

EG915K Series

Hardware Design

LTE Standard Products

Version: 1.1.0

Date: 2025-10-28

Status: Preliminary



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Safety Information

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



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



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



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



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



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



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

About the Document

Revision History

Version	Date	Author	Description
-	2025-02-13	Shaun Li/ Cuby Li/ Yule Deng	Creation of the document
1.0	2025-08-15	Bryan Huang/ Cuby Li/ Yule Deng	First official release
1.1.0	2025-10-28	Bryan Huang/ Cuby Li/ Tung Him Lee	1. Added the applicable EG915K-LA. 2. Added ESD protection component to reference circuit of LTE/Wi-Fi Scan antenna interface and a note on the junction capacitance of ESD component (Chapter 5.1.4).

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1 Introduction

This document mainly introduces the EG915K series (comprising EG915K-EU and EG915K-LA) modules and describes its hardware interfaces and air interfaces which are connected with your applications.

This document can help you quickly understand module interface specifications, electrical and mechanical details, as well as other related information of the module. Associated with application notes and user guides, you can use the module to design and set up wireless applications easily.

1.1. Special Marks

Table 1: Special Marks

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

2 Product Overview

The module is an SMD type module with compact packaging.

Table 2: Brief Introduction

Item	Description
Packaging type	LGA
Pins counts	126
Dimensions	(23.6 ±0.2) mm × (19.9 ±0.2) mm × (2.4 ±0.2) mm
Weight	Approx. 2.3 g
Models	EG915K-EU, EG915K-LA

2.1. Frequency Bands and Functions

Table 3: Frequency Bands and Functions

Wireless Network Type	EG915K-EU	EG915K-LA
LTE-FDD	B1/B3/B5/B7/B8/B20/B28	B2/B3/B4/B5/B7/B8/B28/B66
LTE-TDD	B38/B40/B41 (194 MHz)	-
GNSS (Optional)	BDS/GPS/GLONASS	BDS/GPS/GLONASS/Galileo

NOTE

1. The module supports the above frequency bands in hardware, but actual applications may be subject to local regulations.
2. GNSS function is optional. For more details, please contact Quectel Technical Support.

2.2. Key Features

Table 4: Key Features

Features	Details
Supply Voltage	● 3.4–4.3 V ● Typ.: 3.8 V
SMS	● Text and PDU modes ● Point-to-point MO and MT ● SMS cell broadcast ● SMS storage: stored in USIM card and ME, ME by default ● Only supports SGS SMS
USB Interface	● Complies with USB 2.0 specification (slave mode only) ● Data transmission rates: up to 480 Mbps ● Used for AT command communication, data transmission, software debugging, firmware upgrade and GNSS NMEA message output ● Supports USB serial drivers for Windows 10/11, Linux 2.6–6.7 and Android 4.x–14.x
Forced Download Interface	Supports one forced download interface
USIM Interface	Supports one USIM card: 1.8/3.0 V
UART Interfaces	Main UART: ● Used for AT command communication and data transmission ● Baud rate: 115200 bps by default ● Supports RTS and CTS hardware flow control Debug UART: ● Used for partial logs output and GNSS NMEA sentence output ● Baud rate: 115200 bps
ADC Interfaces*	Supports two ADC (Analog-to-Digital Converter) interfaces
Network Indication	NET_STATUS indicates network activity status
AT Commands	● Complies with 3GPP TS 27.007 and 3GPP TS 27.005 ● Supports Quectel enhanced AT commands
Antenna Interfaces	● LTE/Wi-Fi Scan antenna interface (ANT_MAIN) ● GNSS antenna interface (ANT_GNSS) (optional) ● 50 Ω characteristic impedance
Transmit Power	● LTE-FDD: Class 3 (23 dBm $\pm$2 dB) ● LTE-TDD: Class 3 (23 dBm $\pm$2 dB)
LTE Features	● Supports up to 3GPP Rel-13 Cat 1bis FDD and TDD ● Supports 1.4/3/5/10/15/20 MHz RF bandwidths ● Supports UL QPSK and 16QAM modulations ● Supports DL QPSK, 16QAM and 64QAM modulations ● Max. data transmission rates: – LTE-FDD: 10 Mbps (DL)/5 Mbps (UL) – LTE-TDD: 8.96 Mbps (DL)/3.1 Mbps (UL)
GNSS Features (Optional)	● Constellations: BDS, GPS and GLONASS (EG915K-EU) BDS, GPS, GLONASS and Galileo (EG915K-LA)

	● Complies with NMEA 0183 protocol ● Data update rate: 1 Hz ● Supports AGNSS. For more details, see document [1].
Position Fixing	● Supports Wi-Fi Scan positioning (shares the main antenna) ● Supports GNSS positioning (optional)
Internet Protocol Features	● Supports TCP/UDP/NTP/NITZ/MQTT/SSL/PPP/PING/FTP/HTTP/HTTPS/FTPS protocols ● Supports PAP and CHAP for PPP connections
Temperature Ranges	● Normal operating temperature ¹: -35 °C to +75 °C ● Extended operating temperature ²: -40 °C to +85 °C ● Storage temperature: -40 °C to +90 °C
Firmware Upgrade	Via USB 2.0 interface or DFOTA
RoHS	All hardware components are fully compliant with EU RoHS directive

NOTE

1. The Wi-Fi Scan function utilizes the same antenna interface as the main antenna. Due to this shared interface, Time Division Multiplexing (TDM) is employed since the two functions cannot be used simultaneously. Wi-Fi Scan functionality only supports receiving. Transmitting is not supported. For more details, contact Quectel Technical Support.
2. GNSS function is optional. For more details, contact Quectel Technical Support.
3. The 6.0 and above version QFlash tool must be used for firmware upgrade.

¹ Within this range, the module's indicators comply with 3GPP specification requirements.

² Within the range of -40 to -35 °C or 75 to 85 °C, the module retains the ability to establish and maintain functions such as SMS and data transmission, without any unrecoverable malfunction. Radio spectrum and radio network remain uninfluenced, whereas the value of one or more parameters, such as P_{out}, may decrease and fall below the range of the 3GPP specified tolerances. When the temperature returns to the normal operating temperature range, the module's indicators will comply with 3GPP specification requirements again.

2.3. Pin Assignment

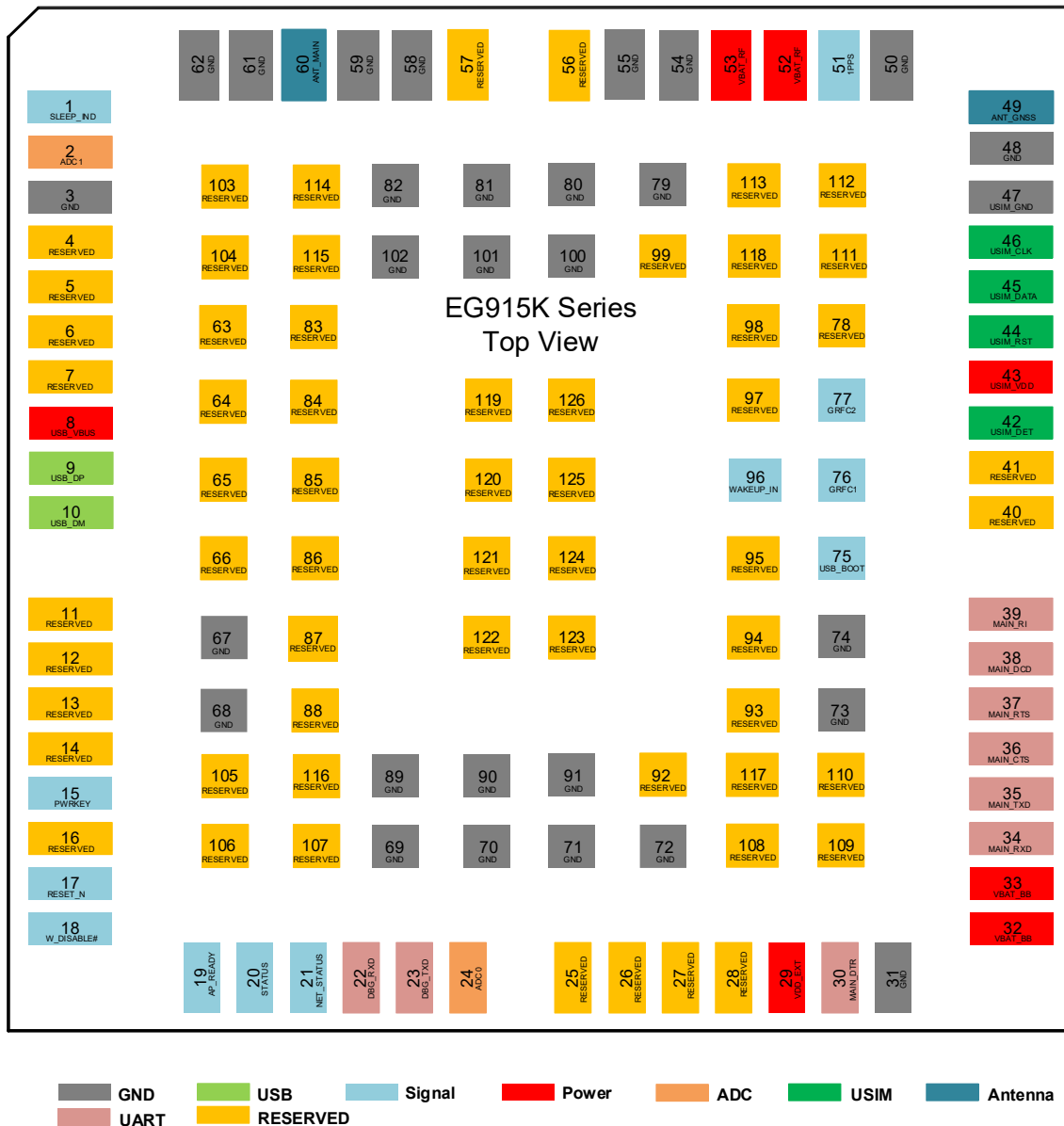


Figure 1: Pin Assignment (Top View)

NOTE

1. If the forced download function is not required, do not pull USB_BOOT up to a high level before the module starts up successfully.
2. Keep all RESERVED and unused pins open. Connect all GND pins to the ground.
3. GNSS function is optional. ANT_GNSS and 1PPS are the GNSS pins for the module with built-in GNSS function. See **Chapter 5.2** for details about GNSS antenna interfaces.

4. Ensure an uninterrupted reference ground plane below the module, with minimal distance between the ground plane and the module layer. Avoid routing other traces on the first layer adjacent to the module layer. At least four-layer board design is recommended.
5. If pins 4, 34–41, 108 of the module are required, the filter capacitors should be reserved and placed near the pins, and the return path for current of capacitors to the main ground should be as short as possible. The capacitance should be selected according to the actual debugging situation. See **document [2]** for details.
6. The 6.0 and above version QFlash tool must be used for firmware upgrade.

2.4. Pin Definitions

Table 5: Parameter Definition

Parameter	Description
AI	Analog Input
AIO	Analog Input/Output
AO	Analog Output
DI	Digital Input
DO	Digital Input/Output
DIO	Digital Output
OD	Open Drain
PI	Power Input
PO	Power Output
PD	Pull Down
PU	Pull Up

DC characteristics include power domain and rated current.

Table 6: Pin Description

Power Supply Input						
Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristics	Comment
VBAT_BB	32, 33	PI	-	Power supply for the module's BB part	Vmax = 4.3 V Vmin = 3.4 V Vnom = 3.8 V	External power supply must be able to provide sufficient current of at least 0.5 A. It is recommended to add external TVS. Test points are recommended to be reserved.
VBAT_RF	52, 53	PI	-	Power supply for the module's RF part		External power supply must be able to provide sufficient current of at least 1 A. It is recommended to add external TVS. Test points are recommended to be reserved.
GND	3, 31, 48, 50, 54, 55, 58, 59, 61, 62, 67–74, 79–82, 89–91, 100–102					Connect these pins to ground.
Power Supply Output						
Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristics	Comment
VDD_EXT	29	PO	-	Provide 1.8 V for external circuit	IOmax = 50 mA Vnom = 1.8 V Vmax = 1.93 V Vmin = 1.67 V	Power supply for external GPIO's pull-up circuits. A test point is recommended to be reserved.
Turn-On/Off/Reset						
Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristics	Comment
PWRKEY	15	DI	-	Turn-on/off the module	VILmax = 0.5 V Vnom = VBAT	A test point is recommended to be reserved.
RESET_N	17	DI	-	Reset the module	VILmax = 0.5 V Vnom = 1.8 V	Active low. A test point is recommended to

be reserved if unused.

Status Indication

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristics	Comment
SLEEP_IND	1	DO	PD	Indicate the module's sleep mode	VDD_EXT	If unused, keep them open.
STATUS	20	DO	PD	Indicate the module's operation status		
NET_STATUS	21	DO	PD	Indicate the module's network activity status		

USB Interface

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristics	Comment
USB_VBUS	8	AI	-	USB connection detect	Vmax = 5.25 V Vmin = 3.0 V Vnom = 5.0 V	A test point must be reserved.
USB_DP	9	AIO	-	USB 2.0 differential data (+)		Complies with USB 2.0 specification. 90 Ω differential impedance is required. Test points must be reserved.
USB_DM	10	AIO	-	USB 2.0 differential data (-)		

USIM Interface

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristics	Comment
USIM_DET	42	DI	PU	USIM card hot-plug detect	VDD_EXT	If unused, keep it open.
USIM_VDD	43	PO	-	USIM card power supply	Low-voltage Vnom=1.8 V High-voltage Vnom=3.0 V	Either 1.8 V or 3.0 V USIM card is supported and can be identified automatically by the module.
USIM_RST	44	DO	PU	USIM card reset	USIM_VDD	
USIM_DATA	45	DIO	PU	USIM card data		
USIM_CLK	46	DO	PU	USIM card clock		
USIM_GND	47	-	-	Dedicated ground for USIM		Connect to the GND of USIM

card

card connector.

Main UART Interface

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristics	Comment
MAIN_DTR	30	DI	PD	Main UART data terminal ready	VDD_EXT	If unused, keep them open.
MAIN_RXD	34	DI	PU	Main UART receive		
MAIN_TXD	35	DO	PU	Main UART transmit		
MAIN_CTS	36	DO	PU	Clear to send signal from the module		Connect to the MCU's CTS. If unused, keep it open.
MAIN_RTS	37	DI	PU	Request to send signal to the module		Connect to the MCU's RTS. If unused, keep it open.
MAIN_DCD	38	DO	PD	Main UART data carrier detect		If unused, keep them open.
MAIN_RI	39	DO	PD	Main UART ring indication		

Debug UART Interface

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristics	Comment
DBG_RXD	22	DI	PU	Debug UART receive	VDD_EXT	Test points must be reserved.
DBG_TXD	23	DO	PU	Debug UART transmit		

ADC Interfaces*

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristics	Comment
ADC0	24	AI	-	General-purpose ADC interface	Voltage range: 0 V to VBAT_BB	If unused, keep them open.
ADC1	2	AI	-			

Antenna Interfaces

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristics	Comment
ANT_MAIN	60	AIO	-	Main antenna/Wi-Fi Scan antenna interface		50 Ω characteristic impedance.

ANT_GNSS	49	AI	-	GNSS antenna interface		50 Ω characteristic impedance. If unused, keep it open.
Antenna Tuner Control Interfaces*						
Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristics	Comment
GRFC1	76	DO	PD	Generic RF controller	VDD_EXT	If unused, keep them open.
GRFC2	77	DO	PD			
Forced Download Interface						
Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristics	Comment
USB_BOOT	75	DI	-	Force the module into download mode	VDD_EXT	Active high. If the forced download function is not required, do not pull it up to a high level before the module starts up successfully. A test point is recommended to be reserved.
Other Interfaces						
Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristics	Comment
WAKEUP_IN*	96	DI	PD	Wake up the module	VDD_EXT	If unused, keep them open.
AP_READY*	19	DI	PD	Application processor ready		
W_DISABLE#*	18	DI	PD	Airplane mode control		Pull-up by default. Driving the pin low can make the module enter the airplane mode. If unused, keep it open.
1PPS	51	DO	-	GNSS pulse per second output		It cannot be pulled down when GNSS function is active.

Reserved Pins

Pin Name	Pin No.	Comment
RESERVED	4–7, 11–14, 16, 25–28, 40, 41, 56, 57, 63–66, 78, 83–88, 92–95, 97–99, 103–126	Keep these pins open.

NOTE

1. If the forced download function is not required, do not pull USB_BOOT up to a high level before the module starts up successfully.
2. Keep all RESERVED and unused pins open. Connect all GND pins to the ground.
3. To reduce the probability of module damage and extend module service life, do not power up and down frequently.
4. GNSS function is optional. ANT_GNSS and 1PPS are the GNSS pins for the module with built-in GNSS function. See **Chapter 5.2** for details about GNSS antenna interfaces.
5. If pins 4, 34–41, 108 of the module are required, the filter capacitors should be reserved and placed near the pins, and the return path for current of capacitors to the main ground should be as short as possible. The capacitance should be selected according to the actual debugging situation. See **document [2]** for details.

2.5. EVB Kit

Quectel supplies an evaluation board (UMTS & LTE EVB) with accessories to develop and test the module. For more details, see **document [3]**.

3 Operating Characteristics

3.1. Operating Modes

Table 7: Overview of Operating Modes

Modes	Details	
Full Functionality Mode	Idle	Software is active. The module remains registered on the network but has no data interaction with the network.
	Data	Network connection is ongoing. Power consumption is decided by network setting and data transmission rate.
Minimum Functionality Mode	● AT+CFUN=0 can set the module into the minimum functionality mode without removing the power supply. ● In this mode, both RF function and USIM card are disabled.	
Airplane Mode	● AT+CFUN=4 or driving W_DISABLE#* pin low can set the module to airplane mode. ● In this mode, RF function is disabled.	
Sleep Mode	Power consumption of the module will be reduced to an ultra-low level. During this mode, the module can still receive paging message, SMS and TCP/UDP data from the network normally.	
Turn-off Mode	PMU shuts down the power supply. In this mode, software is not active. However, the voltage supply for VBAT_BB and VBAT_RF remains applied.	

NOTE

For more details about AT command, see **document [4]**.

3.2. Sleep Mode

With DRX technology, power consumption of the module will be reduced to an ultra-low level.

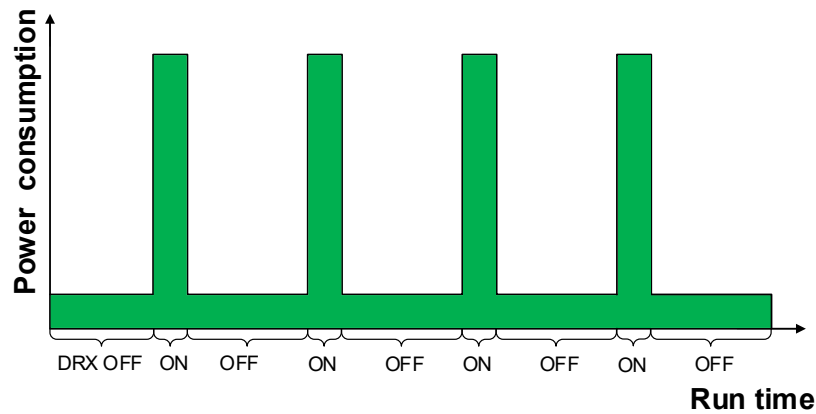


Figure 2: Module Power Consumption in Sleep Mode

NOTE

DRX cycle values are transmitted over the wireless network.

3.2.1. UART Application Scenario

If the module communicates with the MCU via main UART, both the following preconditions should be simultaneously met to set the module to sleep mode:

- Execute **AT+QSClk=1**.
- Ensure MAIN_DTR is held high or is kept open.

The reference figure shows the connection between the module and the MCU.

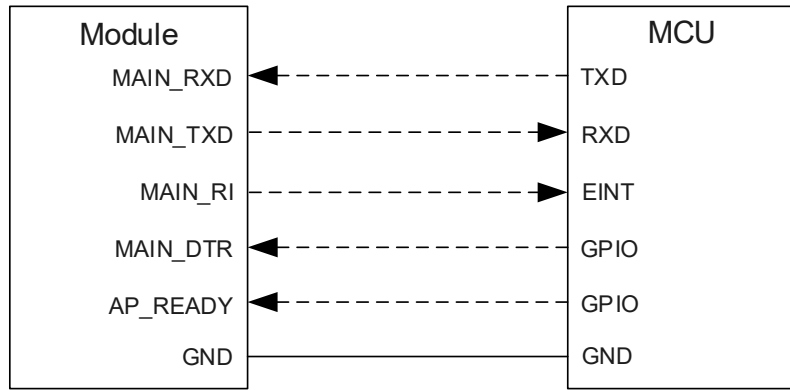


Figure 3: UART Application in Sleep Mode

- Driving MAIN_DTR low with the MCU will wake up the module.
- When the module has a URC to report, MAIN_RI signal will wake up the MCU. For details about MAIN_RI, see **Chapter 4.6.3**.

3.2.2. USB Application Scenarios

For the two situations (“USB application with USB Suspend/Resume and USB remote wakeup function” and “USB application with USB Suspend/Resume and MAIN_RI function”) below, three preconditions must be simultaneously met to set the module to sleep mode:

- Execute **AT+QSClk=1**.
- Ensure MAIN_DTR is held high or is kept open.
- Ensure the host USB bus connected to the module enters Suspend state.

3.2.2.1. With USB Suspend/Resume and USB Remote Wakeup Function

If the host supports USB Suspend/Resume and USB remote wakeup function, the following figure shows the connection between the module and the host.

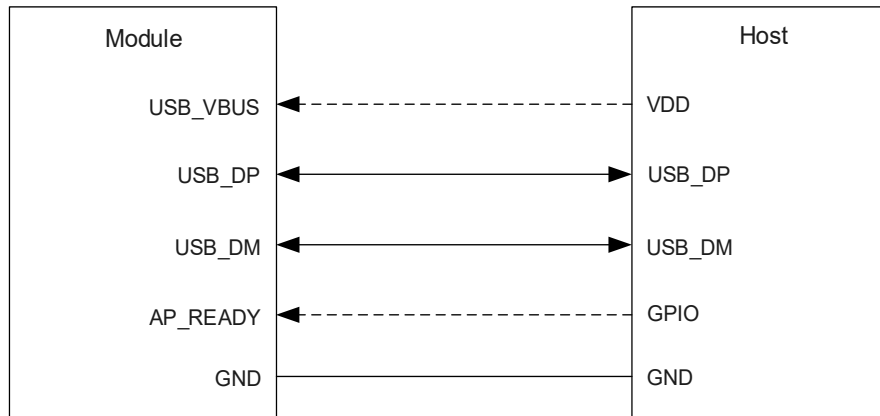


Figure 4: Block Diagram of Application with USB Remote Wakeup Function in Sleep Mode

- Sending data to the module through USB interface will wake up the module.
- When the module has a URC to report, the module will send remote wake-up signals through USB bus to wake up the host.

3.2.2.2. With USB Suspend/Resume and MAIN_RI Function

If the host supports USB Suspend/Resume, but does not support remote wakeup function, the MAIN_RI signal is needed to wake up the host.

The following figure shows the connection between the module and the host.

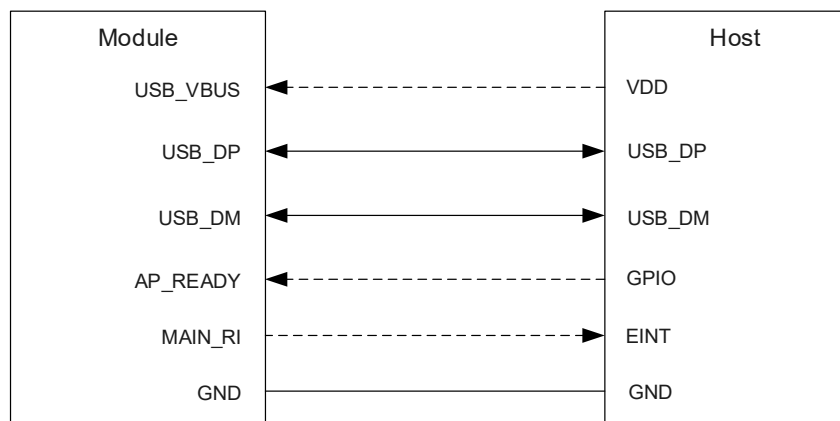


Figure 5: Block Diagram of Application with MAIN_RI Function in Sleep Mode

- Sending data to the module through USB interface will wake up the module.
- When the module has a URC to report, the module will wake up the host through MAIN_RI signal. For details about MAIN_RI, see **Chapter 4.6.3**.

3.2.2.3. Without USB Suspend Function

If the host does not support USB Suspend function, the following three preconditions must be simultaneously met to set the module to sleep mode:

- Execute **AT+QSClk=1**.
- Ensure MAIN_DTR is held high or is kept open.
- Disconnect USB_VBUS.

The following figure shows the connection between the module and the host.

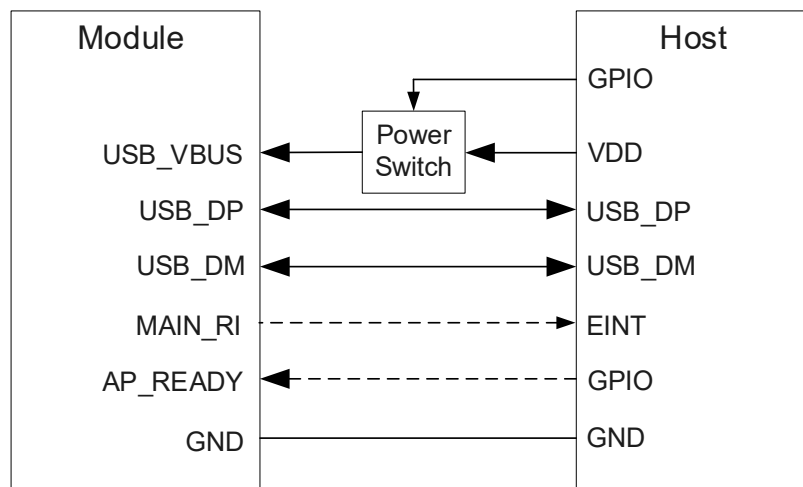


Figure 6: Block Diagram of Application without USB Suspend Function in Sleep Mode

Restoring the power supply of USB_VBUS will wake up the module.

NOTE

1. Pay attention to the level match shown in the dotted line between the module and the MCU/host in **Chapter 3.2**.
2. For more details about AT command, see **document [4]**.

3.3. Airplane Mode

When the module enters airplane mode, the RF function will be disabled, and all AT commands related to the RF function will be inaccessible. The following ways can be used to let the module enter airplane mode.

Hardware:

The W_DISABLE#* pin is pulled up by default. Its control function for airplane mode is disabled by default, and **AT+QCFG="airplanecontrol",1** can be used to enable the function. Driving the pin low can make the module enter the airplane mode.

Software:

AT+CFUN=<fun> provides the choice of the functionality level through setting <fun> into **0**, **1** or **4**.

- **AT+CFUN=0**: Minimum functionality mode (disable USIM and RF functions).
- **AT+CFUN=1**: Full functionality mode (by default).
- **AT+CFUN=4**: Airplane mode (disable RF function).

NOTE

For more details about AT command, see **document [4]**.

3.4. Power Supply

3.4.1. Power Supply Interface

The module provides four VBAT pins dedicated to connecting with the external power supply.

Table 8: Pin Description of Power Supply Interface

Pin Name	Pin No.	I/O	Description	Comment
VBAT_BB	32, 33	PI	Power supply for the module's BB part	External power supply must be able to provide sufficient current of at least 1.5 A.
VBAT_RF	52, 53		Power supply for the module's RF part	It is recommended to add a TVS externally. Test points are recommended to be reserved.
GND	3, 31, 48, 50, 54, 55, 58, 59, 61, 62, 67–74, 79–82, 89–91, 100–102			Connect these pins to ground.

3.4.2. Reference Design for Power Supply

The power source is critical to the module's performance. The power supply of the module must be provided sufficient current of at least 1.5 A. If the voltage difference between the input voltage and the supply voltage is small, it is suggested to use an LDO; if the voltage difference is big, a buck converter is recommended.

The following figure shows a reference design for 5 V input power supply.

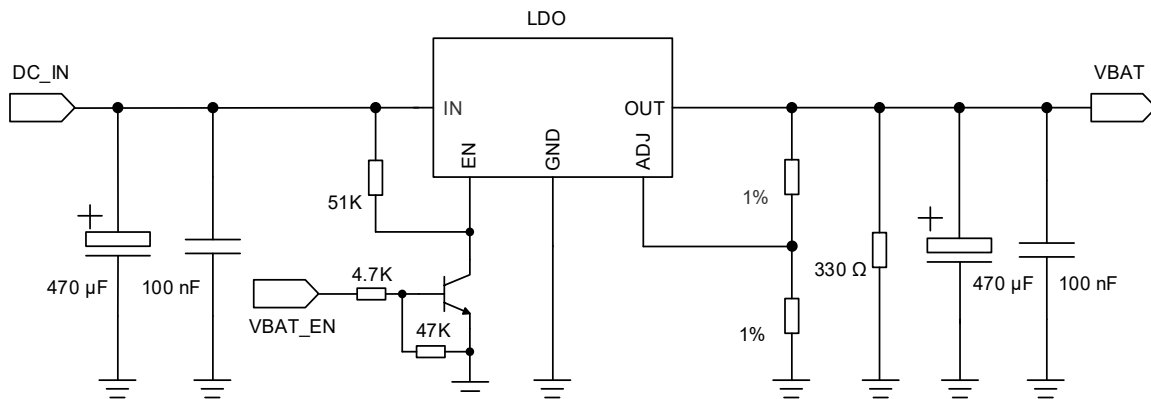


Figure 7: Reference Design of Power Input

NOTE

To avoid corrupting the data in the internal flash, do not cut off the power supply to turn off the module when the module works normally. Only after turning off the module with PWRKEY or AT command can you cut off the power supply.

3.4.3. Power Supply Voltage Monitoring

You can use **AT+CBC** to monitor and query the VBAT_BB voltage. For more details, contact Quectel Technical Support.

3.4.4. Requirements for Voltage Stability

The power supply range of the module is from 3.4 V to 4.3 V. Ensure the input voltage never drops below 3.4 V.

To decrease the voltage drop, use a bypass capacitor of about 100 µF with low ESR ($ESR \leq 0.7 \Omega$) and reserve a multi-layer ceramic chip (MLCC) capacitor array with ultra-low ESR. It is recommended to use five ceramic capacitors (1.8 pF, 3.9 pF, 10 pF, 33 pF and 100 nF) for composing the MLCC array, and place these capacitors close to the VBAT_BB and VBAT_RF pins. The main power supply from an external application has to be a single voltage source and can be expanded to two sub paths with star configuration. The width of VBAT_BB trace should be at least 1 mm; and the width of VBAT_RF trace should be at least 2 mm. As per design rules, the longer the VBAT trace is, the wider it should be.

To avoid the ripple and surge and ensure the stability of the power supply to the module, it is recommended to add a TVS with $V_{RWM} = 4.7$ V, low-clamp voltage and peak pulse current I_{pp} at the front end of the power supply.

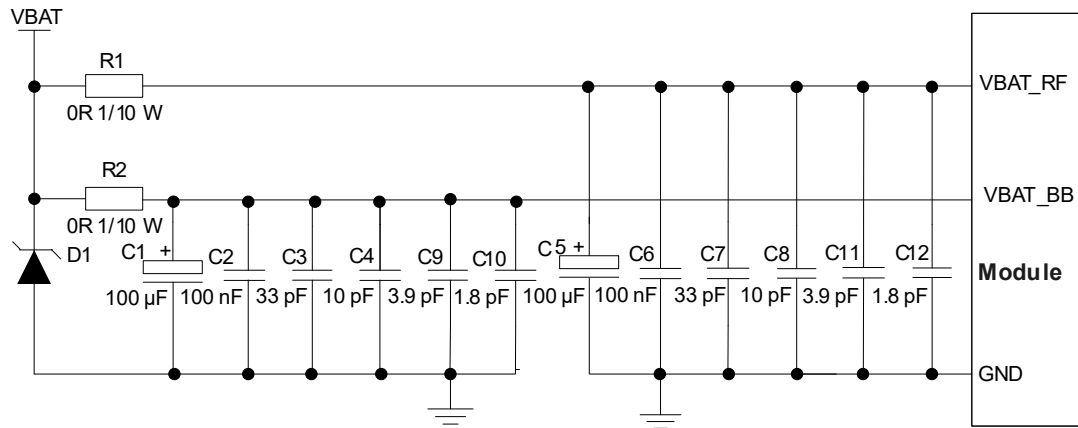


Figure 8: Reference Design of Power Supply

3.5. Turn-on

3.5.1. Turn-on with PWRKEY

Table 9: Pin Description of PWRKEY

Pin Name	Pin No.	I/O	Description	Comment
PWRKEY	15	DI	Turn on/off the module	A test point is recommended to be reserved.

When the module is in turn-off state, it can be turned on by driving PWRKEY low for at least 700 ms. It is recommended to use an open drain/collector driver to control the PWRKEY.

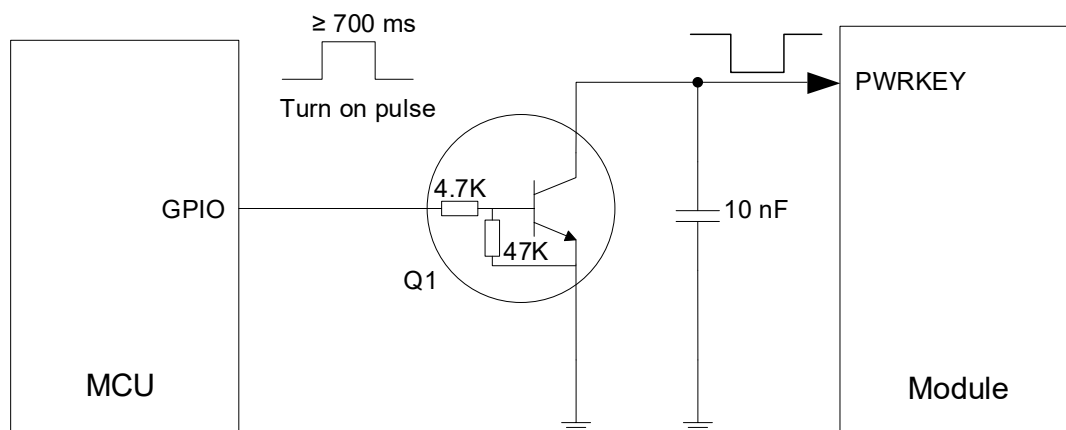


Figure 9: Reference Design of Turn-on with Driving Circuit

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

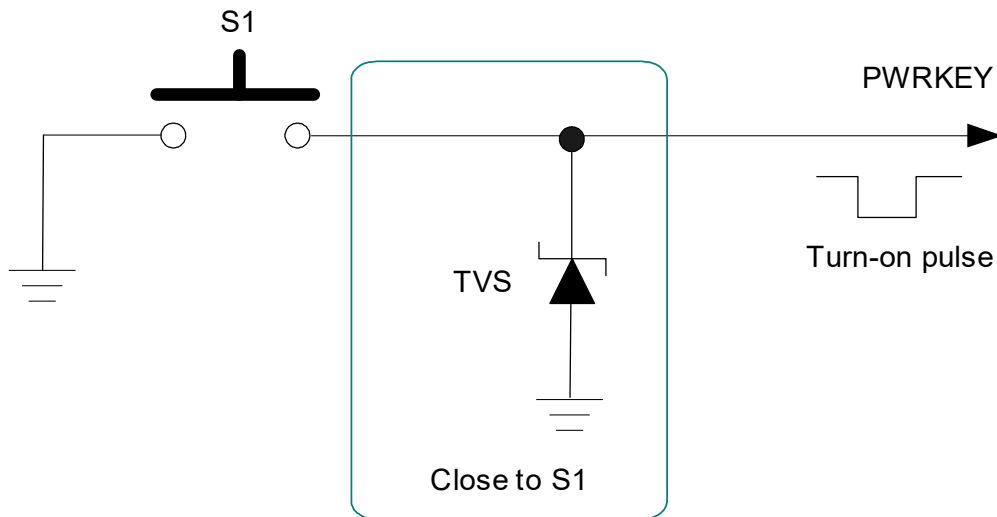


Figure 10: Reference Design of Turn-on with a Button

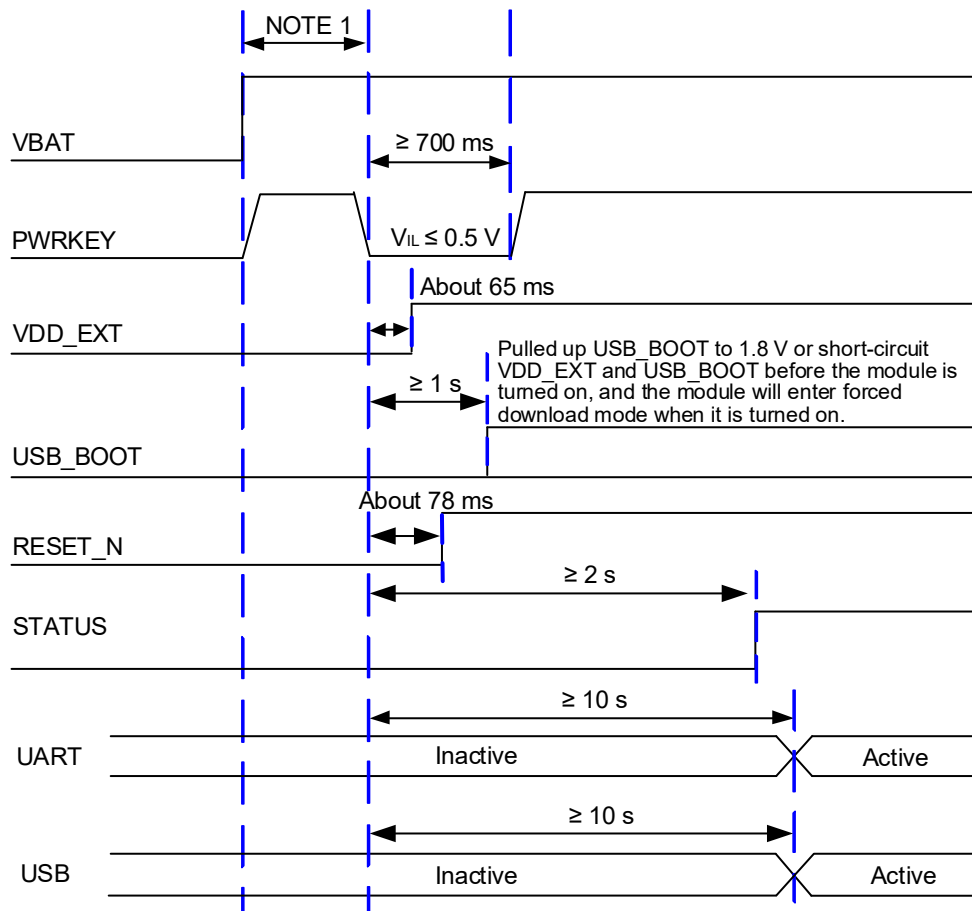


Figure 11: Timing of Turn-on with PWRKEY

NOTE

1. Ensure the voltage of VBAT is stable for at least 30 ms before driving the PWRKEY low.
2. If the module needs to turn on automatically but does not need turn-off function, PWRKEY can be driven low directly to ground with a recommended 4.7 k Ω resistor.

3.6. Turn-off

3.6.1. Turn-off with PWRKEY

Drive PWRKEY low for at least 650 ms and then release it. After this, the module will execute turn-off procedure.

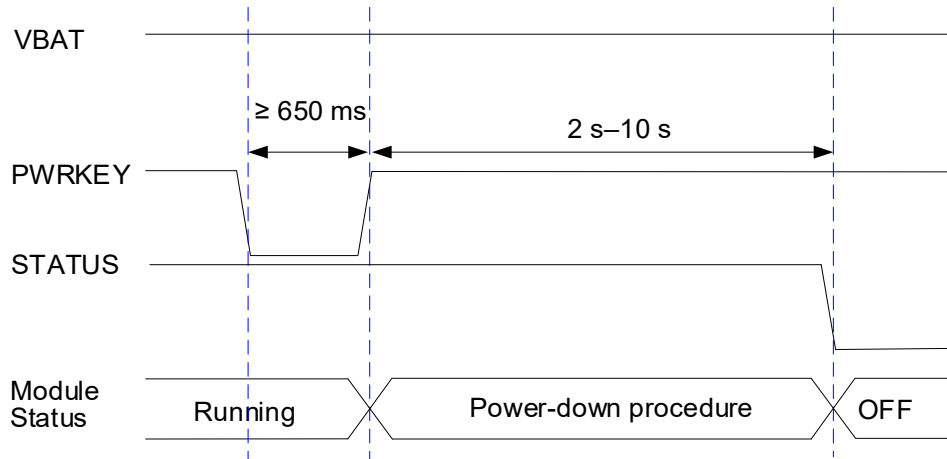


Figure 12: Timing of Turn-off with PWRKEY

3.6.2. Turn-off with AT Command

To turn off the module, you can also execute **AT+QPOWD**, which is the same as turning off the module via the PWRKEY pin. For details about **AT+QPOWD**, see *document [4]*.

NOTE

1. To avoid corrupting the data in the internal flash, do not cut off the power supply to turn off the module when the module works normally. Only after turning off the module with PWRKEY or AT command can you cut off the power supply.
2. When turning off the module with the AT command, keep PWRKEY at high level after the execution of the command. Otherwise, the module will be turned on automatically again after successful turn-off.

3.7. RESET_N

Driving RESET_N low for at least 300 ms and then releasing it can reset the module. RESET_N signal is sensitive to interference, so it is recommended to route the trace as short as possible and surround it with ground.

Table 10: Pin Description of RESET_N

Pin Name	Pin No.	I/O	Description	Comment
RESET_N	17	DI	Reset the module	Active low. A test point is recommended to be reserved if unused.

The recommended circuit for reset function is similar to the PWRKEY control circuit. You can use an open drain/collector driver or a button to control RESET_N.

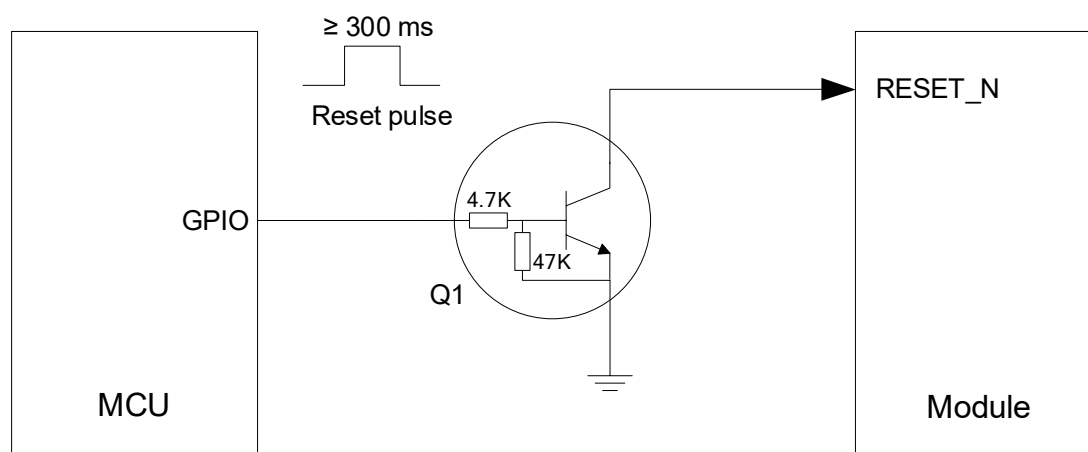


Figure 13: Reference Design of RESET_N with Driving Circuit

You can also use a button to control RESET_N.

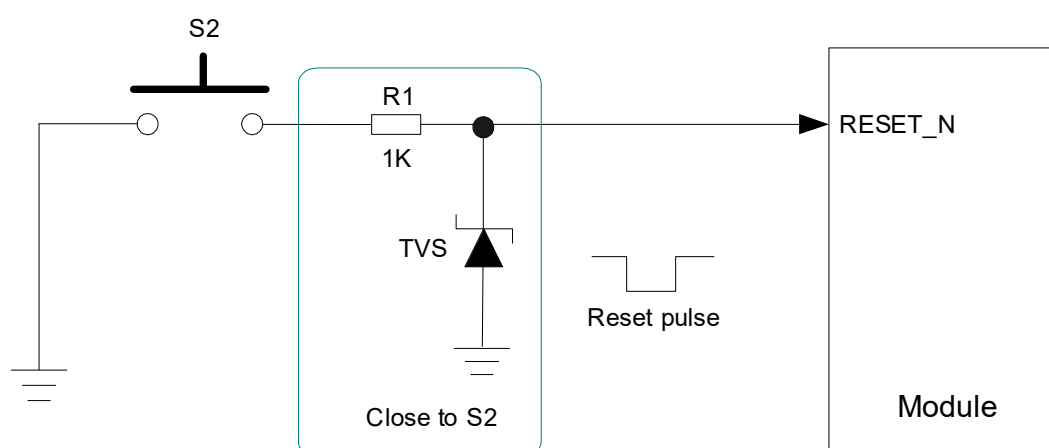


Figure 14: Reference Design of RESET_N with a Button

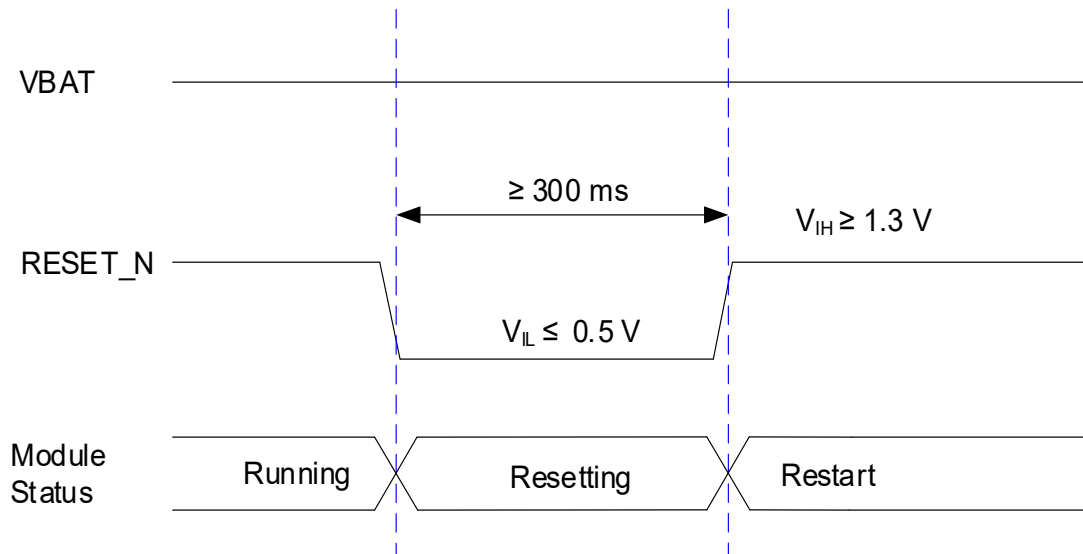


Figure 15: Timing of RESET_N

NOTE

1. Use RESET_N only when you fail to turn off the module with the **AT+QPOWD** and PWRKEY.
2. Ensure the capacitance on PWRKEY and RESET_N does not exceed 10 nF.

4 Application Interfaces

4.1. USB Interface

The module provides one integrated Universal Serial Bus (USB) interface which supports slave mode only. It complies with USB 2.0 specification and supports full-speed (12 Mbps) and high-speed (480 Mbps) on USB 2.0. The USB interface can be used for AT command communication, data transmission, software debugging, firmware upgrade and GNSS NMEA sentence output.

Table 11: Pin Description of USB Interface

Pin Name	Pin No.	I/O	Description	Comment
USB_VBUS	8	AI	USB connection detect	A test point must be reserved.
USB_DP	9	AIO	USB 2.0 differential data (+)	Complies with USB 2.0 specification. 90 Ω differential impedance is required. Test points must be reserved.
USB_DM	10	AIO	USB 2.0 differential data (-)	

It is recommended to use USB 2.0 interface for firmware upgrade, and test points must be reserved for software debugging. The following figure shows a reference design of USB interface.

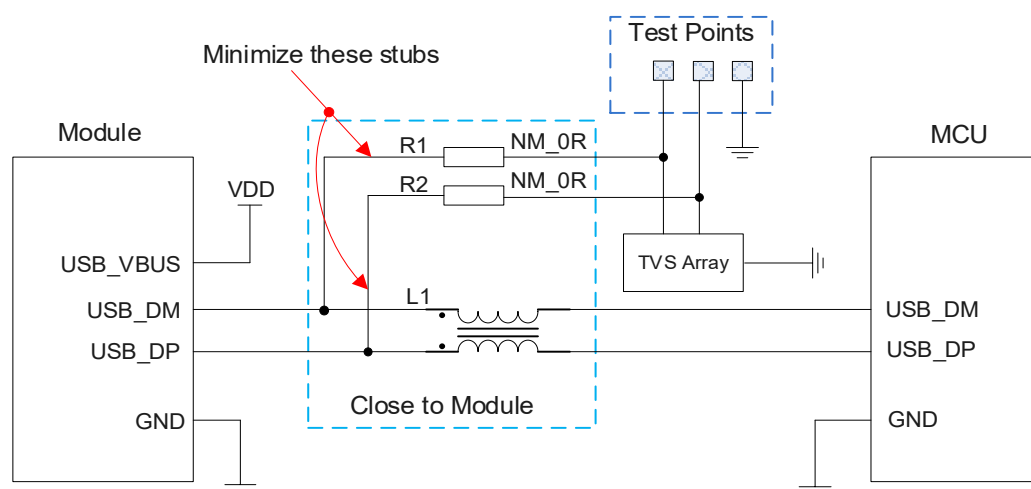


Figure 16: Reference Design of USB 2.0 Interface

It is recommended to add a common-mode choke L1 in series between MCU and the module to suppress EMI. Meanwhile, the 0 Ω resistors (R1 and R2) should be added in series between the module and test points for debugging, and these resistors are not mounted by default. To ensure the signal integrity of USB 2.0 data traces, you should place L1, R1 and R2 close to the module, and keep these resistors close to each other. Moreover, the extra stubs of trace must be as short as possible.

To ensure performance, you should follow the following principles when designing USB interface:

- Route the USB signal traces as differential pairs with ground surrounded. The impedance of USB 2.0 differential trace is 90 Ω .
- Do not route signal traces under crystals, oscillators, magnetic devices and RF signal traces. Route the USB differential traces in inner-layer of the PCB, and surround the traces with ground on the same layer and with ground planes above and below.
- Pay attention to the impact caused by junction capacitance of the ESD protection component on USB data traces. Typically, the junction capacitance should be less than 2 pF and should be placed as close as possible to the USB connector.

For more details about the USB 2.0 specifications, please visit <http://www.usb.org/home>.

4.2. Forced Download Interface

The module provides a USB_BOOT for forced download. Before the module is turned on, pull up USB_BOOT to 1.8 V, or short-circuit VDD_EXT and USB_BOOT, and the module will enter forced download mode. In this mode, the module supports firmware upgrade over USB 2.0 interface.

Table 12: Pin Description of Forced Download Interface

Pin Name	Pin No.	I/O	Description	Comment
USB_BOOT	75	DI	Force the module into download mode	Active high. If the forced download function is not required, do not pull it up to a high level before the module starts up successfully. A test point is recommended to be reserved.

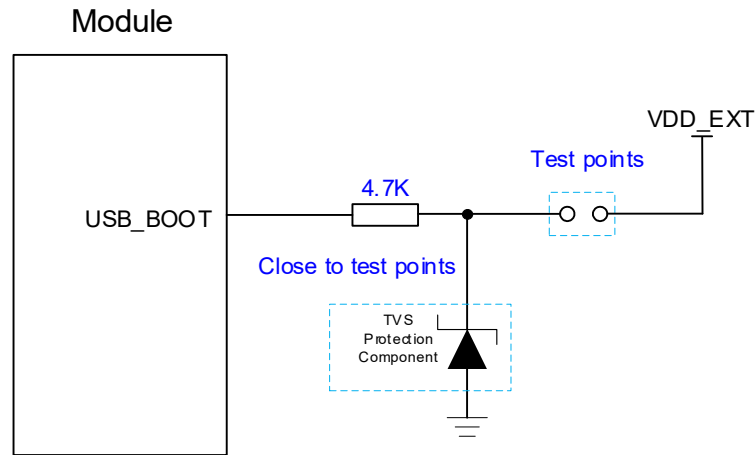


Figure 17: Reference Design of USB_BOOT

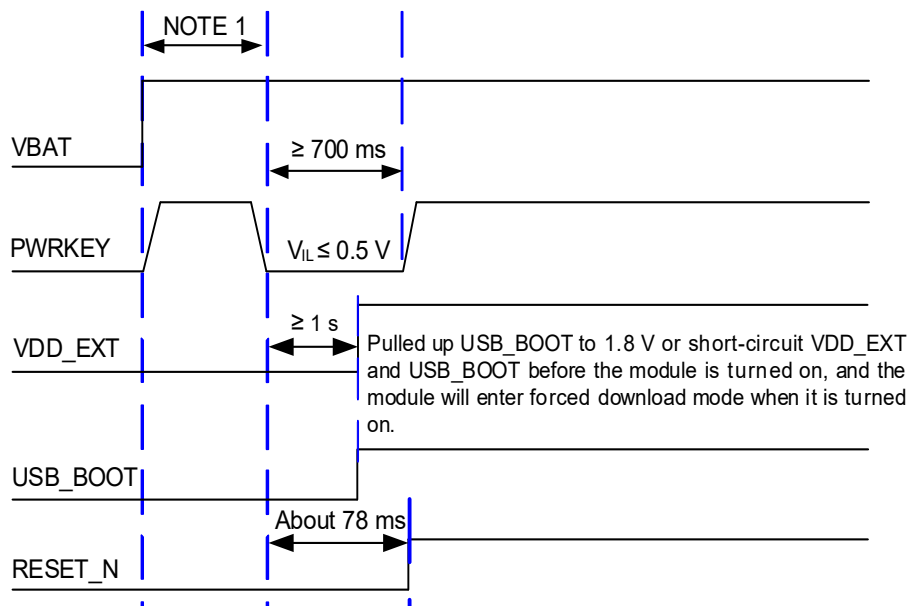


Figure 18: Timing for Entering Forced Download Mode

NOTE

1. Ensure the voltage of VBAT is stable for at least 30 ms before driving the PWRKEY low.
2. Follow the above timing when using MCU to control module to enter the forced download mode. If you need to manually force the module to enter forced download mode, directly connect the test points shown in **Figure 17**.
3. If pull USB_BOOT down to GND, the resistor is recommended to be 4.7 kΩ.
4. The 6.0 and above version QFlash tool must be used for firmware upgrade.

4.3. USIM Interface

The module provides one USIM interface, which meet ETSI and IMT-2000 requirements. Either 1.8 V or 3.0 V USIM card is supported.

Table 13: Pin Description of USIM Interface

Pin Name	Pin No.	I/O	Description	Comment
USIM_DET	42	DI	USIM card hot-plug detect	If unused, keep it open.
USIM_VDD	43	PO	USIM card power supply	Either 1.8 V or 3.0 V USIM card is supported and can be identified automatically by the module.
USIM_RST	44	DO	USIM card reset	
USIM_DATA	45	DIO	USIM card data	
USIM_CLK	46	DO	USIM card clock	
USIM_GND	47	-	Dedicated ground for USIM card	Connect to the GND of USIM card connector.

The module supports USIM card hot-plug via the USIM_DET, and both high-level and low-level detections are supported. Hot-plug function is disabled by default and you can use **AT+QSIMDET** to configure this function. See **document [4]** for more details.

The reference circuit of the USIM interface with an 8-pin USIM card connector is as follows.

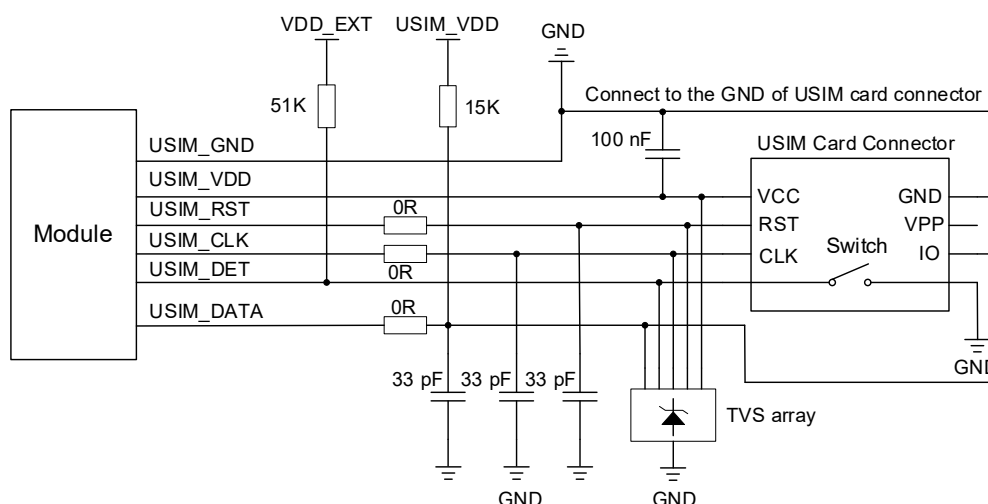


Figure 19: Reference Design of USIM Interface with an 8-pin USIM Card Connector

If the function of USIM card hot-plug is not needed, please keep USIM_DET open. The reference circuit of the USIM interface with a 6-pin SIM card connector is as follows.

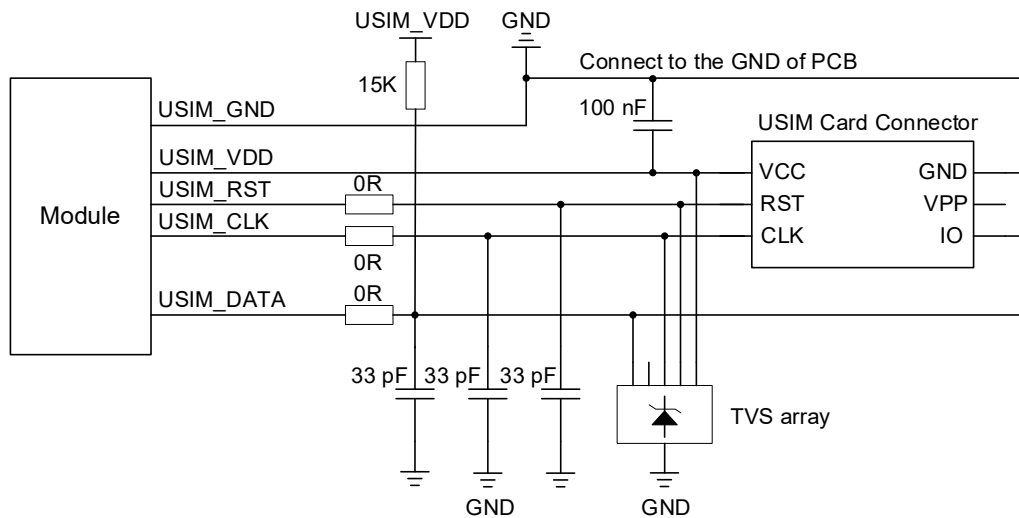


Figure 20: Reference Design of USIM Interface with a 6-pin USIM Card Connector

To enhance the reliability and availability of the USIM card in your applications, follow the criteria below in the USIM circuit design:

- Place the USIM card connector as close to the module as possible. Keep the trace length as short as possible, at most 200 mm.
- Keep USIM card signals away from RF and power supply traces.
- Ensure the tracing between ground of the USIM card connector and USIM_GND is short and wide. Keep the trace width of USIM_GND and USIM_VDD at least 0.5 mm to maintain the same electric potential. USIM_GND can be connected to the GND of your PCB directly if the PCB's GND is complete.
- To avoid cross talk between USIM_DATA and USIM_CLK, keep the traces away from each other and shield them with surrounded ground.
- Ensure the bypass capacitor between USIM_VDD and GND does not exceed 1 μ F, and the capacitor should be placed close to the USIM card connector.
- To offer better ESD protection, you can add a TVS array of which the parasitic capacitance should not exceed 15 pF. Add 0 Ω resistors in series between the module and the USIM card connector to facilitate debugging. Additionally, add 33 pF capacitors in parallel among USIM_DATA, USIM_CLK and USIM_RST signal traces to filter out RF interference. The peripheral components of the USIM card should be placed as close as possible to the USIM card connector.
- The pull-up resistor on USIM_DATA can improve anti-jamming capability of the USIM card. When the routing trace of USIM card is too long or there is a relatively close interference source, it is recommended to add a pull-up resistor near the USIM card connector.
- USIM_GND is recommended to connect to the GND of USIM connector, and it can also be connected to the GND of your PCB directly if the PCB's GND is complete.

4.4. UART Interfaces

The module provides two UART interfaces: main UART interface and debug UART interface. Their features are described below.

Table 14: UART Interfaces Information

UART Types	Supported Baud Rates (bps)	Default Baud Rates (bps)	Functions
Main UART	4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600	115200	Used for AT command communication and data transmission. Supports RTS and CTS hardware flow control
Debug UART	115200	115200	Used for partial logs output and GNSS NMEA sentence output

Table 15: Pin Description of UART Interfaces

Pin Name	Pin No.	I/O	Description	Comment
MAIN_DTR	30	DI	Main UART data terminal ready	If unused, keep them open.
MAIN_RXD	34	DI	Main UART receive	
MAIN_TXD	35	DO	Main UART transmit	
MAIN_CTS	36	DO	Clear to send signal from the module	Connect to the MCU's CTS. If unused, keep it open.
MAIN_RTS	37	DI	Request to send signal to the module	Connect to the MCU's RTS. If unused, keep it open.
MAIN_DCD	38	DO	Main UART data carrier detect	If unused, keep them open.
MAIN_RI	39	DO	Main UART ring indication	
DBG_RXD	22	DI	Debug UART receive	Test points must be reserved.
DBG_TXD	23	DO	Debug UART transmit	

The module provides a 1.8 V UART. You can use a voltage-level translator between the module and MCU's UART if the MCU is equipped with a 3.3 V UART. A voltage-level translator TXS0108EPWR provided by Texas Instruments is recommended. The following figure shows a reference design.

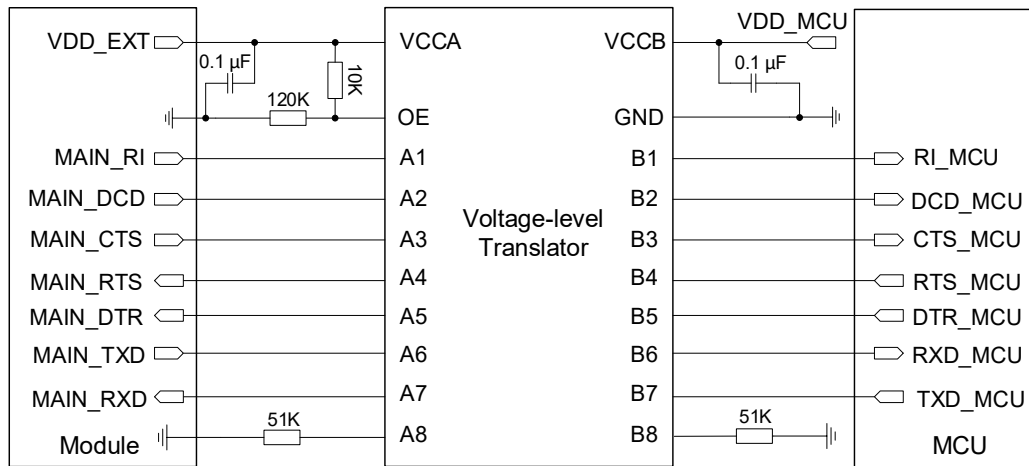


Figure 21: Reference Design of UART with Voltage-level Translator (Main UART)

Visit <http://www.ti.com> for more information.

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

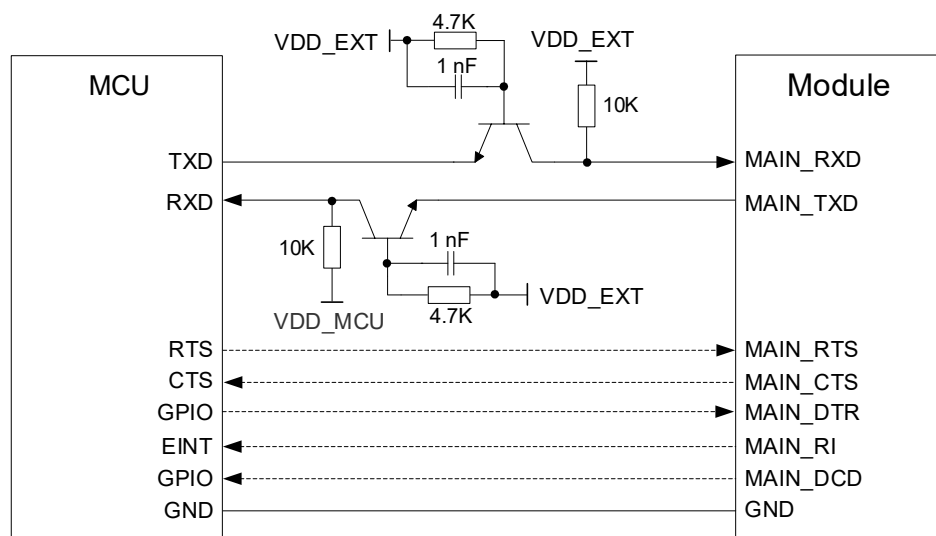


Figure 22: Reference Design of UART with Transistor Level-shifting Circuit (Main UART)

NOTE

1. Transistor level-shifting circuit above is not suitable for applications with baud rates exceeding 460 kbps.
2. Please note that the module's CTS is connected to the MCU's CTS, and the module's RTS is connected to the MCU's RTS.

3. To increase the stability of UART communication, it is recommended to add UART hardware flow control design.
4. The level-shifting circuits (**Figure 21** and **Figure 22**) take the main UART as an example. The circuit of the debug UART is connected in the same way as the main UART.

4.5. ADC Interfaces*

The module provides two Analog-to-Digital Converter (ADC) interfaces. To improve the accuracy of ADC, the trace of ADC interface should be surrounded by ground.

Table 16: Pin Description of ADC Interfaces

Pin Name	Pin No.	I/O	Description	Comment
ADC1	2	AI	General-purpose ADC interface	If unused, keep them open.
ADC0	24	AI		

With **AT+QADC=<port>**, you can read the voltage value on ADC interfaces.

- **AT+QADC=0**: read the voltage value on ADC0
- **AT+QADC=1**: read the voltage value on ADC1

For more details about the AT command, see **document [4]**.

Table 17: Characteristics of ADC Interfaces

Parameter	Min.	Typ.	Max.	Unit
ADC0 Input Voltage Range	0	-	VBAT_BB	V
ADC1 Input Voltage Range	0	-	VBAT_BB	V
ADC Resolution	-	-	12	bits

NOTE

1. When the module is not powered by VBAT, the ADC interface cannot be directly connected to any input voltage.
2. If the collected voltage is greater than 4.3 V, it is recommended to use a resistor divider circuit input for the ADC pin. When designing, reserve a 1 nF capacitor at both ends of the grounding divider resistor. The capacitor is not mounted by default. See **document [2]** for details.
3. The input voltage of ADC should not exceed its corresponding voltage range.

4.6. Indication Signal

Table 18: Pin Description of Indication Signal

Pin Name	Pin No.	I/O	Description	Comment
NET_STATUS	21	DO	Indicate the module's network activity status	If unused, keep them open.
STATUS	20	DO	Indicate the module's operation status	
MAIN_RI	39	DO	Main UART ring indication	

4.6.1. Network Status Indication

The module provides one network status indication pin NET_STATUS. It can drive corresponding LEDs.

Table 19: Module Network Status

Pin Name	Level Status	Module Network Status
NET_STATUS	Blink slowly (200 ms high/1800 ms low)	Network searching
	Blink slowly (1800 ms high/200 ms low)	Idle
	Blink quickly (125 ms high/125 ms low)	Data transmission is ongoing

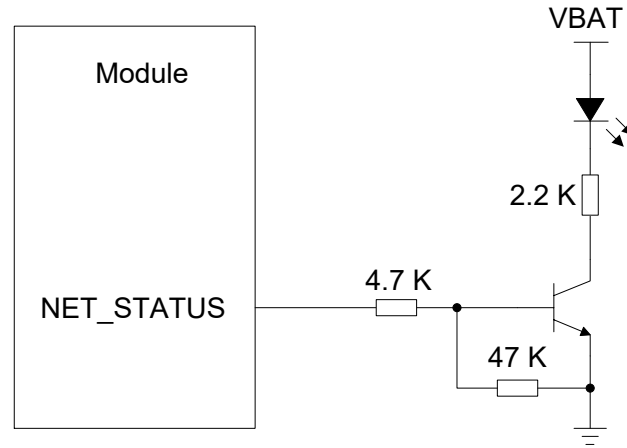


Figure 23: Reference Design of Network Status Indication

4.6.2. STATUS

STATUS is used for indicating module's operation status. It will output high level when the module is turned on normally.

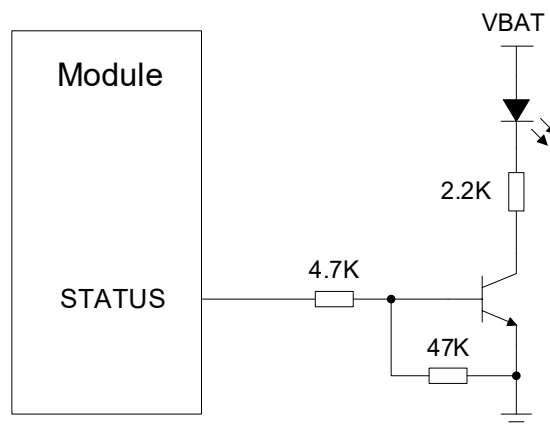


Figure 24: Reference Design of STATUS

4.6.3. MAIN_RI

AT+QCFG="risignalttype","physical" can be used to configure the indication behavior for MAIN_RI. No matter on which port (main UART, USB AT port or USB modem port) a URC information is presented, the URC information will trigger the behavior of the MAIN_RI.

NOTE

1. The **AT+QURCCFG** allows you to set the main UART, USB AT port or USB modem port as the URC information output port. The default port is USB AT port.
2. See **document [4]** for details on the AT commands mentioned above.

You can configure MAIN_RI behaviors flexibly. The default behaviors of the MAIN_RI are shown as below.

Table 20: MAIN_RI Level and Mode Status

State	Level Status
Idle	MAIN_RI keeps at high level.
URC	MAIN_RI outputs at least 120 ms low level. After the module outputs the data, the level status will then become high.

Indication behavior for MAIN_RI can be configured via several commands, e.g. **AT+QCFG="urc/ri/ring"** can be used to specify the MAIN_RI behavior when the URC indicating an incoming call is reported. See **document [4]** for details.

5 RF Specifications

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

5.1. LTE/Wi-Fi Scan Antenna Interface

5.1.1. LTE/Wi-Fi Scan Antenna Interface and Frequency Bands

Table 21: Pin Description of LTE/Wi-Fi Scan Antenna Interface

Pin Name	Pin No.	I/O	Description	Comment
ANT_MAIN	60	AIO	Main antenna/Wi-Fi Scan antenna interface	50 Ω characteristic impedance.

NOTE

The Wi-Fi Scan function utilizes the same antenna interface as the main antenna. Due to this shared interface, Time Division Multiplexing (TDM) is employed since the two functions cannot be used simultaneously. Wi-Fi Scan functionality only supports receiving. Transmitting is not supported. For more details, contact Quectel Technical Support.

Table 22: Operating Frequency for EG915K-EU

Operating Frequency	Transmit	Receive	Unit
LTE-FDD B1	1920–1980	2110–2170	MHz
LTE-FDD B3	1710–1785	1805–1880	MHz
LTE-FDD B5	824–849	869–894	MHz
LTE-FDD B7	2500–2570	2620–2690	MHz

LTE-FDD B8	880–915	925–960	MHz
LTE-FDD B20	832–862	791–821	MHz
LTE-FDD B28	703–748	758–803	MHz
LTE-TDD B38	2570–2620	2570–2620	MHz
LTE-TDD B40	2300–2400	2300–2400	MHz
LTE-TDD B41	2496–2690	2496–2690	MHz

Table 23: Operating Frequency for EG915K-LA

Operating Frequency	Transmit	Receive	Unit
LTE-FDD B2	1850–1910	1930–1990	MHz
LTE-FDD B3	1710–1785	1805–1880	MHz
LTE-FDD B4	1710–1755	2110–2155	MHz
LTE-FDD B5	824–849	869–894	MHz
LTE-FDD B7	2500–2570	2620–2690	MHz
LTE-FDD B8	880–915	925–960	MHz
LTE-FDD B28	703–748	758–803	MHz
LTE-FDD B66	1710–1780	2110–2180	MHz

5.1.2. Transmit Power

Table 24: RF Transmit Power

Frequency Bands	Max.	Min.
LTE bands	23 dBm $\pm$ 2 dB	< -39 dBm

5.1.3. Receiver Sensitivity

Table 25: Conducted RF Receiver Sensitivity for EG915K-EU (Unit: dBm)

Frequency Bands	Receiver Sensitivity (Typ.)	3GPP Requirement
	Primary	
LTE-FDD B1 (10 MHz)	-98.8	-93.3
LTE-FDD B3 (10 MHz)	-98.5	-90.3
LTE-FDD B5 (10 MHz)	-98.9	-91.8
LTE-FDD B7 (10 MHz)	-98.2	-91.3
LTE-FDD B8 (10 MHz)	-99.0	-90.8
LTE-FDD B20 (10 MHz)	-98.5	-90.8
LTE-FDD B28 (10 MHz)	-98.6	-92.3
LTE-TDD B38 (10 MHz)	-98.5	-93.3
LTE-TDD B40 (10 MHz)	-99.3	-93.8
LTE-TDD B41 (10 MHz)	-98.0	-91.8

Table 26: Conducted RF Receiver Sensitivity for EG915K-LA (Unit: dBm)

Frequency Bands	Receiver Sensitivity (Typ.)	3GPP Requirement
	Primary	
LTE-FDD B2 (10 MHz)	-99	-91.3
LTE-FDD B3 (10 MHz)	-98.5	-90.3
LTE-FDD B4 (10 MHz)	-99	-93.3
LTE-FDD B5 (10 MHz)	-98.9	-91.8
LTE-FDD B7 (10 MHz)	-98.2	-91.3
LTE-FDD B8 (10 MHz)	-99	-90.8
LTE-FDD B28 (10 MHz)	-98.6	-92.3

LTE-FDD B66 (10 MHz)

-98.5

-92.8

5.1.4. Reference Design

The reference design of LTE/Wi-Fi scan antenna is shown as below. Reserve a dual L-type circuit for better RF performance. Capacitors C1 and C2 are not mounted by default.

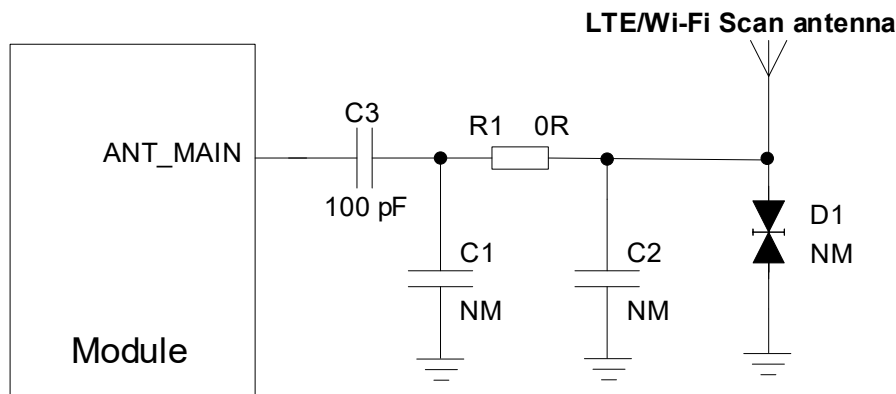


Figure 25: Reference Design of LTE/Wi-Fi Scan Antenna

NOTE

1. To reduce the coexistence problems and avoid the interference of receiving sensitivity, make sure that the isolation between antennas is more than 20 dB.
2. Place the dual-L type components (R1, C1, C2 and C3) to antennas as close as possible.
3. It is recommended to reserve ESD protection component for the antenna interface to effectively prevent static electricity and the junction capacitance should not exceed 0.05 pF.
4. Notes on C3:
 - 1) If there is DC power at the antenna ports, place a capacitor on C3 to prevent short circuit to ground. The capacitance value is recommended to be 100 pF, which can be adjusted according to the debugging results.
 - 2) If there is no DC power in the peripheral design:
 - a) Do not reserve C3.
 - b) If C3 has already been reserved, it should be mounted with a component, and it is recommended to use a 0 Ω resistor. You can also match the components according to the debugging results.

5.2. GNSS (Optional)

GNSS information of the module is as follows:

- Supports BDS, GPS and GLONASS positioning system.
- Supports NMEA 0183 protocol. NMEA message can be output by USB interface or debug UART via AT command. For USB interface, the function can be enabled by **AT+QGPSCFG="outport",usbntmea**; for debug UART, the function can be enabled by **AT+QGPSCFG="outport",uartdebug** (data update rate for positioning: 1 Hz).
- The module's GNSS function is disabled by default. It must be enabled via **AT+QGPS**.

NOTE

1. GNSS function is optional. For more details, contact Quectel Technical Support.
2. For more details about AT command of GNSS usage, see **document [1]**.

5.2.1. Antenna Interface and Frequency Bands

Table 27: Pin Description of GNSS Antenna Interface

Pin Name	Pin No.	I/O	Description	Comment
ANT_GNSS	49	AI	GNSS antenna interface	50 Ω characteristic impedance. If unused, keep it open.

Table 28: GNSS Frequency for EG915K-EU

GNSS Constellation Type	Frequency Band	Unit
BDS	1561.098 $\pm$ 2.046 (B1I)	MHz
GPS	1575.42 $\pm$ 1.023 (L1)	
GLONASS	1601.7 $\pm$ 4.2 (L1)	

Table 29: GNSS Frequency for EG915K-LA

GNSS Constellation Type	Frequency Band	Unit
BDS	1561.098 $\pm$ 2.046 (B1I)	MHz
GPS	1575.42 $\pm$ 1.023 (L1)	

GLONASS	1601.7 ±4.2 (L1)
Galileo	1575.42 ±2.046 (E1)

5.2.2. GNSS Performance

Table 30: GNSS Performance

Parameter	Description	Condition	Typ.	Unit
Sensitivity	Acquisition	Autonomous	-147	dBm
	Reacquisition		-159	
	Tracking		-161	
TTFF	Cold start @ open sky	Autonomous	22.4	s
		AGNSS start	8.96	
	Warm start @ open sky	Autonomous	-	
		AGNSS start	-	
	Hot start @ open sky	Autonomous	1	
		AGNSS start	1	
Accuracy	CEP-50	Autonomous @ open sky	2	m

NOTE

1. Tracking sensitivity: the minimum GNSS signal power at which the module can maintain lock (keep positioning for at least 3 minutes continuously).
2. Reacquisition sensitivity: the minimum GNSS signal power required for the module to maintain lock within 3 minutes after loss of lock.
3. Acquisition sensitivity: the minimum GNSS signal power at which the module can fix position successfully within 3 minutes after executing cold start command.
4. The module does not support warm boot.

5.2.3. Reference Design

5.2.3.1. Active Antenna

In any case, it is recommended to use a passive antenna. However, if an active antenna is needed in your application, it is recommended to reserve a π -type attenuation circuit and use a high-performance LDO in the power system design. The active antenna connection reference circuit is shown in the figure below.

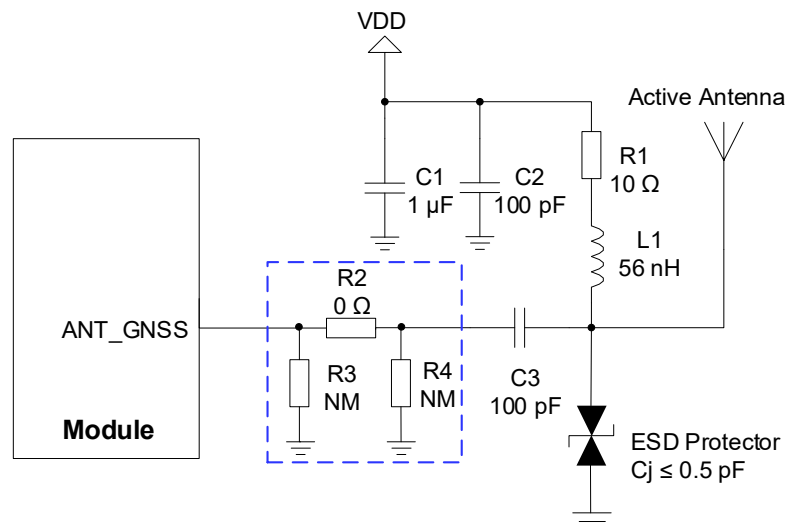


Figure 26: Reference Circuit of Active Antenna

The power supply voltage range of the external active antenna is 2.8–4.3 V, and the typical value is 3.3 V.

5.2.3.2. Passive Antenna

Passive antenna connection reference circuit is shown in the figure below.

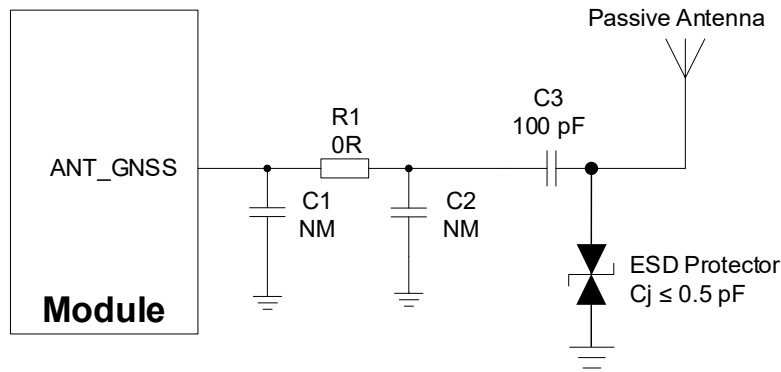


Figure 27: Reference Design of Passive Antenna

C1, R1, C2 and C3 form a dual-L type circuit which is recommended to be reserved for adjusting the antenna impedance. Among them, C1 and C2 are not mounted by default, and R1 is only mounted with 0 Ω resistor. The impedance of the RF trace should be controlled at about 50 Ω , and the trace should be as short as possible.

NOTE

1. You can select an external LDO for power supply according to the active antenna requirements. If the module is designed with a passive antenna, then the VDD circuit is not needed.
2. It is recommended to use passive antenna. If active antenna or an additional LNA is needed, please contact Quectel Technical Support.
3. Notes on C3:
 - 1) If there is DC power at the antenna ports, place a capacitor on C3 to prevent short circuit to ground. The capacitance value is recommended to be 100 pF, which can be adjusted according to the debugging results.
 - 2) If there is no DC power in the peripheral design:
 - a) Do not reserve C3.
 - b) If C3 has already been reserved, it should be mounted with a component, and it is recommended to use a 0 Ω resistor. You can also match the components according to the debugging results.

5.3. RF Routing Guidelines

For user's PCB, the characteristic impedance of all RF traces should be controlled to 50 Ω . 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.

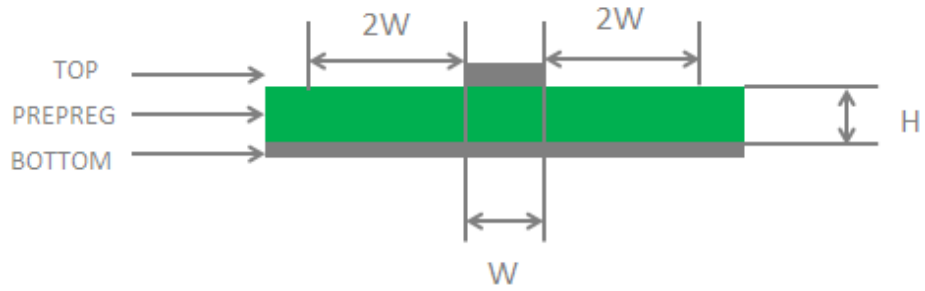


Figure 28: Microstrip Design on a 2-layer PCB

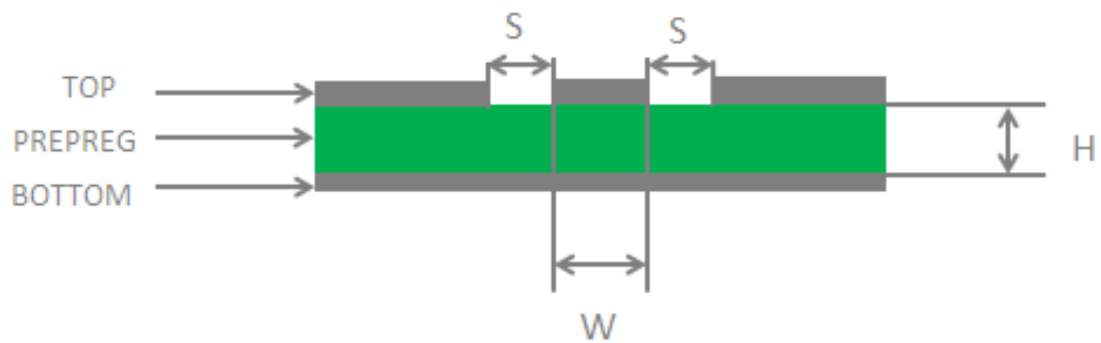


Figure 29: Coplanar Waveguide Design on a 2-layer PCB

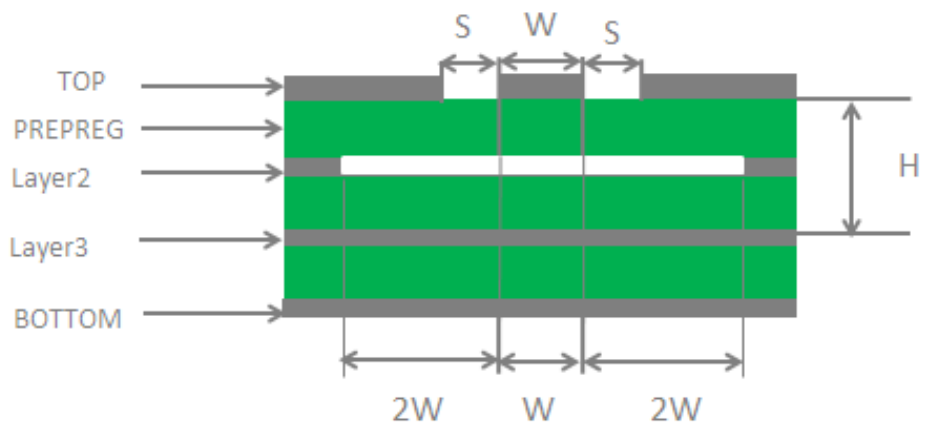


Figure 30: Coplanar Waveguide Design on a 4-layer PCB (Layer 3 as Reference Ground)

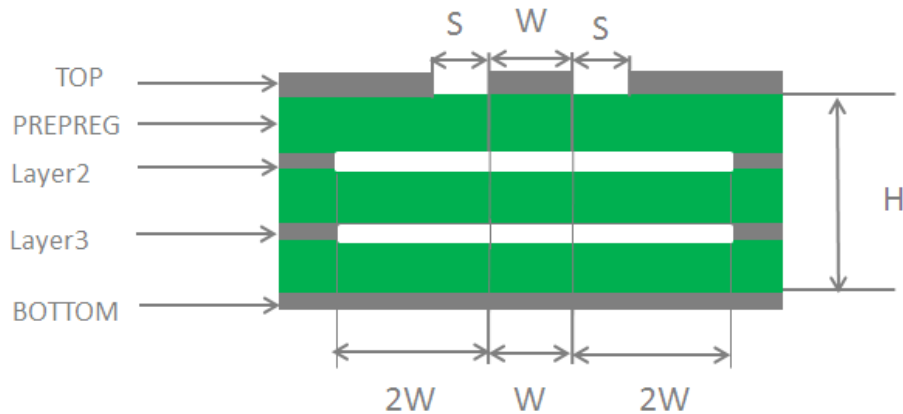


Figure 31: Coplanar Waveguide Design on a 4-layer PCB (Layer 4 as Reference Ground)

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 at least twice the width of RF signal traces ($2 \times W$).
- Keep RF traces away from interference sources (such as DC-DC, (U)SIM/USB/SDIO high frequency digital signals, display signals, and clock signals), and avoid intersection and paralleling between traces on adjacent layers.

For more details about RF layout, see **document [5]**.

5.4. Requirements for Antenna Design

Table 31: Antenna Design Requirements

Antenna Type	Requirements
Cellular/Wi-Fi Scan	● VSWR: ≤ 2 ● Efficiency: $> 30\%$ ● Max input power: 50 W

	● Input impedance: 50 Ω ● Cable insertion loss: $< 1 \text{ dB}$: LB ($< 1 \text{ GHz}$) $< 1.5 \text{ dB}$: MB (1–2.3 GHz) $< 2 \text{ dB}$: HB ($> 2.3 \text{ GHz}$)
GNSS (optional)	● Frequency range: L1: 1559–1606 MHz ● Polarization: RHCP or linear ● VSWR: ≤ 2 (Typ.) For passive antenna usage: Passive antenna gain: $> 0 \text{ dBi}$ For active antenna usage: ● Active antenna noise figure: $< 1.5 \text{ dB}$ ● Active antenna embedded LNA gain: $< 17 \text{ dB}$

5.5. RF Connector Recommendation

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

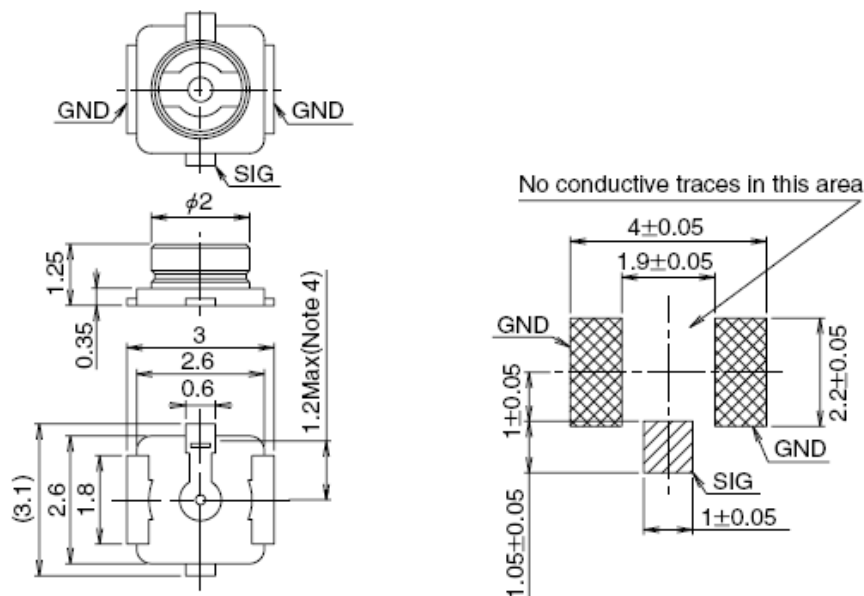


Figure 32: Dimensions of the Receptacle (Unit: mm)

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

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

Figure 33: Specifications of Mated Plugs (Unit: mm)

The following figure describes the space factor of mated connector.

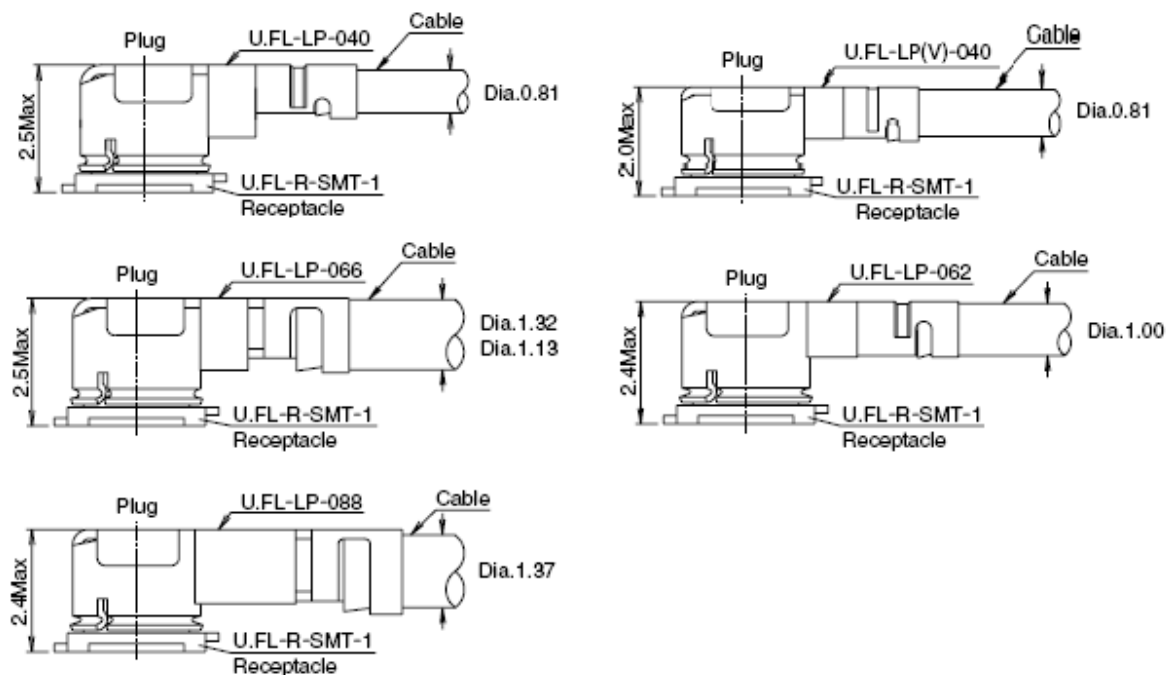


Figure 34: Space Factor of Mated Connectors (Unit: mm)

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

6 Electrical Characteristics and Reliability

6.1. Absolute Maximum Ratings

Table 32: Absolute Maximum Ratings

Parameter	Min.	Max.	Unit
VBAT_BB/VBAT_RF	-0.3	6.0	V
USB_VBUS	-0.3	5.5	V
Voltage at Digital Pins	-0.3	2.2	V
Input voltage at ADC[0:1]	0	VBAT	V

NOTE

Exceeding the conditions of use as shown above may cause permanent damage to the module.

6.2. Power Supply Ratings

Table 33: Module's Power Supply Ratings

Parameter	Description	Conditions	Min.	Typ.	Max.	Unit
VBAT	VBAT_BB and VBAT_RF	The actual input voltages must be kept between the minimum and maximum values.	3.4	3.8	4.3	V

I_{VBAT}	Peak supply current under BB and RF application scenarios	At maximum power control level	-	-	1.5	A
USB_VBUS	USB connection detect	-	3.0	5.0	5.25	V

6.3. Power Consumption

Table 34: Power Consumption for the EG915K-EU

Test Item	Conditions	Typ.		Unit
		Without GNSS	With GNSS	
Turn-off	Turn-off	8.01	16	μ A
Sleep	Minimum Functionality Mode (USB disconnected)	0.43	1.16	mA
	Airplane Mode (USB disconnected)	0.65	1.34	mA
	LTE-FDD @ PF = 32 (USB disconnected)	1.16	2.10	mA
	LTE-FDD @ PF = 64 (USB disconnected)	0.86	1.64	mA
	LTE-FDD @ PF = 64 (USB Suspend)	1.03	1.64	mA
	LTE-FDD @ PF = 128 (USB disconnected)	0.70	1.40	mA
	LTE-FDD @ PF = 256 (USB disconnected)	0.61	1.29	mA
	LTE-TDD @ PF = 32 (USB disconnected)	1.17	2.09	mA
	LTE-TDD @ PF = 64 (USB disconnected)	0.86	1.63	mA
	LTE-TDD @ PF = 64 (USB Suspend)	1.04	1.64	mA
	LTE-TDD @ PF = 128 (USB disconnected)	0.70	1.41	mA
	LTE-TDD @ PF = 256 (USB disconnected)	0.63	1.29	mA
	LTE-FDD @ PF = 64 (USB disconnected)	9.53	15.45	mA
	LTE-FDD @ PF = 64 (USB connected)	18.9	26.90	mA
Idle	LTE-TDD @ PF = 64 (USB disconnected)	9.55	15.49	mA
	LTE-TDD @ PF = 64 (USB connected)	18.92	26.91	mA

LTE data transmission	LTE-FDD B1	538	mA
	LTE-FDD B3	540	mA
	LTE-FDD B5	468	mA
	LTE-FDD B7	495	mA
	LTE-FDD B8	449	mA
	LTE-FDD B20	452	mA
	LTE-FDD B28	523	mA
	LTE-TDD B38	202	mA
	LTE-TDD B40	192	mA
	LTE-TDD B41	204	mA

Table 35: Power Consumption for the EG915K-LA

Test Item	Conditions	Typ.		Unit
		Without GNSS	With GNSS	
Turn-off	Turn-off	TBD	TBD	μA
Sleep	Minimum Functionality Mode (USB disconnected)	TBD	TBD	mA
	Airplane Mode (USB disconnected)	TBD	TBD	mA
	LTE-FDD @ PF = 32 (USB disconnected)	TBD	TBD	mA
	LTE-FDD @ PF = 64 (USB disconnected)	TBD	TBD	mA
	LTE-FDD @ PF = 64 (USB Suspend)	TBD	TBD	mA
	LTE-FDD @ PF = 128 (USB disconnected)	TBD	TBD	mA
	LTE-FDD @ PF = 256 (USB disconnected)	TBD	TBD	mA
	LTE-FDD @ PF = 64 (USB connected)	TBD	TBD	mA
Idle	LTE-FDD @ PF = 64 (USB connected)	TBD	TBD	mA
LTE data transmission	LTE-FDD B2	TBD		mA

LTE-FDD B3	TBD	mA
LTE-FDD B4	TBD	mA
LTE-FDD B5	TBD	mA
LTE-FDD B7	TBD	mA
LTE-FDD B8	TBD	mA
LTE-FDD B28	TBD	mA
LTE-FDD B66	TBD	mA

NOTE

1. For more information about power consumption, contact Quectel Technical Support for the power consumption test report of the module.
2. The above power consumption data are tested under 50 Ω impedance.

6.4. Digital I/O Characteristics

Table 36: 1.8 V I/O Characteristics

Parameter	Description	Min.	Max.	Unit
V_{IH}	High-level input voltage	$0.7 \times V_{DDIO}$	$V_{DDIO} + 0.2$	V
V_{IL}	Low-level input voltage	-0.3	$0.3 \times V_{DDIO}$	V
V_{OH}	High-level output voltage	$V_{DDIO} - 0.2$	-	V
V_{OL}	Low-level output voltage	-	0.2	V

Table 37: USIM Interface High/Low-voltage I/O Characteristics

Parameter	Description	Min.	Max.	Unit
V_{IH}	High-level input voltage	$0.8 \times USIM_VDD$	$USIM_VDD$	V
V_{IL}	Low-level input voltage	0	$0.12 \times USIM_VDD$	V

V_{OH}	High-level output voltage	$0.7 \times USIM_VDD$	$USIM_VDD$	V
V_{OL}	Low-level output voltage	0	$0.15 \times USIM_VDD$	V

6.5. 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 38: Electrostatics Discharge Characteristics (Temperature: 25–30 °C, Humidity: 40 ±5 %)

Tested Interfaces	Contact Discharge	Air Discharge	Unit
VBAT, GND	±5	±10	kV
All Antenna Interfaces	±4	±8	kV
Other Interfaces	±0.5	±1	kV

6.6. Operating and Storage Temperatures

Table 39: Operating and Storage Temperatures

Parameter	Min.	Typ.	Max.	Unit
Normal Operating Temperature ³	-35	+25	+75	°C
Extended Operation Temperature ⁴	-40	-	+85	°C
Storage Temperature	-40	-	+90	°C

³ Within this range, the module's indicators comply with 3GPP specification requirements.

⁴ Within the range of -40 to -35 °C or 75 to 85 °C, the module retains the ability to establish and maintain functions such as SMS, data transmission, without any unrecoverable malfunction. Radio spectrum and radio network remain uninfluenced, whereas the value of one or more parameters, such as P_{out} , may decrease and fall below the range of the 3GPP specified tolerances. When the temperature returns to the normal operating temperature range, the module's indicators will comply with 3GPP specification requirements again.

7 Mechanical Information

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

7.1. Mechanical Dimensions

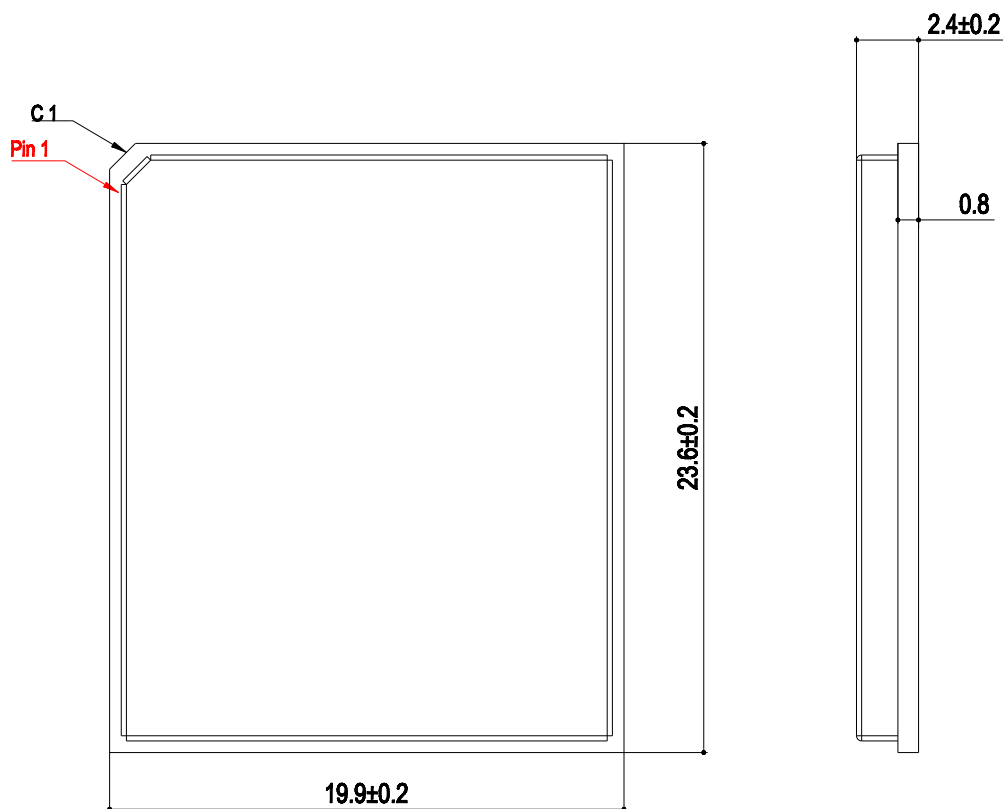


Figure 35: Top and Side Dimensions (Unit: mm)

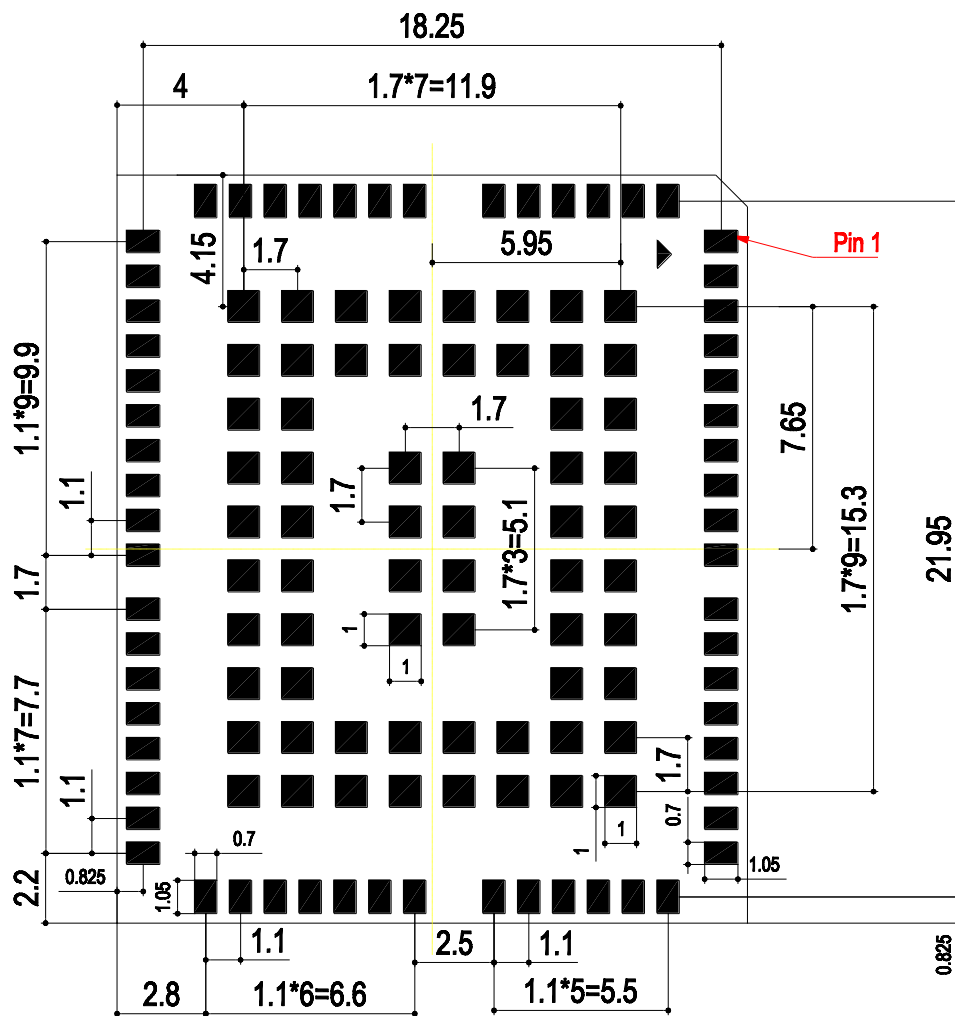


Figure 36: Bottom Dimension (Bottom View)

NOTE

The module's coplanarity standard: ≤ 0.13 mm.

7.2. Recommended Footprint

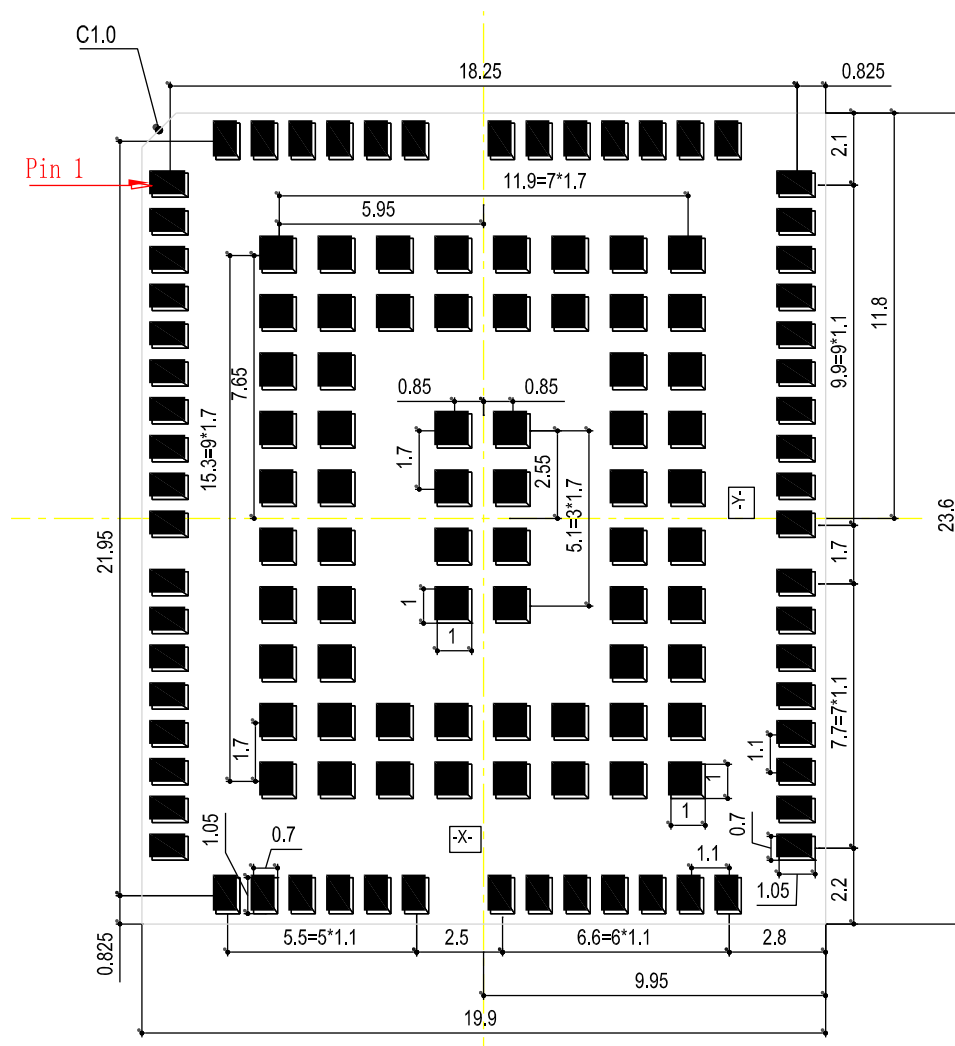


Figure 37: Recommended Footprint

NOTE

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

7.3. Top and Bottom Views

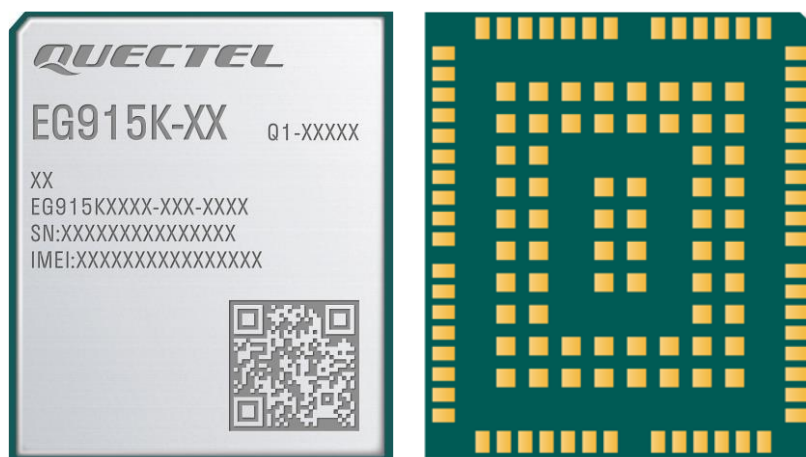


Figure 38: Top and Bottom Views of EG915K Series

NOTE

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

8 Storage, Manufacturing and Packaging

8.1. Storage Conditions

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

1. Recommended Storage Condition: The temperature should be 23 ± 5 °C and the relative humidity should be 35–60 %.
2. The storage life (in vacuum-sealed packaging): 12 months in Recommended Storage Condition.
3. Floor life: 168 hours ⁵ 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 drying 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 above occurs;
 - 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 24 hours at 120 ± 5 °C;
 - The module must be soldered to PCB within 24 hours after the baking, otherwise it should be put in a dry environment such as in a drying cabinet.

⁵ 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.

8.2. Manufacturing and Soldering

Push the squeegee to apply the solder paste on the surface of stencil, thus making the paste fill the stencil openings and then penetrate to the PCB. Apply proper force on the squeegee to produce a clean stencil surface on a single pass. To guarantee module soldering quality, the thickness of stencil for the module is recommended to be 0.13–0.15 mm. For more details, see **document [6]**.

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.

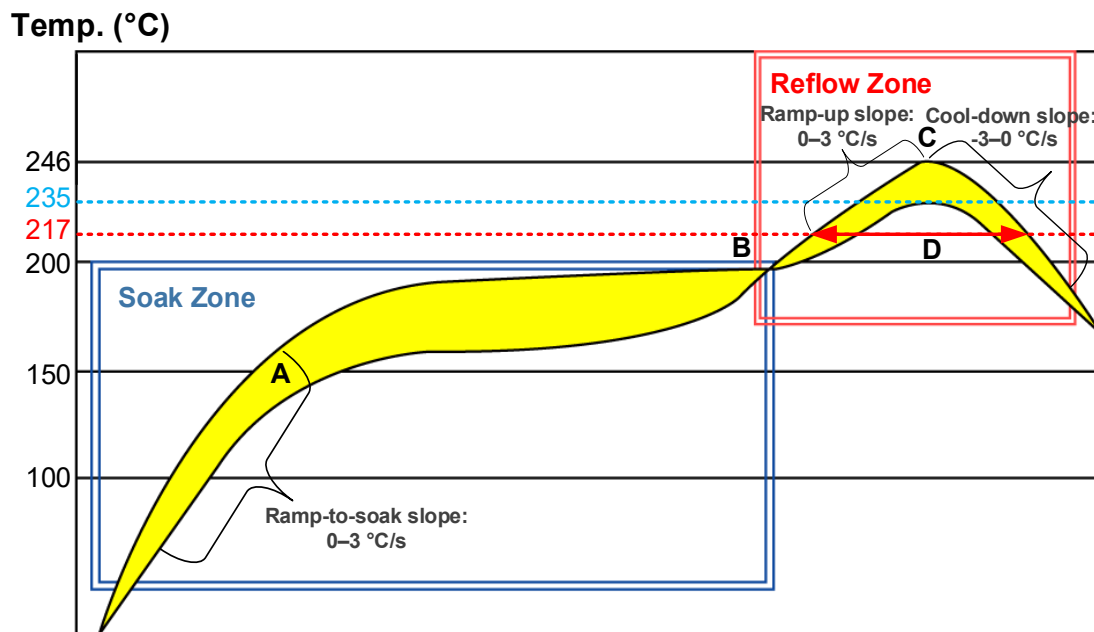


Figure 39: Recommended Reflow Soldering Thermal Profile

Table 40: Recommended Thermal Profile Parameters

Factor	Recommended Value
Soak Zone	
Ramp-up 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 requirement.
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. Avoid using materials that contain mercury (Hg), such as adhesives, for module processing, even if the materials are RoHS compliant and their mercury content is below 1000 ppm (0.1 %).
7. Corrosive gases may corrode the electronic components inside the module, affecting their reliability and performance, and potentially leading to a shortened service life that fails to meet the designed lifespan. Therefore, do not store or use unprotected modules in environments containing corrosive gases such as hydrogen sulfide, sulfur dioxide, chlorine, and ammonia.
8. Due to the complexity of the SMT process, please contact Quectel Technical Supports 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 [7]**.

8.3. Packaging Specification

This chapter outlines the key packaging parameters and processes. All figures below are for reference purposes only, as the actual appearance and structure of packaging materials may vary in delivery.

The modules are packed in a tape and reel packaging as specified in the sub-chapters below.

8.3.1. Carrier Tape

Carrier tape dimensions are illustrated in the following figure and table:

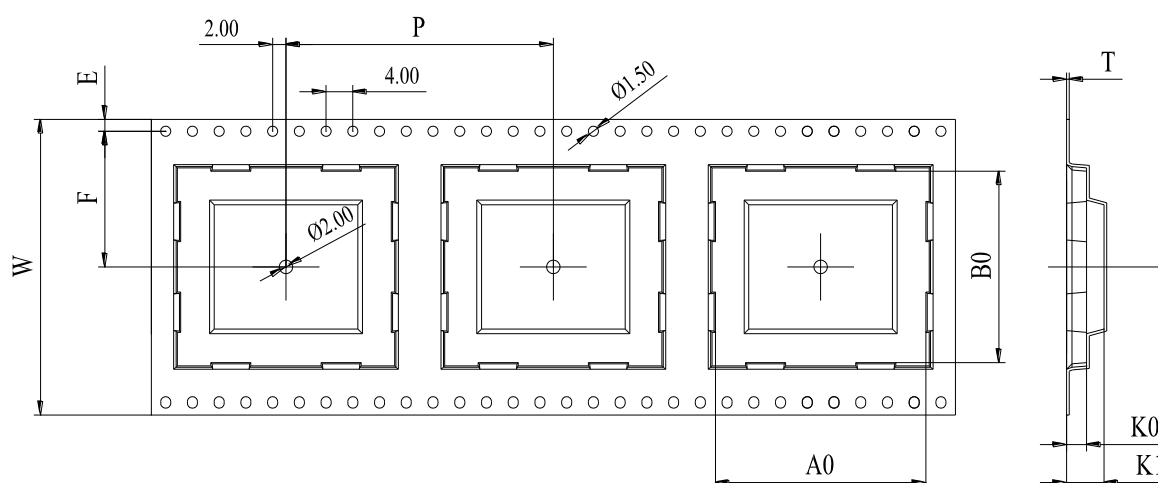


Figure 40: Carrier Tape Dimension Drawing (Unit: mm)

Table 41: Carrier Tape Dimension Table (Unit: mm)

W	P	T	A0	B0	K0	K1	F	E
44	32	0.35	20.2	24	3.15	6.65	20.2	1.75

8.3.2. Plastic Reel

Plastic reel dimensions are illustrated in the following figure and table:

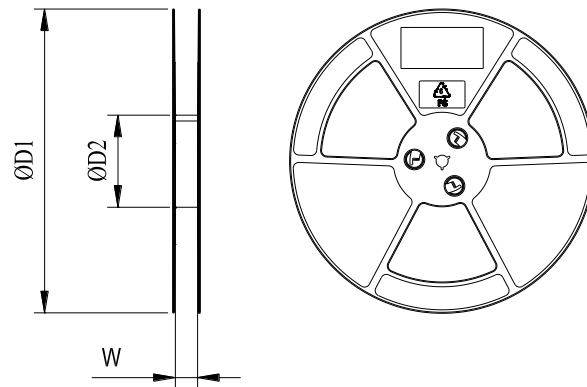


Figure 41: Plastic Reel Dimension Drawing

Table 42: Plastic Reel Dimension Table (Unit: mm)

ØD1	ØD2	W
330	100	44.5

8.3.3. Mounting Direction

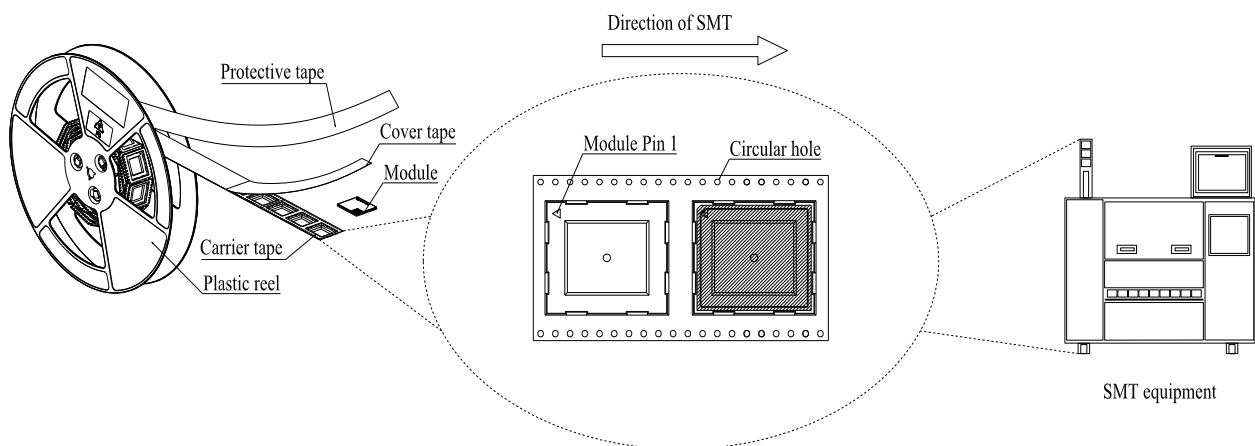
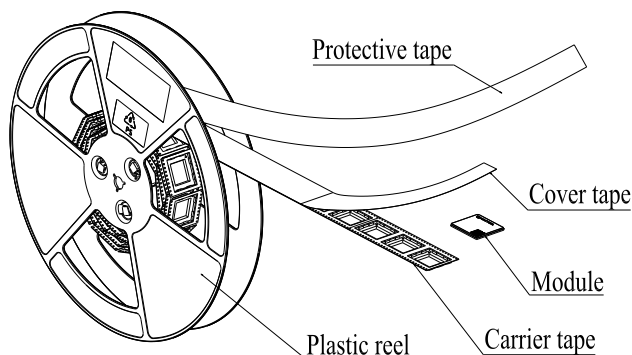


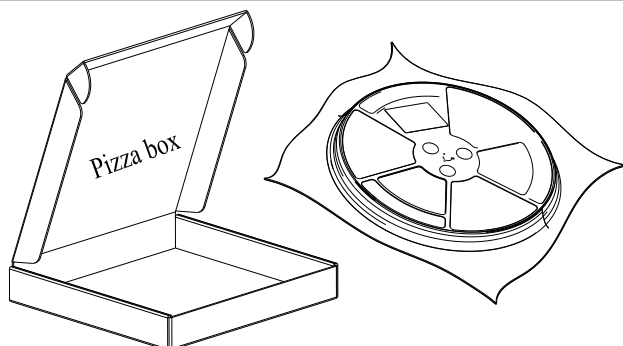
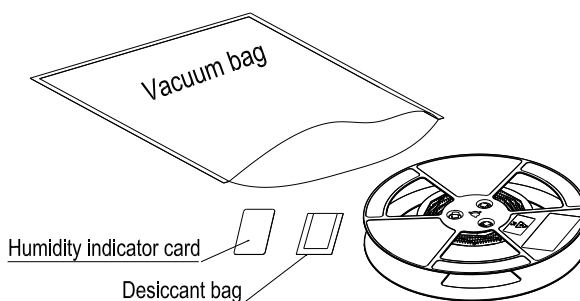
Figure 42: Mounting Direction

8.3.4. Packaging Process



Place the modules onto the carrier tape cavity and cover them securely with cover tape. Wind the heat-sealed carrier tape onto a plastic reel and apply a protective tape for additional protection. 1 plastic reel can pack 250 modules.

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



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

Place the 4 packaged pizza boxes into 1 carton and seal it. 1 carton can pack 1000 modules.

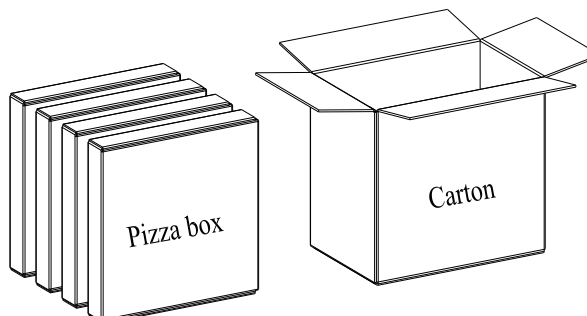


Figure 43: Packaging Process

9 Appendix References

Table 43: Related Documents

Document Name
[1] Quectel_ECx00x&EG800K&EG810M&EG915K&EG915N&EG950A_Series_GNSS_Application_Note
[2] Quectel_EG915K_Series_Reference_Design
[3] Quectel_UMTS<E_EVB_User_Guide
[4] Quectel_ECx00x&EG800AK&EG800K&EG810M&EG91xN&EG915K&EG950A_Series_AT_Commands_Manual
[5] Quectel_RF_Layout_Application_Note
[6] Quectel_Module_Stencil_Design_Requirements
[7] Quectel_Module_SMT_Application_Note

Table 44: Terms and Abbreviations

Abbreviation	Description
3GPP	3rd Generation Partnership Project
ADC	Analog-to-Digital Converter
BB	Baseband
BDS	BeiDou Navigation Satellite System
bps	Bits Per Second
CEP	Circular Error Probable
CHAP	Challenge Handshake Authentication Protocol
Cj	Junction capacitance

CTS	Clear To Send
DC	Direct Current
DFOTA	Delta Firmware Upgrade Over-The-Air
DL	Downlink
DRX	Discontinuous Reception
DTR	Data Terminal Ready
EMI	Electromagnetic Interference
ESD	Electrostatic Discharge
ESR	Equivalent Series Resistance
ETSI	European Telecommunications Standards Institute
EVB	Evaluation Board
FDD	Frequency Division Duplex
FTP	File Transfer Protocol
FTPS	FTP over SSL
GLONASS	Global Navigation Satellite System (Russia)
GND	Ground
GNSS	Global Navigation Satellite System
GPIO	General-Purpose Input/Output
GPS	Global Positioning System
HB	High Band
HTTP	Hyper Text Transfer Protocol
HTTPS	Hyper Text Transfer Protocol over Secure Socket Layer
IMT-2000	International Mobile Telecommunications 2000
I _o max	Maximum Output Load Current
I/O	Input/Output

Ipp	Peak Pulse Current
LB	Low Band
LDO	Low Dropout Regulator
LED	Light Emitting Diode
LGA	Land Grid Array
LNA	Low-Noise Amplifier
LTE	Long Term Evolution
MB	Medium Band
Mbps	Megabits per second
MCU	Microcontroller Unit
ME	Mobile Equipment
MLCC	Multi-layer Ceramic Capacitor
MO	Mobile Origination
MQTT	Message Queuing Telemetry Transport
MSL	Moisture Sensitivity Level
MT	Mobile Terminating
NITZ	Network Identity and Time Zone
NMEA	(National Marine Electronics Association) 0183 Interface Standard
NTP	Network Time Protocol
PAP	Password Authentication Protocol
PCB	Printed Circuit Board
PDU	Protocol Data Unit
PF	Paging Frame
PING	Packet Internet Groper
PMU	Power Management Unit

PPP	Point-to-Point Protocol
PPS	Pulse Per Second
QPSK	Quadrature Phase Shift Keying
RAM	Random Access Memory
RF	Radio Frequency
RHCP	Right Hand Circular Polarization
RoHS	Restriction of Hazardous Substances
RTS	Request to Send
SIMO	Single Input Multiple Output
SMD	Surface Mount Device
SMS	Short Message Service
SMT	Surface Mount Technology
SSL	Secure Sockets Layer
TCP	Transmission Control Protocol
TDD	Time Division Duplexing
TTFF	Time to First Fix
TVS	Transient Voltage Suppressor
UART	Universal Asynchronous Receiver & Transmitter
UDP	User Datagram Protocol
UL	Uplink
UMTS	Universal Mobile Telecommunications System
URC	Unsolicited Result Code
USB	Universal Serial Bus
USIM	Universal Subscriber Identity Module
VBAT	Voltage at Battery (Pin)

V_{IH}	High-level Input Voltage
V_{ILmax}	Maximum Low-level Input Voltage
V_{IL}	Low-level Input Voltage
V_{max}	Maximum Voltage
V_{min}	Minimum Voltage
V_{nom}	Nominal Voltage
V_{OH}	High-level Output Voltage
V_{OL}	Low-level Output Voltage
V_{RWM}	Working Peak Reverse Voltage
VSWR	Voltage Standing Wave Ratio

FCC Statement

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

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

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

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

The device must not be co-located or operating in conjunction with any other antenna or transmitter. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

FCC Radiation Exposure Statement

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

Does not comply with the use restrictions of the product:

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

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

2.2 List of applicable FCC rules

FCC Part 15 Subpart B, FCC Part 15 Subpart C 15.247 & 15.209

2.3 Specific operational use conditions

The module can be used for mobile applications with a maximum 3.6dBi antenna. The host manufacturer installing this module into their product must ensure that the final product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation. The host manufacturer has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as shown in this manual.

2.4 Limited module procedures

Not applicable. The module is a Single module and complies with the requirement of FCC Part 15.212.

2.5 Trace antenna designs

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

2.6 RF exposure considerations

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

2.7 Antennas

Antenna Specification are as follows:

Type: External Antenna

Gain: 3.6 dBi Max

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

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

2.8 Label and compliance information

Host product manufacturers need to provide a physical or e-label stating "Contains FCC ID: XMR2025EG915KLALA" with their finished product.

2.9 Information on test modes and additional testing requirements

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

2.10 Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is only FCC authorized for FCC Part 15 Subpart C 15.247 & 15 209 and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification.If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

Federal Communication Commission Statement (FCC, U S)

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant

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

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

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

FCC Caution:

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

IMPORTANT NOTES

Co-location warning:

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

OEM integration instructions:

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

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

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

Validity of using the module certification:

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

End product labeling:

The final end product must be labeled in a visible area with the following: "Contains Transmitter Module FCC ID: XMR2025EG915KLALA"

Information that must be placed in the end user manual:

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