EG915Q-NA&EG916Q-GL

Hardware Design

LTE Standard Module Series

Version: 1.1

Date: 2023-10-19

Status: Released

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

Quectel Wireless Solutions Co., Ltd.
Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai 200233, China
Tel: +86 21 5108 6236
Email: info@quectel.com

Or our local offices. For more information, please visit:
http://www.quectel.com/support/sales.htm.

For technical support, or to report documentation errors, please visit:
http://www.quectel.com/support/technical.htm.
Or email us at: support@quectel.com.

Legal Notices

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

Use and Disclosure Restrictions

License Agreements

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

Copyright

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

Trademarks

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

Third-Party Rights

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

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

Privacy Policy

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

Disclaimer

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

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

Safety Information

The following safety precautions must be observed during all phases of operation, such as usage, service or repair of any 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
-	2022-11-28	Lex LI/ Lena HUANG	Creation of the document
1.0	2023-02-06	Lex LI/ Barry DENG	First official release
1.1	2023-10-19	Lex LI/ Barry DENG/ Zoey CAO/ Sean FANG	1. Added an applicable module EG916Q-GL. 2. Updated the following pins: pin 25: from SPI_CS to RESERVED. pin 26: from SPI_CLK to RESERVED. pin 27: from SPI_MOSI to GNSS_TXD. pin 28: from SPI_MISO to GNSS_RXD. pin 49: from RESERVED to ANT_GNSS. pin 51: from RESERVED to GNSS_PPS. pin 84: from RESERVED to USIM2_CLK. pin 85: from RESERVED to USIM2_RST. pin 86: from RESERVED to USIM2_DATA. pin 87: from RESERVED to USIM2_VDD. pin 109: from RESERVED to GNSS_ DBG_TXD. pin 110: from RESERVED to GNSS_ DBG_RXD. pin 112: from RESERVED to GNSS_RST. pin 117: from RESERVED to GNSS_PWR_EN. pin 118: from RESERVED to GNSS_VBCKP. 3. Deleted LTE-FDD B14 and B71 (Tables 3, 28, 31 & 40). 4. Added Wi-Fi Scan function (Table 3). 5. Updated the information about USIM interfaces (Table 4 & Chapter 4.3). 6. Updated the USB serial drivers, internet protocol features and the information about SPI interface (Table 4). 7. Updated the functional diagram (Figure 1).

	8. Added the operating modes of GNSS part (Chapter 3.1.2). 9. Added the summary of LTE and GNSS Parts' State in All-in-one solution (Chapter 3.1.3). 10. Added the summary of LTE and GNSS Parts' State in stand-alone solution (Chapter 3.1.4). 11. Added the reference design information for the power supply of GNSS part (Chapter 3.2.2).

Contents

Table Index

Figure Index

1 Introduction

This document describes the EG915Q-NA and EG916Q-GL features, performance, and air interfaces and hardware interfaces connected to your applications. The document provides a quick insight into interface specifications, RF performance, electrical and mechanical specifications, and other module information, as well.

1.1. Special Marks

Table 1: Special Marks

Marks	Definitions
*	Unless otherwise specified, when an asterisk (*) is used after a function, feature, interface, pin name, AT command, argument, and so on, it indicates that the function, feature, interface, pin, AT command, argument, and so on, is under development and currently not supported; and the asterisk (*) after a model indicates that the sample of the model is currently unavailable.
[…]	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

EG915Q-NA and EG916Q-GL are SMD modules with compact packaging, which also support GNSS to meet your specific application demands.

Table 2: Basic Information

Item	EG915Q-NA	EG916Q-GL
Packaging type	LGA	LGA
Pin counts	126	126
Dimensions	(23.6 ±0.2) mm × (19.9 ±0.2) mm × (2.4 ±0.2) mm	(26.5 ±0.2) mm × (22.5 ±0.2) mm × (2.4 ±0.2) mm
Weight	Approx. 2.3 g	Approx. 2.9 g

2.1. Frequency Bands and Functions

Table 3: Frequency Bands and Functions

Technology	EG915Q-NA	EG916Q-GL
LTE-FDD	B2/B4/B5/B12/B13/B66	B1/B2/B3/B4/B5/B7/B8/B12/B13/B18/ B19/B20/B25/B26/B28/B66
LTE-TDD	-	B34/B38/B39/B40/B41
GNSS (Optional)	GPS, GLONASS, BDS, Galileo, QZSS	GPS, GLONASS, BDS, Galileo, QZSS
Wi-Fi Scan	√	√

NOTE

"√" : Supported.

2.2. Key Features

Table 4: Key Features

Categories	Descriptions
Supply Voltage	● 3.3–4.3 V ● Typ.: 3.8 V
SMS	● Text and PDU mode ● Point-to-point MO and MT ● SMS cell broadcast ● SMS storage: ME by default
USIM Interfaces	● Support 2 USIM interfaces: USIM1 interface and USIM2 interface ● Only support dual card single standby ● USIM1: 1.8/3.0 V ● USIM2: 1.8 V ● When USIM1 and USIM2 are used at the same time, the power domain of USIM interfaces should be 1.8 V. Otherwise, USIM2 interface will be damaged. ● USIM2 and Camera SPI interface* cannot be used at the same time.
PCM Interface*	● Supports one digital audio interface: PCM interface ● Used for audio function with external Codec
I2C Interface*	● One I2C interface ● Complies with I2C-bus specification
Camera SPI Interface*	● Supports one camera SPI Interface ● Supports the 2-bit data transmission of SPI ● USIM2 and Camera SPI interface cannot be used at the same time.
USB Interface	● Compliant with USB 2.0 specifications (only supports slave mode) ● Data rate up to 480 Mbps ● Used for AT command communication, data transmission, GNSS NMEA sentence output (**All-in-one** mode only), software debugging, firmware upgrade and the output of partial logs ● USB serial drivers: supports USB serial driver for Windows 7/8/8.1/10/11, Linux 2.6–6.5, Android 4.x–13.x systems
UART Interfaces	**Main UART:** ● Used for AT command communication and data transmission ● Baud rate: 115200 bps by default ● RTS and CTS hardware flow control **Debug UART:** ● Used for the output of partial logs ● Baud rate: up to 3 Mbps, 115200 bps by default **GNSS UART:** ● Used for outputting GNSS data or GNSS NMEA sentence output

	● Baud rate: 921600 bps **GNSS debug UART:** ● Used for outputting GNSS system logs ● Baud rate: 3 Mbps
Network Indication	**NET_STATUS:** ● Used for indicating network connectivity status
AT Commands	● Complies with the AT commands defined in *3GPP TS 27.007* and *3GPP TS 27.005* ● Complies with Quectel enhanced AT commands
Antenna Interface	● Main antenna interface (ANT_MAIN) ● GNSS antenna interface (ANT_GNSS) ● 50 Ω characteristic impedance
Transmitting Power	● LTE bands: Class 3 (23 dBm ±2 dB)
LTE Features	● Complies with 3GPP Rel-14 FDD ● Max. LTE category: Cat 1 bis ● 1.4/3/5/10/15/20 MHz RF bandwidth ● DL modulations: QPSK, 16QAM and 64QAM ● UL modulations: QPSK, 16QAM ● LTE-FDD Max. data rates: 10 Mbps (DL)/5 Mbps (UL)
Internet Protocol Features	● Complies with TCP/UDP/NTP/NITZ/FTP/HTTP/PING/HTTPS/FTPS/SSL/MQTT/CMUX/PPP/FILE/SMTP/SMTPS/MMS* protocols ● Complies with PPP protocol's PAP and CHAP authentication
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 fully comply with EU RoHS directive

NOTE

EG915Q-NA and EG916Q-GL support SPI interface. If you need this function, please contact Quectel Technical Support.

[1] Within the operating temperature range, the module meets 3GPP specifications.
[2] Within the extended temperature range, the module remains the ability to establish and maintain functions such as SMS and data transmission, without any unrecoverable malfunction. Radio spectrum and radio network are not influenced, while one or more specifications, such as P_{out}, may exceed the specified tolerances of 3GPP. When the temperature returns to the operating temperature range, the module meets 3GPP specifications again.

2.3. Pin Assignment

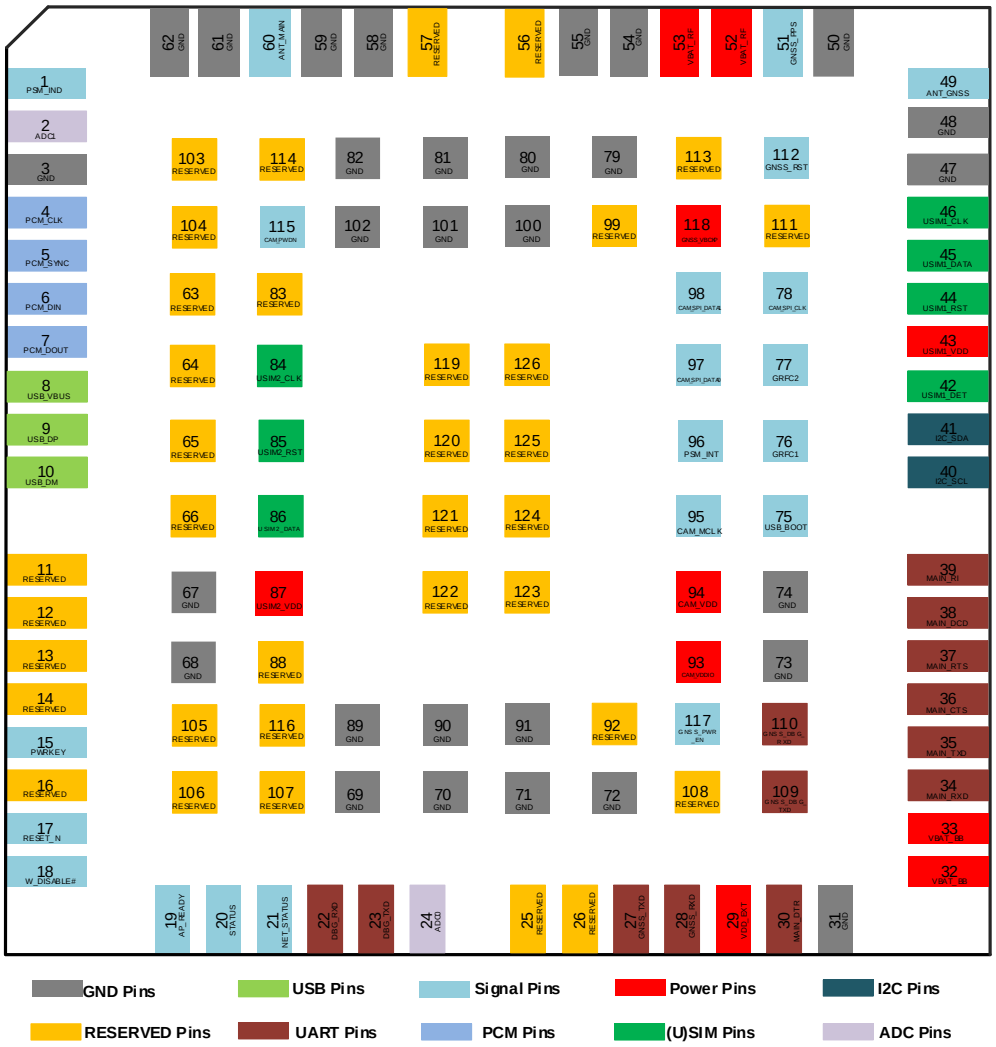


Figure 1: EG915Q-NA Pin Assignment (Top View)

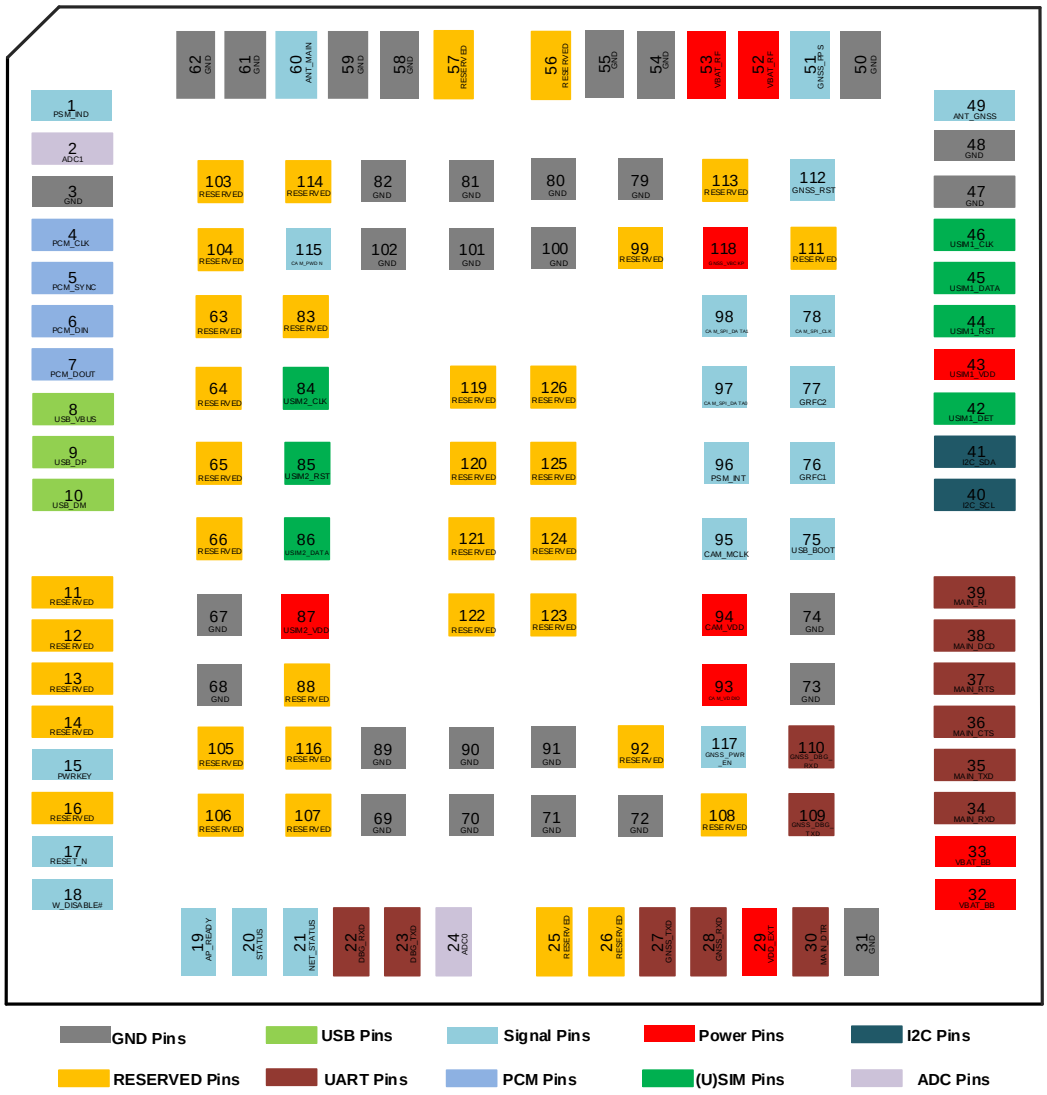


Figure 2: EG916Q-GL Pin Assignment (Top View)

NOTE

1. If the module does not need to enter emergency download mode, USB_BOOT (pin 75) should not be pulled up to VDD_EXT before the module successfully starts up.
2. In sleep mode, pins 34–37 of the main UART interface, pins 22 and 23 of debug UART interface, USB_BOOT (pin 75), pins 4–7 of PCM interface*, pins 40 and 41 of I2C interface*, and pins 78, 93, 95, 97, 98 and 115 of Camera SPI interface* are powered down. The driving capacity will be lost and the functions of status indication and data transmission are disabled. Pay attention to it when designing circuits.
3. When USIM1 and USIM2 are used at the same time, the power domain of USIM interfaces should

be 1.8 V. Otherwise, USIM2 interface will be damaged.
4. The module supports SPI interface. If you need this function, please contact Quectel Technical Support.
5. GNSS interface (Pins 27, 28, 49, 51, 109, 110, 112, 117, 118) is optional. If you need this function, please contact Quectel Technical Support.
6. USIM2 and Camera SPI interface* cannot be used at the same time.
7. Keep all RESERVED pins and unused pins unconnected.

2.4. Pin Description

Table 5: Parameter Definition

Parameters	Descriptions
AI	Analog Input
AIO	Analog Input/Output
DI	Digital Input
DO	Digital Output
DIO	Digital Input/Output
PI	Power Input
PO	Power Output

DC characteristics include power domain and rated current.

Table 6: Pin Description

Power Supply					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristic**	**Comment**
VBAT_BB	32, 33	PI	Power supply for the module's BB part	Vmax = 4.3 V Vmin = 3.3 V Vnom = 3.8 V	It must be provided with sufficient current of 0.5 A at least. A test point is recommended to be reserved.

VBAT_RF	52, 53	PI	Power supply for the module's RF part		It must be provided with sufficient current up to 1.5 A. A test point is recommended to be reserved.
VDD_EXT	29	PO	Provides 1.8 V for external circuit	Vnom = 1.8 V $I_O$max = 50 mA	Power supply for external GPIO's pull-up circuits. A test point is recommended to be reserved.
GNSS_ VBCKP [3]	118	PI	Power supply for GNSS RTC	Vmax = 3.6 V Vmin = 1.9 V Vnom = 3.3 V	If unused, keep it open.
GND	3, 31, 47, 48, 50, 54, 55, 58, 59, 61, 62, 67–74, 79–82, 89–91, 100–102				
Turn On/Off					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristic**	**Comment**
PWRKEY	15	DI	Turns on/off the module	V_{IL}max = 0.5 V	Active low. A test point is recommended to be reserved.
RESET_N	17	DI	Reset the module		Active low. A test point is recommended to be reserved if unused.
Indication Signals					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristic**	**Comment**
STATUS	20	DO	Indicates the module's operation status	VDD_EXT	If unused, keep them open.
NET_STATUS	21	DO	Indicates the module's network activity status		
USB Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristic**	**Comment**
USB_VBUS	8	AI	USB connection detect	Vmax = 5.25 V Vmin = 3.0 V	A test point must be reserved.

[3] This pin is optional. If you need this function, please contact Quectel Technical Support.

				Vnom = 5.0 V	
USB_DP	9	AIO	USB differential data (+)		USB 2.0 compliant. Requires differential impedance of 90 Ω. Test points must be reserved.
USB_DM	10	AIO	USB differential data (-)		
USIM Interfaces [4]					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristic**	**Comment**
USIM1_VDD	43	PO	USIM1 card power supply	$I_O$max = 50 mA **Low-voltage:** Vmax = 1.85 V Vmin = 1.75 V **High-voltage:** Vmax = 3.05 V Vmin = 2.95 V	Either 1.8 V or 3.0 V USIM1 card is supported and can be identified automatically by the module.
USIM1_DATA	45	DIO	USIM1 card data	USIM1_VDD	
USIM1_CLK	46	DO	USIM1 card clock		
USIM1_RST	44	DO	USIM1 card reset		
USIM1_DET	42	DI	USIM1 card hot-plug detect	VDD_EXT	If unused, keep it open.
USIM2_VDD [5]	87	PO	USIM2 card power supply	USIM1_VDD **(Low-voltage)**	Connected with USIM1_VDD inside the module. 1.8 V power domain is required for USIM2. Otherwise, this interface will be damaged.
USIM2_DATA [5]	86	DIO	USIM2 card data	VDD_EXT	Connected with pin 97 (CAM_SPI_DATA0) internally. 1.8 V power domain is required for USIM2. Otherwise, this interface will be

[4] When USIM1 and USIM2 are used at the same time, the power domain of USIM interfaces should be 1.8 V. Otherwise, USIM2 interface will be damaged.
[5] USIM2 and Camera SPI interface* cannot be used at the same time.

					damaged.
USIM2_RST [5]	85	DO	USIM2 card reset		Connected with pin 78 (CAM_SPI_CLK) internally. 1.8 V power domain is required for USIM2. Otherwise, this interface will be damaged.
USIM2_CLK [5]	84	DO	USIM2 card clock		Connected with pin 115 (CAM_PWDN) internally. 1.8 V power domain is required for USIM2. Otherwise, this interface will be damaged.
Main UART					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristic**	**Comment**
MAIN_CTS	36	DO	Clear to send signal from the module	VDD_EXT	Connect to MCU's CTS. If unused, keep it open.
MAIN_RTS	37	DI	Request to send signal to the module		Connect to MCU's RTS. If unused, keep it open.
MAIN_RXD	34	DI	Main UART receive		If unused, keep them open.
MAIN_DCD	38	DO	Main UART data carrier detect		
MAIN_TXD	35	DO	Main UART transmit		
MAIN_RI	39	DO	Main UART ring indication		
MAIN_DTR	30	DI	Main UART data terminal ready		
Debug UART					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristic**	**Comment**

DBG_RXD	22	DI	Debug UART receive	VDD_EXT	Test points must be reserved.
DBG_TXD	23	DO	Debug UART transmit		
GNSS UART					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristic**	**Comment**
GNSS_TXD [3]	27	DO	GNSS UART transmit	VDD_EXT	If unused, keep them open.
GNSS_RXD [3]	28	DI	GNSS UART receive		
GNSS debug UART					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristic**	**Comment**
GNSS_DBG_TXD [3]	109	DO	GNSS debug UART transmit	VDD_EXT	Test points must be reserved.
GNSS_DBG_RXD [3]	110	DI	GNSS debug UART receive		
I2C Interface*					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristic**	**Comment**
I2C_SCL	40	DO	I2C serial clock	VDD_EXT	External pull-up resistor is required. If unused, keep them open.
I2C_SDA	41	DIO	I2C serial data		
PCM Interface*					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristic**	**Comment**
PCM_SYNC	5	DO	PCM data frame sync	VDD_EXT	If unused, keep them open.
PCM_CLK	4	DO	PCM clock		
PCM_DIN	6	DI	PCM data input		
PCM_DOUT	7	DO	PCM data output		
RF Antenna Interface					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristic**	**Comment**
ANT_MAIN [6]	60	AIO	Main antenna interface		50 Ω impedance.

[6] ANT_MAIN only supports passive antennas.

ANT_GNSS [3]	49	AI	GNSS antenna interface		50 Ω impedance.
GRFC Interfaces					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristic**	**Comment**
GRFC1	76	DO	Generic RF controller	VDD_EXT	If unused, keep them open.
GRFC2	77	DO	Generic RF controller		
Camera SPI Interface* [5]					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristic**	**Comment**
CAM_MCLK	95	DO	Master clock of the camera	VDD_EXT	If unused, keep it open.
CAM_SPI_CLK	78	DI	Camera SPI clock		Connected with pin 85 (USIM2_RST) internally. If unused, keep it open.
CAM_SPI_DATA0	97	DI	Camera SPI data bit 0		Connected with pin 86 (USIM2_DATA) internally. If unused, keep it open.
CAM_SPI_DATA1	98	DI	Camera SPI data bit 1		If unused, keep it open.
CAM_PWDN	115	DO	Power down of the camera		Connected with pin 84 (USIM2_CLK) internally. If unused, keep it open.
CAM_VDD	94	PO	Camera analog power supply	Vnom = 2.8 V	If unused, keep them open.
CAM_VDDIO	93	PO	Camera digital power supply	VDD_EXT	
ADC Interfaces					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristic**	**Comment**
ADC0	24	AI	General-purpose ADC interface	Voltage range: 0–1.2 V	If unused, keep them open.
ADC1	2	AI	General-purpose ADC interface		

Other Interfaces					
Pin Name	**Pin No.**	**I/O**	**Description**	**DC Characteristic**	**Comment**
USB_BOOT	75	DI	Forces the module into emergency download mode	VDD_EXT	Active high before power-up. A test point must be reserved.
W_DISABLE#	18	DI	Airplane mode control		If unused, keep them open.
PSM_IND*	1	DO	Indicates the module's power saving mode		
PSM_INT*	96	DI	External interrupt; wake up the module from power saving mode		
AP_READY*	19	DI	Application processor ready		
GNSS_PPS [3]	51	DO	GNSS pulse per second output		
GNSS_RST [3]	112	DI	Resets the GNSS chip		
GNSS_PWR_EN [3]	117	DI	GNSS power enabled		
RESERVED Pins					
Pin Name	**Pin No.**				**Comment**
RESERVED	11–14, 16, 25, 26, 56, 57, 63–66, 83, 88, 92, 99, 103–108, 111, 113, 114, 116, 119–126				Keep these pins open.

2.5. EVB Kit

To help you develop applications with the module, Quectel supplies an evaluation board (UMTS&LTE EVB) with accessories to develop or test the module. For more details, see ***document [1]***.

3 Operating Characteristics

3.1. Operating Modes

The module integrates both LTE and GNSS engines which can work as a whole (**All-in-one** solution) unit or work independently (**Stand-alone** solution) according to your demands.

3.1.1. Operating Modes of LTE Part

Table 7: Operating Modes Overview of LTE Part

Modes	Descriptions	
Full Functionality Mode	Idle	Software is active. The module is 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 rate.
Minimum Functionality Mode	● **AT+CFUN=0** can set the module to the minimum functionality mode when the power is on. ● Both RF function and USIM card will be invalid.	
Airplane Mode	● **AT+CFUN=4** or driving W_DISABLE# low can set the module to airplane mode. ● RF function will be invalid.	
Sleep Mode	Power consumption of the module will be reduced to a minimal level. The module can still receive paging, SMS and TCP/UDP data from the network.	
Power Down Mode	The VBAT_BB and VBAT_RF pins are constantly turned on and the software stops working.	

NOTE

For more details about **AT+CFUN**, see ***document [2]***.

3.1.1.1. Sleep Mode

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

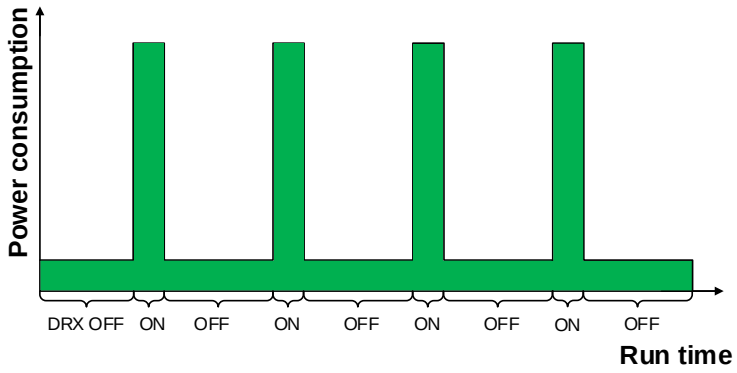


Figure 3: Power Consumption During Sleep Mode

NOTE

The DRX cycle values are transmitted sent over the wireless network.

3.1.1.2. UART Application Scenario

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

- Execute **AT+QSCLK=1**. For more details, see ***document [2]***.
- Ensure MAIN_DTR is held high or is kept unconnected.

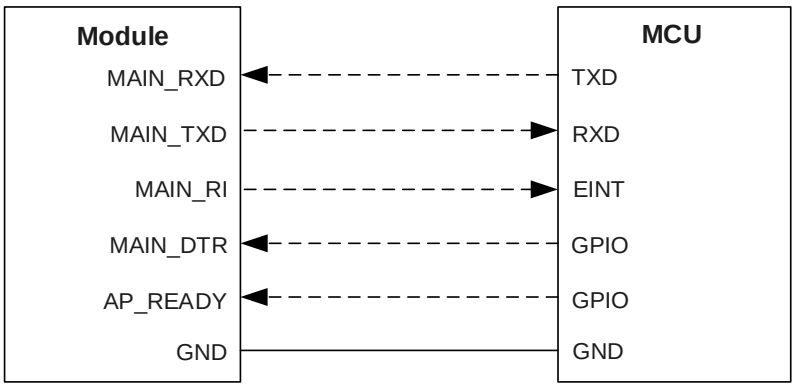


Figure 4: Sleep Mode Application via UART

- 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. See ***Chapter 4.10.3*** for details about MAIN_RI.

3.1.1.3. USB Application with USB Remote Wakeup Function*

If the host supports USB suspend/resume and remote wakeup functions, the following three preconditions must be met to set the module to sleep mode.

- Execute **AT+QSCLK=1**.
- Ensure MAIN_DTR is held high or is kept unconnected.
- Ensure the host's USB bus, which is connected to the module's USB interface, enters suspend state.

The following figure illustrates the connection between the module and the host when the host supports USB suspend, resume and remote wakeup function.

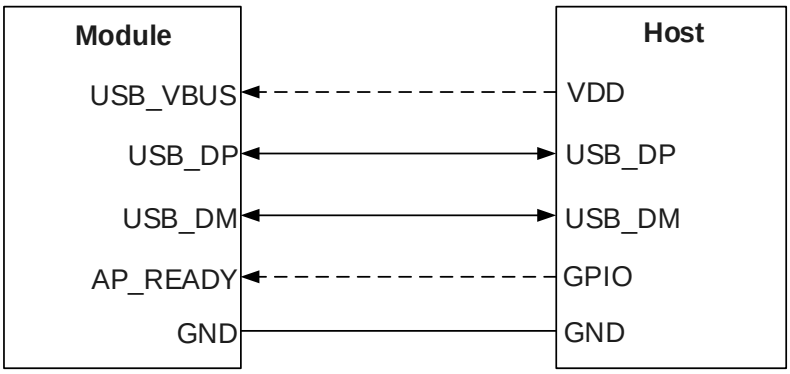


Figure 5:Sleep Mode Application with USB Suspend/Resume and Remote Wakeup

- Sending data to the module through USB 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.

3.1.1.4. USB Application 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 three preconditions must be met to set the module to sleep mode.

- Execute **AT+QSCLK=1**.
- Ensure MAIN_DTR is held high or is kept unconnected.
- Ensure the host's USB bus, which is connected to the module's USB interface, enters suspend state.

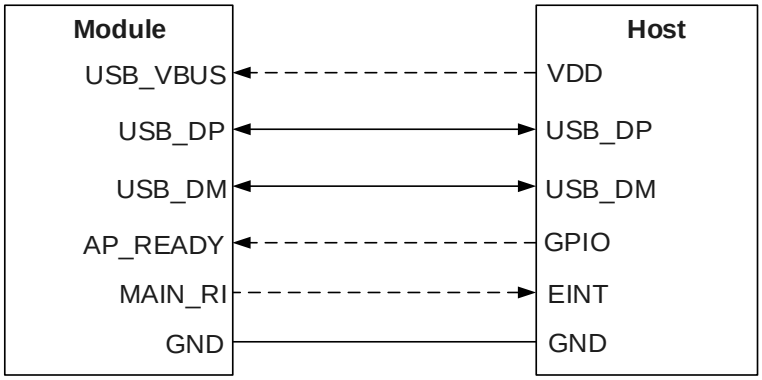


Figure 6: Sleep Mode Application with USB Suspend/Resume and MAIN_RI

- Sending data to the module through USB will wake up the module.
- When the module has a URC to report, the module will wake up the host through MAIN_RI signal. See ***Chapter 4.10.3*** for details about MAIN_RI behavior.

3.1.1.5. USB Application without USB Suspend Function

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

- Execute **AT+QSCLK=1**.
- Ensure MAIN_DTR is held high or is kept unconnected.
- Ensure USB_VBUS is disconnected via the external control circuit.

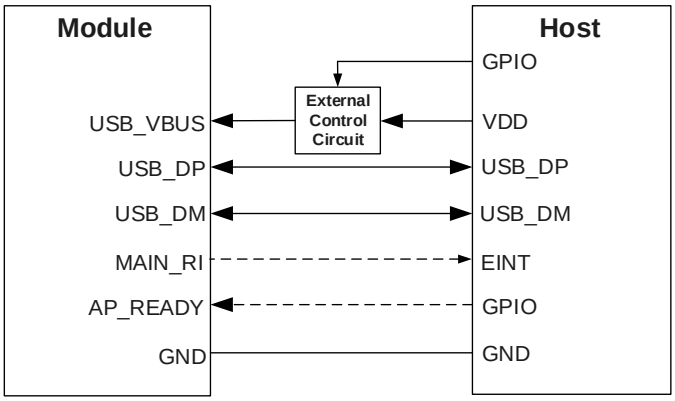


Figure 7: Sleep Mode Application without USB Suspend

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

NOTE

Pay attention to the level match shown in the dotted line between the module and the host.

3.1.1.6. Airplane Mode

When the module enters airplane mode, the RF function will be disabled, and all AT commands correlative with RF function will be inaccessible. This mode can be set via the following methods.

Hardware:

W_DISABLE# is pulled up by default. Driving it low makes the module enter airplane mode.

Software:

AT+CFUN=<fun> provides choice of the functionality level via setting **<fun>** to 0, 1 or 4. For more details, see ***document [2]***.

- **AT+CFUN=0**: Minimum functionality mode (Both USIM and RF functions are disabled).
- **AT+CFUN=1**: Full functionality mode (By default).
- **AT+CFUN=4**: Airplane mode (RF function is disabled).

3.1.2. Operating Modes of GNSS Part

Table 8: Operating Modes Overview of GNSS Part

Modes	Descriptions
Continuous Mode	● GNSS starts to work. It can automatically locate, track, and continuously output positioning information. ● GNSS RF reception function is enabled. ● Entry conditions: GNSS_PWR_EN is at high-level and GNSS_VBCKP is powered on, the module will automatically enter the Continuous mode. ● Continuous mode includes acquisition mode and tracking mode. – **Acquisition mode**: The module starts to search satellites, and to determine visible satellites, coarse frequency, as well as the code phase of satellite signals. When the acquisition is completed, the module automatically switches to tracking mode. – **Tracking mode**: The module tracks satellites and demodulates the navigation data from specific satellites.
Backup Mode*	● Most system components will be shut down to save power consumption. ● Navigation data will be stored in the backup area for quick positioning next time.

Power Down Mode	●	The power supply inside and outside the GNSS is cut off. The software stops working.

3.1.3. Summary of LTE and GNSS Parts' State in All-in-one Solution

In **All-in-one** solution, LTE part and GNSS part can be worked as a whole unit. The GNSS part can be regarded as a peripheral of the LTE part. Without an external power supply, the LTE part can internally control the LDO to supply power to the GNSS. If the LTE part is disabled, the GNSS will not work. This allows for convenient communication between LTE and GNSS parts, such as AT command sending for GNSS control, and AGPS data injection.

It should be noted that the output of the GNSS part is switched by an analog switch inside the module. In **All-in-one** mode, the GNSS serial port (pins 27 and 28) of the module is not connected inside.

The schematic diagram of **All-in-one** solution is shown below.

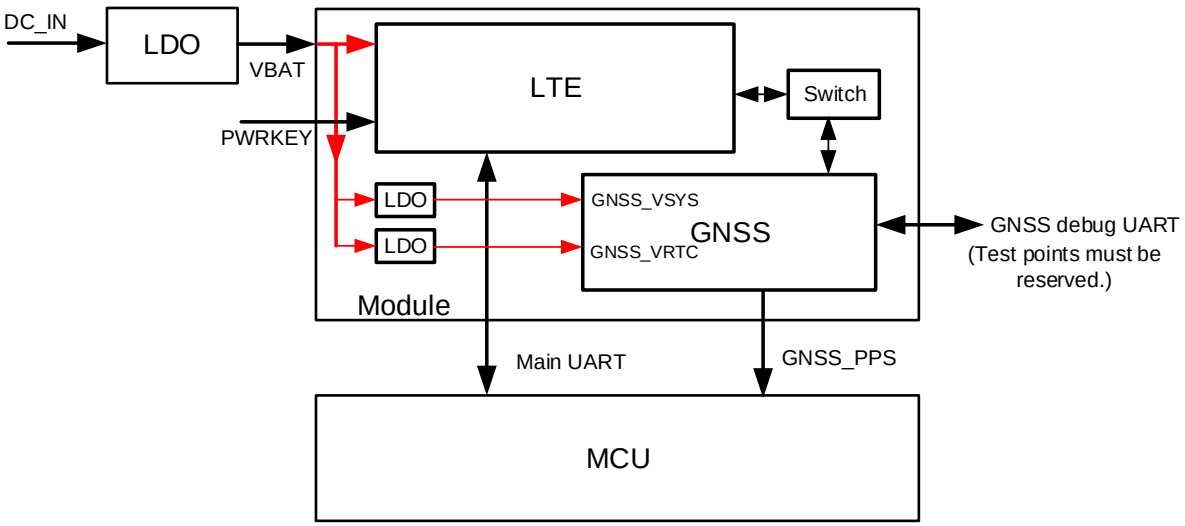


Figure 8: All-in-one Solution Schematic Diagram

3.1.4. Summary of LTE and GNSS Parts' State in Stand-alone Solution

In **Stand-alone** solution, LTE and GNSS parts work separately. Thus, they should be controlled separately by MCU. A lithium battery can be added externally to power GNSS_VBCKP independently. You can use MCU to control GNSS_VSYS to power on GNSS chip. At this time, the LTE part does not need to be enabled, and the GNSS part can still work.

The schematic diagram of **Stand-alone** solution is shown below.

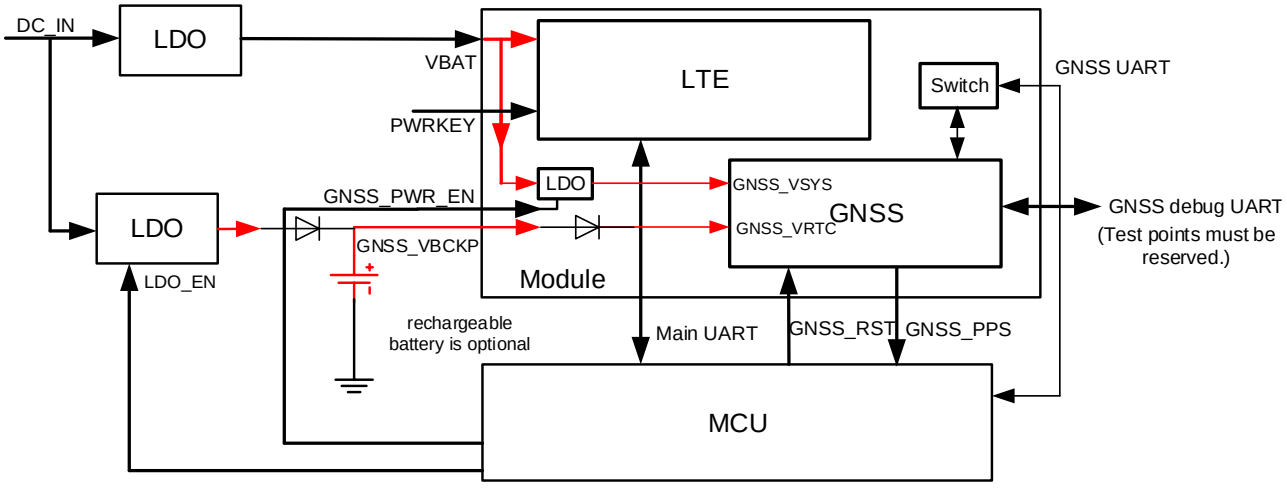


Figure 9: Stand-alone Solution Schematic Diagram

3.2. Power Supply

3.2.1. Power Supply Pins

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

Table 9: Pin Description of Power Supply Interface

Pin Name	Pin No.	I/O	Description	Min.	Typ.	Max.	Units
VBAT_BB	32, 33	PI	Power supply for the module's BB part	3.3	3.8	4.3	V
VBAT_RF	52, 53	PI	Power supply for the module's RF part	3.3	3.8	4.3	V
GNSS_VBCKP	118	PI	Power supply for GNSS RTC	1.9	3.3	3.6	V
GND	3, 31, 47, 48, 50, 54, 55, 58, 59, 61, 62, 67–74, 79–82, 89–91, 100–102						

3.2.2. Reference Design for Power Supply

Power design for the module is essential.

For LTE part, the power supply of the module should be able to provide sufficient current of at least 2 A. If the voltage difference between 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.

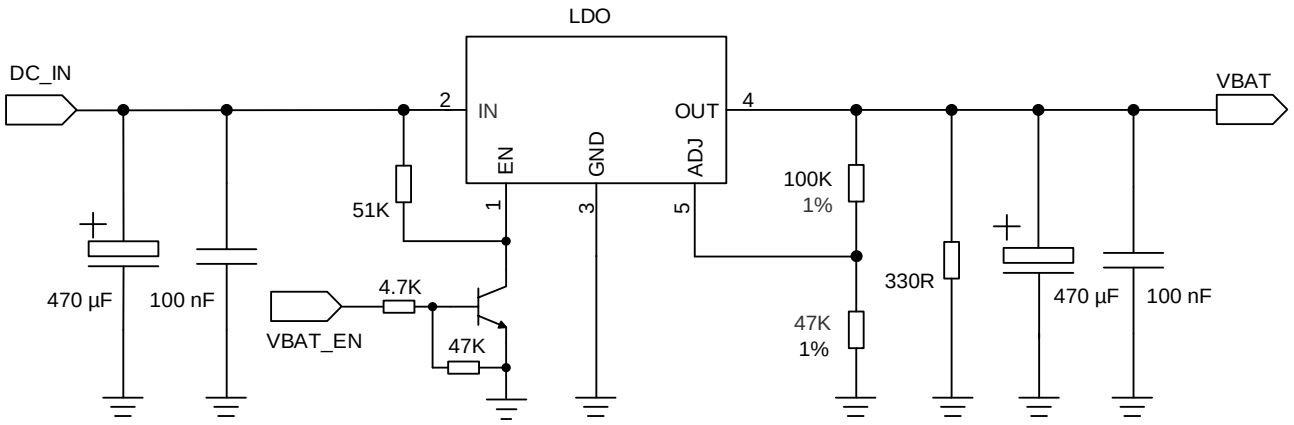


Figure 10: Reference Design of Power Input

NOTE

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

For the power supply of GNSS part:

- In **All-in-one** solution, the power supply of GNSS part is controlled by the LTE part internally.
- In **Stand-alone** solution, the power supply of GNSS part is controlled independently by MCU.

For more information about **All-in-one** solution and **Stand-alone** solution, see ***Chapter 3.1.3 & 3.1.4***.

3.2.3. Voltage Stability Requirements

The power supply range of the module is 3.3–4.3 V. Ensure the input voltage never drops below 3.3 V.

To decrease the voltage drop, use a bypass capacitor of about 100 µF with low ESR for VBAT_BB and VBAT_RF respectively and reserve a multi-layer ceramic chip (MLCC) capacitor array with ultra-low ESR. Use three ceramic capacitors (100 nF, 33 pF and 10 pF) for composing the MLCC array, and place these capacitors close to the VBAT pins. The main power supply from an external application should be a single voltage source and can be expanded to two sub paths with the star configuration. The width of VBAT_BB trace and VBAT_RF trace should be at least 1 mm and 2 mm respectively. In principle, the longer the VBAT trace is, the wider it should be.

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

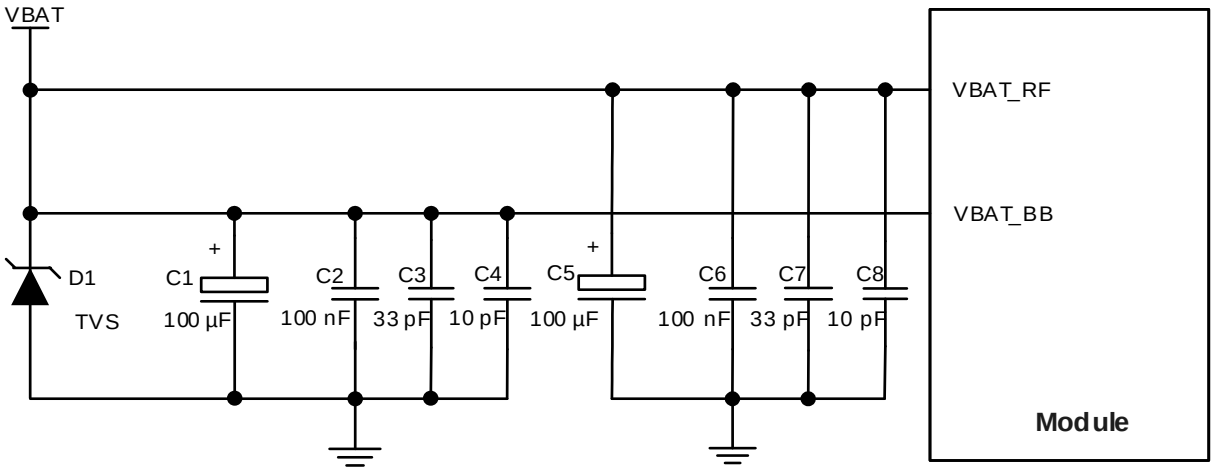


Figure 11: Reference Design of Power Supply

3.3. Turn On

3.3.1. Turn On with PWRKEY

Table 10: Pin Description of PWRKEY

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

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

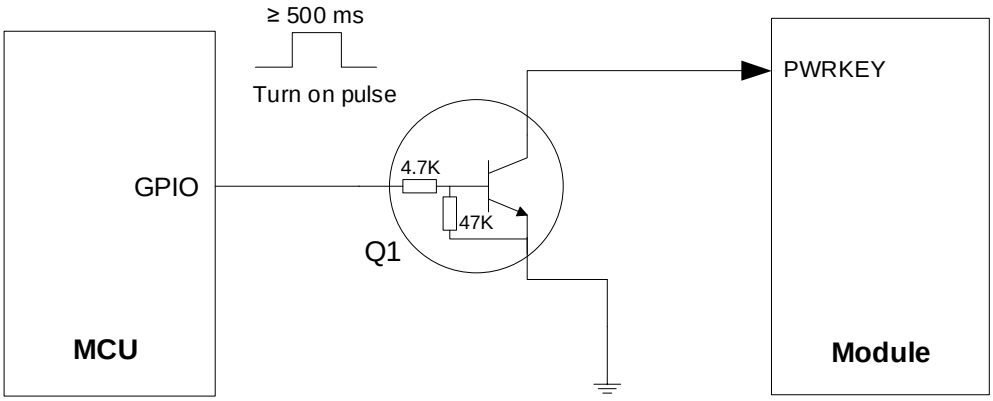


Figure 12: Reference Design of Turn On with Driving Circuit

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

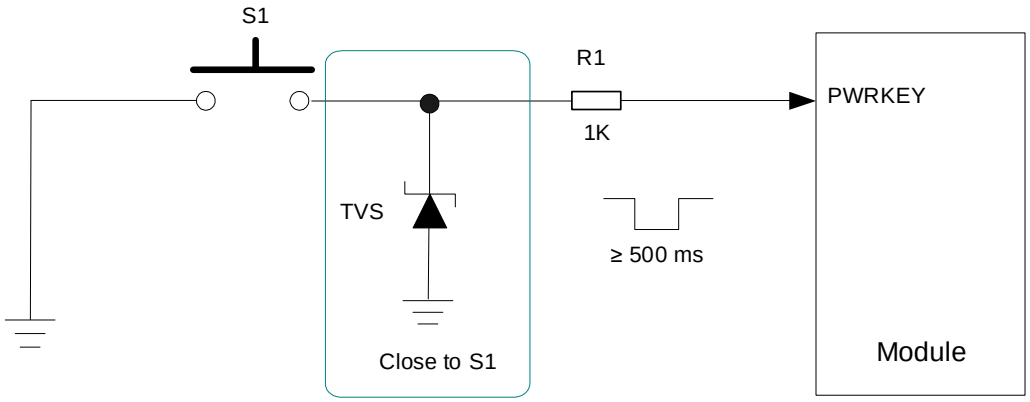


Figure 13: Reference Design of Turn On with Keystroke

The power-up timing is illustrated in the following figure.

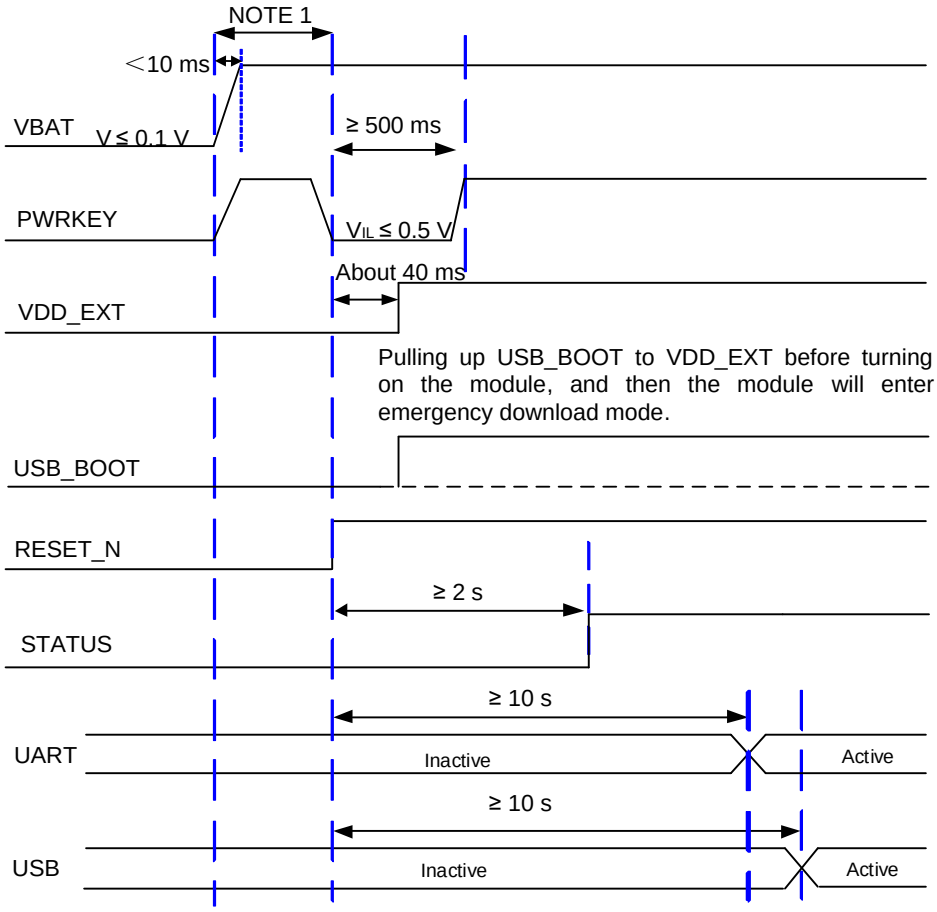


Figure 14: Power-up Timing with PWRKEY

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 the turn-off function, PWRKEY can be driven low directly to ground with a recommended 4.7 kΩ resistor.

3.4. Turn Off

The following procedures can be used to turn off the module normally.

3.4.1. Turn Off with PWRKEY

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

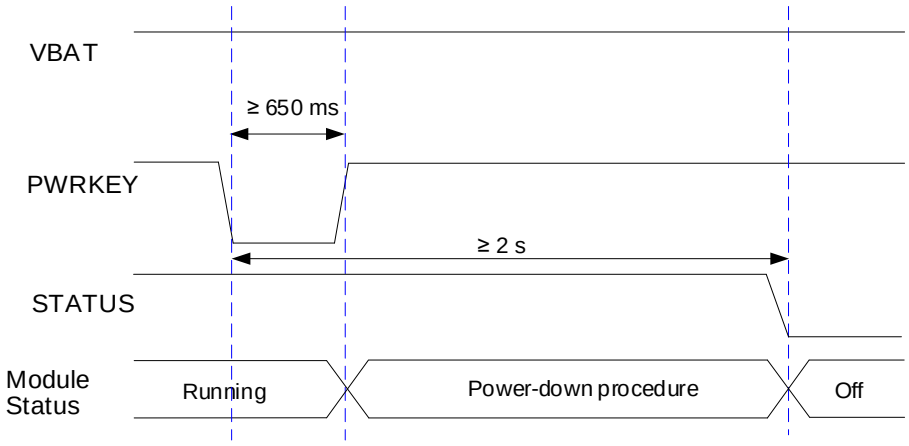


Figure 15: Power-down Timing with PWRKEY

3.4.2. Turn Off with AT Command

For proper shutdown procedure, execute **AT+QPOWD**, which is similar to turning off the module via the PWRKEY pin. See ***document [2]*** for details about **AT+QPOWD**.

NOTE

1. To avoid corrupting the data in the internal flash, do not switch off the power supply 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.

3.5. Reset

The reset function requires the PWRKEY and RESET_N pins to work together to complete. Pulling down PWRKEY when RESET_N is at low level can reset the module. The 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 11: 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 and PWRKEY pins.

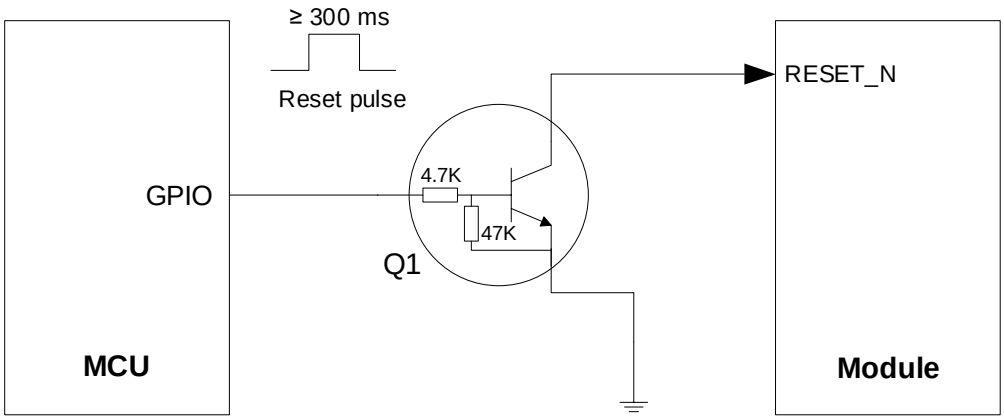


Figure 16: Reference Design of Reset with Driving Circuit

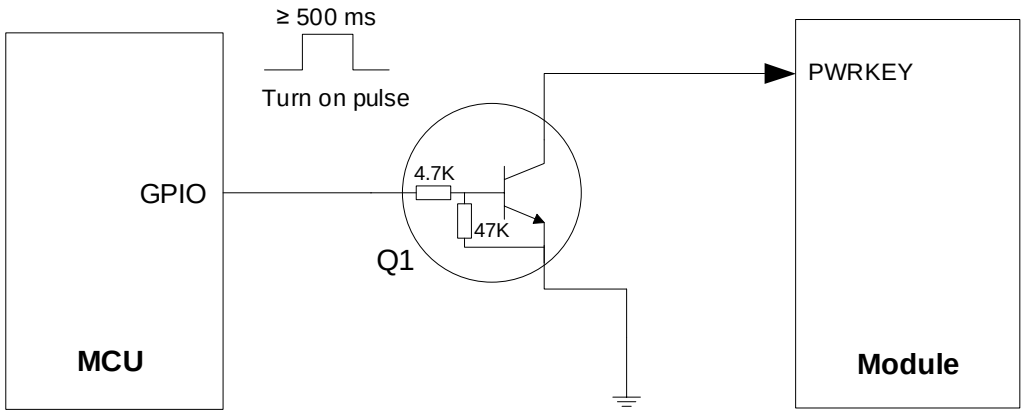


Figure 17: Reference Design of PWRKEY with Driving Circuit

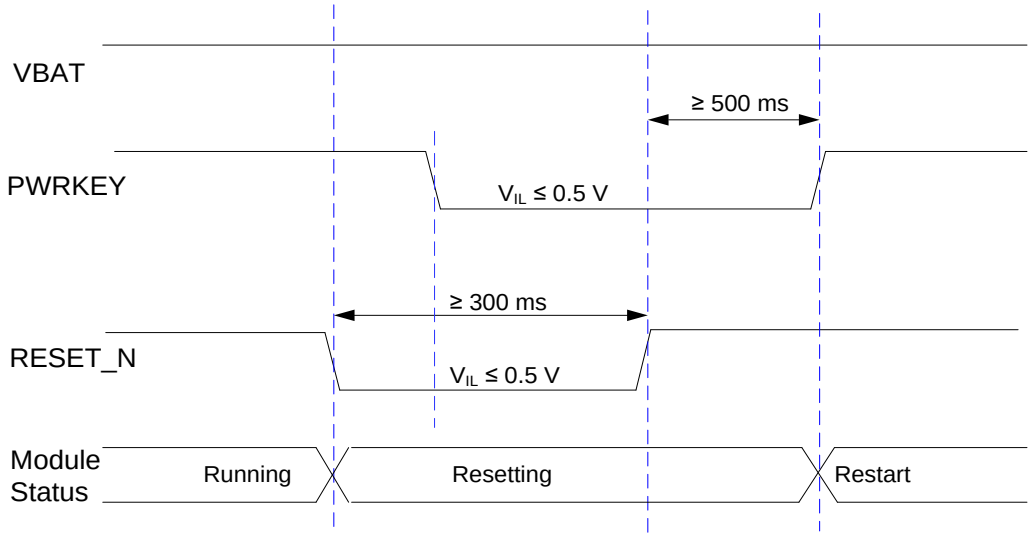


Figure 18: Reset Timing

NOTE

1. In reset timing, pull down PWRKEY when RESET_N is at low level.
2. Ensure the capacitance on PWRKEY and RESET_N is not more than 10 nF.

4 Application Interfaces

4.1. USB Interface

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

Table 12: 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 differential data (+)	USB 2.0 compliant. Requires differential impedance of 90 Ω. Test points must be reserved.
USB_DM	10	AIO	USB differential data (-)	

Test points of USB 2.0 interface must be reserved, which can be used for firmware upgrading and debugging.

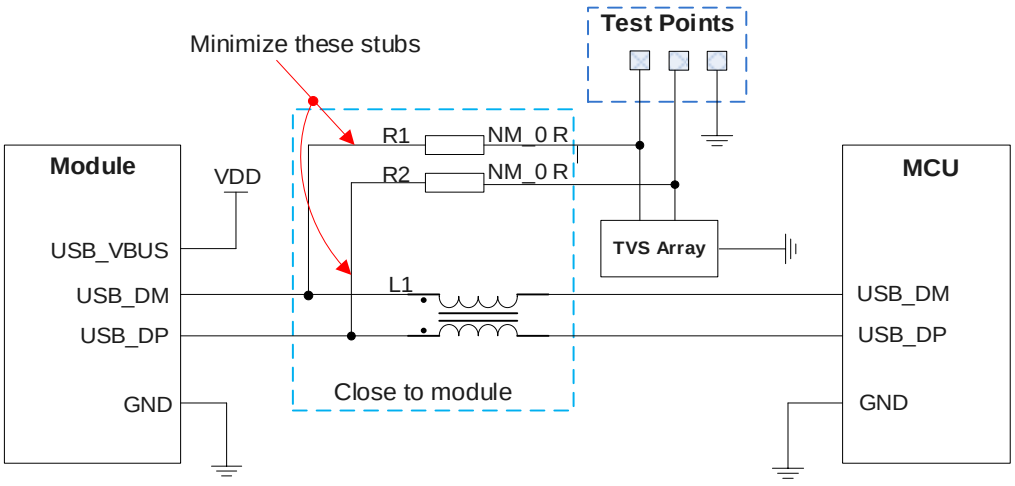


Figure 19: Reference Design of USB 2.0 Interface

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

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

- Route USB signal traces as differential pairs with surrounded ground. The impedance of USB 2.0 differential trace is 90 Ω.
- Route USB differential traces at the inner-layer of the PCB, and surround the traces with ground on that layer and with ground planes above and below. For signal traces, provide clearance from VBAT traces, crystal-oscillators, magnetic devices, sensitive signals like RF signals, analog signals, noise signals generated by clock and DC-DC.
- Pay attention to the impact caused by stray capacitance of the ESD protection component on USB data lines. Typically, the stray capacitance should be less than 2 pF for USB 2.0.
- Keep the ESD protection components as close to the USB port as possible.

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

4.2. USB_BOOT

The module provides a USB_BOOT pin for emergency download. Pulling up USB_BOOT to VDD_EXT before turning on the module, and then the module will enter emergency download mode. In this mode, the module supports firmware upgrade over USB 2.0 interface.

Table 13: Pin Description of USB_BOOT

Pin Name	Pin No.	I/O	Description	Comment
USB_BOOT	75	DI	Forces the module into emergency download mode	Active high before power-up. A test point must be reserved.

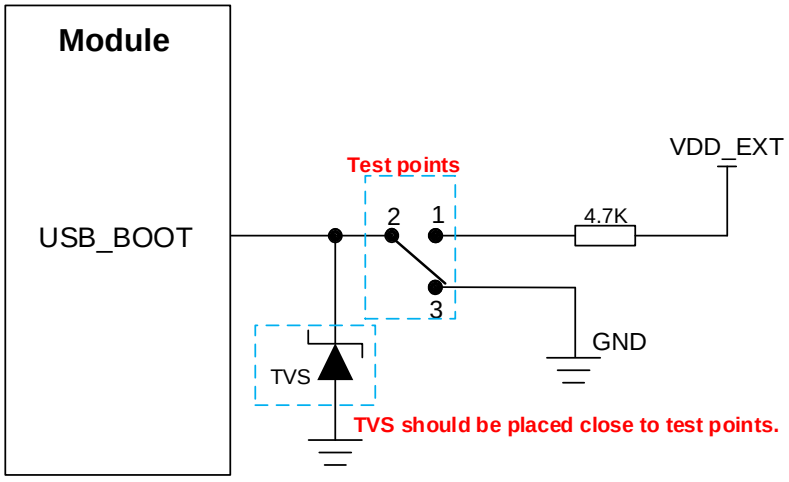


Figure 20: Reference Design of USB_BOOT

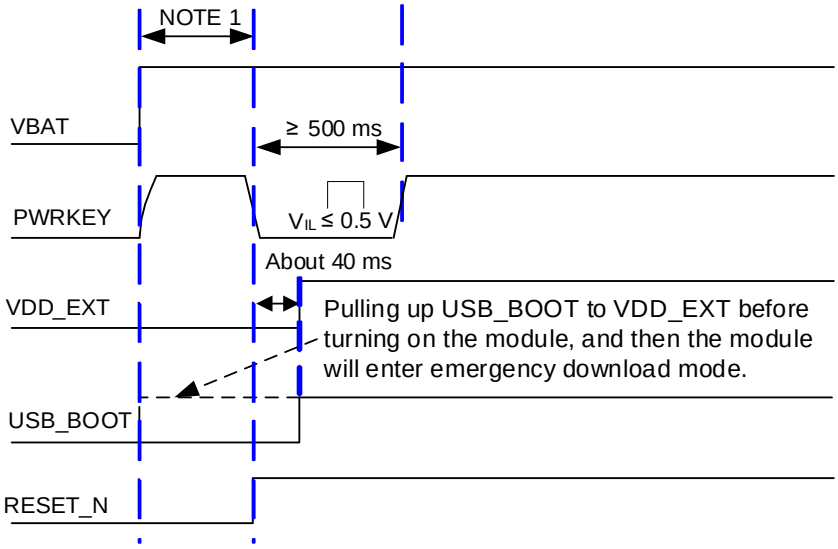


Figure 21: Timing of Entering Emergency Download Mode

NOTE

1. Ensure VBAT is stable before driving PWRKEY low.
2. Follow the above timing when using MCU control the module to enter the emergency download mode.
3. If you need to manually force the module to enter emergency download mode, directly connect the test points shown in ***Figure 20***.

4.3. USIM Interfaces

The USIM interfaces meets ETSI and IMT-2000 requirements.

- USIM1 interface supports 1.8 V or 3.0 V power domain.
- USIM2 interface only supports 1.8 V power domain.
- When USIM1 and USIM2 are used at the same time, the power domain of USIM interfaces should be 1.8 V. Otherwise, USIM2 interface will be damaged.
- USIM interfaces support dual card single standby.
- USIM2 and Camera SPI interface* cannot be used at the same time.

Table 14: Pin Description of USIM Interfaces

Pin Name	Pin No.	I/O	Description	Comment
USIM1_VDD	43	PO	USIM1 card power supply	Either 1.8 V or 3.0 V USIM1 card is supported and can be identified automatically by the module.
USIM1_DATA	45	DIO	USIM1 card data	
USIM1_CLK	46	DO	USIM1 card clock	
USIM1_RST	44	DO	USIM1 card reset	
USIM1_DET	42	DI	USIM1 card hot-plug detect	If unused, keep it open.
USIM2_VDD	87	PO	USIM2 card power supply	Connected with USIM1_VDD inside the module. 1.8 V power domain is required for USIM2. Otherwise, this interface will be damaged.
USIM2_DATA	86	DIO	USIM2 card data	Connected with pin 97 (CAM_SPI_DATA0) internally. 1.8 V power domain is required for USIM2. Otherwise, this interface will be damaged.
USIM2_RST	85	DO	USIM2 card reset	Connected with pin 78 (CAM_SPI_CLK) internally. 1.8 V power domain is required for USIM2. Otherwise, this interface will be damaged.
USIM2_CLK	84	DO	USIM2 card clock	Connected with pin 115 (CAM_PWDN) internally. 1.8 V power domain is required for

	USIM2. Otherwise, this interface will be damaged.

The module supports USIM1 card hot-plug via the USIM1_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 [2]*** for more details. Only USIM1 supports hot-plug detection.

The following figure illustrates a reference design for USIM1 card interface with an 8-pin USIM card connector.

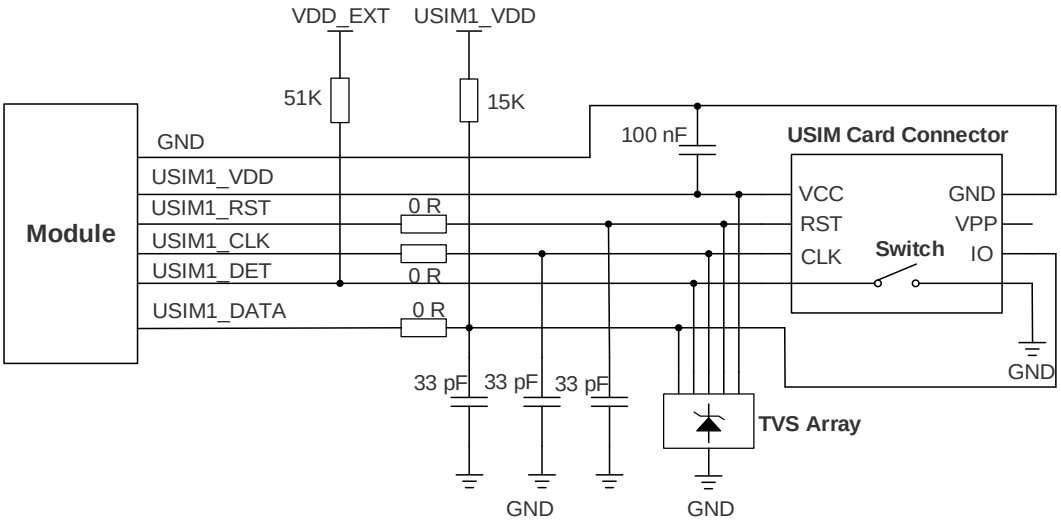


Figure 22: Reference Design of USIM1 Interface with an 8-pin USIM Card Connector

If the function of USIM1 card hot-plug is not needed, keep USIM1_DET disconnected. A reference design for USIM interfaces with a 6-pin USIM card connector is illustrated in the following figure.

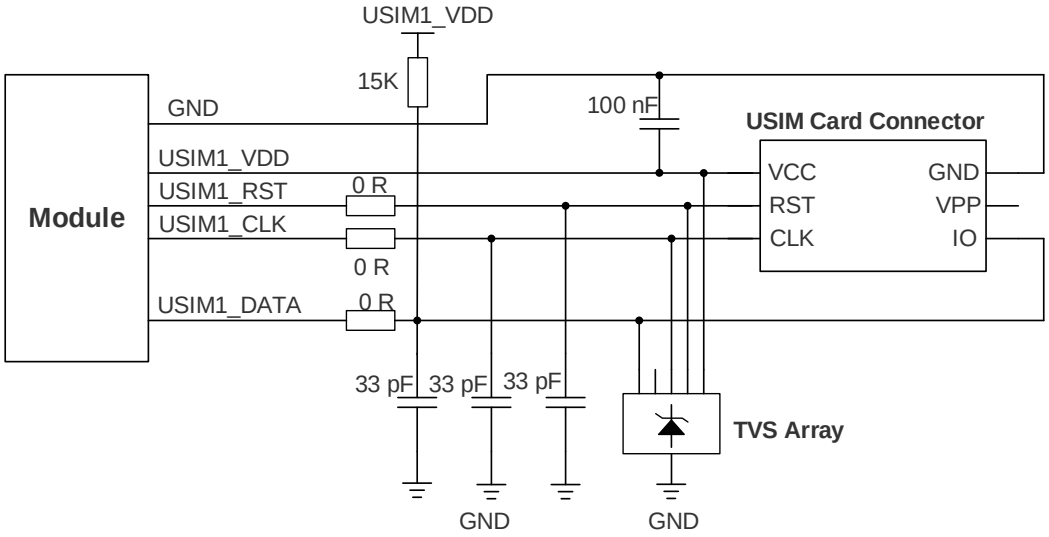


Figure 23: Reference Design of USIM1 Interface with a 6-pin USIM Card Connector

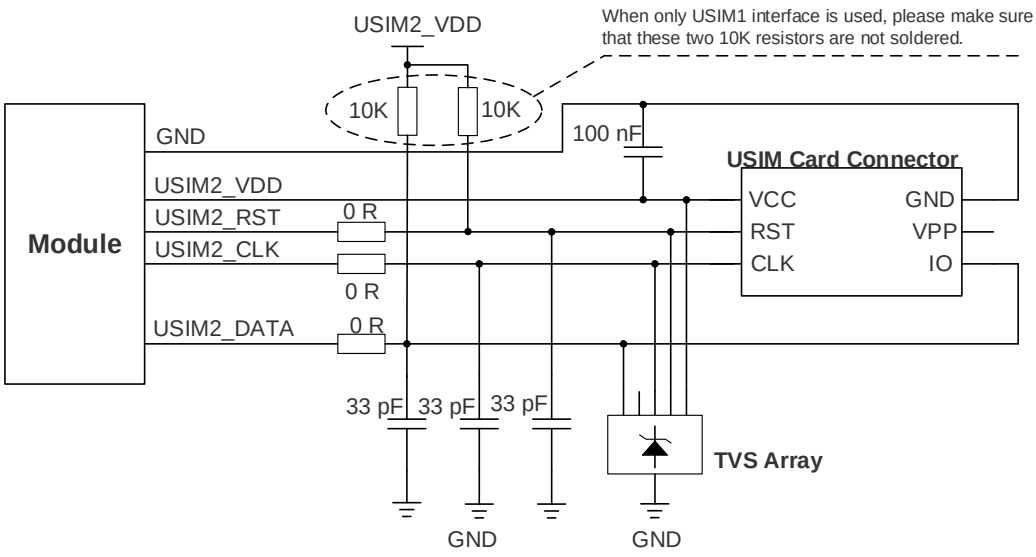


Figure 24: Reference Design of USIM2 Interface with a 6-pin USIM Card Connector

To enhance the reliability and availability of the USIM cards in applications, follow the principles below in the USIM circuit design:

- Place the USIM card connector close to the module. Keep the trace length as short as possible and at most 200 mm.
- Route USIM card differential traces at the inner-layer of the PCB, and surround the traces with ground on that layer and ground planes above and below. For signal traces, provide clearance from VBAT traces, crystal-oscillators, magnetic devices, sensitive signals like RF signals, analog signals, noise signals generated by clock and DC-DC.
- Ensure the tracing between the USIM card connector and the module is short and wide. Keep the trace width of ground and USIM_VDD at least 0.5 mm to maintain the same electric potential.
- To avoid cross-talk between USIM_DATA and USIM_CLK, keep the traces away from each other and shield them with surrounded ground.
- To offer good ESD protection, it is recommended to add a TVS array of which parasitic capacitance should be less than 15 pF. Add 0 Ω resistors in series between the module and the USIM card connector to facilitate debugging. The 33 pF capacitors are used for filtering out RF interference. Additionally, keep the USIM peripheral circuit close to the USIM card connector.
- The pull-up resistor on USIM1_DATA trace, USIM2_DATA and USIM2_RST can improve anti-jamming capability when long layout trace and sensitive occasions are applied, and should be placed close to the USIM card connector.

4.4. UART Interfaces

The module provides four UART Interfaces.

Table 15: UART Information (Unit: bps)

UART Types	Supported Baud Rates	Default Baud Rates	Functions
Main UART	4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600	115200	● AT command communication ● data transmission ● RTS and CTS hardware flow control
Debug UART	115200, 3000000	115200	● Partial logs output
GNSS UART	921600	921600	● GNSS data output ● GNSS NMEA sentence output
GNSS debug UART	3000000	3000000	● GNSS system logs output

Table 16: Pin Description of UART

Pin Name	Pin No.	I/O	Description	Comment
MAIN_CTS	36	DO	Clear to send signal from the module	Connect to MCU's CTS. If unused, keep it open.
MAIN_RTS	37	DI	Request to send signal to the module	Connect to MCU's RTS. If unused, keep it open.
MAIN_RXD	34	DI	Main UART receive	If unused, keep them open.
MAIN_DCD	38	DO	Main UART data carrier detect	
MAIN_TXD	35	DO	Main UART transmit	
MAIN_RI	39	DO	Main UART ring indication	
MAIN_DTR	30	DI	Main UART data terminal ready	
DBG_RXD	22	DI	Debug UART receive	Test points must be reserved.
DBG_TXD	23	DO	Debug UART transmit	
GNSS_TXD [7]	27	DO	GNSS UART transmit	If unused, keep them open.
GNSS_RXD [7]	28	DI	GNSS UART receive	
GNSS_DBG_TXD [7]	109	DO	GNSS debug UART transmit	Test points must be reserved.
GNSS_DBG_RXD [7]	110	DI	GNSS debug UART receive	

[7] This pin is optional. If you need this function, please contact Quectel Technical Support.

The module provides 1.8 V UART interfaces. You can use a level-shifting chip between the module and host's UART if the host is equipped with a 3.3 V UART.

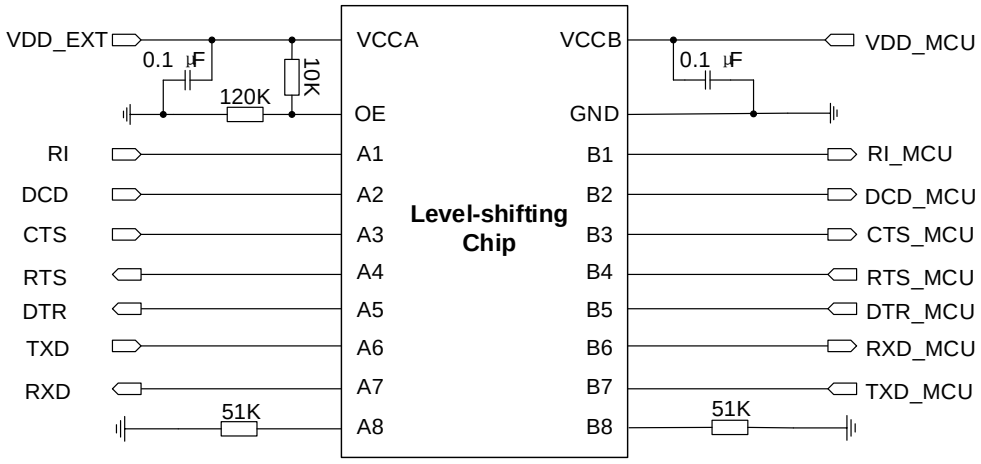


Figure 25: Reference Design of UART with Level-shifting Chip

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

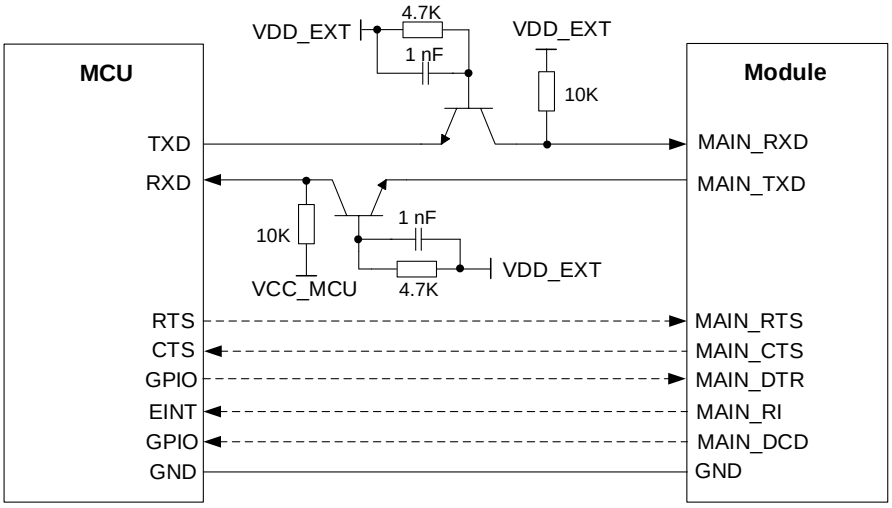


Figure 26: Reference Design of UART with Transistor Level-shifting Circuit

NOTE

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

4.5. PCM and I2C Interfaces*

The module provides one Pulse Code Modulation (PCM) digital interface and one I2C interface.

Table 17: Pin Description of PCM and I2C Interfaces

Pin Name	Pin No.	I/O	Description	Comment
PCM_SYNC	5	DO	PCM data frame sync	If unused, keep them open.
PCM_CLK	4	DO	PCM clock	
PCM_DIN	6	DI	PCM data input	
PCM_DOUT	7	DO	PCM data output	
I2C_SCL	40	DO	I2C serial clock	External pull-up resistor is required. If unused, keep them open.
I2C_SDA	41	DIO	I2C serial data	

The reference design is illustrated as follows.

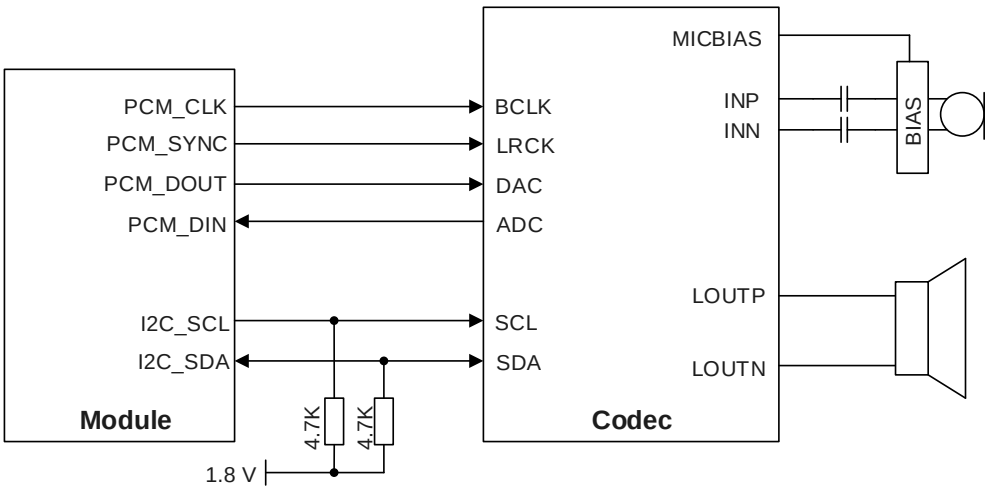


Figure 27: Reference Design of PCM and I2C Interfaces

NOTE

1. It is recommended to reserve RC circuits (R = 22 Ω, C = 22 pF) on the PCM signal traces, especially on the PCM_CLK pin.
2. The module can only be used as a master device in applications related to both the PCM interface and the I2C interface.

4.6. ADC Interfaces

The module provides two Analog-to-Digital Converter (ADC) interfaces. To improve the accuracy of ADC, surround the trace of ADC with ground.

Table 18: Pin Description of ADC Interfaces

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

With **AT+QADC=<port>**, you can:

- **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 [2]***.

Table 19: Characteristics of ADC Interfaces

Parameters	Min.	Typ.	Max.	Units
ADC0 voltage range	0	-	1.2	V
ADC input resistance	0.26	-	0.75	MΩ
ADC resolution	-	12	-	bits

NOTE

1. The input voltage of every ADC interface should not exceed 1.2 V.
2. It is prohibited to directly supply any voltage to ADC Interfaces when the module is not powered by the VBAT.
3. It is recommended to use resistor divider circuit for ADC interface application. Resistance of the external resistor divider should not exceed 100 kΩ, or the measurement accuracy of ADC would be significantly reduced. It is recommended to reserve a 100 nF capacitor for the design.

4.7. Camera SPI Interface*

The module provides one camera SPI interface supporting 2-bit data transmission of SPI. USIM2 and Camera SPI interface cannot be used at the same time.

Table 20: Pin Description of Camera SPI Interface

Pin Name	Pin No.	I/O	Description	Comment
CAM_MCLK	95	DO	Master clock of the camera	If unused, keep it open.
CAM_SPI_CLK	78	DI	Camera SPI clock	Connected with pin 85 (USIM2_RST) internally. If unused, keep it open.
CAM_SPI_DATA0	97	DI	Camera SPI data bit 0	Connected with pin 86 (USIM2_DATA) internally. If unused, keep it open.
CAM_SPI_DATA1	98	DI	Camera SPI data bit 1	If unused, keep it open.
CAM_PWDN	115	DO	Power down of the camera	Connected with pin 84 (USIM2_CLK) internally. If unused, keep it open.
CAM_VDD	94	PO	Camera analog power supply	If unused, keep them open.
CAM_VDDIO	93	PO	Camera digital power supply	

4.8. GRFC Interfaces

The module provides two GRFC (generic RF control) interfaces for the control of external antenna tuners.

Table 21: Pin Description of GRFC Interfaces

Pin Name	Pin No.	I/O	Description	Comment
GRFC1	76	DO	Generic RF controller	If unused, keep them open.
GRFC2	77	DO	Generic RF controller	

4.9. Control Signals

Table 22: Pin Description of Control Signals

Pin Name	Pin No.	I/O	Description	Comment
W_DISABLE#	18	DI	Airplane mode control	If unused, keep them open.
PSM_IND*	1	DO	Indicate the module's power saving mode	
PSM_INT*	96	DI	External interrupt; wake up the module from power saving mode	
AP_READY*	19	DI	Application processor ready	

4.9.1. W_DISABLE#

The module provides W_DISABLE# to enable or disable RF function. When the voltage level of W_DISABLE# is high, you can send **AT+CFUN=<fun>** to set the module's operating mode. Driving W_DISABLE# low will set the module to airplane mode.

Table 23: W_DISABLE# AT Command Configuration Information

Level Status	AT Command	RF Function	Operating Mode
High level	**AT+CFUN=1**	Enabled	Full functionality mode
	AT+CFUN=0	Disabled	Minimum functionality mode
	AT+CFUN=4	Disabled	Airplane mode
Low level	**AT+CFUN=0** **AT+CFUN=1** **AT+CFUN=4**	Disabled	Airplane mode

NOTE

W_DISABLE# is a control function for airplane mode, which is disabled in software by default. It can be enabled through **AT+QCFG="airplanecontrol",1***. For the details of this command, please contact Quectel Technical Support.

4.10. Indication Signals

Table 24: Pin Description of Indication Signals

Pin Name	Pin No.	I/O	Description	Comment
STATUS	20	DO	Indicate the module's operation status	If unused, keep them open.
NET_STATUS	21	DO	Indicate the module's network activity status	
GNSS_PPS	51	DO	GNSS pulse per second output	

4.10.1. Network Status Indication

The module provides one network status indication pin: the NET_STATUS for the module's network operation status indication, which can drive corresponding LEDs.

Table 25: Network Status Indication Pin Level and Module Network Status

Pin Name	NET_STATUS Level Status	Module Network Status
NET_STATUS	Flicker slowly (200 ms High/1800 ms Low)	Network searching
	Flicker slowly (1800 ms High/200 ms Low)	Idle
	Flicker quickly (125 ms High/125 ms Low)	Data transmission is ongoing

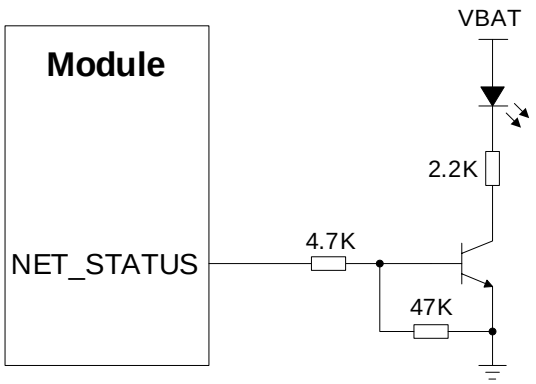


Figure 28: Reference Design of NET_STATUS Indication

4.10.2. STATUS

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

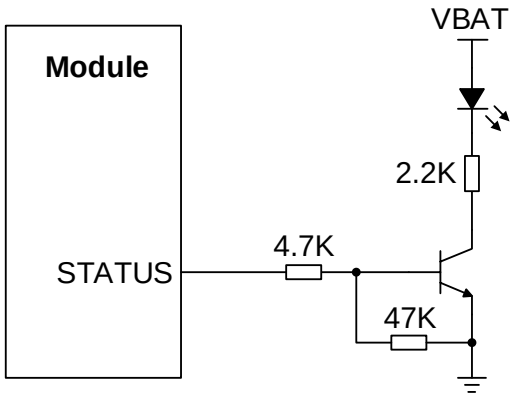


Figure 29: Reference Design of STATUS

4.10.3. MAIN_RI

AT+QCFG= "risignaltype", "physical" can be used to configure MAIN_RI behavior. No matter on which port a URC information is presented, the URC information will trigger the behavior of the MAIN_RI. For the details of **AT+QCFG**, see ***document [2]***.

NOTE

The **AT+QURCCFG** allows you to set the main UART, USB AT port or USB modem port as the URC information output port. The USB AT port is the URC output port by default. For more details about **AT+QURCCFG**, see ***document [2]***.

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

Table 26: MAIN_RI Level and Module Status

Module Status	MAIN_RI Level Status
Idle	High level
When a new URC information returns	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 **AT+QCFG="urc/ri/ring"**.

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. Cellular Network

5.1.1. Antenna Interface & Frequency Bands

Table 27: Pin Description of Cellular Antenna Interface

Pin Name	Pin No.	I/O	Description	Comment
ANT_MAIN [8]	60	AIO	Main antenna interface	50 Ω impedance.

NOTE

EG915Q-NA and EG916Q-GL support Wi-Fi scan function, and this function and LTE network cannot be used simultaneously since they share the same antenna interface.

Table 28: Operating Frequency of EG915Q-NA (Unit: MHz)

Operating Frequency	Transmit	Receive
LTE-FDD B2	1850–1910	1930–1990
LTE-FDD B4	1710–1755	2110–2155
LTE-FDD B5	824–849	869–894
LTE-FDD B12	699–716	729–746
LTE-FDD B13	777–787	746–756

[8] ANT_MAIN only supports passive antennas.

LTE-FDD B66	1710–1780	2110–2180

Table 29: Operating Frequency of EG916Q-GL (Unit: MHz)

Operating Frequency	Transmit	Receive
LTE-FDD B1	1920–1980	2110–2170
LTE-FDD B2	1850–1910	1930–1990
LTE-FDD B3	1710–1785	1805–1880
LTE-FDD B4	1710–1755	2110–2155
LTE-FDD B5	824–849	869–894
LTE-FDD B7	2500–2570	2620–2690
LTE-FDD B8	880–915	925–960
LTE-FDD B12	699–716	729–746
LTE-FDD B13	777–787	746–756
LTE-FDD B18	815–830	860–875
LTE-FDD B19	830–845	875–890
LTE-FDD B20	832–862	791–821
LTE-FDD B25	1850–1915	1930–1995
LTE-FDD B26	814–849	859–894
LTE-FDD B28	703–748	758–803
LTE-TDD B34	2010–2025	2010–2025
LTE-TDD B38	2570–2620	2570–2620
LTE-TDD B39	1880–1920	1880–1920
LTE-TDD B40	2300–2400	2300–2400
LTE-TDD B41	2496–2690	2496–2690
LTE-FDD B66	1710–1780	2110–2180

5.1.2. Tx Power

Table 30: RF Transmitting Power

Frequency Bands	Max. RF Output Power	Min. RF Output Power
LTE bands	23 dBm ±2 dB	< -39 dBm

5.1.3. Rx Sensitivity

Table 31: Conducted RF Receiver Sensitivity of EG915Q-NA (Unit: dBm)

Frequency Bands	Receiver Sensitivity (Typ.)	3GPP (SIMO)
	Primary	
LTE-FDD B2 (10 MHz)	-98 dBm	-94.3 dBm
LTE-FDD B4 (10 MHz)	-98.5 dBm	-96.3 dBm
LTE-FDD B5 (10 MHz)	-99 dBm	-94.3 dBm
LTE-FDD B12 (10 MHz)	-98.5 dBm	-93.3 dBm
LTE-FDD B13 (10 MHz)	-98.5dBm	-93.3 dBm
LTE-FDD B66 (10 MHz)	-98.5 dBm	-95.8 dBm

Table 32: Conducted RF Receiver Sensitivity of EG916Q-GL (Unit: dBm)

Frequency Bands	Receiver Sensitivity (Typ.)	3GPP (SIMO)
	Primary	
LTE-FDD B1 (10 MHz)	-98.6 dBm	-96.3 dBm
LTE-FDD B2 (10 MHz)	-99.4 dBm	-94.3 dBm
LTE-FDD B3 (10 MHz)	-98.9 dBm	-93.3 dBm
LTE-FDD B4 (10 MHz)	-98.6 dBm	-96.3 dBm
LTE-FDD B5 (10 MHz)	-99.1 dBm	-94.3 dBm
LTE-FDD B7 (10 MHz)	-97.4 dBm	-94.3 dBm

LTE-FDD B8 (10 MHz)	-99.3 dBm	-93.3 dBm
LTE-FDD B12 (10 MHz)	-99.5 dBm	-93.3 dBm
LTE-FDD B13 (10 MHz)	-98.3 dBm	-93.3 dBm
LTE-FDD B18 (10 MHz)	-99.3 dBm	-96.3 dBm
LTE-FDD B19 (10 MHz)	-99.1 dBm	-96.3 dBm
LTE-FDD B20 (10 MHz)	-99.8 dBm	-93.3 dBm
LTE-FDD B25 (10 MHz)	-99.4 dBm	-92.8 dBm
LTE-FDD B26 (10 MHz)	-98.9 dBm	-93.8 dBm
LTE-FDD B28 (10 MHz)	-98.6 dBm	-94.8 dBm
LTE-TDD B34 (10 MHz)	-99.2 dBm	-96.3 dBm
LTE-TDD B38 (10 MHz)	-97.6 dBm	-96.3 dBm
LTE-TDD B39 (10 MHz)	-99.8 dBm	-96.3 dBm
LTE-TDD B40 (10 MHz)	-98 dBm	-96.3 dBm
LTE-TDD B41 (10 MHz)	-97.7 dBm	-94.3 dBm
LTE-FDD B66 (10 MHz)	-98.6 dBm	-95.8 dBm

5.1.4. Reference Design

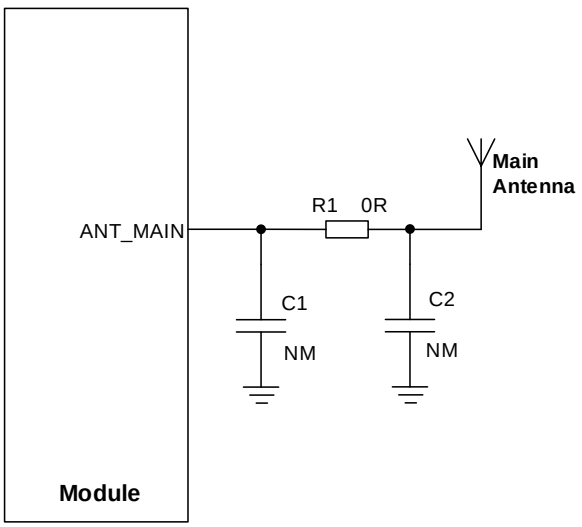


Figure 30: Reference Design of Main Antenna

NOTE

1. Use a π-type matching circuit for the antenna interface for better cellular performance and for the ease of debugging.
2. Capacitors are not mounted by default.
3. Place the π-type matching components (R1 & C1 & C2) to the antenna as close as possible.

5.2. GNSS (Optional)

5.2.1. Antenna Interface & Frequency Bands

The GNSS part of the module supports GPS, GLONASS, BDS, Galileo, and QZSS systems. Since the LTE and GNSS parts work separately, the module allows LTE and GNSS to work simultaneously.

Table 33: Pin Description of Cellular Antenna Interface

Pin Name	Pin No.	I/O	Description	Comment
ANT_GNSS	49	AI	GNSS antenna interface	50 Ω impedance.

Table 34: GNSS Frequency (Unit: MHz)

Antenna Types	Frequency
GPS/Galileo	1575.42 ±1.023
GLONASS	1597.5–1605.8
BDS	1561.098 ±2.046
QZSS	1575.42

5.2.2. GNSS Performance

Table 35: GNSS Performance of EG915Q-NA

Parameter	Description	Conditions	Typ.	Unit
Sensitivity	Acquisition	Autonomous	-145	dBm
	Reacquisition		-157	dBm
	Tracking		-160	dBm
TTFF	Cold start @ open sky	Autonomous	27.43	s
		AGPS enabled	5.6	s
	Warm start @ open sky	Autonomous	27.37	s
	Hot start @ open sky	Autonomous	2.56	s
Accuracy	CEP-50	Autonomous @ open sky	2.5	m

Table 36: GNSS Performance of EG916Q-GL

Parameter	Description	Conditions	Typ.	Unit
Sensitivity	Acquisition	Autonomous	-146	dBm
	Reacquisition		-161	dBm
	Tracking		-165	dBm
TTFF	Cold start @ open sky	Autonomous	24.96	s
		AGPS enabled	TBD	s
	Warm start @ open sky	Autonomous	24.36	s
	Hot start @ open sky	Autonomous	2.22	s
Accuracy	CEP-50	Autonomous @ open sky	2.5	m

5.2.3. Reference Design

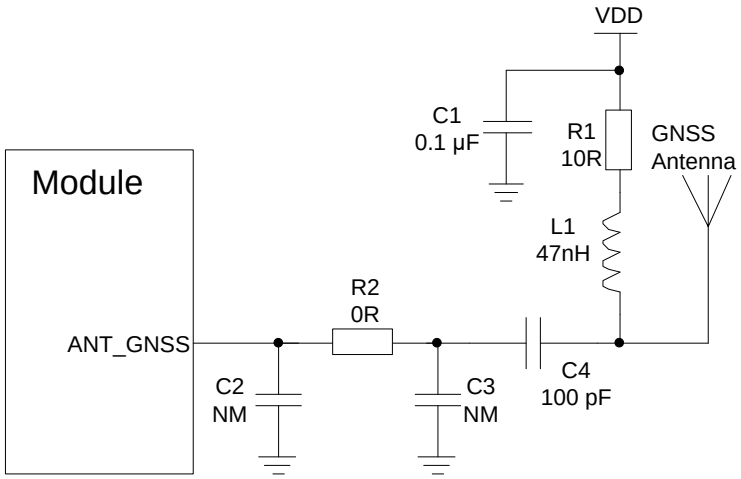


Figure 31: Reference Design of GNSS Antenna

NOTE

1. An external LDO can be selected to supply power according to the active antenna requirement.
2. If the module is designed with a passive antenna, then R1, C1 and L1 are not mounted.

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.

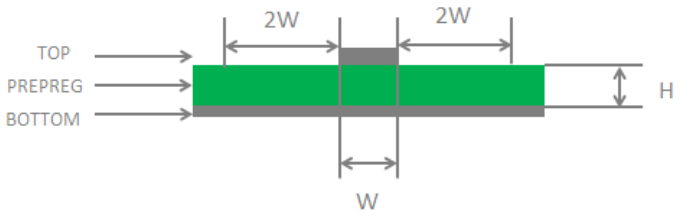


Figure 32: Microstrip Design on a 2-layer PCB

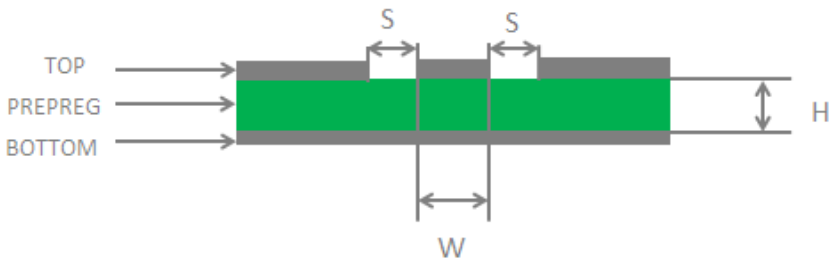


Figure 33: Coplanar Waveguide Design on a 2-layer PCB

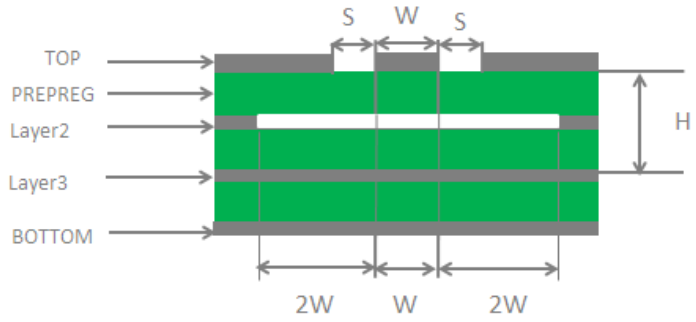


Figure 34: Coplanar Waveguide Design on a 4-layer PCB (Layer 3 as Reference Ground)

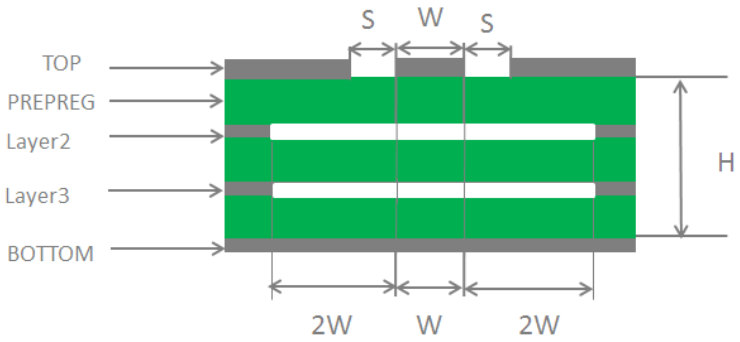


Figure 35: Coplanar Waveguide Design on a 4-layer PCB (Layer 4 as Reference Ground)

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

- Use an impedance simulation tool to accurately control the characteristic impedance of RF traces to 50 Ω.
- The GND pins adjacent to RF pins should not be designed as thermal relief pads, and should be fully connected to ground.
- The distance between the RF pins and the RF connector should be as short as possible and all the right-angle traces should be changed to curved ones. The recommended trace angle is 135°.
- There should be clearance under the signal pin of the antenna connector or solder joint.
- The reference ground of RF traces should be complete. Meanwhile, adding some ground vias around RF traces and the reference ground could help to improve RF performance. The distance between the ground vias and RF traces should be not less than twice the width of RF signal traces (2 × 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 [3]***.

5.4. Antenna Design Requirements

Table 37: Requirements for Antenna Design

Antenna Types	Requirements
GNSS	● Frequency range: 1559–1609 MHz ● Polarization: RHCP or linear ● VSWR: ≤ 2 (Typ.) ● Passive antenna gain: > 0 dBi ● Active antenna noise coefficient: < 1.5 dB ● Active antenna gain: > 0 dBi ● Active antenna embedded LNA gain: < 17 dB
LTE	● VSWR: ≤ 2 ● Efficiency: > 30 % ● Gain: 1 dBi ● Max. input power: 50 W ● Input impedance: 50 Ω ● Vertical polarization ● Cable insertion loss: **< 1 dB:** LB (< 1 GHz) **< 1.5 dB:** MB (1–2.3 GHz)

NOTE

It is recommended to use a passive GNSS antenna when LTE B13 is supported, as the use of active antenna may generate harmonics which will affect the GNSS performance.

5.5. RF Connector Recommendation

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

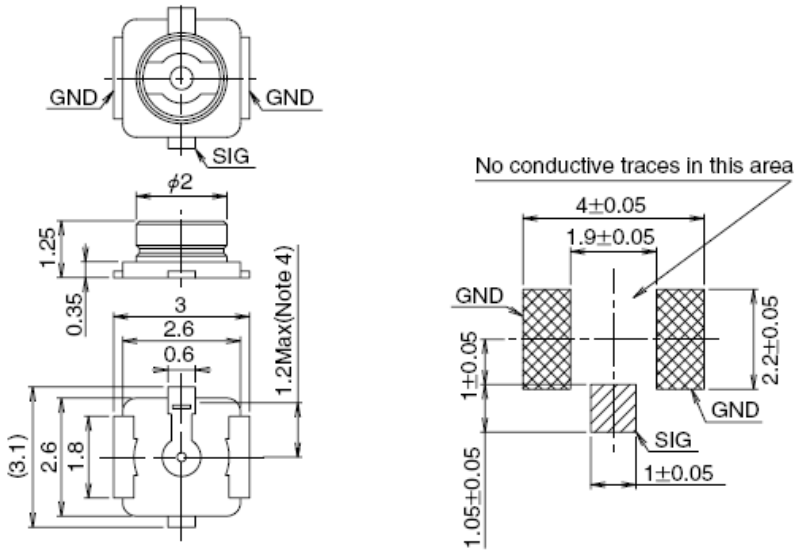


Figure 36: Dimensions of the Receptacle (Unit: mm)

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

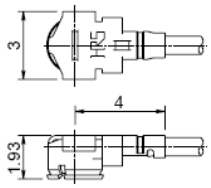
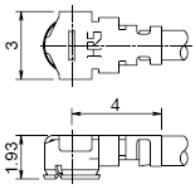
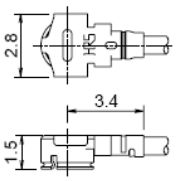
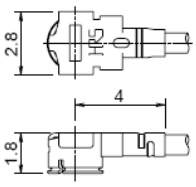
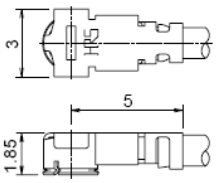
Part No.	U.FL-LP-040	U.FL-LP-066	U.FL-LP(V)-040	U.FL-LP-062	U.FL-LP-088
					
Mated Height	2.5mm Max. (2.4mm Nom.)	2.5mm Max. (2.4mm Nom.)	2.0mm Max. (1.9mm Nom.)	2.4mm Max. (2.3mm Nom.)	2.4mm Max. (2.3mm Nom.)
Applicable cable	Dia. 0.81mm Coaxial cable	Dia. 1.13mm and Dia. 1.32mm Coaxial cable	Dia. 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 37: Specifications of Mated Plugs

The following figure describes the space factor of mated connectors.

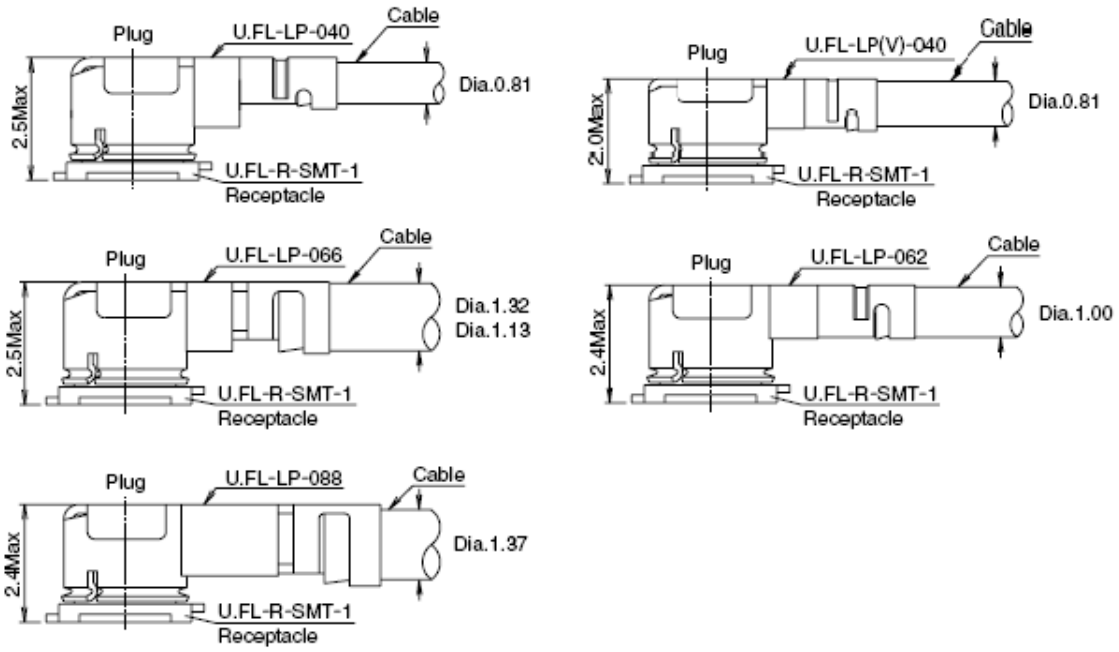


Figure 38: Space Factor of Mated Connectors (Unit: mm)

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

6 Electrical Characteristics and

7 Reliability

7.1. Absolute Maximum Ratings

Table 38: Absolute Maximum Ratings

Parameters	Min.	Max.	Unit
Voltage at VBAT_RF & VBAT_BB	-0.3	5	V
Voltage at USB_VBUS	-0.3	5.25	V
Voltage at GNSS_VBCKP	-0.3	3.63	V
Voltage at digital pins	-0.3	2.3	V

7.2. Power Supply Ratings

Table 39: Power Supply Ratings

Parameters	Descriptions	Conditions	Min.	Typ.	Max.	Units
VBAT	VBAT_BB & VBAT_RF	The actual input voltages must be kept between the minimum and maximum values.	3.3	3.8	4.3	V
GNSS_ VBCKP	Power supply for GNSS RTC	The actual input voltages must be kept between the minimum and maximum values.	1.9	3.3	3.6	V

I_{VBAT}	Peak power consumption	At maximum power control level	-	1.5	2	A
USB_VBUS	USB connection detection	-	3.0	5.0	5.25	V

7.3. Power Consumption

Table 40: Power Consumption of EG915Q-NA LTE Part (GNSS Part Off)

Description	Conditions	Typ.	Units
OFF state	Power down	0.4	μA
Sleep state	**AT+CFUN=0** (USB disconnected)	54	uA
	AT+CFUN=4 (USB disconnected)	130	uA
	LTE-FDD @ PF = 32 (USB disconnected)	1.24	mA
	LTE-FDD @ PF = 64 (USB disconnected)	0.68	mA
	LTE-FDD @ PF = 128 (USB disconnected)	0.41	mA
	LTE-FDD @ PF = 256 (USB disconnected)	0.3	mA
Idle state	LTE-FDD @ PF = 64 (USB disconnected)	4.55	mA
	LTE-FDD @ PF = 64 (USB connected)	28.22	mA
LTE data transfer	LTE-FDD B2	629	mA
	LTE-FDD B4	570	mA
	LTE-FDD B5	544	mA
	LTE-FDD B12	571	mA
	LTE-FDD B13	657	mA
	LTE-FDD B66	543	mA

Table 41: Power Consumption of EG916Q-GL LTE Part (GNSS Part Off)

Description	Conditions	Typ.	Units

OFF state	Power down	TBD	μA
Sleep state	**AT+CFUN=0** (USB disconnected)	TBD	uA
	AT+CFUN=4 (USB disconnected)	TBD	uA
	LTE-FDD @ PF = 32 (USB disconnected)	TBD	mA
	LTE-FDD @ PF = 64 (USB disconnected)	TBD	mA
	LTE-FDD @ PF = 128 (USB disconnected)	TBD	mA
	LTE-FDD @ PF = 256 (USB disconnected)	TBD	mA
Idle state	LTE-FDD @ PF = 64 (USB disconnected)	TBD	mA
	LTE-FDD @ PF = 64 (USB connected)	TBD	mA
LTE data transfer	LTE-FDD B1	616.3	mA
	LTE-FDD B2	529.6	mA
	LTE-FDD B3	585.7	mA
	LTE-FDD B4	572.3	mA
	LTE-FDD B5	506.0	mA
	LTE-FDD B7	722.3	mA
	LTE-FDD B8	581.2	mA
	LTE-FDD B12	520.1	mA
	LTE-FDD B13	559.8	mA
	LTE-FDD B18	480.0	mA
	LTE-FDD B19	474.9	mA
	LTE-FDD B20	550.9	mA
	LTE-FDD B25	546.5	mA
	LTE-FDD B26	493.8	mA
	LTE-FDD B28	580.5	mA
	LTE-TDD B34	246.8	mA

	LTE-TDD B38	258.6	mA
	LTE-TDD B39	249.8	mA
	LTE-TDD B40	216.3	mA
	LTE-TDD B41	259.46	mA
	LTE-FDD B66	574.4	mA

7.4. Digital I/O Characteristics

Table 42: VDD_EXT I/O Characteristics (Unit: V)

Parameters	Descriptions	Min.	Max.
V_{IH}	High-level input voltage	1.2	2
V_{IL}	Low-level input voltage	-0.3	0.6
V_{OH}	High-level output voltage	1.35	-
V_{OL}	Low-level output voltage	-	0.45

Table 43: USIM Low-voltage I/O Characteristics (Unit: V)

Parameters	Descriptions	Min.	Max.
V_{IH}	High-level input voltage	1.2	-
V_{IL}	Low-level input voltage	-	0.6
V_{OH}	High-level output voltage	1.35	-
V_{OL}	Low-level output voltage	-	0.45

Table 44: USIM High-voltage I/O Characteristics (Unit: V)

Parameters	Descriptions	Min.	Max.

V_{IH}	High-level input voltage	1.95	-
V_{IL}	Low-level input voltage	-	1.0
V_{OH}	High-level output voltage	2.55	-
V_{OL}	Low-level output voltage	-	0.45

7.5. 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 45: ESD Characteristics (Temperature: 25–30 °C, Humidity: 40 ±5 %; Unit: kV)

Test Points	Contact Discharge	Air Discharge
VBAT & GND	±8	±12
Antenna interface	±5	±10
Other interfaces	±0.5	±1

7.6. Operating and Storage Temperatures

Table 46: Operating and Storage Temperatures (Unit: °C)

Parameters	Min.	Typ.	Max.
Normal Operating Temperature [9]	-35	+25	+75
Extended Operating Temperature [10]	-40	-	+85

[9] Within the operating temperature range, the module meets 3GPP specifications.
[10] Within the extended temperature range, the module remains the ability to establish and maintain functions such as SMS and data transmission, without any unrecoverable malfunction. Radio spectrum and radio network are not influenced, while one or more specifications, such as P_{out}, may exceed the specified tolerances of 3GPP. When the temperature returns to the operating temperature range, the module meets 3GPP specifications again.

Storage Temperature	-40	-	+90

8 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.

8.1. Mechanical Dimensions

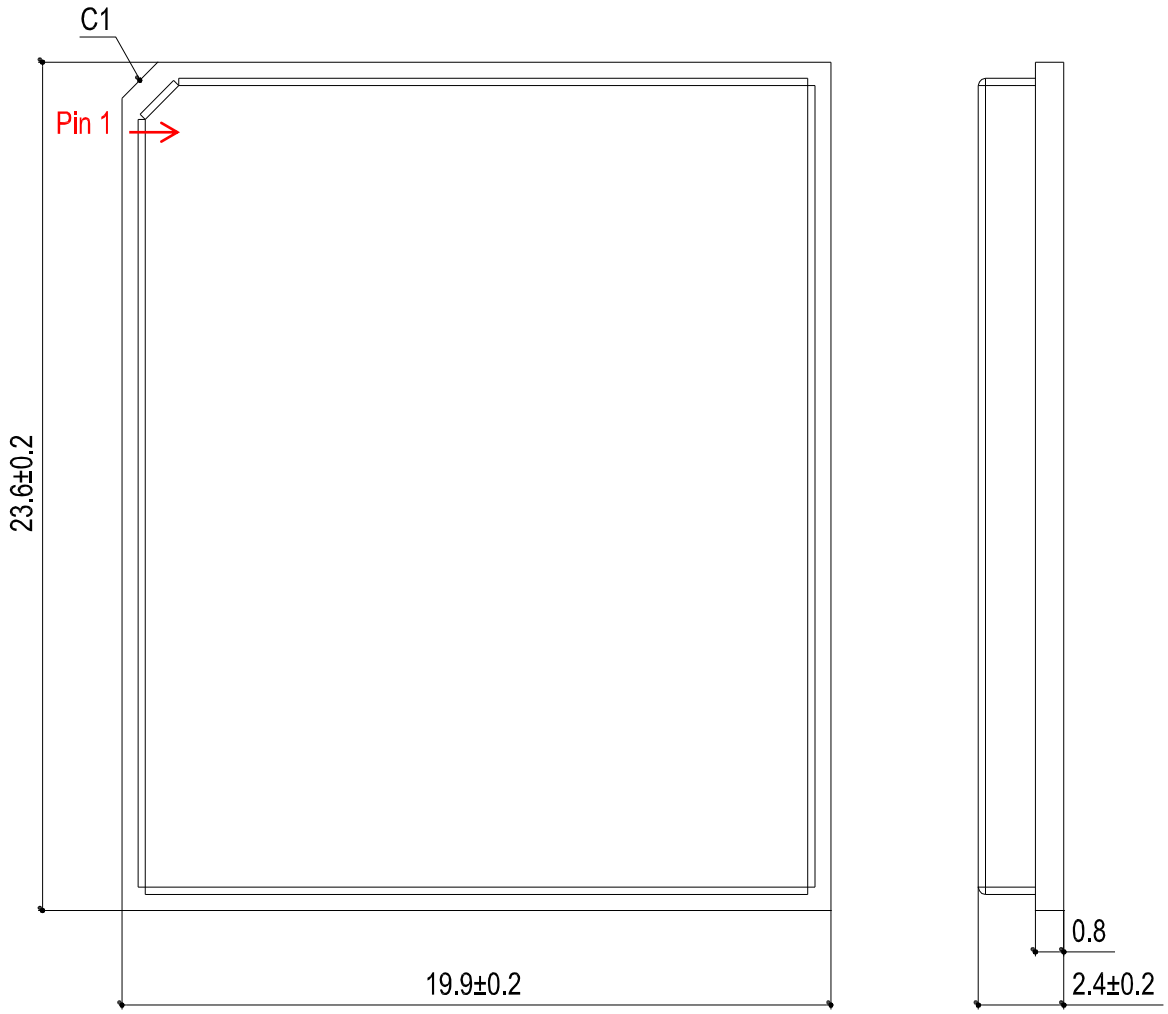


Figure 39: EG915Q-NA Top and Side Dimensions (Unit: mm)

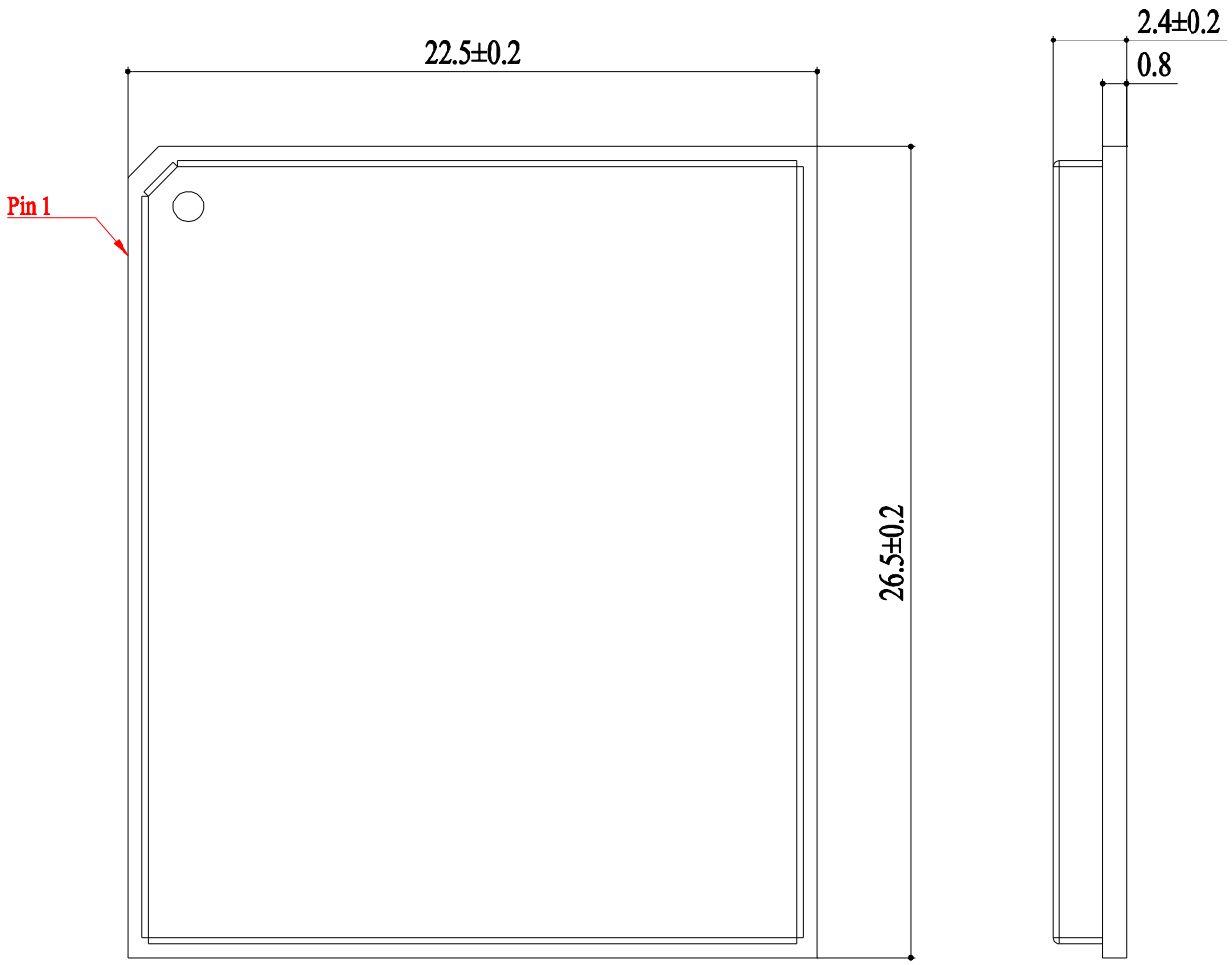


Figure 40: EG916Q-GL Top and Side Dimensions (Unit: mm)

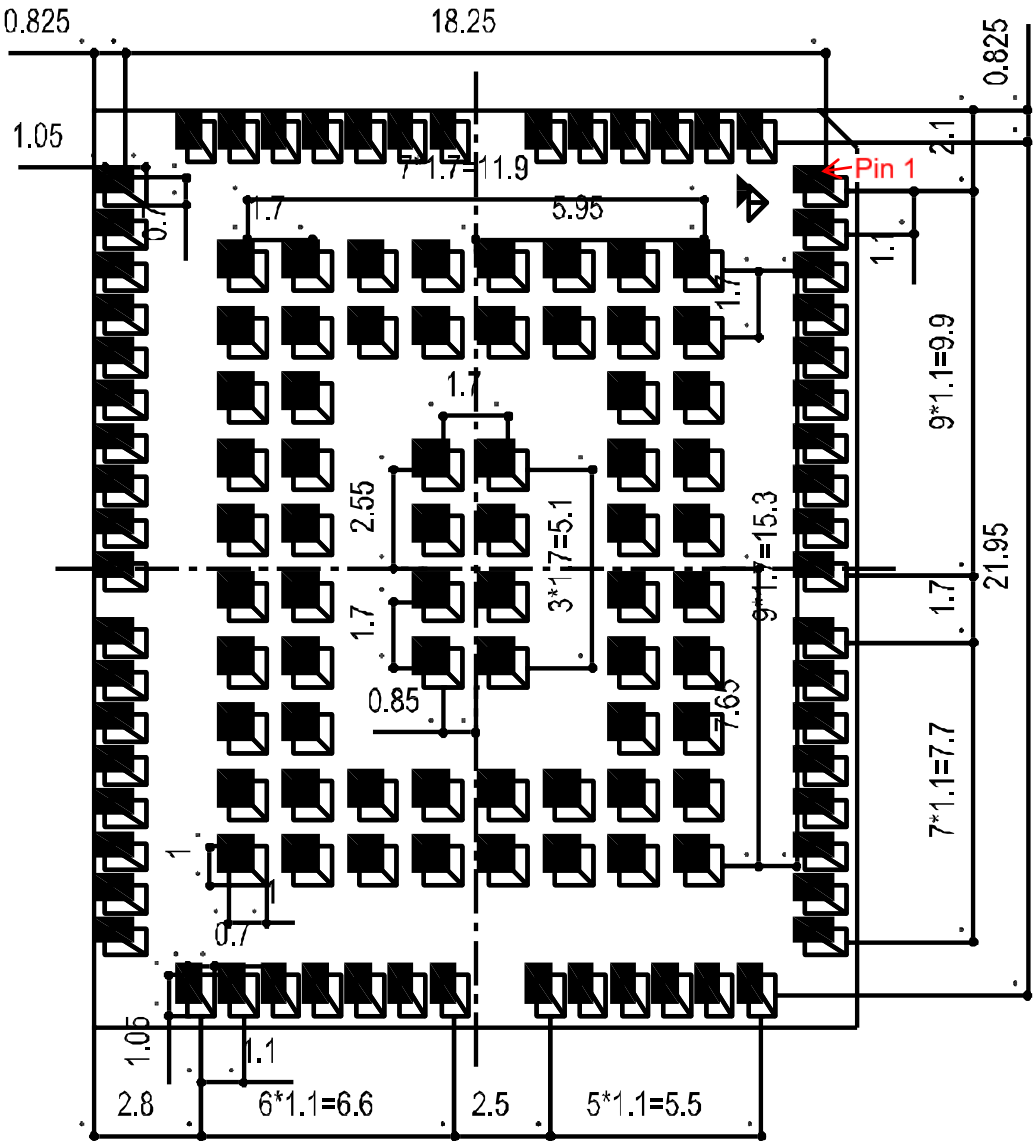


Figure 41: EG915Q-NA Bottom Dimensions (Bottom View, Unit: mm)

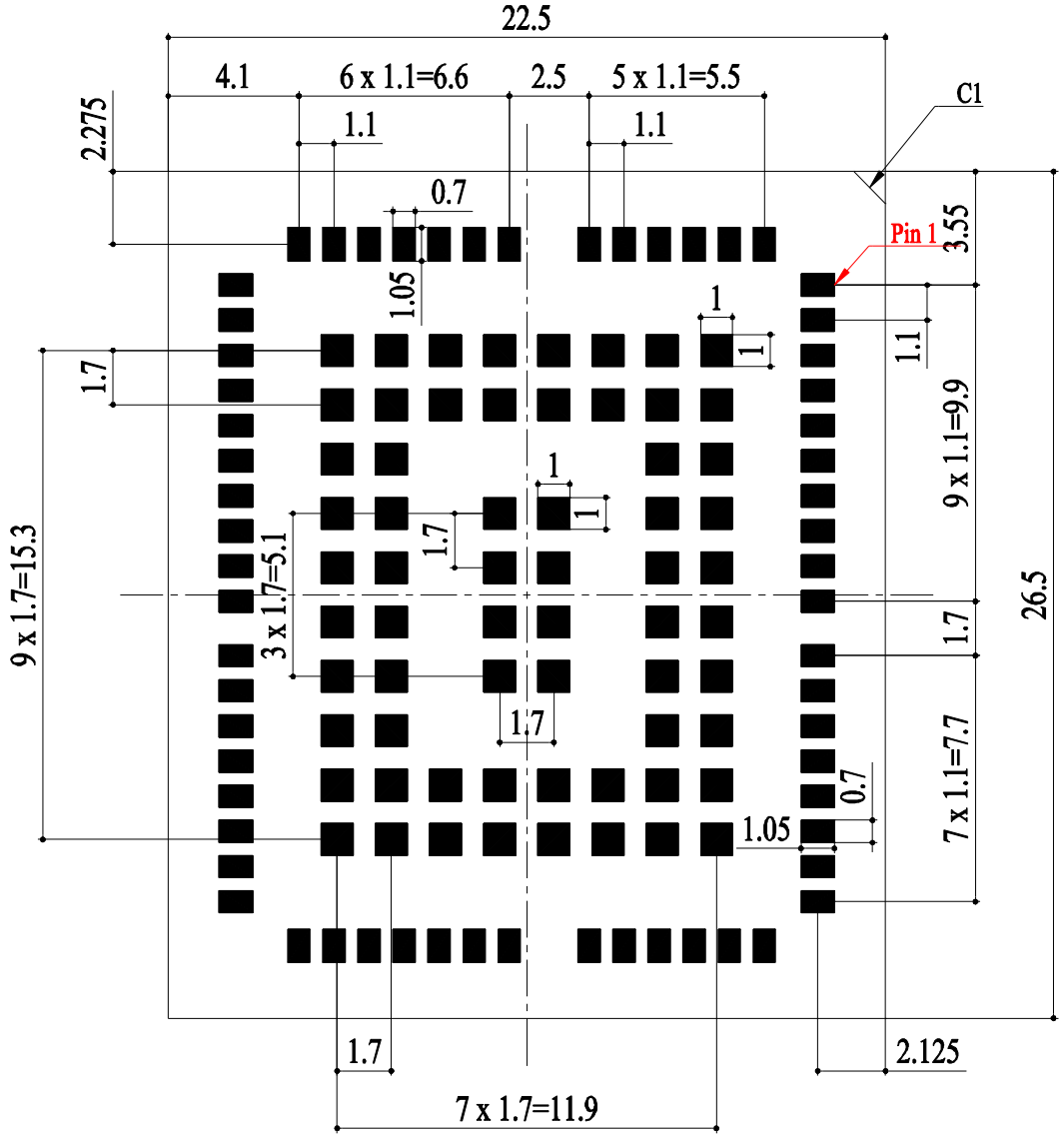


Figure 42: EG916Q-GL Bottom Dimensions (Bottom View, Unit: mm)

NOTE

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

8.2. Recommended Footprint

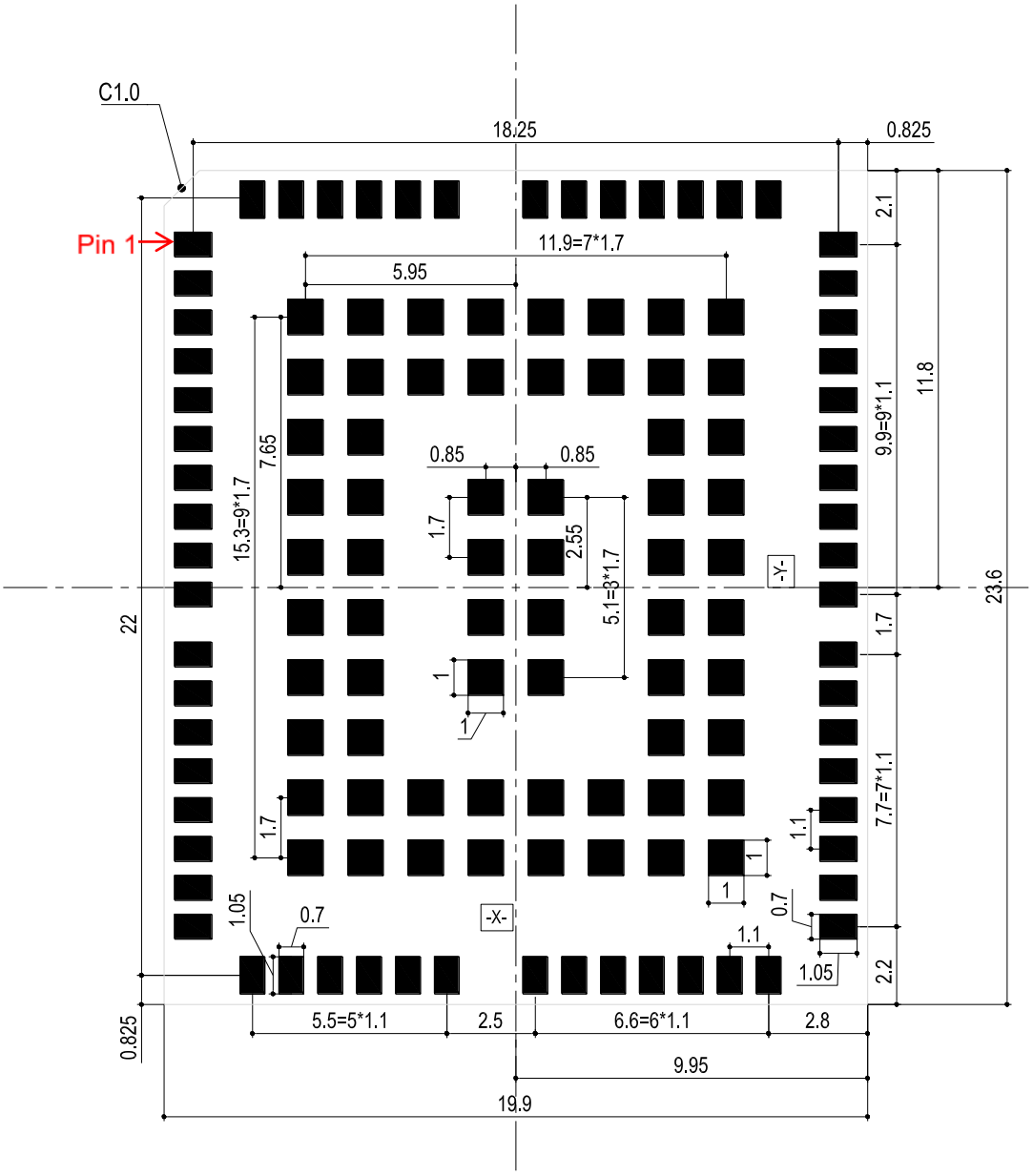


Figure 43: EG915Q-NA Recommended Footprint (Unit: mm)

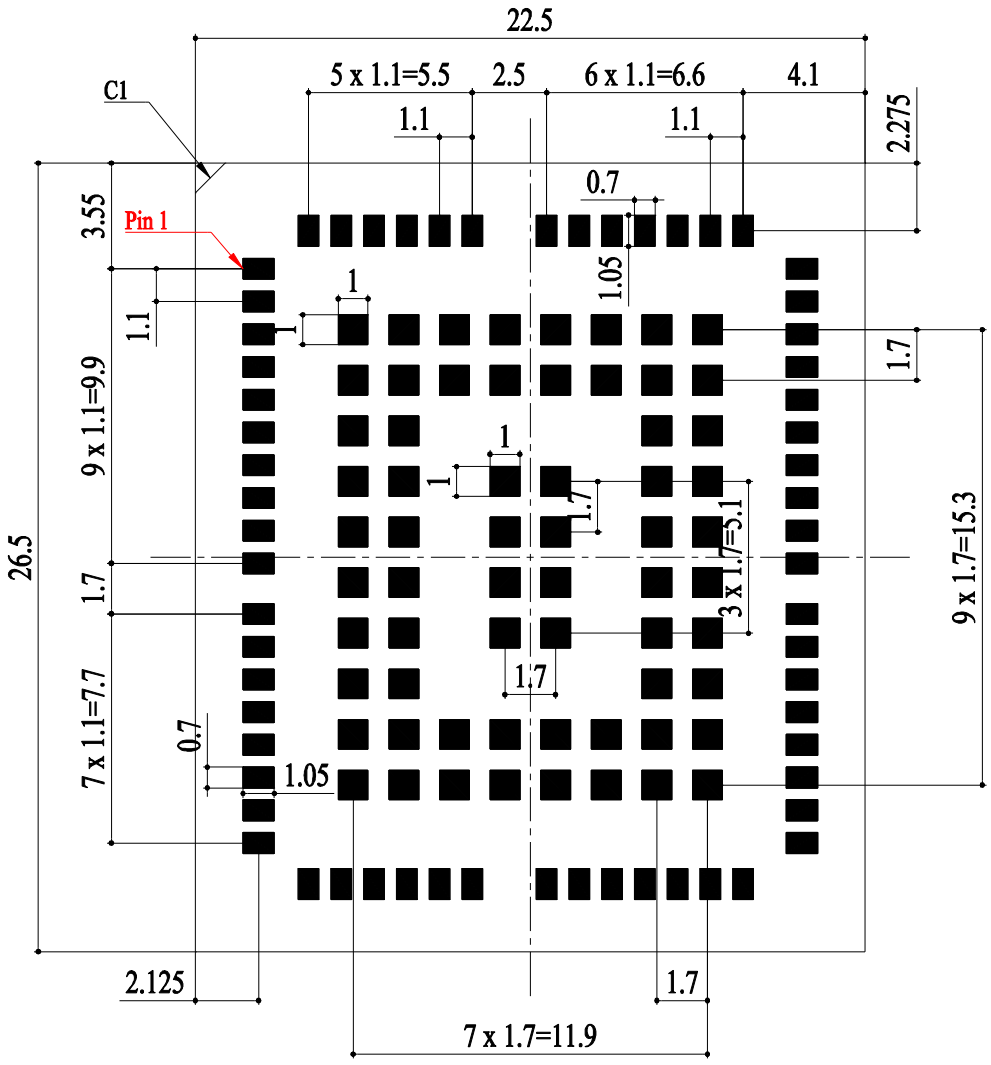


Figure 44: EG916Q-GL Recommended Footprint (Unit: mm)

NOTE

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

8.3. Top and Bottom Views

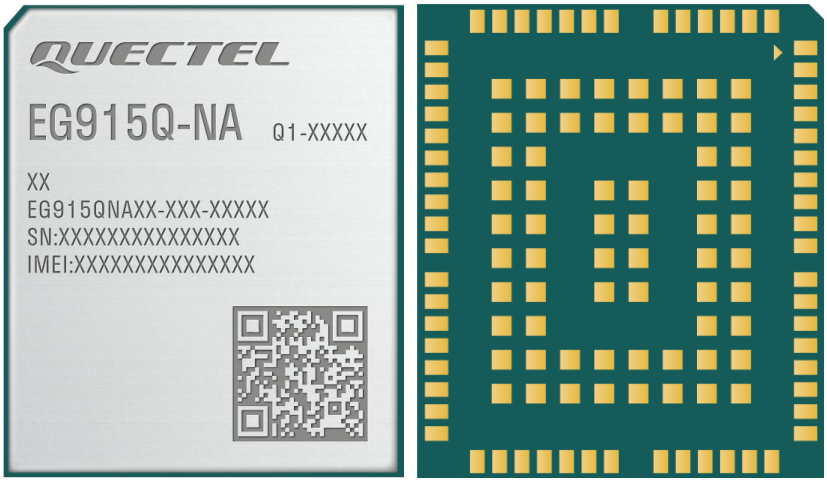


Figure 45: EG915Q-NA Top and Bottom Views of the Module

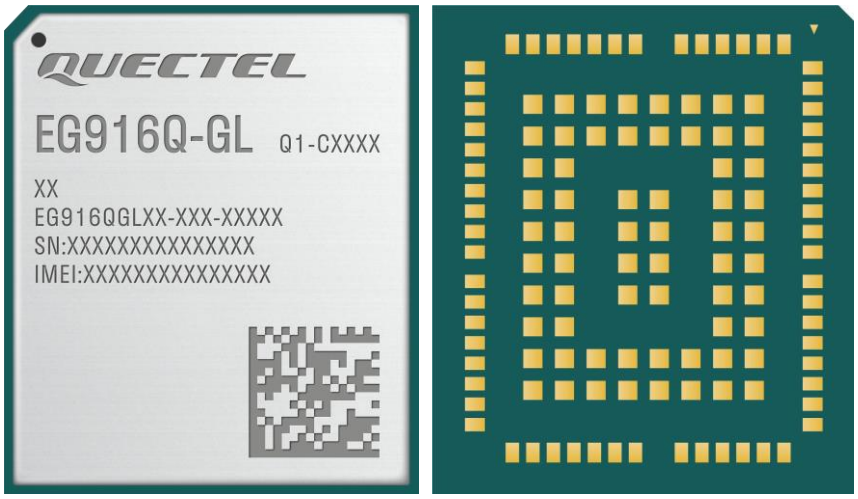


Figure 46: EG916Q-GL Top and Bottom Views of the Module

NOTE

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

9 Storage, Manufacturing & Packaging

9.1. Storage Conditions

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

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

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

3. Floor life: 168 hours [11] in a factory where the temperature is 23 ±5 °C and relative humidity is below 60 %. After the vacuum-sealed packaging is removed, the module must be processed in reflow soldering or other high-temperature operations within 168 hours. Otherwise, the module should be stored in an environment where the relative humidity is less than 10 % (e.g., a dry cabinet).

4. The module should be pre-baked to avoid blistering, cracks and inner-layer separation in PCB under the following circumstances:

   - The module is not stored in Recommended Storage Condition;
   - Violation of the third requirement mentioned above;
   - Vacuum-sealed packaging is broken, or the packaging has been removed for over 24 hours;
   - Before module repairing.

5. If needed, the pre-baking should follow the requirements below:

   - The module should be baked for 8 hours at 120 ±5 °C;
   - The module must be soldered to PCB within 24 hours after the baking, otherwise it should be put in a dry environment such as in a dry cabinet.

[11] 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 unpack the modules in large quantities until they are ready for soldering.

NOTE

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

9.2. 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 [4]***.

The recommended peak reflow temperature should be 235–246 ºC, with 246 ºC as the absolute maximum reflow temperature. To avoid damage to the module caused by repeated heating, it is recommended that the module should be mounted only after reflow soldering for the other side of PCB has been completed. The recommended reflow soldering thermal profile (lead-free reflow soldering) and related parameters are shown below.

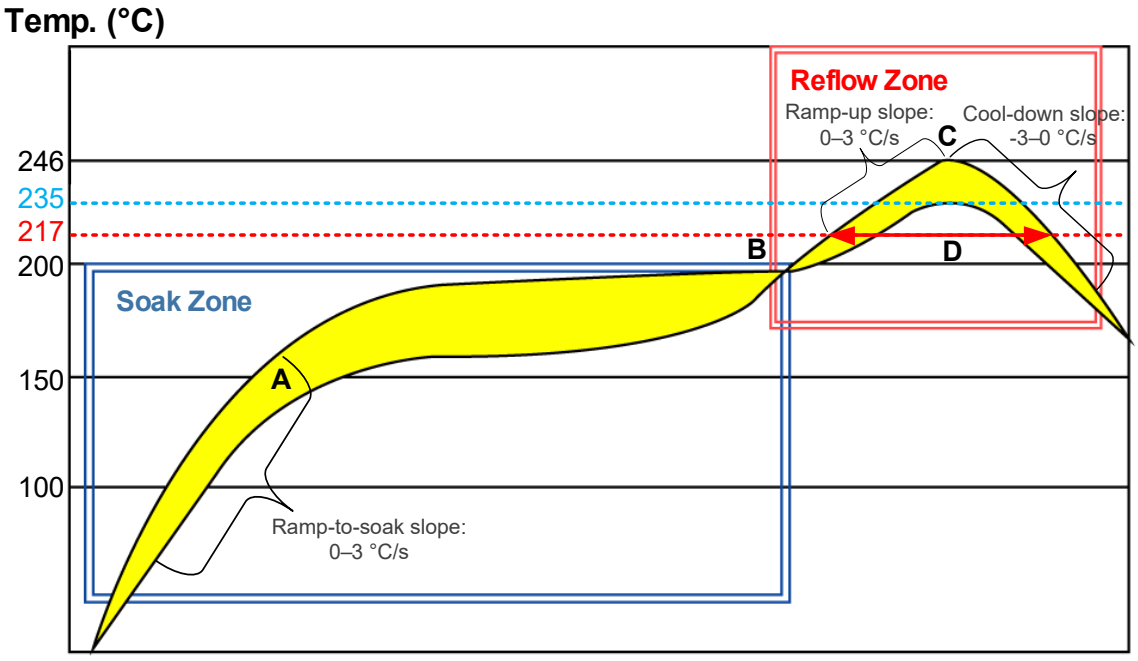


Figure 47: Recommended Reflow Soldering Thermal Profile

Table 47: Recommended Thermal Profile Parameters

Factor	Recommended Value
Soak Zone	
Ramp-to-soak slope	0–3 °C/s
Soak time (between A and B: 150 °C and 200 °C)	70–120 s
Reflow Zone	
Ramp-up slope	0–3 °C/s
Reflow time (D: over 217°C)	40–70 s
Max temperature	235–246 °C
Cool-down slope	-3–0 °C/s
Reflow Cycle	
Max reflow cycle	1

NOTE

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

9.3. 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:

9.3.1. Carrier Tape

Dimension details are as follow:

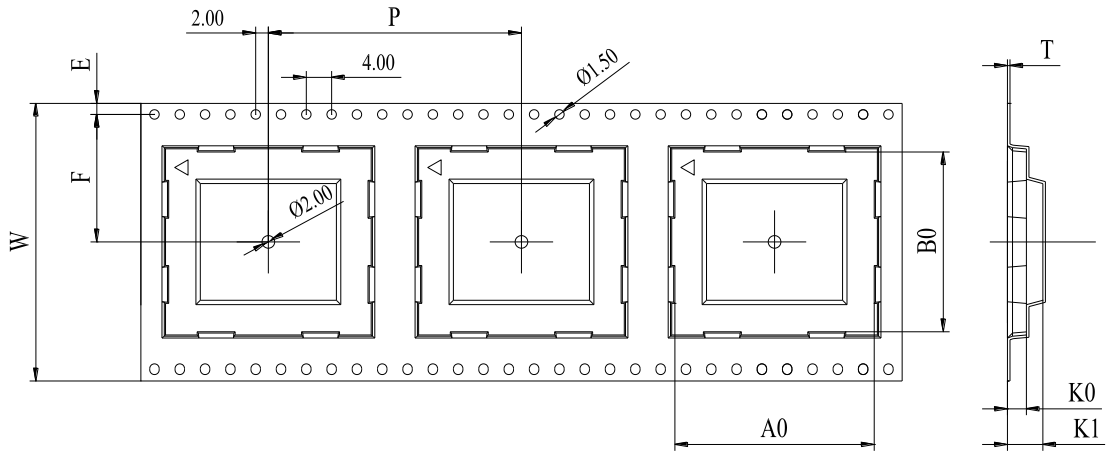


Figure 48: Carrier Tape Dimension Drawing

Table 48: 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

9.3.2. Plastic Reel

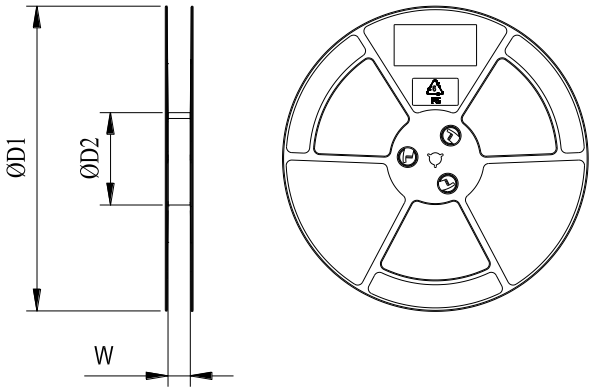


Figure 49: Plastic Reel Dimension Drawing

Table 49: Plastic Reel Dimension Table (Unit: mm)

øD1	øD2	W
330	100	44.5

9.3.3. Mounting Direction

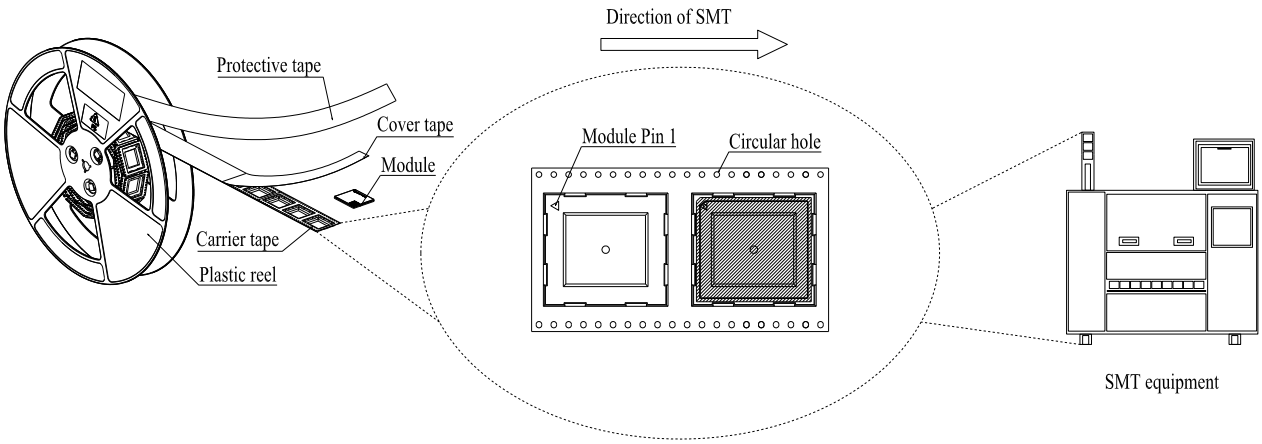
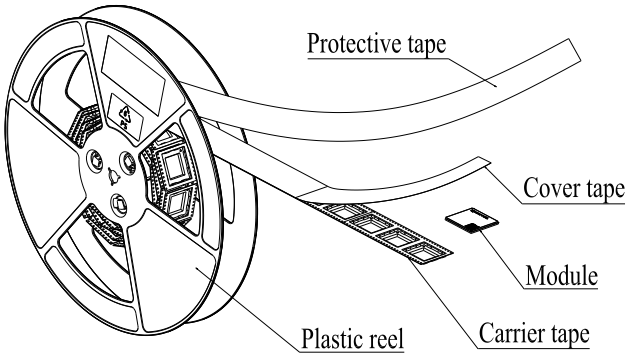


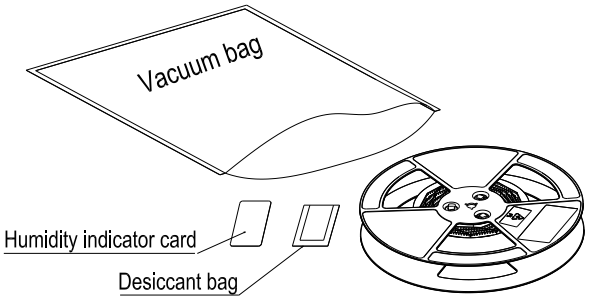
Figure 50: Mounting Direction

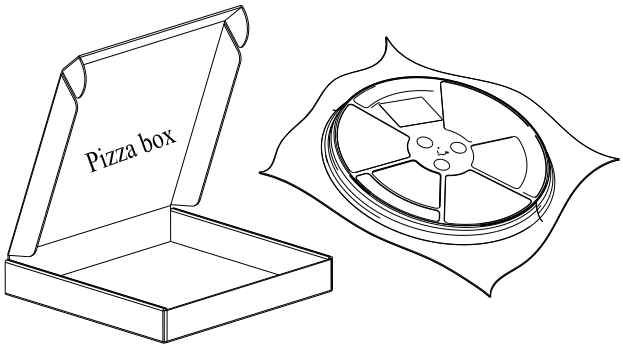
9.3.4. Packaging Process



Place the module into the carrier tape and use the cover tape to cover it; then wind the heat-sealed carrier tape to the plastic reel and use the protective tape for protection. 1 plastic reel can load 250 modules.

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





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

Put 4 packaged pizza boxes into 1 cartoon box and seal it. 1 cartoon box can pack 1000 modules.

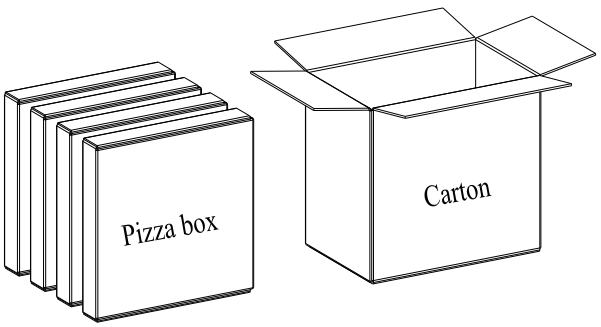


Figure 51: Packaging Process

10 Appendix References

Table 50: Related Documents

Document Name
[1] Quectel_UMTS&LTE_EVB_User_Guide
[2] Quectel_EG800Q&EG91xQ_Series_AT_Commands_Manual
[3] Quectel_RF_Layout_Application_Note
[4] Quectel_Module_SMT_Application_Note

Table 51: Terms and Abbreviations

Abbreviation	Description
3GPP	3rd Generation Partnership Project
ADC	Analog-to-Digital Converter
bps	Bits Per Second
CHAP	Challenge Handshake Authentication Protocol
CMUX	Connection MUX
CTS	Clear To Send
DFOTA	Delta Firmware Upgrade Over the Air
DL	Downlink
DRX	Discontinuous Reception
DTR	Data Terminal Ready
ESD	Electrostatic Discharge
FDD	Frequency Division Duplex

FILE	File Protocol
FTP	File Transfer Protocol
FTPS	FTP over SSL
GRFC	General RF Control
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol Secure
I2C	Inter-Integrated Circuit
I/O	Input/Output
IMT-2000	International Mobile Telecommunications 2000
LB	Low Band
LED	Light Emitting Diode
LGA	Land Grid Array
LTE	Long Term Evolution
MB	Middle Band
MCU	Microcontroller Unit
MO	Mobile Originated
MQTT	Message Queuing Telemetry Transport
MT	Mobile Terminated
NITZ	Network Identity and Time Zone
NTP	Network Time Protocol
PAP	Password Authentication Protocol
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PDU	Protocol Data Unit
PING	Packet Internet Groper

PPP	Point-to-Point Protocol
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RI	Ring Indicator
RF	Radio Frequency
Rx	Receive
SMD	Surface Mount Device
SMS	Short Message Service
SSL	Secure Sockets Layer
SPI	Serial Peripheral Interface
TCP	Transmission Control Protocol
Tx	Transmit
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_{IL}	Low-level input voltage
V_{OH}	High-level output voltage
V_{OL}	Low-level output voltage
Vmax	Maximum Voltage

Vnom	Nominal Voltage
Vmin	Minimum Voltage
V_{IL}max	Maximum Low-level Input Voltage
V_{RWM}	Working Peak Reverse Voltage
VSWR	Voltage Standing Wave Ratio

Important Notice to OEM integrators

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

Important Note

notice that any deviation(s) from the defined parameters of the antenna trace, as described by the instructions, require that the host product manufacturer must notify to Quectel that they wish to change the antenna trace design. In this case, a Class II permissive change application is required to be filed by the USI, or the host manufacturer can take responsibility through the change in FCC ID XMR2024EG916QGL procedure followed by a Class II permissive change application.

End Product Labeling

When the module is installed in the host device, the FCC/IC ID label must be visible through a window on the final device or it must be visible when an access panel, door or cover is easily re-moved. If not, a second label must be placed on the outside of the final device that contains the following text: “Contains FCC ID: XMR2024EG916QGL”
“Contains IC: 10224A-023EG916QGL“
The FCC ID/IC ID can be used only when all FCC/IC compliance requirements are met.

Antenna Installation

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

Antenna Gain	LTE Band 2: 1.25dBi LTE Band 4: 1.50dBi LTE Band 5: 1.90dBi LTE Band 7: 2.00dBi LTE Band 12: 1.60dBi LTE Band 13: 3.60dBi	LTE Band 25: 1.20dBi LTE Band 26: 1.90dBi LTE Band 38: 2.00dBi LTE Band 41: 1.70dBi LTE Band 66: 1.00dBi

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

Manual Information to the End User

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

List of applicable FCC rules

This module has been tested and found to comply with part 22, part 24, part 27, part 90, requirements for Modular Approval.
The modular transmitter is only FCC authorized for the specific rule parts (i.e., FCC transmitter rules) listed on the grant, and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

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

2.2 List of applicable FCC rules

FCC part 22, part 24, part 27, part 90

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 compos it product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation. The host manufacturer has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module The end user manual shall include all required regulatory information/warning as show 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: XMR2024EG916QGL" 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 FCC part 22, part 24, part 27, part 90 and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator

digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

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

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2) The transmitter module may not be co-located with any other transmitter or antenna.
As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Radiation Exposure Statement

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

IC

Industry Canada Statement

This device complies with Industry Canada's licence-exempt RSSs. Operation is subject to the following two conditions:
(1) This device may not cause interference; and
(2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:
(1) l'appareil ne doit pas produire de brouillage, et
(2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement."

Radiation Exposure Statement

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

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements ISED établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

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

1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
2) The transmitter module may not be co-located with any other transmitter or antenna.
As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

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

1) L'antenne doit être installée de telle sorte qu'une distance de 20 cm est respectée entre l'antenne et les

utilisateurs, et
2) Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne.

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

IMPORTANT NOTE:

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

NOTE IMPORTANTE:

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

End Product Labeling

This transmitter module is authorized only for use in device where the antenna may be installed such that 20 cm may be maintained between the antenna and users. The final end product must be labeled in a visible area with the following: “Contains IC:10224A-023EG916QGL”.

Plaque signalétique du produit final

Ce module émetteur est autorisé uniquement pour une utilisation dans un dispositif où l'antenne peut être installée de telle sorte qu'une distance de 20cm peut être maintenue entre l'antenne et les utilisateurs. Le produit final doit être étiqueté dans un endroit visible avec l'inscription suivante: "Contient des IC: 10224A-023EG916QGL ".

Manual Information To the End User

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

Manuel d'information à l'utilisateur final

L'intégrateur OEM doit être conscient de ne pas fournir des informations à l'utilisateur final quant à la façon d'installer ou de supprimer ce module RF dans le manuel de l'utilisateur du produit final qui intègre ce module.
Le manuel de l'utilisateur final doit inclure toutes les informations réglementaires requises et avertissements comme indiqué dans ce manuel.