Build a Smarter World

EP06 Manual

LTE-A Module Series

Rev. EP06_Hardware_Design_V1.0

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About the Document

History

Revision	Date	Author	Description
1.0	2018-06-20	Nina Dou	Initial

Contents

1 Introduction

This document defines EP06 module, and describes its air interface and hardware interfaces which are connected with customers' applications.

This document can help customers to quickly understand the interface specifications, electrical and mechanical details, as well as other related information of EP06 module. To facilitate its application in different fields, 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 the operation, such as usage, service or repair of any cellular terminal or mobile incorporating EP06. 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. You must comply with laws and regulations restricting the use of wireless devices while driving.
	Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it is switched off. The operation of wireless appliances in an aircraft is forbidden, so as to prevent interference with communication systems. Consult the airline staff about the use of wireless devices on boarding the aircraft, if your device offers an Airplane Mode which must be enabled prior to boarding an aircraft.
	Switch off your wireless device when in hospitals, clinics or other health care facilities. These requests are designed to prevent possible interference with sensitive medical equipment.

	Cellular terminals or mobiles operating over radio frequency signal and cellular network cannot be guaranteed to connect in all conditions, for example no mobile fee or with an invalid (U)SIM card. While you are in this condition and need emergent help, please remember using emergency call. In order to make or receive a call, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength.
	Your cellular terminal or mobile contains a transmitter and receiver. When it is ON, it receives and transmits radio frequency energy. 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 includefuelling 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.
	Please do not discard. Maybe wireless devices have an impact on the environment so please do not arbitrarily discarded.

2 Product Concept

2.1. General Description

EP06 is a series of LTE-A Cat 6 module which provides data connectivity on LTE FDD, LTE TDD and WCDMA 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.

EP06 module can be applied in the following fields:

- Rugged Tablet PC and Laptop Computer
- Remote Monitor System
- Wireless Router and Switch
- Other Wireless Terminal Devices

This chapter generally introduces the following aspects of EP06 module:

- Product Series
- Key Features
- Functional Diagram

2.2. Description of Product Series

The following table shows the product series of EP06 module.

Table 1: Description of EP06 Module

Product Series	Description
EP06-A	Support LTE FDD: B2/B4/B5/B7/B12/B13/B25/B26/B29/B30/B66 Support 2×CA: B2+B2/B5/B12/B13/B26/B29[1)]; B4+B4/B5/B12/B13/B26/B29[1)]; B7+B5/B7/B12/B13/B26/B29[1)]; B25+B5/B12/B13/B25/B26/B29[1)]; B30+B5/B12/B26/B29[1)] B66+B5/B12/B13/B26/B29[1)]/B66 Support WCDMA: B2/B4/B5 Support LTE/WCDMA receive diversity Support GNSS Support digital audio
EP06-E	Support LTE FDD: B1/B3/B5/B7/B8/B20/B28/B32[2)] Support LTE TDD: B38/B40/B41 Support 2×CA: B1+B1/B5/B8/B20/B28; B3+B3/B5/B7/B8/B20/B28; B7+B5/B7/B8/B20/B28; B20+B32[2)] ; B38+B38; B40+B40; B41+B41 Support WCDMA: B1/B3/B5/B8 Support LTE/WCDMA receive diversity Support GNSS Support digital audio

NOTE

B29 and B32 is only for secondary component carriers.

2.3. Key Features

The following table describes the detailed features of EP06 module.

Table 2: Key Features of EP06

Feature	Details
Functional Interface	PCI Express Mini Card 1.2 Standard Interface
Power Supply	Supply voltage: 3.1V~4.4V Typical supply voltage: 3.3V
Transmitting Power	Class 3 (23dBm±2dB) for LTE-FDD bands Class 3 (23dBm±2dB) for LTE-TDD bands Class 2 (24dBm+1/-3dB) for TD-SCDMA Class 3 (24dBm+1/-3dB) for UMTS
LTE Features	Support up to CA Cat 6 Support 1.4 to 40MHz (2×CA) RF bandwidth Support MIMO in DL direction FDD: Max 50Mbps (UL), 300Mbps (DL) TDD: Max 28Mbps (UL), 226Mbps (DL)
WCDMA Features	Support 3GPP R10 DC-HSPA+ Support 16-QAM, 64-QAM and QPSK modulation 3GPP R6 Cat 6 HSUPA: Max 5.76Mbps (UL) 3GPP R8 Cat 24 DC-HSPA+: Max 42Mbps (DL)
Internet Protocol Features	Support PPP/QMI/TCP*/UDP*/FTP*/HTTP*/NTP*/PING*/ HTTPS*/SMTP*/MMS*/FTPS*/SMTPS*/SSL*protocols Support the protocols PAP (Password Authentication Protocol) and CHAP (Challenge Handshake Authentication Protocol) 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 (U)SIM card: 1.8V, 3.0V Include USIM and USIM2 interfaces Support Dual SIM Signal Standy*
Audio Feature*	Support one digital audio interface: PCM interface WCDMA: AMR/AMR-WB LTE: AMR/AMR-WB Support echo cancellation and noise suppression
PCM Interface*	Support 8-bit A-law, μ-law and 16-bit linear data formats Support long frame synchronization and short frame synchronization Support master and slave mode, but must be the master in long frame synchronization
USB 2.0&3.0 Interface	Compliant with USB 2.0 specification; the data transfer rate can reach up to 480Mbps Used for AT command communication, data transmission, firmware

	upgrade, software debugging, GNSS NMEA output and voice over USB2.0*
	Compliant with USB 3.0 specification The data transfer rate can reach up to 5.0Gbps. Used for AT command communication, data transmission, GNSS NMEA output and voice over USB 3.0*
	USB Driver: Windows XP, Windows Vista, Windows 7, Windows 8/8.1, Windows 10, Linux 2.6 or later, Android 4.0/4.2/4.4/5.0/5.1/6.0
Antenna Interface	Include 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±0.1) × (30.0±0.1) × (4.3±0.2 mm) Weight: approx. 6g
Temperature Range	Operation temperature range: -35°C ~ +75°C [1)] Extended temperature range: -40°C ~ +85°C [2)] Storage temperature range: -40°C ~ +90°C
Firmware Upgrade	USB interface and DFOTA*
RoHS	All hardware components are fully compliant with EU RoHS directive

NOTES

1. "*"means under development.
2. [1)] Within operating temperature range, the module is 3GPP compliant.
3. [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 operating temperature levels, the module will meet 3GPP specifications again.

2.4. Functional Diagram

The following figure shows the block diagram of EP06.

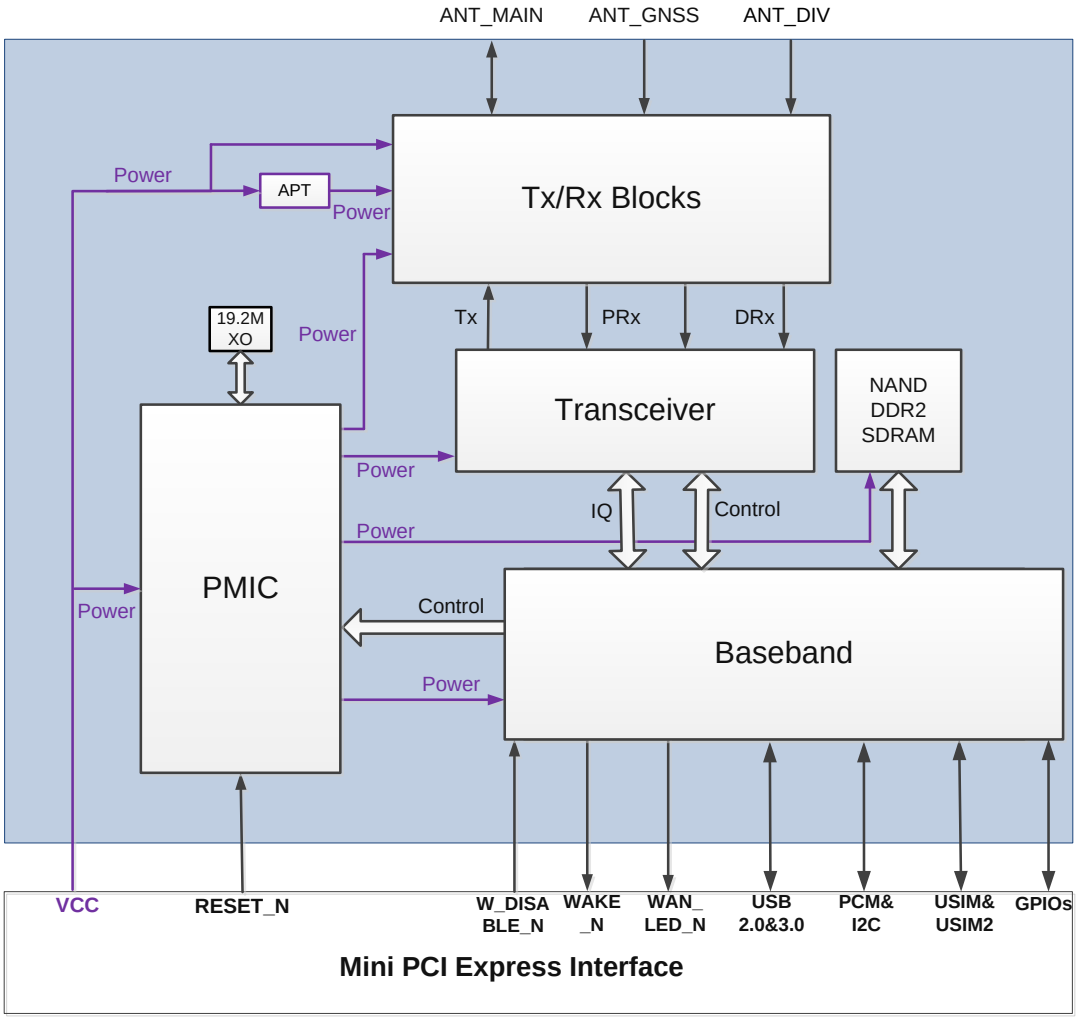


Figure 1: Functional Diagram

2.5. Evaluation Board

In order to help customers develop applications with EP06, Quectel supplies an evaluation board (EVB), USB Type C cable, USB to RS-232 converter cable, earphone, antenna and other peripherals to control or test the module.

3 Application Interface

3.1. General Description

The physical connections and signal levels of EP06 comply with PCI Express Mini CEM specifications. This chapter mainly describes definition and application of the following interface/signals/pins of EP06.

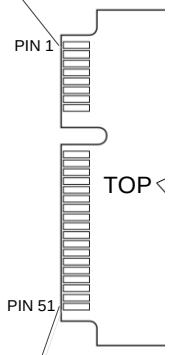
- Power supply
- (U)SIM card interfaces
- USB interfaces
- PCM&I2C interfaces
- Control signals
- Antenna interface

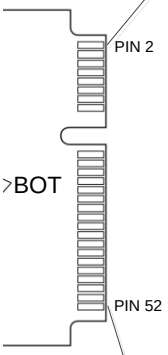
3.2. EP06 Interface

3.2.1. Pin Assignment

The following figure shows the pin assignment of EP06 module. The top side contains EP06 module and antenna connectors.

Pin Name	Pin No.
WAKE_N	1
ANTCTL0/GPIO0	3
ANTCTL1/GPIO1	5
USIM2_RST	7
GND	9
VREF_1.8V	11
USIM2_VDD	13
GND	15
USIM2_CLK	17
USIM2_DATA	19
GND	21
USB3.0_TX-	23
USB3.0_TX+	25
GND	27
GND	29
USB3.0_RX-	31
USB3.0_RX+	33
GND	35
GND	37
VCC	39
VCC	41
GND	43
PCM_CLK	45
PCM_DOUT	47
PCM_DIN	49
PCM_SYNC	51





Pin No.	Pin Name
2	VCC
4	GND
6	NC
8	USIM_VDD
10	USIM_DATA
12	USIM_CLK
14	USIM_RST
16	NC
18	GND
20	W_DISABLE_N
22	RESET_N
24	VCC
26	GND
28	NC
30	I2C_CLK
32	I2C_DATA
34	GND
36	USB_D-
38	USB_D+
40	GND
42	WWAN_LED_N
44	ANTCTL2/GPIO2
46	ANTCTL3/GPIO3
48	NC
50	GND
52	VCC

Figure 2: EP06 Pin Assignment

3.2.2. Definition of Interface

The following tables show the pin definition and description of EP06 on the 52-pin application.

Table 3: Definition of I/O Parameters

Type	Description
IO	Bidirectional
DI	Digital input
DO	Digital output
OC	Open collector
OD	Open Drain
PI	Power input
PO	Power output

Table 4: Description of Pins

Pin No.	Mini PCI Express Standard Name	EP06 Pin Name	I/O	Description	Comment
1	WAKE#	WAKE_N	OC	Output signal, used to wake up the host.	
2	3.3Vaux	VCC	PI	3.3V DC supply	Vmin=3.1V Vnorm=3.3V Vmax=4.4V
3	COEX1	ANTCTL0/ GPIO0	IO	External switch control for multiple antenna/ General purpose I/O	1.8V power domain
4	GND	GND		Ground	
5	COEX2	ANTCTL1/ GPIO1	IO	External switch control for multiple antenna/ General purpose I/O	1.8V power domain
6	1.5V	NC		Not connected	
7	CLKREQ#	USIM2_RST	DO	USIM2 reset	1.8V/3.0V
8	UIM_PWR	USIM_VDD	PO	USIM VCC supply	1.8V/3.0V
9	GND	GND		Ground	
10	UIM_DATA	USIM_DATA	IO	USIM data	1.8V/3.0V
11	REFCLK-	VREF_1.8V	DI	1.8V reference voltage output	
12	UIM_CLK	USIM_CLK	DO	USIM clock	1.8V/3.0V
13	REFCLK+	USIM2_VDD	PO	USIM2 VCC supply	1.8V/3.0V
14	UIM_RESET	USIM_RST	DO	USIM reset	1.8V/3.0V
15	GND	GND		Ground	
16	UIM_VPP	NC		Not connected	
17	RESERVED	USIM2_CLK	DO	USIM2 clock signal	1.8V/3.0V
18	GND	GND		Ground	
19	RESERVED	USIM2_DATA	IO	USIM2 data	1.8V/3.0V
20	W_DISABLE#	W_DISABLE_N	DI	Disable wireless communications	1.8V power domain
21	GND	GND		Ground	
22	PERST#	RESET_N	DI	Functional reset to the module	Active low

23	PERn0	USB3.0_TX-	DO	USB 3.0 transmit data (-)	
24	3.3Vaux	VCC	PI	3.3V DC supply	Vmin=3.1V Vnorm=3.3V Vmax=4.4V
25	PERp0	USB3.0_TX+	DO	USB 3.0 transmit data (+)	
26	GND	GND		Ground	
27	GND	GND		Ground	
28	1.5V	NC		Not connected	
29	GND	GND		Ground	
30	SMB_CLK	I2C_CLK	OD	I2C serial clock	Require external pull-up to 1.8V.
31	PETn0	USB3.0_RX-	DI	USB 3.0 receive data (-)	
32	SMB_DATA	I2C_DATA	OD	I2C serial data	Require external pull-up to 1.8V.
33	PETp0	USB3.0_RX+	DI	USB 3.0 receive data (+)	
34	GND	GND		Ground	
35	GND	GND		Ground	
36	USB_D-	USB_D-	IO	USB differential data (-)	
37	GND	GND		Ground	
38	USB_D+	USB_D+	IO	USB differential data (+)	
39	3.3Vaux	VCC	PI	3.3V DC supply	Vmin=3.1V Vnorm=3.3V Vmax=4.4V
40	GND	GND		Ground	
41	3.3Vaux	VCC	PI	3.3V DC supply	Vmin=3.1V Vnorm=3.3V Vmax=4.4V
42	LED_WWAN#	WWAN_LED_N	OC	LED driver signal for indicating the state of the card.	Active low
43	GND	GND		Ground	
44	LED_WLAN#	ANTCTL2/ GPIO2	IO	External switch control for multiple antenna/ General purpose I/O	1.8V power domain
45	RESERVED	PCM_CLK	DO	PCM clock signal	

46	LED_WPAN#	ANTCTL3/ GPIO3	IO	External switch control for multiple antenna/ General purpose I/O	1.8V power domain
47	RESERVED	PCM_DOUT	DO	PCM data output	
48	1.5V	NC		Not connected	
49	RESERVED	PCM_DIN	DI	PCM data input	
50	GND	GND		Ground	
51	RESERVED	PCM_SYNC	IO	PCM frame synchronization input in slave mode and output in master mode	
52	3.3Vaux	VCC	PI	3.3V DC supply	Vmin=3.1V Vnorm=3.3V Vmax=4.4V

NOTE

Keep all NC and unused pins unconnected.

3.3. Power Supply

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

Table 5: Definition of VCC and GND Pins

Pin No.	Pin Name	I/O	Power Domain	Description
2, 24, 39, 41, 52	VCC	PI	3.1~4.4V	3.3V DC supply
4, 9, 15, 18, 21, 26, 27, 29, 34, 35, 37, 40, 43, 50	GND			Ground

The typical supply voltage of EP06 is 3.3V. The power supply must be able to provide sufficient current up to 2A at least, 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.

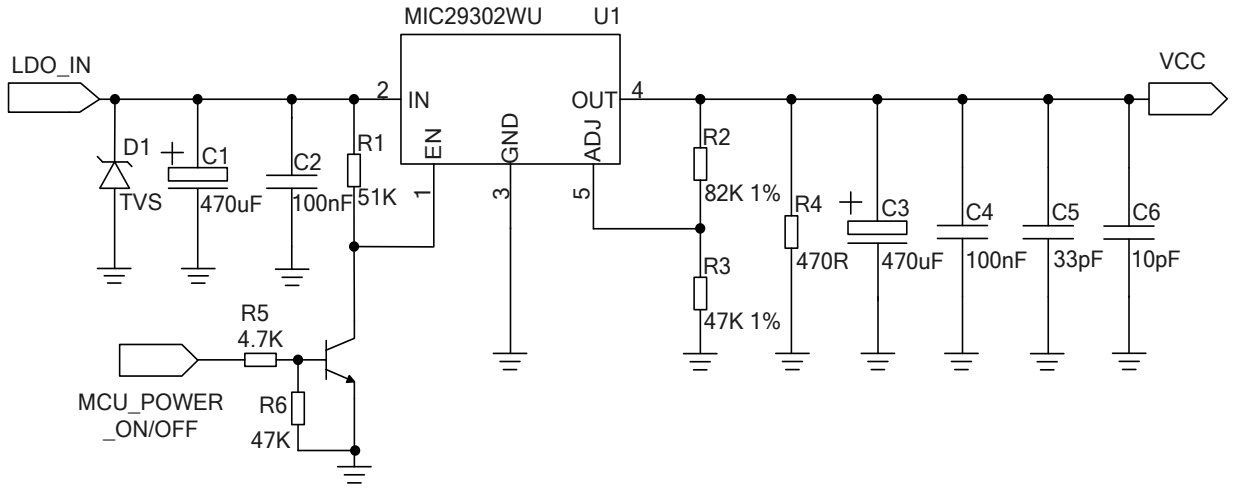


Figure 3: Reference Design of Power Supply

3.4. (U)SIM Card Interfaces

The following table shows the pin definition of (U)SIM card interfaces.

Table 6: (U)SIM Pin Definition

Pin No.	Pin Name	I/O	Power Domain	Description
8,13	USIM_VDD USIM2_VDD	PO	1.8V/3.0V	Power source for the (USIM) card
10,19	USIM_DATA USIM2_DATA	IO	1.8V/3.0V	(U)SIM data signal
12,17	USIM_CLK USIM2_CLK	DO	1.8V/3.0V	(U)SIM clock signal
14,7	USIM_RST USIM2_RST	DO	1.8V/3.0V	(U)SIM reset signal

EP06 supports 1.8V and 3.0V (U)SIM cards. The following figure shows a reference design for a 6-pin (U)SIM card connector.

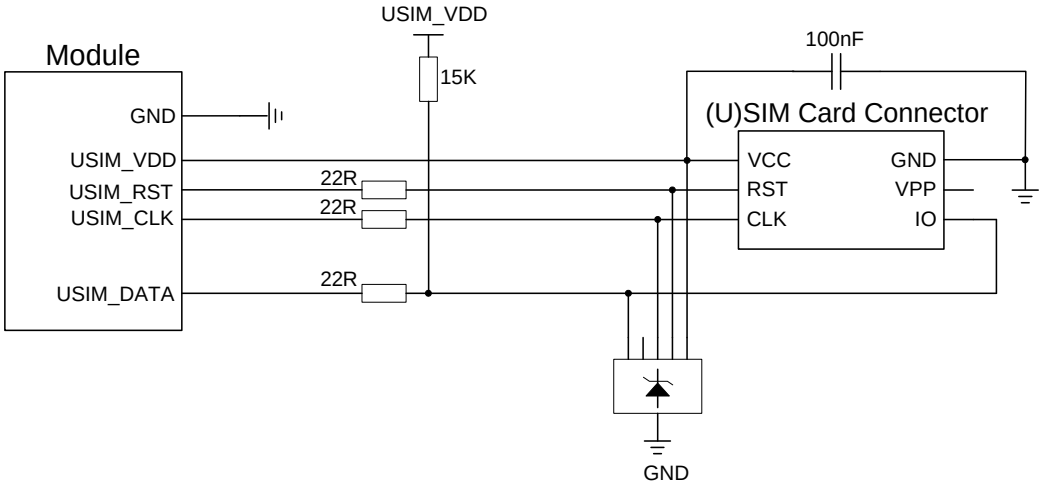


Figure 4: Reference Circuit of (U)SIM Card Interface with a 6-pin (U)SIM Card Connector

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

- Keep layout of (U)SIM card as close to the module as possible. Keep the trace length as less than 200mm as possible.
- Keep (U)SIM card signal away from RF and power supply traces.
- Keep the trace width of ground and USIM_VDD no less than 0.5mm to maintain the same electric potential. The decouple capacitor of USIM_VDD should be less than 1uF and must near to (U)SIM card connector.
- 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 whose parasitic capacitance should not be more than 50pF. The 22 ohm resistors should be added in series between the module and the (U)SIM card so as to suppress EMI spurious transmission and enhance ESD protection. 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 Interfaces

The following table shows the pin definition of USB 2.3&3.0 interfaces.

Table 7: Pin Definition of USB 2.0&3.0 Interfaces

Pin No.	Pin Name	I/O	Power Domain	Description	Comment
36	USB_D-	IO	Compliant with USB 2.0 standard specification	USB differential data (-)	Require differential impedance of 90Ω
38	USB_D+	IO		USB differential data (+)	
23	USB3.0_TX-	DO	Compliant with USB 3.0 standard specification	USB 3.0 transmit data (-)	Require differential impedance of 90Ω
25	USB3.0_TX+	DO		USB 3.0 transmit data (+)	
31	USB3.0_RX-	DI		USB 3.0 receive data (-)	
33	USB3.0_RX+	DI		USB 3.0 receive data (+)	

EP06 is compliant with USB 2.0 and USB 3.0 specifications. Meanwhile, The USB 2.0 interface supports high speed (480Mbps) mode and full speed (12Mbps) mode. It is used for AT command communication, data transmission, GNSS NMEA output, software debugging, firmware upgrade and voice over USB2.0*. The data rate of USB 3.0 interface is up to 5Gbps, and it is used for AT command communication, data transmission, GNSS NMEA output and voice over USB 3.0*. The following figure shows a reference circuit of USB 2.0&3.0 interfaces.

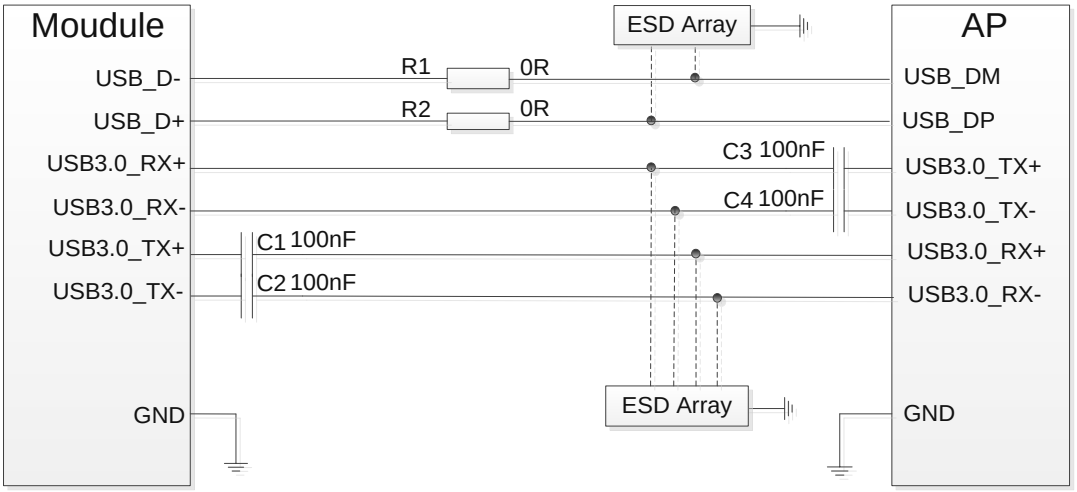


Figure 5: Reference Circuit of USB2.0&3.0 Interfaces

In order to ensure the integrity of USB 2.0&3.0 data line signal, R1, R2, C1 and C2 components must be placed close to the module, C3 and C4 components must be placed close to the MCU, and also these components should be placed close to each other.

In order to ensure the USB 2.0&3.0 interface design corresponding with the USB 2.0&3.0 specifications, please comply with the following principles:

- It is important to route the USB 2.0&3.0 signal traces as differential pairs with total grounding.
  1) For USB 2.0 routing traces, the trace impedance of a differential pair should be 90Ω, and the length matching of the differential pair should be less than 2mm.
  2) For USB 3.0 routing traces, the trace impedance of Tx and Rx differential pairs should be 90Ω, and the length matching of Tx and Rx differential pairs should be less than 0.7mm.
- Do not route signal traces under crystals, oscillators, magnetic devices or RF signal traces. It is important to route the USB 2.0&3.0 differential traces in inner-layer with ground shielding on not only upper and lower layers but also right and left sides.
- If USB connector is used, please keep the ESD protection components to the USB connector as close as possible. Pay attention to the influence of junction capacitance of ESD protection components on USB 2.0&3.0 data lines. The capacitance value of ESD protection components should be less than 2.0pF for USB 2.0, and less than 0.4pF for USB 3.0.
- If possible, reserve a 0R resistor on USB_D+ and USB_D- lines.

NOTE

"*" means under development.

3.6. PCM and I2C Interfaces

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

Table 8: Pin Definition of PCM and I2C Interfaces

Pin No.	Pin Name	I/O	Power Domain	Description	Comment
45	PCM_CLK	IO	1.8V	PCM clock signal	
47	PCM_DOUT	DO	1.8V	PCM data output	
49	PCM_DIN	DI	1.8V	PCM data input	
51	PCM_SYNC	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.

EP06 module provides one PCM digital interface*, which supports 8-bit A-law and μ-law, and also supports 16-bit linear data formats and the following modes:

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

NOTE

"*" means under development.

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 128, 256, 512, 1024 and 2048kHz for different speed codecs. The following figure shows the timing relationship in primary mode with 8kHz PCM_SYNC and 2048kHz PCM_CLK.

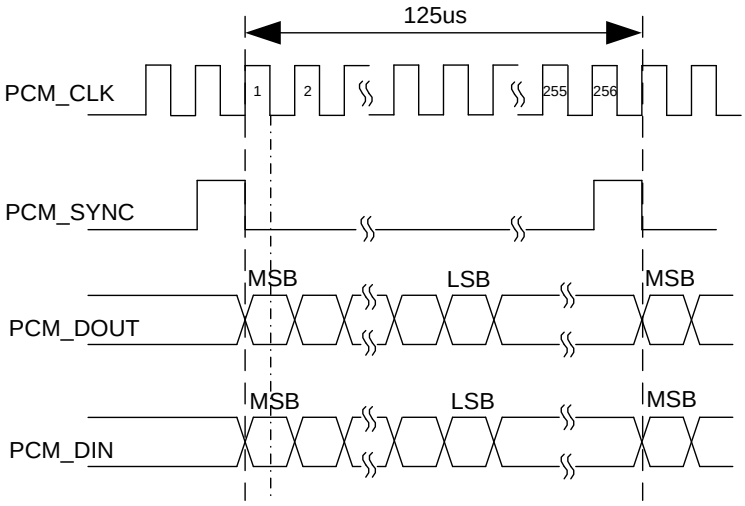


Figure 6: Timing in Primary Mode

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.

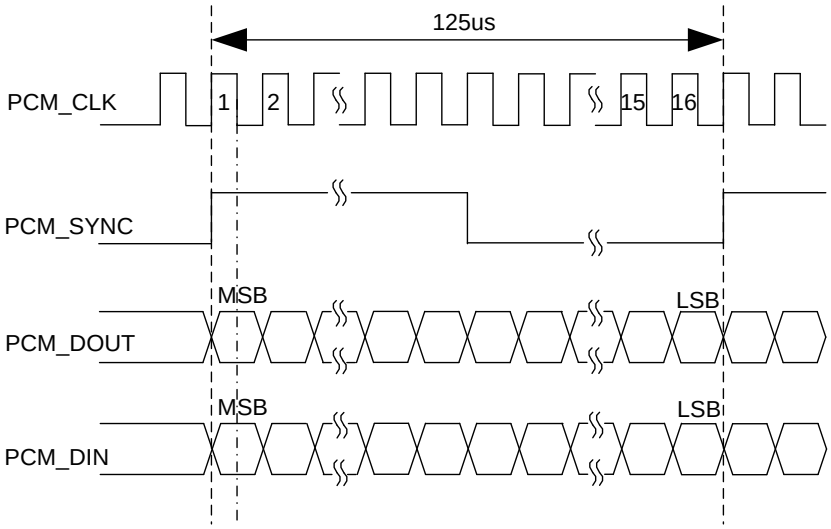


Figure 7: Timing in Auxiliary Mode

Clock and mode can be configured by AT command, and the default configuration is master mode using short frame synchronization data format with 2048kHz PCM_CLK and 8kHz PCM_SYNC. In addition, the module's firmware has integrated the configuration on some PCM codec's application with I2C interface.

The following figure shows a reference design of PCM interface with an external codec IC.

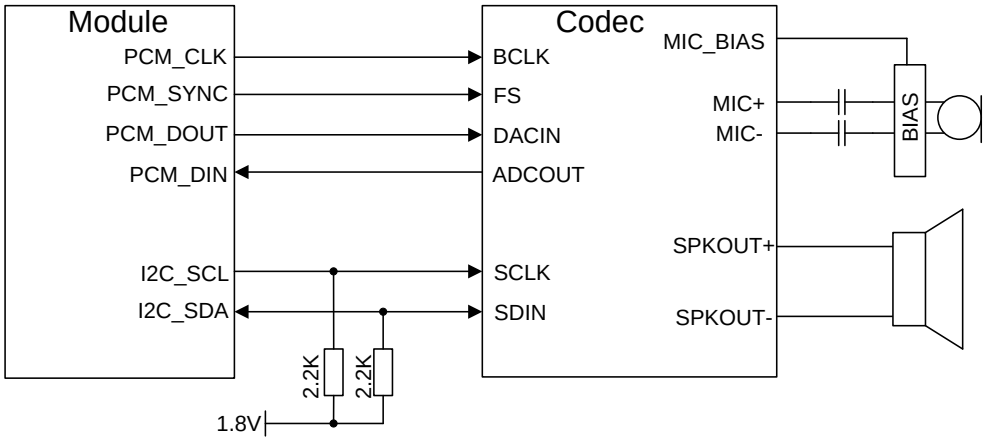


Figure 8: Reference Circuit of PCM Application with Audio Codec

3.7. Control Signals

The following table shows the pin definition of control signals.

Table 9: Pin Definition of Control Signals

Pin No.	Pin Name	I/O	Power Domain	Description	Comment
1	WAKE_N*	OC		Output signal, used to wake up the host.	
20	W_DISABLE_N*	DI	1.8V	Disable wireless communications	Active low.
22	RESET_N	DI	1.8V	Functional reset to the Module	Active low.
42	WWAN_LED_N	OC		LED signal for indicating the state of the module.	Active-low.

NOTE

"*" means under development.

3.7.1. RESET_N Signal

The RESET_N signal can be used to force a hardware reset on the card. Customers can reset the module by driving the RESET_N to a low level voltage with the time frame of TBD1~TBD2ms and then releasing it. The reset scenario is illustrated in the following figure.

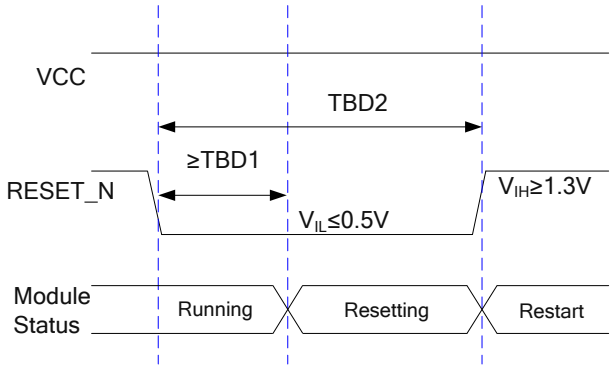


Figure 9: Timing of Resetting Module

3.7.2. WWAN_LED_N Signal

The WWAN_LED_N signal of EP06 module is used to indicate the network status of the module, which 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 WWAN_LED_N output signal is active low.

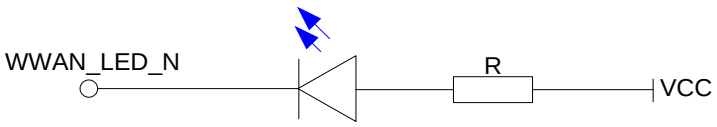


Figure 10: WWAN_LED_N Signal Reference Circuit Diagram

The following table shows the network status indications of the WWAN_LED_N signal.

Table 10: Indications of Network Status

LED_WWAN_N	Description
Low Level (LED ON)	Registered on network
High Level (LED OFF)	● No network coverage or not registered ● W_DISABLE_N signal is at low level. (Disable the RF) ● **AT+CFUN=0** or **AT+CFUN=4**

3.8. Antenna Interfaces

EP06 includes a main antenna interface, an Rx-diversity antenna interface which is used to resist the fall of signals caused by high speed movement and multipath effect, and a GNSS antenna interface. The impedance of antenna port is 50Ω.

3.8.1. Main/Rx-diversity Antenna Interface

3.8.1.1. Pin Definition of RF Antenna

The pin definition of main antenna and Rx-diversity antenna interfaces are shown below.

Table 11: Pin Definition of the RF Antenna

Pin Name	Pin No.	I/O	Description	Comment
ANT_MAIN	107	IO	Main antenna pad	50Ω impedance
ANT_DIV	127	AI	Receive diversity antenna pad	50Ω impedance

3.8.2. Operating Frequency

Table 12: EP6-A Operating Frequencies

3GPP Band	Transmit	Receive	Unit
WCDMA B2	1850~1910	1930~1990	MHz
WCDMA B4	1710~1755	2110~2155	MHz
WCDMA B5	824~849	869~894	MHz
LTE B2	1850~1910	1930~1990	MHz
LTE B4	1710~1755	2110~2155	MHz
LTE B5	824~849	869~894	MHz
LTE B7	2500~2570	2620~2690	MHz
LTE B12	699~716	729~746	MHz
LTE B13	777~787	746~756	MHz
LTE B25	1850~1915	1930~1995	MHz
LTE B26	814~849	859~894	MHz
LTE B29 [1)]	-	716~728	MHz
LTE B30	2305~2315	2350~2360	MHz
LTE B66	1710~1780	2110~2200	MHz

Table 13: EP6-E Operating Frequencies

3GPP Band	Transmit	Receive	Unit
WCDMA B1	1920~1980	2110~2170	MHz
WCDMA B3	1710~1785	1805~1880	MHz
WCDMA B5	824~849	869~894	MHz
WCDMA B8	880~915	925~960	MHz
LTE B1	1920~1980	2110~2170	MHz
LTE B3	1710~1785	1805~1880	MHz

LTE B5	824~849	869~894	MHz
LTE B7	2500~2570	2620~2690	MHz
LTE B8	880~915	925~960	MHz
LTE B20	832~862	791~821	MHz
LTE B28	703~748	758~803	MHz
LTE B32 [1)]	-	1452~1496	MHz
LTE B38	2570~2620	2570~2620	MHz
LTE B40	2300~2400	2300~2400	MHz
LTE B41	2545~2655	2545~2655	MHz

NOTES

1. Keep a proper distance between the main antenna and the Rx-diversity antenna to improve the receiving sensitivity.
2. ANT_DIV function is enabled by default. **AT+QCFG="diversity",0** command can be used to disable receive diversity.
3. Place the π-type matching components (R1/C1/C2 and R2/C3/C4) as close to the antenna as possible.

3.8.3. GNSS Antenna Interface

The following tables show pin definition and frequency specification of GNSS antenna interface.

Table 14: Pin Definition of GNSS Antenna Interface

Pin Name	Pin No.	I/O	Description	Comment
ANT_GNSS	119	AI	GNSS antenna pad	50Ω impedance

Table 15: GNSS Frequency

Type	Frequency	Unit
GPS/Galileo/QZSS	1575.42±1.023	MHz
GLONASS	1597.5~1605.8	MHz
BeiDou	1561.098±2.046	MHz

NOTES

1. An external LDO can be selected to supply power according to the active antenna requirement.
2. If the module is designed with a passive antenna, then the VDD circuit is not needed.

3.8.4. Antenna Installation

3.8.4.1. Antenna Requirement

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

Table 16: Antenna Requirements

Type	Requirements
GNSS[1)]	Frequency range: 1561MHz ~ 1615MHz Polarization: RHCP or linear VSWR: < 2 (Typ.) Passive antenna gain: > 0dBi Active antenna noise figure: < 1.5dB Active antenna gain: > 0dBi Active antenna embedded LNA gain: < 17dB
WCDMA/LTE	VSWR: ≤ 2 Efficiency: > 30% Max Input Power: 50W Input Impedance: 50Ω Cable insertion loss: < 1dB (WCDMA B5/B6/B8/B19, LTE B5/B8/B12/B13/B18/B19/B20/B26/B28/B29/) Cable insertion loss: < 1.5dB (WCDMA B1/B2/B3/B4/B9, LTE B1/B2/B3/B4/B21/B25/B66) Cable insertion loss < 2dB

(LTE B7/B38/B40/B41/B30)

NOTE

[1] It is recommended to use a passive GNSS antenna when LTE B13 or B14 is supported, as the use of active antenna may generate harmonics which will affect the GNSS performance.

The following figure shows the overall sizes of RF connector.

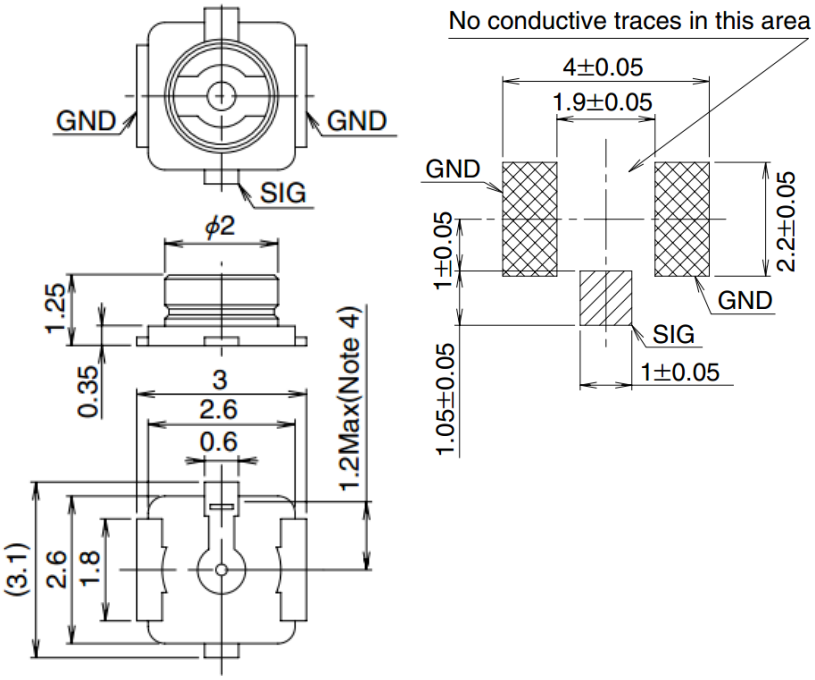


Figure 11: Dimensions of the RF Connector (Unit: mm)

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

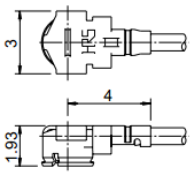
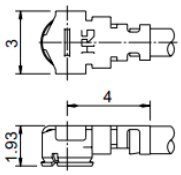
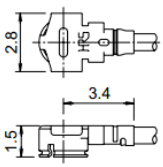
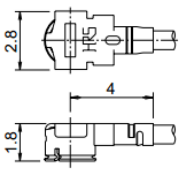
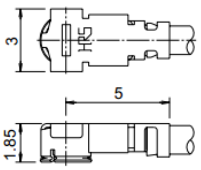
Part No.	U.FL-LP-040	U.FL-LP-066	U.FL-LP(V)-040	U.FL-LP-062	U.FL-LP-088
					
Mated Height	2.5mm Max. (2.4mm Nom.)	2.5mm Max. (2.4mm Nom.)	2.0mm Max. (1.9mm Nom.)	2.4mm Max. (2.3mm Nom.)	2.4mm Max. (2.3mm Nom.)
Applicable cable	Dia. 0.81mm Coaxial cable	Dia. 1.13mm and Dia. 1.32mm Coaxial cable	Dia. 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 12: Mechanicals of U.FL-LP Connectors

4 Electrical and Radio Characteristics

4.1. General Description

This chapter mainly describes the following electrical and radio characteristics of EP06:

- Power supply requirements
- RF characteristics
- GNSS receiver
- Current consumption
- ESD characteristics

4.2. Power Supply Requirements

The input voltage of EP06 is 3.3V±9%, as specified by *PCI Express Mini CEM Specifications 1.2*. And the power supply of EP06 should be able to provide sufficient current up to 2A at least. The following table shows the power supply requirements of EP06.

Table 17: EP06 Power Supply Requirements

Parameter	Description	Min.	Typ.	Max.	Unit
VCC	Power Supply	3.1	3.3	4.4	V

4.3. RF Characteristics

The following table shows the RF output power of EP06 module.

Table 18: RF Output Power

Frequency	Max.	Min.
WCDMA bands	24dBm+1/-3dB	<-50dBm
LTE FDD bands	23dBm±2dB	<-40dBm
LTE TDD bands	23dBm±2dB	<-40dBm

The following tables show conducted RF receiving sensitivity of EP06 series module.

Table 19: EP06-A Conducted RF Receiving Sensitivity

Frequency	Primary	Diversity	SIMO[1)]	3GPP (SIMO)
WCDMA B2	-108.5dBm	/	/	-106.7dBm
WCDMA B4	-108.0dBm	/	/	-103.7dBm
WCDMA B5	-109.5dBm	/	/	-104.7dBm
LTE-FDD B2 (10M)	-97.7dBm	/	-100.7dBm	-94.3dBm
LTE-FDD B4 (10M)	-97.2dBm	/	-100.2dBm	-96.3dBm
LTE-FDD B5 (10M)	-97.7dBm	/	-102.2dBm	-94.3dBm
LTE-FDD B7 (10M)	-96.2dBm	/	-98.7dBm	-94.3dBm
LTE-FDD B12 (10M)	-97.2dBm	/	-101.7dBm	-93.3dBm
LTE-FDD B13 (10M)	-97.7dBm	/	-100.7dBm	-93.3dBm
LTE-FDD B25 (10M)	-98.0dBm	/	-100.9dBm	-92.8dBm
LTE-TDD B26 (10M)	-98.4dBm	/	-102.1dBm	-93.8dBm
LTE-TDD B30 (10M)	-96.7dBm	/	-99.6dBm	-95.3dBm
LTE-TDD B66 (10M)	-97.6dBm	/	-100.7dBm	-95.8dBm

The following tables show conducted RF receiving sensitivity of EP06 series module.

Table 20: EP06-E Conducted RF Receiving Sensitivity

Frequency	Primary	Diversity	SIMO[1)]	3GPP (SIMO)
WCDMA B1	-109.5dBm	/	/	-106.7dBm

WCDMA B3	-108.5dBm	/	/	-103.7dBm
WCDMA B5	-109.0dBm	/	/	-104.7dBm
WCDMA B8	-110.0dBm	/	/	-103.7dBm
LTE-FDD B1 (10M)	-98.0dBm	/	-100.0dBm	-96.3dBm
LTE-FDD B3 (10M)	-97.0dBm	/	-100.0dBm	-93.3dBm
LTE-FDD B5 (10M)	-97.0dBm	/	-100.0dBm	-94.3dBm
LTE-FDD B7 (10M)	-95.2dBm	/	-98.5dBm	-94.3dBm
LTE-FDD B8 (10M)	-98.7dBm	/	-101.0dBm	-93.3dBm
LTE-FDD B20 (10M)	-96.0dBm	/	-102.0dBm	-93.3dBm
LTE-FDD B28 (10M)	-97.4dBm	/	-101.0dBm	-94.8dBm
LTE-TDD B38 (10M)	-96.7dBm	/	-98.4dBm	-96.3dBm
LTE-TDD B40 (10M)	-96.7dBm	/	-100.0dBm	-96.3dBm
LTE-TDD B41 (10M)	-96.7dBm	/	-98.6dBm	-94.3dBm

NOTE

[1] SIMO is a smart antenna technology that uses a single antenna at the transmitter side and two antennas at the receiver side, which can improve Rx performance.

4.4. GNSS Receiver

The following table shows GNSS performance of EP06.

Table 21: GNSS Performance

Parameter	Description	Conditions	Typ.	Unit
Sensitivity (GNSS)	Cold start	Autonomous	TBD	dBm
	Reacquisition	Autonomous	TBD	dBm
	Tracking	Autonomous	TBD	dBm
TTFF	Cold start	Autonomous	TBD	s

(GNSS)	@open sky	XTRA enabled	TBD	s
	Warm start @open sky	Autonomous	TBD	s
		XTRA enabled	TBD	s
	Hot start @open sky	Autonomous	TBD	s
		XTRA enabled	TBD	s
Accuracy (GNSS)	CEP-50	Autonomous @open sky	TBD	m

NOTES

1. Tracking sensitivity: the lowest GNSS signal value at the antenna port on which the module can keep on positioning for 3 minutes.
2. Reacquisition sensitivity: the lowest GNSS signal value at the antenna port on which the module can fix position again within 3 minutes after loss of lock.
3. Cold start sensitivity: the lowest GNSS signal value at the antenna port on which the module fixes position within 3 minutes after executing cold start command.

4.5. ESD Characteristics

The module is not protected against electrostatics discharge (ESD) in general. Consequently, it is subject to ESD handling precautions that typically apply to ESD sensitive components. Proper ESD handling and packaging procedures must be applied throughout the processing, handling and operation of any application that incorporates the module.

The following table shows the module electrostatic discharge characteristics.

Table 22: Electrostatic Discharge Characteristics

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

4.6. Current Consumption

The following table shows the current consumption of the EP06-A.

Table 23: EP06-A Current Consumption

Parameter	Description	Conditions	Typ.	Unit
	Sleep state	AT+CFUN=0 (USB disconnected)	1.88	mA
		WCDMA PF=64 (USB disconnected)	2.4	mA
		WCDMA PF=128 (USB disconnected)	2.29	mA
		WCDMA PF=256 (USB disconnected)	2.29	mA
		WCDMA PF=512 (USB disconnected)	2.28	mA
		LTE-FDD PF=32 (USB disconnected)	3.5	mA
		LTE-FDD PF=64 (USB disconnected)	3.47	mA
		LTE-FDD PF=128 (USB disconnected)	3.5	mA
		LTE-FDD PF=256 (USB disconnected)	3.49	mA
		LTE-TDD PF=32 (USB disconnected)	3.67	mA
		LTE-TDD PF=64 (USB disconnected)	3.6	mA
		LTE-TDD PF=128 (USB disconnected)	3.2	mA
		LTE-TDD PF=256 (USB disconnected)	3.54	mA
	Idle state	WCDMA PF=64 (USB disconnected)	21.2	mA
		WCDMA PF=64 (USB connected)	31.3	mA
		LTE-FDD PF=64 (USB disconnected)	22.7	mA
		LTE-FDD PF=64 (USB connected)	31.1	mA
		LTE-TDD PF=64 (USB disconnected)	23.9	mA
		LTE-TDD PF=64 (USB connected)	31.2	mA
	WCDMA data	WCDMA B2 HSDPA CH9400 @23.5dBm	673.7	mA

	transfer (GNSS OFF)	WCDMA B2 HSUPA CH9400 @23.1dBm	658.8	mA
		WCDMA B4 HSDPA CH1412 @23.4dBm	614.7	mA
		WCDMA B4 HSUPA CH1412 @23.3dBm	655.2	mA
		WCDMA B5 HSDPA CH4407 @23.4dBm	514.2	mA
		WCDMA B5 HSUPA CH4407 @23.3dBm	532.9	mA
	LTE data transfer (GNSS OFF)	LTE-FDD B2 CH900 @23.6dBm	735.4	mA
		LTE-FDD B4 CH 2175 @23.4dBm	725.4	mA
		LTE-FDD B5 CH2525 @23.4dBm	644.2	mA
		LTE-FDD B7 CH3100@22.4dBm	916.8	mA
		LTE-FDD B12 CH5095@23.3dBm	550.0	mA
		LTE-FDD B13 CH5230@23.2dBm	651.6	mA
		LTE-FDD B25 CH8365@23.4dBm	718.4	mA
		LTE-FDD B26 CH8865@23.1dBm	679.2	mA
		LTE-FDD B30 CH9820@22.7dBm	757.7	mA
		LTE-FDD B66 CH132322@22.3dBm	704.6	mA
		LTE-TDD B41 CH40740@23.9dBm	430	mA
	2CA data transfer	LTE-FDD B1+B1 @21.05dBm	TBD	mA
		LTE-FDD B1+B5 @21.07dBm	TBD	mA
		LTE-FDD B1+B8 @21.91dBm	TBD	mA
		LTE-FDD B1+B20 @20.91dBm	TBD	mA
		LTE-FDD B1+B28 @21.09dBm	TBD	mA
		LTE-FDD B3+B5 @21.18dBm	TBD	mA
		LTE-FDD B3+B7 @21.1dBm	TBD	mA
		LTE-FDD B3+B8 @21.2dBm	TBD	mA
		LTE-FDD B3+B20 @21.16dBm	TBD	mA

		LTE-FDD B3+B28 @21.12dBm	TBD	mA
		LTE-FDD B7+B5 @21.29dBm	TBD	mA
		LTE-FDD B7+B7 @21.33dBm	TBD	mA
		LTE-FDD B7+B8 @21.3dBm	TBD	mA
		LTE-FDD B7+B20 @21.32dBm	TBD	mA
		LTE-FDD B7+B28 @21.33dBm	TBD	mA
		LTE-FDD B5+B32 @20.91dBm	TBD	mA
		LTE-FDD B8+B32 @20.88dBm	TBD	mA
		LTE-FDD B20+B32 @20.88dBm	TBD	mA
		LTE-FDD B28+B32 @21.1dBm	TBD	mA
		LTE-TDD B38+B38 @21.3dBm	TBD	mA
		LTE-TDD B40+B40 @20.99dBm	TBD	mA
		LTE-TDD B41+B41 @21.25dBm	TBD	mA
	WCDMA voice call	WCDMA B2 CH9400@23.5dBm	658.8	mA
		WCDMA B4 CH1412 @23.1dBm	655.2	mA
		WCDMA B5 CH4407 @23.1dBm	532.9	mA

The following table shows the current consumption of the EP06-E.

Table 24: EP06-E Current Consumption

Parameter	Description	Conditions	Typ.	Unit
	Sleep state	AT+CFUN=0 (USB disconnected)	1.69	mA
		WCDMA PF=64 (USB disconnected)	2.65	mA
		WCDMA PF=128 (USB disconnected)	2.69	mA
		WCDMA PF=256 (USB disconnected)	2.41	mA
		WCDMA PF=512 (USB disconnected)	2.66	mA

		LTE-FDD PF=32 (USB disconnected)	3.06	mA
		LTE-FDD PF=64 (USB disconnected)	3.26	mA
		LTE-FDD PF=128 (USB disconnected)	2.58	mA
		LTE-FDD PF=256 (USB disconnected)	2.26	mA
		LTE-TDD PF=32 (USB disconnected)	3.1	mA
		LTE-TDD PF=64 (USB disconnected)	3.3	mA
		LTE-TDD PF=128 (USB disconnected)	2.63	mA
		LTE-TDD PF=256 (USB disconnected)	2.29	mA
	Idle state	WCDMA PF=64 (USB disconnected)	24	mA
		WCDMA PF=64 (USB connected)	32.12	mA
		LTE-FDD PF=64 (USB disconnected)	19.2	mA
		LTE-FDD PF=64 (USB connected)	28.5	mA
		LTE-TDD PF=64 (USB disconnected)	21.3	mA
		LTE-TDD PF=64 (USB connected)	28.6	mA
	WCDMA data transfer (GNSS OFF)	WCDMA B1 HSDPA CH10700 @23dBm	577.05	mA
		WCDMA B1 HSUPA CH10700 @23.3dBm	557.63	mA
		WCDMA B3 HSDPA CH 1338 @22.5dBm	807.04	mA
		WCDMA B3 HSUPA CH 1338 @23.1dBm	776.52	mA
		WCDMA B5 HSDPA CH4408 @22.5dBm	572.22	mA
		WCDMA B5 HSUPA CH4408 @21.8dBm	566.37	mA
		WCDMA B8 HSDPA CH3012 @22.6dBm	657.85	mA
		WCDMA B8 HSUPA CH3012 @22.1dBm	643.46	mA
	LTE data transfer (GNSS OFF)	LTE-FDD B1 CH300 @23.9dBm	651.3	mA
		LTE-FDD B3 CH1575 @24.1dBm	898.8	mA
		LTE-FDD B5 CH2525 @23.4dBm	597.5	mA
		LTE-FDD B7 CH3100@23.4dBm	980.0	mA
		LTE-FDD B8 CH3625@23.5dBm	667.2	mA

		LTE-FDD B20 CH6300@23.5dBm	765.1	mA
		LTE-FDD B28 CH9510@21.4dBm	810.0	mA
		LTE-FDD B66 CH132322@22.3dBm	396.1	mA
		LTE-TDD B38 CH38000@24.0dBm	407.0	mA
		LTE-TDD B40 CH39150@23.8dBm	370.2	mA
		LTE-TDD B41 CH40740@24.3dBm	396.1	mA
	2CA data transfer	LTE-FDD B1+B1 @21.05dBm	TBD	mA
		LTE-FDD B1+B5 @21.07dBm	TBD	mA
		LTE-FDD B1+B8 @21.91dBm	TBD	mA
		LTE-FDD B1+B20 @20.91dBm	TBD	mA
		LTE-FDD B1+B28 @21.09dBm	TBD	mA
		LTE-FDD B3+B5 @21.18dBm	TBD	mA
		LTE-FDD B3+B7 @21.1dBm	TBD	mA
		LTE-FDD B3+B8 @21.2dBm	TBD	mA
		LTE-FDD B3+B20 @21.16dBm	TBD	mA
		LTE-FDD B3+B28 @21.12dBm	TBD	mA
		LTE-FDD B7+B5 @21.29dBm	TBD	mA
		LTE-FDD B7+B7 @21.33dBm	TBD	mA
		LTE-FDD B7+B8 @21.3dBm	TBD	mA
		LTE-FDD B7+B20 @21.32dBm	TBD	mA
		LTE-FDD B7+B28 @21.33dBm	TBD	mA
		LTE-FDD B5+B32 @20.91dBm	TBD	mA
		LTE-FDD B8+B32 @20.88dBm	TBD	mA
		LTE-FDD B20+B32 @20.88dBm	TBD	mA
		LTE-FDD B28+B32 @21.1dBm	TBD	mA
		LTE-TDD B38+B38 @21.3dBm	TBD	mA
		LTE-TDD B40+B40 @20.99dBm	TBD	mA

		LTE-TDD B41+B41 @21.25dBm	TBD	mA
	WCDMA voice call	WCDMA B1 CH10700 @23.75dBm	596.7	mA
		WCDMA B3 CH1122 @22.6dBm	576.63	mA
		WCDMA B5 CH4408 @ 22.22dBm	557.01	mA
		WCDMA B8 CH3012 @22.98dBm	638.67	mA

4.7. Thermal Consideration

EP06 is designed to work over an extended temperature range. In order to achieve a maximum performance, it is strongly recommended to comply with the following principles for thermal consideration.

- On customers' PCB design, please keep placement of the module away from heating sources, especially high power components such as ARM processor, audio power amplifier, power supply, etc.
- According to customers' application demands, the heatsink can be mounted on the top of the module, or the thermal pad can be filled between the module and the application board and the corresponding area on the application board need as much GND copper as possible, or both of them.
- 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/PCB.

The following shows the heatsink and thermal pad designs for reference and customers can choose one or both of them according to their application structure.

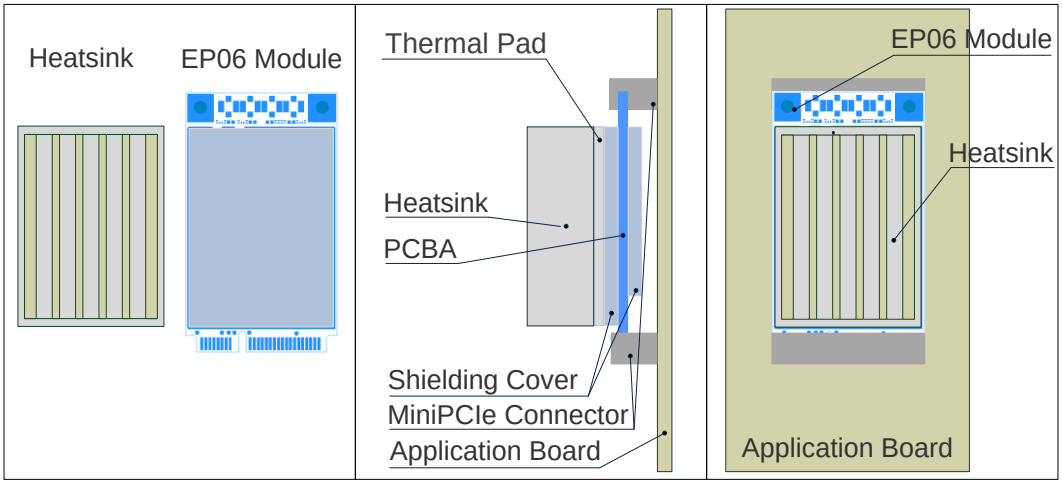


Figure 13: Referenced Heatsink Design (Heatsink at the Top of the Module)

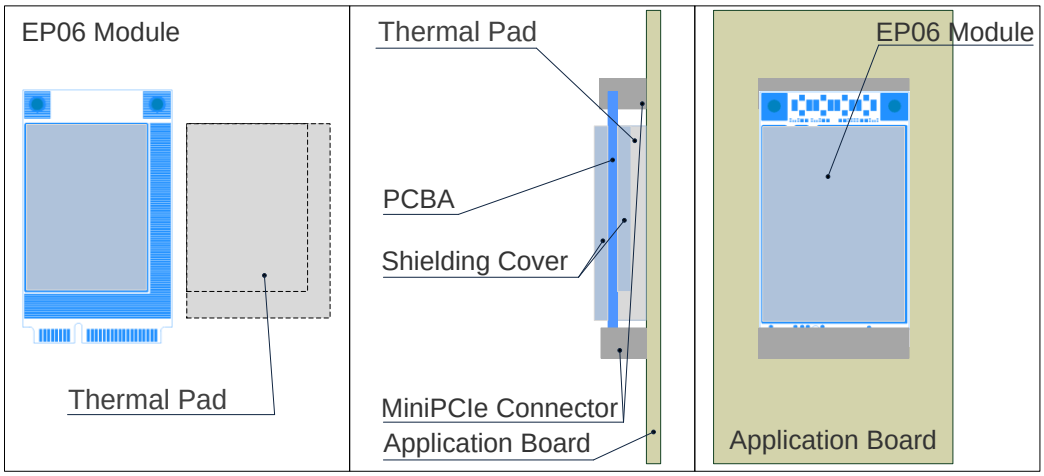


Figure 14: Referenced Thermal Pad Design

NOTES

1. Make sure that customers' PCB design provides sufficient cooling for the module: proper mounting, heatsinks, and active cooling may be required depending on the integrated application.
2. The module's internal temperature must be kept below 105°C to protect the components from damage when it is integrated to customers' applications. And the temperature can be queried by **AT+QTEMP** command.

5 Mechanical Dimensions

5.1. General Description

This chapter mainly describes mechanical dimensions as well as packaging specification of EP06 module.

5.2. Mechanical Dimensions of EP06 module

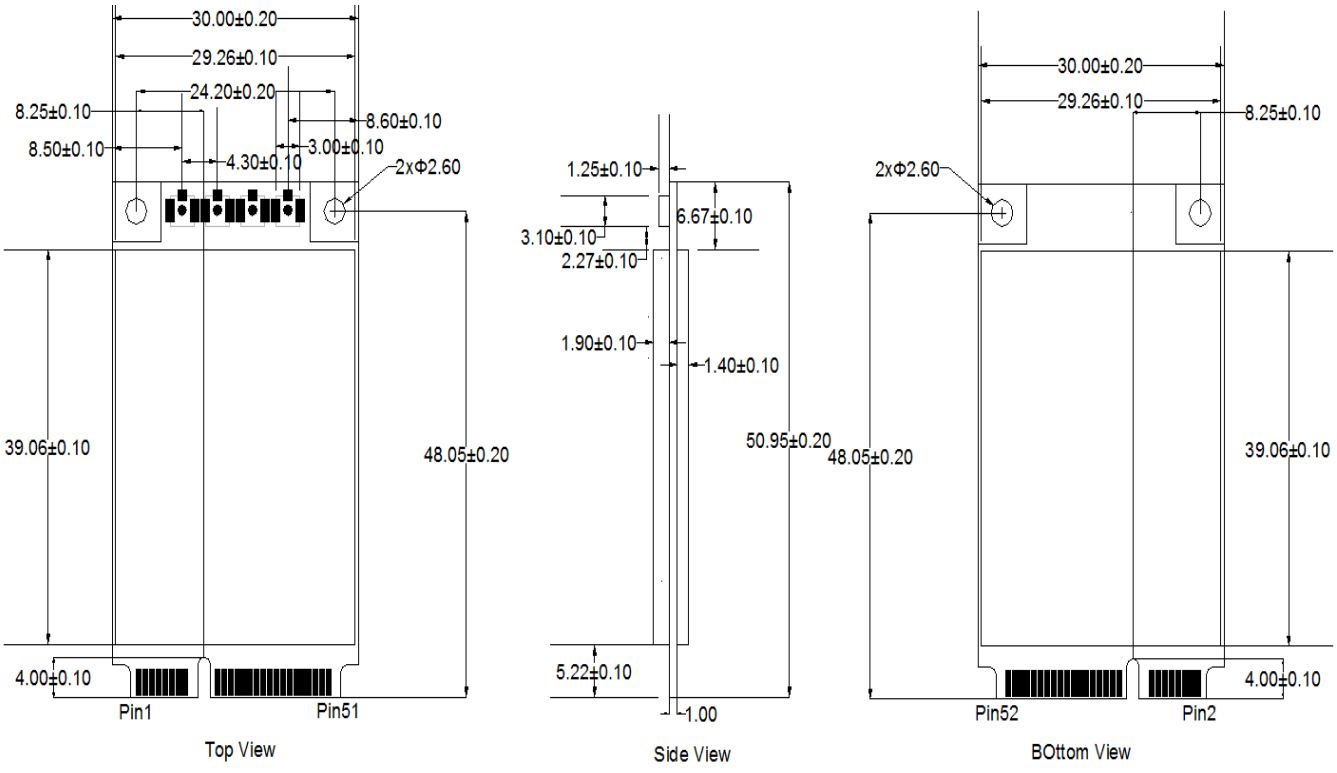


Figure 15: Mechanical Dimensions of EP06module (Unit: mm)

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.

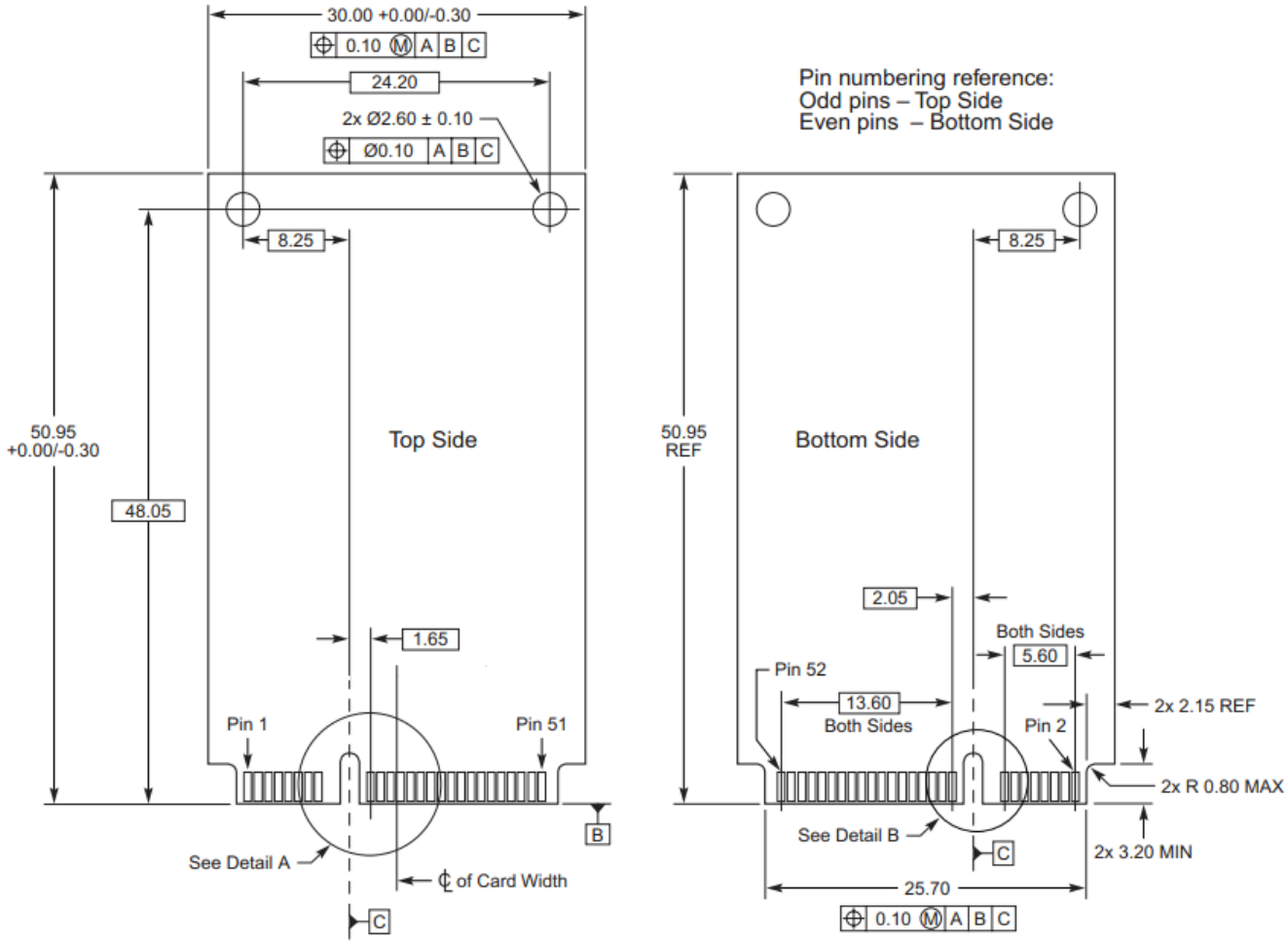


Figure 16: Standard Dimensions of Mini PCI Express (Unit: mm)

EP06 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.

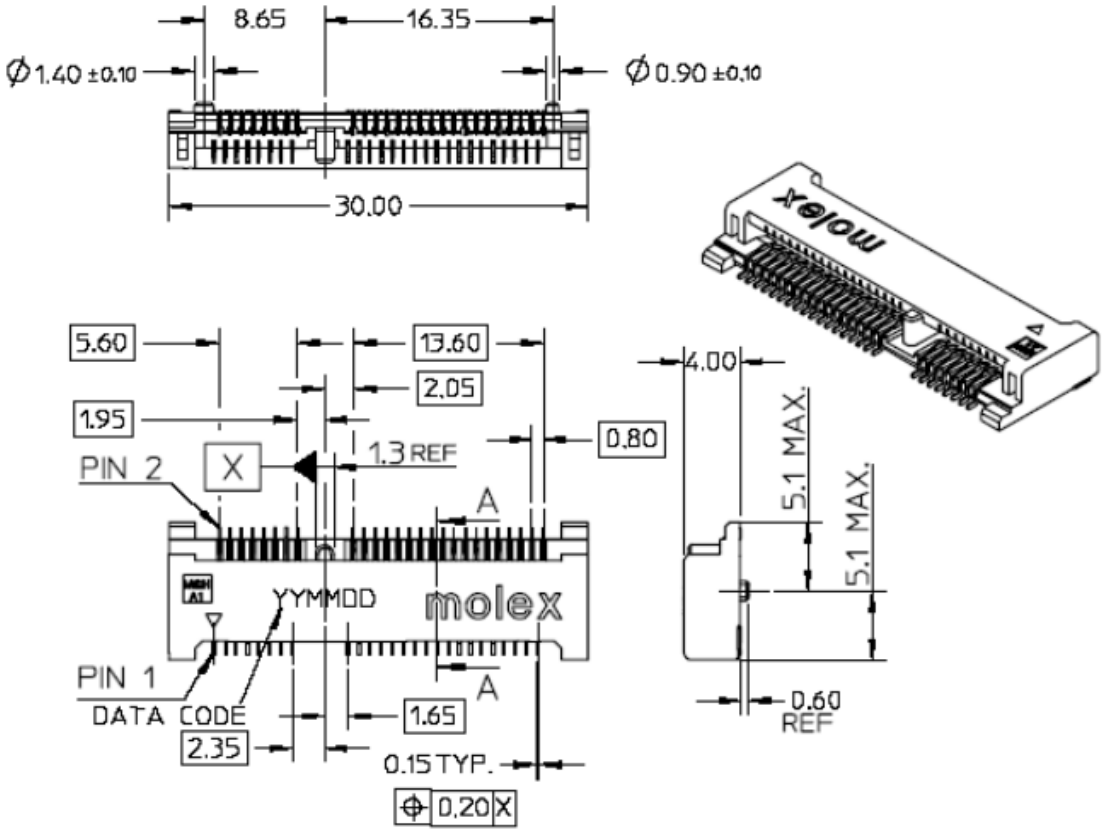


Figure 17: Dimensions of the Mini PCI Express Connector (Molex 679100002, Unit: mm)

5.4. Design Effect Drawings of the Module

Figure 18: Top View of the Module

Figure 19: Bottom View of the Module

NOTE

These are design effect drawings of EP06 module. For more accurate pictures, please refer to the module that you get from Quectel.

6 Storage and Packaging

6.1. Storage

The module is stored in a vacuum-sealed bag. It is rated at MSL 3, and its storage restrictions are listed below.

1. Shelf life in the vacuum-sealed bag: 12 months at < 40ºC/90%RH.

2. After the vacuum-sealed bag is opened, devices must stored at <10% RH.

NOTE

As the plastic container cannot be subjected to high temperature, it should be removed from devices before high temperature (120ºC) baking. If shorter baking time is desired, please refer to *IPC/JEDECJ-STD-033* for baking procedure.

6.2. Packaging

The EP06 Mini PCIe is packaged in a tray. Each tray contains 10pcs of modules. The smallest package of EP06 Mini PCIe contains 100pcs。

7 Appendix References

Table 25: Related Documents

SN	Document Name	Remark
[1]	PCI Express Mini Card Electromechanical Specification Revision 1.2	Mini PCI Express Specification

Table 26: Terms and Abbreviations

Abbreviation	Description
AMR	Adaptive Multi-rate
bps	Bits Per Second
CS	Coding Scheme
DC-HSPA+	Dual-carrier High Speed Packet Access
DFOTA	Delta Firmware Upgrade Over The Air
DL	Down Link
EFR	Enhanced Full Rate
ESD	Electrostatic Discharge
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-A	Long Term Evolution-Advanced
Mbps	Million Bits Per Second
ME	Mobile Equipment (Module)
MIMO	Multiple-Input Multiple-Output
MMS	Multimedia Messaging Service
MO	Mobile Originated
MT	Mobile Terminated
PCM	Pulse Code Modulation
PDU	Protocol Data Unit
PPP	Point-to-Point Protocol
RF	Radio Frequency
Rx	Receive
USIM	(Universal) Subscriber Identification Module
SIMO	Single Input Multiple Output
SMS	Short Message Service
UART	Universal Asynchronous Receiver & Transmitter
UL	Up Link
URC	Unsolicited Result Code
WCDMA	Wideband Code Division Multiple Access

8 IC & FCC Requirement

8.1. FCC Regulations:

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 device 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 radiated radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

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

Caution: Changes or modifications not expressly approved by the party responsible for compliance could void the user‘s authority to operate the equipment.

8.2. RF Exposure Information

This device complies with FCC radiation exposure limits set forth for an uncontrolled environment. In order to avoid the possibility of exceeding the FCC radio frequency exposure limits, human proximity to the antenna shall not be less than 20cm (8 inches) during normal operation.

8.3. ISED Notice

This device complies with Innovation, Science and Economic Development Canada license-exempt RSS standard(s). Operation is subject to the following two conditions:
(1) this device may not cause interference, and
(2) this device must accept any interference, including interference that may cause undesired operation of the device.

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

This Class B digital apparatus complies with Canadian ICES-003.
Cet appareil numérique de la classe B est conforme à la norme NMB-003 du Canada.

8.4. ISED Radiation Exposure Statement

This device complies with RSS-102 radiation exposure limits set forth for an uncontrolled environment. In order to avoid the possibility of exceeding the ISED radio frequency exposure limits, human proximity to the antenna shall not be less than 20cm (8 inches) during normal operation.

Cet appareil est conforme aux limites d'exposition aux rayonnements de la CNR-102 définies pour un environnement non contrôlé. Afin d'éviter la possibilité de dépasser les limites d'exposition aux fréquences radio de la CNR-102, la proximité humaine à l'antenne ne doit pas être inférieure à 20 cm (8 pouces) pendant le fonctionnement normal.

8.5. IMPORTANT NOTE:

This module is intended for OEM integrator. The OEM integrator is still responsible for the FCC compliance requirement of the end product, which integrates this module. 20cm minimum distance has to be able to be maintained between the antenna and the users for the host this module is integrated into. Under such configuration, the FCC radiation exposure limits set forth for an population/uncontrolled environment can be satisfied.

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

8.6. USERS MANUAL OF THE END PRODUCT:

In the users manual of the end product, the end user has to be informed to keep at least 20cm separation with the antenna while this end product is installed and operated. The end user has to be informed that the FCC radio-frequency exposure guidelines for an uncontrolled environment can be satisfied. The end user has to also be informed that any changes or modifications not expressly approved by the manufacturer could void the user's authority to operate this equipment. If the size of the end product is smaller than 8x10cm, then additional FCC part 15.19 statement is required to be available in the users manual: This device complies with Part 15 of 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.

8.7. LABEL OF THE END PRODUCT:

The final end product must be labeled in a visible area with the following " Contains Transmitter Module FCC ID: XMR201807EP06A. If the size of the end product is larger than 8x10cm, then the following FCC part 15.19 statement has to also be available on the label: This device complies with Part 15 of 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.

The Innovation, Science and Economic Development Canada certification label of a module shall be clearly visible at all times when installed in the host device; otherwise, the host device must be labeled to display the Innovation, Science and Economic Development Canada certification number for the module, preceded by the words “Contains transmitter module IC: 10224A-201807EP06A.