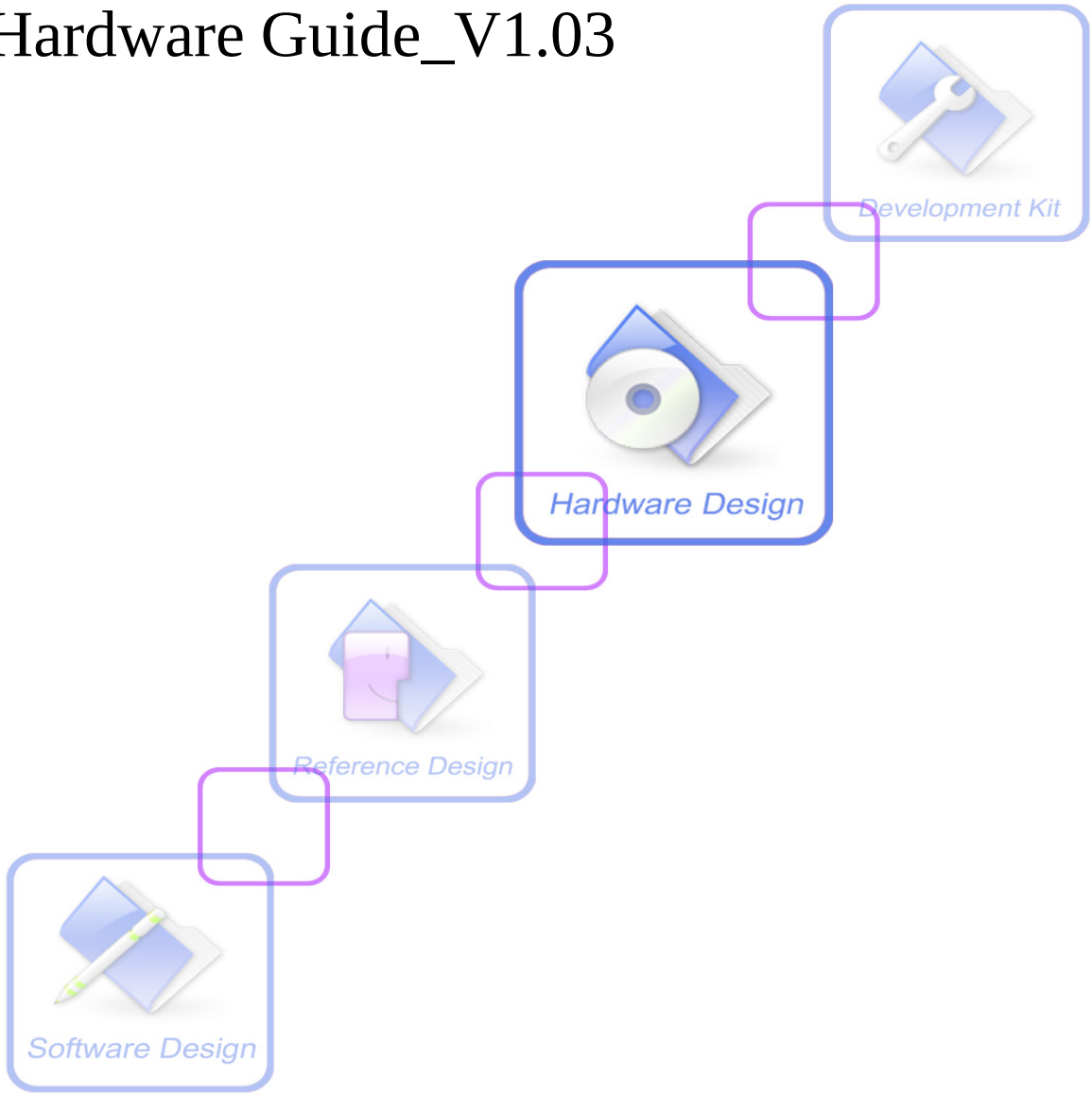
SIM7230 Mini PCIe Module

Hardware Guide_V1.03



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Version History

Date	Version	Description of change	Author
2014-03-12	1.00	Origin	Ma Honggang Li Ya
2014-05-29	1.01	Update figure 23; Update table 1 LTE Category 4 to 150Mbps;	Ma Honggang
2014-06-24	1.02	Correct the document version; Update figure 25;	Ma Honggang

1. Introduction

Scope of this document is to give a detail design guide of the SIMCom SIM7230 series, this document can help user to quickly understand SIM7230 interface specifications, electrical and mechanical details. With the help of this document and other SIM7230 application notes, user guide, users can apply SIM7230 in various applications quickly.

2. SIM7230 Overview

SIM7230 is a PC embedded Wireless Wide Area Network (WWAN) module, it offers a Mini PCI Express interface, which complies with the *PCI Express Mini Card Electromechanical Specification Revision 1.2*. It provides LTE, WCDMA, GSM and GPS connectivity, and it is very convenient to equip in portable or other devices.

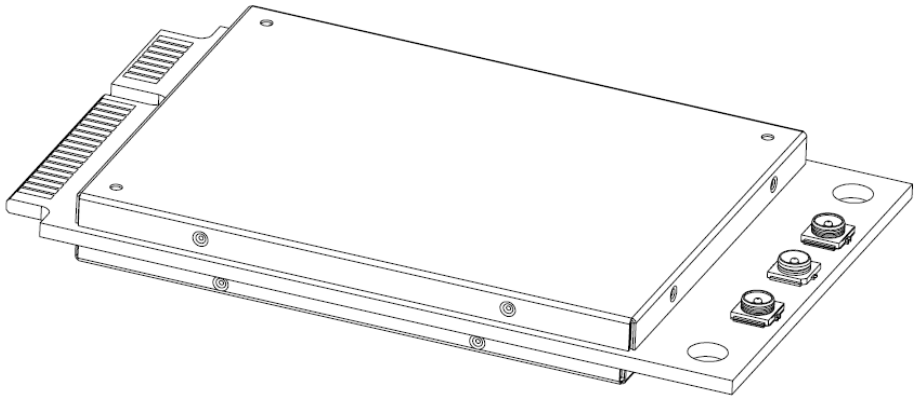

Figure 1: SIM7230 overview

With the frontier technology, SIM7230 supports LTE – FDD Cat 4, it has 3 antenna ports which support multi-band MIMO antenna systems, and the LTE data rate can reach up to 100 Mbps downlink and the 50 Mbps uplink.

SIM7230 has the dimension of 50.95*30*4.65mm, and it provides the following hardware interfaces between the module and customers' board.

- Host device wake up function
- One high speed USB port can be used as data transmission, communication, debugging and firmware upgrading
- One set of PCM interface
- One USIM card interface supporting hot swap function
- One WWAN indicator LED
- Hardware reset function
- Airplane mode control

SIM7230 integrates TCP/IP protocol and extended TCP/IP AT commands which are very useful for data transfer applications. For details about TCP/IP applications, please refer to *document [2]*.

Table 1: SIM7230 key features

Feature	Implementation
Power supply	3.3V
Frequency bands	Reference table 4
Transmitting power	GSM/GPRS: ● Class 4 (2W): GSM850、EGSM900 ● Class 1 (1W): DCS1800、PCS1900 EDGE: ● Class E2 (0.5W): GSM850、EGSM900 ● Class E1 (0.4W): DCS1800、PCS1900 UMTS: ● Class 3 (0.25W): WCDMA2100/1800/900/850/800 LTE: ● Class 3 (0.25W): LTE B1/B2/B3/B4/B5/B7/B8/B11/B17/B18/B19/B20/B21/B41
Connectivity Speed	GPRS Class B, multi-slot class 12 operation, coding scheme: CS1-4, DL maximum speed: 85.6kbps; UL maximum speed: 85.6kbps ● EDGE multi-slot class 12 operation, coding scheme: MSC1-9, DL maximum speed: 236.8kbps; UL maximum speed: 236.8kbps ● UMTS R99 speed: 384 kbps DL/UL ● HSDPA Category 24 - 42.2 Mbps, HSUPA Category 7 - 11.5 Mbps ● LTE Category 4 - 150 Mbps (DL) ● LTE Category 4 - 50 Mbps (UL)
SMS	● MT, MO, CB, Text and PDU mode ● SMS storage: USIM Card or NAND
USB	USB 2.0 High speed port ● USB Application Port ● USB Debug Port ● USB Speech Port ● Modem
USIM interface	Support USIM card: 1.8V, 2.85V
PCM interface	Support PCM master and slave mode. Data length is 16 bits (linear), PCM clock rate is 512KHz (Max).
I2C interface	Compliant with I2C protocol, support high speed and master mode. Open drain output and has been pulled up Inside the module.
External antenna	Three antenna SMT connectors
Temperature range	● Normal operation temperature: -40℃ ~ +80℃ ● Storage temperature: -45 ℃ ~ +90℃
Physical characteristics	Size: 50.95*30*4.65mm Weight: TBD
Memory capacity	2Gbit DDR2 RAM and 4Gbit NAND flash.
Firmware upgrade	Firmware upgrade over USB interface

Table 2: Coding schemes and maximum net data rates over air interface

Multislot definition(GPRS/EDGE)			
Slot class	**DL slot number**	**UL slot number**	**Active slot number**
1	1	1	2
2	2	1	3
3	2	2	3
4	3	1	4
5	2	2	4
6	3	2	4
7	3	3	4
8	4	1	5
9	3	2	5
10	4	2	5
11	4	3	5
12	4	4	5
GPRS coding scheme	**Max data rata（4 slots）**		**Modulation type**
CS 1 = 9.05 kb/s / time slot	36.2 kb/s		GMSK
CS 2 = 13.4 kb/s / time slot	53.6 kb/s		GMSK
CS 3 = 15.6 kb/s / time slot	62.4 kb/s		GMSK
CS 4 = 21.4 kb/s / time slot	85.6 kb/s		GMSK
EDGE coding scheme	**Max data rata（4 slots）**		**Modulation type**
MCS 1 = 8.8 kb/s/ time slot	35.2 kb/s		GMSK
MCS 2 = 11.2 kb/s/ time slot	44.8 kb/s		GMSK
MCS 3 = 14.8 kb/s/ time slot	59.2 kb/s		GMSK
MCS 4 = 17.6 kb/s/ time slot	70.4 kb/s		GMSK
MCS 5 = 22.4 kb/s/ time slot	89.6 kb/s		8PSK
MCS 6 = 29.6 kb/s/ time slot	118.4 kb/s		8PSK
MCS 7 = 44.8 kb/s/ time slot	179.2 kb/s		8PSK
MCS 8 = 54.4 kb/s/ time slot	217.6 kb/s		8PSK
MCS 9 = 59.2 kb/s/ time slot	236.8 kb/s		8PSK
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
Category 7	11.5Mbps	16QAM
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
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

2.1. Operating Mode

The table below summarizes the various operating modes of SIM7230 PCIe.

Table 3: Operating Mode

Mode	Status	Function	
Normal operation	Sleep	GSM/GPRS/ EDGE/WCDMA /LTE	Module will automatically go into sleep mode if the conditions of sleep mode are enabling and there is no on air and no hardware interrupt (such as USB wake-up operation or data on serial port). In this case, the current consumption of module will be reduced to the minimal level. In sleep mode, the module can still receive paging message and SMS.
	Idle	GSM/WCDMA/LTE	Software is active. Module is registered to the GSM/WCDMA/LTE network, and the module is ready to communicate.
	Talk	GSM/WCDMA	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, antenna.
	Standby	EDGE/HSPA+/LTE	Module is ready for EDGE/HSPA+ /LTE data transfer, but no data is currently sent or received. In this case, power consumption depends on network settings and EDGE/HSPA+ /LTE configuration.
	Data transfer	EDGE/HSPA+ /LTE	There is EDGE/HSPA+/LTE data transfer in progress. In this case, power consumption is related to network settings (e.g. power control level); uplink/downlink data rates and GPRS configuration (e.g. used multi-slot settings).
Minimum functionality mode		AT command “AT+CFUN” 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 or the USIM card will not be accessible, or both RF part and USIM card will be closed, and the serial port is still accessible. The power consumption in this mode is lower than normal mode.	

2.2. Functional Diagram

Figure 2 shows the functional diagram of the SIM7230 module, the major functional units of SIM7230 including the following parts:

- Baseband processor
- Power management unit
- Multi-chip package memory
- Radio frequency transceiver
- Antenna interfaces
- 52 PIN Mini PCIe Interface

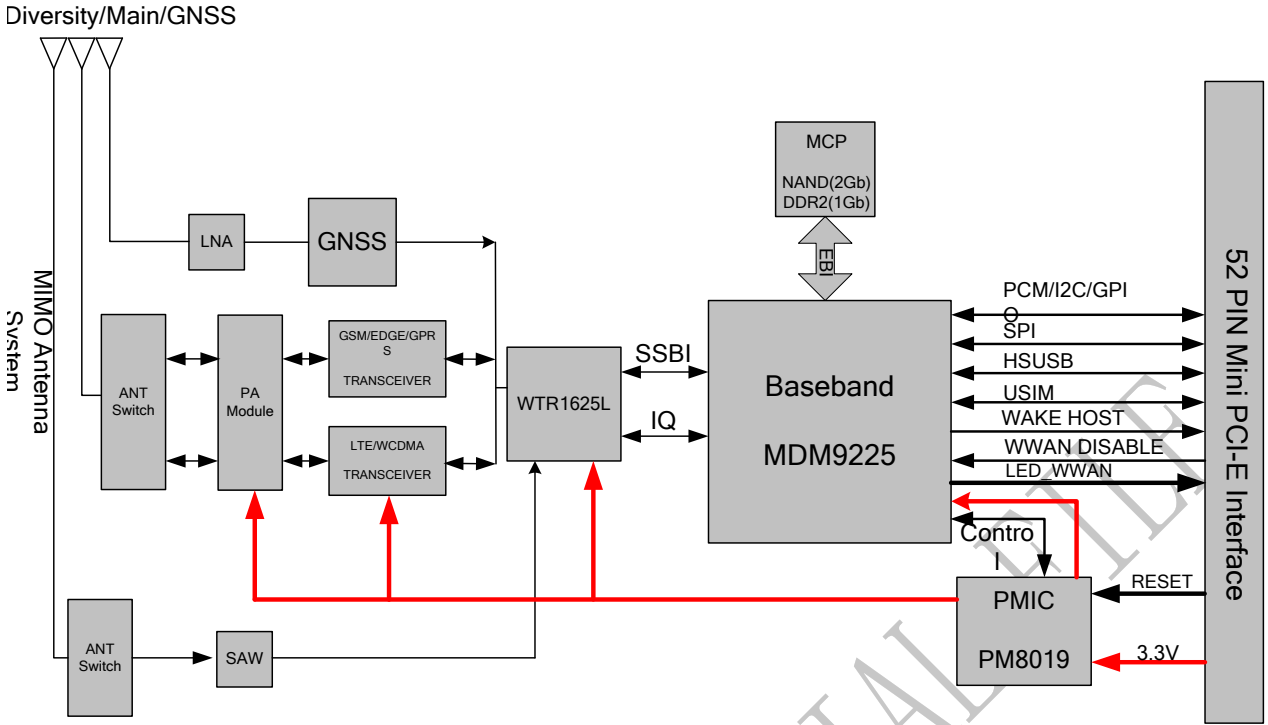

Figure 2: SIM7230 functional diagram

2.3. SIM7230 Variants

Three regional variants of the SIM7230 are available, one for European, APAC and Latin American markets (SIM7230E), one for the North American market (SIM7230A), and the Japan version named SIM7230J. All the variants include multiband configurations, covering different sets of 2G, 3G and 4G bands.

Table 4: SIM7230 variants

Standard	**Frequency** (Band)	**SIM7230E**	**SIM7230A**	**SIM7230J**
GSM	GSM850MHz/DCS1900 MHz		✓	✓
	EGSM900MHz/PCS1800 MHz	✓		✓
HSPA+	900MHz (B8)	✓		✓
	2100 MHz (B1)	✓		✓
	850 MHz (B5)		✓	
	800 MHz (B6)			✓
	1800 MHz (B3)	✓		
	1900 MHz (B2)		✓	
LTE	900MHz (B8)	✓		
	1800 MHz (B3)	✓		
	2100 MHz (B1)	✓		✓
	2600 MHz (B7)	✓		
	800 MHz (B20)	✓		

	850 MHz (B5)		✓	
	1700 MHz (B4)		✓	
	1900 MHz (B2)		✓	
	700 MHz (B17)		✓	
	1400 MHz (B11)			✓
	800 MHz (B18)			✓
	800 MHz (B19)			✓
	1400 MHz (B21)			✓
DRX (MIMO)	Receiver Diversity	✓	✓	✓
GNSS	GPS/ GLONASS	✓	✓	✓

2.4. SIM7230 Mini PCIe Interface

Table 5: PCI Express Mini Card Connector Pin Description

Pin No	PIN Name		I/O	Comment
	Mini PCI Express Standard Description V1.2	SIM7230 PIN Description		
1	WAKE#	WAKE#	O	Active low signal used to wake up the host from stand-by mode
2	3.3Vaux	VCC	I	3.3V power supply
3	COEX1	NC	-	Not connected
4	GND	GND	-	Ground
5	COEX2	NC	-	Not connected
6	1.5V	NC	-	Not connected
7	CLKREQ#	NC	-	Not connected
8	UIM_PWR	USIM_VDD	O	Power source for the external USIM card
9	GND	GND	-	Ground
10	UIM_DATA	USIM_DATA	I/O	External USIM card data signal
11	REFCLK-	NC	-	Not connected
12	UIM_CLK	USIM_CLK	O	External USIM card clock signal
13	REFCLK+	NC	-	Not connected
14	USIM_RESET	USIM_RST	O	External USIM card reset signal
15	GND	GND	-	Ground
16	UIM_VPP	USIM_DET	I	External USIM card presence detect signal, hot swap
17	Reserved* (UIM_C8)	NC	-	Not connected

Pin No	PIN Name		I/O	Comment
	Mini PCI Express Standard Description V1.2	SIM7230 PIN Description		
18	GND	GND	-	Ground
19	Reserved* (UIM_C4)	NC	-	Not connected
20	W_DISABLE#	W_DISABLE#	I	Active low signal for wireless disabling (Airplane mode)
21	GND	GND	-	Ground
22	PERST#	PERST#	I	Active low functional reset to the card
23	PERn0	NC	-	Not connected
24	+3.3Vaux	NC	-	Not connected
25	PERp0	NC	-	Not connected
26	GND	GND	-	Ground
27	GND	GND	-	Ground
28	+1.5V	NC	-	Not connected
29	GND	GND	-	Ground
30	SMB_CLK	SCL	O	I2C bus clock signal
31	PETn0	NC	-	Not connected
32	SMB_DATA	SDA	I/O	I2C bus data signal
33	PETp0	NC	-	Not connected
34	GND	GND	-	Ground
35	GND	GND	-	Ground
36	USB_D-	USB_D-	-	USB differential data (-)
37	GND	GND	-	Ground
38	USB_D+	USB_D+		USB differential data (+)
39	+3.3Vaux	VCC	I	3.3V supply
40	GND	GND	-	Ground
41	+3.3Vaux	VCC	I	3.3V supply
42	LED_WWAN#	LED_WWAN#	O	Active low, open drain signal for WWAN LED driving, used to provide module's status indication
43	GND	GND	-	Ground
44	LED_WLAN#	GPIO3	I/O	General purpose input/output
45	Reserved	PCM_CLK	O	PCM clock
46	LED_WPAN#	GPIO4	I/O	General purpose input/output

Pin No	PIN Name		I/O	Comment
	Mini PCI Express Standard Description V1.2	SIM7230 PIN Description		
47	Reserved	PCM_OUT	O	PCM data output
48	+1.5V	NC	-	Not connected
49	Reserved	PCM_IN	I	PCM data input
50	GND	GND	-	Ground
51	Reserved*	PCM_SYNC	O	PCM frame synchronization
52	+3.3Vaux	VCC	I	3.3V supply

3. Package Information

The Mini PCIe Adapter adopts a standard Mini PCI Express connector that has 52 pins and complies with the *PCI Express Mini Card Electromechanical Specification Revision 1.2.*

3.1 Pin Out Diagram

The following figure shows the PIN sequence of SIM7230:

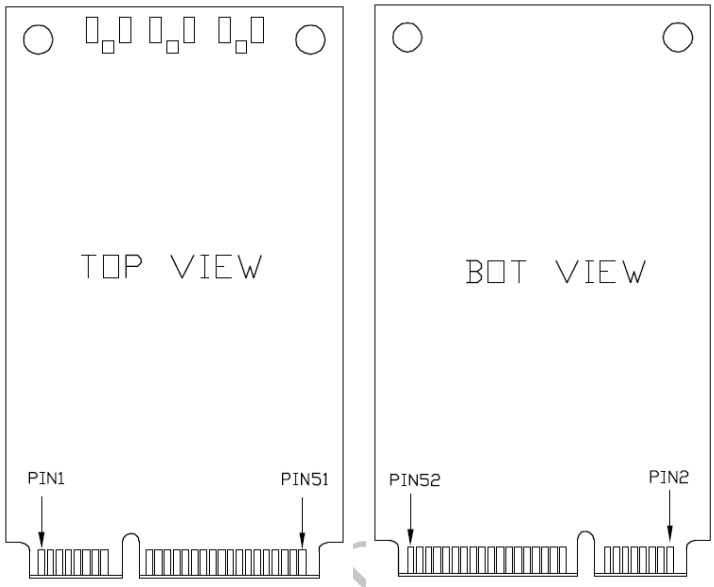

Figure 3: SIM7230-PCIe pin out Diagram

3.2 Package Dimensions

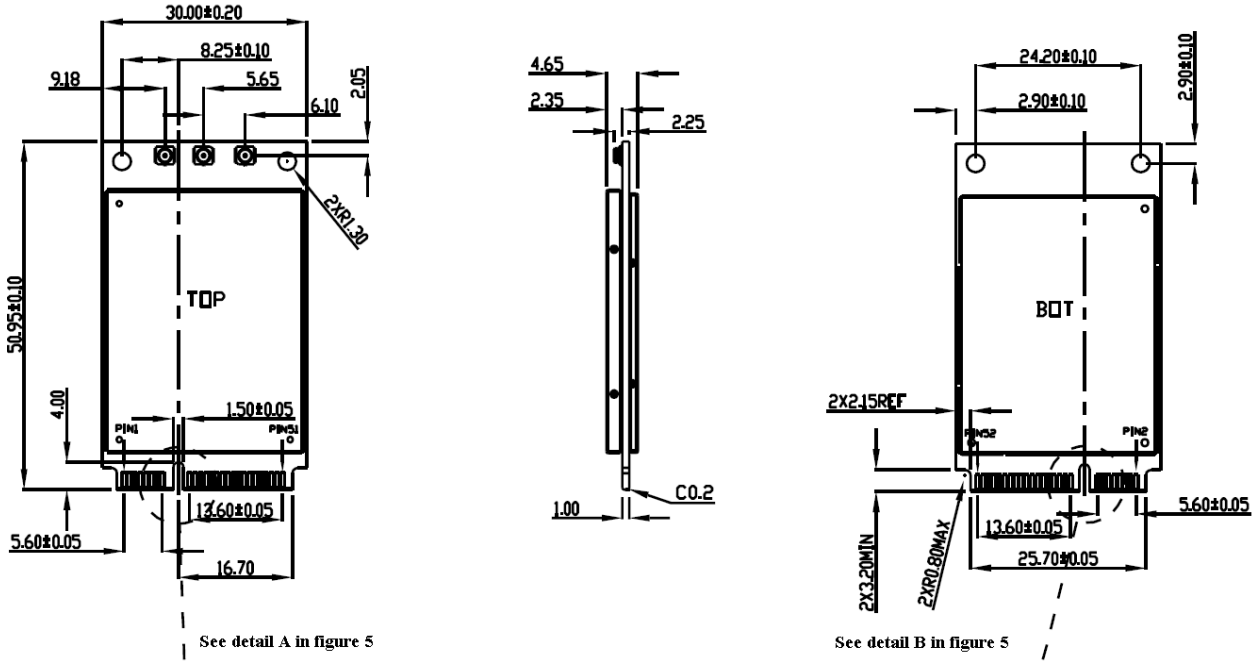

Figure 4: Dimensions of SIM7230-PCIe (Unit: mm)

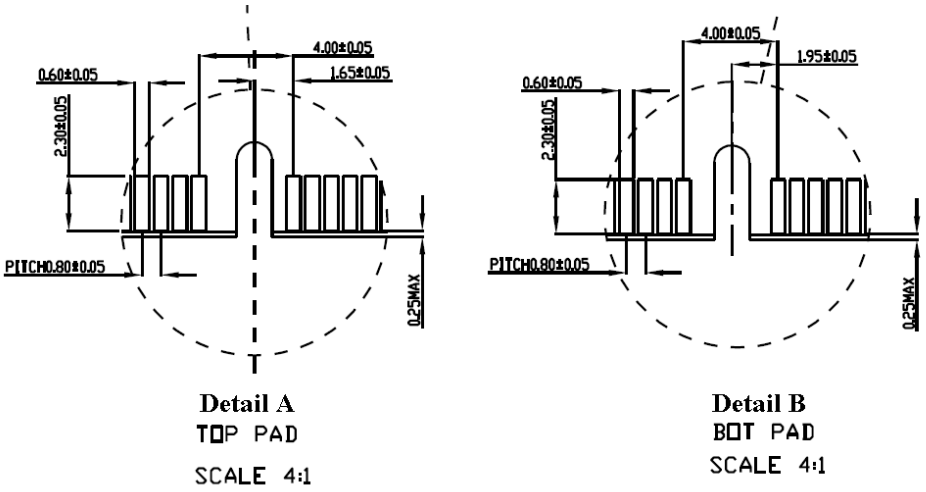

Figure 5: Detail dimensions of golden finger

Please refer to *PCI Express Mini Card Electromechanical Specification Revision 1.2* for package dimension details.

3.3 Mini PCI Express Connector and Latch

SIM7230 should equip to the edge card connector and lock down by the Latch, this chapter takes the Molex 67910-0002 and 48099-4000 as an example.

The figure 6 shows the PCI Express connector dimensions:

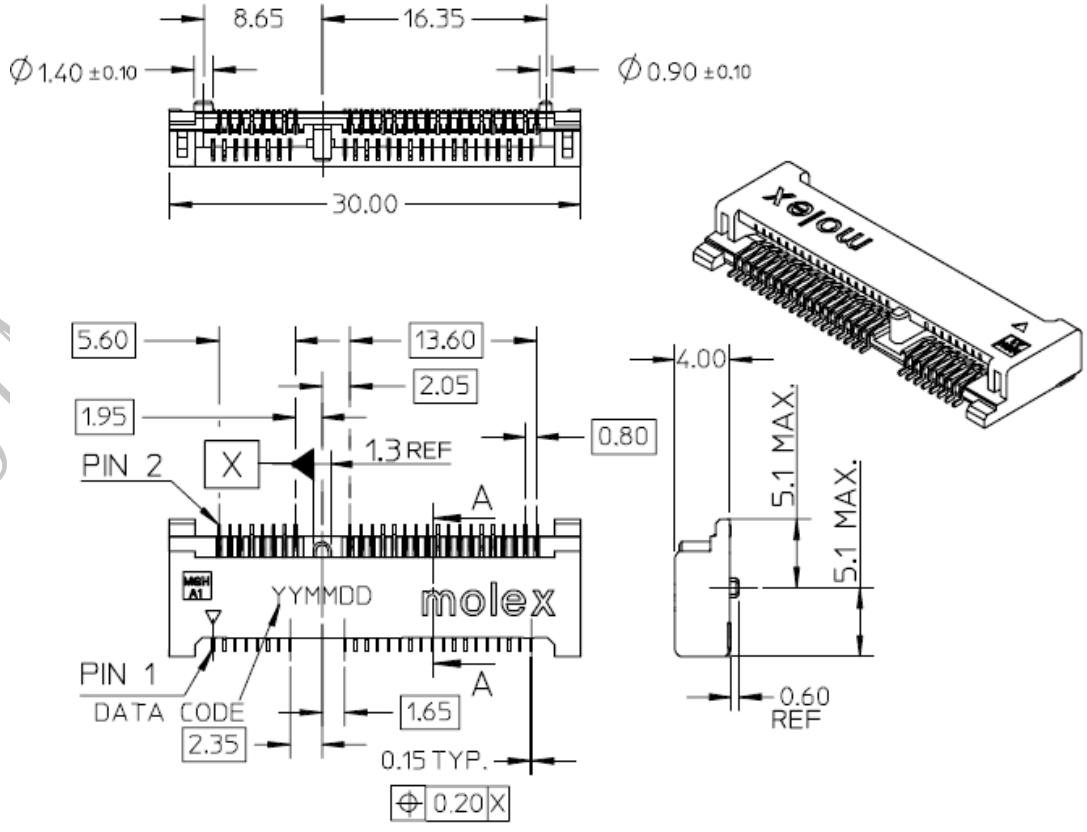

Figure 6: Dimensions of PCI Express connector

The figure 7 shows the Latch for the edge card connector:

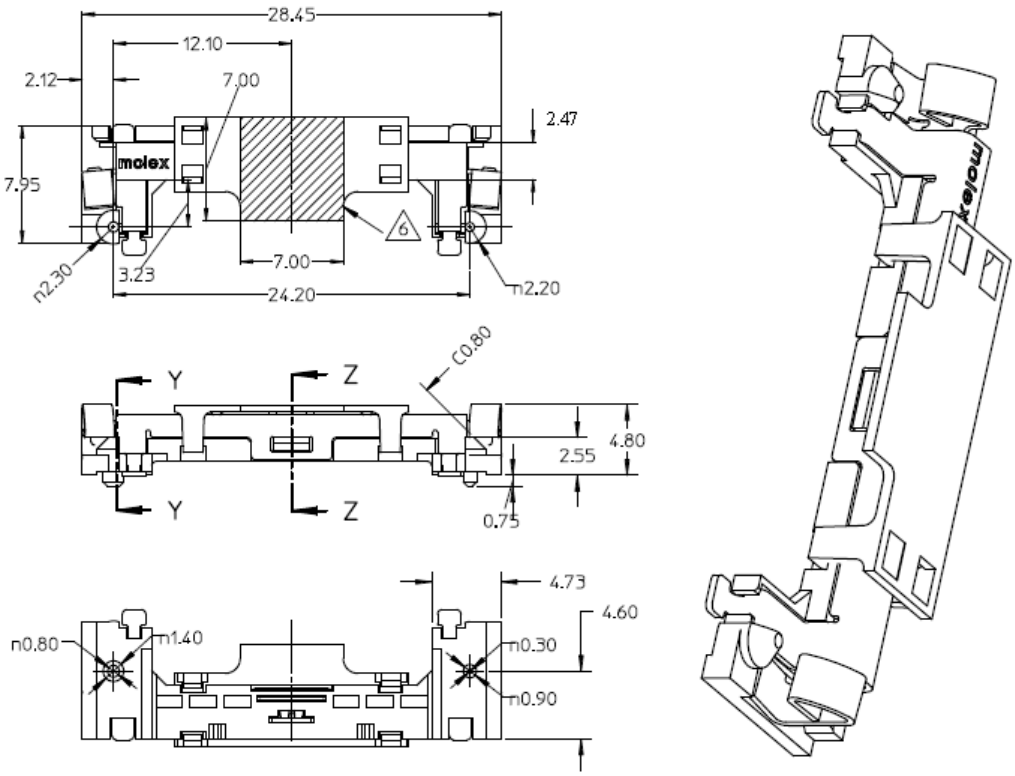

Figure 7: Dimensions of Latch for PCI Express connector

3.4 Installing SIM7230 on main board

Step 1: Insert SIM7230 into the Mini PCI Express connector on the main board.

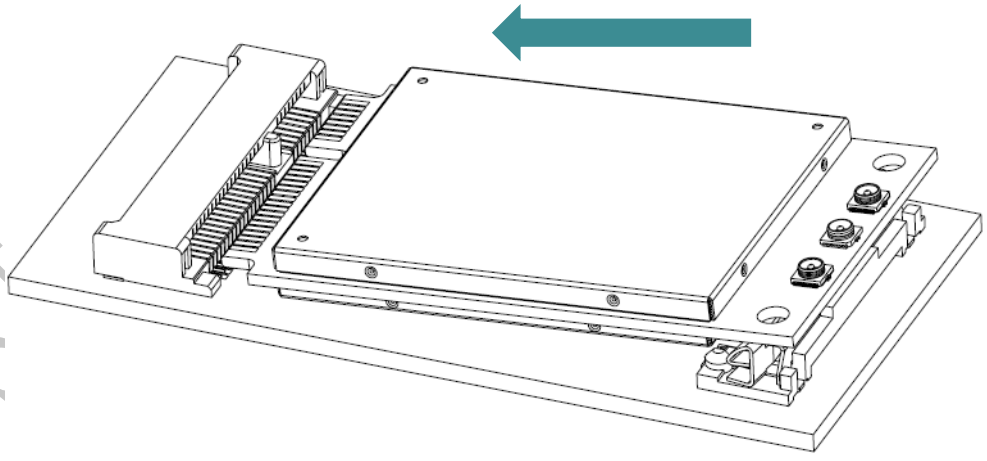

Figure 8: Step 1 of installing SIM7230 on the main board

Step 2: Press downwards to fix SIM7230 Adapter in the module slot.

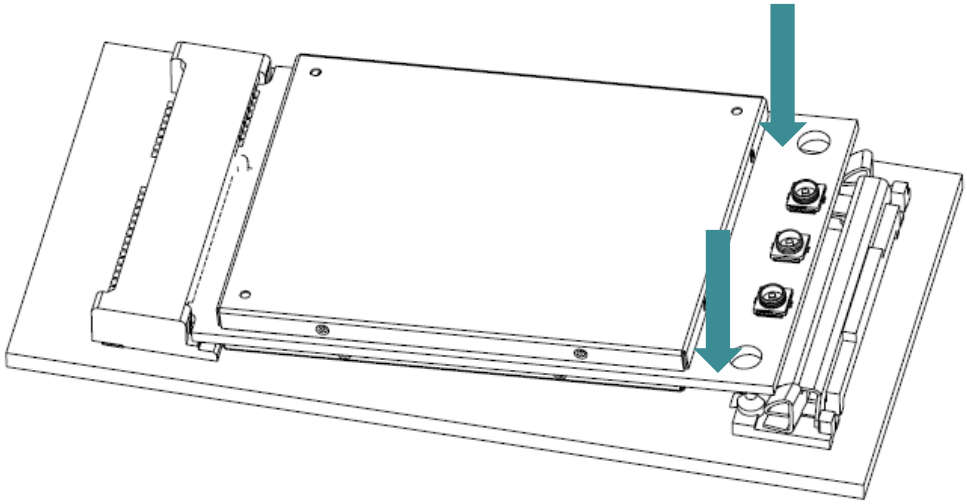

Figure 9: Step 2 of installing SIM7230 on the main board

Step 3: Equip the antenna to the main board via the connector; customer should notice the sequence of antenna and connector size matching.

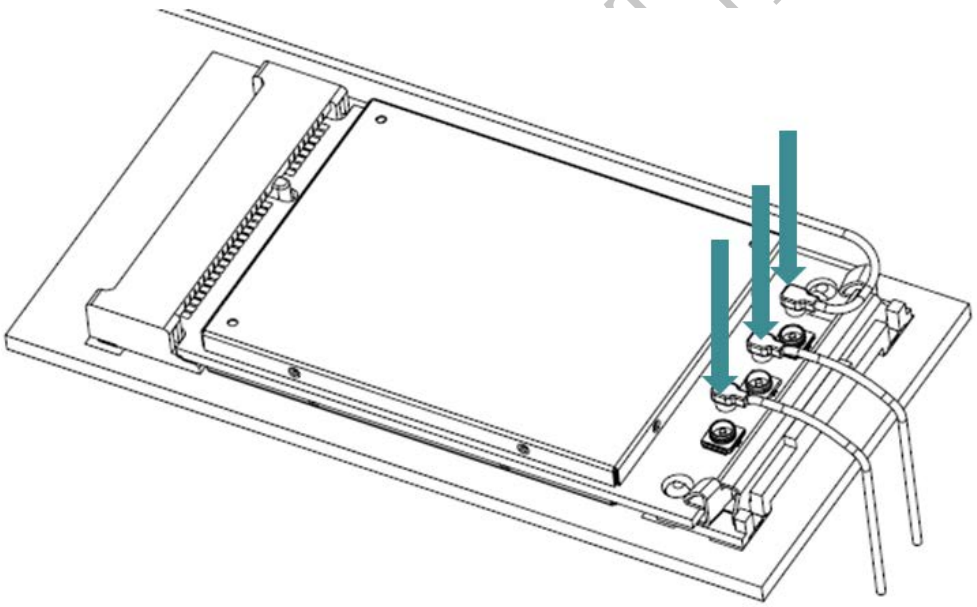

Figure 10: Step 3 of installing SIM7230 on the main board

3.5 Removing SIM7230 from main board

Step 1: Disconnect the antenna cables from SIM7230 cables.

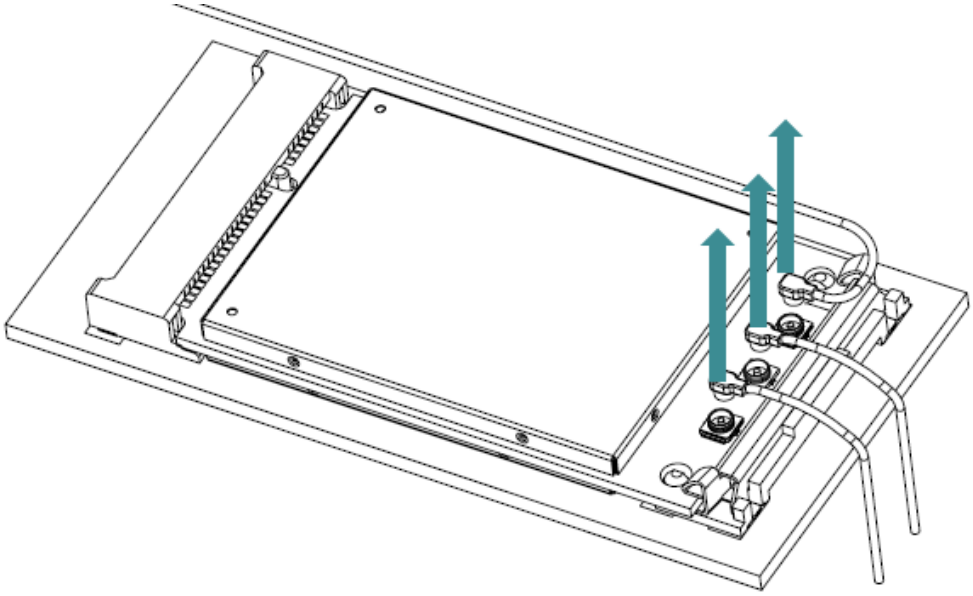

Figure 11: Step 1 of removing SIM7230 from the main board

Step 2: Push the two clips to release SIM7230 from the slot.

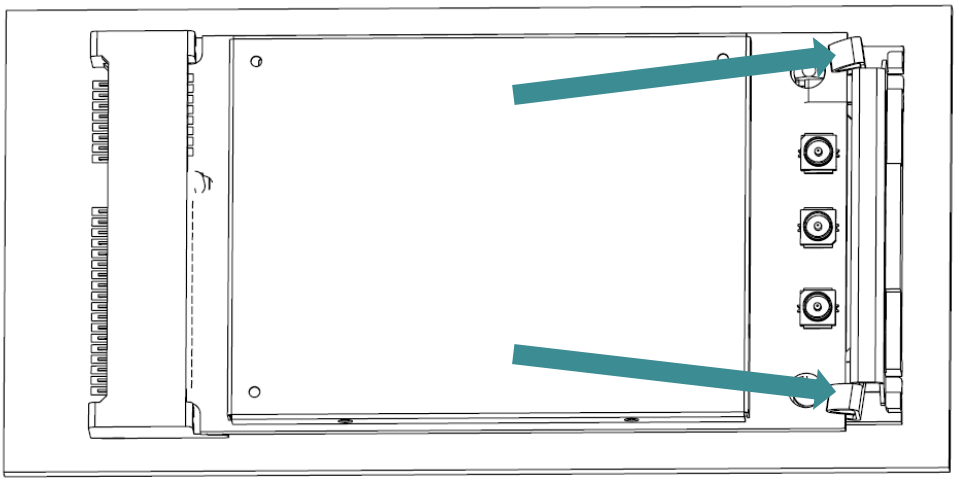

Figure 12: Step 2 of removing SIM7230 from the main board

Step 3: Push SIM7230 from the direction as following figure shows.

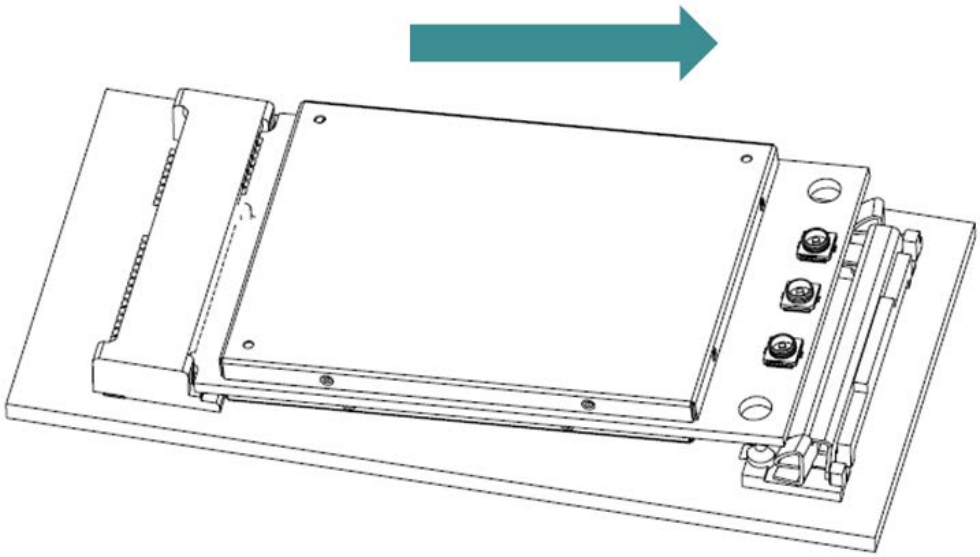

Figure 13: Step 3 of removing SIM7230 from the main board

Step 4: Push SIM7230 from the direction as following figure shows.

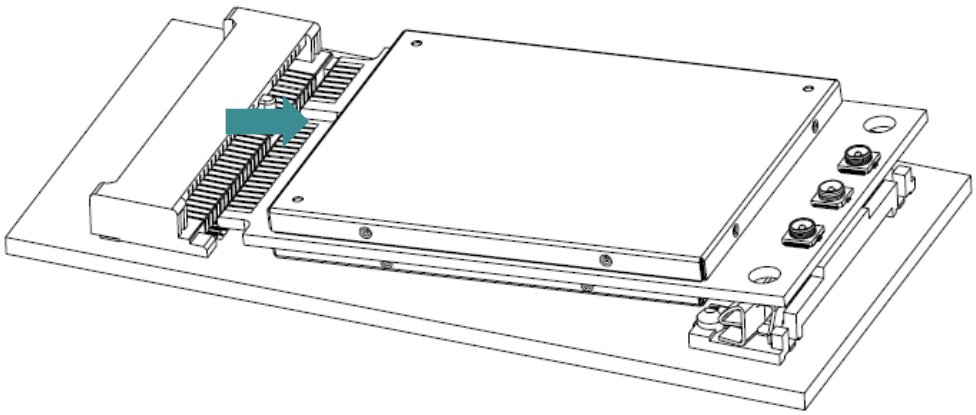

Figure 14: Step 4 of removing SIM7230 from the main board

4. Application Interface

4.1 Power Supply

The recommended power supply of SIM7230 is 3.3V and the voltage ranges from 3.2 V to 3.6 V. The SIM7230 has 4 power pins and 13 Ground pins, to ensure the SIM7230 module works normally, all the pins must be connected. The PCIe connector pin is defined as necessary to support 500mA per Pin continuously.

When the module works at the 2G mode, the transmitting burst will cause voltage drop and the power supply must be able to provide sufficient current up to 2.5A. For the 3.3V input, 3 bypass capacitors (low ESR) such as 220μF are strongly recommended. Make sure that the voltage does not drop below 3.2 V in any case.

The 10pF and 33pF capacitors can effectively eliminate the high frequency interference. A 5.1V/500mW Zener diode can be reserved, the diode can prevent chip from damaging by the voltage surge. These capacitors and Zener diode should be placed as close to SIM7230 VCC pins as possible.

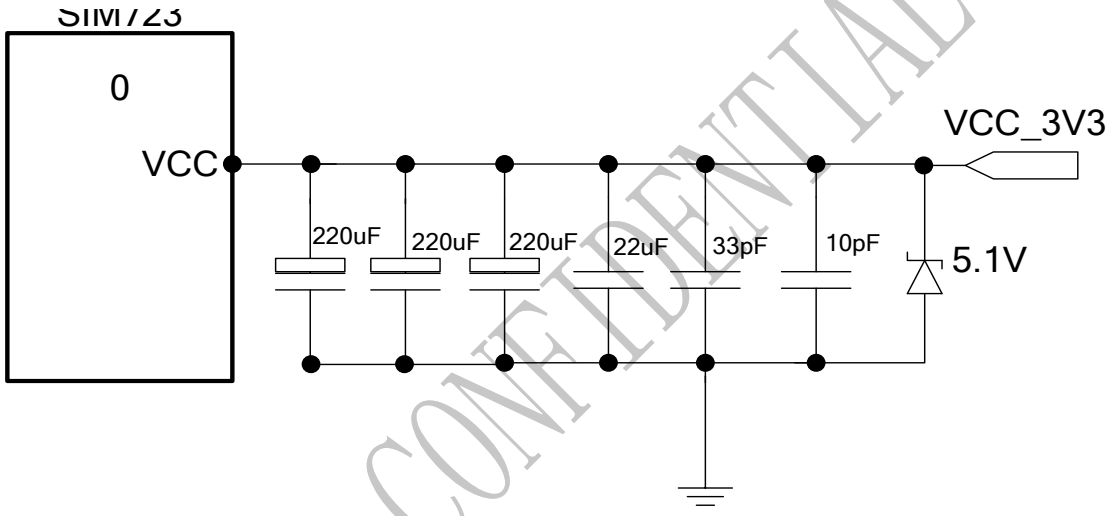

Figure 15: Recommended power circuit of SIM7230 module

Table 6: Recommended Zener diode

	Vendor	Part number	Power (watts)	Package
1	On semi	MMSZ5231BT1G	500mW	SOD123
2	cj-elec	MMSZ5231B	500mW	SOD123
3	Prisemi	PZ3D4V2H	500mW	SOD323
4	Prisemi	PZ5D4V2H	500mW	SOD523
5	Vishay	MMSZ4689-V	500mW	SOD123
6	Crownpo	CDZ55C5V1SM	500mW	0805

Table 7: Power and ground specifications

Pin Name	Pin No	Min	Type	Max
VCC	2, 39,41,52	3.2V	3.3V	3.6V
GND	4,9,15,18,21,26,27,29, 34,35,37,40,43,50			

4.2 Power Saving Mode

SIM7230 has two power saving modes: minimum functionality mode and sleep mode. When SIM7230 is in sleep mode and minimum functionality mode, the current consumption of module is lowest.

4.2.1. Minimum Functionality Mode and Sleep Mode

The AT command “AT+CFUN=<fun>” can be used to set SIM7230 into minimum functionality.
There are three functionality modes, which could be set by the AT command “AT+CFUN=<fun>”. The command provides the choice of the functionality levels <fun>=0, 1, 4.

- AT+CFUN=0: Minimum functionality.
- AT+CFUN=1: Full functionality (default).
- AT+CFUN=4: Airplane mode (disable RF function).

Table 8: The Current Consumption of Minimum Functionality Mode (BS-PA-MFRMS=5)

<fun>	Current consumption(mA) (sleep mode)
0	TBD
1	TBD
4	TBD

Minimum functionality mode minimizes the current consumption to the lowest level. If SIM7230 is set to minimum functionality by “AT+CFUN=0”, the RF function and USIM card function will be disabled. In this case, the serial port and USB port are still accessible, but all AT commands correlative with RF function and USIM card function will not be accessible.

Note: For detailed information about the AT Command “AT+CFUN=<fun>”, please refer to document [1].

If host sends USB suspend request, SIM7230 will enter sleep mode automatically for reducing power consumption, when peripheral equipment of SIM7230 stops working, and module has no on air or audio activity required. In sleep mode, SIM7230 can still receive paging or SMS from network.

Note: SIM7230 could enter sleep mode when the host CPU supports USB suspend mode, otherwise it could not enter sleep mode.

4.2.2. Wake Up SIM7230 from Sleep Mode

When SIM7230 is in sleep mode, the following methods can wake up the module:

- Host sends USB resume request.
- Receive a data call from network.
- Receive a voice call from network.
- Receive a SMS from network.

4.3 USB 2.0

SIM7230 is compliant with Universal Serial Bus Specification Rev 2.0, It supports full-speed and high-speed when acting as a USB device.

For the large data rate of LTE network, SIMCom strongly suggests customer to design the device with the high speed USB specification with the data rate of 480Mbps to satisfy the increasing needs of data application.

USB interface features include:

- Windows: Modem or COM ports, using host Windows drivers
- Linux: / dev / ttyUSBn devices for Linux systems
- USB-compliant transceivers
- Selective suspend mode
- Data rate: Full-speed (12 Mbps) / High-speed (480 Mbps)
- Resumption initiated by host or module

Table 9: USB interface signals

Pin Name	Pin No	I/O	Description	DC Characteristics		
				Min	Typ	Max
USB_DN	36	I/O	USB differential data (-)	-	-	-
USB_DP	38	I/O	USB differential data (+)	-	-	-

4.3.1 USB Port Specification

SIM7230 could achieve data transfer, voice call (voice data input/output from the host device's MIC and SPEAKER), debug and software download, etc, through USB interface. When module is powered on, and USB_DP, USB_DN and GND are connected to the host, and the driver is installed successfully, then 4 COM port could be recognized by the host.

Table 10: USB port Specification

Port Name	Description
SimTech HS-USB AT Port	Module could be controlled by sending AT command via AT port.
SimTech HS-USB Diagnostics	Module could be debugged by grabbing log through Diagnostics port.
SimTech HS-USB NMEA	NMEA information could be grabbed from the NMEA port.
SimTech HS-USB PCM Voice	Voice call could be achieved through PCM Voice port.
SimTech HS-USB Modem	Module could transfer data through Modem.

Note: SimTech HS-USB PCM Voice function is under development.

4.3.2 Firmware Update

If users need to upgrade through USB port, it is necessary to power on SIM7230 first, and then connect USB_DP, USB_DN, GND to host device. For the detail illustration of firmware upgrading please refer to *document [4]*.

4.3.3 High-speed USB Layout Guide Lines

This section summarize the guidelines for designing controlled-impedance, high-speed USB PCBs to comply with the USB specification.

- The impedance could be controlled to 90Ω
- Route the high-speed clock and high-speed USB differential signals with minimum trace lengths.
- Route the high-speed USB signals on the plane closest to the ground plane
- Route the high-speed USB signals using a minimum of vias and corners.
- When it becomes necessary to turn 90°, use two 45° turns or an arc instead of making a single 90° turn. This reduces reflections on the signal traces by minimizing impedance discontinuities.
- Route the high-speed USB signals using a minimum of vias and corners. This reduces signal reflections and impedance changes.
- Do not route USB traces under or near crystals, oscillators, clock signal generators, switching regulators, mounting holes, magnetic devices or IC's that use or duplicate clock signals.
- Avoid stubs on the high-speed USB signals because they cause signal reflections. If a stub is unavoidable, then the stub should be less than 200 mils.
- Route all high-speed USB signal traces over continuous planes (VCC or GND), with no interruptions. Avoid crossing over anti-etch, commonly found with plane splits.

4.4 USIM Card Interface

SIM7230 supports one USIM card, and the USIM interface complies with ISO/IEC 7816-3 standard. Both 1.8V and 3.0V USIM card are supported. The USIM interface is powered from an internal regulator in the module, and it supports USIM card detecting and hot swap function.

Both 1.8V and 3.0V USIM card are supported. The USIM interface is powered from an internal regulator in the module, and supports USIM card detecting and hot swap function.

It is recommended to use an ESD protection component such as PHILIPS (www.ohilips.com) IP42220CZ6, the USIM peripheral circuit including resistors and ESD TVSs should be close to the USIM card socket. The reference circuit of the 8-pin USIM card holder is illustrated as in the following figure.

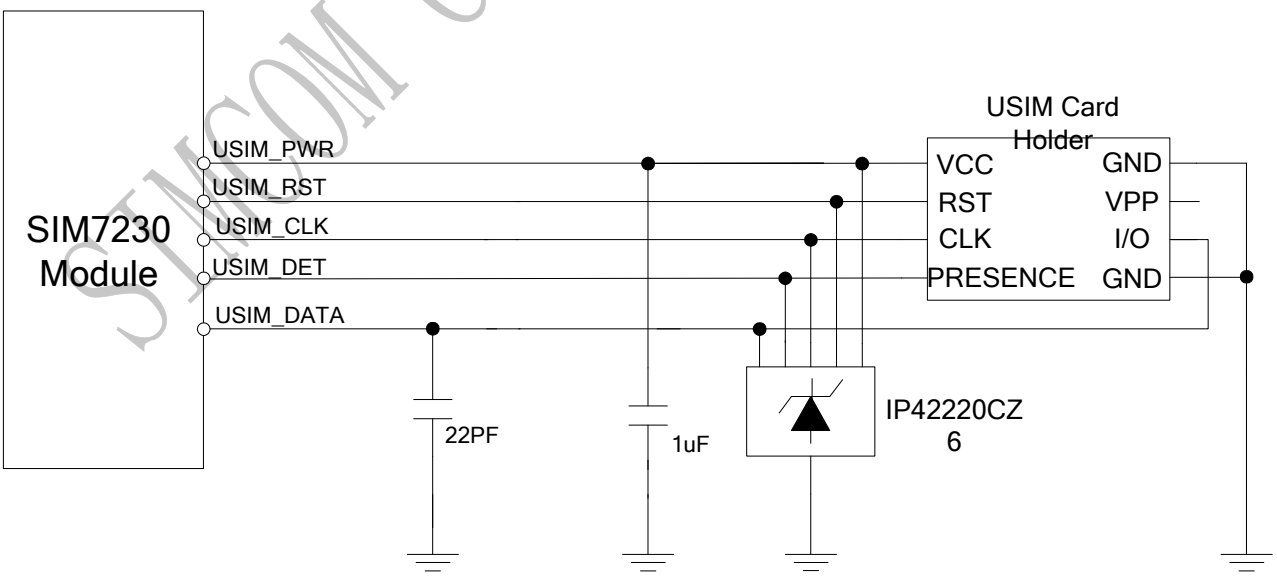

Figure 16: 8 Pin USIM card holder reference circuit

The USIM_DET pin is used for detection of the USIM card hot swap. User can select the 8-pin USIM card holder to implement USIM card detection function.

If the USIM card detection function is not used, user can keep the USIM_DET pin open. The reference circuit of 6-pin USIM card holder is illustrated in the following figure.

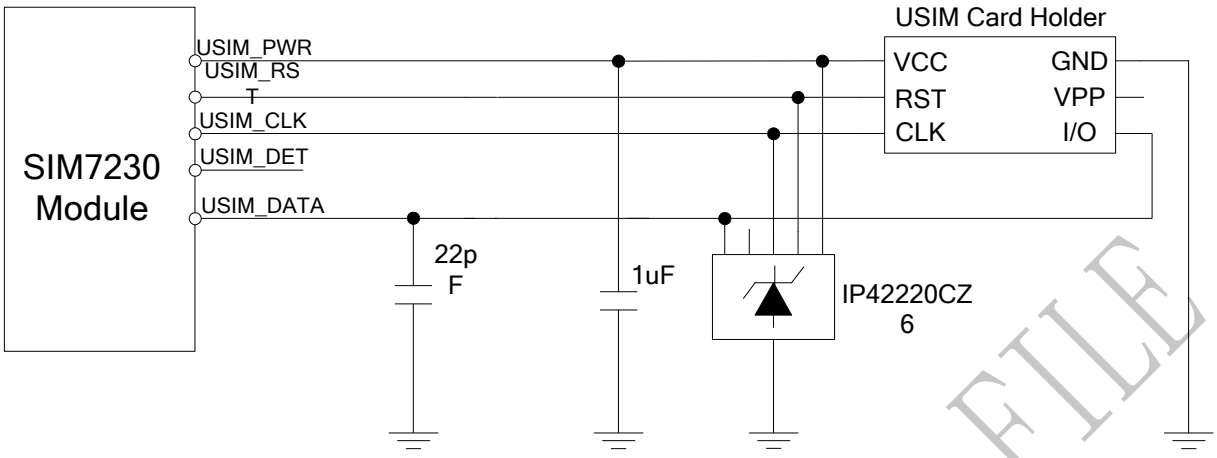

Figure 17: 6 Pin USIM card holder reference circuit

USIM card circuit is susceptible to be interfered, causing the USIM card failure or some other issues, so it is strongly recommended to follow these guidelines while designing:

- Make sure that USIM card holder stay away from antenna while in PCB layout, distance of the USIM connector and the module should be less than 10cm, shield the signals by GND to keep USIM interface away from system noise;
- USIM traces should keep away from RF lines, VBAT and high-speed signal lines, and the shorter the better; Avoid routing the USIM_CLK and USIM_DATA lines in parallel and distances over 2 cm, the cross-coupling of these lines can cause failures;
- The rise time of USIM_CLK and USIM_DATA should be less than 1μs, user should keep low capacitance of these signals when layout, high capacitance will increase signal rise time. To optimize the signal rise time, the USIM_DATA has been pulled up to USIM_VDD with 10K resistor inside the SIM7230, customer do not need to add pull up;.
- Keep good connectivity between USIM holder GND and module GND;
- Recommended to place a 1μF capacitor on USIM_VDD line for decoupling and keep close to the holder;
- Add TVS to protect the USIM card and SIM7230 IC, but the parasitic capacitance should not exceed 50pF. Customer should decide whether the TVS diode is necessary depending on the application, mechanical enclosure, and USIM connector design.

Table 11: USIM card interface signals

Pin Name	Pin No	I/O	Description	DC Characteristics (V)		
				Min	Typ	Max
USIM_VDD	8	O	External USIM card power	-	1.8/2.85	-
USIM_DATA	10	I/O	External USIM card data	-	1.8/2.85	-
USIM_CLK	12	O	External USIM card clock	-	1.8/2.85	-
USIM_RST	14	O	External USIM card reset signal	-	1.8/2.85	-
USIM_DET	16	I	External USIM card detect	-	1.8	-

4.5 PCM Interface

SIM7230 provides PCM interface. The default PCM interface of SIM7230 supports master and slave mode, data length is 16 bits (linear), and PCM clock rate is 512KHZ.

Table 12: PCM Specification

Characteristics	Specification
Line Interface Format	Linear(Fixed)
Data length	16bits
PCM Clock/Sync Source	Master and slave Mode
PCM Clock Rate	512Khz(variable)
PCM Sync Format	Short sync/Long sync both support
Data Ordering	MSB/LSB

Note: PCM interface can be controlled by AT command. For more details please refer to document [1]

Table 13: PCM DC Characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V_{IH}	High-level input voltage	1.2	-	2.1	V
V_{IL}	Low-level input voltage	-0.3	-	0.63	V
V_{OH}	High-level output voltage	1.3	-	1.8	V
V_{OL}	Low-level output voltage	0	-	0.45	V

The PCM interface can be multiplexed with GPIO function, customer can use AT+CGFUNC to config the PCM interface to GPIO, and the function relation ship can be found in the following table.

Table 14: Multiplexing function of PCM

Pin number	Pin name	Mode 0(default)	Mode 1
51	PCM_SYNC	PCM_SYNC	GPIO8
49	PCM_IN	PCM_IN	GPIO7
47	PCM_OUT	PCM_OUT	GPIO6
45	PCM_CLK	PCM_CLK	GPIO5

4.6 I2C Interface

The SIM7250 provides an industry standard I2C serial bus, It is I2C-compliant, high-speed mode (HS-mode)-compliant, and a master-only device. The interface has been pulled up to 1.8V with 2.2K.

Table 15: Pin definition of the I2C

Pin name	Pin number	Description
SCL	30	I2C serial bus clock
SDA	32	I2C serial bus data

I2C has the multiplexing function like the PCM interface, and the relation ship can be found in the following table.

Table 16: I2C multiplexing function

Pin number	Pin name	Mode 0(default)	Mode 1
30	SCL	SCL	GPIO1
32	SDA	SDA	GPIO2

4.7 GPIO Interface

SIM7250 provides 2 GPIO pins. The output voltage level of the GPIO can be set by AT command “AT+ SGPIO”. The input voltage level of the GPIO can also be read by AT command “AT+ SGPIO”. For more details, please refer to *document [1]*.

Table 17: Pin definition of the GPIO

Pin name	Pin number	Reset state
GPIO3	44	Pull up
GPIO4	46	Pull up

4.8 PERST#

The PERST# pin could be used as an emergency reset. SIM7230 has power-up reset function, so power-up reset pulse is not necessary. When the PERST# pin is pulled to ground, the module will be reset.

The following table is the electrical characteristics of The PERST# pin.

Table 18: PERST# Electrical Characteristic

Symbol	Parameter	Min	Typ	Max	Unit
V_{IH}	High-level input voltage	1.2	1.8	2.1	V
V_{IL}	Low-level input voltage	-0.3	-	0.63	V
$T_{low\text{-}hold}$	Reset low level hold on time	50	-	-	us

The low level pulse time must be longer than 50us，The following figure is the timing of reset function.

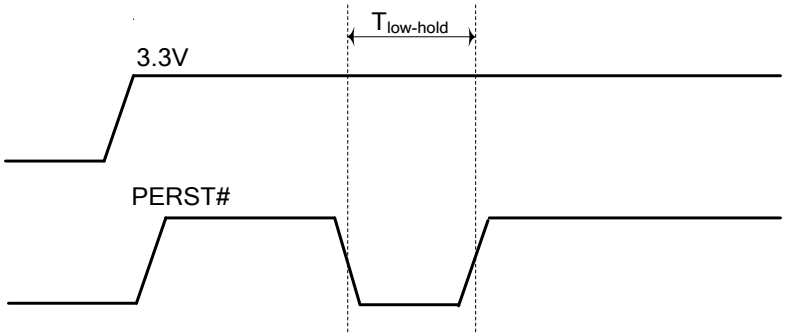

Figure 18: Reset timing

Reference circuit is recommended in the following figure:

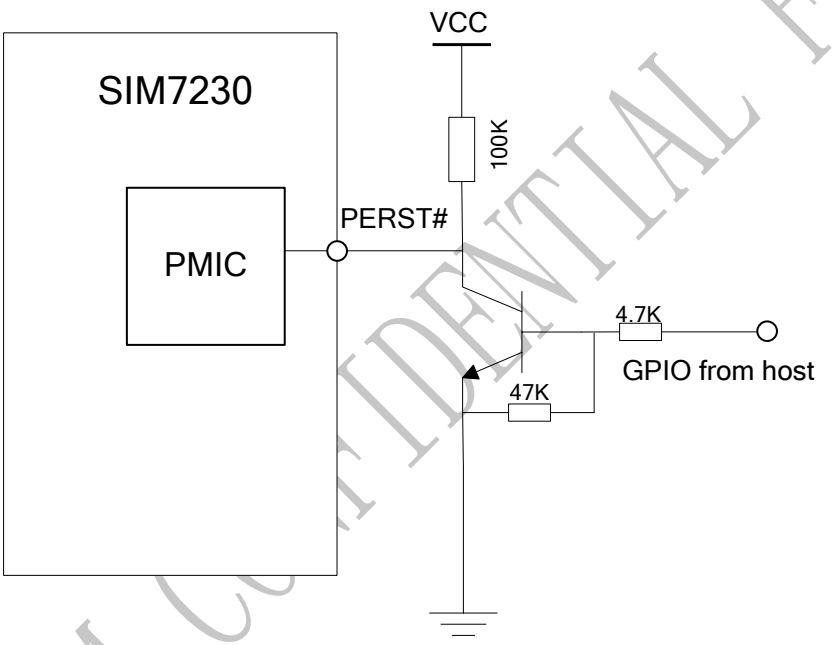

Figure 19: Recommend circuit of PERST#

4.9 W_DISABLE#

The W_DISABLE# pin controls SIM7230 to enter or exit the airplane mode, when the W_DISABLE# signal is asserted, all radios would be disabled. When the W_DISABLE# signal is not asserted, the radio may transmit if it was not disabled by other means such as software.

The W_DISABLE# is an active low signal and has been pulled up inside the module, the combination of the W_DISABLE# and the software configuration can set SIM7230 to airplane mode or normal operation mode.

Table 19: Airplane mode control Function

W_DISABLE# status	AT+CFUN=<fun>	Module operation
High Level	1	Normal Mode: RF is working.
High Level	0	Airplane mode: RF is closed.
Low Level	1	
Low Level	0	

Table 20: W_DISABLE# Electrical Characteristic

Symbol	Parameter	Min	Type	Max	Unit
V_{IH}	High-level input voltage	1.2	1.8	2.1	V
V_{IL}	Low-level input voltage	-	-	0.45	V

4.10 LED_WWAN#

LED_WWAN# is an Open drain active low signal; this signal is used to allow SIM7230 to provide network status via LED which will be provided by the host.

Table 21: Network Status Indication Pin Status

LED_WWAN# Status	Working Status
On	Module is powering up; Searching service;
200ms On, 200ms Off	Data Transmit
800ms On, 800ms Off	Registered network and not in a call
2S, 1S On, 1S Off	Airplane mode
1.6S, 0.6S On, 1S Off	Device error has occurred
Off	Power off / Sleep

Reference circuit is recommended in the following figure:

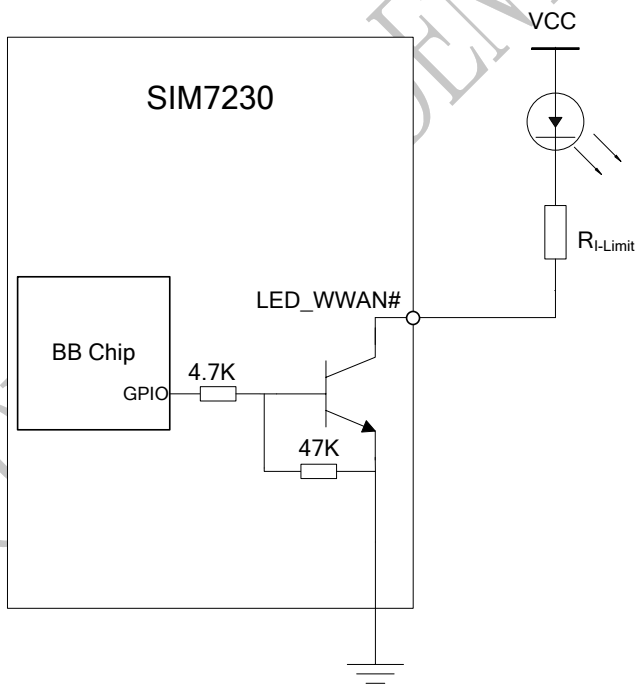

Figure 20: LED_WWAN# reference circuit

4.11 WAKE#

The WAKE# pin is an open drain active low 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 WAKE# will change to low logic level to inform the host (client PC), the pulse time is 1 second.

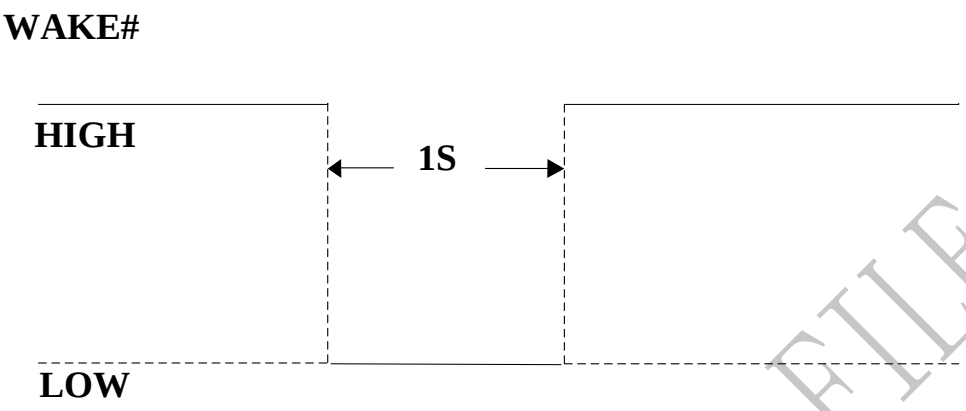

Figure 21: WAKE# signal

WAKE# Reference circuit is recommended in the following figure.

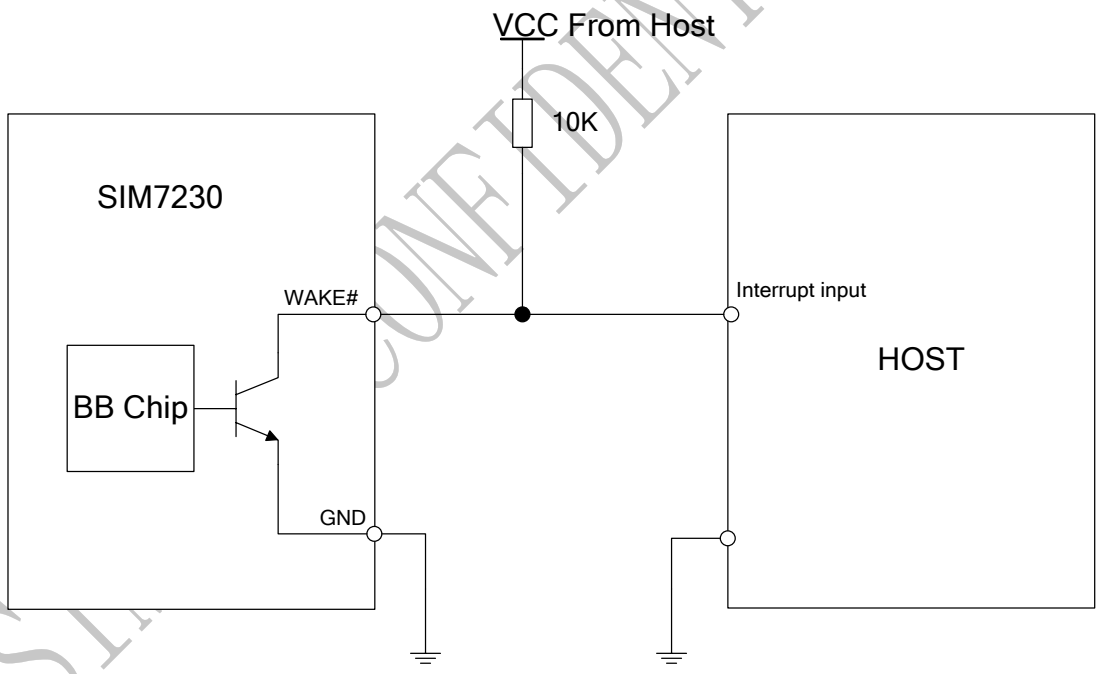

Figure 22: WAKE# reference circuit

5 RF Specifications

SIM7230 has 3 antenna connectors, one of which is the main antenna connector for GSM/WCDMA/LTE, one is the diversity antenna connector for WCDMA/LTE, and the last is the GNSS antenna connector. Customer can find the connector name on the label of SIM7230.

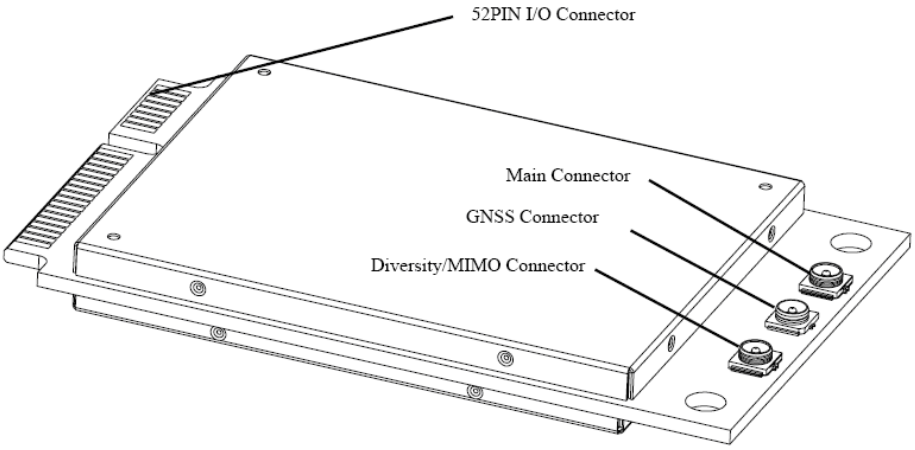

Figure 23: Antenna connector

5.1 The Antenna Connector

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

The dimension of the connector on SIM7230 is 2.6*2.6*1.25mm, which is from Hirose, and the part number is U.FL-R-SMT (10), Use KLC-1401 (www.lccable.com) to attach antennas to connection points on the module, as shown in Figure 18, likewise, customer can choose other vendor if the component's size match with U.FL-R-SMT (10).

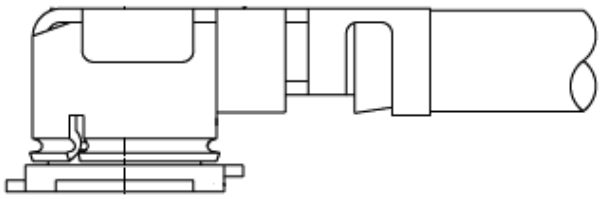

Figure 24: Antenna connector

Match coaxial connections between the module and the antenna to 50Ω. Minimize RF cable losses to the antenna; the recommended maximum cable loss for antenna cabling is 0.5 dB. To ensure best thermal performance, if possible use the mounting holes to attach (ground) the device to the main PCB ground or a metal chassis.

5.2 The Antenna Specifications

Recommended antenna characteristics of SIM7230 are described by following two tables.

Table 22: Recommended Passive Antenna Characteristics

Passive	Recommended standard
Direction	Omni directional
Gain	> -3dBi (Avg)
Input impedance	50 ohm
Efficiency	> 50 %
VSWR	< 2

Table 23: Recommended Active Antenna Characteristics

Band	Performance	
	TRP	TIS
GSM850	≧ 29dBm	≦ -104dBm
EGSM900	≧ 29dBm	≦ -104dBm
DCS1800	≧ 26dBm	≦ -104dBm
PCS1900	≧ 26dBm	≦ -104dBm
WCDMA B1	≧ 19dBm	≦ -104dBm
WCDMA B2	≧ 19dBm	≦ -104dBm
WCDMA B5	≧ 19dBm	≦ -104dBm
WCDMA B8	≧ 19dBm	≦ -104dBm
LTE-FDD B1	≧ 19dBm	≦ -90dBm
LTE-FDD B2	≧ 19dBm	≦ -90dBm
LTE-FDD B3	≧ 19dBm	≦ -90dBm
LTE-FDD B4	≧ 19dBm	≦ -90dBm
LTE-FDD B5	≧ 19dBm	≦ -90dBm
LTE-FDD B7	≧ 19dBm	≦ -90dBm
LTE-FDD B8	≧ 19dBm	≦ -90dBm
LTE-FDD B17	≧ 19dBm	≦ -90dBm
LTE-FDD B20	≧ 19dBm	≦ -90dBm

6. Electrical, Reliability and Radio Characteristics

6.1 Absolute Maximum Ratings

The absolute maximum ratings are described by the following table. Module may be damaged beyond these ratings.

Table 24: Absolute maximum ratings

Symbol	Parameter	Min	Type	Max	Unit
V_{IN}	VCC input voltage	0	-	3.6	V
I_{IN}	VCC total peak current	0	-	2.5	A
I_I*	Input current	2	8	16	mA
I_O*	Output current	2	8	16	mA

Note: * These parameters are for digital interface pins and 2mA steps, such as PCM.

6.2 Recommended Operating Conditions

Please refer to the following table for recommended operating conditions.

Table 25: Operating Conditions

Symbol	Parameter	Min	Type	Max	Unit
VCC	3.3V Input voltage	3.2	3.3	3.6	V
T_{OPER}	Operating temperature	-40	+25	+85	℃
T_{STG}	Storage temperature	-45	+25	+90	℃

6.3 USIM Card Interface Characteristics

Table 26: USIM Card Interface Characteristics

Symbol	Parameter		Min	Type	Max	Unit
USIM_RST	V_{OH}	USIM_VDD=1.8V	1.35	-	1.8	V
		USIM_VDD=2.85V	2.4	-	2.85	V
	V_{OL}	USIM_VDD=1.8V	0	-	0.45	V
		USIM_VDD=2.85V	0	-	0.45	V
USIM_CLK	V_{OH}	USIM_VDD=1.8V	1.35	-	1.8	V
		USIM_VDD=2.85V	2.4	-	2.85	V
	V_{OL}	USIM_VDD=1.8V	1.35	-	1.8	V
		USIM_VDD=2.85V	2.4	-	2.85	V
USIM_DATA	V_{IH}	USIM_VDD=1.8V	1.2	-	2.1	V
		USIM_VDD=2.85V	1.85	-	3.15	V
	V_{IL}	USIM_VDD=1.8V	1.2	-	2.1	V
		USIM_VDD=2.85V	1.85	-	3.15	V
	V_{OH}	USIM_VDD=2.85V	1.35	-	1.8	V

		USIM_VDD=2.85V	2.4	-	2.85	V
	V_{OL}	USIM_VDD=1.8V	1.35	-	1.8	V
		USIM_VDD=2.85V	2.4	-	2.85	V

6.4 USIM_VDD Characteristics

Table 27: USIM_VDD Characteristics

Symbol	Parameter	Min	Type	Max	Unit
V_O	Output voltage	2.75	2.85	3.05	V
		1.7	1.80	1.9	
I_O	Output current	-	-	150	mA

6.5 Current Consumption (3.3V)

Table 28: Current Consumption

GSM Sleep mode	
GSM850	Sleep @DRX=2 1.87mA Sleep @DRX=5 1.68mA Sleep @DRX=9 1.58mA
GSM900	Sleep @DRX=2 1.87mA Sleep @DRX=5 1.68mA Sleep @DRX=9 1.58mA
DCS1800	Sleep @DRX=2 1.87mA Sleep @DRX=5 1.68mA Sleep @DRX=9 1.58mA
PCS1900	Sleep @DRX=2 1.87mA Sleep @DRX=5 1.68mA Sleep @DRX=9 1.58mA
Voice Call	
GSM850	@power level #5 <300mA,Typical 222mA
GSM 900	@power level #5 <300mA,Typical 218mA
DCS1800	@power level #0 <250mA,Typical 151mA
PCS1900	@power level #0 <250mA,Typical 137mA
GPRS Data	
DATA mode, GPRS (1 Rx,4 Tx) CLASS 12 CS4	
GSM 850	@power level #5 <660mA,Typical 530mA
GSM 900	@power level #5 <660mA,Typical 502mA
DCS1800	@power level #0 <530mA,Typical 366mA
PCS1900	@power level #0 <530mA,Typical 317mA
DATA mode, GPRS (3Rx, 2 Tx) CLASS 12 CS4	
GSM 850	@power level #5 <500mA,Typical 368mA
GSM 900	@power level #5 <500mA,Typical 353mA
DCS1800	@power level #0 <400mA,Typical 251mA
PCS1900	@power level #0 <400mA,Typical 224mA

EDGE Data	
DATA mode, EDGE(1 Rx,4 Tx) CLASS 12 MCS9	
GSM 850	@power level #8 <mA,Typical mA
GSM 900	@power level #8 <mA,Typical mA
DCS1800	@power level #2 <mA,Typical mA
PCS1900	@power level #2 <mA,Typical mA
DATA mode, EDGE(3Rx, 2 Tx) CLASS 12 MCS9	
GSM 850	@power level #8 <500mA,Typical 430mA
GSM 900	@power level #8 <500mA,Typical 427mA
DCS1800	@power level #2 <450mA,Typical 319mA
PCS1900	@power level #2 <450mA,Typical 309mA
UMTS Sleep Mode	
WCDMA B1	Sleep @DRX=9 1.52mA Sleep @DRX=8 1.68mA Sleep @DRX=6 2.15mA
WCDMA B2	TBD
WCDMA B5	Sleep @DRX=9 1.52mA Sleep @DRX=8 1.68mA Sleep @DRX=6 2.15mA
WCDMA B8	TBD
UMTS Talk	
WCDMA B1	@Power 23dBm Typical 460mA @Power 21dBm Typical 420mA @Power 10dBm Typical 231mA
WCDMA B2	TBD
WCDMA B5	@Power 23dBm Typical 467mA @Power 21dBm Typical 395mA @Power 10dBm Typical 214mA
WCDMA B8	TBD
HSDPA Data	
WCDMA B1	TBD
WCDMA B2	TBD
WCDMA B5	TBD
WCDMA B8	TBD
HSUPA Data	
WCDMA B1	TBD
WCDMA B2	TBD
WCDMA B5	TBD
WCDMA B8	TBD

Note: In above table the current consumption value is the typical one of the module tested in laboratory. In the mass production stage, there may be differences among each individual.

6.6 Electro-Static Discharge

SIM7230-PCIe is an ESD sensitive component, so more attention should be paid to the procedure of handling and packaging. The ESD test results are shown in the following table.

Table 29: ESD characteristics (Temperature: 25 ℃, Humidity: 45％)

Pin	Contact discharge	Air discharge
VCC	±5KV	±10KV
GND	±5KV	±10KV
Antenna port	±5KV	±10KV
USB_DP,USB_DN	±3KV	±6KV
RESET	±1KV	±3KV

6.7 Radio Characteristics

6.7.1 Conducted Output Power

The following table shows SIM7230-PCIe's conducted output power, comply with 3GPP TS 05.05and TS 34.121.

Table 30: Conducted Output Power

Frequency	Max	Min
GSM850	33dBm ±2dB	5dBm ± 5dB
E-GSM900	33dBm ±2dB	5dBm ± 5dB
DCS1800	30dBm ±2dB	0dBm ± 5dB
PCS1900	30dBm ±2dB	0dBm ± 5dB
GSM850 (8-PSK)	27dBm ±3dB	5dBm ± 5dB
E-GSM900 (8-PSK)	27dBm ±3dB	5dBm ± 5dB
DCS1800 (8-PSK)	26dBm +3/-4dB	0dBm ±5dB
PCS1900(8-PSK)	26dBm +3/-4dB	0dBm ±5dB
WCDMA B1	24dBm +1/-3dB	-56dBm ±5dB
WCDMA B2	24dBm +1/-3dB	-56dBm ±5dB
WCDMA B5	24dBm +1/-3dB	-56dBm ±5dB
WCDMA B8	24dBm + 1/-3dB	-56dBm ±5dB
LTE-FDD B1	23dBm +2.7dB	-50dBm ±5dB
LTE-FDD B2	23dBm +2.7dB	-50dBm ±5dB
LTE-FDD B3	23dBm +2.7dB	-50dBm ±5dB
LTE-FDD B4	23dBm +2.7dB	-50dBm ±5dB
LTE-FDD B5	23dBm +2.7dB	-50dBm ±5dB
LTE-FDD B7	23dBm +2.7dB	-50dBm ±5dB
LTE-FDD B8	23dBm +2.7dB	-50dBm ±5dB
LTE-FDD B17	23dBm +2.7dB	-50dBm ±5dB
LTE-FDD B20	23dBm +2.7dB	-50dBm ±5dB

6.7.2 Conducted Receive Sensitivity

The following table shows conducted receiving sensitivity of SIM7230-PCIe, and the sensitivity of the LTE bands are all depending on the bandwidth 10 MHz..

Table 31: Conducted Receive Sensitivity

Frequency	Receive sensitivity
GSM850	< -106dBm
E-GSM900	< -106dBm
DCS1800	< -106dBm
PCS1900	< -106dBm
WCDMA B1	< -108dBm
WCDMA B2	< -108dBm
WCDMA B5	< -106dBm
WCDMA B8	< -106dBm
LTE-FDD B1	< -97dBm
LTE-FDD B2	< -95dBm
LTE-FDD B3	< -94dBm
LTE-FDD B4	< -97dBm
LTE-FDD B5	< -95dBm
LTE-FDD B7	< -95dBm
LTE-FDD B8	< -94dBm
LTE-FDD B17	< -94dBm
LTE-FDD B20	< -94dBm

Remark: The data in above table are gotten at static condition.

6.7.3 Supported Band

The following table shows the SIM7230-PCIe supported band, and it complies with 3GPP spec.

Table 32: Supported Band

Frequency	Receiving	Transmission
GSM850	869 ～894 MHz	824 ～849 MHz
E-GSM900	925 ～960 MHz	880 ～915 MHz
DCS1800	1805～1880 MHz	1710～1785 MHz
PCS1900	1930～1990 MHz	1850～1910 MHz
WCDMA B1	2110～2170 MHz	1920～1980 MHz
WCDMA B2	1930～1990 MHz	1850～1910 MHz
WCDMA B5	869 ～894 MHz	824 ～849 MHz
WCDMA B8	925 ～960 MHz	880 ～915 MHz
LTE-FDD B1	2110 ～2170 MHz	1920 ～1980 MHz
LTE-FDD B2	1930 ～1990 MHz	1850～1910 MHz
LTE-FDD B3	1805 ～1880 MHz	1710 ～1785 MHz
LTE-FDD B4	2110 ～2155 MHz	1710 ～1755 MHz
LTE-FDD B5	869 ～894 MHz	824 ～849 MHz
LTE-FDD B7	2626 ～2690 MHz	2500 ～2570 MHz
LTE-FDD B8	925 ～960 MHz	880 ～915 MHz
LTE-FDD B17	734 ～746 MHz	704 ～716 MHz
LTE-FDD B20	791 ～821 MHz	832 ～862 MHz
GPS L1 BAND	1574.4 ～1576.44 MHz	-
GLONASS	1598 ～1606 MHz	-

7. Appendix

I. SIM7230-PCIe Top and Bottom View

Figure 25: SIM7230-PCIe top and bottom View

II. Reference Schematic

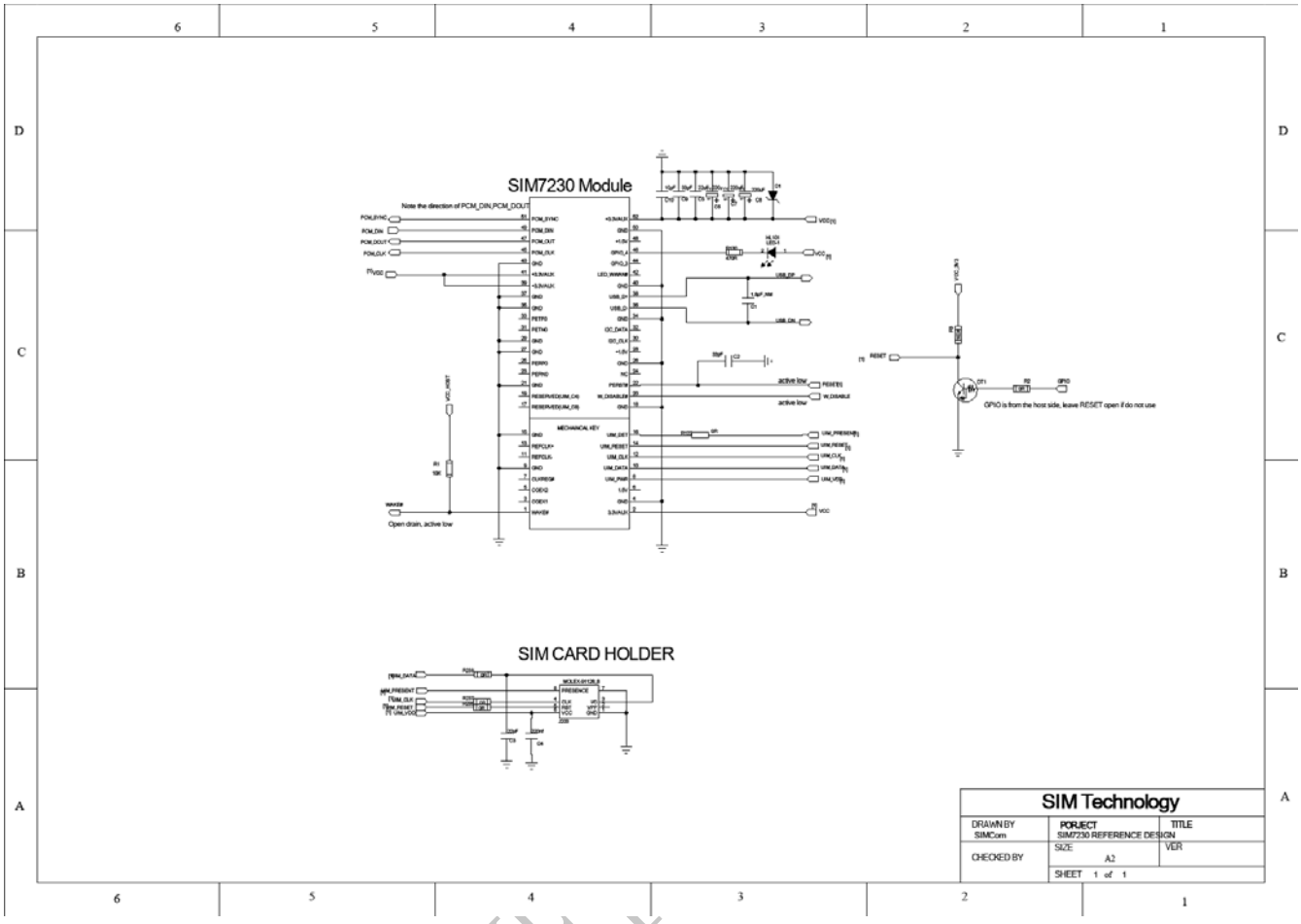

Figure 26: Reference schematic

III. Related Documents

Table 33: Related Documents

SN	Document name	Remark
[1]	SIMCOM_SIM7230_ATC_EN_V1.XX.doc	
[2]	AN_SIM7230_TCPIP	TCP/IP Applications User Manual
[3]	PCI Express Mini Card Electromechanical Specification Revision 1.2	
[4]	Mini PCIe_EVB kit_User Guide_VX.XX	EVB User Guide
[5]	ITU-T Draft new recommendation V.25ter:	Serial asynchronous automatic dialing and control
[6]	GSM 07.07:	Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)
[7]	GSM 07.10:	Support GSM 07.10 multiplexing protocol
[8]	GSM 07.05:	Digital cellular telecommunications (Phase 2+); Use of Data Terminal Equipment – Data Circuit terminating Equipment (DTE – DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)
[9]	GSM 11.14:	Digital cellular telecommunications system (Phase 2+); Specification of the SIM Application Toolkit for the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[10]	GSM 11.11:	Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[11]	GSM 03.38:	Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information
[12]	GSM 11.10	Digital cellular telecommunications system (Phase 2)； Mobile Station (MS) conformance specification； Part 1: Conformance specification

IV. Terms and Abbreviations

Table 34: Terms and Abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
AMR	Adaptive Multi-Rate
APAC	Asia Pacific
BB	Baseband
CA	Carrier aggregation
CS	Coding Scheme
CSD	Circuit Switched Data
CTS	Clear to Send
DRX	Discontinuous Reception
DTE	Data Terminal Equipment (typically computer, terminal, printer)
DTR	Data Terminal Ready
DTX	Discontinuous Transmission
EDGE	Enhanced Data Rate for GSM Evolution
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
ESD	Electrostatic Discharge
ESR	Equivalent Series Resistance
ETS	European Telecommunication Standard
FDD	Frequency Division Dual
FR	Full Rate
GNSS	Global Navigation Satellite System
GPIO	General Purpose Input Output
GPRS	General Packet Radio Service
GPS	Global Position System
GSM	Global Standard for Mobile Communications
HR	Half Rate
I2C	Inter—Integrated Circuit
IMEI	International Mobile Equipment Identity
LED	Light-emitting Diode
LNA	Low Noise Amplifier
Li-ion	Lithium-Ion
LTE	Long Term Evolution
MCP	Multiple-chip Package
MIMO	Multi-Input Multi-Output
MO	Mobile Originated
MS	Mobile Station (GSM engine), also referred to as TE
MT	Mobile Terminated
NC	Not Connect

PAP	Password Authentication Protocol
PBCCH	Packet Broadcast Control Channel
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PCIe	Peripheral Component Interface Express
PCL	Power Control Level
PCS	Personal Communication System, also referred to as GSM 1900
PDU	Protocol Data Unit
PMIC	Power Management IC
PPP	Point-to-point protocol
RF	Radio Frequency
RMS	Root Mean Square (value)
RTC	Real Time Clock
TBD	To Be Determined
WCDMA	Wideband Code Division Multiple Access
HSDPA	High Speed Downlink Packet Access
HSUPA	High Speed Uplink Packet Access
RX	Receive Direction
SMS	Short Message Service
TE	Terminal Equipment, also referred to as DTE
TX	Transmit Direction
UART	Universal Asynchronous Receiver & Transmitter
USIM	User Identity Module
UMTS	Universal Mobile Telecommunications System
USIM	Universal Subscriber Identity Module
URC	Unsolicited Result Code
USB	Universal Serial Bus
USSD	Unstructured Supplementary Service Data
WCDMA	Wide Code Division Multiple Access
WWAN	Wireless Wide Area Network
Phonebook abbreviations	
FD	SIM fix dialing phonebook
LD	USIM last dialing phonebook (list of numbers most recently dialed)
MC	Mobile Equipment list of unanswered MT calls (missed calls)
ON	USIM (or ME) own numbers (MSISDNs) list
RC	Mobile Equipment list of received calls
SM	USIM phonebook
NC	Not connect

V. Safety Caution

Table 35: 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 to not operate normally for 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. Forget to think much of these instructions may lead to the flight safety or offend against 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, for example no mobile fee or a invalid USIM card. While you are in this condition and need emergent help, please remember using 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 USIM card be properly inserted in the cellular terminal or mobile.

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