



# FLM142D Hardware Design

**Wi-Fi&Bluetooth 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              |
|---------|------------|---------------------|--------------------------|
| -       | 2023-03-02 | Devin YU/Neil CHENG | Creation of the document |
| 1.0     | 2023-08-22 | Devin YU/Neil CHENG | First official release   |

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# 1 Introduction

QuecOpen® is a solution where the module acts as the main processor. Constant transition and evolution of both the communication technology and the market highlight its merits. It can help you to:

- Realize embedded applications' quick development and shorten product R&D cycle
- Simplify circuit and hardware structure design to reduce engineering costs
- Miniaturize products
- Reduce product power consumption
- Apply OTA technology
- Enhance product competitiveness and price-performance ratio

This document defines FLM142D in QuecOpen® solution 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.

Hereby, Quectel Wireless Solutions Co., Ltd. declares that the radio equipment type FLM142D 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>

## Disposal of old electrical appliances



The European directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE), requires that old household electrical appliances must not be disposed of in the normal unsorted municipal waste stream. Old appliances must be collected separately in order to optimize the recovery and recycling of the materials they contain, and reduce the impact on human health and the environment.

The crossed out "wheeled bin" symbol on the product reminds you of your obligation, that when you dispose of the appliance, it must be separately collected.

Consumers should contact their local authority or retailer for information concerning the correct disposal of their old appliance.

|   |    |    |    |    |    |    |        |
|---|----|----|----|----|----|----|--------|
|  | AT | BE | BG | HR | CY | CZ | DK     |
|   | EE | FI | FR | DE | EL | HU | IE     |
|   | IT | LV | LT | LU | MT | NL | PL     |
|   | PT | RO | SK | SI | ES | SE | UK(NI) |

This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

## 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. |

## 2 Product Overview

FLM142D is a high-performance MCU Wi-Fi and Bluetooth module supporting IEEE 802.11b/g/n and BLE 5.2 standards. The module provides multiple interfaces including UART, ADC and PWM for various applications.

FLM140D supports secondary development and is manufactured by wave soldering. It includes:

- 160 MHz 32-bit MCU
- Built-in 288 KB RAM and 2 MB flash

**Table 2: Basic Information**

| FLM140D        |   |
|----------------|---|
| Packaging type | DIP   |
| Pin counts     | 11  |
| Dimensions     | (17.9 ±0.15) mm × (15 ±0.15) mm × (2.8 ±0.2) mm |
| Weight         | Approx. 0.84 g                                  |

## 2.1. Key Features

Table 3: Key Features

| Basic Information                  |  |
|------------------------------------|--|
| Protocols and Standards            | <ul style="list-style-type: none"> <li>● Wi-Fi Protocols: IEEE 802.11b/g/n</li> <li>● Bluetooth protocol: BLE 5.2</li> <li>● All hardware components are fully compliant with EU RoHS directive</li> </ul> |
| Power Supply                       | <p><b>VBAT Power Supply:</b></p> <ul style="list-style-type: none"> <li>● 3.0–3.6 V</li> <li>● Typ.: 3.3 V</li> </ul>  |
| Temperature Ranges                 | <ul style="list-style-type: none"> <li>● Operating temperature <sup>1</sup>: -40 to +85 °C</li> <li>● Storage temperature: -45 to +95 °C</li> </ul>  |
| EVB Kit                            | FLM142D TE-B <sup>2</sup>  |
| Antenna/Antenna Interface          |  |
| Antenna/Antenna Interface          | <ul style="list-style-type: none"> <li>● PCB antenna</li> <li>● 50 Ω characteristic impedance</li> </ul>   |
| Application Interface <sup>3</sup> |  |
| Application Interfaces             | UART, PWM, ADC   |

<sup>1</sup> Within the operating temperature range, the module performance meets IEEE and Bluetooth specifications.

<sup>2</sup> For more details about the EVB, see [document \[1\]](#).

<sup>3</sup> For more details about the interfaces, see [Chapters 3.3 and 3.4](#).

# 3 Application Interfaces

## 3.1. Pin Assignment

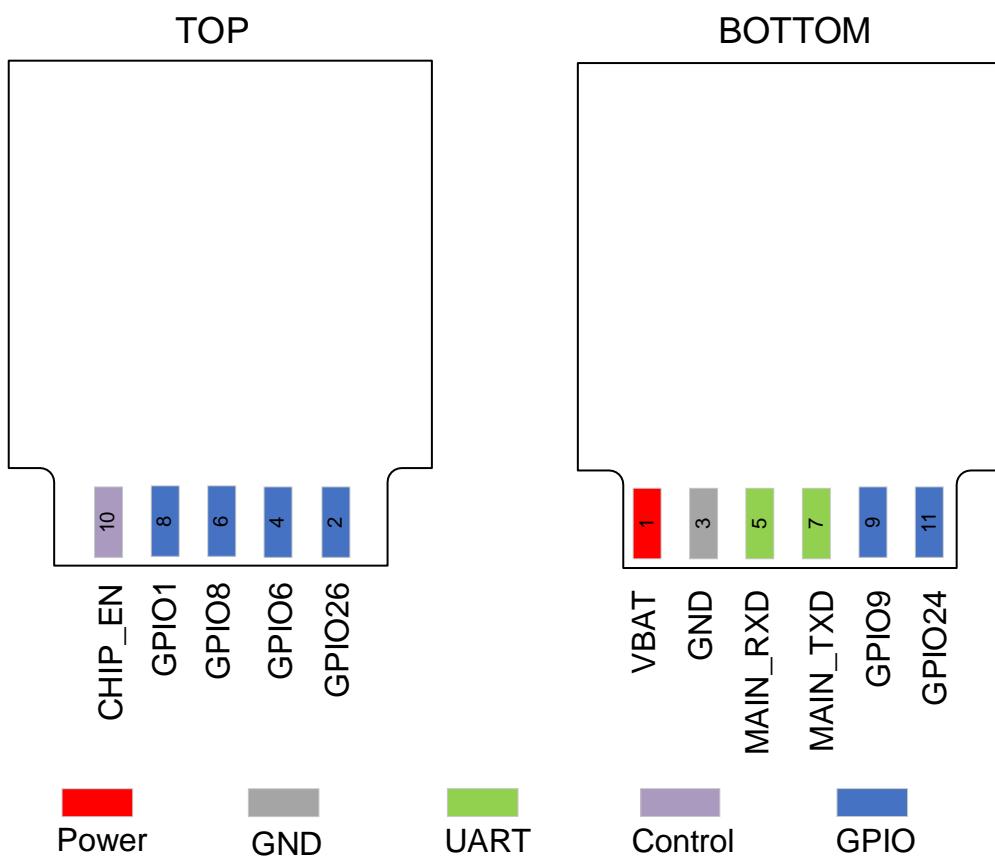


Figure 1: Pin Assignment

**NOTE**

1. The module supports 1 UART and 6 GPIO interfaces by default. In the case of multiplexing, it can support PWM and ADC interfaces. For more details, see **Chapters 3.3 and 3.4**.
2. The GND pin should be connected to ground.

### 3.2. Pin Description

Table 4: Parameter Description

| Parameter | Description          |
|-----------|----------------------|
| DI        | Digital Input        |
| DO        | Digital Output       |
| DIO       | Digital Input/Output |
| PI        | Power Input          |

DC characteristics include power domain and rated current.

Table 5: Pin Description

| Power Supply   |         |     |                             |  |  |
|----------------|---------|-----|-----------------------------|--|--|
| Pin Name       | Pin No. | I/O | Description                 | DC Characteristics                           | Comment  |
| VBAT           | 1       | PI  | Power supply for the module | Vmax = 3.6 V<br>Vmin = 3.0 V<br>Vnom = 3.3 V | It must be provided with sufficient current of at least 0.3 A.     |
| GND            | 3       |     |                             |  |  |
| Control Signal |         |     |                             |  |  |
| Pin Name       | Pin No. | I/O | Description                 | DC Characteristics                           | Comment  |
| CHIP_EN        | 10      | DI  | Enable the module (default) | VBAT   | Hardware enable.<br>Internally pulled up to 3.3 V.<br>Active high. |
|                |         |     |                             |  | Hardware reset.<br>Internally pulled up to 3.3 V.<br>Active low.   |
| Main UART      |         |     |                             |  |  |
| Pin Name       | Pin No. | I/O | Description                 | DC Characteristics                           | Comment  |
| MAIN_TXD       | 7       | DO  | Main UART transmit          | VBAT   |  |

MAIN\_RXD 5 DI Main UART receive

### GPIO Interfaces

| Pin Name | Pin No. | I/O | Description                  | DC Characteristics | Comment           |
|----------|---------|-----|------------------------------|--------------------|-------------------|
| GPIO26   | 2       | DIO |                              |                    |                   |
| GPIO6    | 4       | DIO |                              |                    |                   |
| GPIO8    | 6       | DIO |                              |                    |                   |
| GPIO1    | 8       | DIO | General-purpose input/output | VBAT               | Interrupt wakeup. |
| GPIO9    | 9       | DIO |                              |                    |                   |
| GPIO24   | 11      | DIO |                              |                    |                   |

### 3.3. GPIO Multiplexing

The module provides 6 GPIO interfaces by default. In the case of multiplexing, it supports up to 8 GPIO interfaces. Pins are defined as follows:

**Table 6: GPIO Multiplexing**

| Pin Name | Pin No. | Alternate Function 0<br>(GPIO No.) | Alternate Function 1 | Alternate Function 2 | Alternate Function 3 |
|----------|---------|------------------------------------|----------------------|----------------------|----------------------|
| GPIO26   | 2       | GPIO26                             | ADC1                 | IRDA                 | PWM5                 |
| GPIO6    | 4       | GPIO6                              | 13M_CLK_OUT          | PWM0                 | -                    |
| MAIN_RXD | 5       | GPIO10                             | UART1_RX             | ADC6                 | -                    |
| GPIO8    | 6       | GPIO8                              | BT_ACTIVE            | PWM2                 | -                    |
| MAIN_TXD | 7       | GPIO11                             | UART1_TX             | -                    | -                    |
| GPIO1    | 8       | GPIO1                              | UART2_RX             | ADC5                 |                      |
| GPIO9    | 9       | GPIO9                              | PWM3                 |                      |                      |
| GPIO24   | 11      | GPIO24                             | ADC2                 | 32K_CLK_OUT          | PWM4                 |

**NOTE**

All GPIOs can be configured as interrupt source to interrupt the system in active mode or to wake it up from low power mode. For details, please contact Quectel Technical Support.

### 3.4. Application Interfaces

#### 3.4.1. UART

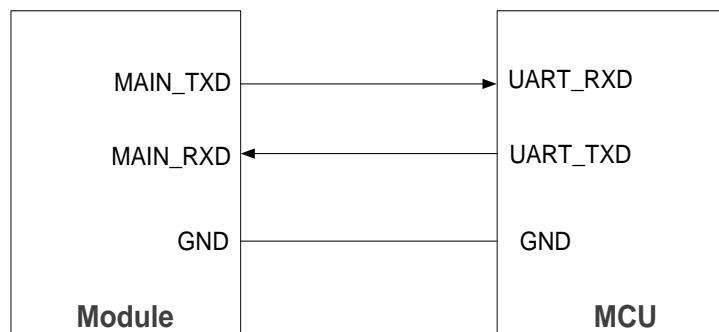
The module supports one UART interface: the main UART.

**Table 7: Pin Definition of UART**

| Pin Name | Pin No. | I/O | Description        |
|----------|---------|-----|--------------------|
| MAIN_TXD | 7       | DO  | Main UART transmit |
| MAIN_RXD | 5       | DI  | Main UART receive  |

The main UART can be used for data transmission. The default baud rate is 115200 bps, and the maximum baud rate is 6 Mbps. The main UART is also available for firmware upgrade, in this case the baud rate is configurable, the default is 921600 bps.

The main UART connection between the module and MCU is illustrated below.



**Figure 2: Main UART Connection**

### 3.4.2. PWM Interfaces

In the case of multiplexing, the module supports up to 5 PWM interfaces. Pin description of PWM interfaces are as follows.

**Table 8: Pin Definition of PWM Interfaces**

| Pin Name | Pin No. | Alternate Function | I/O | Description |
|----------|---------|--------------------|-----|-------------|
| GPIO6    | 4       | PWM0               | DO  | PWM0 out    |
| GPIO8    | 6       | PWM1               | DO  | PWM1 out    |
| GPIO9    | 9       | PWM2               | DO  | PWM2 out    |
| GPIO24   | 11      | PWM4               | DO  | PWM4 out    |
| GPIO26   | 2       | PWM5               | DO  | PWM5 out    |

### 3.4.3. ADC Interfaces

In the case of multiplexing, the module supports up to 3 ADC interfaces whose voltage range is 0–2.4 V. To improve ADC accuracy, surround ADC traces with ground.

**Table 9: Pin Definition of ADC Interfaces**

| Pin Name | Pin No. | Alternate Function | I/O | Description                   |
|----------|---------|--------------------|-----|-------------------------------|
| GPIO24   | 11      | ADC3               | AI  | General-purpose ADC interface |
| GPIO26   | 2       | ADC2               | AI  | General-purpose ADC interface |
| GPIO1    | 8       | ADC1               | AI  | General-purpose ADC interface |

**Table 10: ADC Features**

| Parameter         | Min. | Typ. | Max. | Unit |
|-------------------|------|------|------|------|
| ADC Voltage Range | 0    | -    | 2.4  | V    |
| ADC Resolution    | -    | 13   | -    | bit  |

# 4 Operating Characteristics

## 4.1. Power Supply

Power supply pin and ground pin of the module are defined in the following table.

Table 11: Pin Definition of Power Supply and GND Pins

| Pin Name | Pin No. | I/O | Description                 | Min. | Typ. | Max. | Unit |
|----------|---------|-----|-----------------------------|------|------|------|------|
| VBAT     | 1       | PI  | Power supply for the module | 3.0  | 3.3  | 3.6  | V    |
| GND      | 3       |     |                             |      |      |      |      |

### 4.1.1. Reference Design for Power Supply

The module is powered by VBAT, and it is recommended to use a power supply chip that can provide sufficient current of at least 0.3 A. For better power supply performance, it is recommended to parallel a 22  $\mu$ F decoupling capacitor, and two filter capacitors (1  $\mu$ F and 100 nF) near the module's VBAT pin. C4 is reserved for debugging and not mounted by default. In addition, it is recommended to add a TVS near the VBAT to improve the surge protection capacity of the module. In principle, the longer the VBAT trace is, the wider it should be.

VBAT reference design is shown below:

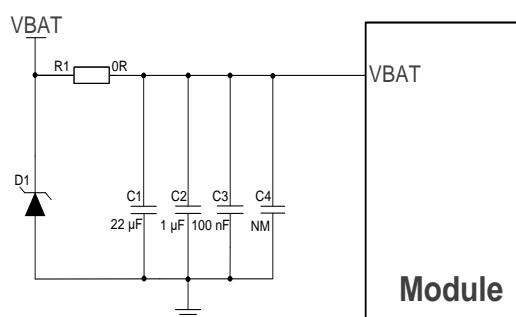


Figure 3: VBAT Reference Design

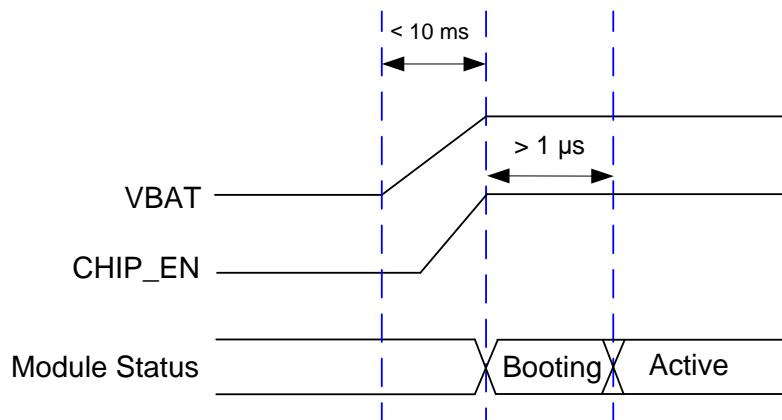
## 4.2. Turn On

After the module VBAT is powered on, keep the CHIP\_EN at high level to realize the automatic startup of the module.

**Table 12: Pin Definition of CHIP\_EN**

| Pin Name | Pin No. | I/O | Description       | Comment  |
|----------|---------|-----|-------------------|--|
| CHIP_EN  | 10      | DI  | Enable the module | Hardware enable.<br>Internally pulled up to 3.3 V.<br>Active high. |

The turn-on timing is shown below:



**Figure 4: Turn-on Timing**

## 4.3. Reset

Drive CHIP\_EN low for at least 1 ms and then release it to reset the module.

**Table 13: Pin Definition of CHIP\_EN**

| Pin Name | Pin No. | I/O | Description      | Comment  |
|----------|---------|-----|------------------|--|
| CHIP_EN  | 10      | DI  | Reset the module | Hardware reset.<br>Internally pulled up to 3.3 V.<br>Active low. |

The reference design for resetting the module is shown below. An open collector driving circuit can be used to control the CHIP\_EN pin.

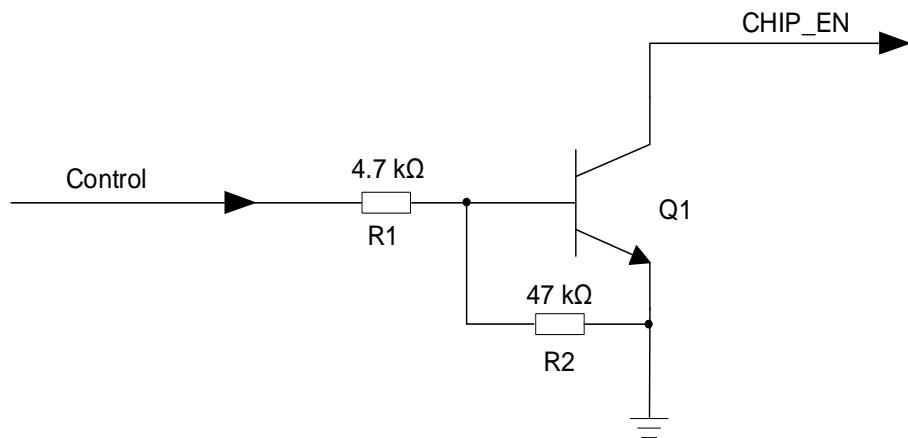


Figure 5: Reference Circuit of CHIP\_EN by A Using Driving Circuit

Another way to control the CHIP\_EN is by using a button directly. When pressing the button, an electrostatic strike may generate from finger. Therefore, a TVS component shall be placed near the button for ESD protection.

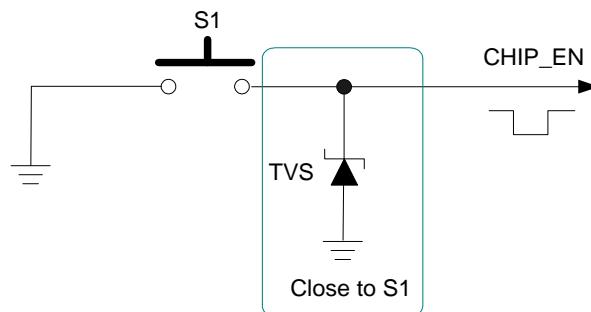


Figure 6: Reference Circuit of CHIP\_EN with A Button

The module reset timing is illustrated in the following figure.

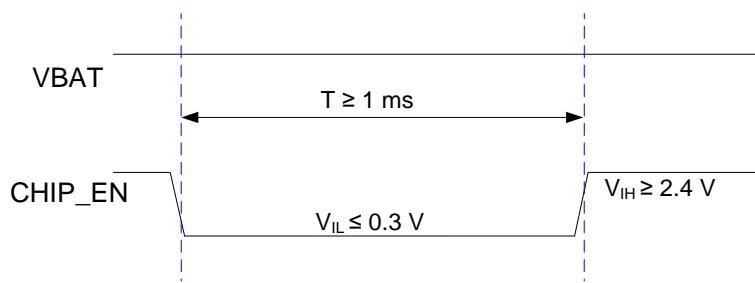


Figure 7: Reset Timing

#### 4.4. Download Mode

Keep the input signal of CHIP\_EN at low level during resetting or power-up and the module will enter download mode. In the download mode, the firmware can be download through the main UART. During the hardware design, the CHIP\_EN pin of the module is connected to the RTS of the serial port chip, or the CHIP\_EN is controlled according to the following waveform, otherwise the download will fail.

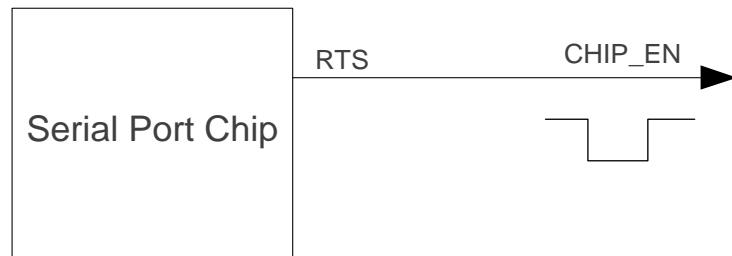


Figure 8: Reference Design for Download Mode

# 5 RF Performances

## 5.1. Wi-Fi Performances

Table 14: Wi-Fi Performances

| Operating Frequency  |  |                                   |                       |
|--|--|-----------------------------------|-----------------------|
| <b>2.4 GHz:</b> 2.400–2.4835 GHz   |  |                                   |                       |
| Modulation   |  |                                   |                       |
| BPSK, QPSK, CCK, 16QAM, 64QAM  |  |                                   |                       |
| Operating Mode   |  |                                   |                       |
| <ul style="list-style-type: none"> <li>● AP</li> <li>● STA</li> </ul>  |  |                                   |                       |
| Encryption Mode  |  |                                   |                       |
| WPA-PSK, WPA2-PSK, WPA3-SAE  |  |                                   |                       |
| Transmission Data Rate   |  |                                   |                       |
| <ul style="list-style-type: none"> <li>● 802.11b: 1 Mbps, 2 Mbps, 5.5 Mbps, 11 Mbps</li> <li>● 802.11g: 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps, 54 Mbps</li> <li>● 802.11n: HT20 (MCS 0–MCS 7)</li> </ul> |  |                                   |                       |
| Condition (VBAT = 3.3 V; Temp. 25 °C)  |  | Typ.; Unit: dBm; Tolerance: ±2 dB |                       |
| EVM  |  | Transmitting Power                | Receiving Sensitivity |
| 802.11b @ 1 Mbps   |  | 18                                | -98                   |
| 802.11b @ 11 Mbps  |  | 18                                | -90                   |
| 2.4 GHz 802.11g @ 6 Mbps   |  | 16                                | -90                   |
| 802.11g @ 54 Mbps  |  | 15                                | -76                   |
| 802.11n, HT20 @ MCS 0  |  | 15                                | -90                   |

|                       |          |    |     |
|-----------------------|----------|----|-----|
| 802.11n, HT20 @ MCS 7 | ≤ -27 dB | 14 | -72 |
|-----------------------|----------|----|-----|

## 5.2. Bluetooth Performances

Table 15: Bluetooth Performances

| Operating Frequency                   |                                   |                       |
|---------------------------------------|-----------------------------------|-----------------------|
| 2.400~2.4835 GHz                      |                                   |                       |
| Modulation                            |                                   |                       |
| GFSK                                  |                                   |                       |
| Operating Mode                        |                                   |                       |
| BLE                                   |                                   |                       |
| Condition (VBAT = 3.3 V; Temp. 25 °C) | Typ.; Unit: dBm; Tolerance: ±2 dB |                       |
|                                       | Transmitting Power                | Receiving Sensitivity |
| BLE (1 Mbps)                          | 6                                 | -96                   |
| BLE (2 Mbps)                          | 6                                 | -94                   |
| BLE (S = 2)                           | 6                                 | -96                   |
| BLE (S = 8)                           | 6                                 | -101                  |

## 5.3. RF Antenna Interface

The module supports PCB antenna. The impedance of antenna port is 50 Ω.

### 5.3.1. PCB Antenna

Table 16: PCB Antenna Specifications

| Parameter | Specification |
|-----------|---------------|
|-----------|---------------|

|                              |              |
|------------------------------|--------------|
| Frequency Range (GHz)        | 2.400–2.500  |
| Input Impedance ( $\Omega$ ) | 50           |
| VSWR                         | $\leq 2$     |
| Gain (dBi)                   | -1.85 (Max.) |
| Efficiency                   | 30 %         |

When using the PCB antenna on the module, the module should be placed near the edge of the motherboard. The distance between the PCB antenna and connectors, vias, traces pin headers, ethernet port and any other metal components on the motherboard should be at least 16 mm. All layers in the PCB of the motherboard under the PCB antenna should be designed as a keepout area.

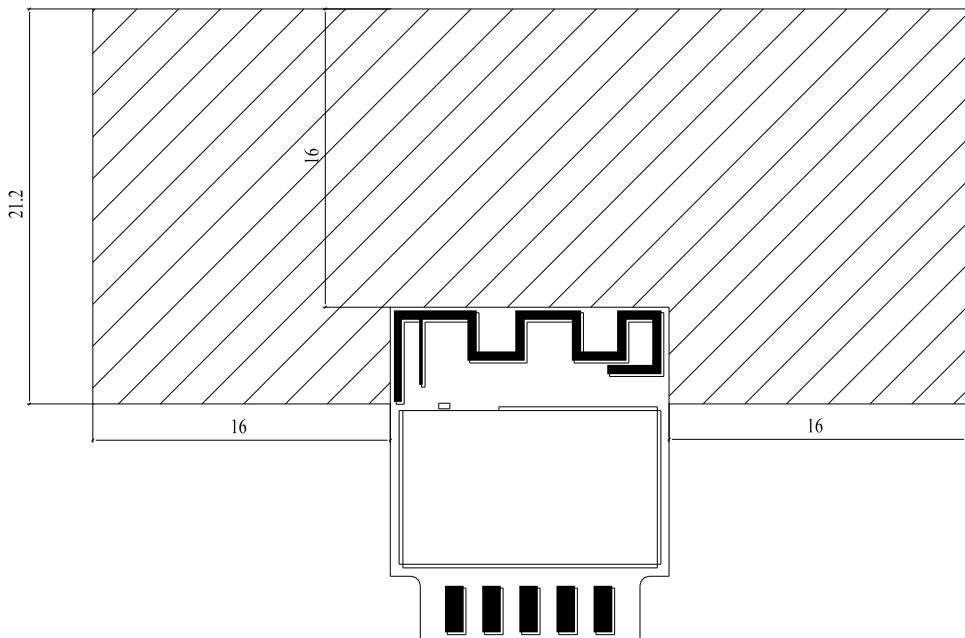


Figure 9: Keepout Area on Motherboard

# 6 Electrical Characteristics & Reliability

## 6.1. Absolute Maximum Ratings

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

**Table 17: Absolute Maximum Ratings (Unit: V)**

| Parameter               | Min. | Max. |
|-------------------------|------|------|
| VBAT                    | -0.3 | 3.9  |
| Voltage at Digital Pins | -0.3 | 3.9  |
| Voltage at ADC1         | 0    | 2.4  |
| Voltage at ADC2         | 0    | 2.4  |
| Voltage at ADC3         | 0    | 2.4  |

## 6.2. Power Supply Ratings

**Table 18: Module Power Supply Ratings (Unit: V)**

| Parameter | Description                 | Condition  | Min. | Typ. | Max. |
|-----------|-----------------------------|--|------|------|------|
| VBAT      | Power supply for the module | The actual input voltages must be kept between the minimum and maximum values. | 3.0  | 3.3  | 3.6  |

## 6.3. Wi-Fi Power Consumption

Table 19: Power Consumption in Non-signaling Mode

| Condition (VBAT = 3.3 V; Temp.: 25 °C; Duty Cycle: 99 %) |                        | I <sub>VBAT</sub> (Typ.) |
|--|------------------------|--------------------------|
| 802.11b  | Tx 1 Mbps @ 18 dBm     | TBD                      |
|  | Tx 11 Mbps @ 18 dBm    | TBD                      |
| 2.4 GHz  | Tx 6 Mbps @ 16 dBm     | TBD                      |
|  | Tx 54 Mbps @ 15 dBm    | TBD                      |
| 802.11n  | Tx HT20 MCS 0 @ 15 dBm | TBD                      |
|  | Tx HT20 MCS 7 @ 14 dBm | TBD                      |

## 6.4. Digital I/O Characteristics

Table 20: VBAT I/O Characteristics (Unit: V)

| Parameter       | Description               | Min.       | Max.       |
|-----------------|---------------------------|------------|------------|
| V <sub>IH</sub> | High-level input voltage  | 0.7 × VBAT | VBAT + 0.2 |
| V <sub>IL</sub> | Low-level input voltage   | -0.3       | 0.3 × VBAT |
| V <sub>OH</sub> | High-level output voltage | 0.9 × VBAT | VBAT       |
| V <sub>OL</sub> | Low-level output voltage  | 0          | 0.1 × VBAT |

## 6.5. ESD Protection

Static electricity occurs naturally and 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.

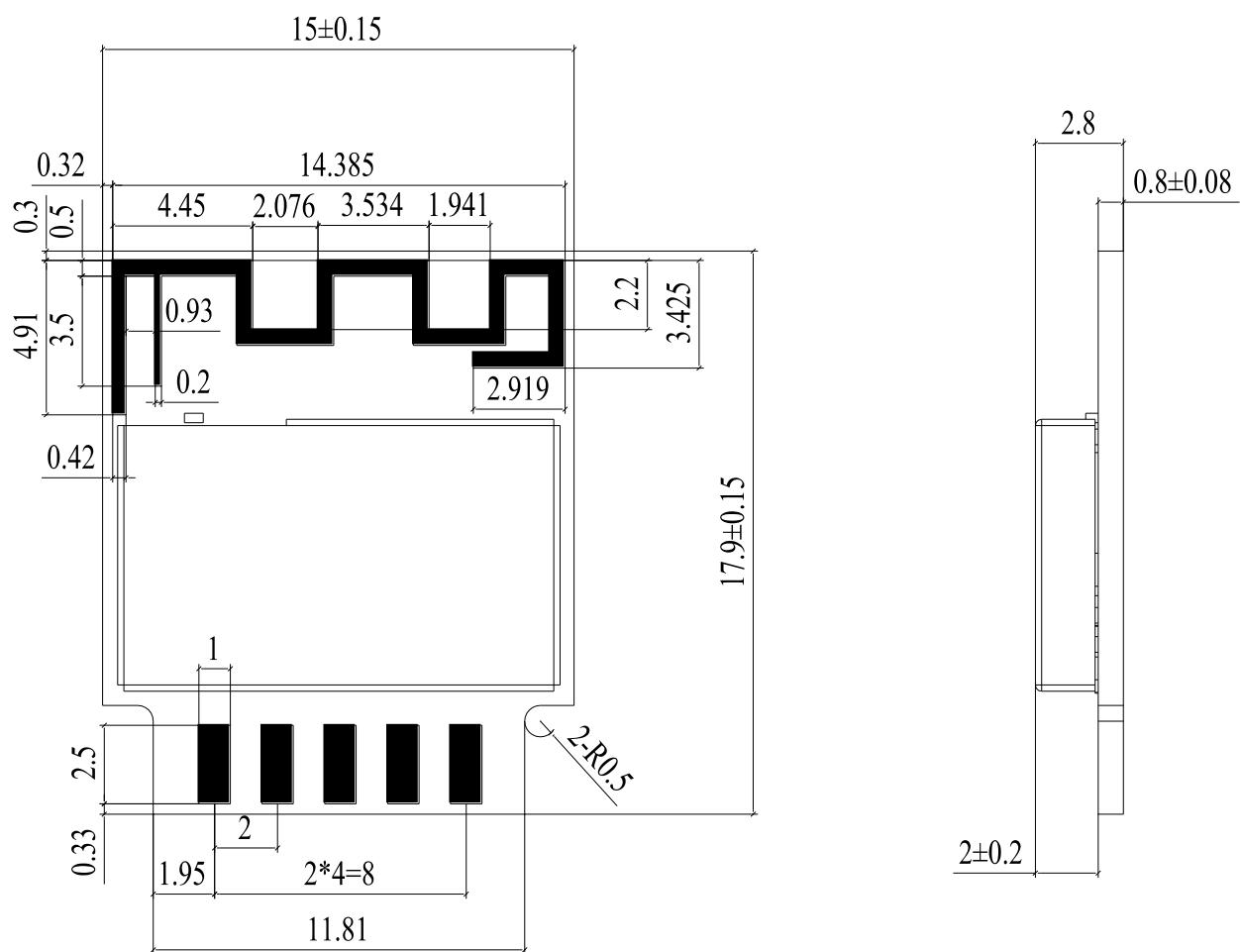
**Table 21: ESD Characteristics (Unit: kV)**

| Model                      | Test Result | Standard                    |
|----------------------------|-------------|-----------------------------|
| Human Body Model (HBM)     | ±4          | ANSI/ESDA/JEDEC JS-001-2017 |
| Charged Device Model (CDM) | ±0.25       | ANSI/ESDA/JEDEC JS-002-2018 |

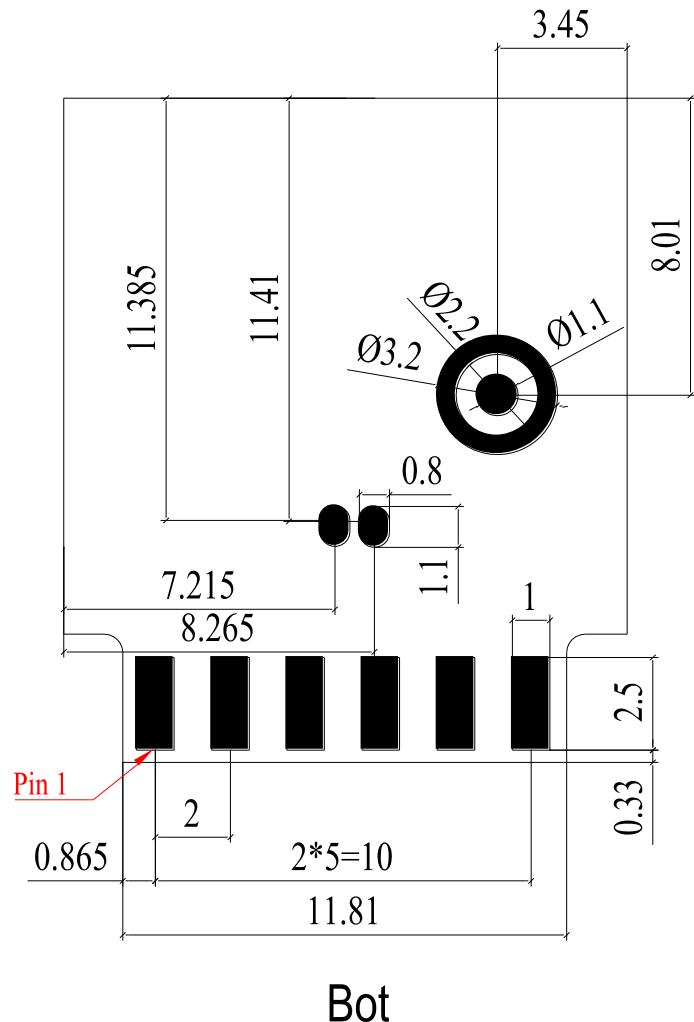
# 7 Mechanical Information

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

## 7.1. Mechanical Dimensions



**Figure 10: Top and Side Dimensions**



**Figure 11: Bottom Dimensions (Bottom View)**

## NOTE

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

## 7.2. Recommended Footprint

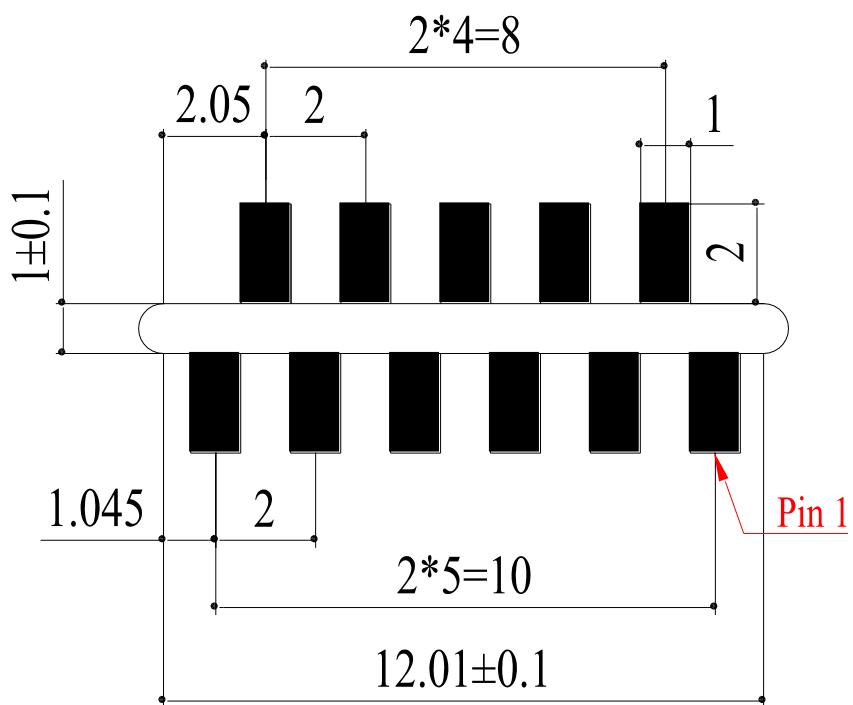


Figure 12: Recommended Footprint

**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

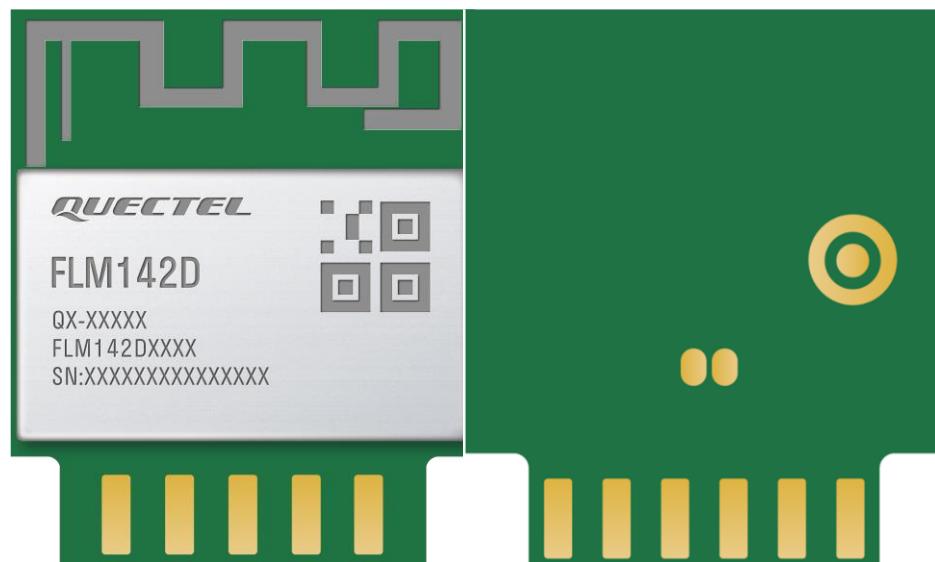


Figure 13: Top and Bottom Views

**NOTE**

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

# 8 Storage and 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  $23 \pm 5$  °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 <sup>4</sup> in a factory where the temperature is  $23 \pm 5$  °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  $120 \pm 5$  °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.

<sup>4</sup> 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.

## 8.2. Manufacturing and Soldering

The module is recommended to be soldered with wave-soldering equipment, and manual soldering is applicable only when the wave soldering cannot be used.

### 8.2.1. Wave Soldering

The recommended peak wave-soldering temperature should be  $265 \pm 5$  °C, with 270 °C as the absolute maximum wave-soldering temperature. The recommended wave-soldering thermal profile (lead-free wave-soldering) and related parameters are shown below.

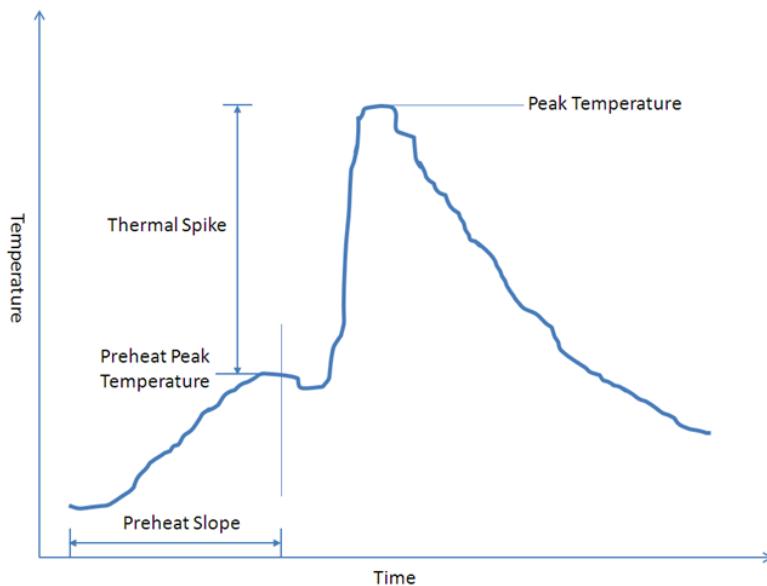


Figure 14: Recommended Lead-free Wave-soldering Thermal Profile

**Table 22: Recommended Thermal Profile Parameters**

| Factor                            | Recommended Value (Typ.) |
|-----------------------------------|--------------------------|
| Preheat ramp-up slope             | 1–3 °C/s                 |
| Preheat peak temperature (Bottom) | 95–145 s                 |
| Peak temperature (Bottom)         | 240–270 °C               |
| Tin immersion time                | 2–6 s                    |
| Tin tab setting temperature       | 265 ±5 °C                |
| Cool-down slope                   | < 8 °C/s                 |
| Tapping temperature               | < 150 °C (Tg)            |
| Chain speed                       | 0.8–1.2 m/min            |
| Orbital elevation                 | 4–6 °                    |

### 8.2.2. Manual Soldering

**Table 23: Recommended Manual-soldering Parameters**

| Factor                | Recommended Value  |
|-----------------------|--------------------|
| Soldering temperature | 360 ±20 °C         |
| Soldering time        | < 3 s/solder joint |

#### 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. 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. For better quality, keep the thermal profile, the amount of flux spraying and the tin slag and copper left over in tin tab in rational levels, and mind the rationality of the opening and the thickness of jigs during production.

## 8.3. Packaging Specifications

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

Carrier tape dimensions are detailed below:

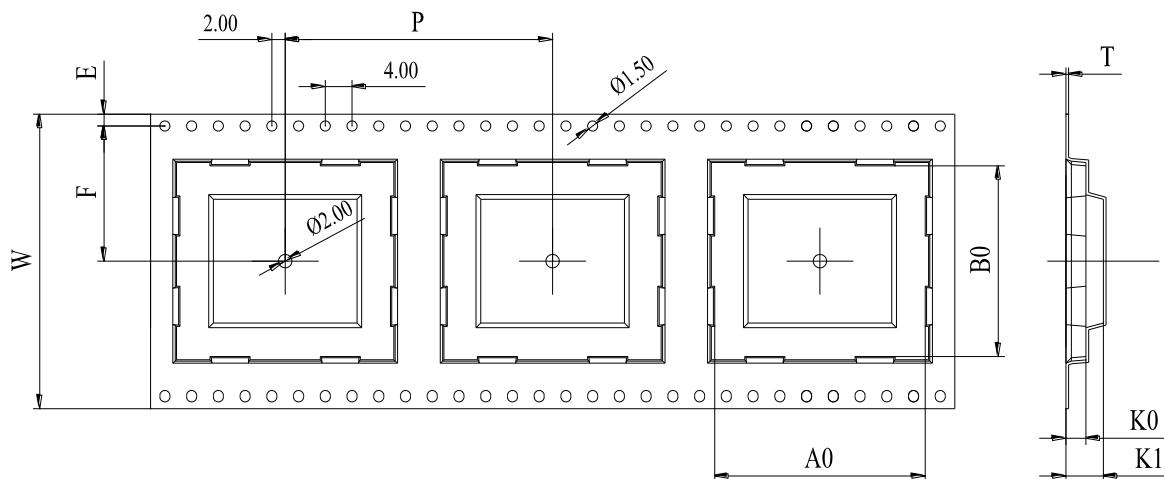


Figure 15: Tape Specifications

Table 24: Carrier Tape Dimension Table (Unit: mm)

| W  | P  | T   | A0   | B0   | K0  | K1  | F    | E    |
|----|----|-----|------|------|-----|-----|------|------|
| 44 | 24 | 0.4 | 15.4 | 18.3 | 3.3 | 4.6 | 20.2 | 1.75 |

### 8.3.2. Plastic Reel

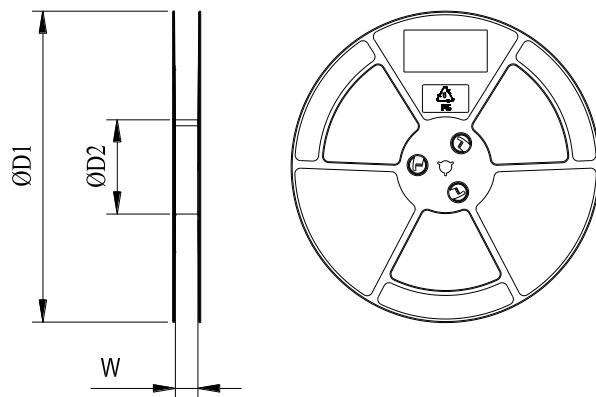
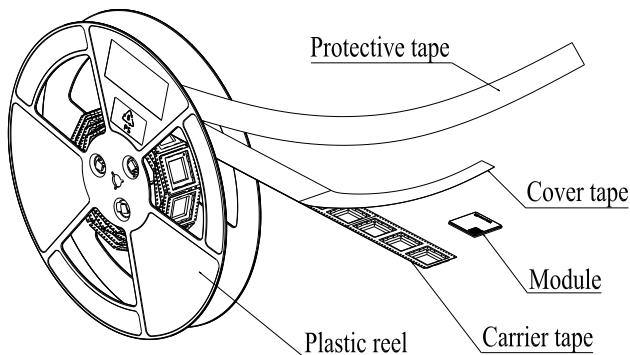


Figure 16: Plastic Reel Dimension Drawing

Table 25: Plastic Reel Dimension Table (Unit: mm)

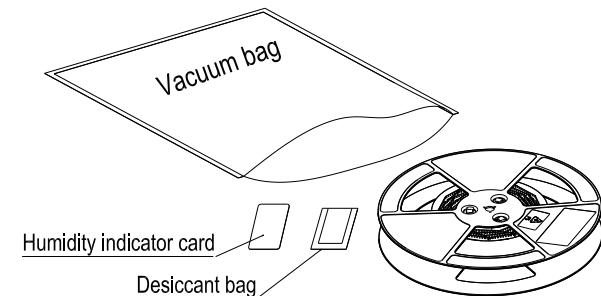
| ØD1 | ØD2 | W    |
|-----|-----|------|
| 330 | 100 | 44.5 |

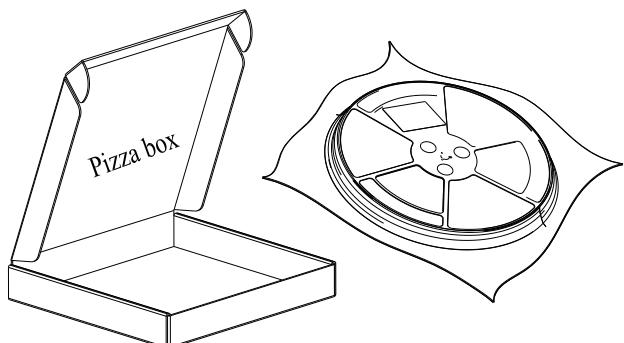
### 8.3.3. Packaging Process



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

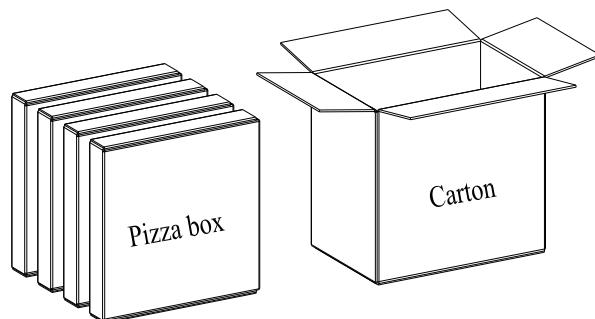
Place the packaged plastic reel, 1 humidity indicator card and 1 desiccant bag into a vacuum bag, vacuumize it.





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

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



**Figure 17: Packaging Process**

# 9 Appendix References

**Table 26: Reference Document**

| Document Name                       |
|-------------------------------------|
| [1] Quectel_FLM140D_TE-B_User_Guide |

**Table 27: Terms and Abbreviations**

| Abbreviation | Description                  |
|--------------|------------------------------|
| ADC          | Analog-to-Digital Converter  |
| AP           | Access Point                 |
| BLE          | Bluetooth Low Energy         |
| BPSK         | Binary Phase Shift Keying    |
| CCK          | Complementary Code Keying    |
| CDM          | Charged Device Model         |
| DIP          | Dual In-line Package         |
| ESD          | Electrostatic Discharge      |
| EVM          | Error Vector Magnitude       |
| GFSK         | Gauss frequency Shift Keying |
| GND          | Ground                       |
| GPIO         | General-Purpose Input/Output |
| HBM          | Human Body Model             |
| HT           | High Throughput              |
| I/O          | Input/Output                 |

---

|          |   |
|----------|---|
| IEEE     | Institute of Electrical and Electronics Engineers |
| IoT      | Internet of Things                                |
| Mbps     | Million Bits Per Second                           |
| MCS      | Modulation and Coding Scheme                      |
| MCU      | Microcontroller Unit                              |
| MSL      | Moisture Sensitivity Levels                       |
| OTA      | Over-the-Air                                      |
| PCB      | Printed Circuit Board                             |
| PSK      | Pre-Shared Key                                    |
| PWM      | Pulse Width Modulation                            |
| QAM      | Quadrature Amplitude Modulation                   |
| QPSK     | Quadrature Phase Shift Keying                     |
| RAM      | Random Access Memory                              |
| RF       | Radio Frequency                                   |
| RoHS     | Restriction of Hazardous Substances               |
| RTS      | Request To Send                                   |
| SAE      | Simultaneous Authentication of Equals             |
| STA      | Station   |
| Tg       | Glass Transition Temperature                      |
| TVS      | Transient Voltage Suppressor                      |
| Tx       | Transmit  |
| UART     | Universal Asynchronous Receiver/Transmitter       |
| $V_{IH}$ | High-level Input Voltage                          |
| $V_{IL}$ | Low-level Input Voltage                           |
| Vmax     | Maximum Voltage                                   |
| Vmin     | Minimum Voltage                                   |
| Vnom     | Nominal Voltage Value                             |

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|          |                             |
|----------|-----------------------------|
| $V_{OH}$ | High-level Output Voltage   |
| $V_{OL}$ | Low-level Output Voltage    |
| VSWR     | Voltage Standing Wave Ratio |
| WPA      | Wi-Fi Protected Access      |

---

## FCC Statement

Warning: Changes or modifications to this unit not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

NOTE: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications.

However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

The device must not be co-located or operating in conjunction with any other antenna or transmitter. 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.

### FCC Radiation Exposure Statement

This equipment should be installed and operated with minimum distance 20cm between the radiator and your body.

Does not comply with the use restrictions of the product:

Portable devices used close with human's body (within 20cm), Like Cell phone, Notebook etc.

### Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

#### 2.2 List of applicable FCC rules

FCC Part 15 Subpart C 15.247 & 15.209.

#### 2.3 Specific operational use conditions

The module can be used for mobile applications with a maximum -1.85dBi antenna. The host manufacturer installing this module into their product must ensure that the final compos it product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules,

including the transmitter operation. The host manufacturer 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 shown in this manual.

## **2.4 Limited module procedures**

Not applicable The module is a Single module and complies with the requirement of FCC Part 15 212.

## **2.5 Trace antenna designs**

Not applicable The module has its own antenna, and doesn't need a host's printed board micro strip trace antenna etc.

## **2.6 RF exposure considerations**

The module must be installed in the host equipment such that at least 20cm is maintained between the antenna and users' body; and if RF exposure statement or module layout is changed, then the host product manufacturer required to take responsibility of the module through a change in FCC ID or new application. The FCC ID of the module cannot be used on the final product. In these circumstances, the host manufacturer will be responsible for reevaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

## **2.7 Antennas**

Antenna Specification are as follows:

Type: PCB Antenna

Gain: -1.85dBi;

This device is intended only for host manufacturers under the following conditions: The transmitter module may not be co-located with any other transmitter or antenna; The module shall be only used with the internal antenna(s) that has been originally tested and certified with this module. The antenna must be either permanently attached or employ a "unique" antenna coupler.

As long as the conditions above are met, further transmitter test will not be required. However, the host manufacturer is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

## **2.8 Label and compliance information**

Host product manufacturers need to provide a physical or e-label stating "Contains FCC ID: XMR2024FLM142D" with their finished product.

## **2.9 Information on test modes and additional testing requirements**

Host manufacturer must perform test of radiated & conducted emission and spurious emission, e.t.c according to the actual test modes for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product. Only when all the test results of test modes comply with FCC requirements, then the end product can be sold legally.

## **2.10 Additional testing, Part 15 Subpart B disclaimer**

The modular transmitter is only FCC authorized for FCC Part 15 Subpart C 15.247 & 15.209 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.

**Federal Communication Commission Statement (FCC, U S)**

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

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.

**FCC Caution:**

Any changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate this equipment.

**IMPORTANT NOTES****Co-location warning:**

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

**OEM integration instructions:**

This device is intended only for OEM integrators under the following conditions:

The transmitter module may not be co-located with any other transmitter or antenna. The module shall be only used with the external antenna(s) that has been originally tested and certified with this module.

As long as the 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 (for example, digital device emissions, PC peripheral requirements, etc.).

#### **Validity of using the module certification:**

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization for this module in combination with the host equipment is no longer considered valid and the FCC ID of the module 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 authorization.

#### **End product labeling:**

The final end product must be labeled in a visible area with the following: "Contains Transmitter Module **FCC ID: XMR2024FLM142D**"

#### **Information that must be placed in the end user manual:**

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 shown in this manual.

## **IC Statement**

This device complies with Industry Canada license-exempt RSS standard(s). 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.

The device is compliant with RF field strength limits, users can obtain Canadian information on RF exposure and compliance.

#### **IC 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 20cm between the radiator & your body.

#### **Déclaration d' exposition aux radiations:**

Cet équipement est conforme aux limites d' exposition aux rayonnements IC 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.

**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-2024FLM142D".

**Étiquetage du produit final**

Ce module émetteur n'est autorisé que pour une utilisation dans un dispositif où l'antenne peut être installée de telle sorte que 20 cm puissent être maintenus entre l'antenne et les utilisateurs. Le produit final doit être étiqueté dans une zone visible avec la mention suivante: "contient IC:10224A-2024FLM142D".