M3 Mini PCIe

Hardware Design

LTE Module Series

Rev.

M3_Mini_PCIe_Hardware_Design_V2.3

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

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History

Revision	Date	Author	Description
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2.0	2020-07-30	Xieencai	IO
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1 Introduction

This document defines M3 Mini PCIe module and describes its hardware interfaces which are connected with your application and air interfaces.

This document can help you to quickly understand the interface specifications, electrical and mechanical details and related product information of the M3 Mini PCIe module. To facilitate its application in different fields, relevant reference design documents are also provided. Associated with application notes and user guide of M3 Mini PCIe module, you can use the module to design and set up mobile applications easily.

1.1. Safety Information

The following safety precautions must be observed during all phases of the operation, such as usage, service or repair of any cellular terminal or mobile incorporating M3 Mini PCIe module. Manufacturers of the cellular terminal should send the following safety information to users and operating personnel and to incorporate these guidelines into all manuals supplied with the product. If not so, UcloudLink does not take on any liability for customer 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) cause distraction and can lead to an accident. You must comply with laws and regulations restricting the use of wireless devices while driving.
	Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it switched off. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. Consult the airline staff about the use of wireless devices on boarding the aircraft, if your device offers a Airplane Mode which must be enabled prior to boarding an aircraft.
	Switch off your wireless device when in hospitals or clinics or other health care facilities. These requests are desinged to prevent possible interference with sentitive medical equipment.
	Cellular terminals or mobiles operate over radio frequency signal and cellular network and cannot be guaranteed to connect in all conditions, for example no mobile fee or an invalid SIM card. While you are in this condition and need emergent help, please remember using emergency call. In order to make or receive call, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength.
	Your cellular terminal or mobile contains a transmitter and receiver. When it is ON, it receives and transmits radio frequency energy. RF interference can occur if it is used close to TV set, radio, computer or other electric equipment.
	In locations with potencially explosive atmospheres, obey all posted signs to turn off wireless devices such as your phone or other cellular terminals. Areas with potencially exposive atmospheres including 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.

2 Product Concept

2.1. General Description

M3 Mini PCIe module provides data connectivity on FDD-LTE, TDD-LTE, WCDMA, TD-SCDMA and GSM networks with PCI Express Mini Card 1.2 standard interface. It supports embedded operating system such as Windows, Linux and Android etc.

M3 Mini PCIe module can be applied in the following fields:

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

This chapter generally introduces the following aspects of M3 Mini PCIe module:

- Product Series
- Key Features
- Functional Diagram

2.2. Description of Product Series

The following table shows the product series of M3 Mini PCIe module.

Table 1: Description of M3 Mini PCIe

Product Series	Description
M3 Mini PCIe	Support GSM: 850/900/1800/1900MHz Support WCDMA: B1/B2/B4/B5/B6/B8/B9/B19 Support LTE FDD: B1/B2/B3/B4/B5/B7/B8/B9/B12/B13/B17 B18/B19/B20/B25/B26/B28/B66 Support TDD-LTE:B34/B38/B39/B40/B41 Support digital audio [1)]

NOTES

1) Digital audio (PCM) function is only supported in **NEW** HW version.

2.3. Key Features

The following table describes the detailed features of M3 Mini PCIe module.

Table 2: Key Features of M3 Mini PCIe

Feature	Details
Function Interface	PCI Express Mini Card 1.2 Standard Interface
Power Supply	Supply voltage: 3.0~4.2 Typical supply voltage: 4.0V
Transmitting Power	Class 4 (33dBm±2dB) for GSM850 and EGSM900 Class 1 (30dBm±2dB) for DCS1800 and PCS1900 Class E2 (27dBm±3dB) for GSM850 and EGSM900 8-PSK Class E2 (26dBm±3dB) for DCS1800 and PCS1900 8-PSK Class 3 (24dBm+1/-3dB) for WCDMA bands Class 3 (23dBm±2dB) for LTE FDD and TDD bands
LTE Features	Support CAT4 FDD and TDD Support 1.4 to 20MHz RF bandwidth Support 2 ×2 MIMO in DL direction FDD: Max 150Mbps (DL), Max 50Mbps (UL) TDD: Max 120Mbps (DL), Max 30Mbps (UL)
WCDMA Features	Support 3GPP R8 DC-HSPA+ Support 16-QAM, 64-QAM and QPSK modulation 3GPP R6 HSUPA: Max 5.76Mbps (UL) 3GPP R8 DC-HSPA+: Max 42Mbps (DL)
GSM Features	R99: CS data: 9.6k, 14.4kbps GPRS: Support GPRS multi-slot class 12 (12 by default) Coding scheme: CS-1, CS-2, CS-3 and CS-4 Maximum of four Rx time slots per frame EDGE: Support EDGE multi-slot class 12 (12 by default) 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
Internet Protocol Features	Support TCP/UDP/PPP/FTP/HTTP/SMTP/MMS/NTP/PING/QMI protocols Support the protocols PAP (Password Authentication Protocol) and CHAP (Challenge Handshake Authentication Protocol) usually used for PPP connections
USIM Interface	Support USIM/SIM card: 1.8V, 3.0V

UART Interface	Baud rate can reach up to 230400bps, 115200bps by default Used for AT command Support multiplexing function
Audio Feature [1)]	Support one digital audio interface: PCM interface GSM: HR/FR/EFR/AMR/AMR-WB WCDMA: AMR/AMR-WB LTE: AMR/AMR-WB Support echo cancellation and noise suppression
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, firmware upgrade, software debug USB Driver: Windows XP, Windows Vista, Windows 7, Windows 8/8.1, Window CE 5.0/6.0/7.0, Linux 2.6 or later, Android 2.3/4.0/4.2/4.4/5.0
Antenna Interface	Include main antenna, diversity antenna
Rx-diversity	Support LTE/WCDMA Rx-diversity
AT Commands	Compliant with 3GPP TS 27.007, 27.005 and UcloudLink enhanced AT commands
Physical Characteristics	Size: 51.0±0.1 × 30.0±0.1 × 4.9±0.2 mm Weight: approx. 9.8g
Temperature Range	Normal operation: -10°C ~ +60°C Restricted operation: -20°C ~ -10°C and +60°C ~ +70°C [2)] Storage temperature: -30°C ~ +80°C
Firmware Upgrade	USB interface and DFOTA
RoHS	All hardware components are fully compliant with EU RoHS directive

NOTES

1. [1)]This function is under development.
2. [2)]When the module works within this temperature range, RF performance might degrade. For example, the frequency error or the phase error may increase.

2.4. Functional Diagram

The following figure shows a block diagram of M3 Mini PCIe.

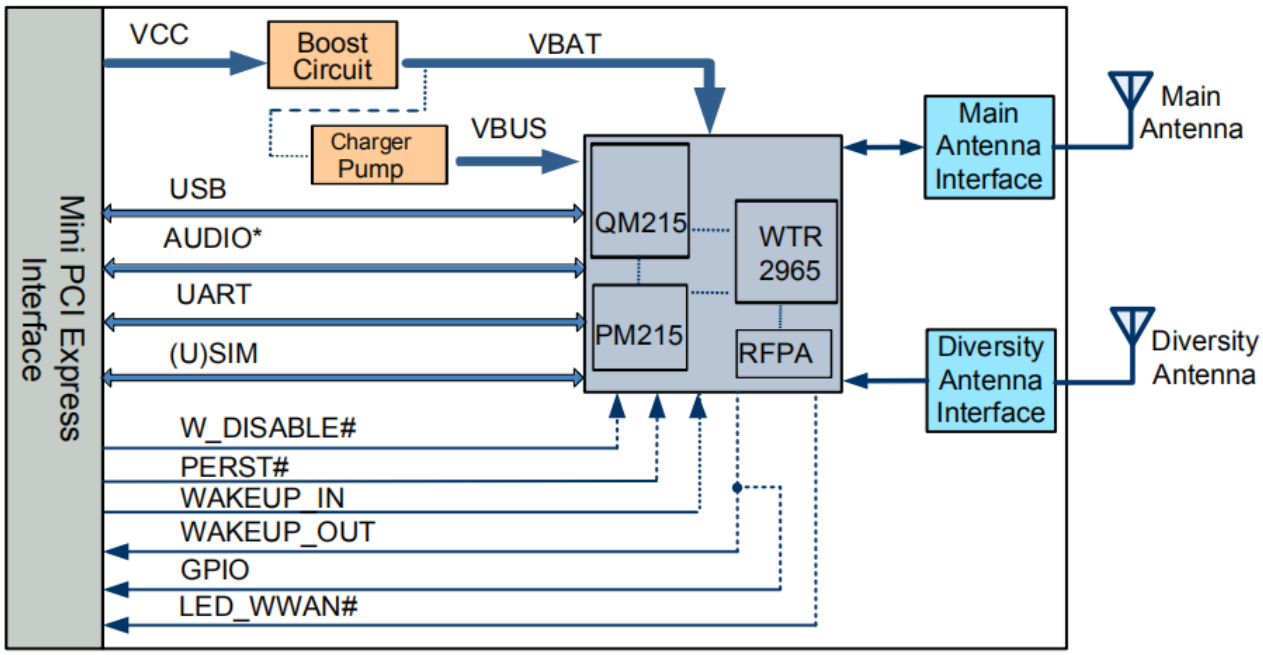


Figure 1: Functional Diagram

3 Application Interface

3.1. General Description

The physical connections and signal levels of M3 Mini PCIe comply with PCI Express Mini CEM specifications. This chapter mainly describes the following interface definition and application of M3 Mini PCIe:

- Power supply
- USIM interface
- USB interface
- UART interface
- Control signals
- Antenna interface

3.2. M3 Mini PCIe Interface

3.2.1. Definition of Interface

The following tables show the pin assignments of M3 Mini PCIe on the 52-pin application.

Table 3: Definition of IO Parameters

Type	Description
IO	Bidirectional input/output
DI	Digital input
DO	Digital output
OC	Open collector
OD	Open drain
PI	Power input

PO	Power output
AI	Analog input
AO	Analog output

Table 4: Description of Pin

Pin No.	Mini PCI Express Standard Name	M3 Mini PCIe Pin Name	I/O	Description	Comment
1	WAKE#	MIC_P*	AI	MIC INPUT +	
2	3.3Vaux	VBAT	PI	DC supply	
3	COEX1	MIC_N*	AI	MIC INPUT -	
4	GND	GND		Ground	
5	COEX2	SPK_P*	AO	SPK OUTPUT +	
6	1.5V	RESERVED	—	—	
7	CLKREQ#	SPK_N*	AO	SPK OUTPUT -	
8	UIM_PWR	USIM_VDD	PO	Power source for the USIM/SIM card	
9	GND	GND		Mini Card ground	
10	UIM_DATA	USIM_DATA	IO	USIM/SIM data signal	
11	REFCLK-	RESERVED	—	—	
12	UIM_CLK	USIM_CLK	DO	USIM/SIM clock signal	
13	REFCLK+	RESERVED	—	—	
14	UIM_RESET	USIM_RST	DO	USIM/SIM reset signal	
15	GND	GND		Ground	
16	UIM_VPP	RESERVED	—	—	
17	RESERVED	RI	DO	URC ring indication	
18	GND	GND		Mini Card ground	
19	RESERVED	WAKEUP_IN	DI	WAKEUP INPUT	

20	W_DISABLE#	W_DISABLE#	DI	Disable wireless communications	Pull-up, Active low
21	GND	GND		Ground	
22	PERST#	PERST#	DI	Functional reset to the card	Active low
23	PERn0	UART_RXD	DI	UART receive	
24	3.3Vaux	VBAT	PI	POWER INPUT	
25	PERp0	UART_RTS	DO	UART request to receive	
26	GND	GND		Ground	
27	GND	GND		Ground	
28	1.5V	UART_CTS	DI	UART clear to send	
29	GND	GND		Ground	
30	SMB_CLK	UART_DCD	DO		
31	PETn0	UART_TXD	DO	UART request to send	
32	SMB_DATA	WAKEUP_OUT	DO	WAKEUP OUT	
33	PETp0	PERST#	DI	Functional reset to the card	
34	GND	GND		Ground	
35	GND	GND		Ground	
36	USB_D-	USB_DM	IO	USB differential data (-)	
37	GND	GND		Ground	
38	USB_D+	USB_DP	IO	USB differential data (+)	
39	3.3Vaux	VBAT	PI	DC supply	
40	GND	GND		Ground	
41	3.3Vaux	VBAT	PI	DC supply	
42	LED_WWAN#	LED_WWAN#	OC	Active-low LED signal for indicating the state of the card	
43	GND	GND		Ground	
44	LED_WLAN#	RESERVED	—	—	
45	RESERVED	PCM_CLK*	IO	PCM clock signal	

46	LED_WPAN#	RESERVED	—	—
47	RESERVED	PCM_DOUT0*	DO	PCM data output
48	1.5V	NC	—	—
49	RESERVED	PCM_DIN*	DI	PCM data input
50	GND	GND		Mini Card ground
51	RESERVED	PCM_DOUT1*	IO	PCM data output
52	3.3Vaux	VBAT	PI	DC supply

NOTES

1. The typical supply voltage is 4.0V
2. Keep all NC, reserved and unused pins unconnected.
3. "*" means digital audio (PCM) function is only supported on **New HW** version.

3.2.2. Pin Assignment

The following figure shows the pin assignment of M3 Mini PCIe module. The top side contains M3 module and antenna connectors.

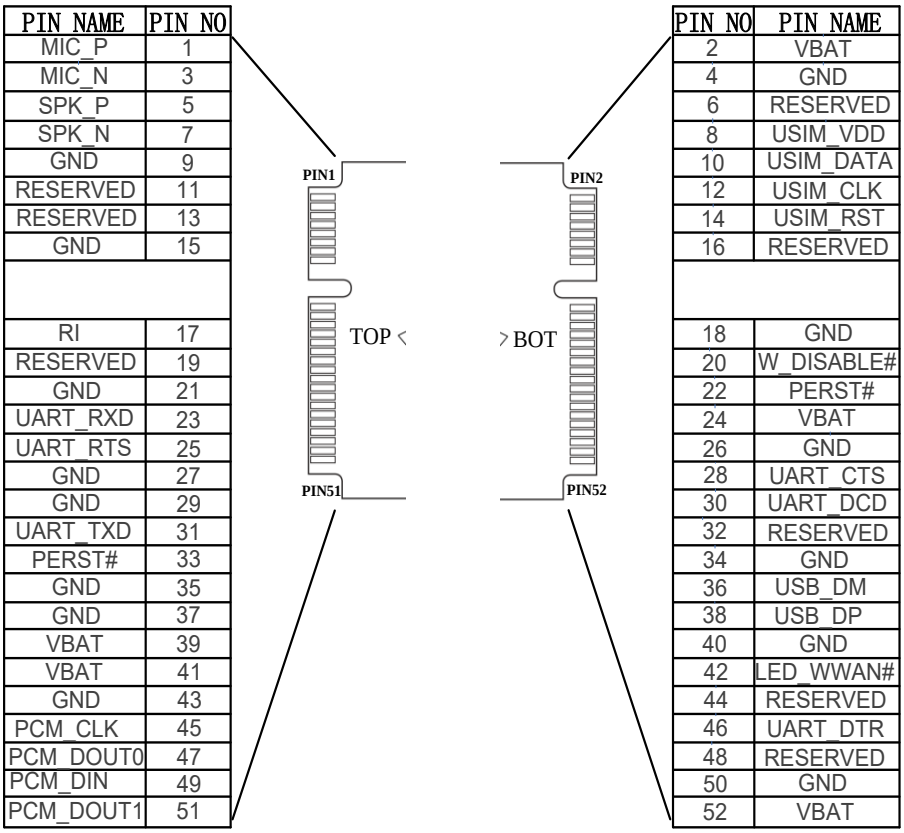


Figure 2: Pin Assignment

3.3. Power Supply

The following table shows the VCC_3V3 pins and ground pins.

Table 5: VCC_3V3 and GND Pin Definition

Pin No.	Pin Name	I/O	Power Domain	Description
2, 39, 41, 52	VCC_3V3	PI	3.0~4.2V	3.8V DC supply
4, 9, 15, 18, 21, 26, 27, 29, 34, 35, 37, 40, 43, 50	GND			Mini Card ground

The typical supply voltage of M3 Mini PCIe is 4.0V. In the GSM900 mode, the input peak current may reach to 3A during the transmitting time, therefore the power supply must be able to provide enough current, and a bypass capacitor of no less than 1000μF with low ESR should be used to prevent the voltage from dropping.

The following figure shows a reference design of power supply. The precision of resistor R3 and R4 is 1%, and the capacitor E1 needs a low ESR.

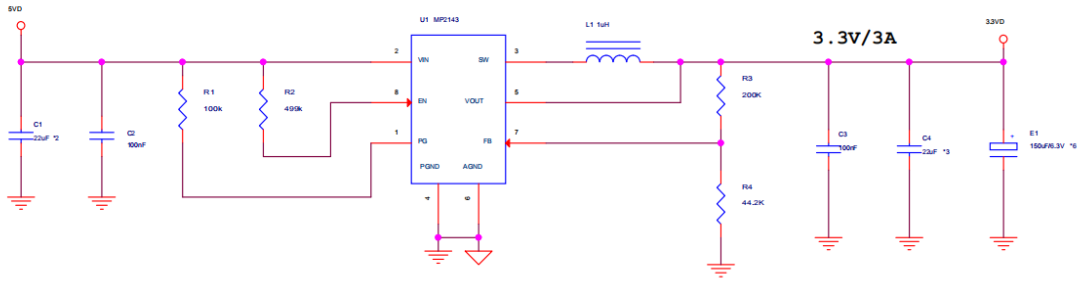


Figure 3: Reference Design of Power Supply

3.4. USIM Card Interface

The following table shows the pin definition of the USIM card interface.

Table 6: USIM Pin Definition

Pin No.	Pin Name	I/O	Power Domain	Description
8	USIM_VDD	PO	1.8V/3.0V	Power source for the USIM/SIM card
10	USIM_DATA	IO	1.8V/3.0V	USIM/SIM data signal
12	USIM_CLK	DO	1.8V/3.0V	USIM/SIM clock signal
14	USIM_RST	DO	1.8V/3.0V	USIM/SIM reset signal

M3 Mini PCIe supports 1.8V and 3.0V USIM cards. The following figure shows the reference design of the 6-pin USIM connector.

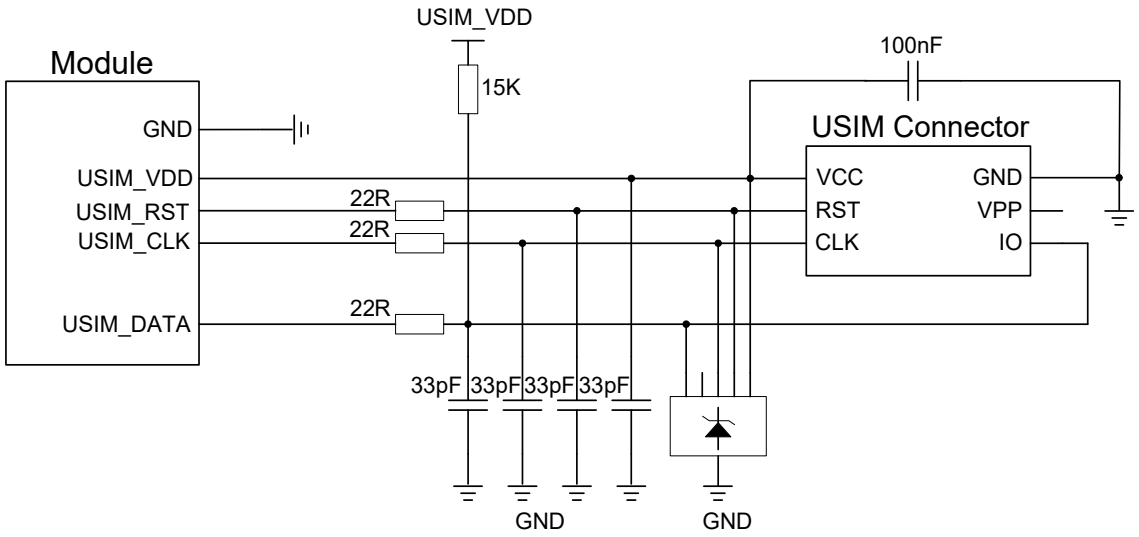


Figure 4: Reference Circuit of the 6-Pin USIM Connector

In order to enhance the reliability and availability of the USIM card in your application, please follow the criteria below in the USIM circuit design:

- Keep layout of USIM card as close to the module as possible. Assure the length of the trace as less than 200mm as possible.
- Keep USIM card signal away from RF and power supply alignment.
- Keep the width of ground and USIM_VDD no less than 0.5mm to maintain the same electric potential. The decouple capacitor of USIM_VDD should be less than 1uF and must near to USIM connector.

- To avoid cross-talk between USIM_DATA and USIM_CLK, keep them away from each other and shield them with surrounding ground.
- In order to offer good ESD protection, it is recommended to add TVS. The 22ohm resistors should be added in series between the module and USIM card so as to suppress the EMI spurious transmission and enhance the ESD protection. The 33pF capacitors are used for filtering interference of GSM850/EGSM900. Please note that the USIM peripheral circuit should be close to the USIM card holder.
- 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 connector.

3.5. USB Interface

The following table shows the pin definition of USB interface.

Table 7: USB Pin Definition

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

M3 Mini PCIe is compliant with USB 2.0 specification. It can only be used as a slave device. Meanwhile, it supports high speed (480Mbps) and full speed (12Mbps) mode. The USB interface is used for AT command, data transmission, software debug and firmware upgrade. The following figure shows the reference circuit of USB interface.

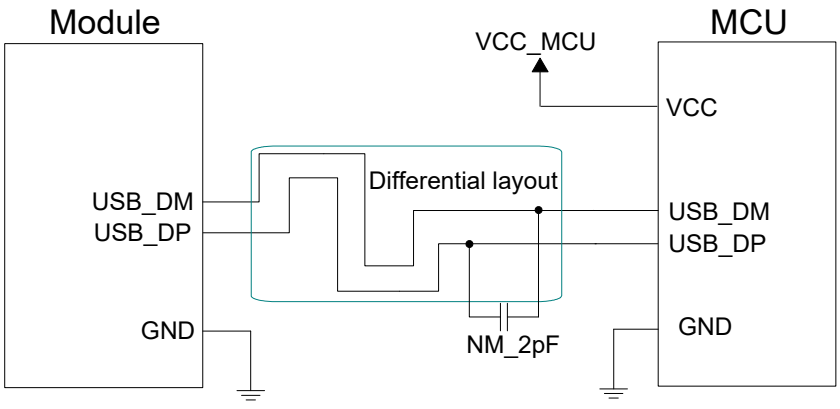


Figure 5: Reference Circuit of USB Interface

The USB interface is recommended to be reserved for firmware upgrade in your design. The following figure shows the recommended test points.

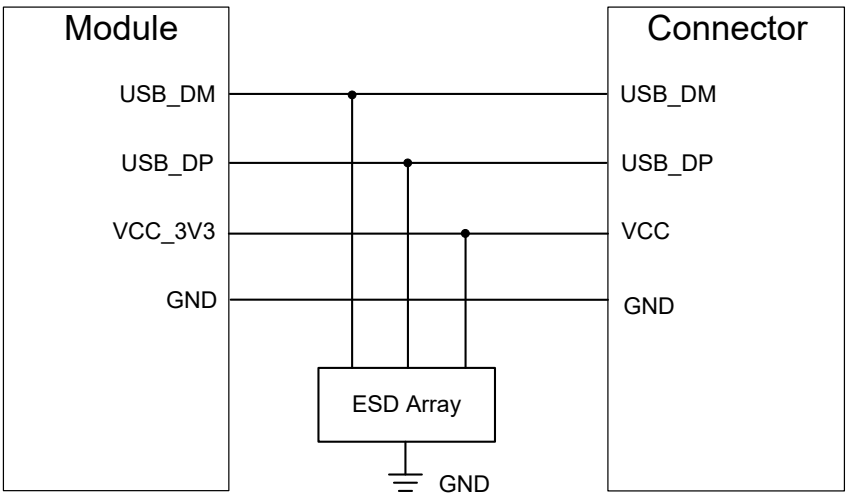


Figure 6: USB Test Points for Firmware Upgrade

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

- It is important to route the USB signal traces as differential pairs with total grounding. The impedance of USB differential trace is 90ohm.
- 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, and not only upper and lower layer but also right and left side should be shielded.
- If you use the USB connector, you should keep the ESD components as close to the USB connector as possible. Pay attention to the influence of junction capacitance of ESD component on USB data lines. Typically, the capacitance value should be less than 2pF.
- Keep the ESD components as close as possible to the connector.
- Keep USB data test points traces short to avoid noise coupled on USB data lines. If possible, reserve 0R resistor on these two lines.

NOTES

There are three preconditions when enabling M3 Mini PCIe to enter into the sleep mode:

1. Execute AT command **AT+QSCLK=1** to enable the sleep mode. Refer to ***document [2]***.
2. DTR pin should be kept in high level (pull-up internally).
3. USB interface on Mini PCIe must be connected with your USB interface and please guarantee USB devices are in the suspended state.

3.6. UART Interface

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

Table 8: Pin Definition of the UART Interface

Pin No.	M3 Mini PCIe Pin Name	I/O	Power Domain	Description
11	UART_RX	DI	1.8V	UART receive data
13	UART_TX	DO	1.8V	UART transmit data
23	UART_CTS	DI	1.8V	UART clear to send
25	UART_RTS	DO	1.8V	UART request to send

The UART interface supports 9600, 19200, 38400, 57600, 115200 and 230400bps baud rate. The default is 115200bps. This interface can be used for AT communication.

NOTE

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

3.7. PCM Interface

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

Table 9: PCM and I2C Pin Definition

Pin No.	Pin Name	I/O	Power Domain	Description
45	PCM_CLK	IO	1.8V	PCM clock signal
47	PCM_DOUT0	DO	1.8V	PCM data output
49	PCM_DIN	DI	1.8V	PCM data input
51	PCM_DOUT1	IO	1.8V	PCM data output

PCM need the NEW HW and SW to support

3.8. Control Signals

The following table shows the pin definition of control signals.

Table 10: Control Signal Pin Definition

Pin No.	Pin Name	I/O	Power Domain	Description
17	RI	DO	1.8V	URC ring indication, can be used to wake up the host.
31	DTR	DI	1.8V	Sleep mode control.
20	W_DISABLE#	DI	1.8V	Disable wireless communications, pull-up by default, active low.
22 33	PERST#	DI	1.8V	Functional reset to the card. active low.
42	LED_WWAN#	OC	—	Active-low LED signal for indicating the state of the Module.

3.8.1. RI Signal

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

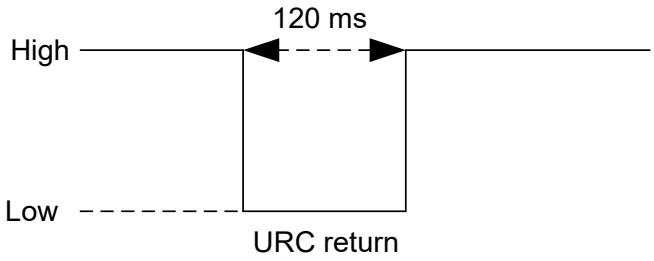


Figure 10: RI Behavior

3.8.2. DTR Signal

The DTR signal supports sleep control function, drive it to low level will wake up the module. AT command **AT+QCFG="pwrsavedtr",0** is used to disable the sleep control function.

3.8.3. W_DISABLE# Signal

M3 Mini PCIe provides W_DISABLE# signal to disable wireless communications through hardware operation. The following table shows the radio operational states of module. Please refer to ***document [2]*** for related AT commands.

Table 11: Radio Operational States

W_DISABLE#	AT Commands	Radio Operation
High Level	AT+CFUN=1	Enabled
High Level	AT+CFUN=0 AT+CFUN=4	Disabled
Low Level	AT+CFUN=0 AT+CFUN=1 AT+CFUN=4	Disabled

3.8.4. PERST# Signal

The PERST# signal can be used to force a hardware reset on the card. You can reset the module by driving the PERST# to a low level voltage of more than 150ms and then release it. The reset scenario is illustrated in the following figure.

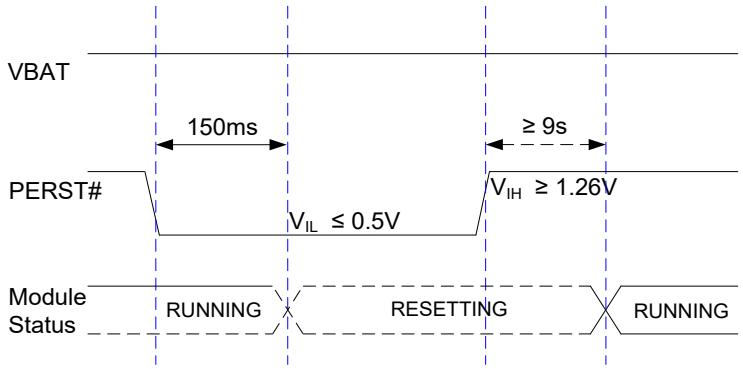


Figure 11: Timing of Resetting Module

3.8.5. LED_WWAN# Signal

The LED_WWAN# signal of M3 Mini PCIe is used to indicate the network status of the module, which can absorb the current up to 40mA. According to the following circuit, in order to reduce the current of the LED, a resistor must be placed in series with the LED. The LED is emitting light when the LED_WWAN# output signal is active low.

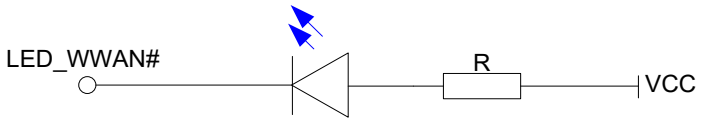


Figure 12: LED_WWAN# Signal Reference Circuit Diagram

The following table shows the indications of network status of the LED_WWAN# signal.

Table 12: Indication of Network Status

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

3.9. Antenna Interface

M3 Mini PCIe antenna interfaces include a main antenna interface, and a Rx-diversity antenna interface . The following figure shows the overall sizes of RF connector.

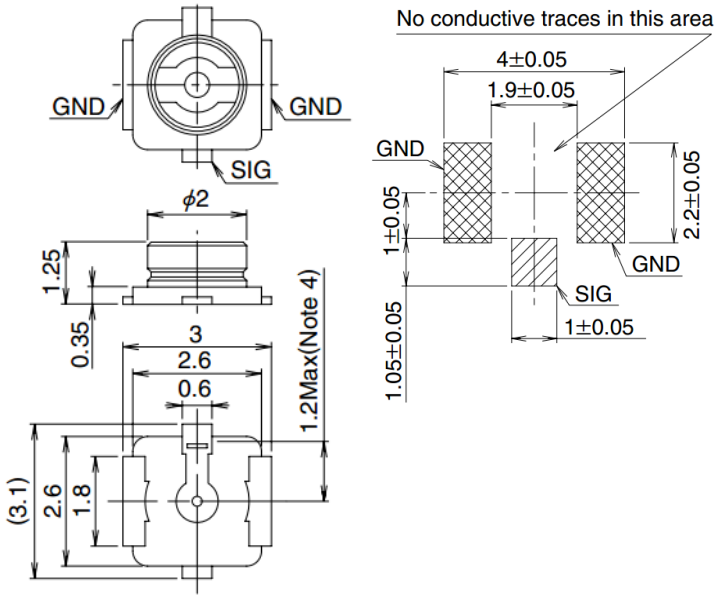


Figure 13: Dimensions of the RF Connector (Unit: mm)

You can use U.FL-LP serial connector listed in the following figure to match the ECT818000117. For more details, please visit http://www.hirose.com.

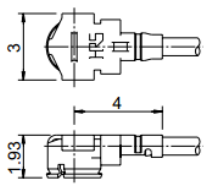
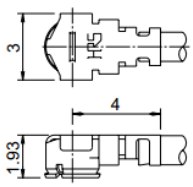
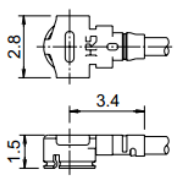
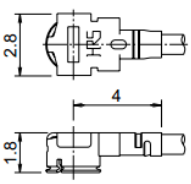
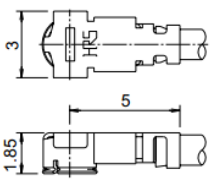
Part No.	U.FL-LP-040	U.FL-LP-066	U.FL-LP(V)-040	U.FL-LP-062	U.FL-LP-088
					
Mated Height	2.5mm Max. (2.4mm Nom.)	2.5mm Max. (2.4mm Nom.)	2.0mm Max. (1.9mm Nom.)	2.4mm Max. (2.3mm Nom.)	2.4mm Max. (2.3mm Nom.)
Applicable cable	Dia. 0.81mm Coaxial cable	Dia. 1.13mm and Dia. 1.32mm Coaxial cable	Dia.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

4 Electrical and Radio Characteristics

4.1. General Description

This chapter mainly describes the following electrical and radio characteristics of M3 Mini PCIe:

- Power supply requirements
- IO requirements
- Current consumption
- RF characteristics
- ESD characteristics

4.2. Power Supply Requirements

The input voltage of M3 Mini PCIe is 4.0±5%, as specified by PCI Express Mini CEM Specifications 1.2. The following table shows the power supply requirements of M3 Mini PCIe.

Table 13: Power Supply Requirements

Parameter	Description	Min.	Typ.	Max.	Unit
VBAT	Power Supply	3.0	4.0	4.2	V

4.3. IO Requirements

The following table shows the IO requirements of M3 Mini PCIe.

Table 14: IO Requirements

Parameter	Description	Min.	Max.	Unit
V_{IH}	Input High Voltage	0.7*VCC_1V8	VCC_1V8+0.3	V
V_{IL}	Input Low Voltage	-0.3	0.3*VCC_1V8	V
V_{OH}	Output High Voltage	VCC_1V8-0.5	VCC_1V8	V
V_{OL}	Output Low Voltage	0	0.4	V

NOTES

1. The PCM and I2C interface belong to 1.8V power domain, all IO interfaces belong to VCC_1V8 power domain.

4.4. RF Characteristics

The following tables show output power and receiving sensitivity of conducted RF of M3 Mini PCIe module.

Table 15: Conducted RF Output Power

Frequency	Max.	Min.
GSM850/EGSM900	33dBm±2dB	5dBm±5dB
DCS1800/PCS1900	30dBm±2dB	0dBm±5dB
GSM850/EGSM900(8-PSK)	27dBm±3dB	5dBm±5dB
DCS1800/PCS1900(8-PSK)	26dBm±3dB	0dBm±5dB
WCDMA bands	24dBm+1/-3dB	<-50dBm

LTE FDD bands	23dBm±2dB	<-44dBm
LTE TDD bands	23dBm±2dB	<-44dBm

Table 16: EC20-A Conducted RF Receiving Sensitivity

Frequency	Receive Sensitivity (Typ.)	
GSM850	-108dBm	NA
EGSM900	-108dBm	NA
DCS1800	-108dBm	NA
PCS1900	-108dBm	NA
WCDMA Band1	-109dBm	-109dBm
WCDMA Band2	-110dBm	-110dBm
WCDMA Band4	-110dBm	-110dBm
WCDMA Band5	-111dBm	-111dBm
WCDMA Band8	-110dBm	-110dBm
WCDMA Band6	-110dBm	-110dBm
WCDMA Band9	-108dBm	-108dBm
WCDMA Band19	-111dBm	-111dBm
LTE-FDD B1(10M)	-96dBm	-97dBm
LTE-FDD B2(10M)	-96dBm	-97dBm
LTE-FDD B3(10M)	-96dBm	-97dBm
LTE-FDD B4(10M)	-96dBm	-98dBm
LTE-FDD B5(10M)	-98dBm	-99dBm
LTE-FDD B7(10M)	-94.5dBm	-95dBm
LTE-FDD B8(10M)	-97dBm	-98dBm
LTE-FDD B9(10M)	-96dBm	-97dBm
LTE-FDD B12(10M)	-98dBm	-99dBm
LTE-FDD B13(10M)	-98dBm	-99dBm
LTE-FDD B17(10M)	-98dBm	-99dBm
LTE-FDD B18(10M)	-98dBm	-99dBm

Frequency	Receive Sensitivity (Typ.)	
LTE-FDD B19(10M)	-98dBm	-99dBm
LTE-FDD B20(10M)	-97dBm	-98dBm
LTE-FDD B25(10M)	-96dBm	-97dBm
LTE-FDD B26(10M)	-98dBm	-99dBm
LTE-FDD B28(10M)	-96dBm	-97dBm
LTE-TDD B34(10M)	-96dBm	-98dBm
LTE-TDD B38(10M)	-96dBm	-98dBm
LTE-TDD B39(10M)	-97dBm	-97dBm
LTE-TDD B40(10M)	-94dBm	-95dBm
LTE-TDD B41(10M)	-94dBm	-95dBm
LTE-FDD B66(10M)	-94dBm	-95dBm

4.5. ESD Characteristics

The following table shows characteristics of M3 Mini PCIe ESD.

Table 17: ESD Characteristics

Part	Contact Discharge	Air Discharge	Unit
Power Supply and GND	+/-5	+/-10	kV
Antenna Interface	+/-4	+/-8	kV
USB Interface	+/-4	+/-8	kV
USIM Interface	+/-4	+/-8	kV
Others	+/-0.5	+/-1	kV

5 Mechanical Dimensions

5.1. General Description

This chapter mainly describes the following dimensions of M3 Mini PCIe:

- Mechanical Dimensions of M3 Mini PCIe
- Standard Dimensions of Mini PCI Express
- Packaging

5.2. Mechanical Dimensions of M3 Mini PCIe

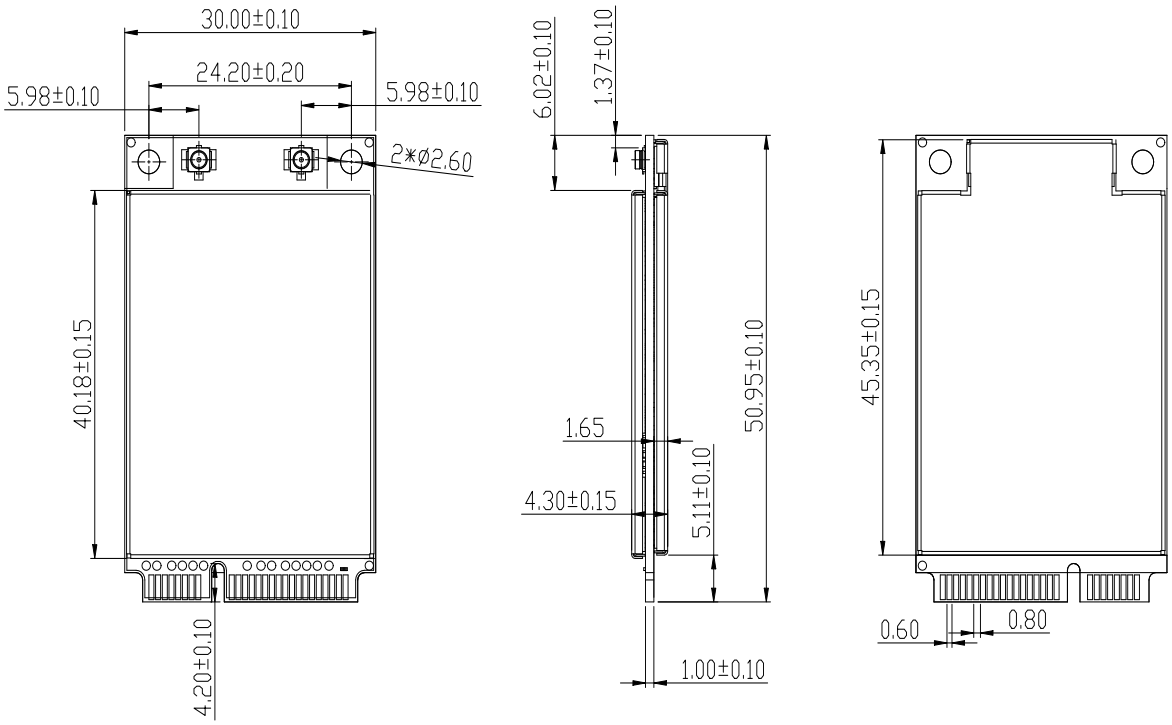


Figure 15: Mechanical Dimensions of M3 Mini PCIe (Unit: mm)

5.3. Standard Dimensions of Mini PCI Express

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

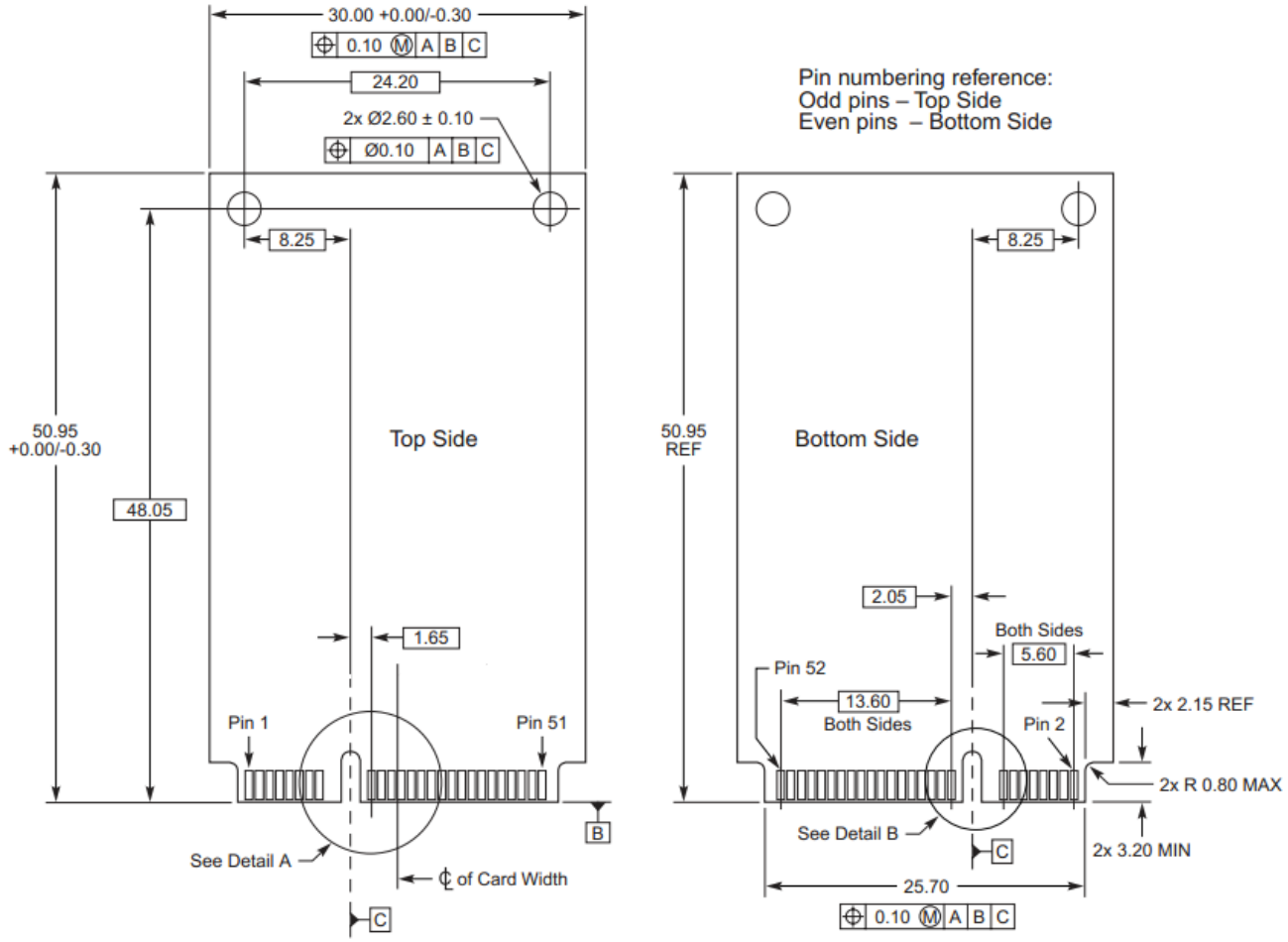


Figure 16: Standard Dimensions of Mini PCI Express (Unit: mm)

M3 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 67910xxxx as an example.

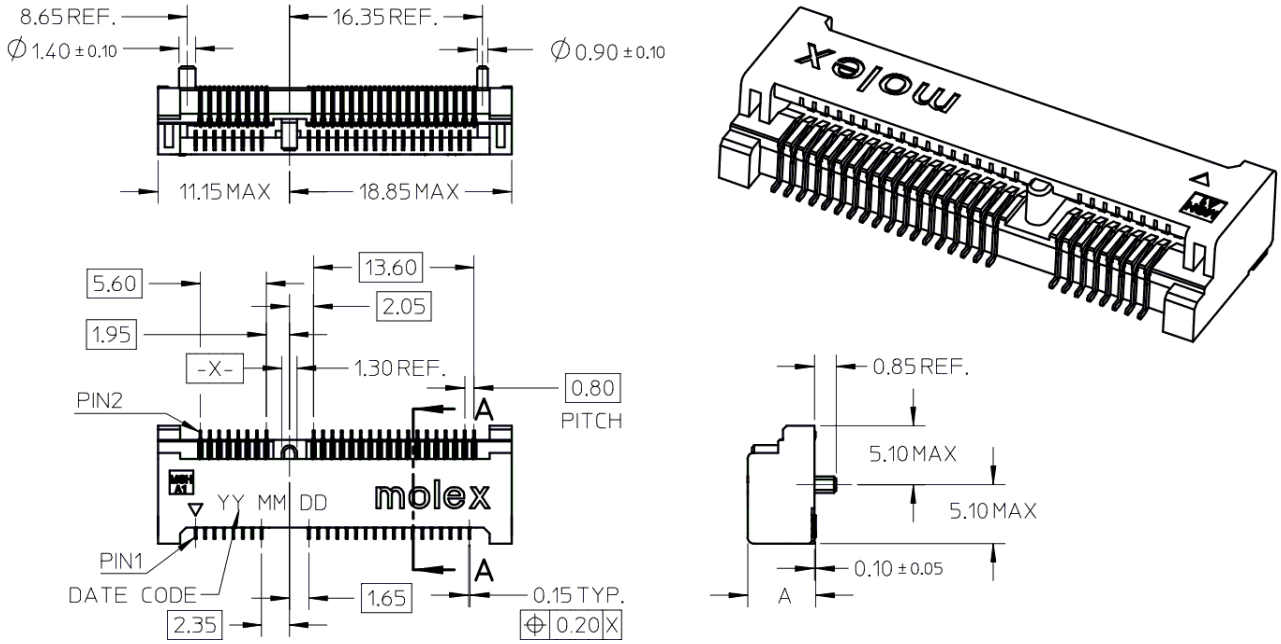


Figure 17: Dimensions of the Mini PCI Express Connector (Unit: mm)

5.4. Packaging

The M3 Mini PCIe is packaged in tray. Each tray contains 10pcs of modules. The smallest package of M3 Mini PCIe contains 100pcs.

6 Appendix Reference

Table 18: Related Documents

SN	Document Name	Remark
[1]	PCI Express Mini Card Electromechanical Specification Revision 1.2	Mini PCI Express Specification
[2]	UcloudLink _M3AT_Commands_Manual	M3 AT Commands Manual

Table 19: Terms and Abbreviations

Abbreviation	Description
AMR	Adaptive Multi-rate
bps	Bits Per Second
CS	Coding Scheme
DC-HSPA+	Dual-carrier High Speed Packet Access
DFOTA	Delta Firmware Upgrade Over The Air
DL	Down Link
EFR	Enhanced Full Rate
ESD	Electrostatic Discharge
FDD	Frequency Division Duplexing
FR	Full Rate
GLONASS	GLObalnaya Navigatsionnaya Sputnikovaya Sistema, the Russian Global Navigation Satellite System
GMSK	Gaussian Minimum Shift Keying

GNSS	Global Navigation Satellite System
GPS	Global Positioning System
GSM	Global System for Mobile Communications
HR	Half Rate
HSPA	High Speed Packet Access
HSDPA	High Speed Downlink 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
ME	Mobile Equipment (Module)
MIMO	Multiple-Input Multiple-Output
MMS	Multimedia Messaging Service
MO	Mobile Originated
MT	Mobile Terminated
PCM	Pulse Code Modulation
PDU	Protocol Data Unit
PPP	Point-to-Point Protocol
RF	Radio Frequency
Rx	Receive
USIM	Universal Subscriber Identification Module
SMS	Short Message Service
TD-SCDMA	Time Division-Synchronous Code Division Multiple Access
UART	Universal Asynchronous Receiver & Transmitter

UL	Up Link
URC	Unsolicited Result Code
WCDMA	Wideband Code Division Multiple Access