

FCU760K

Hardware Design

Wi-Fi&Bluetooth Module Series

Version: 1.0.0

Date: 2023-04-13

Status: Preliminary



At Quectel, our aim is to provide timely and comprehensive services to our customers. If you require any assistance, please contact our headquarters:

Quectel Wireless Solutions Co., Ltd.

Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China

Tel: +86 21 5108 6236

Email: info@quectel.com

Or our local offices. For more information, please visit:

<http://www.quectel.com/support/sales.htm>.

For technical support, or to report documentation errors, please visit:

<http://www.quectel.com/support/technical.htm>.

Or email us at: support@quectel.com.

Legal Notices

We offer information as a service to you. The provided information is based on your requirements and we make every effort to ensure its quality. You agree that you are responsible for using independent analysis and evaluation in designing intended products, and we provide reference designs for illustrative purposes only. Before using any hardware, software or service guided by this document, please read this notice carefully. Even though we employ commercially reasonable efforts to provide the best possible experience, you hereby acknowledge and agree that this document and related services hereunder are provided to you on an “as available” basis. We may revise or restate this document from time to time at our sole discretion without any prior notice to you.

Use and Disclosure Restrictions

License Agreements

Documents and information provided by us shall be kept confidential, unless specific permission is granted. They shall not be accessed or used for any purpose except as expressly provided herein.

Copyright

Our and third-party products hereunder may contain copyrighted material. Such copyrighted material shall not be copied, reproduced, distributed, merged, published, translated, or modified without prior written consent. We and the third party have exclusive rights over copyrighted material. No license shall be granted or conveyed under any patents, copyrights, trademarks, or service mark rights. To avoid ambiguities, purchasing in any form cannot be deemed as granting a license other than the normal non-exclusive, royalty-free license to use the material. We reserve the right to take legal action for noncompliance with abovementioned requirements, unauthorized use, or other illegal or malicious use of the material.

Trademarks

Except as otherwise set forth herein, nothing in this document shall be construed as conferring any rights to use any trademark, trade name or name, abbreviation, or counterfeit product thereof owned by Quectel or any third party in advertising, publicity, or other aspects.

Third-Party Rights

This document may refer to hardware, software and/or documentation owned by one or more third parties ("third-party materials"). Use of such third-party materials shall be governed by all restrictions and obligations applicable thereto.

We make no warranty or representation, either express or implied, regarding the third-party materials, including but not limited to any implied or statutory, warranties of merchantability or fitness for a particular purpose, quiet enjoyment, system integration, information accuracy, and non-infringement of any third-party intellectual property rights with regard to the licensed technology or use thereof. Nothing herein constitutes a representation or warranty by us to either develop, enhance, modify, distribute, market, sell, offer for sale, or otherwise maintain production of any our products or any other hardware, software, device, tool, information, or product. We moreover disclaim any and all warranties arising from the course of dealing or usage of trade.

Privacy Policy

To implement module functionality, certain device data are uploaded to Quectel's or third-party's servers, including carriers, chipset suppliers or customer-designated servers. Quectel, strictly abiding by the relevant laws and regulations, shall retain, use, disclose or otherwise process relevant data for the purpose of performing the service only or as permitted by applicable laws. Before data interaction with third parties, please be informed of their privacy and data security policy.

Disclaimer

- a) We acknowledge no liability for any injury or damage arising from the reliance upon the information.
- b) We shall bear no liability resulting from any inaccuracies or omissions, or from the use of the information contained herein.
- c) While we have made every effort to ensure that the functions and features under development are free from errors, it is possible that they could contain errors, inaccuracies, and omissions. Unless otherwise provided by valid agreement, we make no warranties of any kind, either implied or express, and exclude all liability for any loss or damage suffered in connection with the use of features and functions under development, to the maximum extent permitted by law, regardless of whether such loss or damage may have been foreseeable.
- d) We are not responsible for the accessibility, safety, accuracy, availability, legality, or completeness of information, advertising, commercial offers, products, services, and materials on third-party websites and third-party resources.

Copyright © Quectel Wireless Solutions Co., Ltd. 2023. All rights reserved.

Safety Information

The following safety precautions must be observed during all phases of operation, such as usage, service or repair of any cellular terminal or mobile incorporating the module. Manufacturers of the cellular 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 given to driving at all times in order to reduce the risk of an accident. Using a mobile while driving (even with a handsfree kit) causes distraction and can lead to an accident. Please comply with laws and regulations restricting the use of wireless devices while driving.



Switch off the cellular terminal or mobile before boarding an aircraft. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. If 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.



Cellular 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 cellular 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 cellular 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 cellular 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

| Version | Date | Author | Description |
|---------|------------|----------|--------------------------|
| - | 2023-04-13 | Sunny LV | Creation of the document |
| 1.0.0 | 2023-04-13 | Sunny LV | Preliminary |

Contents

| | |
|--|-----------|
| Safety Information..... | 3 |
| About the Document..... | 4 |
| Contents..... | 5 |
| Table Index..... | 7 |
| Figure Index..... | 8 |
| 1 Introduction..... | 9 |
| 2 Product Overview..... | 10 |
| 2.1. Key Features..... | 11 |
| 3 RF Performances..... | 12 |
| 3.1. Wi-Fi Performances..... | 12 |
| 3.2. Bluetooth Performances..... | 12 |
| 4 Application Interfaces..... | 14 |
| 4.1. Pin Assignment..... | 14 |
| 4.2. Pin Description..... | 15 |
| 4.3. Power Supply..... | 16 |
| 4.4. Wi-Fi/Bluetooth Application Interface..... | 18 |
| 4.4.1. USB Interface..... | 19 |
| 4.5. RF Antenna Interface..... | 19 |
| 4.5.1. Reference Design..... | 20 |
| 4.5.2. RF Routing Guidelines..... | 21 |
| 4.5.3. RF Connector Recommendation..... | 22 |
| 5 Electrical Characteristics & Reliability..... | 25 |
| 5.1. Absolute Maximum Ratings..... | 25 |
| 5.2. Power Supply Ratings..... | 25 |
| 5.3. ESD Protection..... | 25 |
| 5.4. Digital I/O Characteristics..... | 26 |
| 5.5. Thermal Dissipation..... | 26 |
| 6 Mechanical Information..... | 28 |
| 6.1. Mechanical Dimensions..... | 28 |
| 6.2. Recommended Footprint..... | 30 |
| 6.3. Top and Bottom Views..... | 31 |
| 7 Storage, Manufacturing & Packaging..... | 32 |
| 7.1. Storage Conditions..... | 32 |
| 7.2. Manufacturing and Soldering..... | 33 |
| 7.3. Packaging Specifications..... | 34 |
| 7.3.1. Carrier Tape..... | 35 |

| | |
|------------------------------------|-----------|
| 7.3.2. Plastic Reel..... | 36 |
| 7.3.3. Mounting Direction | 36 |
| 7.3.4. Packaging Process..... | 37 |
| 8 Appendix References | 38 |

Table Index

| | |
|--|----|
| Table 1 : Basic Information | 10 |
| Table 2 : Key Features | 11 |
| Table 3 : Wi-Fi Performances | 12 |
| Table 5 : Bluetooth Performances | 12 |
| Table 7 : I/O Parameters Definition..... | 15 |
| Table 8 : Pin Description | 15 |
| Table 9 : Antenna Design Requirements..... | 20 |
| Table 10 : Absolute Maximum Ratings (Unit: V)..... | 25 |
| Table 11 : Module Power Supply Ratings (Unit: V) | 25 |
| Table 12 : Electrostatics Discharge Characteristics (Unit: kV) | 26 |
| Table 13 : Digital I/O Characteristics (Unit: V) | 26 |
| Table 14 : Recommended Thermal Profile Parameters | 34 |
| Table 15 : Carrier Tape Dimension Table (Unit: mm)..... | 35 |
| Table 16 : Plastic Reel Dimension Table (Unit: mm) | 36 |
| Table 17 : Related Documents..... | 38 |
| Table 18 : Terms and Abbreviations | 38 |

Figure Index

| | |
|---|----|
| Figure 2 : Pin Assignment (Top View) | 14 |
| Figure 3 : Reference Circuit of Power Supply..... | 17 |
| Figure 4 : Power-up Timing..... | 17 |
| Figure 5 : Wi-Fi Application Interface Connection | 18 |
| Figure 6 : Bluetooth Application Interface Connection | 18 |
| Figure 7 : USB Interface Connection | 19 |
| Figure 8 : Reference Circuit for RF Antenna Interface | 20 |
| Figure 9 : Microstrip Design on a 2-layer PCB | 21 |
| Figure 10 : Coplanar Waveguide Design on a 2-layer PCB | 21 |
| Figure 11 : Coplanar Waveguide Design on a 4-layer PCB (Layer 3 as Reference Ground)..... | 21 |
| Figure 12 : Coplanar Waveguide Design on a 4-layer PCB (Layer 4 as Reference Ground)..... | 22 |
| Figure 13 : Dimensions of the Receptacle (Unit: mm) | 23 |
| Figure 14 : Specifications of Mated Plugs | 23 |
| Figure 15 : Space Factor of Mated Connectors (Unit: mm)..... | 24 |
| Figure 16 : Placement and Fixing of the Heatsink..... | 27 |
| Figure 17 : Top and Side Dimensions..... | 28 |
| Figure 18 : Bottom Dimension (Bottom View)..... | 29 |
| Figure 19 : Recommended Footprint | 30 |
| Figure 20 : Top and Bottom Views..... | 31 |
| Figure 21 : Recommended Reflow Soldering Thermal Profile | 33 |
| Figure 22 : Carrier Tape Dimension Drawing | 35 |
| Figure 23 : Plastic Reel Dimension Drawing | 36 |
| Figure 24 : Mounting Direction | 36 |
| Figure 25 : Packaging Process | 37 |

1 Introduction

This document defines the FCU760K 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.

FCC ID:XMR2023FCU760K, IC:10224A-2023FCU760K
HVIN:FCU760K

2 Product Overview

FCU760K is a low-energy, high-performance IEEE 802.11 a/b/g/n/ac/ax Wi-Fi 6 and Bluetooth 5.3 module. It supports 2.4 GHz, 5 GHz Wi-Fi and 1T1R with maximum data transmission rate up to 600.5 Mbps. It provides USB 2.0 interface for Wi-Fi function and Bluetooth function.

It is an SMD module with compact packaging. Related information is listed in the table below:

Table 1: Basic Information

| FCU760K | |
|----------------|---|
| Packaging type | LCC |
| Pin counts | 22 |
| Dimensions | (13.0 ±0.15) mm × (12.2 ±0.15) mm × (2.0 ±0.2) mm |
| Weight | TBD |

2.1. Key Features

Table 2: Key Features

| Basic Information | |
|--|---|
| Protocols and Standard | <ul style="list-style-type: none"> ● Wi-Fi protocols: IEEE 802.11 a/b/g/n/ac/ax ● Bluetooth protocol: Bluetooth 5.3 (BLE and SPP) ● All hardware components are fully compliant with EU RoHS directive |
| Power Supply | VBAT Power Supply: <ul style="list-style-type: none"> ● 3.0–3.6 V ● Typ.: 3.3 V I/O Power Supply: <ul style="list-style-type: none"> ● 3.0–3.6 V ● Typ.: 3.3 V |
| Temperature Range | <ul style="list-style-type: none"> ● Operating Temperature ¹: -20 to +85 °C ● Storage Temperature: -40 to +90 °C |
| EVB Kit | FCU760K-TE-A |
| RF Antenna Interface | |
| Wi-Fi Antenna Interface | <ul style="list-style-type: none"> ● ANT_WIFI/BT ● 50 Ω impedance 50 Ω impedance |
| Bluetooth Antenna Interface ² | <ul style="list-style-type: none"> ● ANT_BT (optional) ● 50 Ω impedance |
| Application Interface | |
| Wi-Fi/Bluetooth Application Interface | USB 2.0 |

NOTE

The function of UART interface is under development.

¹ To meet the normal operating temperature range requirements, it is necessary to ensure effective thermal dissipation, e.g., by adding passive or active heatsinks, heat pipes, vapor chambers, etc. Within this range, the module's indicators comply with IEEE and Bluetooth specification requirements.

² The dedicated Bluetooth antenna interface is optional. For more details, contact Quectel Technical Support.

3 RF Performances

3.1. Wi-Fi Performances

Table 3: Wi-Fi Performances

| Operating Frequency |
|---|
| 2.4 GHz: 2.400–2.4835 GHz 5 GHz: 5.150–5.850 GHz |
| Modulation |
| DSSS、CCK、BPSK、QPSK、16QAM、64QAM、256QAM、1024QAM |
| Operating Mode |
| <ul style="list-style-type: none"> ● STA |
| Transmission Data Rate |
| <ul style="list-style-type: none"> ● 802.11b: 1 Mbps, 2 Mbps, 5.5 Mbps, 11 Mbps ● 802.11a/g: 6 Mbps, 9 Mbps, 12 Mbps, 18 Mbps, 24 Mbps, 36 Mbps, 48 Mbps, 54 Mbps ● 802.11n: HT20 (MCS 0–7), HT40 (MCS 0–7) ● 802.11ac: VHT20 (MCS 0–8), VHT40 (MCS 0–9), VHT80 (MCS 0–9) ● 802.11ax: HT20 (MCS 0–9), HT40 (MCS 0–11), HT80 (MCS 0–11) |

3.2. Bluetooth Performances

Table 4: Bluetooth Performances

| Operating Frequency |
|---------------------|
| 2.400–2.4835 GHz |
| Modulation |

GFSK, 8-DPSK, $\pi/4$ -DQPSK

Operating Mode

- Classic Bluetooth (BR + EDR)
 - Bluetooth Low Energy (BLE)
-

4 Application Interfaces

4.1. Pin Assignment

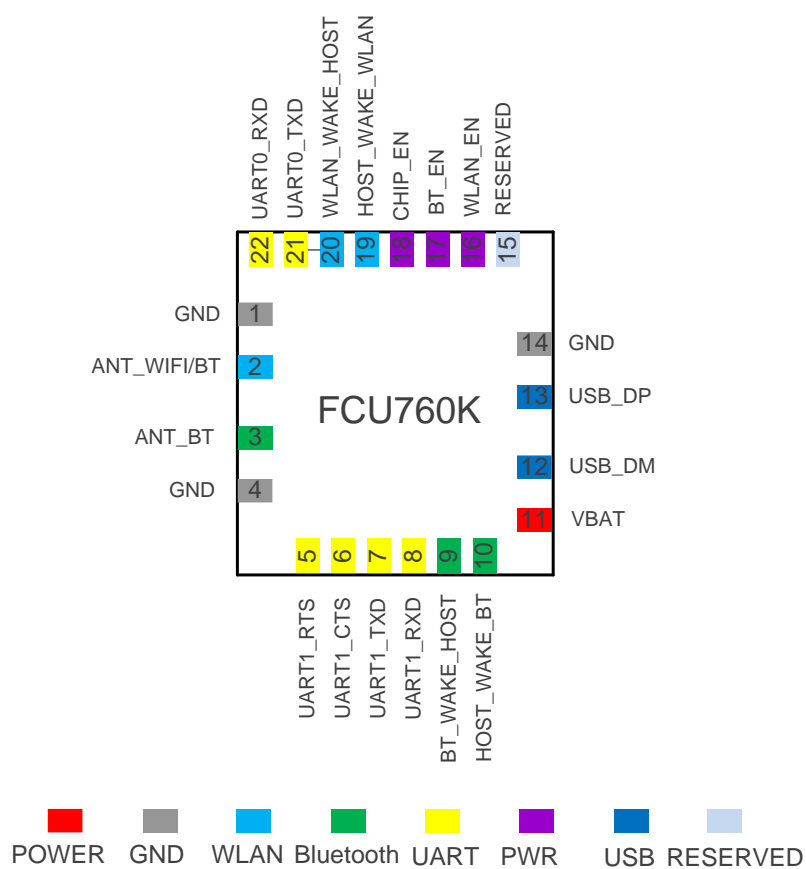


Figure 1: Pin Assignment (Top View)

NOTE

1. Keep all RESERVED or unused pins unconnected.
2. The function of UART interface is under development.

4.2. Pin Description

Table 5: I/O Parameters Definition

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

DC characteristics include power domain and rate current, etc.

Table 6: Pin Description

| Power Supply | | | | | |
|------------------------------|----------|-----|-----------------------------|--|---------|
| Pin Name | Pin No. | I/O | Description | DC Characteristics | Comment |
| VBAT | 11 | PI | Power supply for the module | Vmin = 3.0 V Vnom = 3.3 V Vmax = 3.6 V | |
| GND | 1, 4, 14 | | | | |
| Wi-Fi Application Interfaces | | | | | |
| Pin Name | Pin No. | I/O | Description | DC Characteristics | Comment |
| HOST_WAKE_WLAN | 19 | DI | Host wakes up WLAN | VBAT | |
| WLAN_WAKE_HOST | 20 | DO | WLAN wakes up host | | |
| WLAN_EN | 16 | DI | WLAN enable control | | |
| USB_DM | 12 | AIO | USB differential data (-) | | |
| USB_DP | 13 | AIO | USB differential data (+) | | |
| CHIP_EN | 18 | DI | CHIP enable | | |

Bluetooth Application Interfaces

| Pin Name | Pin No. | I/O | Description | DC Characteristics | Comment |
|--------------|---------|-----|---------------------------|--------------------|---------|
| HOST_WAKE_BT | 10 | DI | Host wakes up Bluetooth | VBAT | |
| BT_WAKE_HOST | 9 | DO | Bluetooth wakes up host | | |
| BT_EN | 17 | DI | Bluetooth enable control | | |
| USB_DM | 12 | AIO | USB differential data (-) | | |
| USB_DP | 13 | AIO | USB differential data (+) | | |
| CHIP_EN | 18 | DI | CHIP enable | | |

RF Antenna Interfaces

| Pin Name | Pin No. | I/O | Description | DC Characteristics | Comment |
|-------------|---------|-----|-----------------------------------|--------------------|------------------------|
| ANT_WIFI/BT | 2 | AIO | Wi-Fi/Bluetooth antenna interface | | 50 Ω impedance. |
| ANT_BT | 3 | AIO | Bluetooth antenna interface | | |

RESERVED Pin

| Pin Name | Pin No. | Comment |
|----------|---------|---------------|
| RESERVED | 15 | Keep it open. |

4.3. Power Supply

The module is powered by VBAT. It is recommended to use a 3.3 V power supply chip with sufficient up to 0.5 A. For better power supply performance, it is recommended to parallel a 47 μ F decoupling capacitor, and 1 μ F and 100 nF filter capacitors near the module's VBAT pin. In addition, it is recommended to add a TVS near the VBAT to improve the surge voltage bearing capacity of the module. In principle, the longer the VBAT trace is, the wider it should be.

VBAT reference circuit is shown below:

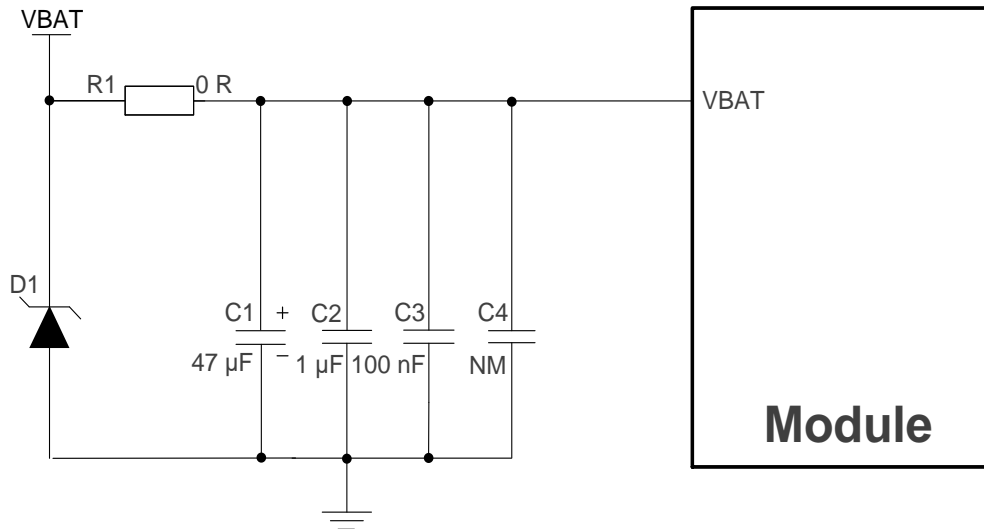


Figure 2: Reference Circuit of Power Supply

The power-up timing of the module is shown below.

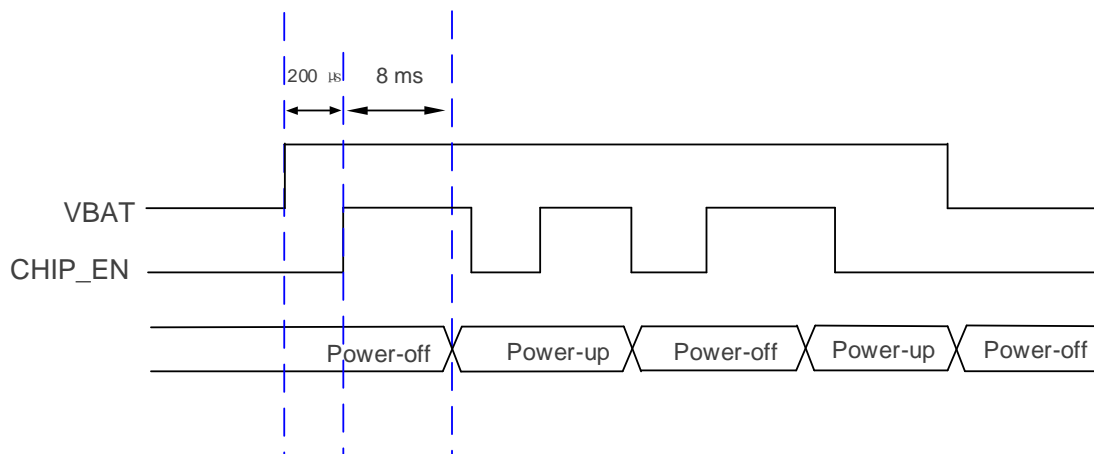


Figure 3: Power-up Timing

4.4. Wi-Fi/Bluetooth Application Interface

The module provides USB 2.0 interface communicating with the host for Wi-Fi/Bluetooth function.

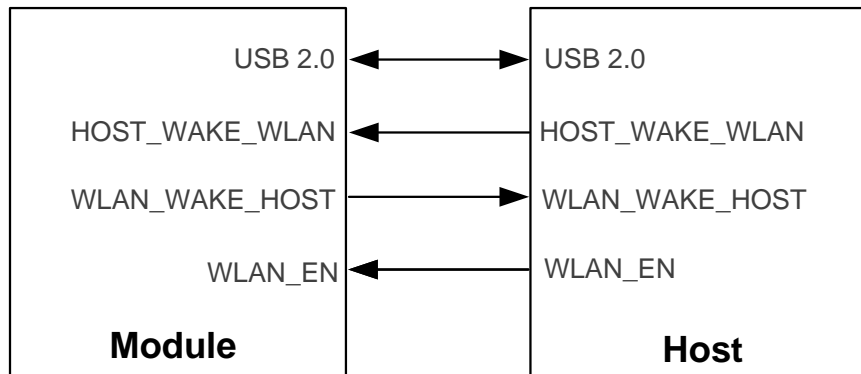


Figure 4: Wi-Fi Application Interface Connection

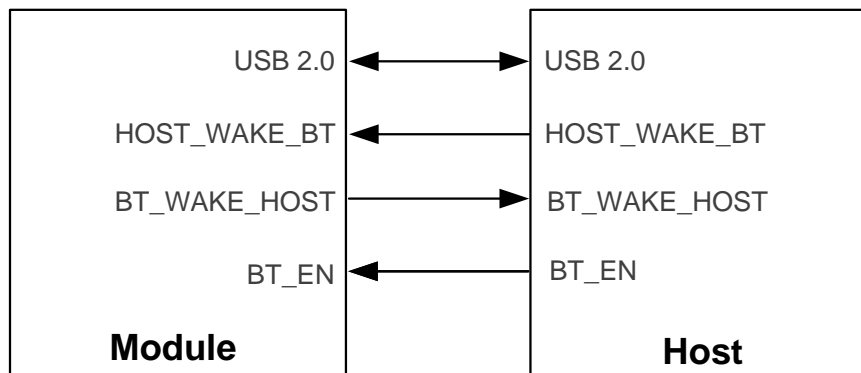


Figure 5: Bluetooth Application Interface Connection

4.4.1. USB Interface

USB interface connection between the module and the host is illustrated in the following figure.

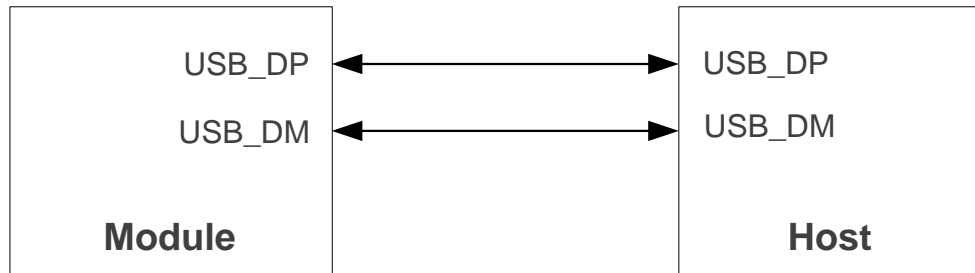


Figure 6: USB Interface Connection

To ensure compliance of interface design with the USB 2.0 specification, it is recommended to adopt the following principles:

- The impedance of USB signal trace is $90\ \Omega \pm 10\%$. Route the USB traces in inner layer of the PCB, and surround the traces with ground on that layer and with ground planes above and below.
- Keep USB signals far away from other sensitive circuits/signals such as RF circuits and analog signals, as well as noise signals such as clock signals and DC-DC signals.
- USB signal traces (USB_DP and USB_DM) need to be equal in length, width and distance (the distance between the traces should be less than 1 mm).
- The distance between USB signal line and other signals must be greater than twice the trace width, and the bus load capacitance must be less than 15 pF.

4.5. RF Antenna Interface

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.

The module provides two antenna pins (ANT_WIFI/BT, ANT_BT), among which the ANT_BT is optional for two-antenna module (FCU760K). The impedance of antenna port is $50\ \Omega$.

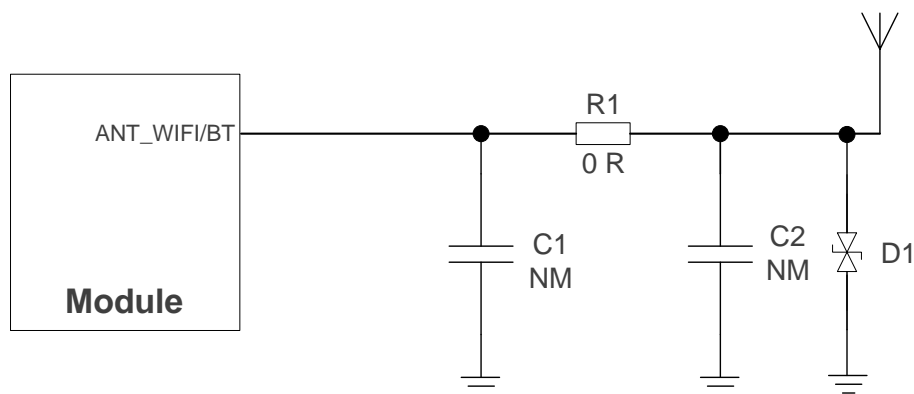
Table 7: Antenna Design Requirements

| Parameter | Requirement ³ |
|---------------------------|---|
| Frequency Ranges (GHz) | <ul style="list-style-type: none"> ● 2.400–2.4835 ● 5.150–5.850 |
| Cable Insertion Loss (dB) | < 1 |
| VSWR | ≤ 2 (Typ.) |
| Gain (dBi) | 2.4G:0.73,5G:1.14 |
| Max Input Power (W) | 50 |
| Input Impedance (Ω) | 50 |
| Polarization Type | Vertical |

4.5.1.Reference Design

The module provides one antenna pins. It is recommended to reserve a π -type matching circuit and add ESD protection components for better RF performance. Reserved matching components (R1, C1 and C2) shall be placed as close to the antenna as possible. C1, C2 and D1 are not mounted by default. The parasitic capacitance of TVS should be less than 0.05 pF.

The following reference design is based on ANT_WIFI/BT as an example, the reference design of other RF antenna interfaces is the same.


Figure 7: Reference Circuit for RF Antenna Interface

³ For more details about the RF performances, see **Chapter 3**.

4.5.2.RF Routing Guidelines

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

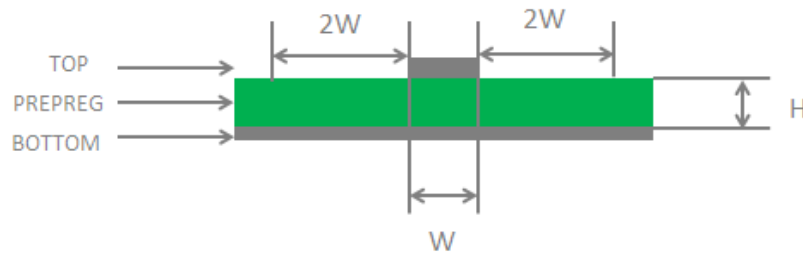


Figure 8: Microstrip Design on a 2-layer PCB

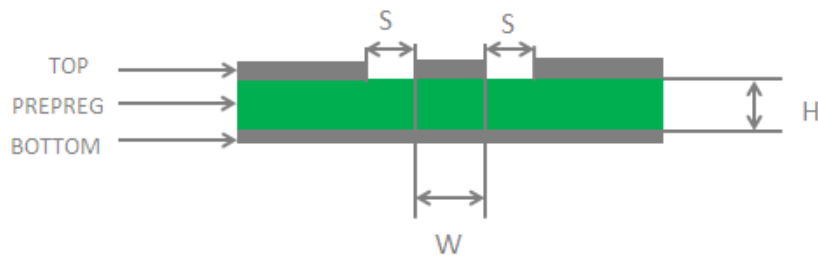


Figure 9: Coplanar Waveguide Design on a 2-layer PCB

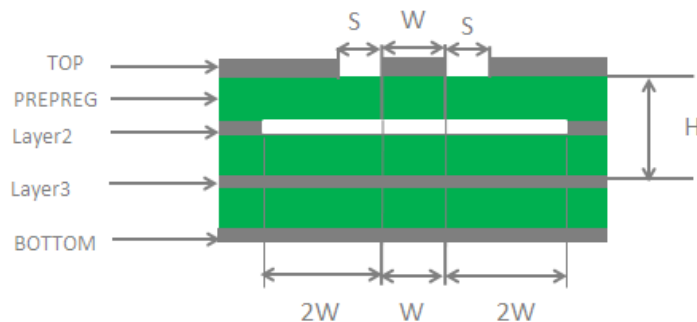


Figure 10: Coplanar Waveguide Design on a 4-layer PCB (Layer 3 as Reference Ground)

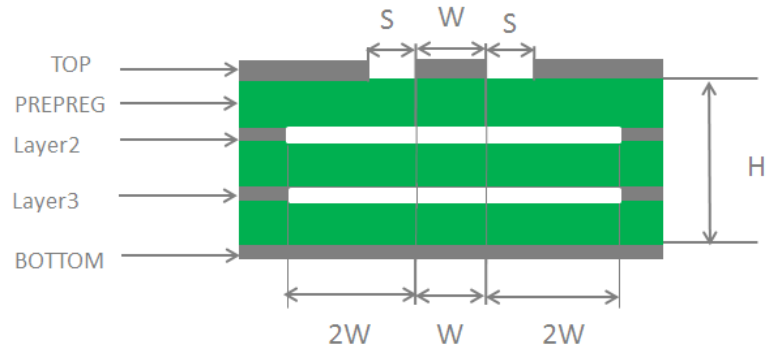


Figure 11: Coplanar Waveguide Design on a 4-layer PCB (Layer 4 as Reference Ground)

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

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

4.5.3. RF Connector Recommendation

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

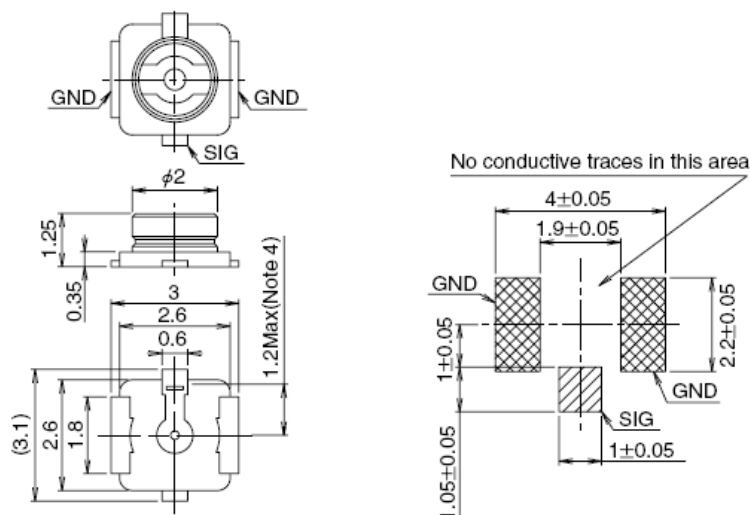


Figure 12: Dimensions of the Receptacle (Unit: mm)

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

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

Figure 13: Specifications of Mated Plugs

The following figure describes the space factor of mated connectors.

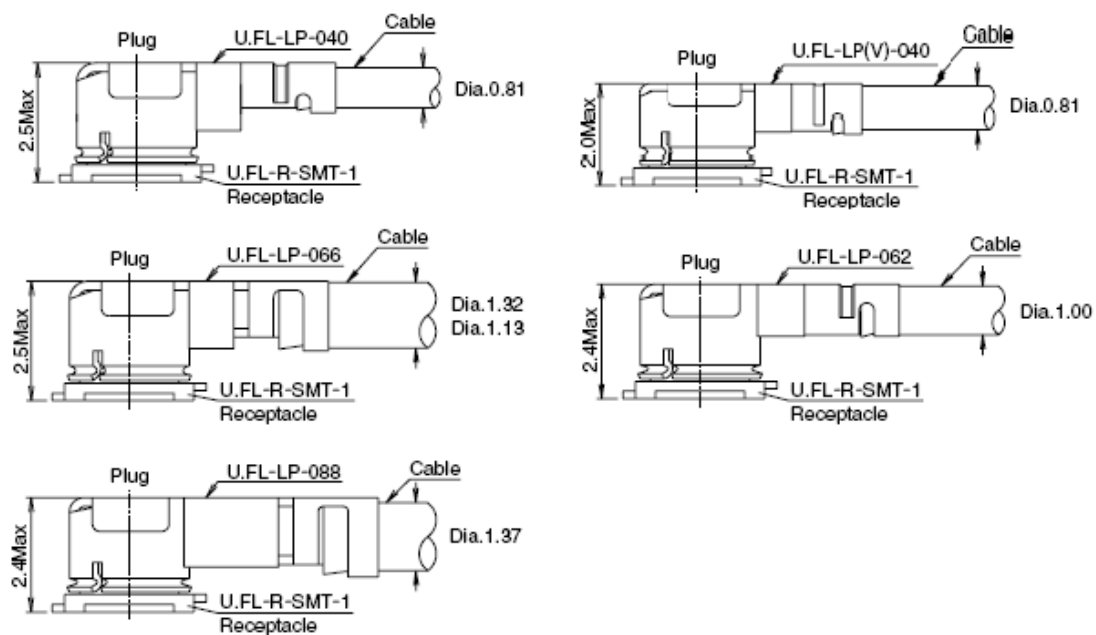


Figure 14: Space Factor of Mated Connectors (Unit: mm)

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

5 Electrical Characteristics & Reliability

5.1. Absolute Maximum Ratings

Table 8: Absolute Maximum Ratings (Unit: V)

| Parameter | Min. | Max. |
|-------------------------|------|------|
| VBAT | -0.3 | 3.6 |
| Voltage at Digital Pins | -0.3 | 3.6 |

5.2. Power Supply Ratings

Table 9: Module Power Supply Ratings (Unit: V)

| Parameter | Min. | Typ. | Max. |
|-----------|------|------|------|
| VBAT | 3.0 | 3.3 | 3.6 |

5.3. 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 10: Electrostatics Discharge Characteristics (Unit: kV)

| Model | Test Result | Standard |
|----------------------------|-------------|------------------------|
| Human Body Model (HBM) | $> \pm 3$ | ESDA/JEDEC JS-001-2017 |
| Charged Device Model (CDM) | $> \pm 0.8$ | ESDA/JEDEC JS-002-2018 |

5.4. Digital I/O Characteristics

Table 11: Digital I/O Characteristics (Unit: V)

| Parameter | Description | Min. | Max. |
|-----------|---------------------------|----------------------|----------------------|
| V_{IH} | High-level Input Voltage | $0.7 \times V_{BAT}$ | V_{BAT} |
| V_{IL} | Low-level Input Voltage | 0 | $0.3 \times V_{BAT}$ |
| V_{OH} | High-level Output Voltage | TBD | TBD |
| V_{OL} | Low-level Output Voltage | TBD | TBD |

5.5. Thermal Dissipation

The module offers the best performance when all internal IC chips are working within their operating temperatures. When the IC chip reaches or exceeds the maximum junction temperature, the module may still work but the performance and function (such as RF output power, data rate, etc.) will be affected to a certain extent. Therefore, the thermal design should be maximally optimized to ensure all internal IC chips always work within the recommended operating temperature range.

The following principles for thermal consideration are provided for reference:

- Keep the module away from heat sources on your PCB, especially high-power components such as processor, power amplifier, and power supply.
- Maintain the integrity of the PCB copper layer and drill as many thermal vias as possible.
- Follow the principles below when the heatsink is necessary:
 - Do not place large size components in the area where the module is mounted on your PCB to reserve enough place for heatsink installation.
 - Attach the heatsink to the shielding cover of the module; In general, the base plate area of the heatsink should be larger than the module area to cover the module completely;

- Choose the heatsink with adequate fins to dissipate heat;
- Choose a TIM (Thermal Interface Material) with high thermal conductivity, good softness and good wettability and place it between the heatsink and the module;
- Fasten the heatsink with four screws to ensure that it is in close contact with the module to prevent the heatsink from falling off during the drop, vibration test, or transportation.

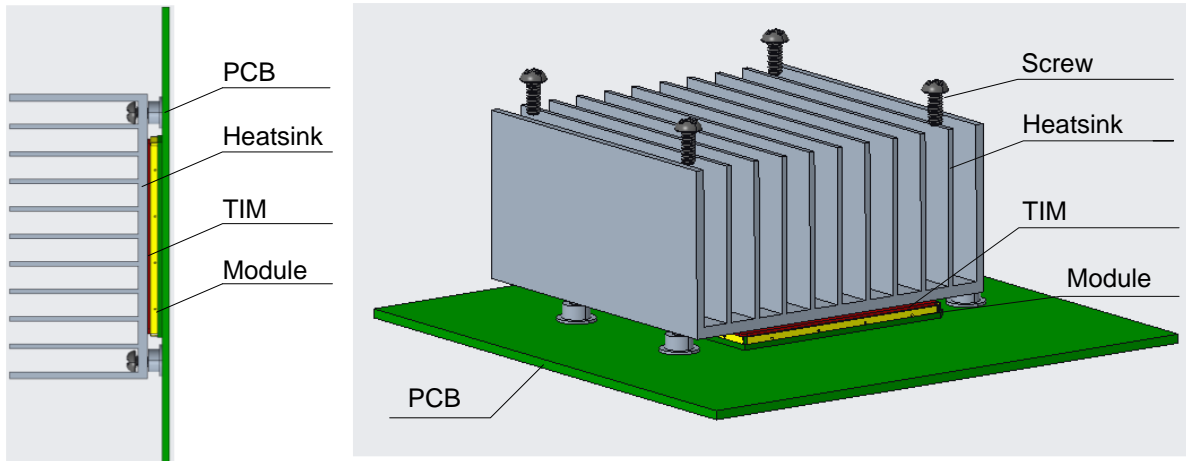


Figure 15: Placement and Fixing of the Heatsink

6 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.

6.1. Mechanical Dimensions

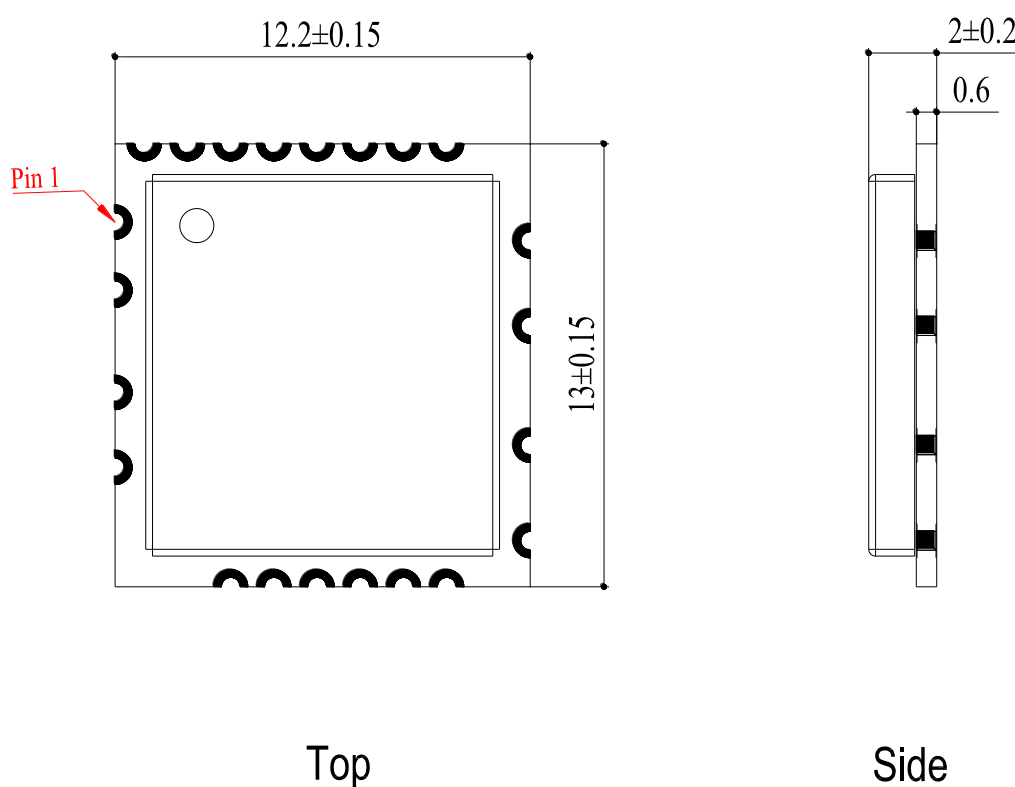


Figure 16: Top and Side Dimensions

NOTE

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

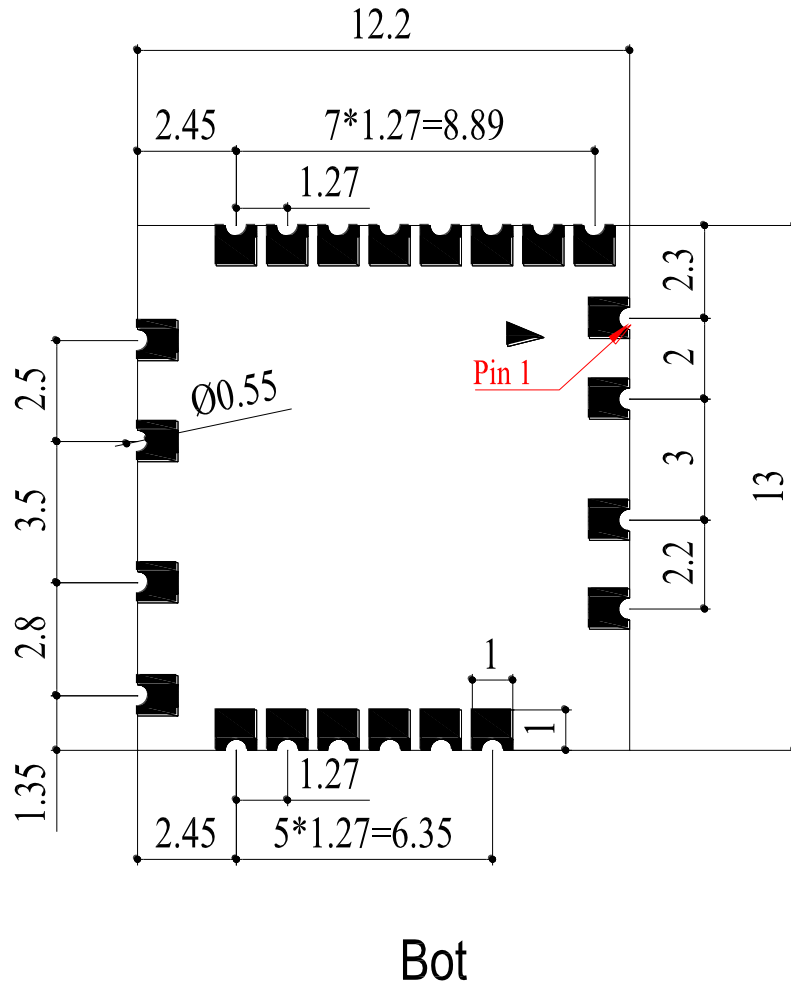


Figure 17: Bottom Dimension (Bottom View)

NOTE

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

6.2. Recommended Footprint

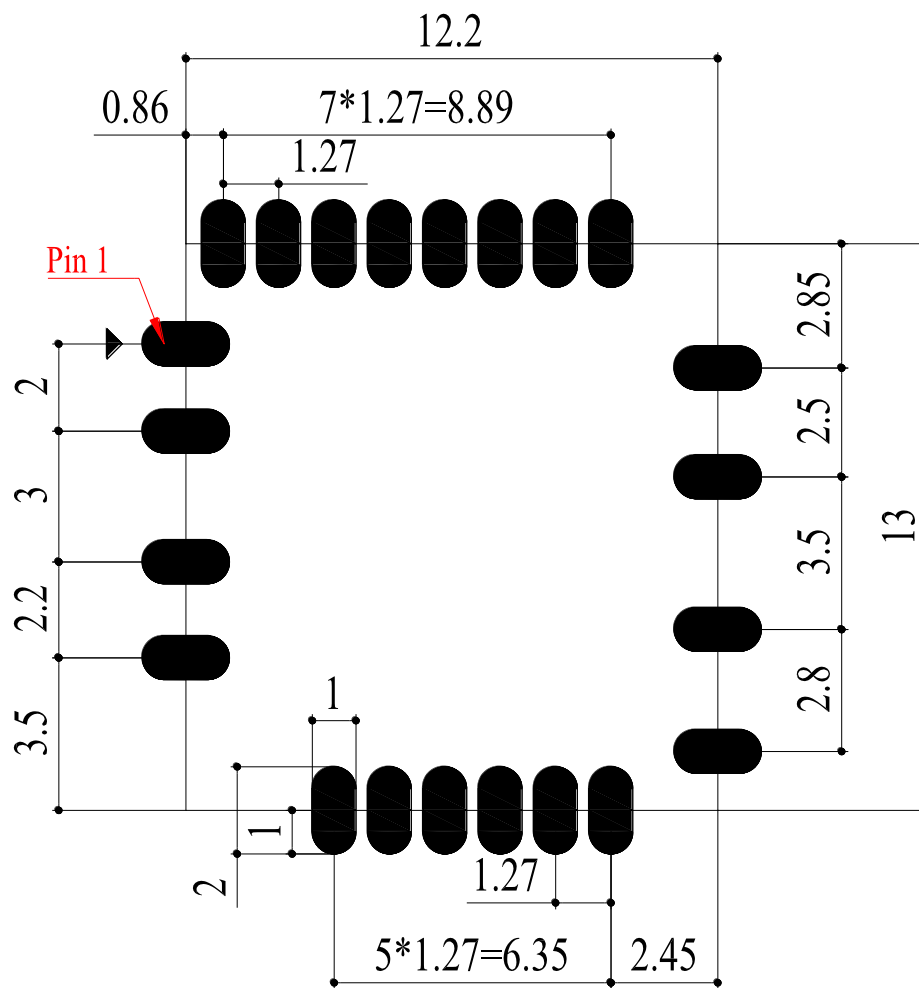


Figure 18: Recommended Footprint

NOTE

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

6.3. Top and Bottom Views

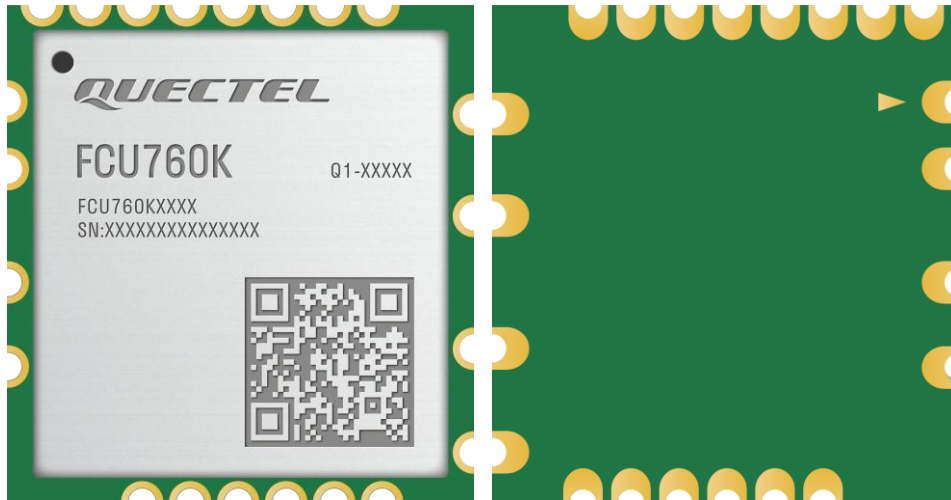


Figure 19: Top and Bottom Views

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.

7 Storage, Manufacturing & Packaging

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

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

NOTE

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

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

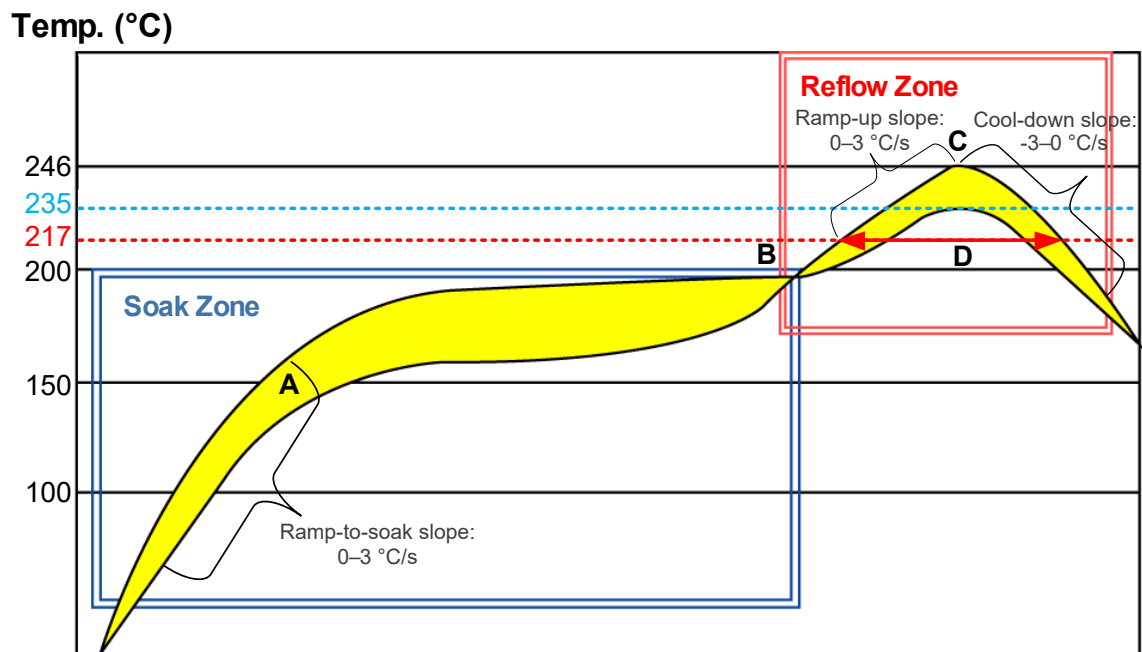


Figure 20: Recommended Reflow Soldering Thermal Profile

Table 12: 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.

7.3. 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:

7.3.1. Carrier Tape

Dimension details are as follow:

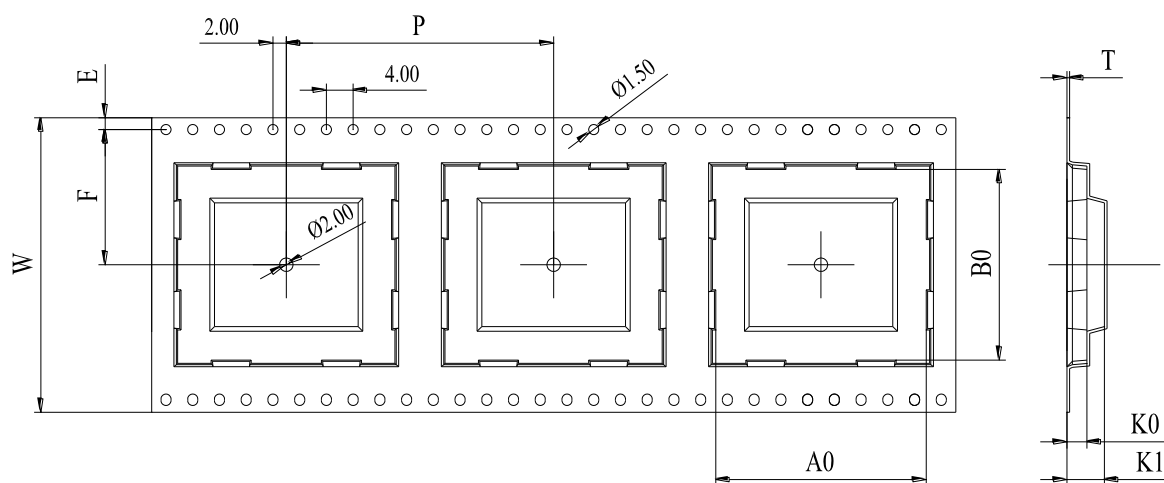


Figure 21: Carrier Tape Dimension Drawing

Table 13: Carrier Tape Dimension Table (Unit: mm)

| W | P | T | A0 | B0 | K0 | K1 | F | E |
|----|----|-----|------|------|------|-----|------|------|
| 32 | 20 | 0.4 | 12.6 | 13.4 | 2.55 | 5.9 | 14.2 | 1.75 |

7.3.2. Plastic Reel

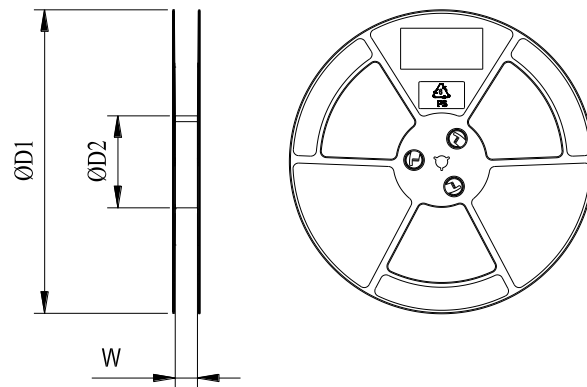


Figure 22: Plastic Reel Dimension Drawing

Table 14: Plastic Reel Dimension Table (Unit: mm)

| ØD1 | ØD2 | W |
|-----|-----|------|
| 330 | 100 | 32.5 |

7.3.3. Mounting Direction

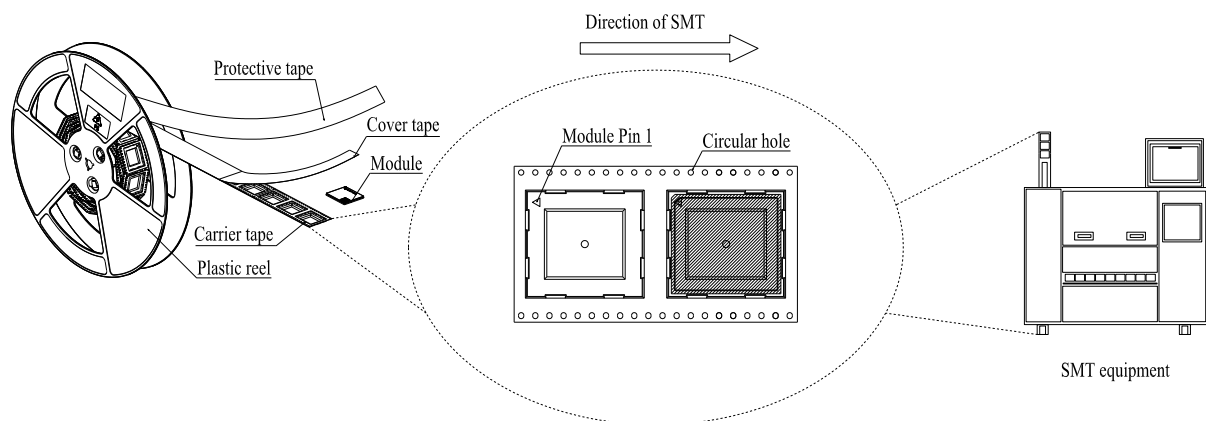
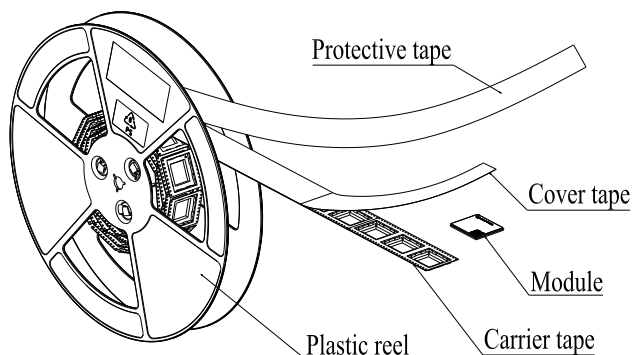


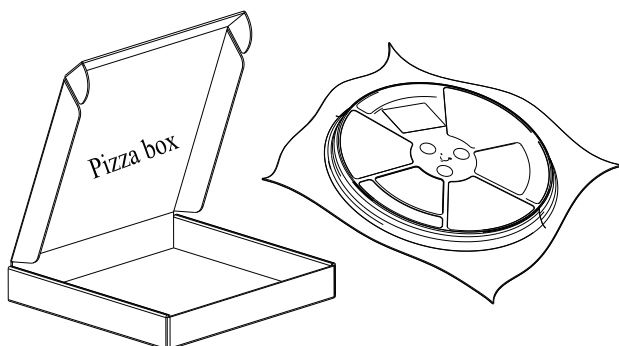
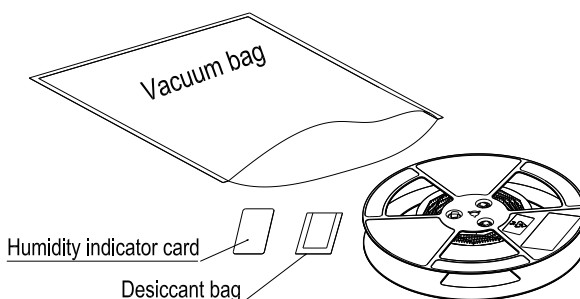
Figure 23: Mounting Direction

7.3.4. Packaging Process



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

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



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

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

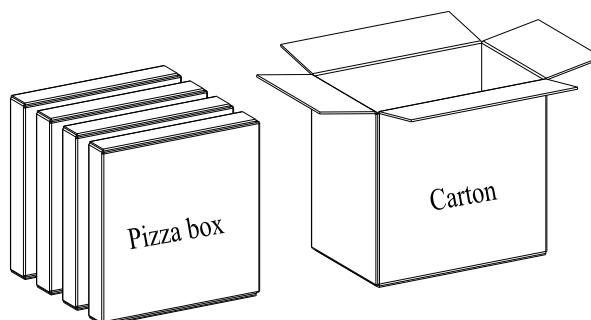


Figure 24: Packaging Process

8 Appendix References

Table 15: Related Documents

| Document Name |
|---|
| [1] Quectel_RF_Layout_Application_Note |
| [2] Quectel_Module_SMT_Application_Note |

Table 16: Terms and Abbreviations

| Abbreviation | Description |
|--------------|--|
| AP | Access Point |
| BLE | Bluetooth Low Energy |
| BPSK | Binary Phase Shift Keying |
| BR | Basic Rate |
| CCK | Complementary Code Keying |
| DPSK | Differential Phase Shift Keying |
| DQPSK | Differential Quadrature Phase Shift Keying |
| DSSS | Direct Sequence Spread Spectrum |
| EDR | Enhanced Data Rate |
| ESD | Electrostatic Discharge |
| EVM | Error Vector Magnitude |
| GFSK | Gauss frequency Shift Keying |
| GND | Ground |

| | |
|-----------------|---|
| HE | High Efficiency |
| HT | High Throughput |
| IEEE | Institute of Electrical and Electronics Engineers |
| I/O | Input/Output |
| Mbps | Million Bits Per Second |
| MCS | Modulation and Coding Scheme |
| MSL | Moisture Sensitivity Levels |
| PCB | Printed Circuit Board |
| QAM | Quadrature Amplitude Modulation |
| QPSK | Quadrature Phase Shift Keying |
| RoHS | Restriction of Hazardous Substances |
| SPP | Serial Port Profile |
| STA | Station |
| Rx | Receive |
| RXD | Receive Data |
| TBD | To Be Determined |
| TVS | Transient Voltage Suppressor |
| Tx | Transmit |
| TXD | Transmit Data |
| UART | Universal Asynchronous Receiver/Transmitter |
| USB | Universal Serial Bus |
| VBAT | Voltage at Battery (Pin) |
| VHT | Very High Throughput |
| V _{IH} | High-level Input Voltage |
| V _{IL} | Low-level Input Voltage |

| | |
|------------------|-----------------------------|
| V _{max} | Maximum Voltage |
| V _{min} | Minimum Voltage |
| V _{nom} | Normal Voltage |
| V _{OH} | High-level Output Voltage |
| V _{OL} | Low-level Output Voltage |
| VSWR | Voltage Standing Wave Ratio |
| Wi-Fi | Wireless Fidelity |

Important Notice to OEM integrators

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

Important Note

notice that any deviation(s) from the defined parameters of the antenna trace, as described by the

instructions, require that the host product manufacturer must notify to 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 (XMR2023FCU760K) 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: XMR2023FCU760K"

"Contains IC: 10224A-2023FCU760K "

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

Antenna Installation

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

module. Other types of antennas and/or higher gain antennas may require additional authorization for operation.

| Antenna type | 2.4GHz band | | 5.2GHz band | | 5.3GHz band | | 5.5GHz band | | 5.8GHz band | |
|--------------|---------------|------|---------------|------|---------------|------|---------------|------|---------------|------|
| | Peak (dBi) | Gain | Peak (dBi) | Gain | Peak (dBi) | Gain | Peak (dBi) | Gain | Peak (dBi) | Gain |
| Dipole | 0.73 | | 1.14 | | 1.00 | | 0.60 | | 0.95 | |

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

Manual Information to the End User

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

Federal Communication Commission Interference Statement

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

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

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

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

List of applicable FCC rules

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

The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

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

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

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

Radiation Exposure Statement

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

IC**Industry Canada Statement**

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

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

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

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

Radiation Exposure Statement

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

Déclaration d'exposition aux radiations:

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

RSS-247 Section 6.4 (5) (6) (for local area network devices, 5GHz)

The device could automatically discontinue transmission in case of absence of information to transmit, or operational failure. Note that this is not intended to prohibit transmission of control or signaling information or the use of repetitive codes where required by the technology.

The device for operation in the band 5150–5250 MHz is only for indoor use to reduce the potential for harmful interference to co-channel mobile satellite systems;

The maximum antenna gain permitted for devices in the bands 5250–5350 MHz and 5470–5725 MHz shall comply with the e.i.r.p. limit; and

The maximum antenna gain permitted for devices in the band 5725–5825 MHz shall comply with the e.i.r.p. limits specified for point-to-point and non point-to-point operation as appropriate.

L'appareil peut interrompre automatiquement la transmission en cas d'absence d'informations à

transmettre ou de panne opérationnelle. Notez que ceci n'est pas destiné à interdire la transmission d'informations de contrôle ou de signalisation ou l'utilisation de codes répétitifs lorsque cela est requis par la technologie.

Le dispositif utilisé dans la bande 5150-5250 MHz est réservé à une utilisation en intérieur afin de réduire le risque de brouillage préjudiciable aux systèmes mobiles par satellite dans le même canal;

Le gain d'antenne maximal autorisé pour les dispositifs dans les bandes 5250-5350 MHz et 5470-5725 MHz doit être conforme à la norme e.r.p. limite; et

Le gain d'antenne maximal autorisé pour les appareils de la bande 5725-5825 MHz doit être conforme à la norme e.i.r.p. les limites spécifiées pour un fonctionnement point à point et non point à point, selon le cas.

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

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

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

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

- 1) L'antenne doit être installée de telle sorte qu'une distance de 20 cm est respectée entre l'antenne et les utilisateurs, et
- 2) Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

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

IMPORTANT NOTE:

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

NOTE IMPORTANTE:

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

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: "Contains IC:10224A-2023FCU760K".

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-2023FCU760K ".

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.