SIM8200EA-M2 ANT4 Hardware Design

5G Module

Document title:	SIM8200EA-M2 ANT4 Hardware Design
Version:	V1.04
Date:	2022-05-18
Status:	Released

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Version History

Data	Version	Description of change	Author
2021-05-14	1.00	Original version	Yao.chen Yi.zheng
2021-06-23	1.01	Modify the PN number of support WIFI function	Yao.chen
2021-08-09	1.02	Modify Antenna Definitions	Yi.zheng
2022-02-24	1.03	Add PCIe power-on sequence Modify net light 3G/4G description of table36	Yao.chen
2022-05-18	1.04	Modify Antenna Definitions	Yi.zheng

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1 Introduction

This document describes the electronic specifications, RF specifications, interfaces, mechanical characteristics and test results of the SIM8200EA-M2 module. With the help of this document，customers can quickly understand SIM8200EA-M2 module.

Associated with other software application notes and user guides, customers can use SIM8200EA-M2 to design and develop mobile and laptop applications easily.

1.1   Product Outline

SIM8200EA-M2 is a wireless communication module focusing on 5G market; it supports multi-air access technology including 5G NR (NSA/SA), LTE-FDD, LTE-TDD, and WCDMA, can meet the 3GPP R15 NR specification, and also integrates GNSS system including dual bands GPS, GLONASS, Beidou, Galileo and QZSS.

The module's supported radio frequency bands are shown in the following table.

Table 1: SIM8200EA-M2 frequency bands

Standard	Frequency bands
5G NR	n1/n3/n5/n7/n8/n28/n38/n40/n41/n48/n77/n78/n79
LTE-FDD	B1/B3/B5/B7/B8/B18/B19/B26/B28
LTE-TDD	B34/B38/B39/B40/B41/B42/B43/B48
WCDMA	B1/B3/B5/B8
GNSS[2]	GPS L1+L5 dual bands/GLONASS/BeiDou/Galileo/QZSS

> **NOTE**
>
> 1. GNSS is optional.

The physical dimension of SIM8200EA-M2 is 30.0mm*52.0mm*2.3mm, which can meet PCI Express M.2 specifications, and can meet almost all space requirements in customer's applications.

With M.2 Type 3052, SIM8200EA-M2 owns rich interfaces, includes USB3.1, PCIe3.0, (U)SIM card, digital audio(I2S or PCM), I2C, GPIOs, six antennas for 3G/4G/5G and GNSS.

With all the interfaces, SIM8200EA-M2 can also be utilized in the handheld terminal, machine-to-machine laptop application and especially the router.

1.2　Hardware Block Diagram

The block diagram of SIM8200EA-M2 is shown in the following figure.
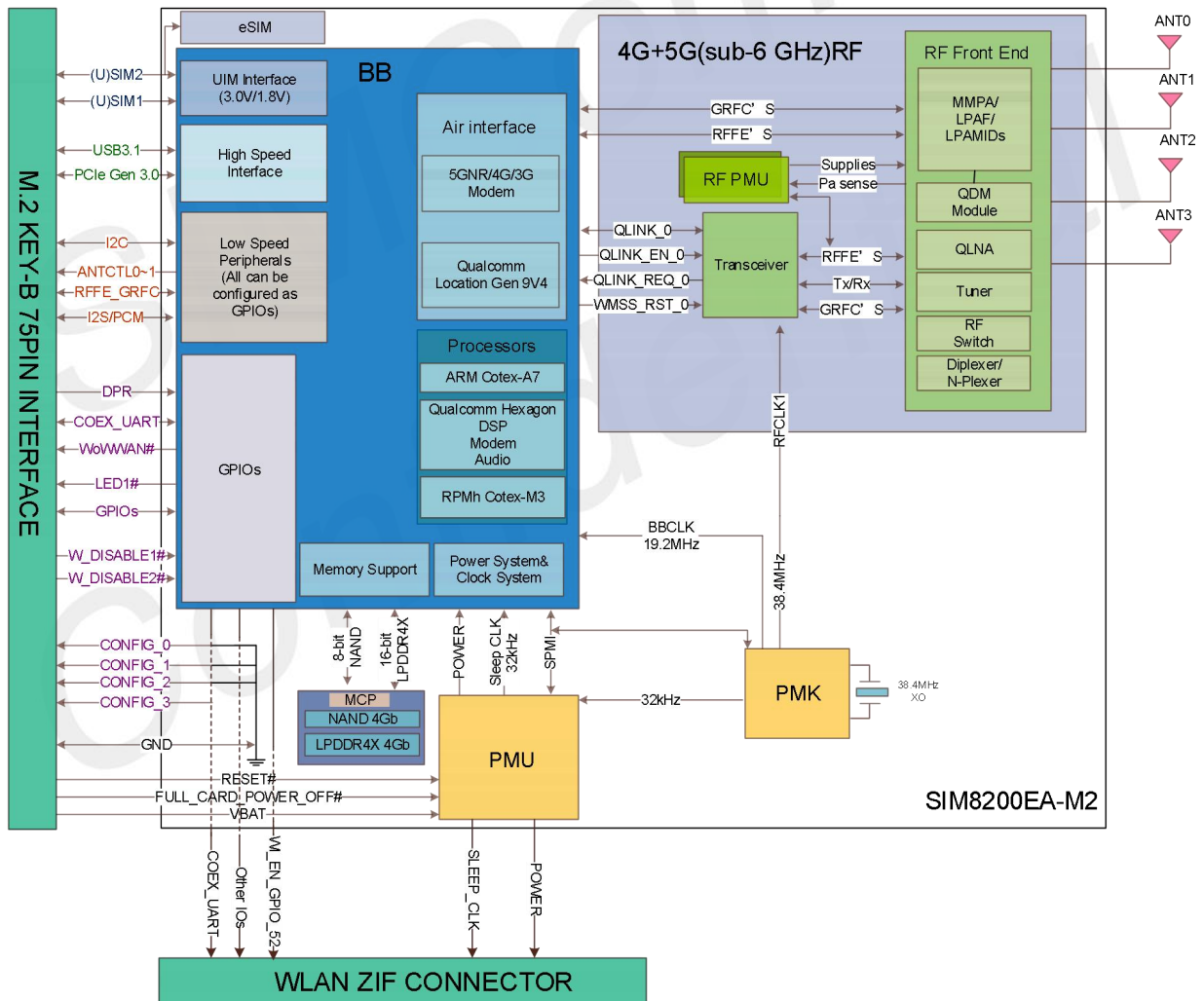
Figure 1: Block diagram

1.3   Feature Overview

Table 2: Key features

Feature	Implementation
Power supply	VBAT: 3.135～4.4V Typical: 3.8V
Power consumption	Typical: 5mA @sleep mode(VABT =3.8V, AT+CFUN=0)*
Transmit power	Power Class 3 for WCDMA/LTE/5G NR Power Class 2 for n41/n77/n78/n79
Data transmission throughput	2.4Gbps (DL)/1Gbps(UL) (optional up to 4Gbps DL1Gbps UL) for NR 1Gbps (DL)/200Mbps (UL) (optional up to 2Gbps DL/200Mbps UL) for LTE 42Mbps(DL)/5.76Mbps(UL) for HSPA+
Antenna	Four antennas for 3G/4G/5G and GNSS
GNSS	GNSS engine : GPS L1+L5/GLONASS/BeiDou/Galileo/QZSS Protocol: NMEA
SMS	MT, MO, CB, Text and PDU mode SMS storage: (U)SIM card or ME(default) Transmission of SMS alternatively over CS or PS
(U)SIM interface	Support (U)SIM card:1.8V/3.0V Include USIM1 and USIM2 interfaces Support dual SIM single standby
(U)SIM application toolkit	Support SAT class 3 Support USAT
Phonebook management	Support phonebook types: DC,MC,RC,SM,ME,FD,ON,LD,EN
Digital audio interface	One I2S interface with dedicated main-clock for primary digital audio, the I2S also can be configured as PCM ● MCLK frequency: 12.288MHz (default) ● WCDMA AMR-NB ● VoLTE AMR-WB ● Echo Cancellation ● Noise Suppression
PCIe interface	● One lane PCIe interface, support Gen 3 (Gen 1/2 compatible) ● High communication data rate which up to 8Gbps
I2C interface	● Meet I2C specification, version 5.0 ● Data rate up to 400Kbps
USB interface	Support USB 3.1 Gen2 or USB 2.0 USB3.1: super speed, with data rate which up to 10Gbps USB2.0: high speed interface, support USB operations at low-speed and full-speed, which refer to USB1.0 and USB1.1

UART interface	SIM8200EA-M2 hardware configures as normal communication UART(AT command) by default
WLAN interface	Support WLAN function, need to work with W80 module
Firmware upgrade	Firmware upgrade over USB interface
Physical characteristics	Size: 30mm*52mm*2.3mm Weight: 8.8g±0.3g
Temperature range	Normal operation temperature: -30°C to +70°C (3GPP compliant) Extended operation temperature: -40°C to +85°C[2] Storage temperature: -40°C to +90°C

> **NOTE**
>
> 1. "*" means under development.
> 2. The module is able to establish and maintain voice, data transmission, SMS and emergency call, etc. The performance may deviate slightly from the 3GPP specifications and will meet 3GPP specifications again when the temperature returns to normal operating temperature levels.

2 Package Information

2.1 Pin Assignment Overview

SIM8200EA-M2 has 75 pins, including 8 notch pins. Customer design should match pins functions. The following figure is the pin assignment of the module.

74	VBAT	PIN74	PIN75	CONFIG_2	75
72	VBAT			GND	73
70	VBAT			GND	71
68	I2C_SDA(IO)			CONFIG_1	69
66	(U)SIM1_DET			RESET#	67
64	COEX1			WL_TX_EN	65
62	COEX2			LAA_TX_EN	63
60	I2S_MCLK(IO)			ANTCTL1	61
58	RFFE_SDATA			ANTCTL0	59
56	RFFE_SCLK			GND	57
54	PEWAKE#			REFCLKP	55
52	CLKREQ#			REFCLKN	53
50	PERST#			GND	51
48	(U)SIM2_PWR	BOT	TOP	PERp0	49
46	(U)SIM2_RESET			PERn0	47
44	(U)SIM2_CLK			GND	45
42	(U)SIM2_DATA			PETp0	43
40	(U)SIM2_DET			PETn0	41
38	I2C_SCL(IO)			GND	39
36	(U)SIM1_PWR			USB3.1_Rx+	37
34	(U)SIM1_DATA			USB3.1_Rx -	35
32	(U)SIM1_CLK			GND	33
30	(U)SIM1_RESET			USB3.1_Tx+	31
28	I2S_WA			USB3.1_Tx -	29
26	TDD_SYNC_PPS (W_DISABLE2#)	PIN20	PIN21	GND	27
24	I2S_TX			DPR	25
22	I2S_RX			WoWWAN#	23
20	I2S_CLK	PIN10	PIN11	CONFIG_0	21
	Notch			Notch	
	Notch			Notch	
	Notch	PIN2	PIN1	Notch	
	Notch			Notch	
10	LED1#			GND	11
8	W_DISABLE1#			USB_D-	9
6	FULL_CARD_ POWER_OFF#			USB_D+	7
				GND	5
4	VBAT			GND	3
2	VBAT			CONFIG_3	1

Figure 2: Pin assignment

2.1.1 WLAN ZIF Connector

SIM8200EA-M2 (The PN number of the module is S2-10A46) provide a WLAN ZIF connector for WIFI function, the connector is position bottom side of the module and it no assembly on the module by default, about this connector and WIFI function more details, please contact SIMCom support teams, the following figure is pin map of the WLAN ZIF connector.

PIN Number	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
PIN Name	GND	VREG_S4E_1P904	VREG_S4E_1P904	VREG_S4E_1P904	GND	VREG_S3E_0P824	VREG_S3E_0P824	VREG_S3E_0P824	VREG_S3E_0P824	VREG_S3E_0P824	VREG_S3E_0P824	GND	VREG_S2E_1P224	VREG_S2E_1P224	VREG_S2E_1P224	GND	VREG_L6E_1P8	GND	WL_SW_CTRL	GND	LAA_AS_EN_GPIO_40	WL_XFEM_CTRL_PA_MUT_GPIO_41	WL_XFEM_CTRL_LAA_RX_GPIO_26	WL_GPIO_GPIO_94	WL_EN_GPIO_52	COEX_UART_RX	COEX_UART_TX	GND	SLEEP_CLK	GND

Figure 3: Pin map of WLAN ZIF connector interface

> **NOTE**
>
> 1. SIM8200 M2 series support WIFI function the PN of the module is S2-10A46, about more details, please contact SIMCom support teams.
> 2. The connector is position bottom side of the module and it no assembly on the module by default.

2.2 Pin Description

Table 3: IO parameters definition

Pin type	Description
PI	Power Input
PO	Power Output
AI	Analog Input
AIO	Analog Input/Output
DIO	Digital Input /Output
DI	Digital Input
DO	Digital Output
DOH	Digital Output with High level
DOL	Digital Output with Low level
PU	Pull Up
PD	Pull Down
OD	Open Drain
OC	Open Collector
pdpukp	pd: = default pull-down with programmable options pu: = default pull-up with programmable options kp: = default keeper with programmable options

Table 4: DC parameters definition

Voltage domain	Parameter		Min	Typ	Max
P3	VDD_P3=1.8V				
	V_{OH}	High level output	1.35V	-	1.8V
	V_{OL}	Low level output	0V	-	0.45V
	V_{IH}	High level input	1.26V	1.8V	2.1V
	V_{IL}	Low level input	0V	-	0.54V
	R_p	Pull up/down resistor	20K ohm	-	60K ohm
P4/P5	VDD_P4/P5=1.8V				
	V_{OH}	High level output	1.44V	-	1.8V
	V_{OL}	Low level output	0V	-	0.4V
	V_{IH}	High level input	1.26V	-	1.95V
	V_{IL}	Low level input	0V	-	0.36V
	R_p	Pull up/down resistor	10K ohm	-	100K ohm
	VDD_P4/P5=3.0V				
	V_{OH}	High level output	2.4V	-	3.0V
	V_{OL}	Low level output	0V	-	0.4V

V$_{IH}$	High level input	2.1V	-	3.05V
V$_{IL}$	Low level input	0V	-	0.6V
Rp	Pull up/down	10K ohm		100K ohm

Table 5: Pin description

Pin name	Pin no.	Electrical description	Description	Comment
Power supply				
VBAT	2,4,70, 72,74	PI	Power supply Range：3.135～4.4V Typical：3.8V	These pins should be connected together to withstand sufficent current
GND	3,5,11, 27,33, 39,45, 51,57, 71,73		Ground	
System control				
FULL_CARD_POWER_OFF#	6	DI,PD	High level: the module power on Low level: the module power off	It's 3.3V tolerant but can be driven by either 1.8V or 3.3V GPIO
RESET#	67	P3 DI,PU	System reset control input Active low	RESET# has been pulled up to 1.8V internally
W_DISABLE1#	8	DI	WWAN RF disable Active low	3.3V tolerant but can be driven by either 1.8V or 3.3V GPIO
TDD_SYNC_PPS (W_DISABLE2#)	26	P3 DO ,DI	W_DISABLE2# and TDD_SYNC_PPS function can compatible PIN26 of SIM8200EA-M2	SIM8200EA-M2 hardware support TDD_SYNC_PPS function by default
WoWWAN#	23	OD	Wake on the host Active low	
Configuration pins				
CONFIG_0	21	GND	Connected to ground internally	The module is configured as the WWAN USB3.1 interface type
CONFIG_1	69	GND	Connected to ground internally	
CONFIG_2	75	GND	Connected to ground internally	
CONFIG_3	1	NC	Not connected	
USB2.0/USB3.1				
USB_D+	7	AIO	Differential USB bi-directional data positive	Main communication interface USB3.1 data rate up to 10Gbps USB2.0 data rate up to 480Mbps
USB_D-	9	AIO	Differential USB bi-directional data negative	
USB3.1_Tx-	29	AO	USB3.1 transmit data negative	
USB3.1_Tx+	31	AO	USB3.1 transmit data positive	

USB3.1_Rx-	35		AI	USB3.1 receive data negative	
USB3.1_Rx+	37		AI	USB3.1 receive data positive	
PCIe interface					
PETn0	41		AO	PCIe transmit data negative	Support PCIe Gen 3.0, data rate up to 8Gbps. If unused, please keep open
PETp0	43		AO	PCIe transmit data positive	
PERn0	47		AI	PCIe receive data negative	
PERp0	49		AI	PCIe receive data positive	
REFCLKN	53		AIO	PCIe reference clock negative	
REFCLKP	55		AIO	PCIe reference clock positive	
PCIe assistant interface					
PERST#	50		DI	PCIe reset signal Active low	3.3V voltage domain, CLKREQ# and PEWAKE# required pull up external, Default as EP mode, If unused, please keep open
CLKREQ#	52		DIO	PCIe reference clock request signal Active low	
PEWAKE#	54		DIO	PCIe wake up control Active low	
(U)SIM interface					
(U)SIM1_PWR	36		PO	Power supply for (U)SIM1 card	
(U)SIM1_DATA	34	P4	DIO	(U)SIM1 card data, which has been pulled up to (U)SIM1_VDD via a 20KR resistor internally	
(U)SIM1_CLK	32	P4	DO	(U)SIM1 clock signal	
(U)SIM1_RESET	30	P4	DO	(U)SIM1 reset control	
(U)SIM1_DET	66	P3	DI	(U)SIM1 card detect, which has been pulled up to VDD_P3 via a 470KR resistor internally	1.8/3.0V voltage domain, (U)SIM interfaces should be protected against ESD , If unused, please keep open
(U)SIM2_PWR	48		PO	Power supply for (U)SIM2 card	
(U)SIM2_DATA	42	P5	DIO	(U)SIM2 card data, which has been pulled up to (U)SIM2_VDD via a 20KR resistor internally	
(U)SIM2_CLK	44	P5	DO	(U)SIM2 clock signal	
(U)SIM2_RESET	46	P5	DO	(U)SIM2 reset control	
(U)SIM2_DET	40	P3	DI	(U)SIM2 card detect, which has been pulled up to VDD_P3 via a 470KR resistor internally	
Antenna control interface[2]					
ANTCTL0	59	P3	DO	Antenna tuner control0	1.8V voltage domain. If unused, please keep open
ANTCTL1	61	P3	DO	Antenna tuner control1	
ANTCTL 2 (RFFE_SDATA)[3]	58	P3	DO (DIO)	Antenna tuner control2 (Antenna tuner MIPI DATA)[3]	

ANTCTL3 (RFFE_SCLK)[3]	56	P3	DO	Antenna tuner control3 (Antenna tuner MIPI CLK)[3]	
I2S interface					
I2S_CLK	20	P3	DO	I2S clock output	1.8V voltage domain, also can be used as PCM interface, If unused, please keep open
I2S_RX	22	P3	DI	I2S data input	
I2S_TX	24	P3	DO	I2S data output	
I2S_WA	28	P3	DO	I2S word alignment select (L/R)	
I2S_MCLK	60	P3	DO	I2S master clock	
I2C interface					
I2C_SDA	68	P3	DIO	I2C data signal	1.8V voltage domain, Internal pulled up to 1.8V. If unused, please keep open
I2C_SCL	38	P3	DO	I2C clock signal	
Coex interface[2]					
COEX1* (COEX_TX*)	64	P3	DO	SIM8200EA-M2 hardware configures as normal communication UART(AT command) by default	If need coexistence signal function, please contact SIMCom support teams
COEX2* (COEX_RX*)	62	P3	DI		
WL_TX_EN*	65	P3	DI	WiFi 5G TX indicator	If unused, please keep open
LAA_TX_EN*	63	P3	DO	n79 TX indicator	If unused, please keep open
Other pins					
LED1#	10		OD	The module status indicator via LED devices Active low	
DPR*	25	P3	DI	DPR (Dynamic Power Reduction) signal is used for SAR (Specific Absorption Rate) sensor interrupt input	
Notch					
Notch	12, 13, 14, 15, 16, 17, 18, 19			Notch	

NOTE

1. "*" means under development.
2. The RFFE signals are multiplexed with ANTCTL2 and ANTCTL3.
3. SIM8200EA-M2 interface the pin of 62 and 64 hardware support UART function by default.

Table 6: Pin description of WLAN ZIF connector interface

Pin name	PIN no.	Electrical description		Discribtion
SLEEP_CLK	2	P3	DO	Sleep clock output for W80 only
COEX_UART_TX	4	P3	DO	LTE&WLAN coexistence data transmit
COEX_UART_RX	5	P3	DI	LTE&WLAN coexistence data receive
WL_EN_GPIO_52	6	P3	DO	
WL_GPIO_GPIO_94	7	P3	DO	
WL_XFEM_CTRL_LAA_RX_GPIO_26	8	P3	DO	W80 RF coexistence signals
WL_XFEM_CTRL_PA_MUT_GPIO_41	9	P3	DO	
LAA_AS_EN_GPIO_40	10	P3	DO	
WL_SW_CTRL	12	P3	DO	
VREG_L6E_1P8	14		PO	Output power supply for W80 only
VREG_S2E_1P224	16,17, 18		PO	Output power supply for W80 only
VREG_S3E_0P824	20,21, 22,23, 24,25		PO	Output power supply for W80 only
VREG_S4E_1P904	27,28, 29		PO	Output power supply for W80 only
GNG	1,3,11, 13,15, 19,26, 30			Ground

2.3   Mechanical Dimensions

The following figure shows the mechanical dimensions of SIM8200EA-M2.
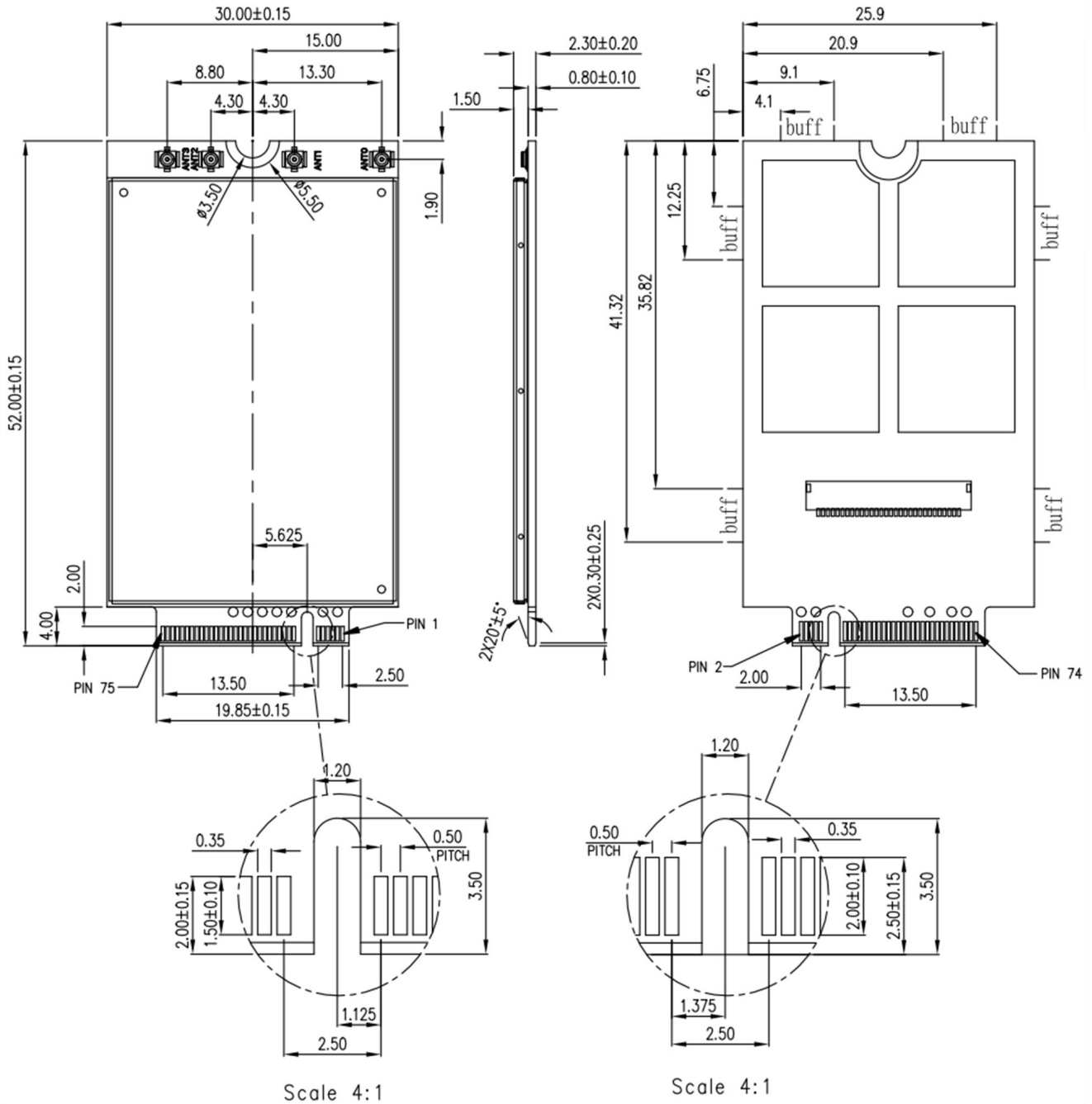
Figure 4: Dimensions of the module (unit: mm)

3 Interface Application

3.1 Power Supply

The recommended power supply of SIM8200EA-M2 is 3.8V and the voltage ranges from 3.135 V to 4.4 V. Please make sure that the input voltage will never drop below 3.135V, otherwise the module will be powered off automatically. The module has 5 power pins and 11 ground pins. To ensure the module works properly, all pins should be connected.

Table 7: VBAT pins electrical characteristics

Symbol	Description	Min.	Typ.	Max.	Unit
VBAT	Module power supply voltage	3.135	3.8	4.4	V
I_{peak}	Peak current	-	-	2^2	A
I_{sleep}	Current in sleep mode(AT+CFUN=0)	-	5	-	mA
$I_{leakage}$	Current in power off mode	-	50	-	uA

3.1.1 Power Supply Design Guide

When B3 (20MHz) and N78 (100MHz) ENDC combination are connected under the instrument, the peak current can reach to 2A. In order to ensure that the VBAT voltage is no less than 3.135V when the module at maximum power radio transmission, and considering the voltage drop and conversion efficiency, it is strongly recommend the DC-DC or LDO output capacity should not be less than 3A.
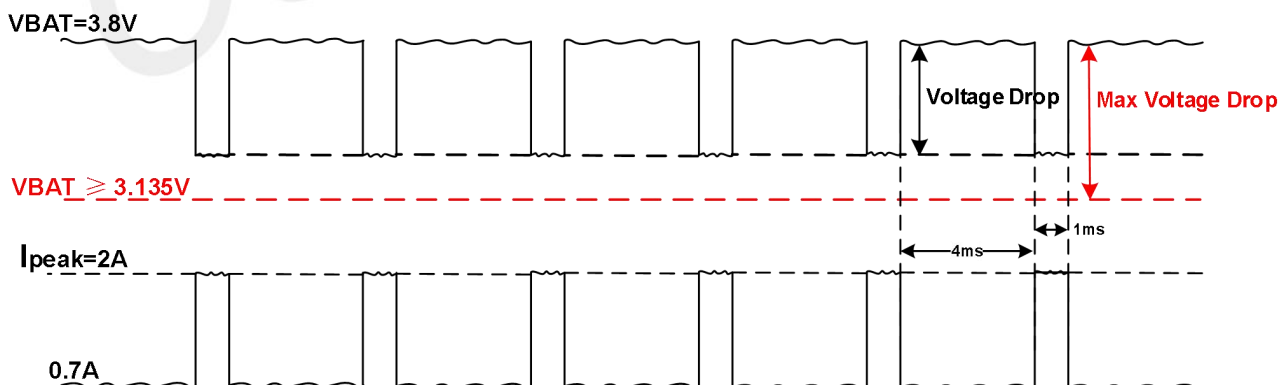
Figure 5: Power consumption at ENDC combination of B3 (20MHz) and N78 (100MHz)

> **NOTE**
>
> 1. The total capacitors of VBAT net are not less than 420uF.
> 2. The I_{peak} and voltage drop data in Table 6 and Figure 4 were tested use SIMCom EVB and connect instrument, module power supply voltage is 3.8V, ENDC combination is B3 (20MHz) and N78 (100MHz), subcarrier spacing is 30KHz.
> 3. When the voltage drop on VBAT reaches its maximum value, please ensure that it minimum voltage is not less than 3.135V.

To decrease the voltage dropping, make sure that the capacitors of VBAT net must not less than 420uF. The following figure shows the reference circuit of power supply for the VBAT.
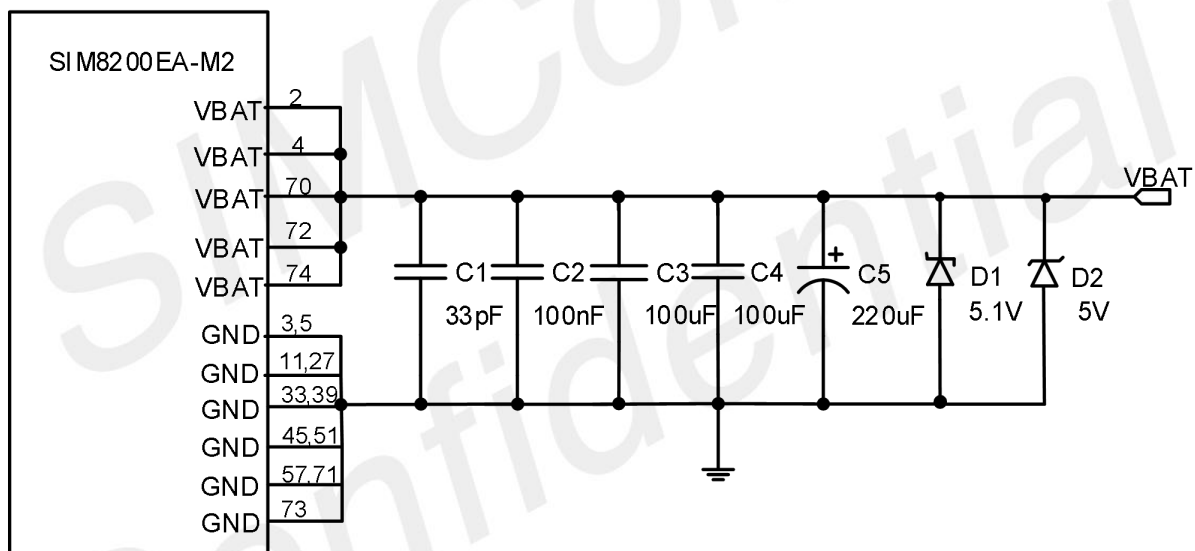
Figure 6: Power supply application circuit

Table 8: Definition of VBAT and GND pins

Pin name	Pin no.	Electrical description	Description	Comment
VABT	2,4,70,72, 74	PI	Power supply Range：3.135～4.4V Typical：3.8V	These pins should be connected together to withstand sufficent current
GND	3,5,11,27, 33,39,45,51 ,57,71,73		Ground	

In this reference circuit, some multi-layer ceramic chip (MLCC) capacitors (0.1/1uF) with low ESR in high frequency band can be used for EMI suppression.

These capacitors should be put as close as possible to VBAT pins. Also, users should keep VBAT trace on circuit board wider than 3.0 mm to minimize PCB trace impedance.

> **NOTE**
>
> 1. C5 is 220 µF tantalum capacitor, ESR=0.7Ω.
> 2. C1 and C2 are multi-layer ceramic chip (MLCC) capacitors from 0.1uF to 1uF with low ESR in high frequency band, which can be used for EMC performance.
> 3. D2 is used for ESD protection and D1 is used for surge protection.

Table 9: Recommended D1 and D2 list

No.	Manufacturer	Part number	VRWM	Package	Ref. Designator
1	JCET	ESDBW5V0A1	5V	DFN1006-2L	D2
2	WAYON	WS05DPF-B	5V	DFN1006-2L	
3	LRC	LEDZ5.1BT1G	5.1V	SOD-523	D1
4	Prisemi	PZ5D4V2H	5.1V	SOD-523	

Power supply layout guidelines:
● Both VBAT and return trace should be as short and wide as possible to minimize the voltage drop.
● The width of VBAT trace cannot be less than 3.0mm.
● These capacitors should be placed as closely as possible with VBAT pins.
● The VBAT trace should pass through TVS diode, zener diode and capacitors, and then VBAT pins. The capacitor of the small value should be placed close to VBAT pins.
● The PCB design must have a solid ground plane as the primary reference plane for most signals.

3.1.2 Recommended Power Supply Circuit

It is recommended to use a switching mode power supply or a linear regulator power supply. Make sure it can provide the current up to 3A at least.
Figure6 shows the linear regulator reference circuit with 5V input and 3.8V output.
Figure7 shows the switching mode power supply reference circuit with 5~12V input and 3.8V output.
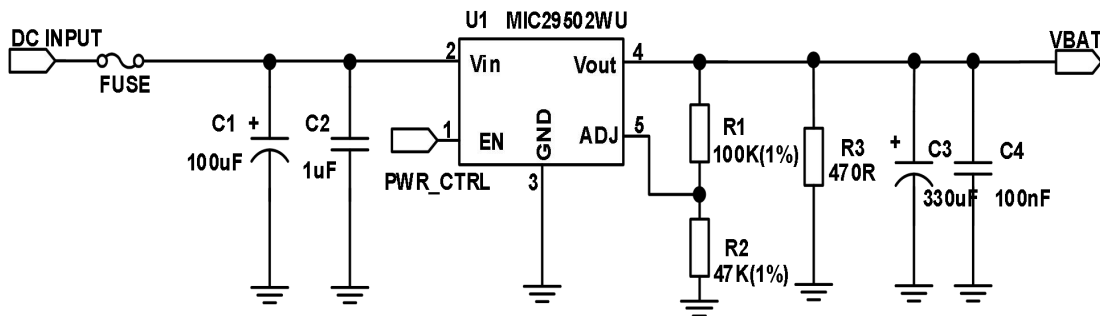
Figure 7: Linear regulator reference circuit

> **NOTE**
>
> An extra minimum load of R3 is required, to ensure it work properly under light load in sleep mode and power off mode. For the details about minimum load, please refer to specification of MIC29502WU.
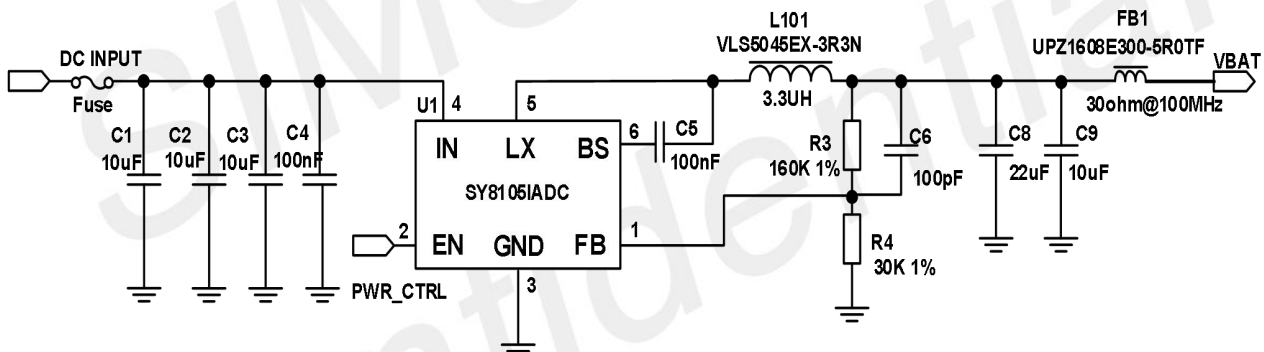
Figure 8: Switching mode power supply reference circuit

> **NOTE**
>
> 1. In order to avoid damaging the module, please do not switch off the power supply when module works normally. Only after the module is shut down by FULL_CARD_POWER_OFF# or AT command, then the power supply can be cut off.
> 2. It is suggested that customer's design should have the ability to switch off the power supply for module in abnormal state, and then switch on the power to restart the module.
> 3. The PWR_CTRL signal recommend connect to the host and can be controlled.

3.1.3 Voltage Monitor

To monitor the VBAT voltage, the AT command "AT+CBC" can be used.

NOTE

For the details about voltage monitor commands, please refer to Document [1] in the appendix.

3.2 Power On and Off Module

Driving the FULL_CARD_POWER_OFF# pin to a high level, SIM8200EA-M2 will be powered on. It can be driven by either 1.8V or 3.3V GPIO. The following figure shows the power on/off circuit.
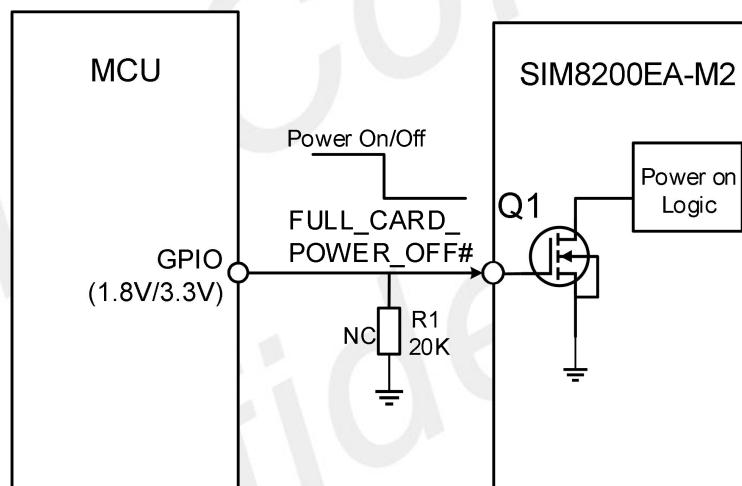
Figure 9: Reference power on/off circuit

Table 10: Definition of FULL_CARD_POWER_OFF# pin

Pin name	Pin no.	Electrical description	Description	Comment
FULL_CARD_POWER_OFF#	6	DI,PD	High level: the module powers on Low level: the module powers off	It's 3.3V tolerant but can be driven by either 1.8V or 3.3V GPIO

NOTE

After the module enter force download mode, the FULL_CARD_POWER_OFF# signal need to release and don't pull high always. If not, the module will restart and then cause the download fail.

3.2.1 Power On

The power on sequence is shown in the following figure.
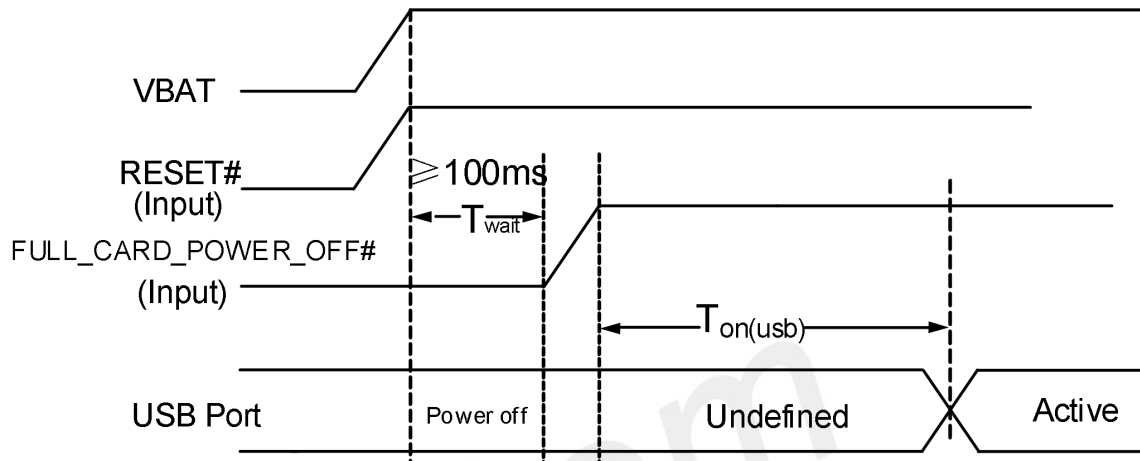
Figure 10: Power on sequence

Table 11: Power on timing and electrical characteristics

Symbol	Parameter	Min.	Typ.	Max.	Unit
T_{wait}	The waiting time from power supply available to power-on action	100	-	-	ms
$T_{on(usb)}$	The time from power-on action to USB port ready	-	12	-	s
V_{IH}	Input high level voltage on FULL_CARD_POWER_OFF# pin	1.2	1.8	4.4	V
V_{IL}	Input low level voltage on FULL_CARD_POWER_OFF# pin	0	-	0.2	V

NOTE

After the module is shut down, please wait at least 12 seconds before turning off the power, and then power on the module.

3.2.2 Power Off

The following methods can be used to power off the module.
● Method 1: Power off the module by holding the FULL_CARD_POWER_OFF# pin to low level.
● Method 2: Power off module by AT command "AT+CPOF".

NOTE

1. If the temperature is outside the range of -30℃~+70℃, some warning will be reported via AT port. If the temperature is outside the range of -40℃~+85℃, module will be powered off automatically.
For the details about "AT+CPOF", please refer to Document [1] in the appendix.
2. When the module is powered off by AT command, if the power supply and FULL_CARD_POWER_OFF# are not shut down, the module will automatically power on again.

Above normal power-off action will make the module disconnect from the network, allow the software to enter a safe state, and save key data before the module is powered off completely.

The power off sequence is shown in the following figure.
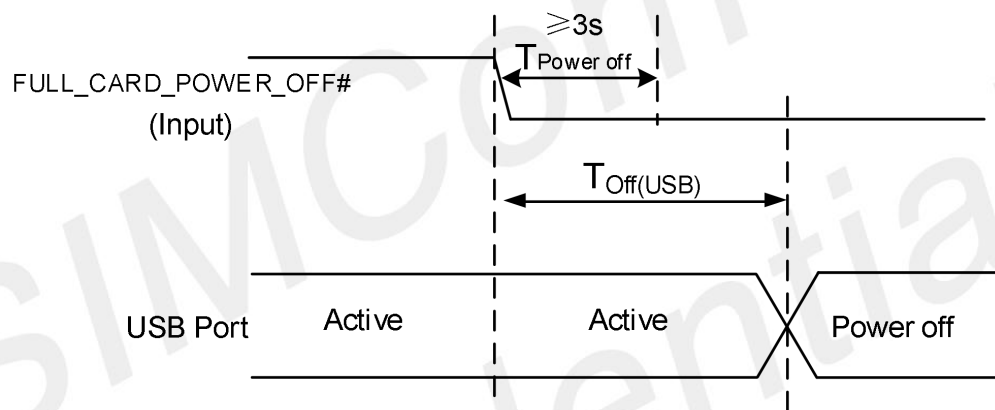
Figure 11: Power off sequence

Table 12: Power off timing and electrical characteristics

Symbol	Parameter	Time value			Unit
		Min.	Typ.	Max.	
$T_{Off(USB)}$	The time from power-off action to USB port off	-	9	-	s
$T_{Power\ off}$	The time holding the FULL_CARD_POWER_OFF# pin to low level for the module into power off status	-	3	-	s

3.3   Reset Function

SIM8200EA-M2 can be reset by driving the RESET# pin down to a low level.

The RESET# signal has been internally pulled up to 1.8V, so it does not need pull up externally. Please refer to the following figure for the recommended reference circuit.
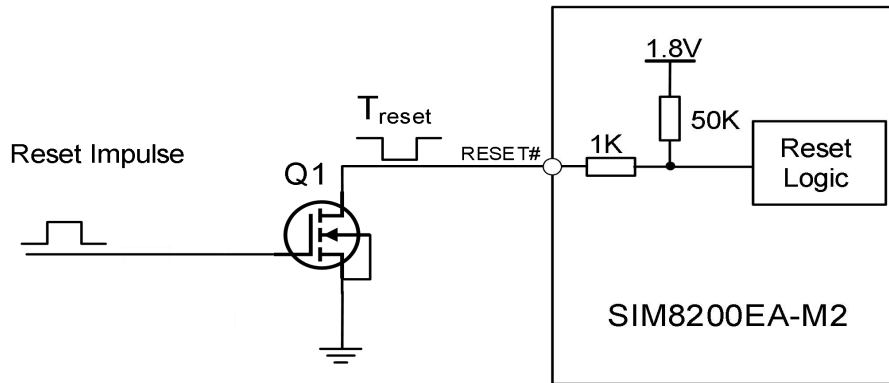
Figure 12: Reference reset circuit

Table 13: Definition of RESET# pin

Pin name	Pin no.	Electrical description	Description	Comment
RESET#	67	DI,PU	System reset control input Active low	RESET# has been pulled up to1.8V internally

The reset timing sequence of the module is shown in the following figure.
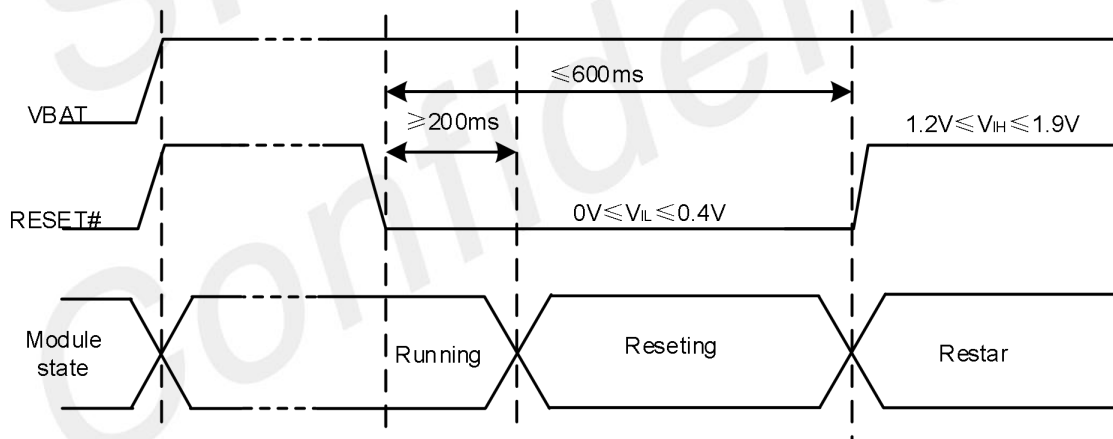
Figure 13: The reset timing sequence of the module

Table 14: RESET# pin electrical characteristics

Symbol	Description	Min.	Typ.	Max.	Unit
T_{reset}	Low level hold time on RESET# pin	200	-	600	ms
V_{IH}	Input high level voltage	1.2	-	1.9	V
V_{IL}	Input low level voltage	0	-	0.4	V

> **NOTE**
>
> Please ensure that there is no capacitance on RESET# pin.

3.4 I2C Interface

SIM8200EA-M2 supports an I2C interface meet I2C specification version 5.0, with data rate up to 400kbps.

The following figure shows the I2C interface reference circuit.
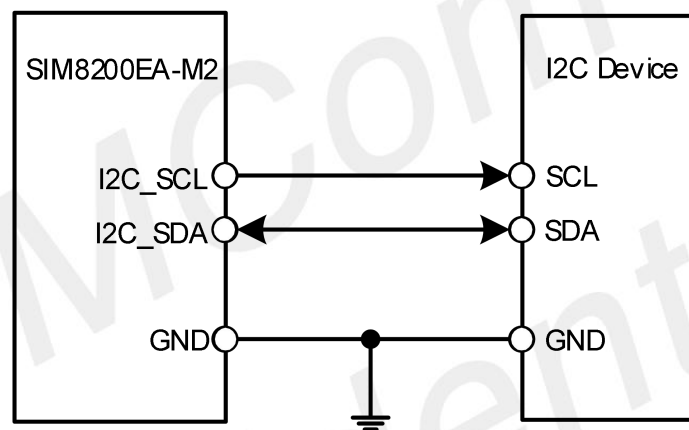
Figure 14: I2C reference circuit

Table 15: Definition of I2C interface

Pin name	Pin no.	Electrical description	Description	Comment
I2C_SDA	68	DIO	I2C data signal	1.8V voltage domain, Internal pulled up to 1.8V. If unused, please keep open
I2C_SCL	38	DO	I2C clock signal	

3.5 WoWWAN#*

The WoWWAN# pin is a system wake-on signal which can be used as an interrupt signal for the host. Normally it keeps high level. And it will change to low level when certain conditions occur, such as receiving SMS, voice call (CSD, video) or URC reporting, the low level pulse time is 1 second.
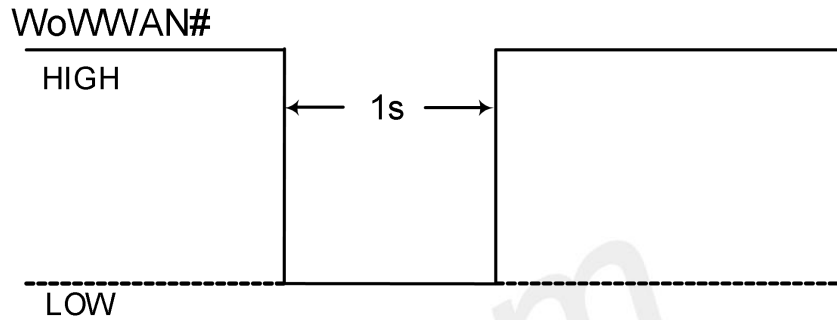
Figure 15: WoWWAN# signal level at SMS and URC report

WoWWAN# recommended reference circuit is shown in the following figure.
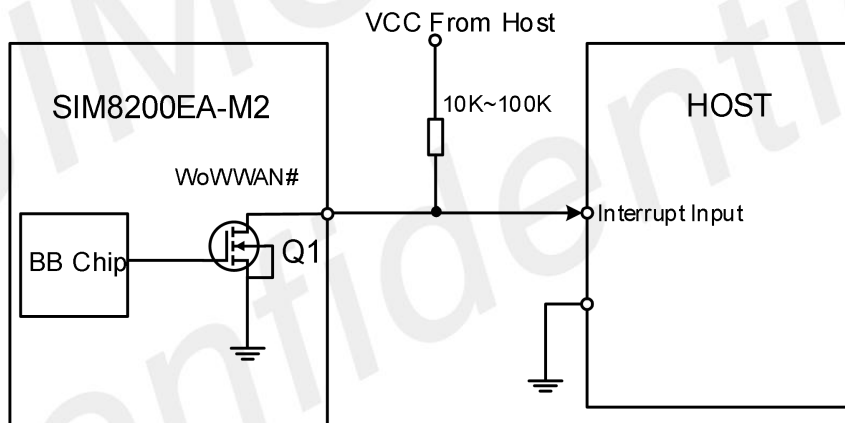
Figure 16: WoWWAN# reference circuit

Table 16: Definition of WoWWAN# pin

Pin name	Pin no.	Electrical description	Description	Comment
WoWWAN#	23	OD	Wake on the host Active low	

NOTE

"*" means under development.

3.6   USB Interface

SIM8200EA-M2 supports one USB interface which complies with the USB3.1 and 2.0 specifications. Customers can choose USB3.1 or USB2.0 for their needs. USB 3.1 data rate up to 10Gbps.

The USB interface is used for AT command communication, data transmission, GNSS NMEA output, firmware upgrade and software debugging.

The module supports USB suspend and resume mechanism which can save power consumption. If there is no data transmission on the USB bus, the module will enter suspend mode automatically.

The following figure is the USB reference circuit.
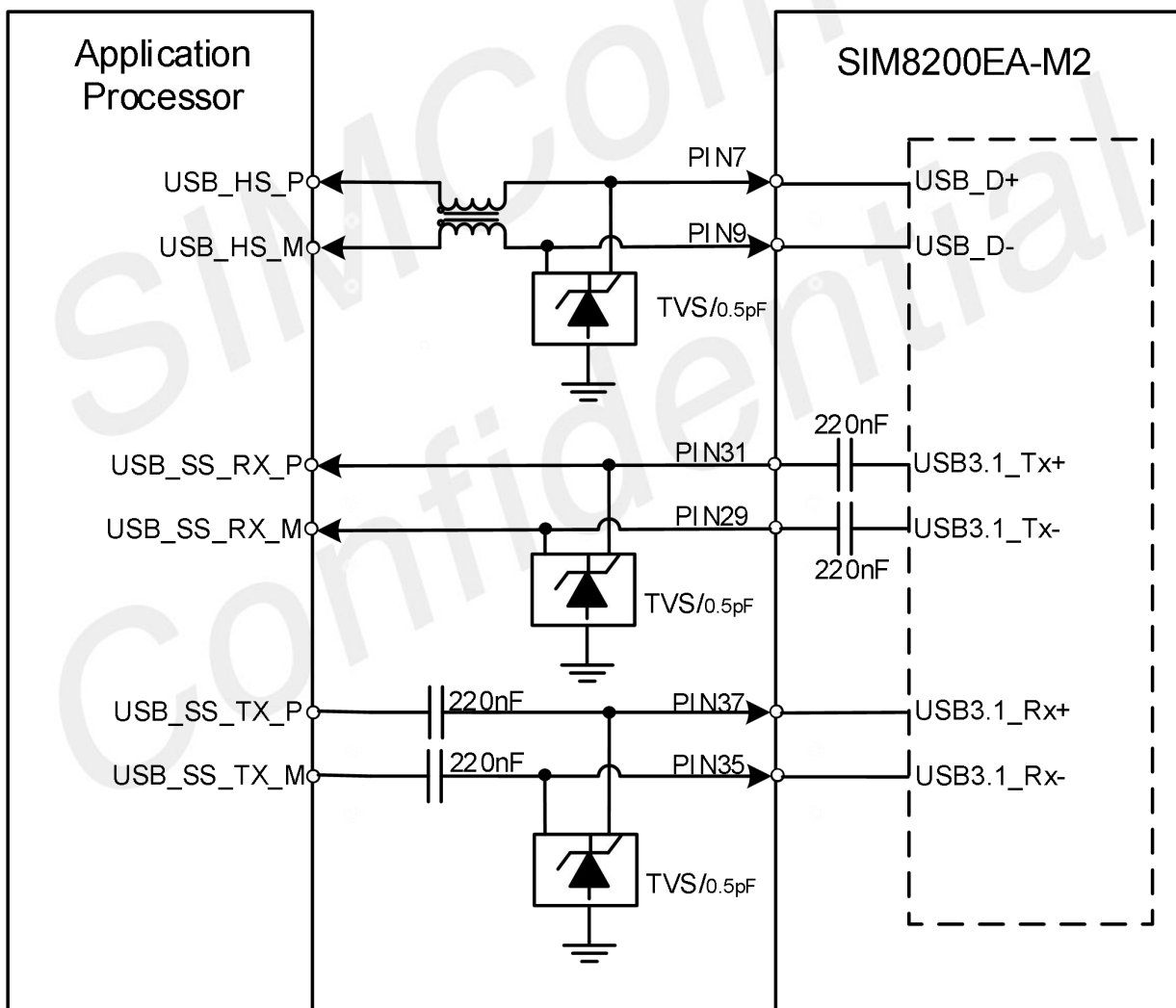
Figure 17: USB reference circuit

The following figure is the type-C USB reference circuit with CC detector.
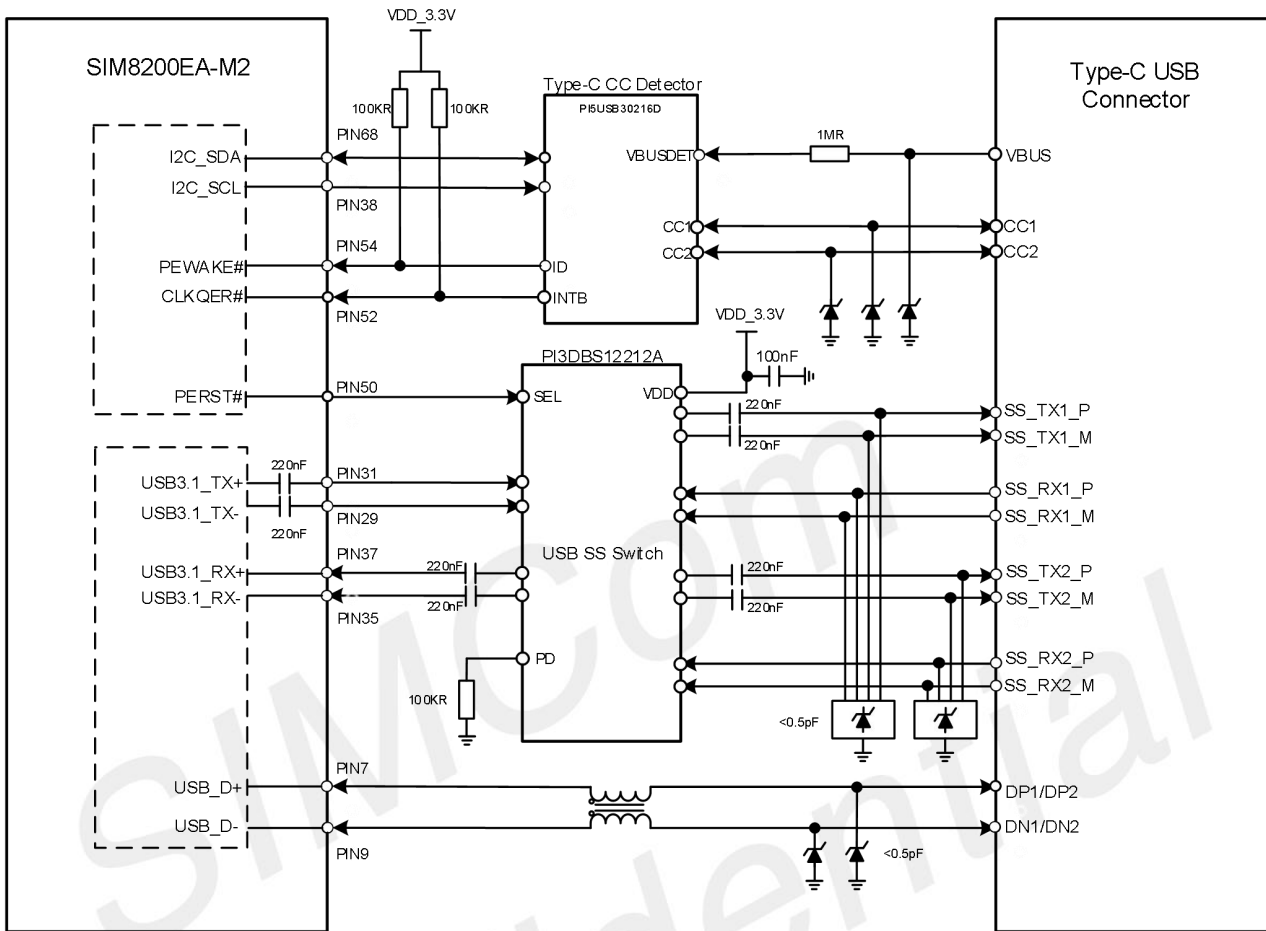
Figure 18: Type-C USB reference circuit with CC detector

Table 17: Definition of USB interface

Pin name	Pin no.	Electrical description	Description	Comment
USB_D+	7	AIO	Differential USB bi-directional data positive	USB3.1 data rate up to 10Gbps USB2.0 data rate up to 480Mbps
USB_D-	9	AIO	Differential USB bi-directional data negative	
USB3.1_Tx-	29	AO	USB3.1 transmit data negative	
USB3.1_Tx+	31	AO	USB3.1 transmit data positive	
USB3.1_Rx-	35	AI	USB3.1 receive data negative	
USB3.1_Rx+	37	AI	USB3.1 receive data positive	
PEWAKE#*	54	DI	For CC detector function	Need external pull up to 3.3V by 100KR resistor
CLKREQ#*	52	DI	For indicating change in I2C registers interrupt signal.	
PERST#*	50	DO	USB3.1 type-C switch control signal	

> **NOTE**
>
> 1."*": PEWAKE#, CLKREQ#, PERST# be used for PCIe control signal by default , if need configure
>
> type-c USB interface , recommend these three signal used for GPIO function.

Table 18: USB interface recommended CC detector, USB3.1 type-C switch and TVS diode list

No.	Manufacturer	Part number	Package
1	WILL	ESD5302N-3/TR	DFN1006-3L
2	PERICOM	PI5USB30216D	QFN12
3	PERICOM	PI3DBS12212A	QFN3X3

USB HS D+/D- layout guidelines:
- Require differential trace impedance is 90±10% Ω.
- The intra-lane length mismatch of the differential signal lanes is less than 1mm.
- Gap from other signals keeps 3xline width.
- External components should be placed near the USB connector.
- Trace routes away from other sensitive signals (RF, audio, and 38.4M XO).
- The TVS diode should be placed close to the USB pins of M.2 connector.
- Maximum PCB trace length cannot exceed 100mm outside of module, the shorter trace and more better.

USB SS TX/RX layout guidelines:

- Require differential trace impedance is 90±10% Ω.
- The intra-lane length mismatch of the differential signal lanes is less than 500um.
- Gap from other signals keeps 4xline width.
- Gap between Rx-to-Tx keeps 4xline width.
- External components should be placed near the USB connector.
- Trace routes away from other sensitive signals (RF, especially 2.4 GHz).
- The TVS diode should be placed close to the USB pins of M.2 connector.
- Route differential pairs in the inner layers with a solid GND reference to have good impedance control and to minimize discontinuities.
- Keep isolation between the Tx pair, Rx pair, and DP/DM to avoid crosstalk.
- If core vias are used, use no more than two core vias per signal line to limit stubs.

3.7   PCIe Interface

SIM8200EA-M2 supports PCIe Gen3 one lane interfaces, which data rate up to 8Gbps, and can be used as EP or RC* mode. CLKREQ# and PEWAKE# needs pull up to 3.3V by 100K resesitor in customers' design. The following figure is the PCIe reference circuit.
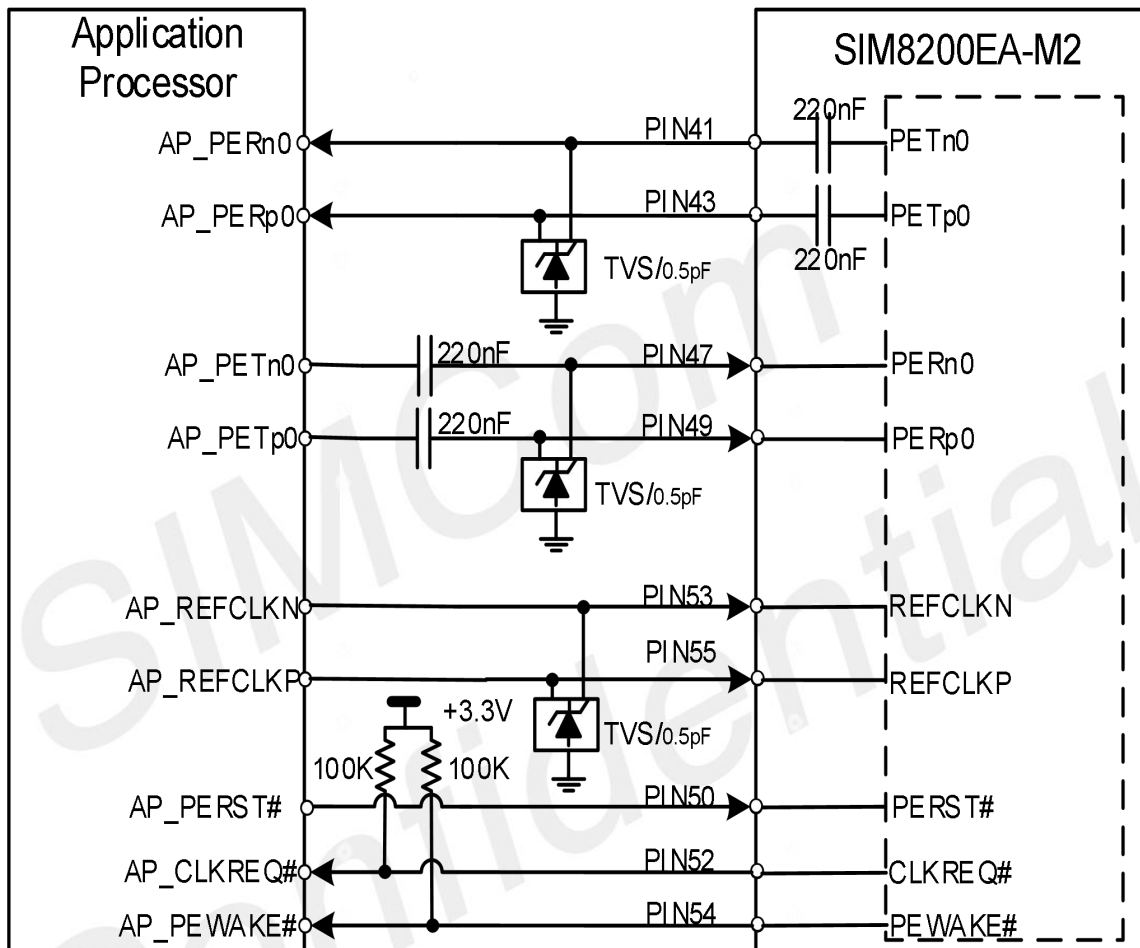
Figure 19: PCIe interface reference circuit (EP Mode)

> **NOTE**
>
> 1. "*" means under development.
> 2. The AC capacitors of AP_PETn0 and AP_PETp0 should be closed to AP.
> 3. The voltage domain of PCIe assistant signals is 3.3V.

Table 19: Definition of PCIe interface

Pin name	Pin no.	Electrical description	Functional description	Comment
PETn0	41	AO	PCIe transmit data negative	
PETp0	43	AO	PCIe transmit data positive	
PERn0	47	AI	PCIe receive data negative	
PERp0	49	AI	PCIe receive data positive	
REFCLKN	53	AIO	PCIe reference clock negative	
REFCLKP	55	AIO	PCIe reference clock positive	
PERST#	50	DI	PERST# is a functional reset to the Add-In module active low	3.3V voltage domain, CLKREQ# and PEWAKE# required pull up external, Default as EP mode. If unused, please keep open
CLKREQ#	52	DIO	PCIe reference clock request signal active low	
PEWAKE#	54	DIO	PCIe wake up signal active low	

Table 20: PCIe interface recommended TVS diode list

No.	Manufacturer	Part number	Package
1	WILL	ESD5302N-3/TR	DFN1006-3L
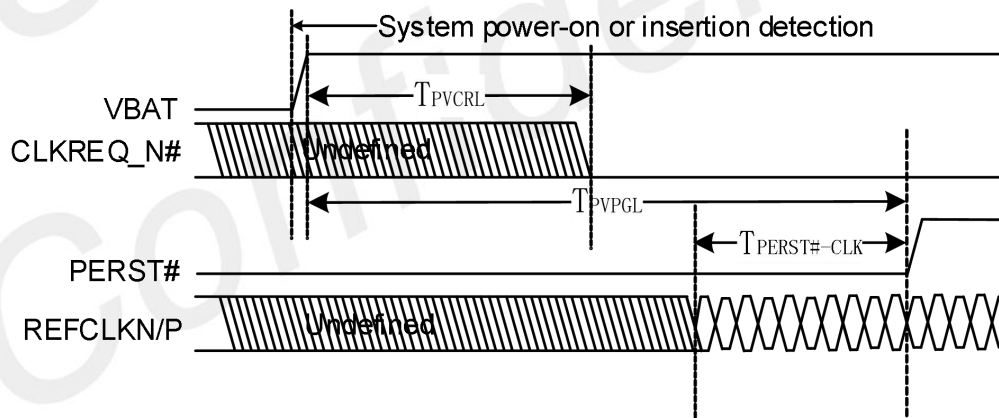
Symbol	Parameter	Min	Max	Units
T_{PVCRL}	Power Valid to CLKREQ# Output active		100	uS
T_{PVPGL}	Power Valid to PERST# Input inactive	1		mS
$T_{PERST\#-CLK}$	REFCLK stable before PERST# inactive	100		uS

Figure 20: PCIe power-on sequence requirements of M.2 specification
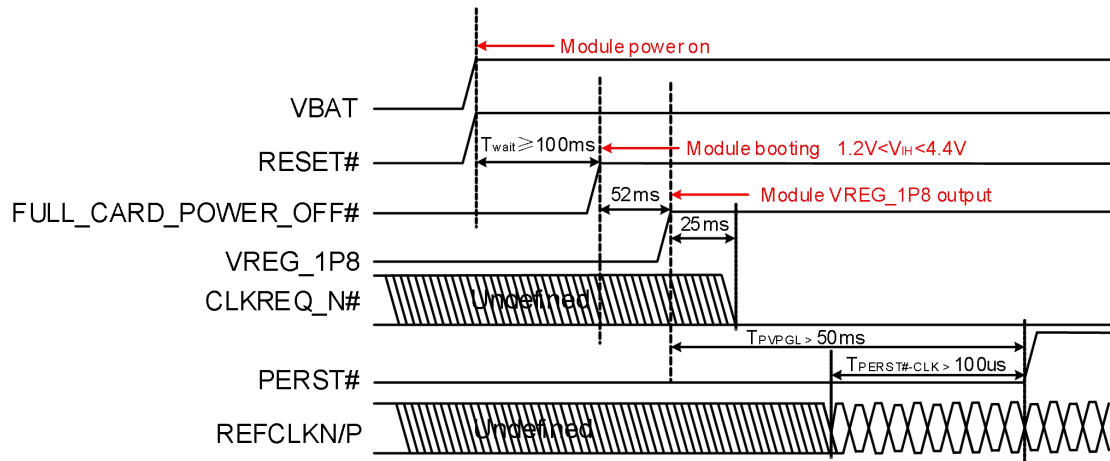
Figure 21: PCIe power-on sequence requirements of module

PCIe interface layout guidelines:

● Require differential trace impedance is 90±10% Ω.

● The intra-lane length mismatch of the differential signal lanes is less than 500um.

● Gap from other signals keeps 4xline width.

● Gap between Rx-to-Tx keeps 4xline width.

● Should be routed away from sensitive signals.

● The TVS diode should be placed close to the PCIe pins of M.2 connector.

● All other sensitive/high-speed signals and circuits must be protected from PCIe corruption.

● PCIe signals must be protected from noisy signals (clocks, SMPS).

● Each trace needs to be adjacent to a ground plane.

● Maximum PCB trace length cannot exceed 150mm outside of module, the shorter trace and more better.

3.7.1 PCIe for W80

PCIe Gen3 can be connected to W80 as WLAN data interface, WLAN ZIF connector for W80 power supply and assistance control, SIM8200EA-M2 (The PN number of the module is S2-10A46) as RC and W80 as EP.

CLKREQ#, PEWAKE# and PERST# signals need to connect 3.3V to 1.8V shift level between SIM8200EA-M2 and W80, the following figure is the PCIe reference circuit, the details design please refer to the reference circuit document.
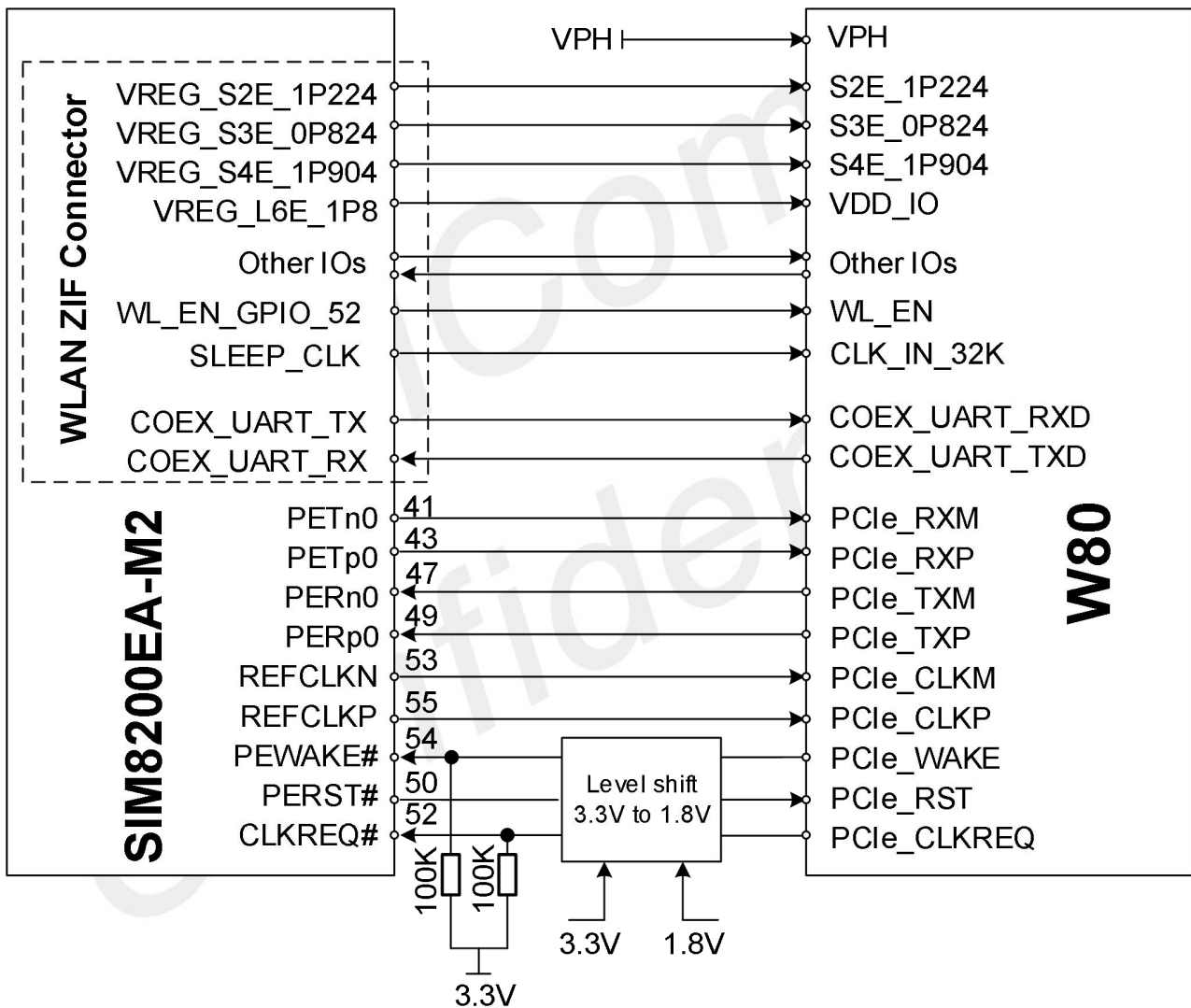
Figure 22: The module connect W80 reference circuit

> **NOTE**
>
> 1. On the module side, the PEWAKE# and CLKREQ# signals need to be pulled up to 3.3V by 100K resister.
> 2. On the W80 side, the PEWAKE# and CLKREQ# signals internal pull up to 1.8V already.

Table 21: Recommended shift level list

No.	Manufacturer	Part number	Package
1	TI	TXS0104EYZT	GXU/ZXU(BGA)

The following table is pin description of WLAN ZIF connector.

Table 22: Pin description of WLAN ZIF connector

Pin name	PIN no.	Electrical description		Discribtion
SLEEP_CLK	2	P3	DO	Sleep clock for WIFI module
COEX_UART_TX	4	P3	DO	WLAN coexistence UART transmit
COEX_UART_RX	5	P3	DI	WLAN coexistence UART receive
WL_EN_GPIO_52	6	P3	DO	
WL_GPIO_GPIO_94	7	P3	DO	
WL_XFEM_CTRL_LAA_RX_GPIO_26	8	P3	DO	WIFI module control assistant signal
WL_XFEM_CTRL_PA_MUT_GPIO_41	9	P3	DO	
LAA_AS_EN_GPIO_40	10	P3	DO	
WL_SW_CTRL	12	P3	DO	
VREG_L6E_1P8	14		PO	Power supply for WIFI module
VREG_S2E_1P224	16,17,18		PO	Power supply for WIFI module
VREG_S3E_0P824	20,21,22,23,24,25		PO	Power supply for WIFI module
VREG_S4E_1P904	27,28,29		PO	Power supply for WIFI module
GNG	1,3,11,13,15,19,26,30			Ground

> **NOTE**
>
> 1. SIM8200 M2 series support WIFI function the PN of the module is S2-10A46, about more details, please contact SIMCom support teams.
> 2. The connector is position bottom side of the module and it no assembly on the module by default.

3.7.2 PCIe for RTL8125B-TE

PCIe Gen3 can be connected to W80 as Ethernet data interface, SIM8200EA-M2 as RC and RTL8125B-TE as EP.

CLKREQ# and PEWAKE# needs pull up to 3.3V by 100K resistor in customers' design, the details design please refers to the reference circuit document.
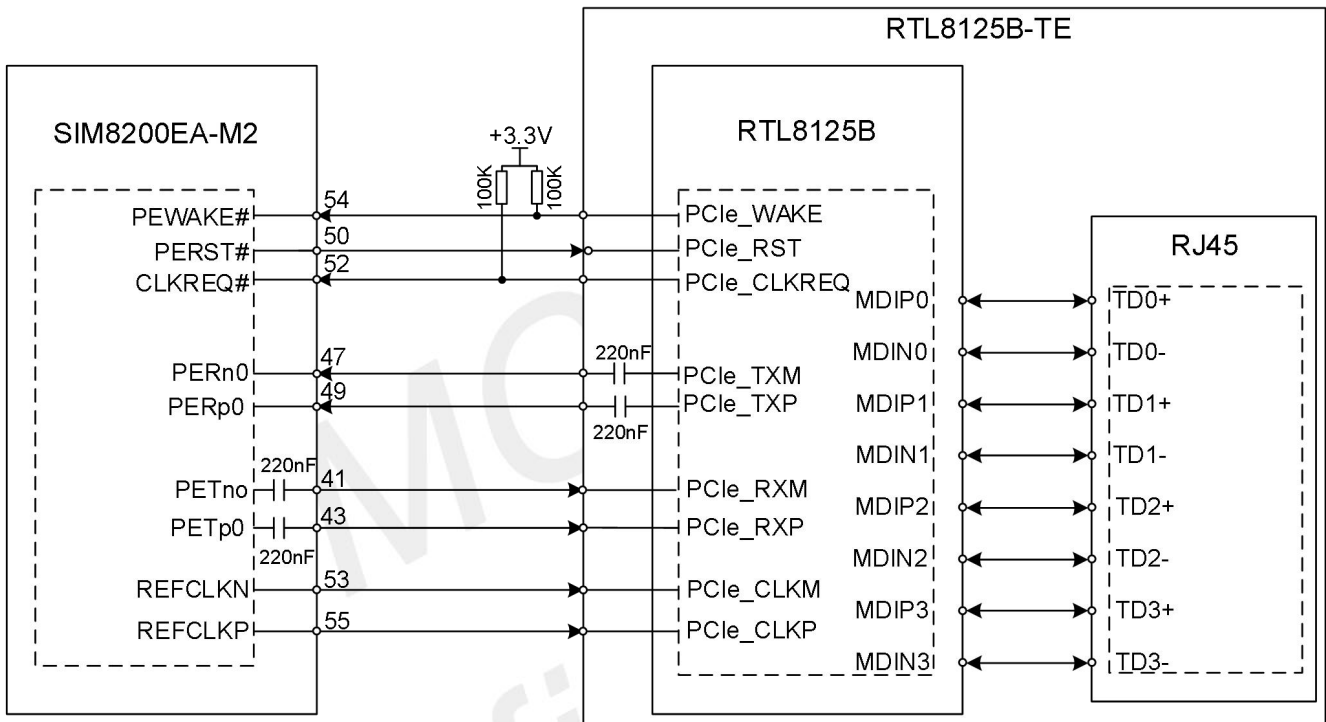
Figure 23: The module connect RTL8125B-TE reference circuit

Table 23: Recommended RTL8125B IC list

No.	Manufacturer	Part number	Package
1	REALTEK	RTL8125B-CG	6mm*6mm*1mm

NOTE

1. The AC capacitors of PCIe_TXM and PCIe_TXP should be placed near the RTL8125B.
2. The voltage domain of PCIe_WAKE, PCIe_RST, PCIe_CLKREQ is 3.3V when using.
3. For more details about PCIe to Ethernet, please refer to Document [16] in the appendix.

3.8   (U)SIM Interface

SIM8200EA-M2 supports two (U)SIM cards but single standby. The (U)SIM2 can use e-(U)SIM[*] card in the module or external (U)SIM card, the size is 2mm*2mm*1mm of the e-(U)SIM. Both (U)SIM1 and (U)SIM2 are dual-voltage 1.8V or 3.0V.

> **NOTE**
>
> Customer choose the e-(U)SIM product in accordance with above size, SIMCom will provide the e-(U)SIM assemble into the module.

Table 24: (U)SIM electrical characteristics in 1.8V mode ((U)SIM_PWR=1.8V)

Symbol	Parameter	Min.	Typ.	Max.	Unit
(U)SIM_PWR	Power supply for (U)SIM card	1.65	1.8	1.95	V
V_{IH}	High-level input voltage	1.26	-	1.95	V
V_{IL}	Low-level input voltage	0	-	0.36	V
V_{OH}	High-level output voltage	1.44	-	1.8	V
V_{OL}	Low-level output voltage	0	-	0.4	V

Table 25: (U)SIM electrical characteristics in 3.0V mode ((U)SIM_PWR=3.0V)

Symbol	Parameter	Min.	Typ.	Max.	Unit
(U)SIM_PWR	Power supply for (U)SIM card	2.7	3.0	3.05	V
V_{IH}	High-level input voltage	2.1	-	3.05	V
V_{IL}	Low-level input voltage	0	0	0.6	V
V_{OH}	High-level output voltage	2.4	-	3.0	V
V_{OL}	Low-level output voltage	0	0	0.4	V

The module supports (U)SIM card hot-swap by the (U)SIM_DET pin, which is a level trigger pin. The (U)SIM_DET pin pulled up internally.

The following figure shows (U)SIM card reference circuit.
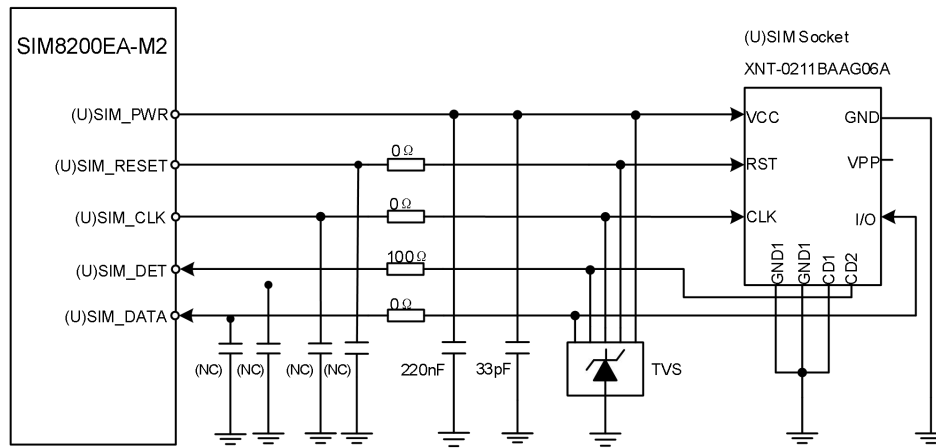
Figure 24: (U)SIM interface reference circuit

When the (U)SIM card is inserted, the (U)SIM_DET will change from high to low level. The falling edge will indicate insertion of the (U)SIM card. When the (U)SIM card is removed, the (U)SIM_DET will change from low to high level. This rising edge will indicate unplug the (U)SIM card.

Using "AT+UIMHOTSWAPON=0 or 1" and "AT+UIMHOTSWAPLEVEL=0 or 1"AT command to set module SIM card hot swap function enable and SIM card detection level, for more details, please refer to SIM8200 Series_AT Command Manual document.

Using "AT+SMSIMCFG=1,1" and "AT+SMSIMCFG=1,2" AT command to switch (U)SIM1 and (U)SIM2 function, for more details, please refer to SIM8200 Series_AT Command Manual document.

Table 26: Definition of (U)SIM interface

Pin name	Pin no.	Electrical description	Description	Comment
(U)SIM1_PWR	36	PO	Power supply for (U)SIM1 card	
(U)SIM 1_DATA	34	DIO	(U)SIM1 card data, which has been pulled up to (U)SIM1_VDD via a 20KR resistor internally	
(U)SIM 1_CLK	32	DO	(U)SIM1 clock signal	
(U)SIM1_RESET	30	DO	(U)SIM1 Reset control	
(U)SIM 1_DET	66	DI	(U)SIM1 card detect, which has been pulled up to VDD_P3 via a 470KR resistor internally	1.8/3.0V voltage domain, all (U)SIM interfaces should be protected against ESD. If unused, please keep open
(U)SIM2_PWR	48	PO	Power supply for (U)SIM2 card	
(U)SIM2_DATA	42	DIO	(U)SIM2 card data, which has been pulled up to (U)SIM2_VDD via a 20KR resistor internally	
(U)SIM2_CLK	44	DO	(U)SIM2 clock signal	
(U)SIM2_RESET	46	DO	(U)SIM2 Reset control	
(U)SIM2_DET	40	DI	(U)SIM2 card detect, which has been pulled up to VDD_P3 via a 470KR resistor internally	

The following table shows recommended TVS of ESD protect and (U)SIM socket.

Table 27: Recommended TVS and (U)SIM socket list

No.	Name	Manufacturer	Part number
1	TVS	ST	ESDA6V1-5W6
2	(U)SIM socket	Suntech	XNT-0211BAAG06A

If the (U)SIM card hot-swap function is not used, customers can keep the (U)SIM_DET pin open.

The (U)SIM card layout guidelines:
● Make sure that the (U)SIM card holder should be far away from the antenna while in PCB layout.
● (U)SIM traces should keep away from RF lines, VBAT and high-speed signal lines.
● The traces should be as short as possible.
● Keep (U)SIM holder's GND connect to main ground directly.
● Shielding the (U)SIM card signal by ground.
● Recommended to place a 33pF ~ 1uF capacitor on (U)SIM_PWR line and keep close to the holder.
● The rise/fall time of (U)SIM_CLK should not be more than 40ns.
● The parasitic capacitance of TVS should not exceed 60pF and the TVS should be placed close to the (U)SIM socket.

3.9 I2S Interface

SIM8200EA-M2 supports one I2S interface for external codec, which follows the requirements in the Phillips I2S bus specification.

Table 28: I2S format

Characteristics	Specification
Line interface format	Linear(Fixed)
Data length	16bits(Fixed)
I2S clock/sync source	Master mode(Fixed)
I2S clock frequency	1.536MHz (Default)
I2S MCLK frequency	12.288MHz (Default)
Data ordering	MSB

NOTE

For the details about I2S AT commands, please refer to document [1]. in the appendix.

3.9.1 I2S Timing

The module supports I2S sampling rate of 48 KHz and 32 bit coding signal (16 bit length), the timing sequence is shown in the following figure.
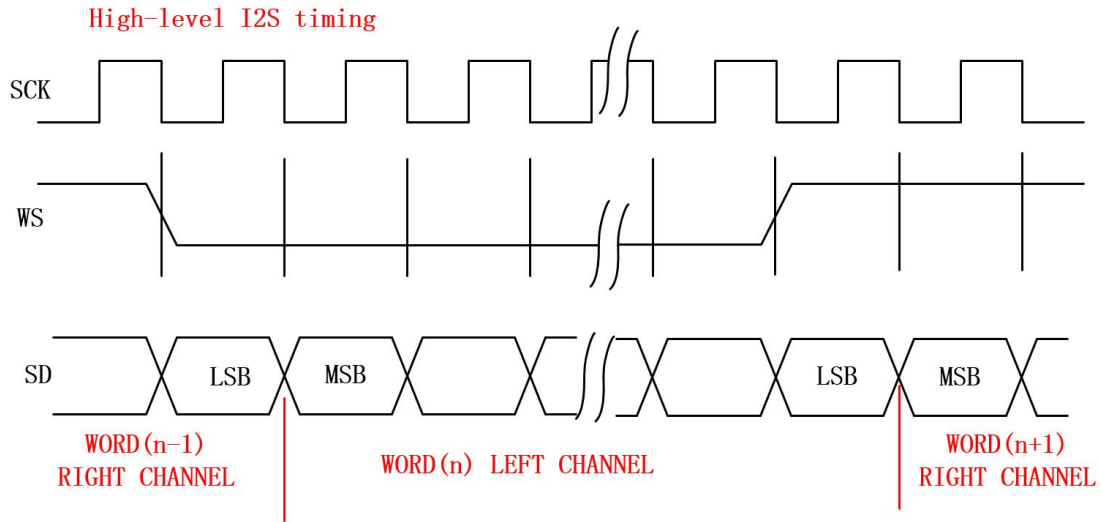
Figure 25: I2S timing

Table 29: I2S timing parameters

Signal	Parameter	Description	Min.	Typ.	Max.	Unit
I2S_MCLK	Frequency	Working Frequency	–	12.288	12.288	MHz
	T	Clock period	81.380	81.380	–	ns
	t(HC)	Clock high	0.45T	–	0.55T	ns
	t(LC)	Clock low	0.45T	–	0.55T	ns
I2S_CLK	Frequency	Working Frequency	8	48	48	KHz
	T	Clock period	20.83	20.83	125	us
	t(HC)	Clock high	0.45T	–	0.55T	ns
	t(LC)	Clock low	0.45T	–	0.55T	ns
I2S_WA	t(sr)	DIN/DOUT and WA input setup time	16.276	–	–	ns
	t(hr)	DIN/DOUT and WA input hold time	0	–	–	ns
	t(dtr)	DIN/DOUT and WA output delay	–	–	65.10	ns
	t(htr)	DIN/DOUT and WA output hold time	0	–	–	ns

3.9.2 I2S Reference Circuit

The following figure is the external codec reference design circuit.
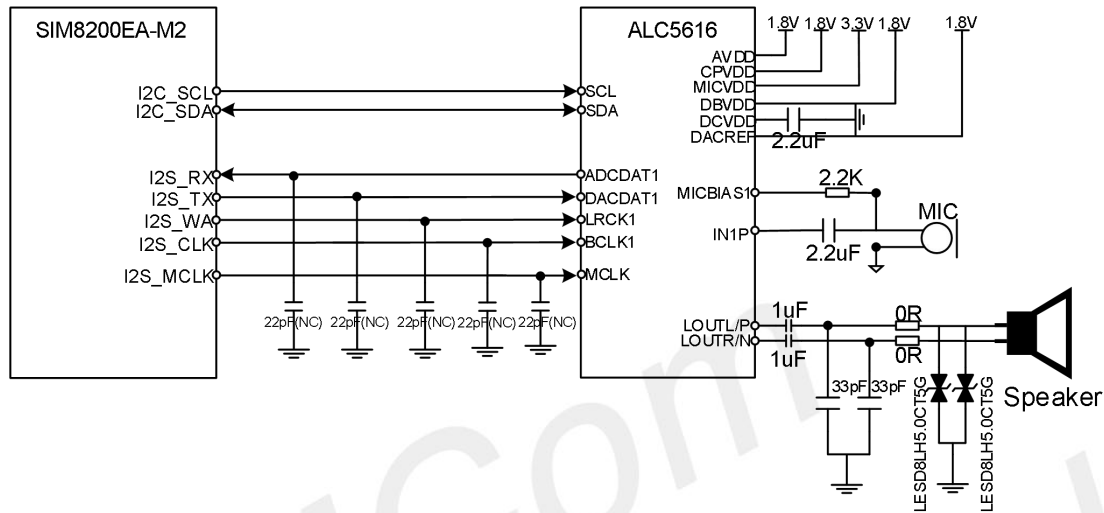
Figure 26: Audio codec diagram circuit

Table 30: Definition of I2S interface

Pin name	Pin no.	Electrical description	Description	Comment
I2S_CLK	20	DO	I2S clock output	1.8V voltage domain, also can be used as PCM interface, If unused, please keep open
I2S_RX	22	DI	I2S data input	
I2S_TX	24	DO	I2S data output	
I2S_WA	28	DO	I2S word alignment select (L/R)	
I2S_MCLK	60	DO	I2S master clock	

The PCM interface is multiplexing with I2S interface. The default audio interface of the module is I2S.

Table 31: The PCM interface is multiplexing with I2S interface

Pin name	PCM interface
I2S_RX	PCM_DIN
I2S_TX	PCM_OUT
I2S_WA	PCM_SYNC
I2S_CLK	PCM_CLK
I2S_MCLK	-

Audio layout guidelines:

Analog input
● 0.2mm trace widths; 0.2mm spacing between other signals trace.
● Pseudo differential route for MIC.
● Isolate from noise sources, such as antenna, RF signals, SMPS, clocks, and other high speed signals.

Analog output
● Isolate from noise sources such as antenna, RF signals, SMPS, clocks, and other high speed signals.
● Speaker output signal – route as differential pair with 0.5mm trace widths.

Audio power and GND
● Recommend add magnetic bead on AVDD net reserved for debug.
● VDD cannot directly use VBAT as the power supply.
● AGND need add GND via to the main GND plane directly.

3.10 DPR*

DPR (Dynamic Power Reduction) signal is used for SAR (Specific Absorption Rate) sensor requirements. The RF output power would reduce if this signal is triggered by sensor under some certain conditions, such as SAR sensor triggered, defined by customers.

User can activate this function with AT command.

Table 32: Definition of DPR# pin

Pin no.	Pin name	Pin status	Function
25	DPR	Low	Max transmitting power will be reduced by set through AT command
		High	Max transmitting power will not be reduced (default)
		Floating	Max transmitting power will not be reduced

NOTE

"*" means under development.

3.11 CONFIG Pins

These signals are provided to indicate its specific configuration that is WWAN-USB3.1 of SIM8200EA-M2.

Table 33: CONFIG pins state of the module

Pin no.	Pin name	Description
21	CONFIG_0	Connected to ground internally
69	CONFIG_1	Connected to ground internally
75	CONFIG_2	Connected to ground internally
1	CONFIG_3	Not connected

In the M.2 specifications, the CONFIG pins are defined as below.

Table 34: CONFIG interface definition

CONFIG_0 (Pin 21)	CONFIG _1 (Pin 69)	CONFIG _2 (Pin 75)	CONFIG _3 (Pin 1)	Module type and main host interface	Comments
GND	GND	GND	NC	WWAN – USB 3.1	Vender defined

3.12 LED1#

LED1# is open drain output and is used to allow SIM8200EA-M2 to provide network status via LED which will be provided by the host.
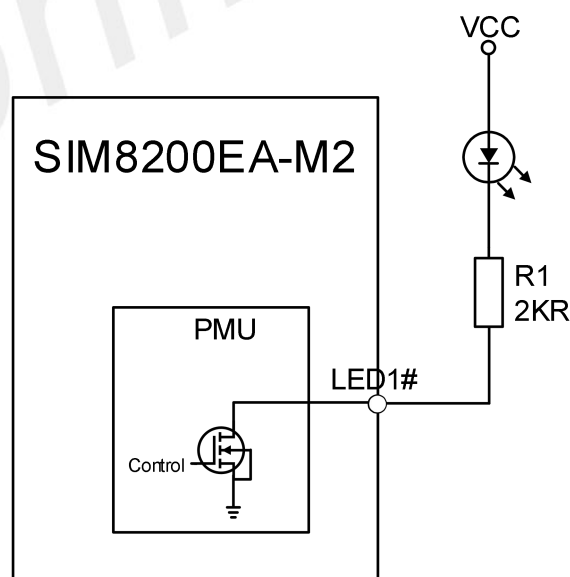
Figure 27: LED1# reference circuit

Table 35: Definition of LED1# pin

Pin name	Pin no.	Electrical description	Description	Comments
LED1#	10	OD	The module status indicator via LED devices Active low	

> **NOTE**
>
> 1. The value of the resistor R1 depends on the LED characteristics. The recommend value of R1 is 2KR.

The timing parameters are shown in the following table.

Table 36: LED1# pin status

LED1# pin status	Module status
Always On	Searching network; call connection(including 5G,VOLTE)
100ms ON, 100ms OFF	Data transmit; 5G registered network
200ms ON, 200ms OFF	Data transmit; 3G Data transmit; 4G registered network;
800ms ON, 800ms OFF	3G registered network
OFF	Power off ;Sleep mode

3.13 W_DISABLE1#

The W_DISABLE1# pin controls SIM8200EA-M2 to enter the flight mode. When the W_DISABLE1# signal is pulled to low level, RF function would be disabled. Otherwise the RF function would be active. Recommended reference circuit is shown in the following figure.

Figure 28: W_DISABLE1# pin reference circuit

Table 37: Definition of W_DISABLE1# pin

Pin name	Pin no.	Electrical description	Description	Comments
W_DISABLE1#	8	DI	WWAN RF disable Active low	3.3V tolerant but can be driven by either 1.8V or 3.3V GPIO

Table 38: W_DISABLE1# pin status

W_DISABLE1# pin status	Module operation
Input low level	Flight mode: RF is disabled
Input high level	AT+CFUN=4: Flight mode AT+CFUN=1: RF is enabled (Default)

3.14 TDD_SYNC_PPS

In SIM8200EA-M2 design, W_DISABLE2# and TDD_SYNC_PPS function can compatible PIN26 of SIM8200EA-M2. SIM8200EA-M2 hardware support TDD_SYNC_PPS function by default.

When PIN26 configure as TDD_SYNC_PPS function, it can generate pulse use for indication NSA and SA sub6 the beginning frame flag of DL-UL, the pin level is 1.8V.

Recommended reference circuit is shown in the following figure.
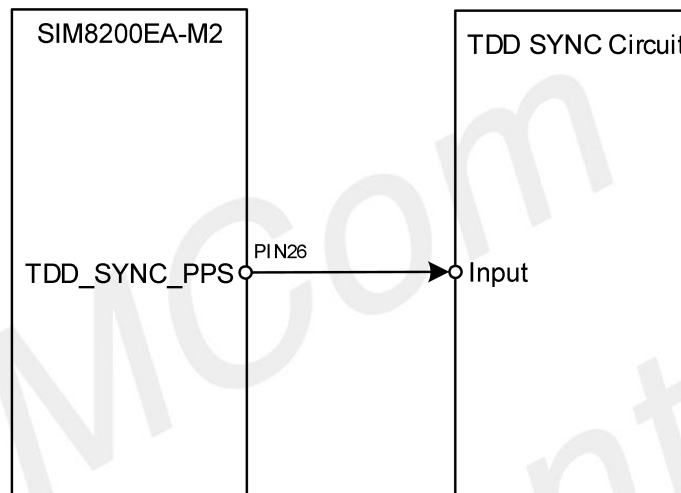
Figure 29: TDD_SYNC_PPS pin reference circuit

Table 39: Definition of TDD_SYNC_PPS pin

Pin name	Pin no.	Electrical description	Description	Comments
TDD_SYNC_PPS	26	DO	It can generate pulse use for indication NSA and SA sub6 the beginning frame flag of DL-UL	1.8V voltage domain

---

NOTE

1. "*" means under development.
2. The TDD_SYNC_PPS pin also can be configured GPS_1PPS signal output by software, the TDD_SYNC_PPS and GPS_1PPS function can't be used at the same time.
3. About TDD_SYNC_PPS and GPS_1PPS function more detail, please contact SIMCom support teams.
4. Support TDD_SYNC_PPS function the PN of the module is S2-109WE, for more details, please contact SIMCom support teams.

The following is TDD_SYNC_PPS signal design guidelines:

- This signal trace should be treated as a data transmission line, required impedance is 50 Ω.
- This signal trace should as short as possible and cannot exceed 40mm out of the module.
- This signal trace should far away from RF, power and high-speed signals.
- This signal trace should be protected completely by GND.
- The rising slew rate is no poor than 3ns, falling slew rate is no poor than 5ns, even with default lowest drive strength (2mA) being selected.

3.14.1 W_DISABLE2#

In SIM8200EA-M2 design, W_DISABLE2# and TDD_SYNC_PPS function can compatible PIN26 of SIM8200EA-M2. SIM8200EA-M2 hardware support TDD_SYNC_PPS function by default.

The W_DISABLE2# pin controls SIM8200EA-M2 to disable the GNSS function. When the W_DISABLE2# signal is pulled to low level, the GNSS function would be disabled. The following figure shows the reference circuit of W_DISABLE2#.
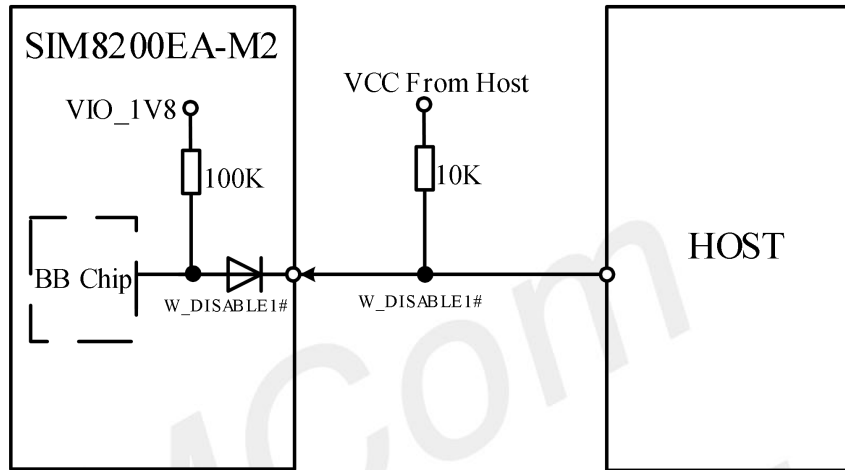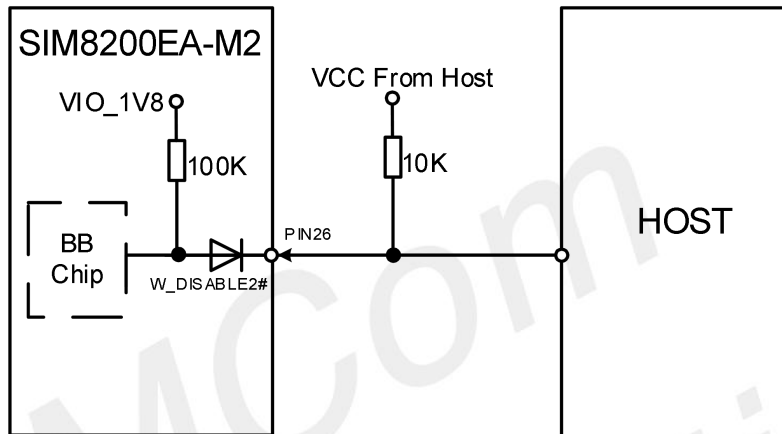

Figure 30: W_DISABLE2#pin reference circuit

Table 40: Definition of W_DISABLE2# pin

Pin name	Pin no.	Electrical description	Description	Comments
W_DISABLE2#	26	DI	GNSS disable Active low	3.3V tolerant but can be driven by either 1.8V or 3.3V GPIO

Table 41: W_DISABLE2# pin status

W_DISABLE2# pin status	Module operation
Input Low Level	GNSS function is disabled
Input High Level	AT+CGPS=0: GNSS function is disabled AT+CGPS=1: GNSS function is enabled(default)

3.15　Antenna Control Interface*

ANTCTL [0:3] and RFFE signals are used for tunable antenna control and should be routed to an appropriate antenna control circuitry.

The following table is the definitions for antenna control interfaces.

Table 42: Definition of antenna control interface through GPIOs

Pin name	Pin no.	Electrical description	Description	Comments
ANTCTL0	59	DO	Antenna tuner control0	
ANTCTL1	61	DO	Antenna tuner control1	1.8V voltage domain. If unused, please keep open
ANTCTL 2 (RFFE_SDATA)[2]	58	DO (DIO)	Antenna tuner control2 (Antenna tuner MIPI DATA)[2]	
ANTCTL3 (RFFE_SCLK)[2]	56	DO	Antenna tuner control3 (Antenna tuner MIPI CLK)[2]	

NOTE

1. "*" means under development, for details please contact SIMCom support teams.
2. The RFFE signals are multiplexed with ANTCTL2 and ANTCTL3.

3.16 UART Interface

SIM8200EA-M2 hardware configure as normal communication UART (AT command) by default. If need coexistence signal function, please contact SIMCom support teams.

Table 43: Definition of UART interface

Pin name	Pin no.	Electrical description	Description	Comments
COEX1* (COEX_TX*)	64	DO	SIM8200EA-M2 hardware configures as normal communication UART(AT command) by default	If need coexistence signal function, please contact SIMCom support teams
COEX2* (COEX_RX*)	62	DI		

The UART level of SIM8200EA-M2 is 1.8V, if need communication with 3.3V serial port level , it recommended to use level shift IC. The following figure shows the reference design circuit of level shift.
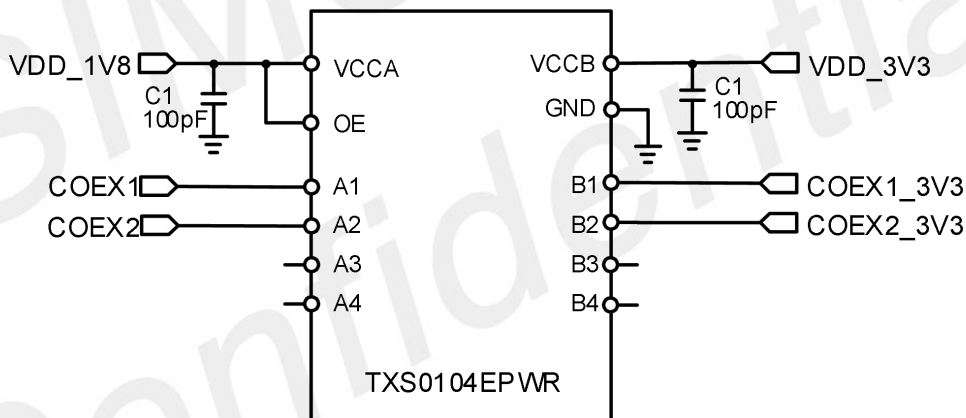
Figure 31: UART level conversion circuit

3.17   GPIOs Interface

There pins can be configured as GPIO function of SIM8200EA-M2 in following table, and it configuration by software configure according to the customer's requirements.

Table 44: GPIO list

SIM8200EA-M2 Pin Name	Pin no.	Interrupt function	Pull (default options)
COEX1	64		B-PD: nppukp
COEX2	62	Y	B-PD: nppukp
I2S_WA	28	Y	B-PD: nppukp
I2S_RX	22	Y	B-PD: nppukp
I2S_TX	24	Y	B-PD: nppukp
I2S_CLK	20	Y	B-PD: nppukp
DPR	25	Y	B-PD: nppukp
I2C_SDA(IO)	68	Y	B-PU: nppukp
I2C_SCL(IO)	38	Y	B-PU: nppukp
I2S_MCLK(IO)	60		B-PD: nppukp

> **NOTE**
>
> 1. "*" means under development, about TDD_SYNC_PPS function more detail, please contact SIMCom support teams.
> 2. I2C_SDA and I2C_SCL signal of the module pulled up to 1.8V already.

4 Antenna Interfaces

SIM8200EA-M2 provides six antenna interfaces, and all of them should be 50Ω impedance controlled for RF signal.

4.1 Antenna Definitions

Antenna interfaces are shown in the following figure.

Figure 32: Antenna interfaces

Table 45: Antenna port definitions

天线端口	天线功能	频率范围	功能描述
ANT0	3G/4G/5G LB/MHB TRX 5G n41 UL/DL-MIMO1 5G n77/n78/n79 UL/DL-MIMO1	617MHz~960MHz 1710MHz~2690MHz 3300MHz~5000MHz	3G/4G/5G TX AND RX
ANT1	3G/4G/5G LB/MHB DIV 5G n41/n77/n78/n79 DIV GNSS	617MHz~960MHz 1710MHz~2690MHz 3300MHz~5000MHz 1561MHZ~1609MHz	3G/4G/5G/GNSS RX
ANT2	3G/4G/5G MHB DL-MIMO2 5G n41/n77/n78/n79 DL-MIMO2	1710MHz~2690MHz 3300MHz~5000MHz	3G/4G/5G RX
ANT3	5G n41/n77/n78/n79 TRX 4G UHB TRX 3G/4G MHB DL-MIMO1	2496MHz~5000MHz 3300MHz~5000MHz 1710MHz~2690MHz	3G/4G/5G TX AND RX

Table 46: SIM8200EA-M2 frequency band and antenna ports mapping

BANDS FUNCTIONS		ANTENNAS	ANT0	ANT1	ANT2	ANT3
3G/4G/5G	LB[1]/MHB	TRX[1]				
4G	UHB	DL-MIMO1	✓			
5G	n41/n77/n78/n79	UL/DL-MIMO1				
3G/4G/5G		DIV				
4G	LB/MHB	DIV				
5G	UHB	DIV		✓		
GNSS	n41/n77/n78/n79					
3G/4G/5G	MHB	DL-MIMO2				
4G	UHB	DL-MIMO2			✓	
5G	n41/n77/n78/n79	DL-MIMO2				
3G/4G/5G	MHB	DL-MIMO1				
4G	UHB	TRX				✓
5G	n41/n77/n78/n79	TRX				

NOTE

1. For basic function, only the antennas responding to TRX are needed.

4.1.1 3G/4G/5G Operating Frequency

Table 47: The module operating frequency

Frequency bands	Uplink (UL)	Downlink (DL)	Duplex mode
WCDMA B1	1920 ~1980MHz	2110 ~2170MHz	FDD
WCDMA B3	1710 ~1785MHz	1805 ~1880MHz	FDD
WCDMA B5	824～849MHz	869～894MHz	FDD
WCDMA B8	880 ~915MHz	925 ~960MHz	FDD
LTE B1	1920 ~1980MHz	2110 ~2170MHz	FDD
LTE B3	1710 ~1785 MHz	1805 ~1880MHz	FDD
LTE B5	824～849 MHz	869～894MHz	FDD
LTE B7	2500~2570MHz	2620~2690MHz	FDD
LTE B8	880 ~915MHz	925 ~960MHz	FDD
LTE B18	815~830MHz	860~875MHz	FDD
LTE B19	830~845MHz	875~890MHz	FDD
LTE B26	814~849MHz	859~894MHz	FDD
LTE B28	703~748MHz	758~803MHz	FDD
LTE B34	2010~2025MHz	2010~2025MHz	TDD
LTE B38	2570 ~2620MHz	2570 ~2620MHz	TDD
LTE B39	1880~1920MHz	1880~1920MHz	TDD
LTE B40	2300 ~2400MHz	2300 ~2400MHz	TDD
LTE B41	2496 ~2690MHz	2496 ~2690MHz	TDD
LTE B42	3400~3600MHz	3400~3600MHz	TDD
LTE B48	3550~3700MHz	3550~3700MHz	TDD
5G n1	1920 ~1980MHz	2110 ~2170MHz	FDD
5G n3	1710 ~1785MHz	1805 ~1880MHz	FDD
5G n5	824～849MHz	869～894MHz	FDD
5G n7	2500~2570MHz	2620~2690MHz	FDD
5G n8	880 ~915MHz	925 ~960MHz	FDD
5G n28	703~748MHz	758~803MHz	FDD
5G n40	2300 ~2400MHz	2300 ~2400MHz	TDD
5G n41	2496 ~2690MHz	2496 ~2690MHz	TDD
5G n77	3300~4200MHz	3300~4200MHz	TDD
5G n78	3300~3800MHz	3300~3800MHz	TDD
5G n79[2]	4400~5000MHz	4400~5000MHz	TDD

4.1.2 GNSS Frequency

The following table shows frequency specifications of GNSS antenna interface.

Table 48: GNSS frequency

Type	Frequency
GPS L1/Galileo/QZSS	1575.42±1.023MHz
GPS L5	1176.45±10.23MHz
GLONASS	1597.5~1605.8MHz
BeiDou/Compass	1561.098±2.046MHz

4.2   Antenna Installation

4.2.1 Antenna Requirements

The following table shows the requirements on 3G/4G/5G antennas and GNSS antenna.

Table 49: 3G/4G/5G/GNSS antennas

Parameter	Requirement
Operating Frequency	See Table 45 for each antenna
Direction	Omni Directional
Gain	> -3dBi (Avg)
Impedance	50 Ω
Efficiency	> 50 %
Max. Input Power	50W
VSWR	< 2
Isolation	20dB is preferred
Cable Insertion Loss <1GHz	<1dB
Cable Insertion Loss 1GHz~2.2GHz	<1.5dB
Cable Insertion Loss 2.3GHz~2.7GHz	<2dB
Cable Insertion Loss 3.3GHz~6GHz	<2.5dB

Table 50: GNSS antenna (for dedicated GNSS antenna only)*

Parameter	Requirement
Operating Frequency	L1: 1559~1609MHZ L5: 1166~1187MHz
Direction	Hemisphere, face to sky

Antenna Gain	> 2 dB$_{ic}$
Impedance	50 Ω
Efficiency	> 50 %
Max. Input Power	50W
VSWR	< 2
Polarization	RHCP or Linear
Noise Figure for Active Antenna	< 1.5
Total Gain for Active Antenna	< 17 dB
Cable Insertion Loss	<1.5dB

> **NOTE**
>
> *: These recommendations are for dedicated GNSS antenna which the application need best of class GNSS tracking performance.

4.2.2 RF Plug Recommendation

SIM8200EA-M2 is mounted with I-PEX's receptacle RF connectors 20449-001E-03, which size is 2.0mm*2.0mm*0.6mm. The connector dimensions are shown as below.
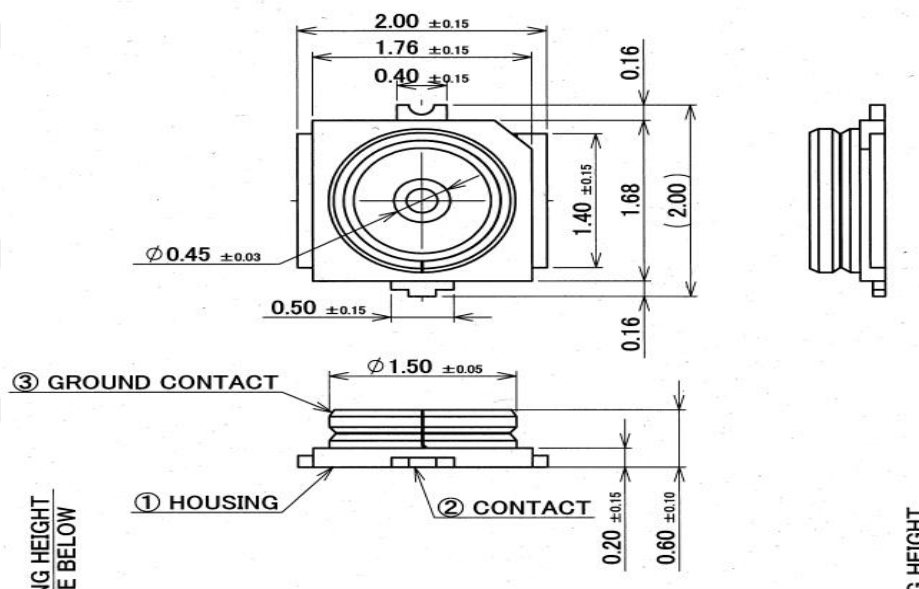
Figure 33: 3D view of 20449-001E-03

The following table shows the RF connector's electrical specifications.

Table 51: Electrical Specifications of 20449-001E-03

Item	Specification
Voltage Rating	250V r.m.s. maximum
Nominal Frequency Range	DC to 6GHz
Nominal Impedance	50Ω
Temperature Rating	-40°C to +85°C
Insulation Resistance	500 MΩ minimum
Withstanding Voltage	No evidence of breakdown
Initial Contact Resistance (without conductor resistance)	Center contact 20.0mΩmax. Outer contact 20.0mΩmax.
Voltage Standing Wave Ratio (V.S.W.R.)	Meet the requirements of 1.3max.(DC~3GHz) 1.45max.(3GHz~6GHz)

To get best RF performance, the RF plug connector should be designed to match the receptacle 20449-001E-03, and the parts come from Murata is the recommended.

The following is the mechanical information of the Murata's RF coaxial cable MXHJD3HJ1000 for reference. For further technical support, the customer could visit the Murata's website (www.murata.com) or contact the local sales team.

muRata

Preliminary Specification of COAXIAL CONNECTOR
Preliminary SPEC No.   : NMM04-PH0938A
Part Number   : MXHJD3HJ1000
SPECIFICATION
1.   MECHANICAL

Written by   H. Toda
Checked by   T.Kuriyama
Date   25/Jan./2018
Revised A: 26/Feb./'19 IU

*2   *1

L

0 +/- 45 degree

See X

2.09

1.09

Dia.1.45+/−0.03

Dia.0.42+/−0.02

Min. 1.036

(3.91)

2.95

*1. Connector: HSC right angle plug connector
*2. Cable

Scale: Free
Tolerance Unless
Otherwise Specified: +/-0.3
Unit: mm

L
100+/- 3
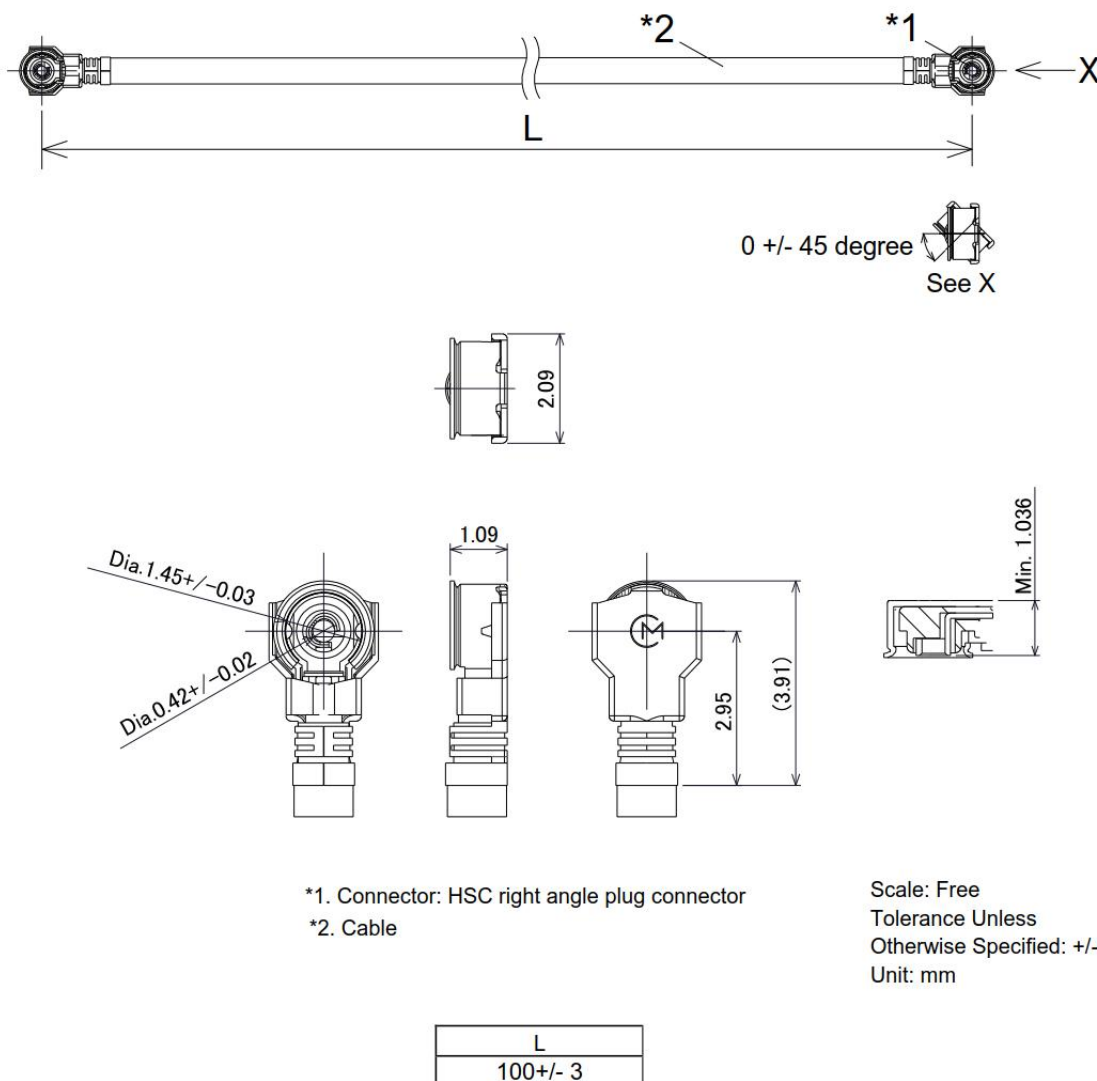
Figure 34: 3D view of MXHJD3HJ1000

5 Electrical Specifications

5.1 Absolute Maximum Ratings

Absolute maximum rating for digital and analog pins of module are listed in the following table.

Table 52: Absolute maximum ratings

Parameter	Min.	Typ.	Max.	Unit
Voltage at VBAT pins	-	-	4.8	V
Voltage at digital pins (GPIO,I2C,UART, I2S)	-	-	2.1	V
Voltage at digital pins ((U)SIM)	-	-	3.05	V
Voltage at FULL_CARD_POWER_OFF#	-	-	4.4	V
Voltage at RESET#	-	-	1.9	V

5.2 Operating Conditions

Table 53: VBAT recommended operating ratings

Parameter	Min.	Typ.	Max.	Unit
Voltage at VBAT	3.135	3.8	4.4	V

Table 54: 1.8V Digital I/O characteristics

Parameter	description	Min.	Typ.	Max.	Unit
V_{IH}	High-level input voltage	1.17	-	2.1	V
V_{IL}	Low-level input voltage	0	-	0.63	V
V_{OH}	High-level output voltage	1.35	-	1.8	V
V_{OL}	Low-level output voltage	0	-	0.45	V
I_{OZH}	High-level, tri-state leakage current (no pull down resistor)	-	-	1	uA
I_{OZL}	Low-level, tri-state leakage current (no pull up resistor)	-1	-	-	uA
I_{IH}	Input high leakage current (no	-	-	1	uA

	pull down resistor)				
I_{IL}	Input low leakage current(no pull up resistor)	-1	-	-	uA

Table 55: Operating temperature

Parameter	Min.	Typ.	Max.	Unit
Normal operation temperature(3GPP compliant)	-30	-	70	℃
Extended operation temperature*	-40	-	85	℃
Storage temperature	-40	-	90	℃

5.3   Operating Mode

5.3.1 Operating Mode Definition

The table below summarizes the various operating modes of SIM8200EA-M2.

Table 56: Operating mode definition

Mode		Function
Normal operation	UMTS/LTE/5G Sleep	AT command "AT+CSCLK=1" can be used to set the module to a sleep mode. In this case, the current consumption of module will be reduced to a very low level and the module can still receive paging message and SMS.
	UMTS/LTE/5G Idle	Software is active. Module is registered to the network, and ready to communicate.
	UMTS/LTE/5G Talk	Connection between two subscribers is in progress. In this case, the power consumption depends on network settings such as DTX off/on, FR/EFR/HR, hopping sequences, and antennas.
	UMTS/LTE/5G Standby	Module is ready for data transmission, but no data is currently sent or received. In this case, power consumption depends on network settings.
	UMTS/LTE/5G Data transmission	There is data transmission in progress. In this case, power consumption is related to network settings (e.g. power control level); uplink/downlink data rates, etc.
Minimum functionality mode		AT command "AT+CFUN=0" can be used to set the module to a minimum functionality mode without removing the power supply. In this mode, the RF part of the module will not work and the (U)SIM card will not be accessible, but the serial port and USB port are still accessible. The power consumption in this mode is lower than normal mode.
Flight mode		AT command "AT+CFUN=4" or pulling down the W_disable1# pin can be used to set the module to flight mode without removing the power

	supply. In this case, the RF part of the module will not work, but the serial port and USB are still available. The power consumption is lower than normal mode.
Power off	Normally module will go into power off mode by sending the AT command "AT+CPOF" or pull down the FULL_CARD_POWER_OFF# pin. In this mode the power management unit shuts down the power supply, and software is not active. The serial port and USB are not available.

5.3.2 Sleep Mode

In sleep mode, the current consumption of the module will be reduced to a very low level.

Several hardware and software conditions must be satisfied in order to let module enter into sleep mode:
1. UART condition
2. USB condition
3. Software condition

NOTE

Before designing, pay attention to how to realize sleeping/waking function.

5.3.3 Minimum Functionality Mode and Flight Mode

Minimum functionality mode ceases a majority of functions of the module, in order to minimize the power consumption. This mode is set by the AT command which provides a choice of 3 different functionality levels.

● AT+CFUN=0: Minimum functionality
● AT+CFUN=1: Full functionality (Default)
● AT+CFUN=4: Flight mode

If module has been set to minimum functionality mode, the RF (U)SIM card functions will be closed while the serial port and USB are still available.
If module has been set to flight mode, the RF function will be closed while the (U)SIM card, the serial port and USB are still available.
When module is in minimum functionality or flight mode, it can return to full functionality by the AT command "AT+CFUN=1".

5.4 Current Consumption

The current consumptions are listed in the table below.

Table 57: Current consumption on VBAT pins (VBAT=3.8V)

Description	Condition	Typical	Unit
Power off mode	Power off	50	uA
GNSS mode	(AT+CFUN=0, connection USB)	22	mA
Sleep mode (GNSS off, without connection USB)	WCDMA (AT+CFUN=0)	5.3	mA
	WCDMA DRX=1.28s	5.8	mA
	WCDMA DRX=2.56s	5.9	mA
	LTE-FDD (AT+CFUN=0)	5.3	mA
	LTE-FDD DRX=0.32s	8.9	mA
	LTE-FDD DRX=0.64s	6.8	mA
	LTE-FDD DRX=1.28s	6.7	mA
	LTE-FDD DRX=2.56s	6.1	mA
	LTE-TDD (AT+CFUN=0)	5.3	mA
	LTE-TDD DRX=0.32s	7.5	mA
	LTE-TDD DRX=0.64s	7.1	mA
	LTE-TDD DRX=1.28s	6.4	mA
	LTE-TDD DRX=2.56s	5.9	mA
	5G NR SA	9	mA
Idle mode (GNSS off, without connection USB)	WCDMA	25.5	mA
	LTE FDD	26.5	mA
	LTE TDD	26.5	mA
	5G NR SA	28	mA
HSDPA			
WCDMA B1	@Power 22.90dBm TYPE: 430mA		
WCDMA B3	@Power 22.11dBm TYPE: 515mA		
WCDMA B5	@Power 22.57dBm TYPE: 418mA		
WCDMA B8	@Power 22.78dBm TYPE: 524mA		
LTE			
LTE-FDD B1	@5MHz 21.83dBm TYPE:474mA @10MHz 21.80dBm TYPE:490mA @20MHz 21.97dBm TYPE:542mA		
LTE-FDD B3	@5MHz 22.31dBm TYPE:472mA @10MHz 22.43dBm TYPE:499mA @20MHz 22.30dBm TYPE:509mA		
LTE-FDD B5	@5MHz 22.35dBm TYPE:462mA @10MHz 21.70dBm TYPE:449mA		
LTE-FDD B7	@5MHz 22.20dBm TYPE:554mA		

	@10MHz	22.22dBm	TYPE:563mA
	@20MHz	22.01dBm	TYPE:547mA
LTE-FDD B8	@5MHz	22.88dBm	TYPE:581mA
	@10MHz	22.76dBm	TYPE:572mA
LTE-FDD B18	@5MHz	22.19dBm	TYPE:476mA
	@10MHz	22.16dBm	TYPE:476mA
LTE-FDD B19	@5MHz	21.71dBm	TYPE:430mA
	@10MHz	21.73dBm	TYPE:442mA
LTE-FDD B26	@5MHz	21.88dBm	TYPE:440mA
	@10MHz	21.92dBm	TYPE:445mA
LTE-FDD B28	@5MHz	22.38dBm	TYPE:422mA
	@10MHz	22.29dBm	TYPE:502mA
	@20MHz	22.12dBm	TYPE:437mA
LTE-TDD B34	@5MHz	21.71dBm	TYPE:400mA
	@10MHz	21.71dBm	TYPE:398mA
LTE-TDD B38	@5MHz	22.86dBm	TYPE:483mA
	@10MHz	21.40dBm	TYPE:490mA
	@20MHz	21.27dBm	TYPE:478mA
LTE-TDD B39	@5MHz	21.54dBm	TYPE:392mA
	@10MHz	21.62dBm	TYPE:393mA
	@20MHz	21.62dBm	TYPE:408mA
LTE-TDD B40	@5MHz	21.67dBm	TYPE:429mA
	@10MHz	21.50dBm	TYPE:446mA
	@20MHz	21.45dBm	TYPE:458mA
LTE-TDD B41	@5MHz	21.29dBm	TYPE:629mA
	@10MHz	22.02dBm	TYPE:635mA
	@20MHz	21.92dBm	TYPE:602mA
LTE-TDD B42	@5MHz	21.55dBm	TYPE:472mA
	@10MHz	21.72dBm	TYPE:506mA
	@20MHz	21.48dBm	TYPE:498mA
LTE-TDD B48	@5MHz	21.55dBm	TYPE:571mA
	@10MHz	21.61dBm	TYPE:556mA
	@20MHz	21.78dBm	TYPE:573mA
5G NR			
5G n1	@20MHz	23.23dBm TYPE: 508mA (SCS:15KHz)	
5G n3	@Power 23dBm TYPE:TBD		
5G n5	@Power 23dBm TYPE:TBD		
5G n7	@Power 23dBm TYPE:TBD		
5G n8	@Power 23dBm TYPE:TBD		
5G n28	@20MHz	23.28dBm TYPE: 462mA (SCS:15KHz)	
5G n40	@Power 23dBm TYPE:TBD		
5G n41	@100MHz	25.42dBm TYPE: 1229mA (SCS:30KHz)	
5G n77	@100MHz	25.51dBm TYPE: 1347mA (SCS:30KHz)	
5G n78	@100MHz	25.71dBm TYPE: 1268mA (SCS:30KHz)	

5G n79	@100MHz 25.43dBm TYPE: 1556mA (SCS:30KHz)

NOTE

1. The current consumption of table57 only for reference, please refer to actual current consumption.

5.5 RF Output Power

The RF output power is shown in the following table.

Table 58: Conducted output power

Bands	Max	Min
WCDMA Bands	23dBm + 1/-3dB	< -50dBm
LTE-FDD Bands	23dBm + 2/-2dB	< -40dBm
LTE-TDD Bands	23dBm + 2/-2dB	< -40dBm
5G Sub-6 Bands	26dBm + 2/-3dB	< -40dBm

5.6   Conducted Receive Sensitivity

The conducted RF receiving sensitivity is shown in the following table.

Table 59: Conducted RF receiving sensitivity

Frequency	Primary (Typ.)	Diversity (Typ.)	SIMO1(Typ.)	SIMO2(Worst case)
WCDMA B1	TBD	TBD	TBD	-106.7dBm
WCDMA B3	TBD	TBD	TBD	-104.7dBm
WCDMA B5	TBD	TBD	TBD	-96.3dBm
WCDMA B8	TBD	TBD	TBD	-93.3dBm
LTE B1	TBD	TBD	TBD	-94.3dBm
LTE B3	TBD	TBD	TBD	-93.3dBm
LTE B5	TBD	TBD	TBD	-94.8dBm
LTE B7	TBD	TBD	TBD	-96.3dBm
LTE B8	TBD	TBD	TBD	-96.3dBm
LTE B18	TBD	TBD	TBD	-96.3dBm
LTE B19	TBD	TBD	TBD	-96.3dBm
LTE B26	TBD	TBD	TBD	-93.8dBm
LTE B28	TBD	TBD	TBD	-94.8dBm
LTE B34	TBD	TBD	TBD	-96.3dBm
LTE B38	TBD	TBD	TBD	-96.3dBm
LTE B39	TBD	TBD	TBD	-96.3dBm
LTE B40	TBD	TBD	TBD	-96.3dBm
LTE B41	TBD	TBD	TBD	-94.3dBm
LTE B42	TBD	TBD	TBD	-95.0dBm
LTE B48	TBD	TBD	TBD	TBD
5G n1	TBD	TBD	TBD	-97.1dBm
5G n3	TBD	TBD	TBD	-94.1dBm
5G n5	TBD	TBD	TBD	-95.1dBm
5G n7	TBD	TBD	TBD	-95.1dBm
5G n8	TBD	TBD	TBD	-94.1dBm
5G n28	TBD	TBD	TBD	-95.6dBm
5G n40	TBD	TBD	TBD	-97.1dBm
5G n41	TBD	TBD	TBD	-95.1dBm
5G n77	TBD	TBD	TBD	-94.1dBm
5G n78	TBD	TBD	TBD	-94.1dBm
5G n79	TBD	TBD	TBD	-94.1dBm

5.7   Thermal Design

Make sure that the SIM8200EA-M2 can reach maximum work performance under extended temperature or extreme conditions for a long time, thermal dissipation design is very important.

It is strongly recommended to add a thermal pad or other thermally conductive material between the module and the main PCB. The thermal dissipation area on bottom side of the module and the dimensions is shown in the following figure. The size of recommended thermal dissipation area is 44mm*26mm. The dimensions are measured in mm.
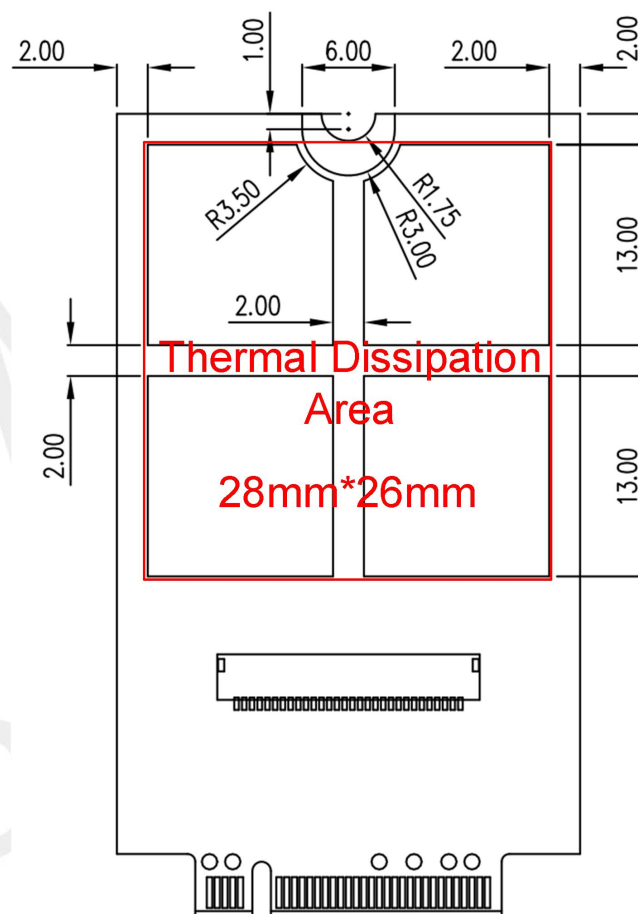
Figure 35: Thermal dissipation area on bottom side of the module

There are some design rules to enhance thermal dissipation performance:
● Keep the module away from other heat sources such as battery, power, AP, etc.
● Make sure that the module mounting holes connect to the main PCB ground fully.
● Add enough through via on the main PCB. Via material is very important solid copper and stacked via is better.
● Make sure maximize airflow around the module.
● Recommend use heat dissipation material connect to the customers' device on the top side of the module to enhance the heat dissipation. Large heat dissipation area is better.
● Chose a high effective heat dissipation material is better such as heat pipe, graphite sheets.

5.8   ESD

SIM8200EA-M2 is sensitive to ESD in the process of storage, transporting, and assembling. When module is mounted on the users' mother board, the ESD components should be placed beside the connectors which human body may touch, such as (U)SIM card holder, SD card holder, audio jacks, switches, USB interface, etc. The following table shows the module ESD test performance.

Table 60: The ESD performance measurement table (Temperature: 25℃, Humidity: 45%)

Part	Contact discharge	Air discharge
VBAT,GND	+/- 4KV	+/- 8KV
Antenna	+/- 4KV	+/- 8KV
FULL_CARD_POWER_OFF#	+/- 3KV	+/- 6KV
USB	+/- 3KV	+/- 6KV
RESET#	+/- 2KV	+/- 5KV
(U)SIM	+/- 2KV	+/- 5KV
Other PAD	+/- 2KV	+/- 5KV

> **NOTE**
>
> 1.Test conditions: the external of the module has surge protection diodes and ESD protection diodes
> 2. The data in Table 60 was tested using SIMCom EVB.

6 Appearance
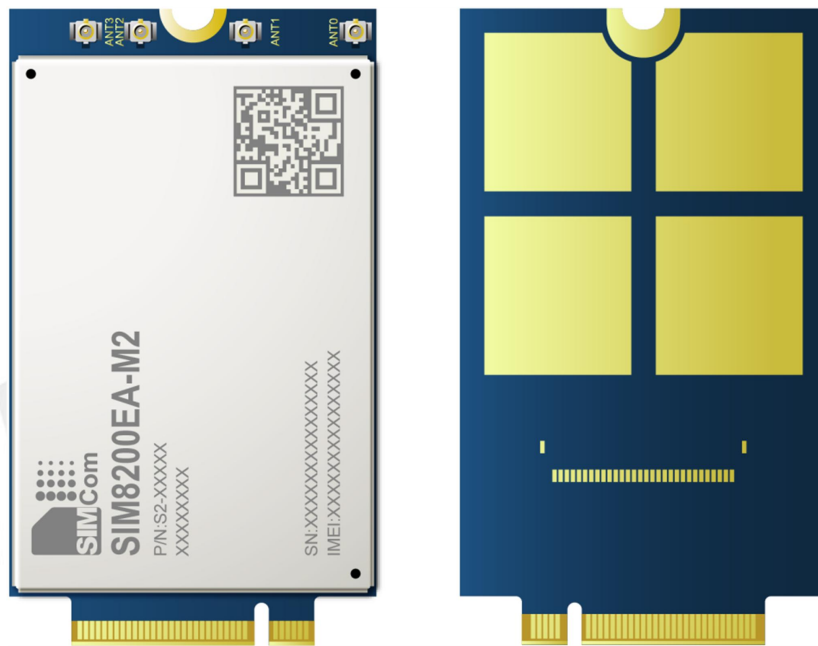
6.1 Top and Bottom View of SIM8200EA-M2

Figure 36: Top and bottom view of the module

6.2 Label Description Information

Figure 37: Label description of the module

Table 61: Label description of the module information

No.	Description
A	LOGO
B	Project name
C	Product code
D	QR code
E	Serial number
F	International mobile equipment identity

NOTE

Figure 34 and Figure 35 are the effect diagrams of the module, for reference only. Please refer to the actual product for appearance.

7 Packaging

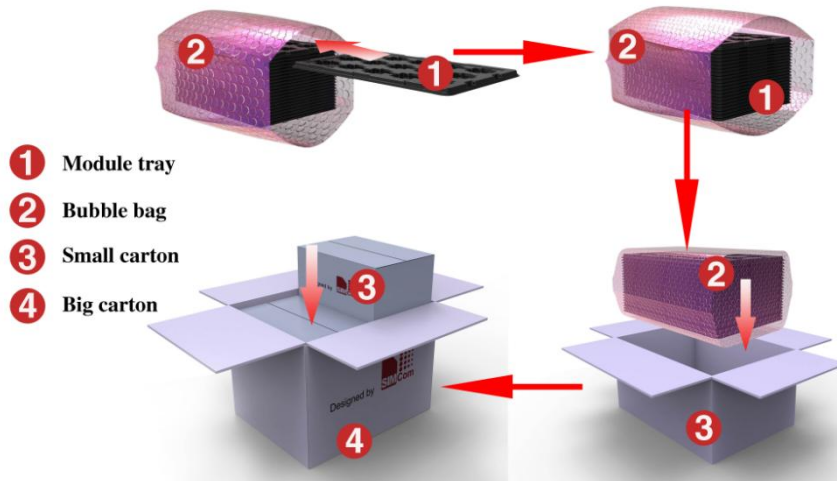SIM8200EA-M2 supports tray packaging. The packaging procedures are shown in the following figure.
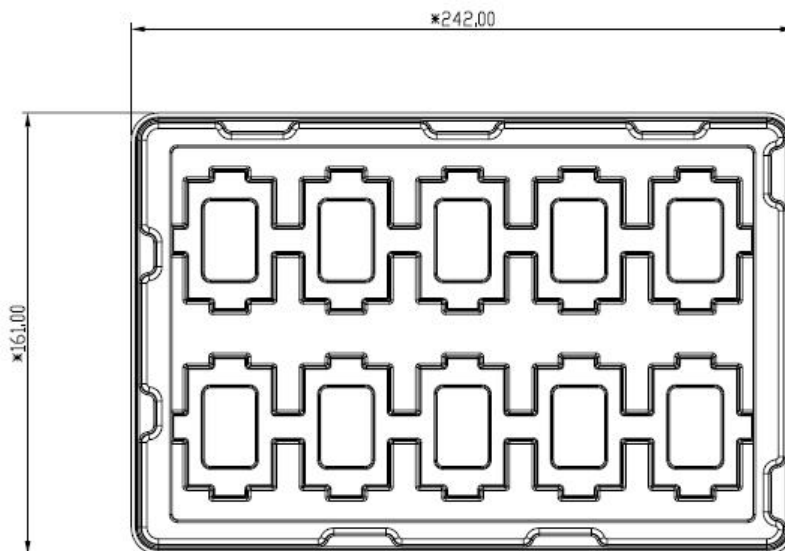

Figure 38: Packaging procedures

Figure 39: Tray view of the module

Table 62: Tray size

Length（±3mm）	Width（±3mm）	Number
245.0	165.0	10
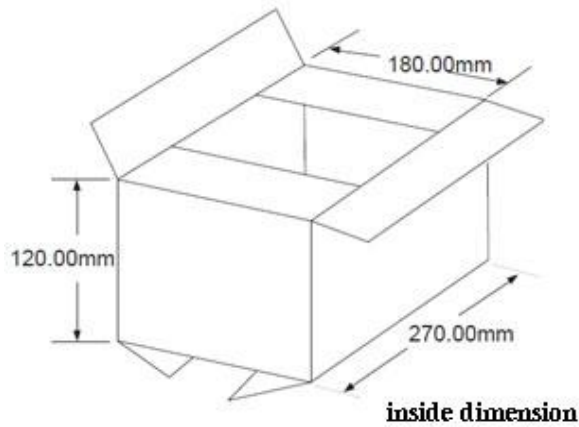
Figure 40: Small carton view

Table 63: Small carton size

Length（±10mm）	Width（±10mm）	Height（±10mm）	Number
270	180	120	10*20=200
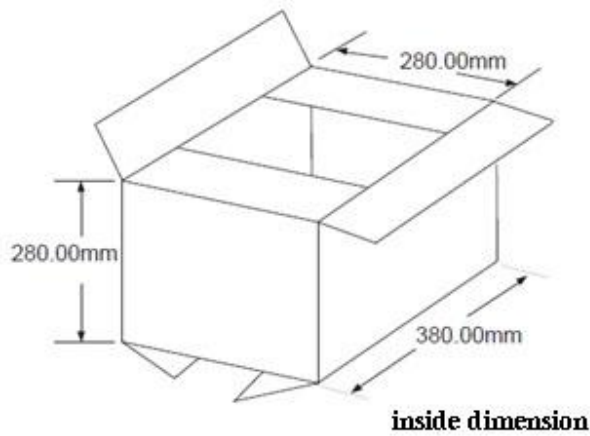
Figure 41: Big carton view

Table 64: Big carton size

Length（±10mm）	Width（±10mm）	Height（±10mm）	Number
380	280	280	200*4=800

8 Appendix

8.1 Coding Schemes and Maximum Net Data Rates over Air Interface

Table 65: Coding schemes and maximum net data rates over air interface

HSDPA device category	Max data rate（Peak）	Modulation type
Category 1	1.2Mbps	16QAM,QPSK
Category 2	1.2Mbps	16QAM,QPSK
Category 3	1.8Mbps	16QAM,QPSK
Category 4	1.8Mbps	16QAM,QPSK
Category 5	3.6Mbps	16QAM,QPSK
Category 6	3.6Mbps	16QAM,QPSK
Category 7	7.2Mbps	16QAM,QPSK
Category 8	7.2Mbps	16QAM,QPSK
Category 9	10.2Mbps	16QAM,QPSK
Category 10	14.4Mbps	16QAM,QPSK
Category 11	0.9Mbps	QPSK
Category 12	1.8Mbps	QPSK
Category 13	17.6Mbps	64QAM
Category 14	21.1Mbps	64QAM
Category 15	23.4Mbps	16QAM
Category 16	28Mbps	16QAM
Category 17	23.4Mbps	64QAM
Category 18	28Mbps	64QAM
Category 19	35.5Mbps	64QAM
Category 20	42Mbps	64QAM
Category 21	23.4Mbps	16QAM
Category 22	28Mbps	16QAM
Category 23	35.5Mbps	64QAM
Category 24	42.2Mbps	64QAM
HSUPA device category	**Max data rate（Peak）**	**Modulation type**
Category 1	0.96Mbps	QPSK
Category 2	1.92Mbps	QPSK
Category 3	1.92Mbps	QPSK
Category 4	3.84Mbps	QPSK

Category 5	3.84Mbps	QPSK
Category 6	5.76Mbps	QPSK
LTE-FDD device category (Downlink)	**Max data rate（Peak）**	**Modulation type**
Category 1	10Mbps	QPSK/16QAM/64QAM
Category 2	50Mbps	QPSK/16QAM/64QAM
Category 3	100Mbps	QPSK/16QAM/64QAM
Category 4	150Mbps	QPSK/16QAM/64QAM
Category 5	300Mbps	QPSK/16QAM/64QAM
Category 6	300Mbps	QPSK/16QAM/64QAM
LTE-FDD device category (Uplink)	**Max data rate（Peak）**	**Modulation type**
Category 1	5Mbps	QPSK/16QAM
Category 2	25Mbps	QPSK/16QAM
Category 3	50Mbps	QPSK/16QAM
Category 4	50Mbps	QPSK/16QAM
Category 5	75Mbps	QPSK/16QAM/64QAM
Category 6	50Mbps	QPSK/16QAM

8.2　Related Documents

Table 66: Related documents

No.	Title	Description
[1]	SIM8200 Series_AT Command Manual	AT Command Manual
[2]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[3]	3GPP TS 38.401	NG-RAN; Architecture description
[4]	3GPP TS 34.124	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[5]	3GPP TS 34.121	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[6]	3GPP TS 34.123-1	Technical Specification Group Radio Access Network; Terminal conformance specification; Radio transmission and reception (FDD)
[7]	3GPP TS 34.123-3	User Equipment (UE) conformance specification; Part 3: Abstract Test Suites.
[8]	EN 301 908-02 V2.2.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS) and User Equipment (UE) for IMT-2000. Third Generation cellular networks; Part 2: Harmonized EN for IMT-2000, CDMA Direct Spread (UTRA FDD) (UE) covering essential requirements of article 3.2 of the R&TTE Directive
[9]	EN 301 489-24 V1.2.1	Electromagnetic compatibility and Radio Spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 24: Specific conditions for IMT-2000 CDMA Direct Spread (UTRA) for Mobile and portable (UE) radio and ancillary equipment
[10]	IEC/EN60950-1(2001)	Safety of information technology equipment (2000)
[11]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[12]	GCF-CC V3.23.1	Global Certification Forum - Certification Criteria
[13]	2002/95/EC	Directive of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)
[14]	3GPP TS 38.101	NR radio transmission and reception technical specification
[15]	SIM8200EA_M2_Antenna Port Mapping and Design Guide	Antenna design guidelines
[16]	SIM8200 Series Ethernet RT8125_HDK	About PCIe to Ethernet interface documents

8.3   Terms and Abbreviations

Table 67: Terms and abbreviations

Abbreviation	Description
ADC	Analog-To-Digital Converter
ARP	Antenna Reference Point
BER	Bit Error Rate
BTS	Base Transceiver Station
CS	Coding Scheme
CSD	Circuit Switched Data
CTS	Clear To Send
DAC	Digital-To-Analog Converter
DRX	Discontinuous Reception
DSP	Digital Signal Processor
DTE	Data Terminal Equipment (typically computer, terminal, printer)
DTR	Data Terminal Ready
DTX	Discontinuous Transmission
DPR	Dynamic Power Reduction
DIV	The Diversity Receive signal
EFR	Enhanced Full Rate
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
EVDO	Evolution Data Only
FCC	Federal Communications Commission (U.S.)
FD	(U)SIM fix dialing phonebook
FDD	Frequency Division Dual
FDMA	Frequency Division Multiple Access
FR	Full Rate
GMSK	Gaussian Minimum Shift Keying
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HR	Half Rate
HSPA	High Speed Packet Access
HSIC	High-Speed Inter-Chip
I2C	Inter-Integrated Circuit
I2S	Inter-IC Sound
IMEI	International Mobile Equipment Identity
LTE	Long Term Evolution
LB	Low Frequency Band

LAA	Limited Access Authorization
MO	Mobile Originated
MSB	Most Significant Bit
MHB	Middle And High Frequency Band
MT	Mobile Terminated
MIMO	Multiple Input Multiple Output
NMEA	National Marine Electronics Association
PAP	Password Authentication Protocol
PBCCH	Packet Switched Broadcast Control Channel
PCB	Printed Circuit Board
PCIe	Peripheral Component Interface Express
RF	Radio Frequency
RMS	Root Mean Square (value)
RTC	Real Time Clock
SIM	Subscriber Identification Module
SMS	Short Message Service
SPI	Serial Peripheral Interface
SMPS	Switched-Mode Power Supply
TDD	Time Division Dual
TDMA	Time Division Multiple Access
TE	Terminal Equipment(also referred to as DTE)
TX	Transmit Direction
TRX	The Diversity Receive signal
VSWR	Voltage Standing Wave Ratio
SM	(U)SIM Phonebook
SGMII	Serial Gigabit Media Independent Interface
NC	Not connect
HSDPA	High Speed Downlink Packet Access
HSUPA	High Speed Uplink Packet Access
ZIF	Zero Intermediate Frequency
WCDMA	Wideband Code Division Multiple Access
VCTCXO	Voltage Control Temperature-Compensated Crystal Oscillator
(U)SIM	Universal Subscriber Identity Module
UHB	Ultra High Frequency Band
UMTS	Universal Mobile Telecommunications System
UART	Universal Asynchronous Receiver Transmitter

8.4   Safety Caution

Table 68: Safety caution

Marks	Requirements
♥	When in a hospital or other health care facility, observe the restrictions about the use of mobiles. Switch the cellular terminal or mobile off, medical equipment may be sensitive and not operate normally due to RF energy interference.
✈	Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it is switched off. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. Forgetting to think much of these instructions may impact the flight safety, or offend local legal action, or both.
🔥	Do not operate the cellular terminal or mobile in the presence of flammable gases or fumes. Switch off the cellular terminal when you are near petrol stations, fuel depots, chemical plants or where blasting operations are in progress. Operation of any electrical equipment in potentially explosive atmospheres can constitute a safety hazard.
▦	Your cellular terminal or mobile receives and transmits radio frequency energy while switched on. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment.
🚗	Road safety comes first! Do not use a hand-held cellular terminal or mobile when driving a vehicle, unless it is securely mounted in a holder for hands free operation. Before making a call with a hand-held terminal or mobile, park the vehicle.
SOS	Mobiles operate over radio frequency signals and cellular networks and cannot be guaranteed to connect in all conditions, especially with a mobile fee or an invalid (U)SIM card. While you are in this condition and need emergent help, please remember to use emergency calls. In order to make or receive calls, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength. Some networks do not allow for emergency call if certain network services or phone features are in use (e.g. lock functions, fixed dialing etc.). You may have to deactivate those features before you can make an emergency call. Also, some networks require that a valid (U)SIM card be properly inserted in the cellular terminal or mobile.