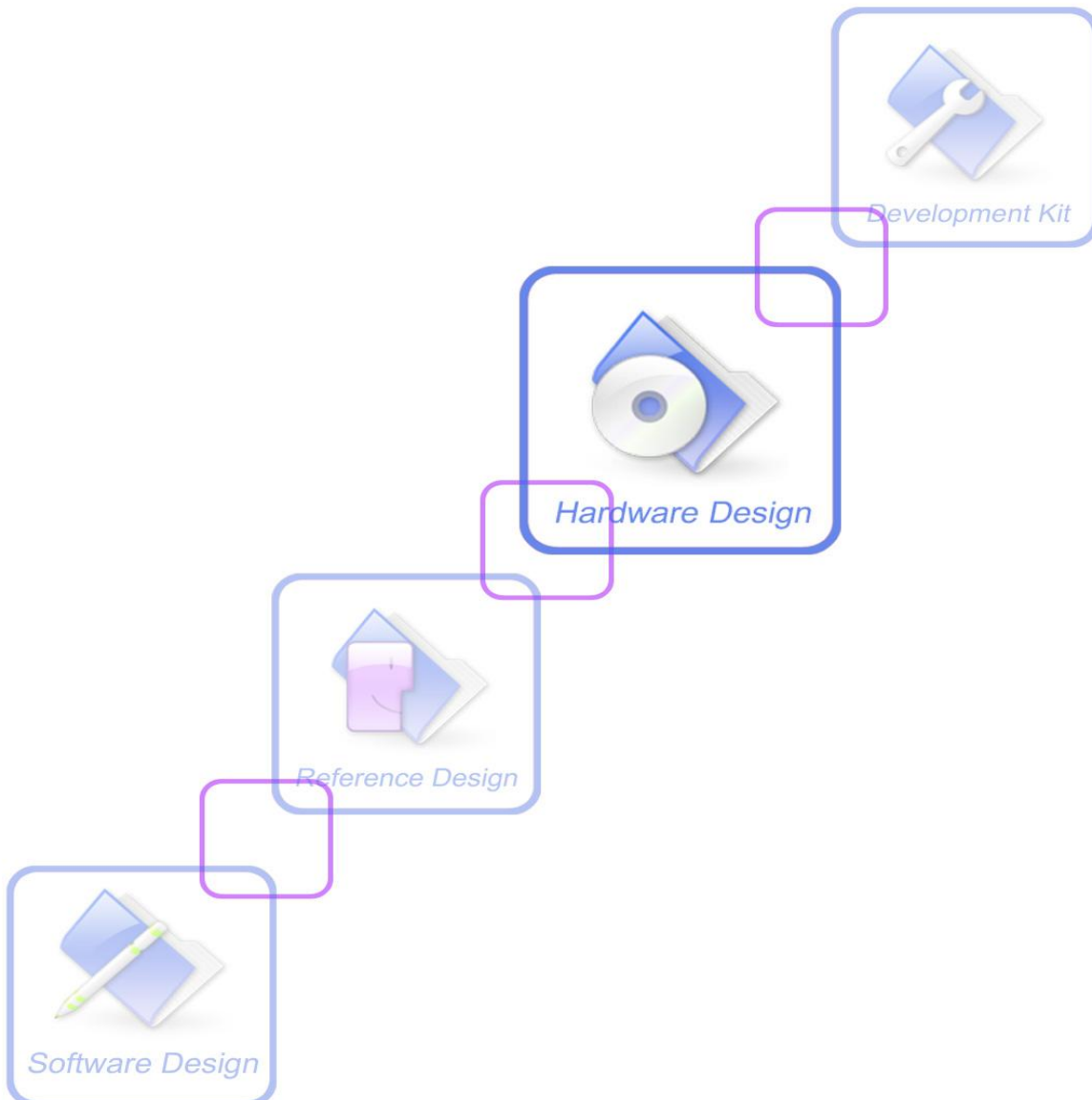




A company of SIM Tech

# **SIM7600E\_SIM7600E-H-PCIE\_Hardware Design\_V1.01**



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## Version History

Date	Version	Description of change	Author
2017-11-23	1.00	Origin	Ma Honggang Gao Fan Yuan Shijie
2022-11-03	1.01	Update uart rate.	Liu Wang Rong

## 1. Introduction

This document describes the electronic specifications, RF specifications, interfaces, mechanical characteristics and testing results of the SIMCom SIM7600E/SIM7600E-H-PCIE (in the following chapter, the document only describe the SIM7600E-PCIE) modules. With the help of this document and other related software application notes/user guides, users can understand and use SIM7600E-PCIE modules to design and develop applications quickly.

## 2. Product Outline

Aimed at global market, the SIM7600E-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.

**Table 1: SIM7600E/SIM7600E-PCIE Series Frequency Bands**

Standard	Frequency	Module	
		SIM7600E-PCIE	SIM7600E-H-PCIE
GSM	EGSM 900MHz	✓	✓
	DCS1800MHz	✓	✓
WCDMA	BAND1	✓	✓
	BAND5	✓	✓
	BAND8	✓	✓
LTE-FDD	LTE-FDD B1	✓	✓
	LTE-FDD B3	✓	✓
	LTE-FDD B5	✓	✓
	LTE-FDD B7	✓	✓
	LTE-FDD B8	✓	✓
	LTE-FDD B20	✓	✓
LTE-TDD	LTE TDD B38	✓	✓
	LTE TDD B40	✓	✓
	LTE TDD B41	✓	✓
Category		CAT1	CAT4
GNSS		✓	✓

*\*Note: SIM7600E-PCIE do not support audio feature, SIM7600E-PCIEA provides Analog audio interface.*



## 2.1 Hardware Interface Overview

SIM7600E-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**
- **Analog Audio Interface\* (Only provided on PCIEA products)**

## 2.2 Hardware Block Diagram

The following figure is SIM7600E-PCIE hardware block diagram.

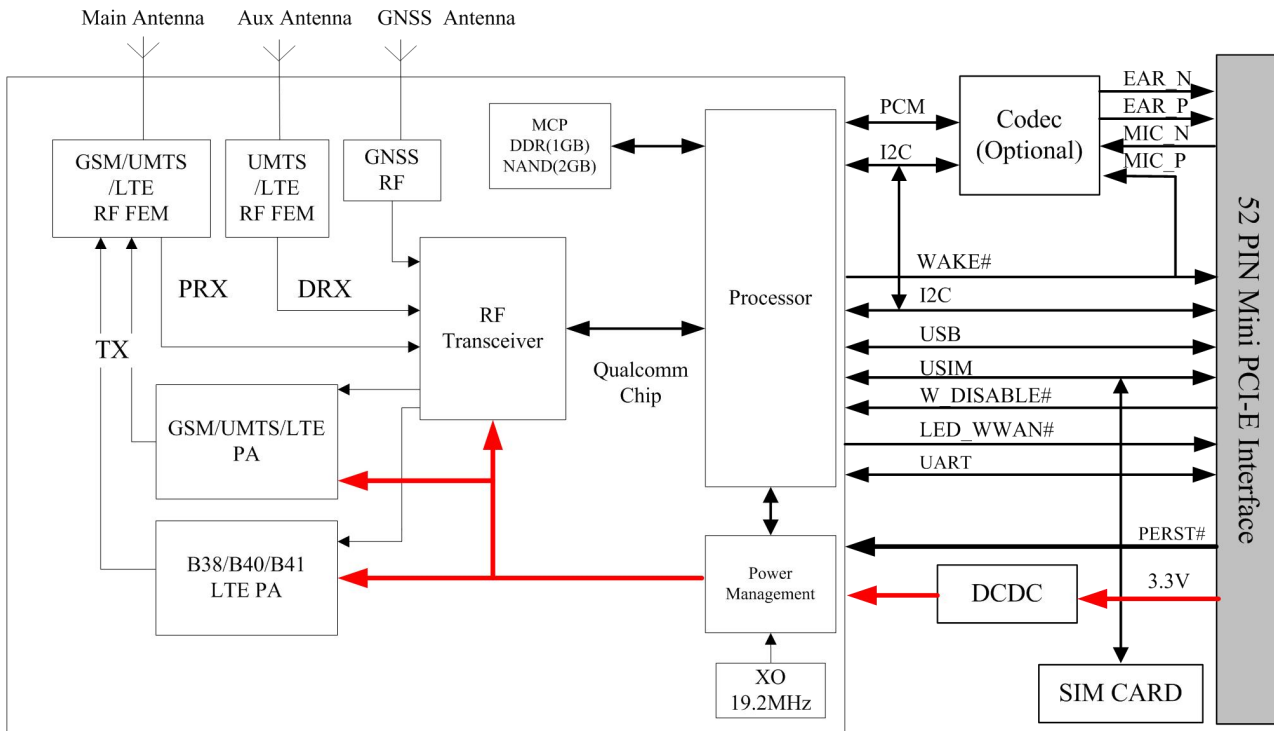


Figure 1: SIM7600E-PCIE Block Diagram

## 2.3 Functional Overview

Table 2: SIM7600E-PCIE Key Features

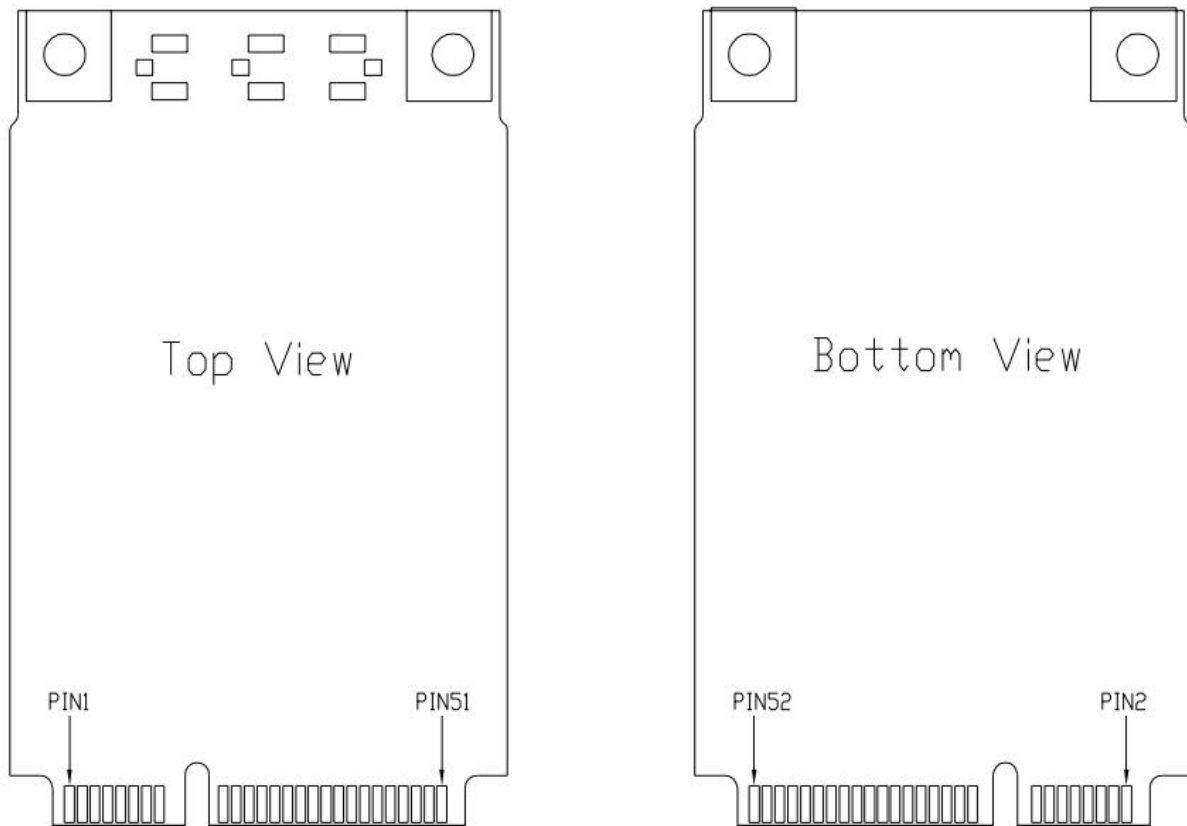
Feature	Implementation
Power supply	Single supply voltage 3.0V~3.6V (3.3V typical)
Radio frequency bands	Please refer to the table 1
Transmitting power	GSM/GPRS power class: --EGSM900: 4 (2W) --DCS1800: 1 (1W) EDGE power class: --EGSM900: E2 (0.5W) --DCS1800: E1 (0.4W) UMTS power class: --WCDMA :3 (0.25W) --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)

	<p>TD-HSDPA/HSUPA: 2.2 Mbps(UL), 2.8 Mbps(DL)</p> <p>LTE CAT 4 : 150 Mbps (DL)</p> <p>LTE CAT 4 : 50 Mbps (UL)</p> <p>LTE CAT 1 : 10 Mbps (DL)</p> <p>LTE CAT 1 : 5 Mbps (UL)</p>
Antenna	<p>GSM/UMTS/LTE main antenna.</p> <p>UMTS/LTE auxiliary antenna</p> <p>GNSS antenna</p>
GNSS	<p>GNSS engine (GPS, GLONASS and BD)</p> <p>Protocol: NMEA</p>
SMS	<p>MT, MO, CB, Text and PDU mode</p> <p>SMS storage: USIM card or ME(default)</p> <p>Transmission of SMS alternatively over CS or PS</p>
USIM interface	Support identity card: 1.8V/ 3V
USIM application toolkit	<p>Support SAT class 3, GSM 11.14 Release 98</p> <p>Support USAT</p>
Phonebook management	Support phonebook types: SM, FD, LD, RC, ON, MC
Audio feature	<p><b><i>SIM7600E-PCIE do not support audio interface. SIM7600E-PCIEA product support analog audio interface.</i></b></p> <p>One analog signal output with 32 Ω load resistance, 50mW output power, and one analog input.</p>
UART interface	<p>A full modem serial port by default</p> <p>Baud rate: 300bps to 3.6Mbps(default: 115200bps)</p> <p>Autobauding baud rate: 9600, 19200, 38400, 57600, 115200bps</p> <p>Can be used as the AT commands or data stream channel.</p> <p>Support RTS/CTS hardware handshake and software ON/OFF flow control</p> <p>Multiplex ability according to GSM 07.10 Multiplexer Protocol.</p>
USB	USB 2.0 high speed interface
Firmware upgrade	Firmware upgrade over USB interface or FOTA
Physical characteristics	<p>Size: 50.80*31*5.35mm</p> <p>Weight: less than 12g</p>
Temperature range	<p>Normal operation temperature: -30°C to +80°C</p> <p>Extended operation temperature: -40°C to +85°C*</p> <p>Storage temperature -45°C to +90°C</p>

***\*Note: Module is able to make and receive voice calls, data calls, SMS and make GPRS/WCDMA/HSPA+/LTE traffic in -40°C~+85°C. 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.***

### 3. Package Information

#### 3.1 Pin Out Diagram



**Figure 2: SIM7600E-PCIE Pin out Diagram**

### 3.2 PCI Express Mini Card Connector Pin Description

Table 3: PCI Express Mini Card Connector Pin Description

Pin name	Pin number	I/O	Description	Comment
<b>Power supply</b>				
VCC	2,24,39,41,52	I	Power supply for module	3.3V typical
GND	4,9,15,18,21, 26,27,29,34,3 5,37,40,43,50		Ground	-
<b>Reset</b>				
PERST#	22	I	Reset input (Active low)	If unused, keep open.
<b>USB 2.0</b>				
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			
<b>USIM card interface</b>				
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.	-
<b>UART interface</b>				
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	
<b>I2C interface</b>				
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	SIM7600E-PCIE: Wake up host SIM7600E-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	SIM7600E-PCIE: NC SIM7600E-PCIEA: MIC negative input	
EARP	5	O	SIM7600E-PCIE: NC SIM7600E-PCIEA: Receiver positive output	
EARN	7	O	SIM7600E-PCIE: NC SIM7600E-PCIEA: Receiver negative output	
W_DISABLE#	20	I	RF Control Input	
LED_WWAN#	42	O	Network Status Indication output	
NC	6,23,25,28,31,33,45,47,48,49,51	--	No connection	

### 3.3 Package Dimensions

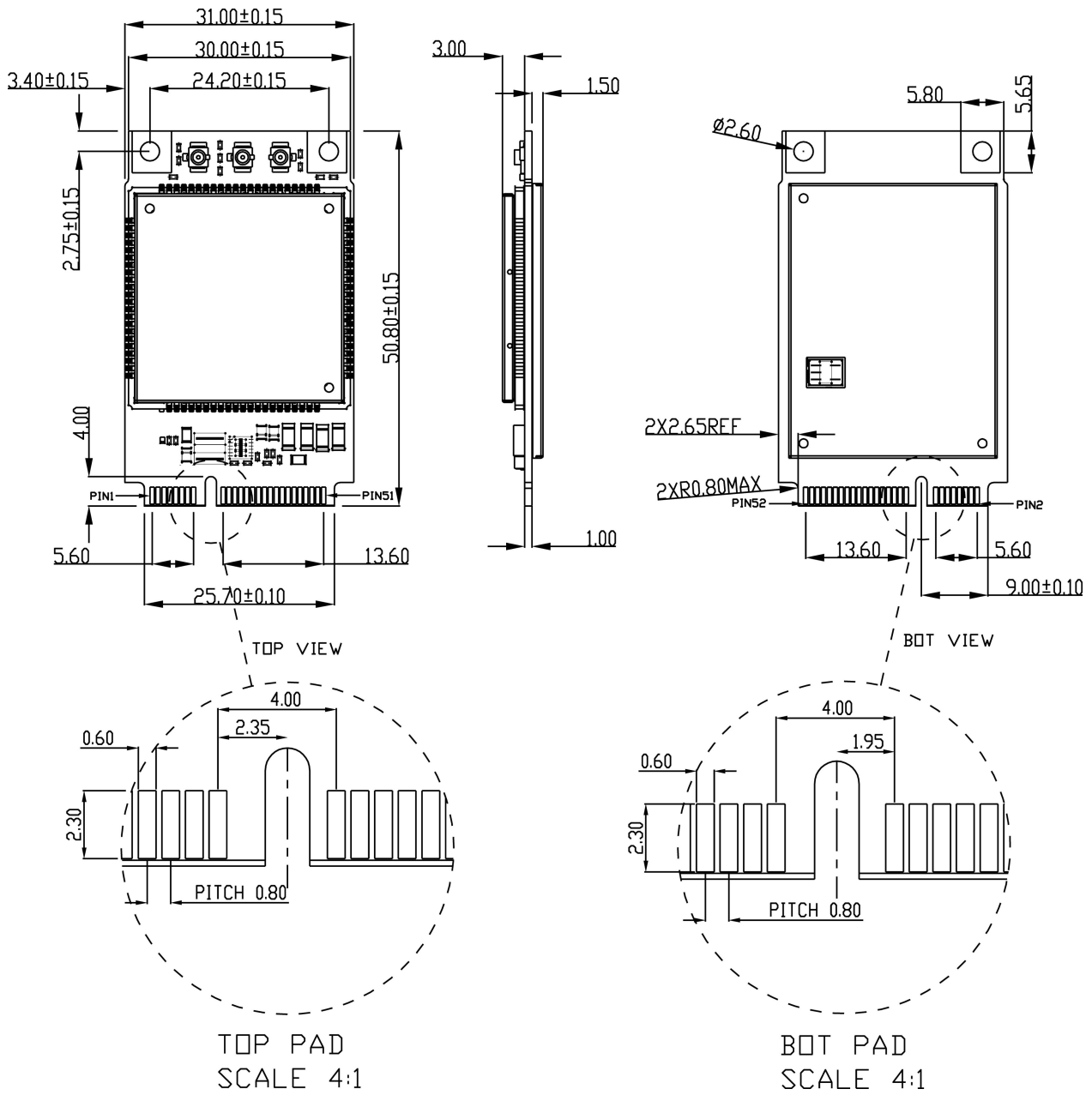


Figure 3: Dimensions of SIM7600E-PCIE (Unit: mm)

## 4. Interface Application

### 4.1 Power Supply

The recommended power supply voltage of SIM7600E-PCIE is 3.3V.

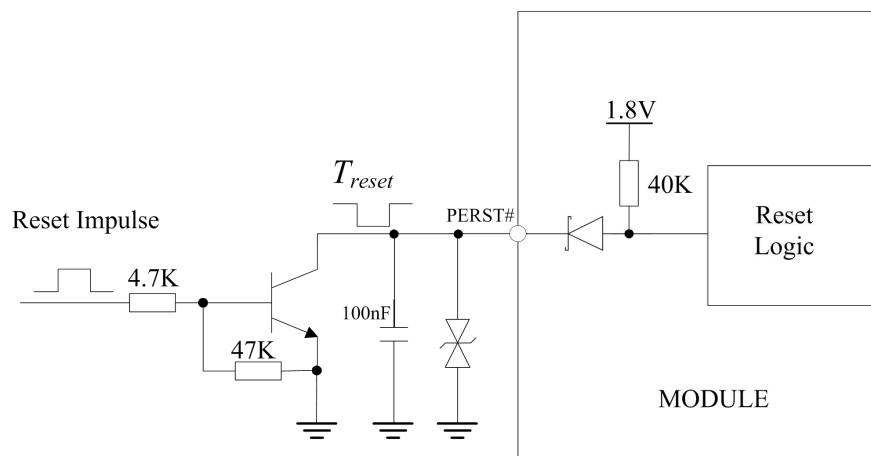
**Table 4: Recommended 3.3V Power Supply Characteristics**

Symbol	Parameter	Min	Type	Max	Unit
V <sub>o</sub>	Power supply voltage	3.0	3.3	3.6	V
I <sub>o</sub>	Supply current capability	-	2000	-	mA

### 4.2 PERST#

SIM7600E-PCIE can be reset by pulling the PERST# pin down to ground.

The PERST# pin has been pulled up with a 47KΩ 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 <sub>reset</sub>	The active low level time impulse on PERST# pin to reset module	50	100	500	ms
V <sub>IH</sub>	Input high level voltage	1.17	1.8	3.6	V
V <sub>IL</sub>	Input low level voltage	-0.3	0	0.2	V

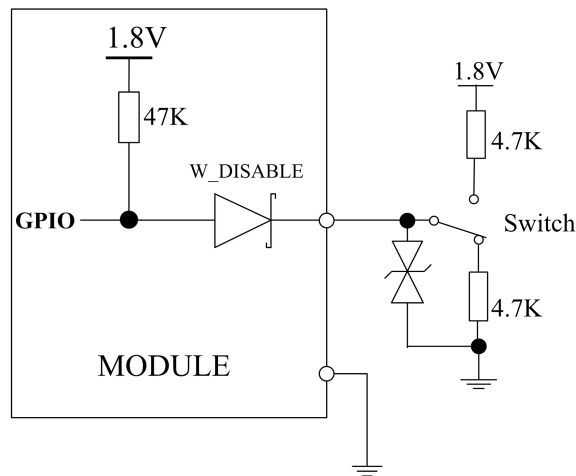


### 4.3 W\_DISABLE#

The W\_DISABLE# pin can be used to control SIM7600E-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 <sub>IH</sub>	High-level input voltage	1.17	1.8	3.6	V
V <sub>IL</sub>	Low-level input voltage	-0.3	0	0.3	V

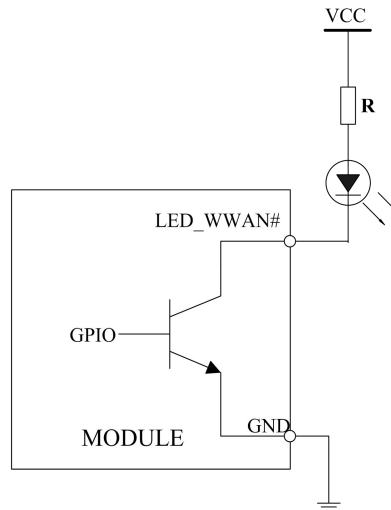
### 4.4 LED\_WWAN#

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

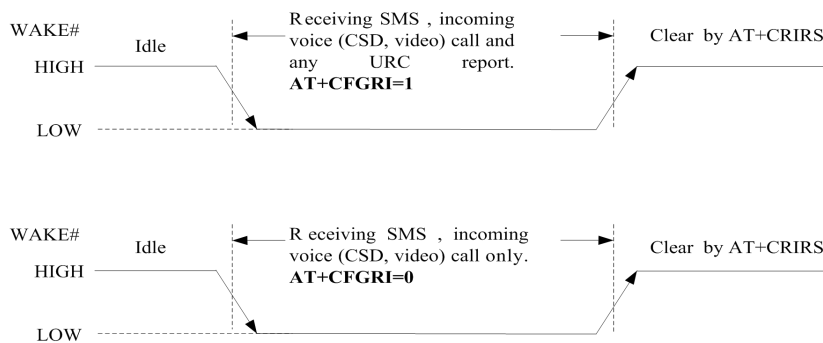
Reference circuit is recommended in the following figure:



**Figure 6: LED\_WWAN# Reference Circuit**

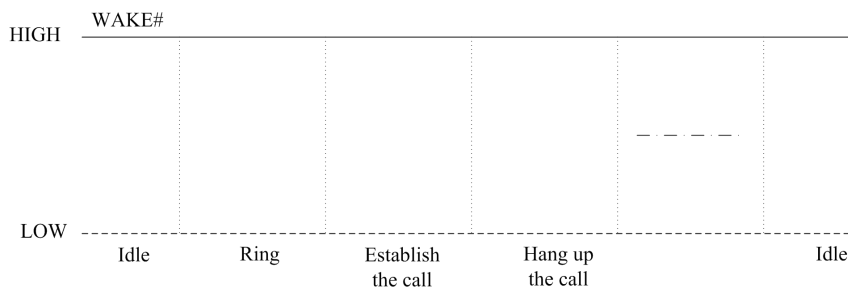
### 4.5 WAKE#

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.



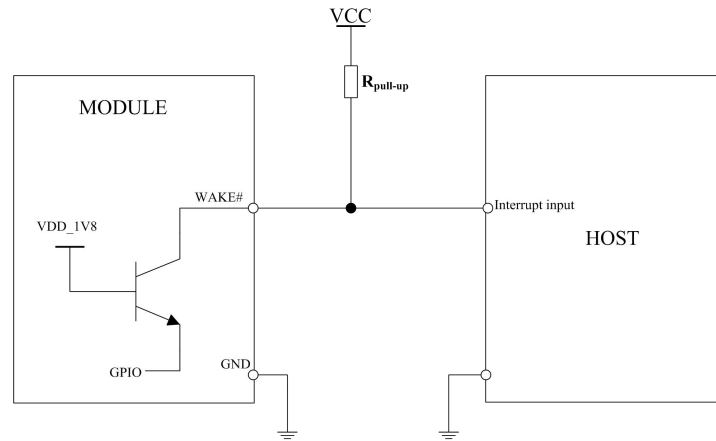
**Figure 7: WAKE# behaviour**

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:



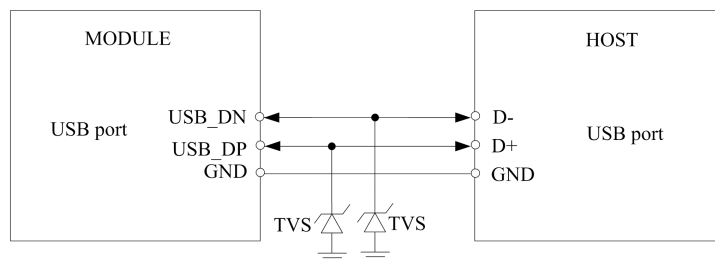
**Figure 9: WAKE# Reference Circuit**

*Note: If Analog audio is available, WAKE# function is invalid.*

## 4.6 USB 2.0

SIM7600E-PCIE is compliant with USB 2.0 specification. It supports full-speed and high-speed when acting as a peripheral device.

SIM7600E-PCIE can be used as a USB device. SIM7600E-PCIE supports the USB suspend and resume mechanism which can reduce power consumption. If there is no data transmission on the USB bus, SIM7600E-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](http://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 SIM7600E-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 4 virtual ports: “SimTech HS-USB Audio 9001”, “SimTech HS-USB AT port 9001”, “SimTech HS-USB Diagnostics 9001”, “SimTech HS-USB NMEA 9001”.*

## 4.7 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)**

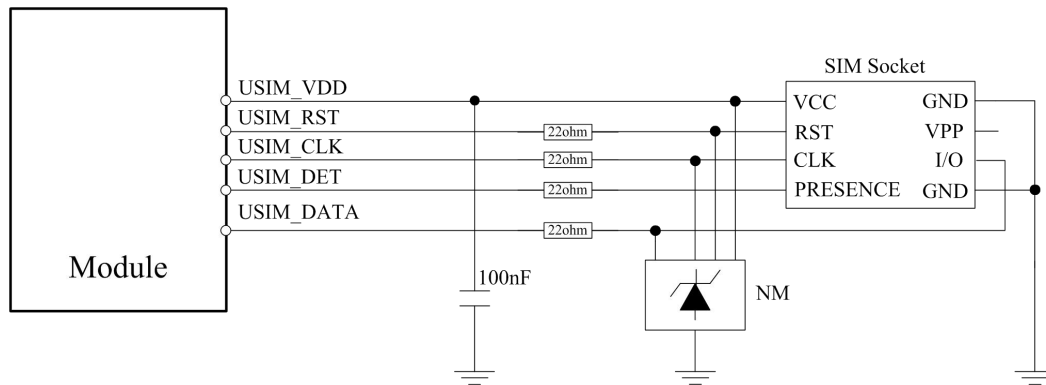
Symbol	Parameter	Min.	Typ.	Max.	Unit
USIM_VDD	LDO power output voltage	1.75	1.8	1.95	V
V <sub>IH</sub>	High-level input voltage	0.65*USIM_V DD	-	USIM_VDD +0.3	V
V <sub>IL</sub>	Low-level input voltage	-0.3	0	0.35*USIM_V DD	V
V <sub>OH</sub>	High-level output voltage	USIM_VDD -0.45	-	USIM_VDD	V
V <sub>OL</sub>	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 <sub>IH</sub>	High-level input voltage	0.65*USIM_V DD	-	USIM_VDD +0.3	V
V <sub>IL</sub>	Low-level input voltage	-0.3	0	0.25·USIM_V DD	V
V <sub>OH</sub>	High-level output voltage	USIM_VDD -0.45	-	USIM_VDD	V
V <sub>OL</sub>	Low-level output voltage	0	0	0.45	V

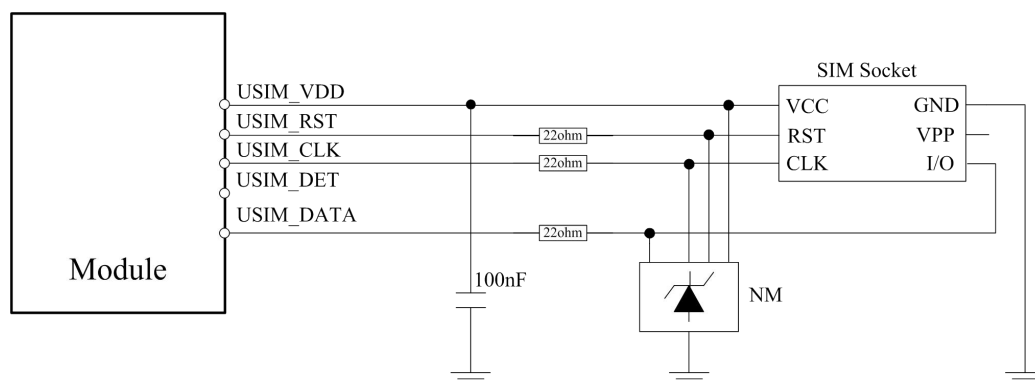
The USIM\_DET pin is used for detection of the USIM card hot plug. User can select the 8-pin USIM card holder to implement USIM card detection function.

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**

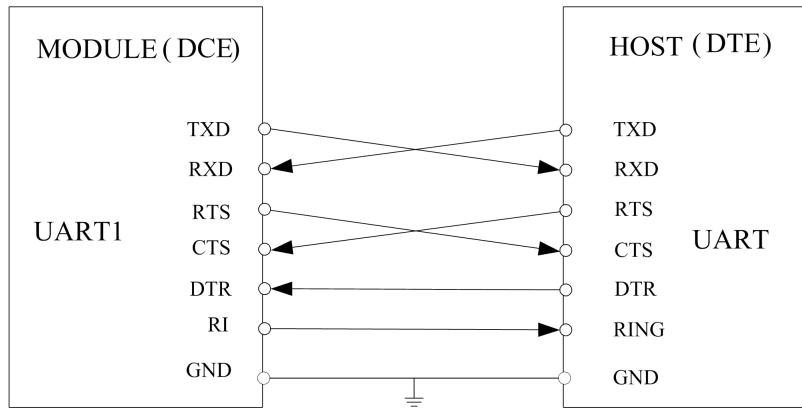
*Note: USIM\_DATA has been pulled up with a 10KΩ resistor to USIM\_VDD in module. A 100nF capacitor on USIM\_VDD is used to reduce interference.*

*Note: USIM\_CLK is very important signal; customer must make sure the rise time and fall time of USIM\_CLK less than 40ns!*

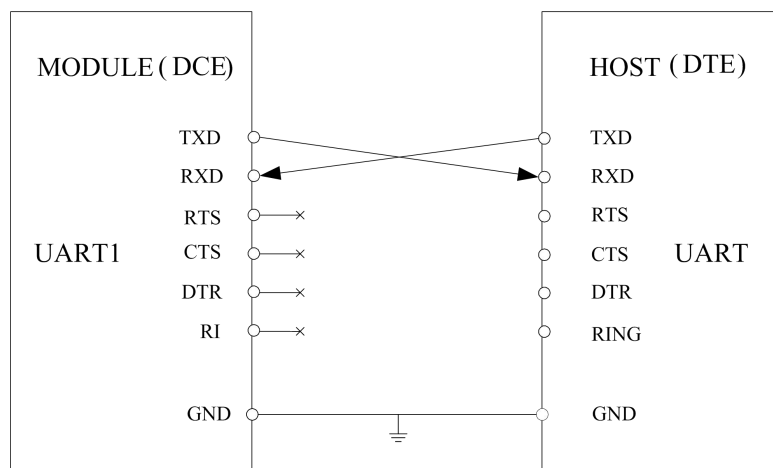
## 4.8 UART Interface

SIM7600E-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**



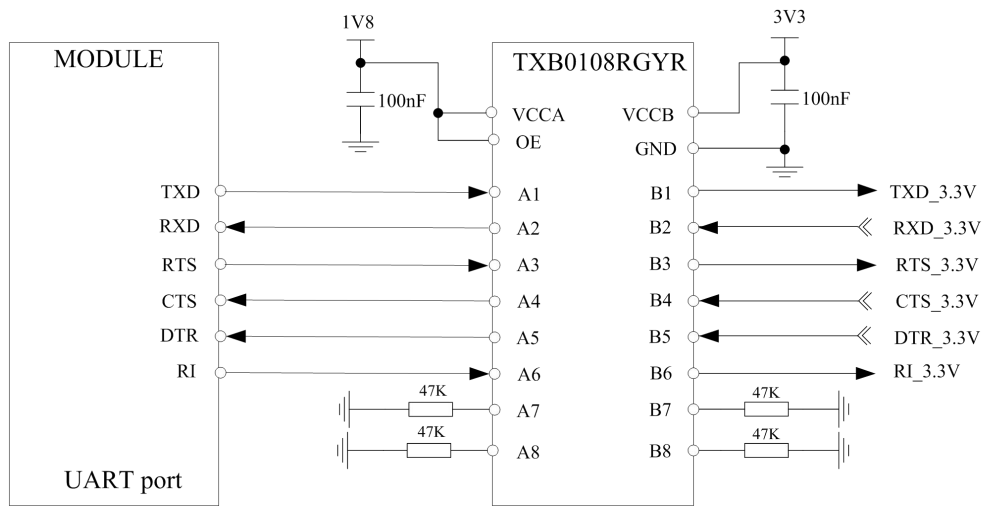
**Figure 14: UART Null modem**

**Table 11: UART Electrical Characteristic**

Symbol	Parameter	Min	Typ	Max	Unit
V <sub>IH</sub>	High-level input voltage	1.17	1.8	2.1	V
V <sub>IL</sub>	Low-level input voltage	-0.3	0	0.63	V
V <sub>OH</sub>	High-level output voltage	1.35	1.8	1.8	V
V <sub>OL</sub>	Low-level output voltage	0	0	0.45	V

The SIM7600E-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**

To comply with RS-232-C protocol, the RS-232-C level shifter chip should be used to connect SIM7600E-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.

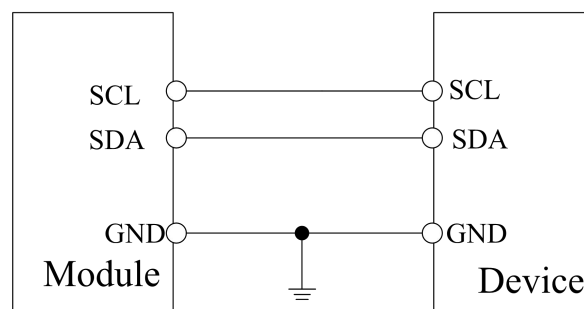
**Note:** *SIM7600E-PCIE supports the following baud rate: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600, 3200000, 3686400bps. Default baud rate is 115200bps.*

## 4.9 I2C Interface

SIM7600E-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 16: 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	Typ	Max	Unit
V <sub>IH</sub>	High-level input voltage	1.17	1.8	2.1	V
V <sub>IL</sub>	Low-level input voltage	-0.3	0	0.63	V
V <sub>OH</sub>	High-level output voltage	1.35	1.8	1.8	V
V <sub>OL</sub>	Low-level output voltage	0	0	0.45	V

#### 4.10 Analog Audio Interface

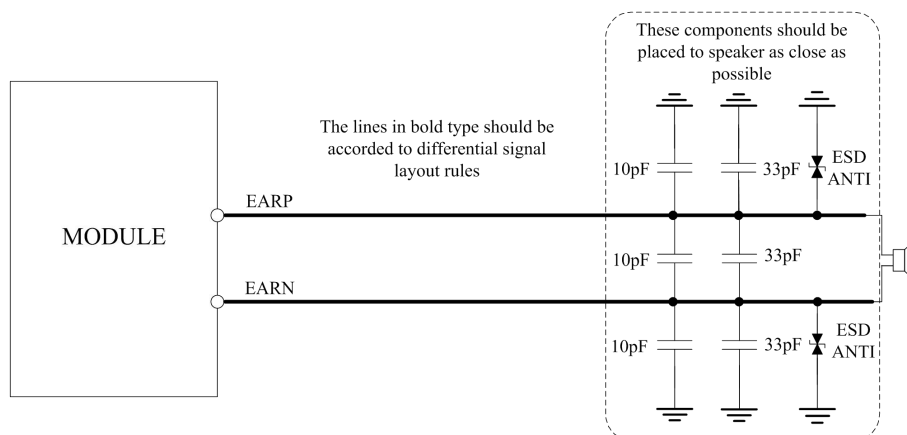
SIM7600E-PCIEA provides one analog signal output and one analog input. MICP/N is used as microphone input; EARP/N is used as audio output. Regarding audio parameters configuration, please refer to the ATC manual.

**Table 13: 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		K Ω

**Table 14: Audio output characteristics**

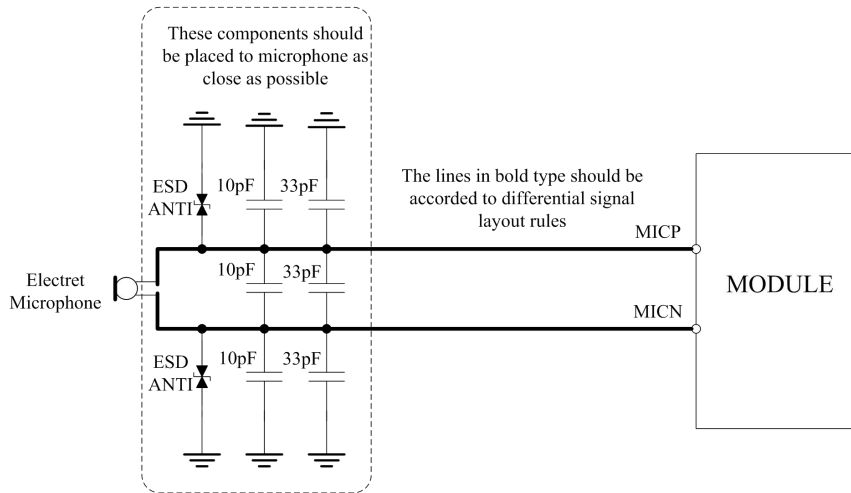
Parameter	Min	Typ	Max	Unit
Load resistance	27	32	-	Ω
Output power	-	50	-	mW



**Figure 17: Receiver interface configuration**

*Note: EARN is connected to GND in module, a pseudo-differential circuit is suggested.*





**Figure 18: Microphone interface configuration**

**Note:** SIM7600E-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.

## 5. RF Specifications

### 5.1 GSM/WCDMA/LTE RF Specifications

**Table 15: Conducted transmission power**

Frequency	Power	Min.
EGSM900	33dBm $\pm$ 2dB	5dBm $\pm$ 5dB
DCS1800	30dBm $\pm$ 2dB	0dBm $\pm$ 5dB
EGSM900 (8-PSK)	27dBm $\pm$ 3dB	5dBm $\pm$ 5dB
DCS1800 (8-PSK)	26dBm +3/-4dB	0dBm $\pm$ 5dB
WCDMA B1	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 B3	23dBm +/-2.7dB	<-40dBm
LTE-FDD B5	23dBm +/-2.7dB	<-40dBm
LTE-FDD B7	23dBm +/-2.7dB	<-40dBm
LTE-TDD B8	23dBm +/-2.7dB	<-40dBm
LTE-FDD B20	23dBm +/-2.7dB	<-40dBm
LTE-TDD B38	23dBm +/-2.7dB	<-40dBm
LTE-TDD B40	23dBm +/-2.7dB	<-40dBm
LTE-TDD B41	23dBm +/-2.7dB	<-40dBm

**Table 16: Operating frequencies**

Frequency	Receiving	Transmission
EGSM900	925~960MHz	880~915 MHz
DCS1800	1805~1880 MHz	1710~1785 MHz
WCDMA B1	2110~2170 MHz	1920~1980 MHz
WCDMA B5	869~894 MHz	824~849 MHz
WCDMA B8	925~960 MHz	880~915 MHz
The LTE Operating frequencies are shown in the following table 17.		
GPS	1574.4 ~1576.44 MHz	-
GLONASS	1598 ~1606 MHz	-
BD	1559 ~1563 MHz	

**Table 17: 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
3	1710 ~1785 MHz	1805 ~1880 MHz	FDD
5	824~849 MHz	869~894MHz	FDD
7	2500~2570MHz	2620~2690MHz	FDD
8	880 ~915 MHz	925 ~960 MHz	FDD
20	832~862MHz	791~ 821	FDD
38	2570 ~2620 MHz	2570 ~2620 MHz	TDD
40	2300 ~2400 MHz	2300 ~2400 MHz	TDD
41	2496 ~2690 MHz	2496 ~2690 MHz	TDD

Note: Operating frequencies of LTE TDD B41 for the SIM7600E-PCIE is 100MHz BW, 2555~2655 MHz

**Table 18: Conducted receive sensitivity**

Frequency	Receive sensitivity(Typical)	Receive sensitivity(MAX)
EGSM900	< -109dBm	3GPP
DCS1800	< -109dBm	3GPP
WCDMA 2100	< -110dBm	3GPP
WCDMA 900	< -110dBm	3GPP
WCDMA 800	< -110dBm	3GPP
LTE FDD/TDD	See table 26.	3GPP

**Table 19: Reference sensitivity (QPSK)**

E-UTR A band	1.4 MHz Standard	3 MHz Standard	5 MHz Standard	10 MHz Standard	5 MHz Test Resort	15 MHz Standard	20 MHz Standard	Duplex Mode
1	-	-	-100	-97	-101	-95.2	-94	FDD
3	-101.7	-98.7	-97	-94	-99	-92.2	-91	FDD
5	-103.2	-100.2	-98	-95	-99			FDD
7			-98	-95	-97	-93.2	-92	FDD
8	-102.2	-99.2	-97	-94	-102			FDD
20			-97	-94	-97	-91.2	-90	FDD
38	-	-	-100	-97	-101	-95.2	-94	TDD
40	-	-	-100	-97	-101	-95.2	-94	TDD
41	-	-	-99	-96	-101	-94.2	-93	TDD

## 5.2 RF Antenna Connector

SIM7600E-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/BD antenna connector. Recommended antenna characteristics of SIM7600E-PCIE are described by 2 following tables.

**Table 20: Recommended Passive Antenna Characteristics**

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

**Table 21: Recommended Active Antenna Characteristics**

Band	Performance	
	TRP	TIS
EGSM900	≧ 29dBm	≧ -104dBm
DCS1800	≧ 26dBm	≧ -104dBm
WCDMA B1	≧ 19dBm	≧ -104dBm
WCDMA B5	≧ 19dBm	≧ -104dBm
WCDMA B8	≧ 19dBm	≧ -104dBm
LTE B1	≧ 18dBm	≧ -92dBm(10MHz)
LTE B3	≧ 18dBm	≧ -89dBm(10MHz)
LTE B5	≧ 18dBm	≧ -89dBm(10MHz)
LTE B7	≧ 18dBm	≧ -89dBm(10MHz)
LTE B8	≧ 18dBm	≧ -89dBm(10MHz)
LTE B20	≧ 18dBm	≧ -92dBm(10MHz)
LTE B38	≧ 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.

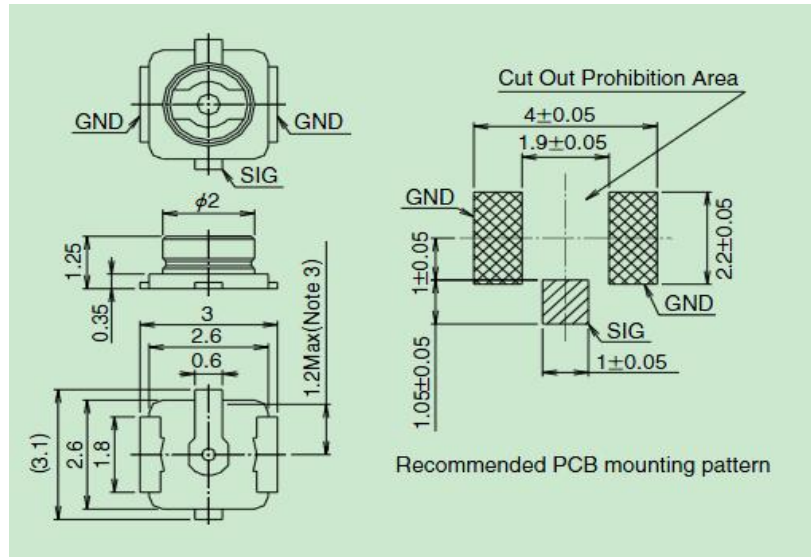


Figure 19: U.FL-R-SMT (Unit: mm)

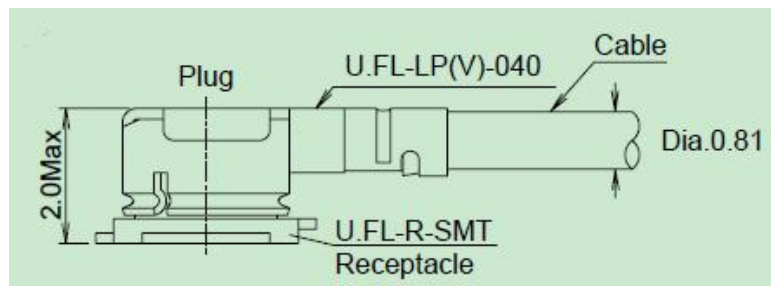
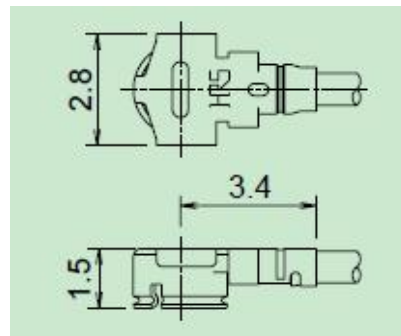


Figure 20: U.FL series RF adapter cable (Unit: mm)

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.

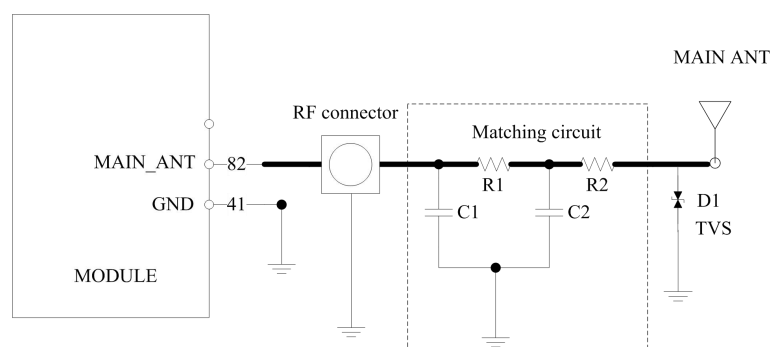


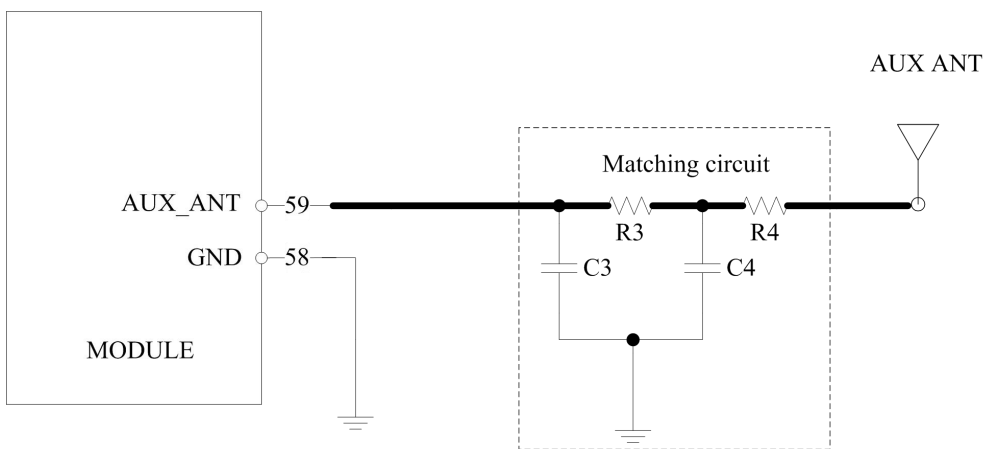
Figure 21: Antenna matching circuit (MAIN\_ANT)

In above figure, the components R1,C1,C2 and R2 are used for antenna matching, the value of components can only be got after the antenna tuning, usually, they are provided by antenna vendor. By default, the R1, R2 are 0 Ω resistors, and the C1, C2 are reserved for tuning.

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 50 Ω . The component D1 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 22: TVS part number list**

Package	Type	Supplier
0201	LXES03AAA1-154	Murata
0402	LXES15AAA1-153	Murata



**Figure 22: Antenna matching circuit (AUX\_ANT)**

In above figure, R3, C3, C4 and R4 are used for auxiliary antenna matching. By default, the R3, R4 are 0 Ω resistors, and the C3, C4 are reserved for tuning.

**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.

### 5.3 GNSS

SIM7600E-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.

#### 5.3.1 GNSS Technical specification

Tracking sensitivity: -159 dBm (GPS) /-158 dBm (GLONASS) /-159dbm (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.**

### 5.3.2 GNSS Operate Mode

SIM7600E-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:

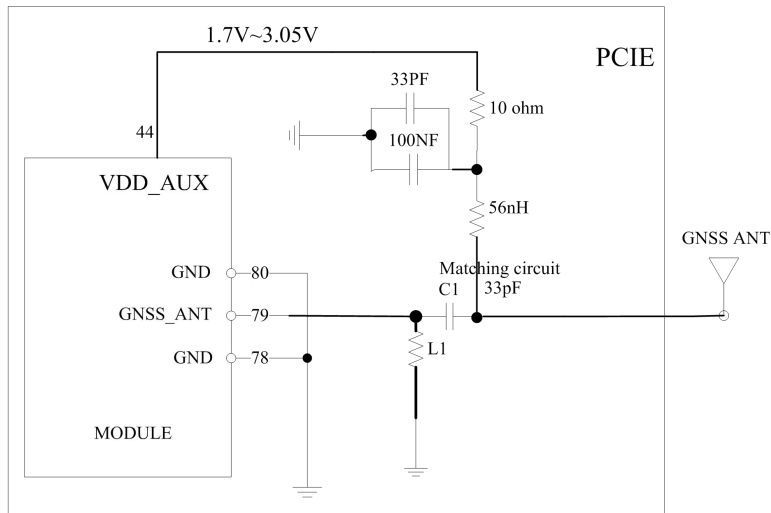
- High-sensitivity solution that works in all terrains: Indoor, outdoor, urban, and rural
- High availability that is enabled by using both satellite and network information

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 SIM7600E-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 SIM7600E-PCIE in proper operating mode by AT command. Please refer to related document for details. SIM7600E-PCIE can also get position location information through AT directly.

### 5.3.3 Application Guide

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



**Figure 23: Active antenna circuit**

In above Figure 23 the active antenna is used, If users want to change the voltage of VDD\_AUX, 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\_AUX is from 1.7V to 3.05V.

*Note; For more details of AT commands about VDD\_AUX, please refer to document [1].*

*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.*



## 6. Electrical Specifications

### 6.1 Absolute Maximum Ratings

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

**Table 23: Absolute maximum ratings**

Symbol	Parameter	Min	Type	Max	Unit
V <sub>CC</sub>	VCC input voltage	-0.3	-	3.6	V
V <sub>IO</sub>	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.*

### 6.2 Recommended Operating Conditions

Please refer to the follow table for recommended operating conditions.

**Table 24: Operating Conditions**

Symbol	Parameter	Min	Type	Max	Unit
V <sub>CC</sub>	3.3V Input voltage	3.0	3.3	3.6	V
V <sub>IO</sub>	Voltage at digital pins (1.8V digital I/O)	0	1.8	1.95	V
T <sub>OPER</sub>	Operating temperature	-40	+25	+85	°C
T <sub>STG</sub>	Storage temperature	-45	+25	+90	°C

### 6.3 Operating Mode

#### 6.3.1 Operating Mode

The table below summarizes the various operating modes of SIM7600E-PCIE.

**Table 25: 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		Customer could cut off the VBAT to power off module.

### 6.3.2 Power saving mode

SIM7600E-PCIE has two power saving modes: minimum functionality mode and sleep mode. In which module will achieve lower power consumption for power saving.

### 6.3.3 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 SIM7600E-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.*

### 6.3.4 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 SIM7600E-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 SIM7600E-PCIE is in minimum functionality or flight mode, it can return to full functionality by the AT command “AT+CFUN=1”.

## 6.4 Current Consumption

The current consumption is listed in the table below.

**Table 26: Current Consumption (VCC=3.3V)**

<b>GNSS</b>			
GNSS supply current (AT+CFUN=0,with USB connection)	@ -140dBm, Tracking Typical:35mA		
<b>GSM sleep/idle mode</b>			
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		
<b>UMTS sleep/idle mode</b>			
WCDMA supply current (GNSS off, without USB connection)	Sleep mode @DRX=9 Typical: 3.3mA Idle mode @DRX=9 Typical: 17.5mA		
<b>LTE sleep/idle mode</b>			
LTE supply current (GNSS off, without USB connection)	Sleep mode Typical: 4.6mA Idle mode Typical: 17.5mA		
<b>GSM Talk</b>			
EGSM900	@power 33.0 dBm Typical: 293mA		
DCS1800	@power 29.5dBm Typical: 227mA		
<b>UMTS Talk</b>			
WCDMA B1	@Power 22.5dBm Typical: 511mA		
WCDMA B5	@Power 23.6dBm Typical: 595mA		
WCDMA B8	@Power 23.0dBm Typical: 603mA		
<b>GPRS</b>			
EGSM900( 1 Rx,4 Tx )	@power 28.7 dBm Typical: 647mA		
DCS1800( 1 Rx,4 Tx )	@power 25.3 dBm Typical: 526mA		
EGSM900( 3Rx, 2 Tx )	@power 31.9 dBm Typical: 433mA		
DCS1800( 3Rx, 2 Tx )	@power 28.4 dBm Typical: 350mA		
<b>EDGE</b>			
EGSM900( 1 Rx,4 Tx )	@power 23.3dBm Typical: 430mA		
DCS1800( 1 Rx,4 Tx )	@power 21.9 dBm Typical: 439mA		
EGSM900( 3Rx, 2 Tx )	@power 25.9 dBm Typical: 246mA		
DCS1800( 3Rx, 2 Tx )	@power 25.2 dBm Typical: 265mA		
<b>HSDPA data</b>			
WCDMA B1	@Power 24dBm Typical: 478mA		
WCDMA B8	@Power 24dBm Typical: 430mA		
<b>LTE data</b>			
LTE-FDD B1	@5Mbps	22.5dBm	Typical: 597mA
	@10Mbps	22.5dBm	Typical: 608mA
	@20Mbps	22.5dBm	Typical: 687mA
LTE-FDD B3	@5Mbps	22.9dBm	Typical: 656mA
	@10Mbps	22.6dBm	Typical: 684mA
	@20Mbps	22.8dBm	Typical: 746mA
LTE-FDD B5	@5Mbps	22.5dBm	Typical: 564mA
	@10Mbps	22.5dBm	Typical: 598mA
LTE-FDD B7	@5Mbps	23.4dBm	Typical: 762mA
	@10Mbps	23.4dBm	Typical: 707mA
	@20Mbps	23.4dBm	Typical: 726mA

LTE-FDD B8	@5Mbps	22.6dBm	Typical: 560mA
	@10Mbps	22.6dBm	Typical: 600mA
LTE-FDD B20	@5Mbps	23.4dBm	Typical: 689mA
	@10Mbps	23.6dBm	Typical: 698mA
LTE-TDD B38	@5Mbps	23.0dBm	Typical: 512mA
	@10Mbps	23.0dBm	Typical: 544mA
LTE-TDD B40	@5Mbps	23.0dBm	Typical: 495mA
	@10Mbps	23.0dBm	Typical: 512mA
LTE-TDD B41	@5Mbps	23.0dBm	Typical: 428mA
	@10Mbps	23.0dBm	Typical: 450mA

*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.*

## 6.5 Electro-Static Discharge

SIM7600E-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 27: ESD characteristics (Temperature: 25°C, 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

# 7. Packaging

SIM7600E-PCIE module support tray packaging.

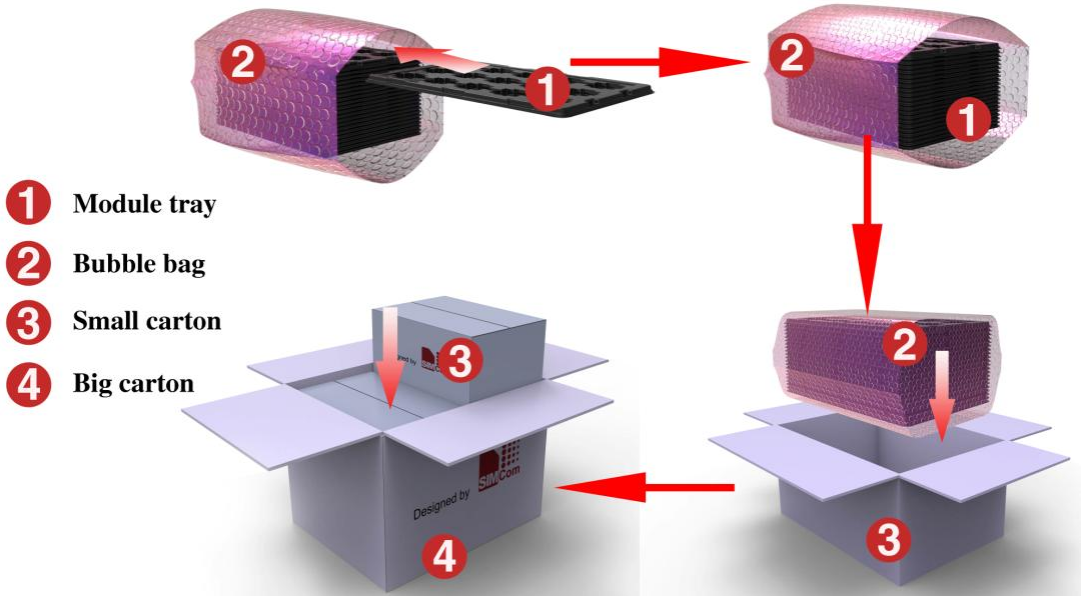


Figure 24: Tray packaging

Module tray drawing:

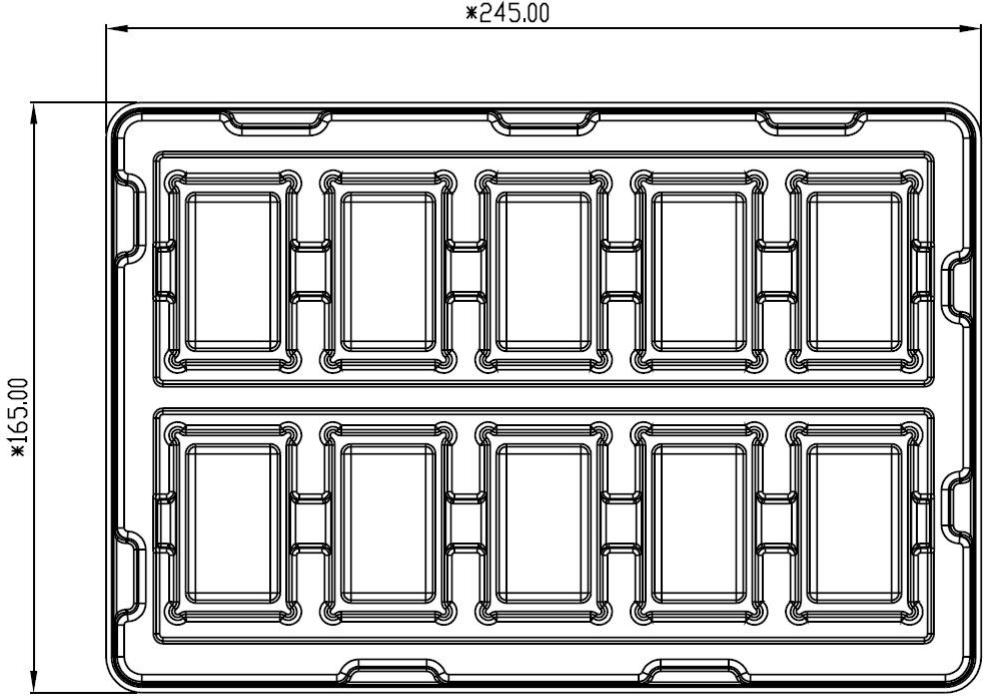
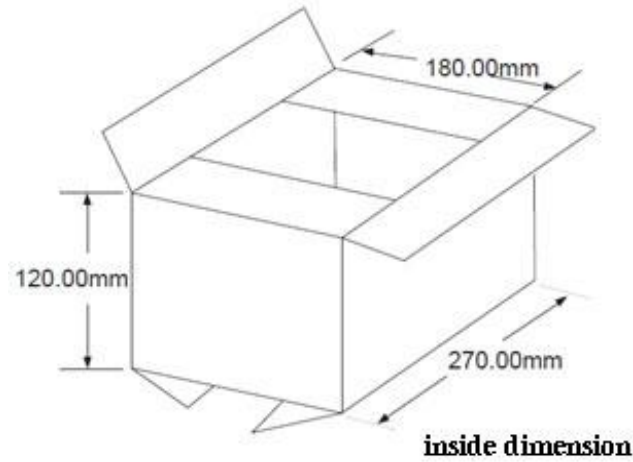


Figure 25: Tray drawing

**Table 28: Tray size**

Length ( $\pm 3\text{mm}$ )	Width ( $\pm 3\text{mm}$ )	Number
245.0	165.0	10

Small carton drawing:

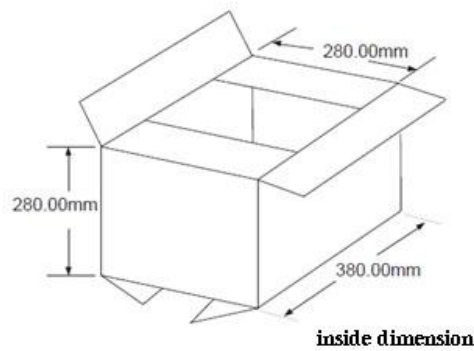


**Figure 26: Small carton drawing**

**Table 29: Small Carton size**

Length( $\pm 10\text{mm}$ )	Width ( $\pm 10\text{mm}$ )	Height ( $\pm 10\text{mm}$ )	Number
270	180	120	10*10=100

**Big carton drawing:**



**Figure 27: Big carton drawing**

**Table 30: Big Carton size**

Length( $\pm 10\text{mm}$ )	Width ( $\pm 10\text{mm}$ )	Height ( $\pm 10\text{mm}$ )	Number
380	280	280	100*4=400

## Appendix

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

**Table 31: Coding Schemes and Maximum Net Data Rates over Air Interface**

<b>Multislot definition(GPRS/EDGE)</b>			
<b>Slot class</b>	<b>DL slot number</b>	<b>UL slot number</b>	<b>Active slot number</b>
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
<b>GPRS coding scheme</b>	<b>Max data rata (4 slots)</b>		<b>Modulation type</b>
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
<b>EDGE coding scheme</b>	<b>Max data rata (4 slots)</b>		<b>Modulation type</b>
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
<b>HSDPA device category</b>	<b>Max data rate (peak)</b>		<b>Modulation type</b>
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
<b>HSUPA device category</b>	<b>Max data rate (peak)</b>	<b>Modulation type</b>
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
<b>LTE-FDD device category (Downlink)</b>	<b>Max data rate (peak)</b>	<b>Modulation type</b>
Category 1	10Mbps	QPSK/16QAM/64QAM
Category 2	50Mbps	QPSK/16QAM/64QAM
Category 3	100Mbps	QPSK/16QAM/64QAM
Category 4	150Mbps	QPSK/16QAM/64QAM
<b>LTE-FDD device category (Uplink)</b>	<b>Max data rate (peak)</b>	<b>Modulation type</b>
Category 1	5Mbps	QPSK/16QAM
Category 2	25Mbps	QPSK/16QAM
Category 3	50Mbps	QPSK/16QAM
Category 4	50Mbps	QPSK/16QAM



## II. Related Documents

**Table 32: Related Documents**

SN	Title	Description
[1]	SIM7500_SIM7600 Series_AT Command Manual_V1.xx.pdf	SIM7600 AT command document
[2]	ITU-T Draft new recommendation V.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

### III. Terms and Abbreviations

Table 33: 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 34: Safety caution**

Marks	Requirements
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	<p>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.</p>
	<p>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.</p>
	<p>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.</p>
	<p>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.</p>
	<p>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.</p>
	<p>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.</p> <p>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.</p> <p>Also, some networks require that a valid SIM card be properly inserted in the cellular terminal or mobile.</p>

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