SIM7500 Series_ PCIE_Hardware Design_V1.02

Development Kit

Hardware Design

Reference Design

Software Design

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Version History

Date	Version	Description of change	Author
2016-11-01	1.00	Origin Modify figure 11,figure 12 and figure 20 Modify table 4, table 20,table 21,figure 11 figure 12 and figure 20. Modify VCC Voltage range :3.4V ~4.2V Modify Power off mode :table 26 Modify active antenna voltage to 3.8V,Figure 25,Figure 26.	Shijie.Yuan Lili.Teng
2017-01-03	1.01	Modify table 27	Shijie.yuan
2018-5-23	1.02	Modify table 1,2,8 ADD SIM7500V project Modify document name Modify VCC Voltage range :3.0V~3.6V Modify Figure 2,3	Shijie.yuan Fan.gao

1. Introduction

This document describes the electronic specifications, RF specifications, interfaces, mechanical characteristics and testing results of the SIMCom SIM7500 Series-PCIE modules. With the help of this document and other related software application notes/user guides, users can understand and use SIM7500 Series-PCIE modules to design and develop applications quickly.

1.1 Product Outline

Aimed at global market, the SIM7500 Series-PCIE modules support 4 air-interface standards including GSM, WCDMA, TDD-LTE and FDD-LTE. Users can choose the module according to the wireless network configuration. The supported radio frequency bands are described in the following table.

Table 1: SIM7500 Series-PCIE Series Frequency Bands

Standard	Frequency	SIM7500A	SIM7500E	SIM7500JE	SIM7500JC	SIM7500V	SIM7500SA
GSM	900MHz		✓				
	1800M Hz		✓				
WCDMA	BAND1		✓		✓		✓
	BAND2	✓					
	BAND5	✓					✓
	BAND6				✓		
	BAND8		✓				
LTE	LTE-FDD B1		✓	✓	✓		✓
	LTE-FDD B2	✓					
	LTE-FDD B3		✓	✓			✓
	LTE-FDD B4	✓				✓	
	LTE-FDD B5						✓
	LTE-FDD B7		✓				✓
	LTE-FDD B8		✓	✓			✓
	LTE-FDD B12	✓					
	LTE-FDD B13					✓	
	LTE-FDD B18				✓		
	LTE-FDD B19				✓		
	LTE-FDD B20		✓				
	LTE-FDD B26				✓		
	LTE-FDD B28						✓
Category		CAT1	CAT1	CAT1	CAT1	CAT1	CAT1
Remark		-H for CAT4	-H for CAT4				-H for CAT4
GNSS		✓	✓	✓	✓	✓	✓

Note: SIM7500 Series-PCIE only support digital audio feature through PCM interface. SIM7500 Series-PCIEA only support Analog audio feature through analog audio interface.

Note: CAT1 or CAT4 correspond to different PN numbers.

1.2 Hardware Interface Overview

SIM7500 Series-PCIE provides various hardware interfaces via Mini PCI Express card connector.

- **Power Supply**
- **PERST#**
- **W_DISABLE#**
- **LED_WWAN#**
- **WAKE#**
- **USB Interface**
- **USIM Interface**
- **UART Interface**
- **I2C Interface**
- **PCM Interface**
- **Analog Audio Interface***

1.3 Hardware Block Diagram

The following figure is SIM7500 Series-PCIE hardware block diagram.
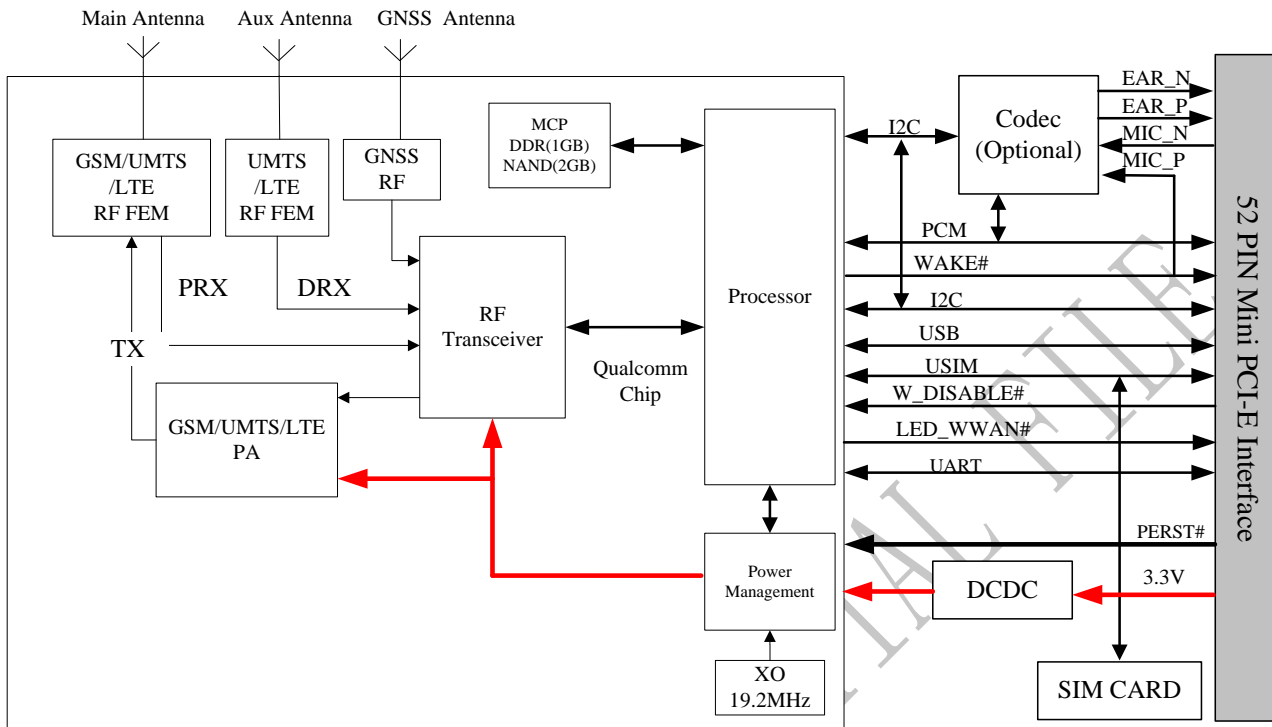
Figure 1: SIM7500 Series-PCIE Block Diagram

1.4 Functional Overview

Table 2: SIM7500 Series-PCIE Key Features

Feature	Implementation
Power supply	Single supply voltage 3.0~3.6V
Radio frequency bands	Please refer to the table 1

Transmitting power	GSM/GPRS power class:
	    --EGSM900: 4 (2W)
	    --DCS1800: 1 (1W)
	EDGE power class:
	    --EGSM900: E2 (0.5W)
	    --DCS1800: E1 (0.4W)
	UMTS power class:
	    --WCDMA :3 (0.25W)
	LTE power class: 3 (0.25W)

Data Transmission Throughput	GPRS multi-slot class 12 EDGE multi-slot class 12 UMTS R99 speed: 384 kbps DL/UL HSPA+: 5.76 Mbps(UL), 42 Mbps(DL) LTE CAT 4 ： Support MIMO in DL Direction

	FDD-LTE CAT4：150 Mbps (DL), 50 Mbps (UL)
	TDD-LTE CAT4：130 Mbps (DL), 35 Mbps (UL)
	FDD-LTE CAT 1：10 Mbps (DL), 5 Mbps (UL)
	TDD-LTE CAT 1：8.96 Mbps (DL), 3.1 Mbps (UL)
Antenna	GSM/UMTS/LTE main antenna. UMTS/LTE auxiliary antenna GNSS antenna
GNSS	GNSS engine (GPS,GLONASS and BD) Protocol: NMEA
SMS	MT, MO, CB, Text and PDU mode SMS storage: USIM card or ME(default) Transmission of SMS alternatively over CS or PS
USIM interface	Support identity card: 1.8V/ 3V
USIM application toolkit	Support SAT class 3, GSM 11.14 Release 98 Support USAT
Phonebook management	Support phonebook types: SM, FD, LD, RC, ON, MC
Audio feature	*SIM7500 Series-PCIE product support digital audio interface.* Support PCM interface. Only support PCM master mode and short frame sync, 16-bit linear data formats. Available only when audio codec chip is not mounted on PCIE board. *SIM7500 Series-PCIEA product support analog audio interface.* One analog signal output with 32Ω load resistance,50mW output power, and one analog input. Available only when audio codec chip is mounted on PCIE board.
UART interface	A full modem serial port by default Baud rate: 300bps to 4Mbps(default:115200bps) Autobauding baud rate: 9600,19200,38400,57600,115200bps Can be used as the AT commands or data stream channel. Support RTS/CTS hardware handshake and software ON/OFF flow control Multiplex ability according to GSM 07.10 Multiplexer Protocol.
USB	USB 2.0 high speed interface
Firmware upgrade	Firmware upgrade over USB interface
Physical characteristics	Size: 50.80*31*5.35mm Weight: less than 12g
Temperature range	Normal operation temperature: -30°C to +80°C Extended operation temperature: -40°C to +85°C* Storage temperature -45°C to +90°C

Note: Module is able to make and receive voice calls, data calls, SMS and make GPRS/WCDMA/HSPA+/LTE traffic in -40℃~+85℃. The performance will reduce slightly from the 3GPP specifications if the temperature is outside of the normal operating temperature and still within the extreme operating temperature.

2. Package Information

2.1 Pin Out Diagram
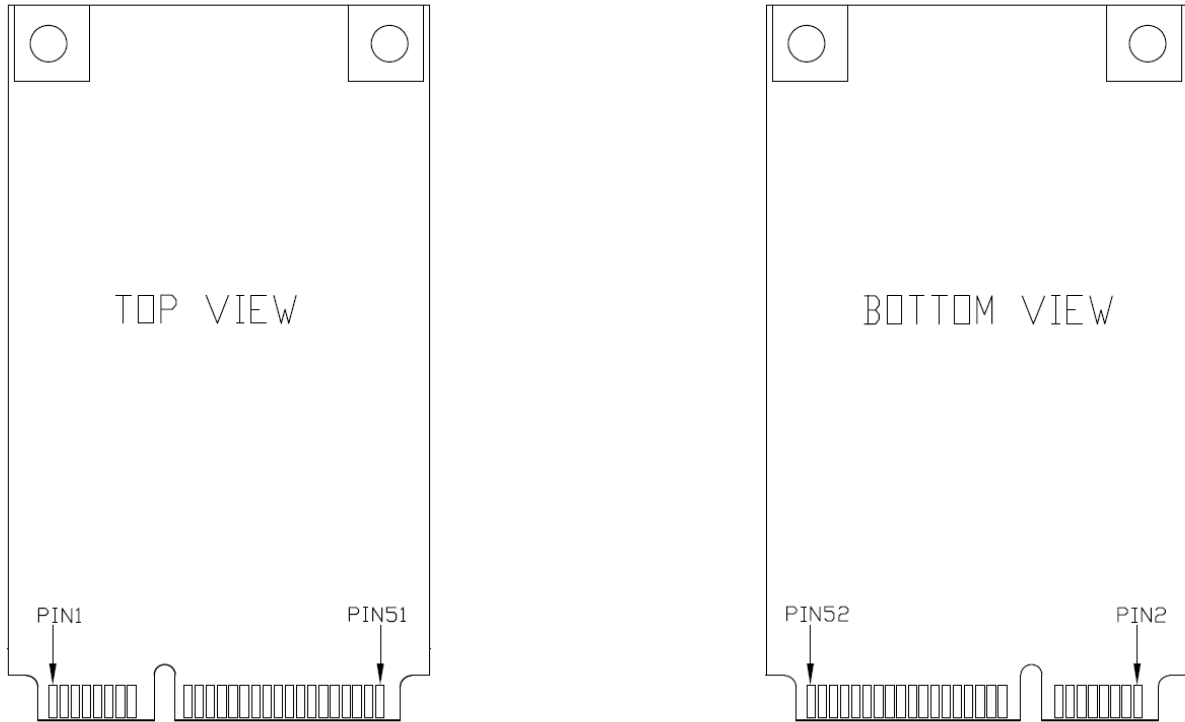
Figure 2: SIM7500 Series-PCIE Pin out Diagram

2.2 PCI Express Mini Card Connector Pin Description

Table 3: PCI Express Mini Card Connector Pin Description

Pin name	Pin number	I/O	Description	Comment
Power supply				
VCC	2,24,39,41,52	I	3.3 Power supply for module	3.3V typical
GND	4,9,15,18,21, 26,27,29,34,3 5,37,40,43,50		Ground	-
Reset				
PERST#	22	I	Reset input (Active low)	If unused, keep open.
USB 2.0				
USB_DP	38	I/O	USB 2.0 high speed port for data transfer, voice call, debug and FW download, etc.	If unused, keep open.
USB_DN	36			
USIM card interface				
USIM_VDD	8	O	Power output for USIM card, its output Voltage depends on USIM card type automatically. Its output current is up to 50mA.	-
USIM_DATA	10	I/O	USIM Card data I/O, which has been pulled up via a 20KR resistor to USIM_VDD internally. Do not pull it up or down externally.	-
USIM_CLK	12	O	USIM clock	Make sure the rise time and fall time of USIM_CLK less than 40ns;
USIM_RST	14	O	USIM Reset	-
USIM_DET	16	I	USIM card detect	-
PCM interface *(Only supported at SIM7500 Series-PCIE, these are NC pins for SIM7500 Series-PCIEA product)*				
PCM_CLK	45	O	PCM data bit clock.	If these pins are unused, keep open. The PCM interface cannot be used, if Audio Codec chip is mounted on PCIE board.
PCM_OUT	47	O	PCM data output	
PCM_IN	49	I	PCM data input	
PCM_SYNC	51	O	PCM data frame sync signal.	
UART interface				

UART_CTS	11	I	Clear to Send	If unused, keep open
UART_RTS	13	O	Request to send	
UART_RXD	17	I	Receive Data	
UART_TXD	19	O	Transmit Data	
UART_RI	44	O	Ring Indicator	
UART_DTR	46	I	DTE get ready	
I2C interface				
SCL	30	O	I2C clock output	Pulled up inside the module; If unused, keep open
SDA	32	I/O	I2C data input/output	
Others				
WAKE#/MICP	1	I/O	SIM750 Series-PCIE: Wake up host SIM750 Series-PCIEA: MIC positive input	If unused, keep open. If Analog audio is available, wake up function is invalid. If Analog audio is needed, please consult our sales staff, for more information .
MICN	3	I	SIM750 Series-PCIE: NC SIM750 Series-PCIEA: MIC negative input	
EARP	5	O	SIM750 Series-PCIE: NC SIM750 Series-PCIEA: Receiver positive output	
EARN	7	O	SIM750 Series-PCIE: NC SIM750 Series-PCIEA: Receiver negative output	
W_DISABLE#	20	I	RF Control Input	If unused, keep open.
LED_WWAN#	42	O	Network Status Indication output	If unused, keep open.
NC	6,23,25,28,31,33,48	--	No connection	Keep open

2.3   Package Dimensions
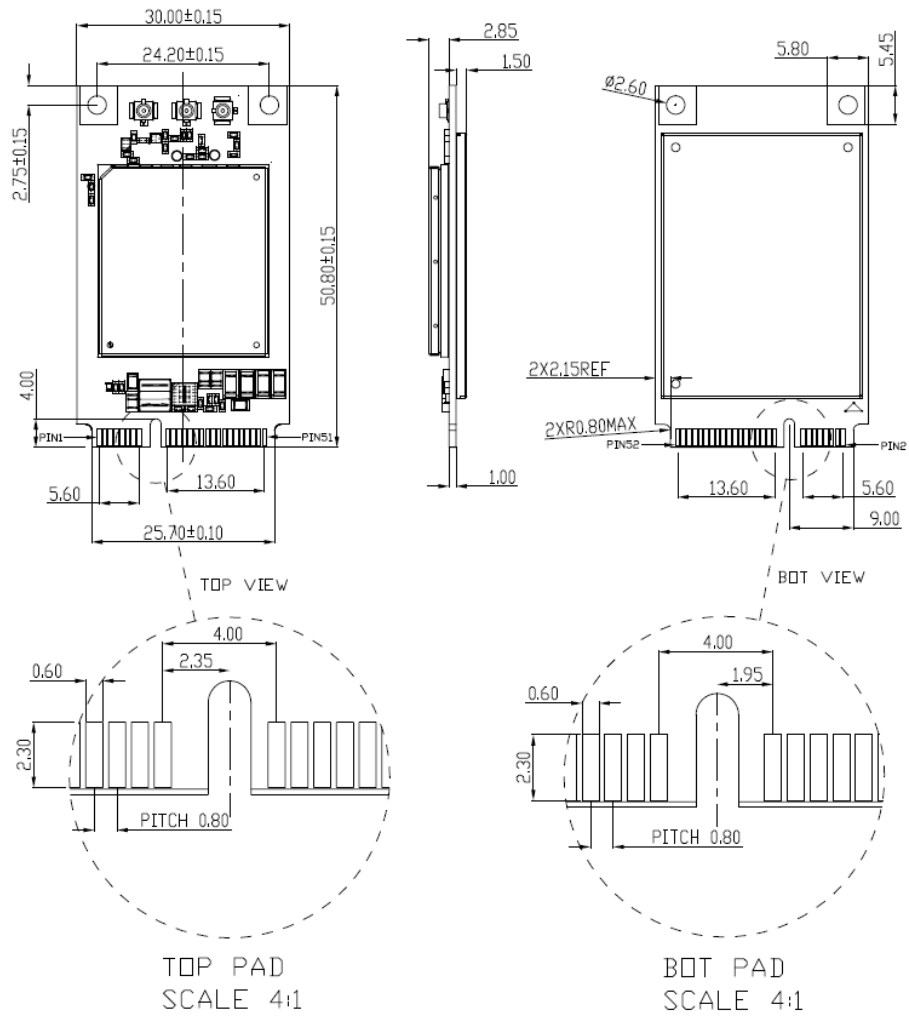
Figure 3: Dimensions of SIM7500 Series-PCIE (Unit: mm)

3. Interface Application

3.1 Power Supply

The recommended power supply voltage of SIM7500 Series-PCIE is 3.3V.

Table 4: Recommended 3.3 V Power Supply Characteristics

Symbol	Parameter	Min	Type	Max	Unit
Vo	Power supply voltage	3.0	3.3	3.6	V
Io	Supply current capability	-	2000	-	mA

3.2 PERST#

SIM7500 Series-PCIE can be reset by pulling the PERST# pin down to ground.

The PERST# pin has been pulled up with a 40KΩ resistor to 1.8V internally, so there is no need to pull it up externally. It is strongly recommended to put a 100nF capacitor and an ESD protection diode close to the PERST# pin. Please refer to the following figure for the recommended reference circuit.
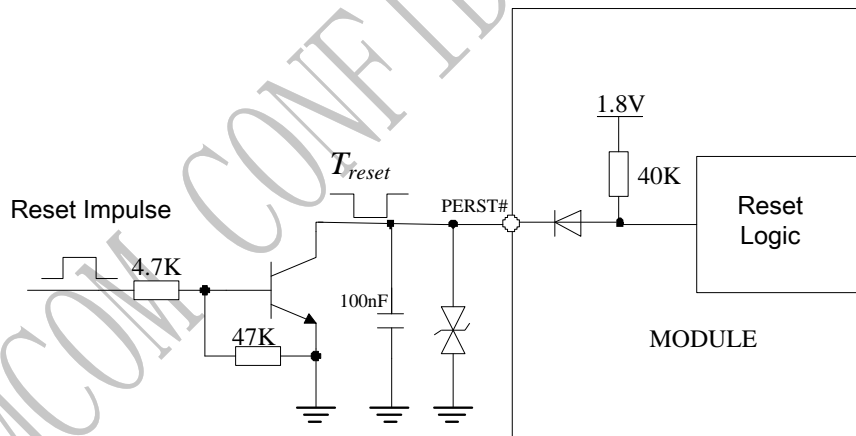
Figure 4: PERST# Reference Circuit

Table 5: PERST# Pin Electronic Characteristic

Symbol	Description	Min.	Typ.	Max.	Unit
T_{reset}	The active low level time impulse on PERST# pin to reset module	50	100	500	ms
V_{IH}	Input high level voltage	1.17	1.8	3.6	V
V_{IL}	Input low level voltage	-0.3	0	0.2	V

3.3 W_DISABLE#

The W_DISABLE# pin can be used to control SIM7500 Series-PCIE to enter or exit the Flight mode. In Flight mode, the RF circuit is closed to prevent interference with other equipments and minimize current consumption.

Table 6: W_DISABLE# Pin Status

W_DISABLE# status	Module operation
Input Low Level	Flight Mode: RF is closed.
Input High Level	The module mode depends on AT+CFUN command: AT+CFUN=1: RF is working. AT+CFUN=0: RF is closed.
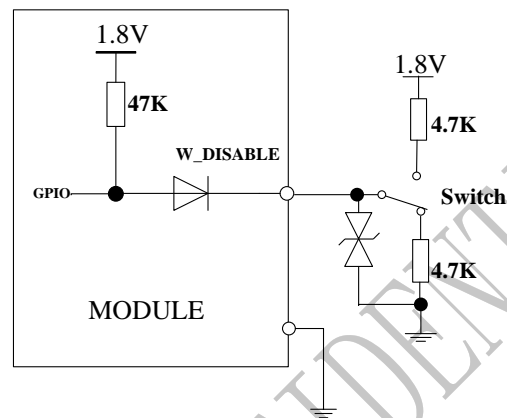
Figure 5: W_DISABLE# Reference Circuit

Table 7: W_DISABLE# Pin Electrical Characteristic

Symbol	Parameter	Min	Type	Max	Unit
V_{IH}	High-level input voltage	1.17	1.8	3.6	V
V_{IL}	Low-level input voltage	-0.3	0	0.3	V

3.4 LED_WWAN#

The LED_WWAN# pin can be used to drive a network status indication LED by default. Its status is listed in the following table.

Table 8: Network Status Indication LED Status

LED Status	Module Status
On	Searching Network; Call Connect(include VOLTE,SRLTE)
200ms On, 200ms Off	Data Transmit; 4G registered;
800ms On, 800ms Off	2G/3G registered network
Off	Power off ;Sleep

Note: NETLIGHT output low level as "OFF", and high level as "ON".

Reference circuit is recommended in the following figure:
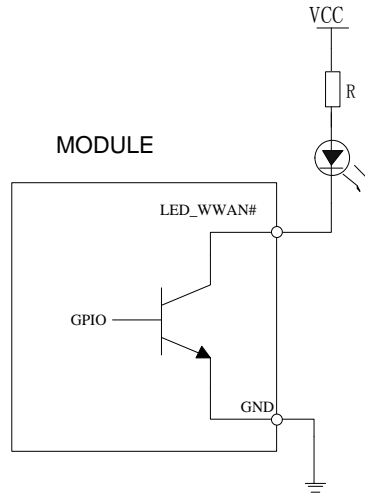
Figure 6: LED_WWAN# Reference Circuit

3.5   WAKE#

The WAKE# pin can be used as an interrupt signal to host. Normally it will keep high logic level until certain condition such as receiving SMS, voice call (CSD, video) or URC reporting, then WAKE# will change to low logic level to inform the master (client PC). It will stay low until the master clears the interrupt event with AT command.
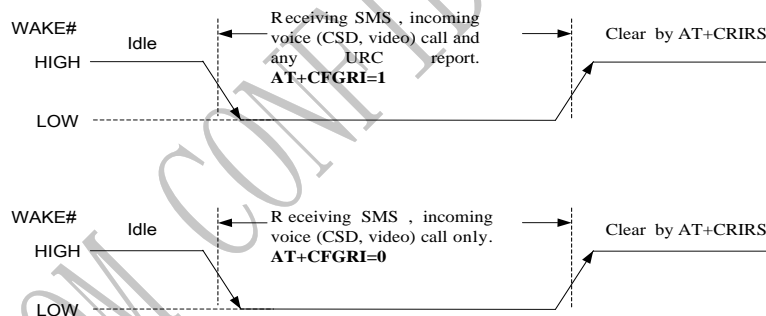
Figure 7: WAKE# behaviour

However, if the module is used as caller, the WAKE# will remain high. Please refer to the following figure.
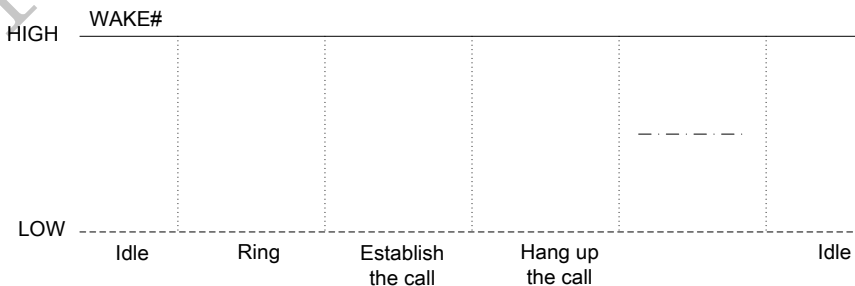
Figure 8: WAKE# behaviour as a caller

WAKE# Reference circuit is recommended in the following figure:
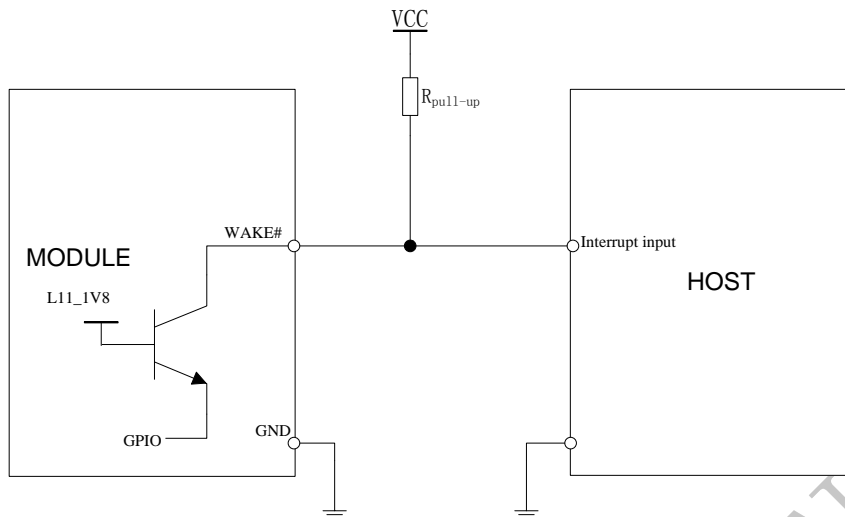
Figure 9: WAKE# Reference Circuit

Note: If Analog audio is available, wake up function is invalid.

3.6 USB 2.0

SIM7500 Series-PCIE is compliant with USB 2.0 specification. It supports full-speed and high- speed when acting as a peripheral device.

SIM7500 Series-PCIE can be used as a USB device. SIM7500 Series-PCIE supports the USB suspend and resume mechanism which can reduce power consumption. If there is no data transmission on the USB bus, SIM7500 Series-PCIE will enter suspend mode automatically, and will be resumed by some events such as voice call or receiving SMS, etc.
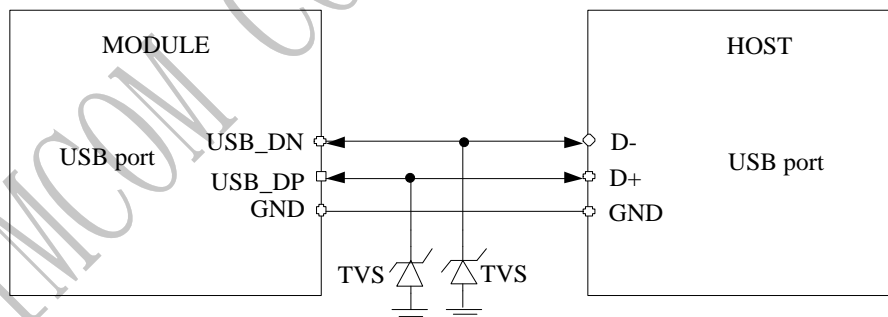
Figure 10: USB Reference Circuit

Because of the high bit rate on USB bus, please pay more attention to the influence of the junction capacitance of the ESD component on USB data lines. Typically, the capacitance should be less than 1pF. It is recommended to use an ESD protection component such as ESD9L5.0ST5G provided by On Semiconductor (www.onsemi.com).

Note;

1. *The USB_DN and USB_DP nets must be traced by 90Ohm+/-10% differential impedance.*
2. *The USB VBUS of the module is connected to VBAT internally, so there is no need to connect externally.*
3. *The SIM7500 Series-PCIE has two kinds of interface (UART and USB) to connect to host CPU. For example, on windows XP operating system, USB interface is mapped to 4virtual ports: "SIMTECH*

HS-USB Modem 9001", "SIMTECH HS-USB AT port 9001", "SIMTECH HS-USB Diagnostics 9001",
"SIMTECH HS-USB NMEA 9001".

3.7   USIM Interface

USIM interface complies with the GSM Phase 1 specification and the new GSM Phase 2+ specification for FAST 64 kbps USIM card. Both 1.8V and 3.0V USIM card are supported. USIM interface is powered from an internal regulator in the module.

Table 9: USIM Electronic characteristic in 1.8V mode (USIM_VDD =1.8V)

Symbol	Parameter	Min.	Typ.	Max.	Unit
USIM_VDD	LDO power output voltage	1.75	1.8	1.95	V
V_{IH}	High-level input voltage	0.65·USIM_VDD	-	USIM_VDD +0.3	V
V_{IL}	Low-level input voltage	-0.3	0	0.35·USIM_VDD	V
V_{OH}	High-level output voltage	USIM_VDD -0.45	-	USIM_VDD	V
V_{OL}	Low-level output voltage	0	0	0.45	V

Table 10: USIM Electronic characteristic 3.0V mode (USIM_VDD =2.95V)

Symbol	Parameter	Min.	Typ.	Max.	Unit
USIM_VDD	LDO power output voltage	2.75	2.95	3.05	V
V_{IH}	High-level input voltage	0.65*USIM_VDD	-	USIM_VDD +0.3	V
V_{IL}	Low-level input voltage	-0.3	0	0.25·USIM_VDD	V
V_{OH}	High-level output voltage	USIM_VDD -0.45	-	USIM_VDD	V
V_{OL}	Low-level output voltage	0	0	0.45	V

It is recommended to use an ESD protection component such as ST (www.st.com) ESDA6V-5W6. Note that the USIM peripheral circuit should be close to the USIM card socket. For more details of AT commands about USIM, please refer to document [1].

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

USIM_DET has been pulled up to 1.8V inside module;
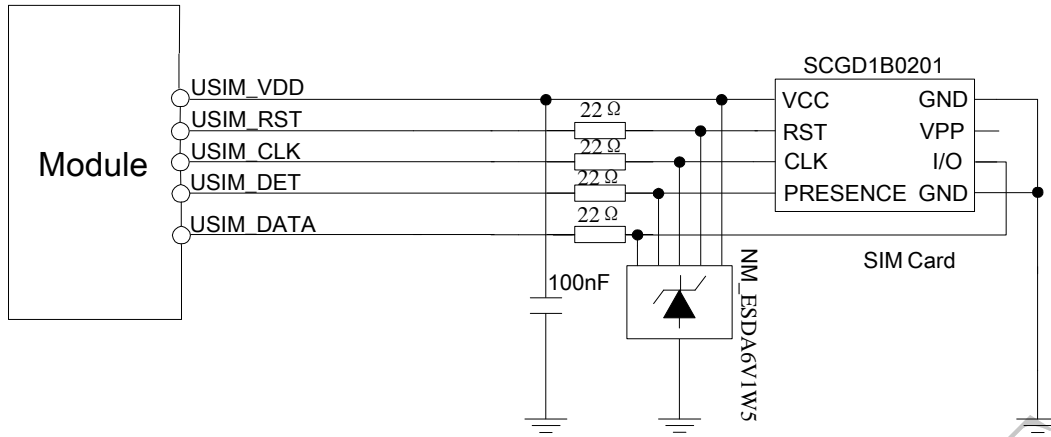
Figure 11: USIM interface reference circuit with detection function

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.
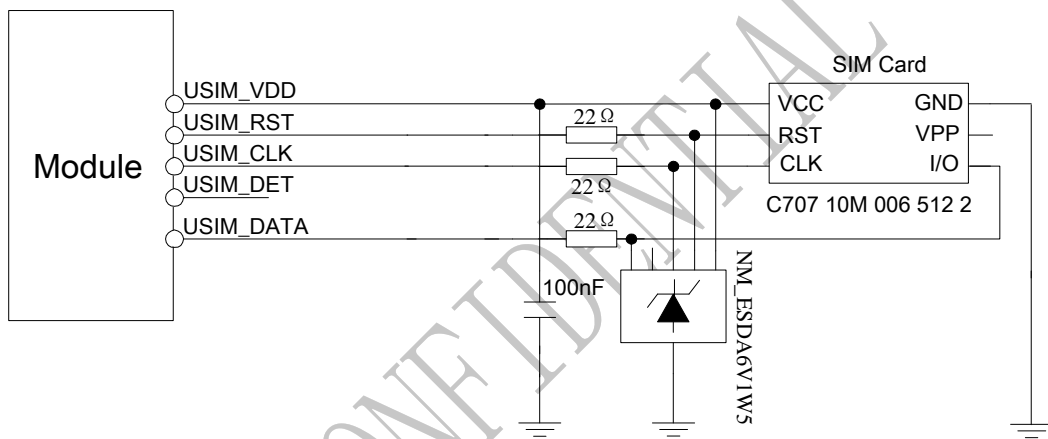
Figure 12: USIM interface reference circuit

Note : USIM_DATA has been pulled up with a 10KΩ resistor to USIM_VDD in module. A 100nF capacitor on USIM_VDD is used to reduce interference. Ensure USIM_CLK rising time less than 40ns.

3.8 UART Interface

SIM7500 Series-PCIE provides one UART (universal asynchronous serial transmission) port. The module is as the DCE (Data Communication Equipment) and the client PC is as the DTE (Data Terminal Equipment). AT commands are entered and serial communication is performed through UART interface.

The application circuit is in the following figures.
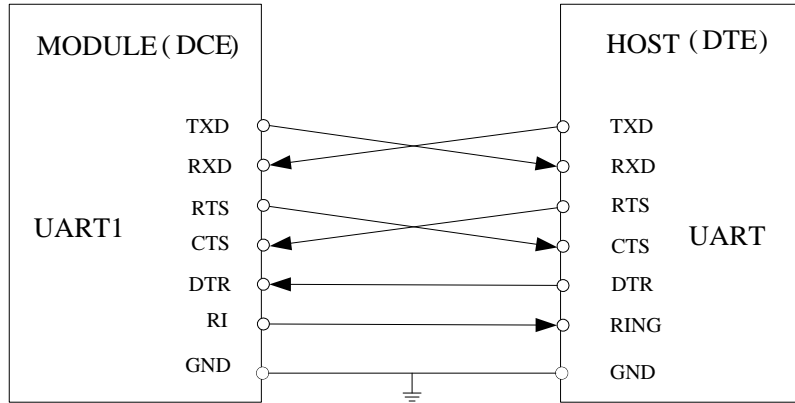
Figure 13: UART Full modem
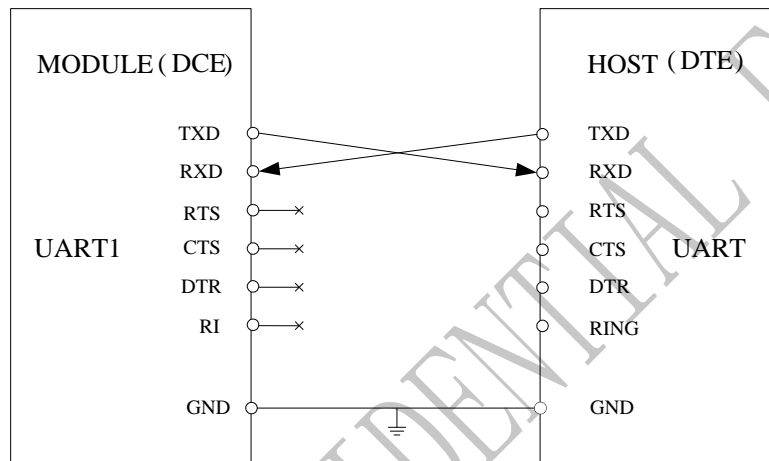
Figure 14: UART Null modem

Table 11: UART Electrical Characteristic

Symbol	Parameter	Min	Typ	Max	Unit
V_{IH}	High-level input voltage	1.17	1.8	2.1	V
V_{IL}	Low-level input voltage	-0.3	0	0.63	V
V_{OH}	High-level output voltage	1.35	1.8	1.8	V
V_{OL}	Low-level output voltage	0	0	0.45	V

The SIM7500 Series-PCIE UART is 1.8V interface. A level shifter should be used if user's application is equipped with a 3.3V UART interface. The level shifter TXB0108RGYR provided by Texas Instruments is recommended. The reference design of the TXB0108RGYR is in the following figures.
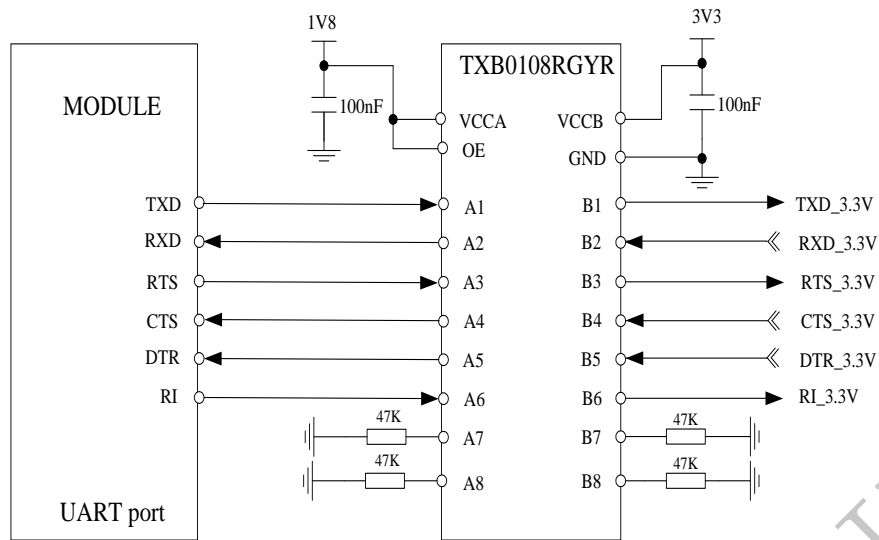
Figure 15: Reference circuit of level shift

customers can use another level shifter circuits as follow
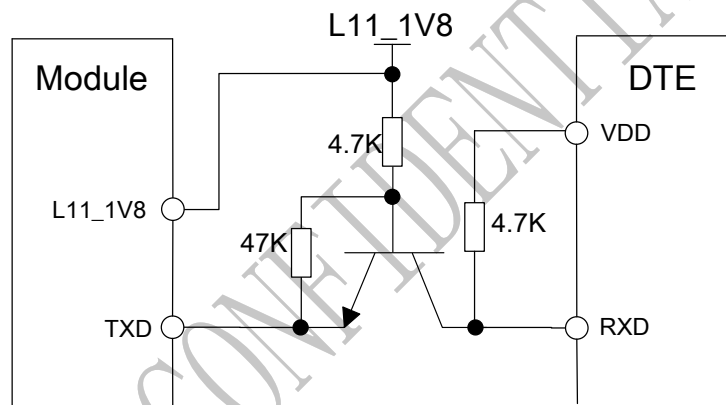
Figure 16: TX level matching circuit
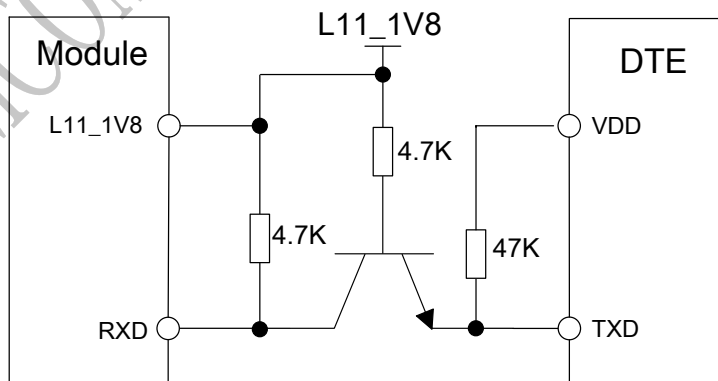
Figure 17: RX level matching circuit

To comply with RS-232-C protocol, the RS-232-C level shifter chip should be used to connect SIM7500 Series-PCIE to the RS-232-C interface. In this connection, the TTL level and RS-232-C level are converted

mutually. SIMCom recommends that user uses the SP3238ECA chip with a full modem. For more information please refers to the RS-232-C chip datasheet.

Note1: User need to use high speed transistors such as MMBT3904.

Note2: SIM7500 Series-PCIE supports the following baud rate: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600, 3200000, 3686400, 4000000bps. Default baud rate is 115200bps.

3.9 I2C Interface

SIM7500 Series-PCIE provides I2C interface compatible with I2C specification, version 5.0, with clock rate up to 400 kbps. Its operation voltage is 1.8V.

Note: Since the I2C is connected to the audio codec chip on board, the users should choose the I2C device whose address is not the same with the audio codec (0x34). If the the audio codec chip is not mounted on board, users could ignore this.

The following figure shows the I2C bus reference design.
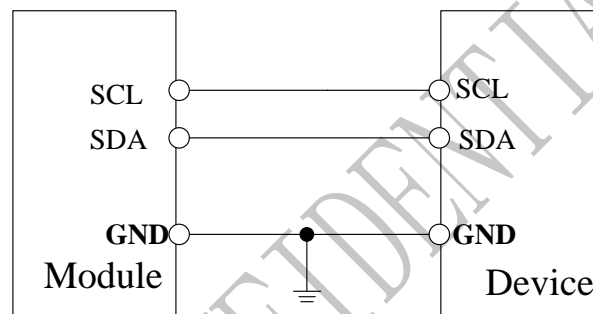
Figure 18: I2C Reference Circuit

Note: SDA and SCL are pulled up to 1.8V via 10K resistors in module. So external pull up resistors are not needed in application circuit. For more details about I2C AT commands please refer to document [1].

Table 12: I2C Electrical Characteristic

Symbol	Parameter	Min	Typ	Max	Unit
V_{IH}	High-level input voltage	1.17	1.8	2.1	V
V_{IL}	Low-level input voltage	-0.3	0	0.63	V
V_{OH}	High-level output voltage	1.35	1.8	1.8	V
V_{OL}	Low-level output voltage	0	0	0.45	V

3.10 PCM/Analog Audio Interface

3.10.1 PCM Interface

SIM7500 Series-PCIE provides hardware PCM interface for external codec. SIM7500 Series-PCIE PCM interface

can be used in short sync master mode only, and only supports 16 bits linear format.

Note: The PCM interface cannot be used if audio codec chip is mounted on PCIE board.

Table 13: PCM Specification

Characteristics	Specification
Line Interface Format	Linear(Fixed)
Data length	16bits(Fixed)
PCM Clock/Sync Source	Master Mode(Fixed)
PCM Clock Rate	2048 KHz (Fixed)
PCM Sync Format	Short sync(Fixed)
Data Ordering	MSB

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

Table 14: PCM DC Characteristics

Symbol	Parameter	Min	Type	Max	Unit
V_{IH}	High-level input voltage	1.17	1.8	2.1	V
V_{IL}	Low-level input voltage	-0.3	0	0.63	V
V_{OH}	High-level output voltage	1.35	1.8	1.8	V
V_{OL}	Low-level output voltage	0	0	0.45	V

3.10.2　PCM timing

SIM7500 Series-PCIE supports 2.048 MHz PCM data and sync timing for 16 bits linear format codec.
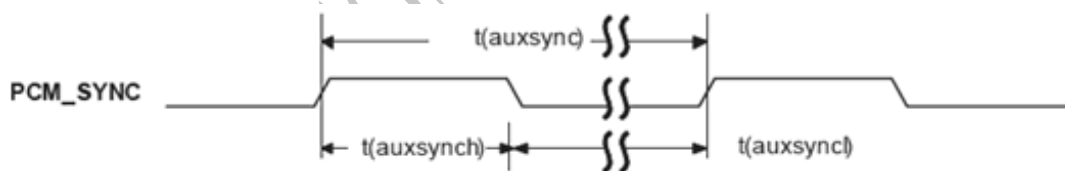
Figure 19: PCM_SYNC timing
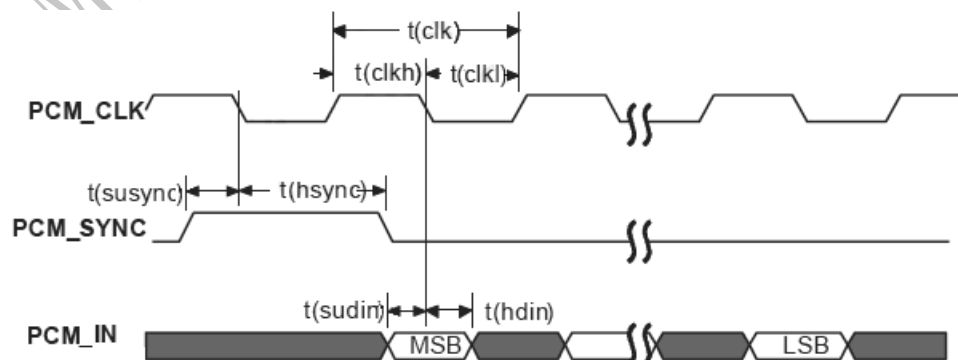
Figure 20: EXT CODEC to MODULE timing
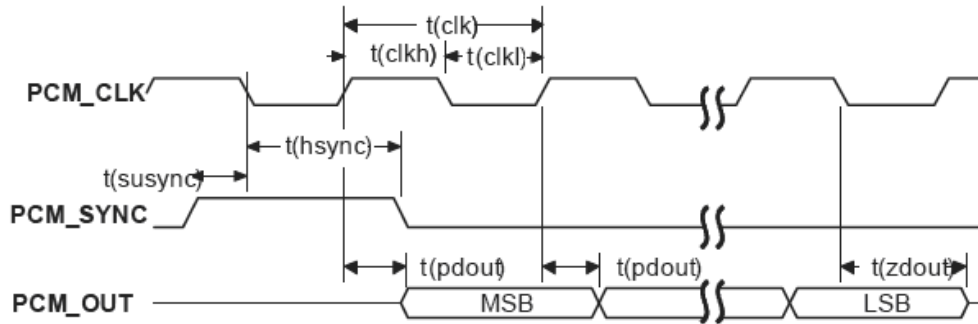
Figure 21: MODULE to EXT CODEC timing

Table 15: PCM Timing parameters

Parameter	Description	Min.	Typ.	Max.	Unit
T(sync)	PCM_SYNC cycle time	–	125	–	μs
T(synch)	PCM_SYNC high level time	–	488	–	ns
T(syncl)	PCM_SYNC low level time	–	124.5	–	μs
T(clk)	PCM_CLK cycle time	–	488	–	ns
T(clkh)	PCM_CLK high level time	–	244	–	ns
T(clkl)	PCM_CLK low level time	–	244	–	ns
T(susync)	PCM_SYNC setup time high before falling edge of PCM_CLK	–	122	–	ns
T(hsync)	PCM_SYNC hold time after falling edge of PCM_CLK	–	366	–	ns
T(sudin)	PCM_IN setup time before falling edge of PCM_CLK	60	–	–	ns
T(hdin)	PCM_IN hold time after falling edge of PCM_CLK	60	–	–	ns
T(pdout)	Delay from PCM_CLK rising to PCM_OUT valid	–	–	60	ns
T(zdout)	Delay from PCM_CLK falling to PCM_OUT HIGH-Z	–	–	60	ns

3.10.3   PCM Application Guide

The following figure shows the reference design of Audio codec chip NAU8810 with SIM7500 Series-PCIE.
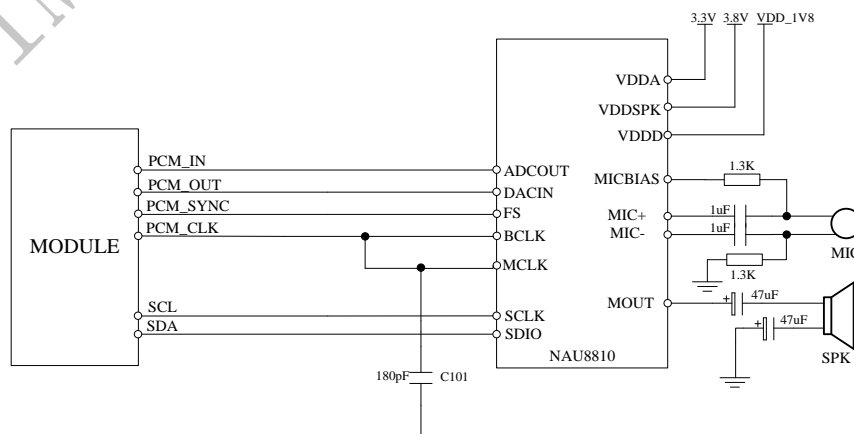
Figure 22: Audio Codec Reference Circuit

Note: C101 must be mounted.

3.10.4 Analog Audio Interface

SIM7500 Series-PCIEA support analogy audio function, and provides one analog signal output and one analog input. MICP/N is used as microphone input; EARP/N is used as audio output. Regarding audio parameters configuration, please refer to the ATC manual.

Table 16: MIC input characteristics

Parameter	Min	Typ	Max	Unit
Mic biasing voltage		1.80		V
Working Current			3	mA
External Microphone Load Resistance	1.2	2.2		KΩ

Table 17: Audio output characteristics

Parameter	Min	Typ	Max	Unit
Load resistance	27	32	-	Ω
Output power	-	50	-	mW
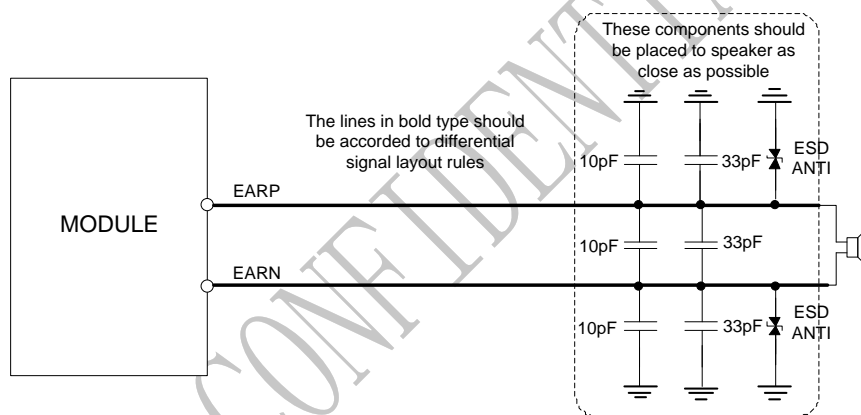
Figure 23: Receiver interface configuration
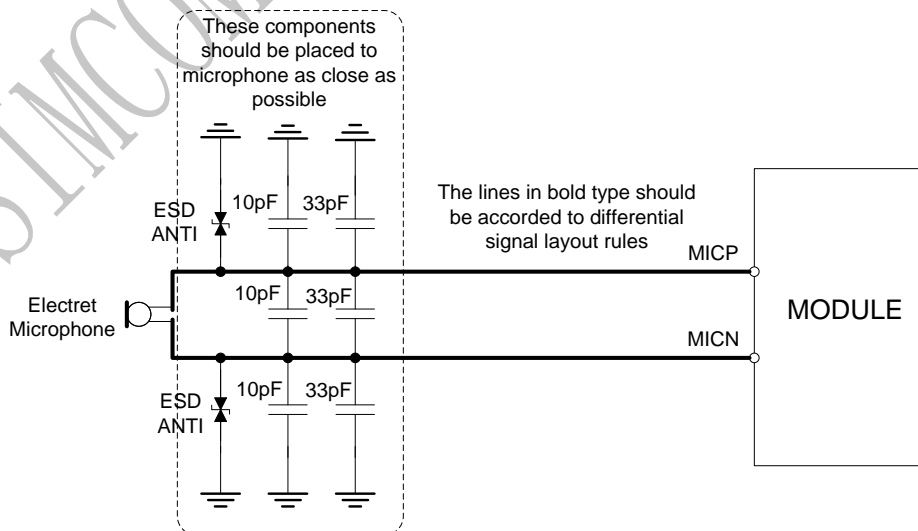
Figure 24: Microphone interface configuration

Note: SIM7500 Series-PCIEA has integrated MIC bias circuit. There is no need to pull the MICP and MICN

up to the external power, just connect it to microphone. MICP and MICN must be differential lines.

Main audio parameters can be changed to satisfy users' requirement. User can adjust them through AT command according to their own electronic and mechanical design. For more details please refers to audio application document.

4. RF Specifications

4.1 GSM/WCDMA/ LTE RF Specifications

Table 18: Conducted transmission power

Frequency	Power	Min.
E-GSM900	33dBm ±2dB	5dBm ± 5dB
DCS1800	30dBm ±2dB	0dBm ± 5dB
E-GSM900 (8-PSK)	27dBm ±3dB	5dBm ± 5dB
DCS1800 (8-PSK)	26dBm +3/-4dB	0dBm ±5dB
WCDMA B1	24dBm +1/-3dB	<-50dBm
WCDMA B2	24dBm +1/-3dB	<-50dBm
WCDMA B5	24dBm +1/-3dB	<-50dBm
WCDMA B8	24dBm +1/-3dB	<-50dBm
LTE-FDD B1	23dBm +/-2.7dB	<-40dBm
LTE-FDD B2	23dBm +/-2.7dB	<-40dBm
LTE-FDD B3	23dBm +/-2.7dB	<-40dBm
LTE-FDD B4	23dBm +/-2.7dB	<-40dBm
LTE-FDD B5	23dBm +/-2.7dB	<-40dBm
LTE-FDD B7	23dBm +/-2.7dB	<-40dBm
LTE-FDD B8	23dBm +/-2.7dB	<-40dBm
LTE-FDD B12	23dBm +/-2.7dB	<-40dBm
LTE-FDD B18	23dBm +/-2.7dB	<-40dBm
LTE-FDD B19	23dBm +/-2.7dB	<-40dBm
LTE-FDD B20	23dBm +/-2.7dB	<-40dBm
LTE-FDD B26	23dBm +/-2.7dB	<-40dBm
LTE-FDD B28	23dBm +/-2.7dB	<-40dBm

Table 19: Operating frequencies

Frequency	Receiving	Transmission
E-GSM900	925～960MHz	880～915 MHz
DCS1800	1805～1880MHz	1710～1785MHz
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	2620~2690 MHz	2500 ~2570 MHz
LTE-FDD B8	925~960 MHz	880 ~915 MHz
LTE-FDD B12	729 ~746 MHz	699 ~716 MHz
LTE-FDD B18	860 ~875 MHz	815~830 MHz
LTE-FDD B19	875 ~890 MHz	830~845 MHz
LTE-FDD B20	832 ~862 MHz	791~821 MHz

LTE-FDD B26	859 ~894 MHz	814~849 MHz
LTE-FDD B28	758 ~803 MHz	703~748 MHz
GPS	1574.4 ～1576.44 MHz	-
GLONASS	1598 ～1606 MHz	-
BD	1559 ～1563 MHz	

Table 20: Conducted receive sensitivity

Frequency	Receive sensitivity(Typical)	Receive sensitivity(MAX)
E-GSM900	< -109dBm	3GPP
DCS1800	< -109dBm	3GPP
WCDMA B1	< -110dBm	3GPP
WCDMA B2	< -110dBm	3GPP
WCDMA B5	< -110dBm	3GPP
WCDMA B8	< -110dBm	3GPP
LTE FDD/TDD	See table 21.	3GPP

Table 21: Reference sensitivity (QPSK)

E-UTRA band	3GPP standard				Test value	3GPP standard		Duplex
	1.4 MHz	3MHz	5MHz	10MHz	10 MHz	15 MHz	20 MHz	
1	-	-	-100	-97	-101.3	-95.2	-94	FDD
2	-102.7	-99.7	-98	-95	-101	-93.2	-92	FDD
3	-101.7	-98.7	-97	-94	-100	-92.2	-91	FDD
4	-104.7	-101.7	-100	-97	-102	-95.2	-94	FDD
5	-103.2	-100.2	-98	-95	-101	-	-	FDD
7	-	-	-98	-95	-98	-93.2	-92	FDD
8	-102.2	-99.2	-97	-94	-99.8	-	-	FDD
12	-101.7	-98.7	-97	-94	-101.5	-	-	FDD
18	-	-	-100	-97	-101	-95.2	-	FDD
19	-	-	-100	-97	-101	-95.2	-	FDD
20	-	-	-97	-94	-102	-91.2	-90	FDD
25	-101.2	-98.2	-96.5	-93.5	-100	-91.7	-90.5	FDD
26	-102.7	-99.7	-97.5	-94.5	-101	-92.7	-	FDD
28		-100.2	-98.5	-95.5	TBD	-93.7	-91	FDD

4.2 RF Antenna Connector

SIM7500 Series-PCIE have 3 antenna connectors, one of which is the GSM/UMTS/LTE main antenna connector, the others are UMTS/LTE auxiliary antenna connector and GPS/GLONASS antenna connector. Recommended antenna characteristics of SIM7500 Series-PCIE are described by 2 following tables.

Table 22: Recommended Passive Antenna Characteristics

Passive	Recommended standard

Direction	omnidirectional
Gain	> -3dBi (Avg)
Input impedance	50 ohm
Efficiency	> 50 %
VSWR	< 2

Table 23: Recommended Active Antenna Characteristics

Band	Performance	
	TRP	TIS
EGSM900	≧ 29dBm	≦ -104dBm
DCS1800	≧ 26dBm	≦ -104dBm
WCDMA	≧ 19dBm	≦ -104dBm
LTE	≧ 18dBm	4dB worse than 3GPP standard

NOTE: The above LTE only test 10MHZ bandwidth

The RF connector in the module side is an ultra small surface mount coaxial connector (Part Number: U.FL-R-SMT, vended by HRS). It has high performance with wide frequency range, surface mountable and reflows solderable. Following are parameters (Figure 23). Certainly user can visit http://www.hirose-connectors.com/ for more information.

To get good RF performance in user's design, SIMCom suggests user to use the matching RF adapter cable which is also supplied by HRS (Part Number: U.FL-LP（V）-040), the following figure (Figure 24) is the dimensions of U.FL series RF adapter cable. User can contact SIMCom for more information.
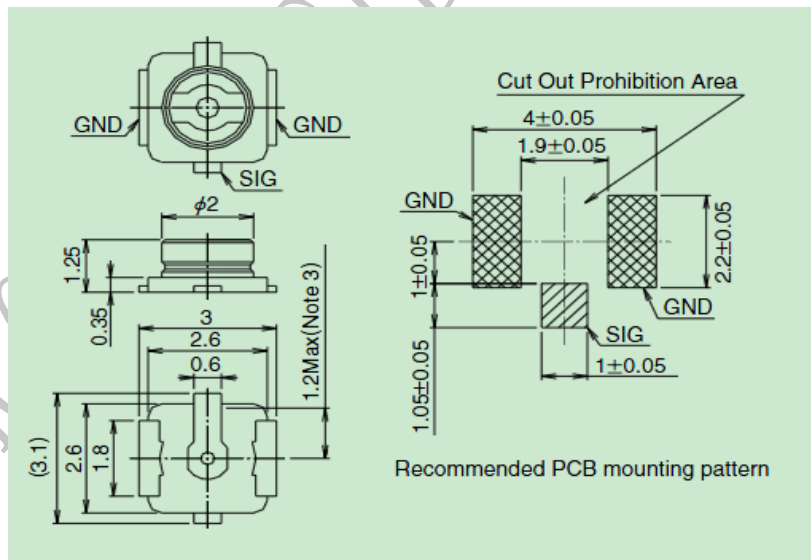
Figure 25: U.FL-R-SMT (Unit: mm)
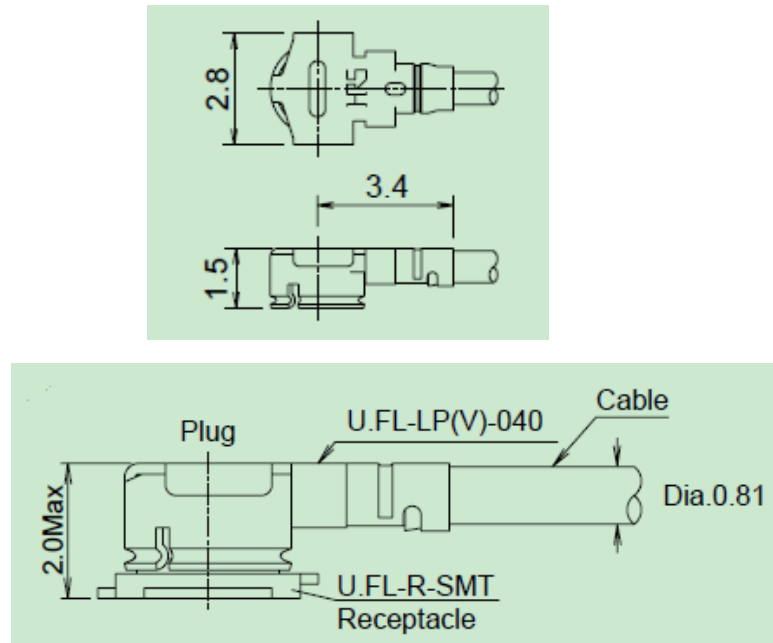
Figure 26: U.FL series RF adapter cable (Unit: mm)

4.3 GNSS

SIM7500 Series-PCIE merges GNSS (GPS/GLONASS/BD) satellite and network information to provide a high-availability solution that offers industry-leading accuracy and performance. This solution performs well, even in very challenging environmental conditions where conventional GNSS receivers fail, and provides a platform to enable wireless operators to address both location-based services and emergency mandates.

4.3.1 GNSS Technical specification

Tracking sensitivity: -159 dBm（GPS）/-158 dBm（GLONASS）/TBD (BD)

Cold-start sensitivity: -148 dBm

Accuracy (Open Sky): 2.5m (CEP50)

TTFF (Open Sky) : Hot start <1s, Cold start<35s

Receiver Type: 16-channel, C/A Code

GPS L1 Frequency: 1575.42 ± 1.023MHz

GLONASS: 1597.5~1605.8 MHz

BD: 1559.05~1563.14 MHz

Update rate: Default 1 Hz

GNSS data format: NMEA-0183

GNSS Current consumption : 100mA (GSM/CDMA 1X/UMTS/LTE Sleep ,in total on VBAT pins)

GNSS antenna: Passive/Active antenna

It is suggested either the external LNA or active antenna used. It is not needed for both of them at the same time.

Note: Performance will vary depending on the environment, antenna type and signal conditions and so on.

4.3.2 GNSS Operate Mode

SIM7500 Series-PCIE supports both A-GPS and S-GPS, and then provides three operating modes: mobile-assisted mode, mobile-based mode and standalone mode. A-GPS includes mobile-assisted and mobile-based mode.

In mobile-assisted mode, when a request for position location is issued, available network information is provided

to the location server (e.g. Cell-ID) and assistance is requested from the location server. The location server sends the assistance information to the handset. The handset/mobile unit measures the GNSS observables and provides the GNSS measurements along with available network data (that is appropriate for the given air interface technology) to the location server. The location server then calculates the position location and returns results to the requesting entity.

In mobile-based mode, the assistant data provided by the location server encompasses not only the information required to assist the handset in measuring the satellite signals, but also the information required to calculate the handset's position. Therefore, rather than provide the GNSS measurements and available network data back to the location server, the mobile calculates the location on the handset and passes the result to the requesting entity.

In standalone (autonomous) mode, the handset demodulates the data directly from the GNSS satellites. This mode has some reduced cold-start sensitivity, and a longer time to first fix as compared to the assisted modes. However, it requires no server interaction and works out of network coverage.

This combination of GNSS measurements and available network information provides:

● High-sensitivity solution that works in all terrains: Indoor, outdoor, urban, and rural
● High availability that is enabled by using both satellite and network information

Therefore, while network solutions typically perform poorly in rural areas and areas of poor cell geometry/density, and while unassisted, GNSS-only solutions typically perform poorly indoors. The SIM7500 Series-PCIE GNSS solution provides optimal time to fix, accuracy, sensitivity, availability, and reduced network utilization in both of these environments, depending on the given condition.

GNSS can be used by NMEA port. User can select NMEA as output through UART or USB. NMEA sentences are automatic and no command is provided. NMEA sentences include GSV, GGA, RMC, GSA, and VTG. Before using GNSS, user should configure SIM7500 Series-PCIE in proper operating mode by AT command. Please refer to related document for details. SIM7500 Series-PCIE can also get position location information through AT directly.

4.3.3 Application Guide

Users can adopt an active antenna or a passive antenna to receive GNSS signal.
In this document, all GNSS specifications mentioned are from passive antenna. The following is the reference circuit.
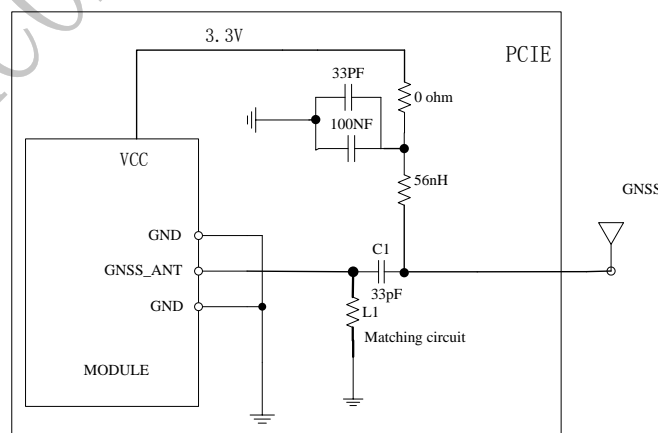
Figure 27: Active antenna circuit
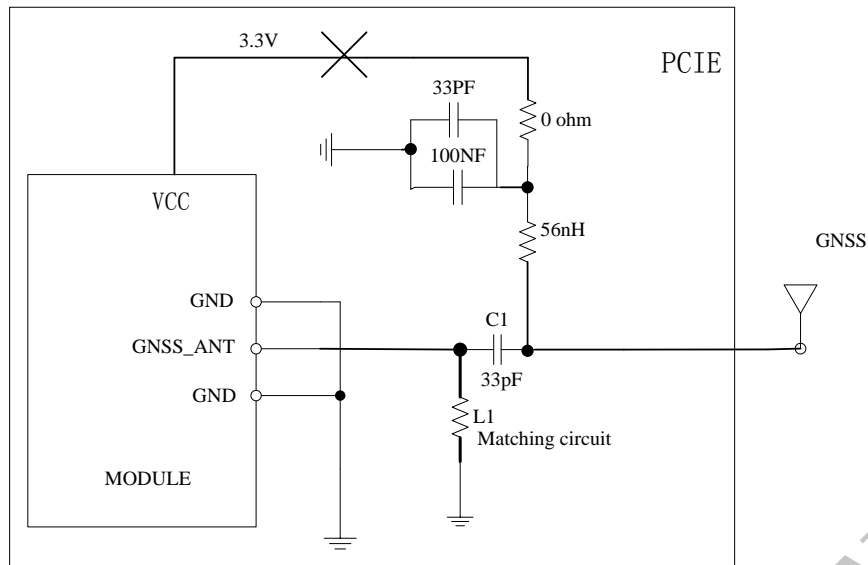
Figure 28: Passive antenna circuit (Default)

Note: When using an active antenna, VCC(3.3V by default) is the power of the active antenna.
Note: GNSS is closed by default, it could be started by AT+CGPS. The AT command has two parameters, the first is on/off, and the second is GNSS mode. Default mode is standalone mode.
AGPS mode needs more support from the mobile telecommunication network. Please refer to document [22] for more details.

5. Electrical Specifications

5.1 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_{CC}	VCC input voltage	-0.3	-	3.6	V
V_{IO}	Voltage at digital pins (1.8V digital I/O) *	-0.3	-	2.1	V

Note: These parameters are for digital interface pins, such as PCM,I2C,UART.

5.2 Recommended Operating Conditions

Please refer to the follow table for recommended operating conditions.

Table 25: Operating Conditions

Symbol	Parameter	Min	Type	Max	Unit
V_{CC}	3.3 V Input voltage	3.0	3.3	3.6	V
V_{IO}	Voltage at digital pins (1.8V digital I/O)	0	1.8	1.95	V
T_{OPER}	Operating temperature	-40	+25	+85	℃
T_{STG}	Storage temperature	-45	+25	+90	℃

5.3 Operating Mode

5.3.1 Operating Mode

The table below summarizes the various operating modes of SIM7500 Series-PCIE.

Table 26: Operating Mode

Mode		Function
Normal operation	GSM/UMTS/LTE Sleep	In this case, the current consumption of module will be reduced to the minimal level and the module can still receive paging message and SMS.
	GSM/UMTS/LTE Idle	Software is active. Module is registered to the network, and the module is ready to communicate.
	GSM/ UMTS/LTE 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, antenna.
	GPRS/EDGE/UMTS/ LTE Standby	Module is ready for data transmission, but no data is currently sent or received. In this case, power consumption depends on network settings.
	GPRS/EDGE/UMTS/ LTE 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" 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 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 shutting down the power.

5.3.2　Power saving mode

SIM7500 Series-PCIE has two power saving modes: minimum functionality mode and sleep mode. in which module will achieve lower power consumption for power saving.

5.3.3　Sleep mode

In sleep mode, the current consumption of module will be reduced to the minimal level, and module can still receive paging message and SMS.

Several hardware and software conditions must be satisfied together in order to let SIM7500 Series-PCIE enter into sleep mode:

1. UART condition

2. USB condition

3. Software condition

Note: Before designing, pay attention to how to realize sleeping/waking function and refer to Document [22] for more details.

5.3.4　Minimum functionality 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: Disable RF function of the module (Flight mode)

If SIM7500 Series-PCIE has been set to minimum functionality mode, the module will firstly enter sleep mode, then the RF function and USIM card function will be closed. In this case, the serial port is still accessible, but RF function or USIM card will be unavailable. When SIM7500 Series-PCIE is in minimum functionality or flight mode, it can return to full functionality by the AT command "AT+CFUN=1".

5.4 Current Consumption

The current consumption is listed in the table below.

Table 27: Current Consumption(VCC =3.3 V)

GNSS	
GNSS supply current (AT+CFUN=0,with USB connection)	@ -140dBm，Tracking Typical:35mA
GSM Sleep mode/Idle Mode	
GSM/GPRS supply current (GNSS off，without USB connection)	Sleep mode@ BS_PA_MFRMS=2 Typical: 6mA Idle mode@ BS_PA_MFRMS=2　Typical: 28mA
UMTS Sleep/Idle Mode	
WCDMA supply current (without USB connection)	Sleep mode @DRX=9　Typical: 5.5mA Idle mode @DRX=9　Typical: 28mA
LTE Sleep/Idle mode	
LTE supply current (without USB connection)	Sleep mode Typical: 5.5mA Idle mode Typical: 30mA
GSM Talk	
GSM 900	@power level #5 Typical: 220mA
DCS1800	@power level #5 Typical: 162mA
UMTS Talk	
WCDMA B1	@Power 23dBm　　Typical: 535mA
WCDMA B2	@Power 22dBm　　Typical: 524mA
WCDMA B5	@Power 23.48dBm　Typical: 480mA
WCDMA B8	@Power 23.5dBm　　Typical: 530mA
GPRS	
GSM 900 (1 Rx,4 Tx)	@power level #5 Typical: 230mA
DCS1800 (1 Rx,4 Tx)	@power level #0 Typical: 195mA
GSM 900 (3Rx, 2 Tx)	@power level #5 Typical: 370mA
DCS1800 (3Rx, 2 Tx)	@power level #0 Typical: 275mA
EDGE	
GSM 900 (1 Rx,4 Tx)	@power level #8 Typical: 400mA
DCS1800 (1 Rx,4 Tx)	@power level #2 Typical: 300mA
GSM 900 (3Rx, 2 Tx)	@power level #8 Typical: 320mA
DCS1800 (3Rx, 2 Tx)	@power level #2 Typical: 230mA
HSDPA Data	
WCDMA B1	@Power 23.1dBm Typical: 485.5mA
WCDMA B2	@Power 23.4dBm Typical: 458mA
WCDMA B5	@Power 24.1dBm Typical: 485.5mA
WCDMA B8	@Power 24.1dBm Typical: 485.5mA
LTE Data	
LTE-FDD B1	@5 MHz　22.7dBm　Typical: 568mA @10 MHz　22.5dBm　Typical: 567mA @20 MHz　23.06dBm　Typical: 580mA
LTE-FDD B2	@5 MHz　22.3dBm　Typical: 685 mA @10 MHz　22.7dBm　Typical: 670 mA @20 MHz　22.4 dBm　Typical: 690mA
LTE-FDD B3	@5 MHz　22.2dBm　Typical: 568mA @10 MHz　22.7dBm　Typical: 594mA

	@20 MHz	22.4 dBm	Typical: 660mA
LTE-FDD B4	@5 MHz @10 MHz @20 MHz	23.1dBm 23.1dBm 22.8dBm	Typical: 600mA Typical: 640mA Typical: 680mA
LTE-FDD B5	@3 MHz @5 MHz @10 MHz	24.0 dBm 23.8dBm 23.91dBm	Typical: 600mA Typical: 482mA Typical: 596mA
LTE-FDD B7	@5 MHz @10 MHz @20 MHz	22.6dBm 22.6dBm 24.5dBm	Typical: 680mA Typical: 689mA Typical: 690mA
LTE-FDD B8	@5 MHz @10 MHz	22.2dBm 22.7dBm	Typical: 580mA Typical: 590mA
LTE-FDD B12	@5 MHz @10 MHz	22.6dBm 22.9dBm	Typical: 600mA Typical: 610mA
LTE-FDD B18	@5 MHz @10 MHz	23.3dBm 23.5dBm	Typical: 560mA Typical: 580mA
LTE-FDD B19	@5 MHz @10 MHz	23.6dBm 23.4dBm	Typical: 520mA Typical: 540mA
LTE-FDD B20	@5 MHz @10 MHz @20 MHz	24dBm 24dBm 23.9dBm	Typical: 680mA Typical: 600mA Typical: 670mA
LTE-FDD B26	@5 MHz @10 MHz	23.6dBm 23.4dBm	Typical: 530mA Typical: 560mA
LTE-FDD B28	@5 MHz @10 MHz @20 MHz	23.88dBm 23.75dBm 24.5dBm	Typical: 700mA Typical: 608mA Typical: 700mA

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

5.5 Electro-Static Discharge

SIM7500 Series-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 28: ESD characteristics (Temperature: 25℃, Humidity: 45 %)

Part	Contact discharge	Air discharge
VBAT,GND	+/-6K	+/-12K
Antenna port	+/-5K	+/-10K
USB	+/-4K	+/-8K
UART	+/-3K	+/-6K
Other PADs	+/-3K	+/-6K

6. Packaging

SIM7600 Series-PCIE module support tray packaging.
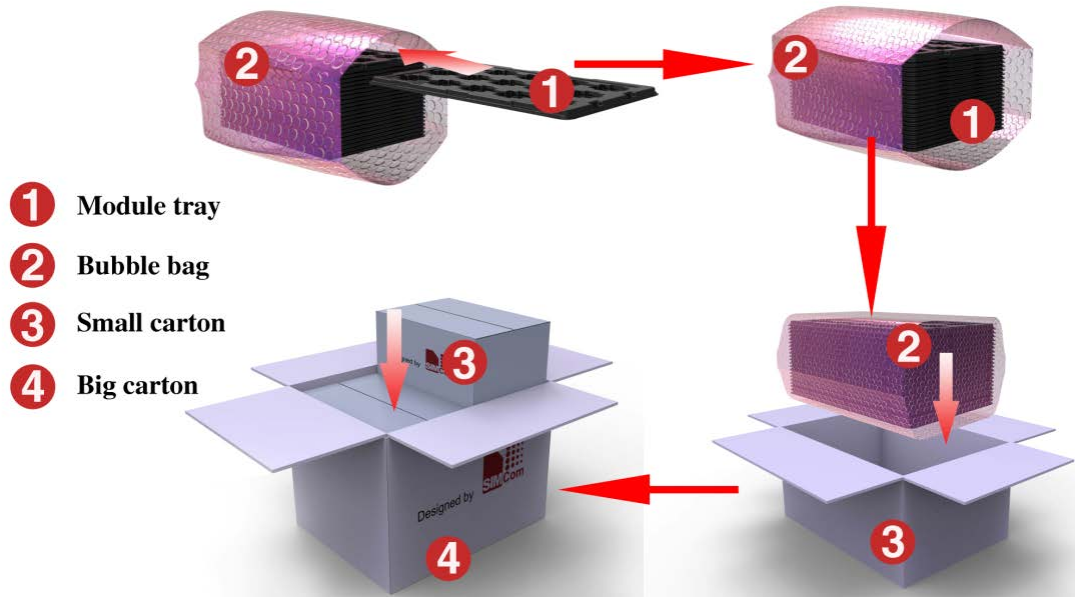
Figure 29: Tray packaging

Module tray drawing:
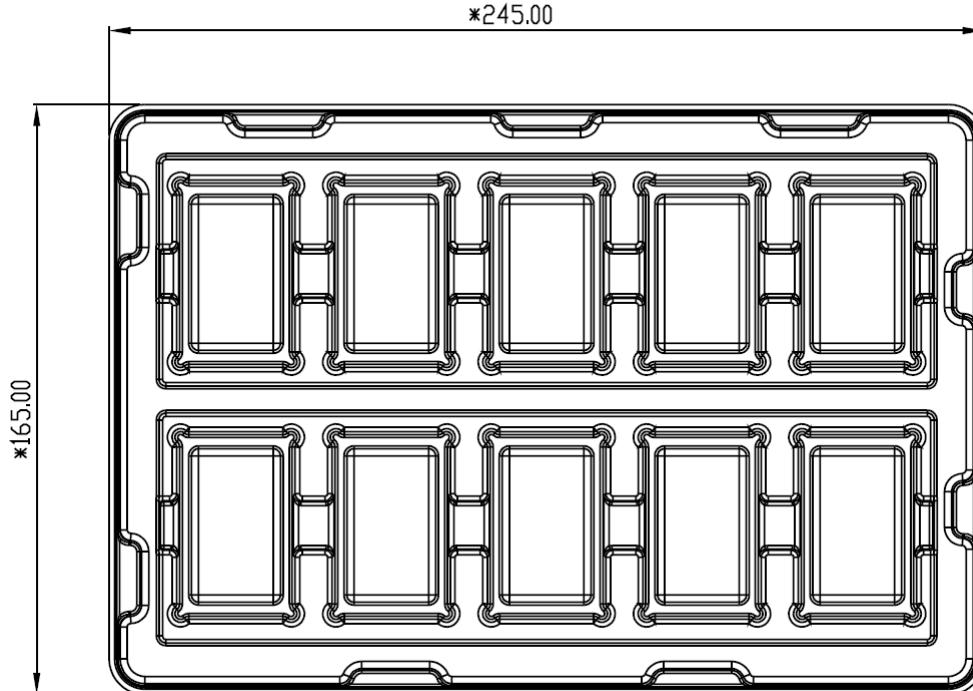
Figure 30: Tray drawing

Table 29: Tray size

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

Small carton drawing:
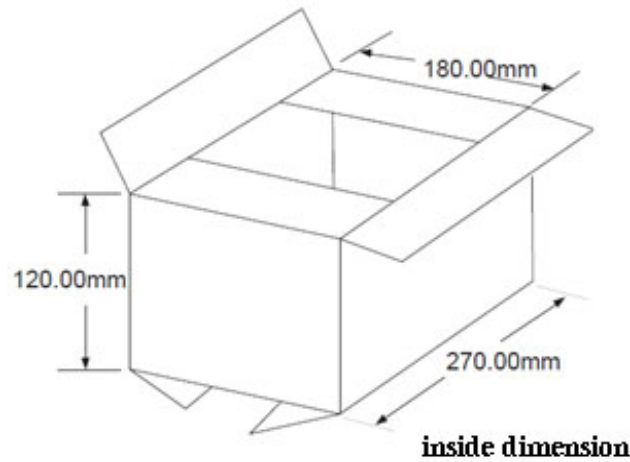
Figure 31: Small carton drawing

Table 30: Small Carton size

Length（±10mm）	Width（±10mm）	Height（±10mm）	Number
270	180	120	10*10=100

Big carton drawing:
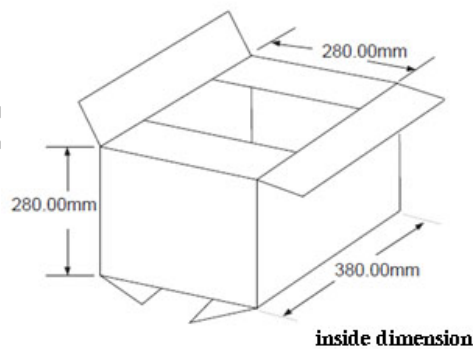
Figure 32: Big carton drawing

Table 31: Big Carton size

Length（±10mm）	Width（±10mm）	Height（±10mm）	Number
380	280	280	100*4=400

Appendix

I. Coding Schemes and Maximum Net Data Rates over Air Interface

Table 32: 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
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

II. Related Documents

Table 33: Related Documents

SN	Title	Description
[1]	SIM7500_SIM7600 Series_AT Command Manual_V1.xx	SIM7X00 Series_AT Command Manual
[2]	ITU-T Draft new recommendationV.25ter	Serial asynchronous automatic dialing and control
[3]	GSM 07.07	Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)
[4]	GSM 07.10	Support GSM 07.10 multiplexing protocol
[5]	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)
[6]	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
[7]	GSM 11.11	Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[8]	GSM 03.38	Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information
[9]	GSM 11.10	Digital cellular telecommunications system (Phase 2); Mobile Station (MS) conformance specification; Part 1: Conformance specification
[10]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[11]	3GPP TS 34.124	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[12]	3GPP TS 34.121	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[13]	3GPP TS 34.123-1	Technical Specification Group Radio Access Network; Terminal conformance specification; Radio transmission and reception (FDD)
[14]	3GPP TS 34.123-3	User Equipment (UE) conformance specification; Part 3: Abstract Test Suites.
[15]	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
[16]	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
[17]	IEC/EN60950-1(2001)	Safety of information technology equipment (2000)
[18]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[19]	GCF-CC V3.23.1	Global Certification Forum - Certification Criteria

[20]	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)
[21]	Module secondary-SMT-UGD-V1.xx	Module secondary SMT Guidelines
[22]	SIM7100_GPS_Application_Note_V0.xx	SIM7100 GPS Application Note
[23]	ANTENNA DESIGN GUIDELINES FOR DIVERSITY RECEIVER SYSTEM	ANTENNA DESIGN GUIDELINES FOR DIVERSITY RECEIVER SYSTEM

III. Terms and Abbreviations

Table 34: 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
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
HR	Half Rate
HSPA	High Speed Packet Access
I2C	Inter-Integrated Circuit
IMEI	International Mobile Equipment Identity
LTE	Long Term Evolution
MO	Mobile Originated
MS	Mobile Station (GSM engine), also referred to as TE
MT	Mobile Terminated
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
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

IV. 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.
SOS	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 SIM 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 SIM card be properly inserted in the cellular terminal or mobile.

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