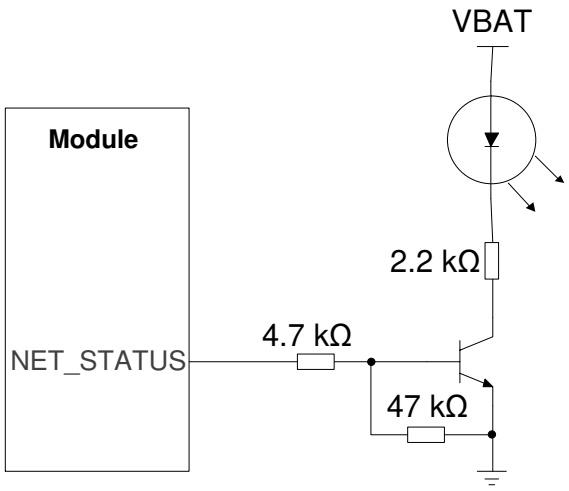



**Figure 22: Reference Design of Network Status Indication**

### 4.5.2. RI

When there is a message received or URC information output, the module will notify MCU through the RI.

**Table 17: RI Level and Module Status**

| Module Status | RI Level Status |
|---|---|
| Idle | High |
| When receiving SMS/ outputting URC information | RI outputs at least 120 ms low level. After the module outputs the data, the level status will then become high. |

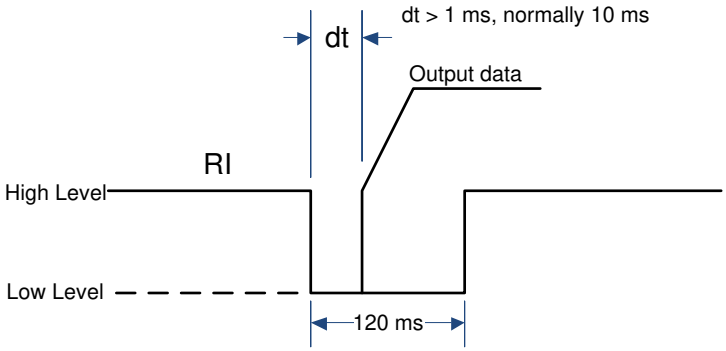


**Figure 23: Timing of RI When Receiving SMS/Outputting URC Information**

**NOTE**

The maximum time for the RI to keep outputting low level depends on the data length of the SMS/URC to be output and the baud rate of UART interface.

# 5 RF Specifications

The module offers one RF antenna interface with a characteristic impedance of 50 Ω.

Appropriate antenna type and design should be used with matched antenna parameters according to specific application. It is required to perform a comprehensive functional test for the RF design before mass production of terminal products. The entire content of this chapter is provided for illustration only. Analysis, evaluation and determination are still necessary when designing target products.

## 5.1. Cellular Network

### 5.1.1. Antenna Interface & Frequency Bands

**Table 18: Pin Description of Cellular Antenna Interface**

| Pin Name | Pin No. | I/O | Description | Comment |
|---|---|---|---|---|
| ANT_RF | 35 | AIO | RF antenna interface | 50 Ω characteristic impedance |
| GND | 34, 36, 37 | | GND | Isolated interference |

**Table 19: Operating Frequency (Unit: MHz)**

| Operating Frequency | Transmit | Receive |
|---|---|---|
| B255 | 1626.5–1660.5 (For FCC)<br>1626.6–1660.4 (For CE) | 1525–1559 (For FCC)<br>1525.1–1558.9 (For CE) |
| B256 | 1980–2010 | 2170–2200 |
| B23 | 2000–2020 | 2180–2200 |

### 5.1.2. Transmitting Power

**Table 20: RF Transmitting Power (Uplink QPSK and BPSK Modulation)**

| Mode | Frequency Band | Max. | Min. |
|---|---|---|---|
| IoT-NTN | B255/B256/B23 | 23 dBm ±2 dB | < -39 dBm |

**NOTE**

This design is compliant with the IoT-NTN radio protocol in 3GPP Rel-17, which is still under discussion, and the RF performance test is based on 3GPP Rel-16 NB-IoT standard.

### 5.1.3. Receiver Sensitivity

**Table 21: RF Receiver Sensitivity (Throughput ≥ 95 %)**

| Frequency | Receiver Sensitivity | 3GPP Requirements |
|---|---|---|
| B255/B256/B23 | -114 dBm ±1 dB | -108.2 dBm |

### 5.1.4. Reference Design

For the peripheral circuit design of the antenna interface, it is recommended to reserve a π-type matching circuit for better RF performance, and the π-type matching components (R1, C1 and C2) should be placed as close to the antenna as possible. C1 and C2 are not mounted by default. Only a 0 Ω resistor is mounted on R1.

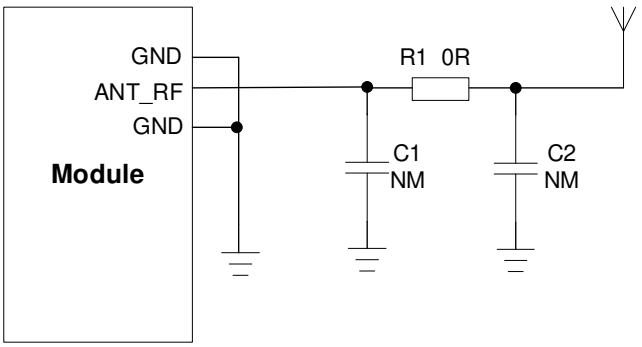



**Figure 24: Reference Design of RF Antenna**

The module provides an RF antenna pad for external antenna connection. Both sides of the RF antenna

pad are equipped with ground pads for better grounding.

## 5.2. RF Routing Guidelines

When designing PCB, characteristic impedance of all RF traces should be controlled to 50 Ω. Generally, the impedance of RF traces is determined by materials' dielectric constant, trace width (W), space between RF traces and grounds (S) and height from the reference ground to the signal layer (H). 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 when characteristic impedance of RF traces is controlled to 50 Ω.

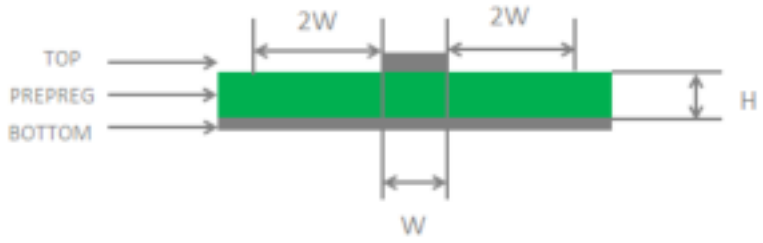



**Figure 25: Microstrip Design on a 2-layer PCB**

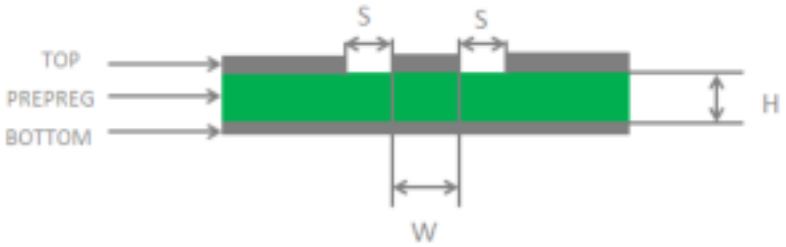



**Figure 26: Coplanar Waveguide Design on a 2-layer PCB**

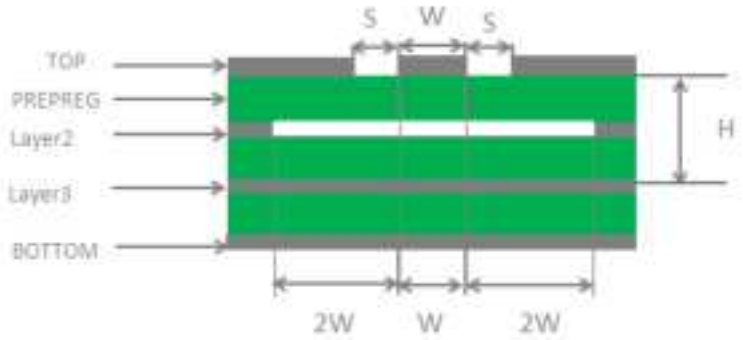



**Figure 27: Coplanar Waveguide Design on a 4-layer PCB (Layer 3 as Reference Ground)**

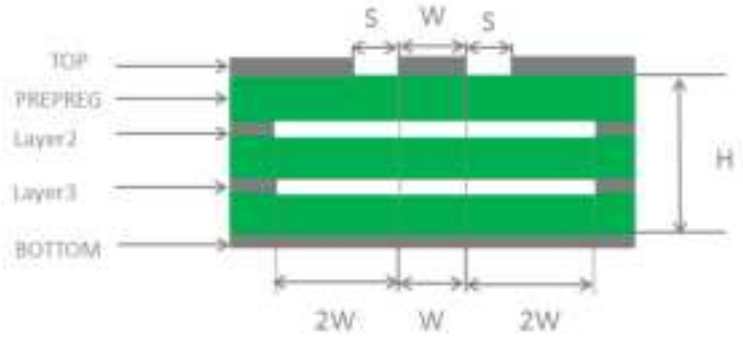



**Figure 28: Coplanar Waveguide Design on a 4-layer PCB (Layer 4 as Reference Ground)**

To ensure better RF performance and reliability, the following conditions should be complied with in RF layout design:

- Use an impedance simulation tool to accurately control the characteristic impedance of RF traces to 50 Ω.
- GND pins adjacent to RF pins should not be designed as thermal relief pads, and should be fully connected to ground.
- Clearance between RF pins and RF connector should be as short as possible, and all right-angle (90°) traces should be changed to the ones with the angle of 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, ground vias around RF traces and the reference ground can improve RF performance. The clearance between ground vias and RF traces should be at least twice the width of RF signal traces (2 × W).
- Keep RF traces away from interference sources, and avoid intersection and paralleling between any traces on adjacent layers.

## 5.3. Requirements for Antenna Design

**Table 22: Requirements for Antenna Design**

| Antenna Type | Requirements |
|---|---|
| IoT-NTN | **Frequency range:**<br>● L-Band (B255): 1525–1660.5 MHz (cable insertion loss: < 1 dB)<br>● S-Band (B256/B23): 1980–2200 MHz (cable insertion loss: < 1.5 dB)<br>VSWR: ≤ 2<br>Gain: 2 dBi (max.)<br>Max input power: 50 W<br>Input impedance: 50 Ω<br>Linear polarization |

## 5.4. RF Connector Recommendation

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

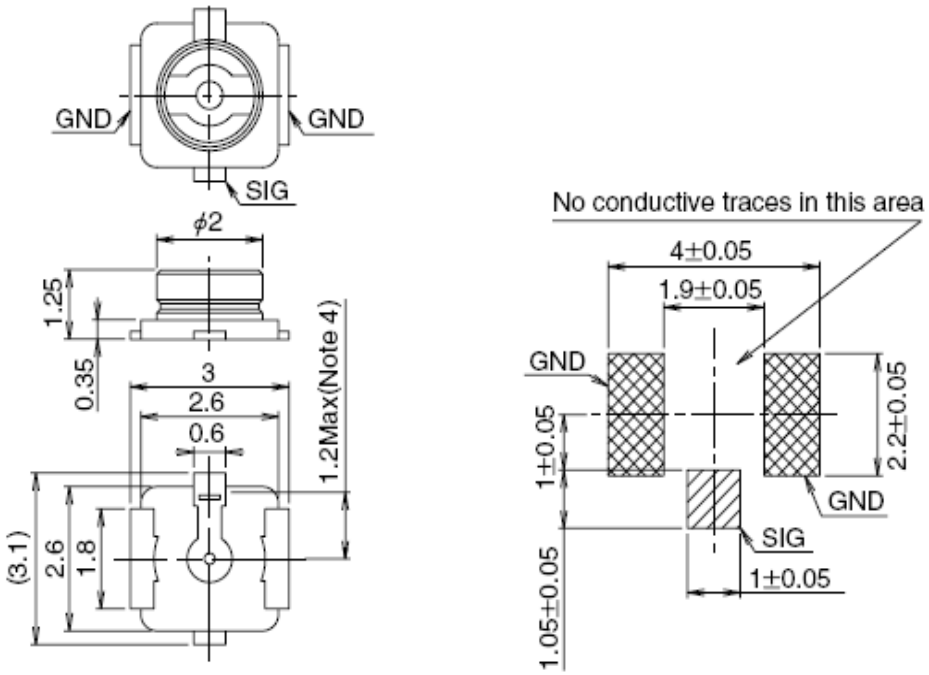



**Figure 29: Dimensions of the Receptacle (Unit: mm)**

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

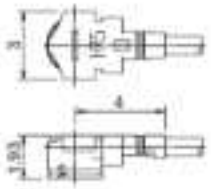
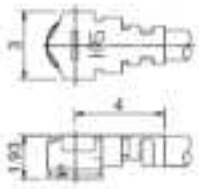
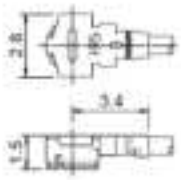
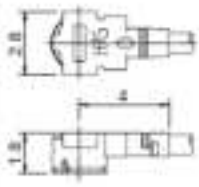
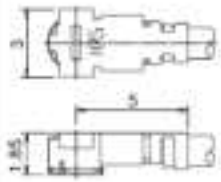
| Part No. | U.FL-LP-040 | U.FL-LP-066 | U.FL-LP(V)-040 | U.FL-LP-062 | U.FL-LP-088 |
|---|---|---|---|---|---|
| |  |  |  |  |  |
| Mated Height | 2.5mm Max. (2.4mm Nom.) | 2.5mm Max. (2.4mm Nom.) | 2.0mm Max. (1.9mm Nom.) | 2.4mm Max. (2.3mm Nom.) | 2.4mm Max. (2.3mm Nom.) |
| Applicable cable | Dia. 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 30: Specifications of Mated Plugs (Unit: mm)**

The following figure describes the space factor of the mated connector.

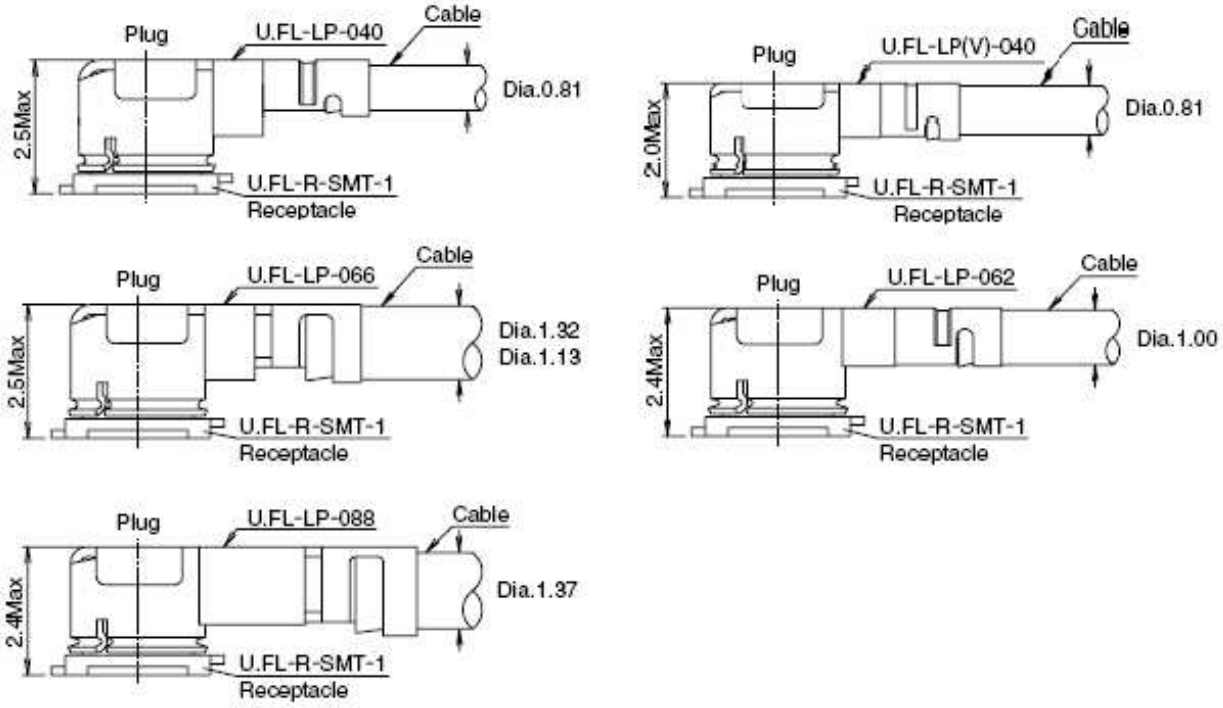



**Figure 31: Space Factor of the Mated Connectors (Unit: mm)**

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

# 6 Electrical Characteristics and Reliability

## 6.1. Absolute Maximum Ratings

**Table 23: Absolute Maximum Ratings**

| Parameter | Min. | Max. | Unit |
|---|---|---|---|
| Voltage at VBAT | -0.3 | 3.6 | V |
| Voltage at digital pins | -0.3 | 3.6 | V |
| Voltage at analog pins | -0.3 | 3.6 | V |

## 6.2. Power Consumption

**Table 24: CC660D-LS Power Consumption**

| AP Mode | Modem Mode | Typ. | Unit |
|---|---|---|---|
| Idle | PSM | 3.4[4] | μA |
| | Sleep mode @ DRX = 2.56 s, ECL0 | 1 | mA |
| Active @ Single-tone (3.75/15 kHz) | Radio transmission @ 23 dBm (B255) | 300 | mA |
| | Radio transmission @ 23 dBm (B256) | 255 | mA |
| | Radio transmission @ 23 dBm (B23) | 252 | mA |

[4] Reference data provided by the baseband chip platform.

| | | | |
|---|---|---|---|
| | Radio transmission @ 0 dBm (B255) | 35 | mA |
| | Radio transmission @ 0 dBm (B256) | 35 | mA |
| | Radio transmission @ 0 dBm (B23) | 35 | mA |
| Active @ Multi-tone (15 kHz) | Radio transmission @ 23 dBm (B255) | 100 | mA |
| | Radio transmission @ 23 dBm (B256) | 89 | mA |
| | Radio transmission @ 23 dBm (B23) | 87 | mA |

**NOTE**

The power consumption data above is for reference only, which may vary among different modules. For detailed information, contact Quectel Technical Support for the power consumption test report of the specific module.

## 6.3. Digital I/O Characteristics

**Table 25: VDD_EXT I/O Characteristics (Unit: V)**

| Parameter | Description | Min. | Max. |
|---|---|---|---|
| $V_{IH}$ | High-level input voltage | 0.75 × VDD_EXT | - |
| $V_{IL}$ | Low-level input voltage | - | 0.25 × VDD_EXT |
| $V_{OH}$ | High-level output voltage | 0.85 × VDD_EXT | - |
| $V_{OL}$ | Low-level output voltage | - | 0.15 × VDD_EXT |

**Table 26: RESET_N/PWRKEY I/O Characteristics (Unit: V)**

| Parameter | Description | Min. | Max. |
|---|---|---|---|
| $V_{IH}$ | High-level input voltage | 0.7 × VBAT | - |
| $V_{IL}$ | Low-level input voltage | - | 0.3 × VBAT |

**Table 27: PSM_EINT I/O Characteristics (Unit: V)**

| Parameter | Description | Min. | Max. |
|---|---|---|---|
| $V_{IH}$ | High-level input voltage | 0.75 × VBAT | - |
| $V_{IL}$ | Low-level input voltage | - | 0.25 × VBAT |

**Table 28: USIM High/Low-voltage I/O Characteristics (Unit: V)**

| Parameter | Description | Min. | Max. |
|---|---|---|---|
| $V_{IH}$ | High-level input voltage | 0.75 × USIM_VDD | - |
| $V_{IL}$ | Low-level input voltage | - | 0.25 × USIM_VDD |
| $V_{OH}$ | High-level output voltage | 0.85 × USIM_VDD | - |
| $V_{OL}$ | Low-level output voltage | - | 0.15 × USIM_VDD |

## 6.4. 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 29: ESD Characteristics (Temperature: 25–30 °C, Humidity: 40 ±5 %; Unit: kV)**

| Test Point | Contact Discharge | Air Discharge |
|---|---|---|
| VBAT & GND | ±5 | ±10 |
| All antenna interfaces | ±5 | ±10 |
| Other interfaces | ±0.5 | ±1 |

## 6.5. Operating and Storage Temperatures

**Table 30: Operating and Storage Temperatures (Unit: °C)**

| Parameter | Min. | Typ. | Max. |
|---|---|---|---|
| Normal Operating Temperature [5] | -35 | +25 | +75 |
| Extended Operating Temperature [6] | -40 | - | +85 |
| Storage Temperature | -40 | - | +90 |

[5] Within this range, the module's related indicators can meet 3GPP specifications.
[6] Within this range, the module retains the ability to establish and maintain functions such as SMS, without any unrecoverable malfunction. Radio spectrum and radio network remain uninfluenced, whereas the value of one or more parameters, such as $P_{out}$, may decrease and fall below the range of the 3GPP specified tolerances. When the temperature returns to the normal operating temperature range, the module's indicators will comply with 3GPP specification requirements again.

# 7 Mechanical Information

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.

## 7.1. Mechanical Dimensions

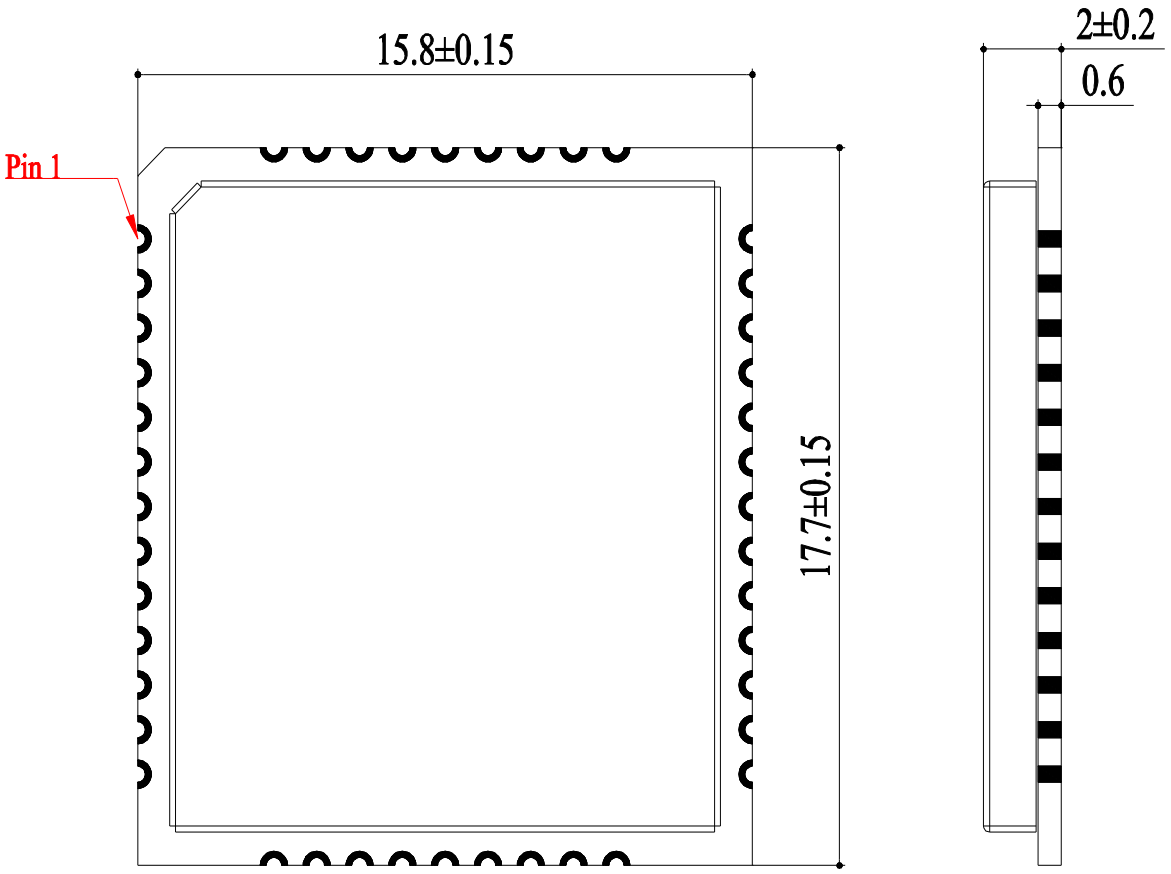



**Figure 32: Top and Side Dimensions**

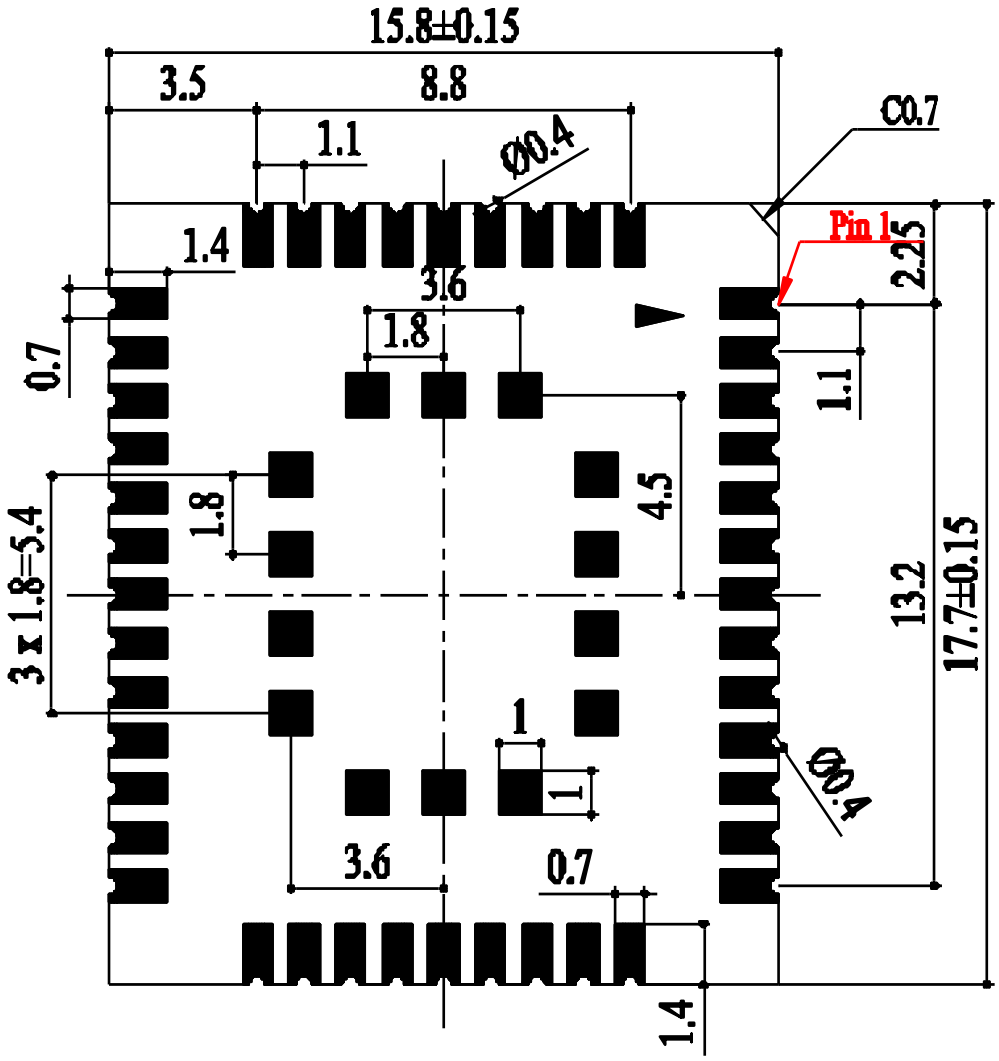



**Figure 33: Bottom Dimensions**

**NOTE**

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

## 7.2. Recommended Footprint

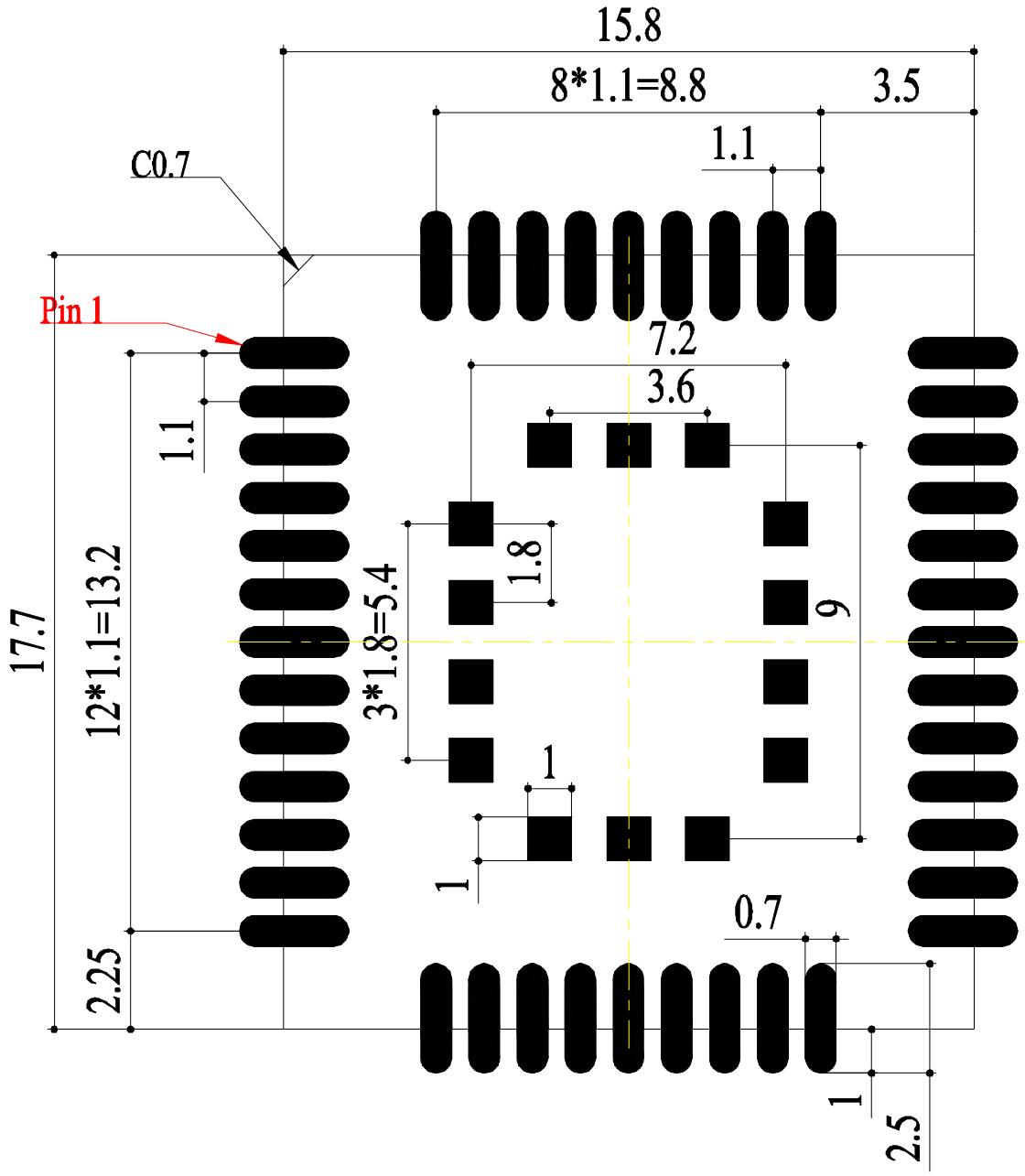



**Figure 34: Recommended Footprint**

**NOTE**

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

## 7.3. Top and Bottom Views


**Figure 35: 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.

# 8 Storage, Manufacturing & Packaging

## 8.1. Storage Conditions

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

1. Recommended Storage Condition: the temperature should be 23 ±5 °C and the relative humidity should be 35–60 %.

2. Shelf life (in a vacuum-sealed packaging): 12 months in Recommended Storage Condition.

3. Floor life: 168 hours [7] 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 dry cabinet.

[7] 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 module.

## 8.2. 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.

The recommended peak reflow temperature should be 235–246 ºC, with 246 ºC as the absolute maximum reflow temperature. To avoid damage to the module caused by repeated heating, it is 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.

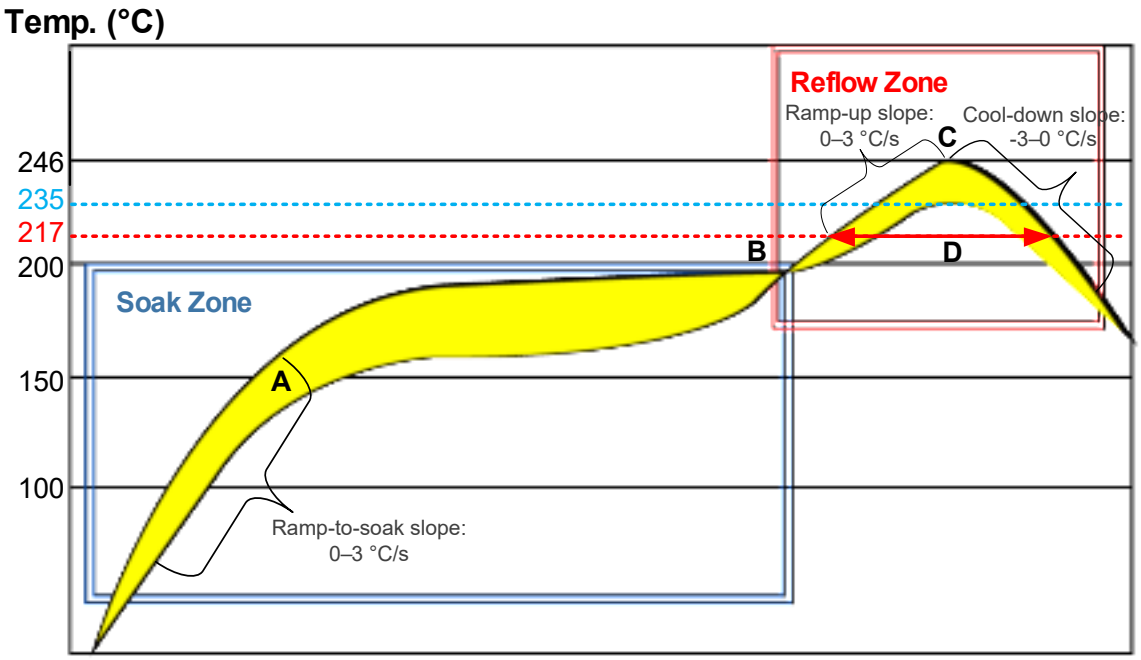



**Figure 36: Recommended Reflow Soldering Thermal Profile**

**Table 31: 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.

## 8.3. 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:

### 8.3.1. Carrier Tape

Dimension details are as follow:

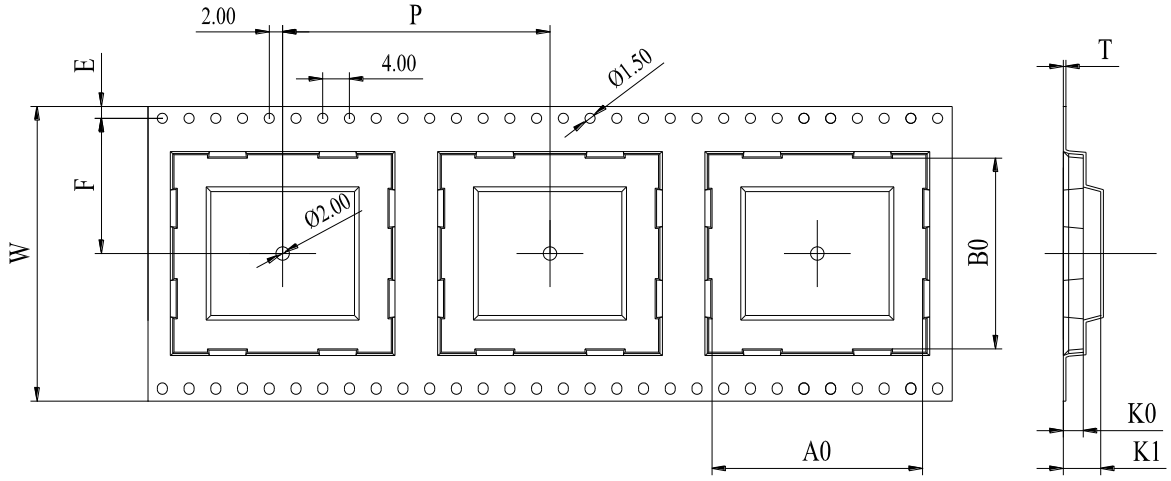



**Figure 37: Carrier Tape Dimension Drawing**

**Table 32: Carrier Tape Dimension Table (Unit: mm)**

| W | P | T | A0 | B0 | K0 | K1 | F | E |
|---|---|---|---|---|---|---|---|---|
| 32 | 24 | 0.4 | 16.2 | 18.1 | 2.8 | 7.6 | 14.2 | 1.75 |

### 8.3.2. Plastic Reel

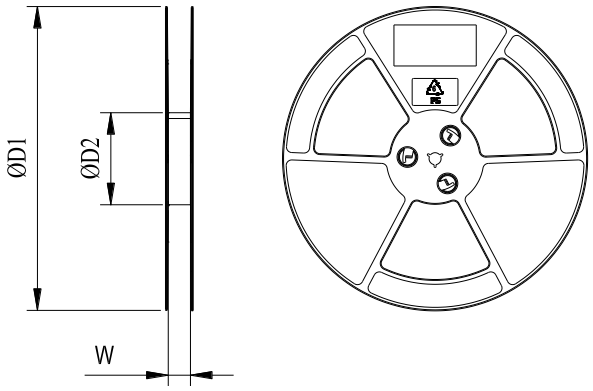



**Figure 38: Plastic Reel Dimension Drawing**

**Table 33: Plastic Reel Dimension Table (Unit: mm)**

| øD1 | øD2 | W |
|---|---|---|
| 330 | 100 | 32.5 |

### 8.3.3. Mounting Direction

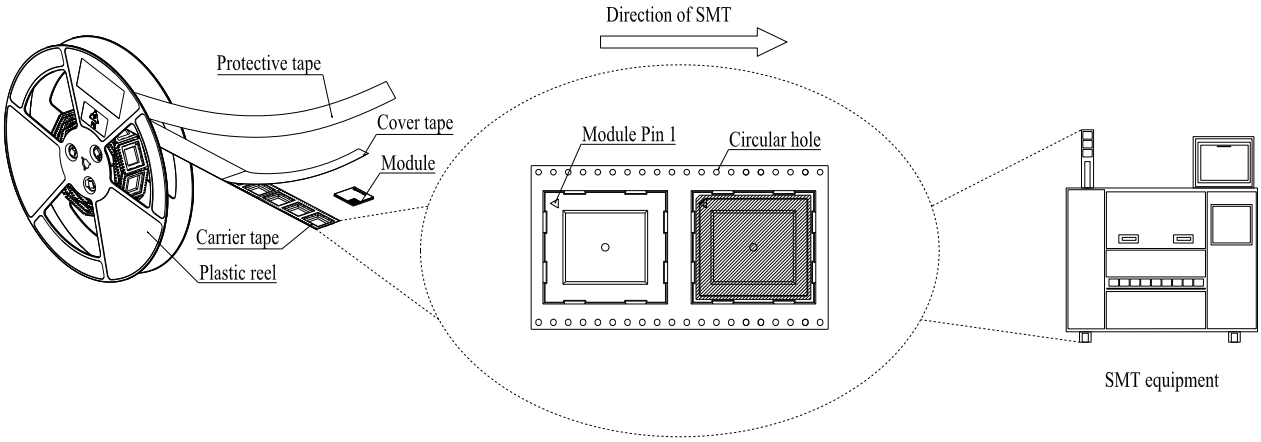
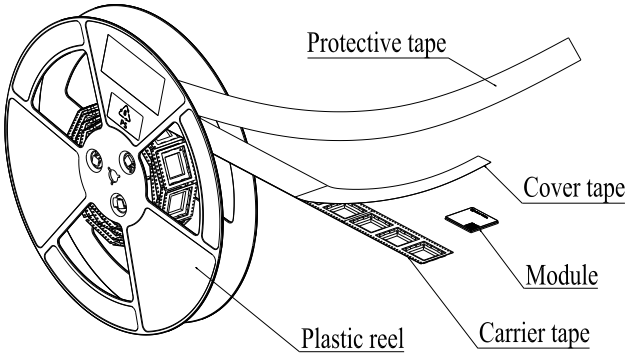


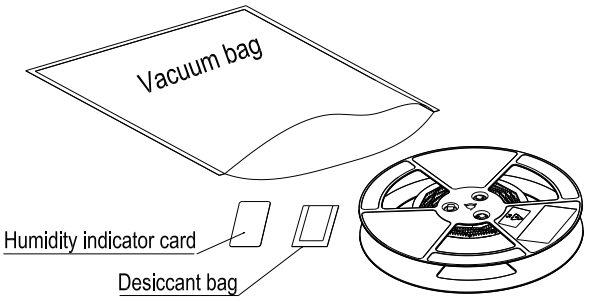

**Figure 39: Mounting Direction**

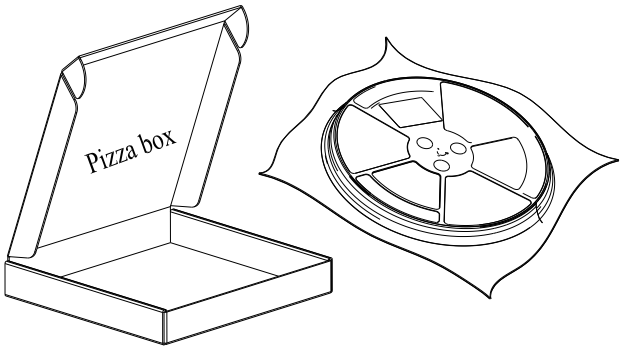
### 8.3.4. Packaging Process




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 250 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 1000 modules.

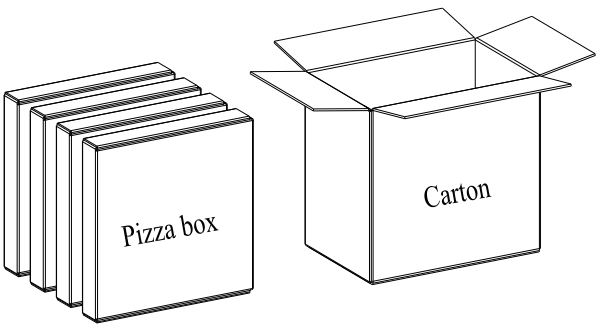



**Figure 40: Packaging Process**

# 9 Appendix Reference

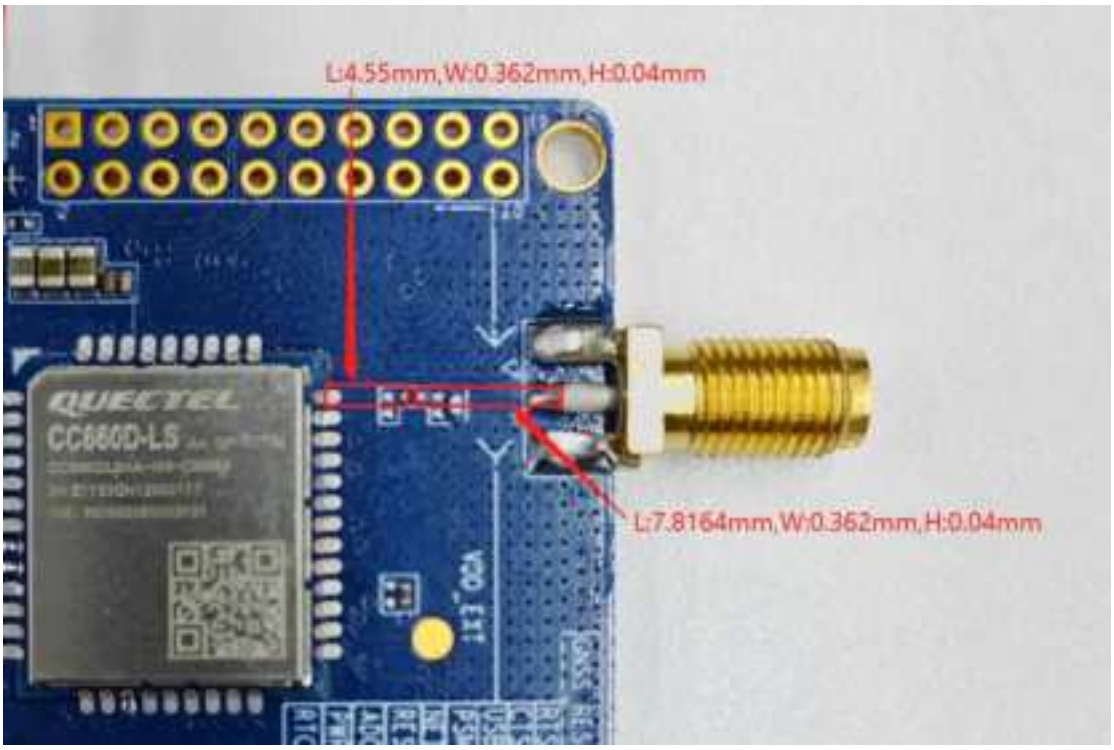
**Table 34: Terms and Abbreviations**

| Abbreviation | Description |
|---|---|
| ADC | Analog-to-Digital Converter |
| AP | Application Processor |
| DRX | Discontinuous Reception |
| eDRX | extended Discontinuous Reception |
| E-CID | Enhanced Cell Identity |
| EMI | Electromagnetic Interference |
| ESD | Electrostatic Discharge |
| ESR | Equivalent Series Resistance |
| HTTP | Hyper Text Transfer Protocol |
| I/O | Input/Output |
| kbps | Kilobits per second |
| LED | Light Emitting Diode |
| LwM2M | Lightweight M2M |
| MQTT | Message Queuing Telemetry Transport |
| NTN | Non-Terrestrial Networks |
| OC | Open Collector |
| OD | Open Drain |
| OTDOA | Observed Time Difference of Arrival |
| PCB | Printed Circuit Board |

| | |
|---|---|
| PSM | Power Save Mode |
| PTW | Paging Time Window |
| RF | Radio Frequency |
| RTC | Real Time Clock |
| RXD | Receive Data |
| SMD | Surface Mount Device |
| SMS | Short Message Service |
| TAU | Tracking Area Update |
| TCP | Transmission Control Protocol |
| TE | Terminal Equipment |
| TLS | Transport Layer Security |
| TXD | Transmitting Data |
| UART | Universal Asynchronous Receiver & Transmitter |
| UDP | User Datagram Protocol |
| UE | User Equipment |
| URC | Unsolicited Result Code |
| USIM | Universal Subscriber Identification Module |
| VSWR | Voltage Standing Wave Ratio |
| Vmax | Maximum Voltage |
| Vnom | Nominal Voltage |
| Vmin | Minimum Voltage |
| $V_{IH}$max | Maximum High-level Input Voltage |
| $V_{IH}$min | Minimum High-level Input Voltage |
| $V_{IL}$max | Maximum Low-level Input Voltage |
| $V_{IL}$min | Minimum Low-level Input Voltage |

| | |
|---|---|
| $V_I$max | Absolute Maximum Input Voltage |
| $V_I$nom | Absolute Nominal Input Voltage |
| $V_I$min | Absolute Minimum Input Voltage |
| $V_{OH}$max | Maximum High-level Output Voltage |
| $V_{OH}$min | Minimum High-level Output Voltage |
| $V_{OL}$max | Maximum Low-level Output Voltage |
| $V_{OL}$min | Minimum Low-level Output Voltage |

## Trace design




Hereby, [Quectel Wireless Solutions Co., Ltd.] declares that the radio equipment type [CC660D-LS] is in compliance with Directive 2014/53/EU. The full text of the EU declaration of conformity is available at the following internet address: http://www.quectel.com/support/technical.htm

The device could be used with a separation distance of 20cm to the human body.

**OEM/Integrators Installation Manual**

## 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 Part15 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 XXXX that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the USI, or the host manufacturer can take responsibility through the change in FCC ID (new application) procedure followed by a Class II permissive change application.

## End Product Labeling

When the module is installed in the host device, the FCC/IC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily re-moved. If not, a second label must be placed on the outside of the final device that contains the following text: “Contains FCC ID: XMR2023CC660DLS”
“Contains IC: 10224A-023CC660DLS “
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.

| Antenna type | Certification | Band23<br>Max Gain (dBi) | Band 255<br>Max Gain (dBi) |
|---|---|---|---|
| PCB Antenna | FCC | 12 | 12 |
| | IC | 3.4 | 2.8 |

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 part 25 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 circuity), 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: 10224A-023CC660DLS**

## 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 cannot 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-023CC660DLS”.

## 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-023CC660DLS ".

## 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.