

# EC200T Mini PCIe-C(Audio) Hardware Design

**LTE Standard Module Series**

Rev. EC200T\_Mini\_PCl-e-C(Audio)\_Hardware\_Design\_V1.0

Date: 2020-02-21

Status: Released



**Our aim is to provide customers with timely and comprehensive service. For any assistance, please contact our company headquarters:**

**Quectel Wireless Solutions Co., Ltd.**

Building 5, Shanghai Business Park Phase III (Area B), No.1016 Tianlin Road, Minhang District, Shanghai, China 200233

Tel: +86 21 5108 6236

Email: [info@quectel.com](mailto:info@quectel.com)

**Or our local office. For more information, please visit:**

<http://www.quectel.com/support/sales.htm>

**For technical support, or to report documentation errors, please visit:**

<http://www.quectel.com/support/technical.htm>

Or email to: [support@quectel.com](mailto:support@quectel.com)

**GENERAL NOTES**

QUECTEL OFFERS THE INFORMATION AS A SERVICE TO ITS CUSTOMERS. THE INFORMATION PROVIDED IS BASED UPON CUSTOMERS' REQUIREMENTS. QUECTEL MAKES EVERY EFFORT TO ENSURE THE QUALITY OF THE INFORMATION IT MAKES AVAILABLE. QUECTEL DOES NOT MAKE ANY WARRANTY AS TO THE INFORMATION CONTAINED HEREIN, AND DOES NOT ACCEPT ANY LIABILITY FOR ANY INJURY, LOSS OR DAMAGE OF ANY KIND INCURRED BY USE OF OR RELIANCE UPON THE INFORMATION. ALL INFORMATION SUPPLIED HEREIN IS SUBJECT TO CHANGE WITHOUT PRIOR NOTICE.

**COPYRIGHT**

THE INFORMATION CONTAINED HERE IS PROPRIETARY TECHNICAL INFORMATION OF QUECTEL WIRELESS SOLUTIONS CO., LTD. TRANSMITTING, REPRODUCTION, DISSEMINATION AND EDITING OF THIS DOCUMENT AS WELL AS UTILIZATION OF THE CONTENT ARE FORBIDDEN WITHOUT PERMISSION. OFFENDERS WILL BE HELD LIABLE FOR PAYMENT OF DAMAGES. ALL RIGHTS ARE RESERVED IN THE EVENT OF A PATENT GRANT OR REGISTRATION OF A UTILITY MODEL OR DESIGN.

***Copyright © Quectel Wireless Solutions Co., Ltd. 2020. All rights reserved.***

# About the Document

## Revision History

Version	Date	Author	Description
1.0	2020-02-21	Jaye SANG/ Niko WU	Initial

---

## Contents

<b>About the Document</b> .....	<b>2</b>
<b>Contents</b> .....	<b>3</b>
<b>Table Index</b> .....	<b>5</b>
<b>Figure Index</b> .....	<b>6</b>
<b>1 Introduction</b> .....	<b>7</b>
1.1. Safety Information.....	8
<b>2 Product Concept</b> .....	<b>9</b>
2.1. General Description.....	9
2.2. Key Features.....	10
2.3. Functional Diagram.....	12
<b>3 Application Interfaces</b> .....	<b>13</b>
3.1. Pin Assignment.....	13
3.2. Pin Description.....	14
3.3. Operating Modes.....	17
3.4. Power Supply.....	18
3.5. UART Interface.....	19
3.6. USB Interface.....	20
3.7. (U)SIM Interface.....	21
3.8. Analog Audio Interfaces.....	23
3.8.1. Audio Interfaces Design Considerations.....	23
3.8.2. Microphone Interface Circuit.....	24
3.8.3. Receiver Interface Circuit.....	25
3.9. Control and Indication Signals.....	26
3.9.1. Sleep Mode Control and State Indication Signals.....	26
3.9.1.1. UART_DTR Signal.....	27
3.9.1.2. WAKEUP_IN* and WAKEUP_OUT Signals.....	27
3.9.2. W_DISABLE# Signal.....	27
3.9.3. PERST# Signal.....	28
3.9.4. LED_WWAN# Signal.....	29
<b>4 Antenna Connection</b> .....	<b>31</b>
4.1. Antenna Connectors.....	31
4.1.1. Operating Frequency.....	31
4.2. Antenna Requirements.....	32
4.3. Recommended Mating Plugs for Antenna Connection.....	32
<b>5 Electrical, Reliability and Radio Characteristics</b> .....	<b>34</b>
5.1. General Description.....	34
5.2. Power Supply Requirements.....	34
5.3. I/O Requirements.....	34
5.4. RF Characteristics.....	35

5.5.	ESD Characteristics .....	36
<b>6</b>	<b>Dimensions and Packaging .....</b>	<b>38</b>
6.1.	General Description .....	38
6.2.	Mechanical Dimensions of EC200T Mini PCIe-C.....	38
6.3.	Standard Dimensions of Mini PCI Express .....	39
6.4.	Packaging Specifications.....	40
<b>7</b>	<b>Appendix A References.....</b>	<b>41</b>

## Table Index

Table 1: Supported Bands of EC200T Mini PCIe-C .....	9
Table 2: Key Features of EC200T Mini PCIe-C .....	10
Table 3: I/O Parameters Definition .....	14
Table 4: Pin Description .....	14
Table 5: Overview of Operating Modes .....	17
Table 6: Definition of Power Supply Interface .....	18
Table 7: Pin Definition of Main UART Interface.....	19
Table 8: Pin Definition of USB Interface.....	20
Table 9: Pin Definition of (U)SIM Interface.....	21
Table 10: Pin Definition of Analog Audio Interfaces .....	23
Table 11: Pin Definition of Control and Indication Signals .....	26
Table 12: Pin Definition of WAKEUP_IN and WAKEUP_OUT Signals.....	27
Table 13: Airplane Mode Controlled by Hardware Method .....	28
Table 14: Airplane Mode Controlled by Software Method.....	28
Table 15: Indications of Network Status (AT+QCFG="ledmode",0, Default Setting).....	29
Table 16: Indications of Network Status (AT+QCFG="ledmode",2).....	30
Table 17: Operating Frequencies .....	31
Table 18: Antenna Requirements .....	32
Table 19: Power Supply Requirements .....	34
Table 20: I/O Requirements .....	35
Table 21: Conducted RF Output Power of EC200T Mini PCIe-C .....	35
Table 22: Conducted RF Receiving Sensitivity of EC200T Mini PCIe-C .....	36
Table 23: ESD Characteristics of EC200T Mini PCIe-C .....	36
Table 24: Related Documents .....	41
Table 25: Terms and Abbreviations .....	41

## Figure Index

Figure 1: Functional Diagram.....	12
Figure 2: Pin Assignment .....	13
Figure 3: Reference Circuit of Power Supply.....	18
Figure 4: Reference Circuit of 3.3V Level-shift .....	19
Figure 5: Reference Circuit of USB Interface .....	20
Figure 6: Reference Circuit of (U)SIM Interface with an 8-pin (U)SIM Card Connector .....	22
Figure 7: Reference Circuit of (U)SIM Interface with a 6-pin (U)SIM Card Connector .....	22
Figure 8: Reference Circuit of Microphone Interface .....	24
Figure 9: Reference Circuit of SPK Output.....	25
Figure 10: Reference Circuit of SPK Output with Audio Amplifier .....	25
Figure 11: Timing of Resetting Module .....	28
Figure 12: LED_WWAN# Signal Reference Circuit Diagram .....	29
Figure 13: Dimensions of the Receptacle RF Connectors (Unit: mm) .....	32
Figure 14: Mechanicals of U.FL-LP Mating Plugs .....	33
Figure 15: Space Factor of Mating Plugs (Unit: mm).....	33
Figure 16: Mechanical Dimensions of EC200T Mini PCIe-C.....	38
Figure 17: Standard Dimensions of Mini PCI Express.....	39
Figure 18: Dimensions of the Mini PCI Express Connector (Molex 679105700).....	40

# 1 Introduction

This document defines the EC200T Mini PCIe-C module supporting audio function, 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 Mini PCIe-C.



## 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 Mini PCIe-C 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.

# 2 Product Concept

## 2.1. General Description

EC200T Mini PCIe-C module provides data connectivity on LTE-FDD, LTE-TDD, HSDPA, HSUPA, HSPA+, WCDMA, EDGE and GPRS networks with PCI Express Mini Card 1.2 standard interface. It supports embedded operating systems such as Linux, Android, etc.

EC200T Mini PCIe-C 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

**Table 1: Supported Bands of EC200T Mini PCIe-C**

Module	Description
EC200T Mini PCIe-C	LTE-FDD (with receive diversity) <sup>1)</sup> : B1/B3/B5/B8 LTE-TDD (with receive diversity) <sup>1)</sup> : B34/B38/B39/B40/B41 WCDMA: B1/B5/B8 GSM: 900/1800MHz Support analog audio

**NOTE**

<sup>1)</sup> Rx-diversity function is optional.

## 2.2. Key Features

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

**Table 2: Key Features of EC200T Mini PCIe-C**

Features	Description
Function Interface	PCI Express Mini Card 1.2 Standard Interface
Power Supply	Supply voltage: 3.4V~4.5V Typical supply voltage: 3.8V
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	<b>GPRS:</b> 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) <b>EDGE:</b> Support EDGE multi-slot class 12 Support GMSK and 8-PSK for different MCS (Modulation and Coding Scheme) Downlink coding schemes: CS 1-4, MCS 1-9 Uplink coding schemes: CS 1-4, 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 (Password Authentication Protocol) and CHAP (Challenge

	Handshake Authentication Protocol) protocols which are usually used for PPP connection
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: 1.8V, 3.0V
UART Interface	Support RTS and CTS hardware flow control Baud rate can reach up to 230400bps, 115200bps by default Used for AT command communication and data transmission
Analog Audio Interfaces	Support one differential input and differential output
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.
AT Commands	Compliant with 3GPP TS 27.007, 27.005 and Quectel enhanced AT commands
Antenna Connectors	Include main antenna and diversity antenna connectors
Physical Characteristics	Size: (51.0±0.15)mm × (30.0±0.15)mm × (4.9±0.2)mm Weight: approx. 11.4g
Temperature Range	Operation temperature range: -35°C to +75°C <sup>1)</sup> Extended temperature range: -40°C to +80°C <sup>2)</sup> 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

- <sup>1)</sup> Within operation temperature range, the module is 3GPP compliant.
- <sup>2)</sup> 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<sub>out</sub> 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.
- “\*” means under development.

### 2.3. Functional Diagram

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

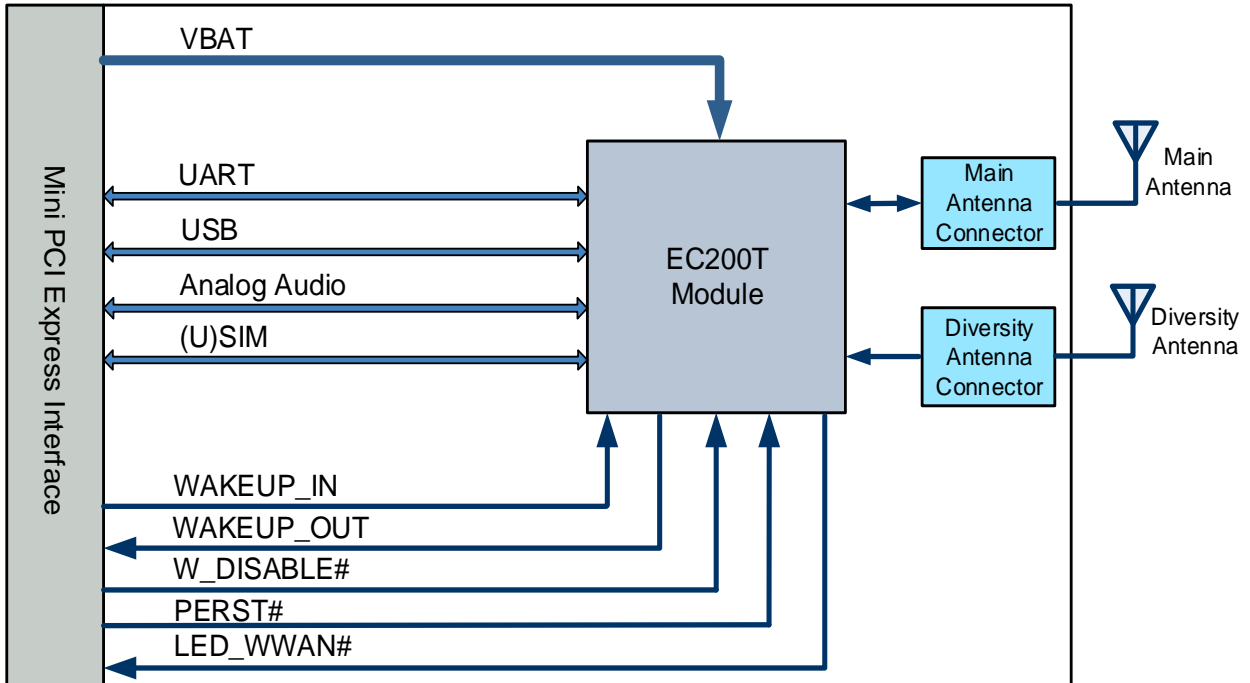


Figure 1: Functional Diagram

# 3 Application Interfaces

This chapter mainly describes the definition and application of the following interfaces for EC200T Mini PCIe-C:

- Power supply
- UART interface
- USB interface
- (U)SIM interface
- Analog audio interfaces
- Control and indication signals

## 3.1. Pin Assignment

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

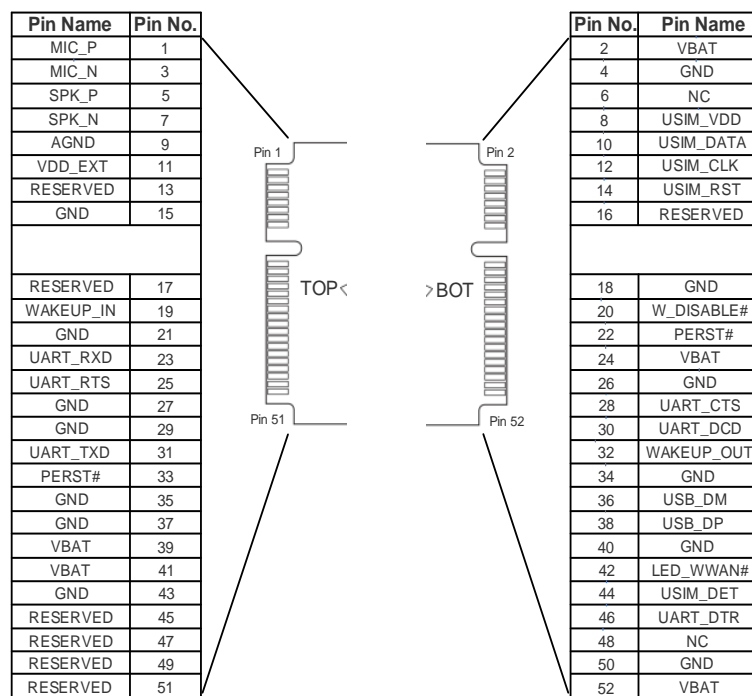


Figure 2: Pin Assignment

## 3.2. Pin Description

The following tables show the pin definition and description of EC200T Mini PCIe-C on the 52-pin application.

**Table 3: I/O Parameters Definition**

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

**Table 4: Pin Description**

Pin No.	Mini PCI Express Standard Name	EC200T Mini PCIe-C Pin Name	I/O	Description	Comment
1	WAKE#	MIC_P	AI	Analog audio input (+)	If unused, keep it open.
2	3.3Vaux	VBAT	PI	3.4V~4.5V, typically 3.8V DC supply	
3	COEX1	MIC_N	AI	Analog audio input (-)	If unused, keep it open.
4	GND	GND		Mini card ground	
5	COEX2	SPK_P	AO	Analog audio output (+)	If unused, keep it open.
6	1.5V	NC			

7	CLKREQ#	SPK_N	AO	Analog audio output (-)	If unused, keep it open.
8	UIM_PWR	USIM_VDD	PO	Power supply for the (U)SIM card	
9	GND	AGND		Analog audio ground	
10	UIM_DATA	USIM_DATA	IO	Data signal of (U)SIM card	
11	REFCLK-	VDD_EXT	PO	Provide 1.8V for external circuit	I <sub>max</sub> = 50mA
12	UIM_CLK	USIM_CLK	DO	Clock signal of (U)SIM card	
13	REFCLK+	RESERVED		Reserved	
14	UIM_RESET	USIM_RST	DO	Reset signal of (U)SIM card	
15	GND	GND		Mini card ground	
16	UIM_VPP	RESERVED		Reserved	
17	RESERVED	RESERVED		Reserved	
18	GND	GND		Mini card ground	
19	RESERVED	WAKEUP_IN	DI	Sleep mode control	Low level makes the module enter sleep mode.
20	W_DISABLE#	W_DISABLE#	DI	Airplane mode control	Active low.
21	GND	GND		Mini card ground	
22	PERST#	PERST#	DI	Reset the module	Active low.
23	PERn0	UART_RXD	DI	UART receive data	
24	3.3Vaux	VBAT	PI	3.4V~4.5V, typically 3.8V DC supply	
25	PERp0	UART_RTS	DO	UART request to send	
26	GND	GND		Mini card ground	
27	GND	GND		Mini card ground	
28	1.5V	UART_CTS	DI	UART clear to send	
29	GND	GND		Mini card ground	



30	SMB_CLK	UART_DCD	DO	UART data carrier detection	
31	PETn0	UART_TXD	DO	UART transmit data	
32	SMB_DATA	WAKEUP_OUT	DO	Module sleep indication	Active low.
33	PETp0	PERST#	DI	Reset the module	Active low.
34	GND	GND		Mini card ground	
35	GND	GND		Mini card ground	
36	USB_D-	USB_DM	IO	USB differential data (-)	Require differential impedance of 90Ω
37	GND	GND		Mini card ground	
38	USB_D+	USB_DP	IO	USB differential data (+)	Require differential impedance of 90Ω
39	3.3Vaux	VBAT	PI	3.4V~4.5V, typically 3.8V DC supply	
40	GND	GND		Mini card ground	
41	3.3Vaux	VBAT	PI	3.4V~4.5V, typically 3.8V DC supply	
42	LED_WWAN#	LED_WWAN#	OC	LED signal for indicating the network status of the module	
43	GND	GND		Mini card ground	
44	LED_WLAN#	USIM_DET	DI	(U)SIM card insertion detection	
45	RESERVED	RESERVED		Reserved	
46	LED_WPAN#	UART_DTR	DI	Data terminal ready, sleep mode control	
47	RESERVED	RESERVED		Reserved	
48	1.5V	NC		Not connected	
49	RESERVED	RESERVED		Reserved	
50	GND	GND		Mini card ground	
51	RESERVED	RESERVED		Reserved	

52	3.3Vaux	VBAT	PI	3.4V~4.5V, typically 3.8V DC supply
----	---------	------	----	--

#### NOTES

1. All the digital interface power domain is 1.8V except for the (U)SIM interface. The (U)SIM interface voltage can support both 1.8V and 3.0V.
2. 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**

Modes	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	<b>AT+CFUN=0</b> 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	<b>AT+CFUN=4</b> command or <b>W_DISABLE#</b> pin can set the module to airplane mode. In this case, RF function will be disabled.	
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 Supply

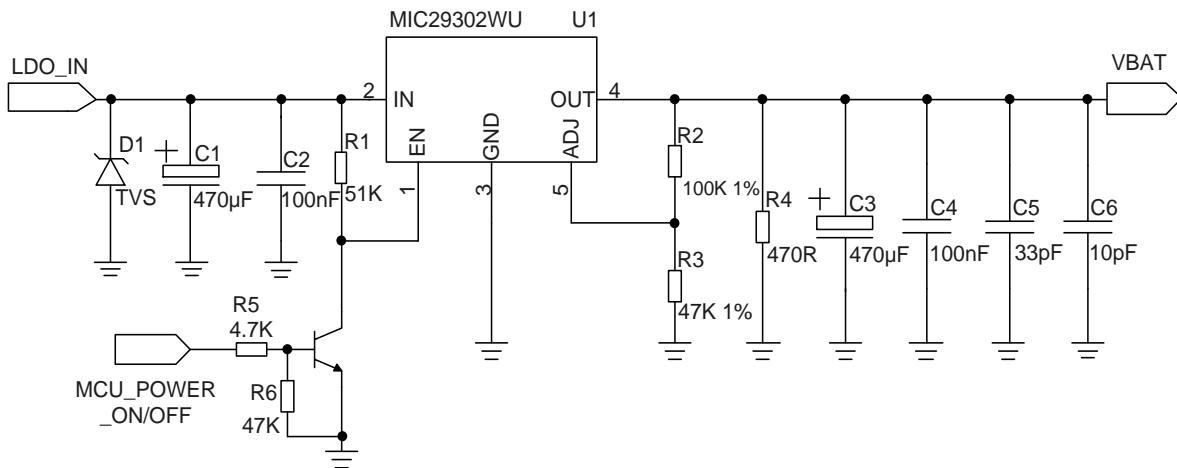
The following table shows the pin definition of power supply interface.

**Table 6: Definition of Power Supply Interface**

Pin Name	Pin No.	I/O	Description
VBAT	2, 24, 39, 41, 52	PI	3.4V~4.5V, typically 3.8V DC supply
GND	4, 9, 15, 18, 21, 26, 27, 29, 34, 35, 37, 40, 43, 50		Mini card ground

EC200T Mini PCIe-C is powered by VBAT. In the 2G network, the input peak current may reach 2.0A during the transmitting time. Therefore, the power supply must be able to provide a rated output current of 2.0A at least, and a bypass capacitor of no less than 470µF with low ESR should be used to prevent the voltage from dropping. If a switching power supply is used to power the module, the power components and power traces of the switching power supply should be kept away from the antenna 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**

### 3.5. UART Interface

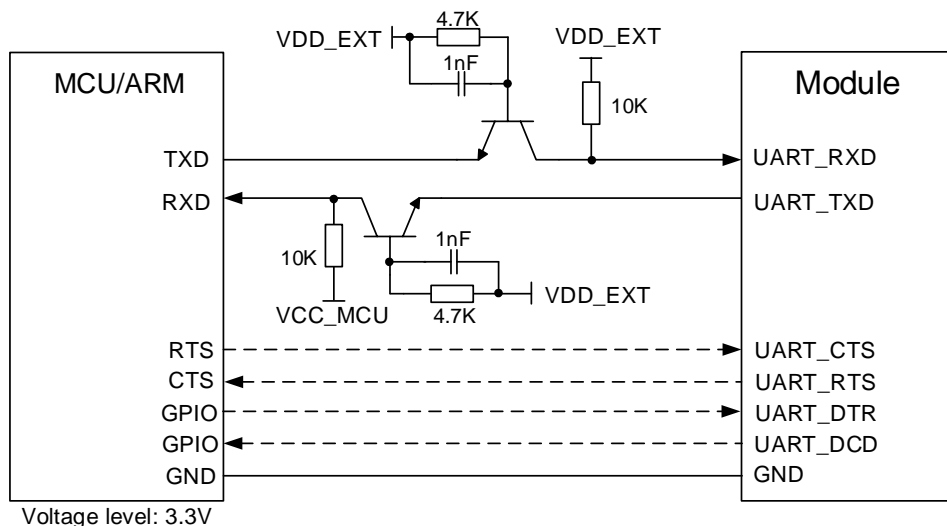
EC200T Mini PCIe-C supports one UART with RTS/CTS hardware flow control function. The UART interface supports 9600bps, 19200bps, 38400bps, 57600bps, 115200bps and 230400bps baud rates. The default is 115200bps.

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

**Table 7: Pin Definition of Main UART Interface**

Pin Name	Pin No.	I/O	Power Domain	Description
UART_RXD	23	DI	1.8V	UART receive data
UART_TXD	31	DO	1.8V	UART transmit data
UART_CTS	28	DI	1.8V	UART clear to send
UART_RTS	25	DO	1.8V	UART request to send
UART_DTR	46	DI	1.8V	Data terminal ready, sleep mode control
UART_DCD	30	DO	1.8V	UART data carrier detection

A level translator should be used if customers' application is equipped with a 3.3V UART interface. For the design of circuits in dotted lines, please refer to that of circuits in solid lines, but please pay attention to the direction of connection.



**Figure 4: Reference Circuit of 3.3V Level-shift**

**NOTES**

1. The hardware flow control function is disabled by default, and can be enabled by via **AT+IFC=2,2** and disabled via **AT+IFC=0,0**. For more details, please refer to **document [2]**.
2. The baud rate of the serial port can be changed via **AT+IPR**. For more related configuration information, please refer to **document [2]**.

### 3.6. USB Interface

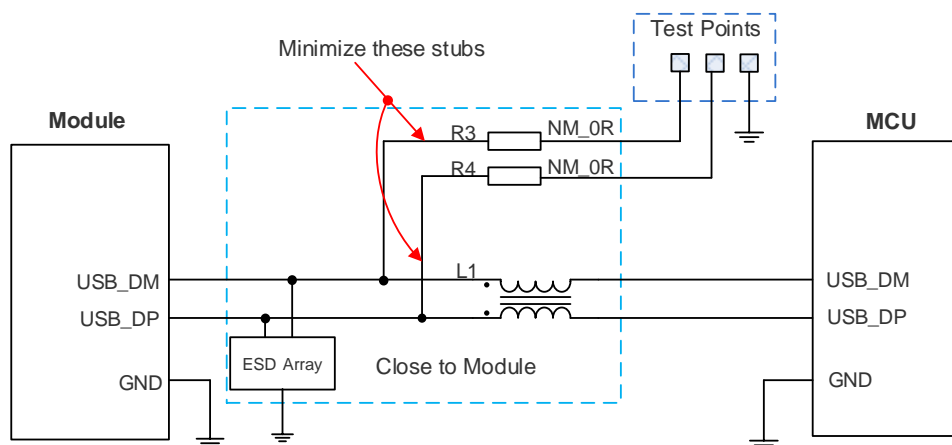
EC200T Mini PCIe-C provides one integrated Universal Serial Bus (USB) interface which complies with USB 2.0 specification. It can only be used as a slave device. Meanwhile, it supports high speed (480Mbps) mode and full speed (12Mbps) mode. The USB interface is used for AT command communication, data 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 differential data (-)	Require differential impedance of 90Ω
USB_DP	38	IO	USB differential data (+)	Require differential impedance of 90Ω

The following figure shows a reference circuit of USB interface.



**Figure 5: 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 R3 and R4 should be placed close to each other. The extra stubs of trace must be as short as possible.

Please follow the requirements below during USB interface design 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 or 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 2pF and should be placed as close as possible to the USB interface.

### 3.7. (U)SIM Interface

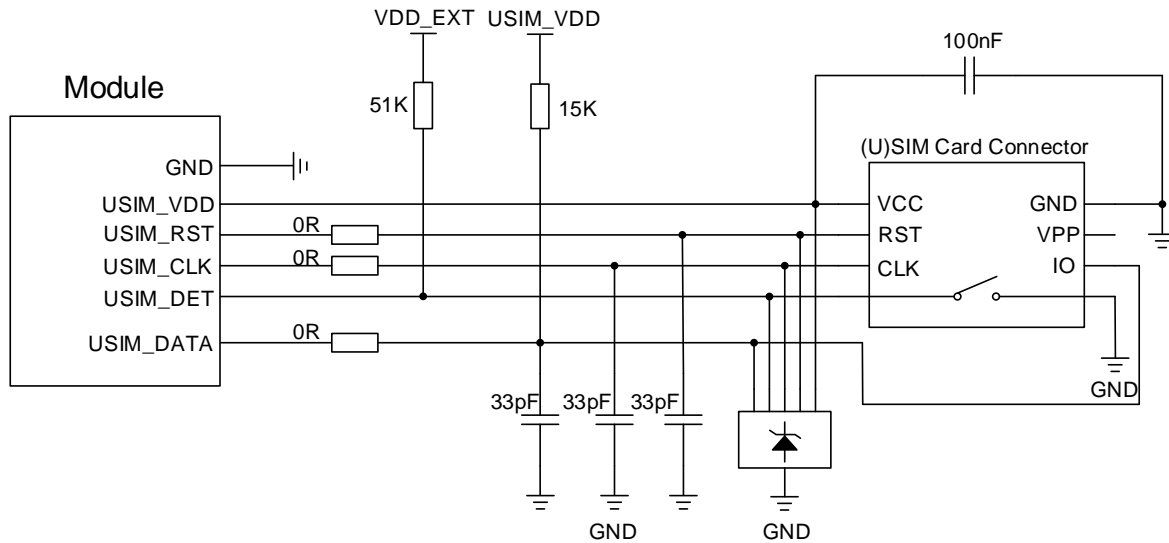
EC200T Mini PCIe-C's (U)SIM interface circuitry meets ETSI and IMT-2000 requirements. Both 1.8V and 3.0V (U)SIM cards are supported. The following table shows the pin definition of the (U)SIM interface.

**Table 9: Pin Definition of (U)SIM Interface**

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

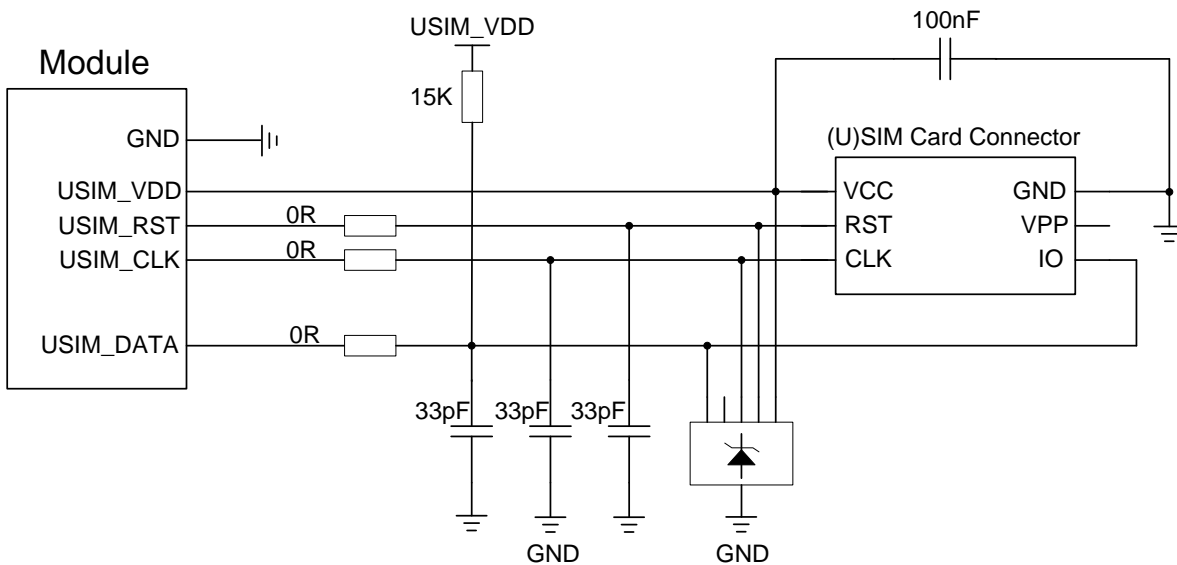
EC200T Mini PCIe-C supports (U)SIM card hot-plug via the USIM\_DET pin. The function supports low level and high level detections. By default, It is disabled, and can be configured via **AT+QSIMDET** command. Please refer to **document [2]** for details about the command.

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



**Figure 6: 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 7: 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 15pF.
- The 0Ω resistors should be added in series between the module and the (U)SIM card connector so as to facilitate debugging. The 33pF capacitors are used for filtering interference of EGSM900. Please note that the (U)SIM peripheral circuit should be close to the (U)SIM card connector.
- The pull-up resistor on USIM\_DATA line can improve anti-jamming capability when long layout trace and sensitive occasion are applied, and should be placed close to the (U)SIM card connector.

### 3.8. Analog Audio Interfaces

EC200T Mini PCIe-C provides two analog audio input channels and two analog output channels. The following table shows the pin definition of analog audio interfaces.

**Table 10: Pin Definition of Analog Audio Interfaces**

Pin Name	Pin No.	I/O	Description	Comment
MIC_P	1	AI	Analog audio input (+)	If unused, keep it open.
MIC_N	3	AI	Analog audio input (-)	If unused, keep it open.
SPK_P	5	AO	Analog audio output (+)	If unused, keep it open.
SPK_N	7	AO	Analog audio input (-)	If unused, keep it open.

MIC\_P and MIN\_N channels are used for microphone differential input. Electret microphones are usually used in microphones.

SPK\_P and SPK\_N channels are used for differential output of the receiver or loudspeaker (requiring external audio power amplifier).

**AT+QMIC** can be used for adjusting the microphone input gain. **AT+CLVL** can be used for adjusting the volume gain between output and receiver. Please refer to **document [2]** or **[3]** for details.

#### 3.8.1. Audio Interfaces Design Considerations

It is recommended to use the electret microphone with dual built-in capacitors (e.g. 10pF and 33pF) for filtering out RF interference, thus reducing TDD noise. The 33pF capacitor is applied for filtering out RF interference when the module is transmitting at EGSM900. Without placing this capacitor, TDD noise could be heard. The 10pF capacitor here is used for filtering out RF interference at DCS1800. Please note



that the resonant frequency point of a capacitor largely depends on the material and production technique. Therefore, customers would have to discuss with their capacitor vendors to choose the most suitable capacitor for filtering out high-frequency noises.

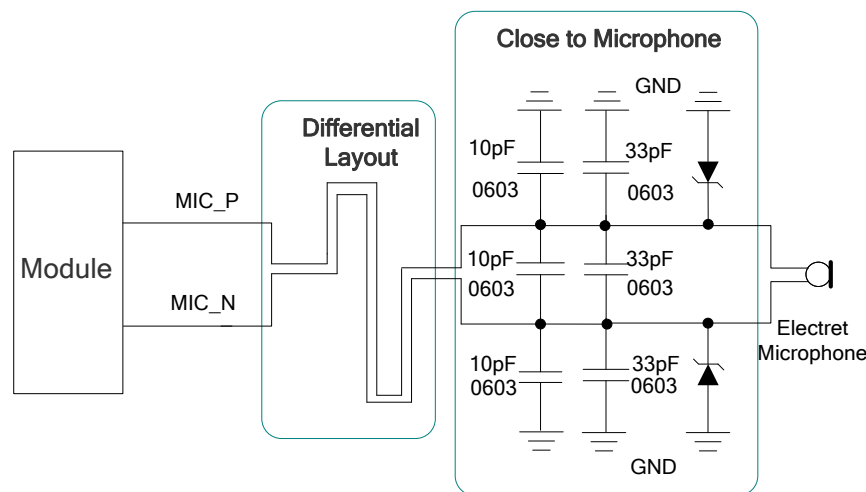
The severity degree of the RF interference in the voice channel during GSM transmitting largely depends on the application design. In some cases, EGSM900 TDD noise is more severe; while in other cases, DCS1800 TDD noise is more obvious. Therefore, a suitable capacitor can be selected based on the test results. Sometimes, even no RF filtering capacitor is required.

In order to decrease radio or other signal interference, RF antennas should be placed away from audio interfaces and audio traces. Power traces cannot be parallel with and also should be far away from the audio traces.

The differential audio traces must be routed according to the differential signal layout rule.

### 3.8.2. Microphone Interface Circuit

MIC\_P/MIC\_N channel provides electret microphone bias voltage in EC200T Mini PCIe-C without additional bias circuit outside. The microphone channel reference circuit is shown in the following figure:



**Figure 8: Reference Circuit of Microphone Interface**

### 3.8.3. Receiver Interface Circuit

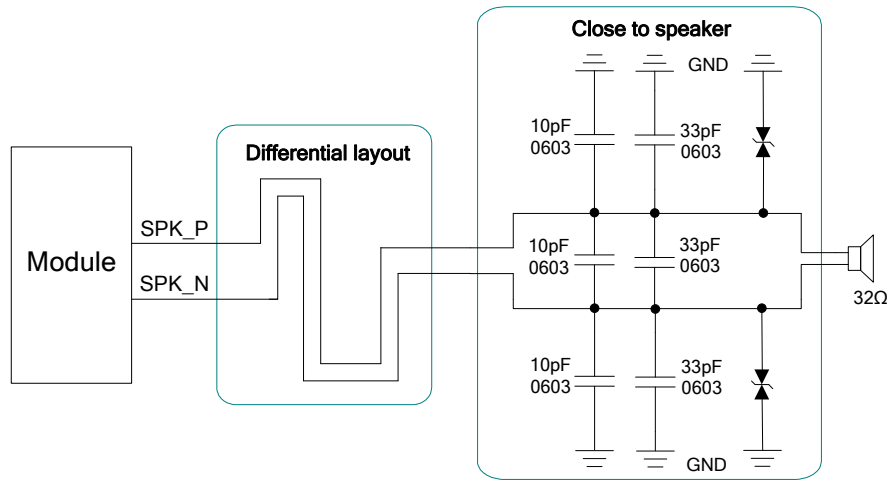


Figure 9: Reference Circuit of SPK Output

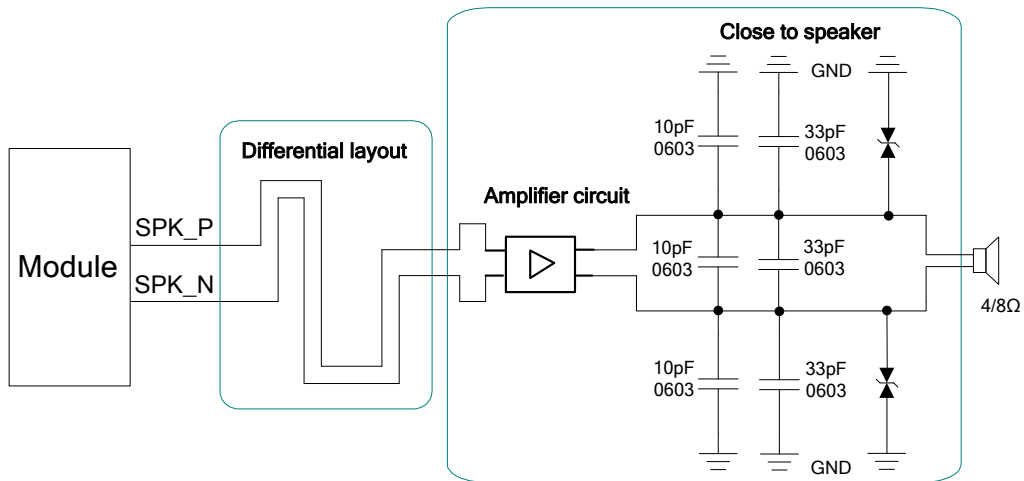


Figure 10: Reference Circuit of SPK Output with Audio Amplifier

### 3.9. 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
UART_DTR	46	DI	1.8V	Data terminal ready, sleep mode control
W_DISABLE#	20	DI	1.8V	Airplane mode control. Active low.
PERST#	22, 33	DI	1.8V	Reset the module. Active low.
LED_WWAN#	42	OC		LED signal for indicating the network status of the module.
WAKEUP_IN*	19	DI	1.8V	Sleep mode control. Active low.
WAKEUP_OUT	32	DO	1.8V	Module sleep indication. Active low.

#### NOTE

“\*” means under development.

#### 3.9.1. Sleep Mode Control and State Indication Signals

EC200T Mini PCIe-C has two pins including UART\_DTR and WAKEUP\_IN\* for sleep mode control and one pin WAKEUP\_OUT for sleep state indication. There are four preconditions when enabling EC200T Mini PCIe-C to enter the sleep mode:

- Execute **AT+QSCLK=1** to enable the Sleep mode. Please refer to **document [2]** for details.
- WAKEUP\_IN\* pin should be kept at low level or open.
- UART\_DTR pin should be kept at high level or open.
- USB on Mini PCIe-C must be connected to a USB host and please guarantee the USB host is in suspend state.

#### NOTE

“\*” means under development.

### 3.9.1.1. UART\_DTR Signal

UART\_DTR can be used for sleep mode control. It is pulled up by default. When module is in sleep mode, driving it to low level can wake up the module.

#### NOTE

When using UART\_DTR for wakeup function, WAKEUP\_IN (under development) should be kept at low level.

### 3.9.1.2. WAKEUP\_IN\* and WAKEUP\_OUT Signals

EC200T Mini PCIe-C module provides WAKEUP\_IN for sleep mode control and WAKEUP\_OUT for sleep state indication.

**Table 12: Pin Definition of WAKEUP\_IN and WAKEUP\_OUT Signals**

Pin Name	Description
WAKEUP_IN	High level: DTE wakes up the module Low level: DTE makes the module enter sleep mode
WAKEUP_OUT	High level: The module is in wake up mode, and USB and UART can be used Low level: The module is in sleep mode, and USB and UART cannot be used

#### NOTE

“\*” means under development.

### 3.9.2. W\_DISABLE# Signal

EC200T Mini PCIe-C 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 to low level can make the module enter airplane mode.

**Table 13: Airplane Mode Controlled by Hardware Method**

W_DISABLE#	RF Function Status	Module Operation Modes
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 14: Airplane Mode Controlled by Software Method**

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

### 3.9.3. PERST# Signal

The PERST# signal can be used to force a hardware reset on the card. The module can be reset by driving 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.

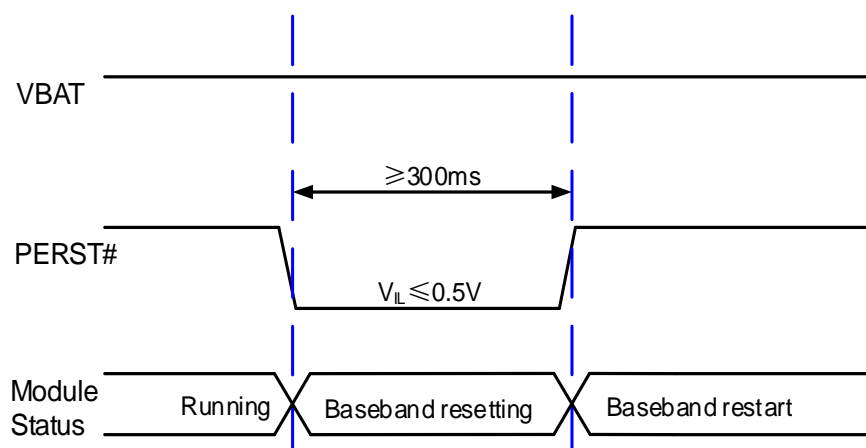


Figure 11: Timing of Resetting Module

## 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.

### 3.9.4. LED\_WWAN# Signal

The LED\_WWAN# signal of EC200T Mini PCIe-C 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.

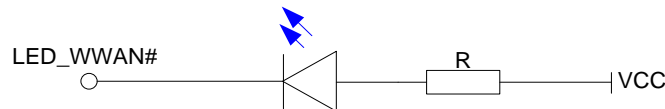


Figure 12: LED\_WWAN# Signal Reference Circuit Diagram

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 15: 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 16: Indications of Network Status (AT+QCFG="ledmode",2)

Pin Status	Description
Low Level (Light ON)	Registered on network successfully
High Impedance (Light OFF)	<ul style="list-style-type: none"><li>● No network coverage or not registered</li><li>● W_DISABLE# signal is at low level. (Disable RF)</li><li>● <b>AT+CFUN=0, AT+CFUN=4</b></li></ul>

# 4 Antenna Connection

## 4.1. Antenna Connectors

EC200T Mini PCIe-C is mounted with 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 17: Operating Frequencies

3GPP Bands	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



## 4.2. Antenna Requirements

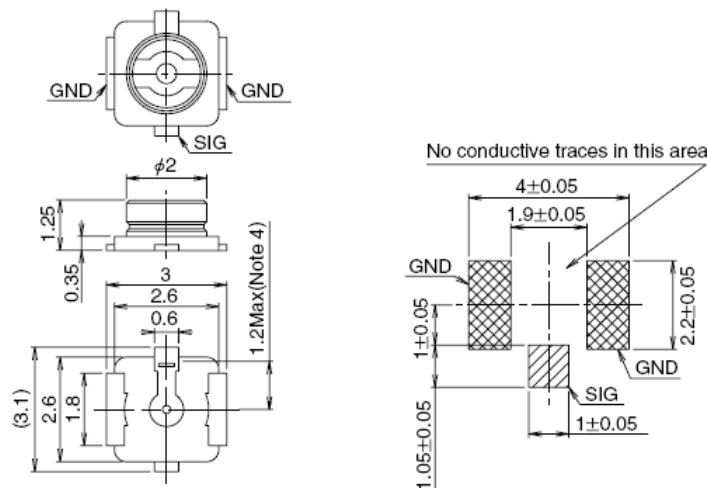
The following table shows the requirements on main antenna and Rx-diversity antenna.

**Table 18: Antenna Requirements**

Type	Requirements
GSM/UMTS/LTE	VSWR: $\leq 2$
	Efficiency: $> 30\%$
	Max input power: 50W
	Input impedance: $50\Omega$
	Cable insertion loss: $< 1\text{dB}$ (EGSM900, WCDMA B5/B8, LTE-FDD B5/B8)
	Cable insertion loss: $< 1.5\text{dB}$ (DCS1800, WCDMA B1, LTE B1/B3/B34/B39)
	Cable insertion loss: $< 2\text{dB}$ (LTE-TDD B38/B40/B41)

## 4.3. Recommended Mating Plugs for Antenna Connection

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



**Figure 13: 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 14: Mechanicals of U.FL-LP Mating Plugs

The following figure describes the space factor of mating plugs.

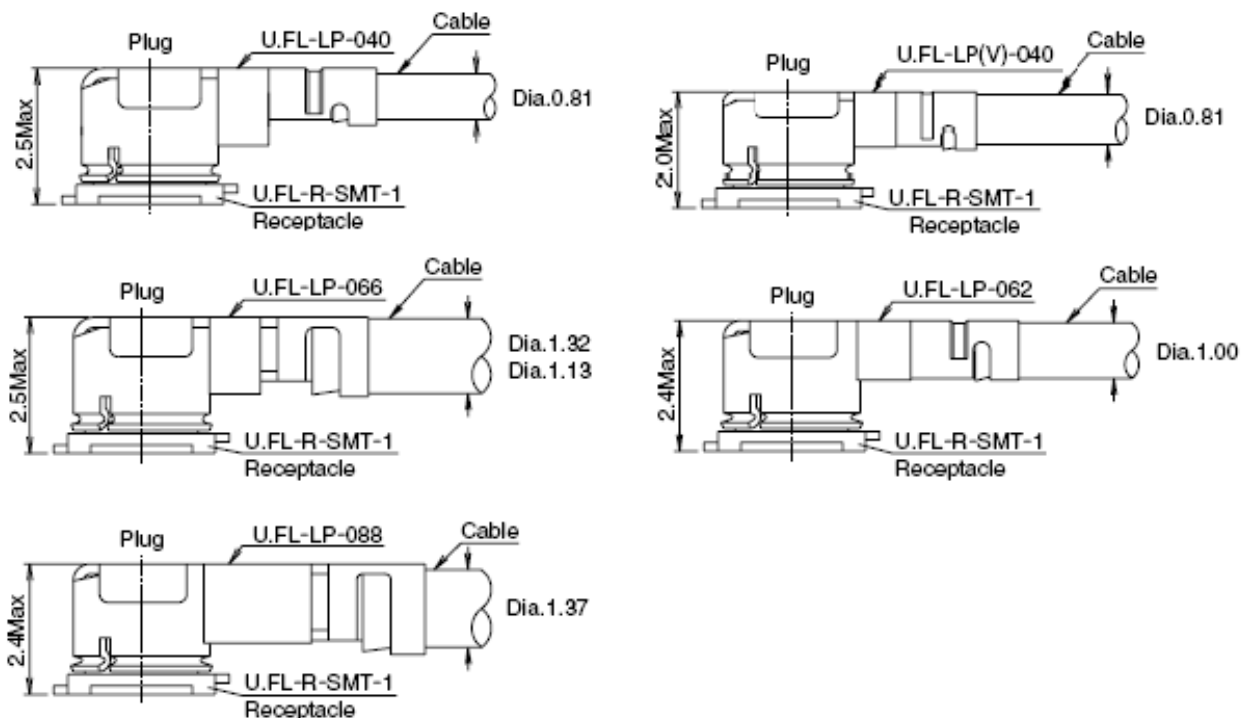


Figure 15: Space Factor of Mating Plugs (Unit: mm)

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

# 5 Electrical, Reliability and Radio Characteristics

## 5.1. General Description

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

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

## 5.2. Power Supply Requirements

The input voltage of EC200T Mini PCIe-C is 3.4V~4.5V, and should satisfy at least 2.0A supply capacity. The following table shows the power supply requirements of EC200T Mini PCIe-C.

**Table 19: Power Supply Requirements**

Parameter	Description	Min.	Max.	Unit
VBAT	Power Supply	3.4	4.5	V

## 5.3. I/O Requirements

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

**Table 20: I/O Requirements**

Parameter	Description	Min.	Max.	Unit
V <sub>IH</sub>	Input High Voltage	0.7 × VDDIO <sup>1)</sup>	VDDIO <sup>1)</sup> + 0.3	V
V <sub>IL</sub>	Input Low Voltage	-0.3	0.3 × VDDIO <sup>1)</sup>	V
V <sub>OH</sub>	Output High Voltage	VDDIO <sup>1)</sup> - 0.5	VDDIO <sup>1)</sup>	V
V <sub>OL</sub>	Output Low Voltage	0	0.4	V

**NOTES**

1. The maximum voltage value of V<sub>IL</sub> for PERST# signal and W\_DISABLE# signal is 0.5V.
2. <sup>1)</sup>VDDIO is the IO voltage of chipset and equals to 1.8V.

## 5.4. RF Characteristics

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

**Table 21: Conducted RF Output Power of EC200T Mini PCIe-C**

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/B8	23dBm±2dB	< -39dBm
LTE-TDD B34/B38/B39/B40/B41	23dBm±2dB	< -39dBm

**Table 22: Conducted RF Receiving Sensitivity of EC200T Mini PCIe-C**

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

## 5.5. ESD Characteristics

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

**Table 23: ESD Characteristics of EC200T Mini PCIe-C**

Tested Interfaces	Contact Discharge	Air Discharge	Unit
Power Supply and GND	+/-5	+/-10	kV
Antenna Interfaces	+/-4	+/-8	kV

---

Others

+/-0.5

+/-1

kV

---

# 6 Dimensions and Packaging

## 6.1. General Description

This chapter mainly describes mechanical dimensions as well as packaging specification of EC200T Mini PCIe-C module. All dimensions are measured in millimeter (mm), and the dimensional tolerances are  $\pm 0.05\text{mm}$  unless otherwise specified.

## 6.2. Mechanical Dimensions of EC200T Mini PCIe-C

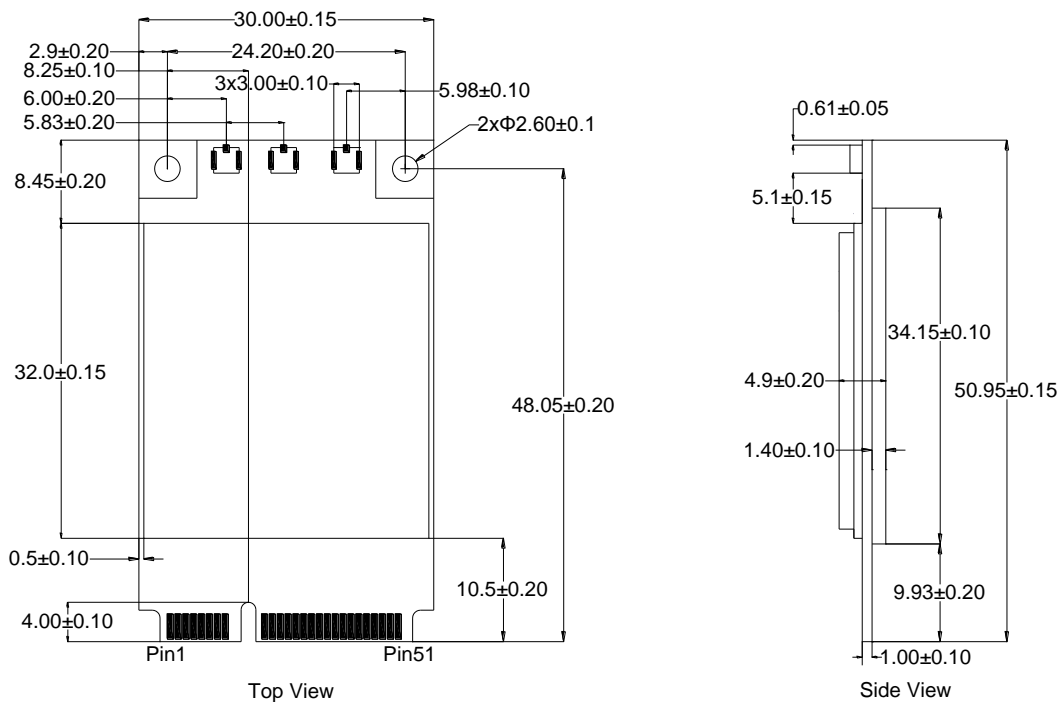


Figure 16: Mechanical Dimensions of EC200T Mini PCIe-C

### 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.

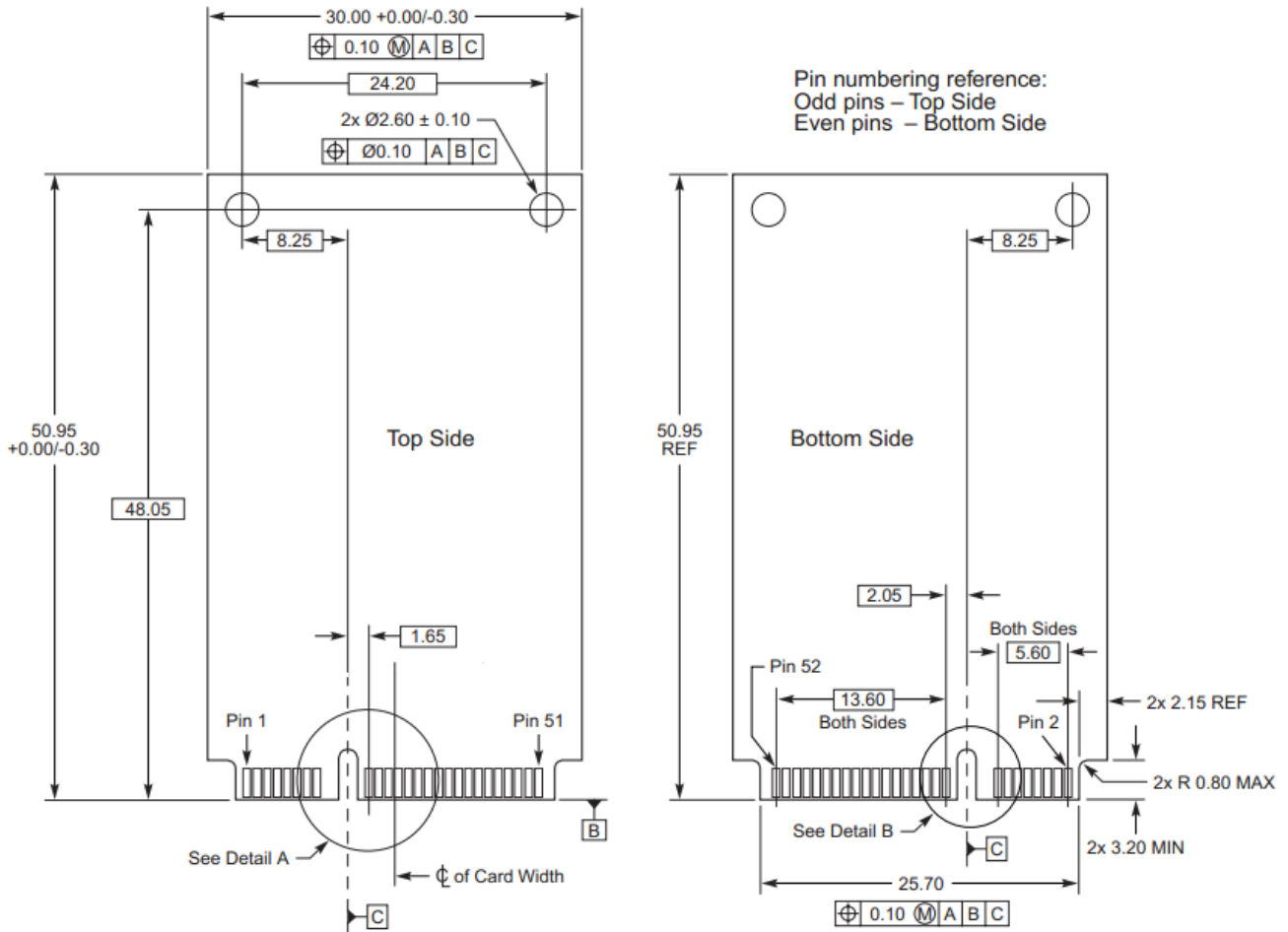
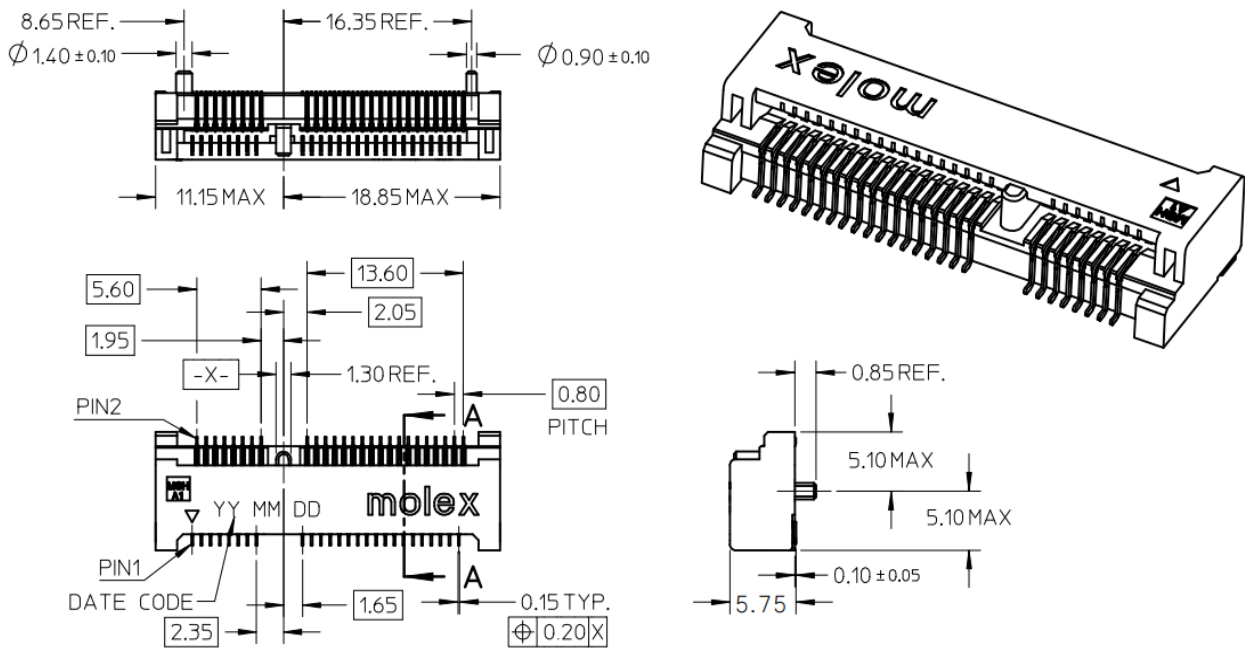


Figure 17: Standard Dimensions of Mini PCI Express



EC200T Mini PCIe-C adopts a standard Mini PCI Express connector which complies with the directives and standards listed in **document [1]**. The following figure takes the Molex 679105700 as an example.



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

## 6.4. Packaging Specifications

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

# 7 Appendix A References

**Table 24: 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_AT_Commands_Manual	EC200T AT commands manual
[3]	Quectel_WCDMA&LTE_Audio_Design_Note	Audio design note for UMTS/HSPA(+) and LTE Standard modules

**Table 25: Terms and Abbreviations**

Abbreviation	Description
8-PSK	8-Phase Shift Keying
bps	Bits Per Second
CS	Coding Scheme
CTS	Clear to Send
DCE	Data Communications Equipment
DL	Downlink
DTE	Data Terminal Equipment
DTR	Data Terminal Ready
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
ESR	Equivalent Series Resistance
FDD	Frequency Division Duplexing

---

GMSK	Gaussian Minimum Shift Keying
GSM	Global System for Mobile Communications
HSDPA	High Speed Down Link Packet Access
HSPA	High Speed Packet Access
HTTP	Hyper Text Transfer Protocol
HTTPS	Hyper Text Transfer Protocol over Secure Socket Layer
I/O	Input/Output
kbps	Kilobit Per Second
LED	Light Emitting Diode
LTE	Long Term Evolution
Mbps	Million Bits Per Second
MCS	Modulation and Coding Scheme
ME	Mobile Equipment
MMS	Multimedia Messaging Service
MO	Mobile Originated
MS	Mobile Station (GSM engine)
MT	Mobile Terminated
PAP	Password Authentication Protocol
PCB	Printed Circuit Board
PDU	Protocol Data Unit
PPP	Point-to-Point Protocol
RF	Radio Frequency
RX	Receive Direction
SMS	Short Message Service
TDD	Time Division Duplexing

---

---

TE	Terminal Equipment
TTFF	Time to First Fix
TX	Transmitting Direction
UART	Universal Asynchronous Receiver & Transmitter
UL	Uplink
UMTS	Universal Mobile Telecommunications System
URC	Unsolicited Result Code
(U)SIM	(Universal) Subscriber Identity Module
USSD	Unstructured Supplementary Service Data
WCDMA	Wideband Code Division Multiple Access

---