

# Quectel **KG100S**

## Hardware Design

Wireless Module for Amazon Sidewalk

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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 cellular terminal or mobile incorporating the module. Manufacturers of the cellular terminal shall 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 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 shall 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 emergent 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

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metal powders.

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# About the Document

## Revision History

Version	Date	Author	Description
-	2022-08-24	Wain ZHAO/Soni RAO	Creation of the document
1.0.0	2022-11-04	Wain ZHAO/Soni RAO	Preliminary

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# 1 Introduction

This document defines the Quectel KG100S and describes its air interface and hardware interfaces which are connected with your applications.

With this document, you can quickly understand module interface specifications, electrical and mechanical details, as well as other related information of the module. The document, coupled with application notes and user guides, makes it easy to design and set up mobile applications with the module.

## 1.1. Special Mark

**Table 1: Special Mark**

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

## 2.1. General Description

Quectel KG100S is a low-power, cost-effective wireless module for Amazon Sidewalk, which integrates the hardware and software resources required for Amazon Sidewalk applications. It is suitable for low flow control and data acquisition applications such as home intelligent terminal, industrial application and so on.

Quectel KG100S has an energy-friendly micro controller with a high performance 2.4 GHz radio transiever for Bluetooth Low Energy (BLE), and a built-in long-range low power LoRa transceiver, the module includes:

- 80 MHz ARM Cortex®-M33 core
- 96K Byte RAM
- 1M Byte Flash
- Built-in LoRa transceiver
- A controller that supports BLE 5.1 standards

With a compact profile of 15.0 mm × 15.0 mm × 2.25 mm, the module, powered by 3.3 V and 1.8 V power supply can be embedded in applications through its 49 LGA pins.

## 2.2. Key Features

The following table describes the key features of Quectel KG100S.

Table 2: Key Features

Features	Details
Power Supply	<ul style="list-style-type: none"><li>● <b>VSYS Power Supply:</b> Supply voltage range: 3.0–3.6 V Typical supply voltage: 3.3 V</li><li>● <b>VMCU Power Supply:</b></li></ul>

	Supply voltage range: 1.71–3.6 V Typical supply voltage: 1.8/3.3 V
Operating Frequency	<ul style="list-style-type: none"><li>● LoRa/FSK: 863–928 MHz</li><li>● BLE: 2.402–2.480 GHz</li></ul>
LoRa/FSK Features	<ul style="list-style-type: none"><li>● +22 dBm efficient PA</li><li>● Integrated DC-DC converter and LDO</li><li>● FSK, GFSK and LoRa CSS modem</li><li>● Sidewalk LoRa CSS raw bit rate 2.4 kbps @ BW 500 kHz, SF11 and Sidewalk GFSK 50 kbps raw data rate</li><li>● High sensitivity: down to -128 dBm @ BW 500 kHz, SF11</li><li>● Built-in clock recovery synchronizer</li></ul>
Bluetooth Protocol	BLE 5.1
Bluetooth Operation Mode	BLE
Bluetooth Modulation	GFSK
Wireless Application Interfaces	UART, JLINK, SPI, I2C*
Antenna Interfaces	<ul style="list-style-type: none"><li>● LoRa/FSK antenna interface (ANT_LORA)</li><li>● BLE antenna interface (ANT_BT)</li><li>● 50 Ω impedance</li></ul>
Physical Characteristics	<ul style="list-style-type: none"><li>● Size: (15.0 ±0.2) mm × (15.0 ±0.2) mm × (2.25 ±0.2) mm</li><li>● Package: LGA</li><li>● Weight: approx 0.94 g</li></ul>
Temperature Range	<ul style="list-style-type: none"><li>● Operating temperature range: -40 °C<sup>1</sup> to +85 °C</li><li>● Storage temperature range: -40 °C to +95°C</li></ul>
RoHS	All hardware components are fully compliant with EU RoHS directive

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

## 2.3. Functional Diagram

The following figure shows a block diagram of Quectel KG100S.

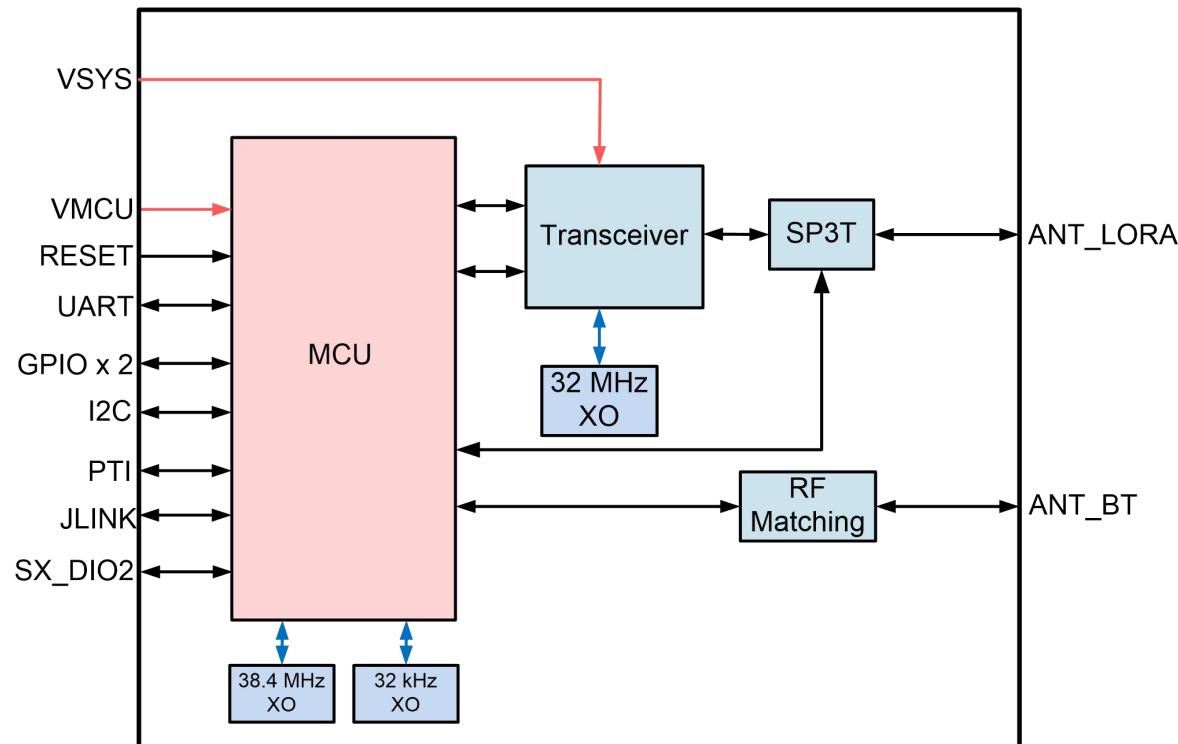


Figure 1: Functional Diagram

## 2.4. EVB Kit

To help you develop applications with the module, Quectel supplies an evaluation board (Quectel KG100S TE-B) with accessories to control or test the module. For more details, see [document \[1\]](#).

# 3 Application Interfaces

## 3.1. General Description

Quectel KG100S has 49 LGA pins. The following interfaces and functions are described in detail in subsequent chapters:

- Power supply
- Reset
- UART interface
- I2C interface\*
- JLINK interface
- GPIOs
- RF antenna interfaces

### 3.2. Pin Assignment

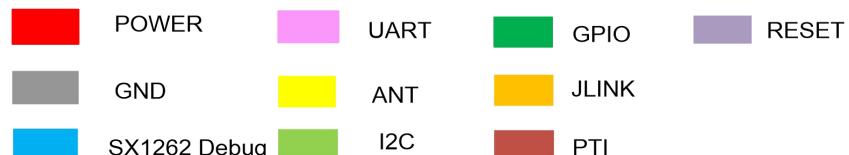
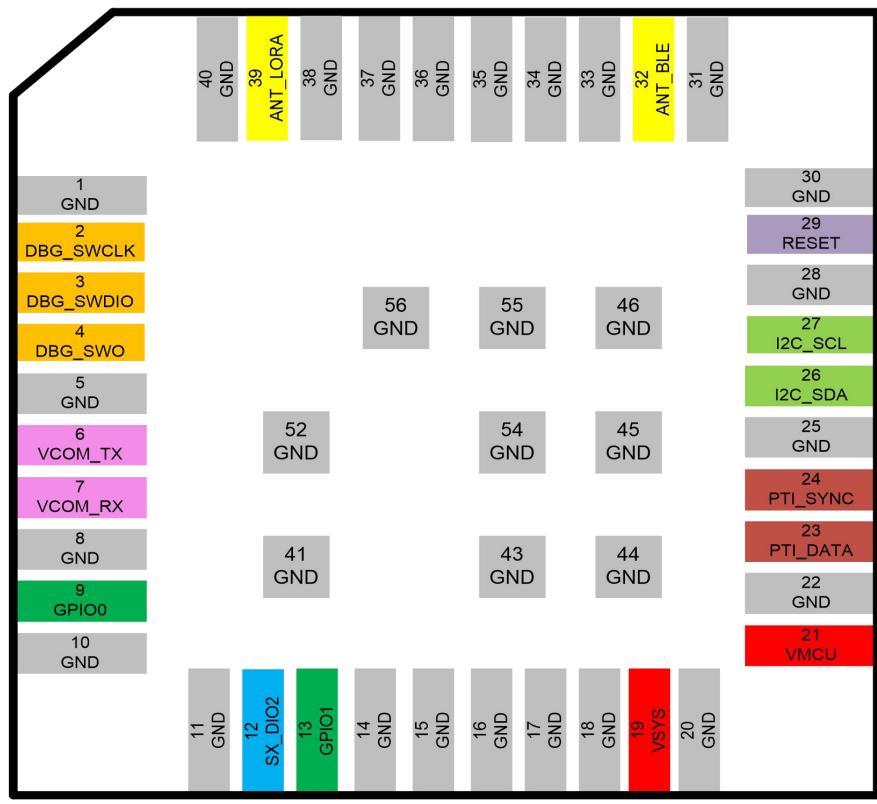


Figure 2: Pin Assignment (Top View)

### 3.3. Pin Description

The following tables show the pin description of module:

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

Type	Description
AIO	Analog Input/Output
DI	Digital Input
DO	Digital Output
DIO	Digital Input/Output
OD	Open Drain
PI	Power Input

**Table 4: Pin Description**

Power Supply					
Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
VSYS	19	PI	Power supply for the LoRa part	Vmax = 3.6 V Vmin = 3.0 V Vnom = 3.3 V	It must be provided with sufficient current up to 0.3 A.
VMCU	21	PI	Power supply for the MCU part	Vmax = 3.6 V Vmin = 1.71 V Vnom = 1.8 V	It must be provided with sufficient current up to 0.2 A.
GND	1, 5, 8, 10, 11, 14–18, 20, 22, 25, 28, 30, 31, 33–38, 40, 41, 43–46, 52, 54–56				
RESET					
Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
RESET	29	DI	Resets the module	VMCU power domain	Active low.
UART Interface					
Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
VCOM_TX	6	DO	UART transmit	VMCU power domain	

VCOM_RX	7	DI	UART receive
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#### JLINK Interface

Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
DBG_SWCLK	2	DI	SWD clock		Mandatory
DBG_SWDIO	3	DIO	SWD data	VMCU power domain	Mandatory
DBG_SWO	4	DIO	SWD state		

#### I2C Interface

Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
I2C_SCL	27	OD	I2C serial clock		VMCU power domain
I2C_SDA	26	OD	I2C serial data		

#### GPIO Interfaces

Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
GPIO0	9	DIO	General-purpose input/output	VMCU power domain	Needs to cooperate with LoRa Tx & Rx state.
GPIO1	13	DIO	General-purpose input/output		

#### RF Antenna Interface

Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
ANT_BLE	32	AIO	Bluetooth antenna interface		50 Ω impedance
ANT_LORA	39	AIO	LoRa antenna interface		

#### SX1262 Debug Interface

Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
SX_DIO2	12	DIO	Multi-purpose digital input/output	VMCU power domain	

#### Other Interfaces

Pin Name	Pin No.	I/O	Description	DC Characteristics	Comment
PTI_DATA	23	DIO	PTI data	VMCU power domain	
PTI_SYNC	24	DI	PTI sync		

### 3.4. Power Supply

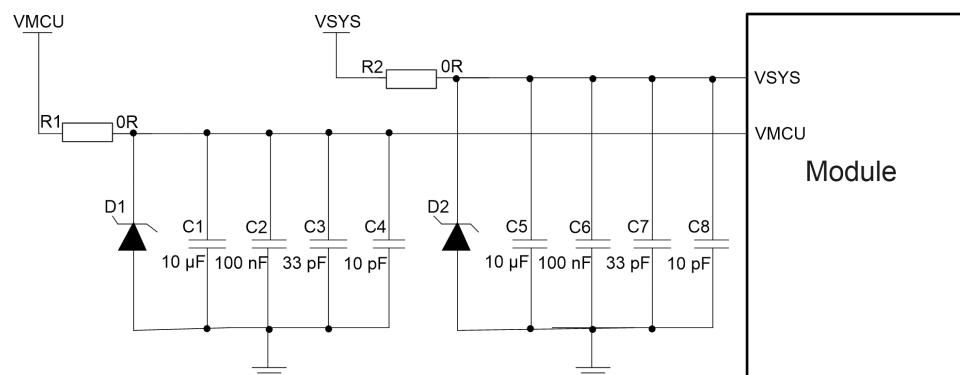
The following table shows the power supply pin and ground pin of Quectel KG100S.

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

Pin Name	Pin No.	Description	Min.	Typ.	Max.	Unit
VSYS	19	Power supply for the LoRa part	3.0	3.3	3.6	V
VMCU	21	Power supply for the MCU part	1.71	1.8/3.3	3.6	V
GND	1, 5, 8, 10, 11, 14–18, 20, 22, 25, 28, 30, 31, 33–38, 40, 41, 43–46, 52, 54–56					

Quectel KG100S is powered by VSYS and VMCU, and it is recommended to use a power supply chip with sufficient current of at least 0.3 A. In order to achieve better power supply performance, it is recommended to parallel a 10  $\mu$ F decoupling capacitor for VSYS and VMCU respectively and 100 nF, 33 pF, 10 pF filter capacitors near the module's power pins. At the same time, it is suggested to add a TVS on each power rail to improve the surge voltage bearing capacity of the module. In principle, the longer the power supply trace is, the wider it shall be.

Reference circuit of power supply is shown as below:

**Figure 3: Reference Circuit of Power Supply**

### 3.5. Reset

Drive RESET low for at least 100 ms and then release it to reset the module.

**Table 6: Definition of Power Supply and GND Pins**

Pin Name	Pin No.	Description	Comment

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RESET	29	Resets the module	Active low.
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The reference design for resetting the module are shown below. An open drain/collector driving circuit or a button can be used to control the RESET pin.

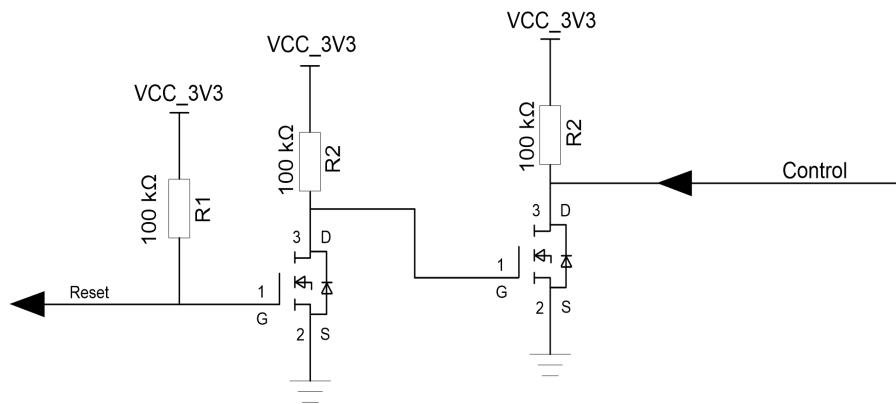


Figure 4: Reference Circuit of RESET by Using Driving Circuit

Another way to control the RESET is using a button directly through. A TVS shall be placed near the button for ESD protection. The reference circuit is as follows:

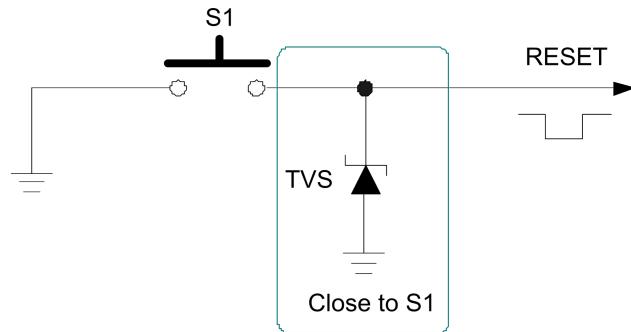
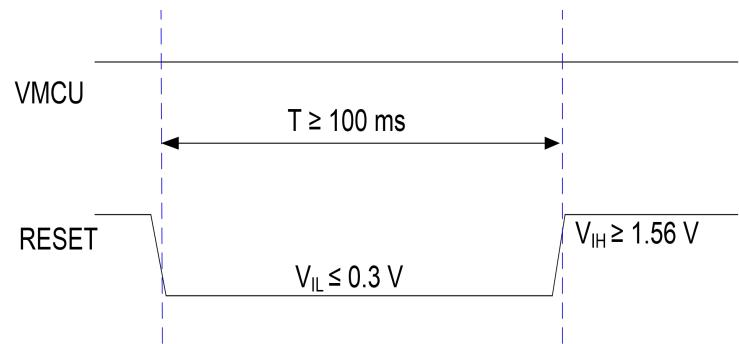


Figure 5: Reference Circuit of RESET by Using Button

The reset timing is illustrated in the following figure.



**Figure 6: Reset Timing**

### 3.6. UART Interface

The module provides one UART interface which is used as DCE, and is connected in the traditional DCE-DTE mode.

**Table 7: UART Interface Pin Definition**

Pin Name	Pin No.	Description	SPI
VCOM_TX	6	UART transmit	MOSI
VCOM_RX	7	UART receive	MISO

**Table 8: PTI Interface Pin Definition**

Pin Name	Pin No.	Description	UART	SPI
PTI_DATA	23	PTI data	RTS	SCS
PTI_SYNC	24	PTI sync	CTS	SCLK

Through debug tools, the UART interface can be used to output logs for software debugging. Its baud rate is 115200 bps by default. The following is a reference design of UART.

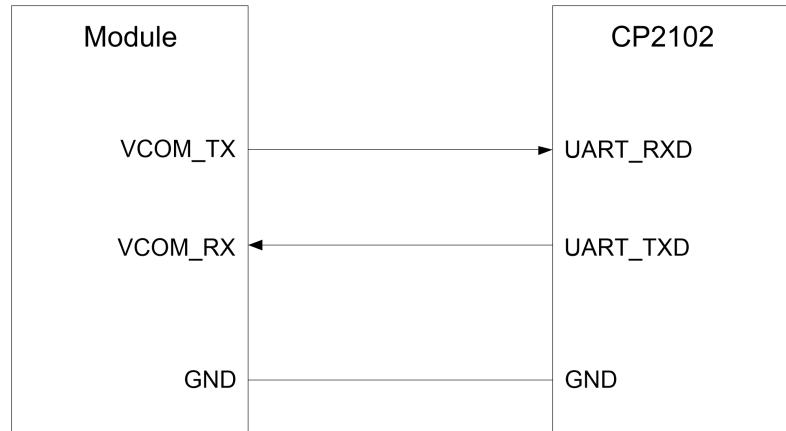


Figure 7: UART Connection Diagram

### 3.7. I2C Interface\*

Quectel KG100S provides an I2C interface that supports standard-mode, fast-mode and fast-mode plus, allowing transmission rates from 10 kbps up to 1 Mbps.

Table 9: I2C Pin Definition

Pin Name	Pin No.	I/O	Description	Comment
I2C_SCL	27	OD	I2C serial clock	Requires external pull-up resistor to VMCU.
I2C_SDA	26	OD	I2C serial data	

### 3.8. JLINK Interface

Quectel KG100S provides one JLINK interface for developers to program/debug the module. To use JLINK, developers can download and install the JLINK tools and the reference connection diagram is as below.

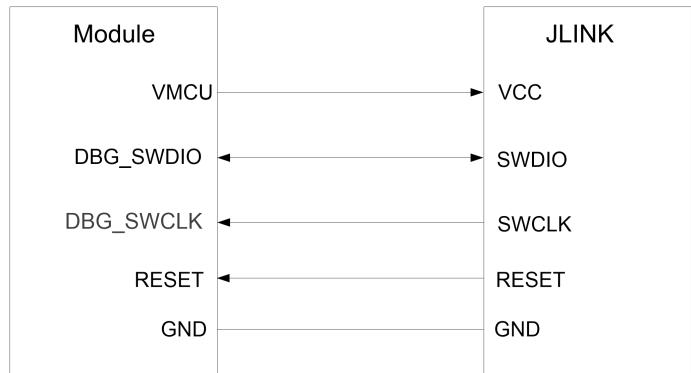


Figure 8: JLINK Connection Diagram

### 3.9. GPIOs

Quectel KG100S provides two GPIOs by default. Any GPIO can be configured as an interrupt to wake the module from low power consumption mode.

Table 10: GPIOs Pin Definition

Pin Name	Pin No.	I/O	Description	Comment
GPIO0	9	DIO	General-purpose input/output	VMCU voltage domain.
GPIO1	13			

GPIO0 is internally used to determine the transmitting and receiving of the gating module. When GPIO0 = 0, the gating module receives US band. When GPIO0 = 1, the gating module transmits and receives EU band. GPIO1 is not used internally. Users can define it by themselves.

## 3.10. RF Antenna Interfaces

### 3.10.1. RF Antenna Pin Description

RF Antenna pin description is as below:

**Table 11: Antenna Pin Definition**

Pin Name	Pin No.	I/O	Description	Comment
ANT_BLE	32	AIO	Bluetooth antenna interface	50 Ω impedance
ANT_LORA	39	AIO	LoRa antenna interface	

### 3.10.2. Operating Frequency

The operating frequency of Quectel KG100S is shown in the table below:

**Table 12: Operating Frequency**

Mode	Frequency	Unit
LoRa/FSK	863–928	MHz
BLE	2.402–2.480	GHz

### 3.10.3. RF Antenna Reference Design

Quectel KG100S is equipped with RF antenna pad for connecting LoRa & BLE antennas. The GND pins of Quectel KG100S is close to the antenna solder pad for better grounding effect.

The circuit of RF antenna interface is shown below. For better RF performance, it is necessary to reserve a  $\pi$ -type matching circuit. Matching components such as R1, C1, C2 shall be placed as close to the antenna as possible, C1, C2 are not mounted by default.

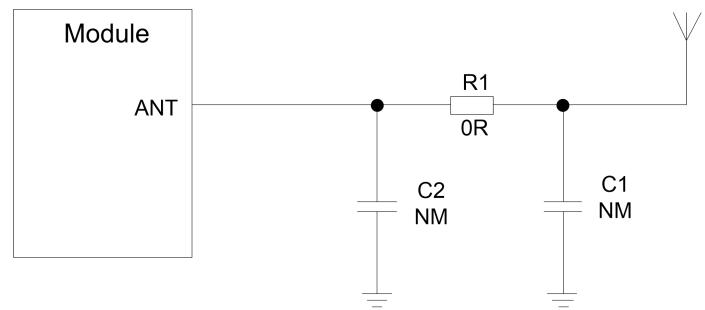


Figure 9: Reference Circuit of RF Antenna

### 3.10.4. 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.

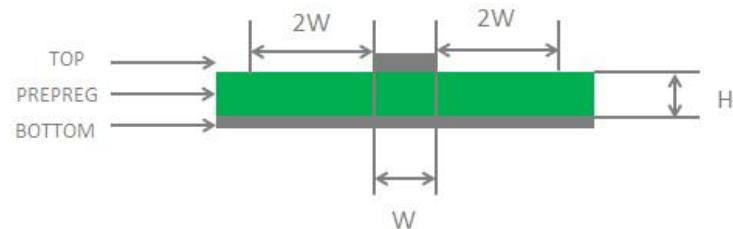


Figure 10: Microstrip Design on a 2-layer PCB

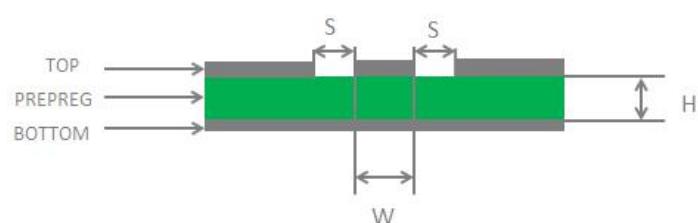


Figure 11: Coplanar Waveguide Design on a 2-layer PCB

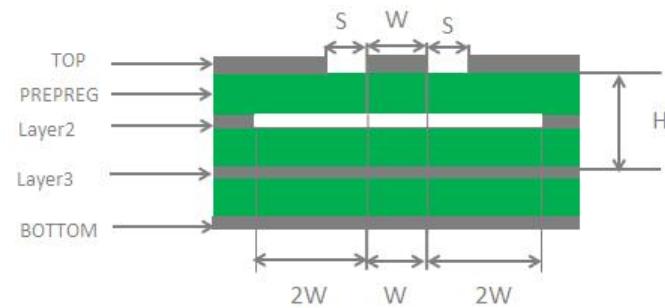


Figure 12: Coplanar Waveguide Design on a 4-layer PCB (Layer 3 as Reference Ground)

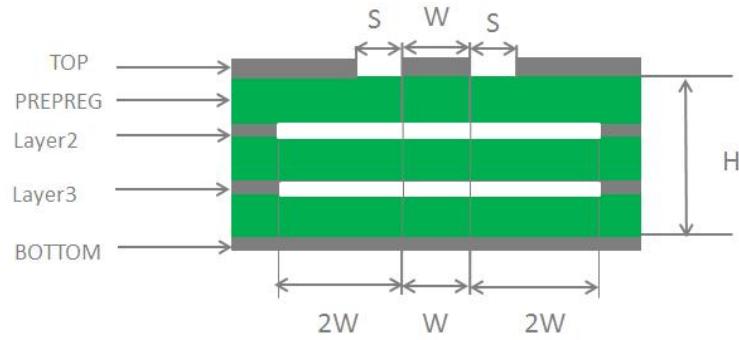


Figure 13: Coplanar Waveguide Design on a 4-layer PCB (Layer 4 as Reference Ground)

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  $50\ \Omega$ .
- 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  $135^\circ$ .
- 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 no less than twice the width of RF signal traces ( $2 \times W$ ).
- Keep RF traces away from interference sources, and avoid intersection and paralleling between traces on adjacent layers.

For more details about RF layout, see [document \[1\]](#).

### 3.11. RF Connector Recommendation

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

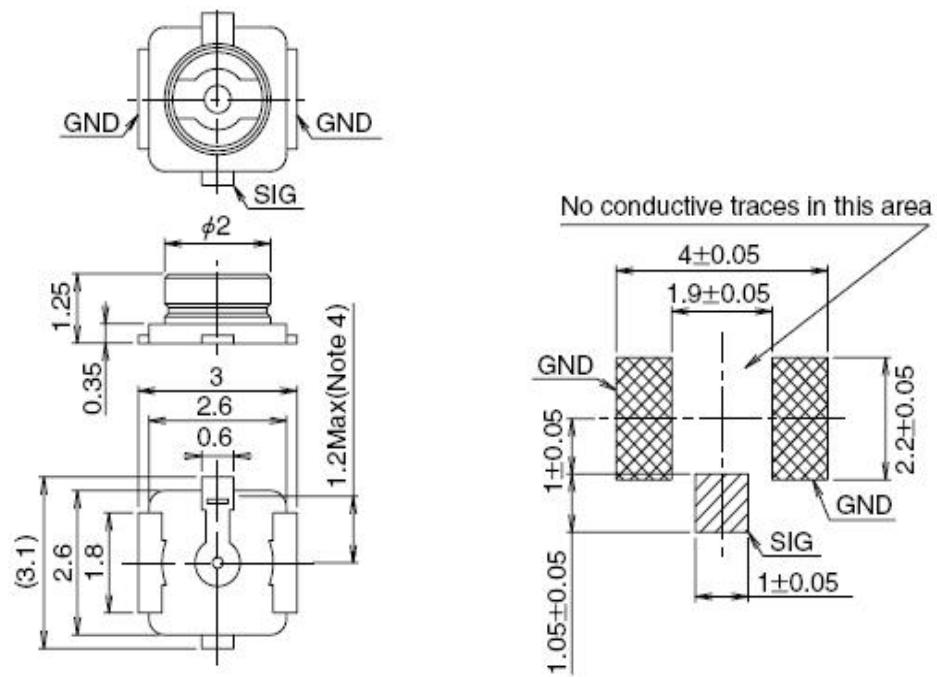


Figure 14: Dimensions of the Receptacle (Unit: mm)

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 15: Specifications of Mated Plugs

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

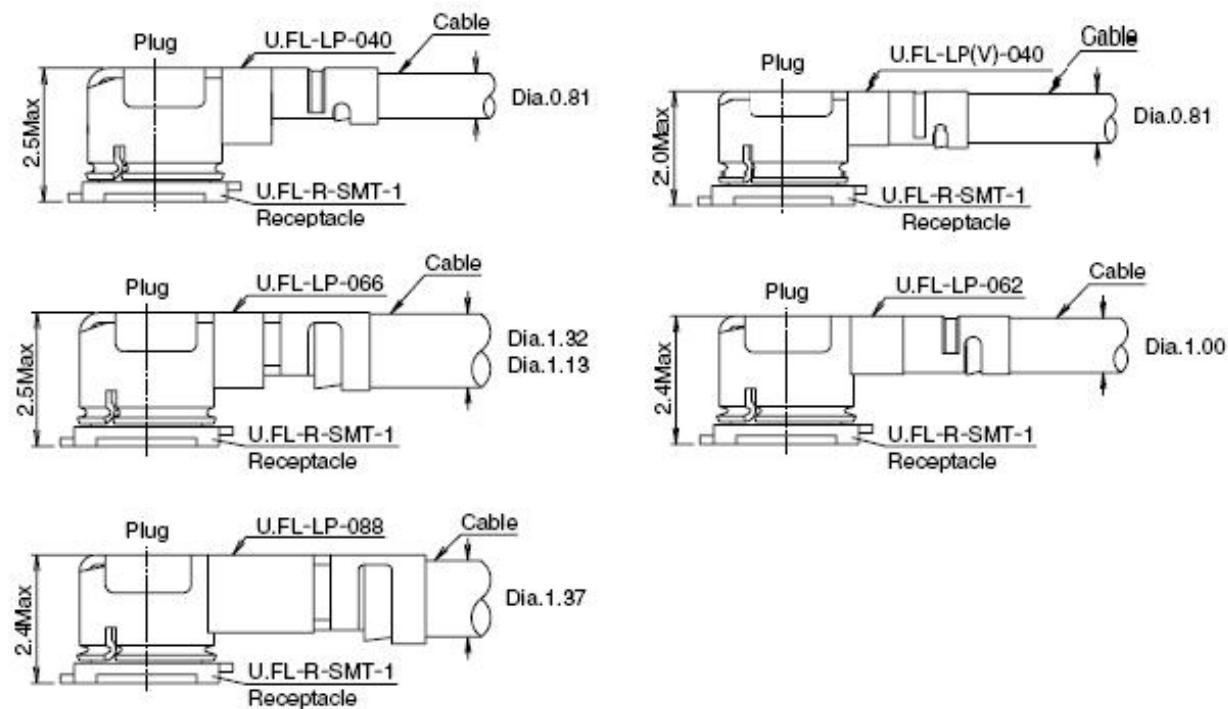


Figure 16: Space Factor of the Mated Connectors (Unit: mm)

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

# 4 Electrical Characteristics & Reliability

## 4.1. Absolute Maximum Ratings

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

**Table 13: Absolute Maximum Ratings (Unit: V)**

Parameter	Min.	Max.
VSYS	-0.5	3.9
VMCU	-0.3	3.8
Voltage at Digital Pins	-0.3	VMCU + 0.3

**Table 14: Recommended Operating Conditions (Unit: V)**

Parameter	Min.	Typ.	Max.
VSYS	3.0	3.3	3.6
VMCU	1.71	1.8/3.3	3.6

## 4.2. Digital I/O Characteristics

Table 15: General DC Electrical Characteristics (Unit: V)

Parameter	Description	Min.	Max.
$V_{IH}$	High-Level Input Voltage	$0.7 \times V_{MCU}$	$V_{MCU} + 0.2$
$V_{IL}$	Low-level Input Voltage	-0.3	$0.3 \times V_{MCU}$
$V_{OH}$	High-level Output Voltage	$0.9 \times V_{MCU}$	-
$V_{OL}$	Low-level Output Voltage	-	$0.1 \times V_{MCU}$

## 4.3. Power Consumption

Table 16: Power Consumption

Operating Mode		VMCU (+1.8 V)	VSYS (+3.3 V)	Unit
LoRa	Idle Mode	-	0.6	mA
	Sleep	-	20	uA
	Tx @ 22 dBm	-	115	mA
	Rx	-	5	mA
FSK	Idle Mode	-	0.6	mA
	Sleep	-	20	uA
	Tx @ 22 dBm	-	85	mA
	Rx	-	5	mA
BLE	Idle Mode	TBD	-	mA
	Sleep	TBD	-	mA
	Tx @ 10 dBm	10	-	mA
	Rx	12	-	mA

## 4.4. RF Performance

### 4.4.1. LoRa & FSK Performance

The following tables summarize the transmitting and receiving performances of the module.

**Table 17: LoRa Conducted Mode Output Power/Receive Sensitivity (Unit: dBm)**

Operating Mode	Output Power (Typ.)	Receive Sensitivity (Typ.)
863–928 MHz	20	BW_L = 125 kHz, SF = 7 -122
		BW_L = 500 kHz, SF = 7 -115
		BW_L = 500 kHz, SF = 11 -128

**Table 18: FSK Conducted Mode Output Power/Receive Sensitivity (Unit: dBm)**

Operating Mode	Output Power (Typ.)	Receive Sensitivity (Typ.)
863–928 MHz	20	50 kbps -104
		150 kbps -98
		250 kbps -95

### 4.4.2. BLE Performance

The following tables summarize the transmitting and receiving performances of the module.

**Table 19: BLE Conducted Mode Output Power/Receive Sensitivity (Unit: dBm)**

Operating Mode	Output Power (Typ.)	Receive Sensitivity (Typ.)
BLE (1 Mbps)	10.0	-93
BLE (2 Mbps)	10.0	-93

## 4.5. ESD Protection

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

**Table 20: Electrostatic Discharge Characteristics (Temperature: 25 °C, Humidity: 45 %, Unit: kV)**

Tested Interfaces	Contact Discharge	Air Discharge
VSYS, VMCU	±8	±12
GND	±8	±12
Antenna interfaces	±5	±10

## 4.6. Operating and Storage Temperatures

**Table 21: Operating and Storage Temperatures (Unit: °C)**

Parameter	Min.	Typ.	Max.
Operating Temperature Range <sup>2</sup>	-40	-	+85
Storage Temperature Range	-40	-	+95

## 4.7. 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:

<sup>2</sup> Within the operating temperature range, the module's related performance meets IEEE and Bluetooth specifications.

- 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.

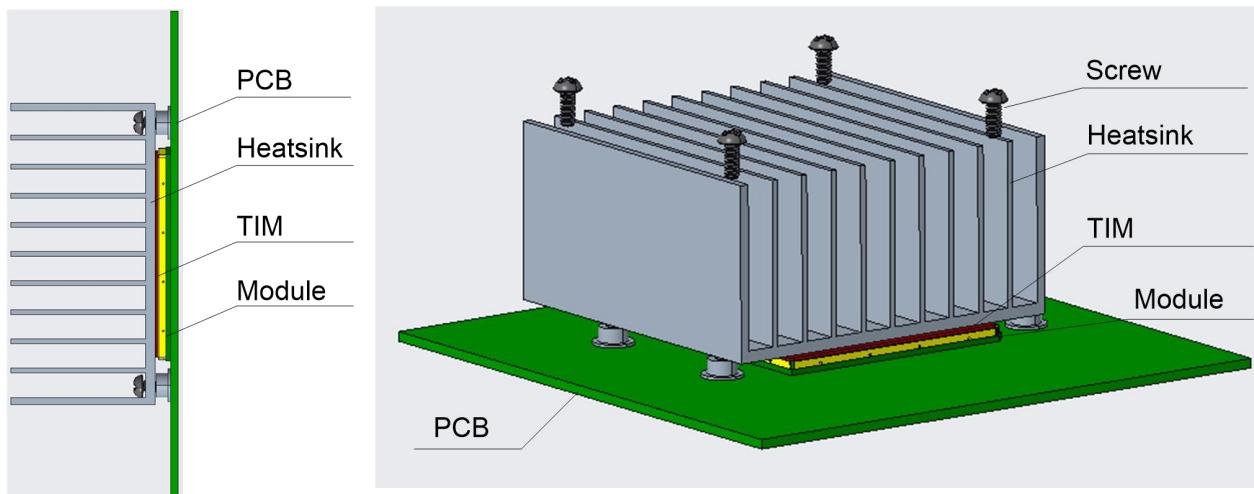


Figure 17: Placement and Fixing of the Heatsink

# 5 Mechanical Information

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

## 5.1. Mechanical Dimensions

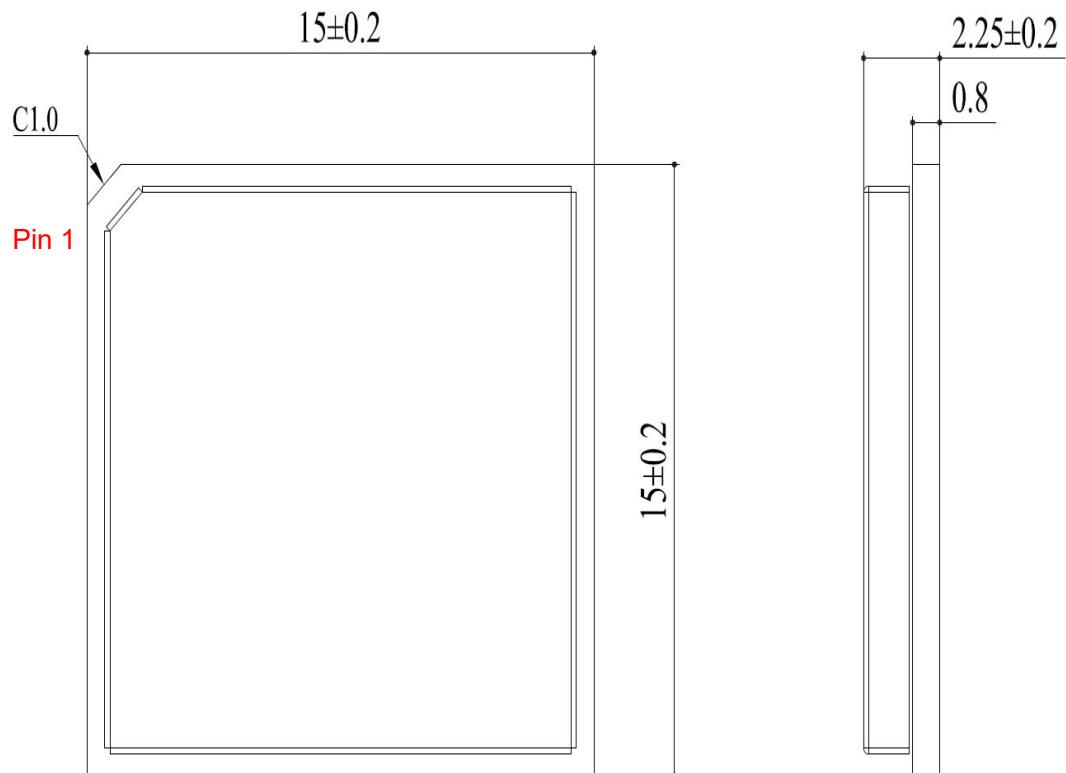


Figure 18: Top and Side Dimensions

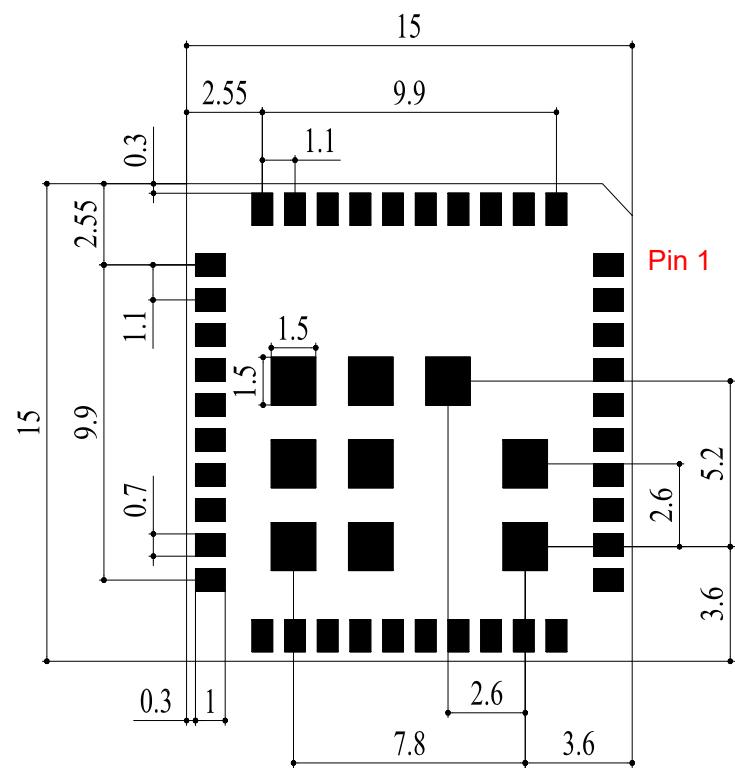


Figure 19: Bottom Dimensions (Bottom View)



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

## 5.2. Recommended Footprint

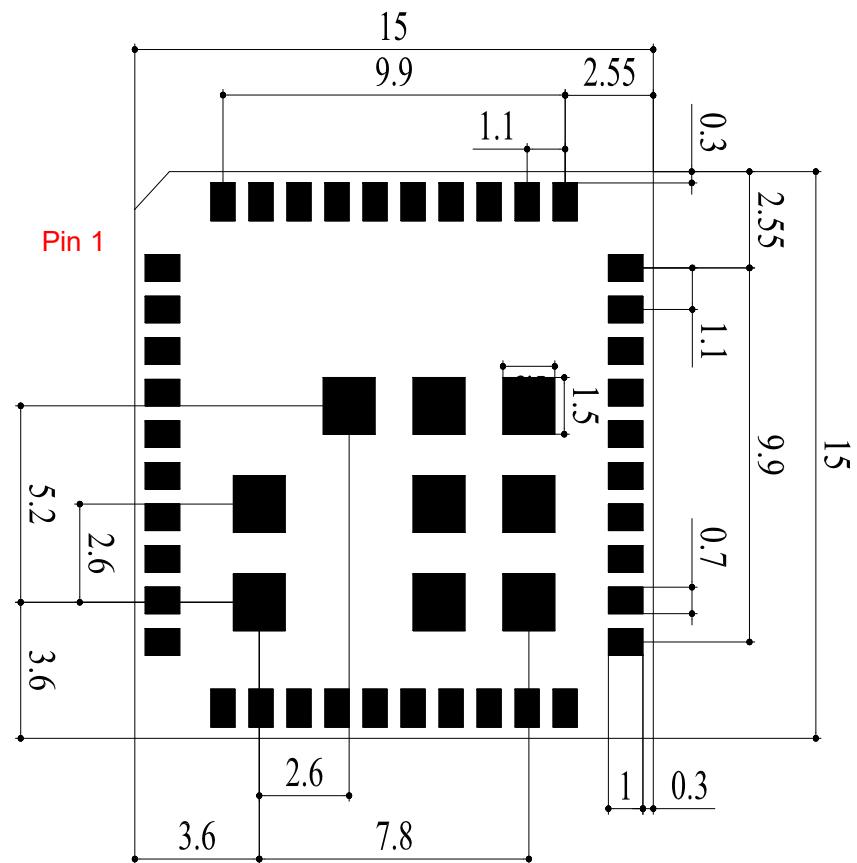


Figure 20: Recommended Footprint (Top View)

**NOTE**

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

### 5.3. Top and Bottom Views

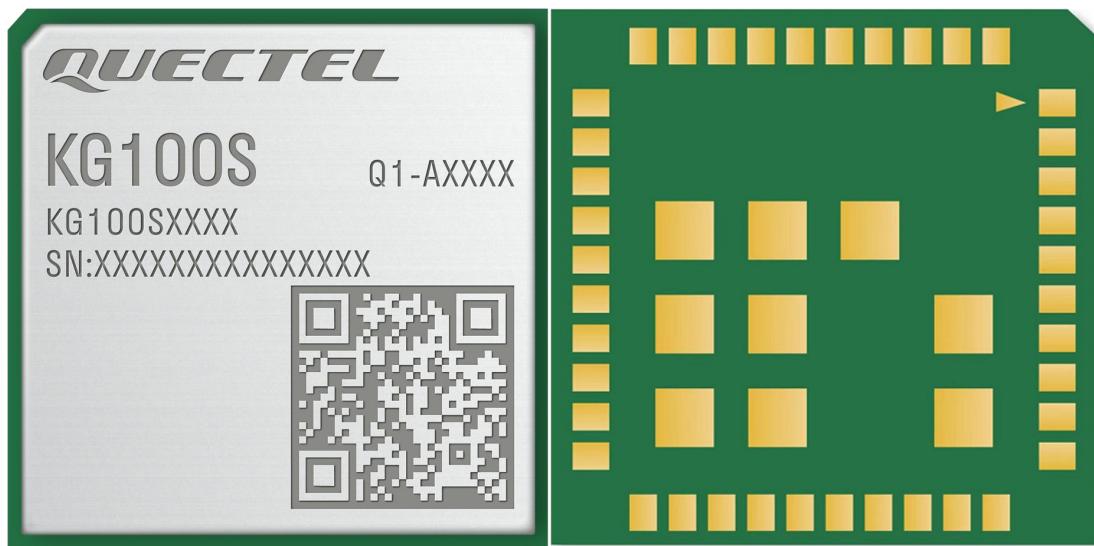


Figure 21: Top and Bottom Views of the Module

**NOTE**

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

# 6 Storage, Manufacturing & Packaging

## 6.1. 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>3</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>3</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*. And do not remove the packages of tremendous modules if they are not ready for soldering.

## NOTE

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

## 6.2. Manufacturing and Soldering

Push the squeegee to apply the solder paste on the surface of stencil, thus making the paste fill the stencil openings and then penetrate to the PCB. Apply proper force on the squeegee to produce a clean stencil surface on a single pass. To guarantee module soldering quality, the thickness of stencil for the module is recommended to be 0.15–0.18 mm. For more details, see *document [2]*.

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.

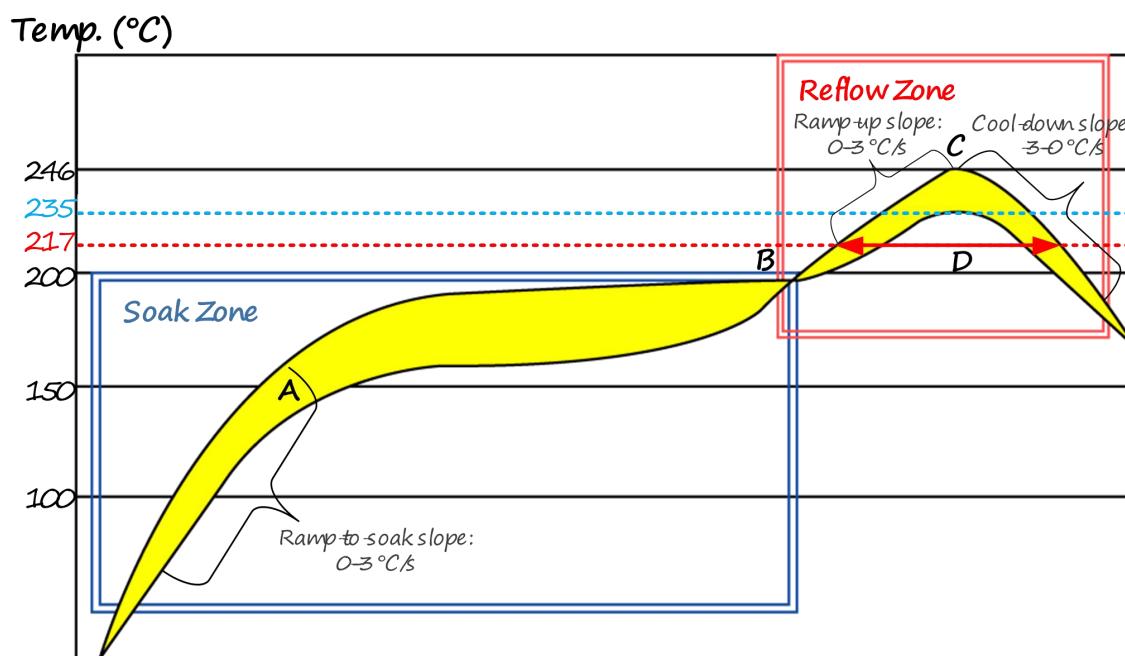


Figure 22: Recommended Reflow Soldering Thermal Profile

Table 22: Recommended Thermal Profile Parameters

Factor	Recommended Value
<b>Soak Zone</b>	
Ramp-to-soak slope	0–3 °C/s
Soak time (between A and B: 150 °C and 200 °C)	70–120 s
<b>Reflow Zone</b>	
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
<b>Reflow Cycle</b>	
Max reflow cycle	1

**NOTE**

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

## 6.3. Packaging Specification

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

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

### 6.3.1. Carrier Tape

Dimension details are as follow:

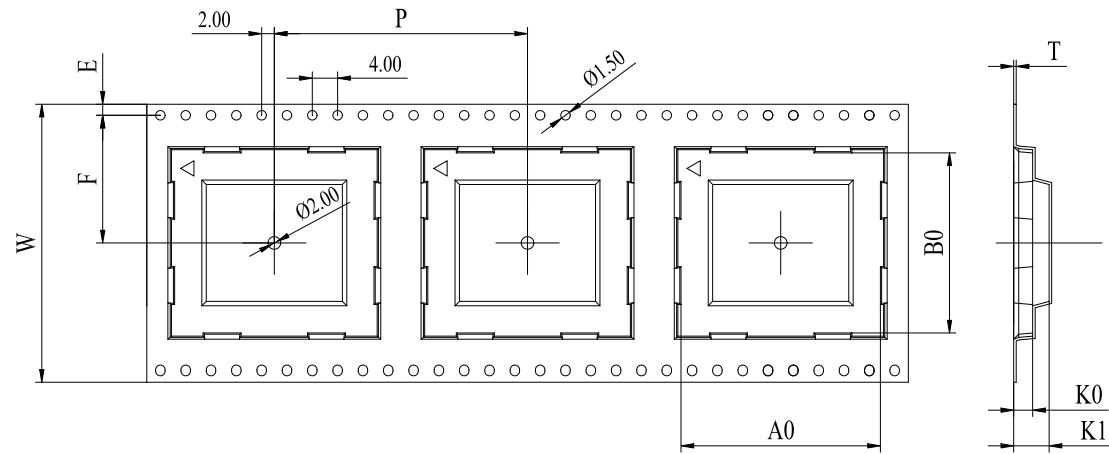


Figure 23: Carrier Tape Dimension Drawing

Table 23: Carrier Tape Dimension Table (Unit: mm)

W	P	T	A0	B0	K0	K1	F	E
32	24	0.4	15.4	15.4	2.75	4.6	14.2	1.75

### 6.3.2. Plastic Reel

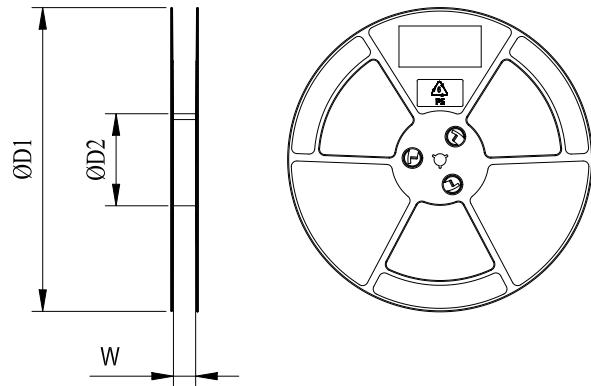
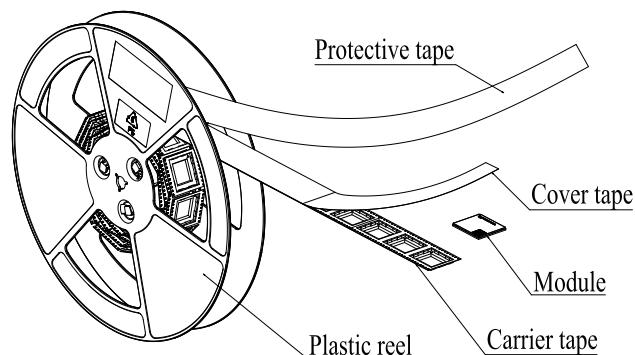


Figure 24: Plastic Reel Dimension Drawing

Table 24: Plastic Reel Dimension Table (Unit: mm)

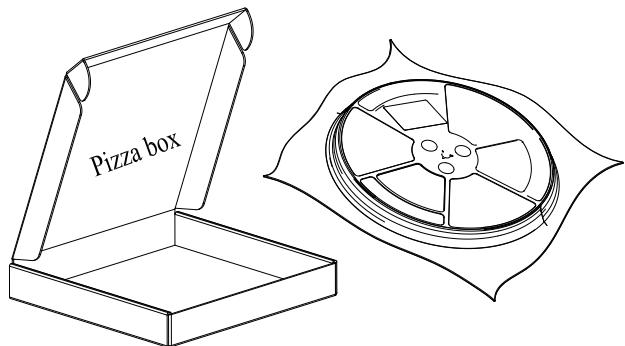
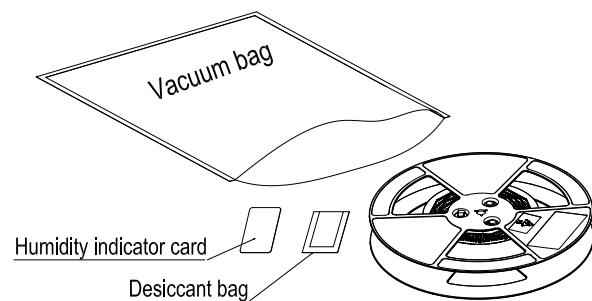
$\varnothing D1$	$\varnothing D2$	W
330	100	32.5

### 6.3.3. 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 into the pizza box.

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

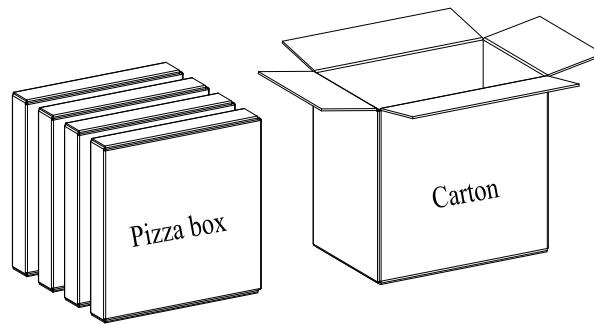


Figure 25: Packaging Process

# 7 Appendix References

**Table 25: Reference Documents**

Document Name
[1] Quectel_KG100S_TE-B_User_Guide
[2] Quectel_RF_Layout_Application_Note
[3] Quectel_Module_SMT_Application_Note

**Table 26: Terms and Abbreviations**

Abbreviation	Description
ARM	Advanced RISC Machine
BLE	Bluetooth Low Energy
BT	Bluetooth
CTS	Clear To Send
DCE	Data Communication Equipment
DTE	Data Terminal Equipment
ESD	Electrostatic Discharge
FSK	Frequency Shift Keying
GFSK	Gauss Frequency Shift Keying
GND	Ground
IEEE	Institute of Electrical and Electronics Engineers
I2C	Inter-Integrated Circuit

I/O	Input/Output
LDO	Low-dropout Regulator
LGA	Land Grid Array
LoRa	Long Range
MCU	Microcontroller Unit
Mbps	Million Bits Per Second
MISO	Multiple Input Multiple Output
MOSI	Master Out Slave In
PA	Power Amplifier
PCB	Printed Circuit Board
RAM	Random Access Memory
RF	Radio Frequency
RoHS	Restriction of Hazardous Substances
Rx	Receive
SCLK	Serial Clock
SCS	Sub-Carrier Space
SF	Spreading Factor
SPI	Serial Peripheral Interface
SWD	Serial Wire Debug
TBD	To Be Determined
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	Normal Voltage
V <sub>OH</sub>	High-level Output Voltage
V <sub>OL</sub>	Low-level Output Voltage
VSWR	Voltage Standing Wave Ratio

## **FCC 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.

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

This device meets all the other requirements specified in [Part15C, Section 15.247](#) of the FCC Rules.

**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 [20cm](#) between the radiator & your body.

**IMPORTANT NOTE:**

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

The module is tested for standalone mobile RF exposure use condition. Any other usage conditions such as co-location with other transmitter(s) or being used in a portable condition will need a separate reassessment through a class II permissive change application or new certification.

**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 FCC ID: XMR202211KG100S](#)". The grantee's FCC ID can be used only when all FCC compliance requirements are met.

The end product shall bear the following 15.19 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.

## **Antennas**

The following antennas have been certified for use with this module; antennas of the same type with equal or lower gain may also be used with this module. The antenna must be installed such that 20cm can be maintained between the antenna and users.

[Antenna Specification list below:](#)

Antenna Type	Frequency Band (MHz)	Antenna Gain (dBi)
Dipole	2402 ~ 2480	3.4
Dipole	902 ~ 928	2.5

## **Part 15 Subpart B disclaimer**

This transmitter module is tested as a subsystem and its certification does not cover the FCC Part 15 Subpart B rule requirement applicable to the final host. The final host will still need to be reassessed for compliance to this portion of rule requirements if applicable.

As long as all 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.

## **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.

The host integrator must follow the integration instructions provided in this document and ensure that the composite-system end product complies with the requirements by a technical assessment or evaluation to the rules and to KDB Publication 996369.

The host integrator installing this module into their product must ensure that the final composite product complies with the requirements by a technical assessment or evaluation to the rules, including the transmitter operation and should refer to guidance in KDB 996369.

## **OEM/Host manufacturer responsibilities**

Must use the device only in host devices that meet the FCC/ISED RF exposure category of mobile, which means the device is installed and used at distances of at least 20cm from persons.

OEM/Host manufacturers are ultimately responsible for the compliance of the Host and Module. The final product must be reassessed against all the essential requirements of the FCC rule such as FCC Part 15 Subpart B before it can be placed on the US market. This includes reassessing the transmitter module for compliance with the Radio and EMF essential requirements of the FCC rules. This module must not be incorporated into any other device or system without retesting for compliance as multi-radio and combined equipment.

Additional text needed for the host product manufacturer to provide to end users in their end-product manuals. If RF exposure statements and use conditions are not provided, then the host product manufacturer is required to take responsibility of the module through a change in FCC ID (new application).

## **ISED Statement:**

This Class B digital apparatus complies with Canadian ICES-003.

*Cet appareil numérique de classe B est conforme à la norme canadienne ICES-003.*

**This device complies with Industry Canada licence-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 adioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.*

## **RF Radiation Exposure Statement:**

This equipment complies with ISED radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of **20 centimeters** between the radiator and your body.

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

*Cet appareil est conforme aux limites d'exposition aux rayonnements définies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé à une distance minimale de **20 centimètres** entre le radiateur et votre corps.*

## **IMPORTANT NOTE:**

In the event that these conditions can not be met (for example certain laptop configurations or co-location with another transmitter), then the Canada authorization is no longer considered valid and the IC 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 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.*

### **Required end product labeling:**

This transmitter module is authorized only for use in device where the antenna may be installed and operated with greater than [20cm](#) between the antenna and users. The final end product must be labeled in a visible area with the following: "[Contains IC: 10224A-202211KG100S](#)".

### ***Plaque signalétique du produit final***

*Ce module émetteur est autorisé uniquement pour une utilisation dans un appareil où l'antenne peut être installée et utilisée à plus de [20 cm](#) entre l'antenne et les utilisateurs. Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "[Contient des IC: 10224A-202211KG100S](#)".*

### ***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.

The following text, or an equivalent notice, that shall be displayed in a conspicuous location, either in the user manual or on the device, or both:

This device contains licence-exempt transmitter(s)/receiver(s) that comply with Innovation, Science and Economic Development Canada's licence-exempt RSS(s). Operation is subject to the following two conditions:

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

### ***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.*

*l'énoncé qui suit, ou l'équivalent, à un endroit bien en vue dans le manuel d'utilisation ou sur l'appareil, ou encore aux deux endroits :*

*L'émetteur/récepteur exempt de licence contenu dans le présent appareil est conforme aux CNR d'Innovation, Sciences et Développement économique 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;*
2. *L'appareil doit accepter toute interférence, y compris toute interférence pouvant entraîner un fonctionnement indésirable du dispositif.*

## Antennas

The following antennas have been certified for use with this module; antennas of the same type with equal or lower gain may also be used with this module. The antenna must be installed such that [20 cm](#) can be maintained between the antenna and users.

This radio transmitter has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have a gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

[Antenna Specification list below:](#)

Antenna Type	Frequency Band (MHz)	Antenna Gain (dBi)
Dipole	2402 ~ 2480	3.4
Dipole	902 ~ 928	2.5

## ANTENNE

*Les antennes suivantes ont été certifiées pour une utilisation avec ce module; des antennes du même type à gain égal ou inférieur peuvent également être utilisées avec ce module. L'antenne doit être installée de telle sorte que 20 cm puissent être maintenus entre l'antenne et les utilisateurs.*

*Cet émetteur radio a été approuvé par Innovation, Sciences et Développement économique Canada pour fonctionner avec les types d'antenne énumérés ci-dessous, avec le gain maximal autorisé indiqué. Les types d'antenne non inclus dans cette liste qui ont un gain supérieur au gain maximum indiqué pour tout type répertorié sont strictement interdits pour l'utilisation avec cet appareil.*

Antenna Type	Frequency Band (MHz)	Antenna Gain (dBi)
Dipole	2402 ~ 2480	3.4
Dipole	902 ~ 928	2.5