

uCloudlink M2 Mini PCIe-C

Hardware Design Guide

GLMM18A02

LTE Module

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uCloudlink was found by some senior international communications experts. uCloudlink has its headquarter, R&D center and call center located in Shenzhen, various branch offices and operations centers in the United States, United Kingdom and Hong Kong(China).

uCloudlink has been focusing on Cloud SIM technology and providing more convenient, fast and cheap data services for mobile users and enterprise users with the coverage more than 100 countries and regions globally so they can access the Internet at local rate anywhere, anytime. Meanwhile, setting up the world's leading Cloud SIM PaaS brings the benefits of winning and serving customers with lower cost to these global mobile data providers. uCloudlink has achieved success in the wireless industry by providing Internet access for more than a hundred million users. Now we are on our way to enter Internet of Things (IoT) market with the aim to provide global connectivity for billion IoT links.

M2 is the M2M module based on Cloud SIM technology launched by uCloudlink providing SIM-free wireless access services for Industrial IoT (IIoT), Connected Car, Vending Machine, Advertising Machine and POS Machine and more across different network operators.

uCloudlink always strives to provide our customers with the fastest and most comprehensive services. Should you have any questions, please contact our headquarter in Shenzhen as follows:

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Preface

This guide can help our customers to design their products. They shall design the product according to the specifications and parameters contained herein. We shall not be liable or responsible for any loss or damage resulting from their improper operation. We reserve the right to make any updates and any other modifications to this manual at any time without prior notice.

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1 Introduction

This document gives a general introduction of key features, functions, interface description, electrical characteristics and RF characteristics and layout of the M2 Mini PCIe-C module (“M2”).

1.1 Safety Information

The following safety precautions shall be observed to ensure your safety and protect your device and working environment from potential damage.



Road safety comes first! Using a mobile device while driving is prohibited even it has speakerphone. Please pull over your car in a safe place first then make or receive a call.



Switch your phone off before take-off. Electromagnetic waves emitted by your phone may affect the electronic navigation equipment in the aircraft. The ignorance of this tip may affect flight safety or even break the law.



Be aware if there are any restrictions on mobile device use during a hospital or healthcare facility. All medical equipment may be susceptible to radio frequency interference, which could affect performance, so you shall switch off your mobile device.



It cannot guarantee that mobile device can access Internet under any circumstances. For example, when you run out of credits or insert invalid SIM card. For any emergency situations, remember to make the emergency call and make sure your device is powered on and you are in an area with known-good signal strength.



Your mobile device would send and receive radio frequency signal when switched on. The interference occurs when you place the device near television, radio, computer and other electronic devices.



Do not place your mobile device near inflammable gas. Always switch off your mobile device near gas station, oil depot, chemical plant or explosion areas. Operating the mobile device in potential explosion areas has risk.

2 Product Overview

2.1 About This Chapter

M2 module is the LTE module with the PCI Express Mini Card 1.2 standard interface providing FDD-LTE/TDD-LTE/WCDMA/GSM network connections and compatible with embedded operating system, such as Linux or Android.

M2 module is available for the following occasions:

- Tablet, notebook
- Remote monitoring
- Car-mounted device
- Wireless POS machine
- Intelligent metering
- Wireless router, exchanger
- Other wireless devices

This chapter gives a brief introduction of the M2 module including:

- Product Introduction
- Key Features
- Function Overview

2.2 Product Introduction

The M2 module is only available with Data Only version.

Table 1 M2 module features

Name	Description
uCloudlink M2 Mini PCIe-C	LTE-FDD: B1/B2/B3/B4/B5/B7/B8/B12/B13/B17/B19/B20/B26/B28 TDD-LTE: B34/B38/B39/B40/B41 WCDMA: B1/B2/B4/B5/B8 GSM850/900/1800 /1900 2.4G WiFi : 802.11 b/g/n GPS /BT

2.3 Key features

The following table describes detailed features of the M2 module.

Table 2 key features

Feature	Description
Mini PCIe Interface	Standard PCI Express Mini Card 1.2 interface
Power Voltage	3.3~3.6V
Output Power	Class 4 (33dBm±2dB) for GSM900 Class 1 (30dBm±2dB) for DCS1800 Class E2 (27dBm±3dB) for GSM900 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	Up to non-CA CAT7 Support 1.4~20MHz RF bandwidth Support downlink multi-user MIMO

FDD: Max uplink speed 50Mbps, max downlink speed 150Mbps

TDD: Max uplink speed 35Mbps, max downlink speed 130Mbps

WCDMA

Support 3GPP R8 DC-HSPA+

Support 16-QAM, 64-QAM and QPSK modulation

3GPP R6 CAT6 HSUPA: max uplink speed 5.76Mbps

3GPP R8 CAT24 DC-HSPA+: max downlink speed 42Mbps

GSM/GPRS/EDGE

R99:

CSD transmission speed: 9.6kbps, 14.4kbps

GPRS:

GPRS multi-slot class 12 by default

Encoding: CS-1/CS-2/CS-3 and CS-4

Up to 4 RX time slots per frame

EDGE:

Support EDGE multi-slot class 12 by default

Support different modulation and encoding of GMSK and 8-PSK

Support uplink and downlink encoding CS 1-4 and MCS 1-9

Internet Protocol

Support TCP/UDP/PPP/FTP/HTTP/SMTP/MMS/NTP/PING/QMI

Support PAP (Password Authentication Protocol) and CHAP
(Challenge Handshake Authentication Protocol)

USIM Interface

Support USIM/SIM: 1.8V and 3.0V

UART Interface

Support RTS and CTS hardware flow control

Baud rate can reach up to 230400bps, 115200 bps by default

Used for AT command and data transmission

USB Interface	<p>Compliant with USB2.0 specification (slave only) , the data transfer can reach up to 480 Mbps.</p> <p>Used for firmware upgrade, AT command, data transmission, log output;</p> <p>USB driver: Support Windows 7, Windows 8/8.1, Linux 2.6 or Later, Android 4.0/4.2/4.4/5.0</p>
AT Commands	Compliant with 3GPP TS 27.007, 27.005 and enhanced AT commands
Antenna Interface	Support main antenna pad, diversity antenna pad and WIFI/BT antenna pad
WIFI	Protocol: 802.11 b/g/n
Dimension and weight	<p>Dimensions (L x W x H): 51.0 mm ×3 0.0 mm×4 .9 mm</p> <p>Weight: about 11 g</p>
Operating Temperature	<p>Normal operating temperature: -30°C ~+75°C ¹⁾</p> <p>Extended operating temperature: -40°C ~ +85°C ²⁾</p>
Firmware upgrade	USB interface or DFOTA interface
RoHS	All hardware components meet the EU RoHS standard

Note

¹⁾ when M2 module works within this temperature range, and all its RF performances comply with the 3GPP standard requirements.

²⁾ when M2 module works within this temperature range, and can still work properly with data transmission, irretrievable malfunctions won't occur; radio spectrum and network won't be affected. And only few features may be out of the 3GPP standard such as output power. When the temperature is back within normal range, all features properly resume.

2.4 Function Overview

Figure 1 shows the functional diagram of the M2 module. The major functions are following:

- Support line 1 of USIM card interface
- Support line 1 of USIM 2.0 interface
- Support line 1 of UART interface
- Support LED status indication
- Support RF shut-down feature
- Support external reset feature
- Support sleep control and sleep indication
- Support 3 RF antenna interfaces

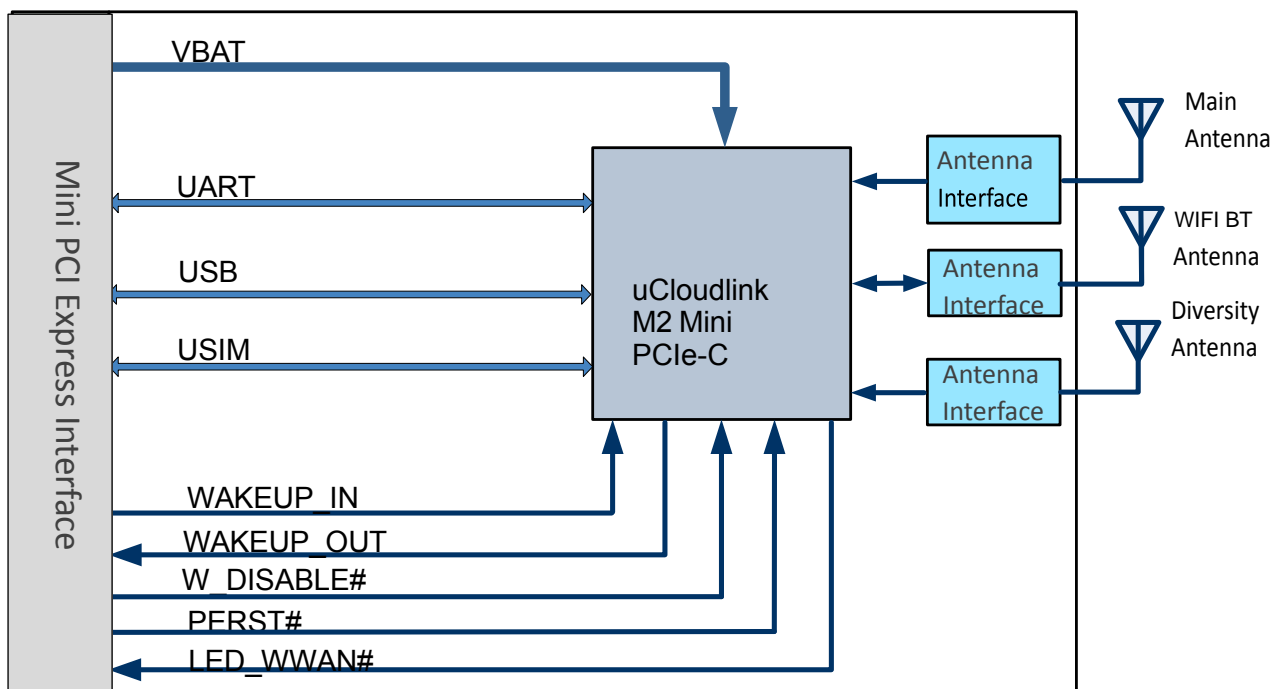


Figure 1 Functional Diagram

3 Interface Application

3.1 About This Chapter

This chapter mainly gives the external application interfaces of the M2 module, including:

- Power Interface
- UART Interface
- USIM Interface
- USB Interface
- Control Signal
- Antenna Interface

3.2 M2 Module Interface

3.2.1 Interface Definition

The interface of the M2 module is the standard Mini PCI Express interface. For details about the 52-pin interfaces, see table 3 I/O parameters definition.

Table 3 Definition of I/O parameters

Mark	Description
IO	Bidirectional input/output
DI	Digital Input
DO	Digital Output
AI	Analog Input

AO	Analog Output
PI	Power Input
PO	Power Output
OC	Open Collector

Table 4 Definition of pins on the M2 module

Pin No.	Status	Pin Name	I/O	Description	Note
1	WAKE#	MIC_P*	AI	Audio Input(Positive)	
2	3.3Vaux	VBAT	PI	Power Input	
3	COEX1	MIC_N*	AI	Audio Input(Negative)	
4	GND	GND		Ground	
5	COEX2	SPK_P*	AO	Audio Output(Positive)	
6	1.5V	NC	—	—	
7	CLKREQ#	SPK_N*	AO	Audio Output(Negative)	
8	UIM_PWR	USIM_VDD	PO	USIM Power Output	
9	GND	GND		Ground	
10	UIM_DATA	USIM_DATA	IO	USIM data signal	
11	REFCLK-	VDD_EXT	PO	1.8V Power Output	

12	UIM_CLK	USIM_CLK	DO	USIM Clock Signal	
13	REFCLK+	RESERVED	—	Reserved	
14	UIM_RESET	USIM_RST	DO	USIM Reset Signal	
15	GND	GND		Ground	
16	UIM_VPP	RESERVED	—	Reserved	
17	RESERVED	RESERVED	—	Reserved	
18	GND	GND		Ground	
19	RESERVED	WAKEUP_IN	DI	Module Sleep Control Pin	Allows to sleep when low level
20	W_DISABLE#	W_DISABLE#	DI	Disable RF Communication	Valid when low level
21	GND	GND		Ground	
22	PERST#	PERST#	DI	Reset Control Pin	Valid when low level
23	PERn0	UART_RXD	DI	Module receiving end	
24	3.3Vaux	VBAT	PI	Power Input	
25	PERp0	UART_RTS	DO	Module request to send	
26	GND	GND		Ground	
27	GND	GND		Ground	
28	1.5V	UART_CTS	DI	Module request to delete	

29	GND	GND		Ground
30	SMB_CLK	UART_DCD	DO	Module Carrier Sense
31	PETn0	UART_TXD	DO	Module sending end
32	SMB_DATA	WAKEUP_OUT	DO	Module Sleep Indication
33	PETp0	PERST#	DI	Reset Control Pin Valid when low level
34	GND	GND		Ground
35	GND	GND		Ground
36	USB_D-	USB_DM	IO	USB Differential Signal (-)
37	GND	GND		Ground
38	USB_D+	USB_DP	IO	USB Differential Signal (+)
39	3.3Vaux	VBAT	PI	Power Input
40	GND	GND		Ground
41	3.3Vaux	VBAT	PI	Power Input
42	LED_WWAN#	LED_WWAN#	OC	Status Light Indication
43	GND	GND		Ground
44	LED_WLAN#	RESERVED	—	Reserved
45	RESERVED	RESERVED	—	Reserved
46	LED_WPAN#	UART_DTR	DI	DTE is ready
47	RESERVED	RESERVED	—	Reserved
48	1.5V	NC	—	—
49	RESERVED	RESERVED	—	Reserved
50	GND	GND		Ground
51	RESERVED	RESERVED	—	Reserved

52	3.3Vaux	VBAT	PI	Power Input
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Note

1. Besides USIM interfaces, the voltage domain of other digital interfaces is 1.8V, and the USIM interface is available with 1.8V and 3.0V.
2. Please suspend all of NC, RESERVED and unused pins.
3. “*” indicates the audio feature is not available and reserved function.

3.2.2 Pin Assignment

The following figure shows the pin assignment of the M2 module, and the top face is for sticking antenna connector and opposite face is the BOT.

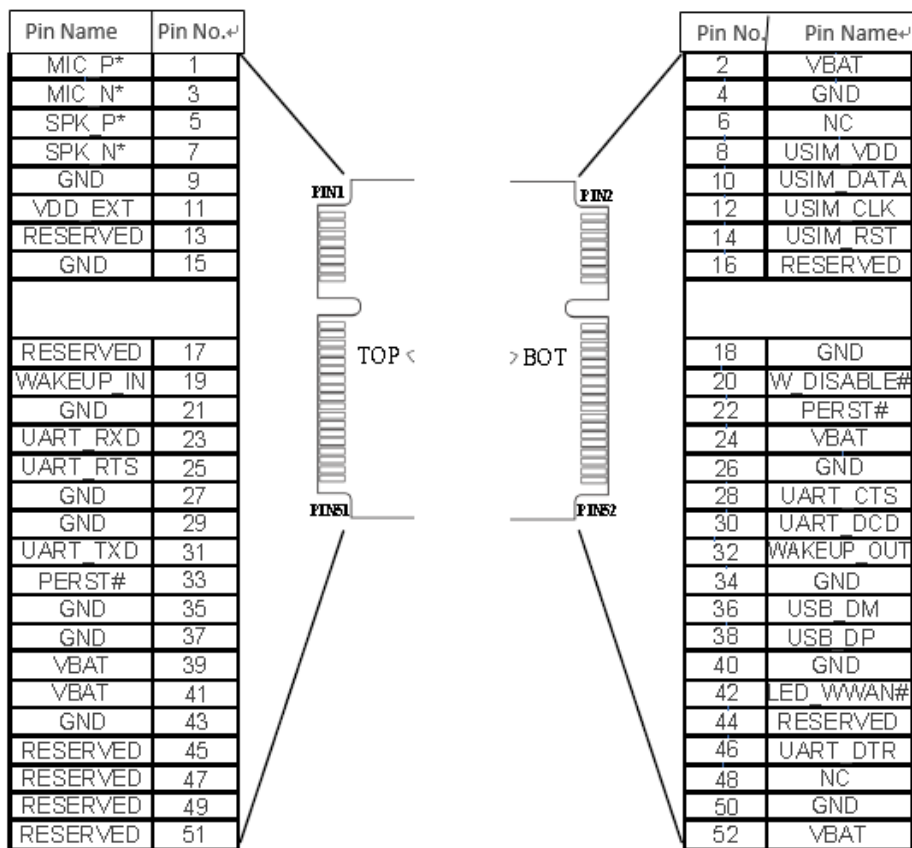


Figure 2 Pin Assignment (Top View)

3.3 Power Interface

Table 5 lists the definitions of the pins on the power supply interface.

Table 5 Definition of power interfaces

Pin No.	Pin Name	I/O	Description
2, 24, 39, 41, 52	VBAT	PI	3.3~3.6V Power Input
4, 9, 15, 18, 21, 26, 27, 29, 34, 35, 37, 40, 43, 50	GND		Ground

When the M2 module works normally, power is supplied through the VBAT pins. When it works at EGSM900 mode and transmits current may reach the transient peak value of about 2.5 A. To make sure that the voltage does not decrease below 3.3V, a low-dropout (LDO) regulator or switch power with current output of more than 2.5 A is recommended for external power supply. Furthermore, it is recommended that customers add the 1000uF or above energy storage capacitor to connect in parallel at the power interface of the M2 module. And keep the power device and power cable away from antenna to avoid EMI interference.

Figure 3 shows the recommended power circuit of M2 module using DC-DC power supply. The resistance accuracy of R3 and R4 is 1%. The capacitance E1 needs to use high polymer tantalum capacitor to add the drive capability of pulse current in dialing process.

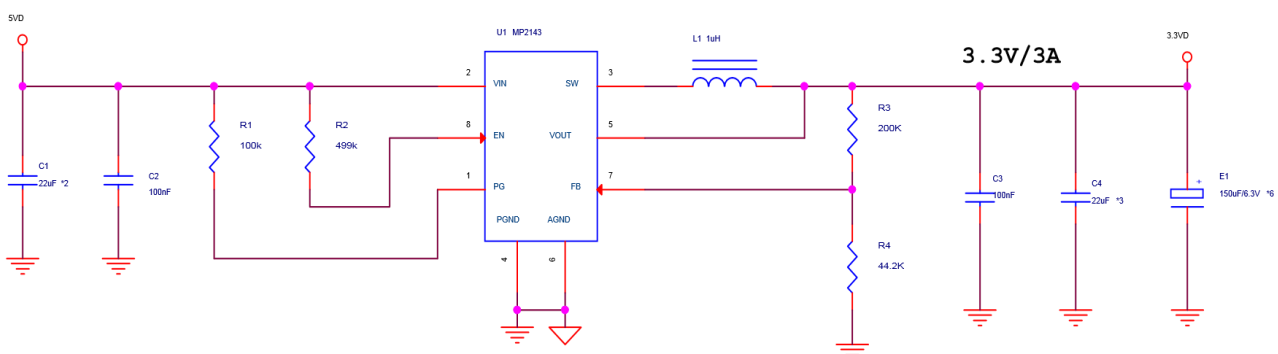


Figure 3 Recommended Power Circuit of the M2 module

3.4 UART Interface

Table 6 lists the UART interface signals.

Table 6 UART interface signals

Pin No.	Pin name	- I/O	Typ.(V)	Description
23	UART_RXD	DI	1.8V	Receive data
31	UART_TXD	DO	1.8V	Send data
28	UART_CTS	DI	1.8V	Clear to Send
25	UART_RTS	DO	1.8V	Ready for Receive

The M2 module is available with 1-wire hardware flow control UART (DSR and R1 signal are not supported), which supports 9600, 19200, 38400, 57600, 115200, 230400bps and the default value is 115200bps.

Figure 4 shows the recommended power circuit of level match in the 3.3V power. Pay attention to the connection direction. The dotted circuit and full circuit can be used as reference to each other.

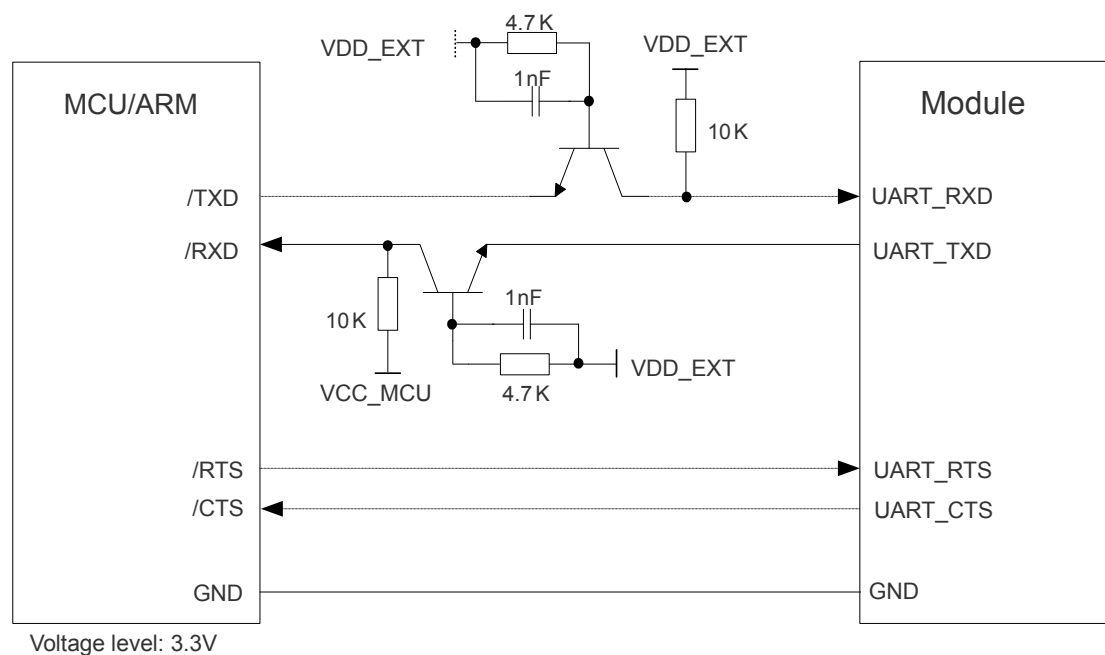


Figure 4 Recommended Power Circuit of Level Match

3.5 USIM Card Interface

The signal definition of the M2 module USIM card interface is as below.

Table 7 USIM card interface signals

Pin No.	Pin Name	I/O	Typ.(V)	Description
8	USIM_VDD	PO	1.8V/3.0V	Output Power supply for USIM card
10	USIM_DATA	IO	1.8V/3.0V	USIM/SIM Data
12	USIM_CLK	DO	1.8V/3.0V	USIM/SIM Clock
14	USIM_RST	DO	1.8V/3.0V	USIM/SIM Reset

The M2 module is available with 1.8V and 3.0V USIM/SIM card.

Figure 5 shows the circuit of the 6-pin USIM card interface.

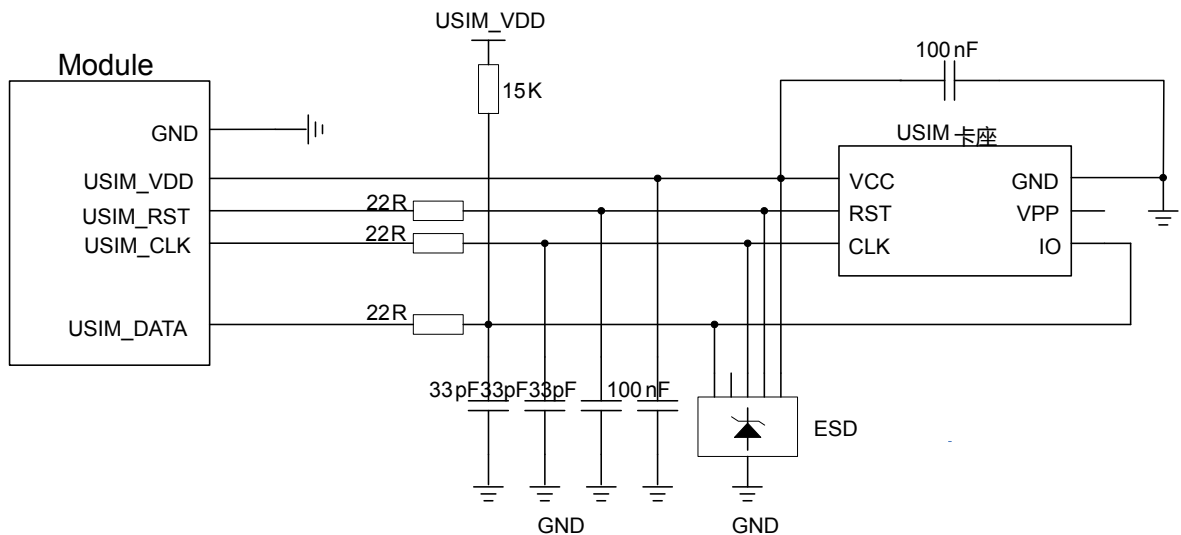


Figure 5 Circuit of the 6-pin USIM Card Interface

In order to enhance the reliability and availability of the USIM card, please pay attention to these key points:

1. The USIM socket should be placed near the USIM interface and it is recommend that PCB circuit connecting the USIM interface to the USIM socket does not exceed 200 mm.
2. Keep USIM card signal cable away from RF antenna and module power cable.
3. The decouple capacitor of USIM_VDD should be less than 1uF and placed near the USIM socket.
4. To avoid the mutual interference between USIM_DATA and USIM_CLK, keep them away with each other and shield them with surrounded ground including USIM_RST.
5. In order to ensure ESD protection in good performance, it is recommended to place the TVS with stray capacitance of less than 50pF near USIM card socket.
6. It is recommended to connect the 22Ω resistors to USIM_CLK, USIM_DATA and USIM_RST to avoid EMI interference and enhance ESD protection. Meanwhile, connecting the 33pF capacitor in parallel to filter interference from EGSM900 RF signals, and keep these components close to the USIM card socket.
7. USIM_DATA is pulled up internally, which is good for improving the anti-jamming capability. When the PCB circuit of USIM card is too long or the interference is nearby, the pull-up resistor is recommended to be placed close to the USIM socket.

3.6 USB Interface

The Pin definition of the M2 module USB interface is as below.

Table 8 Definition of the USB interface

Pin No.	Pin Name	Pad Type	Description	Comment
36	USB_DM	IO	USB differential data bus(minus)	Require differential impedance of 90ohm
38	USB_DP	IO	USB differential data bus(positive)	Require differential impedance of 90ohm

The M2 module is compliant with USB 2.0 High Speed Mode (480Mbps) and Full Speed Mode (12Mbps). And only can be used as slave device. The USB interface is mainly for AT commands, data transfer, catch log, and software upgrade.

Figure 6 shows the circuit of the USB interface

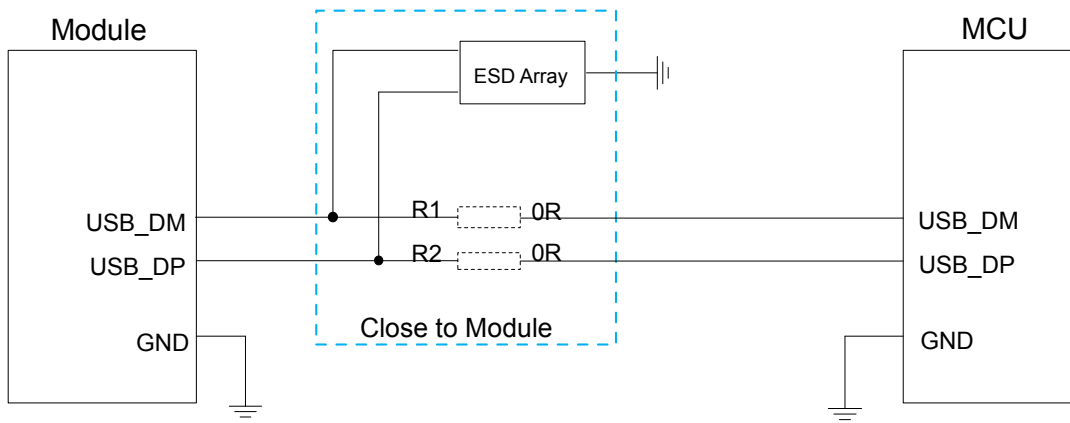


Figure 6 Recommended Circuit of USB Interface

In order to meet the requirement for completeness of USB signal trace, R1 and R2 shall be placed near the M2 module and ESD protection components.

Based on the USB 2.0 specification, please comply with the following requirements:

1. It is required to control the differential impedance -90ohm.
2. Do not route the USB signal trace under the following components: crystals, oscillator, electromagnetic component and RF signal. Keep it away from interference sources and signals susceptible to disturbance and shielding with ground.
3. If the USB interface of the M2 module is connected to the USB socket, place ESD protection component with no more than of 2pF capacitance near the USB socket.
4. Avoid the coupled noise on the USB signal trace, keep the testing stubs as short as possible. If possible, add resistor of 0 ohm or common mode choke to the USB signal trace.

3.7 Signal Control Signal

Table 9 lists the pins on the signal control interface.

Table 9 Definition of the pins on the signal control interface

Pin No.	Pin Name	Pad Type	Typ.(V)	Description
20	W_DISABLE#	DI	1.8V	Disable RF communication, effective low level (inside pull up)
22, 33	PERST#	DI	1.8V	Reset control, low level reset (internal pull up)
42	LED_WWAN#	OC	—	Status Indication

19	WAKEUP_IN	DI	1.8V	Sleep control pin (internal pull-down)
32	WAKEUP_OUT	DO	1.8V	Sleep indication

3.7.1 W_DISABLE# Signal

The W_DISABLE# signal can be used to disable the RF communication, which can be controlled through hardware and software. Table 10 shows the operating status of radio frequency.

Table 10 Operating status of radio frequency

W_DISABLE#	RF status
High Level	Enable RF
High Level	Disable RF
Low Level	Disable RF

3.7.2 PERST# Signal

PERST# signal can be used externally reset the module. PERST# 150~460ms can be pulled down to reset the module. PERST# signal is sensitive to interference, so keep the route on the module interface board as short as possible and shield with ground.

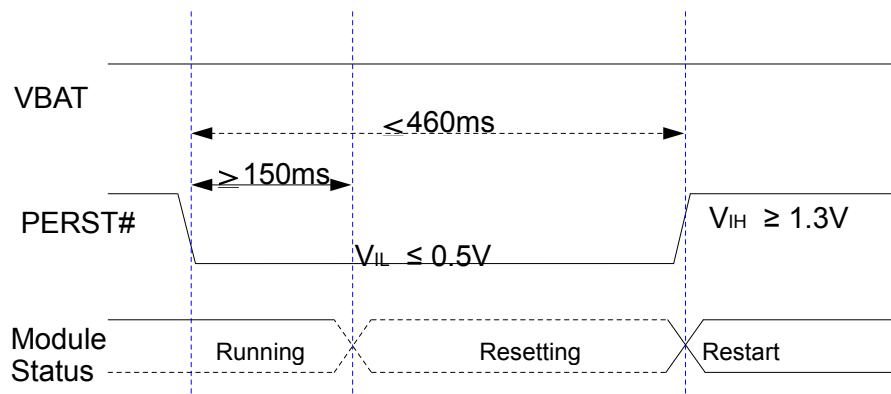


Figure 7 Timing Sequence of Module Reset

3.7.3 LED_WWAN# Signal

The LED_WWAN# signal interface is OC output format and the max current can reach up to the 40mA. When it connects to LED externally, connects the resistor in serial. You can adjust the LED brightness by adjusting the resistance of resistor. When it is low, the external LED lights up.

Figure 8 shows the recommended circuit of the LED_WWAN# pin.

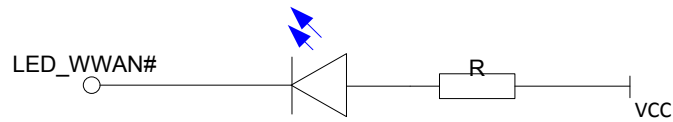


Figure 8 Driving Circuit

Check the LED_WWAN# signal network status indicator as below, when the M2 module is successfully registered, the LED is on. When the RF is disabled, turned off or error (No SIM card or registration failed), the LED is off.

Table 11 Network status indication

LED_WWAN#	Description
Low Level (LED is on)	Successfully registered
High Impedance (LED is off)	<ol style="list-style-type: none"> No Internet or registration failed W_DISABLE# pin is pulled down(disable RF)

3.7.4 WAKEUP_IN and WAKEUP_OUT Signal

WAKEUP_IN pin is the authorization signal of the M2 module entering sleep mode. WAKEUP_OUT pin is used to wake up the external devices.

Table 12 shows the definition of the WAKEUP_IN pin and WAKEUP_OUT signal.

Table 12 WAKEUP_IN and WAKEUP_OUT pin

Pin Name	Description
WAKEUP_IN	<p>H: DTE Wake up Module</p> <p>L: DTE Allows to enable sleep mode</p>

WAKEUP_OUT	H: Wake-up mode is on, USB and serial port are available
	L: Wake-up is on, USB and serial port are not available

3.8 Antenna Interface

The M2 module provides three antenna pads (WIFI BT antenna pad, main antenna pad and DIV antenna pad) for connecting the external antennas.

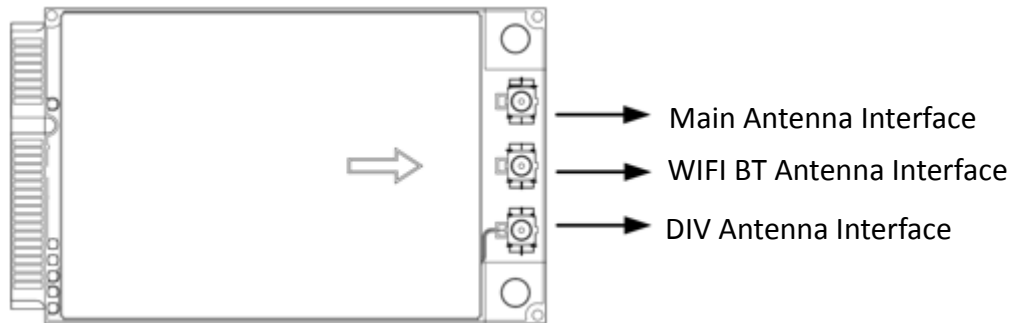


Figure 9 Antenna Interface

3.8.1 Antenna Requirements

Table 13 lists the requirements for main antenna, diversity antenna and WIFI/BT antenna.

Table 13 Antenna requirements

Type	Requirements
WIFI/BT/GPS	GPS Frequency range: 1575.42MHz Polarization: RHCP or linear VSWR: < 2 (Typ.) Passive antenna gain: > 0dBi
	WIFI Frequency range:2412 - 2472Hz BT Frequency range:2402 - 2482Hz Passive antenna gain: > 0dBi
	VSWR: ≤ 2 Gain (dBi): 1

	Max input power (W): 50
GSM/	Input resistance(ohm): 50
WCDMA/	Polarization type: vertical
TD-SCDMA/	Cable insertion loss: < 1dB
LTE	(GSM900, WCDMA B8, LTE B8)
	Cable insertion loss: < 1.5dB
	Cable insertion loss: < 2dB

4 Electrical Interface and RF Specifications

4.1 About This Chapter

This chapter describes the mainly gives the electrical interface and RF specifications of the M2 module, including:

- Power Supply Ratings
- IO Interface
- Working Current
- RF Performance
- WIFI/BT Receiving Sensitivity
- ESD Feature

4.2 Power Supply Ratings

M2 module comes with VBAT voltage with the input voltage 3.3~3.6V and the input power at least meets the requirement of 2.3A capacity. Table shows the power range of the M2 module.

Table 14 Input Power Range

Parameter	Description	Min.	Typ.	Max.	Unit
-----------	-------------	------	------	------	------

VBAT	Module power supply	3.3	3.6	V
------	---------------------	-----	-----	---

4.3 I/O Interface

Table 15 shows the I/O interface of the M2 module.

Table 15 I/O Interface

Parameter	Description	Min.	Max.	Unit
V _{IH}	High Level Input Voltage	0.7*VDDIO ¹⁾	VDDIO ¹⁾ +0.3	V
V _{IL}	Low Level Input Voltage	-0.3	0.3*VDDIO ¹⁾	V
V _{OH}	High Level Input Voltage	VDDIO ¹⁾ -0.5	VDDIO ¹⁾	V
V _{OL}	Low Level Input Voltage	0	0.4	V

Notes

1. The voltage of PERST# and W_DISABLE VIL_(max) is 0.5V.
2. VDDIO voltage is 1.8V

4.4 RF Specifications

Table 16 shows the RF output power and RF receiving sensitivity of the M2 module.

Table 16 RF Output Power

Band	Max	Min
GSM900	33dBm±2dB	5dBm±5dB
DCS1800	30dBm±2dB	0dBm±5dB
GSM900 (8-PSK)	27dBm±3dB	5dBm±5dB
DCS1800 (8-PSK)	26dBm±3dB	0dBm±5dB
WCDMA B1/B8	24dBm+1/-3dB	<-49dBm

LTE FDD B1/B3/B8	23dBm±2dB	<-39dBm
LTE TDD B38/B39/B40/B41	23dBm±2dB	<-39dBm

Table 17 RF Receiving Sensitivity

Band	Receiving		Master set	
	Sensitivity(Typ.)		+Diversity	3GPP(Main+Diversity)
EGSM900	-109dBm	NA	NA	-102dBm
DCS1800	-109dBm	NA	NA	-102dBm
WCDMA Band1	-110dBm	NA	NA	-106.7dBm
WCDMA Band8	-110dBm	NA	NA	-103.7dBm
LTE-FDD B1(10M)	-97dBm	-97dBm	-101dBm	-96.3dBm
LTE-FDD B3(10M)	-95dBm	-94dBm	-96dBm	-93.3dBm
LTE-FDD B8(10M)	-94dBm	-94dBm	-97dBm	-93.3dBm
LTE-TDD B38(10M)	-97dBm	-97dBm	-97.5dBm	-96.3dBm
LTE-TDD B39(10M)	-97dBm	-97dBm	-102dBm	-96.3dBm
LTE-TDD B40(10M)	-97dBm	-97dBm	-100dBm	-96.3dBm
LTE-TDD B41(10M)	-96dBm	-96dBm	-98dBm	-94.3dBm

4.5 WIFI BT Receiving Sensitivity

The WIFI/BT receiver is disabled by default. As the WIFI/BT antenna interface connects to the power 2.95V, it is recommended to use the active antenna suitable for the voltage.

4.6 Electrostatic Discharge Characteristics

Table 18 lists the ESD (Electrostatic Discharge) characteristics of the M2 module.

Table 18 Electrostatics discharge characteristics

Parameter	Contact Discharge	Air Discharge	Unit
Power and grounding interface	+/-5	+/-10	kV
Antenna Interface	+/-4	+/-8	kV
USB Interface	+/-4	+/-8	kV
USIM Card Interface	+/-4	+/-8	kV
Other Interface s	+/-0.5	+/-1	kV

5 Mechanical Dimensions

This chapter gives the mechanical dimensions of the M2 module, including:

- Outer Dimension of the M2 module
- Standard dimension of Mini PCI Express

5.1. Outer Dimension of M2 Module

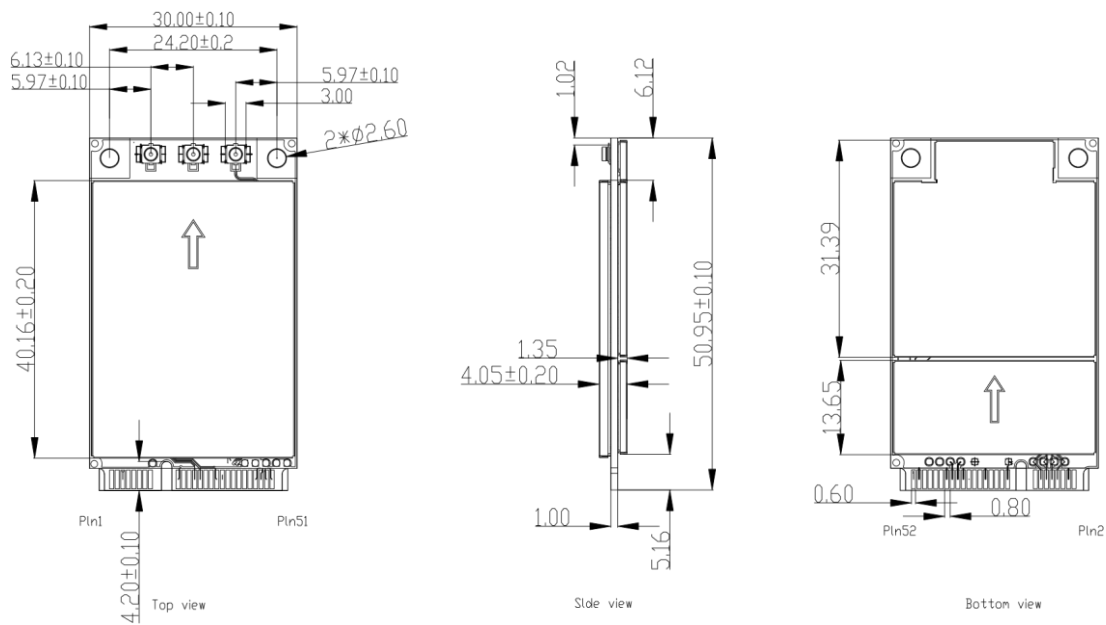


Figure 10 Outer Dimension of M2 Module (Unit: mm)

5.2. Standard Dimension

The M2 module comes with standard interfaces.

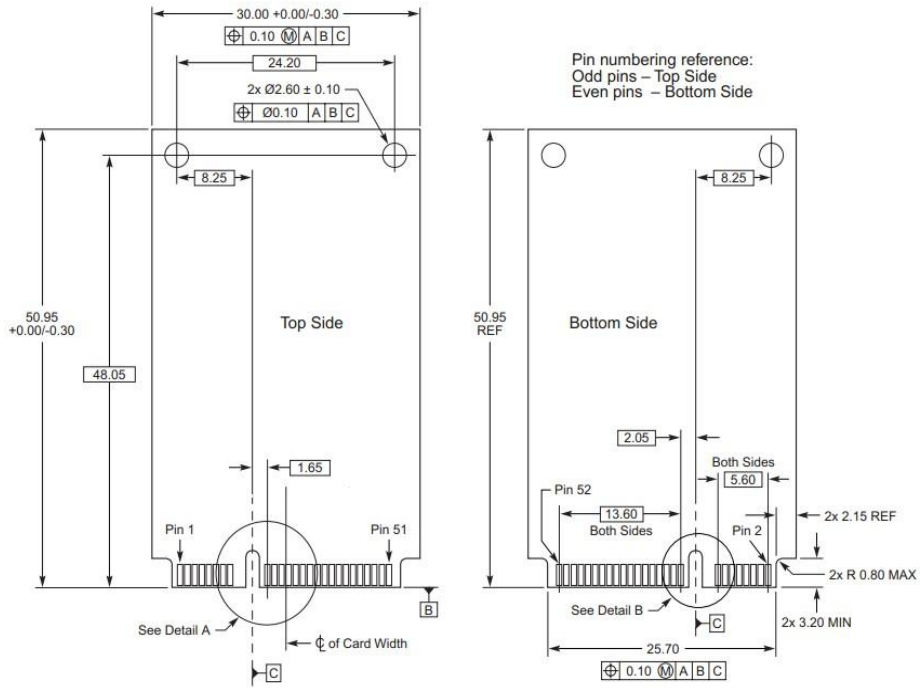


Figure 11 Standard Dimension of Mini PCI Express (Unit: mm)

Any qualified PCI Express Mini Card connectors are compatible with the M2 module. Figure 12 shows the connector 679100002 made of Molex Company.

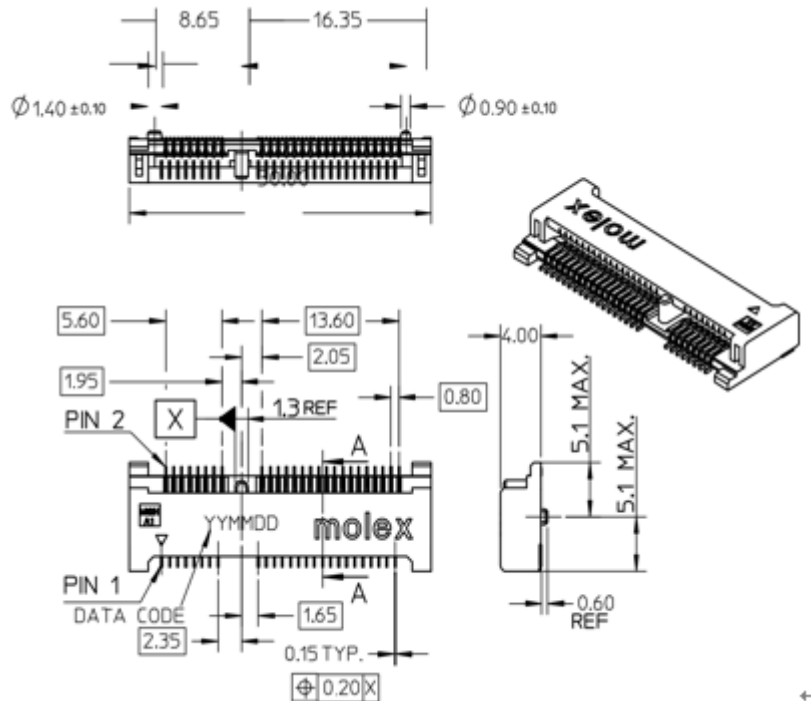


Figure 12 Mini PCI Express Connector (Unit: mm)

6 Appendix Terms and Abbreviation

Table 19 Terms and Abbreviation

Abbr.	Description
8-PSK	8-Phase Shift Keying
bps	Bits Per Second
CS	Coding Scheme
CSD	Circuit Switched Data
CTS	Clear To Send
DCE	Data Communications Equipment (typically module)
DL	Down Link
DTE	Data Terminal Equipment (typically computer, external controller)
DTR	Data Terminal Ready
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
FDD	Frequency Division Duplexing
GLONASS	GLObalnayaNAvigatsionnayaSputnikovaya 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
HSPA	High Speed Packet Access

PAD TYPE	Input/Output
kbps	KiloBitsPer 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
PDU	Protocol Data Unit
PPP	Point-to-Point Protocol
RF	Radio Frequency
RX	Receive Direction
SIM	Subscriber Identification Module
SMS	Short Message Service
TDD	Time Division Duplexing
TD-SCDMA	Time Division-Synchronous Code Division Multiple Access
TE	Terminal Equipment
TTF	Time to First Fix
TX	Transmitting Direction
UART	Universal Asynchronous Receiver & Transmitter
UL	Up Link
UMTS	Universal Mobile Telecommunications System

URC	Unsolicited Result Code
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USSD	Unstructured Supplementary Service Data
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WCDMA	Wideband Code Division Multiple Access
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FCC Statement

NOTICE: 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 party responsible for compliance could void the user's authority to operate the equipment.

Please notice that if the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains FCC ID:2AC88-GLMM18A02" any similar wording that expresses the same meaning may be used.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with a minimum distance of 20cm between the radiator & your body. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

The module is limited to OEM installation ONLY.

The OEM integrator is responsible for ensuring that the end-user has no manual instruction to remove or install module.

The module is limited to installation in mobile application.

A separate approval is required for all other operating configurations, including portable configurations with respect to Part 2.1093 and difference antenna configurations.

There is requirement that the grantee provide guidance to the host manufacturer for compliance with Part 15B requirements.

The finished product is required to comply with all applicable FCC equipment authorisations, regulations and equipment. We will provide guidance to the host manufacturer for compliance with the FCC part 15B requirements.

The OEM integrator is responsible for ensuring that the end-user has no manual instructions to remove or install module.

The module is limited to installation in mobile or fixed application.