EC200A Series Mini PCIe Hardware Design

LTE Standard Module Series

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

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Safety Information

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

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

Switch off the 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 there is an Airplane Mode, it should be enabled prior to boarding an aircraft. Please consult the airline staff for more restrictions on the use of wireless devices on an aircraft.

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

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

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

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

About the Document

Revision History

Version	Date	Author	Description
-	2022-01-14	Johen SUN/ Kexiang ZHANG	Creation of the document
1.0	2022-01-24	Johen SUN/ Kexiang ZHANG	First official release

Contents

Table Index

Figure Index

1 Introduction

This document defines EC200A series Mini PCIe module, and describes its air interfaces and hardware interfaces which are connected with your applications.

This document helps you quickly understand module interface specifications, electrical characteristics, mechanical specifications and other related information of the module. To facilitate application designs, it also includes some reference designs for your reference. The document, coupled with application notes and user guides, makes it easy to design and set up wireless applications with the module.

2 Product Overview

2.1. General Description

EC200A series Mini PCIe module provides data connectivity on LTE-FDD, LTE-TDD, HSPA+, HSDPA, HSUPA, WCDMA, EDGE and GPRS networks with PCI Express Mini Card 1.2 standard interface. It supports embedded operating systems such as Linux, Android, etc., and also provides audio, high-speed data transmission for your applications.

EC200A series Mini PCIe module can be applied in the following fields:

- PDA and laptop computer
- Remote monitor system
- Wireless POS system
- Intelligent meter reading system
- Wireless router and switch
- Other wireless terminal devices

2.2. Frequency Bands and Functions

EC200A series Mini PCIe module contains 3 variants, and are listed in the following table.

Table 1: Frequency Bands and Functions of EC200A Series Mini PCIe

Module Series	Description
EC200A-CN Mini PCIe	Supports LTE-FDD (with receive diversity) [1]: B1/B3/B5/B8 Supports LTE-TDD (with receive diversity) [1]: B34/B38/B39/B40/B41 Supports WCDMA: B1/B5/B8 Supports GSM: EGSM900/DCS1800 Supports digital audio
EC200A-EU Mini PCIe	Supports LTE-FDD (with receive diversity) [1]: B1/B3/B5/B7/B8/B20/B28 Supports LTE-TDD (with receive diversity) [1]: B38/B40/B41

[1] Rx-diversity is optional.

	Supports WCDMA: B1/B5/B8 Supports GSM: EGSM900/DCS1800 Supports digital audio
EC200A-AU Mini PCIe	Supports LTE-FDD (with receive diversity) [1]: B1/B2/B3/B4/B5/B7/B8/B28/B66 Supports LTE-TDD (with receive diversity) [1]: B40 Supports WCDMA: B1/B2/B4/B5/B8 Supports GSM: GSM850/EGSM900/DCS1800/PCS1900 Support digital audio

2.3. Key Features

The following table describes the detailed features of EC200A series Mini PCIe module.

Table 2: Key Features of EC200A Series Mini PCIe

Features	Description
Mini PCIe Interface	PCI Express Mini Card 1.2 Standard Interface
Power Supply	● Supply voltage: 3.0–3.6 V ● Typical supply voltage: 3.3 V
Transmitting Power	● GSM850: Class 4 (33 dBm ±2 dB) ● EGSM900: Class 4 (33 dBm ±2 dB) ● DCS1800: Class 1 (30 dBm ±2 dB) ● PCS1900: Class 1 (30 dBm ±2 dB) ● GSM850 8-PSK: Class E2 (27 dBm ±3 dB) ● EGSM900 8-PSK: Class E2 (27 dBm ±3 dB) ● DCS1800 8-PSK: Class E2 (26 dBm ±3 dB) ● PCS1900 8-PSK: Class E2 (26 dBm ±3 dB) ● WCDMA: Class 3 (24 dBm +1/-3 dB) ● LTE-FDD: Class 3 (23 dBm ±2 dB) ● LTE-TDD: Class 3 (23 dBm ±2 dB)
LTE Features	● Support up to 3GPP Rel-9 non-CA Cat 4 FDD and TDD ● Support 1.4/3/5/10/15/20 MHz RF bandwidth ● Support MIMO in DL direction ● FDD: Max. 150 Mbps (DL), Max. 50 Mbps (UL) ● TDD: Max. 130 Mbps (DL), Max. 30 Mbps (UL)
UMTS Features	● Support 3GPP Rel-7 HSPA+, HSDPA, HSUPA and WCDMA ● Support QPSK, 16QAM and 64QAM modulation ● HSDPA+: Max. 21 Mbps (DL) ● HSUPA: Max. 5.76 Mbps (UL) ● WCDMA: Max. 384 kbps (UL), Max. 384 kbps (DL)

GSM Features	**GPRS:** ● Support GPRS multi-slot class 12 ● Coding scheme: CS-1, CS-2, CS-3 and CS-4 ● Max. 85.6 kbps (DL), Max. 85.6 kbps (UL) **EDGE:** ● Support EDGE multi-slot class 12 ● Support GMSK and 8-PSK for different MCS (Modulation and Coding Scheme) ● Downlink coding schemes: MCS 1–9 ● Uplink coding schemes: MCS 1–9 ● Max. 236.8 kbps (DL), Max. 236.8 kbps (UL)
Internet Protocol Features	● Support protocols: TCP/UDP/PPP/NTP/NITZ/FTP/HTTP/PING/CMUX/HTTPS/FTPS/ SSL/FILE/MQTT/MMS/SMTP/SMTPS ● Support PAP and CHAP for PPP connection
SMS	● Text and PDU modes ● Point-to-point MO and MT ● SMS cell broadcast ● SMS storage: ME by default
(U)SIM Interface	Supports USIM/SIM card: 1.8 V, 3.0 V
UART Interface	**Main UART:** ● Supports RTS and CTS hardware flow control ● Baud rate: 115200 bps 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 ● Support echo cancellation and noise suppression
PCM Interface	● Used for audio function with external codec ● Supports 16-bit linear data format ● Supports short frame synchronization ● Supports master and slave modes
USB Interface	● Compliant with USB 2.0 specification (slave only); the data transfer rate can reach up to 480 Mbps ● Used for AT command communication, data transmission, software debugging and firmware upgrade ● Supports USB serial drivers for: Windows 7/8/8.1/10, Linux 2.6–5.14, Android 4.x–11.x, etc.
Antenna Connectors	Includes main antenna and Rx-diversity antenna connectors
Rx-diversity (Optional)	Supports LTE Rx-diversity
AT Commands	Compliant with *3GPP TS 27.007*, *3GPP TS 27.005* and Quectel enhanced

	AT commands
Physical Characteristics	● Size: 30.0 mm × 51.0 mm × 4.9 mm ● Weight: approx. 9.7 g
Temperature Range	● Operating temperature range: -35 °C to +75 °C [2] ● Extended temperature range: -40 °C to +80 °C [3] ● Storage temperature range: -40 °C to +90°C
Firmware Upgrade	Upgrade via USB interface or DFOTA
RoHS	All hardware components are fully compliant with EU RoHS directive

2.4. Functional Diagram

The following figure shows the block diagram of EC200A series Mini PCIe.

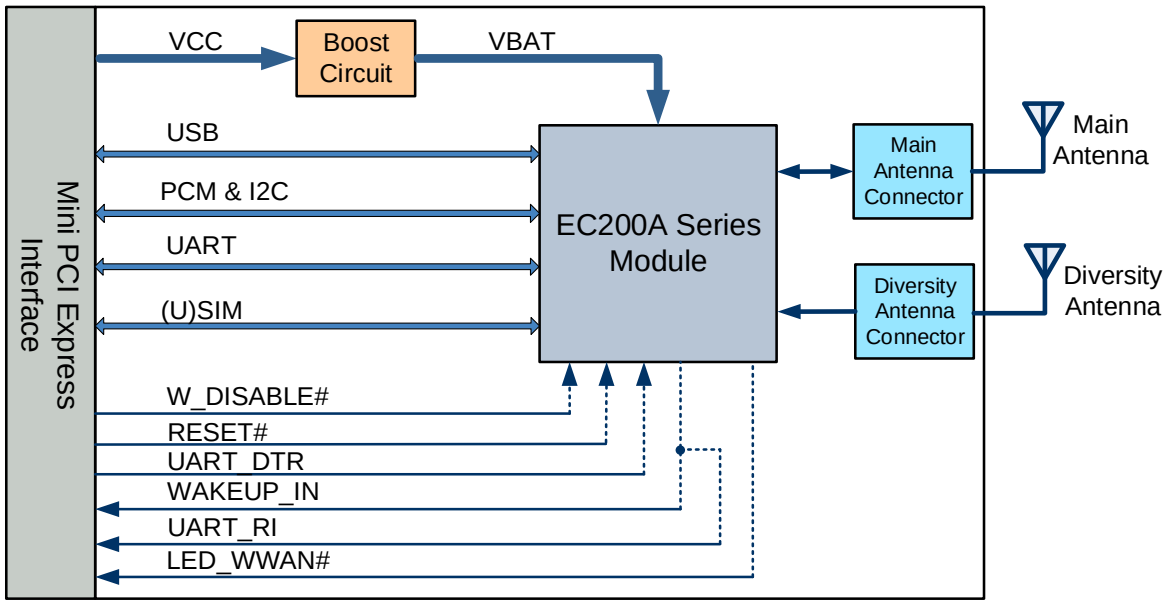


Figure 1: Functional Diagram

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

2.5. EVB

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

3 Application Interfaces

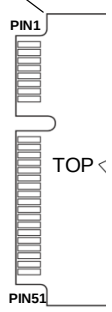
The physical connections and signal levels of EC200A series Mini PCIe comply with *PCI Express Mini Card Electromechanical Specification*. This chapter mainly describes the definition and application of the following interfaces/pins of EC200A series Mini PCIe.

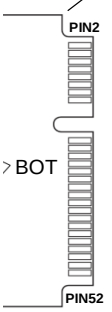
- Power supply
- (U)SIM interface
- USB interface
- UART interface
- PCM and I2C interfaces
- Control and indication Interfaces

3.1. Pin Assignment

The following figure shows the pin assignment of EC200A series Mini PCIe module. The top side contains EC200A series module and antenna connectors.

Pin Name	Pin No.
WAKEUP_IN	1
RESERVED	3
RESERVED	5
RESERVED	7
GND	9
UART_RXD	11
UART_TXD	13
GND	15
UART_RI	17
RESERVED	19
GND	21
UART_CTS	23
UART_RTS	25
GND	27
GND	29
UART_DTR	31
RESERVED	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	RESERVED
18	GND
20	W_DISABLE#
22	RESET#
24	RESERVED
26	GND
28	NC
30	I2C_SCL
32	I2C_SDA
34	GND
36	USB_DM
38	USB_DP
40	GND
42	LED_WWAN#
44	USIM_DET
46	RESERVED
48	NC
50	GND
52	VCC

Figure 2: Pin Assignment

3.2. Pin Description

The following tables show the pin definition and description of the 52 pins on EC200A series Mini PCIe.

Table 3: I/O Parameters Definition

Type	Description
AIO	Analog Input/Output
DI	Digital Input
DO	Digital Output
DIO	Digital Input/Output
OC	Open Collector
OD	Open drain
PI	Power Input
PO	Power Output

Table 4: Pin Description

Pin No.	Pin Name	I/O	Description	Comment
1	WAKEUP_IN	OC	Wake up the module	
2	VCC	PI	Power supply for the module	3.0–3.6 V, typically 3.3 V DC supply
3	RESERVED	-	Reserved	
4	GND	-	Ground	
5	RESERVED	-	Reserved	
6	NC	-	Not connected	
7	RESERVED	-	Reserved	
8	USIM_VDD	PO	Power supply for the (U)SIM card	
9	GND	-	Ground	

10	USIM_DATA	DIO	(U)SIM card data	
11	UART_RXD	DI	UART receive	
12	USIM_CLK	DO	(U)SIM card clock	
13	UART_TXD	DO	UART transmit	
14	USIM_RST	DO	(U)SIM card reset	
15	GND	-	Ground	
16	RESERVED	-	Reserved	
17	UART_RI	DO	UART Ring indication	
18	GND	-	Ground	
19	RESERVED	-	Reserved	
20	W_DISABLE#	DI	Airplane mode control	Pulled up by default. Active low.
21	GND	-	Ground	
22	RESET#	DI	Reset the module	Pulled up by default. Active low.
23	UART_CTS	DI	DCE clear to send signal from DTE	Connects to DTE's RTS.
24	RESERVED	-	Reserved	
25	UART_RTS	DO	DCE request to send signal from DTE	Connects to DTE's CTS.
26	GND	-	Ground	
27	GND	-	Ground	
28	NC	-	Not connected	
29	GND	-	Ground	
30	I2C_SCL	OD	I2C serial clock	Require external pull-up to 1.8 V.
31	UART_DTR	DI	Sleep mode control	
32	I2C_SDA	OD	I2C serial data	Require external pull-up to 1.8 V.

33	RESERVED	-	Reserved	
34	GND	-	Ground	
35	GND	-	Ground	
36	USB_DM	AIO	USB differential data (-)	Require differential impedance of 90 Ω.
37	GND	-	Ground	
38	USB_DP	AIO	USB differential data (+)	Require differential impedance of 90 Ω.
39	VCC	PI	Power supply for the module	3.0–3.6 V, typically 3.3 V DC supply
40	GND	-	Ground	
41	VCC	PI	Power supply for the module	3.0–3.6 V, typically 3.3 V DC supply
42	LED_WWAN#	OC	LED signal for indicating the network status of the module	Active low.
43	GND	-	Ground	
44	USIM_DET	DI	(U)SIM card hot-plug detect	
45	PCM_CLK	DIO	PCM clock	
46	RESERVED	-	Reserved	
47	PCM_DOUT	DO	PCM data output	
48	NC	-	Not connected	
49	PCM_DIN	DI	PCM data input	
50	GND	-	Ground	
51	PCM_SYNC	DIO	PCM frame sync	
52	VCC	PI	Power supply for the module	3.0–3.6 V, typically 3.3 V DC supply

NOTE

Keep all NC, RESERVED and unused pins unconnected.

3.3. Operating Modes

The following table briefly outlines the operating modes to be mentioned in the following chapters.

Table 5: Overview of Operating Modes

Mode	Details	
Normal Operation	Idle	The module is connected to network. Its power consumption varies with the network setting and data transfer rate.
	Talk/Data	The module remains registered on network, and is ready to send and receive data. In this mode, the software is active.
Minimum Functionality Mode	**AT+CFUN=0** can set the module to a minimum functionality mode without removing the power supply. In this case, both RF function and (U)SIM card are invalid.	
Airplane Mode	**AT+CFUN=4** or W_DISABLE# pin can set the module to airplane mode where the RF function is invalid.	
Sleep Mode	The module remains the ability to receive paging message, SMS, voice call and TCP/UDP data from the network normally. In this mode, the power consumption is reduced to a low level.	

NOTE

For more details about the AT command, see ***document [2]***.

3.4. Power Saving

3.4.1. Sleep Mode

EC200A series Mini PCIe can reduce its current consumption to a minimum value in sleep mode. There are three preconditions must be met to make the module enter sleep mode.

- Execute **AT+QSCLK=1** to enable sleep mode. For more details, see ***document [2]***.
- Drive UART_DTR high or keep it open.
- The host's USB bus, which connects to the module's USB interface, enters suspend state.

3.4.2. Airplane Mode

When the module enters airplane mode, the RF function will be disabled, and all AT commands related to it will be inaccessible. For more details, see ***Chapter 3.10.3***.

3.5. Power Supply

The following table shows pin definition of power supply pins and ground pins.

Table 6: Definition of VCC and GND Pins

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

The typical supply voltage of EC200A series Mini PCIe is 3.3 V. In the 2G network, the input peak current may reach 2.7 A during the transmitting time. Therefore, the power supply must be able to provide a rated output current of 2.7 A at least, and a bypass capacitor of no less than 470 μF with low ESR should be used to prevent the voltage from dropping. If the switching power supply is used to supply power to the module, the power device and power supply routing traces of the switching power supply should be kept away from the antennas as much as possible to prevent EMI interference.

The following figure shows a reference design of power supply where R2 and R3 are 1 % tolerance resistors and C3 is a low-ESR capacitor.

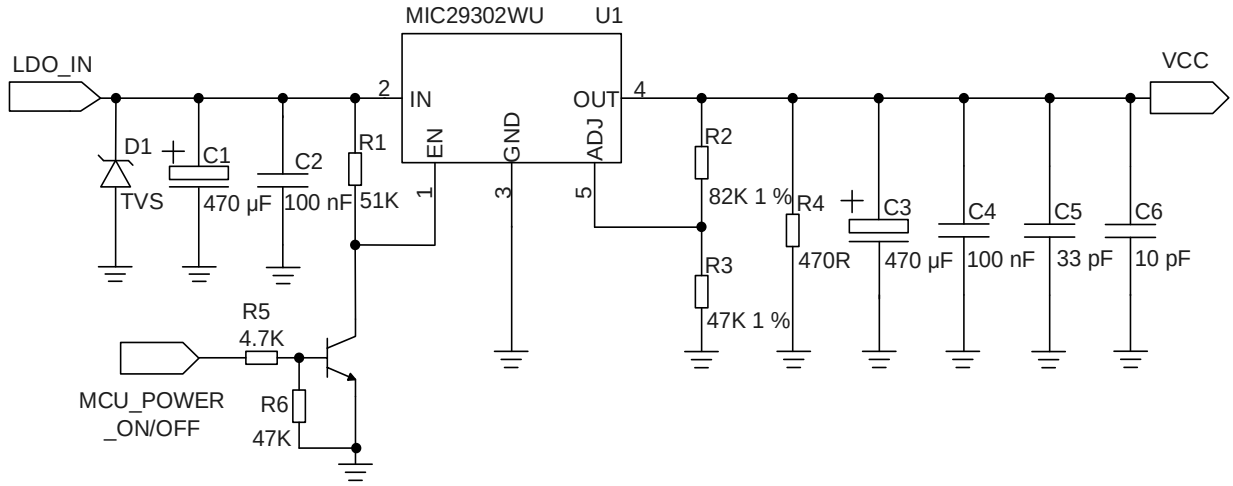


Figure 3: Reference Circuit of Power Supply

3.6. (U)SIM Interface

(U)SIM interface circuitry meets ETSI and IMT-2000 requirements. Both 1.8 V and 3.0 V (U)SIM cards are supported. The following table shows the pin definition of (U)SIM interface.

Table 7: Pin Definition of (U)SIM Interface

Pin Name	Pin No.	I/O	Power Domain	Description
USIM_VDD	8	PO	1.8/3.0 V	(U)SIM card power supply
USIM_DATA	10	DIO	1.8/3.0 V	(U)SIM card data
USIM_CLK	12	DO	1.8/3.0 V	(U)SIM card clock
USIM_RST	14	DO	1.8/3.0 V	(U)SIM card reset
USIM_DET	44	DI	1.8 V	(U)SIM card hot-plug detect

The module supports (U)SIM card hot-plug via the USIM_DET pin. The function supports low level and high level detections, and is disabled by default. And the function can be configured via **AT+QSIMDET**. See ***document [2]*** for details about the command.

The following figure shows a reference design for (U)SIM interface with an 8-pin (U)SIM card connector.

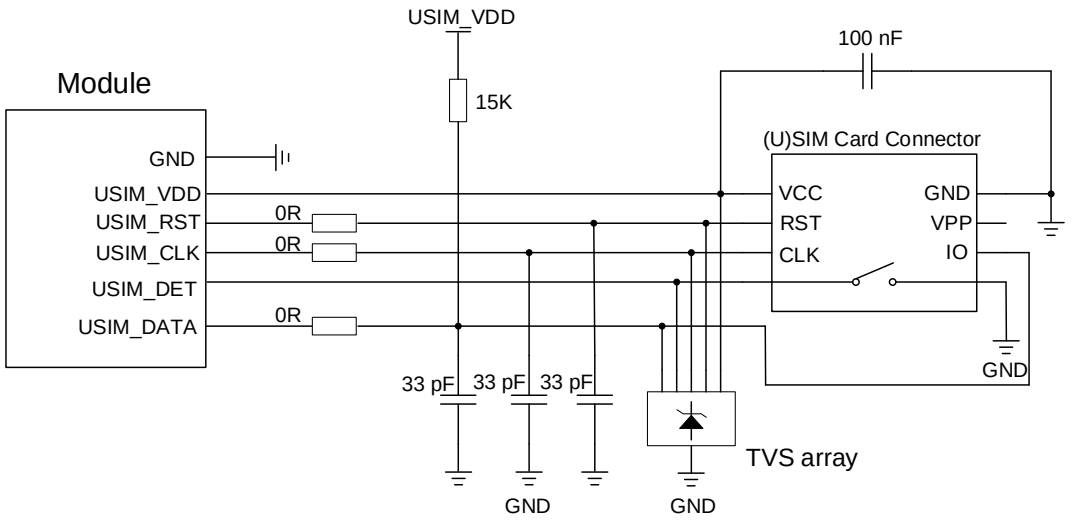


Figure 4: Reference Circuit of (U)SIM Interface with an 8-pin (U)SIM Card Connector

If (U)SIM card hot-plug detection function is not needed, keep USIM_DET unconnected. A reference circuit for (U)SIM interface with a 6-pin (U)SIM card connector is illustrated in the following figure.

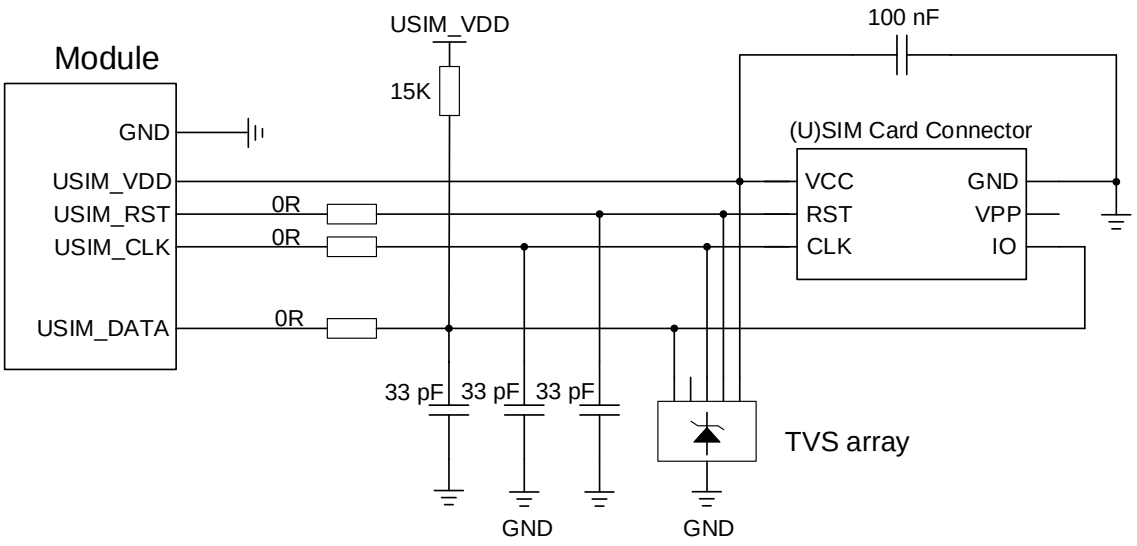


Figure 5: Reference Circuit of (U)SIM Interface with a 6-pin (U)SIM Card Connector

To enhance the reliability and availability of the (U)SIM card in your applications, follow the criteria below in (U)SIM circuit design:

- Keep the placement of (U)SIM card connector to the module as close as possible. Keep the trace length less than 200 mm.
- Keep (U)SIM card signals away from RF and power supply traces.
- To avoid cross-talk between USIM_DATA and USIM_CLK, keep them away from each other and shield them with surrounded ground.
- For better ESD protection, it is recommended to add a TVS array with parasitic capacitance not exceeding 15 pF.
- The 0 Ω resistors should be added on USIM_CLK、USIM_DATA、USIM_RST in series between the module and the (U)SIM card connector to facilitate debugging. The 33 pF 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.

3.7. USB Interface

EC200A series Mini PCIe provides one integrated Universal Serial Bus (USB) interface which complies with USB 2.0 specification. It can only be used as a slave device.

The module supports high speed (480 Mbps) and full speed (12 Mbps) modes. The USB interface is used for AT command communication, data transmission, software debugging and firmware upgrade.

The following table shows the pin definition of USB interface.

Table 8: Pin Definition of USB Interface

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

The following figure shows a reference circuit of USB interface.

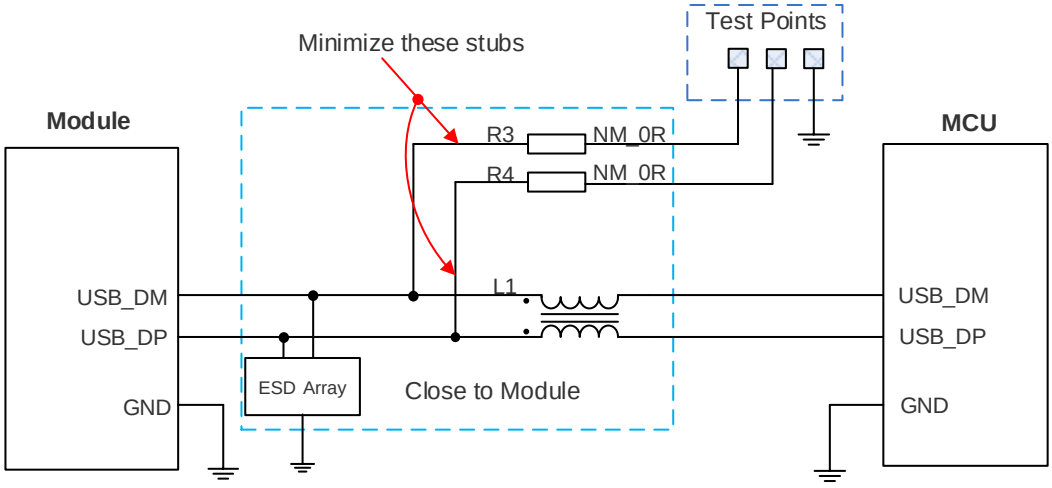


Figure 6: Reference Circuit of USB Interface

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

To meet USB 2.0 specification, the following principles should be complied with when design the USB interface.

- It is important to route the USB signal traces as differential pairs with ground surrounded. The impedance of USB differential trace is 90 Ω.
- 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 of the PCB, and surround the traces with ground on that layer and with ground planes above and below.
- Pay attention to the selection of ESD device on the USB data trace. Its parasitic capacitance should not exceed 2 pF and should be placed as close as possible to the USB interface.

3.8. UART Interface

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

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

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

Table 9: Pin Definition of Main UART Interface

Pin Name	Pin No.	I/O	Power Domain	Description
UART_RXD	11	DI	3.3 V	UART receive
UART_TXD	13	DO	3.3 V	UART transmit
UART_CTS	23	DI	3.3 V	DCE clear to send signal from DTE
UART_RTS	25	DO	3.3 V	DCE request to send signal from DTE

The signal level of main UART interface is 3.3 V. When connecting to the peripheral MCU/ARM, pay attention to the signal direction. The reference circuit is as follows:

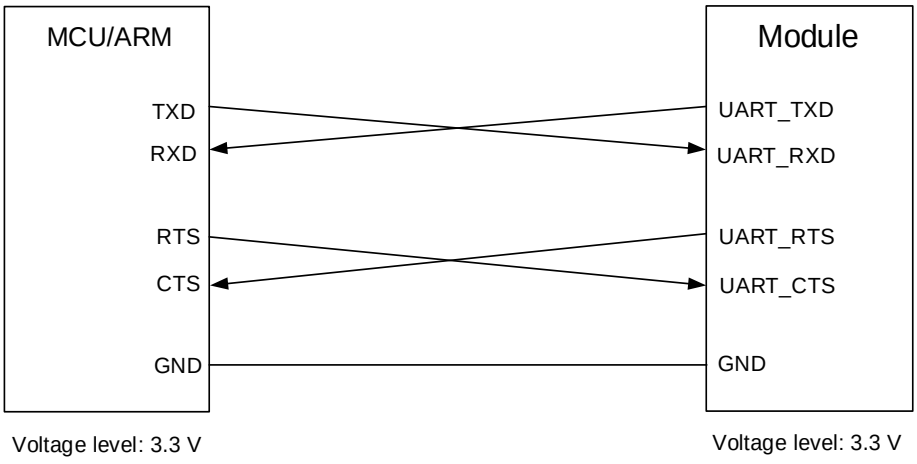


Figure 7: Reference Circuit of Power Supply

3.9. PCM and I2C Interfaces

EC200A series 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 10: Pin Definition of PCM and I2C Interfaces

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

The module provides one PCM digital interface, which supports 16-bit linear data format and short frame synchronization (works as either master or slave).

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, the PCM interface supports 256 kHz, 512 kHz, 1024 kHz or 2048 kHz PCM_CLK at 8 kHz PCM_SYNC, and also supports 4096 kHz PCM_CLK at 16 kHz PCM_SYNC. The following figure shows the timing relationship in primary mode with 8 kHz PCM_SYNC and 2048 kHz PCM_CLK.

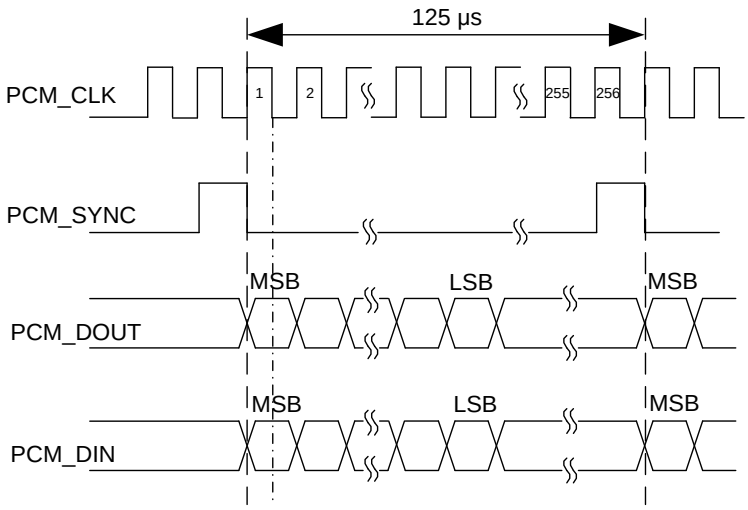


Figure 8: Timing in Short Frame Synchronization

Clock and mode can be configured by AT command, and the default configuration is master mode using short frame synchronization format with 2048 kHz PCM_CLK and 8 kHz PCM_SYNC.

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

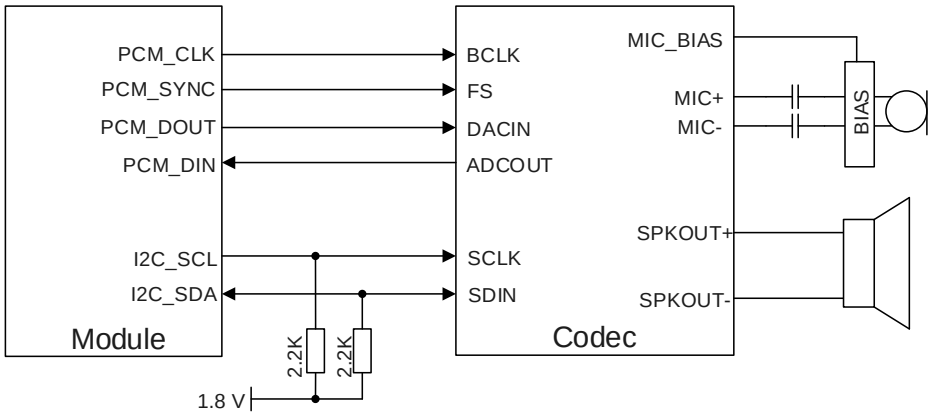


Figure 9: Reference Circuit of PCM and I2C Application with Audio Codec

NOTE

It is recommended to reserve an RC (R = 22 Ω, C = 22 pF) circuit on the PCM signal traces, and close to codec, especially for PCM_CLK.

3.10. Control and Indication Interfaces

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

Table 11: Pin Definition of Control and Indication Signals

Pin Name	Pin No.	I/O	Power Domain	Description	Comment
UART_RI	17	DO	3.3 V	UART Ring indication	
UART_DTR	31	DI	3.3 V	Sleep mode control	
W_DISABLE#	20	DI	3.3 V	Airplane mode control;	Pulled up by default; Active low.
RESET#	22	DI	3.3 V	Reset the module	Pulled up by default; Active low.
LED_WWAN#	42	OC	-	LED signal for indicating the network status of the module	Active low.
WAKEUP_IN	1	OC	-	Wake up the module	

3.10.1. UART_RI

The UART_RI can be used to wake up the host. When a URC returns, there will be the following behaviors on the UART_RI pin after executing **AT+QCFG="risignaltype","physical"**. See ***document [2]*** for details about the command.

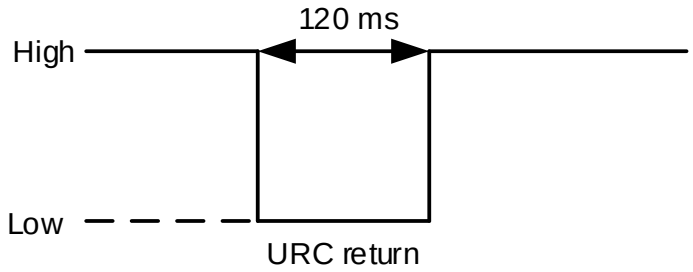


Figure 10: UART_RI Behaviors

3.10.2. UART_DTR

The UART_DTR signal is used for sleep mode control. It is pulled up by default. When the module is in sleep mode, driving it low can wake up the module. For more details about the preconditions for the module to enter sleep mode, see ***Chapter 3.4.1***.

3.10.3. W_DISABLE#

The W_DISABLE# signal supports airplane mode control, i.e., enabling/disabling RF function. W_DISABLE# is pulled up by default. Driving it low can make the module enter airplane mode. The pin function is disabled by default, you can enable it with **AT+QCFG="airplanecontrol",1**.

Table 12: Airplane Mode Controlled by Hardware Method

W_DISABLE#	RF Function Status	Module Operation Mode
High level	RF enabled	Normal operation mode
Low level	RF disabled	Airplane mode

The RF function can also be enabled/disabled with **AT+CFUN**, and the details are as follows.

Table 13: Airplane Mode Controlled by Software Method

AT+CFUN=?	RF Function Status	Module Operation Mode
0	RF and (U)SIM disabled	Minimum functionality mode
1	RF enabled	Normal operation mode
4	RF disabled	Airplane mode

3.10.4. RESET#

The RESET# signal can be used to force a hardware reset on the module. The module can be reset by driving RESET# low for at least 300 ms and then releasing it. The RESET# signal is sensitive to interference. The traces should be as short as possible and be surrounded with ground. The reset scenario is illustrated in the following figure.

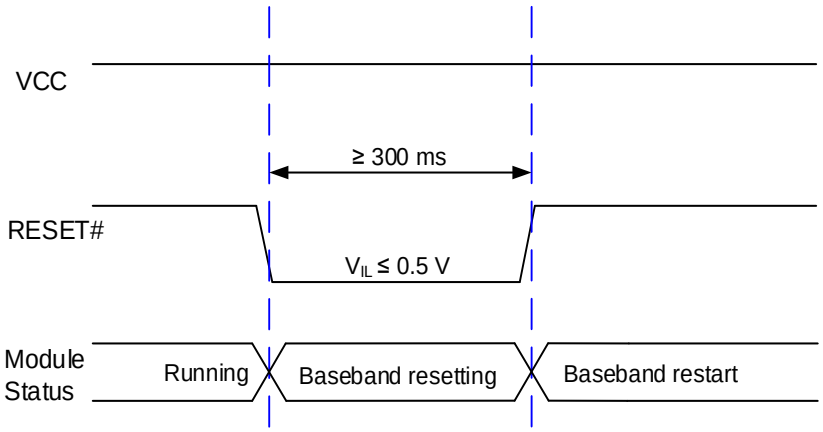


Figure 11: Reset Timing

NOTE

1. Please ensure that the maximum load capacitance of pin RESET_N does not exceed 10 nF.
2. RESET# only resets the internal baseband chip of the module and does not reset the power management chip.

3.10.5. LED_WWAN#

LED_WWAN# indicates the network status of the module, and it absorbs a current up to 40 mA. According to the following circuit, a resistor must be placed in series with the LED to reduce the current of the LED.

The LED is powered on when LED_WWAN# is pulled low.

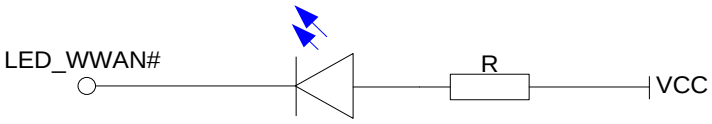


Figure 12: Reference Design of LED_WWAN#

LED_WWAN# supports multiple indication modes which can be switched with **AT+QCFG="ledmode"**:

- **AT+QCFG="ledmode",0** (Default setting, see ***Table 14*** for details)
- **AT+QCFG="ledmode",2** (See ***Table 15*** for details)

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

Table 14: Indications of Network Status (AT+QCFG="ledmode",0, Default Setting)

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

Table 15: Indications of Network Status (AT+QCFG="ledmode",2)

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

3.10.6. WAKEUP_IN

Similar to UART_RI, WAKEUP_IN is an open collector signal, it requires an external pull-up resistor and executing of **AT+QCFG="risignaltype","physical"**. When a URC returns, a 120 ms low level pulse will be outputted. The state of WAKEUP_IN signal is shown as below.

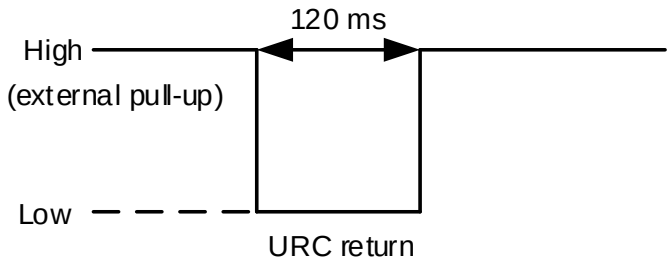


Figure 13: WAKEUP_IN Behavior

4 Antenna Connectors

EC200A series Mini PCIe is mounted with two antenna connectors for external antenna connection: a main antenna connector and an Rx-diversity antenna connector. And Rx-diversity function is enabled by default. The impedance of the antenna connectors is 50 Ω.

4.1. Operating Frequency

Table 16: EC200A-CN Mini PCIe Operating Frequencies

3GPP Band	Transmit	Receive	Unit
EGSM900	880–915	925–960	MHz
DCS1800	1710–1785	1805–1880	MHz
WCDMA B1	1922–1978	2112–2168	MHz
WCDMA B5	826–847	871–892	MHz
WCDMA B8	882–913	927–958	MHz
LTE-FDD B1	1920–1980	2110–2170	MHz
LTE-FDD B3	1710–1785	1805–1880	MHz
LTE-FDD B5	824–849	869–894	MHz
LTE-FDD B8	880–915	925–960	MHz
LTE-TDD B34	2010–2025	2010–2025	MHz
LTE-TDD B38	2570–2620	2570–2620	MHz
LTE-TDD B39	1880–1920	1880–1920	MHz
LTE-TDD B40	2300–2400	2300–2400	MHz
LTE-TDD B41	2535–2675	2535–2675	MHz

Table 17: EC200A-EU Mini PCIe Operating Frequencies

3GPP Band	Transmit	Receive	Unit
EGSM900	880–915	925–960	MHz
DCS1800	1710–1785	1805–1880	MHz
WCDMA B1	1922–1978	2112–2168	MHz
WCDMA B5	826–847	871–892	MHz
WCDMA B8	882–913	927–958	MHz
LTE-FDD B1	1920–1980	2110–2170	MHz
LTE-FDD B3	1710–1785	1805–1880	MHz
LTE-FDD B5	824–849	869–894	MHz
LTE-FDD B7	2500–2570	2620–2690	MHz
LTE-FDD B8	880–915	925–960	MHz
LTE-FDD B20	832–862	791–821	MHz
LTE-FDD B28	703–748	758–803	MHz
LTE-TDD B38	2570–2620	2570–2620	MHz
LTE-TDD B40	2300–2400	2300–2400	MHz
LTE-TDD B41	2535–2675	2535–2675	MHz

Table 18: EC200A-AU Mini PCIe Operating Frequencies

3GPP Band	Transmit	Receive	Unit
GSM850	824–849	869–894	MHz
EGSM900	880–915	925–960	MHz
DCS1800	1710–1785	1805–1880	MHz
PCS1900	1850–1910	1930–1990	MHz
WCDMA B1	1922–1978	2112–2168	MHz

WCDMA B2	1852–1908	1932–1988	MHz
WCDMA B4	1712–1753	2112–2153	MHz
WCDMA B5	826–847	871–892	MHz
WCDMA B8	882–913	927–958	MHz
LTE-FDD B1	1920–1980	2110–2170	MHz
LTE-FDD B2	1850–1910	1930–1990	MHz
LTE-FDD B3	1710–1785	1805–1880	MHz
LTE-FDD B4	1710–1755	2110–2155	MHz
LTE-FDD B5	824–849	869–894	MHz
LTE-FDD B7	2500–2570	2620–2690	MHz
LTE-FDD B8	880–915	925–960	MHz
LTE-FDD B28	703–748	758–803	MHz
LTE-TDD B40	2300–2400	2300–2400	MHz
LTE-FDD B66	1710–1780	2110–2180	MHz

4.2. Antenna Design Requirements

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

Table 19: Antenna Design Requirements

Type	Requirements
GSM/UMTS/LTE	VSWR: ≤ 2 Efficiency: > 30 % Max input power: 50 W Input impedance: 50 Ω Cable insertion loss: **< 1 dB:** LB (<1 GHz) **< 1.5 dB:** MB (1–2.3 GHz) **< 2 dB**: HB (> 2.3 GHz)

4.3. Recommended Mating Plugs for Antenna Connection

EC200A series Mini PCIe is mounted with RF connectors (receptacles) for convenient antenna connection. The dimensions of the antenna connectors are shown as below.

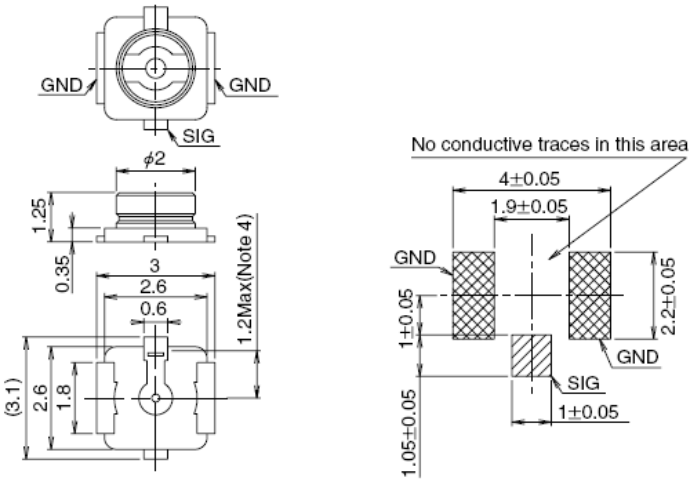


Figure 14: Dimensions of the Receptacle RF Connectors (Unit: mm)

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

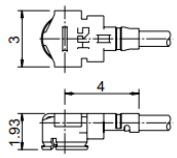
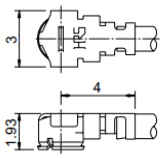
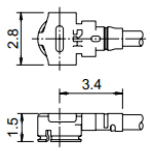
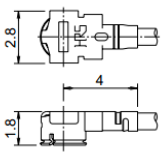
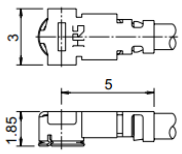
Part No.	U.FL-LP-040	U.FL-LP-066	U.FL-LP(V)-040	U.FL-LP-062	U.FL-LP-088
					
Mated Height	2.5mm Max. (2.4mm Nom.)	2.5mm Max. (2.4mm Nom.)	2.0mm Max. (1.9mm Nom.)	2.4mm Max. (2.3mm Nom.)	2.4mm Max. (2.3mm Nom.)
Applicable cable	Dia. 0.81mm Coaxial cable	Dia. 1.13mm and Dia. 1.32mm Coaxial cable	Dia. 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 15: Mechanicals of U.FL-LP Mating Plugs

The following figure describes the space factor of mating plugs.

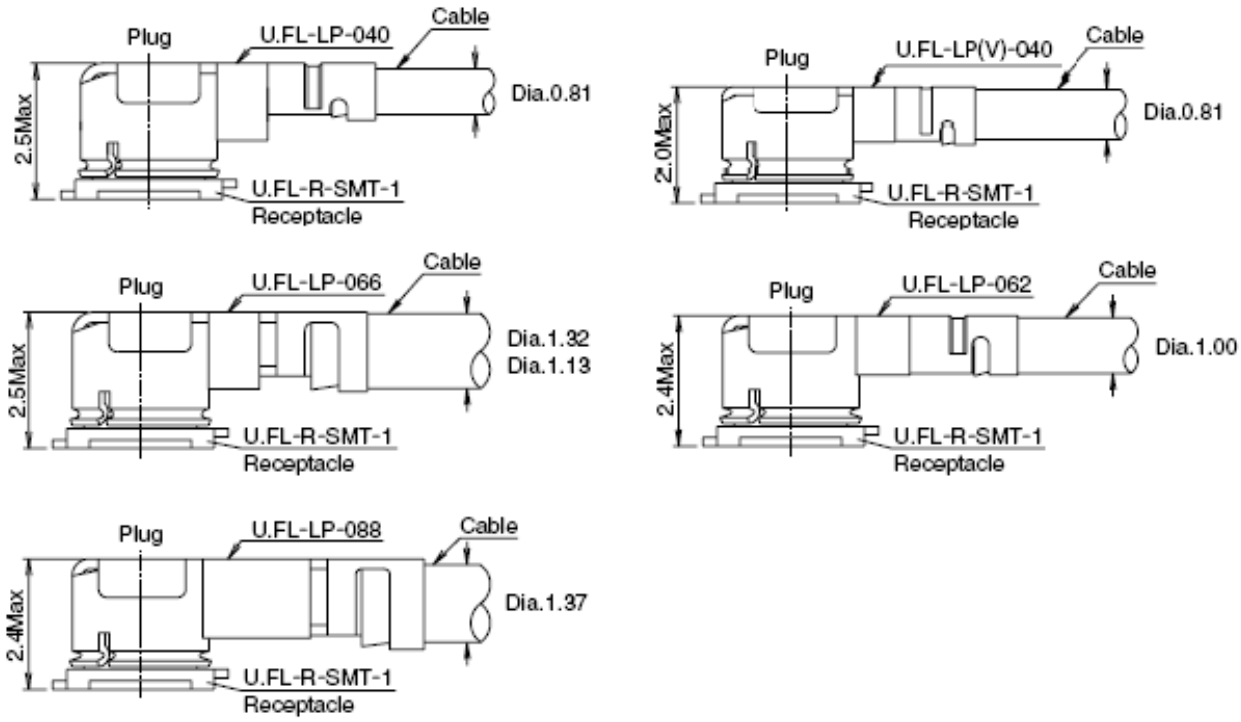


Figure 16: Space Factor of Mating Plugs (Unit: mm)

For more details of the recommended mating plugs, please visit http://www.hirose.com.

5 Reliability, Radio and Electrical Characteristics

This chapter mainly describes the following electrical and radio characteristics of EC200A series Mini PCIe:

- Power supply requirements
- Digital I/O characteristics
- RF characteristics
- ESD protection

5.1. Power Supply Requirements

The input voltage of EC200A series Mini PCIe is 3.0–3.6 V, as specified by *PCI Express Mini CEM Specifications Rev 1.2*. The following table shows the power supply requirements of the module.

Table 20: Power Supply Requirements

Parameter	Description	Min.	Typ.	Max.	Unit
VCC	Power supply for the module	3.0	3.3	3.6	V

5.2. Digital I/O Characteristics

The following table shows the digital I/O characteristics of EC200A series Mini PCIe.

Table 21: I/O Requirements

Parameter	Description	Min.	Max.	Unit
V_{IH}	Input High Voltage	0.7 × VCC	VCC + 0.3	V

V_{IL}	Input Low Voltage	-0.3	0.3 × VCC	V
V_{OH}	Output High Voltage	VCC - 0.5	VCC	V
V_{OL}	Output Low Voltage	0	0.4	V

Table 22: (U)SIM 1.8 V I/O Requirements

Parameter	Description	Min.	Max.	Unit
USIM_VDD	Power supply for (U)SIM card	1.7	1.9	V
V_{IH}	Input High Voltage	1.2	2.0	V
V_{IL}	Input Low Voltage	-0.3	0.6	V
V_{OH}	Output High Voltage	1.35	1.8	V
V_{OL}	Output Low Voltage	-0.3	0.45	V

Table 23: (U)SIM 3.0 V I/O Requirements

Parameter	Description	Min.	Max.	Unit
USIM_VDD	Power supply for (U)SIM card	2.7	3.05	V
V_{IH}	Input High Voltage	1.95	3.05	V
V_{IL}	Input Low Voltage	-0.3	1.0	V
V_{OH}	Output High Voltage	2.55	3.0	V
V_{OL}	Output Low Voltage	-0.3	0.45	V

NOTE

1. The PCM and I2C interfaces belong to 1.8 V power domain, (U)SIM interface belongs to 1.8/3.0 V, and other I/O interfaces belong to 3.3 V power domain.
2. The maximum voltage value of V_{IL} for RESET# and W_DISABLE# signal is 0.5 V.

5.3. RF Characteristics

The following tables show the conducted Tx power and Rx sensitivity of the module.

Table 24: Conducted RF Output Power of EC200A Mini PCIe

Frequency Bands	Max. Tx power	Min. Tx power
GSM850	33 dBm ±2 dB	5 dBm ±5 dB
EGSM900	33 dBm ±2 dB	5 dBm ±5 dB
DCS1800	30 dBm ±2 dB	0 dBm ±5 dB
PCS1900	30 dBm ±2 dB	0 dBm ±5 dB
GSM850 (8-PSK)	27 dBm ±3 dB	5 dBm ±5 dB
EGSM900 (8-PSK)	27 dBm ±3 dB	5 dBm ±5 dB
DCS1800 (8-PSK)	26 dBm ±3 dB	0 dBm ±5 dB
PCS1900 (8-PSK)	26 dBm ±3 dB	0 dBm ±5 dB
WCDMA B1/B2/B4/B5/B8	24 dBm +1/-3 dB	< -49 dBm
LTE-FDD B1/B2/B3/B4/B5/B7/B8/B20/B28/B66	23 dBm ±2 dB	< -39 dBm
LTE-TDD B34/B38/B39/B40/B41	23 dBm ±2 dB	< -39 dBm

Table 25: Conducted Rx Sensitivity of EC200A-CN Mini PCIe

Frequency Bands	Receiving Sensitivity (Typ.) (dBm)			3GPP (SIMO)
	Primary	Diversity	SIMO [4]	
EGSM900	-109	-	-	-102 dBm
DCS1800	-107	-	-	-102 dBm
WCDMA B1	-109.4	-	-	-106.7 dBm
WCDMA B5	-109.7	-	-	-104.7 dBm

[4] 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 receiving performance.

WCDMA B8	-110.2	-	-	-103.7 dBm
LTE-FDD B1 (10 MHz)	-98.1	-98.4	-101.3	-96.3 dBm
LTE-FDD B3 (10 MHz)	-97.1	-98.1	-100.8	-93.3 dBm
LTE-FDD B5 (10 MHz)	-98.9	-99.7	-101.9	-94.3 dBm
LTE-FDD B8 (10 MHz)	-97.4	-99.2	-101.9	-93.3 dBm
LTE-TDD B34 (10 MHz)	-96.6	-98.7	-100.5	-96.3 dBm
LTE-TDD B38 (10 MHz)	-96.7	-96.2	-98.9	-96.3 dBm
LTE-TDD B39 (10 MHz)	-97.6	-98	-100.3	-96.3 dBm
LTE-TDD B40 (10 MHz)	-97.4	-98.9	-101.4	-96.3 dBm
LTE-TDD B41 (10 MHz)	-95	-95.8	-99.1	-94.3 dBm

Table 26: Conducted Rx Sensitivity of EC200A-EU Mini PCIe

Frequency Bands	Receiving Sensitivity (Typ.) (dBm)			3GPP (SIMO)
	Primary	Diversity	SIMO [4]	
EGSM900	-108.7	-	-	-102.0 dBm
DCS1800	-107	-	-	-102.0 dbm
WCDMA B1	-109.7	-	-	-106.7 dBm
WCDMA B5	-110.6	-	-	-104.7 dBm
WCDMA B8	-110.3	-	-	-103.7 dBm
LTE-FDD B1 (10 MHz)	-96.9	-97	-100.8	-96.3 dBm
LTE-FDD B3 (10 MHz)	-95.9	-96.8	-100.4	-93.3 dBm
LTE-FDD B5 (10 MHz)	-98.3	-99	-102.2	-94.3 dBm
LTE-FDD B7 (10 MHz)	-94.4	-95.8	-98	-94.3 dBm
LTE-FDD B8 (10 MHz)	-96.7	-98.9	-100.1	-93.3 dBm
LTE-FDD B20 (10 MHz)	-98.1	-99.3	-101.4	-93.3 dBm

LTE-FDD B28 (10 MHz)	-98.9	-99.5	-102.6	-94.8 dBm
LTE-TDD B38 (10 MHz)	-96.5	-95.2	-99.3	-96.3 dBm
LTE-TDD B40 (10 MHz)	-97.3	-97.3	-100.5	-96.3 dBm
LTE-TDD B41 (10 MHz)	-94.9	-95.1	-97.8	-94.3 dBm

Table 27: Conducted Rx Sensitivity of EC200A-AU Mini PCIe

Frequency Bands	Receiving Sensitivity (Typ.) (dBm)			3GPP (SIMO)
	Primary	Diversity	SIMO [4]	
GSM850	-109.3	-	-	-102 dBm
EGSM900	-108.2	-	-	-102 dBm
DCS1800	-106.8	-	-	-102 dBm
DCS1900	-107	-	-	-102 dBm
WCDMA B1	-109.2	-	-	-106.7 dBm
WCDMA B2	-107.7	-	-	-104.7 dBm
WCDMA B4	-109.2	-	-	-106.7 dBm
WCDMA B5	-110.7	-	-	-104.7 dBm
WCDMA B8	-110.2	-	-	-103.7 dBm
LTE-FDD B1 (10 MHz)	-97.8	-97.8	-101	-96.3 dBm
LTE-FDD B2 (10 MHz)	-96.1	-97.8	-100.2	-94.3 dBm
LTE-FDD B3 (10 MHz)	-96.7	-97.5	-100.9	-93.3 dBm
LTE-FDD B4 (10 MHz)	-96.6	-97.4	-101.1	-96.3 dBm
LTE-FDD B5 (10 MHz)	-98.2	-99.2	-101.7	-94.3 dBm
LTE-FDD B7 (10 MHz)	-95.8	-97.3	-99.9	-94.3 dBm
LTE-FDD B8 (10 MHz)	-96.9	-98.6	-100.2	-93.3 dBm
LTE-FDD B28 (10 MHz)	-98.5	-99.3	-102.4	-94.8 dBm

LTE-TDD B40 (10 MHz)	-96.9	-98.5	-101.3	-96.3 dBm
LTE-FDD B66 (10 MHz)	-95.5	-97.7	-100	-95.8 dBm

5.4. ESD Protection

If the static electricity generated by various ways discharges to the module, the module maybe damaged to a certain extent. Thus, please take proper ESD countermeasures and handling methods. For example, wearing anti-static gloves during the development, production, assembly and testing of the module; adding ESD protective components to the ESD sensitive interfaces and points in the product design.

The following table shows the ESD characteristics of EC200A series Mini PCIe.

Table 28: ESD Characteristics of EC200A Series Mini PCIe

Tested Interfaces	Contact Discharge	Air Discharge	Unit
Power supply and GND	±5	±10	kV
Antenna interfaces	±4	±8	kV
Others	±0.5	±1	kV

5.5. Operating and Storage Temperatures

Table 29: Operating and Storage Temperatures

Parameter	Min.	Typ.	Max.	Unit
Operating Temperature Range [5]	-35	+25	+75	ºC
Extended Temperature Range [6]	-40	-	+80	ºC
Storage Temperature Range	-40	-	+90	ºC

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

5.6. Power Consumption

The following tables describe the power consumption of EC200A series Mini PCIe. And the data of EC200A-AU Mini PCIe will be provided in the next version.

Table 30: Power Consumption of EC200A-CN Mini PCIe

Description	Conditions	Typ.	Unit
Sleep Mode	**AT+CFUN=0** (USB disconnected)	3.23	mA
	EGSM900 @ DRX = 2 (USB disconnected)	6.45	mA
	EGSM900 @ DRX = 5 (USB disconnected)	5.66	mA
	EGSM900 @ DRX = 5 (USB suspend)	6.10	mA
	EGSM900 @ DRX = 9 (USB disconnected)	5.77	mA
	DCS1800 @ DRX = 2 (USB disconnected)	6.03	mA
	DCS1800 @ DRX = 5 (USB disconnected)	5.37	mA
	DCS1800 @ DRX = 5 (USB suspend)	5.80	mA
	DCS1800 @ DRX = 9 (USB disconnected)	6.38	mA
	WCDMA @ PF = 64 (USB disconnected)	7.16	mA
	WCDMA @ PF = 64 (USB suspend)	7.02	mA
	WCDMA @ PF = 128 (USB disconnected)	6.50	mA
	WCDMA @ PF = 256 (USB disconnected)	6.33	mA
	WCDMA @ PF = 512 (USB disconnected)	6.34	mA
	LTE-FDD @ PF = 32 (USB disconnected)	7.64	mA
	LTE-FDD @ PF = 64 (USB disconnected)	6.08	mA
	LTE-FDD @ PF = 64 (USB suspend)	6.11	mA
	LTE-FDD @ PF = 128 (USB disconnected)	5.58	mA
	LTE-FDD @ PF = 256 (USB disconnected)	5.91	mA

	LTE-TDD @ PF = 32 (USB disconnected)	8.63	mA
	LTE-TDD @ PF = 64 (USB disconnected)	6.96	mA
	LTE-TDD @ PF = 64 (USB suspend)	6.92	mA
	LTE-TDD @ PF = 128 (USB disconnected)	6.43	mA
	LTE-TDD @ PF = 256 (USB disconnected)	6.31	mA
Idle Mode	EGSM900 DRX = 5 (USB disconnected)	45.05	mA
	EGSM900 DRX = 5 (USB connected)	68.67	mA
	WCDMA @ PF = 64 (USB disconnected)	49.08	mA
	WCDMA @ PF = 64 (USB connected)	69.77	mA
	LTE-FDD @ PF = 64 (USB disconnected)	48.11	mA
	LTE-FDD @ PF = 64 (USB connected)	69.07	mA
	LTE-TDD @ PF = 64 (USB disconnected)	49.16	mA
	LTE-TDD @ PF = 64 (USB connected)	69.88	mA
GPRS data transfer	EGSM900 4DL/1UL @ 31.37 dBm	197.6	mA
	EGSM900 3DL/2UL @ 31.32 dBm	364.8	mA
	EGSM900 2DL/3UL @ 30.22 dBm	468.8	mA
	EGSM900 1DL/4UL @ 28.15 dBm	523.2	mA
	DCS1800 4DL/1UL @ 29.57 dBm	134.3	mA
	DCS1800 3DL/2UL @ 29.59 dBm	242.3	mA
	DCS1800 2DL/3UL @ 28.09 dBm	281.8	mA
	DCS1800 1DL/4UL @ 26.16 dBm	298.5	mA
EDGE data transfer	EGSM900 4DL/1UL @ 28.05 dBm	136.6	mA
	EGSM900 3DL/2UL @ 27.72 dBm	243.3	mA
	EGSM900 2DL/3UL @ 24.16 dBm	314.2	mA
	EGSM900 1DL/4UL @ 21.98 dBm	359.2	mA

	DCS1800 4DL/1UL @ 26.53 dBm	119.4	mA
	DCS1800 3DL/2UL @ 26.27 dBm	214.1	mA
	DCS1800 2DL/3UL @ 24.69 dBm	289.1	mA
	DCS1800 1DL/4UL @ 22.00 dBm	344.8	mA
WCDMA data transfer	WCDMA B1 HSDPA @ 23.63 dBm	511.97	mA
	WCDMA B1 HSUPA @ 22.45 dBm	443.02	mA
	WCDMA B5 HSDPA @ 23.08 dBm	483.22	mA
	WCDMA B5 HSUPA @ 21.56 dBm	489.72	mA
	WCDMA B8 HSDPA @ 22.47 dBm	405.29	mA
	WCDMA B8 HSUPA @ 21.17 dBm	451.78	mA
LTE data transfer	LTE-FDD B1 @ 22.46 dBm	563.82	mA
	LTE-FDD B3 @ 22.15 dBm	583.24	mA
	LTE-FDD B5 @ 22.84 dBm	530.15	mA
	LTE-FDD B8 @ 22.49 dBm	578.26	mA
	LTE-TDD B34 @ 22.78 dBm	228.47	mA
	LTE-TDD B38 @ 22.51 dBm	357.07	mA
	LTE-TDD B39 @ 22.48 dBm	236.27	mA
	LTE-TDD B40 @ 23.19 dBm	333.39	mA
	LTE-TDD B41 @ 21.83 dBm	381.70	mA
GSM voice call	EGSM900 PCL = 5 @ 31.47 dBm	202.3	mA
	EGSM900 PCL = 12 @ 18.77 dBm	74.5	mA
	EGSM900 PCL = 19 @ 5.00 dBm	47.2	mA
	DCS1800 PCL = 0 @ 29.67 dBm	134.9	mA
	DCS1800 PCL = 7 @ 16.59 dBm	59.4	mA
	DCS1800 PCL = 15 @ 0.92 dBm	46.8	mA

WCDMA voice call	WCDMA B1 @ 23.15 dBm	557.69	mA
	WCDMA B5 @ 22.16 dBm	483.34	mA
	WCDMA B8 @ 21.45 dBm	529.50	mA

Table 31: Power Consumption of EC200A-EU Mini PCIe

Description	Conditions	Typ.	Unit
Sleep Mode	**AT+CFUN=0** (USB disconnected)	3.25	mA
	EGSM900 @ DRX = 2 (USB disconnected)	5.59	mA
	EGSM900 @ DRX = 5 (USB disconnected)	4.26	mA
	EGSM900 @ DRX = 5 (USB suspend)	4.58	mA
	EGSM900 @ DRX = 9 (USB disconnected)	3.99	mA
	DCS1800 @ DRX = 2 (USB disconnected)	5.71	mA
	DCS1800 @ DRX = 5 (USB disconnected)	4.24	mA
	DCS1800 @ DRX = 5 (USB suspend)	4.64	mA
	DCS1800 @ DRX = 9 (USB disconnected)	3.73	mA
	WCDMA @ PF = 64 (USB disconnected)	5.94	mA
	WCDMA @ PF = 64 (USB suspend)	6.15	mA
	WCDMA @ PF = 128 (USB disconnected)	4.45	mA
	WCDMA @ PF = 256 (USB disconnected)	3.72	mA
	WCDMA @ PF = 512 (USB disconnected)	3.45	mA
	LTE-FDD @ PF = 32 (USB disconnected)	7.29	mA
	LTE-FDD @ PF = 64 (USB disconnected)	5.46	mA
	LTE-FDD @ PF = 64 (USB suspend)	5.66	mA
	LTE-FDD @ PF = 128 (USB disconnected)	4.22	mA
	LTE-FDD @ PF = 256 (USB disconnected)	3.48	mA

	LTE-TDD @ PF = 32 (USB disconnected)	7.69	mA
	LTE-TDD @ PF = 64 (USB disconnected)	5.94	mA
	LTE-TDD @ PF = 64 (USB suspend)	6.12	mA
	LTE-TDD @ PF = 128 (USB disconnected)	4.71	mA
	LTE-TDD @ PF = 256 (USB disconnected)	4.24	mA
Idle Mode	EGSM900 DRX = 5 (USB disconnected)	48.69	mA
	EGSM900 DRX = 5 (USB connected)	73.96	mA
	WCDMA @ PF = 64 (USB disconnected)	54.88	mA
	WCDMA @ PF = 64 (USB connected)	74.74	mA
	LTE-FDD @ PF = 64 (USB disconnected)	52.94	mA
	LTE-FDD @ PF = 64 (USB connected)	73.83	mA
	LTE-TDD @ PF = 64 (USB disconnected)	51.45	mA
	LTE-TDD @ PF = 64 (USB connected)	74.27	mA
GPRS data transfer	EGSM900 4DL/1UL @ 33.01dBm	199	mA
	EGSM900 3DL/2UL @ 32.93 dBm	372	mA
	EGSM900 2DL/3UL @ 30.91 dBm	478	mA
	EGSM900 1DL/4UL @ 28.95 dBm	533	mA
	DCS1800 4DL/1UL @ 29.74 dBm	136	mA
	DCS1800 3DL/2UL @ 29.82 dBm	244	mA
	DCS1800 2DL/3UL @ 28.35 dBm	293	mA
	DCS1800 1DL/4UL @ 26.35 dBm	309	mA
EDGE data transfer	EGSM900 4DL/1UL @ 26.09 dBm	137	mA
	EGSM900 3DL/2UL @ 25.45 dBm	246	mA
	EGSM900 2DL/3UL @ 23.43 dBm	315	mA
	EGSM900 1DL/4UL @ 20.82 dBm	375	mA

	DCS1800 4DL/1UL @ 25.27 dBm	121	mA
	DCS1800 3DL/2UL @ 25.14 dBm	215	mA
	DCS1800 2DL/3UL @ 23.49 dBm	289	mA
	DCS1800 1DL/4UL @ 20.92 dBm	360	mA
WCDMA data transfer	WCDMA B1 HSDPA @ 21.99 dBm	520	mA
	WCDMA B5 HSDPA @ 21.76 dBm	474	mA
	WCDMA B8 HSDPA @ 21.81 dBm	496	mA
	WCDMA B1 HSUPA @ 21.21 dBm	504	mA
	WCDMA B5 HSUPA @ 21.13 dBm	454	mA
	WCDMA B8 HSUPA @ 21.49 dBm	497	mA
LTE data transfer	LTE-FDD B1 @ 23.08 dBm	607	mA
	LTE-FDD B3 @ 23.69 dBm	636	mA
	LTE-FDD B5 @ 23.70 dBm	568	mA
	LTE-FDD B7 @ 23.98 dBm	813	mA
	LTE-FDD B8 @ 23.16 dBm	591	mA
	LTE-FDD B20 @ 23.18 dBm	592	mA
	LTE-FDD B28 @ 23.21 dBm	559	mA
	LTE-TDD B38 @ 23.13 dBm	230	mA
	LTE-TDD B40 @ 22.72 dBm	233	mA
	LTE-TDD B41 @ 23.29 dBm	242	mA
GSM voice call	EGSM900 PCL = 5 @ 32.34 dBm	206	mA
	EGSM900 PCL = 12 @ 19.11 dBm	76	mA
	EGSM900 PCL = 19 @ 6.05 dBm	48	mA
	DCS1800 PCL = 0 @ 29.50 dBm	136	mA
	DCS1800 PCL = 7 @ 16.07 dBm	61	mA

	DCS1800 PCL = 15 @ -1.14 dBm	48	mA
WCDMA voice call	WCDMA B1 @ 22.29 dBm	543	mA
	WCDMA B5 @ 22.26 dBm	496	mA
	WCDMA B8 @ 22.25 dBm	533	mA

5.7. Notification

Please follow the principles below in the module application.

5.7.1. Coating

If a conformal coating is necessary for the module, do NOT use any coating material that may chemically react with the PCB or shielding cover, and prevent the coating material from flowing into the module.

5.7.2. Cleaning

Avoid using ultrasonic technology for module cleaning since it can damage crystals inside the module.

6 Mechanical Information

6.1. General Description

This chapter mainly describes the mechanical dimensions as well as packaging specification of EC200A series Mini PCIe module. All dimensions are measured in millimeter (mm), and the dimensional tolerances are ±0.15 mm unless otherwise specified.

6.2. Mechanical Dimensions

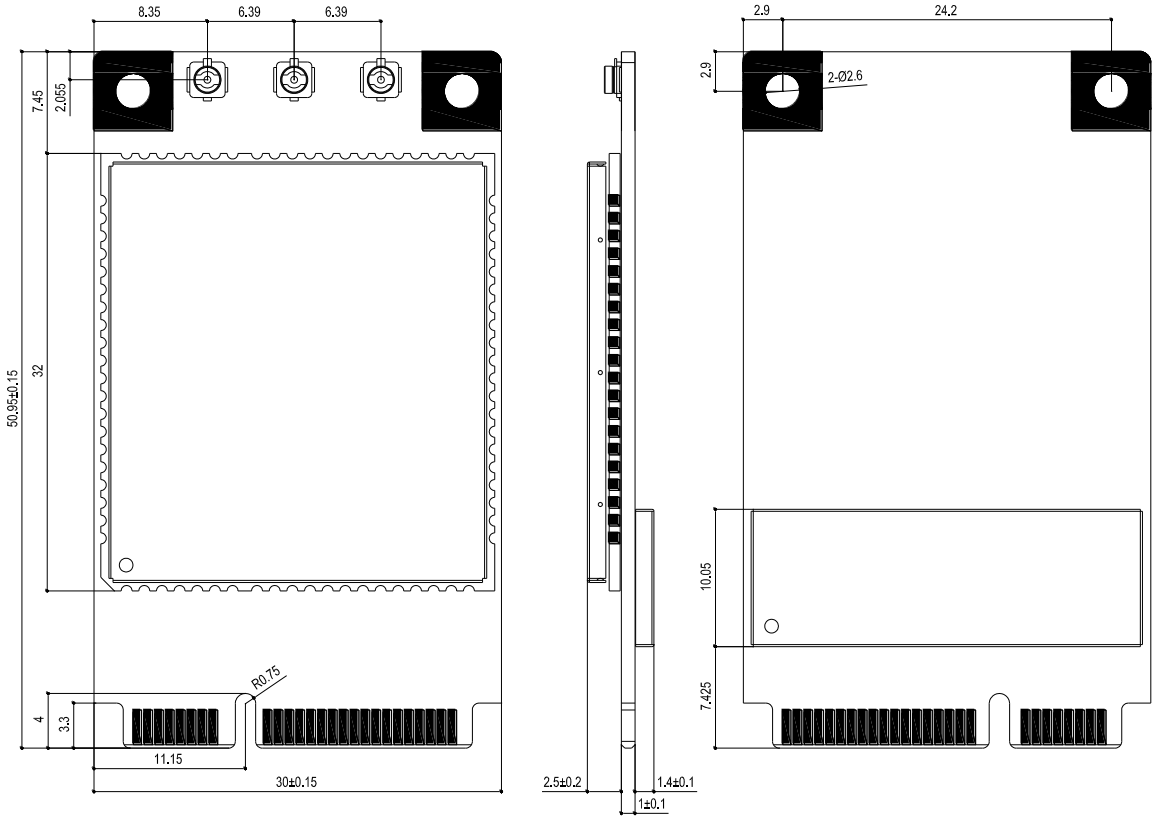


Figure 17: Mechanical Dimensions of EC200A Series Mini PCIe

EC200A Mini PCIe adopts a standard Mini PCI Express connector. The following figure takes the Molex 679105700 as an example.

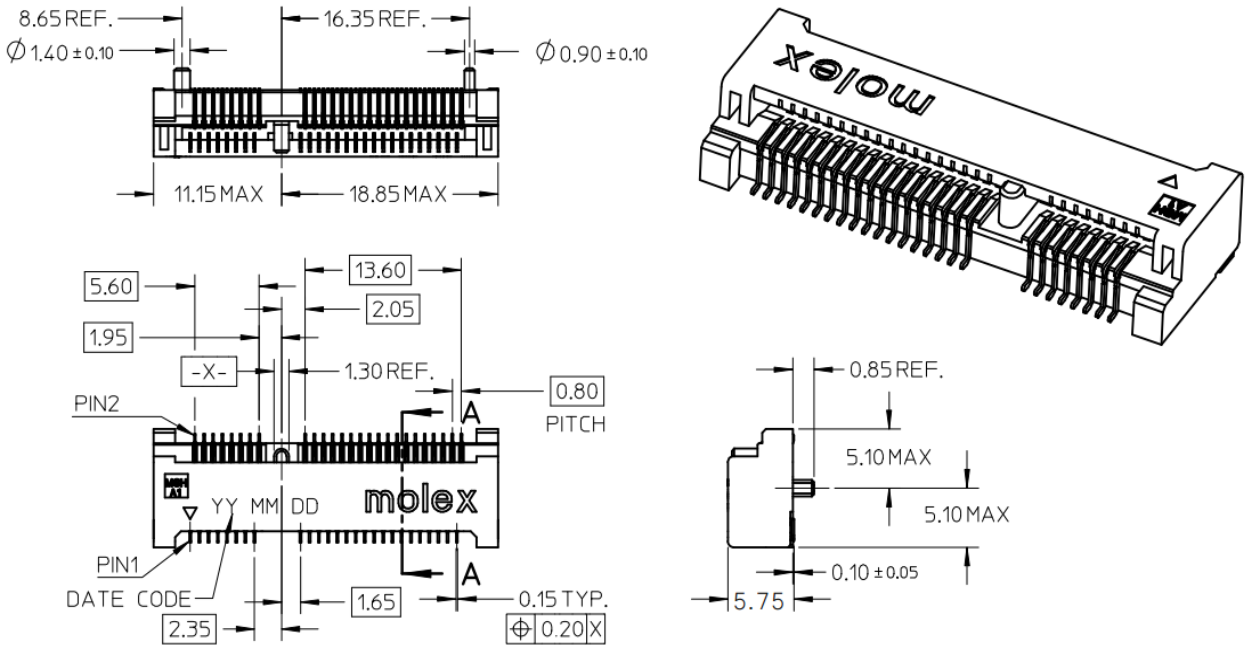


Figure 18: Dimensions of the Mini PCI Express Connector (Molex 679105700)

6.3. Packaging Specifications

The module adopts blister tray packaging and details are as follow:

6.3.1. Blister Tray

Dimension details are as follow:

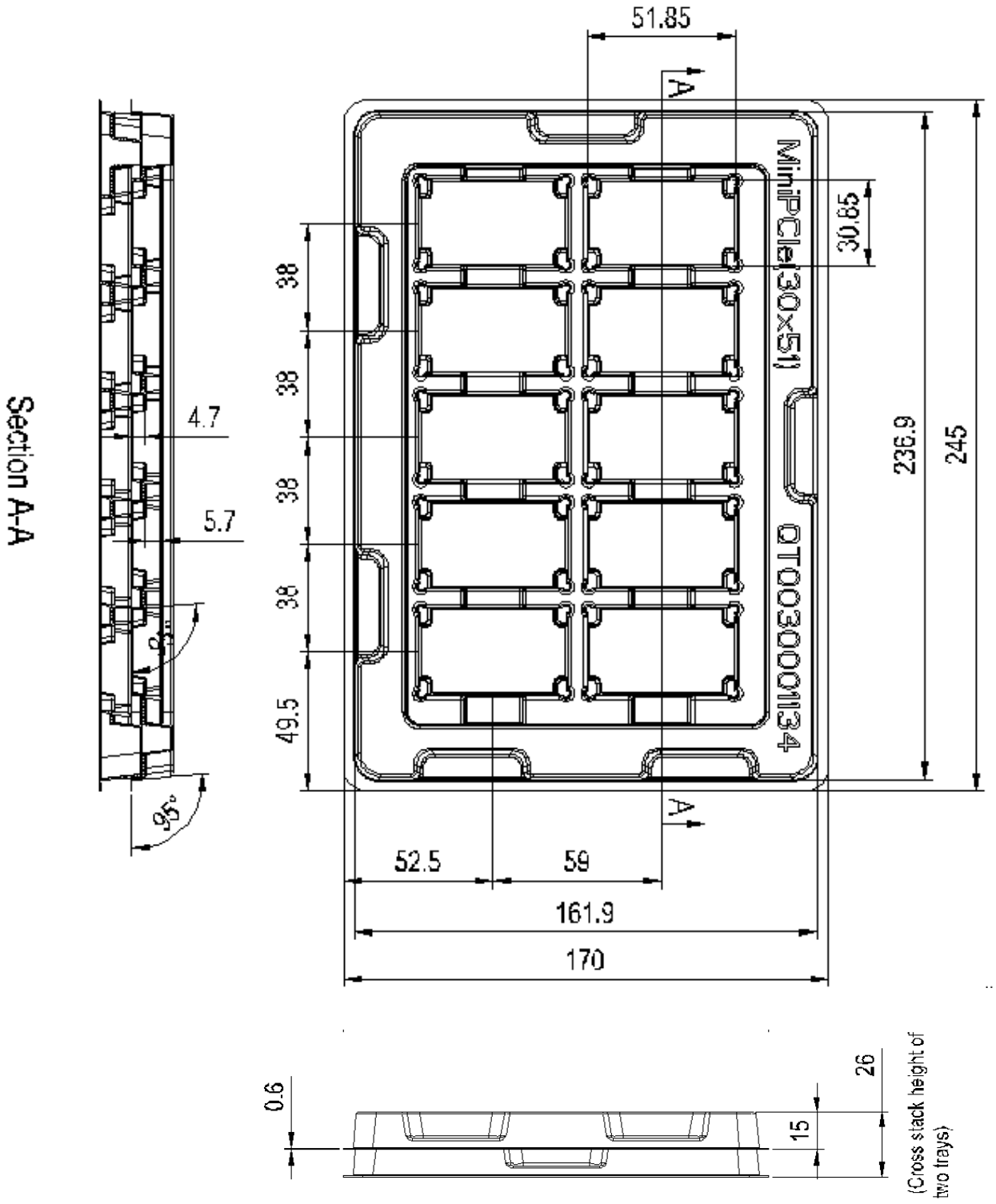
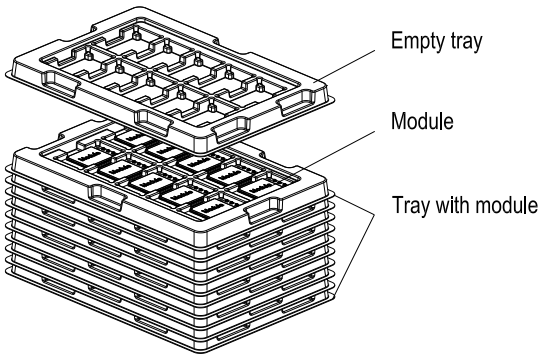
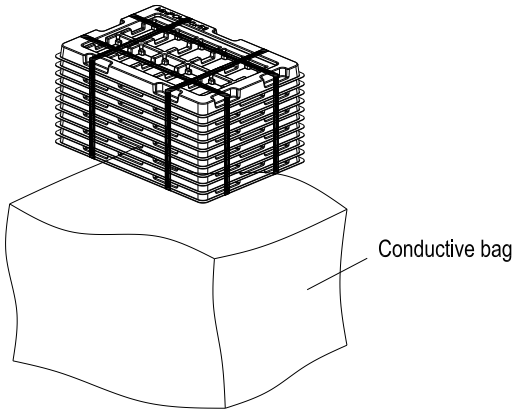


Figure 19: Blister Tray Dimension Drawing

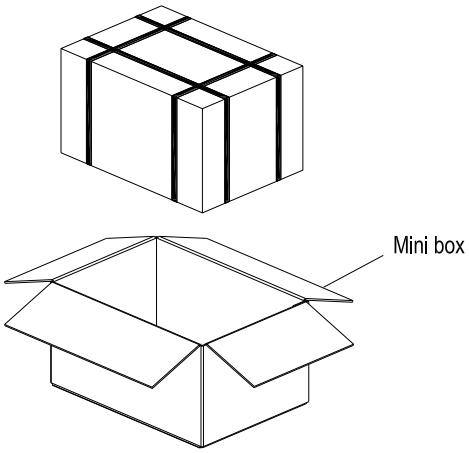
6.3.2. Packaging Process



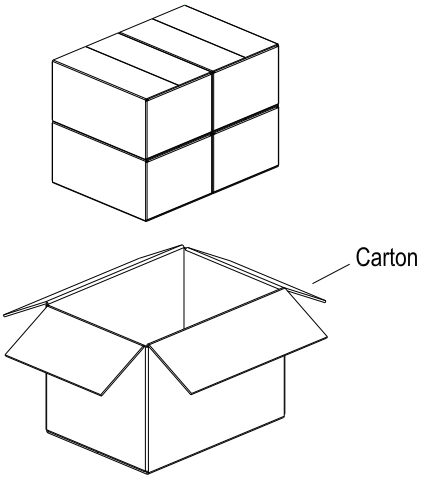
Each blister tray packs 10 modules. Stack 10 blister trays with modules together, and put 1 empty blister tray on the top.



Packing 11 blister trays together and then put blister trays into a conductive bag, seal and pack the conductive bag.



Put seal-packed blister trays into a mini box. One mini box can pack 100 modules.



Put 4 mini boxes into 1 carton and then seal it. One carton can pack 400 modules.

Figure 20: Packaging Process

7 Appendix References

Table 32: Related Documents

Document Name
[1] Quectel_Mini_PCIe_EVB_User_Guide
[2] Quectel_LTE Standard(A)_Series_AT_Commands_Manual

Table 33: Terms and Abbreviations

Abbreviation	Description
AMR	Adaptive Multi-rate
bps	Bits Per Second
CS	Coding Scheme
CTS	Clear to Send
DFOTA	Delta Firmware Upgrade Over-The-Air
DL	Down Link
DTE	Data Terminal Equipment
DTR	Data Terminal Ready
EDGE	Enhanced Data Rates for GSM Evolution
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
EMI	Electro Magnetic Interference
ESD	Electrostatic Discharge

ESR	Equivalent Series Resistance
FDD	Frequency Division Duplexing
FR	Full Rate
GMSK	Gaussian Minimum Shift Keying
GSM	Global System for Mobile Communications
HR	Half Rate
HSPA	High Speed Packet Access
HSUPA	High Speed Uplink Packet Access
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
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
SIMO	Single Input Multiple Output
SMS	Short Message Service
TDD	Time Division Duplex
TX	Transmitting Direction
TVS	Transient Voltage Suppressor
UART	Universal Asynchronous Receiver & Transmitter
UL	Uplink
URC	Unsolicited Result Code
USB	Universal Serial Bus
(U)SIM	(Universal) Subscriber Identification Module
WCDMA	Wideband Code Division Multiple Access