EG25-G Mini PCIe

Hardware Design

LTE Module Series

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About the Document

History

Revision	Date	Author	Description
1.0	2019-01-03	Lorry XU/ Ethan SHAN	Initial

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1 Introduction

This document defines EG25-G Mini PCIe module, and describes its air interfaces and hardware interfaces which are connected with customers' applications.

This document can help customers quickly understand module interface specifications, electrical and mechanical details as well as other related information of EG25-G Mini PCIe module. To facilitate its application in different fields, relevant reference design is also provided for customers' reference. Associated with application note and user guide, customers can use the module to design and set up mobile applications easily.

1.1. Safety Information

The following safety precautions must be observed during all phases of operation, such as usage, service or repair of any cellular terminal or mobile incorporating EG25-G Mini PCIe module. Manufacturers of the cellular terminal should send the following safety information to users and operating personnel, and incorporate these guidelines into all manuals supplied with the product. If not so, Quectel assumes no liability for customers' failure to comply with these precautions.

	Full attention must be given to driving at all times in order to reduce the risk of an accident. Using a mobile while driving (even with a handsfree kit) causes distraction and can lead to an accident. Please comply with laws and regulations restricting the use of wireless devices while driving.
	Switch off the cellular terminal or mobile before boarding an aircraft. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. If the device offers an Airplane Mode, then it should be enabled prior to boarding an aircraft. Please consult the airline staff for more restrictions on the use of wireless devices on boarding the aircraft.
	Wireless devices may cause interference on sensitive medical equipment, so please be aware of the restrictions on the use of wireless devices when in hospitals, clinics or other healthcare facilities.
	Cellular terminals or mobiles operating over radio signals and cellular network cannot be guaranteed to connect in all possible conditions (for example, with unpaid bills or with an invalid (U)SIM card). When emergent help is needed in such conditions, please remember using emergency call. In order to make or receive a call, the cellular terminal or mobile must be switched on in a service area with adequate cellular signal strength.
	The cellular terminal or mobile contains a transmitter and receiver. When it is ON, it receives and transmits radio frequency signals. RF interference can occur if it is used close to TV set, radio, computer or other electric equipment.
	In locations with potentially explosive atmospheres, obey all posted signs to turn off wireless devices such as your phone or other cellular terminals. Areas with potentially explosive atmospheres include fuelling areas, below decks on boats, fuel or chemical transfer or storage facilities, areas where the air contains chemicals or particles such as grain, dust or metal powders, etc.

2 Product Concept

2.1. General Description

EG25-G Mini PCIe module provides data connectivity on LTE-FDD, LTE-TDD, DC-HSDPA, HSPA+, HSDPA, HSUPA, WCDMA, EDGE and GPRS networks with PCI Express Mini Card 1.2 standard interface. It supports embedded operating systems such as WinCE, Linux, Android, etc., and also provides audio, high-speed data transmission and GNSS functionalities for customers' applications.

EG25-G Mini PCIe module can be applied in the following fields:

- PDA and Laptop Computer
- Remote Monitor System
- Vehicle System
- Wireless POS System
- Intelligent Meter Reading System
- Wireless Router and Switch
- Other Wireless Terminal Devices

This chapter generally introduces the following aspects of EG25-G Mini PCIe module:

- Product Series
- Key Features
- Functional Diagram

> **NOTE**
>
> EG25-G Mini PCIe contains **Telematics** version and **Data-only** version. **Telematics** version supports voice and data functions, while **Data-only** version only supports data function.

2.2. Module Description

The following table shows the description of EG25-G Mini PCIe module.

Table 1: Description of EG25-G Mini PCIe

Module	Description
EG25-G Mini PCIe	Support LTE-FDD: B1/B2/B3/B4/B5/B7/B8/B12/B13/B18/B19/B20/B25/B26/B28 Support LTE-TDD: B38/B39/B40/B41 Support WCDMA: B1/B2/B4/B5/B6/B8/B19 Support GSM: 850/900/1800/1900MHz Support GPS, GLONASS, BeiDou/Compass, Galileo, QZSS [1] Support digital audio [2]

NOTES

1. [1] GNSS function is optional.
2. [2] Digital audio (PCM) function is only supported on **Telematics** version.

2.3. Key Features

The following table describes the detailed features of EG25-G Mini PCIe module.

Table 2: Key Features of EG25-G Mini PCIe

Feature	Details
Function Interface	PCI Express Mini Card 1.2 Standard Interface
Power Supply	Supply voltage: 3.0V~3.6V Typical supply voltage: 3.3V
Transmitting Power	Class 4 (33dBm±2dB) for GSM850 Class 4 (33dBm±2dB) for EGSM900 Class 1 (30dBm±2dB) for DCS1800 Class 1 (30dBm±2dB) for PCS1900 Class E2 (27dBm±3dB) for GSM850 8-PSK Class E2 (27dBm±3dB) for EGSM900 8-PSK Class E2 (26dBm±3dB) for DCS1800 8-PSK

	Class E2 (26dBm±3dB) for PCS1900 8-PSK Class 3 (24dBm+1/-3dB) for WCDMA bands Class 3 (23dBm±2dB) for LTE FDD bands Class 3 (23dBm±2dB) for LTE TDD bands
LTE Features	Support up to non-CA Cat 4 FDD and TDD Support 1.4MHz~20MHz RF bandwidth Support MIMO in DL direction LTE-FDD: Max 150Mbps (DL), Max 50Mbps (UL) LTE-TDD: Max 130Mbps (DL), Max 30Mbps (UL)
UMTS Features	Support 3GPP R8 DC-HSDPA, HSPA+, HSDPA, HSUPA and WCDMA Support QPSK,16-QAM and 64-QAM modulation DC-HSDPA: Max 42Mbps (DL) HSUPA: Max 5.76Mbps (UL) WCDMA: Max 384Kbps (DL), Max 384Kbps (UL)
GSM Features	**GPRS:** Support GPRS multi-slot class 33 (33 by default) Coding scheme: CS-1, CS-2, CS-3 and CS-4 Max 107Kbps (DL), Max 85.6Kbps (UL) **EDGE:** Support EDGE multi-slot class 33 (33 by default) Support GMSK and 8-PSK for different MCS (Modulation and Coding Scheme) Downlink coding schemes: CS 1-4 and MCS 1-9 Uplink coding schemes: CS 1-4 and MCS 1-9 Max 296Kbps (DL), Max 236.8Kbps (UL)
Internet Protocol Features	Support TCP/UDP/PPP/FTP/HTTP/NTP/PING/QMI/NITZ/SMTP/CMUX*/HTTPS*/ /MMS*/FTPS*/SMTPS*/SSL*/FILE* protocols Support PAP (Password Authentication Protocol) and CHAP (Challenge Handshake Authentication Protocol) protocols which are usually used for PPP connections
SMS	Text and PDU mode Point-to-point MO and MT SMS cell broadcast SMS storage: ME by default
(U)SIM Interface	Support USIM/SIM card: 1.8V, 3.0V
UART Interface	Support RTS and CTS hardware flow control Baud rate can reach up to 230400bps, 115200bps by default Used for AT command communication and data transmission
Audio Features	Support one digital audio interface: PCM interface GSM: HR/FR/EFR/AMR/AMR-WB WCDMA: AMR/AMR-WB LTE: AMR/AMR-WB

	Support echo cancellation and noise suppression
PCM Interface	Used for audio function with external codec
	Support 16-bit linear data format
	Support long frame synchronization and short frame synchronization
	Support master and slave modes, but must be the master in long frame synchronization
USB Interface	Compliant with USB 2.0 specification (slave only); the data transfer rate can reach up to 480Mbps
	Used for AT command communication, data transmission, GNSS NMEA output, software debugging, firmware upgrade and voice over USB*
	Support USB serial drivers for: Windows 7/8/8.1/10, Windows CE 5.0/6.0/7.0*, Linux 2.6/3.x/4.1~4.14, Android 4.x/5.x/6.x/7.x/8.x, etc.
Antenna Interfaces	Including main antenna, diversity antenna and GNSS antenna
Rx-diversity	Support LTE/WCDMA Rx-diversity
GNSS Features	Gen8C Lite of Qualcomm
	Protocol: NMEA 0183
AT Commands	Compliant with 3GPP TS 27.007, 27.005 and Quectel enhanced AT commands
Physical Characteristics	Size: (51.0±0.15)mm × (30.0±0.15)mm × (4.9±0.2)mm
	Weight: approx. 9.8g
Temperature Range	Operation temperature range: -35°C ~ +75°C [1]
	Extended temperature range: -40°C ~ +80°C [2]
	Storage temperature range: -40°C ~ +90°C
Firmware Upgrade	Upgrade via USB interface or DFOTA*
RoHS	All hardware components are fully compliant with EU RoHS directive

NOTES

1. [1] Within operation temperature range, the module is 3GPP compliant.
2. [2] Within extended temperature range, the module remains the ability to establish and maintain a voice, SMS, data transmission, emergency call, etc. There is no unrecoverable malfunction. There are also no effects on radio spectrum and no harm to radio network. Only one or more parameters like P_{out} might reduce in their value and exceed the specified tolerances. When the temperature returns to normal operation temperature levels, the module will meet 3GPP specifications again.
3. "*" means under development.

2.4. Functional Diagram

The following figure shows the block diagram of EG25-G Mini PCIe.
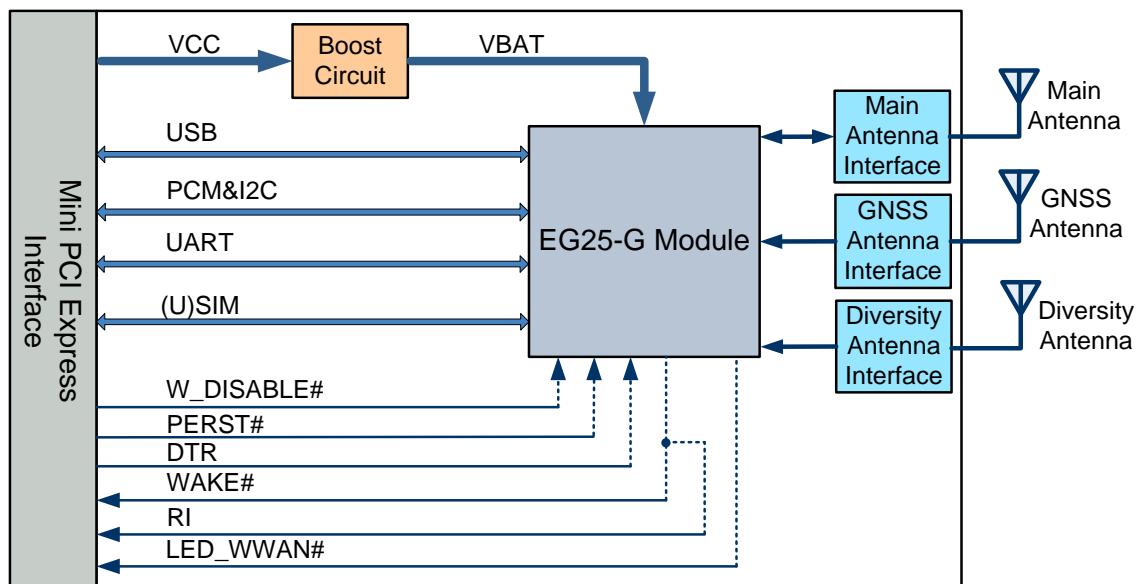
Figure 1: Functional Diagram

3 Application Interfaces

The physical connections and signal levels of EG25-G Mini PCIe comply with PCI Express Mini CEM specifications. This chapter mainly describes the definition and application of the following interfaces for EG25-G Mini PCIe:

- Power supply
- (U)SIM interface
- USB interface
- UART interface
- PCM&I2C interfaces
- Control and Indicator signals
- Antenna interfaces

3.1. Pin Assignment

The following figure shows the pin assignment of EG25-G Mini PCIe module. The top side contains EG25-G module and antenna connectors.

Pin Name	Pin No.			Pin No.	Pin Name
WAKE#	1			2	VCC_3V3
RESERVED	3			4	GND
RESERVED	5			6	NC
RESERVED	7			8	USIM_VDD
GND	9	PIN1	PIN2	10	USIM_DATA
UART_RX	11			12	USIM_CLK
UART_TX	13			14	USIM_RST
GND	15			16	RESERVED
RI	17			18	GND
RESERVED	19	TOP	BOT	20	W_DISABLE#
GND	21			22	PERST#
UART_CTS	23			24	RESERVED
UART_RTS	25			26	GND
GND	27			28	NC
GND	29			30	I2C_SCL
DTR	31	PIN51	PIN52	32	I2C_SDA
RESERVED	33			34	GND
GND	35			36	USB_DM
GND	37			38	USB_DP
VCC_3V3	39			40	GND
VCC_3V3	41			42	LED_WWAN#
GND	43			44	USIM_PRESENCE
PCM_CLK	45			46	RESERVED
PCM_DOUT	47			48	NC
PCM_DI	49			50	GND
PCM_SYNC	51			52	VCC_3V3

Figure 2: Pin Assignment

3.2. Pin Description

The following tables show the pin definition and description of EG25-G Mini PCIe on the 52-pin application.

Table 3: I/O Parameters Definition

Type	Description
DI	Digital Input
DO	Digital Output
IO	Bidirectional
OC	Open Collector
PI	Power Input
PO	Power Output

Table 4: Pin Description

Pin No.	Mini PCI Express Standard Name	EG25-G Mini PCIe Pin Name	I/O	Description	Comment
1	WAKE#	WAKE#	OC	Output signal to wake up the host.	
2	3.3Vaux	VCC_3V3	PI	3.3V DC supply	
3	RESERVED	RESERVED		Reserved	
4	GND	GND		Mini card ground	
5	RESERVED	RESERVED		Reserved	
6	1.5V	NC		Not connected	
7	CLKREQ#	RESERVED		Reserved	
8	UIM_PWR	USIM_VDD	PO	Power source for the (U)SIM card	
9	GND	GND		Mini card ground	
10	UIM_DATA	USIM_DATA	IO	Data signal of (U)SIM card	
11	REFCLK-	UART_RX	DI	UART receive data	Connect to

				DTE's TX.
12	UIM_CLK	USIM_CLK	DO	Clock signal of (U)SIM card
13	REFCLK+	UART_TX	DO	UART transmit data	Connect to DTE's RX.
14	UIM_RESET	USIM_RST	DO	Reset signal of (U)SIM card
15	GND	GND		Mini card ground
16	UIM_VPP	RESERVED		Reserved
17	RESERVED	RI	DO	Output signal to wake up the host.
18	GND	GND		Mini card ground
19	RESERVED	RESERVED		Reserved
20	W_DISABLE#	W_DISABLE#	DI	Airplane mode control	Pull-up by default. Active low.
21	GND	GND		Mini card ground
22	PERST#	PERST#	DI	Fundamental reset signal	Pull-up by default. Active low
23	PERn0	UART_CTS	DI	UART clear to send	Connect to DTE's RTS.
24	3.3Vaux	RESERVED		Reserved
25	PERp0	UART_RTS	DO	UART request to send	Connect to DTE's CTS
26	GND	GND		Mini card ground
27	GND	GND		Mini card ground
28	1.5V	NC		Not connected
29	GND	GND		Mini card ground
30	SMB_CLK	I2C_SCL	DO	I2C serial clock	Require external pull-up to 1.8V.
31	PETn0	DTR	DI	Sleep mode control
32	SMB_DATA	I2C_SDA	IO	I2C serial data	Require

				external pull-up to 1.8V.
33	PETp0	RESERVED		Reserved
34	GND	GND		Mini card ground
35	GND	GND		Mini card ground
36	USB_D-	USB_DM	IO	USB differential data (-)	Require differential impedance of 90Ω
37	GND	GND		Mini card ground
38	USB_D+	USB_DP	IO	USB differential data (+)	Require differential impedance of 90Ω
39	3.3Vaux	VCC_3V3	PI	3.3V DC supply
40	GND	GND		Mini card ground
41	3.3Vaux	VCC_3V3	PI	3.3V DC supply
42	LED_WWAN#	LED_WWAN#	OC	LED signal for indicating the network status of the module	Active low
43	GND	GND		Mini card ground
44	LED_WLAN#	USIM_PRESENCE	DI	(U)SIM card insertion detection
45	RESERVED	PCM_CLK [1]	IO	PCM clock signal
46	LED_WPAN#	RESERVED		Reserved
47	RESERVED	PCM_DOUT [1]	DO	PCM data output
48	1.5V	NC		Not connected
49	RESERVED	PCM_DIN [1]	DI	PCM data input
50	GND	GND		Mini card ground
51	RESERVED	PCM_SYNC [1]	IO	PCM frame synchronization
52	3.3Vaux	VCC_3V3	PI	3.3V DC supply

NOTES

1. Keep all NC, reserved and unused pins unconnected.
2. [1] The digital audio (PCM) function is only supported on **Telematics** version.

3.3. Power Supply

The following table shows pin definition of VCC_3V3 pins and ground pins.

Table 5: Definition of VCC_3V3 and GND Pins

Pin No.	Pin Name	I/O	Power Domain	Description
2, 39, 41, 52	VCC_3V3	PI	3.0V~3.6V	3.3V DC supply
4, 9, 15, 18, 21, 26, 27, 29, 34, 35, 37, 40, 43, 50	GND			Mini card ground

The typical supply voltage of EG25-G Mini PCIe is 3.3V. In the 2G network, the input peak current may reach 2.7A during the transmitting time. Therefore, the power supply must be able to provide enough current, and a bypass capacitor of no less than 470μF with low ESR should be used to prevent the voltage from dropping.

The following figure shows a reference design of power supply. The precision of resistor R2 and R3 is 1%, and the capacitor C3 needs a low ESR.
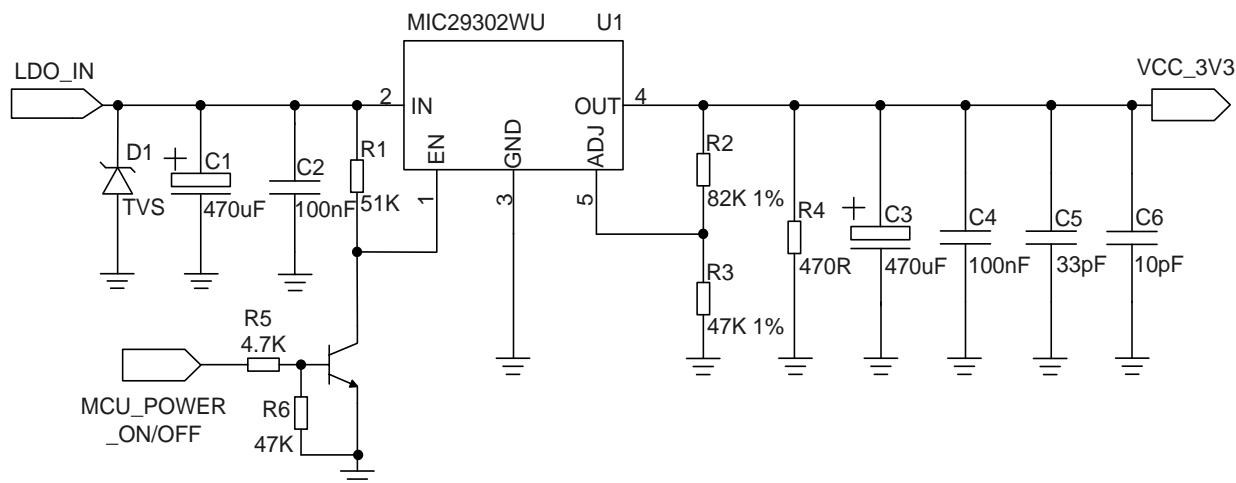
Figure 3: Reference Circuit of Power Supply

3.4. (U)SIM Interface

The (U)SIM interface circuitry meets ETSI and IMT-2000 requirements. Both 1.8V and 3.0V (U)SIM cards are supported.

Table 6: Pin Definition of (U)SIM Interface

Pin No.	Pin Name	I/O	Power Domain	Description
8	USIM_VDD	PO	1.8V/3.0V	Power source for (U)SIM card
10	USIM_DATA	IO	1.8V/3.0V	Data signal of (U)SIM card
12	USIM_CLK	DO	1.8V/3.0V	Clock signal of (U)SIM card
14	USIM_RST	DO	1.8V/3.0V	Reset signal of (U)SIM card
44	USIM_PRESENCE	DI	1.8V/3.0V	(U)SIM card insertion detection

EG25-G Mini PCIe supports (U)SIM card hot-plug via the USIM_PRESENCE pin. The function supports low level and high level detections, and is disabled by default. For more details of **AT+QSIMDET** command, please refer to *document [2]*.

The following figure shows a reference design for (U)SIM interface with an 8-pin (U)SIM card connector.
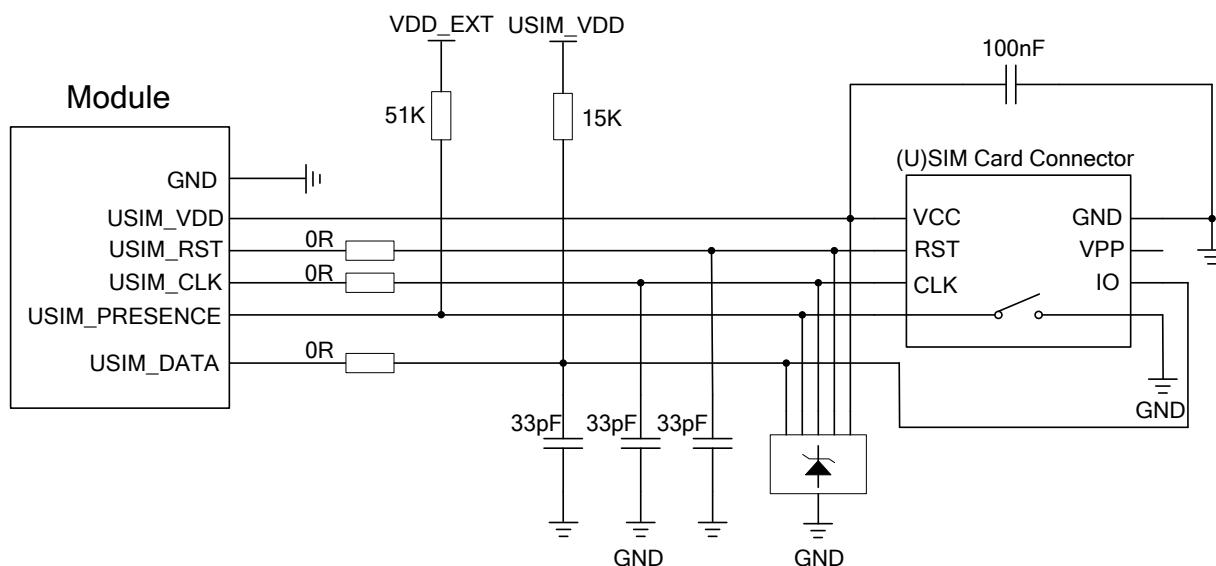
Figure 4: Reference Circuit of (U)SIM Interface with an 8-Pin (U)SIM Card Connector

If (U)SIM card detection function is not needed, please keep USIM_PRESENCE unconnected. A reference circuit for (U)SIM interface with a 6-pin (U)SIM card connector is illustrated in the following figure.
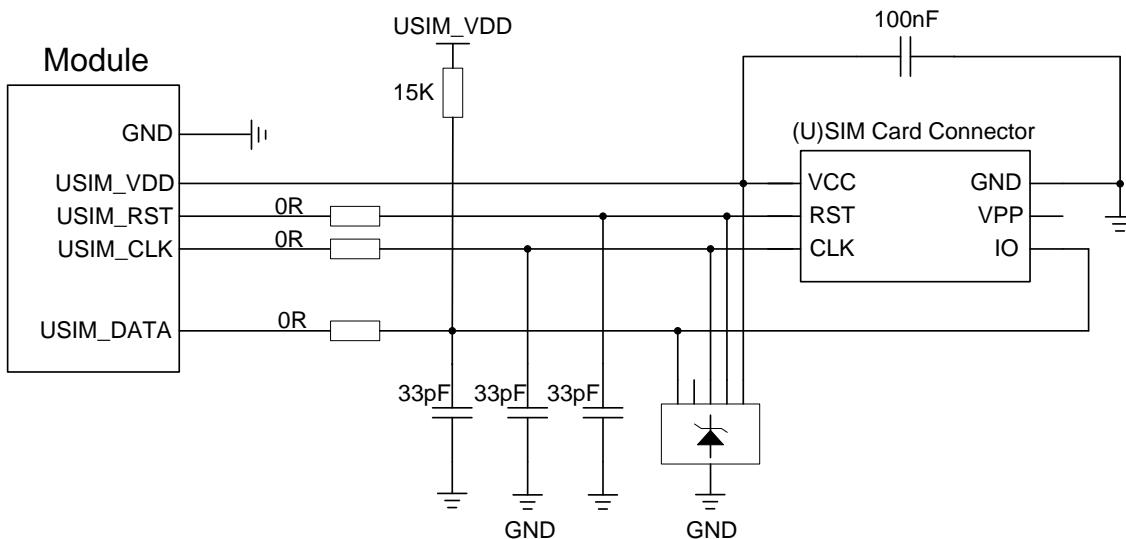
Figure 5: Reference Circuit of (U)SIM Interface with a 6-Pin (U)SIM Card Connector

In order to enhance the reliability and availability of the (U)SIM card in customers' applications, please follow the criteria below in (U)SIM circuit design:

● Keep placement of (U)SIM card connector to the module as close as possible. Keep the trace length as less than 200mm as possible.

● Keep (U)SIM card signals away from RF and power supply traces.

● Assure the ground trace between the module and the (U)SIM card connector short and wide. Keep the trace width of ground and USIM_VDD no less than 0.5mm to maintain the same electric potential. Make sure the bypass capacitor between USIM_VDD and USIM_GND is less than 1uF, and be placed as close to (U)SIM card connector as possible. If the ground is complete on customers' PCB, USIM_GND can be connected to PCB ground directly.

● To avoid cross-talk between USIM_DATA and USIM_CLK, keep them away from each other and shield them with surrounded ground.

● In order to offer good ESD protection, it is recommended to add a TVS diode array with parasitic capacitance not exceeding 15pF. The 0Ω resistors should be added in series between the module and the (U)SIM card so as to facilitate debugging. The 33pF capacitors are used for filtering interference of EGSM900. Please note that the (U)SIM peripheral circuit should be close to the (U)SIM card connector.

● The pull-up resistor on USIM_DATA line can improve anti-jamming capability when long layout trace and sensitive occasion are applied, and should be placed close to the (U)SIM card connector.

3.5. USB Interface

The following table shows the pin definition of USB interface.

Table 7: Pin Definition of USB Interface

Pin No.	Pin Name	I/O	Description	Comment
36	USB_DM	IO	USB differential data (-)	Require differential impedance of 90Ω
38	USB_DP	IO	USB differential data (+)	Require differential impedance of 90Ω

EG25-G Mini PCIe is compliant with USB 2.0 specification. It can only be used as a slave device. Meanwhile, it supports high speed (480Mbps) mode and full speed (12Mbps) mode. The USB interface is used for AT command communication, data transmission, GNSS NMEA output, software debugging, firmware upgrade and voice over USB*. The following figure shows a reference circuit of USB interface.
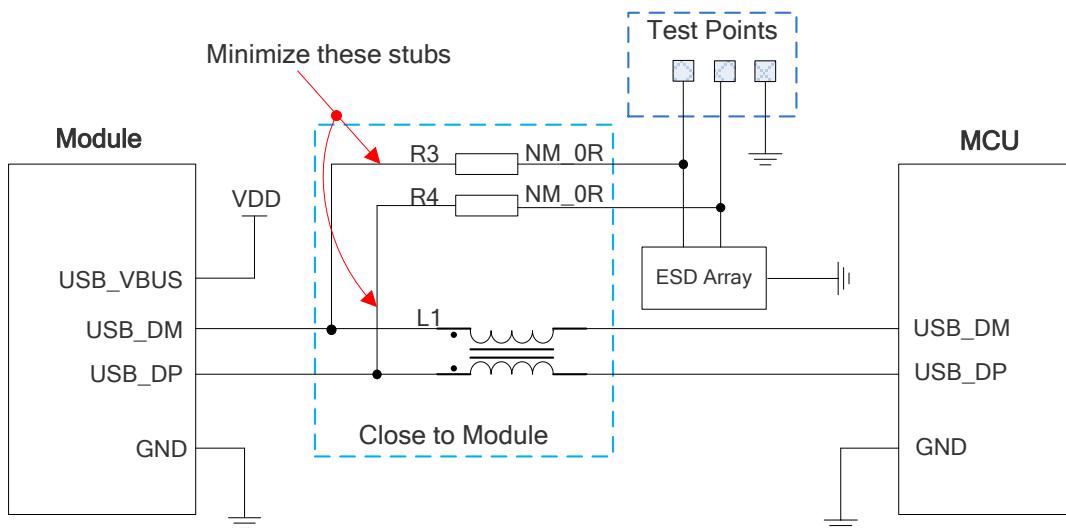
Figure 6: Reference Circuit of USB Interface

A common mode choke L1 is recommended to be added in series between the module and customer's MCU in order to suppress EMI spurious transmission. Meanwhile, the 0Ω resistors (R3 and R4) should be added in series between the module and the test points so as to facilitate debugging, and the resistors are not mounted by default. In order to ensure the integrity of USB data line signal, L1/R3/R4 components must be placed close to the module, and also these resistors should be placed close to each other. The extra stubs of trace must be as short as possible.

The following principles should be complied with when design the USB interface, so as to meet USB 2.0 specification.

● It is important to route the USB signal traces as differential pairs with total grounding. The impedance of USB differential trace is 90Ω.
● Do not route signal traces under crystals, oscillators, magnetic devices and RF signal traces. It is important to route the USB differential traces in inner-layer with ground shielding on not only upper and lower layers but also right and left sides.
● Pay attention to the influence of junction capacitance of ESD protection components on USB data lines. Typically, the capacitance value should be less than 2pF.
● Keep the ESD protection components as close to the USB connector as possible.

NOTES

1. There are three preconditions when enabling EG25-G Mini PCIe to enter into the sleep mode:
   a) Execute **AT+QSCLK=1** command to enable the sleep mode. Please refer to *document [2]* for details.
   b) DTR pin should be kept at high level (pull-up internally).
   c) USB interface on Mini PCIe must be connected with the USB interface of the host and please guarantee the USB of the host is in suspension state.
2. "*" means under development.

3.6. UART Interface

The following table shows the pin definition of the main UART interface.

Table 8: Pin Definition of Main UART Interface

Pin No.	Pin Name	I/O	Power Domain	Description
11	UART_RX	DI	3.3V	UART receive data
13	UART_TX	DO	3.3V	UART transmit data
23	UART_CTS	DI	3.3V	UART clear to send
25	UART_RTS	DO	3.3V	UART request to send

The main UART interface supports 9600bps, 19200bps, 38400bps, 57600bps, 115200bps and 230400bps baud rates, and the default is 115200bps. This interface can be used for AT command communication and data transmission.

AT+IPR command can be used to set the baud rate of the main UART, and **AT+IFC** command can be used to set the hardware flow control (hardware flow control is disabled by default). Please refer to *document [2]* for details.

3.7. PCM and I2C Interfaces

EG25-G Mini PCIe provides one Pulse Code Modulation (PCM) digital interface and one I2C interface.

The following table shows the pin definition of PCM and I2C interfaces that can be applied in audio codec design.

Table 9: Pin Definition of PCM and I2C Interfaces

Pin No.	Pin Name	I/O	Power Domain	Description
45	PCM_CLK [1]	IO	1.8V	PCM clock signal
47	PCM_DOUT [1]	DO	1.8V	PCM data output
49	PCM_DIN [1]	DI	1.8V	PCM data input
51	PCM_SYNC [1]	IO	1.8V	PCM frame synchronization
30	I2C_SCL	DO	1.8V	I2C serial clock. Require external pull-up to 1.8V.
32	I2C_SDA	IO	1.8V	I2C serial data. Require external pull-up to 1.8V.

EG25-G Mini PCIe provides one PCM digital interface, which supports 16-bit linear data format and the following modes:

● Primary mode (short frame synchronization, works as either master or slave)
● Auxiliary mode (long frame synchronization, works as master only)

1. "*" means under development.
2. [1] The digital audio (PCM) function is only supported on **Telematics** version.

In primary mode, the data is sampled on the falling edge of the PCM_CLK and transmitted on the rising edge. The PCM_SYNC falling edge represents the MSB. In this mode, PCM_CLK supports 128KHz, 256KHz, 512KHz, 1024KHz and 2048KHz for different speed codecs. The following figure shows the timing relationship in primary mode with 8KHz PCM_SYNC and 2048KHz PCM_CLK.
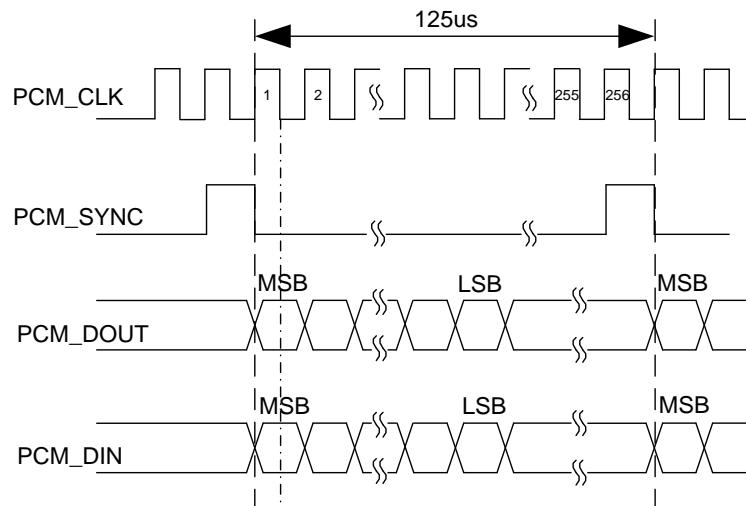
Figure 7: Timing in Primary Mode

In auxiliary mode, the data is sampled on the falling edge of the PCM_CLK and transmitted on the rising edge; while the PCM_SYNC rising edge represents the MSB. In this mode, PCM interface operates with a 128KHz PCM_CLK and an 8KHz, 50% duty cycle PCM_SYNC only. The following figure shows the timing relationship in auxiliary mode with 8KHz PCM_SYNC and 128KHz PCM_CLK.
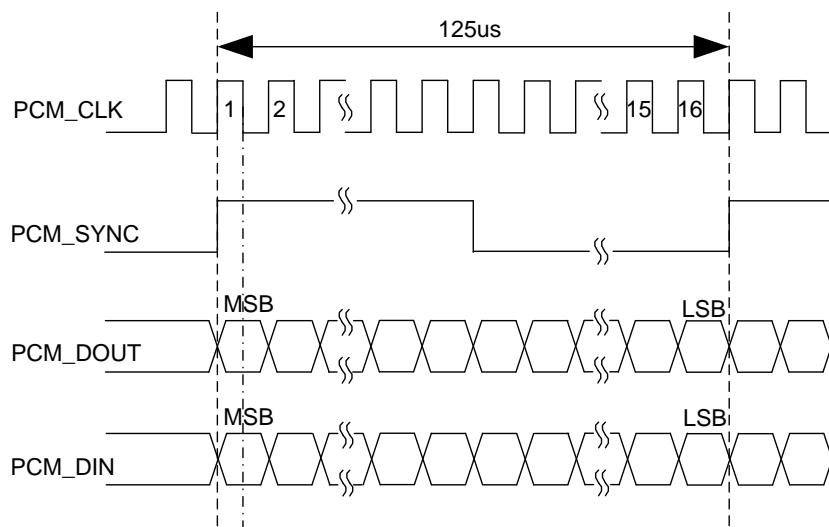
Figure 8: Timing in Auxiliary Mode

Clock and mode can be configured by AT command, and the default configuration is master mode using short frame synchronization format with 2048KHz PCM_CLK and 8KHz PCM_SYNC. In addition, EG25-G Mini PCIe's firmware has integrated the configuration on some PCM codec's application with I2C interface. Please refer to **document [2]** for details about **AT+QDAI** command.

The following figure shows a reference design of PCM interface with an external codec IC.
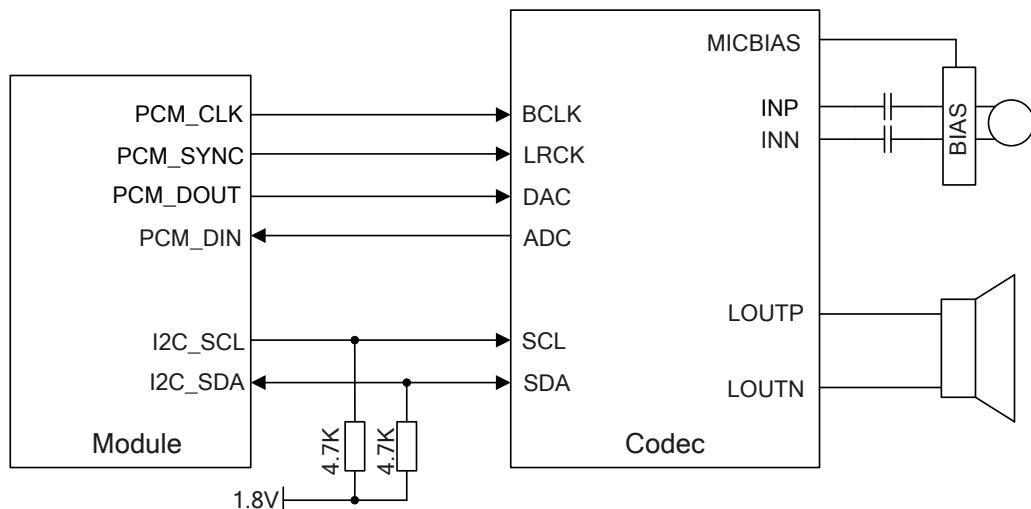
Figure 9: Reference Circuit of PCM Application with Audio Codec

3.8. Control and Indicator Signals

The following table shows the pin definition of control and indicator signals.

Table 10: Pin Definition of Control and Indicator Signals

Pin No.	Pin Name	I/O	Power Domain	Description
17	RI	DO	3.3V	Output signal to wake up the host.
31	DTR	DI	3.3V	Sleep mode control
20	W_DISABLE#	DI	3.3V	Airplane mode control; pull-up by default; active low.
22	PERST#	DI	3.3V	Fundamental reset signal; active low.
42	LED_WWAN#	OC		LED signal for indicating the network status of the module; active low
1	WAKE#	OC		Output signal to wake up the host.

3.8.1. RI Signal

The RI signal can be used to wake up the host. When a URC returns, there will be the following behaviors on the RI pin after executing **AT+QCFG="risignaltype","physical"** command.
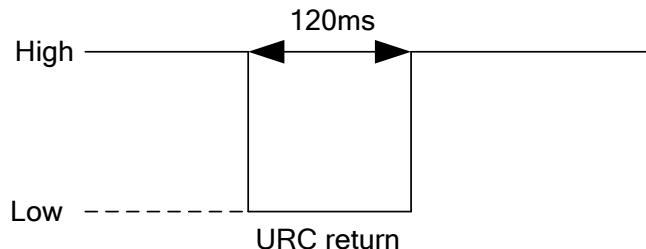
Figure 10: RI Behavior

3.8.2. DTR Signal

The DTR signal supports sleep control function. Driving it to low level will wake up the module.

3.8.3. W_DISABLE# Signal

EG25-G Mini PCIe provides a W_DISABLE# signal to disable or enable the RF function (not include GNSS).

W_DISABLE# signal function is disabled by default, and **AT+QCFG="airplanecontrol",1** can be used to enable this function. The W_DISABLE# pin is pulled up by default. Driving it to low level will let the module enter into airplane mode.

AT+CFUN can also be used to control the RF status, and the details are as follows:

Table 11: RF Function Status

W_DISABLE1# Level	AT Commands	RF Function Status
High Level	**AT+CFUN=1**	Enabled
High Level	**AT+CFUN=0** **AT+CFUN=4**	Disabled
Low Level	**AT+CFUN=0** **AT+CFUN=1** **AT+CFUN=4**	Disabled

3.8.4. PERST# Signal

The PERST# signal can be used to force a hardware reset on the card. Customers can reset the module by driving the PERST# to a low level voltage with the time frame of 150ms~460ms and then releasing it. The reset scenario is illustrated in the following figure.
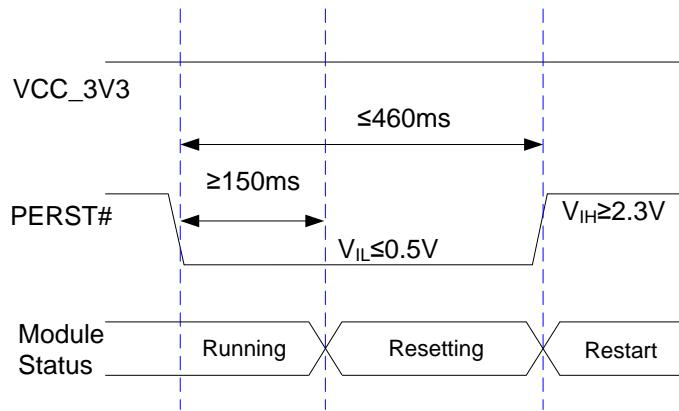
Figure 11: Timing of Resetting Module

3.8.5. LED_WWAN# Signal

The LED_WWAN# signal of EG25-G Mini PCIe is used to indicate the network status of the module, and can absorb the current up to 40mA. According to the following circuit, in order to reduce the current of the LED, a resistor must be placed in series with the LED. The LED is emitting light when the LED_WWAN# output signal is active low.
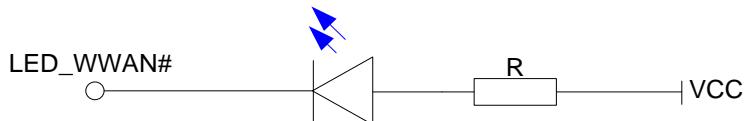
Figure 12: LED_WWAN# Signal Reference Circuit Diagram

There are two indication modes for LED_WWAN# signal to indicate network status, which can be switched through following AT commands:

● **AT+QCFG="ledmode",0 (Default setting)**
● **AT+QCFG="ledmode",2**

The following tables show the detailed network status indications of the LED_WWAN# signal.

Table 12: Indications of Network Status (AT+QCFG="ledmode",0, Default Setting)

Pin Status	Description
Flicker slowly (200ms High/1800ms Low)	Network searching
Flicker slowly (1800ms High/200ms Low)	Idle
Flicker quickly (125ms High/125ms Low)	Data transfer is ongoing
Always High	Voice calling

Table 13: Indications of Network Status (AT+QCFG="ledmode",2)

Pin Status	Description
Low Level (Light on)	Registered on network
High-impedance (Light off)	● No network coverage or not registered ● W_DISABLE# signal is at low level. (Disable the RF) ● **AT+CFUN=0**, **AT+CFUN=4**

3.8.6. WAKE# Signal

The WAKE# signal is an open collector signal which is similar to RI signal, but a host pull-up resistor and **AT+QCFG="risignaltype","physical"** command are required. When a URC returns, there will be 120ms low level pulse output as below.
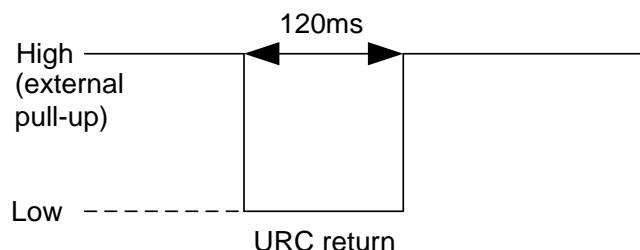
Figure 13: WAKE# Behavior

3.9. Antenna Interfaces

EG25-G Mini PCIe antenna interfaces include a main antenna interface, an Rx-diversity antenna interface and a GNSS antenna interface. Rx-diversity function is enabled by default.

3.9.1. Antenna Requirements

The following table shows the requirements on main antenna, Rx-diversity antenna and GNSS antenna.

Table 14: Antenna Requirements

Type	Requirements
GNSS	Frequency range: 1559MHz~1609MHz Polarization: RHCP or linear VSWR: < 2 (Typ.) Passive antenna gain: > 0dBi Active antenna noise figure: <1.5dB Active antenna gain: > -2dBi Active antenna embedded LNA gain: 20dB (Typ.) Active antenna total gain: > 18dBi (Typ.)
GSM/UMTS/LTE	VSWR: ≤ 2 Gain: 1dBi Max Input Power: 50W Input Impedance: 50Ω Polarization Type: Vertical Cable Insertion Loss: < 1dB (GSM850, EGSM900, WCDMA B5/B6/B8/B19, LTE B5/B8/B12/B13/B18/B19/B20/B26/B28) Cable Insertion Loss: < 1.5dB (DCS1800, PCS1900, WCDMA B1/B2/B4, LTE B1/B2/B3/B4/B25/B39) Cable insertion loss: < 2dB (LTE B7/B38/B40/B41)

3.9.2. Recommended RF Connector for Antenna Installation

EG25-G Mini PCIe is mounted with 2mm × 2mm RF connectors for convenient antenna connection. The dimensions of the RF connectors are shown as below.
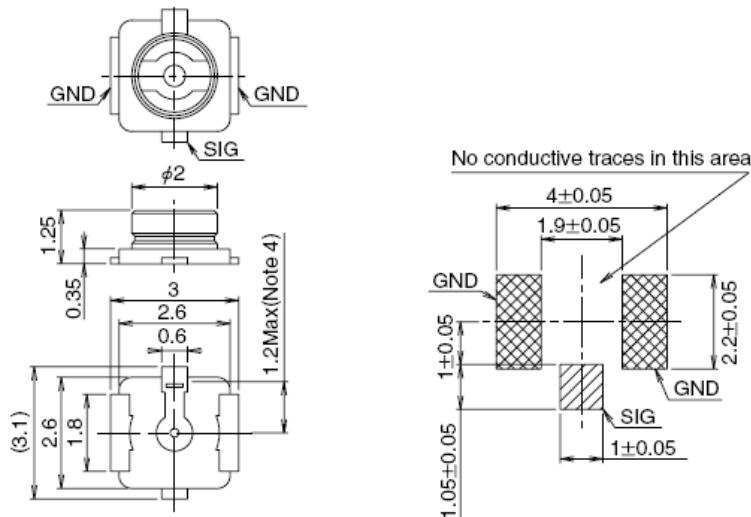
Figure 14: Dimensions of the RF Connectors (Unit: mm)

U.FL-LP mating plugs listed in the following figure can be used to match the RF connectors.

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

Figure 15: Mechanicals of U.FL-LP Mating Plugs

The following figure describes the space factor of mating plugs.
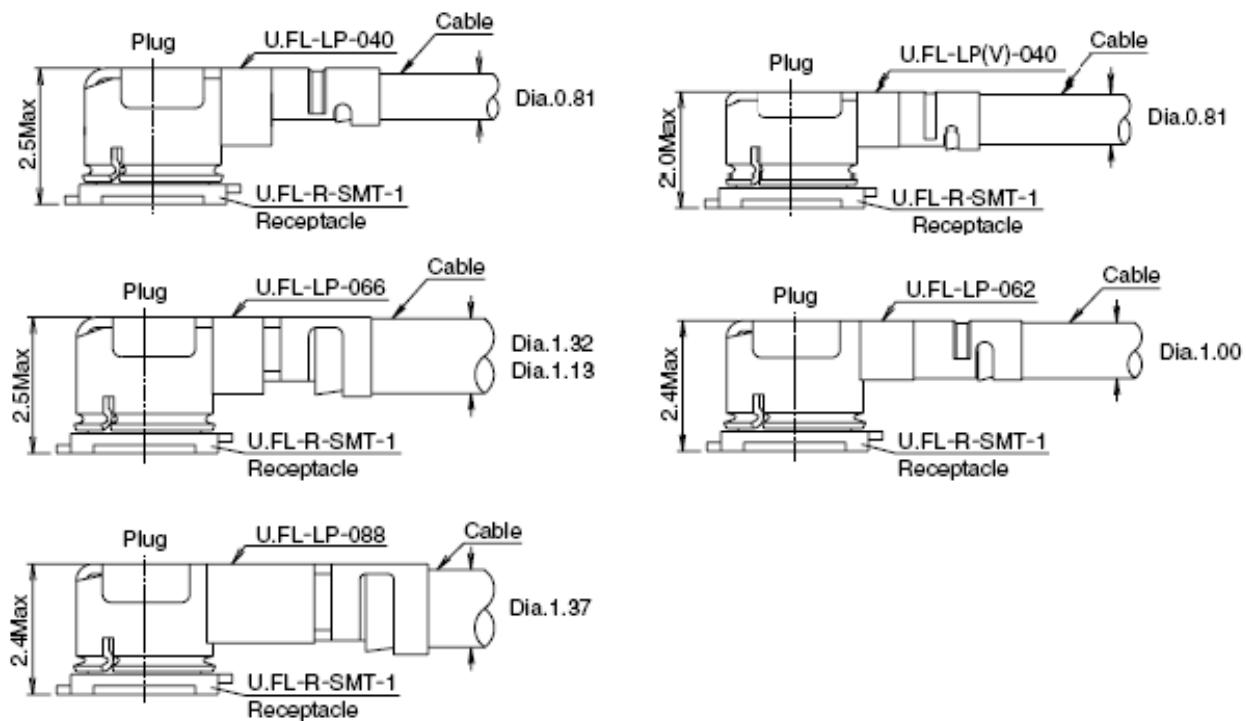
Figure 16: Space Factor of Mating Plugs (Unit: mm)

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

4 Electrical, Reliability and Radio Characteristics

4.1. General Description

This chapter mainly describes the following electrical and radio characteristics of EG25-G Mini PCIe:

- Power supply requirements
- I/O requirements
- RF characteristics
- GNSS receiver
- ESD characteristics
- Thermal consideration
- Current consumption

4.2. Power Supply Requirements

The input voltage of EG25-G Mini PCIe is 3.3V±9%, as specified by *PCI Express Mini CEM Specifications 1.2*. The following table shows the power supply requirements of EG25-G Mini PCIe.

Table 15: Power Supply Requirements

Parameter	Description	Min.	Typ.	Max.	Unit
VCC_3V3	Power Supply	3.0	3.3	3.6	V

4.3. I/O Requirements

The following table shows the I/O requirements of EG25-G Mini PCIe.

Table 16: I/O Requirements

Parameter	Description	Min.	Max.	Unit
V_{IH}	Input High Voltage	0.7 × VCC_3V3	VCC_3V3 + 0.3	V
V_{IL}	Input Low Voltage	-0.3	0.3 × VCC_3V3	V
V_{OH}	Output High Voltage	VCC_3V3 - 0.5	VCC_3V3	V
V_{OL}	Output Low Voltage	0	0.4	V

NOTES

1. The PCM and I2C interfaces belong to 1.8V power domain and other I/O interfaces belong to VCC_3V3 power domain.
2. The maximum voltage value of V_{IL} for PERST# signal and W_DISABLE# signal is 0.5V.

4.4. RF Characteristics

The following tables show the conducted RF output power and receiving sensitivity of EG25-G Mini PCIe module.

Table 17: EG25-G Mini PCIe Conducted RF Output Power

Frequency	Max.	Min.
GSM850/EGSM900	33dBm±2dB	5dBm±5dB
DCS1800/PCS1900	30dBm±2dB	0dBm±5dB
GSM850/EGSM900 (8-PSK)	27dBm±3dB	5dBm±5dB
DCS1800/PCS1900 (8-PSK)	26dBm±3dB	0dBm±5dB
WCDMA B1/B2/B4/B5/B6/B8/B19	24dBm+1/-3dB	< -49dBm
LTE-FDD B1/B2/B3/B4/B5/B7/B8/B12	23dBm±2dB	< -39dBm

LTE-FDD B13/B18/B19/B20/B25/B26/B28	23dBm±2dB	< -39dBm
LTE-TDD B38/B39/B40/B41	23dBm±2dB	< -39dBm

Table 18: EG25-G Mini PCIe Conducted RF Receiving Sensitivity

Frequency	Primary	Diversity	SIMO	3GPP (SIMO)
GSM850	-108dBm	NA	NA	-102dBm
EGSM900	-108dBm	NA	NA	-102dBm
DCS1800	-107.5dBm	NA	NA	-102dBm
PCS1900	-107.5dBm	NA	NA	-102dBm
WCDMA B1	-108.2dBm	-108.5dBm	-109.2dBm	-106.7dBm
WCDMA B2	-109.5dBm	-109dBm	-110dBm	-104.7dBm
WCDMA B4	-108.5dBm	-109dBm	-109.7dBm	-103.7dBm
WCDMA B5	-109dBm	-109.5dBm	-110dBm	-104.7dBm
WCDMA B6	-109dBm	-109.5dBm	-110.5dBm	-106.7dBm
WCDMA B8	-109.2dBm	-109.5dBm	-110.5dBm	-103.7dBm
WCDMA B19	-109dBm	-109.5dBm	-110.5dBm	-106.7dBm
LTE-FDD B1 (10M)	-97.3dBm	-98.3dBm	-99.5dBm	-96.3dBm
LTE-FDD B2 (10M)	-98dBm	-99dBm	-99.9dBm	-94.3dBm
LTE-FDD B3 (10M)	-97.4dBm	-98.1dBm	-99.8dBm	-93.3dBm
LTE-FDD B4 (10M)	-97.7dBm	-98.2dBm	-99.7dBm	-96.3dBm
LTE-TDD B5 (10M)	-98dBm	-98.5dBm	-99.9dBm	-94.3dBm
LTE-TDD B7 (10M)	-97.3dBm	-97.3dBm	-99.1dBm	-94.3dBm
LTE-TDD B8 (10M)	-98dBm	-98.1dBm	-99.8dBm	-93.3dBm
LTE-TDD B12 (10M)	-98dBm	-98.1dBm	-99.9dBm	-93.3dBm
LTE-TDD B13 (10M)	-98dBm	-98.1dBm	-100.1dBm	-93.3dBm

LTE-TDD B18 (10M)	-98dBm	-99.5dBm	-100dBm	-96.3dBm
LTE-TDD B19 (10M)	-98dBm	-99dBm	-99.8dBm	-96.3dBm
LTE-TDD B20 (10M)	-98dBm	-98.8dBm	-99.7dBm	-93.3dBm
LTE-TDD B25 (10M)	-98dBm	-98dBm	-100.2dBm	-92.8dBm
LTE-TDD B26 (10M)	-98dBm	-98.8dBm	-100dBm	-93.8dBm
LTE-TDD B28 (10M)	-98.1dBm	-98.9dBm	-99.8dBm	-94.8dBm
LTE-TDD B38 (10M)	-97.2dBm	-97.3dBm	-99.2dBm	-96.3dBm
LTE-TDD B39 (10M)	-98dBm	-98.2dBm	-99.8dBm	-96.3dBm
LTE-TDD B40 (10M)	-97.7dBm	-97.5dBm	-99.7dBm	-96.3dBm
LTE-TDD B41 (10M)	-97.2dBm	-97.2dBm	-99.3dBm	-94.3dBm

4.5. GNSS Receiver

EG25-G Mini PCIe integrates a GNSS receiver that supports IZat Gen 8C Lite of Qualcomm (GPS, GLONASS, BeiDou, Galileo, QZSS). Meanwhile, it supports Qualcomm gpsOneXTRA technology (one kind of A-GNSS). This technology will download XTRA file from the internet server to enhance the TTFF. XTRA file contains predicted GPS and GLONASS satellites coordinates and clock biases valid for up to 7 days. It is best if XTRA file is downloaded every 1~2 days. Additionally, EG25-G Mini PCIe can support standard NMEA-0183 protocol and output NMEA messages with 1Hz via USB NMEA interface.

EG25-G Mini PCIe's GNSS engine is switched off by default. Customers must switch on it by AT command. Please refer to *document [3]* for more details about GNSS engine technology and configurations. A passive antenna should be used for the GNSS engine.

4.6. ESD Characteristics

The following table shows the ESD characteristics of EG25-G Mini PCIe.

Table 19: ESD Characteristics of EG25-G Mini PCIe

Part	Contact Discharge	Air Discharge	Unit
Power Supply and GND	+/-5	+/-10	kV
Antenna Interfaces	+/-4	+/-8	kV
USB Interface	+/-4	+/-8	kV
(U)SIM Interface	+/-4	+/-8	kV
Others	+/-0.5	+/-1	kV

4.7. Thermal Consideration

In order to achieve better performance of the module, it is recommended to comply with the following principles for thermal consideration:

- On customers' PCB design, please keep placement of the PCI Express Mini Card away from heating sources.
- Do not place components on the PCB area where the module is mounted, in order to facilitate adding of heatsink.
- Do not apply solder mask on the PCB area where the module is mounted, so as to ensure better heat dissipation performance.
- The reference ground of the area where the module is mounted should be complete, and add ground vias as many as possible for better heat dissipation.
- Add a heatsink on the top of the module and the heatsink should be designed with as many fins as possible to increase heat dissipation area. Meanwhile, a thermal pad with high thermal conductivity should be used between the heatsink and module.
- Add a thermal pad with appropriate thickness at the bottom of the module to conduct the heat to PCB.

The following figure shows the referenced heatsink design.
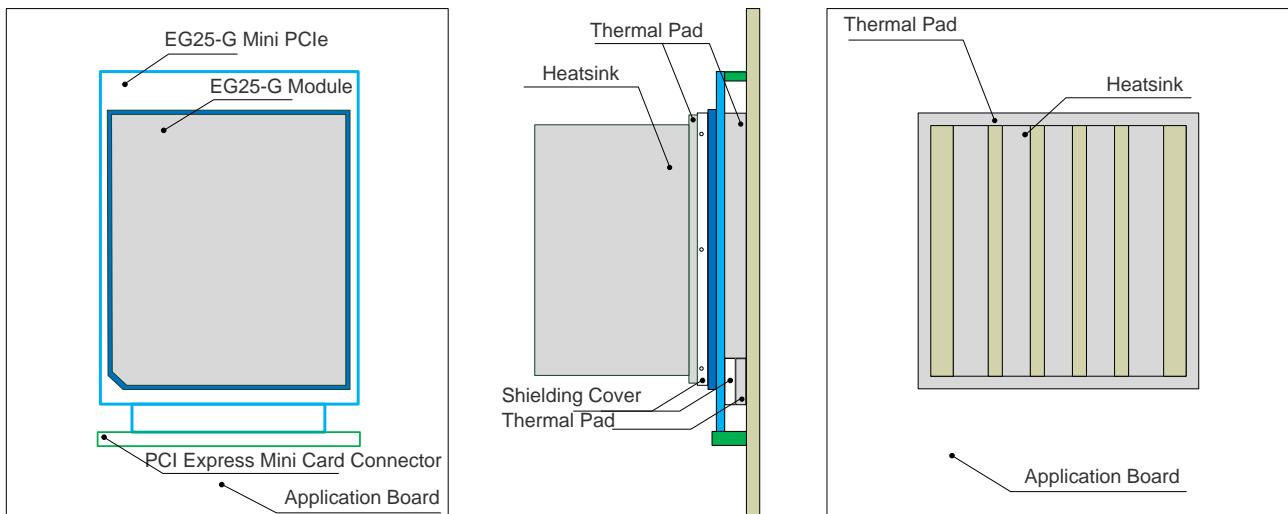
Figure 17: Referenced Heatsink Design

> **NOTES**
>
> 1. The module offers the best performance when the internal BB chip stays below 105°C. When the maximum temperature of the BB chip reaches or exceeds 105°C, the module works normal but provides reduced performance (such as RF output power, data rate, etc.). When the maximum BB chip temperature reaches or exceeds 115°C, the module will disconnect from the network, and it will recover to network connected state after the maximum temperature falls below 115°C. Therefore, the thermal design should be maximally optimized to make sure the maximum BB chip temperature always maintains below 105°C. Customers can execute **AT+QTEMP** command and get the maximum BB chip temperature from the first returned value.
> 2. For more detailed guidelines on thermal design, please refer to *document [4]*.

4.8. Current Consumption

Table 20: Current Consumption of EG25-G Mini PCIe

Parameter	Description	Conditions	Typ.	Unit
I_{VBAT}	Sleep state	**AT+CFUN=0** (USB disconnected)	3.2	mA
		EGSM @DRX=2 (USB disconnected)	4.4	mA
		EGSM @DRX=5 (USB disconnected)	3.9	mA
		EGSM @DRX=5 (USB suspended)	4.1	mA

	EGSM @DRX=9 (USB disconnected)	3.7	mA
	DCS1800 @DRX=2 (USB disconnected)	4.5	mA
	DCS1800 @DRX=5 (USB disconnected)	3.9	mA
	DCS1800 @DRX=5 (USB suspended)	4.1	mA
	DCS1800 @DRX=9 (USB disconnected)	3.7	mA
	WCDMA @PF=64 (USB suspended)	4.2	mA
	WCDMA @PF=128 (USB disconnected)	3.9	mA
	WCDMA @PF=256 (USB disconnected)	3.6	mA
	WCDMA @ PF=512 (USB disconnected)	3.5	mA
	LTE-FDD @PF=32 (USB disconnected)	6.4	mA
	LTE-FDD @PF=64 (USB disconnected)	4.9	mA
	LTE-FDD @PF=64 (USB suspended)	5.1	mA
	LTE-FDD @PF=128 (USB disconnected)	4.2	mA
	LTE-FDD @PF=256 (USB disconnected)	4.0	mA
	LTE-TDD @PF=32 (USB disconnected)	6.5	mA
	LTE-TDD @PF=64 (USB disconnected)	5.2	mA
	LTE-TDD @PF=64 (USB suspended)	5.3	mA
	LTE-TDD @PF=128 (USB disconnected)	4.4	mA
	LTE-TDD @PF=256 (USB disconnected)	4.1	mA
Idle state	EGSM DRX=5 (USB disconnected)	25	mA
	EGSM DRX=5 (USB connected)	36	mA
	WCDMA @PF=64 (USB disconnected)	24	mA
	WCDMA @PF=64 (USB connected)	37	mA
	LTE-FDD @PF=64 (USB disconnected)	16	mA
	LTE-FDD @PF=64 (USB connected)	30	mA

	LTE-TDD @PF=64 (USB disconnected)	16	mA
	LTE-TDD @PF=64 (USB connected)	30	mA
GPRS data transfer (GNSS OFF)	GSM850 1UL/4DL @32.5dBm	285	mA
	GSM850 2UL/3DL @32.3dBm	370	mA
	GSM850 3UL/2DL @30.2dBm	470	mA
	GSM850 4UL/1DL @29.1dBm	600	mA
	EGSM900 1UL/4DL @32.3dBm	275	mA
	EGSM900 2UL/3DL @32.2dBm	370	mA
	EGSM900 3UL/2DL @30.1dBm	545	mA
	EGSM900 4UL/1DL @28.9dBm	605	mA
	DCS1800 1UL/4DL @29.7dBm	190	mA
	DCS1800 2UL/3DL @29.5dBm	290	mA
	DCS1800 3UL/2DL @29.4dBm	400	mA
	DCS1800 4UL/1DL @29.3dBm	490	mA
	PCS1900 1UL/4DL @29.6dBm	195	mA
	PCS1900 1UL/4DL @29.4dBm	295	mA
	PCS1900 1UL/4DL @29.2dBm	398	mA
	PCS1900 1UL/4DL @29.0dBm	500	mA
EDGE data transfer (GNSS OFF)	GSM850 1UL/4DL @27.1dBm	198	mA
	GSM850 2UL/3DL @26.74dBm	370	mA
	GSM850 3UL/2DL @26.5dBm	530	mA
	GSM850 4UL/1DL @26.2dBm	610	mA
	EGSM900 1UL/4DL @26.2dBm	199	mA
	EGSM900 2UL/3DL @26.3dBm	365	mA
	EGSM900 3UL/2DL @26.5dBm	535	mA

	EGSM900 4UL/1DL @26.4dBm	598	mA
	DCS18001UL/4DL @26.0dBm	170	mA
	DCS1800 2UL/3DL @25.6dBm	280	mA
	DCS1800 3UL/2DL @25.4dBm	370	mA
	DCS1800 4UL/1DL @25.2dBm	460	mA
	PCS1900 1UL/4DL @25.6dBm	180	mA
	PCS1900 1UL/4DL @25.6dBm	270	mA
	PCS1900 1UL/4DL @25.5dBm	365	mA
	PCS1900 1UL/4DL @25.2dBm	460	mA
WCDMA data transfer (GNSS OFF)	WCDMA B1 HSDPA @22.0dBm	600	mA
	WCDMA B2 HSDPA @22.1dBm	600	mA
	WCDMA B4 HSDPA @22.1dBm	600	mA
	WCDMA B5 HSDPA @22.3dBm	530	mA
	WCDMA B6 HSUPA @22.2dBm	510	mA
	WCDMA B8 HSDPA @22.5dBm	580	mA
	WCDMA B19 HSUPA @22.4dBm	510	mA
LTE data transfer (GNSS OFF)	LTE-FDD B1 @22.9dBm	710	mA
	LTE-FDD B2 @23.0dBm	800	mA
	LTE-FDD B3 @23.1dBm	770	mA
	LTE-FDD B4 @22.9dBm	760	mA
	LTE-FDD B5 @23.0dBm	700	mA
	LTE-FDD B7 @22.9dBm	730	mA
	LTE-FDD B8 @23.2dBm	780	mA
	LTE-FDD B12 @23.1dBm	670	mA
	LTE-FDD B13 @23.0dBm	820	mA

	LTE-FDD B18 @23.2dBm	800	mA
	LTE-FDD B19 @23.1dBm	720	mA
	LTE-FDD B20 @23.0dBm	730	mA
	LTE-FDD B25 @22.9dBm	720	mA
	LTE-FDD B26 @23.0dBm	740	mA
	LTE-FDD B28 @23.1dBm	720	mA
	LTE-TDD B38 @22.8dBm	430	mA
	LTE-TDD B39 @23.0dBm	370	mA
	LTE-TDD B40 @22.8dBm	370	mA
	LTE-TDD B41 @22.9dBm	440	mA
GSM voice call	GSM850PCL=5 @32.6dBm	300	mA
	EGSM900PCL=5 @32.6dBm	299	mA
	DCS1800PCL=0 @29.5dBm	200	mA
	PCS1900PCL=0 @29.5dBm	189	mA
WCDMA voice call	WCDMA B1 @22.7dBm	630	mA
	WCDMA B2 @22.8dBm	650	mA
	WCDMA B4 @22.7dBm	620	mA
	WCDMA B5 @22.8dBm	580	mA
	WCDMA B6 @22.8dBm	580	mA
	WCDMA B8 @22.9dBm	620	mA
	WCDMA B19 @22.8dBm	560	mA

Table 21: GNSS Current Consumption of EG25-G Mini PCIe

Parameter	Description	Conditions	Typ.	Unit
I$_{VBAT}$ (GNSS)	Searching (**AT+CFUN=0**)	Cold start @Passive Antenna	61	mA
		Lost state @Passive Antenna	59	mA
	Tracking (**AT+CFUN=0**)	Instrument Environment	39	mA

5 Dimensions and Packaging

5.1. General Description

This chapter mainly describes mechanical dimensions as well as packaging specification of EG25-G Mini PCIe module. All dimensions are measured in mm. The tolerances for dimensions without tolerance values are ±0.05mm.

## 5.2. Mechanical Dimensions of EG25-G Mini PCIe
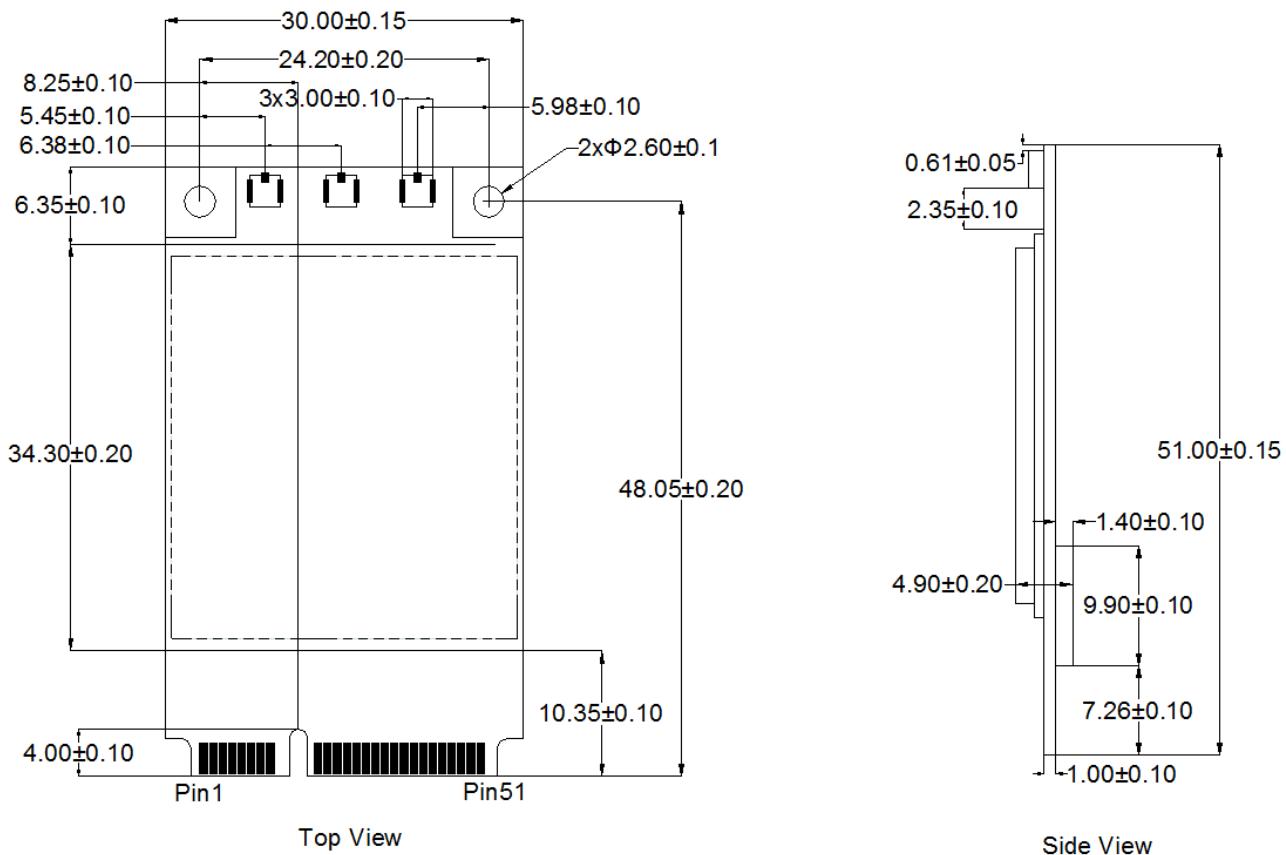
Figure 18: Mechanical Dimensions of EG25-G Mini PCIe

5.3. Standard Dimensions of Mini PCI Express

The following figure shows the standard dimensions of Mini PCI Express. Please refer to *document [1]* for detailed A and B.
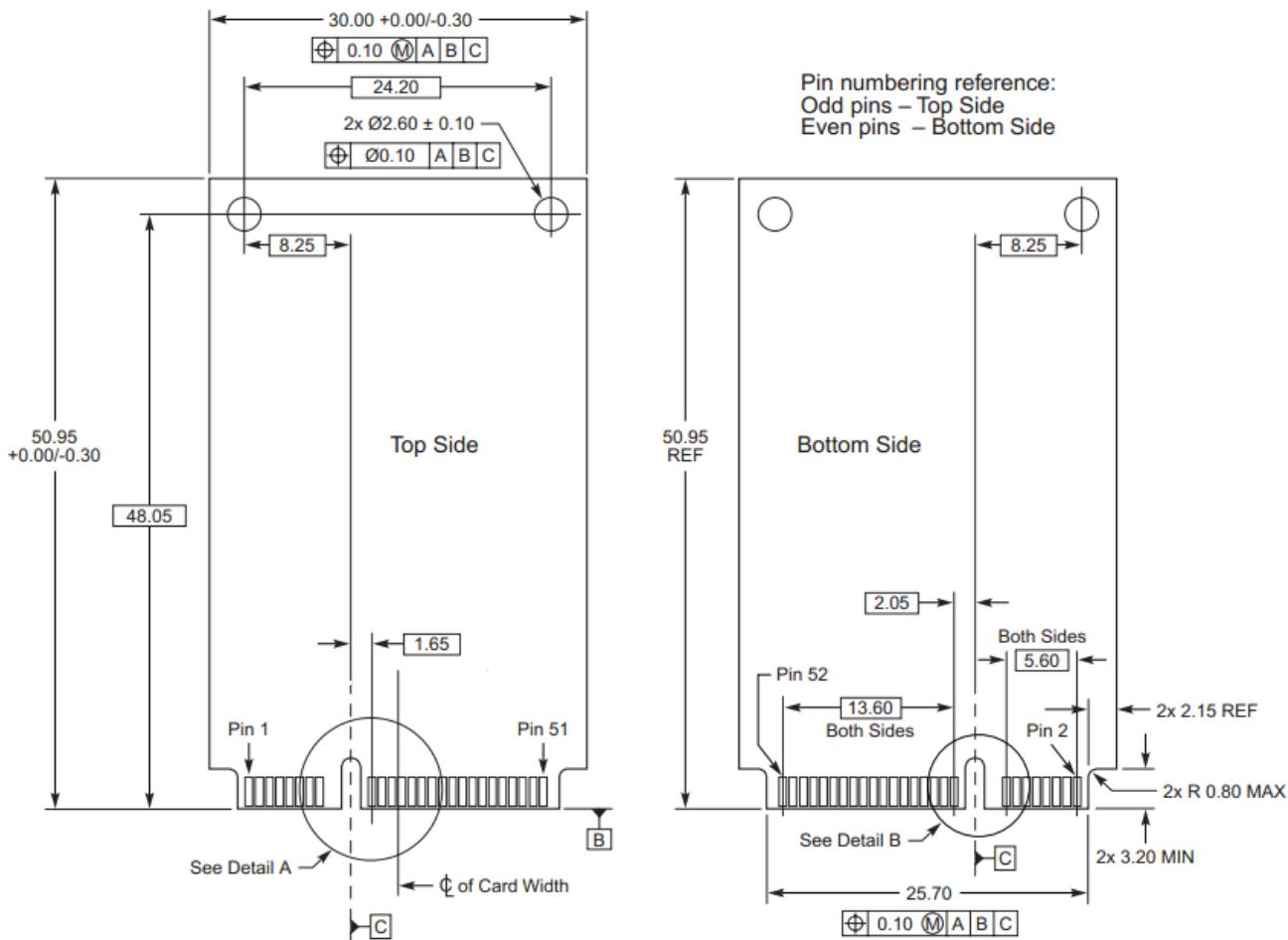

Figure 19: Standard Dimensions of Mini PCI Express

EG25-G Mini PCIe adopts a standard Mini PCI Express connector which compiles with the directives and standards listed in the *document [1]*. The following figure takes the Molex 679100002 as an example.
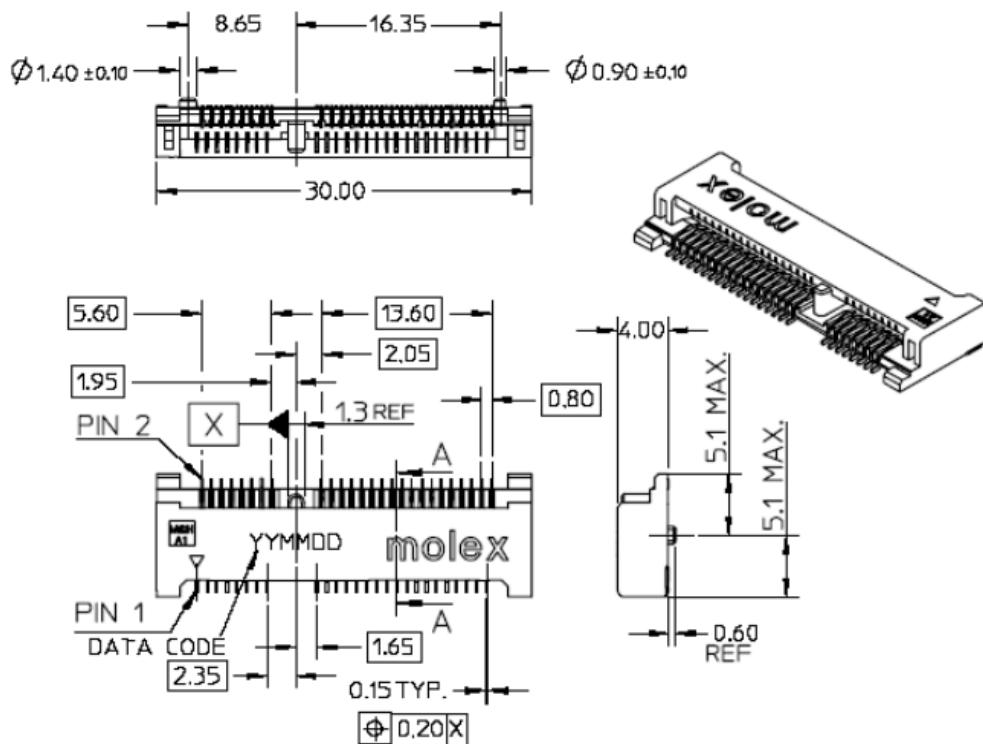

Figure 20: Dimensions of the Mini PCI Express Connector (Molex 679100002)

5.4. Packaging

The EG25-G Mini PCIe is packaged in a tray. Each tray contains 10pcs of modules. The smallest package of EG25-G Mini PCIe contains 100pcs.

6 Appendix References

Table 22: Related Documents

SN	Document Name	Remark
[1]	PCI Express Mini Card Electromechanical Specification Revision 1.2	Mini PCI Express specification
[2]	Quectel_EC2x&EG2x-G_AT_Commands_Manual	AT commands manual for EC25, EC21, EG25-G and EG21-G modules
[3]	Quectel_EC2x&EGxx&EM05_GNSS_AT_Commands_ Manual	GNSS AT commands manual for EC25, EC21, EC20 R2.0, EC20 R2.1, EG91-NA, EG95-NA, EG61-NA, EG25-G, EG21-G and EM05 modules
[4]	Quectel_LTE_Module_Thermal_Design_Guide	Thermal design guide for LTE modules including EC25, EC21, EC20 R2.0, EC20 R2.1, EG91, EG95, EP06, EG06, EM06 and AG35.

Table 23: Terms and Abbreviations

Abbreviation	Description
AMR	Adaptive Multi-rate
bps	Bits Per Second
CS	Coding Scheme
CTS	Clear to Send
DC-HSPA+	Dual-carrier High Speed Packet Access
DFOTA	Delta Firmware Upgrade Over-The-Air
DL	Down Link
DTE	Data Terminal Equipment

DTR	Data Terminal Ready
EFR	Enhanced Full Rate
EMI	Electro Magnetic Interference
ESD	Electrostatic Discharge
ESR	Equivalent Series Resistance
FDD	Frequency Division Duplexing
FR	Full Rate
GLONASS	GLObalnaya Navigatsionnaya Sputnikovaya Sistema, the Russian Global Navigation Satellite System
GMSK	Gaussian Minimum Shift Keying
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSM	Global System for Mobile Communications
HR	Half Rate
kbps	Kilo Bits Per Second
LED	Light Emitting Diode
LTE	Long-Term Evolution
Mbps	Million Bits Per Second
MCU	Micro Control Unit
ME	Mobile Equipment
MIMO	Multiple-Input Multiple-Output
MMS	Multimedia Messaging Service
MO	Mobile Originated
MT	Mobile Terminated
NMEA	National Marine Electronics Association
PCM	Pulse Code Modulation

PDA	Personal Digital Assistant
PDU	Protocol Data Unit
POS	Point of Sale
PPP	Point-to-Point Protocol
RF	Radio Frequency
RTS	Ready To Send
Rx	Receive Direction
SIMO	Single Input Multiple Output
SMS	Short Message Service
TX	Transmitting Direction
TVS	Transient Voltage Suppressor
UART	Universal Asynchronous Receiver & Transmitter
UL	Up Link
URC	Unsolicited Result Code
USB	Universal Serial Bus
(U)SIM	(Universal) Subscriber Identification Module
WCDMA	Wideband Code Division Multiple Access
WLAN	Wireless Local Area Networks

IC & FCC Requirement

FCC Certification Requirements.

According to the definition of mobile and fixed device is described in Part 2.1091(b), this device is a mobile device.

And the following conditions must be met:

1. This Modular Approval is limited to OEM installation for mobile and fixed applications only. The antenna installation and operating configurations of this transmitter, including any applicable source-based timeaveraging

duty factor, antenna gain and cable loss must satisfy MPE categorical Exclusion Requirements of 2.1091.

2. The EUT is a mobile device; maintain at least a 20 cm separation between the EUT and the user's body

and must not transmit simultaneously with any other antenna or transmitter.

3.A label with the following statements must be attached to the host end product: This device contains FCC ID: XMR201903EG25G

4.To comply with FCC regulations limiting both maximum RF output power and human exposure to RF radiation, maximum antenna gain (including cable loss) must not exceed:

Operating Band	FCC Max Antenna Gain（dBi）	IC Max Antenna Gain（dBi）
GSM850	8.60	7.44
GSM1900	10.19	10.19
WCDMA BAND II	8.00	8.00
WCDMA BAND IV	5.00	5.00
WCDMA BAND V	9.42	8.26
LTE BAND 2	8.00	8.00
LTE BAND 4	5.00	5.00
LTE BAND 5	9.41	8.25
LTE BAND 7	8.00	8.00
LTE BAND 12	8.70	7.76
LTE BAND 13	9.16	8.09
LTE BAND 25	8.00	8.00
LTE BAND 26(814-824)	9.36	NA
LTE BAND 26(824-849)	9.41	8.25
LTE BAND 38	8.00	8.00
LTE BAND 41	8.00	8.00

5. This module must not transmit simultaneously with any other antenna or transmitter

6. The host end product must include a user manual that clearly defines operating requirements and conditions that must be observed to ensure compliance with current FCC RF exposure guidelines.

For portable devices, in addition to the conditions 3 through 6 described above, a separate approval is

required to satisfy the SAR requirements of FCC Part 2.1093

If the device is used for other equipment that separate approval is required for all other operating configurations, including portable configurations with respect to 2.1093 and different antenna configurations.

For this device, OEM integrators must be provided with labeling instructions of finished products. Please refer to KDB784748 D01 v07, section 8. Page 6/7 last two paragraphs:

A certified modular has the option to use a permanently affixed label, or an electronic label. For a permanently affixed label, the module must be labeled with an FCC ID - Section 2.926 (see 2.2 Certification (labeling requirements) above). The OEM manual must provide clear instructions explaining to the OEM the labeling requirements, options and OEM user manual instructions that are required (see next paragraph).

For a host using a certified modular with a standard fixed label, if (1) the module's FCC ID is not visible when installed in the host, or (2) if the host is marketed so that end users do not have straightforward commonly used methods for access to remove the module so that the FCC ID of the module is visible; then an additional permanent label referring to the enclosed module:"Contains Transmitter Module FCC ID: XMR201903EG25G" or "Contains FCC ID: XMR201903EG25G" must be used. The host OEM user manual must also contain clear instructions on how end users can find and/or access the module and the FCC ID.

The final host / module combination may also need to be evaluated against the FCC Part 15B criteria for unintentional radiators in order to be properly authorized for operation as a Part 15 digital device.

The user's manual or instruction manual for an intentional or unintentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment. In cases where the manual is provided only in a form other than paper, such as on a computer disk or over the Internet, the information required by this section may be included in the manual in that alternative form, provided the user can reasonably be expected to have the capability to access information in that form.

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.

Changes or modifications not expressly approved by the manufacturer could void the user's authority to operate the equipment.

To ensure compliance with all non-transmitter functions the host manufacturer is responsible for ensuring compliance with the module(s) installed and fully operational. For example, if a host was previously authorized as an unintentional radiator under the Supplier's Declaration of Conformity procedure without a transmitter certified module and a module is added, the host manufacturer is responsible for ensuring that the after the module is installed and operational the host continues to be compliant with the Part 15B unintentional radiator requirements.

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.

IC Statement

IRSS-GEN

"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." or "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; 2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement."

Déclaration sur l'exposition aux rayonnements RF

L'autre utilisé pour l'émetteur doit être installé pour fournir une distance de séparation d'au moins 20 cm de toutes les personnes et ne doit pas être colocalisé ou fonctionner conjointement avec une autre antenne ou un autre émetteur.

The host product shall be properly labeled to identify the modules within the host product.

The Innovation, Science and Economic Development Canada certification label of a module shall be clearly visible at all times when installed in the host product; otherwise, the host product must be labeled to display the Innovation, Science and Economic Development Canada certification number for the module, preceded by the word "Contains" or similar wording expressing the same meaning, as follows: "Contains IC: 10224A-201903EG25G" or "where: 10224A-201903EG25G is the module's certification number".

Le produit hôte doit être correctement étiqueté pour identifier les modules dans le produit hôte.

L'étiquette de certification d'Innovation, Sciences et Développement économique Canada d'un module doit être clairement visible en tout temps lorsqu'il est installédans le produit hôte; sinon, le produit hôte doit porter une étiquette indiquant le numéro de certification d'Innovation, Sciences et Développement économique Canada pour le module, précédé du mot «Contient» ou d'un libellé semblable exprimant la même signification, comme suit:

"Contient IC: 10224A-201903EG25G " ou "où: 10224A-201903EG25G est le numéro de certification du module".