EC200T-AU Series Mini PCIe

Hardware Design

LTE Standard Module Series

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About the Document

Revision History

Version	Date	Author	Description
1.0	2020-02-27	Jaye SANG/ Niko WU	Initial
1.1	2020-10-17	Anthony LIU/ Niko WU	Added Current Consumption operation and storage temperatures

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1 Introduction

This document defines EC200T Series Mini PCIe module, and describes its air interfaces and hardware interfaces which are connected with customers' applications.

This document helps customers 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 customers' reference. The document, coupled with application notes and user guides, makes it easy to design and set up wireless applications with EC200T Series Mini PCIe.

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

And the following conditions must be met:

1. This Modular Approval is limited to OEM installation for mobile and fixed applications only. The antenna installation and operating configurations of this transmitter, including any applicable source-based time-averaging duty factor, antenna gain and cable loss must satisfy MPE categorical Exclusion Requirements of 2.1091.

2. The EUT is a mobile device; maintain at least a 20 cm separation between the EUT and the user's body and must not transmit simultaneously with any other antenna or transmitter.

3.A label with the following statements must be attached to the host end product: This device contains FCC ID: XMR202011EC200TAU.

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

- GSM850 :≤8.571dBi
- GSM1900 :≤10.03dBi
- LTE Band2/25:≤11.000dBi

- ❒ WCDMA Band II/LTE Band2/ LTE Band 7 :≤8.000dBi
- ❒ WCDMA Band IV/ LTE Band 4 / LTE Band 66:≤5.000dBi
- ❒ WCDMA Band V / LTE Band 5:≤9.541dBi

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

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

For portable devices, in addition to the conditions 3 through 6 described above, a separate approval is required to satisfy the SAR requirements of FCC Part 2.1093

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

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

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

For a host using a certified modular with a standard fixed label, if (1) the module's FCC ID is not visible when installed in the host, or (2) if the host is marketed so that end users do not have straightforward commonly used methods for access to remove the module so that the FCC ID of the module is visible; then an additional permanent label referring to the enclosed module:"Contains Transmitter Module FCC ID: XMR202011EC200TAU" or "Contains FCC ID: XMR202011EC200TAU" must be used. The host OEM user manual must also contain clear instructions on how end users can find and/or access the module and the FCC ID.

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

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

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

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

1.1. Safety Information

The following safety precautions must be observed during all phases of operation, such as usage, service or repair of any cellular terminal or mobile incorporating EC200T Series Mini PCIe module. Manufacturers of the cellular terminal should send the following safety information to users and operating personnel, and incorporate these guidelines into all manuals supplied with the product. If not so, Quectel assumes no liability for customers' failure to comply with these precautions.

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

2 Product Concept

2.1. General Description

EC200T 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 customers' applications.

EC200T 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

This chapter generally introduces the following aspects of EC200T Series Mini PCIe module:

- Product Series
- Key Features
- Functional Diagram

2.2. Description of Module Series

EC200T Series Mini PCIe series contains 3 variants, and are listed in the following table.

Table 1: Description of EC200T Series Mini PCIe

Module Series	Description
EC200T-CN Mini PCIe	Support LTE-FDD (with receive diversity) [1]: B1/B3/B5/B8 Support LTE-TDD (with receive diversity) [1]: B34/B38/B39/B40/B41 Support WCDMA: B1/B5/B8 Support GSM: 900/1800MHz Support digital audio
EC200T-EU Mini PCIe	Support LTE-FDD (with receive diversity) [1]: B1/B3/B7/B8/B20/B28 Support LTE-TDD (with receive diversity) [1]: B38/B40/B41 Support WCDMA: B1/B8 Support GSM: 900/1800MHz Support digital audio
EC200T-AU Mini PCIe*	Support LTE-FDD (with receive diversity) [1]: B1/B2/B3/B4/B5/B7/B8/B28/B66 Support LTE-TDD (with receive diversity) [1]: B40 Support WCDMA: B1/B2/B4/B5/B8 Support GSM: 850/900/1800/1900MHz Support digital audio

NOTES

1. [1] Rx-diversity is optional.
2. "*" means under development.

2.3. Key Features

The following table describes the detailed features of EC200T Series Mini PCIe module.

Table 2: Key Features of EC200T Series Mini PCIe

Features	Description
Function 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	Class 4 (33dBm±2dB) for EGSM900 Class 1 (30dBm±2dB) for DCS1800 Class E2 (27dBm±3dB) for EGSM900 8-PSK Class E2 (26dBm±3dB) for DCS1800 8-PSK Class 3 (24dBm+1/-3dB) for WCDMA bands Class 3 (23dBm±2dB) for LTE-FDD bands Class 3 (23dBm±2dB) for LTE-TDD bands
LTE Features	Support up to 3GPP R8 non-CA Cat 4 FDD and TDD Support 1.4/3/5/10/15/20MHz RF bandwidth Support MIMO in DL direction FDD: Max 150Mbps (DL), Max 50Mbps (UL) TDD: Max 130Mbps (DL), Max 30Mbps (UL)
UMTS Features	Support 3GPP R7 HSPA+, HSDPA, HSUPA and WCDMA Support QPSK and 16-QAM modulation HSDPA+: Max 21Mbps (DL) HSUPA: Max 5.76Mbps (UL) WCDMA: Max 384kbps (UL), Max 384kbps (DL)
GSM Features	**GPRS:** Support GPRS multi-slot class 12 Coding scheme: CS-1, CS-2, CS-3 and CS-4 Max 85.6kbps (DL), Max 85.6kbps (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 236.8kbps (DL), Max 236.8kbps (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 connections
SMS	Text and PDU modes Point-to-point MO and MT SMS cell broadcast SMS storage: (U)SIM card currently
(U)SIM Interface	Support USIM/SIM card: 1.8 V, 3.0 V
UART Interface	**Main UART:** Support RTS and CTS hardware flow control Baud rate can reach up to 230400bps, 115200bps by default Used for AT command communication and data transmission

Audio Features	Support one digital audio interface: PCM interface GSM: HR/FR/EFR/AMR/AMR-WB WCDMA: AMR/AMR-WB Support echo cancellation and noise suppression
PCM Interface	Used for audio function with external codec Support 16-bit linear data format Support short frame synchronization Support master and slave modes
USB Interface	Compliant with USB 2.0 specification (slave only); the data transfer rate can reach up to 480Mbps Used for AT command communication, data transmission, software debugging, and firmware upgrade Support USB serial drivers for: Windows 7/8/8.1/10, Linux 2.6–5.4, Android 4.x/5.x/6.x/7.x/8.x/9.x, etc.
Antenna Connectors	Include main antenna and diversity antenna connectors
Rx-diversity (Optional)	Support LTE Rx-diversity
AT Commands	Compliant with 3GPP TS 27.007, 27.005 and Quectel enhanced AT commands
Physical Characteristics	Size: (51.0±0.15)mm × (30.0±0.15)mm × (4.9±0.2)mm Weight: approx. 9.7g
Temperature Range	Operating temperature range: -35°C to +75°C [1)] Extended temperature range: -40°C to +80°C [2)] Storage temperature range: -40°C to +90°C
Firmware Upgrade	Upgrade via USB interface or FOTA
RoHS	All hardware components are fully compliant with EU RoHS directive

NOTES

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

2.4. Functional Diagram

The following figure shows the block diagram of EC200T Series Mini PCIe.

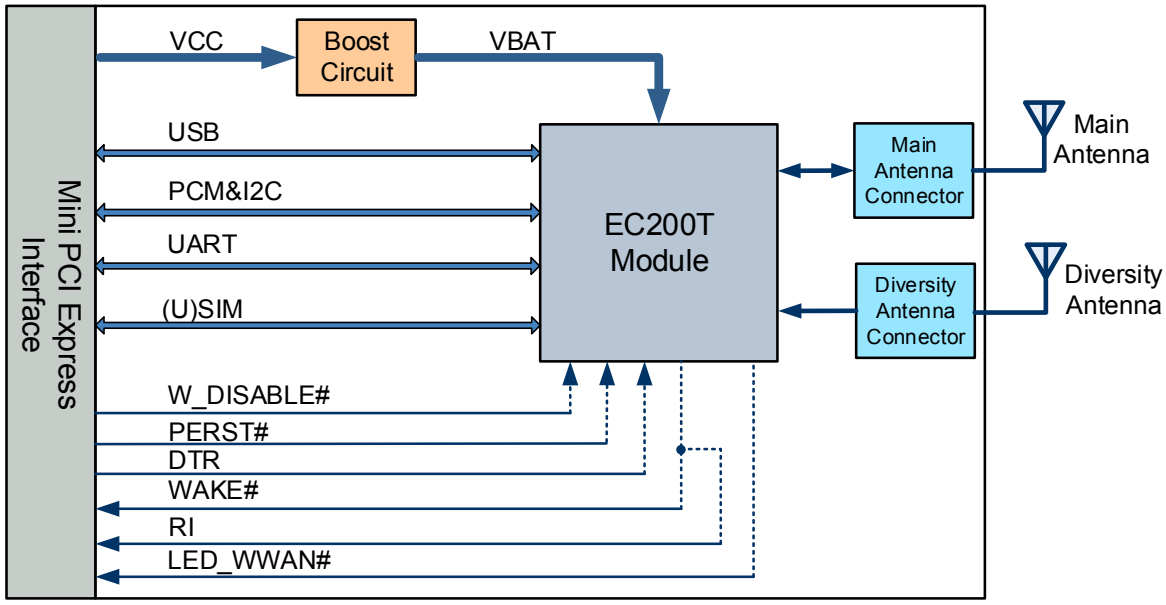


Figure 1: Functional Diagram

3 Application Interfaces

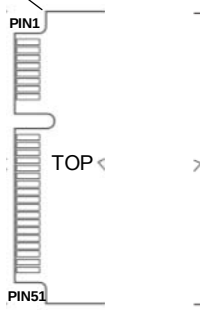
The physical connections and signal levels of EC200T Series Mini PCIe comply with PCI Express Mini Card Electromechanical Specification. This chapter mainly describes the definition and application of the following interfaces/pins of EC200T Series Mini PCIe.

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

3.1. Pin Assignment

The following figure shows the pin assignment of EC200T Series Mini PCIe module. The top side contains EC200T module and antenna connectors.

Pin Name	Pin No.
WAKE#	1
RESERVED	3
RESERVED	5
RESERVED	7
GND	9
UART_RX	11
UART_TX	13
GND	15
RI	17
RESERVED	19
GND	21
UART_CTS	23
UART_RTS	25
GND	27
GND	29
DTR	31
RESERVED	33
GND	35
GND	37
VCC_3V3	39
VCC_3V3	41
GND	43
PCM_CLK	45
PCM_DOUT	47
PCM_DIN	49
PCM_SYNC	51



Pin No.	Pin Name
2	VCC_3V3
4	GND
6	NC
8	USIM_VDD
10	USIM_DATA
12	USIM_CLK
14	USIM_RST
16	RESERVED
18	GND
20	W_DISABLE#
22	PERST#
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_3V3

Figure 2: Pin Assignment

3.2. Pin Description

The following tables show the pin definition and description of the 52 pins on EC200T Series Mini PCIe.

Table 3: I/O Parameters Definition

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

Table 4: Pin Description

Mini PCI Express Standard Name	EC200T Series Mini PCIe Pin Name	Pin No.	I/O	Description	Comment
WAKE#	WAKE#	1	OC	Wake up the module.	
3.3Vaux	VCC_3V3	2	PI	Power supply for the module	
COEX1	RESERVED	3		Reserved	
GND	GND	4		Mini card ground	
COEX2	RESERVED	5		Reserved	
1.5V	NC	6		Not connected	
CLKREQ#	RESERVED	7		Reserved	
UIM_PWR	USIM_VDD	8	PO	(U)SIM card power supply	
GND	GND	9		Mini card ground	

UIM_DATA	USIM_DATA	10	IO	(U)SIM card data	
REFCLK-	UART_RX	11	DI	receive	Connect to DTE's TX.
UIM_CLK	USIM_CLK	12	DO	(U)SIM card clock	
REFCLK+	UART_TX	13	DO	transmit	Connect to DTE's RX.
UIM_RESET	USIM_RST	14	DO	(U)SIM card reset	
GND	GND	15		Mini card ground	
UIM_VPP	RESERVED	16		Reserved	
RESERVED	RI	17	DO	Ring indication	
GND	GND	18		Mini card ground	
RESERVED	RESERVED	19		Reserved	
W_DISABLE#	W_DISABLE#	20	DI	Airplane mode control	Pulled up by default. Active low.
GND	GND	21		Mini card ground	
PERST#	PERST#	22	DI	Module reset	Pulled up by default. Active low.
PERn0	UART_CTS	23	DI	clear to send	Connect to DTE's RTS.
3.3Vaux	RESERVED	24		Reserved	
PERp0	UART_RTS	25	DO	request to send	Connect to DTE's CTS.
GND	GND	26		Mini card ground	
GND	GND	27		Mini card ground	
1.5V	NC	28		Not connected	
GND	GND	29		Mini card ground	
SMB_CLK	I2C_SCL	30	OD	I2C serial clock	Require external pull-up to 1.8V.

PETn0	DTR	31	DI	Data terminal ready	
SMB_DATA	I2C_SDA	32	OD	I2C serial data	Require external pull-up to 1.8V.
PETp0	RESERVED	33		Reserved	
GND	GND	34		Mini card ground	
GND	GND	35		Mini card ground	
USB_D-	USB_DM	36	IO	USB differential data (-)	Require differential impedance of 90Ω.
GND	GND	37		Mini card ground	
USB_D+	USB_DP	38	IO	USB differential data (+)	Require differential impedance of 90Ω.
3.3Vaux	VCC_3V3	39	PI	Power supply for the module	
GND	GND	40		Mini card ground	
3.3Vaux	VCC_3V3	41	PI	Power supply for the module	
LED_WWAN#	LED_WWAN#	42	OC	LED signal for indicating the network status of the module	Active low
GND	GND	43		Mini card ground	
LED_WLAN#	USIM_DET	44	DI	(U)SIM card hot-plug detect	
RESERVED	PCM_CLK	45	IO	PCM clock	
LED_WPAN#	RESERVED	46		Reserved	
RESERVED	PCM_DOUT	47	DO	PCM data output	
1.5V	NC	48		Not connected	
RESERVED	PCM_DIN	49	DI	PCM data input	
GND	GND	50		Mini card ground	

RESERVED	PCM_SYNC	51	IO	PCM data frame sync
3.3Vaux	VCC_3V3	52	PI	Power supply for the module

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	Software is active. The module has registered on the network, and it is ready to send and receive data.
	Talk/Data	Network connection is ongoing. In this mode, the power consumption is decided by network setting and data transfer rate.
Minimum Functionality Mode	**AT+CFUN=0** command can set the module to a minimum functionality mode without removing the power supply. In this case, both RF function and (U)SIM card will be invalid.	
Airplane Mode	**AT+CFUN=4** command or W_DISABLE# pin can set the module to airplane mode. In this case, RF function will be invalid.	
Sleep Mode	In this mode, the current consumption of the module will be reduced to the minimal level. In this mode, the module can still receive paging message, SMS, voice call and TCP/UDP data from the network normally.	

3.4. Power Saving

3.4.1. Sleep Mode

EC200T Series Mini PCIe is able to 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.
- Ensure the DTR is kept at high level or be kept open.
- The host's USB bus, which is connected with 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, please refer to ***Chapter 3.10.3***.

3.5. Power Supply

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

Table 6: Definition of VCC_3V3 and GND Pins

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

The typical supply voltage of EC200T 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.

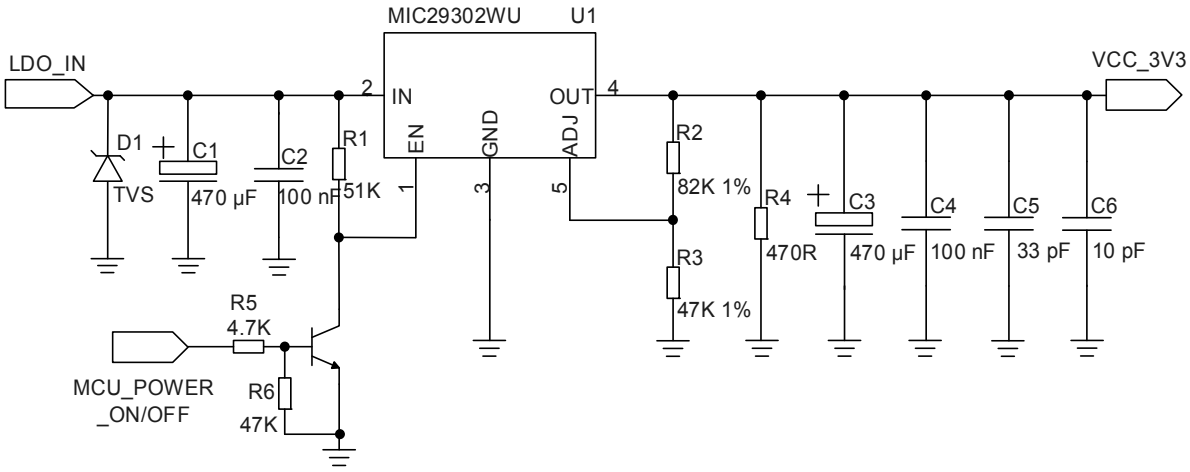


Figure 3: Reference Circuit of Power Supply

3.6. (U)SIM Interface

EC200T Series Mini PCIe's (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 V/3.0 V	(U)SIM card power supply
USIM_DATA	10	IO	1.8 V/3.0 V	(U)SIM card data
USIM_CLK	12	DO	1.8 V/3.0 V	(U)SIM card clock
USIM_RST	14	DO	1.8 V/3.0 V	(U)SIM card reset
USIM_DET	44	DI	1.8 V	(U)SIM card hot-plug detect

EC200T Series Mini PCIe supports (U)SIM card hot-plug via the USIM_DET pin. The function supports low level and high level detections. By default, It is disabled, and can be configured via **AT+QSIMDET** command. Please refer to ***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.

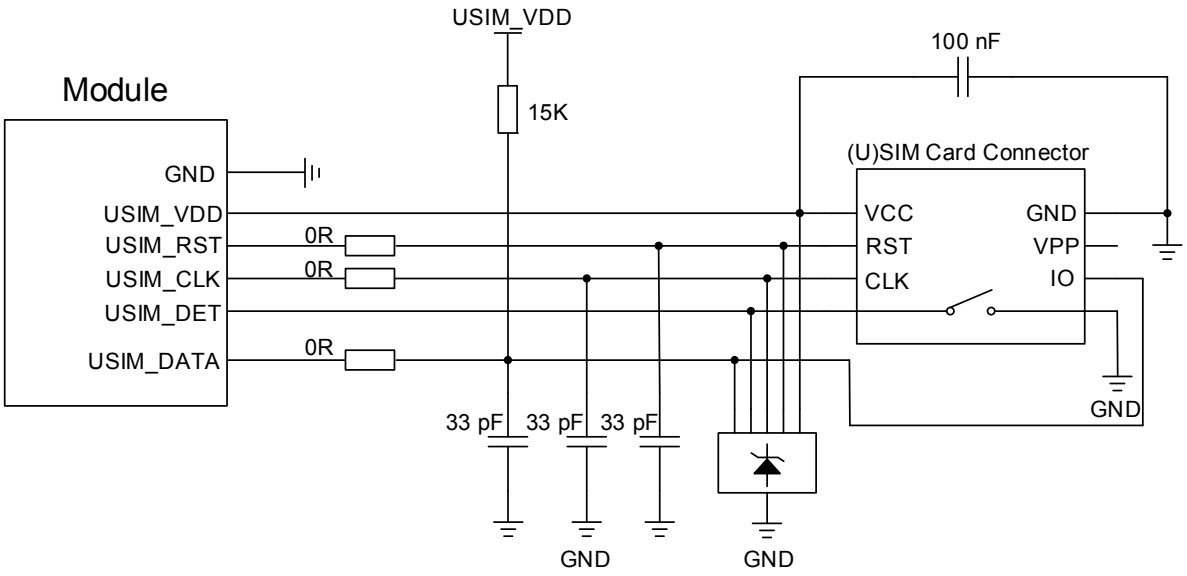


Figure 4: Reference Circuit of (U)SIM Interface with an 8-pin (U)SIM Card Connector

If (U)SIM card detection function is not needed, please 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.

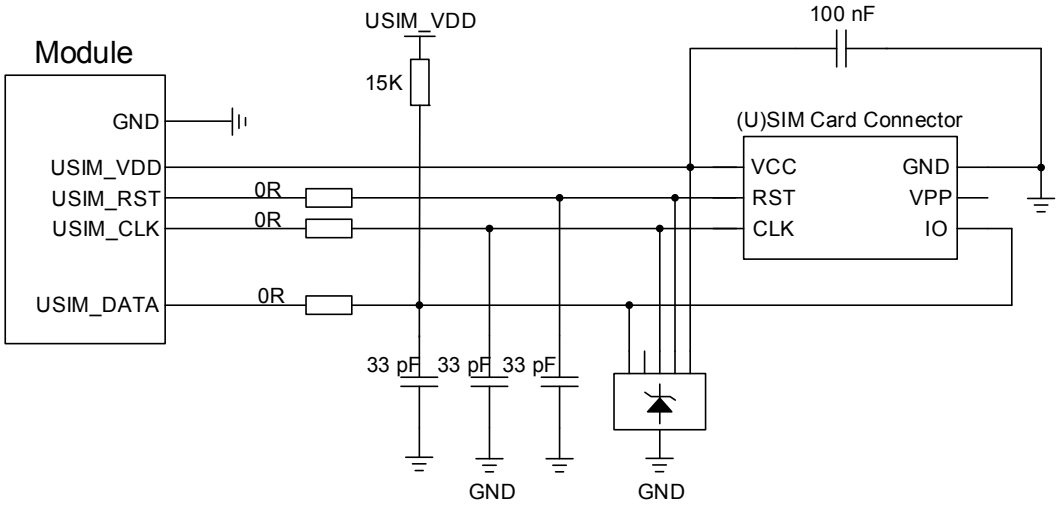


Figure 5: Reference Circuit of (U)SIM Interface with a 6-pin (U)SIM Card Connector

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

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

EC200T 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. Meanwhile, it supports high speed (480Mbps) mode and full speed (12Mbps) mode. 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	IO	USB 2.0 differential data (-)	Require differential impedance of 90Ω
USB_DP	38	IO	USB 2.0 differential data (+)	Require differential impedance of 90Ω

The following figure shows a reference circuit of USB interface.

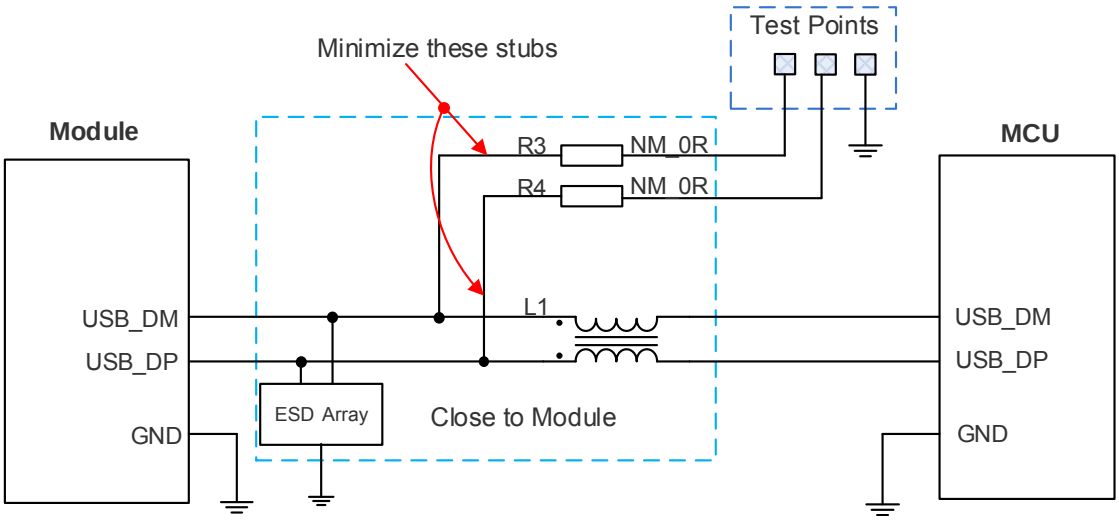


Figure 6: Reference Circuit of USB Interface

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

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

- It is important to route the USB signal traces as differential pairs with total grounding. The impedance of USB differential trace is 90Ω.
- Do not route signal traces under crystals, oscillators, magnetic devices and RF signal traces. It is important to route the USB differential traces in inner layer with ground shielding on not only upper and lower layers but also right and left sides.
- Special attention should be paid to the selection of ESD device on the USB data line. 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 9600bps, 19200bps, 38400bps, 57600bps, 115200bps and 230400bps baud rates, and the default is 115200bps. 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_RX	11	DI	3.3 V	receive
UART_TX	13	DO	3.3 V	transmit
UART_CTS	23	DI	3.3 V	clear to send
UART_RTS	25	DO	3.3 V	request to send

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

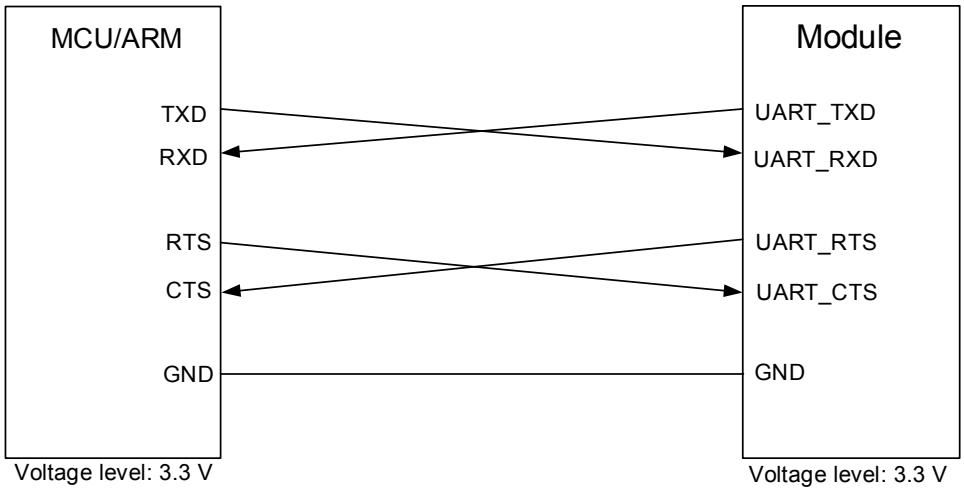


Figure 7: Reference Circuit of Power Supply

3.9. PCM and I2C Interfaces

EC200T 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	IO	1.8 V	PCM clock signal
PCM_DOUT	47	DO	1.8 V	PCM data output
PCM_DIN	49	DI	1.8 V	PCM data input
PCM_SYNC	51	IO	1.8 V	PCM data frame sync
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.

EC200T Series Mini PCIe provides one PCM digital interface, which supports 16-bit linear data format and the primary mode (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 256kHz, 512kHz, 1024kHz or 2048kHz PCM_CLK at 8kHz PCM_SYNC, and also supports 4096kHz PCM_CLK at 16kHz PCM_SYNC. The following figure shows the timing relationship in primary mode with 8kHz PCM_SYNC and 2048kHz PCM_CLK.

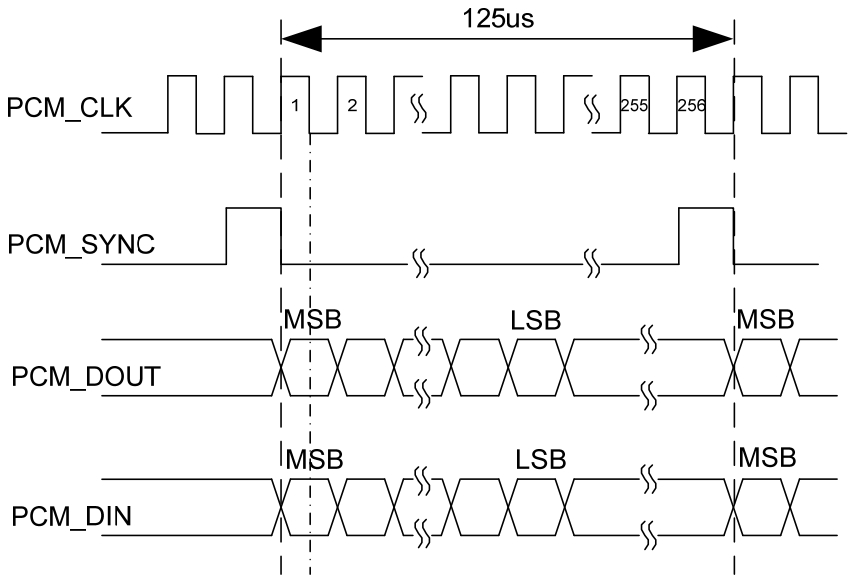


Figure 8: Timing in Primary Mode

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

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

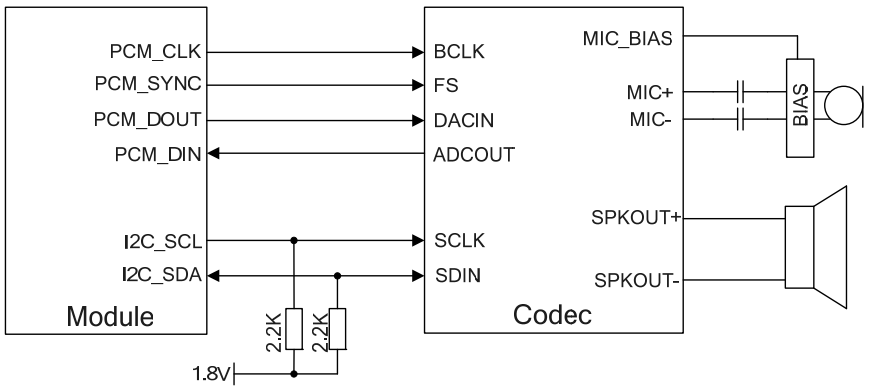


Figure 9: Reference Circuit of PCM Application with Audio Codec

NOTE

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

3.10. Control and Indication Signals

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
RI	17	DO	3.3 V	Ring indication
DTR	31	DI	3.3 V	Data terminal ready
W_DISABLE#	20	DI	3.3 V	Airplane mode control; Pulled up by default; Active low.
PERST#	22	DI	3.3 V	Module reset ; Active low.
LED_WWAN#	42	OC		LED signal for indicating the network

			status of the module; Active low.
WAKE#	1	OC	Wake up the module.

3.10.1. RI Signal

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

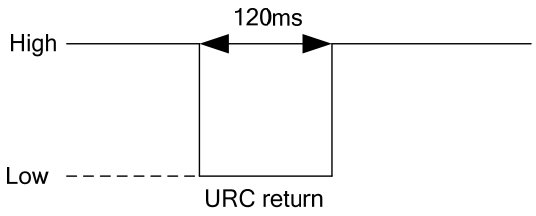


Figure 10: RI Behaviors

3.10.2. DTR Signal

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

3.10.3. W_DISABLE# Signal

EC200T Series Mini PCIe provides a W_DISABLE# signal to disable or enable the RF function. The W_DISABLE# pin is pulled up by default. Its control function for airplane mode is disabled by default, and **AT+QCFG="airplanecontrol",1** can be used to enable the function. Driving it low can make the module enter airplane mode.

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

Table 12: Airplane Mode Controlled by Hardware Method

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

Software method can be controlled by **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 mode
4	RF disabled	Airplane mode

3.10.4. PERST# Signal

The PERST# signal can be used to force a hardware reset on the card. The module can be reset by driving the PERST# signal low for at least 300ms and then releasing it. The PERST# 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.

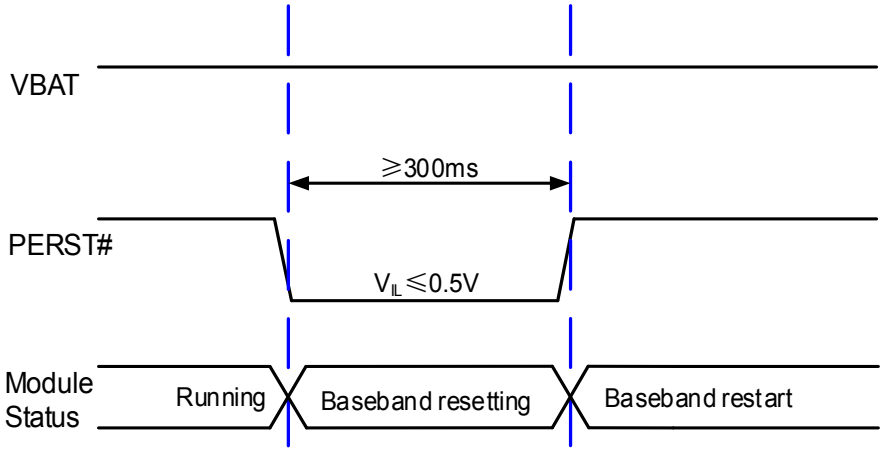


Figure 11: Timing of Resetting Module

NOTES

1. Please ensure that there is no large capacitance with the max value exceeding 10nF on PERST# pin.
2. PEREST# only resets the internal baseband chip of the module and does not reset the power management chip.

3.10.5. LED_WWAN# Signal

The LED_WWAN# signal of EC200T Series Mini PCIe is used to indicate the network status of the module, and can absorb a current up to 40mA. According to the following circuit, in order to reduce the current of the LED, a resistor must be placed in series with the LED.

The LED is emitting light when the LED_WWAN# output signal is low.

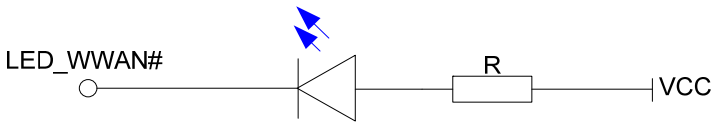


Figure 12: LED_WWAN# Signal Reference Circuit Diagram

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

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

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

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

Pin Status	Description
Flicker slowly (200ms Low/1800ms High)	Network searching
Flicker slowly (1800ms Low/200ms High)	Idle
Flicker quickly (125ms Low/125ms 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. WAKE# Signal

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

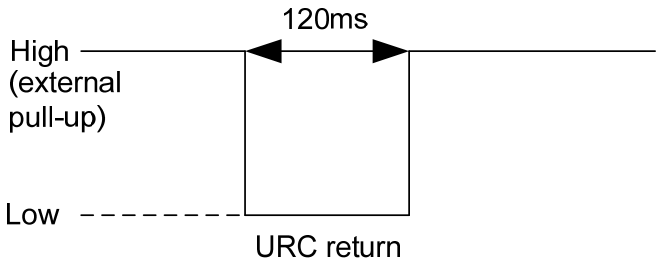


Figure 13: WAKE# Behavior

4 Antenna Connection

4.1. Antenna Connectors

EC200T 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 50Ω.

4.1.1. Operating Frequency

Table 16: EC200T-CN Mini PCIe Operating Frequencies

3GPP Band	Transmit	Receive	Unit
EGSM900	880–915	925–960	MHz
DCS1800	1710–1785	1805–1880	MHz
WCDMA B1	1920–1980	2110–2170	MHz
WCDMA B5	824–849	869–894	MHz
WCDMA B8	880–915	925–960	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	2555–2655	2555–2655	MHz

Table 17: EC200T-EU Mini PCIe Operating Frequencies

3GPP Band	Transmit	Receive	Unit
EGSM900	880–915	925–960	MHz
DCS1800	1710–1785	1805–1880	MHz
WCDMA B1	1920–1980	2110–2170	MHz
WCDMA B8	880–915	925–960	MHz
LTE-FDD B1	1920–1980	2110–2170	MHz
LTE-FDD B3	1710–1785	1805–1880	MHz
LTE-FDD B7	2500–2570	2620–2690	MHz
LTE-FDD B8	880–915	925–960	MHz
LTE-FDD B20[1)]	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	2555–2655	2555–2655	MHz

Table 18: EC200T-AU Mini PCIe* Operating Frequencies

3GPP Band	Transmit	Receive	Unit
EGSM900	880–915	925–960	MHz
GSM850	824–849	869–894	MHz
DCS1800	1710–1785	1805–1880	MHz
PCS1900	1850–1910	1930–1990	MHz
WCDMA B1	1920–1980	2110–2170	MHz

WCDMA B2	1850–1910	1930–1990	MHz
WCDMA B4	1710–1755	2110–2155	MHz
WCDMA B5	824–849	869–894	MHz
WCDMA B8	880–915	925–960	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-TDD B66	1710–1780	2110–2200	MHz

4.2. Antenna Requirements

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

Table 19: Antenna Requirements

Type	Requirements
GSM/UMTS/LTE	VSWR: ≤ 2 Efficiency: > 30% Max input power: 50W Input impedance: 50Ω Cable insertion loss: < 1dB (EGSM900, WCDMA B5/B8, LTE-FDD B5/B8/B20/B28) Cable insertion loss: < 1.5dB (DCS1800, WCDMA B1, LTE B1/B3/B34/B39) Cable insertion loss: < 2dB

(LTE-FDD B7, LTE-TDD B38/B40/B41)

4.3. Recommended Mating Plugs for Antenna Connection

EC200T Series Mini PCIe is mounted with RF connectors (receptacles) for convenient antenna connection. The dimensions of the antenna connectors are shown as below.

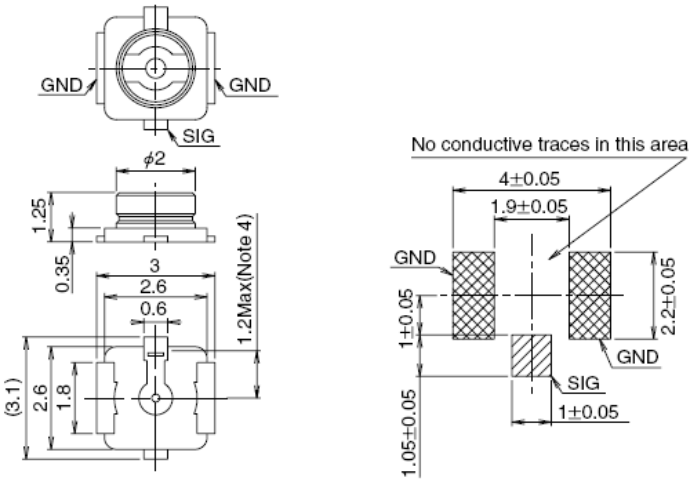


Figure 14: Dimensions of the Receptacle RF Connectors (Unit: mm)

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

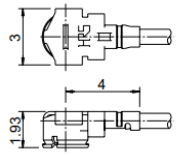
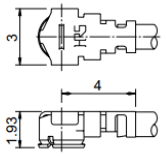
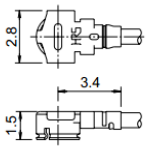
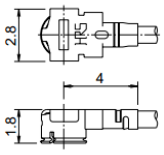
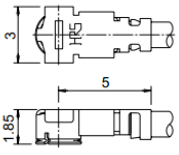
Part No.	U.FL-LP-040	U.FL-LP-066	U.FL-LP(V)-040	U.FL-LP-062	U.FL-LP-088
					
Mated Height	2.5mm Max. (2.4mm Nom.)	2.5mm Max. (2.4mm Nom.)	2.0mm Max. (1.9mm Nom.)	2.4mm Max. (2.3mm Nom.)	2.4mm Max. (2.3mm Nom.)
Applicable cable	Dia. 0.81mm Coaxial cable	Dia. 1.13mm and Dia. 1.32mm Coaxial cable	Dia.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

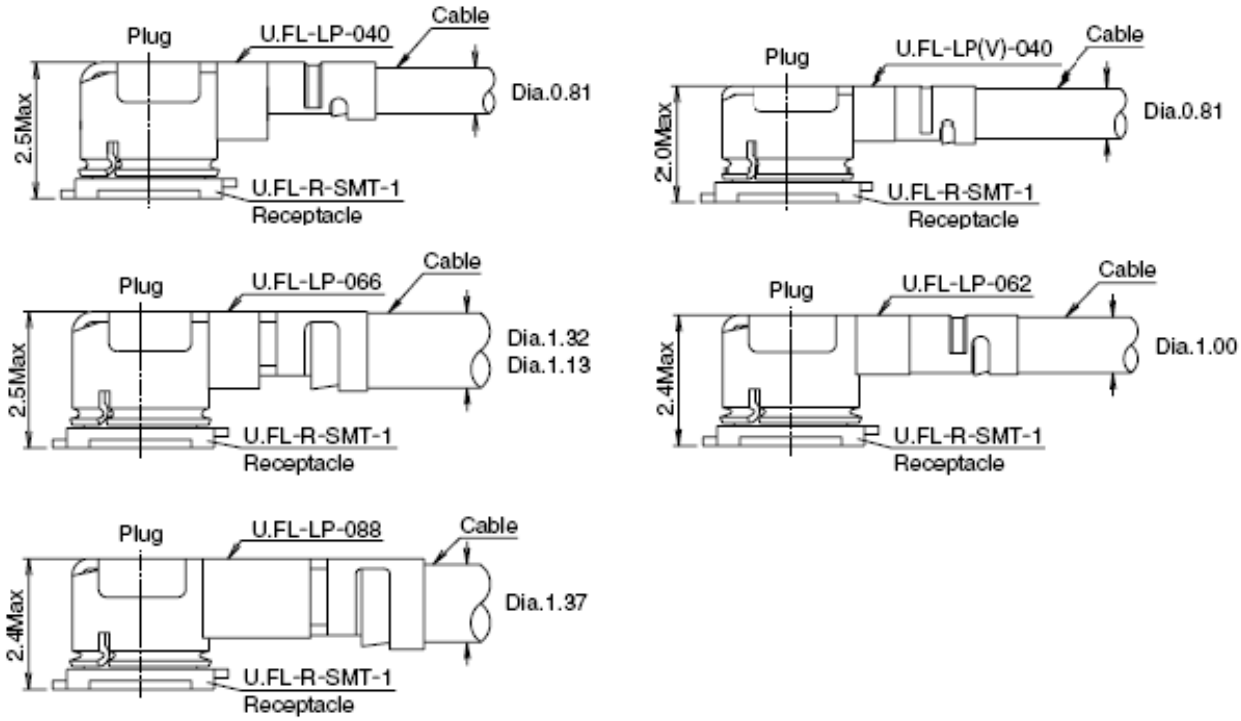


Figure 16: Space Factor of Mating Plugs (Unit: mm)

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

5 Reliability, Radio and Electrical Characteristics

5.1. General Description

This chapter mainly describes the following electrical and radio characteristics of EC200T Series Mini PCIe:

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

5.2. Power Supply Requirements

The input voltage of EC200T Series Mini PCIe is 3.0V – 3.6V, as specified by *PCI Express Mini CEM Specifications 1.2*. The following table shows the power supply requirements of EC200T Series Mini PCIe.

Table 20: Power Supply Requirements

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

5.3. I/O Requirements

The following table shows the I/O requirements of EC200T Series Mini PCIe.

Table 21: I/O Requirements

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

NOTES

1. The PCM and I2C interfaces belong to 1.8 V power domain and other I/O interfaces belong to 3.3 V power domain.
2. The maximum voltage value of V_{IL} for PERST# signal and W_DISABLE# signal is 0.5 V.

5.4. RF Characteristics

The following tables show the conducted RF output power and receiving sensitivity of EC200T Series Mini PCIe module.

Table 22: Conducted RF Output Power of EC200T Series Mini PCIe

Frequency Bands	Max.	Min.
EGSM900	33dBm±2dB	5dBm±5dB
DCS1800	30dBm±2dB	0dBm±5dB
EGSM900 (8-PSK)	27dBm±3dB	5dBm±5dB
DCS1800 (8-PSK)	26dBm±3dB	0dBm±5dB
WCDMA B1/B5/B8	24dBm+1/-3dB	< -49dBm

LTE-FDD B1/B3/B5/B7/B8/B20/B28	23dBm±2dB	< -39dBm
LTE-TDD B34/B38/B39/B40/B41	23dBm±2dB	< -39dBm

Table 23: Conducted RF Receiving Sensitivity of EC200T-CN Mini PCIe

Frequency	Receiving Sensitivity (Typ.)			3GPP (SIMO)
	Primary	Diversity	SIMO	
EGSM900	-108dBm	NA	NA	-102dBm
DCS1800	-108dBm	NA	NA	-102dBm
WCDMA B1	-108dBm	NA	NA	-106.7dBm
WCDMA B5	-109dBm	NA	NA	-104.7dBm
WCDMA B8	-110dBm	NA	NA	-103.7dBm
LTE-FDD B1 (10MHz)	-97dBm	-98.5dBm	-100dBm	-96.3dBm
LTE-FDD B3 (10MHz)	-97.5dBm	-97.5dBm	-100.5dBm	-93.3dBm
LTE-FDD B5 (10MHz)	-98dBm	-99dBm	-101dBm	-94.3dBm
LTE-FDD B8 (10MHz)	-98dBm	-98dBm	-101dBm	-93.3dBm
LTE-TDD B34 (10MHz)	-96.5dBm	-97dBm	-100dBm	-96.3dBm
LTE-TDD B38 (10MHz)	-97dBm	-97.5dBm	-100dBm	-96.3dBm
LTE-TDD B39 (10MHz)	-97dBm	-97.5dBm	-100dBm	-96.3dBm
LTE-TDD B40 (10MHz)	-97dBm	-97dBm	-100dBm	-96.3dBm
LTE-TDD B41 (10MHz)	-96dBm	-97dBm	-99dBm	-94.3dBm

Table 24: Conducted RF Receiving Sensitivity of EC200T-EU Mini PCIe

Frequency Bands	Primary	Diversity	SIMO[1)]	3GPP (SIMO)
EGSM900	-108dBm	/	/	-102.0dBm
DCS1800	-108.6dBm	/	/	-102.0dbm

WCDMA B1	-108dBm	/	/	-106.7dBm
WCDMA B5 [2)]	TBD	NA	NA	-104.7dBm
WCDMA B8	-108dBm	/	/	-103.7dBm
LTE-FDD B1 (10MHz)	-98.2dBm	-98.0dBm	-101.8dBm	-96.3dBm
LTE-FDD B3 (10MHz)	-97.8dBm	-97.5dBm	-100.5dBm	-93.3dBm
LTE-FDD B5 [2)] (10MHz)	TBD	TBD	TBD	-94.3dBm
LTE-FDD B7 (10MHz)	-96.5dBm	-96.5dBm	-99.5dBm	-94.3dBm
LTE-FDD B8 (10MHz)	-98.2dBm	-98.5dBm	-101 dBm	-93.3dBm
LTE-FDD B20 [2)] (10MHz)	-97.7dBm	-97dBm	-100.9dBm	-93.3dBm
LTE-FDD B28 (10MHz)	-97.2dBm	-97dBm	-100dBm	-94.8dBm
LTE-TDD B38 (10MHz)	-97.7dBm	-97.0dBm	-101dBm	-96.3dBm
LTE-TDD B40 (10MHz)	-98dBm	-98.0dBm	-101dBm	-96.3dBm
LTE-TDD B41 (10MHz)	-97.5dBm	-97.0dBm	-100dBm	-94.3dBm

Table 25: Conducted RF Receiving Sensitivity of EC200T-AU Mini PCIe*

Frequency	Receiving Sensitivity (Typ.)			3GPP (SIMO)
	Primary	Diversity	SIMO	
GSM850	TBD	NA	NA	-102 dBm
EGSM900	TBD	NA	NA	-102 dBm
DCS1800	TBD	NA	NA	-102 dBm
DCS1900	TBD	NA	NA	-102 dBm
WCDMA B1	TBD	NA	NA	-106.7 dBm
WCDMA B2	TBD	NA	NA	-104.7 dBm
WCDMA B4	TBD	NA	NA	-106.7 dBm
WCDMA B5	TBD	NA	NA	-104.7 dBm

WCDMA B8	TBD	NA	NA	-103.7 dBm
LTE-FDD B1 (10 MHz)	TBD	TBD	TBD	-96.3 dBm
LTE-FDD B2 (10 MHz)	TBD	TBD	TBD	-94.3 dBm
LTE-FDD B3 (10 MHz)	TBD	TBD	TBD	-93.3 dBm
LTE-FDD B4 (10 MHz)	TBD	TBD	TBD	-96.3 dBm
LTE-FDD B5 (10 MHz)	TBD	TBD	TBD	-94.3 dBm
LTE-FDD B7 (10 MHz)	TBD	TBD	TBD	-94.3 dBm
LTE-FDD B8 (10 MHz)	TBD	TBD	TBD	-93.3 dBm
LTE-TDD B28 (10 MHz)	TBD	TBD	TBD	-94.8 dBm
LTE-TDD B40 (10 MHz)	TBD	TBD	TBD	-96.3 dBm
LTE-TDD B66 (10 MHz)	TBD	TBD	TBD	-96.3 dBm

NOTES

1. [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 receiving performance.

5.5. ESD Characteristics

The following table shows the ESD characteristics of EC200T Series Mini PCIe.

Table 26: ESD Characteristics of EC200T 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

5.6. Operation and Storage Temperatures

The operation and storage temperatures are listed in the following table

Table 27: Operation and Storage Temperatures

Parameter	Min.	Typ.	Max.	Unit
Operation Temperature Range [1)]	-35	+25	+75	ºC
Extended Operation Range [2)]	-40		+85	ºC
Storage Temperature Range	-40		+90	ºC

NOTE

1. [1)] Within the operation temperature range, the module is 3GPP compliant.
2. [2)] Within the extended temperature range, the module remains the ability to establish and maintain a voice, SMS, data transmission, 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 Pout might reduce their value and exceed the specified tolerances. When the temperature returns to the normal operating temperature levels, the module will meet 3GPP specifications again.

5.7. Current Consumption

The following table shows the current consumption of EC200T Series Mini PCIe.
The current consumption of EC200T-AU Mini PCIe* will appear in the next version.

Table 28: EC200T-CN Mini PCIe Current Consumption

Description	Conditions	Typ.	Unit
Sleep state	**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 state	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	331.2	mA
	EGSM900 3DL/2UL @ 31.32 dBm	559.5	mA
	EGSM900 2DL/3UL @ 30.22 dBm	689.4	mA
	EGSM900 1DL/4UL @ 28.15 dBm	707.4	mA
	DCS1800 4DL/1UL @ 29.57 dBm	297.5	mA
	DCS1800 3DL/2UL @ 29.59 dBm	492.5	mA
	DCS1800 2DL/3UL @ 28.09 dBm	579.0	mA
	DCS1800 1DL/4UL @ 26.16 dBm	606.1	mA
EDGE data transfer	EGSM900 4DL/1UL @ 28.05 dBm	290.0	mA
	EGSM900 3DL/2UL @ 27.72 dBm	474.3	mA
	EGSM900 2DL/3UL @ 24.16 dBm	610.0	mA
	EGSM900 1DL/4UL @ 21.98 dBm	740.2	mA
	DCS1800 4DL/1UL @ 26.53 dBm	238.4	mA
	DCS1800 3DL/2UL @ 26.27 dBm	377.2	mA
	DCS1800 2DL/3UL @ 24.69 dBm	490.1	mA
	DCS1800 1DL/4UL @ 22.00 dBm	594.5	mA
WCDMA data transfer	WCDMA B1 HSDPA @ 23.63 dBm	850.39	mA
	WCDMA B1 HSUPA @ 22.45 dBm	847.89	mA
	WCDMA B5 HSDPA @ 23.08 dBm	741.16	mA
	WCDMA B5 HSUPA @ 21.56 dBm	717.72	mA

	WCDMA B8 HSDPA @ 22.47 dBm	843.54	mA
	WCDMA B8 HSUPA @ 21.17 dBm	824.58	mA
LTE data transfer	LTE-FDD B1 @ 22.46 dBm	828.24	mA
	LTE-FDD B3 @ 22.15 dBm	841.85	mA
	LTE-FDD B5 @ 22.84 dBm	750.57	mA
	LTE-FDD B8 @ 22.49 dBm	878.72	mA
	LTE-TDD B34 @ 22.78 dBm	435.50	mA
	LTE-TDD B38 @ 22.51 dBm	483.14	mA
	LTE-TDD B39 @ 22.48 dBm	410.16	mA
	LTE-TDD B40 @ 23.19 dBm	549.74	mA
	LTE-TDD B41 @ 21.83 dBm	514.43	mA
GSM voice call	EGSM900 PCL=5 @ 31.47 dBm	344.5	mA
	EGSM900 PCL=12 @ 18.77 dBm	165.3	mA
	EGSM900 PCL=19 @ 5.00 dBm	133.9	mA
	DCS1800 PCL=0 @ 29.67 dBm	308.4	mA
	DCS1800 PCL=7 @ 16.59 dBm	158.3	mA
	DCS1800 PCL=15 @ 0.92 dBm	131.5	mA
WCDMA voice call	WCDMA B1 @ 23.15 dBm	802.36	mA
	WCDMA B5 @ 22.16 dBm	708.40	mA
	WCDMA B8 @ 21.45 dBm	801.31	mA

Table 29: EC200T-EU Mini PCIe Current Consumption

Description	Conditions	Typ.	Unit
Sleep state	**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 state	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	367.6	mA
	EGSM900 3DL/2UL @ 32.93 dBm	605.7	mA
	EGSM900 2DL/3UL @ 30.91 dBm	671.4	mA
	EGSM900 1DL/4UL @ 28.95 dBm	682.7	mA
	DCS1800 4DL/1UL @ 29.74 dBm	299.8	mA
	DCS1800 3DL/2UL @ 29.82 dBm	476.1	mA
	DCS1800 2DL/3UL @ 28.35 dBm	558.7	mA
	DCS1800 1DL/4UL @ 26.35 dBm	582.5	mA
EDGE data transfer	EGSM900 4DL/1UL @ 26.09 dBm	298.4	mA
	EGSM900 3DL/2UL @ 25.45 dBm	470.2	mA
	EGSM900 2DL/3UL @ 23.43 dBm	628.7	mA
	EGSM900 1DL/4UL @ 20.82 dBm	766.2	mA
	DCS1800 4DL/1UL @ 25.27 dBm	243.6	mA
	DCS1800 3DL/2UL @ 25.14 dBm	370.4	mA
	DCS1800 2DL/3UL @ 23.49 dBm	493.4	mA
	DCS1800 1DL/4UL @ 20.92 dBm	612.9	mA
WCDMA data transfer	WCDMA B1 HSDPA @ 23.79 dBm	866.1	mA
	WCDMA B1 HSUPA @ 23.29 dBm	855.5	mA
	WCDMA B8 HSDPA @ 23.71 dBm	762.1	mA
	WCDMA B8 HSUPA @ 22.87 dBm	744.9	mA

LTE data transfer	LTE-FDD B1 @ 23.08 dBm	1016	mA
	LTE-FDD B3 @ 23.69 dBm	961.1	mA
	LTE-FDD B7 @ 23.98 dBm	1089	mA
	LTE-FDD B8 @ 23.16 dBm	865.1	mA
	LTE-FDD B20 @ 23.18 dBm	876.7	mA
	LTE-FDD B28 @ 23.21 dBm	967.6	mA
	LTE-TDD B38 @ 23.13 dBm	484.7	mA
	LTE-TDD B40 @ 22.72 dBm	513.8	mA
	LTE-TDD B41 @ 23.29 dBm	510.9	mA
GSM voice call	EGSM900 PCL=5 @ 33.14 dBm	363.7	mA
	EGSM900 PCL=12 @ 19.51 dBm	164.1	mA
	EGSM900 PCL=19 @ 5.59 dBm	133.6	mA
	DCS1800 PCL=0 @ 30.20 dBm	296.7	mA
	DCS1800 PCL=7 @ 17.04 dBm	154.3	mA
	DCS1800 PCL=15 @ 1.08 dBm	128.7	mA
WCDMA voice call	WCDMA B1 @ 23.51 dBm	822.5	mA
	WCDMA B8 @ 23.32 dBm	726.5	mA

6 Dimensions and Packaging

6.1. General Description

This chapter mainly describes mechanical dimensions as well as packaging specification of EC200T Series Mini PCIe module. All dimensions are measured in millimeter (mm), and the dimensional tolerances are ±0.05mm unless otherwise specified.

6.2. Mechanical Dimensions of EC200T Series Mini PCIe

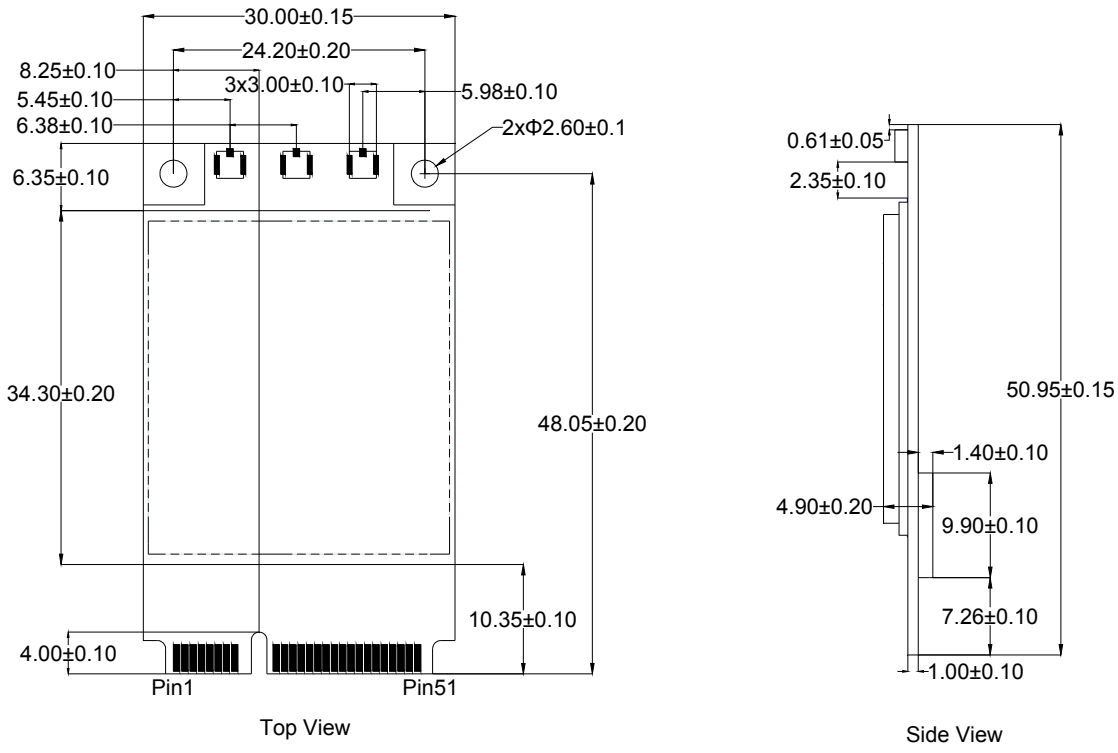


Figure 17: Mechanical Dimensions of EC200T Series Mini PCIe

6.3. Standard Dimensions of Mini PCI Express

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

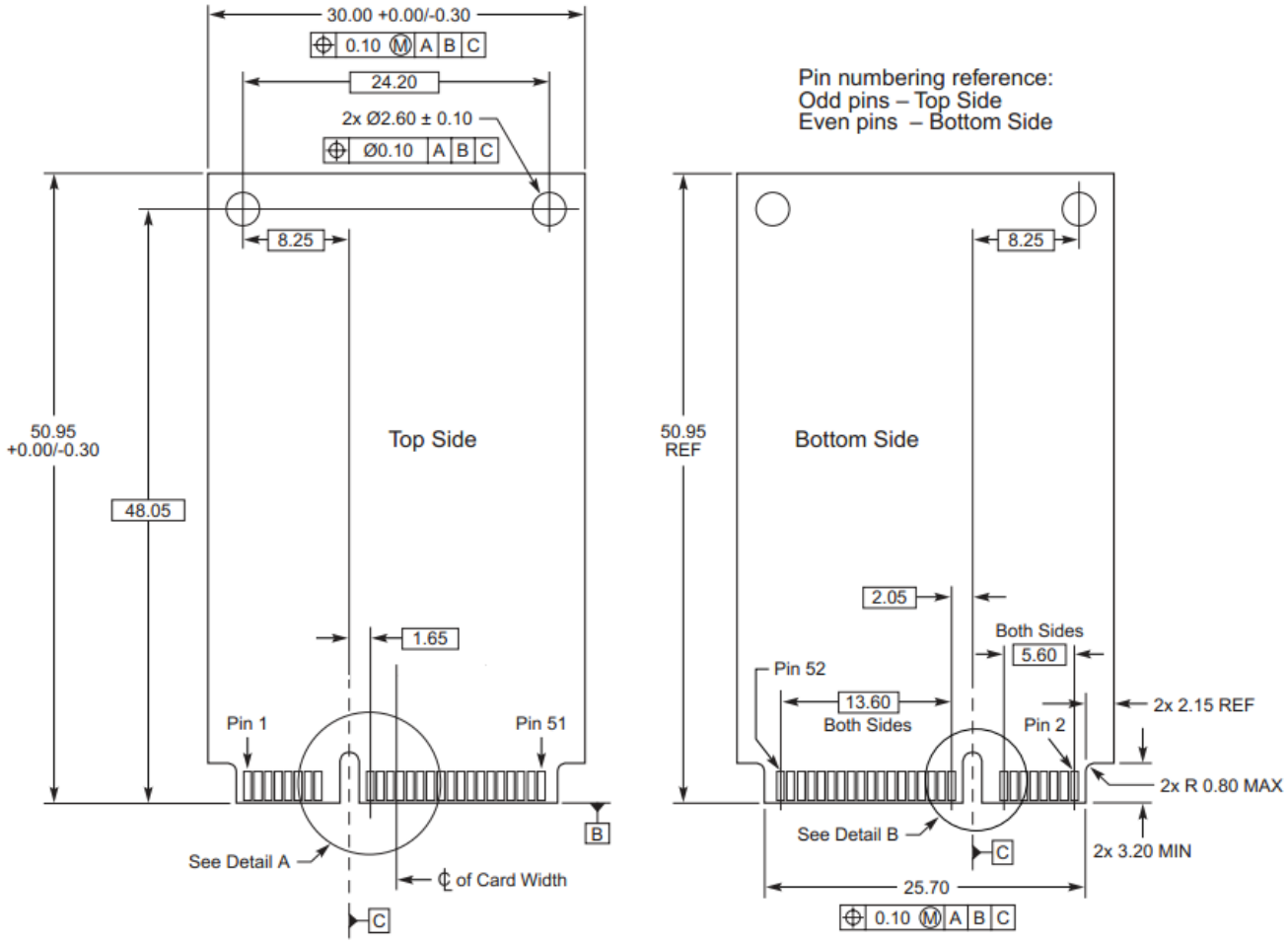


Figure 18: Standard Dimensions of Mini PCI Express

EC200T Series 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 679105700 as an example.

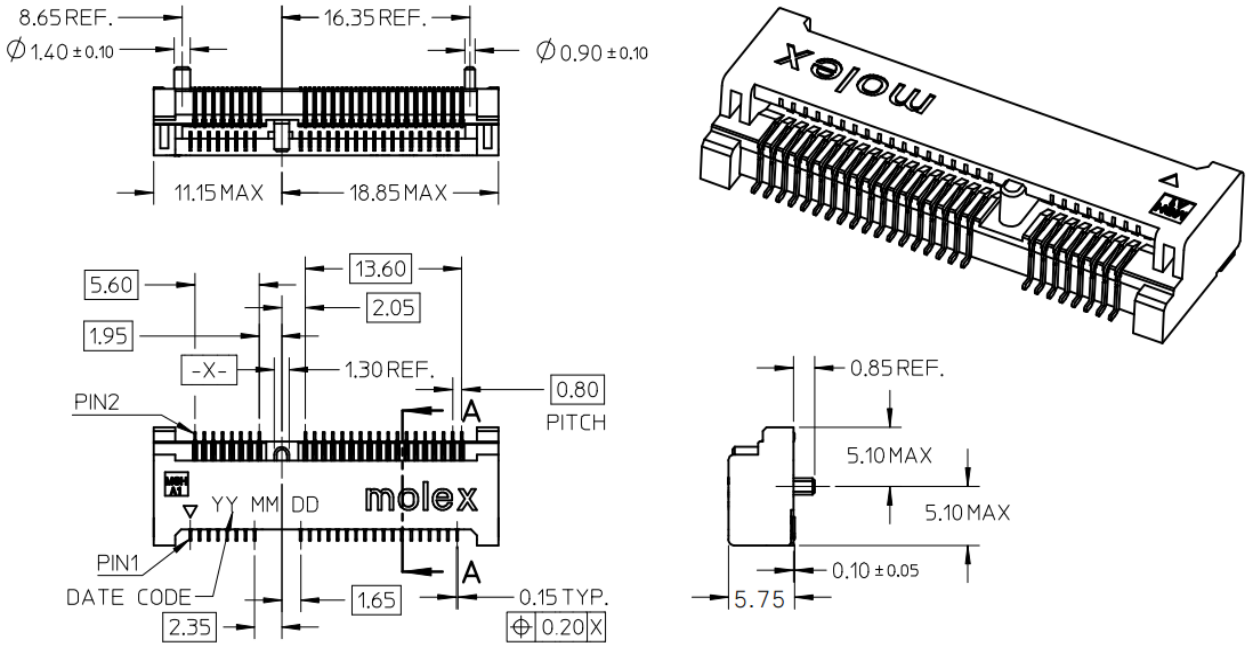


Figure 19: Dimensions of the Mini PCI Express Connector (Molex 679105700)

6.4. Packaging Specifications

EC200T Series Mini PCIe modules are packaged in a tray. Each tray contains 10 modules. The smallest package of EC200T Series Mini PCIe contains 100 modules.

7 Appendix References

Table 30: Related Documents

SN.	Document Name	Remark
[1]	PCI Express Mini Card Electromechanical Specification Revision 1.2	PCI Express Mini Card Electromechanical Specification
[2]	Quectel_EC200T-CN_AT_Commands_Manual_v1.0	EC200T AT commands manual

Table 31: Terms and Abbreviations

Abbreviation	Description
AMR	Adaptive Multi-rate
bps	Bits Per Second
CS	Coding Scheme
CTS	Clear to Send
FOTA	Firmware Upgrade Over-The-Air
DL	Down Link
DTE	Data Terminal Equipment
DTR	Data Terminal Ready
EFR	Enhanced Full Rate
EMI	Electro Magnetic Interference
ESD	Electrostatic Discharge
ESR	Equivalent Series Resistance
FDD	Frequency Division Duplexing

FR	Full Rate
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
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
WLAN	Wireless Local Area Networks