SIM7600 Series PCIE Hardware Design

LTE Module

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		Add figure30	
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1 Introduction

This document describes the electronic specifications, RF specifications, interfaces, mechanical characteristics and testing results of the SIMCom SIM7600 Series-PCIE (in the following chapter, the document only describe the SIM7600 Series-PCIE) modules. With the help of this document and other related software application notes/user guides, users can understand and use SIM7600 Series-PCIE modules to design and develop applications quickly.

1.1 Product Outline

Aimed at global market, the SIM7600 Series-PCIE modules support 4 air-interface standards including GSM, WCDMA, LTE-TDD and LTE-FDD. Users can choose the module according to the wireless network configuration. The supported radio frequency bands are described in the following table.
So far, the following models have been included, that A/A-H/V-H/E/E-H/JC-H/SA/SA-H/G/G-H.

Table 1: SIM7600 Series-PCIE Series Frequency Bands

Standard	Frequency	A	A-H	V-H	E	E-H	JC-H	SA	SA-H	NA	NA-H	G	G-H
GSM	850MHz							√	√			√	√
	900MHz				√	√		√	√			√	√
	1800M Hz				√	√		√	√			√	√
	1900M Hz							√	√			√	√
WCDMA	BAND1				√	√		√	√			√	√
	BAND2	√	√					√	√			√	√
	BAND4											√	√
	BAND5	√	√		√	√		√	√			√	√
	BAND6											√	√
	BAND8				√	√		√	√			√	√
	BAND19											√	√
LTE	FDD B1				√	√	√	√	√			√	√
	FDD B2	√	√	√				√	√	√	√	√	√
	FDD B3				√	√	√	√	√			√	√
	FDD B4	√	√	√				√	√	√	√	√	√
	FDD B5			√	√	√		√	√	√	√	√	√
	FDD B7				√	√		√	√			√	√
	FDD B8				√	√	√	√	√			√	√

	FDD B12	√	√							√	√	√	√
	FDD B13			√						√	√	√	√
	FDD B14									√	√		
	FDD B18						√					√	√
	FDD B19						√					√	√
	FDD B20				√	√						√	√
	FDD B25									√	√	√	√
	FDD B26						√			√	√	√	√
	FDD B28							√	√			√	√
	FDD B66									√	√	√	√
	FDD B71									√	√		
	TDD B34											√	√
	TDD B38				√	√						√	√
	TDD B39											√	√
	TDD B40				√	√		√	√			√	√
	TDD B41				√	√				√	√	√	√
Category(CAT)		1	4	4	1	4	4	1	4	1	4	1	4
GNSS		√	√	√	√	√	√	√	√	√	√	√	√

NOTE

1.SIM7600 Series-PCIE only support digital audio feature through PCM interface. SIM7600 Series-PCIEA only support Analog audio feature through analog audio interface.
2.CAT1 or CAT4 correspond to different PN numbers.
3.SIM socket on board is supported, contact local sales for details.

1.2 Hardware Interface Overview

SIM7600 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* (Only provided on PCIEA products)**

1.3 Hardware Block Diagram

The following figure is SIM7600 Series-PCIE hardware block diagram.

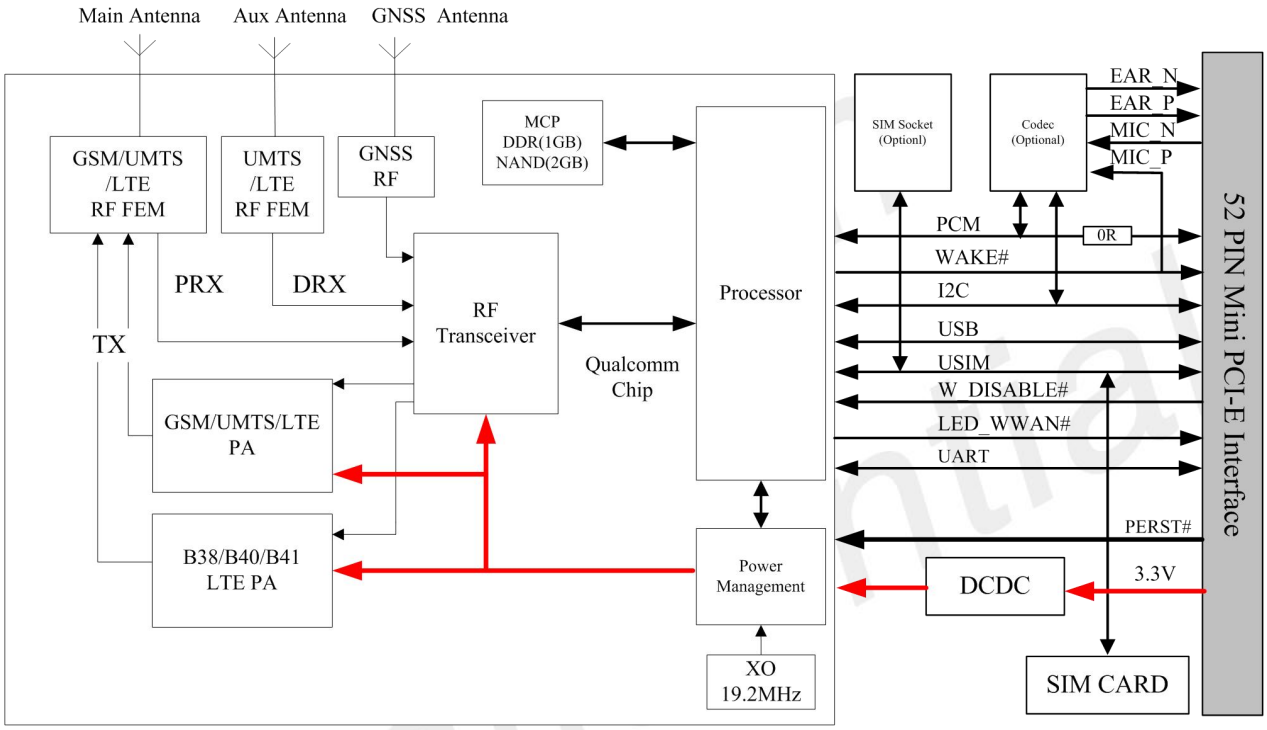

Figure 1: SIM7600 Series-PCIE Block Diagram

1.4 Functional Overview

Table 2: SIM7600 Series-PCIE Key Features

Feature	Implementation
Power supply	Single supply voltage 3.0V~3.6V (3.3V typical)
Radio frequency bands	Please refer to the table 1
Transmitting power	GSM/GPRS power class: --GSM850: 4 (2W) --EGSM900: 4 (2W) --DCS1800: 1 (1W) --PCS1900: 1 (1W)

	EDGE power class: --GSM850: E2 (0.5W) --EGSM900: E2 (0.5W) --DCS1800: E1 (0.4W) --PCS1900: 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) TD-HSDPA/HSUPA: 2.2 Mbps(UL), 2.8 Mbps(DL) LTE CAT4 ： 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 CAT1：10 Mbps (DL), 5 Mbps (UL) TDD-LTE CAT1：8.96 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	***SIM7600 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 ***SIM7600 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 3.6Mbps(default:115200bps) 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 or FOTA
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

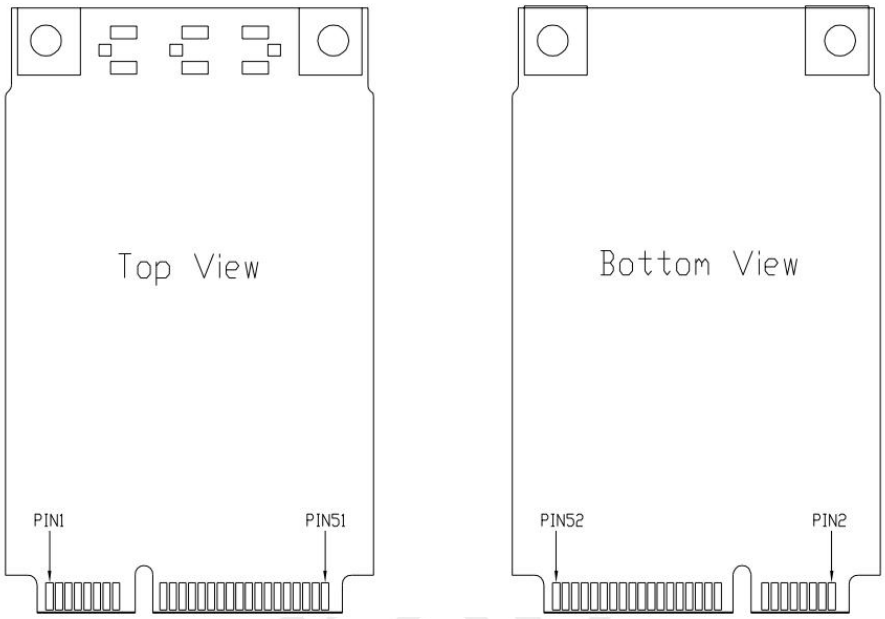

Figure 2: SIM7600 Series-PCIE Pin out Diagram

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	Power supply for module	3.3V typical
GND	4,9,15,18,21,26,27,29,34,35,37,40,43,50		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 100KR 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 SIM7600 Series-PCIE, these are NC pins for SIM7600 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 1.8V interface
SDA	32	I/O	I2C data input/output	

Others				
WAKE#/MICP	1	I/O	SIM7600 Series-PCIE: Wake up host SIM7600 Series-PCIEA: MIC positive input	If unused, keep open.
MICN	3	I	SIM7600 Series-PCIE: NC SIM7600 Series-PCIEA: MIC negative input	If Analog audio is available, wake up function is invalid. If Analog audio is needed, please consult our sales staff, for more information.
EARP	5	O	SIM7600 Series-PCIE: NC SIM7600 Series-PCIEA: Receiver positive output	
EARN	7	O	SIM7600 Series-PCIE: NC SIM7600 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	6,23,25,28,31,33,45,47,48,49,51	--	No connection	Keep open

2.3 Package Dimensions

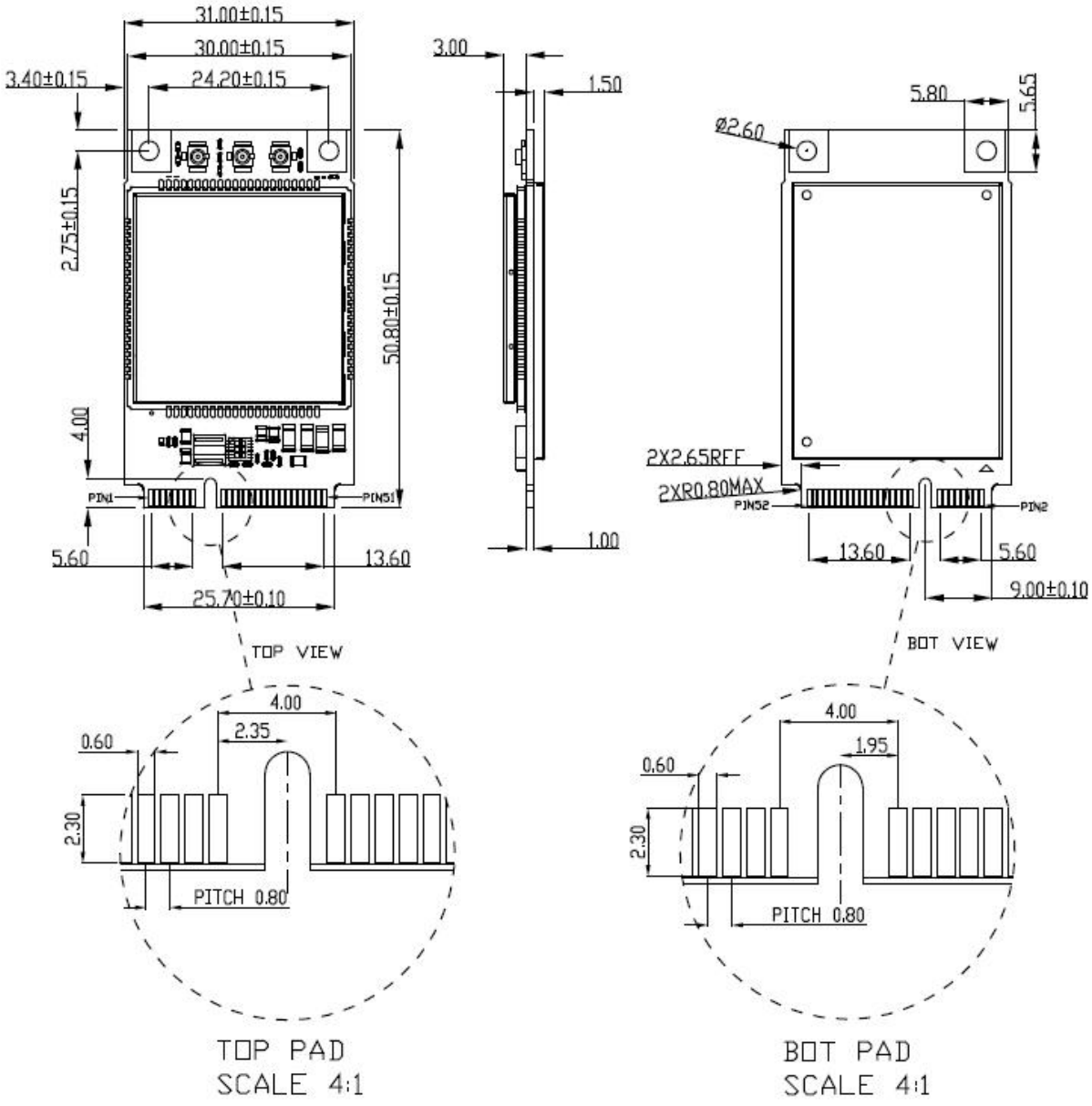

Figure 3: Dimensions of SIM7600 Series-PCIE (Unit: mm)

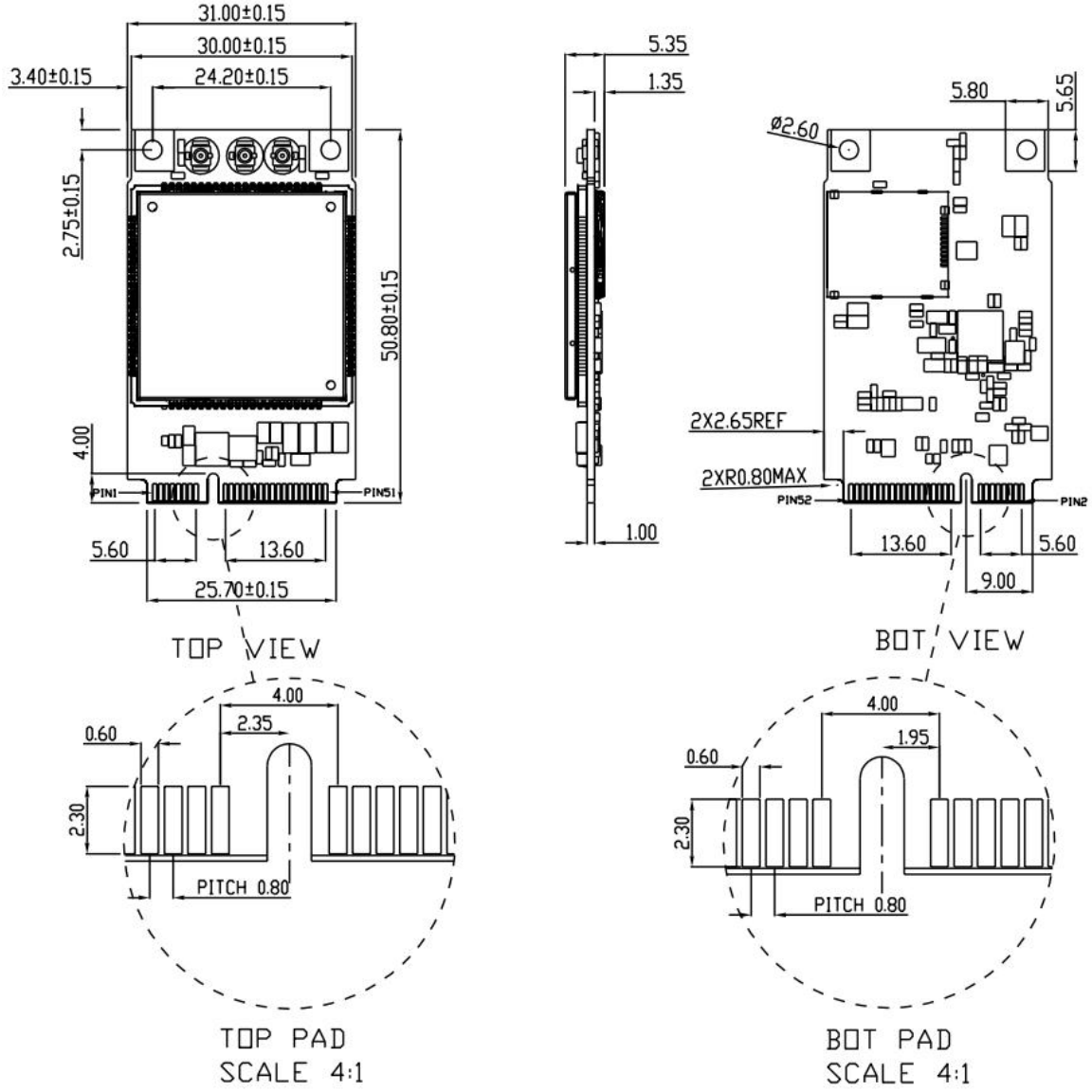

Figure 4: Dimensions of SIM7600 Series-PCIE with SIM holder

3 Interface Application

3.1 Power Supply

The recommended power supply voltage of SIM7600 Series-PCIE is 3.3V.

The module would be auto power on when the 3.3V appears, and customer should remove the 3.3V to power off the module. So, when customer design the power circuit, make sure the main power is controlled by host.

Table 4: Recommended 3.3V 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#

SIM7600 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.

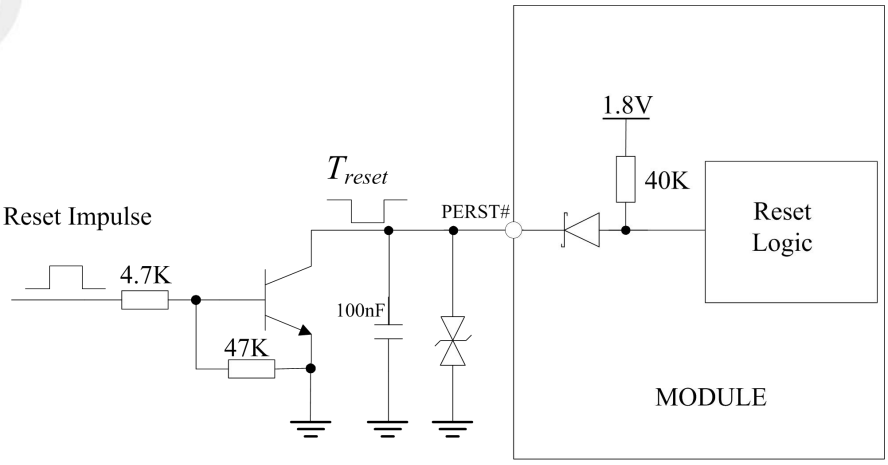

Figure 5: PERST# Reference Circuit

Table 5: PERST# Pin Electronic Characteristic

Symbol	Description	Min.	Typ.	Max.	Unit
Treset	The active low level time impulse on PERST# pin to reset module	100	200	500	mS
VIH	Input high level voltage	1.17	1.8	3.6	V
VIL	Input low level voltage	-0.3	0	0.2	V

3.3 W_DISABLE#

The W_DISABLE# pin can be used to control SIM7600 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.

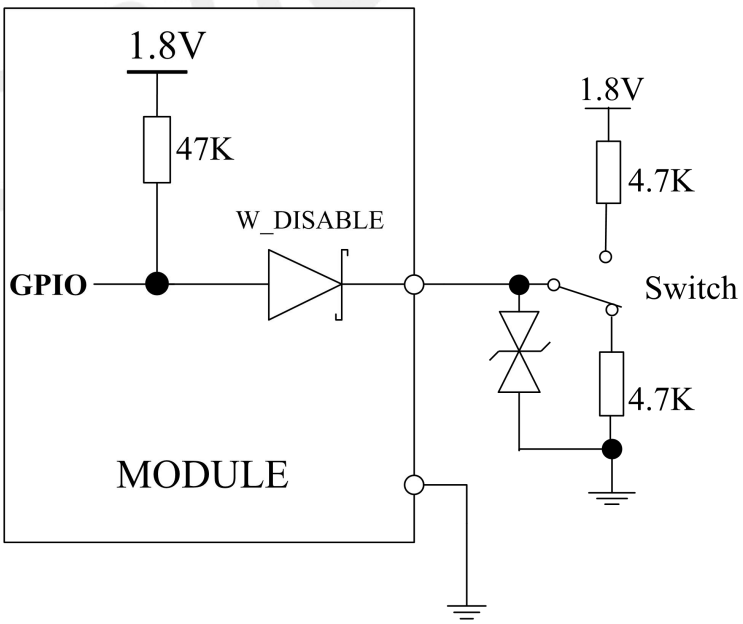

Figure 6: W_DISABLE# Reference Circuit

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
Always 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:

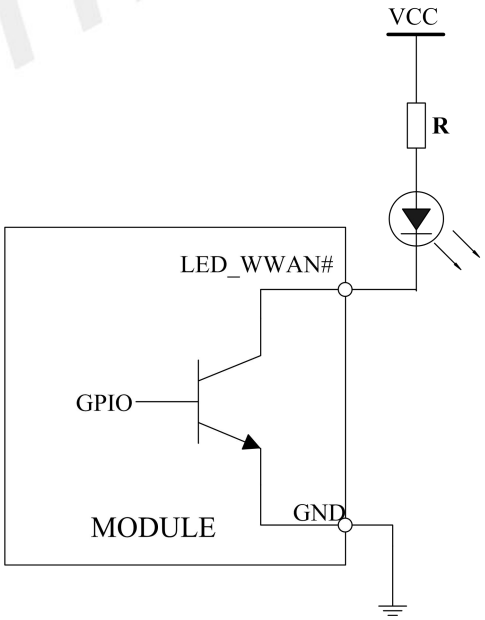

Figure 7: LED_WWAN# Reference Circuit

NOTE

The current input the LED_WWAN# should less than 50mA.The value of R should be selected by the LED character, usually the value is 1K ohm or larger.

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.

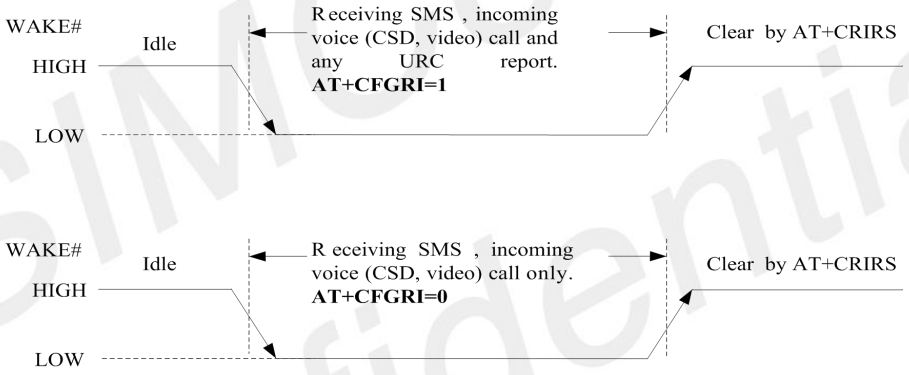

Figure 8: WAKE# behaviour

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

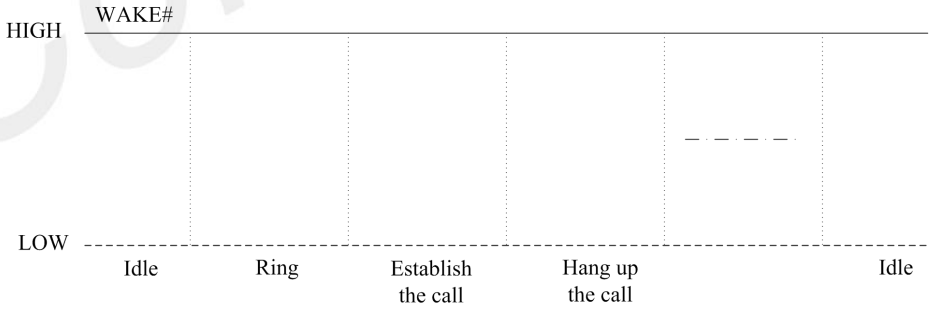

Figure 9: WAKE# behaviour as a caller

WAKE# Reference circuit is recommended in the following figure:

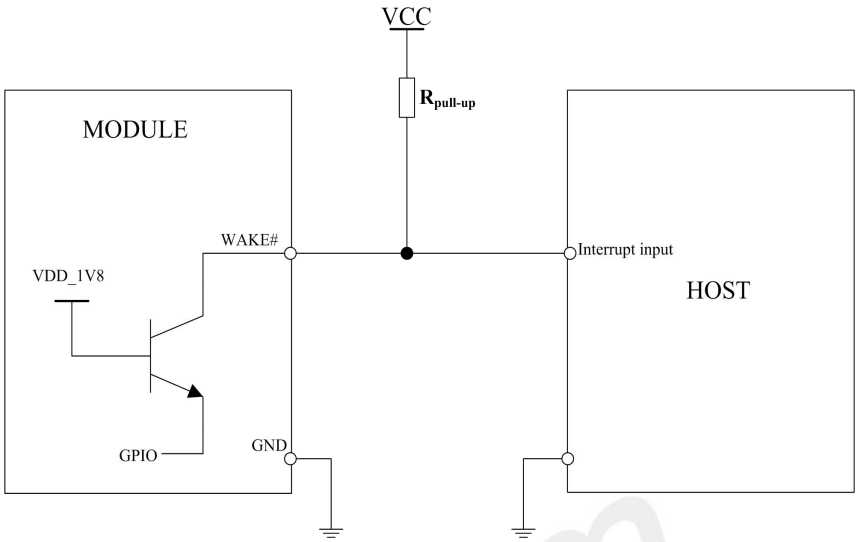

Figure 10: WAKE# Reference Circuit

NOTE

If Analog audio is available, WAKE# function is invalid.
$R_{pull-up}$ should larger than 47K ohm.

3.6 USB 2.0

SIM7600 Series-PCIE is compliant with USB 2.0 specification. It supports full-speed and high- speed when acting as a peripheral device.

SIM7600 Series-PCIE can be used as a USB device. SIM7600 Series-PCIE supports the USB suspend and resume mechanism which can reduce power consumption. If there is no data transmission on the USB bus, SIM7600 Series-PCIE will enter suspend mode automatically, and will be resumed by some events such as voice call or receiving SMS, etc.

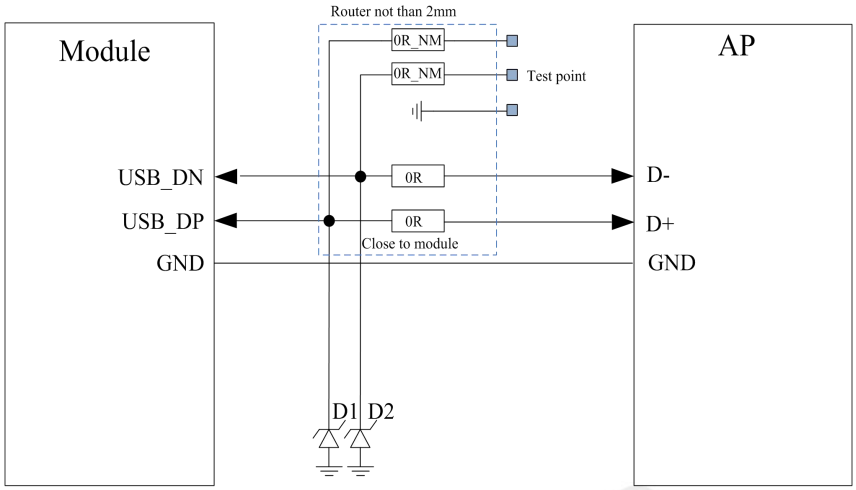

Figure 11: USB Reference Circuit

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 ESD5302N-3 or WE05MUC.

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 SIM7600 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 Audio 9001”, “SimTech HS-USB AT port 9001”, “SimTech HS-USB Diagnostics 9001”, “SimTech HS-USB NMEA 9001”.
4. It is suggested to reserved test point.

3.7 USIM Interface

SIM7600 series PCIE modules provide SIM socket on board product, so the external socket can be saved, for the detail please contact local sales.

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;

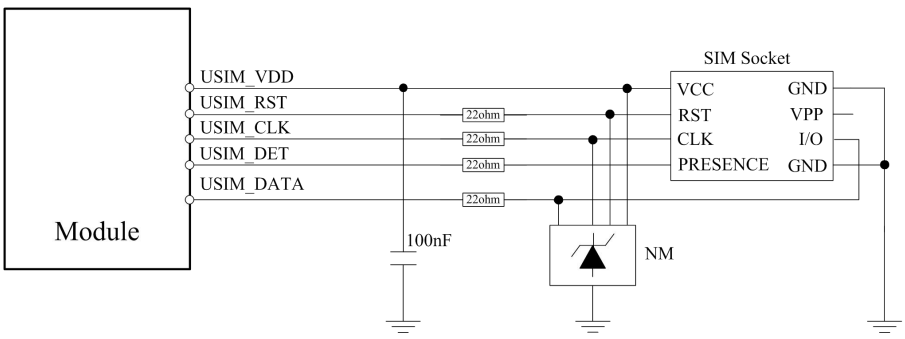

Figure 12: USIM interface reference circuit with detection function

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.

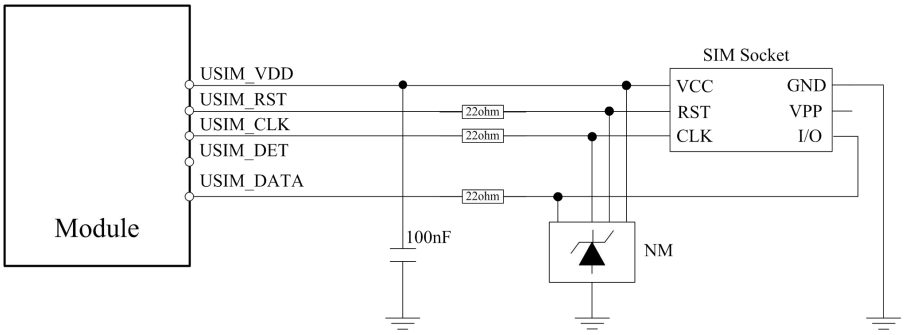

Figure 13: USIM interface reference circuit

NOTE

1. 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.
2. USIM_CLK is very important signal; customer must make sure the rise time and fall time of USIM_CLK less than 40ns!
3. The recommend TVS is ESD9B5.0ST5G and AZ5315-02F.

3.8 UART Interface

SIM7600 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.

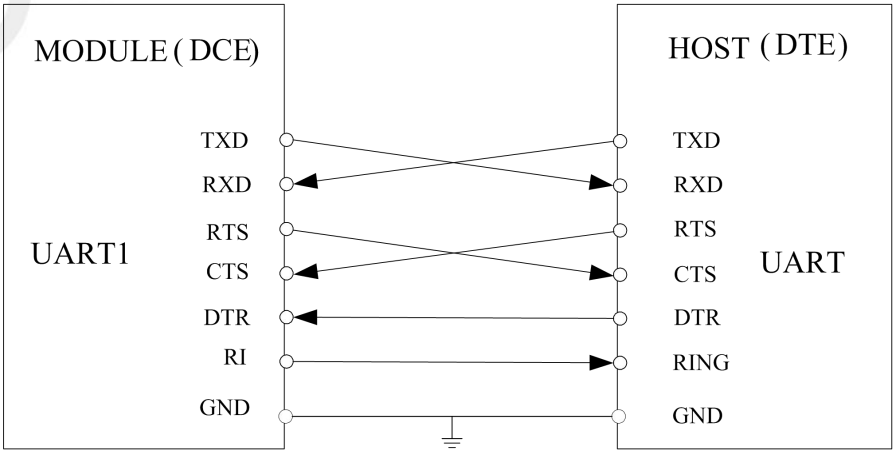

Figure 14: UART Full modem

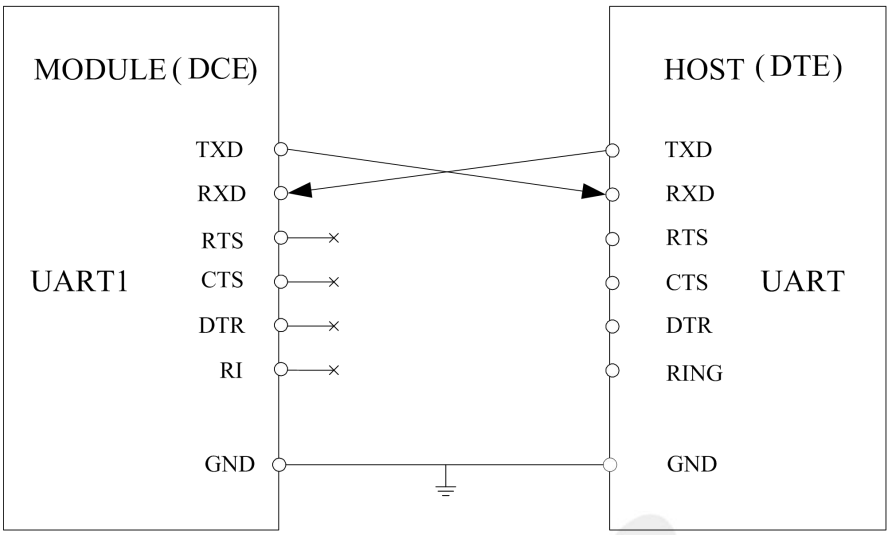

Figure 15: UART Null modem

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 SIM7600 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.

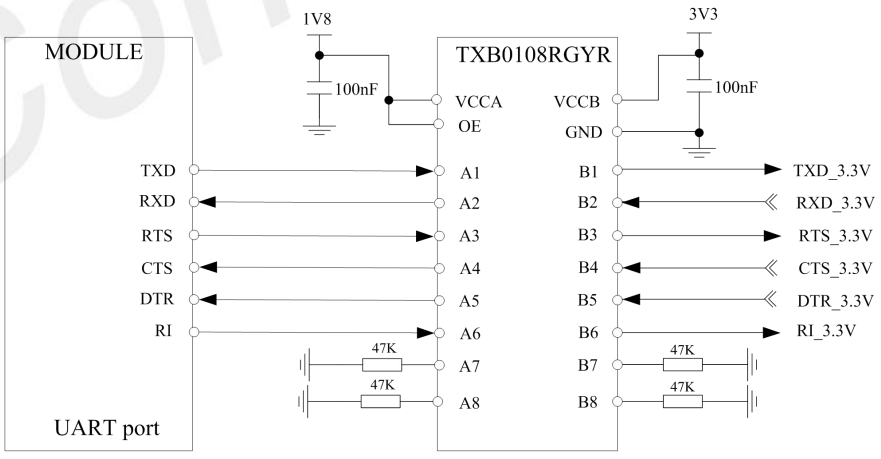

Figure 16: Reference circuit of level shift

customers can use another level shifter circuits as follow

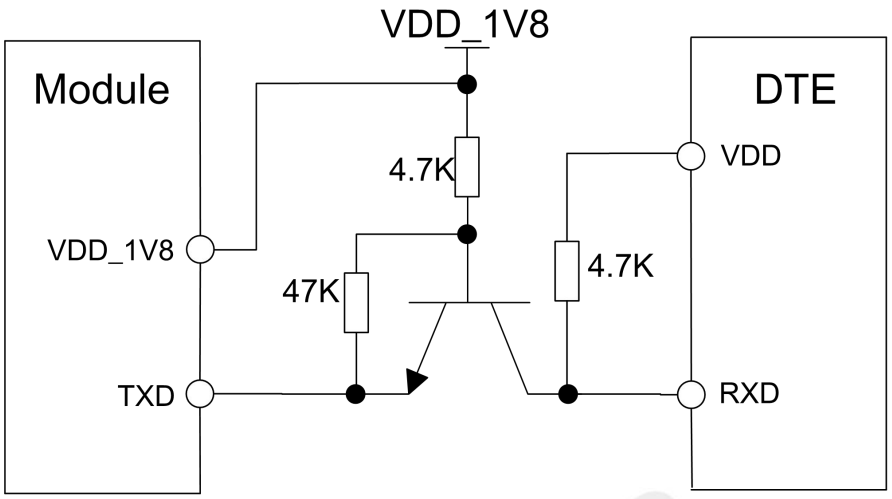

Figure 17: TX level matching circuit

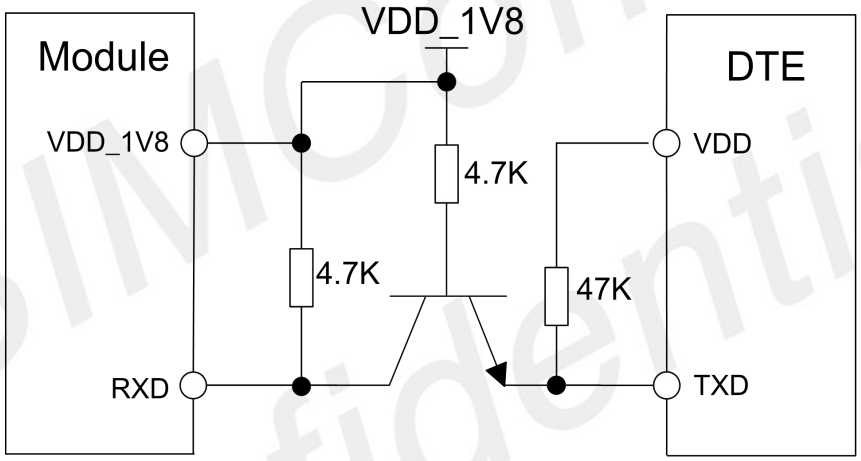

Figure 18: RX level matching circuit

To comply with RS-232-C protocol, the RS-232-C level shifter chip should be used to connect SIM7600 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.

NOTE

1. User need to use high speed transistors such as MMBT3904.
2. SIM7600 Series-PCIE supports the following baud rate: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600, 3200000, 3686400bps. Default baud rate is 115200bps.
3. The recommend NPN is MMBT3904, or customer could select NMPS such as 2SK3541 or WNM2046.

3.9 I2C Interface

SIM7600 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 audio codec chip is not mounted on board, users could ignore this.

.

The following figure shows the I2C bus reference design.

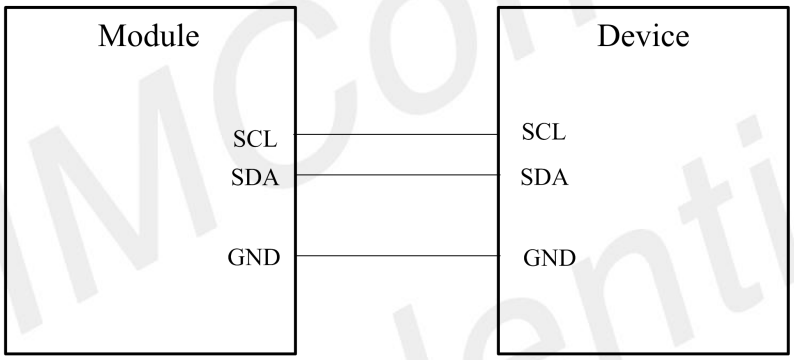

Figure 19: I2C Reference Circuit

NOTE

SDA and SCL are pulled up to 1.8V via 2.2K 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	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 PCM/Analog Audio Interface

3.10.1 PCM Interface

SIM7600 Series-PCIE provides hardware PCM interface for external codec. SIM7600 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	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

3.10.2 PCM timing

SIM7600 Series-PCIE supports 2.048 MHz PCM data and sync timing for 16 bits linear format codec.

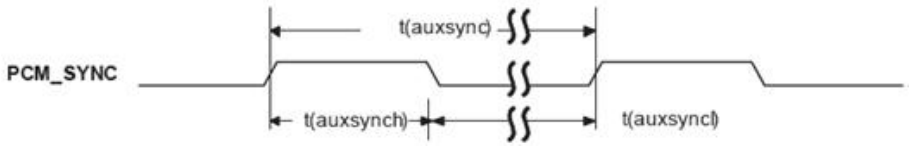

Figure 20: PCM_SYNC timing

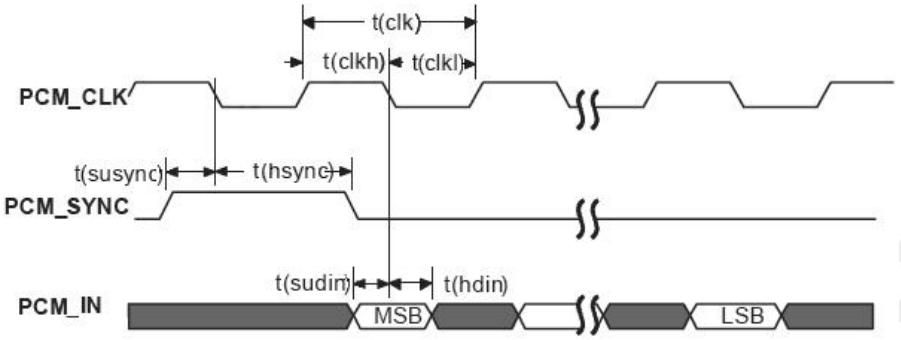

Figure 21: EXT CODEC to MODULE timing

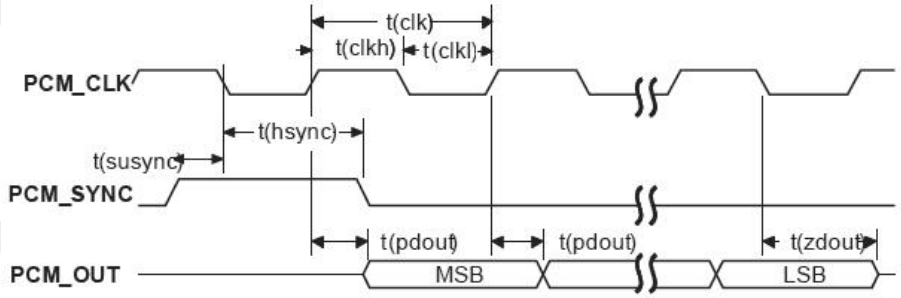

Figure 22: MODULE to EXT CODEC timing

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 SIM7600 Series-PCIE.

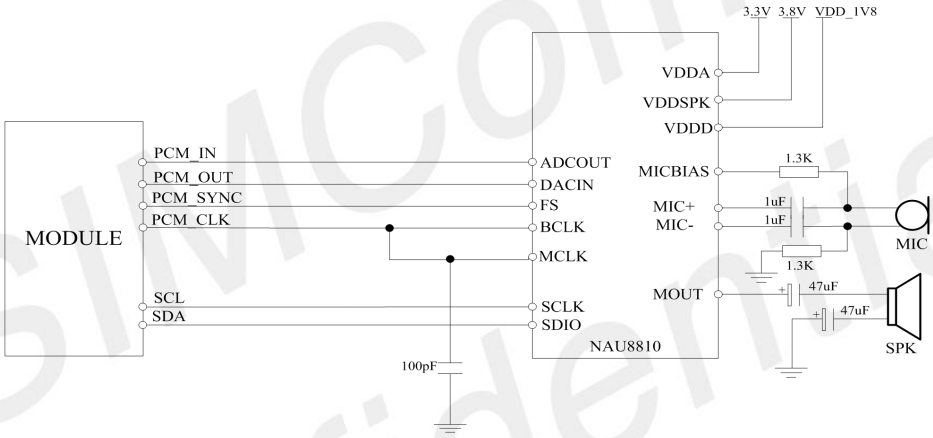

Figure 23: Audio Codec Reference Circuit

3.10.4 Analog Audio Interface

When audio codec chip is mounted on the PCIE board, SIM7600 Series-PCIEA 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

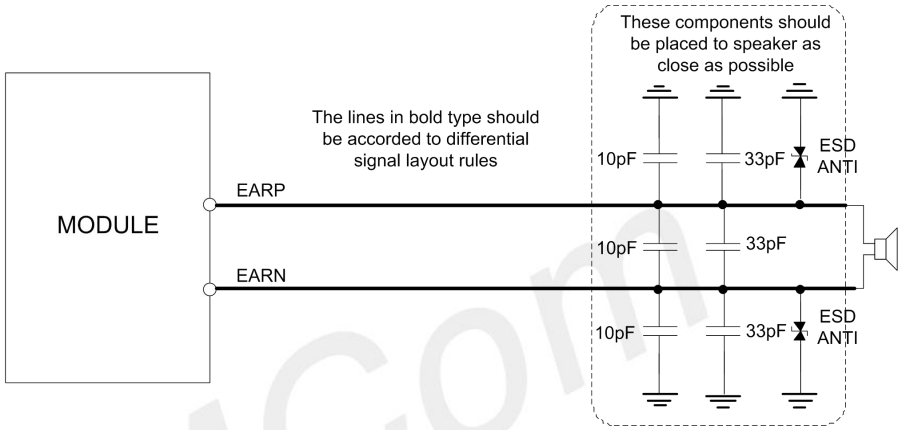

Figure 24: Receiver interface configuration

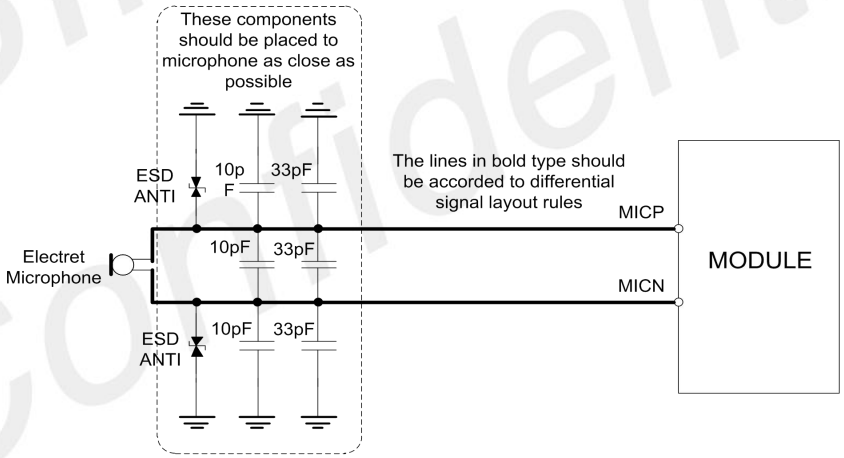

Figure 25: Microphone interface configuration

NOTE

1. SIM7600 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.
2. The recommend TVS is ESD9X5V-2 or ESD9B5.0ST5G.

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

Table 18: Conducted transmission power

Frequency	Power	Min.
GSM850	33dBm ±2dB	5dBm ± 5dB
EGSM900	33dBm ±2dB	5dBm ± 5dB
DCS1800	30dBm ±2dB	0dBm ± 5dB
PCS1900	30dBm ±2dB	0dBm ± 5dB
GSM850 (8-PSK)	27dBm ±3dB	5dBm ± 5dB
EGSM900 (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	<-50dBm
WCDMA B2	24dBm +1/-3dB	<-50dBm
WCDMA B4	24dBm +1/-3dB	<-50dBm
WCDMA B5	24dBm +1/-3dB	<-50dBm
WCDMA B6	24dBm +1/-3dB	<-50dBm
WCDMA B8	24dBm + 1/-3dB	<-50dBm
WCDMA B19	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 B13	23dBm +/-2.7dB	<-40dBm
LTE-FDD B14	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 B25	23dBm +/-2.7dB	<-40dBm
LTE-FDD B26	23dBm +/-2.7dB	<-40dBm
LTE-FDD B28	23dBm +/-2.7dB	<-40dBm
LTE-FDD B66	23dBm +/-2.7dB	<-40dBm
LTE-FDD B71	23dBm +/-2.7dB	<-40dBm
LTE-TDD B34	23dBm +/-2.7dB	<-40dBm
LTE-TDD B38	23dBm +/-2.7dB	<-40dBm
LTE-TDD B39	23dBm +/-2.7dB	<-40dBm
LTE-TDD B40	23dBm +/-2.7dB	<-40dBm
LTE-TDD B41	23dBm +/-2.7dB	<-40dBm

Table 19: Operating frequencies

Frequency	Receiving	Transmission
GSM850	869～894MHz	824～849 MHz
EGSM900	925～960MHz	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 B4	2110~2155MHz	1710~1755MHz
WCDMA B5	869～894 MHz	824～849 MHz
WCDMA B6	877~882MHz	832~837MHz
WCDMA B8	925～960 MHz	880～915 MHz
WCDMA B19	875~890MHz	835~845MHz
The LTE Operating frequencies are shown in the following table 20. Note: Operating frequencies of LTE TDD B41 for the MODULE is 100MHz BW, 2555～2655 MHz		
GPS	1574.4 ～1576.44 MHz	-
GLONASS	1598 ～1606 MHz	-
BD	1559 ～1563 MHz	

Table 20: E-UTRA operating bands

E-UTRA Operating Band	Uplink (UL) operating band	Downlink (DL) operating band	Duplex Mode
1	1920 ~1980 MHz	2110 ~2170 MHz	FDD
2	1850~1910 MHz	1930~1990 MHz	FDD
3	1710 ~1785 MHz	1805 ~1880 MHz	FDD
4	1710~1755MHz	2110~2155MHz	FDD

5	824～849 MHz	869～894MHz	FDD
7	2500~2570MHz	2620~2690MHz	FDD
8	880 ~915 MHz	925 ~960 MHz	FDD
12	699~716MHz	728~746MHz	FDD
13	777~787MHz	746~757MHz	FDD
14	788~798MHz	758~768MHz	FDD
18	815~830MHz	860~875MHz	FDD
19	830~845MHz	875~890MHz	FDD
20	832~862MHz	791~ 821MHz	FDD
25	1850~1915MHz	1930~1995MHz	FDD
26	814~849MHz	859~894MHz	FDD
28	703~748MHz	758~803MHz	FDD
66	1710~1780MHz	2110~2200MHz	FDD
71	663~698MHz	617~652MHz	FDD
34	2010~2025MHz	2010~2025MHz	TDD
38	2570 ~2620 MHz	2570 ~2620 MHz	TDD
39	1880~1920MHz	1880~1920MHz	TDD
40	2300 ~2400 MHz	2300 ~2400 MHz	TDD
41	2496~2696 MHz	2496~2696 MHz	TDD

NOTE

Operating frequencies of LTE TDD B41 for the SIM7600 Series-PCIE is 100MHz BW, 2555～2655 MHz

Table 21: Conducted receive sensitivity

Frequency	Receive sensitivity(Typical)	Receive sensitivity(MAX)
GSM850	< -109dBm	3GPP
EGSM900	< -109dBm	3GPP
DCS1800	< -109dBm	3GPP
PCS1900	< -109dBm	3GPP
WCDMA B1	< -110dBm	3GPP
WCDMA B2	< -110dBm	3GPP
WCDMA B4	< -110dBm	3GPP
WCDMA B5	< -110dBm	3GPP
WCDMA B6	< -110dBm	3GPP
WCDMA B8	< -110dBm	3GPP
WCDMA B19	< -110dBm	3GPP

LTE FDD/TDD	See table 26.	3GPP

Table 22: Reference sensitivity (QPSK)

E-UTRA band	3GPP standard							Test Value
	1.4 MHz	3 MHz	5 MHz	10 MHz	5 MHz	15 MHz	20 MHz	
FDD B1	-	-	-100	-97	-95.2	-94	FDD	-985
FDD B2	-102.7	-99.7	-98	-95	-93.2	-92	FDD	-98.5
FDD B3	-101.7	-98.7	-97	-94	-92.2	-91	FDD	-99
FDD B4	-104.7	-101.7	-100	-97	-95.2	-94	FDD	-98
FDD B5	-103.2	-100.2	-98	-95			FDD	-99.5
FDD B7			-98	-95	-93.2	-92	FDD	-96.5
FDD B8	-102.2	-99.2	-97	-94			FDD	-98.5
FDD B12	-101.7	-98.7	-97	-94			FDD	-98.5
FDD B13			-97	-94			FDD	-97.5
FDD B14			-97	-94			FDD	-97.5
FDD B18			-100	-97	-95.2		FDD	-99.5
FDD B19			-100	-97	-95.2		FDD	-99.5
FDD B20			-97	-94	-91.2	-90	FDD	-96.5
FDD B25	-101.2	-98.2	-96.5	-93.5	-91.7	-90.5	FDD	-98.5
FDD B26	-102.7	-99.7	-97.5	-94.5	-92.7		FDD	-99.5
FDD B28		-100.2	-98.5	-95.5	-93.7	-91	FDD	99.5
FDD B66	-104.7	-101.7	-100	-97	-95.2	-94	FDD	-98.5
FDD B71			-97	-94	-91.7	-90.5	FDD	-97.5
FDD B34			-100	-97	-95.2		TDD	-99
FDD B38	-	-	-100	-97	-95.2	-94	TDD	-97.5
FDD B39			-100	-97	-95.2		TDD	-99.5
FDD B40	-	-	-100	-97	-95.2	-94	TDD	-98
FDD B41	-	-	-99	-96	-94.2	-93	TDD	-99

NOTE

Test value @ 10MHz

4.2 RF Antenna Connector

SIM7600 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 SIM7600 Series-PCIE are described by 2 following tables.

Table 23: Recommended Passive Antenna Characteristics

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

Table 24: Recommended Active Antenna Characteristics

	Performance	
Band	TRP	TIS
GSM850	≧ 29dBm	≦ -104dBm
EGSM900	≧ 29dBm	≦ -104dBm
DCS1800	≧ 26dBm	≦ -104dBm
PCS1900	≧ 26dBm	≦ -104dBm
WCDMA B1	≧ 19dBm	≦ -104dBm
WCDMA B2	≧ 19dBm	≦ -104dBm
WCDMA B4	≧ 19dBm	≦ -104dBm
WCDMA B5	≧ 19dBm	≦ -104dBm
WCDMA B6	≧ 19dBm	≦ -104dBm
WCDMA B8	≧ 19dBm	≦ -104dBm
WCDMA B19	≧ 19dBm	≦ -104dBm
LTE B1	≧ 18dBm	≦ -92dBm(10MHz)
LTE B2	≧ 18dBm	≦ -92dBm(10MHz)
LTE B3	≧ 18dBm	≦ -89dBm(10MHz)
LTE B4	≧ 18dBm	≦ -89dBm(10MHz)
LTE B5	≧ 18dBm	≦ -89dBm(10MHz)
LTE B7	≧ 18dBm	≦ -89dBm(10MHz)
LTE B8	≧ 18dBm	≦ -89dBm(10MHz)
LTE B12	≧ 18dBm	≦ -89dBm(10MHz)
LTE B13	≧ 18dBm	≦ -89dBm(10MHz)

LTE B14	≧ 18dBm	≦ -89dBm(10MHz)
LTE B18	≧ 18dBm	≦ -89dBm(10MHz)
LTE B19	≧ 18dBm	≦ -89dBm(10MHz)
LTE B20	≧ 18dBm	≦ -89dBm(10MHz)
LTE B25	≧ 18dBm	≦ -89dBm(10MHz)
LTE B26	≧ 18dBm	≦ -89dBm(10MHz)
LTE B28	≧ 18dBm	≦ -89dBm(10MHz)
LTE B66	≧ 18dBm	≦ -89dBm(10MHz)
LTE B71	≧ 18dBm	≦ -89dBm(10MHz)
LTE B38	≧ 18dBm	≦ -92dBm(10MHz)
LTE B39	≧ 18dBm	≦ -92dBm(10MHz)
LTE B40	≧ 18dBm	≦ -92dBm(10MHz)
LTE B41	≧ 18dBm	≦ -91dBm(10MHz)

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 19). 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 20) is the dimensions of U.FL series RF adapter cable. User can contact SIMCom for more information.

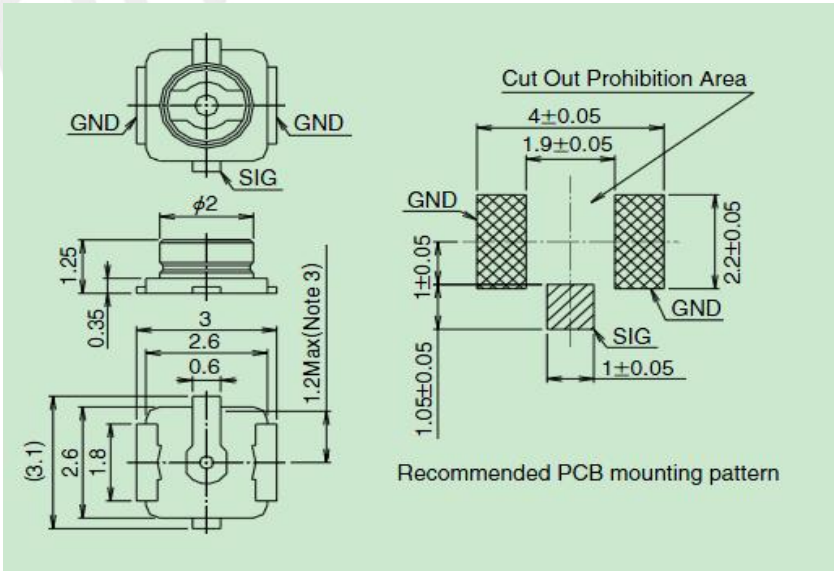

Figure 26: U.FL-R-SMT (Unit: mm)

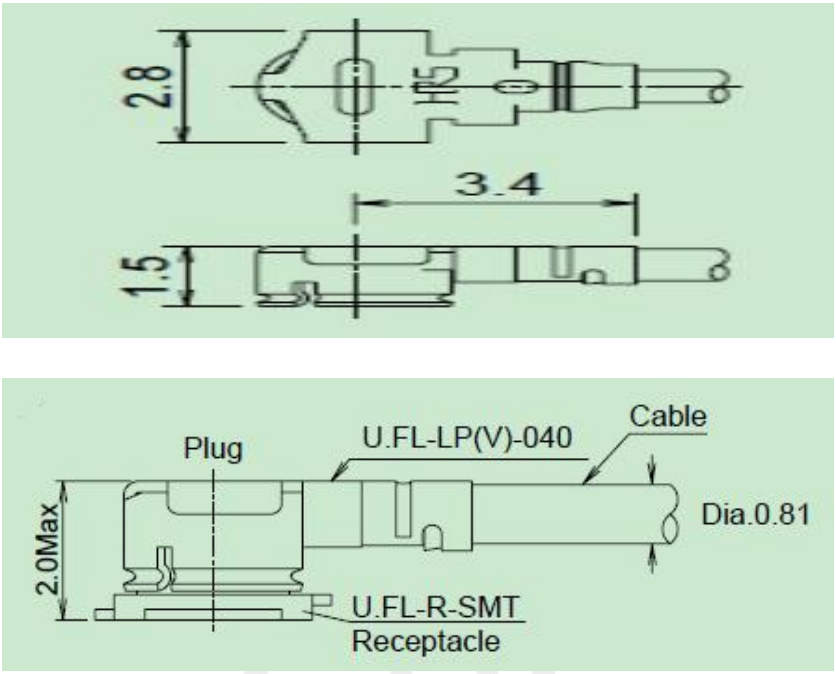

Figure 27: U.FL series RF adapter cable (Unit: mm)

To facilitate the antenna tuning and certification test, a RF connector and an antenna matching circuit should be added. The following figure is the recommended circuit.

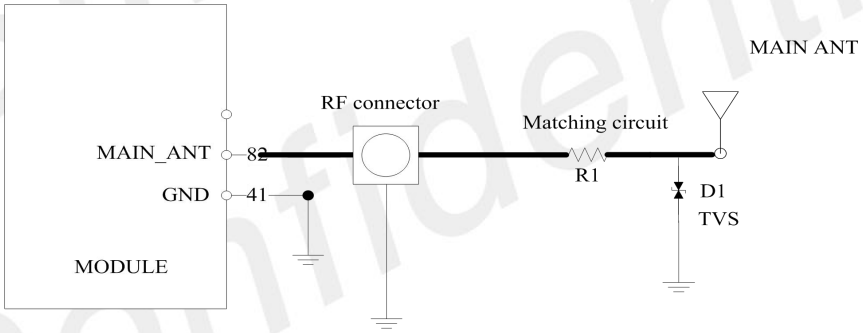

Figure 28: Antenna matching circuit (MAIN_ANT)

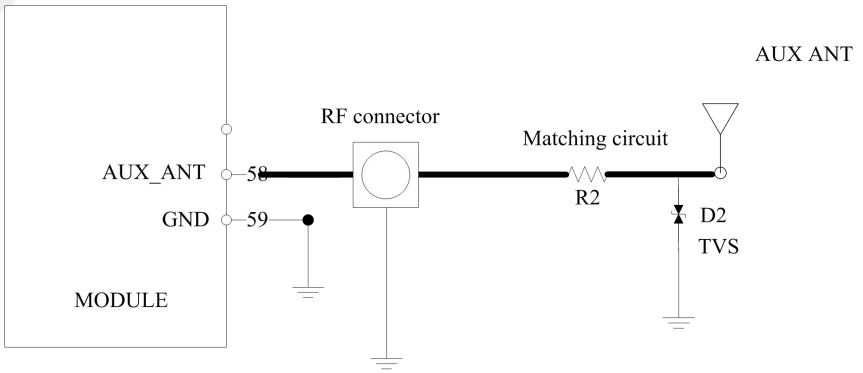

Figure 29: Antenna matching circuit (AUX_ANT)

In above figure, the component R1/R2 is reserved for antenna matching, the value of components can only be got after the antenna tuning, usually, The RF test connector in the figure is used for the conducted RF performance test, and should be placed as close as to the module's antenna pin. The traces impedance between components must be controlled in 50Ω. The component D1/D2 is a Bidirectional ESD Protection device, which is suggested to add to protection circuit, the recommended Part Numbers of the TVS are listed in the following table:

Table 25: TVS part number list

Package	Type	Supplier
0201	WE05DGCMS-BH	CYGWAYON
0402	PESD0402-03	PRISEMI
0402	PESD0402-12	PRISEMI

NOTE

SIMCom suggests the LTE auxiliary antenna to be kept on, since there are many high bands in the designing of LTE-TDD, such as band38, band40 and band41.

4.3 GNSS

SIM7600 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/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

SIM7600 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 SIM7600 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 SIM7600 Series-PCIE in proper operating mode by AT

command. Please refer to related document for details. SIM7600 Series-PCIE can also get position location information through AT directly.

4.3.3 Application Guide

Users can adopt an active antenna as GNSS signal receiver. The following is the reference circuit.

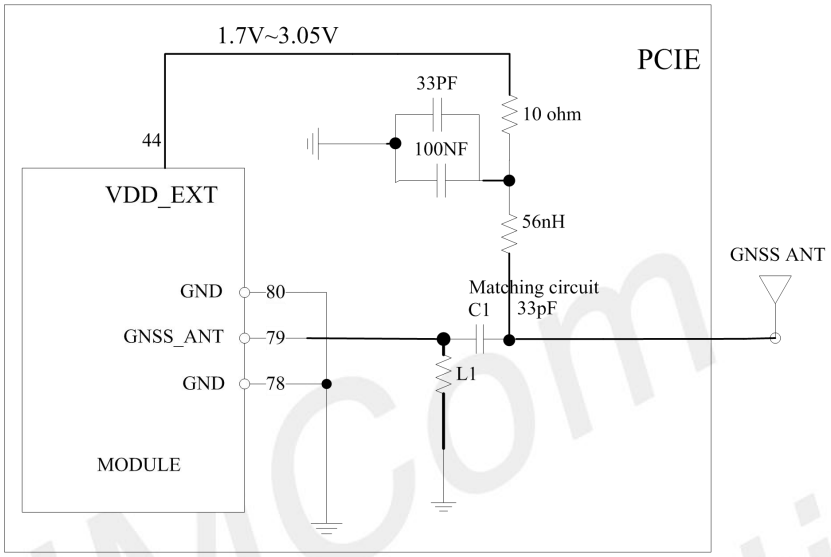

Figure 30: Active antenna circuit

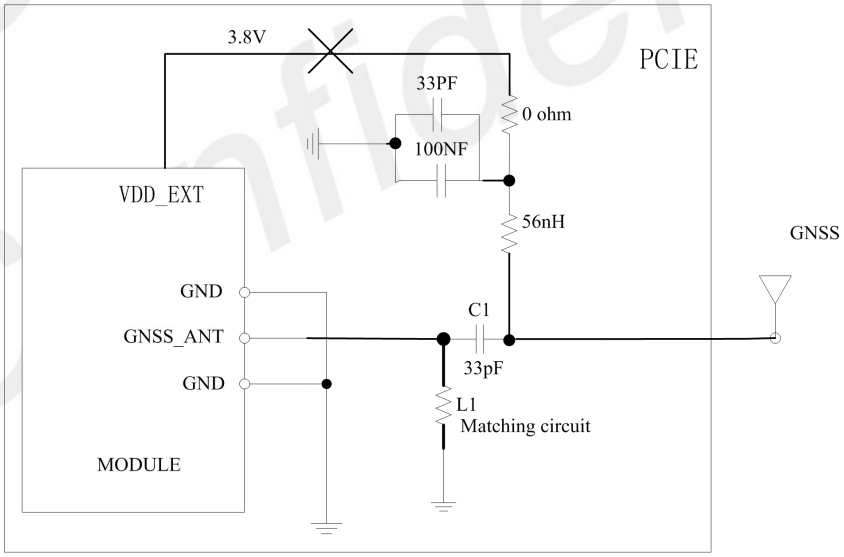

Figure 31: Passive antenna circuit

In above Figure 30 the active antenna is used, If users want to change the voltage of VDD_EXT, use this AT command; “AT+CVAUXV”. For example, if customer needs the output voltage value to be 1.8V, the AT command should be “AT+CVAUXV=1800000”. The output voltage range of VDD_EXT is from 1.7V to 3.05V.

In above two figures, the component C1 is used for DC isolation, and L1 is used for antenna matching, the value of it can be obtained after the antenna tuning usually, so the default value is NC. In active antenna circuit, users also can use an external LDO/DCDC to provide VDD voltage which value should be taken according to active antenna characteristic, and VDD can be shut down to avoid consuming additional current when not being used.

NOTE

1. For more details of AT commands about VDD_EXT, please refer to document [1].
2. 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.
3. 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 26: 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 I2C, UART, GPIO.

5.2 Recommended Operating Conditions

Please refer to the follow table for recommended operating conditions.

Table 27: Operating Conditions

Symbol	Parameter	Min	Type	Max	Unit
V_{CC}	3.3V 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 SIM7600 Series-PCIE.

Table 28: 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, SMS, TCP and UDP.
	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		Customer could cut off the VBAT to power off module.

5.3.2 Power saving mode

SIM7600 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, SMS, TCP and UDP.
Several hardware and software conditions must be satisfied together in order to let SIM7600 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 SIM7600 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 SIM7600 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 29: Current Consumption (VCC=3.3V)

GNSS	
GNSS supply current (AT+CFUN=0, with USB connection)	@ -140dBm，Tracking Typical:35mA
GSM sleep/idle mode	

GSM/GPRS supply current (GNSS off，without USB connection)	Sleep mode@ BS_PA_MFRMS=2 Typical: 2.8mA Idle mode@ BS_PA_MFRMS=2 Typical: 18mA
UMTS sleep/idle mode	
WCDMA supply current (GNSS off，without USB connection)	Sleep mode @DRX=9 Typical: 3.3mA Idle mode @DRX=9 Typical: 17.5mA
LTE sleep/idle mode	
LTE supply current (GNSS off，without USB connection)	Sleep mode Typical: 4.6mA Idle mode Typical: 17.5mA
GSM Talk	
GSM850	@power level #5 Typical: 220mA
EGSM900	@ power level #5 Typical: 230mA
DCS1800	@power level #5 Typical: 162mA
PCS1900	@power level #5 Typical: 190mA
UMTS Talk	
WCDMA B1	@Power 24dBm Typical: 540mA
WCDMA B2	@Power 24dBm Typical: 470mA
WCDMA B4	@Power 24dBm Typical: TBD
WCDMA B5	@Power 24dBm Typical: 530mA
WCDMA B6	@Power 24dBm Typical: 530mA
WCDMA B8	@Power 24dBm Typical: 385mA
WCDMA B19	@Power 24dBm Typical: TBD
GPRS	
GSM850(1 Rx,4 Tx)	@power level #5 Typical: 480mA
EGSM900(1 Rx,4 Tx)	@power level #5 Typical: 230mA
DCS1800(1 Rx,4 Tx)	@power level #0 Typical: 195mA
PCS1900(1 Rx,4 Tx)	@power level #0 Typical: 390mA
GSM850(3Rx, 2 Tx)	@power level #5 Typical: 330mA
EGSM900(3Rx, 2 Tx)	@power level #5 Typical: 370mA
DCS1800(3Rx, 2 Tx)	@power level #0 Typical: 275mA
PCS1900(3Rx, 2 Tx)	@power level #0 Typical: 245mA
EDGE	
GSM850(1 Rx,4 Tx)	@power level #8 Typical: 340mA
EGSM900(1 Rx,4 Tx)	@power level #8 Typical: 400mA
DCS1800(1 Rx,4 Tx)	@power level #2 Typical: 300mA
PCS1900(1 Rx,4 Tx)	@power level #2 Typical: 330mA
GSM850(3Rx, 2 Tx)	@power level #8 Typical: 280mA
EGSM900(3Rx, 2 Tx)	@power level #8 Typical: 320mA
DCS1800(3Rx, 2 Tx)	@power level #2 Typical: 230mA
PCS1900(3Rx, 2 Tx)	@power level #2 Typical: 268mA
HSDPA data	
WCDMA B1	@Power 24dBm Typical: 478mA

WCDMA B2	@Power 23dBm	Typical: 475mA
WCDMA B4	@Power 24dBm	Typical: TBD
WCDMA B5	@Power 24dBm	Typical: 480mA
WCDMA B6	@Power TBD	Typical: TBD
WCDMA B8	@Power 24dBm	Typical: 430mA
WCDMA B19	@Power 24dBm	Typical: TBD
LTE data		
LTE-FDD B1	@5MHz 22.3dBm @10MHz 22.4dBm @20MHz 22.4dBm	Typical: 577mA Typical: 590mA Typical: 630mA
LTE-FDD B2	@5MHz 22.1dBm @10MHz 22.4dBm @20MHz 22.3dBm	Typical: 515mA Typical: 544mA Typical:575mA
LTE-FDD B3	@5MHz 22.2dBm @10MHz 22.1dBm @20MHz 22.1dBm	Typical: 479mA Typical: 498mA Typical: 530mA
LTE-FDD B4	@5MHz 22.0dBm @10MHz 22.1dBm @20MHz 22.6dBm	Typical: 527mA Typical: 559mA Typical: 555mA
LTE-FDD B5	@5MHz 22.2dBm @10MHz 22.1dBm @20MHz 22.1dBm	Typical: 610mA Typical: 600mA Typical: 630mA
LTE-FDD B7	@5MHz 22.2dBm @10MHz 22.1dBm @20MHz 22.1dBm	Typical: 650mA Typical: 650mA Typical: 630mA
LTE-FDD B8	@5MHz 22.8dBm @10MHz 22.8dBm	Typical: 644mA Typical: 646mA
LTE-FDD B12	@5MHz 22.7dBm @10MHz 22.7dBm	Typical: 493mA Typical: 510mA
LTE-FDD B13	@5MHz 21.9dBm @10MHz 22.0dBm	Typical: 505mA Typical: 497mA
LTE-FDD B14	@5MHz 22.1dBm @10MHz 22.4dBm	Typical: 524mA Typical: 560mA
LTE-FDD B18	@5MHz 21.3dBm @10MHz 22.5dBm @15MHz 22.6dBm	Typical: 531mA Typical: 523mA Typical: 570mA
LTE-FDD B19	@5MHz 22.4dBm @10MHz 22.3dBm @15MHz 22.5dBm	Typical: 532mA Typical: 541mA Typical: 590mA
LTE-FDD B20	@5MHz 21.8dBm @10MHz 21.8dBm @20MHz 21.8dBm	Typical: 579mA Typical: 590mA Typical: 600mA
LTE-FDD B25	@5MHz 22dBm @10MHz 22dBm @20MHz 22dBm	Typical: TBD Typical: TBD Typical: TBD
LTE-FDD B26	@5MHz 22.4dBm @10MHz 22.7dBm @15MHz 22.3dBm	Typical: 525mA Typical: 570mA Typical: 580mA
LTE-FDD B28	@5MHz 22.4dBm @10MHz 22.5dBm @20MHz 22.4dBm	Typical: 612mA Typical: 510mA Typical: 670mA
LTE-FDD B66	@5MHz 22dBm @10MHz 22dBm @20MHz 22dBm	Typical: TBD Typical: TBD Typical: TBD
LTE-FDD B71	@5MHz 22dBm	Typical: 575mA

	@10MHz	22dBm	Typical: 622mA
	@20MHz	22dBm	Typical: 712mA
LTE-TDD B38	@5MHz	21.8dBm	Typical: 370mA
	@10MHz	21.8dBm	Typical: 380mA
	@20MHz	21.8dBm	Typical: 403mA
LTE-TDD B39	@5MHz	22dBm	Typical: TBD
	@10MHz	22dBm	Typical: TBD
	@20MHz	22dBm	Typical: TBD
LTE-TDD B40	@5MHz	21.5dBm	Typical: 407mA
	@10MHz	21.7dBm	Typical: 416mA
	@20MHz	21.7dBm	Typical: 444mA
LTE-TDD B41	@5MHz	21.6dBm	Typical: 390mA
	@10MHz	21.7dBm	Typical: 396mA
	@20MHz	21.7dBm	Typical: 420mA

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

SIM7600 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 30: ESD characteristics (Temperature: 25℃, Humidity: 45 %)

Part	Contact discharge	Air discharge
VBAT, GND	+/-5K	+/-10K
Antenna port	+/-4K	+/-8K
Other PADs	+/-0.5K	+/-1K

6 Packaging

SIM7600 Series-PCIE module support tray packaging.

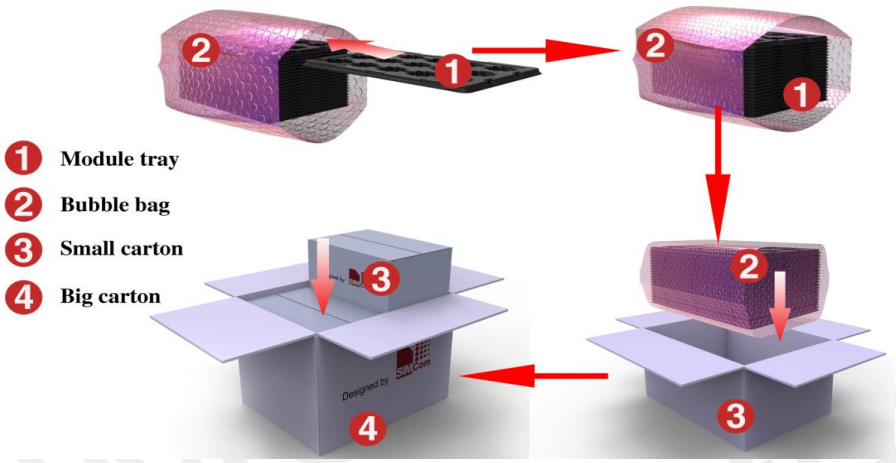

Figure 32: Tray packaging

Module tray drawing:

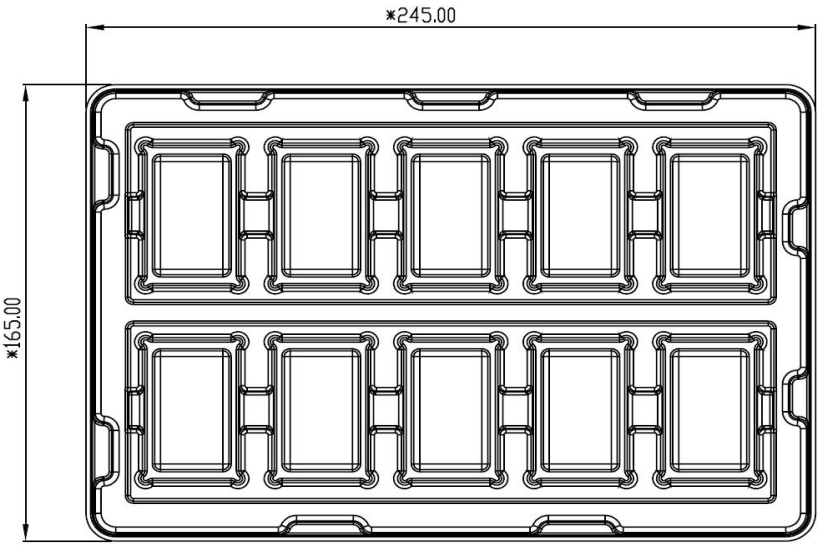

Figure 33: Tray drawing

Table 31: Tray size

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

Small carton drawing:

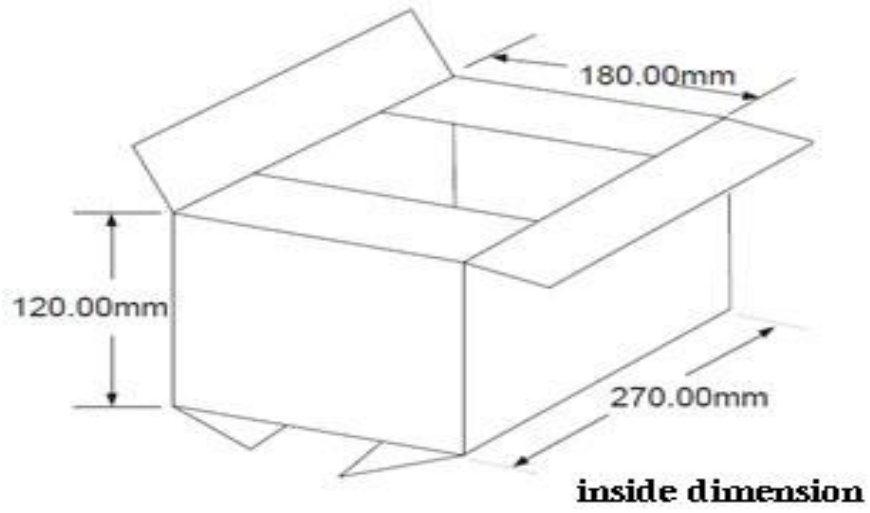

Figure 34: Small carton drawing

Table 32: Small Carton size

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

Big carton drawing:

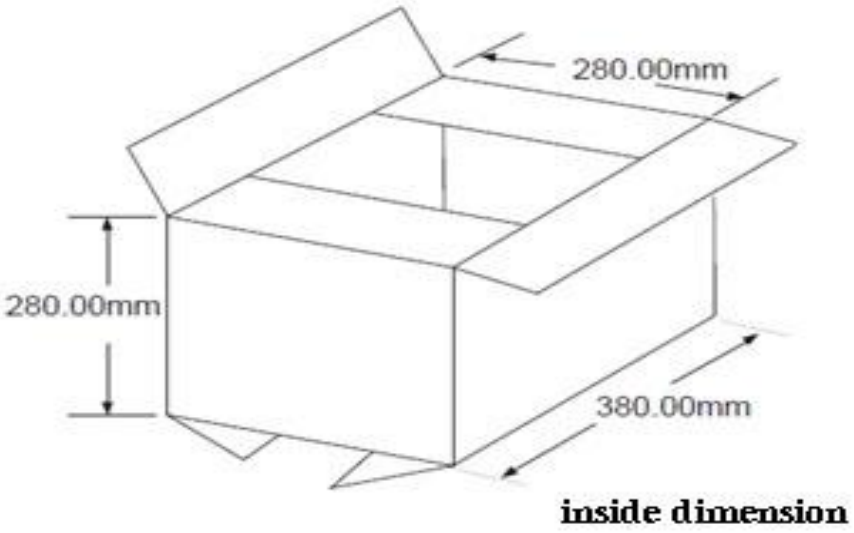

Figure 35: Big carton drawing

Table 33: Big Carton size

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

7 Appendix

7.1 Coding Schemes and Maximum Net Data Rates over Air Interface

Table 34: 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	**Max data rate（peak）**	**Modulation type**

(Uplink)		
Category 1	5Mbps	QPSK/16QAM
Category 2	25Mbps	QPSK/16QAM
Category 3	50Mbps	QPSK/16QAM
Category 4	50Mbps	QPSK/16QAM

7.2 Related Documents

Table 35: Related Documents

SN	Title	Description
[1]	SIM7500_SIM7600 Series_AT Command Manual_V1.xx.pdf	SIM7600 AT command document
[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
[24]	SIM7100_SIM7500_SIM7600_Sleep Mode_Application Note_V1.xx	Sleep Mode Application Note
[25]	SIM7100_SIM7500_SIM7600 Series_USB AUDIO_Application Note_V1.xx	USB AUDIO Application Note

7.3 Terms and Abbreviations

Table 36: 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

7.4 Safety Caution

Table 37: 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 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.