SIM8230X-M2 Hardware Design

5G Module

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Version History

Date	Version	Description of change	Author
2024-05-30	V1.00	Original	Hanke Wang Jia Wang

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1 Introduction

This document describes the electronic specifications, RF specifications, interfaces, mechanical characteristics and testing results of the SIMCom M.2 card. With the help of this document and other software application notes/user guides, users can understand and use SIM8230X-M2 to design and develop mobile and laptop applications quickly.

1.1 Document Overview

Technical information for the module is primarily covered by the documents listed in Table 1. All documents must be studied for a thorough understanding of the device and its applications.

Table 1:SIM8230X-M2 Documents Overview

NO.	Document	Description
1	SIM8230X-M2 Hardware Design_V1.00 (This document)	Mainly introducing interface functions, Recommend circuit, PCB layout guideline, packaging and other hardware components, as well as the use of AT commands
2	SIM8300G-M2-EVB User Guidelines Manual V1.04	The use of EVB board, forced download, startup, reset, and the location of other measurement points, as well as the use method in conjunction with EVB
3	SIMCOM_Module_Thermal_Design_Guide_V1.00	Introduces the thermal design part of the Module design, for reference only
4	SIM8230X_Series_5G_Module_Schematic&Layout_checklist_V1.00	SIM8230X Series 5G Module peripheral circuit schematic and PCB checklist
5	SIM8230 Series Antenna Port Mapping and Design Guide	Antenna design guidelines for transmitter and receiver system

1.2 Product Outline

The SIM8230X-M2 module supports 5G NR, LTE-FDD and LTE-TDD, meet 3GPP Rel-17 NR RedCap and Release 15 LTE standalone only. Users can flexibly choose different models to meet the diversified market

demands. The supported radio frequency bands are described in the Table 2.

Table 2:SIM8230X-M2 frequency bands

Standard	SIM8230G-M2	SIM8230C-M2	SIM8230E-M2
5G NR	n1/n2/n3/n5/n7/n8/n12/n13/n14/n18/n20/n25/n26/n28/n30/n38/n40/n41/n48/n66/n70/n71/n77/n78	n1/n3/n5/n8/n28/n40/n41/n78/n79	n1/n3/n5/n7/n8/n20/n28/n38/n40/n41/n77/n78
LTE FDD	B1/B2/B3/B4/B5/B7/B8/B12/B13/B14/B17/B18/B19/B20/B25/B26/B28/B30/B66/B71	B1/B3/B5/B8	B1/B3/B5/B7/B8/B20/B28
LTE TDD	B34/B38/B39/B40/B41/B42/B43/B48	B34/B38/B39/B40/B41	B38/B40/B41/B42/B43
GNSS(optional)	L1 and L2*/L5； GPS, GLONASS, Galileo, NavIC, and BeiDou support		

NOTE

1. * If need the function of L2, please contact SIMCom for technical support.

With a physical dimension of 42.0*31.4*3.4mm , SIM8230X-M2 can meet PCI Express M.2 Specification, and can meet almost any space requirement in users' applications.

SIM8230X-M2 has almost all common interface integrated, such as USB2.0, PCIe, (U)SIM card, UART, I2C, DRP, LED#, MAIN_ANT,AUX_ANT and GNSS ANT,etc.

With all the interfaces, SIM8230X-M2 can also be utilized in the industrial handheld, machine-to-machine laptop application and especially the router.

1.3 Hardware Block Diagram

The block diagram of SIM8230X-M2 is shown as below:

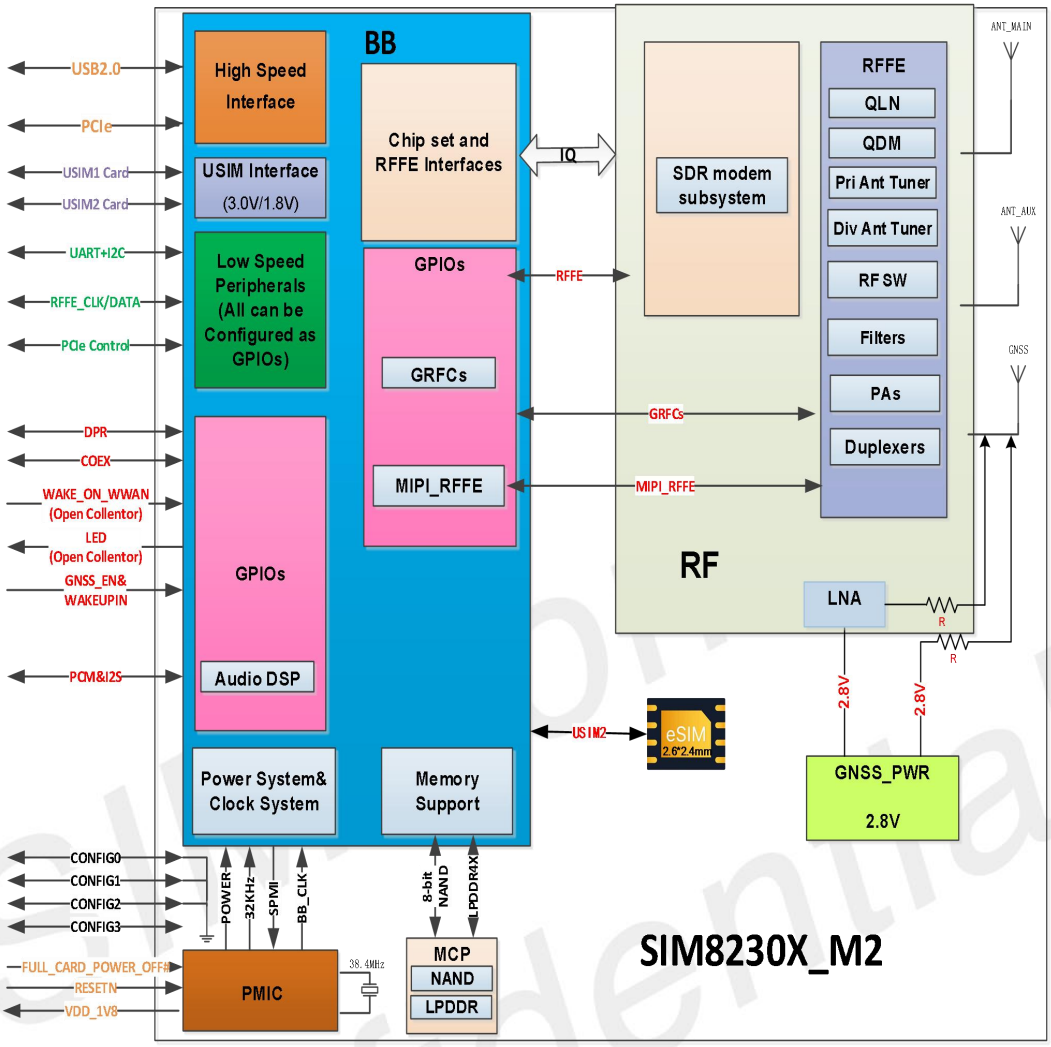

Figure 1:Module block diagram

1.4 Functional Overview

Table 3:SIM8230X-M2 General features

Feature	Implementation
Power supply	● VBAT:3.4～4.4V ● Typical supply voltage: 3.8V
Power consumption	● Power off current: <200uA ● Current in sleep mode:Typical: 5.3mA (VBAT=3.8V, AT+CFUN=0 & AT+CSCLK=1 & USB no connect)
Radio frequency bands	● Please refer to the table 2
Transmitting power	● Power Class 3 for LTE/NR bands

LTE Features	● Release 15 LTE standalone only and Cat4/Cat1.bis support ● Uplink modulation: QPSK,16QAM,64QAM and 256QAM* ● Downlink modulation: QPSK, 16 QAM, 64 QAM and 256 QAM ● BW 20MHz max ● Peak data rates***: FDD: 200Mbps(DL), 75Mbps(UL) TDD: 200Mbps(DL), 50Mbps(UL)
NR Features	● 3GPP Rel-17 NR RedCap ● Uplink modulation: QPSK, 16 QAM, 64 QAM and 256 QAM ● Downlink modulation: QPSK, 16 QAM, 64 QAM and 256 QAM ● NR SA sub-6 20 MHz ● Peak data rates***: FDD: 220Mbps(DL), 120Mbps(UL) TDD: 200Mbps(DL), 100Mbps(UL)
Antenna	● Main antenna interface (ANT_MAIN) ● Rx-diversity antenna interface (ANT_AUX) ● GNSS antenna interface (ANT_GNSS) (optional)
GNSS Features**	● GNSS L1 and L2/L5 ● Support GPS, GLONASS, Galileo, NavIC, and BeiDou ● Protocol: NMEA
SMS	● Text and PDU mode ● Point to point MO and MT ● SMS cell broadcast ● SMS storage: ME by default
(U)SIM interface	● Support identity card: 1.8V/ 3.0V ● Include (U)SIM1 and (U)SIM2 interfaces ● Support Dual SIM single standby
USIM application toolkit	● Support SAT class 3 ● Support USAT
Phonebook management	● Support phonebook types: DC,MC,RC,SM,ME,FD,ON,LD,EN
eSIM	● The eSIM has been reserved internal,compatible with (U)SIM2 signal
PCIe interface	● Comply with PCI Express Specification Revision 2.1 and support 5Gbps per lane ● Used for data transmission
UART interface	● Data rate up to 4Mbps,115200 bps by default ● Can be used as the AT commands or data stream channel ● Support up to two UART:Main UART and Debug UART
I2C interface	● Support I2C ● Data rate up to 1 Mbps in fast mode plus
USB interface	● Comply with 2.0 specifications, with maximum transmission rates up to 480Mbps on USB 2.0 ● Used for AT command communication, data transmission, firmware upgrade, software debugging, GNSS NMEA sentence output, and voice over USB* ● Support USB serial drivers for: Windows 7/8/8.1/10; Linux 2.6/3.x/4.1~4.15;

	● Android 4.x/5.x/6.x/7.x/8.x/9.x
Firmware upgrade	● Firmware upgrade over USB2.0 interface
Physical characteristics	● Size: 42.0mm*31.4mm*3.4mm ● Weight: Almost 8.6g
Temperature range	● Normal operation temperature: -30°C to +75°C ● Extended operation temperature: -40°C to +85°C[3] ● Storage temperature: -40°C to +90°C

NOTE

1. The recommended operating voltage of the module is 3.8V. If the voltage is lower than 3.4V, the RF performance may deviate from the 3GPP specifications.
2. "*" means under development.
3. "**" If need the function of L2, please contact the SIMCom support team.
4. "***" the actual values depend on the network configuration.
5. 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 Top and Bottom View of Module

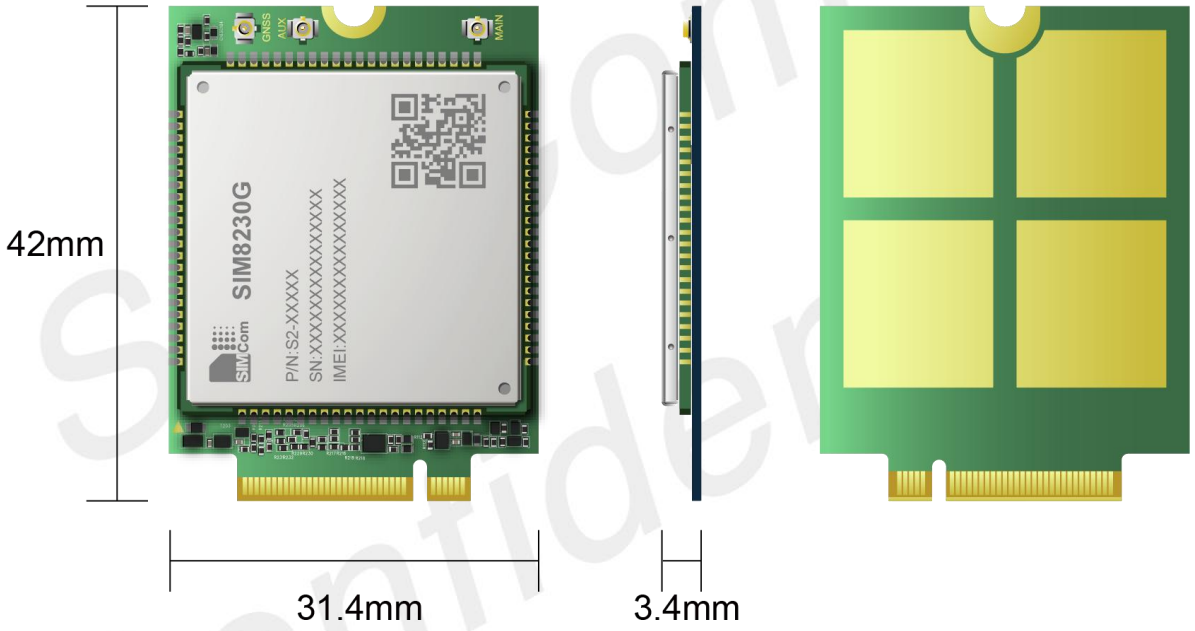

Figure 2:Top and bottom view of module (bottom side reserved ground plane for thermal)

NOTE

1.The above is the design effect drawing of the module for reference, and the actual appearance shall prevail in kind.

2.2 Pin Assignment Overview

All functions of the M.2 card will be provided through 75 (including 8 notch pins) pads that will be connected to the customers' platform. The following table is the high-level view of the pin assignment of the card.

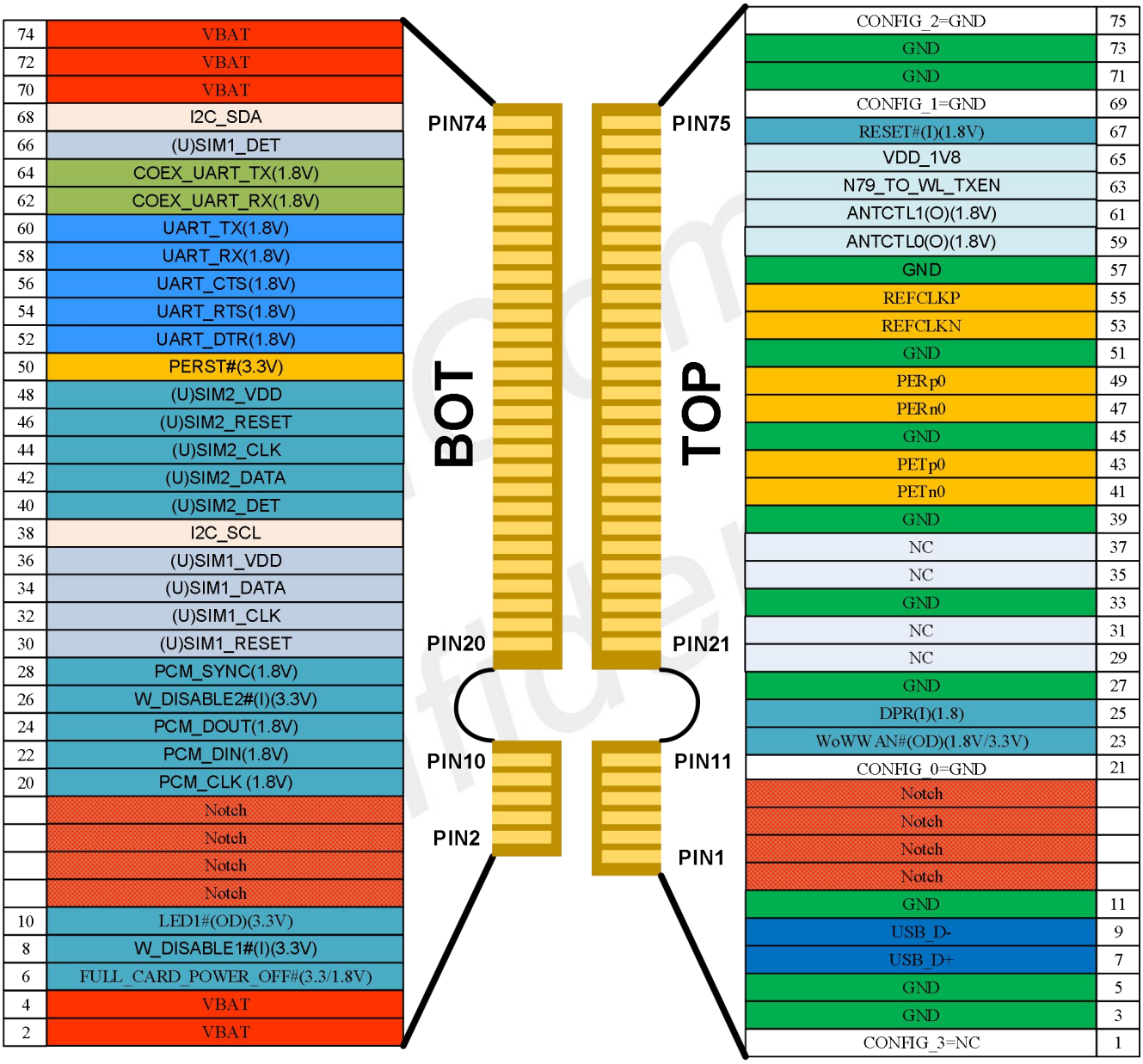

Figure 3:Pin assignment

2.3 Pin Description

Table 4:IO parameters definition

Pin type	Description
PI	Power input
PO	Power output
AI	Analog input
AIO	Analog input/output
DIO	Bidirectional 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

Table 5: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	.V	-	0.54V
	Rp	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
	Rp	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 resistor	10K ohm	-	100K ohm

Table 6:Pin description

Pin name	Pin no.	Electrical description	Description	Comment
Power supply				
VBAT	2,4,70, 72,74	PI	Power supply Range：3.4～4.4V 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	
VDD_1V8	65	PO	Output power supply for external IO pull up circuits	Ipk：50mA
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	It's 3.3V tolerant but can be driven by either 1.8V or 3.3V GPIO
W_DISABLE2#	26	P3 DI	GNSS disable Active low	3.3V tolerant but can be driven by either 1.8V or 3.3V GPIO
WoWWAN#	23	OD	Wake on the host Active low	Pins need to be added externally 100KR pull-up resistor to 1.8 V
Configuration pins				
CONFIG_0	21	GND	Connected to ground internally	The module is configured as the WWAN USB2.0 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				
USB_D+	7	AIO	Differential USB bi-directional data positive	Main communication interface USB2.0 data rate up to 480Mbps
USB_D-	9	AIO	Differential USB bi-directional data negative	
PCIe interface				
PETn0	41	AO	PCIe transmit data negative	Support One port; PCIe Gen 2 (PCIe Gen 1 compatible) If unused, please
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	keep open
REFCLKP	55		AIO	PCIe reference clock positive	
PCIe assistant interface					
PERST#	50		DI	PCIe reset signal Active low	SIM8230-M2 hardware configures as UART signal function by default, If need PCIe function, please contact SIMCom.
CLKREQ#	52		DIO	PCIe reference clock request signal Active low	
UART_DTR		P3	DI	SIM8230-M2 hardware configures as UART signal function by default	
PEWAKE#	54		DIO	PCIe wake up control Active low	
UART_RTS		P3	DO	SIM8230-M2 hardware configures as UART signal function by default	
(U)SIM interface					
(U)SIM1_VDD	36	P4	PO	Power supply for (U)SIM1 card	1.8/3.0V voltage domain, (U)SIM interfaces should be protected against ESD, If unused, please keep open.
(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 signal, the software has been pulled up internally	
(U)SIM2_VDD	48	P5	PO	Power supply for (U)SIM2 card	The eSIM has been reserved internal. 1.8/3.0V voltage domain, (U)SIM interfaces should be protected against ESD, If unused, please keep open
(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 signal, the software has been pulled up internally	
Antenna control interface					
ANTCTL0 (RFFE_DATA)	59	P3	DIO	Used for MIPI tuner IC, and also can be configured as GPIO function.	1.8V voltage domain. If unused, please keep open
ANTCTL1 (RFFE_CLK)	61	P3	DO		
Audio interface[2]					
PCM_CLK	20	P3	DO	PCM clock output; I2S clock output	These signals are 1.8V voltage domain. If unused, keep them open.
PCM_IN	22	P3	DI	PCM data input; I2S data input	
PCM_OUT	24	P3	DO	PCM data output; I2S data output	
PCM_SYNC	28	P3	DO	PCM synchronous Signal;	

				I2S word select	
UART interface					
UART_TX	60	P3	DO	UART transmit Data(default)	1.8V voltage domain, also can be used as UART interface. If unused, please keep open.
I2S_MCLK*			DO	I2S master clock	
UART_RX	58	P3	DI	UART receive Data	
UART_CTS	56	P3	DI	UART clear to Send	
UART_RTS	54	P3	DO	UART request to send	
UART_DTR	52	P3	DI	DTE get ready	
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[3]					
COEX_UART_TX*	64	P3	DO	SIM8230X-M2 hardware configures as UART signal function by default	If need normal communication UART(AT command), please contact SIMCom support teams
UART_TX					
COEX_UART_RX*	62	P3	DI		
UART_RX					
Other pins					
LED1#	10	P3	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	
N79_TO_WL_TXEN	63	P3	DO	WIFI module GPIO	
Notch					
Notch	12, 13, 14, 15, 16, 17, 18, 19			Notch	

NOTE

1. "*" means under development. For more details, please contact the SIMCom support team.
2. SIM8230X-M2 hardware configures as PCM function by default.If need I2S data, please contact SIMCom support teams.
3. SIM8230X-M2 interface the pin of 62 and 64 hardware support UART function by default.

2.4 Package Dimensions

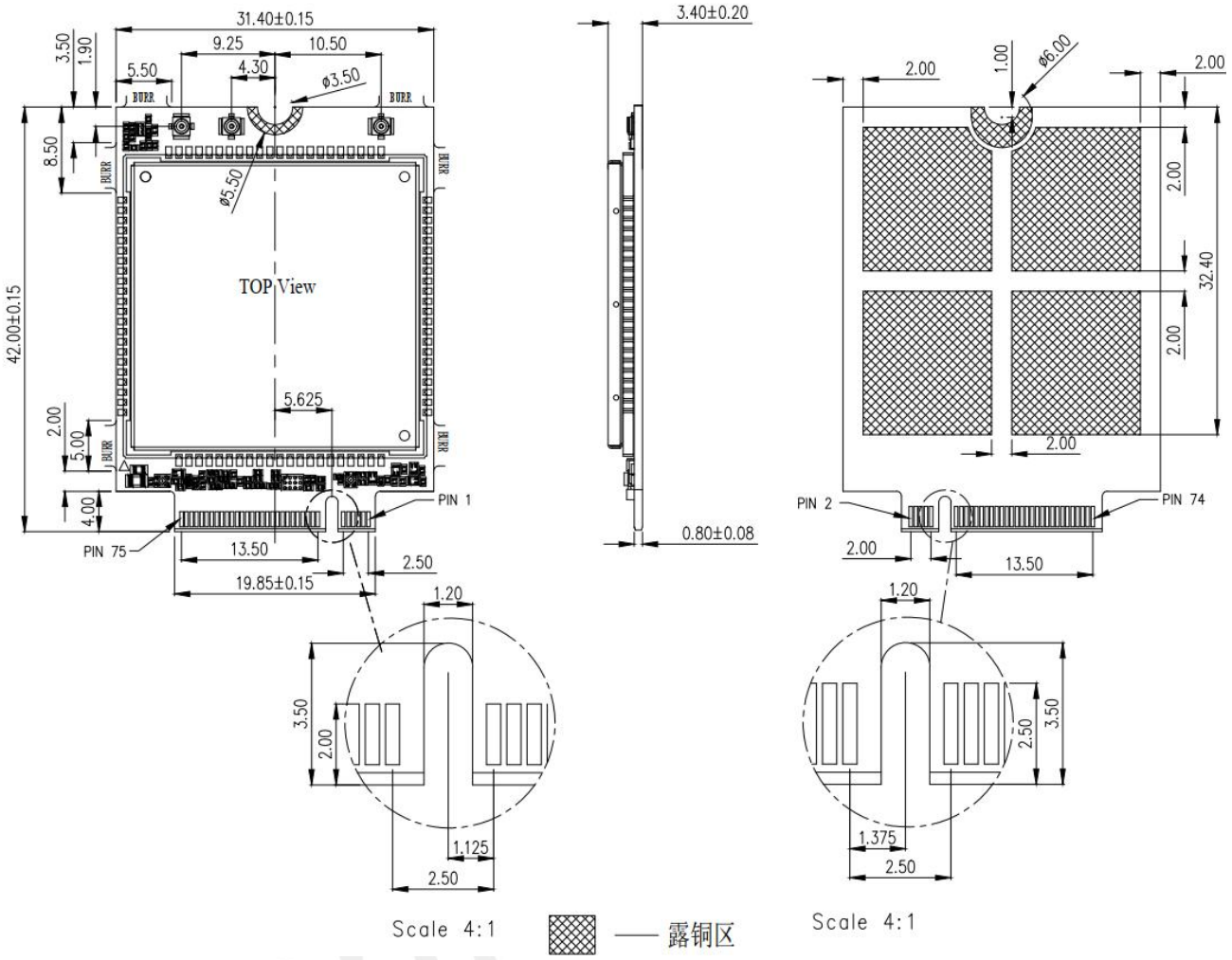

Figure 4:Dimensions of SIM8230X-M2 (Unit: mm)

NOTE

1.The side length dimension is (42.00±0.15mm)x(31.40±0.15mm) excluding the burr area.

2.5 Label information

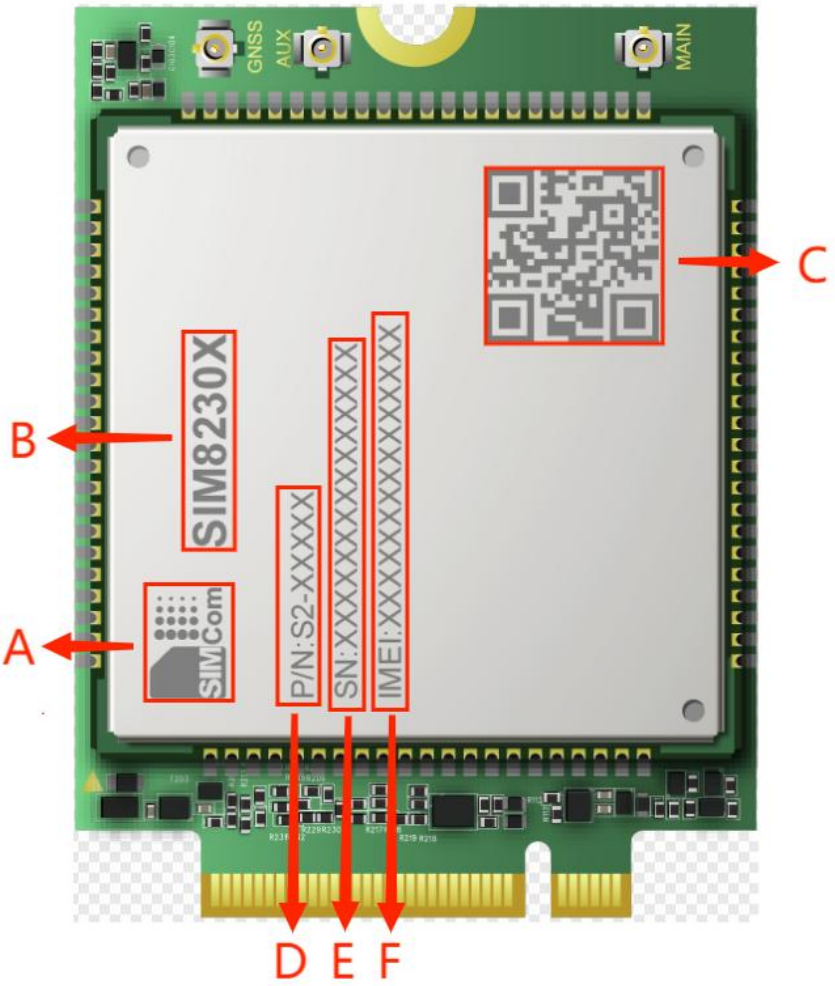

Figure 5:Label information

Table 7:The description of label information

No.	Description
A	SIMCom logo
B	Project name
C	QR code
D	Module part number
E	Serial number
F	International mobile equipment identity

3 Interface Application

3.1 Power Supply

The recommended power supply of SIM8230X-M2 is 3.8V and the voltage ranges from 3.4V to 4.4V. The SIM8230X-M2 has 5 power pins and 11 ground pins, to ensure the SIM8230X-M2 card works normally, all the pins must be connected. The connector pin is defined to support 500mA current per pin continuously.

Table 8:VBAT pins electronic characteristic

Symbol	Description	Min.	Typ.	Max.	Unit
VBAT	Module power voltage.	3.4	3.8	4.4	V
$I_{VBAT(peak)}$	Module power peak current in normal mode.	-	-	2.0	A
I_{min}	Minimum power mode(VBAT=3.8V, AT+CFUN=0 & AT+CSCLK=1 & disconnect USB)	-	5.3	-	mA
$I_{VBAT(power-off)}$	Module power current in power off mode.	-	160	-	uA

3.1.1 Power Supply Design Guide

Make sure that the voltage on the VBAT pins will never drop below 3.4V, even during a transmit event, when current consumption may rise up to 2.0A. If the voltage drops below 3.4V, the module might be powered off automatically.

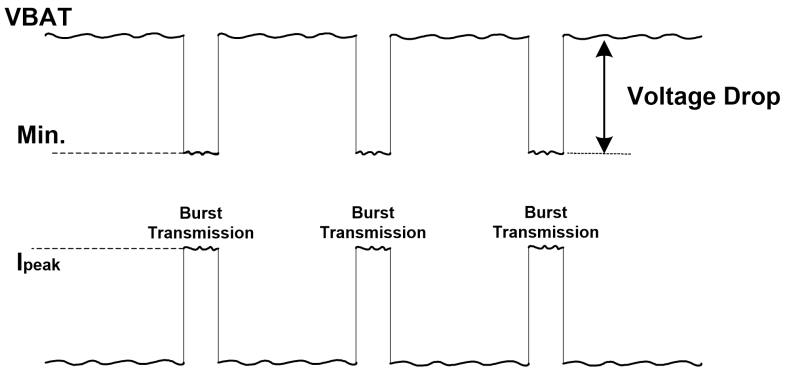

Figure 6:Power Supply Limits during Burst Transmission

NOTE

Test conditions
1.The total capacitors of VBAT net are not less than 420uF.
2.The peak current is only the current consumption of the module, don't include the current consumption of other devices outside the module.

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.

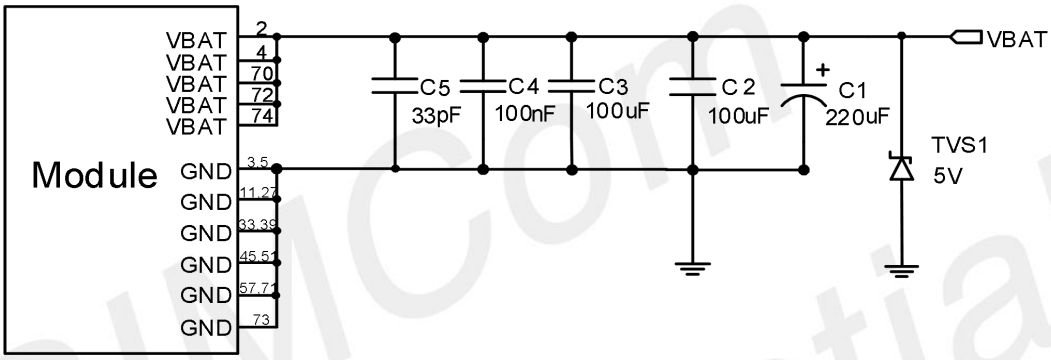

Figure 7:Power supply application circuit

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.

NOTE

1. Both C1 are 220 μF tantalum capacitor (ESR=0.7Ω).
2. C4 and C5 are multi-layer ceramic chip (MLCC) capacitors from 33pF to 1uF with low ESR in high frequency band, which can be used for EMC performance.
3. TVS1 is used for surge protection.

Table 9:Recommended TVS1 list

No.	Manufacturer	Part Number	VRWM	Package
1	Js-ele	ESDBW5V0A1	5V	DFN1006-2L
2	Prisem	PESDHC2FD4V5BH	4.5V	DFN1006-2L
3	Way-on	WS05DPF-B	5V	DFN1006-2L

4	Will semi	ESD5611N	5V	DFN1006-2L
5	Will semi	ESD56151W05	5V	SOD-323
6	Way-on	WS4.5DPV	4.5V	DFN1610-2L

Power supply layout guidelines:

- Both VBAT and return path should be as short and wide as possible to minimize the voltage drop.
- The width of VBAT trace should be no less than 2mm.
- These capacitors should be placed as closely as possible to the VBAT.
- The VBAT trace should pass through TVS and capacitors, and then pass through the VBAT pins. The small value capacitors should be placed close to the VBAT pins.
- The customer's PCB design must have a solid ground plane throughout the board as the primary reference plane for most signals.

3.1.2 Recommended Power Supply Circuit

It is recommended that a switching mode power supply or a linear regulator power supply is used. It is important to make sure that all the components used in the power supply circuit can resist the current which could be more than 2A.

The following figure shows the linear regulator reference circuit with 5V input and 3.8V output.

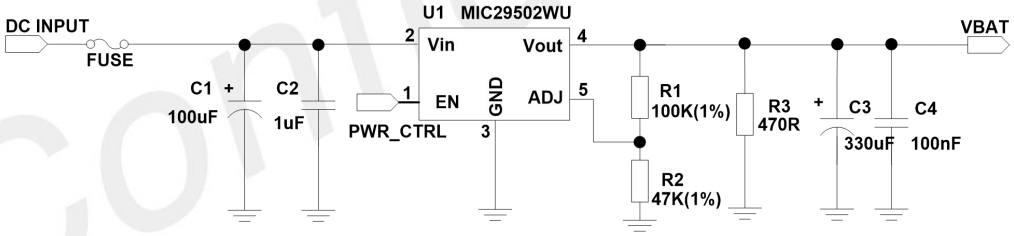

Figure 8:Linear regulator reference circuit

NOTE

1.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.

If there is a high dropout between input and VBAT, or the efficiency is extremely important, then a switching mode power supply will be preferable. The following figure shows the switching mode power supply

reference circuit with 5~12V input and 3.8V output.

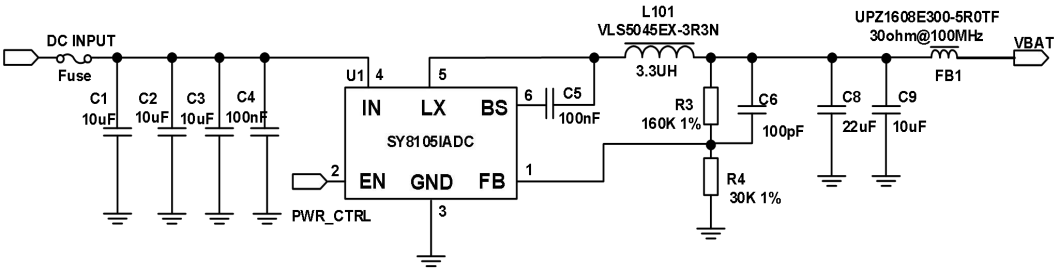

Figure 9:Switching mode power supply reference circuit

NOTE

1.The Switching Mode power supply solution for VBAT must be chosen carefully against Electro Magnetic Interference and ripple current from depraving RF performance.
2.PWR_CTRL must connect to host in case that the module system crash.

3.1.3 Voltage Monitor

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

For monitoring the VBAT voltage outside or within a special range, the AT command “AT+CVALARM” can be used to enable the Over-voltage warning function.

If users need to power off module when the VBAT voltage is out of a range, the AT command “AT+CPMVT” can be used to enable over-voltage power-off function.

NOTE

1.Over-voltage warning function and over-voltage power-off function are disabled by default. For more information about these AT commands, please refer to Document [1].
2.The module will power on automatically after the under-voltage power off procedure if the Full_Card_Power_Off# signal keeps at high level.

3.2 Full_Card_Power_Off#

Module can be powered on by pulling the Full_Card_Power_Off# pin up to high level through GPIO, which is 3.3V tolerant.

Full_Card_Power_Off# signal is an active low input signal and will turn the module on when asserted high (≥1.7 V) and will force the module to shut down when asserted low (≤0.2 V). This pin is 3.3V tolerant and can be driven by either 1.8V or 3.3V GPIO and has been pulled down internal.

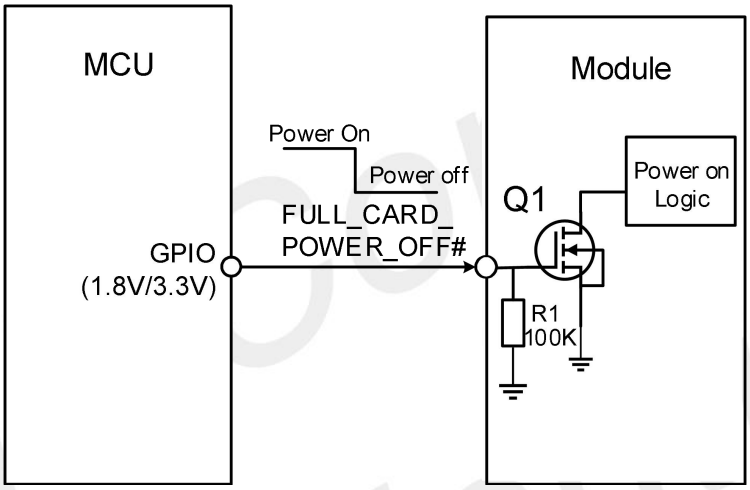

Figure 10:Reference power on/off circuit

Table 10:Definition of FULL_CARD_POWER_ OFF# pin

Pin name	Pin no.	Electrical description	Description	Comment
FULL_CARD_POWER_OFF#	6	DI,PD	Module on/off input signal 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

NOTE

1.Module could be automatically power on by connecting Full_Card_Power_Off# pin to VBAT via 0R resistor directly.

3.2.1 Power on

The power-on scenarios are illustrated in the following figure.

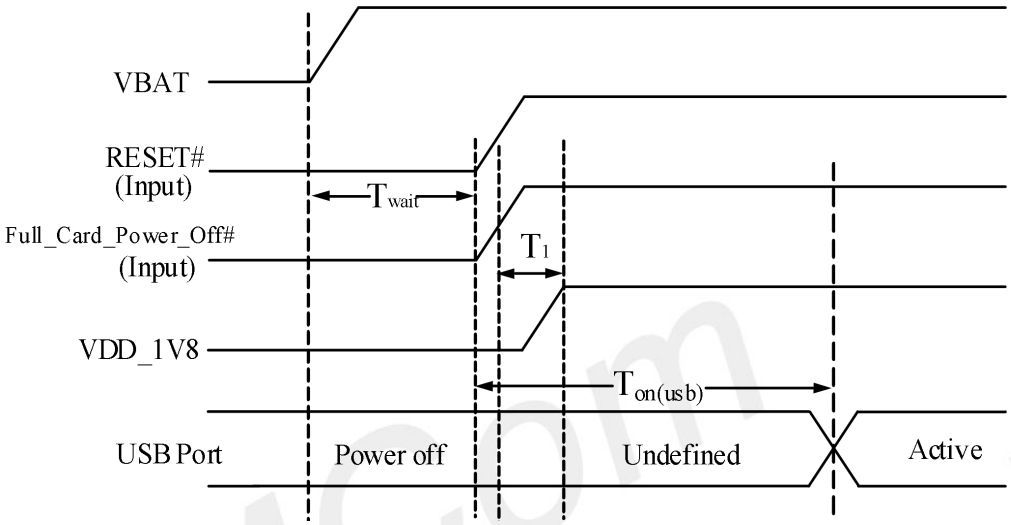

Figure 11:Power on timing sequence

Table 11:Power on timing and electronic characteristic

Symbol	Parameter	Min.	Typ.	Max.	Unit
T_{wait}	The time which is used to wait the VBAT to be stable.	100	-	-	ms
$T_{on(usb)}$	The time from power-on issue to USB port ready	-	30	-	s
V_{IH}	Input high level voltage on Full_Card_Power_Off# pin	-	1.8	4.4	V
V_{IL}	Input low level voltage on Full_Card_Power_Off# pin	0	0	0.2	V

3.2.2 Power off

The following conditions could make the module power off.

- Condition 1: Power off module by holding the Full_Card_Power_Off# pin to a low level.
- Condition 2: Power off module by removing the VBAT.
- Condition 3: Power off module by AT command “AT+CPOF”.
- Condition 4: Over-voltage or under-voltage automatic power off.
- Condition 5: Over-temperature or under-temperature automatic power off.

NOTE

1.The over-temperature and over-voltage function is disabled by default.
2.If the temperature is outside the range of -30~+75℃, some warnings will be reported via AT port. If the temperature is outside the range of -40~+85℃, module will be powered off automatically. (if the function is enabled)
3.The module will power on automatically after the condition 3 ~ 4 power off procedure if the Full_Card_Power_Off# signal keeps at high level.

These procedures under condition 1~3 will make the M.2 card disconnect from the network and allow the software to enter a safe state, and save data before the card be powered off completely.

The power off scenario by pulling down the Full_Card_Power_Off# pin is illustrated in the following figure.

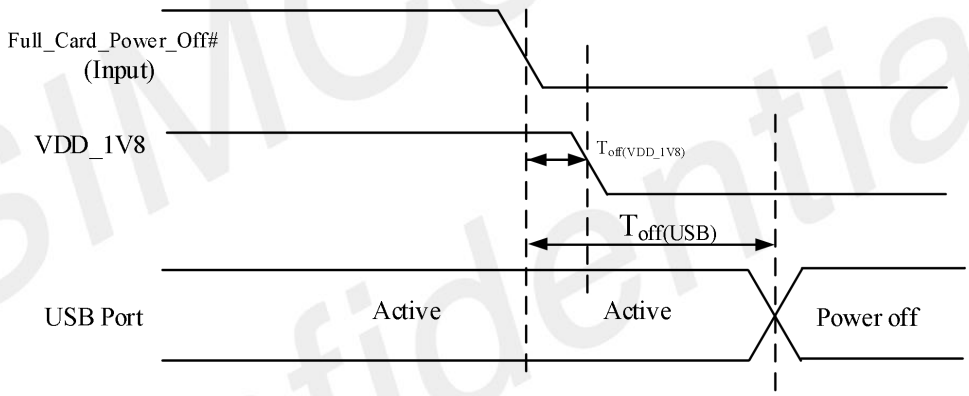

Figure 12:Power off timing sequence

Table 12:Power off timing and electronic characteristic

Symbol	Parameter	Time value			Unit
		Min.	Typ.	Max.	
$T_{off(usb)}$	The time from power-off issue to USB port off	-	8	-	s
T_{on-off}	The buffer time from power-off issue to power-on issue	30	-	-	s

3.3 Reset Function

Module can be reset by pulling the RESET# pin down to ground.

NOTE

This function is only used as an emergency reset, when both AT command “AT+CPOF” and the Full_Card_Power_Off# pin have lost efficacy.

The RESET# signal has been internally pulled up to 1.8V, so there is no need to pull it up externally.It is strongly recommended to put a 100pF capacitor and an ESD protection diode close to the RESET# pin. Please refer to the following figure for the recommended reference circuit.

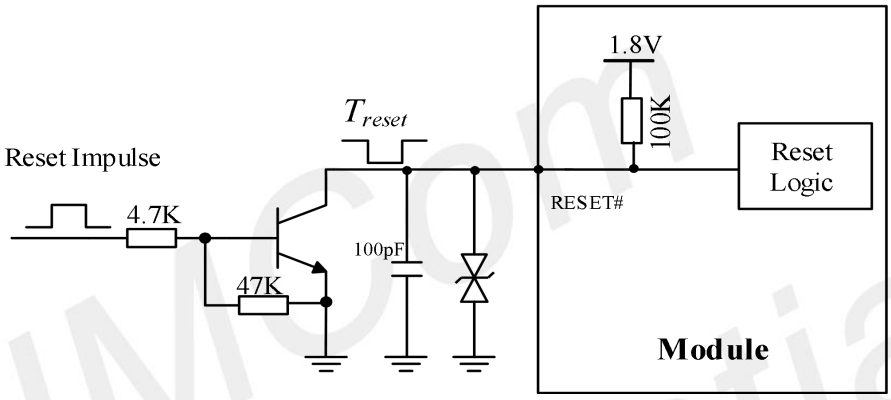

Figure 13:Reference reset circuit

Table 13:Definition of RESET# pin

Pin name	Pin no.	Electrical description	Description	Comment
RESET#	67	DI	Module reset input signal Low Active low	RESET# has been pulled up to 1.8V internally

Table 14:RESET# pin electronic characteristic

Symbol	Description	Min.	Typ.	Max.	Unit
T_{reset}	The active low level impulse time on RESET# pin to reset module	400	-	2000	ms
V_{IH}	Input high level voltage	1.2	1.8	1.9	V
V_{IL}	Input low level voltage	0	0	0.4	V

3.4 UART interface

Module provides a 5-wire UART (universal asynchronous serial transmission) interface as DCE (Data Communication Equipment). AT commands and data transmission can be performed through UART interface.

The following figures show the reference design.

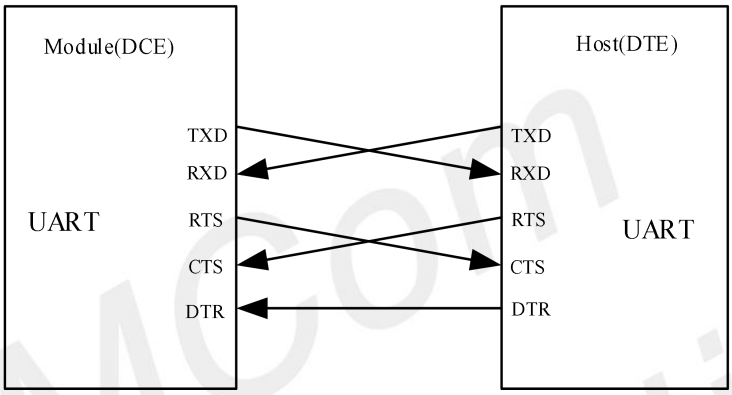

Figure 14: UART reference circuit

Table 15:Definition of UART pin

Pin name	Pin no.	Electrical description	Description	Comment
UART_TX	60	DO	UART transmit Data	1.8V voltage domain, also can be used as UART interface. If unused, please keep open.
UART_RX	58	DI	UART receive data	
UART_CTS	56	DI	UART clear to send	
UART_RTS	54	DO	UART request to send	
UART_DTR	52	DI	DTE get ready	SIM8230-M2 hardware configures as UART signal function by default

The module UART is 1.8V voltage interface. If user's UART application circuit is 3.3V voltage interface, the level shifter circuits should be used for voltage matching. The TXB0102RGYR provided by Texas Instruments is recommended. The following figure shows the voltage matching reference design.

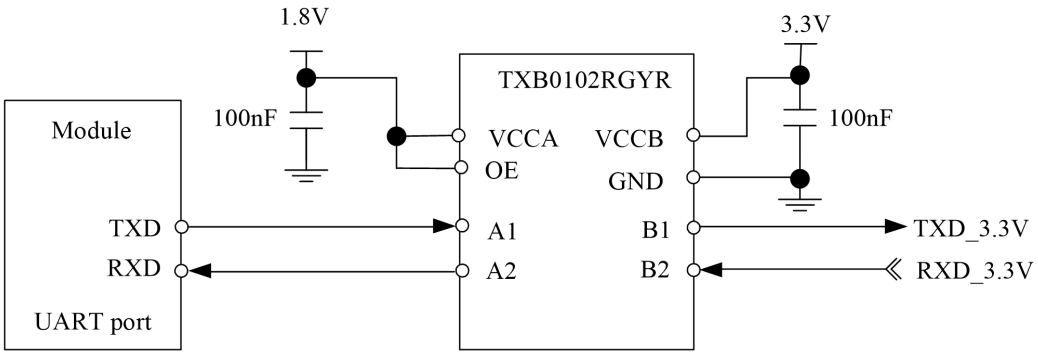

Figure 15:Reference circuit of level shift

Customers can use another level shifter circuits as follow.

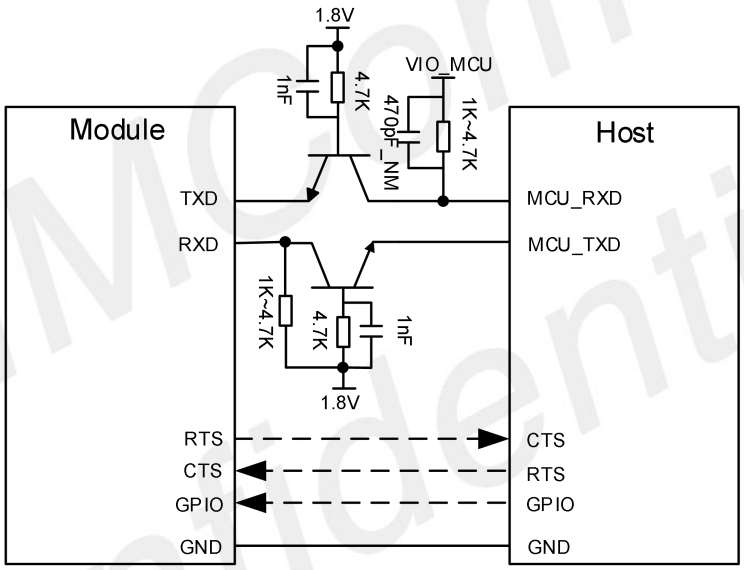

Figure 16:Level matching circuit with triode

NOTE

1.User need to use high speed transistors such as MMBT3904, or use NMOS such as 2SK3541T2L.
2.Module supports the following baud rates: 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600,3200000, 3686400bps and up to 4M bps baud rates. The default band rate is 115200bps.
3.Dotted line signal should refer to the TXD and RXD circuit.
4.If need the function of COEX_UART，please contact SIMCom support teams.

3.5 I2C Interface

Module supports one I2C interfaces, meet I2C specification version 5.0, and data rate up to 1 Mbps in fast mode plus.

The following figure shows the I2C bus reference design.

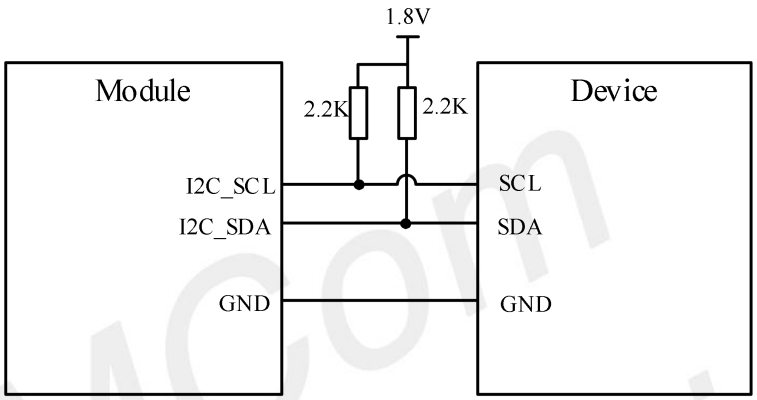

Figure 17:I2C reference circuit

Table 16:Definition of I2C pin

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	

NOTE

1.SDA and SCL need to pull up to VDD_1V8 by a 2.2K resistor externally.
2.For more details about AT commands please refer to document [1].

3.6 WoWWAN#

The WoWWAN# pin is an open drain signal which can be used as an interrupt signal to the host. Normally it

will keep high logic level until certain conditions such as receiving SMS, voice call (CSD, video) or URC reporting, then WoWWAN# will change to low logic level to inform the host (client PC), the pulse time is 1 second.

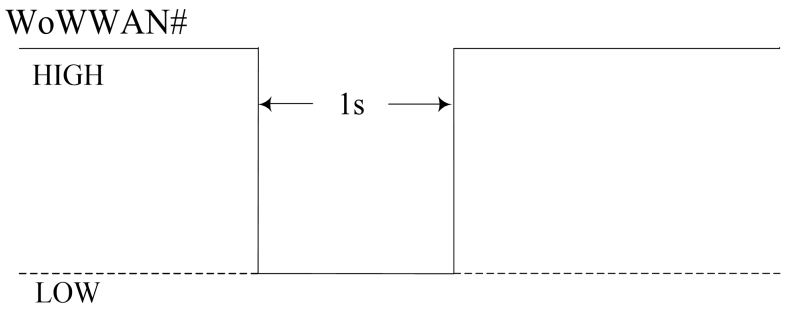

Figure 18:WoWWAN# behavior(SMS and URC report etc)

WoWWAN# Reference circuit is recommended in the following figure.

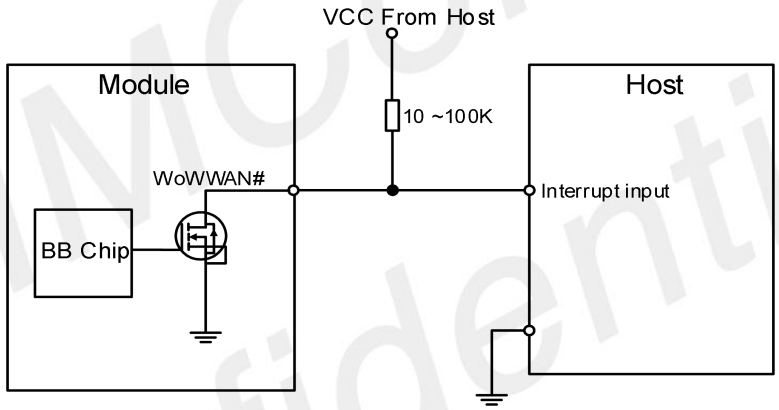

Figure 19:WoWWAN# reference circuit

Table 17:Definition of WoWWAN# pin

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

3.7 USB Interface

Module provides one integrated Universal Serial Bus (USB) interface which complies with the USB 2.0 specifications. This USB interface supports high speed (480 Mbps) and full speed (12 Mbps) modes on USB 2.0.

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

The following figure is the USB reference circuit.

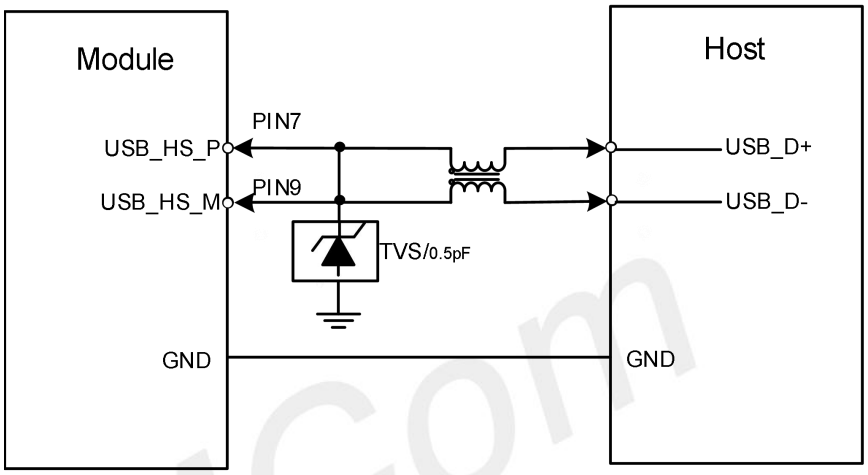

Figure 20:USB reference circuit

Table 18:Definition of USB interface

Pin name	Pin no.	Electrical description	Description	Comment
USB_D+	7	AIO	Differential USB bi-directional data positive	USB2.0 data rate up to 480Mbps
USB_D-	9	AIO	Differential USB bi-directional data negative	

Table 19:USB interface TVS diode list

No.	Manufacturer	Part number	Package
1	WILL	ESD5302N-3/TR	DFN1006-3L

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.

3.8 PCIe Interface

Module provides one integrated PCIe (Peripheral Component Interconnect Express) interface which complies with the PCI Express Specification, Revision 2.1 and supports 5Gbps per lane. The PCIe interface of module is only used for data transmission.

- PCI Express Specification Revision 2.1 compliance.
- Data rate at 5Gbps per lane.
- Can be used to connect to an external Ethernet IC (MAC and PHY) or WLAN IC.

In Root Complex Mode, the module is configured to act as a PCIe RC device. The following figure shows a reference circuit of PCIe RC mode.

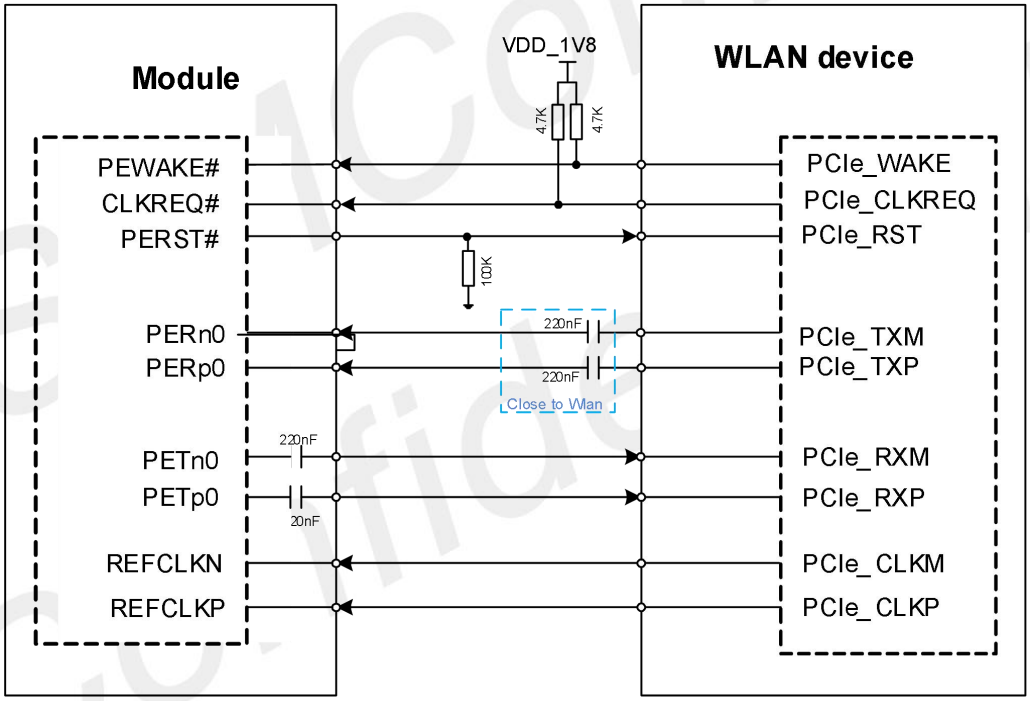

Figure 21:PCIe interface reference circuit (RC Mode)

NOTE

1.PCIe auxiliary control signals are available in 1.8V and 3.3V versions，Contact the SIMCom support team for more details.
2.The PIN52 and PIN54 of SIM8230X-M2 hardware configures as UART signal function by default, If need PCIe function, please contact SIMCom

Table 20:Definition of PCIe interface

Pin name	Pin no.	I/O	Functional description	Comment
PETn0	41	AO	PCIe transmit minus	Need to control 90 ohm differential impedance. If unused, keep it open.
PETp0	43	AO	PCIe transmit plus	
PERn0	47	AI	PCIe receive minus	
PERp0	49	AI	PCIe receive plus	
REFCLKN	53	AIO	PCIe reference clock minus	
REFCLKP	55	AIO	PCIe reference clock plus	
PERST#	50	DI	PCIe clock request signal	CLKREQ and WAKE need pull up to VDD_1V8 externally, Default as RC mode
CLKREQ#	52	DIO	PCIe wake-up signal	
PEWAKE#	54	DIO	PCIe reset signal	

Table 21:PCIe interface recommended TVS diode list

No.	Manufacturer	Part Number	Package
1	WILL	ESD5302N-3/TR	DFN1006-3L

PCIe interface layout guidelines:

- 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.
- 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.
- Maximum PCB trace length cannot exceed 150mm outside of module, the shorter trace and more better.
- The TVS diode should be placed close to the PCIe pins of M.2 connector.

3.9 (U)SIM Interface

Module supports both 1.8V and 3.0V (U)SIM Cards.The eSIM has been reserved internal , which is compatible with (U)SIM2 signal,and it no assembly on the module by default.

Table 22:(U)SIM electronic characteristic in 1.8V mode ((U)SIM_VDD=1.8V)

Symbol	Parameter	Min.	Typ.	Max.	Unit

(U)SIM_VDD	LDO power output voltage	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	0.36	V
V_{OH}	High-level output voltage	1.44	-	1.8	V
V_{OL}	Low-level output voltage	0	0	0.4	V

Table 23:(U)SIM electronic characteristic 3.0V mode ((U)SIM_VDD=3.0V)

Symbol	Parameter	Min.	Typ.	Max.	Unit
(U)SIM_VDD	LDO power output voltage	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

Table 24:Definition of (U)SIM interface

Pin name	Pin no.	I/O	Functional description	Comment
(U)SIM1_VDD	36	PO	Power supply for (U)SIM1 card	1.8/3.0V voltage domain,(U)SIM interface should be protected against ESD. If unused, please keep open.
(U)SIM1_DATA	34	DIO	(U)SIM1 card data signal, which has been pulled up to (U)SIM1_VDD by a 20K resistor internally	
(U)SIM1_CLK	32	DO	(U)SIM1 clock signal	
(U)SIM1_RST	30	DO	(U)SIM1 reset signal	
(U)SIM1_DET*	66	DI	(U)SIM1 card detect signal,the software has been pulled up internally	
(U)SIM2_VDD	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 by a 20K resistor internally	
(U)SIM2_CLK	44	DO	(U)SIM2 clock signal	
(U)SIM2_RST	46	DO	(U)SIM2 reset signal	
(U)SIM2_DET*	40	DI	(U)SIM2 card detect signal,the software has been pulled up internally	

Table 25:Recommended Devices for Normally Closed (U)SIM Card Slot Reference Circuits

Tag No.	Manufacturer	PART No.
D1	ON	ESD9L3.3ST5G
J1	MUP	MUP-C792-3

The (U)SIM card layout guidelines:

- Make sure that the (U)SIM card socket should be far away from the antennas.
- (U)SIM traces should be away from RF, VBAT and high-speed signals.
- The traces should be as short as possible.
- Keep (U)SIM socket's GND pins directly connect to the main ground.
- Shielding the (U)SIM card signals by ground.
- Recommended to place a 33pF ~ 1uF capacitor on (U)SIM_VDD net and place close to the holder.
- The rise/fall time of (U)SIM_CLK should not exceed 40ns.
- The parasitic capacitance of TVS should not exceed 60pF, and the TVS should be placed close to the (U)SIM socket.

NOTE

1. The (U)SIM hot swap function is disabled by default,for more details about (U)SIM AT commands, please refer to document [1].
2. (U)SIM_DET does not pull by default, but can be set to pull up by running the AT command.

3.9.1 Normally Closed (U)SIM Card Slot Design

The normally closed (U)SIM card slot reference circuit is shown in the following figure.

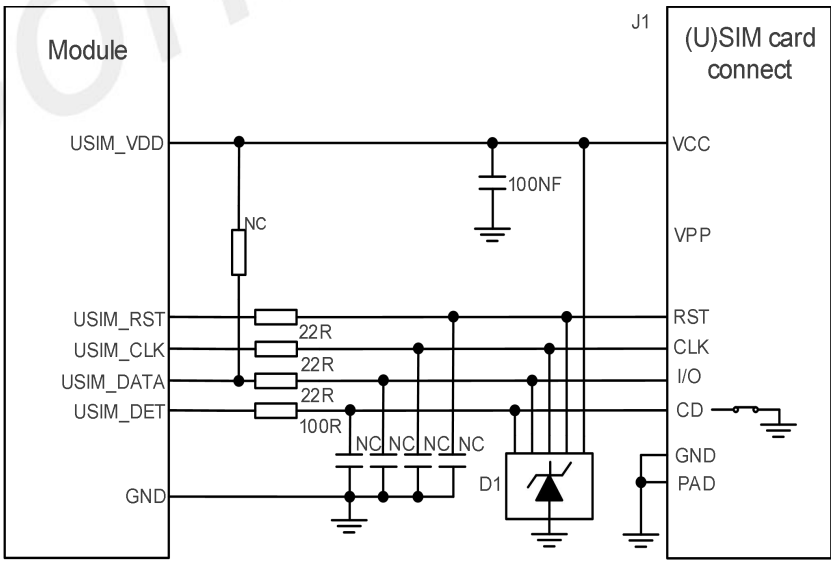

Figure 22:Normally Closed (U)SIM Card Slot Reference Circuit

- When no (U)SIM card is inserted into the card slot, the CD pin of the card holder is shorted to GND, (U)SIM_DET pin detected as low level;
- When a (U) SIM card is inserted into the card slot, the CD pin of the card holder is disconnected from the GND inside the card slot, and the (U)SIM_DET pin is detected as high.

3.9.2 Normally Open (U)SIM Card Slot Design

The normally open (U)SIM card slot reference circuit is shown in the following figure.

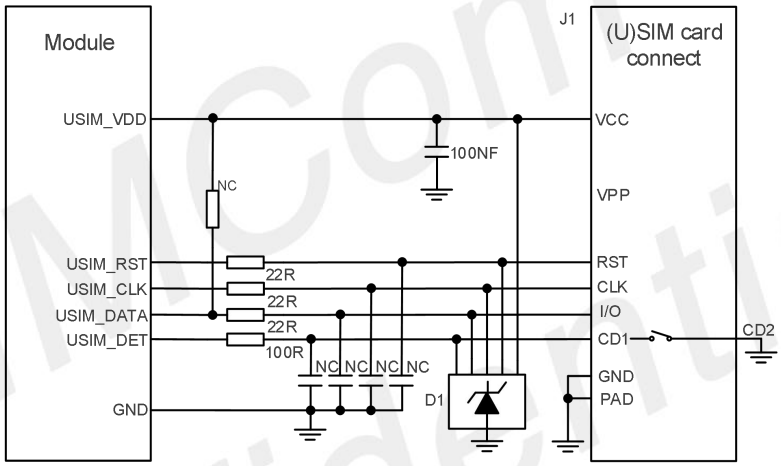

Figure 23:Normally Open (U)SIM Card Slot Reference Circuit

- When no (U) SIM card is inserted into the card slot, the CD1 and CD2 pins of the card holder are internally disconnected, and the (U)SIM_DET pin is detected as high;
- When a (U)SIM card is inserted into the card slot, the pins of the card holder CD1 and CD2 are short-circuited, and the (U)SIM_DET pin detected as low level.

3.9.3 (U)SIM card slot design without detection pins

If the hot plug detection function is not required, the (U)SIM_DET needs to remain suspended, and the (U)SIM card slot reference circuit without detection pins is shown in the following figure.

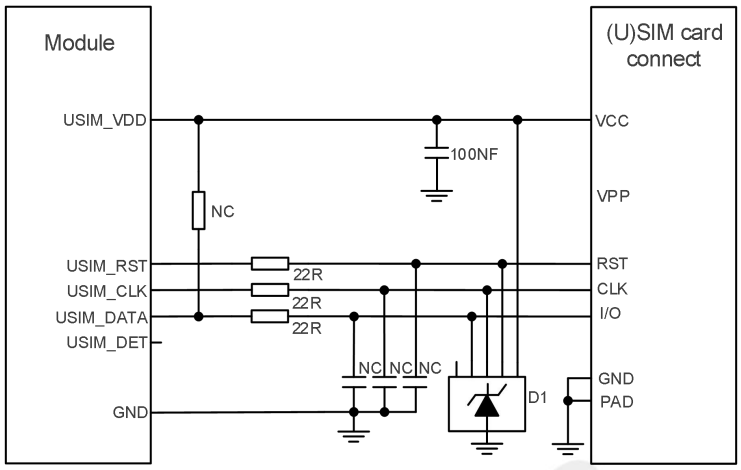

Figure 24:(U)SIM card slot reference circuit without detection pin

3.10 PCM Interface

Module provides a PCM interface for external codec, which can be used in master mode with short sync and 16 bits linear format.

Table 26:PCM format

Characteristics	Specification
Line interface format	Linear(Fixed)
Data length	16bits(Fixed)
PCM Clock/Sync Source	Master Mode(Fixed)
PCM Clock Rate	4096KHz (Fixed)
PCM Sync Format	Short sync(Fixed)
Data Ordering	MSB

NOTE

1.For more details about PCM AT commands, please refer to document [1].

3.10.1 PCM Timing

Module supports 4.096MHz PCM data and sync timing for 16 bits linear format codec.

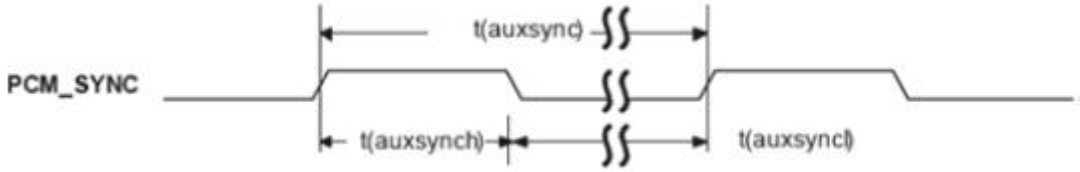

Figure 25:PCM_SYNC timing

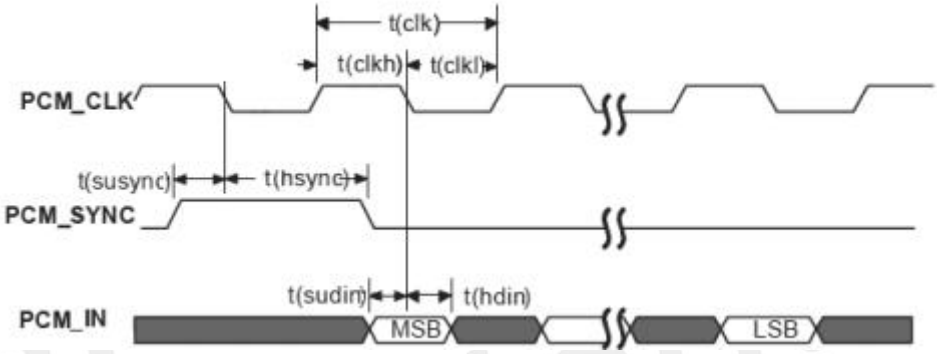

Figure 26:EXT codec to module timing

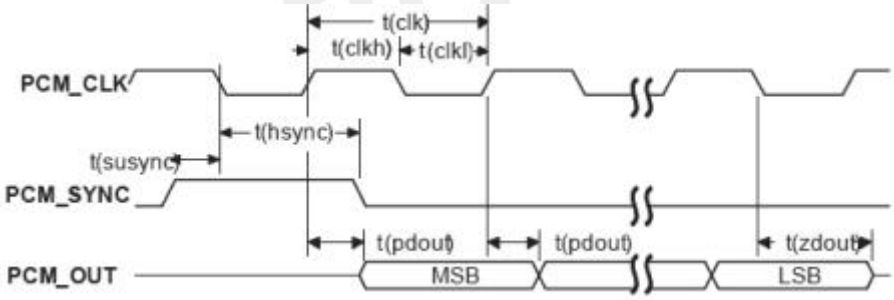

Figure 27:Module to codec timing

Table 27:PCM timing parameters

Parameter	Description	Min.	Typ.	Max.	Unit
T(sync)	PCM_SYNC cycle time	-	62.5	-	μs
T(synch)	PCM_SYNC high level time	-	244	-	ns
T(syncl)	PCM_SYNC low level time	-	62.256	-	μs
T(clk)	PCM_CLK cycle time	-	243.2	-	ns
T(clkh)	PCM_CLK high level time	-	121.2	-	ns

T(clkl)	PCM_CLK low level time	-	121.2	-	ns
T(susync)	PCM_SYNC setup time high before falling edge of PCM_CLK	-	121.6	-	ns
T(hsync)	PCM_SYNC hold time after falling edge of PCM_CLK	-	121.6	-	ns
T(sudin)	PCM_IN setup time before falling edge of PCM_CLK	228	-	-	ns
T(hdin)	PCM_IN hold time after falling edge of PCM_CLK	228	-	-	ns
T(pdout)	Delay from PCM_CLK rising to PCM_OUT valid	-	-	246	ns
T(zdout)	Delay from PCM_CLK falling to PCM_OUT HIGH-Z	-	-	246	ns

3.10.2 PCM Application Guide

The following figure shows the external codec reference design.

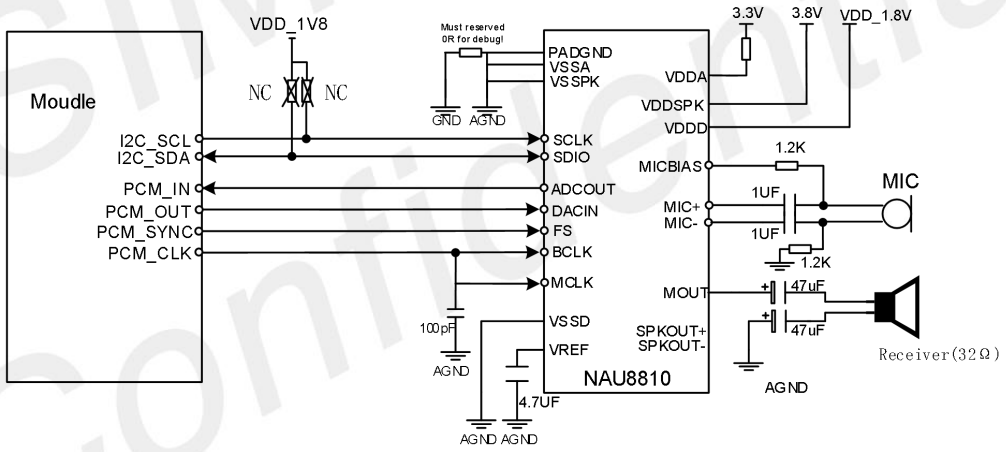

Figure 28:Audio codec reference circuit

Table 28:Definition of PCM interface

Pin name	Pin no.	I/O	Description	Comment
PCM_CLK	20	DO	PCM clock output; I2S clock output	1.8V voltage domain, also can be used as PCM interface, If unused, please keep open
PCM_DIN	22	DI	PCM data input; I2S data input	
PCM_DOUT	24	DO	PCM data output; I2S data output	

PCM_SYNC	28	DO	PCM synchronous signal; I2S word select

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

Table 29: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.

3.10.3 DPR*

DPR (Dynamic Power Reduction) signal is used by SIM8230X-M2 to assist in meeting regulatory SAR (Specific Absorption Rate) requirements for RF exposure. The signal is provided by a host system proximity sensor to module to provide an input trigger causing a reduction in the radio transmit output power.

User can use AT command to active this function, if do not need this function, this pin can be keep floating.

Table 30:Definition of DPR pin

Pin Name	Pin no.	Pin status	Function
DPR	25	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

1. "*" means under development,For more details, please contact the SIMCom support team.

3.11 CONFIG Pins

These signals provide the means to indicate the specific configuration of the module. SIM8230X-M2 is configured as WWAN-USB2.0(SIM8230X-M2 do not support USB3.0).

Table 31:CONFIG Pins

Pin Name	Pin no.	Description
CONFIG_0	21	Connected to GND internally.
CONFIG_1	69	Connected to GND internally.
CONFIG_2	75	Connected to GND internally.
CONFIG_3	1	No Connect internally.

In the M.2 specification, the 4 pins are defined as below:

Table 32: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 2.0	Vender defined

3.12 LED1#

LED1# is open drain output and is used to allow SIM8230X-M2 to provide network status via LED which will be provided by the host.

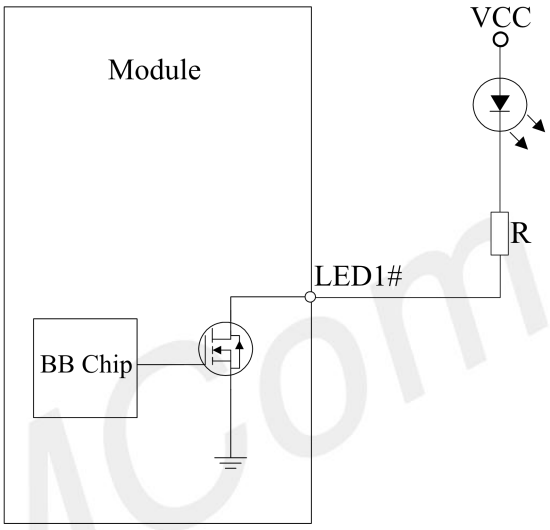

Figure 29:LED1# reference circuit

Table 33:Definition of LED1# pin

Pin name	Pin no.	I/O	Functional description	Comment
LED1#	10	OD	The indicator signal of the module status active low	

NOTE

1.The value of the resistor named “R” depends on the LED characteristic.

The timing sequence is as followed:

Table 34:LED1# pin status

LED1# pin status	Module status
Always On	Search the network; Establish/maintain voice call connections (including 5G and VOLTE)
100ms ON, 100ms OFF	Data transmit; 5G registered network

200ms ON, 200ms OFF	4G registered on the networkd
OFF	Shutdown, sleep mode, minimum power consumption mode

3.13 W_DISABLE1#

The W_DISABLE1# pin controls SIM8230X-M2 to enter or exit the flight mode, when the W_DISABLE1# signal is asserted to low level, all RF functions would be disabled. When the W_DISABLE1# signal is not asserted, the RF function will be active if it was not disabled by other means such as software.

Its reference circuit is shown in the following figure.

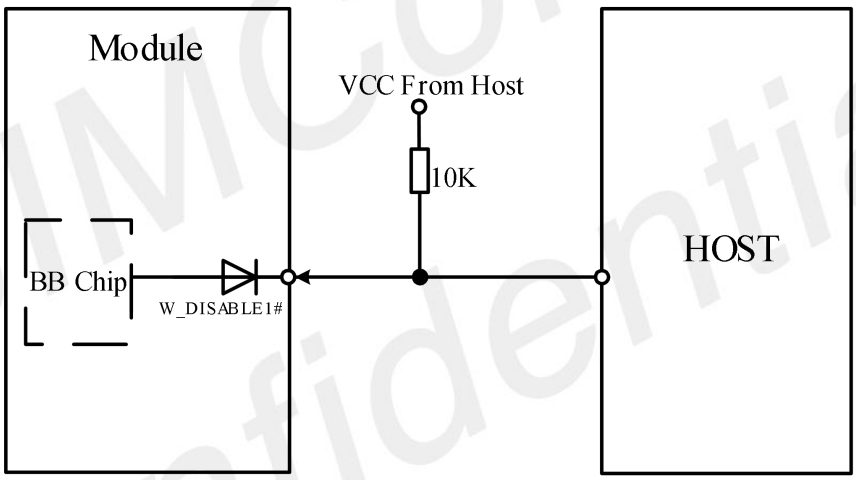

Figure 30:Flight mode switch reference circuit

Table 35:Definition of W_DISABLE1# pin

Pin name	Pin no.	I/O	Functional description	Comment
W_DISABLE1#	8	DI	Flight mode control input active low	

Table 36:W_DISABLE1# pin status

W_DISABLE1# pin status	Module operation
Input Low Level	Flight Mode: RF is closed
Input High Level	AT+CFUN=4: Flight mode AT+CFUN=1: RF is working (default)

3.14 ANTCTRL interface

ANTCTL[0:1] are used for tunable antenna control and should be routed to anappropriate antenna control circuitry.

The following table are the definitions for antenn control interfaces.

Table 37:Definition of antenna control interface

Pin Name	Pin No.	Electrical Description	Description	Comments
ANTCTL0 (RFFE_DATA)	59	DIO	Used for MIPI tuner IC, and also can be configured as GPIO function.	1.8V voltage domain. If unused, please keep open
ANTCTL1 (RFFE_CLK)	61	DO		
N79_TO_WL_TXEN*	63	DO	Active high The n79 coexists with WIFI. When the output power of the n79 is too high, the output is high Level to WIFI module off WIFI 5G LNA	

NOTE

1.This function is under development.For more details, please contact SIMCom support teams.

3.15 W_DISABLE2#*

The W_DISABLE2# pin controls SIM8230X-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#.

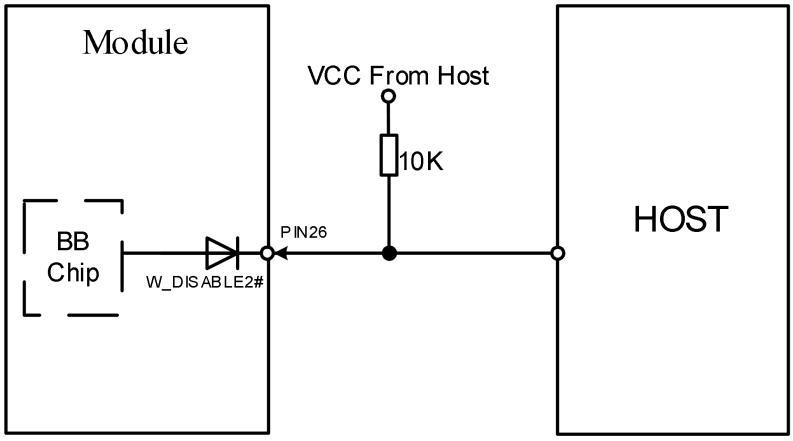

Figure 31:W_DISABLE2#pin reference circuit

Table 38: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 39: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)

NOTE

1. “*” means under development. For more details, please contact the SIMCom support team.
2. The function of W_DISABLE2# can be set through the AT command of the software. If the function of W_DISABLE#2 is required, please contact for more details the SIMCom support team.

4 Antenna Interfaces

SIM8230X-M2 provides three antennas for 4G/5G and GNSS. The antenna ports have an RF impedance of 50Ω.

4.1 Antenna Definitions

For detailed designs about antenna, please refer to the antenna design guide Document [14] "SIM8230X-M2 Antenna Port Mapping and Design Guide" in the appendix.

Table 40:Antenna port definitions

FUNCTIONS	MAIN	AUX	GNSS
3G/4G LB/MHB TRX	✓		
3G/4G LB/MHB DIV		✓	
GNSS			✓

NOTE

1.Supports 2 × 2 MIMO for 4G/5G sub-6.

Table 41: Frequency and antenna ports mapping

ANT item	ANT function	Frequency range	Functional description
ANT_MAIN	4G/5G LB/MHB TRX	617 MHz ~ 5000 MHz	4G/5G signal send and receive
ANT_DIV	4G/5G LB/MHB DRX	617 MHz ~ 5000 MHz	4G/5G signal receive
ANT_GNSS	GNSS L1 and L2/L5	1575.42 MHz ±1.023 MHz (L1) 1227.60 MHz ±1.023 MHz (L2) 1176.45 MHz ±10.23 MHz (L5) 1597.5 MHz~1605.8MHz (GLONASS) 1561.098 MHz ±2.046 MHz (BDS) 1575.42 MHz ±2.046 MHz (Galileo)	GNSS receive

		1176.45 MHz±10.23 MHz (Galileo)	

4.1.1 4G/5G Operating Frequency

The following table shows 4G/5G Operating frequencies

Table 42:SIM8230G-M2 Operating frequencies

Frequency band	Uplink (UL)	Downlink (DL)	Duplex mode
LTE B1	1920 MHz ~ 1980 MHz	2110 MHz ~ 2170 MHz	FDD
LTE B2	1850 MHz ~ 1910MHz	1930 MHz ~ 1990MHz	FDD
LTE B3	1710 MHz ~ 1785 MHz	1805 MHz ~ 1880 MHz	FDD
LTE B4	1710 MHz ~ 1755MHz	2110 MHz ~ 2155MHz	FDD
LTE B5	824 MHz ~ 849 MHz	869 MHz ~ 894MHz	FDD
LTE B7	2500 MHz ~ 2570MHz	2620 MHz ~ 2690MHz	FDD
LTE B8	880 MHz ~ 915 MHz	925 MHz ~ 960 MHz	FDD
LTE B12	698 MHz ~ 716MHz	728 MHz ~ 746MHz	FDD
LTE B13	777 MHz ~787MHz	746 MHz ~ 756MHz	FDD
LTE B14	788 MHz ~ 798MHz	758 MHz ~ 768MHz	FDD
LTE B17	704 MHz ~ 716MHz	734 MHz ~ 746MHz	FDD
LTE B18	815 MHz ~ 830MHz	860 MHz ~ 875MHz	FDD
LTE B19	830 MHz ~ 845MHz	875 MHz ~ 890MHz	FDD
LTE B20	832 MHz ~ 862MHz	791 MHz ~ 821MHz	FDD
LTE B25	1850 MHz ~ 1915MHz	1930 MHz ~ 1995MHz	FDD
LTE B26	814 MHz ~849MHz	859 MHz ~ 894MHz	FDD
LTE B28	703 MHz ~ 748MHz	758 MHz ~ 803MHz	FDD
LTE B30	2305 MHz ~ 2315MHz	2350 MHz ~ 2360MHz	FDD
LTE B34	2010 MHz ~ 2025MHz	2010 MHz ~ 2025MHz	TDD
LTE B38	2570 MHz ~ 2620 MHz	2570 MHz ~ 2620 MHz	TDD
LTE B39	1880 MHz ~ 1920MHz	1880 MHz ~ 1920MHz	TDD
LTE B40	2300 MHz ~ 2400 MHz	2300 MHz ~ 2400 MHz	TDD
LTE B41	2496 MHz ~ 2690 MHz	2496 MHz ~ 2690 MHz	TDD
LTE B42	3400MHz ~ 3600MHz	3400 MHz ~ 3600MHz	TDD
LTE B43	3600MHz ~ 3800MHz	3600 MHz ~ 3800MHz	TDD
LTE B48	3550 MHz ~ 3700MHz	3550 MHz ~ 3700MHz	TDD
LTE B66	1710 MHz ~ 1780MHz	2110 MHz ~ 2180MHz	FDD
LTE B71	663 MHz ~ 698MHz	617MHz ~ 652MHz	FDD

Frequency band	Uplink (UL)	Downlink (DL)	Duplex mode
NR n1	1920MHz ~ 1980MHz	2110MHz ~ 2170MHz	FDD
NR n2	1850MHz ~ 1910MHz	1930MHz ~ 1990MHz	FDD
NR n3	1710MHz ~ 1785MHz	1805MHz ~ 1880MHz	FDD
NR n5	824MHz ~ 849MHz	869MHz ~ 894MHz	FDD
NR n7	2500MHz ~ 2570MHz	2620MHz ~ 2690MHz	FDD
NR n8	880MHz ~ 915 MHz	925MHz ~ 960 MHz	FDD
NR n12	698MHz ~ 716MHz	728MHz ~ 746MHz	FDD
NR n13	777 MHz ~787MHz	746 MHz ~ 756MHz	FDD
NR n14	788MHz ~ 798MHz	758MHz ~ 768MHz	FDD
NR n18	815 MHz ~ 830MHz	860 MHz ~ 875MHz	FDD
NR n20	832MHz ~ 862MHz	791MHz ~ 821MHz	FDD
NR n25	1850MHz ~ 1915MHz	1930MHz ~ 1995MHz	FDD
NR n26	814 MHz ~849MHz	859 MHz ~ 894MHz	FDD
NR n28	703MHz ~ 748MHz	758MHz ~ 803MHz	FDD
NR n30	2305MHz ~ 2315MHz	2350MHz ~ 2360MHz	FDD
NR n38	2570MHz~2620MHz	2570MHz~2620MHz	TDD
NR n40	2300MHz ~ 2400MHz	2300MHz ~ 2400MHz	TDD
NR n41	2496MHz ~ 2690MHz	2496MHz ~ 2690MHz	TDD
NR n48	3550 MHz ~ 3700MHz	3550 MHz ~ 3700MHz	TDD
NR n66	1710MHz ~ 1780MHz	2110MHz ~ 2220MHz	FDD
NR n70	1695 MHz ~ 1710MHz	1995MHz ~ 2020MHz	FDD
NR n71	663 MHz ~ 698MHz	617MHz ~ 652MHz	FDD
NR n77	3300MHz ~ 4200MHz	3300MHz ~ 4200MHz	TDD
NR n78	3300MHz ~ 3800MHz	3300MHz ~ 3800MHz	TDD

Table 43:SIM8230E-M2 Operating frequencies

Frequency band	Uplink (UL)	Downlink (DL)	Duplex mode
LTE B1	1920 MHz ~ 1980 MHz	2110 MHz ~ 2170 MHz	FDD
LTE B3	1710 MHz ~ 1785 MHz	1805 MHz ~ 1880 MHz	FDD
LTE B5	824 MHz ~ 849 MHz	869 MHz ~ 894MHz	FDD
LTE B7	2500 MHz ~ 2570MHz	2620 MHz ~ 2690MHz	FDD
LTE B8	880 MHz ~ 915 MHz	925 MHz ~ 960 MHz	FDD
LTE B20	832 MHz ~ 862MHz	791 MHz ~ 821MHz	FDD
LTE B28	703 MHz ~ 748MHz	758 MHz ~ 803MHz	FDD
LTE B38	2570 MHz ~ 2620 MHz	2570 MHz ~ 2620 MHz	TDD
LTE B40	2300 MHz ~ 2400 MHz	2300 MHz ~ 2400 MHz	TDD
LTE B41	2496 MHz ~ 2690 MHz	2496 MHz ~ 2690 MHz	TDD

LTE B42	3400MHz ~ 3600MHz	3400 MHz ~ 3600MHz	TDD
LTE B43	3600MHz ~ 3800MHz	3600 MHz ~ 3800MHz	TDD

Frequency band	Uplink (UL)	Downlink (DL)	Duplex mode
NR n1	1920MHz ~ 1980MHz	2110MHz ~ 2170MHz	FDD
NR n3	1710MHz ~ 1785MHz	1805MHz ~ 1880MHz	FDD
NR n5	824MHz ~ 849MHz	869MHz ~ 894MHz	FDD
NR n7	2500MHz ~ 2570MHz	2620MHz ~ 2690MHz	FDD
NR n8	880MHz ~ 915 MHz	925MHz ~ 960 MHz	FDD
NR n20	832MHz ~ 862MHz	791MHz ~ 821MHz	FDD
NR n28	703MHz ~ 748MHz	758MHz ~ 803MHz	FDD
NR n38	2570MHz~2620MHz	2570MHz~2620MHz	TDD
NR n40	2300MHz ~ 2400MHz	2300MHz ~ 2400MHz	TDD
NR n41	2496MHz ~ 2690MHz	2496MHz ~ 2690MHz	TDD
NR n77	3300MHz ~ 4200MHz	3300MHz ~ 4200MHz	TDD
NR n78	3300MHz ~ 3800MHz	3300MHz ~ 3800MHz	TDD

Table 44: SIM8230C-M2 operating frequencies

Frequency band	Uplink (UL)	Downlink (DL)	Duplex mode
LTE B1	1920 MHz ~ 1980 MHz	2110 MHz ~ 2170 MHz	FDD
LTE B3	1710 MHz ~ 1785 MHz	1805 MHz ~ 1880 MHz	FDD
LTE B5	824 MHz ~ 849 MHz	869 MHz ~ 894MHz	FDD
LTE B8	880 MHz ~ 915 MHz	925 MHz ~ 960 MHz	FDD
LTE B34	2010 MHz ~ 2025MHz	2010 MHz ~ 2025MHz	TDD
LTE B38	2570 MHz ~ 2620 MHz	2570 MHz ~ 2620 MHz	TDD
LTE B39	1880 MHz ~ 1920MHz	1880 MHz ~ 1920MHz	TDD
LTE B40	2300 MHz ~ 2400 MHz	2300 MHz ~ 2400 MHz	TDD
LTE B41	2496 MHz ~ 2690 MHz	2496 MHz ~ 2690 MHz	TDD

Frequency band	Uplink (UL)	Downlink (DL)	Duplex mode
NR n1	1920MHz ~ 1980MHz	2110MHz ~ 2170MHz	FDD
NR n3	1710MHz ~ 1785MHz	1805MHz ~ 1880MHz	FDD
NR n5	824MHz ~ 849MHz	869MHz ~ 894MHz	FDD
NR n8	880MHz ~ 915 MHz	925MHz ~ 960 MHz	FDD
NR n28	703MHz ~ 748MHz	758MHz ~ 803MHz	FDD
NR n40	2300MHz ~ 2400MHz	2300MHz ~ 2400MHz	TDD
NR n41	2496MHz ~ 2690MHz	2496MHz ~ 2690MHz	TDD
NR n78	3300MHz ~ 3800MHz	3300MHz ~ 3800MHz	TDD

NR n79	4400MHz ~ 5000MHz	4400MHz ~ 5000MHz	TDD

4.1.2 GNSS Frequency

The following table shows frequency specification of GNSS antenna interface.

Table 45:GNSS frequency

Type	Frequecy
GPS L1	1575.42 ± 1.023 MHz
GPS L2	1227.60 ± 1.023 MHz
GPS L5	1176.45 ± 10.23 MHz
GLONASS	1597.5~1605.8 MHz
BeiDou/Compass	1561.098 ± 2.046 MHz
Galileo	1575.42 ± 2.046 MHz 1176.45 ±10.23 MHz

4.2 Antenna Installation

4.2.1 Antenna Requirements

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

Recommended Antenna Characteristics

Table 46:4G/5G antenna

Item	Requirements
Operating Frequency	See Table 41: SIM8230X-M2 Operating frequencies for each antenna
Direction	Omni directional
Gain	> -3dBi (Avg)
Impedance	50 Ω
Efficiency	> 50 %
Max. Input Power	50W
VSWR	< 2

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 47:GNSS antenna (for dedicated GNSS antenna)*

Parameter	Requirement
Operating Frequency	L1: 1559~1609MHZ L2: 1226~1229 MHz 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

1.“*” These recommendations are for dedicated GNSS antenna which the application need best GNSS tracking performance.

4.2.2 Recommended RF Connector for Antenna Installation

When choosing antennas, user should pay attentions to the connector on antenna which should match with the connector on the module.

The standard 2x2 mm size RF receptacle connectors have been used on SIM8230X-M2. The dimension of the connector on SIM8230X-M2 is 2.0*2.0*0.6mm, which is from I-PEX, and the Part Number is 20449-001E-03.

Shows the RF connector dimension in the following figure:

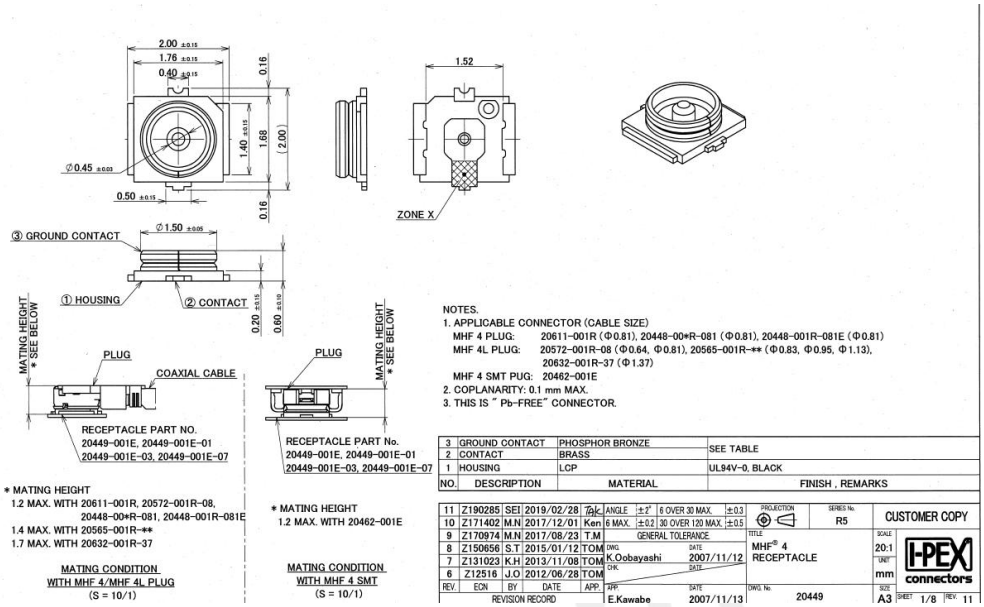

Figure 32:3D view of 20449-001E-03

The major specifications of the RF connector as below:

Table 48:The major specifications of the RF connector

Item	Specification
Voltage Rating	60V r.m.s. maximum
Nominal Frequency Range	DC to 9GHz
Nominal Impedance	50Ω
Temperature Rating	-40°C to +90°C
Insulation Resistance	500 MΩ minimum
Withstanding Voltage	200V AC 1MINUTE
Main Contact Resistance Ground Contact Resistance	20.0mΩ max.
Voltage Standing Wave Ratio (V.S.W.R.)	Meet the requirements of 1.3max.(DC~ 3GHz) 1.45max.(3GHz~ 6GHz) 2.00max.(6GHz~ 9GHz)

To get best RF performance, the RF plug connector should be designed to match the receptacle 20449-001E-03. The following figure shows the mechanical information of RF coaxial cables.

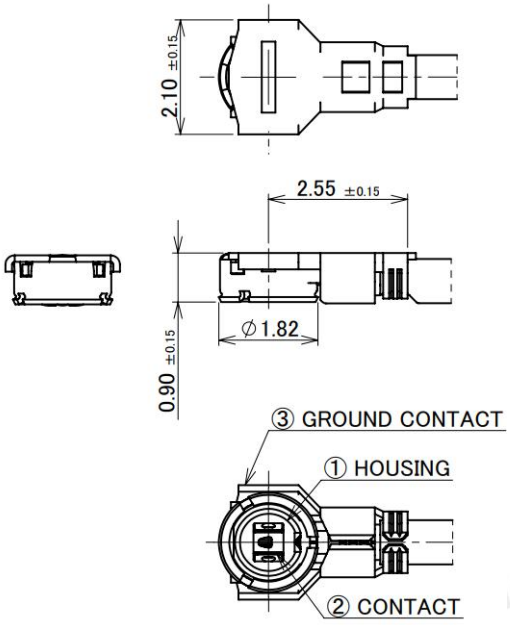

Figure 33:Mechanical information of RF plug

4.2.3 RF Cable Assembly Operation

RF cables correct pull and push operation as shown in the following figure.

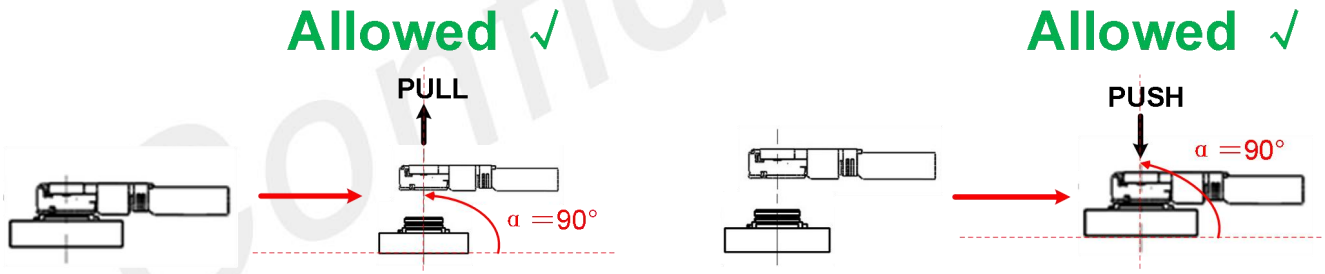

Figure 34:RF cable correct pull and push operation

RF cables error pull and push operation as shown in the following figure.

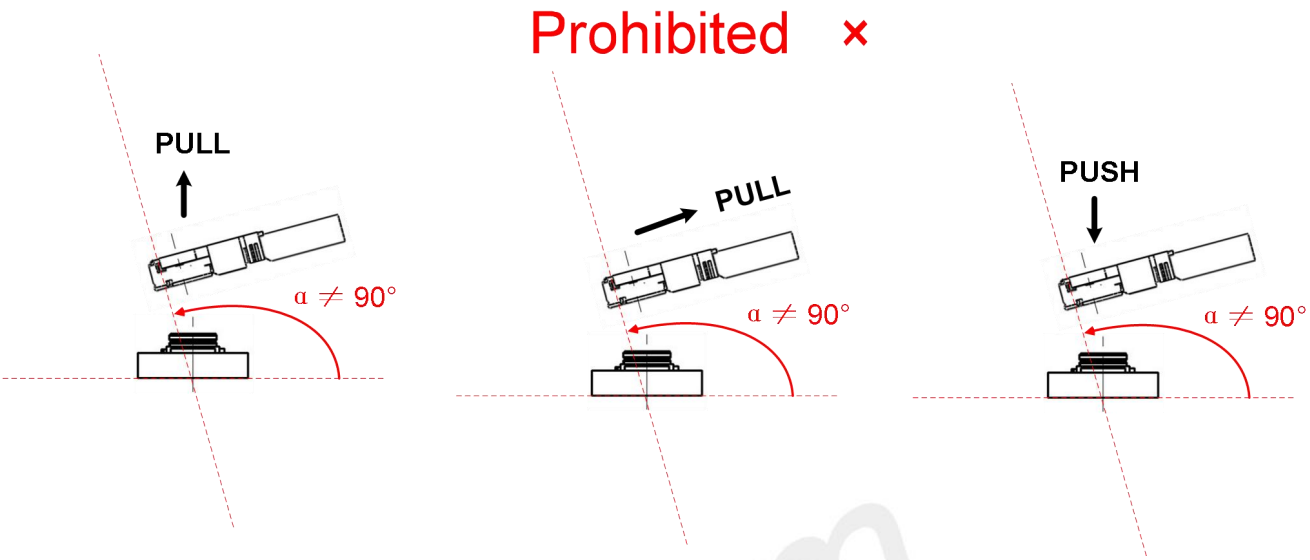

Figure 35:RF cable error pull and push operation

Use RF cable tool correct pull and push operation as shown in the following figure, for more details, please visit *https://www.i-pex.com*.

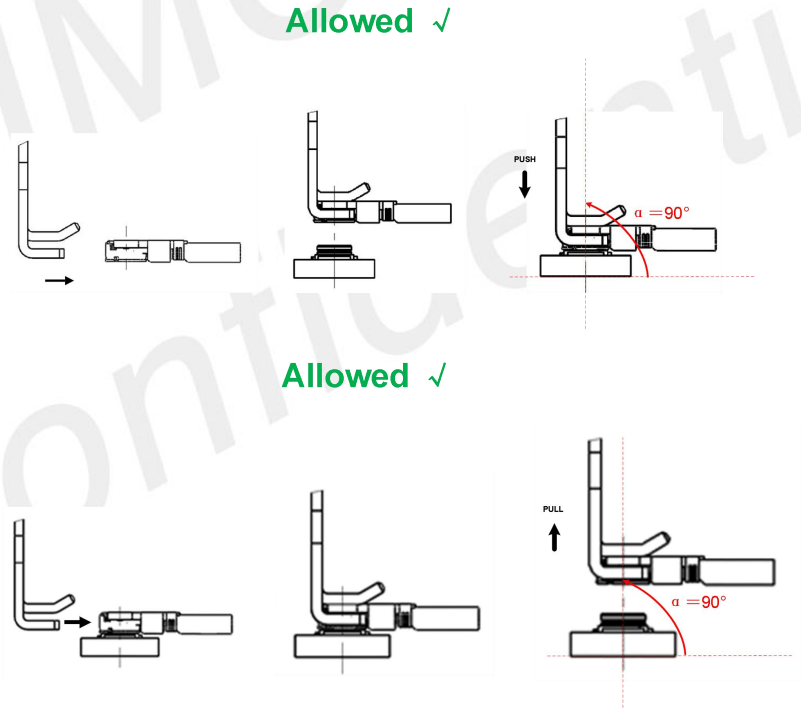

Figure 36:Use RF cable tool correct pull and push operation

Use RF cable tool error pull and push operation as shown in the following figure, for more details, please visit *https://www.i-pex.com*.

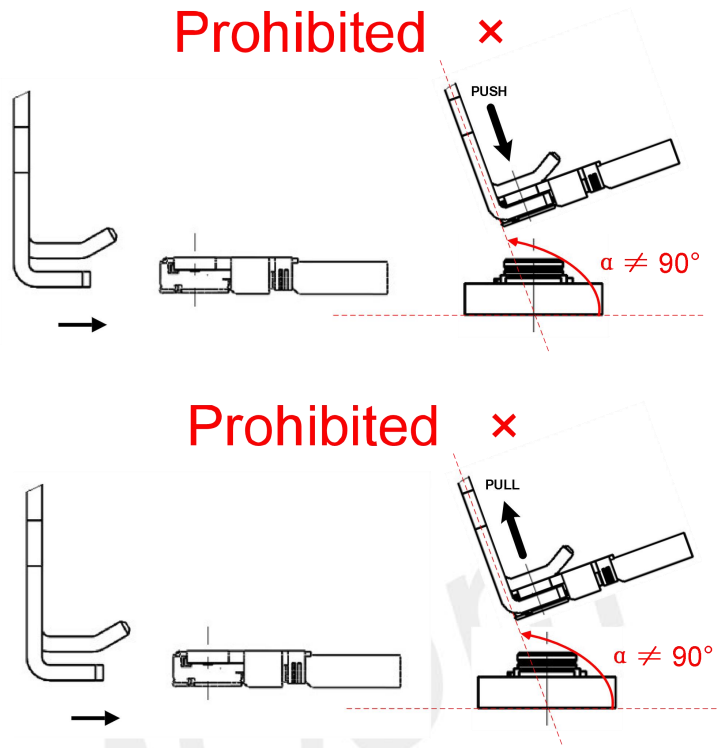

Figure 37:Use RF cable tool error pull and push operation

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 49:Absolute maximum ratings

Parameter	Min.	Typ.	Max.	Unit
Voltage at VBAT pins	-	-	4.7	V
Voltage at digital pins (GPIO,I2C,UART, I2S)	-	-	2.1	V
Voltage at digital pins (USIM)	-	-	3.05	V
Voltage at FULCARD_POWER_OFF#	-	-	4.5	V
Voltage at RESET#	-	-	1.9	V

5.2 Operating conditions

Table 50:Recommended operating ratings

Parameter	Min.	Typ.	Max.	Unit
Voltage at VBAT	3.4	3.8	4.4	V

Table 51:1.8V 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_{OH}	High-level output current(no pull down resistor)	-	-	1	uA

I_{OL}	Low-level output current(no pull up resistor)	-1	-	-	uA
I_{IH}	Input high leakage current (no pull down resistor)	-	-	1	uA
I_{IL}	Input low leakage current(no pull up resistor)	-1	-	-	uA

NOTE

1.These parameters are for digital interface pins, such as UART, I2C, ANTCTL and GPIOs (DPR, SIM DETECT).

The operating temperature of module is listed in the following table.

Table 52:Operating temperature

Parameter	Min.	Typ.	Max.	Unit
Normal operation temperature(3GPP compliant)	-30	+25	+75	℃
Extended operation temperature*	-40	-	+85	℃
Storage temperature	-40	-	+90	℃

NOTE

1.Module is able to make and receive voice calls, data calls, SMS and make UMTX/LTE traffic in -40℃ ~ +85℃. The performance will be reduced slightly from the 3GPP specifications if the temperature is outside the normal operating temperature range and still within the extreme operating temperature range.

5.3 Operating Mode

5.3.1 Operating Mode Definition

The table below summarizes the various operating modes of module product.

Table 53:Operating mode Definition

Mode		Function
Normal operation	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.
	Idle	Software is active. Module is registered to the network, and the module is ready to communicate.
	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 antenna.
	Standby	Module is ready for data transmission, but no data is currently sent or received. In this case, power consumption depends on network settings.
	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 USIM 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 mode, the RF part of the module will not work, but the serial port and USB port are still accessible. The power consumption in this mode is lower than normal mode.
Power off		Module will go into power off mode by pull down the Full_Card_Power_Off# pin, normally. In this mode the power management unit shuts down the power supply, and software is not active. The serial port and USB are is not accessible.

NOTE

1.Some special software version can’t be used to set the module to a sleep、 Idle and Standby mode .For details please contact SIMCom support teams.

5.3.2 Sleep mode

In sleep mode, the current consumption of 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

1.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 function of module, thus minimizing the power consumption. This mode is set by the AT command which provides a choice of the 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 function and (U)SIM card function will be closed. In this case, the serial port and USB are still accessible, but RF function and (U)SIM card will be unavailable.

If module has been set to flight mode, the RF function will be closed. In this case, the serial port and USB are still accessible, but RF function will be unavailable.

When module is in minimum functionality or flight mode, it can return to full functionality by the AT command “AT+CFUN=1”.

5.4 Real time clocks (RTC)*

The RTC (Real-Time Clock) function of the module only supports an internal clock source.Real time clock

(RTC) support with alarms.

Table 54:RTC performance specifications

Mode	Min	Typ	Max	Units
ACTIVE	-24	-	24	ppm
SLEEP	-24	-	24	ppm
AIR	-24	-	24	ppm
DEEP SLEEP	-500	-	500	ppm
OFF	-500	-	500	ppm

NOTE

"*" means under development, for details please contact SIMCom support teams.

5.5 Current Consumption

The current consumptions are listed in the follows table.

Table 55:SIM8230X-M2 Current consumption on VBAT Pins (VBAT=3.8V)

Description	Condition.	Typical	Unit
Power off mode	Power off	160	uA
GNSS mode	DPO (AT+CFUN=0, connection USB)	TBD	mA
	LTE-FDD(AT+CFUN=0)	TBD	mA
	LTE-FDD DRX=0.32s	TBD	mA
	LTE-FDD DRX=0.64s	TBD	mA
	LTE-FDD DRX=1.28s	TBD	mA
	LTE-FDD DRX=2.56s	TBD	mA
	LTE-TDD(AT+CFUN=0)	TBD	mA
	LTE-TDD DRX=0.32s	TBD	mA
	LTE-TDD DRX=0.64s	TBD	mA
	LTE-TDD DRX=1.28s	TBD	mA
	LTE-TDD DRX=2.56s	TBD	mA
	NR* (AT+CFUN=0)	TBD	mA

	NR DRX=0.32s	TBD	mA
	NR DRX=0.64s	TBD	mA
	NR DRX=1.28s	TBD	mA
	NR DRX=2.56s	TBD	mA
	LTE FDD	TBD	mA
	LTE TDD	TBD	mA
	5G SA	TBD	mA
LTE data			
LTE-FDD B1	TBD		
LTE-FDD B2	TBD		
LTE-FDD B3	TBD		
LTE-FDD B4	TBD		
LTE-FDD B5	TBD		
LTE-FDD B7	TBD		
LTE-FDD B8	TBD		
LTE-FDD B12	TBD		
LTE-FDD B13	TBD		
LTE-FDD B14	TBD		
LTE-FDD B17	TBD		
LTE-FDD B18	TBD		
LTE-FDD B19	TBD		
LTE-FDD B20	TBD		
LTE-FDD B25	TBD		
LTE-FDD B26	TBD		
LTE-FDD B28	TBD		
LTE-FDD B30	TBD		
LTE-FDD B66	TBD		
LTE-FDD B71	TBD		
LTE-TDD B34	TBD		
LTE-TDD B38	TBD		
LTE-TDD B39	TBD		
LTE-TDD B40	TBD		
LTE-TDD B41	TBD		
LTE-TDD B42	TBD		
LTE-FDD B43	TBD		
LTE-TDD B48	TBD		
5G NR data			
5G n1	TBD		
5G n2	TBD		
5G n3	TBD		
5G n5	TBD		

5G n7	TBD	
5G n8	TBD	
5G n12	TBD	
5G n13	TBD	
5G n14	TBD	
5G n18	TBD	
5G n20	TBD	
5G n25	TBD	
5G n26	TBD	
5G n28	TBD	
5G n30	TBD	
5G n38	TBD	
5G n40	TBD	
5G n41	TBD	
5G n48	TBD	
5G n66	TBD	
5G n71	TBD	
5G n77	TBD	
5G n78	TBD	
5G n79	TBD	

NOTE

1.The current consumption of Table 55:SIM8230X-M2 Current consumption on VBAT Pins (VBAT=3.8V) based on SIM8230G-M2 and it is only for reference, please refer to actual current consumption.

5.6 RF Output Power

The RF output power is shown in the following table.

Table 56:Conducted output power

Band	Max.	Min.
LTE band	23dBm + 2/-2dB	< -40dBm
NR band(Power class 3)	23dBm + 2/-2dB*	< -40dBm

NOTE

1.n28/n71 is 23dBm + 2/-2.5dB for power class 3.

5.7 Conducted Receive Sensitivity

The following tables show conducted RF receiving sensitivity of SIM8230X-M2 module.

Table 57:SIM8230X-M2 Conducted RF Receiving Sensitivity

SIM8230X-M2 Series				
	Frequency	Primary (Typ.)dBm	Diversity (Typ.)dBm	SIMO1(Typ.) dBm
LTE	LTE-FDD B1(5M)	TBD	TBD	TBD
	LTE-FDD B2(5M)	TBD	TBD	TBD
	LTE-FDD B3(5M)	TBD	TBD	TBD
	LTE-FDD B4(10M)	TBD	TBD	TBD
	LTE-FDD B5(10M)	TBD	TBD	TBD
	LTE-FDD B7(10M)	TBD	TBD	TBD
	LTE-FDD B8(10M)	TBD	TBD	TBD
	LTE-FDD B12(10M)	TBD	TBD	TBD
	LTE-FDD B13(10M)	TBD	TBD	TBD
	LTE-FDD B14(10M)	TBD	TBD	TBD
	LTE-FDD B17(10M)	TBD	TBD	TBD
	LTE-FDD B18(10M)	TBD	TBD	TBD
	LTE-FDD B19(10M)	TBD	TBD	TBD
	LTE-FDD B20(10M)	TBD	TBD	TBD
	LTE-FDD B25(10M)	TBD	TBD	TBD
	LTE-FDD B26(10M)	TBD	TBD	TBD
	LTE-FDD B28(10M)	TBD	TBD	TBD
	LTE-FDD B30(10M)	TBD	TBD	TBD
	LTE-FDD B66(10M)	TBD	TBD	TBD
	LTE-FDD B71(10M)	TBD	TBD	TBD
	LTE-TDD B34(10M)	TBD	TBD	TBD
	LTE-TDD B38(10M)	TBD	TBD	TBD

	LTE-TDD B39(10M)	TBD	TBD	TBD
	LTE-TDD B40(10M)	TBD	TBD	TBD
	LTE-TDD B41(10M)	TBD	TBD	TBD
	LTE-TDD B42(10M)	TBD	TBD	TBD
	LTE-TDD B43(10M)	TBD	TBD	TBD
	LTE-TDD B48(10M)	TBD	TBD	TBD
5G NR	5G NR-FDD N1	TBD	TBD	TBD
	5G NR-FDD N2	TBD	TBD	TBD
	5G NR-FDD N3	TBD	TBD	TBD
	5G NR-FDD N5	TBD	TBD	TBD
	5G NR-FDD N7	TBD	TBD	TBD
	5G NR-FDD N8	TBD	TBD	TBD
	5G NR-FDD N12	TBD	TBD	TBD
	5G NR-FDD N13	TBD	TBD	TBD
	5G NR-FDD N14	TBD	TBD	TBD
	5G NR-FDD N18	TBD	TBD	TBD
	5G NR-FDD N20	TBD	TBD	TBD
	5G NR-FDD N25	TBD	TBD	TBD
	5G NR-FDD N26	TBD	TBD	TBD
	5G NR-FDD N28	TBD	TBD	TBD
	5G NR-FDD N30	TBD	TBD	TBD
	5G NR-FDD N66	TBD	TBD	TBD
	5G NR-FDD N70	TBD	TBD	TBD
	5G NR-FDD N71	TBD	TBD	TBD
	5G NR-TDD N38(20M SCS:30kHz)	TBD	TBD	TBD
	5G NR-TDD N40(20M SCS:30kHz)	TBD	TBD	TBD
	5G NR-TDD N41(20M SCS:30kHz)	TBD	TBD	TBD
	5G NR-TDD N48(20M SCS:30kHz)	TBD	TBD	TBD
	5G NR-TDD N77(20M SCS:30kHz)	TBD	TBD	TBD
	5G NR-TDD N78(20M SCS:30kHz)	TBD	TBD	TBD
	5G NR-TDD N79(20M SCS:30kHz)	TBD	TBD	TBD

5.8 ESD

Module is sensitive to ESD in the process of storage, transporting, and assembling. When module is mounted on the customers' main board, the ESD components should be placed closed to the connectors which human body may touch, such as SIM card socket, audio jacks, switches, USB interface, etc. The following table shows the module ESD measurement performance.

Table 58:The ESD performance measurement table (Temperature: 25℃, Humidity: 45%)

Part	Contact discharge	Air discharge
VBAT,GND	+/- 4KV	+/- 8KV
Antenna port	+/- 4KV	+/- 8KV
Full_Card_Power_Off#	+/- 3KV	+/- 6KV
USB	+/- 3KV	+/- 6KV
RESET_N	+/- 0.5KV	+/- 2KV
(U)SIM Card	+/- 0.5KV	+/- 2KV
Other PADs	+/- 0.5KV	+/- 2KV

NOTE

Test condition:
1. There are surge protection diodes and ESD protection diodes outside the module.
2. The data in the table was tested using SIMCom EVB.

6 Connect SIM8230X-M2 to board

The module should be equipped well by the connector and screw as the following figure illustration.

The module Stand-off and mounting screw also serve as part of the module Electrical Ground path. The Stand-off should be connected directly to the ground plane on the platform. So that when the module is mounted and the mounting screw is screwed on to hold the module in place, this will make the electrical ground connection from the module to the platform ground plane.

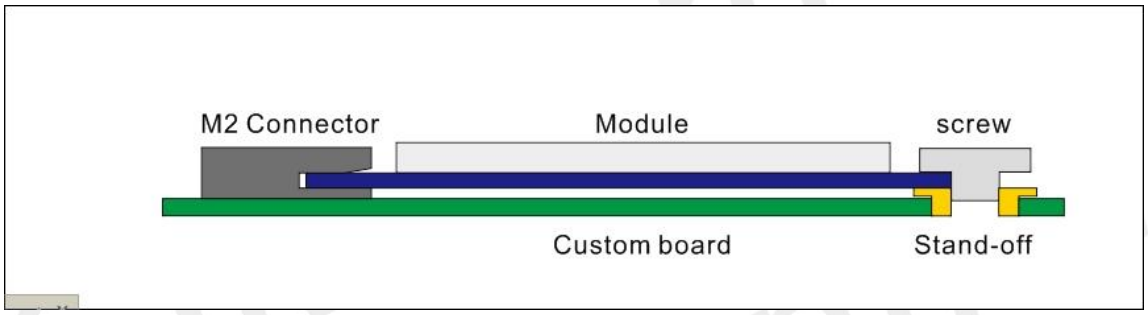

Figure 38:Equipment diagram

7 Thermal Design

Customer should pay attentions to the thermal design of SIM8230X-M2, for the mass data application scenario, the module would work in max power status and last long time, the temperature of module would increase quickly, especially in high temperature environment.

Module reserved a ground plane on the bottom side for the heat dissipating, customer could conduct the heat to the large board by the silica gel, and the surface area on large board should be more than 460 mm^2. For better thermal performance, customer could use a heat sink device to conduct the heat to the air.

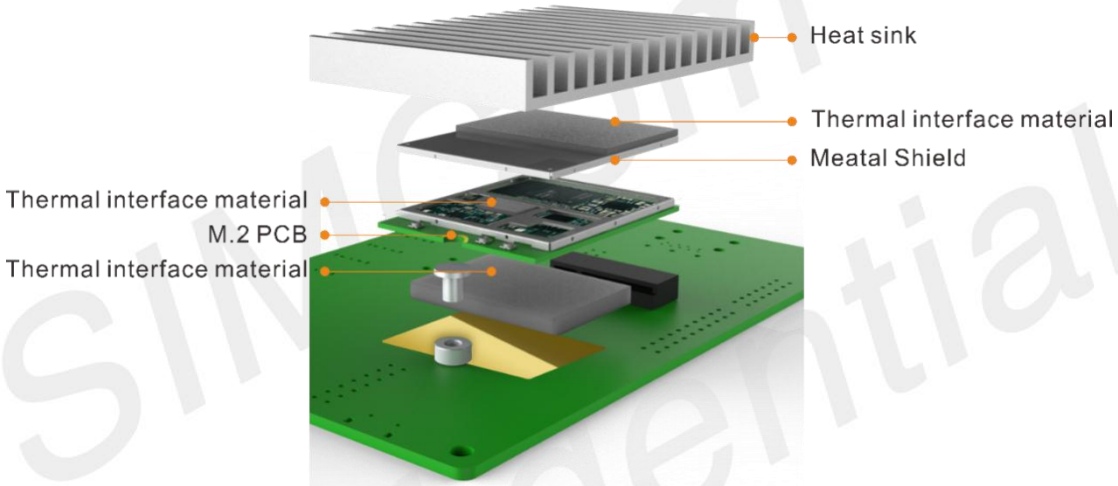

Figure 39:Thermal design diagram

Table 59:The silica gel selection guide

Item	Test method	Recommend value	Unit
Specific Gravity	ASTMD792	3.2±0.1	g/cc
Continuous use Temp	EN344	-40~+220	℃
Volume Resistivity	ASTMD257	$1.0*10^{11}$	Ω-CM
Voltage Endurance	ASTMD149	4	KV/mm
Flame Rating	UL-94	V-0	
Conductivity	ASTMD5470	8	w/m-k

8 Packaging

Module support tray packaging.

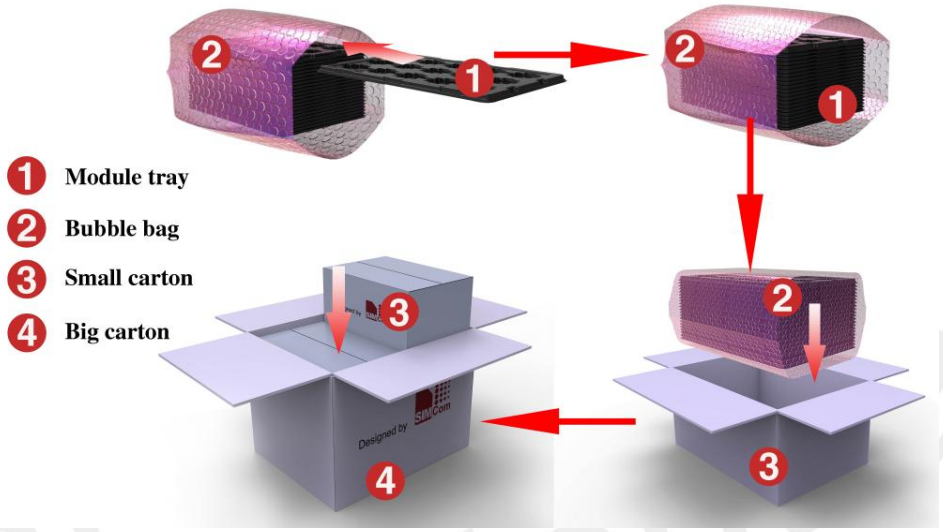

Figure 40:Packaging diagram

Module tray drawing：

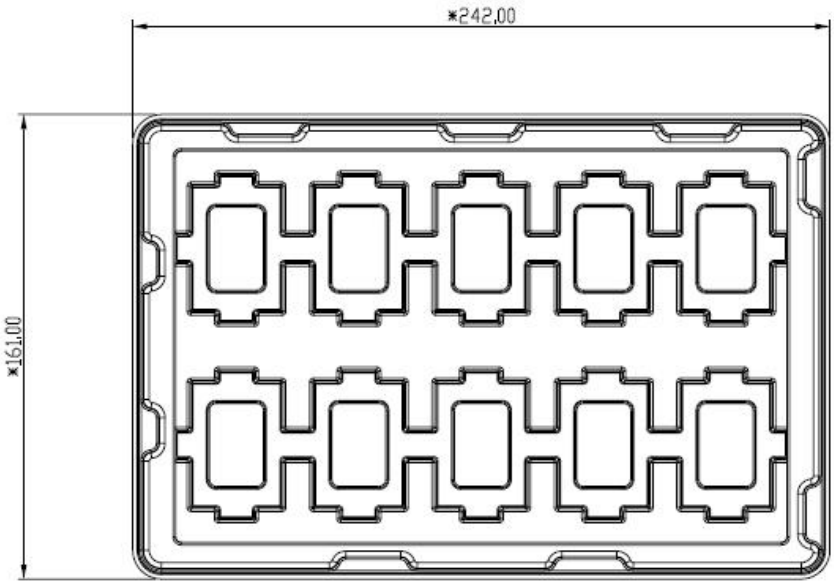

Figure 41:Tray drawing

Table 60:Tray size

Length（±3mm）	Width（±3mm）	Number
245.0	165.0	10

Small carton drawing：

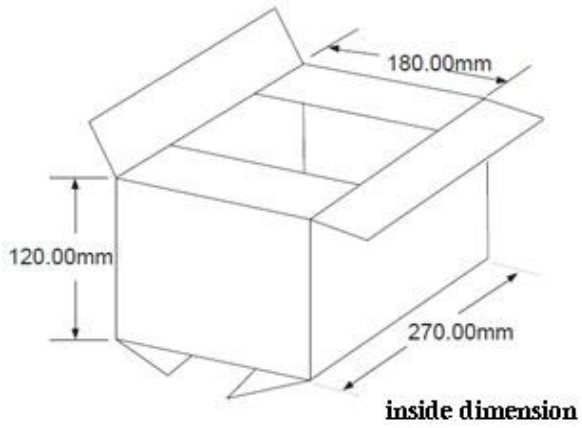

Figure 42:Small carton drawing

Table 61:Small Carton size

Length（±10mm）	Width（±10mm）	Height（±10mm）	Number
270	180	120	10*15=150

Big carton drawing：

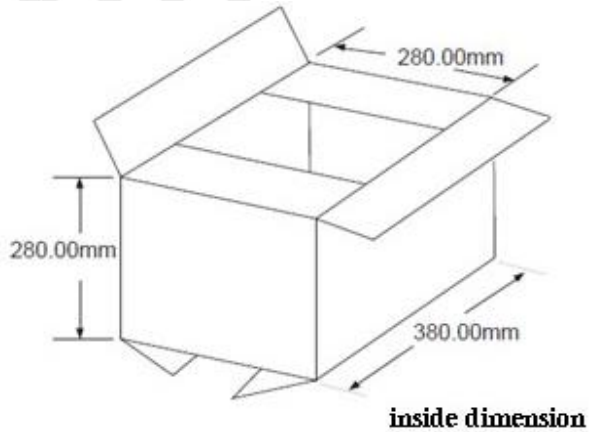

Figure 43:Big carton drawing

Table 62:Big Carton size

Length（±10mm）	Width（±10mm）	Height（±10mm）	Number
380	280	280	150*4=600

9 Appendix

9.1 Coding Schemes and Maximum Net Data Rates over Air Interface

Table 63:Coding Schemes and Maximum Net Data Rates over Air Interface

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
Category 12	600Mbps	QPSK/16QAM/64QAM/256QAM
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
Category 12	100Mbps	QPSK/16QAM/64QAM

9.2 Related Documents

Table 64:Related Documents

NO.	Title	Description
[1]	SIM8230 Series AT Command	AT Command Manual

	Manual	
[2]	ITU-T Draft new ecommendation.25ter	Serial asynchronous automatic dialing and control
[3]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[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]	Antenna Tuner reference design	Antenna tuning method and antenna tuning reference design example

9.3 Terms and Abbreviations

Table 65: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
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
EVDO	Evolution Data Only
FCC	Federal Communications Commission (U.S.)
FD	SIM fix dialing phonebook
FDMA	Frequency Division Multiple Access
FR	Full Rate
GMSK	Gaussian Minimum Shift Keying
GNSS	Global Navigation Satellite System
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global Standard for Mobile Communications
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

MDIO	Management Data Input/Output
MMD	MDIO manageable device
MO	Mobile Originated
MS	Mobile Station (GSM engine), also referred to as TE
MT	Mobile Terminated
NMEA	National Marine Electronics Association
PAP	Password Authentication Protocol
PBCCH	Packet Switched Broadcast Control Channel
PCB	Printed Circuit Board
PCS	Personal Communication System, also referred to as GSM 1900
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
TDMA	Time Division Multiple Access
TE	Terminal Equipment, also referred to as DTE
TX	Transmit Direction
UART	Universal Asynchronous Receiver & Transmitter
VSWR	Voltage Standing Wave Ratio
SM	SIM phonebook
SGMII	Serial gigabit media independent interface
NC	Not connect
EDGE	Enhanced data rates for GSM evolution
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
USIM	Universal subscriber identity module
UMTS	Universal mobile telecommunications system
UART	Universal asynchronous receiver transmitter

9.4 Safety Caution

Table 66: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.
	GSM cellular terminals or 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 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 SIM card be properly inserted in the cellular terminal or mobile.