

EG91xQA Series (With Aware)

Hardware Design

LTE Standard Module Series

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Safety Information

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



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



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



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



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



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



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

About the Document

Revision History

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1 Introduction

This document describes the EG91xQA series 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.

This document is applicable to the following modules:

- EG915QA-NA
- EG916QA-GL

1.1. Special Mark

Table 1: Special Mark

Mark	Definition
*	Unless otherwise specified, an asterisk (*) after a function, feature, interface, pin name, command, argument, and so on indicates that it is under development and currently not supported; and the asterisk (*) after a model indicates that the model sample is currently unavailable.

2 Product Overview

EG91xQA series are SMD modules with compact packaging, which also support GNSS ¹ to meet your specific application demands.

Table 2: Basic Information

Item	EG915QA-NA	EG916QA-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. 3.2 g

2.1. Frequency Bands and Functions

Table 3: Frequency Bands and Functions

Technology	EG915QA-NA	EG916QA-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 ¹	GPS L1*	Optional: ● GPS, GLONASS, BDS, Galileo, QZSS ● Dual-band GNSS: L1+L5
Wi-Fi Scan	802.11b/g/n with 2.4G DSSS beacon	802.11b/g/n with 2.4G DSSS beacon

¹ EG915QA-NA supports SoftGPS* function. If you need this function, GNSS RF front end needs to be added. The GNSS function of EG916QA-GL is optional. For more details, contact Quectel Technical Support.

NOTE

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

2.2. Key Features

Table 4: Key Features

Categories	Descriptions
Supply Voltage	3.3–4.3 V - Typ.: 3.8 V
USB Interface	- Compliant with USB 2.0 specifications (only supports slave mode) - Data transmission rate up to 480 Mbps - Used for data transmission, GNSS NMEA sentence output, software debugging, firmware upgrade and the output of partial logs - The USB interface can be used to upgrade firmware only after the module entering forced download mode (Pulling up USB_BOOT to VDD_EXT before turning on the module, and then the module will enter forced download mode).
USIM Interfaces	- Support 2 USIM interfaces: USIM0 and USIM1 - Only support Dual SIM Single Standby - USIM0: 1.8/3.0 V - USIM1: 1.8 V - When USIM0 and USIM1 are used at the same time, the power domain of the USIM interfaces should be 1.8 V. Otherwise, USIM1 interface will be damaged.
UART Interfaces	UART1: - Used for data transmission and firmware upgrade - Default baud rate: 115200 bps - Supports LPUART - Supports RTS and CTS hardware flow control UART2, UART3 ²: - Used for data transmission - Default baud rate: 115200 bps - Supports RTS and CTS hardware flow control Debug UART:

² UART3 is only supported by EG915QA-NA.

	- Used for the output of partial logs - Baud rate: up to 3 Mbps GNSS debug UART ³: - Used for outputting GNSS system logs - Baud rate: TBD
I2S Interface*	- Supports one digital audio interface: I2S interface - Used for audio function with external Codec
I2C Interfaces*	- Two I2C interfaces - Complies with I2C-bus specification
ADC Interfaces	Supports three ADC interfaces
SPI interface*	Supports one SPI interface
QSPI interface*	Supports one Quad SPI interface
Indication Interface	STATUS*: Used for indicating the module's operation status
Antenna Interface	- Main antenna/Wi-Fi Scan antenna interface (ANT_MAIN) - GNSS antenna interface (ANT_GNSS) *¹ 50 Ω characteristic impedance
Transmitting Power	LTE bands: Class 3 (23 dBm $\pm$2 dB)
LTE Features	- Complies with 3GPP Rel-14 FDD - Max. LTE category: Cat 1bis 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) - LTE-TDD Max. data rates: 8.96 Mbps (DL)/3.1 Mbps (UL)
GNSS	- Constellations: GPS, GLONASS, BDS, Galileo, NavIC and QZSS - Augmentation system: SBAS - Dual-band GNSS: L1 and L5 - Triple-band GNSS: L1, L2 and L5 - The module complies with NMEA 0183 protocol - The data update rate is {num} Hz by default and can support a max. value of {num} H
Temperature Ranges	- Normal operating temperature ⁴: -35 °C to +75 °C - Extended operating temperature ⁵: -40 °C to +85 °C - Storage temperature: -40 °C to +90 °C

³ GNSS debug UART is only supported by EG916QA-GL.

⁴ Within this range, the module's indicators comply with 3GPP specification requirements.

⁵ Within the range of -40 to -35 °C or 75 to 85 °C, the module retains the ability to establish and maintain functions such as SMS and data transmission, without any unrecoverable malfunction. Radio spectrum and radio network remain uninfluenced, whereas the value of one or more parameters, such as P_{out}, may decrease and fall below the range of the 3GPP specified tolerances. When the temperature returns to the normal operating temperature range, the module's indicators will comply with 3GPP specification requirements again.

Firmware Upgrade Via USB 2.0 interface

RoHS All hardware components fully comply with EU RoHS directive

2.3. Pin Assignment

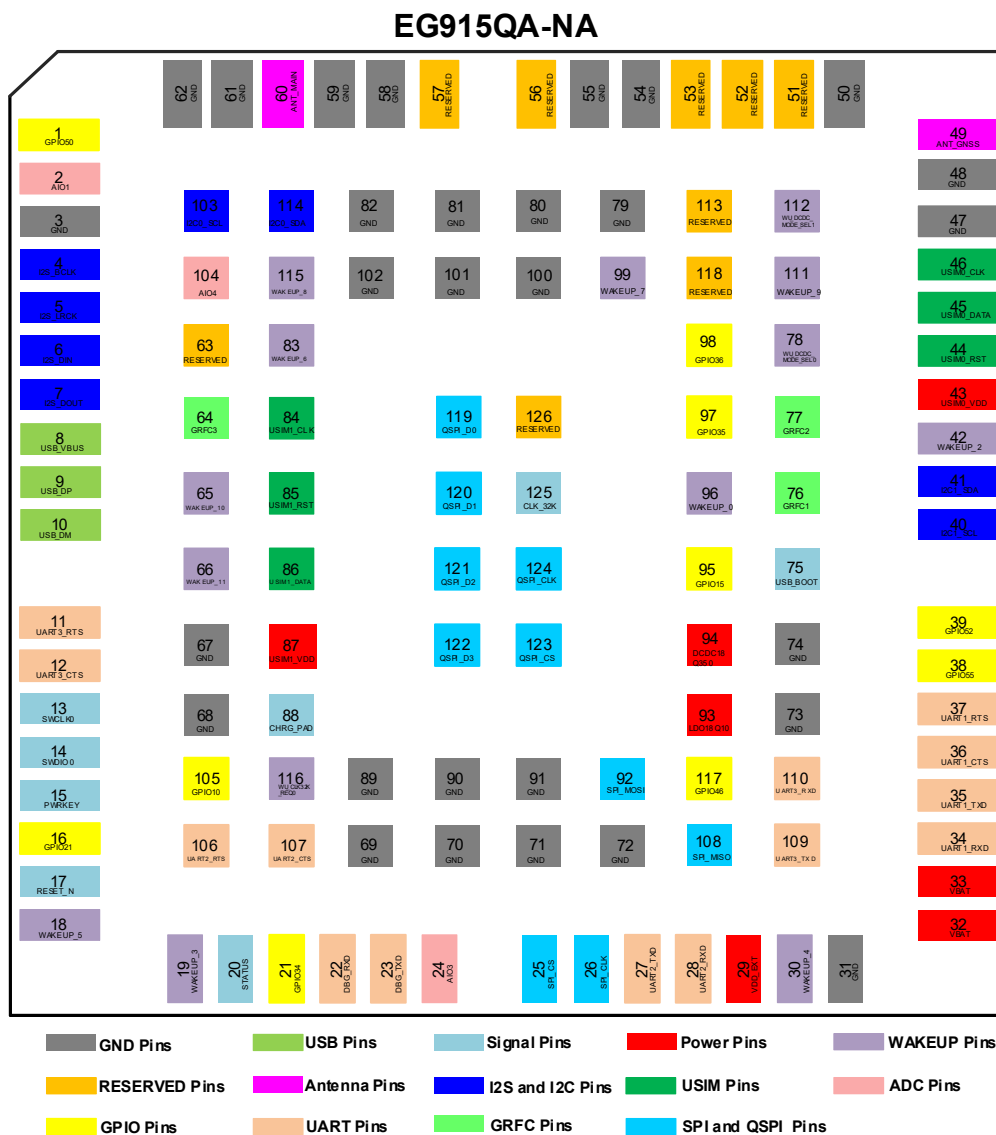


Figure 1: EG915QA-NA Pin Assignment (Top View)

EG916QA-GL

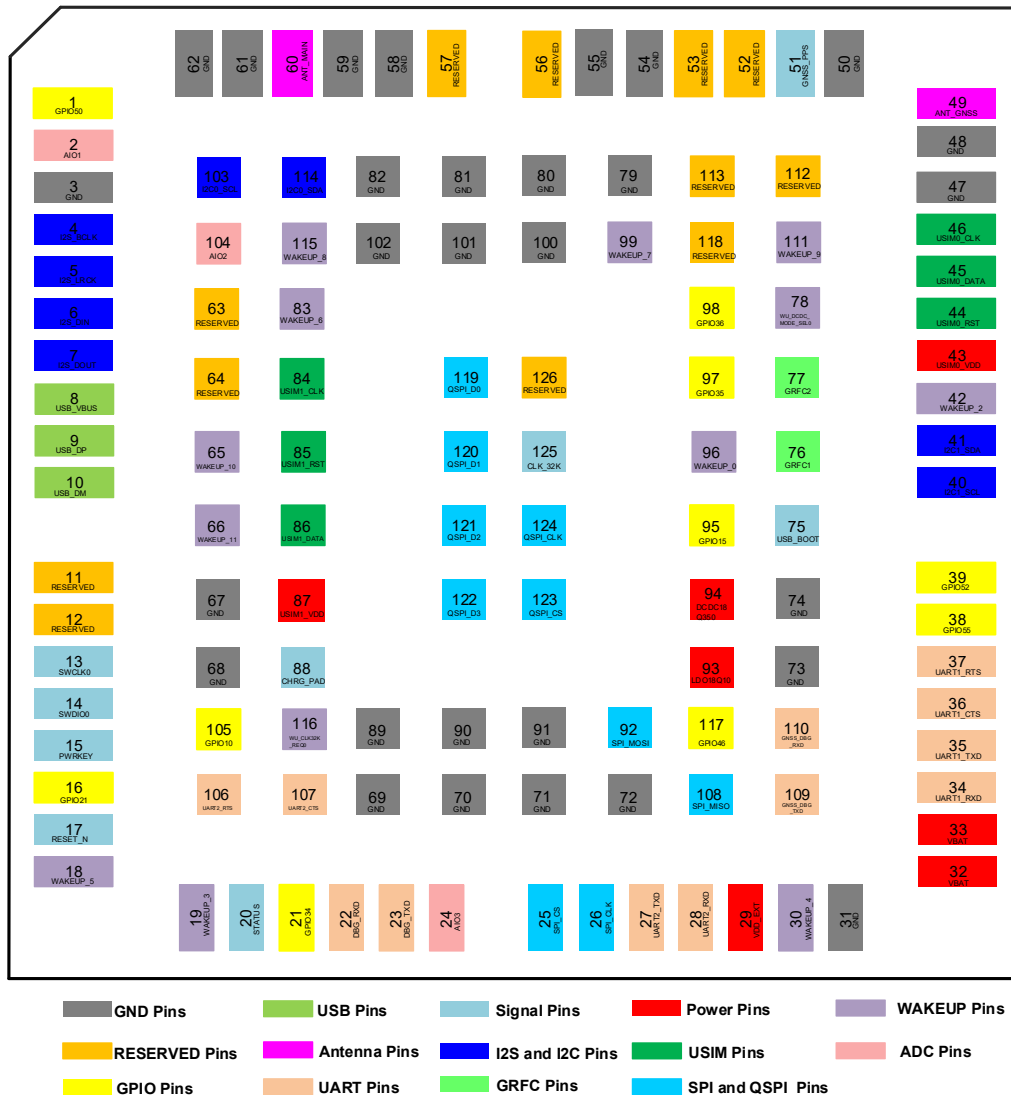


Figure 2: EG916QA-GL Pin Assignment (Top View)

NOTE

1. If the module does not need to enter forced download mode, USB_BOOT (pin 75) should not be pulled up to VDD_EXT before the module successfully starts up.
2. When designing circuits, pay attention to the following pins and evaluate them based on usage scenarios and circuit design: pins of I2S interface*, UART1–UART3, debug UART, SPI interface*, I2C interfaces*, USB_BOOT and SW interface, and pins 16, 21, 95, 97, 98, 105, 117 of GPIO interfaces. The following notes should be emphasized:
 - In sleep mode, the driving capacity of these pins is lost and data transmission are disabled.
 - During the turn-on or reset process, these pins have a high-level output for about 2 ms.

3. During the turn-on or reset process, pins 1, 38 and 39 of GPIO interfaces, STATUS (pin 20) and pins 18, 19 and 30 of WAKEUP interfaces also have a high-level output for about 2 ms. Please evaluate whether it meets the specific application design requirements based on the usage scenario and circuit design.
4. When USIM0 and USIM1 are used at the same time, the power domain of the USIM interfaces should be 1.8 V. Otherwise, USIM1 interface will be damaged.
5. Pins 11, 12, 51, 64, 109, 110 and 112 have different functions on EG915QA-NA and EG916QA-GL. For more details, see **Table 6**.
6. Keep all RESERVED pins and unused pins unconnected.
7. EG915QA-NA supports SoftGPS* function. If you need this function, GNSS RF front end needs to be added. The GNSS function of EG916QA-GL is optional. For more details, contact Quectel Technical Support.

2.4. Pin Definitions

Table 5: Parameter Definition

Parameter	Description
AI	Analog Input
AO	Analog Output
AIO	Analog Input/Output
DI	Digital Input
DO	Digital Output
DIO	Digital Input/Output
OD	Open Drain
PI	Power Input
PO	Power Output
PD	Pull-down
PU	Pull-up
NP	No-pull

DC characteristics include power domain and rated current.

Table 6: Pin Description

Power Supply						
Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristic	Comment
VBAT	32, 33	PI	-	Power supply for the module	Vmax = 4.3 V Vmin = 3.3 V Vnom = 3.8 V	External power supply is recommended to provide with current of 1.5 A at least. Test points are recommended to be reserved.
VDD_EXT	29	PO	-	Provide 1.8 V for external circuit	Vmax = 1.89 V Vnom = 1.8 V Vmin = 1.71 V Iomax = 50 mA	Power supply for external GPIO's pull-up circuits. A test point is recommended to be reserved.
LDO18Q10*	93	PO	-	Provide 1.8 V for external circuit	Vnom = 1.8 V Iomax = 10 mA	If unused, keep it open.
DCDC18Q350*	94	PO	-	Provide 1.8 V for external circuit	Vnom = 1.8 V Iomax = 50 mA	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	Status After Reset	Description	DC Characteristic	Comment
PWRKEY	15	DI	PU	Turn on/off the module	VILmax = 0.5 V	Active low. A test point is recommended to be reserved.
RESET_N	17	DI	PU	Reset the module	VILmax = 0.3 V	Active low. A test point is recommended to be reserved if unused.
Indication Signal						
Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristic	Comment

STATUS*	20	DO	NP	Indicate the module's operation status	1.8 V	If unused, keep them open. Can maintain original status in sleep mode.
USB Interface						
Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristic	Comment
USB_VBUS	8	AI	-	USB connection detect	Vmax = 5.25 V Vmin = 3.0 V Vnom = 5.0 V	A test point must be reserved.
USB_DP	9	AIO	-	USB 2.0 differential data (+)		Requires differential impedance of 90 Ω. Test points must be reserved.
USB_DM	10	AIO	-	USB 2.0 differential data (-)		
USIM Interfaces ⁶						
Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristic	Comment
USIM0_VDD	43	PO	-	USIM0 card power supply	Iomax = 34 mA	Either 1.8 V or 3.0 V USIM0 card is supported and can be identified automatically by the module.
					Low-voltage: Vmax = 1.89 V Vnom = 1.8 V Vmin = 1.71 V	
					High-voltage: Vmax = 3.09 V Vnom = 3.0 V Vmin = 2.90 V	
USIM0_DATA	45	DIO	-	USIM0 card data	USIM_VDD	
USIM0_CLK	46	DO	-	USIM0 card clock		
USIM0_RST	44	DO	-	USIM0 card reset		
USIM1_VDD	87	PO	-	USIM1 card power supply	USIM0_VDD (Low-voltage)	Connected with USIM0_VDD inside the module.

⁶ When USIM0 and USIM1 are used at the same time, the power domain of the USIM interfaces should be 1.8 V. Otherwise, USIM1 interface will be damaged.

						1.8 V power domain is required for USIM1. Otherwise, this interface will be damaged.
USIM1_DATA	86	DIO	NP	USIM1 card data	1.8 V	1.8 V power domain is required for USIM1. Otherwise, this interface will be damaged.
USIM1_RST	85	DO	NP	USIM1 card reset		
USIM1_CLK	84	DO	NP	USIM1 card clock		
UART Interfaces						
Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristic	Comment
UART1_RXD	34	DI	NP	UART1 receive	1.8 V	If unused, keep them open.
UART1_TXD	35	DO	NP	UART1 transmit		
UART1_CTS	36	DO	NP	Clear to send signal from the module		Connect to MCU's CTS. If unused, keep it open.
UART1_RTS	37	DI	NP	Request to send signal to the module		Connect to MCU's RTS. If unused, keep it open.
UART2_TXD	27	DO	NP	UART2 transmit		If unused, keep them open.
UART2_RXD	28	DI	NP	UART2 receive		
UART2_RTS	106	DI	NP	Request to send signal to the module		Connect to MCU's RTS. If unused, keep it open.
UART2_CTS	107	DO	NP	Clear to send signal from the module		Connect to MCU's CTS. If unused, keep it open.
UART3_TXD	109	DO	NP	Only for EG915QA-NA: UART3 transmit		If unused, keep it open.
GNSS_DBG_TXD		DO	-	Only for EG916QA-GL: GNSS debug UART transmit		A test point must be reserved.

UART3_RXD	110	DI	NP	Only for EG915QA-NA: UART3 receive		If unused, keep it open.
GNSS_DBG_RXD		DI	-	Only for EG916QA-GL: GNSS debug UART receive		A test point must be reserved.
UART3_RTS	11	DI	NP	Only for EG915QA-NA: Request to send signal to the module		Connect to MCU's RTS. If unused, keep it open.
RESERVED		-	-	Only for EG916QA-GL: Reserved		
UART3_CTS	12	DO	NP	Only for EG915QA-NA: Clear to send signal from the module	1.8 V	Connect to MCU's CTS. If unused, keep it open.
RESERVED		-	-	Only for EG916QA-GL: Reserved		

Debug UART interface

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristic	Comment
DBG_RXD	22	DI	NP	Debug UART receive	1.8 V	Test points must be reserved.
DBG_TXD	23	DO	NP	Debug UART transmit		

I2C Interfaces*

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristic	Comment
I2C0_SCL	103	OD	NP	I2C0 serial clock	1.8 V	External pull-up resistor is required. If unused, keep them open.
I2C0_SDA	114	OD	NP	I2C0 serial data		
I2C1_SCL	40	OD	NP	I2C1 serial clock		
I2C1_SDA	41	OD	NP	I2C1 serial data		

I2S Interface*

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristic	Comment
I2S_LRCK	5	DO	NP	I2S strobe clock	1.8 V	If unused, keep them open.
I2S_BCLK	4	DO	NP	I2S bit clock		
I2S_DIN	6	DI	NP	I2S data input		
I2S_DOUT	7	DO	NP	I2S data output		

RF Antenna Interfaces

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristic	Comment
ANT_MAIN	60	AIO	-	Main antenna/ Wi-Fi Scan antenna interface		50 Ω impedance.
ANT_GNSS ^{7*}	49	AI	-	GNSS antenna interface		

GRFC Interfaces

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristic	Comment
GRFC1	76	DO	NP	Generic RF controller	1.8 V	If unused, keep them open.
GRFC2	77	DO	NP	Generic RF controller		
GRFC3	64	DO	NP	Only for EG915QA-NA: Generic RF controller		If unused, keep it open.
RESERVED		-	-	Only for EG916QA-GL: Reserved		

SPI Interface*

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristic	Comment
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⁷ EG915QA-NA supports SoftGPS* function. If you need this function, GNSS RF front end needs to be added. The GNSS function of EG916QA-GL is optional. For more details, contact Quectel Technical Support.

SPI_CS	25	DO	NP	SPI chip select	1.8 V	If unused, keep them open.
SPI_CLK	26	DO	NP	SPI clock		
SPI_MOSI	92	DO	NP	SPI master-out slave-in		
SPI_MISO	108	DI	NP	SPI master-in slave-out		

ADC Interfaces

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristic	Comment
AIO3	24	AI	-	General-purpose ADC interface	Input voltage range: 0–1.6 V	If unused, keep them open.
AIO1	2	AI	-	General-purpose ADC interface		
AIO4	104	AI	-	General-purpose ADC interface		

QSPI Interface*

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristic	Comment
QSPI_D0	119	DIO	-	Quad SPI data 0	1.8 V	If unused, keep them open.
QSPI_D1	120	DIO	-	Quad SPI data 1		
QSPI_D2	121	DIO	-	Quad SPI data 2		
QSPI_D3	122	DIO	-	Quad SPI data 3		
QSPI_CS	123	DIO	-	Quad SPI chip select		
QSPI_CLK	124	DIO	-	Quad SPI clock		

WAKEUP Interfaces

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristic	Comment
WAKEUP_0	96	AI	-	Wakeup signal	1.8 V	If unused, keep them open.
WAKEUP_2	42	AI	-	Wakeup signal		
WAKEUP_3 ⁸	19	AI	-	Wakeup signal		

⁸ The functions of pins 18, 19 and 30 can be changed by software commands. For more details, contact Quectel Technical

		DIO	NP	AGPIO	
WAKEUP_4 ⁸	30	AI	-	Wakeup signal	
		DIO	NP	AGPIO	
WAKEUP_5 ⁸	18	AI	-	Wakeup signal	
		DIO	NP	AGPIO	
WAKEUP_6	83	AI	-	Wakeup signal	
WAKEUP_7	99	AI	-	Wakeup signal	
WAKEUP_8	115	AI	-	Wakeup signal	
WAKEUP_9	111	AI	-	Wakeup signal	
WAKEUP_10	65	AI	-	Wakeup signal	
WAKEUP_11	66	AI	-	Wakeup signal	
WU_DCDC_MODE_SEL0	78	AI	-	Wakeup signal	
WU_DCDC_MODE_SEL1	112	AI	-	Only EG915QA-NA: Wakeup signal	If unused, keep it open.
RESERVED		-	-	Only for EG916QA-GL: Reserved	
WU_CLK32K_REQ0	116	AI	-	Wakeup signal	If unused, keep it open.
GPIO Interfaces					

Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristic	Comment
GPIO10	105	DIO	NP	General-purpose input/output	1.8 V	If unused, keep them open.
GPIO15	95	DIO	NP	General-purpose input/output		
GPIO21	16	DIO	PD	General-purpose input/output		
GPIO34	21	DIO	NP	General-purpose input/output		

Support.

GPIO35	97	DIO	NP	General-purpose input/output	If unused, keep them open. Can maintain original status in sleep state.	
GPIO36	98	DIO	NP	General-purpose input/output		
GPIO46	117	DIO	NP	General-purpose input/output		
GPIO50	1	DIO	NP	General-purpose input/output		
GPIO52	39	DIO	NP	General-purpose input/output		
GPIO55	38	DIO	NP	General-purpose input/output		
SW Interface						
Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristic	Comment
SWCLK0	13	DO	PU	Serial wire debug clock	1.8 V	If unused, keep them open.
SWDIO0	14	DIO	PU	Serial wire data input/output		Test points are recommended to be reserved.
Other Interfaces						
Pin Name	Pin No.	I/O	Status After Reset	Description	DC Characteristic	Comment
USB_BOOT	75	DI	PD	Force the module into download mode	1.8 V	Active high before power-up. A test point must be reserved.
CHRG_PAD*	88	AI	-	Charge state detect	-	If unused, keep them open.
CLK_32K*	125	AO	-	32 kHz crystal output	-	
RESERVED	51	-	-	Only for EG915QA-NA: Reserved		
GNSS_PPS*		DO	-	Only for EG916QA-GL: GNSS pulse per second output	1.8 V	If unused, keep it open.
RESERVED Pins						

Pin Name	Pin No.	Comment
RESERVED	For EG915QA-NA:	Keep these pins open.
	51–53, 56, 57, 63, 113, 118, 126	
	For EG916QA-GL:	
	11, 12, 52, 53, 56, 57, 63, 64, 112, 113, 118, 126	

2.5. EVB Kit

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

EG915QA-NA supports **operating modes of both LTE and SoftGPS***. If you need SoftGPS* function, GNSS RF front end needs to be added. For more details, contact Quectel Technical Support.

EG916QA-GL integrates both LTE and GNSS. The GNSS function is optional. For more details, contact Quectel Technical Support.

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	Both RF function and USIM cards will be invalid.	
Airplane Mode	RF function will be invalid.	
Sleep Mode	Power consumption of the module will be reduced to an ultra-low level. The module can still receive paging, TCP/UDP data from the network.	
Turn-off Mode	The VBAT pins are constantly turned on and the software stops working.	

3.1.1.1. Sleep Mode

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

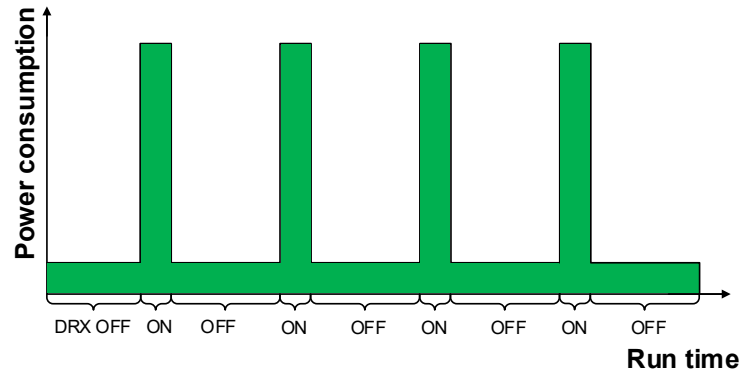


Figure 3: Power Consumption During Sleep Mode

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 UART1, both the following preconditions should be met to set the module to sleep mode:

- Software enable sleep.
- Ensure all wakeup pins are in a stable state.

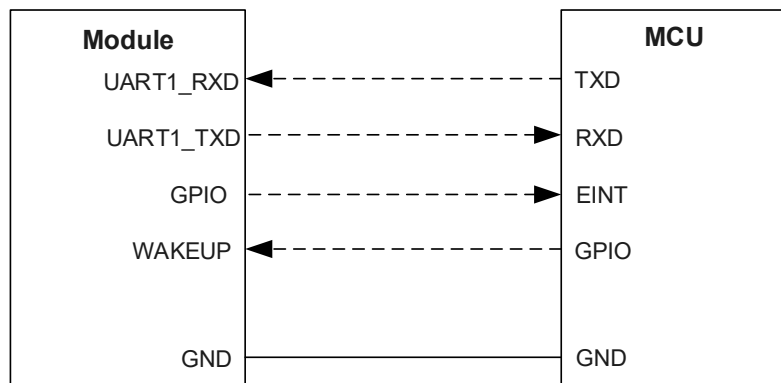


Figure 4: Sleep Mode Application via UART1

- The module can be wake up by triggering the module's wakeup pin.

NOTE

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

3.1.1.3. USB Application with USB Suspend/Resume

If the host supports USB Suspend/Resume, but does not support remote wakeup function, the GPIO signal is needed to wake up the host. The following three preconditions must be met to set the module to sleep mode.

- Software enable sleep.
- Ensure all wakeup pins are in a stable state.
- Ensure the host's USB bus, which is connected to the module's USB interface, enters Suspend state.

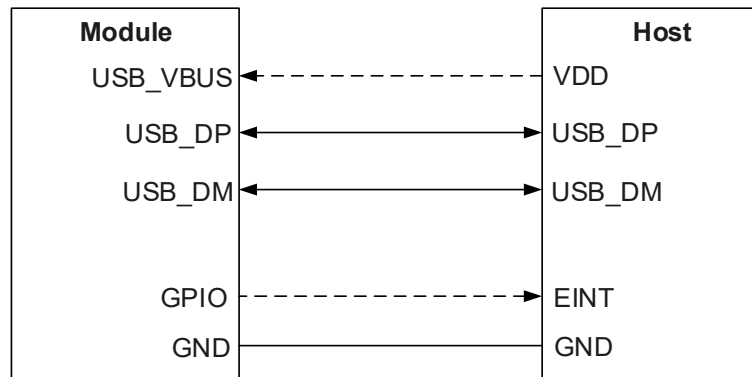


Figure 5: Sleep Mode Application with USB Suspend/Resume

- 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 GPIO signal.

3.1.1.4. 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:

- Software enable sleep.
- Ensure all wakeup pins are in a stable state.
- Ensure USB_VBUS is disconnected via the external control circuit.

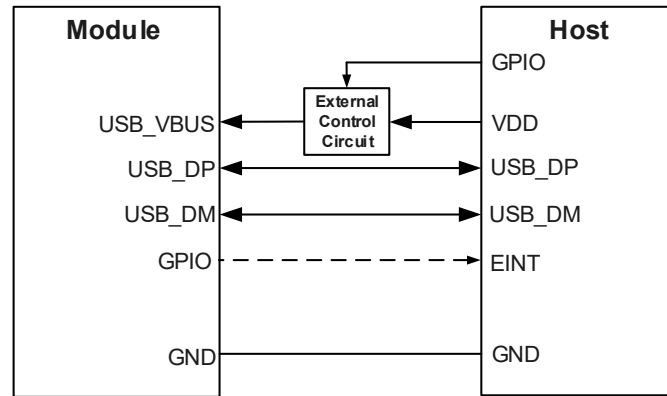


Figure 6: Sleep Mode Application without USB Suspend

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.

3.1.2. Operating Modes of GNSS Part*

EG915QA-NA supports SoftGPS* function. If you need this function, GNSS RF front end needs to be added. The GNSS function of EG916QA-GL is optional. For more details, contact Quectel Technical Support.

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. - 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	●	The power supply inside the GNSS is cut off.
Mode	●	The software stops working.

3.2. Power Supply

3.2.1. Power Supply Interface

The module provides two 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	32, 33	PI	Power supply for the module	3.3	3.8	4.3	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.

It is recommended to use a power supply that can provide the module with at least 1.5 A current. 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.

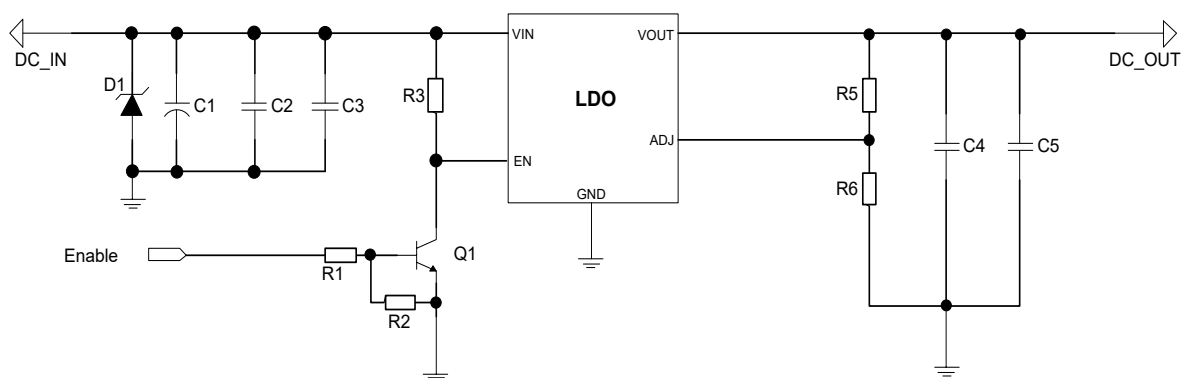


Figure 7: Reference Design of Power Input

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 software power off you can cut off the power supply.

3.2.3. Requirements for Voltage Stability

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 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 trace should be at least 2 mm. 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 $V_{\text{RWM}} = 4.7 \text{ V}$, low clamping voltage and high reverse peak pulse current I_{pp} at the front end of the power supply.

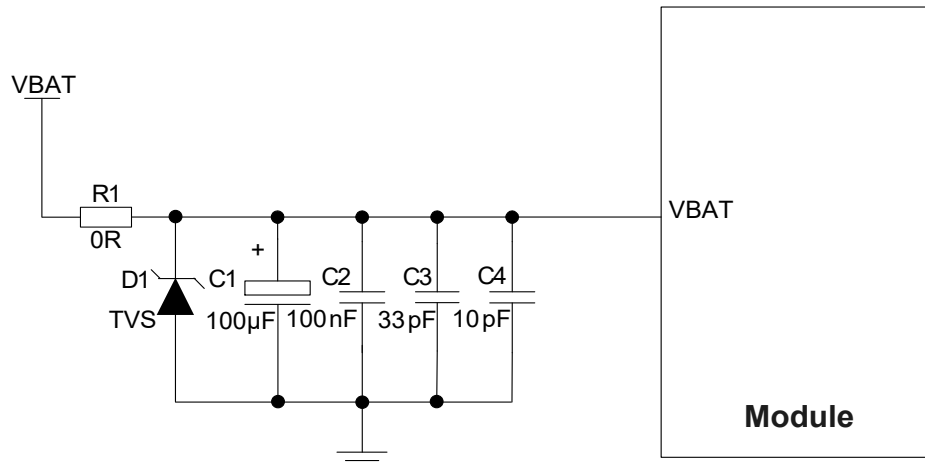


Figure 8: Reference Design of Power Supply

3.3. Turn-on

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 level. It is recommended to use an open drain/collector driver to control the PWRKEY.

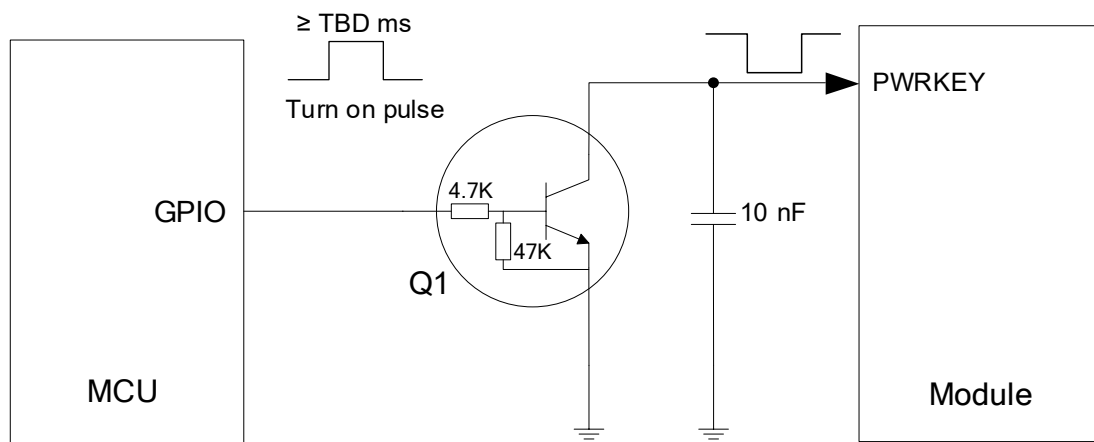


Figure 9: Reference Design of Turn-on with Driving Circuit

Another way to control the PWRKEY is using a 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.

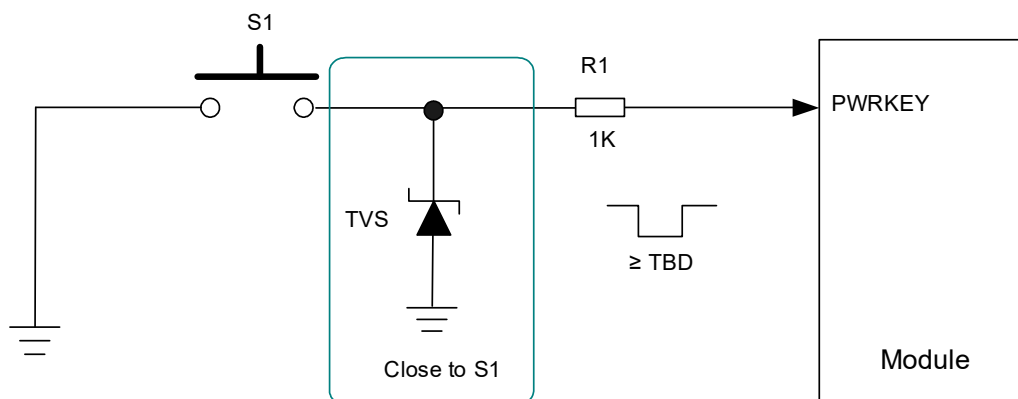


Figure 10: Reference Design of Turn-on with Keystroke

The turn-on timing is illustrated in the following figure.

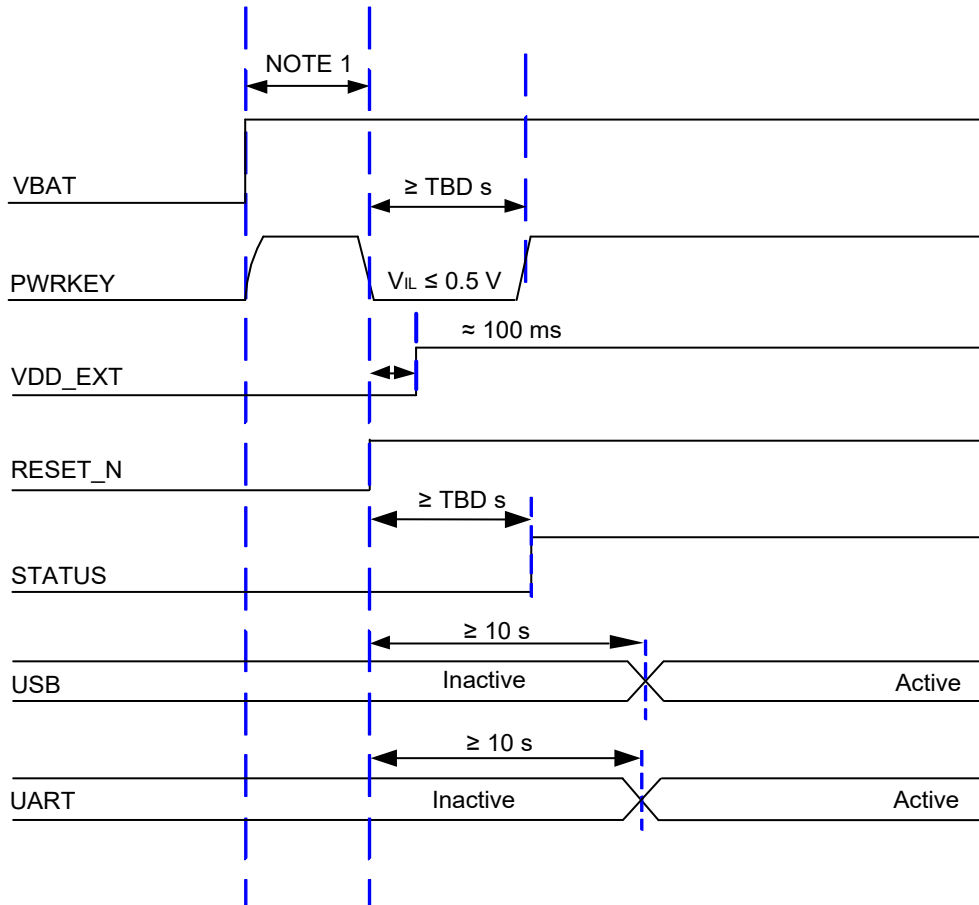


Figure 11: Turn-on Timing with PWRKEY

NOTE

1. Ensure VBAT is stable before driving 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

Drive PWRKEY low for at least 2 s and then release it. Then, the module will execute the turn-off procedure.

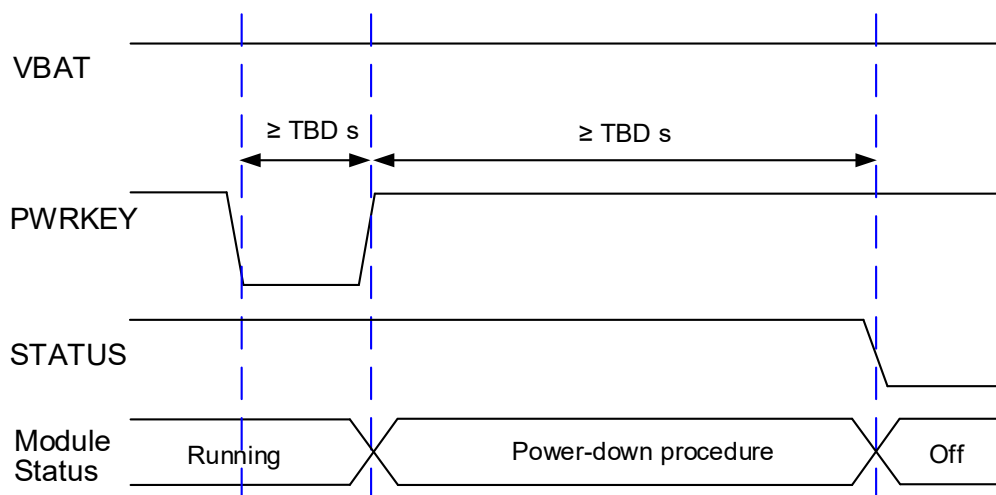


Figure 12: Turn-off Timing with PWRKEY

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 using software power off you can cut off the power supply.
2. When turning off the module via software power off, keep PWRKEY at high level, otherwise, the module cannot be turned off successfully.

3.5. RESET_N

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 pin.

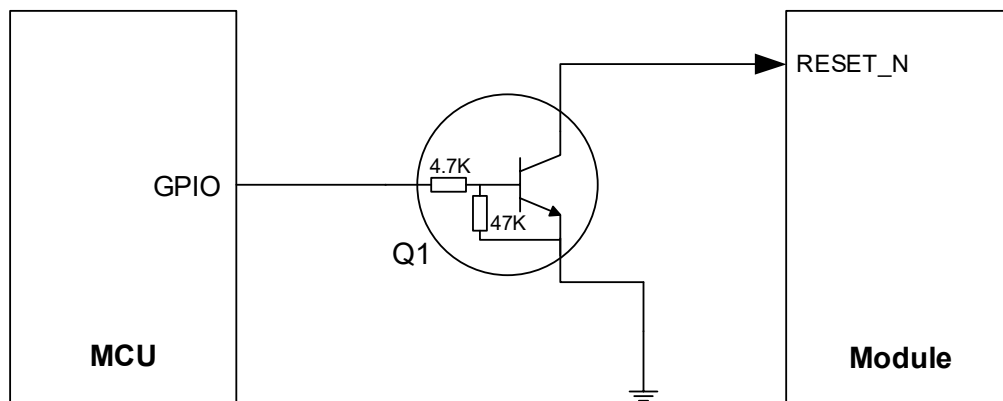


Figure 13: Reference Design of Reset with Driving Circuit

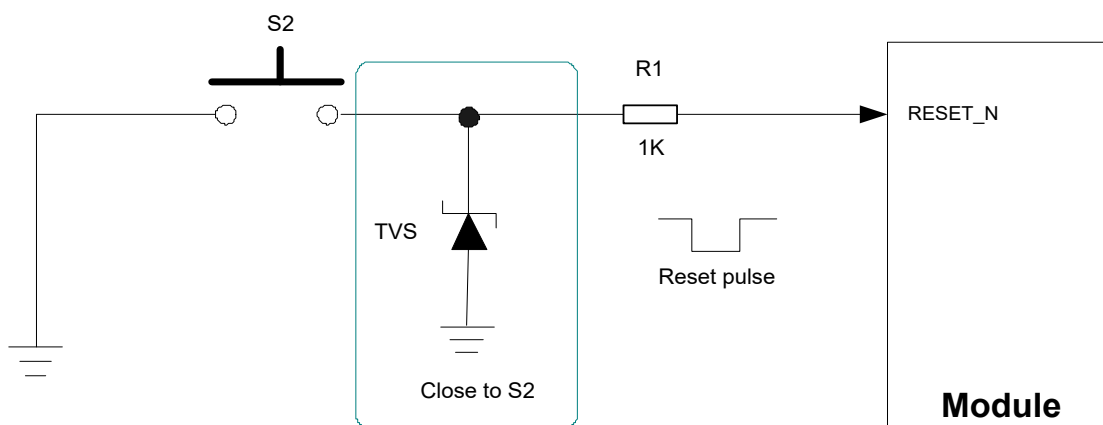


Figure 15: Reference Design of Reset with a Button

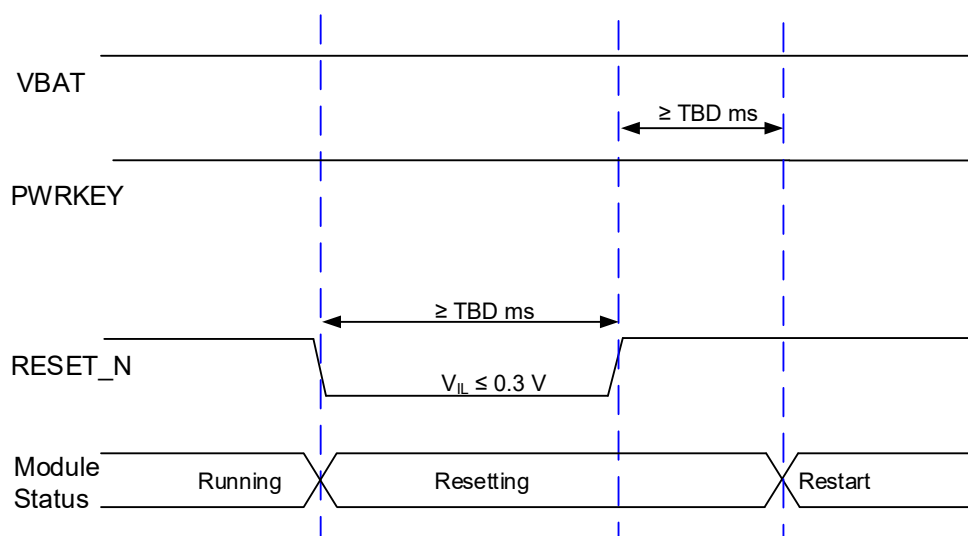


Figure 16: Reset Timing**NOTE**

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

4 Application Interfaces

4.1. USB Interface

The module provides one integrated Universal Serial Bus (USB) interface which 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 data transmission, GNSS NMEA sentence output, software debugging, firmware upgrade and the output of 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 2.0 differential data (+)	Requires differential impedance of 90 Ω . Test points must be reserved.
USB_DM	10	AIO	USB 2.0 differential data (-)	

Test points of USB 2.0 interface must be reserved, which can be used for firmware upgrading, debugging and output of partial logs. Only in forced download mode, the module supports firmware upgrade over USB 2.0 interface.

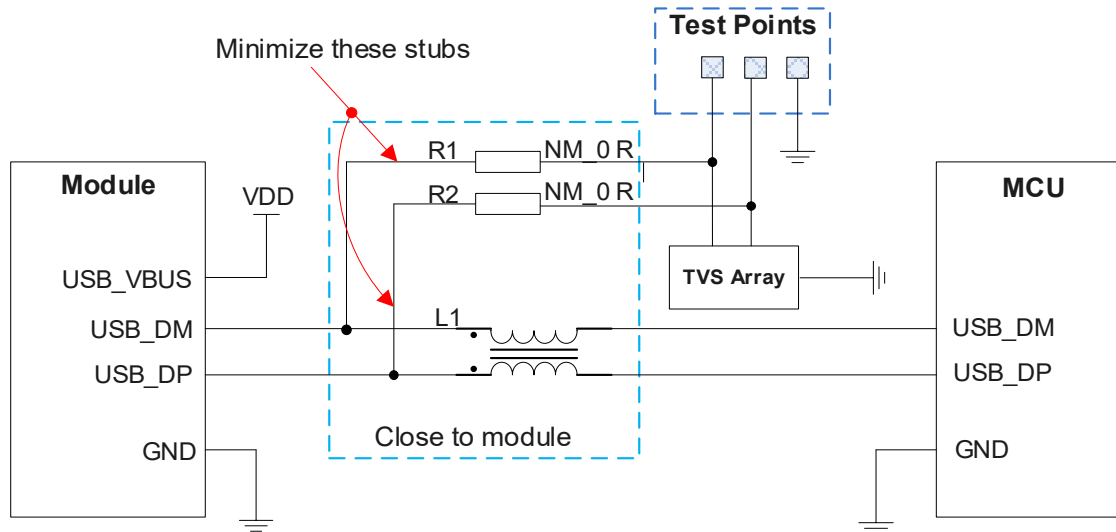


Figure 14: Reference Design of USB 2.0 Interface

It is recommended to add a common-mode choke L1 in series between MCU and the module to suppress EMI. Meanwhile, 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 power supply 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. Forced Download Interface

The module provides a USB_BOOT pin for forced download. Pulling up USB_BOOT to VDD_EXT before turning on the module, and then the module will enter forced download mode. Only 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	Force the module into download mode	Active high before power-up. A test point must be reserved.

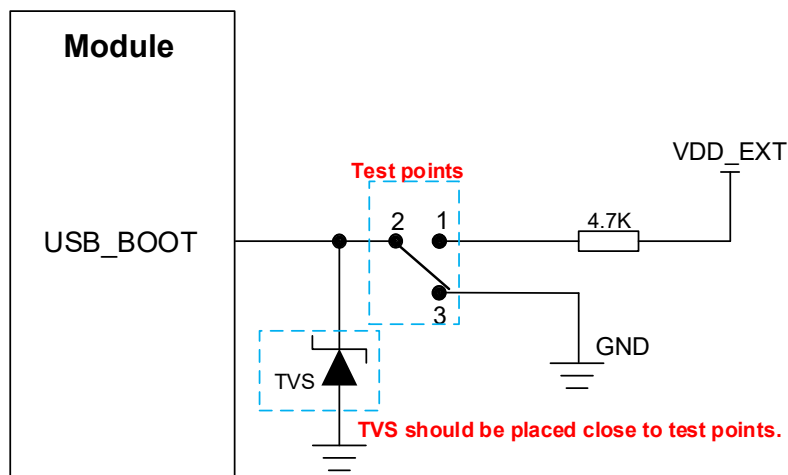


Figure 15: Reference Design of USB_BOOT

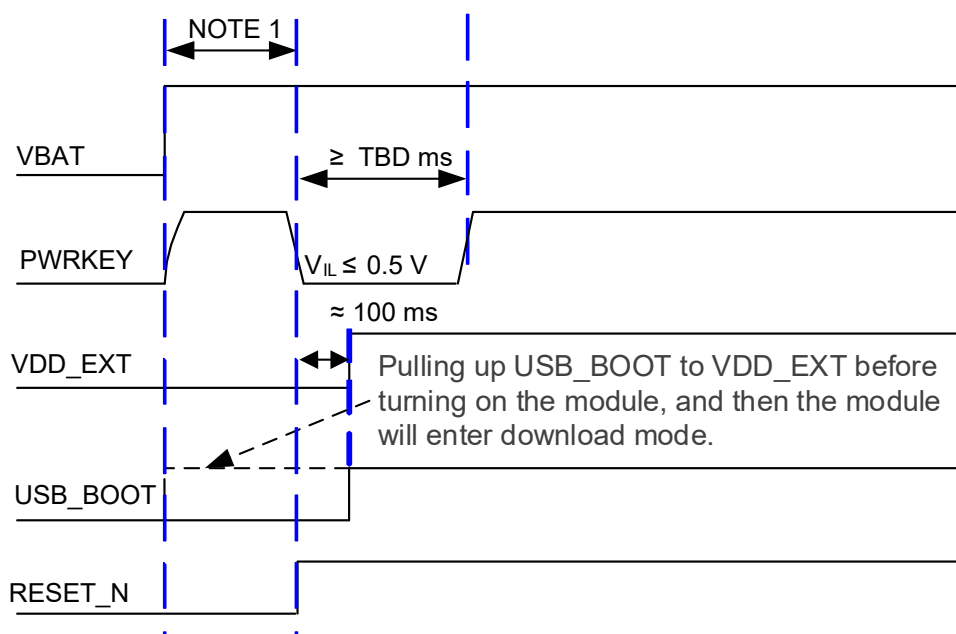


Figure 16: Timing of Entering Forced Download Mode

NOTE

1. Ensure VBAT is stable before driving PWRKEY low.
2. If you need to manually force the module to enter forced download mode, directly connect the test points shown in **Figure 15**.
3. The firmware upgrade function of USB interface can only be used in forced download mode. It is strongly recommended to lead out USB_BOOT and VDD_EXT together with the USB interface.

4.3. USIM Interfaces

The USIM interfaces meets ETSI and IMT-2000 requirements.

- USIM0 interface supports 1.8 V or 3.0 V power domain.
- USIM1 interface only supports 1.8 V power domain.
- When USIM0 and USIM1 are used at the same time, the power domain of both USIM interfaces should be 1.8 V. Otherwise, USIM1 interface will be damaged.
- The USIM interfaces support Dual SIM Single Standby.

Table 14: Pin Description of USIM Interfaces

Pin Name	Pin No.	I/O	Description	Comment
USIM0_VDD	43	PO	USIM0 card power supply	Either 1.8 V or 3.0 V USIM0 card is supported and can be identified automatically by the module.
USIM0_DATA	45	DIO	USIM0 card data	
USIM0_CLK	46	DO	USIM0 card clock	
USIM0_RST	44	DO	USIM0 card reset	
USIM1_VDD	87	PO	USIM1 card power supply	Connected with USIM0_VDD inside the module. 1.8 V power domain is required for USIM1. Otherwise, this interface will be damaged.
USIM1_DATA	86	DIO	USIM1 card data	
USIM1_RST	85	DO	USIM1 card reset	1.8 V power domain is required for USIM1. Otherwise, this interface will be damaged.
USIM1_CLK	84	DO	USIM1 card clock	

The following figures illustrate reference design for USIM card interfaces with 6-pin USIM card connectors.

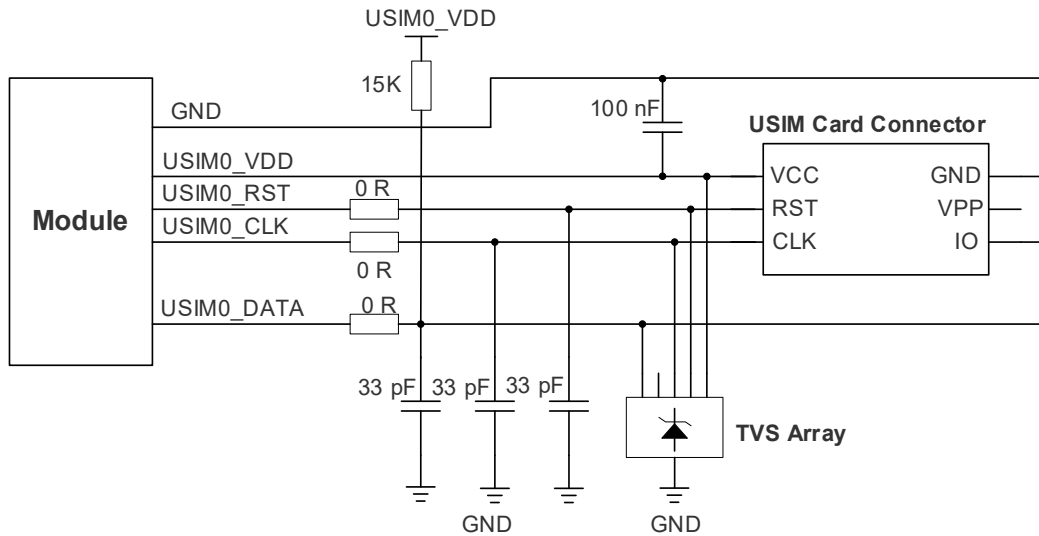


Figure 17: Reference Design of USIM0 Interface with a 6-pin USIM Card Connector

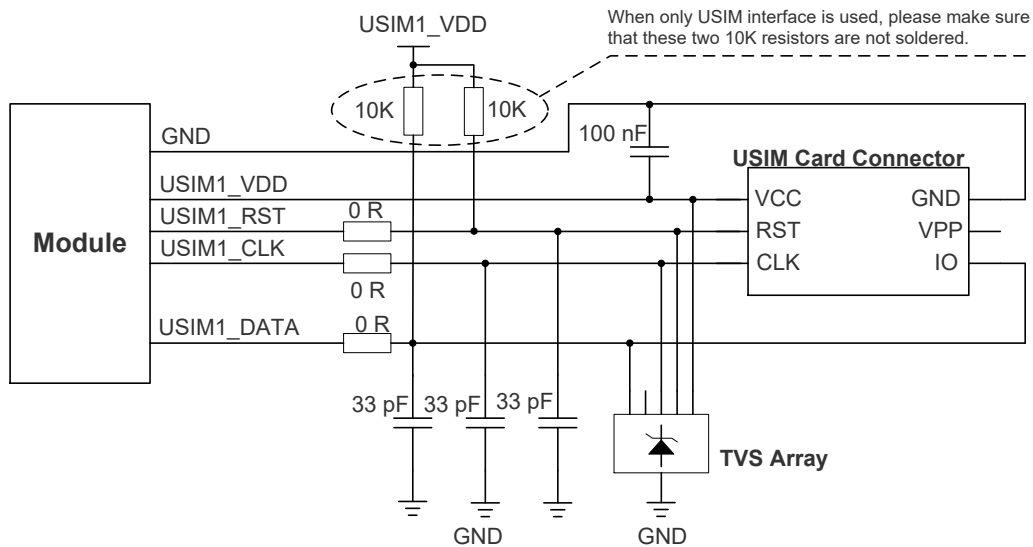


Figure 18: Reference Design of USIM1 Interface with a 6-pin USIM Card Connector

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 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 spacing from power supply traces, crystal-oscillators, magnetic devices, sensitive signals such as RF signals, analog signals, and noise signals generated by clock, DC-DC.

- Ensure the tracing between the USIM card connector and the module is short and wide. Keep the trace width of ground and **USIM0_VDD** at least 0.5 mm to maintain the same electric potential.
- To avoid cross-talk between **USIM0_DATA** and **USIM0_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 USIM0_DATA, USIM1_DATA and USIM1_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 UART information is as follows.

Table 15: UART Information (Unit: bps)

UART Types	EG915QA-NA	EG916QA-GL	Supported Baud Rates	Default Baud Rates	Functions
UART1	√	√	4800, 9600, 19200, 38400, 57600, 115200,	115200	● Data transmission ● Firmware upgrade ● LPUART ● RTS and CTS hardware flow control
UART2	√	√	230400, 460800, 921600		● Data transmission ● RTS and CTS hardware flow control
UART3	√	-			
Debug UART	√	√	115200, 3000000	3000000	Partial Logs output
GNSS debug UART	-	√	TBD	TBD	GNSS system logs output

NOTE

"√": Supported. "-": Not supported.

Table 16: Pin Description of UART

Pin Name	Pin No.	I/O	Description	Comment
UART1_CTS	36	DO	Clear to send signal from the module	Connect to MCU's CTS. If unused, keep it open.
UART1_RTS	37	DI	Request to send signal to the module	Connect to MCU's RTS. If unused, keep it open.
UART1_RXD	34	DI	UART1 receive	If unused, keep them open.
UART1_TXD	35	DO	UART1 transmit	
UART2_TXD	27	DO	UART2 transmit	
UART2_RXD	28	DI	UART2 receive	
UART3_TXD	109	DO	Only for EG915QA-NA: UART3 transmit	If unused, keep it open.
GNSS_DBG_TXD		DO	Only for EG916QA-GL: GNSS debug UART transmit	A test point must be reserved.
UART3_RXD	110	DI	Only for EG915QA-NA: UART3 receive	If unused, keep it open.
GNSS_DBG_RXD		DI	Only for EG916QA-GL: GNSS debug UART receive	A test point must be reserved.
UART3_RTS	11	DI	Only for EG915QA-NA: Request to send signal to the module	Connect to MCU's RTS. If unused, keep it open.
UART3_CTS	12	DO	Only for EG915QA-NA: Clear to send signal from the module	Connect to MCU's CTS. If unused, keep it open.
DBG_RXD	22	DI	Debug UART receive	Test points must be reserved.
DBG_TXD	23	DO	Debug UART transmit	

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

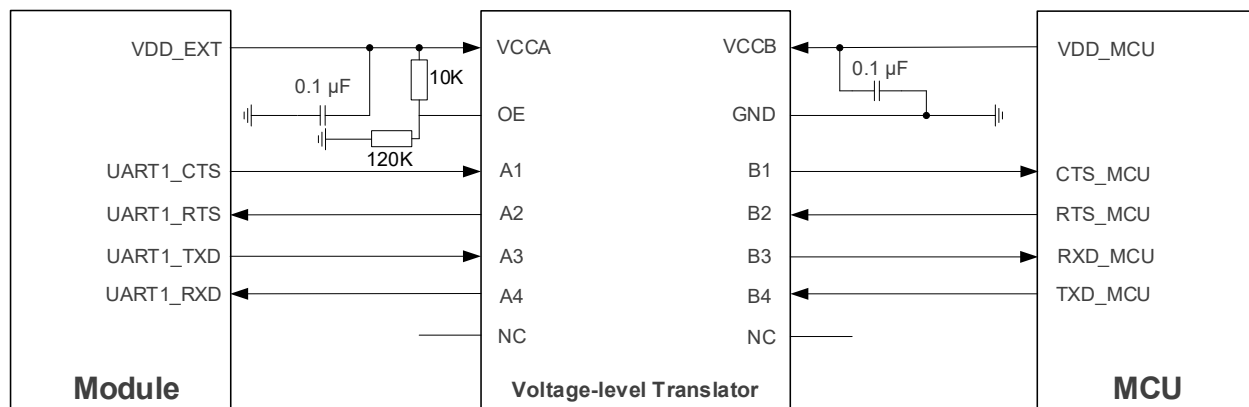


Figure 19: Reference Design of UART with Level-shifting Chip (UART1)

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.

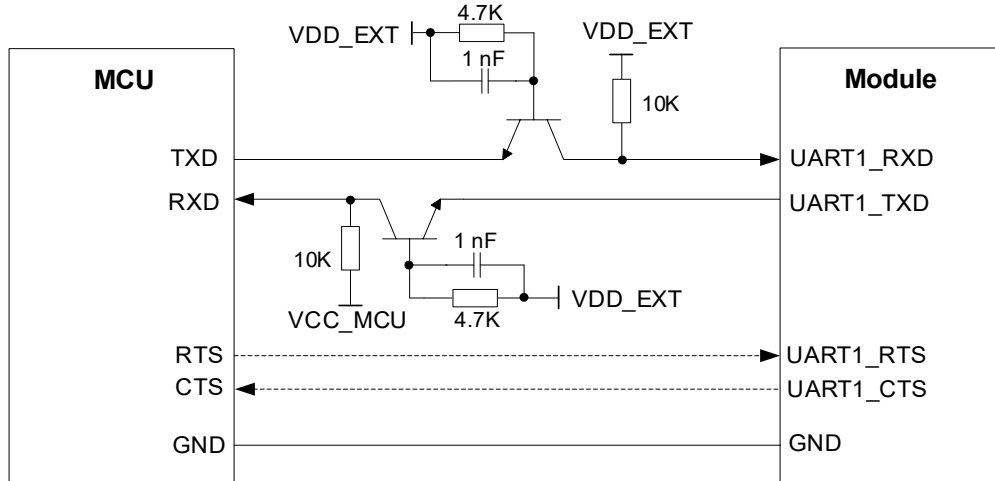


Figure 20: Reference Design of UART with Transistor Level-shifting Circuit (UART1)

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.
3. The level-shifting circuits (**Figure 19** and **Figure 20**) take the UART1 as an example. The circuits of debug UART, UART2, UART3 and GNSS debug UART are connected in the same way as the UART1.
4. To increase the stability of UART communication, it is recommended to add UART hardware flow control design.
5. If the level-shifting circuit is not used when the module's TXD is connected to MCU's RXD, a pull-up resistor should be added.

4.5. I2S and I2C Interfaces*

The module provides one I2S interface and two I2C interfaces.

Table 17: Pin Description of I2S and I2C Interfaces

Pin Name	Pin No.	I/O	Description	Comment
I2S_LRCK	5	DO	I2S strobe clock	
I2S_BCLK	4	DO	I2S bit clock	If unused, keep them open.
I2S_DIN	6	DI	I2S data input	
I2S_DOUT	7	DO	I2S data output	
I2C0_SCL	103	OD	I2C0 serial clock	
I2C0_SDA	114	OD	I2C0 serial data	External pull-up resistor is required. If unused, keep them open.
I2C1_SCL	40	OD	I2C1 serial clock	
I2C1_SDA	41	OD	I2C1 serial data	

The reference design is illustrated as follows.

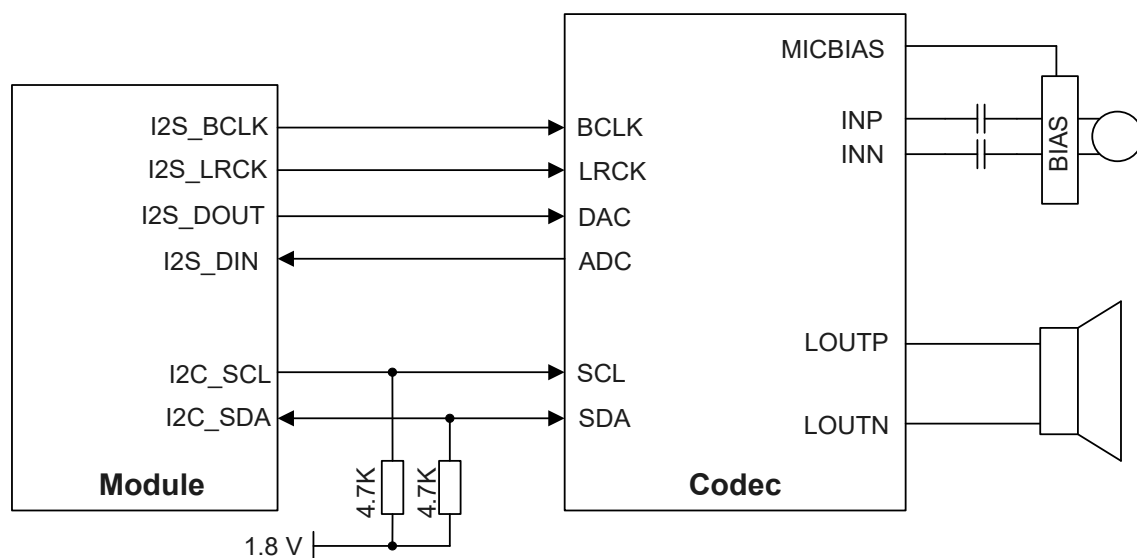


Figure 21: Reference Design of I2S and I2C Interfaces

NOTE

1. It is recommended to reserve RC circuits ($R = 22\ \Omega$, $C = 22\ \text{pF}$) on the I2S signal traces, especially on the I2S_BCLKpin.
2. The module can only be used as a master device in applications related to both the I2S interface and the I2C interface.

4.6. ADC Interfaces

The module provides three 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
AIO3	24	AI	General-purpose ADC interface	If unused, keep them open.
AIO1	2	AI	General-purpose ADC interface	
AIO4	104	AI	General-purpose ADC interface	

Table 19: Characteristics of ADC Interfaces

Parameters	Min.	Typ.	Max.	Units
ADC input voltage range	0	-	1.6	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 1.6 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, and the divider resistor accuracy should not higher than 1 %, otherwise the measurement accuracy of ADC would be significantly reduced. It is recommended to reserve a 100 nF capacitor for the design.

4.7. SPI and QSPI Interfaces*

The module provides one SPI and one Quad SPI.

Table 20: Pin Description of SPI Interfaces*

Pin Name	Pin No.	I/O	Description	Comment
SPI_CS	25	DO	SPI chip select	If unused, keep them open.
SPI_CLK	26	DO	SPI clock	
SPI_MOSI	92	DO	SPI master-out slave-in	
SPI_MISO	108	DI	SPI master-in slave-out	

Table 21: Pin Description of QSPI Interface

Pin Name	Pin No.	I/O	Description	Comment
QSPI_D0	119	DIO	Quad SPI data 0	If unused, keep them open.
QSPI_D1	120	DIO	Quad SPI data 1	
QSPI_D2	121	DIO	Quad SPI data 2	
QSPI_D3	122	DIO	Quad SPI data 3	
QSPI_CS	123	DIO	Quad SPI chip select	
QSPI_CLK	124	DIO	Quad SPI clock	

The module has a 1.8 V SPI interface. A voltage-level translator should be used between the module and the MCU if the application is equipped with a 3.3 V processor or device interface. The following figure shows a reference design:

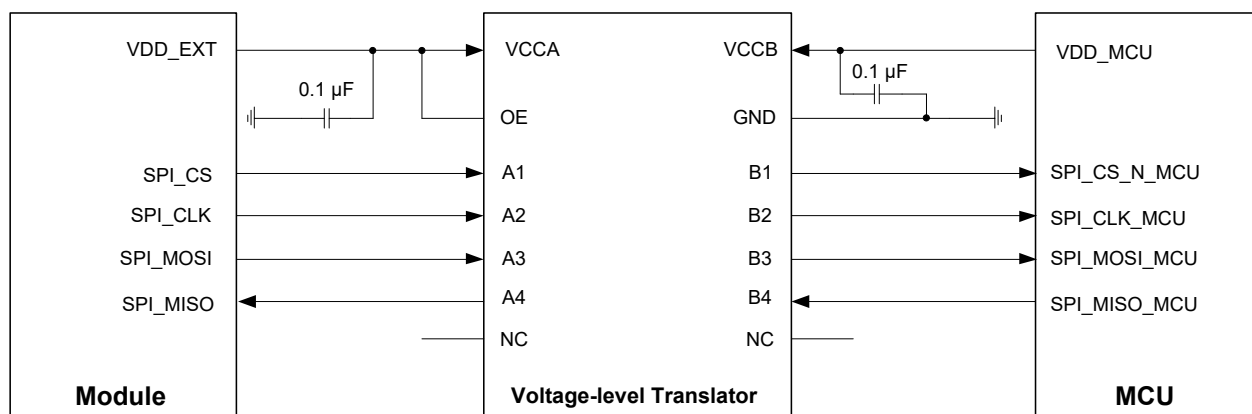


Figure 22: Reference Design of SPI Interface with a Voltage-level Translator

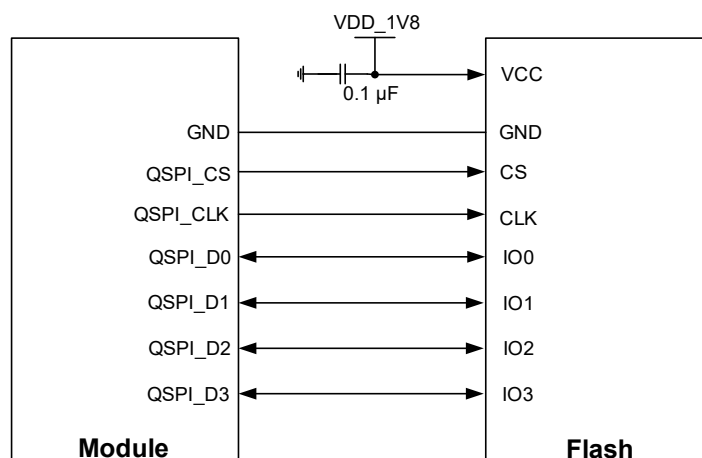


Figure 23: Reference Design of QSPI Interface (Master Mode)

4.8. Indication Signal*

Table 22: Pin Description of Indication Signal

Pin Name	Pin No.	I/O	Description	Comment
STATUS*	20	DO	Indicate the module's operation status	If unused, keep it open.

4.8.1. STATUS*

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

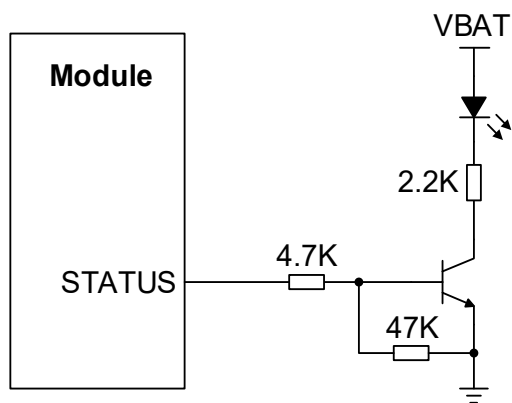


Figure 24: Reference Design of STATUS

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/Wi-Fi Scan Antenna Interface

5.1.1. Antenna Interface and Frequency Bands

Table 23: Pin Description of Cellular/Wi-Fi Scan Antenna Interface

Pin Name	Pin No.	I/O	Description	Comment
ANT_MAIN ⁹	60	AIO	Main antenna/Wi-Fi Scan antenna interface	50 Ω impedance.

NOTE

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

Table 24: Operating Frequency of EG915QA-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

⁹ ANT_MAIN only supports passive antennas.

LTE-FDD B13	777–787	746–756
LTE-FDD B66	1710–1780	2110–2180

Table 25: Operating Frequency of EG916QA-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. Antenna Tuner Control Interface

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

Table 26: 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	
GRFC3	64	DO	Generic RF controller	Only supported by EG915QA-NA. If unused, keep it open.

5.1.3. Transmitting Power

Table 27: RF Transmitting Power

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

5.1.4. Receiver Sensitivity

Table 28: Conducted RF Receiver Sensitivity of EG915QA-NA (Unit: dBm)

Frequency Bands	Receiver Sensitivity (Typ.)	3GPP Requirements
	Primary	
LTE-FDD B2 (10 MHz)	-98 dBm	-91.3 dBm
LTE-FDD B4 (10 MHz)	-98 dBm	-93.3 dBm
LTE-FDD B5 (10 MHz)	-98.5 dBm	-91.8 dBm
LTE-FDD B12 (10 MHz)	-97.2 dBm	-90.3 dBm
LTE-FDD B13 (10 MHz)	-97.2 dBm	-90.3 dBm
LTE-FDD B66 (10 MHz)	-98 dBm	-92.8 dBm

Table 29: Conducted RF Receiver Sensitivity of EG916QA-GL (Unit: dBm)

Frequency Bands	Receiver Sensitivity (Typ.)	3GPP Requirements
	Primary	
LTE-FDD B1 (10 MHz)	-99 dBm	-93.3 dBm
LTE-FDD B2 (10 MHz)	-98.5 dBm	-91.3 dBm
LTE-FDD B3 (10 MHz)	-97.5 dBm	-90.3 dBm
LTE-FDD B4 (10 MHz)	-99 dBm	-93.3 dBm
LTE-FDD B5 (10 MHz)	-98.5 dBm	-91.8 dBm
LTE-FDD B7 (10 MHz)	-96.5 dBm	-91.3 dBm
LTE-FDD B8 (10 MHz)	-98.5 dBm	-90.8 dBm
LTE-FDD B12 (10 MHz)	-97.5 dBm	-90.3 dBm
LTE-FDD B13 (10 MHz)	-97.5 dBm	-90.3 dBm
LTE-FDD B18 (10 MHz)	-98 dBm	-93.8 dBm
LTE-FDD B19 (10 MHz)	-98 dBm	-93.3 dBm
LTE-FDD B20 (10 MHz)	-98 dBm	-90.8 dBm
LTE-FDD B25 (10 MHz)	-98.5 dBm	-89.8 dBm
LTE-FDD B26 (10 MHz)	-98.5 dBm	-91.3 dBm
LTE-FDD B28 (10 MHz)	-98 dBm	-92.3 dBm
LTE-TDD B34 (10 MHz)	-98.5 dBm	-93.8 dBm
LTE-TDD B38 (10 MHz)	-96 dBm	-93.3 dBm
LTE-TDD B39 (10 MHz)	-99 dBm	-93.8 dBm
LTE-TDD B40 (10 MHz)	-97.5 dBm	-93.8 dBm
LTE-TDD B41 (10 MHz)	-95.7 dBm	-91.8 dBm
LTE-FDD B66 (10 MHz)	-99 dBm	-92.8 dBm

5.1.5. Reference Design

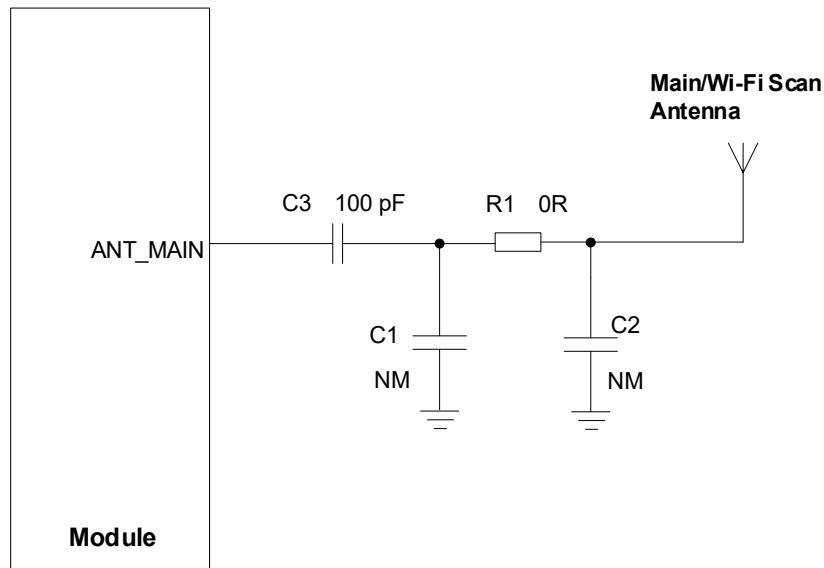


Figure 25: Reference Design of Main/Wi-Fi Scan Antenna

NOTE

1. Use a dual L-type circuit for the antenna interface for better cellular performance and for the ease of debugging.
2. Capacitors C1 and C2 are not mounted by default.
3. Place the dual L-type components (R1 & C1 & C2 & C3) to the antenna as close as possible.
4. Notes on C3:
 - 1) If there is DC power at the antenna ports, place capacitor on C3 to prevent short circuit to ground. The capacitance value is recommended to be 100 pF, which can be adjusted according to the debugging results.
 - 2) If there is no DC power in the peripheral design:
 - a) Do not reserve C3.
 - b) If C3 has already been reserved, it should be mounted with components, and it is recommended to use 0 Ω resistors. You can also match the component according to the debugging results.

5.2. GNSS

EG915QA-NA supports SoftGPS* function. If you need this function, GNSS RF front end needs to be added. The GNSS function of EG916QA-GL is optional. For more details, contact Quectel Technical Support.

5.2.1. Antenna Interface and Frequency Bands

The GNSS part of the module supports GPS, GLONASS, BDS, Galileo, and QZSS systems.

Table 30: Pin Description of GNSS Antenna Interface

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

Table 31: GNSS Frequency (Unit: MHz)

GNSS Constellation Type	Frequency
GPS	1575.42 $\pm$ 1.023 (L1)
	1176.45 $\pm$ 10.23 (L5)
GLONASS	1601.7 $\pm$ 4.2 (L1)
BDS	1561.098 $\pm$ 2.046 (B1I)
Galileo	1575.42 $\pm$ 2.046 (E1)
QZSS	1575.42 $\pm$ 1.023 (L1)

5.2.2. GNSS Performance

Table 32: GNSS Performance of EG916QA-GL

Parameter	Description	Conditions	Typ.	Unit
Sensitivity	Acquisition	Autonomous	TBD	dBm
	Reacquisition		TBD	
	Tracking		TBD	

TTFF	Cold start @ open sky	Autonomous	TBD	s
		AGNSS start	TBD	
	Warm start @ open sky	Autonomous	TBD	
		AGNSS start	TBD	
	Hot start @ open sky	Autonomous	TBD	
		AGNSS start	TBD	
Accuracy	CEP-50	Autonomous @ open sky	TBD	m

NOTE

1. Tracking sensitivity: the minimum GNSS signal power at which the module can maintain lock (keep positioning for at least 3 minutes continuously).
2. Reacquisition sensitivity: the minimum GNSS signal power required for the module to maintain lock within 3 minutes after loss of lock.
3. Acquisition sensitivity: the minimum GNSS signal power at which the module can fix position successfully within 3 minutes after executing cold start command.

5.2.3. Reference Design

5.2.3.1. Passive Antenna

GNSS antenna interface supports passive ceramic antennas and other types of passive antennas. A reference circuit design is shown below.

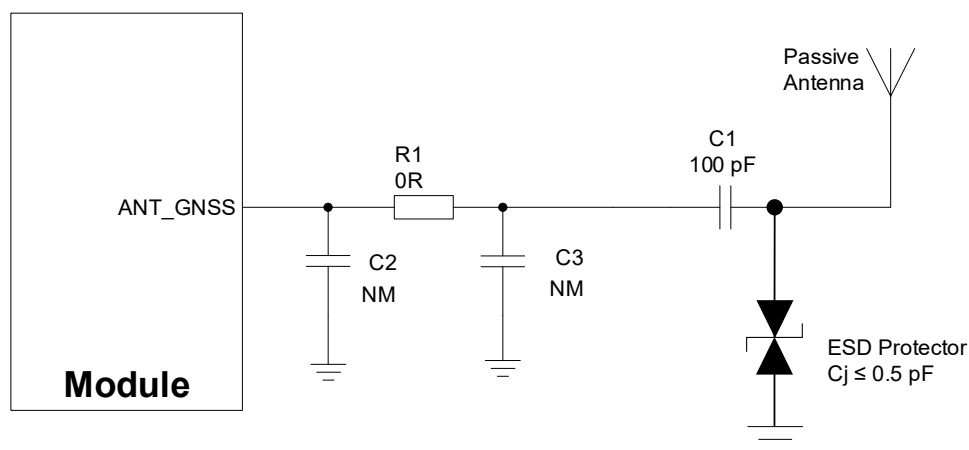


Figure 26: Reference Design of Passive Antenna

It is recommended to reserve a dual L-type circuit in the peripheral circuit design for antenna interface for better RF performance. Components (C2, R1, C3, C1) of the dual L-type circuit shall be placed as close to the antenna as possible. C2 and C3 are not mounted by default. Only a 0 Ω resistor is mounted on R1. Keep the characteristic impedance for RF trace as 50 Ω when routing and keep the trace as short as possible.

NOTE

1. Notes on C1:
 - 1) If there is DC power at the antenna ports, place a capacitor on C1 to prevent short circuit to ground. The capacitance value is recommended to be 100 pF, which can be adjusted according to the debugging results.
 - 2) If there is no DC power in the peripheral design:
 - a) Do not reserve C1.
 - b) If C1 has already been reserved, it should be mounted with a component, and it is recommended to use a 0 Ω resistor. You can also match the component according to the debugging results.
2. It is recommended to use passive antenna. If active antenna or an additional LNA is needed, please contact Quectel Technical Support.

5.2.3.2. Active Antenna

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

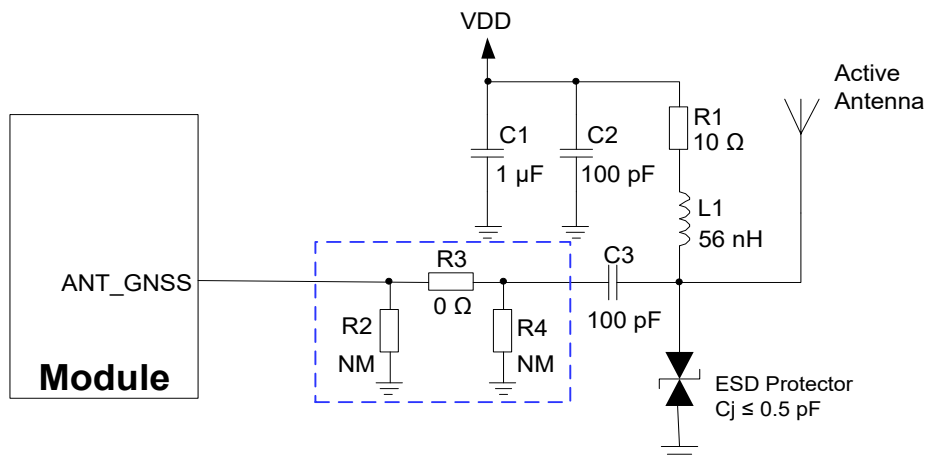


Figure 27: Reference Design of GNSS Antenna

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

NOTE

You can select an external LDO according to the active antenna types.

5.3. RF Routing Guidelines

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

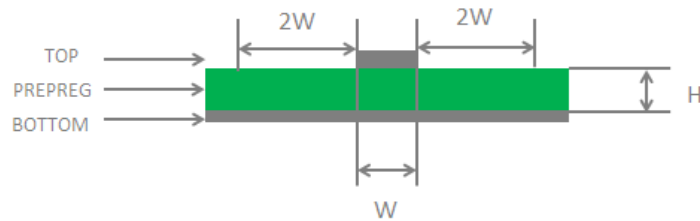


Figure 28: Microstrip Design on a 2-layer PCB

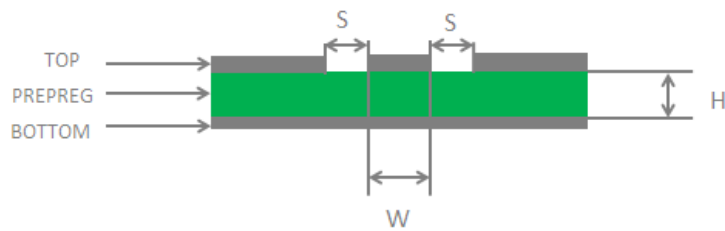


Figure 29: Coplanar Waveguide Design on a 2-layer PCB

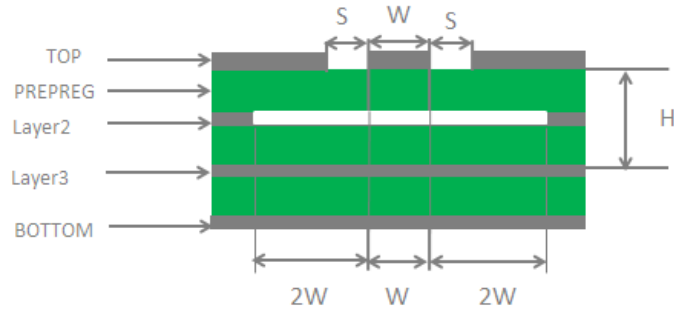


Figure 30: Coplanar Waveguide Design on a 4-layer PCB (Layer 3 as Reference Ground)

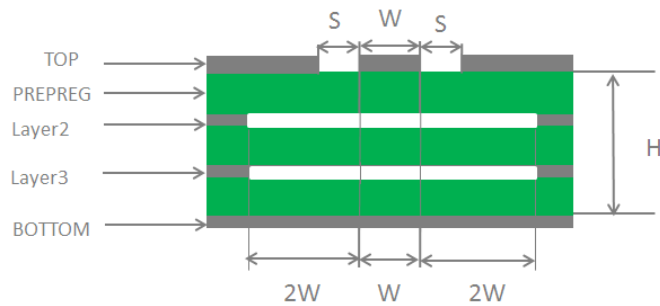


Figure 31: Coplanar Waveguide Design on a 4-layer PCB (Layer 4 as Reference Ground)

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

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

For more details about RF layout, see **document [2]**.

5.4. Requirements for Antenna Design

Table 33: Requirements for Antenna Design

Antenna Types	Requirements
GNSS	● Frequency range: L1: 1559–1609 MHz L5: 1166–1187 MHz ● Polarization: RHCP or linear ● VSWR: ≤ 2 (Typ.)
	For passive antenna usage:
	● Passive antenna gain: > 0 dBi
	For active antenna usage:
Cellular/Wi-Fi Scan	● Active antenna noise figure: < 1.5 dB ● Active antenna embedded LNA gain: < 17 dB
	● 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) < 2 dB: HB (> 2.3 GHz)

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.

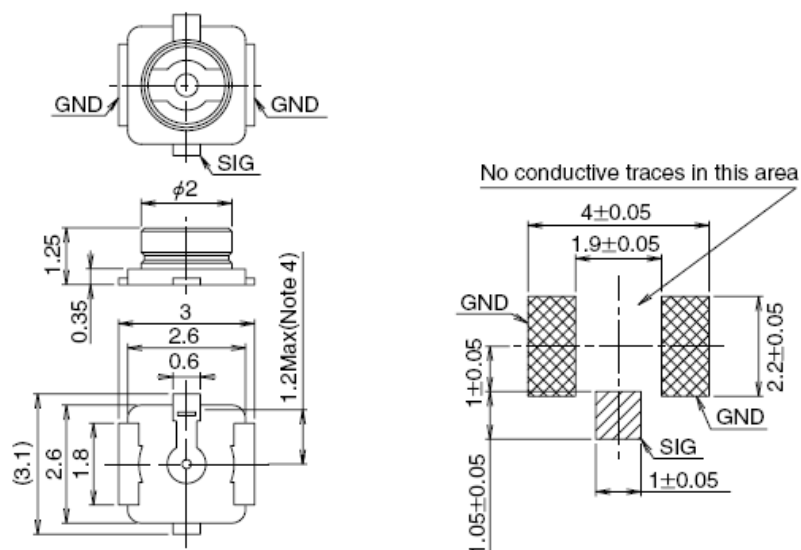


Figure 32: Dimensions of the Receptacle (Unit: mm)

U.FL-LP series mated plugs listed in the following figure can be used to match the U.FL-R-SMT 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 33: Specifications of Mated Plugs

The following figure describes the space factor of mated connectors.

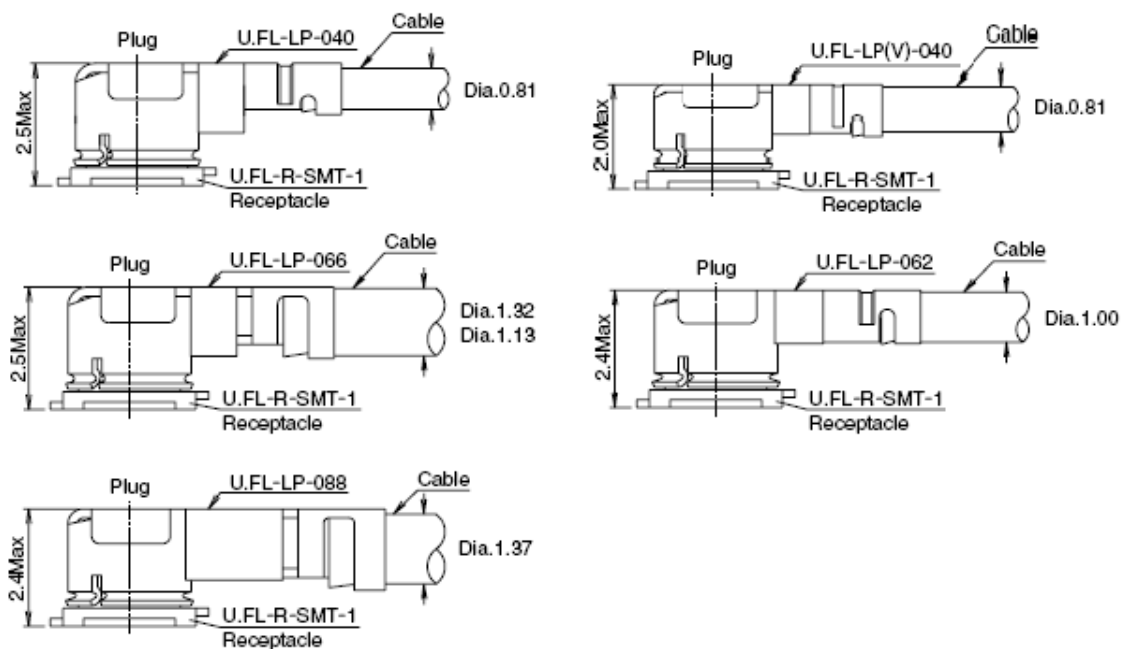


Figure 34: Space Factor of Mated Connectors (Unit: mm)

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

6 Electrical Characteristics and Reliability

6.1. Absolute Maximum Ratings

Table 34: Absolute Maximum Ratings

Parameters	Min.	Max.	Unit
Voltage at VBAT	-0.3	5	V
Voltage at USB_VBUS	-0.3	5.25	V
Voltage at digital pins	-0.3	3.6	V

NOTE

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

6.2. Power Supply Ratings

Table 35: Power Supply Ratings

Parameters	Descriptions	Conditions	Min.	Typ.	Max.	Units
VBAT	VBAT	The actual input voltages must be kept between the minimum and maximum values.	3.3	3.8	4.3	V
I _{VBAT}	Peak supply current under BB and RF application	At maximum power control level	-	-	TBD	A

scenarios						
USB_VBUS	USB connection detect	-	3.0	5.0	5.25	V

6.3. Power Consumption

Table 36: Power Consumption of EG915QA-NA LTE Part

Test Item	Condition	Typ.	Unit
Turn-off	Turn off	0.9	μA
Sleep	Minimum Functionality Mode (USB disconnected)	90	μA
	Airplane mode (USB disconnected)	180	μA
	LTE-FDD @ PF = 32 (USB disconnected)	1.03	mA
	LTE-FDD @ PF = 64 (USB disconnected)	0.63	mA
	LTE-FDD @ PF = 128 (USB disconnected)	0.41	mA
	LTE-FDD @ PF = 256 (USB disconnected)	0.31	mA
Idle	LTE-FDD @ PF = 64 (USB disconnected)	2.8	mA
	LTE-FDD @ PF = 64 (USB connected)	25.21	mA
LTE data transmission	LTE-FDD B2	562	mA
	LTE-FDD B4	594	mA
	LTE-FDD B5	544	mA
	LTE-FDD B12	534	mA
	LTE-FDD B13	565	mA
	LTE-FDD B66	590	mA

Table 37: Power Consumption of EG916QA-GL LTE Part (GNSS Part Off)

Test Item	Condition	Typ.	Unit
Turn-off	Turn off	0.9	μA
Sleep	Minimum Functionality Mode (USB disconnected)	88	μA
	Airplane Mode (USB disconnected)	175	μA
	LTE-FDD @ PF = 32 (USB disconnected)	0.98	mA
	LTE-FDD @ PF = 64 (USB disconnected)	0.58	mA
	LTE-FDD @ PF = 128 (USB disconnected)	0.35	mA
	LTE-FDD @ PF = 256 (USB disconnected)	0.22	mA
Idle	LTE-FDD @ PF = 64 (USB disconnected)	2.9	mA
	LTE-FDD @ PF = 64 (USB connected)	25.9	mA
LTE data transmission	LTE-FDD B1	653	mA
	LTE-FDD B2	627	mA
	LTE-FDD B3	645	mA
	LTE-FDD B4	674	mA
	LTE-FDD B5	637	mA
	LTE-FDD B7	653	mA
	LTE-FDD B8	582	mA
	LTE-FDD B12	624	mA
	LTE-FDD B13	576	mA
	LTE-FDD B18	629	mA
	LTE-FDD B19	633	mA
	LTE-FDD B20	626	mA
	LTE-FDD B25	608	mA
	LTE-FDD B26	656	mA

LTE-FDD B28	628	mA
LTE-TDD B34	264	mA
LTE-TDD B38	271	mA
LTE-TDD B39	235	mA
LTE-TDD B40	292	mA
LTE-TDD B41	307	mA
LTE-FDD B66	684	mA

NOTE

The above power consumption data are tested under 50 Ω impedance.

6.4. Digital I/O Characteristics

Table 38: LDOIO I/O Characteristics (Unit: V)

Parameters	Descriptions	Min.	Max.
V_{IH}	High-level input voltage	0.7 x LDOIO	-
V_{IL}	Low-level input voltage	-	0.2 x LDOIO
V_{OH}	High-level output voltage	0.8 x LDOIO	-
V_{OL}	Low-level output voltage	-	0.15 x LDOIO

Table 39: USIM Low/High-voltage I/O Characteristics (Unit: V)

Parameters	Descriptions	Min.	Max.
V_{IH}	High-level input voltage	0.7 x USIM_VDD	-
V_{IL}	Low-level input voltage	-	0.2 x USIM_VDD
V_{OH}	High-level output voltage	0.8 x USIM_VDD	-

V_{OL}	Low-level output voltage	-	0.15 x USIM_VDD
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6.5. ESD Protection

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

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

Test Points	Contact Discharge	Air Discharge
VBAT & GND	±5	±10
Antenna interface	±4	±8
Other interfaces	±0.5	±1

6.6. Operating and Storage Temperatures

Table 41: Operating and Storage Temperatures (Unit: °C)

Parameters	Min.	Typ.	Max.
Normal Operating Temperature ¹⁰	-35	+25	+75
Extended Operating Temperature ¹¹	-40	-	+85
Storage Temperature	-40	-	+90

¹⁰ Within this range, the module's indicators comply with 3GPP specification requirements.

¹¹ Within the range of -40 to -35 °C or 75 to 85 °C, the module retains the ability to establish and maintain functions such as SMS and data transmission, without any unrecoverable malfunction. Radio spectrum and radio network remain uninfluenced, whereas the value of one or more parameters, such as P_{out} , may decrease and fall below the range of the 3GPP specified tolerances. When the temperature returns to the normal operating temperature range, the module's indicators will comply with 3GPP specification requirements again.

7 Mechanical Information

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

7.1. Mechanical Dimensions

7.1.1. Mechanical Dimensions of EG915QA-NA

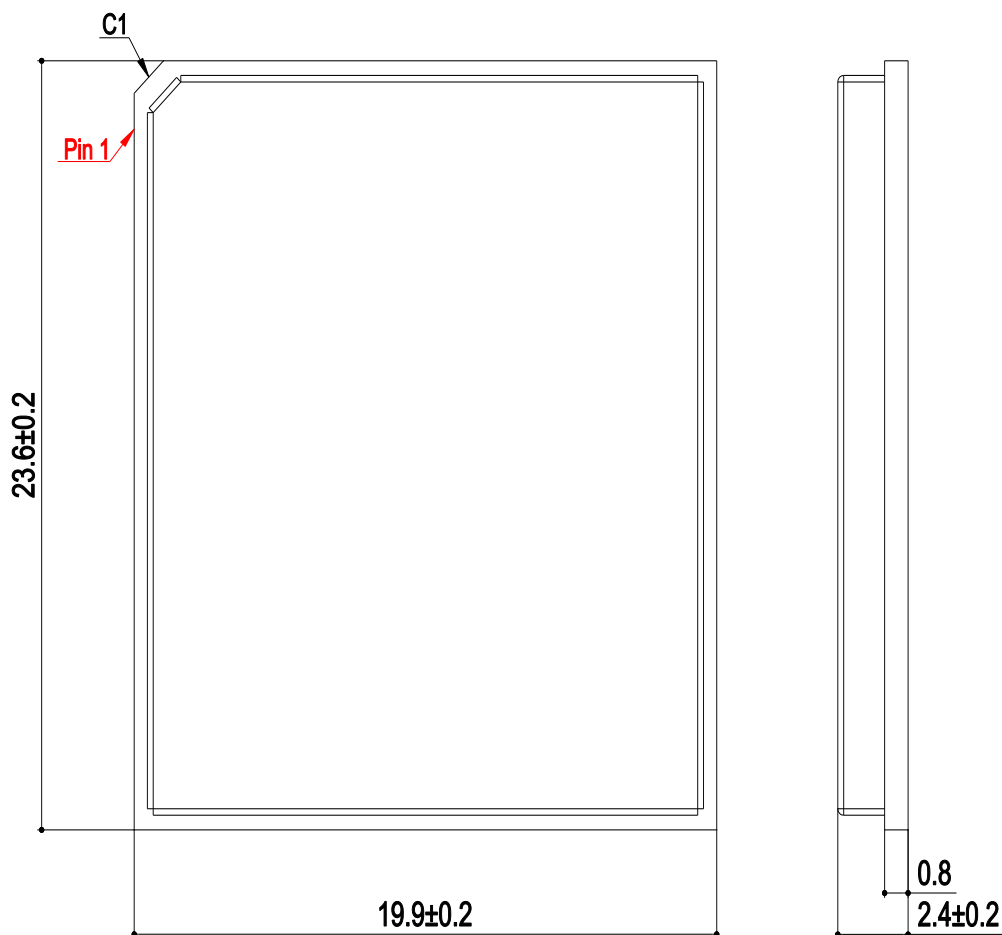


Figure 35: EG915QA-NA Top and Side Dimensions (Unit: mm)

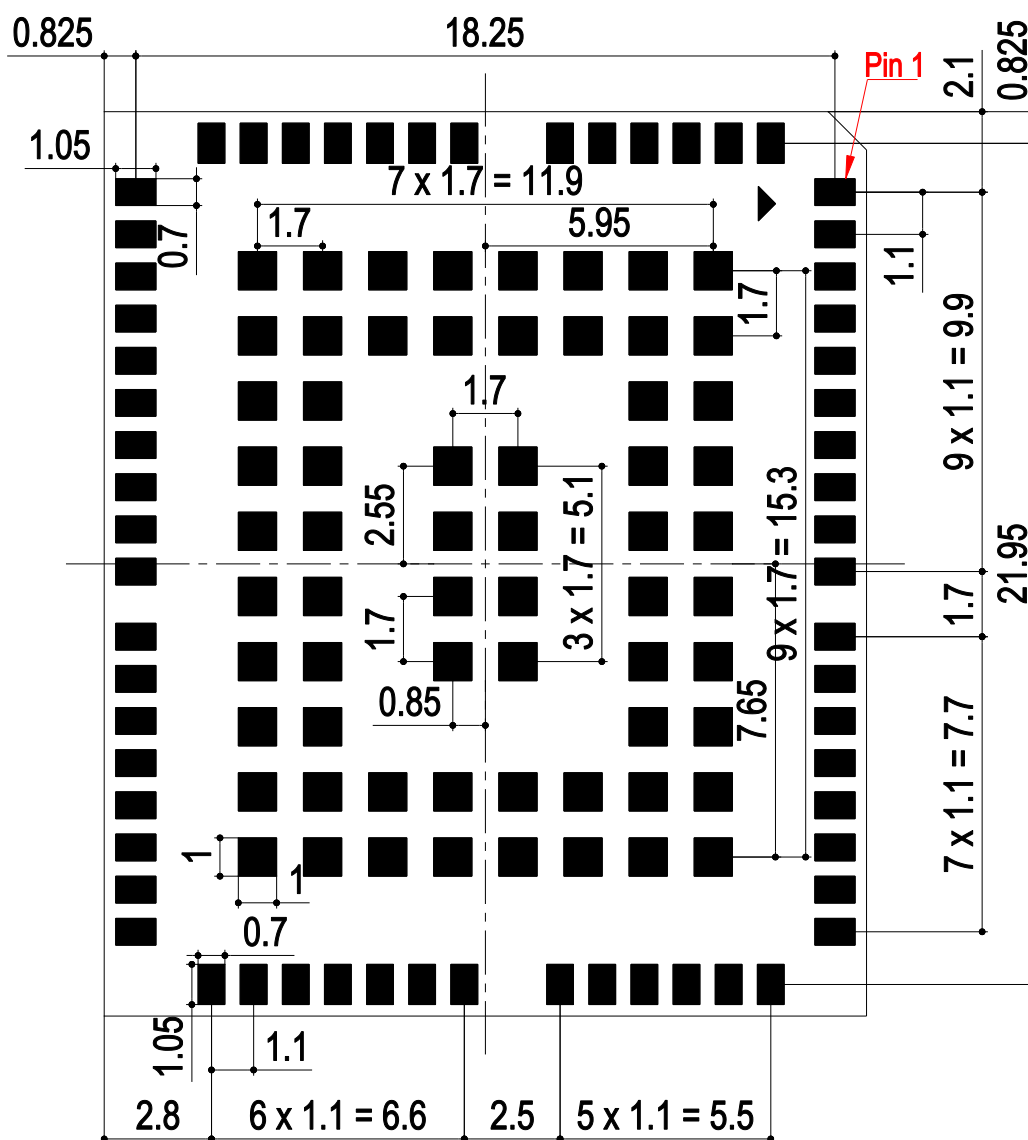


Figure 36: EG915QA-NA Bottom Dimension (Bottom View, Unit: mm)

NOTE

The module's coplanarity standard: ≤ 0.13 mm.

7.1.2. Mechanical Dimensions of EG916QA-GL

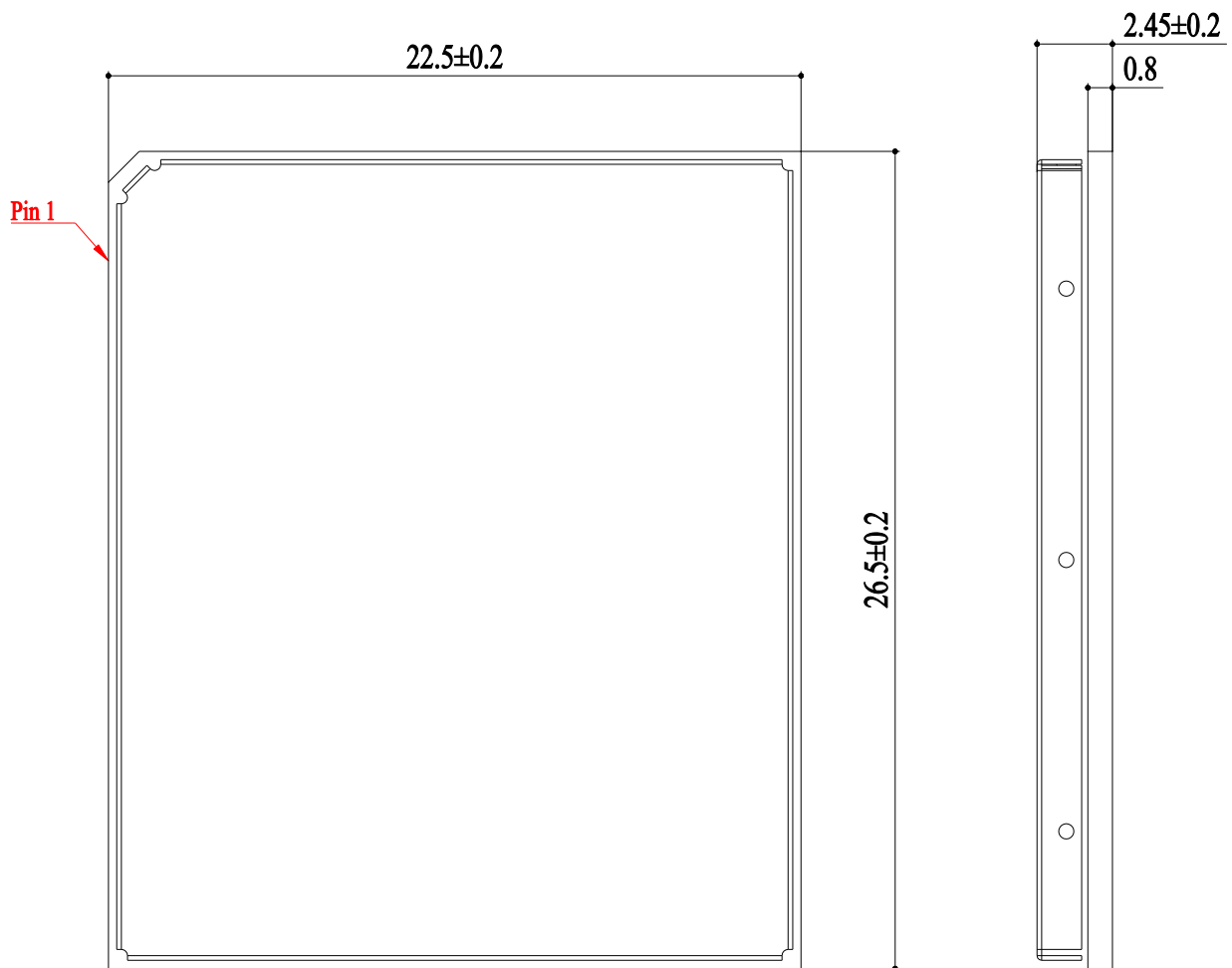


Figure 37: EG916QA-GL Top and Side Dimensions (Unit: mm)

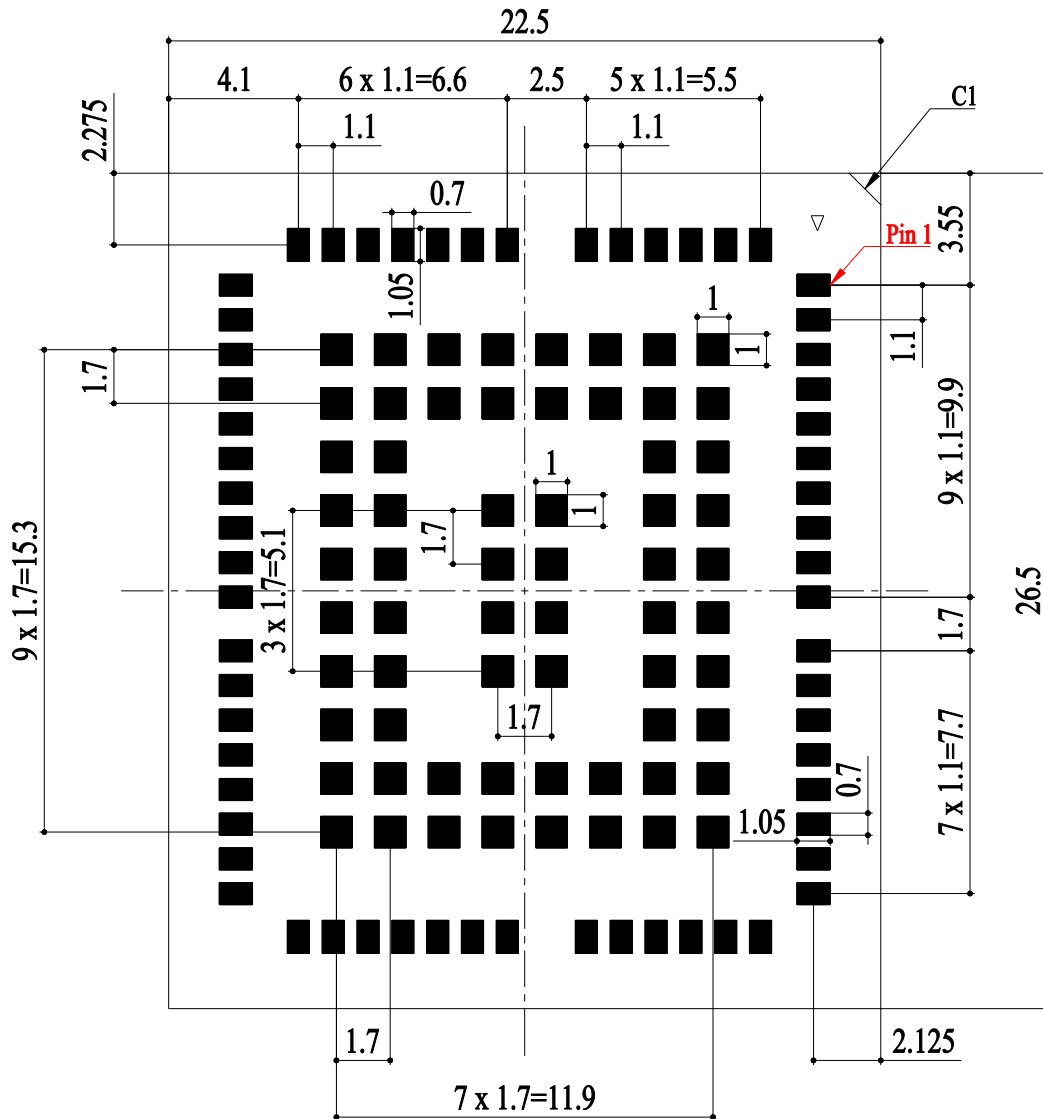


Figure 38: EG916QA-GL Bottom Dimension (Bottom View, Unit: mm)

NOTE

The module's coplanarity standard: ≤ 0.13 mm.

7.2. Recommended Footprint

7.2.1. Recommended Footprint of EG915QA-NA

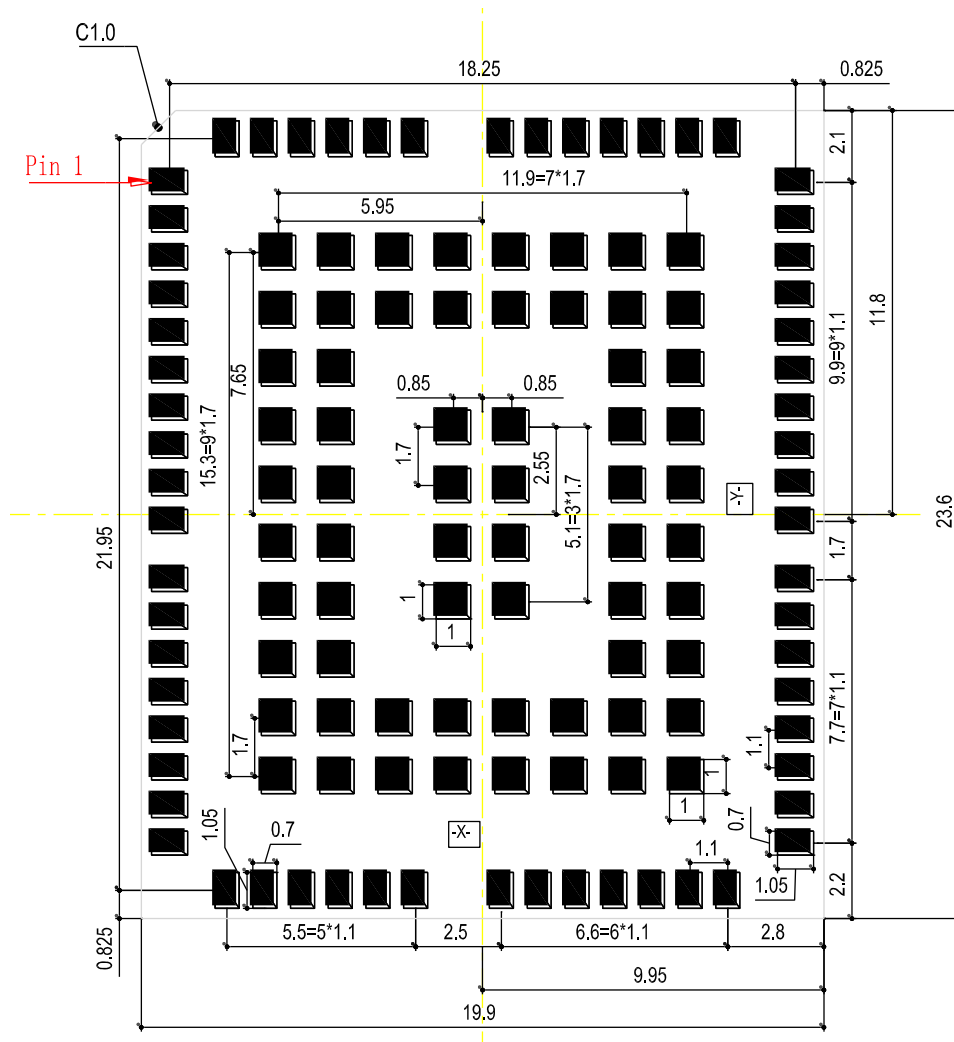


Figure 39: EG915QA-NA Recommended Footprint (Unit: mm)

NOTE

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

7.2.2. Recommended Footprint of EG916QA-GL

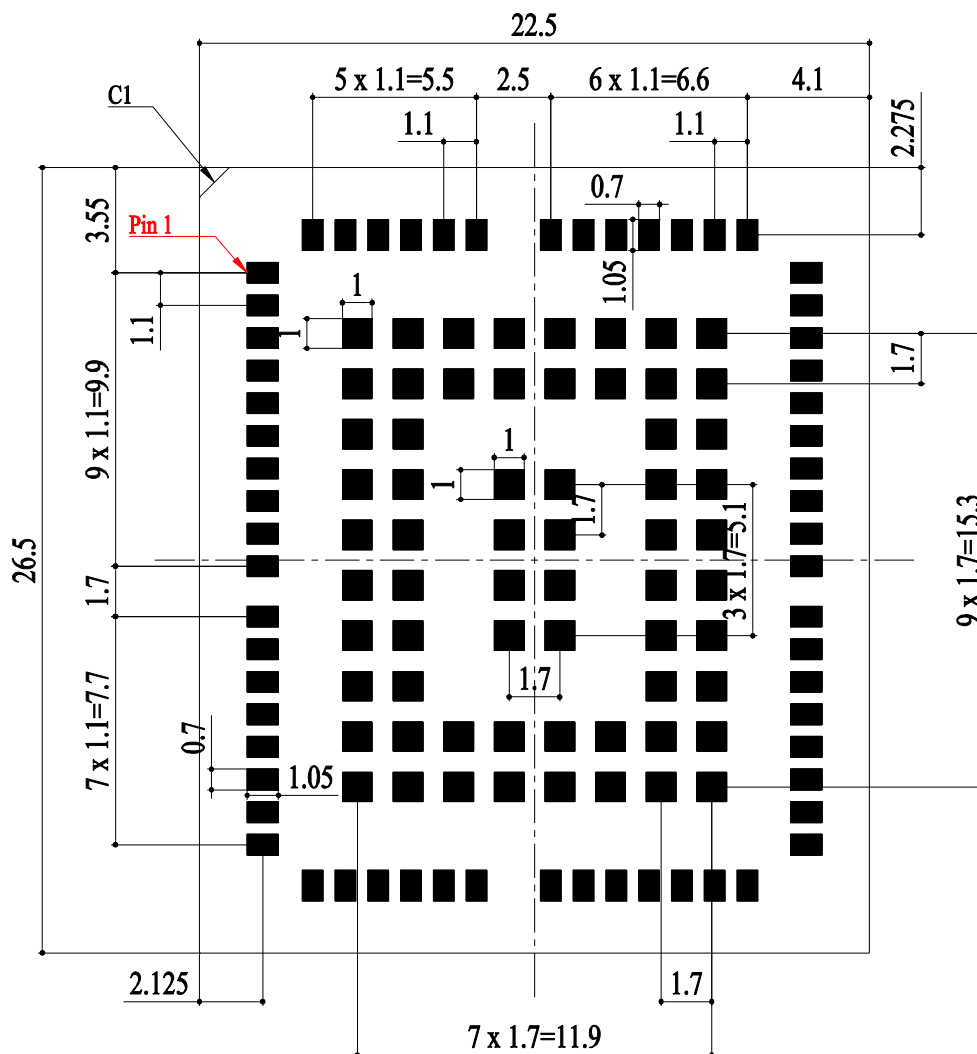


Figure 40: EG916QA-GL Recommended Footprint (Unit: mm)

NOTE

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

7.3. Top and Bottom Views

7.3.1. Top and Bottom Views of EG915QA-NA

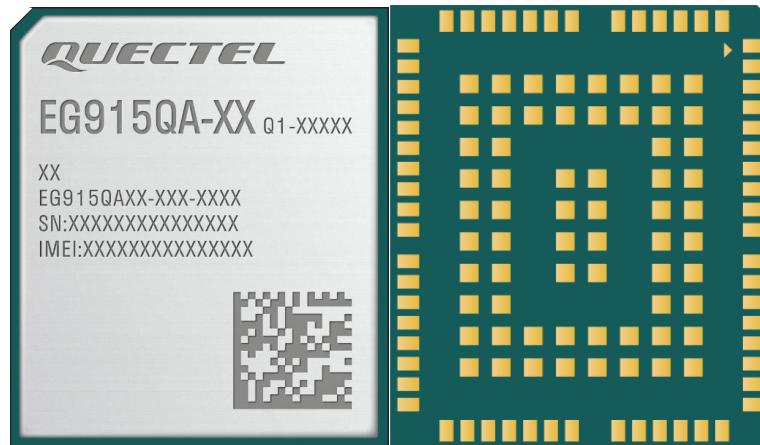


Figure 41: EG915QA-NA Top and Bottom Views

7.3.2. Top and Bottom Views of EG916QA-GL

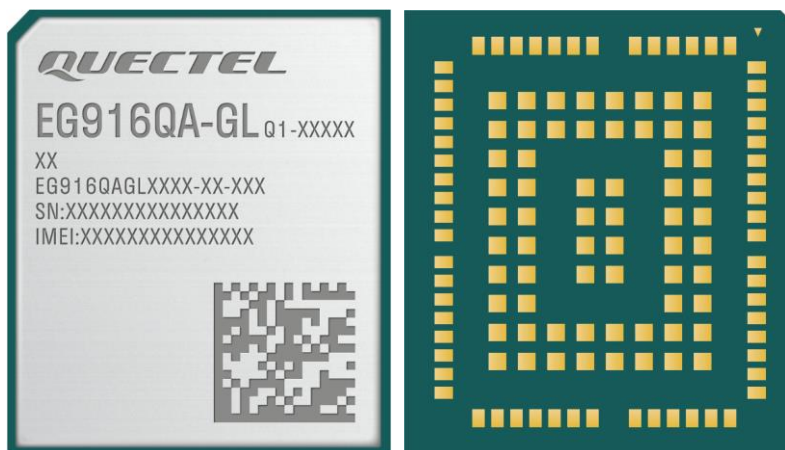


Figure 42: EG916QA-GL Top and Bottom Views

NOTE

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

8 Storage, Manufacturing and Packaging

8.1. Storage Conditions

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

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

¹² 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.

8.2. Manufacturing and Soldering

Push the squeegee to apply the solder paste on the surface of stencil, thus making the paste fill the stencil openings and then penetrate to the PCB. Apply proper force on the squeegee to produce a clean stencil surface on a single pass. To guarantee module soldering quality, the thickness of stencil for the module is recommended to be 0.13–0.15 mm. For more details, see **document [3]**.

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

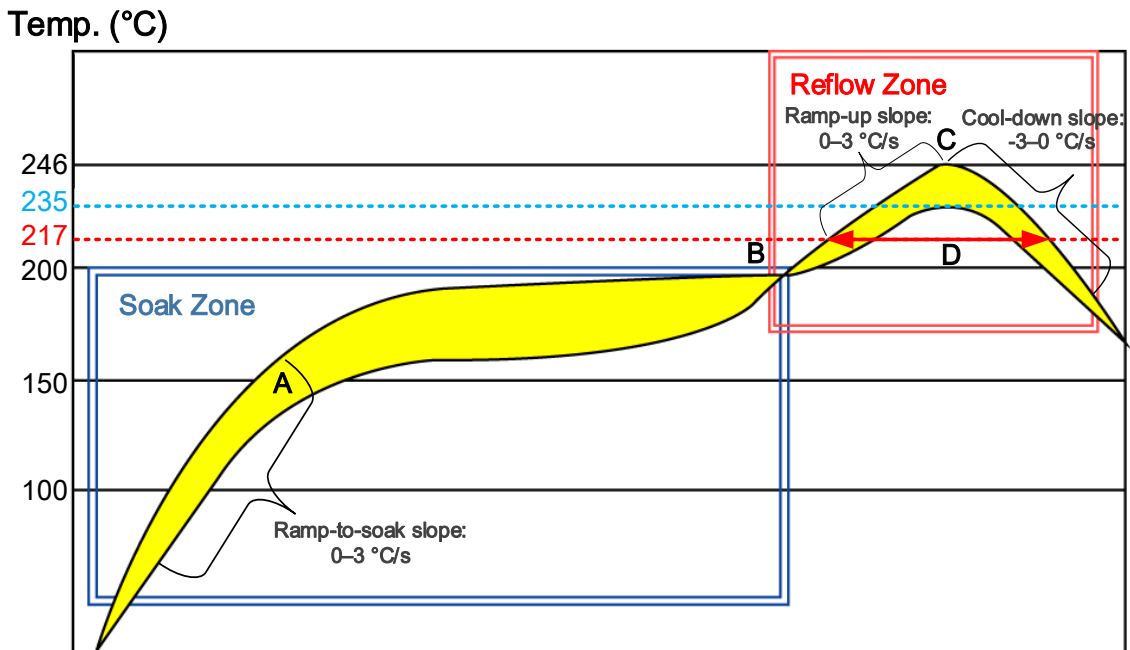


Figure 43: Recommended Reflow Soldering Thermal Profile

Table 42: Recommended Thermal Profile Parameters

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

NOTE

1. The above profile parameter requirements are for the measured temperature of the solder joints. Both the hottest and coldest spots of solder joints on the PCB should meet the above requirements.
2. During manufacturing and soldering, or any other processes that may contact the module directly, NEVER wipe the module's shielding can with organic solvents, such as acetone, ethyl alcohol, isopropyl alcohol, trichloroethylene. Otherwise, the shielding can may become rusted.
3. The shielding can for the module is made of Cupro-Nickel base material. It is tested that after 12 hours' Neutral Salt Spray test, the laser engraved label information on the shielding can is still clearly identifiable and the QR code is still readable, although white rust may be found.
4. If a conformal coating is necessary for the module, do NOT use any coating material that may chemically react with the PCB or shielding cover, and prevent the coating material from flowing into the module.
5. Avoid using ultrasonic technology for module cleaning since it can damage crystals inside the module.
6. Avoid using materials that contain mercury (Hg), such as adhesives, for module processing, even if the materials are RoHS compliant and their mercury content is below 1000 ppm (0.1 %).
7. Corrosive gases may corrode the electronic components inside the module, affecting their reliability and performance, and potentially leading to a shortened service life that fails to meet the designed lifespan. Therefore, do not store or use unprotected modules in environments containing corrosive gases such as hydrogen sulfide, sulfur dioxide, chlorine, and ammonia.

8. Due to the complexity of the SMT process, 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]**.

8.3. Packaging Specification

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

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

8.3.1. Carrier Tape

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

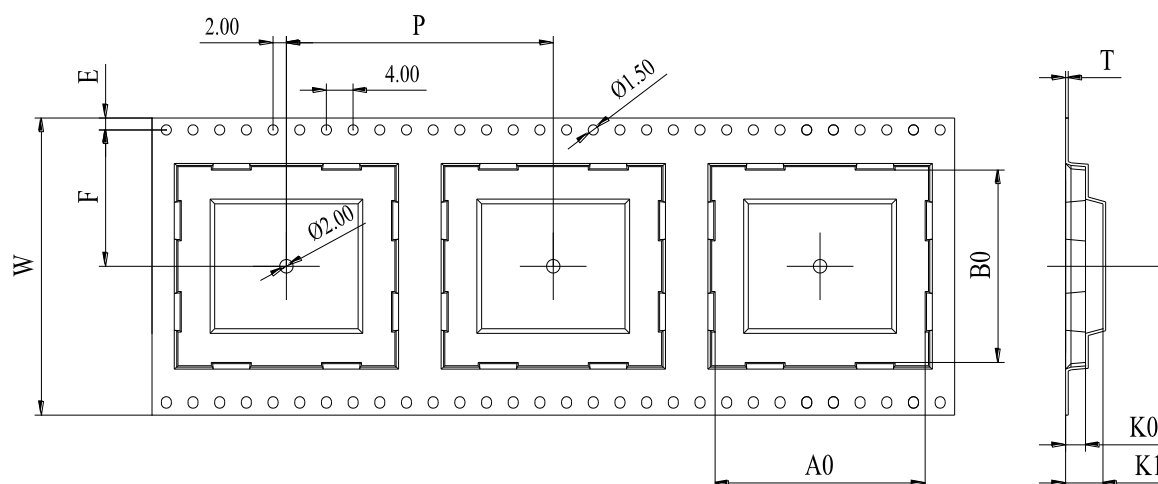


Figure 44: Carrier Tape Dimension Drawing (Unit: mm)

Table 43: Carrier Tape Dimension Table (Unit: mm)

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

8.3.2. Plastic Reel

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

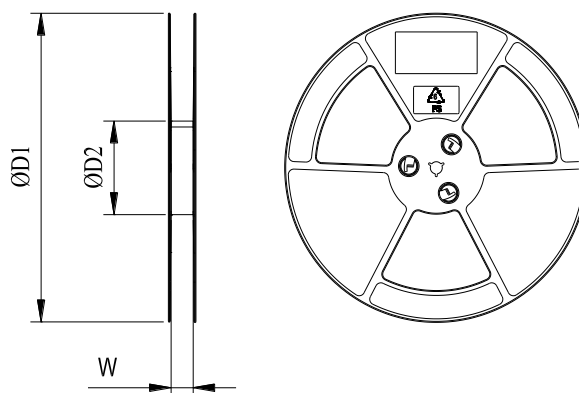


Figure 45: Plastic Reel Dimension Drawing

Table 44: Plastic Reel Dimension Table (Unit: mm)

ØD1	ØD2	W
330	100	44.5

8.3.3. Mounting Direction

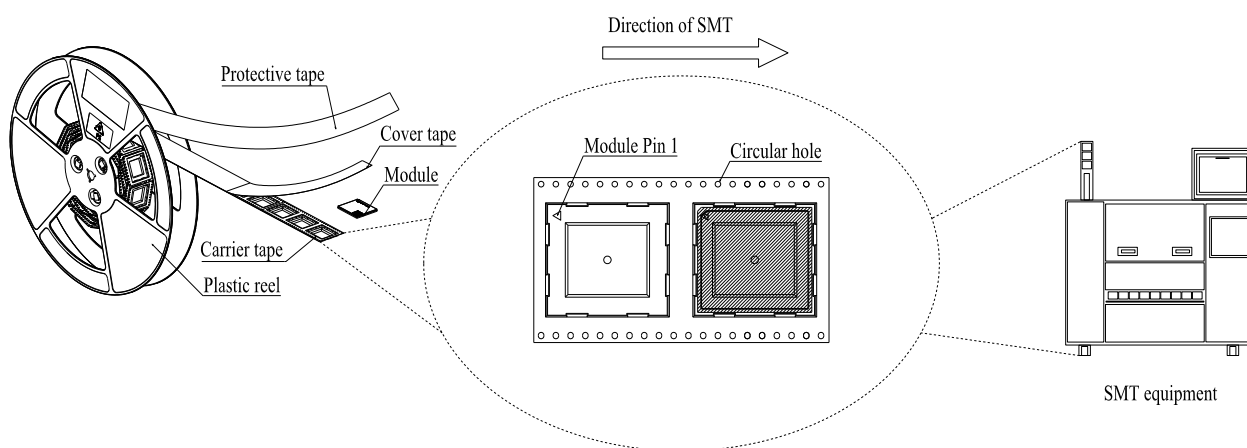
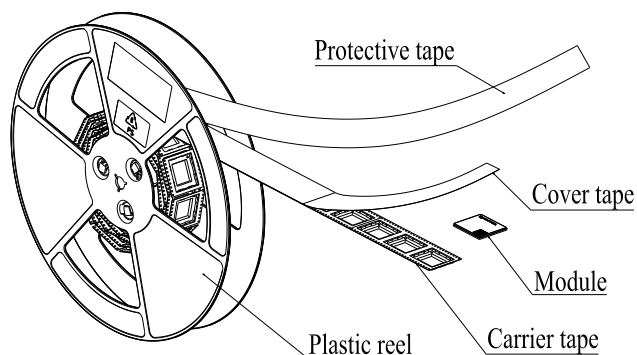


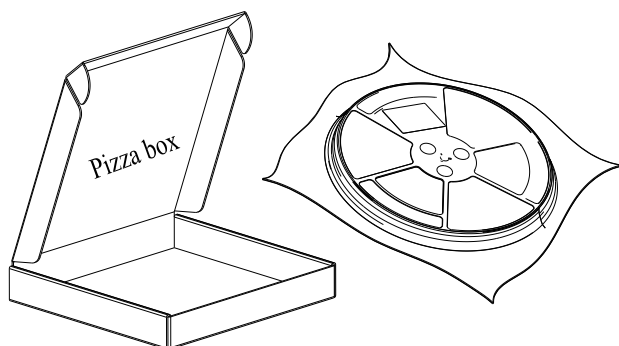
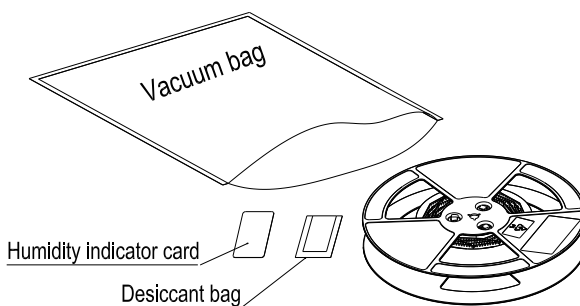
Figure 46: Mounting Direction

8.3.4. Packaging Process



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

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



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

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

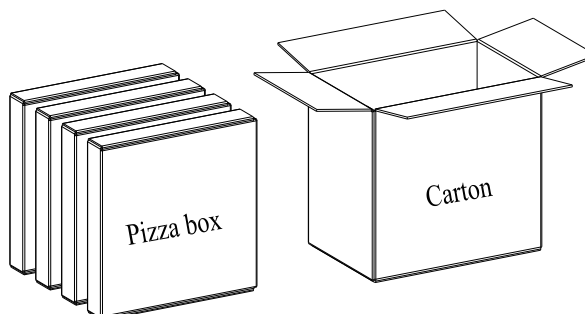


Figure 47: Packaging Process

9 Appendix References

Table 45: Related Documents

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

Table 46: 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
DSSS	direct-sequence spread spectrum
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
HB	High Band
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
LPUART	Low-power Universal Asynchronous Receiver/Transmitter
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

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
RoHS	Restriction of Hazardous Substances
RTS	Request To Send
Rx	Receive
SMD	Surface Mount Device
SMS	Short Message Service
SMTP	Simple Mail Transfer Protocol
SMTPS	Simple Mail Transfer Protocol Secure
SPI	Serial Peripheral Interface
SSL	Secure Sockets Layer
SW	Serial Wire
TCP	Transmission Control Protocol
TVS	Transient Voltage Suppressor
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
V_{max}	Maximum Voltage
V_{nom}	Nominal Voltage
V_{min}	Minimum Voltage
V_{ILmax}	Maximum Low-level Input Voltage
V_{RWM}	Working Peak Reverse Voltage
VSWR	Voltage Standing Wave Ratio

OEM/Integrators Installation Manual

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 Eagle 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 (new application) 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: XMR2025EG915QANA”

“Contains IC: 10224A-25EG915QANA “

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.

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.

Antenna Type: External Antenna

LTE B2: 1.59dBi

LTE B4: 2dBi

LTE B5: 2.13dBi

LTE B12: 4dBi

LTE B13: 3.26dBi

LTE B66: 2dBi

Manual Information to the End User

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

Federal Communication Commission Interference Statement

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

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

be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one of the following measures:

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

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

List of applicable FCC rules

This module has been tested and found to comply with part 15, part 22, part 24, part 27 and 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 circuitry), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.

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

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

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

Radiation Exposure Statement

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

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 20cm between the radiator & your body.

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements ISSED établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20cm 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 20cm 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 20cm 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 cannot 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 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 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 20cm 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-25EG915QANA".

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-25EG915QANA".

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.