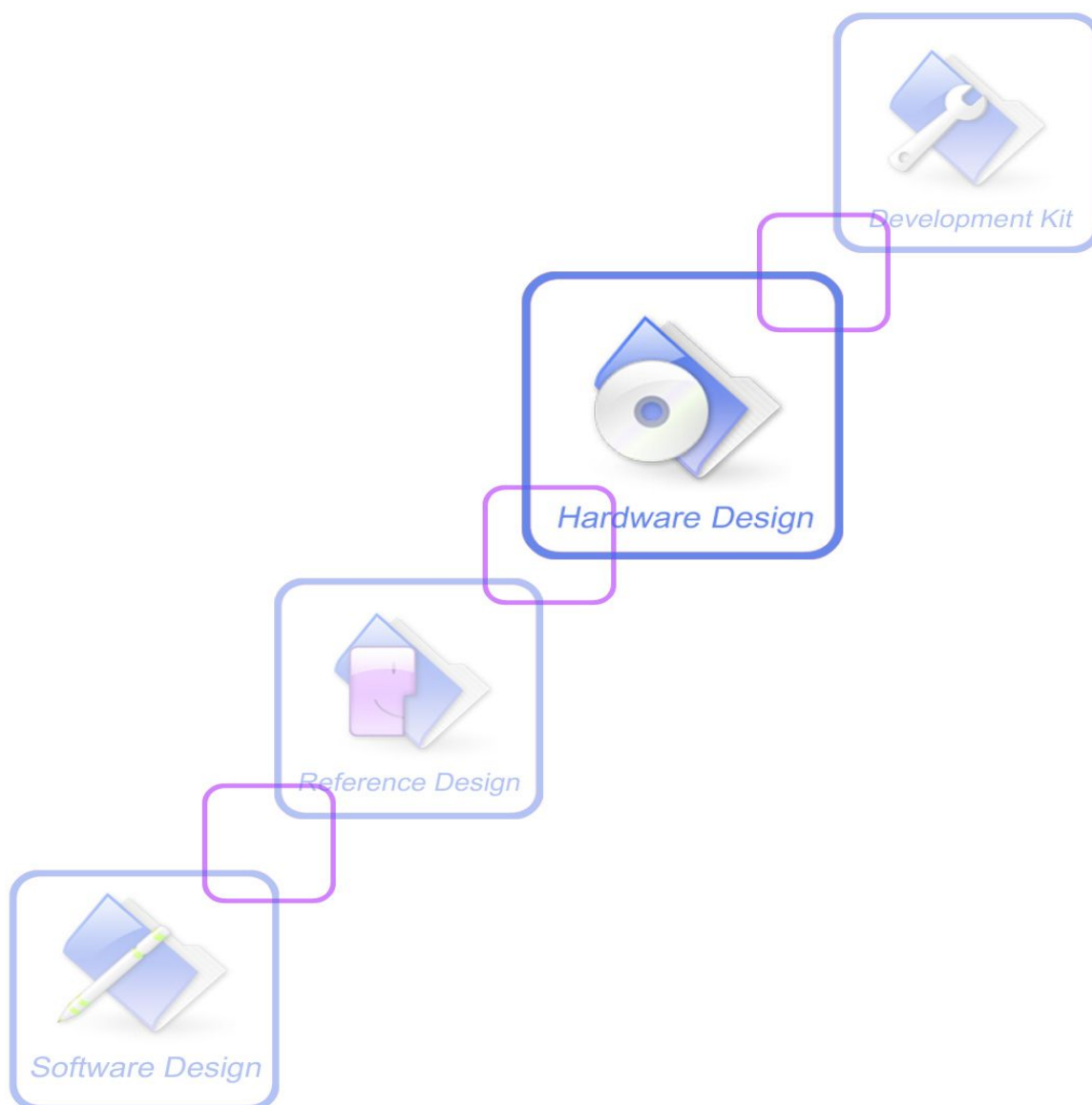




SIM7100-PCIE(A)_Hardware Design_V1.01



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Version History

Date	Version	Description of change	Author
2014-11-03	1.01	Origin	Yang Hongliang, Li Ya

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1 Introduction

SIM7100-PCIE(A) module is PCI Express Mini Card. This document describes SIM7100-PCIE(A) hardware interface in great detail, which can help user to quickly understand SIM7100-PCIE(A) interface specifications, electrical and mechanical details.

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2 SIM7100-PCIE(A) Overview

SIM7100-PCIE(A) series support dual-band GSM/GPRS/EDGE and dual-band UMTS /HSPA+ that works on frequencies of GSM 850MHz/EGSM 900 MHz, DCS 1800 MHz/PCS 1900MHz and WCDMA 850/900MHz, 1900/18000 MHz, 2100MHz, TDSCDMA band A and band B, LTE-FDD band1/2/3/4/5/6/7/8/13/17/20, LTE-TDD band 38/39/40/41.

The modules can be chosen based on the wireless network configuration. In this document, the entire radio band configuration of SIM7100-PCIE(A) series is described in the following table.

Table 1: SIM7100-PCIE(A) Series Frequency Bands

Standard	Frequency	SIM7100C-PCIE(A)	SIM7100E-PCIE(A)	SIM7100A-PCIE(A)
GSM	GSM 850MHz			
	EGSM 900MHz	✓	✓	
	DCS1800MHz	✓	✓	
	PCS1900MHz			
WCDMA	WCDMA 850MHz			✓
	WCDMA 900MHz	✓	✓	
	WCDMA 1900MHz			✓
	WCDMA 2100MHz	✓	✓	
TD-SCDMA	1880-1920MHz	✓		
	2010-2025MHz	✓		
HSPA	HSDPA	✓	✓	✓
	HSUPA	✓	✓	✓
HSPA+	HSPA+	✓	✓	✓
	DC-HSPA+	✓	✓	✓
GNSS	GPS	✓	✓	✓
	GLONASS	✓	✓	✓
LTE-FDD	LTE-FDD B1	✓	✓	
	LTE-FDD B2			✓
	LTE-FDD B3	✓	✓	
	LTE-FDD B4			✓
	LTE-FDD B5			✓
	LTE-FDD B7	✓	✓	
	LTE-FDD B8	✓	✓	
	LTE-FDD B13			
	LTE-FDD B17			✓
	LTE-FDD B20		✓	
LTE-TDD	LTE TDD B38	✓	✓	
	LTE TDD B39	✓		

	LTE TDD B40	✓	✓	
	LTE TDD B41 (100M BW)	✓		

SIM7100-PCIE(A) provides various hardware interfaces via Mini PCI Express card connector.

- **Power supply: : 3.3V+0.3/-0.1V**
- **USB Interface**
- **Audio Interface**
- **UART Interface**
- **SIM Interface**
- **PCM Interface**
- **W_DISABLE#**
- **WAKE#**
- **PERST#**
- **LED_WWAN#**

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2.1. SIM7100-PCIE(A) Key Features

Table 2: SIM7100-PCIE(A) Key Features

Feature	Implementation
Power supply	Single supply voltage 3.3V+0.3V/-0.1V
Transmission data	<ul style="list-style-type: none"> ● 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 Category 3 - 100 Mbps (DL) ● LTE Category 3 - 50 Mbps (UL)
SMS	<ul style="list-style-type: none"> ● MT, MO, CB, Text and PDU mode ● SMS storage: SIM card or ME(default) ● Support transmission of SMS alternatively over CSD or GPRS. User can choose preferred mode.
SIM interface	Support identity card: 1.8V, 3V.
USB	Support USB2.0 Slave mode
Audio features(optional)	Only available on SIM7100X-PCIEA Speech codec modes: <ul style="list-style-type: none"> ● Half Rate (ETS 06.20) ● Full Rate (ETS 06.10) ● Enhanced Full Rate (ETS 06.50 / 06.60 / 06.80) ● AMR (WCDMA)
Serial interface	<ul style="list-style-type: none"> ● Serial Port standard or null modem mode on Serial Port Interface ● Serial Port can be used to control module by sending AT command
Rx-diversity	Support UMTS Rx-diversity.
Phonebook management	Support phonebook types: SM, FD, LD, RC, ON, MC.
SIM application toolkit	Support SAT class 3, GSM 11.14 Release 98 Support USAT
Physical characteristics	Size: 50.95*31*4.95mm Weight:10.8 g
Firmware upgrade	Firmware upgrade over USB interface
PCM	Multiplex on GPIOs. Only available on SIM7100X-PCIE Used for analog audio function with external codec. Support long frame sync and short frame sync. Support 8-bit A-law, μ -law and 16-bit linear data formats. Support master and slave mode, but must be the master in long frame sync.
Temperature range	<ul style="list-style-type: none"> ● Normal operation temperature: -30°C to +80°C ● Extended operation temperature: -40°C to +85°C ● Storage temperature -45°C to +90°C

Table 3: Coding schemes and maximum net data rates over air interface

Multislot definition(GPRS/EDGE)			
Slot class	DL slot number	UL slot number	Active slot number
1	1	1	2
2	2	1	3
3	2	2	3
4	3	1	4
5	2	2	4
6	3	2	4
7	3	3	4
8	4	1	5
9	3	2	5
10	4	2	5
11	4	3	5
12	4	4	5
GPRS coding scheme	Max data rata (4 slots)		Modulation type
CS 1 = 9.05 kb/s / time slot	36.2 kb/s		GMSK
CS 2 = 13.4 kb/s / time slot	53.6 kb/s		GMSK
CS 3 = 15.6 kb/s / time slot	62.4 kb/s		GMSK
CS 4 = 21.4 kb/s / time slot	85.6 kb/s		GMSK
EDGE coding scheme	Max data rata (4 slots)		Modulation type
MCS 1 = 8.8 kb/s/ time slot	35.2 kb/s		GMSK
MCS 2 = 11.2 kb/s/ time slot	44.8 kb/s		GMSK
MCS 3 = 14.8 kb/s/ time slot	59.2 kb/s		GMSK
MCS 4 = 17.6 kb/s/ time slot	70.4 kb/s		GMSK
MCS 5 = 22.4 kb/s/ time slot	89.6 kb/s		8PSK
MCS 6 = 29.6 kb/s/ time slot	118.4 kb/s		8PSK
MCS 7 = 44.8 kb/s/ time slot	179.2 kb/s		8PSK
MCS 8 = 54.4 kb/s/ time slot	217.6 kb/s		8PSK
MCS 9 = 59.2 kb/s/ time slot	236.8 kb/s		8PSK
HSDPA device category	Max data rate (peak)		Modulation type
Category 1	1.2Mbps		16QAM,QPSK
Category 2	1.2Mbps		16QAM,QPSK
Category 3	1.8Mbps		16QAM,QPSK
Category 4	1.8Mbps		16QAM,QPSK
Category 5	3.6Mbps		16QAM,QPSK
Category 6	3.6Mbps		16QAM,QPSK
Category 7	7.2Mbps		16QAM,QPSK
Category 8	7.2Mbps		16QAM,QPSK
Category 9	10.2Mbps		16QAM,QPSK

Category 10	14.4Mbps	16QAM,QPSK
Category 11	0.9Mbps	QPSK
Category 12	1.8Mbps	QPSK
Category 13	17.6Mbps	64QAM
Category 14	21.1Mbps	64QAM
Category 15	23.4Mbps	16QAM
Category 16	28Mbps	16QAM
Category 17	23.4Mbps	64QAM
Category 18	28Mbps	64QAM
Category 19	35.5Mbps	64QAM
Category 20	42Mbps	64QAM
Category 21	23.4Mbps	16QAM
Category 22	28Mbps	16QAM
Category 23	35.5Mbps	64QAM
Category 24	42.2Mbps	64QAM
HSUPA device category	Max data rate (peak)	Modulation type
Category 1	0.96Mbps	QPSK
Category 2	1.92Mbps	QPSK
Category 3	1.92Mbps	QPSK
Category 4	3.84Mbps	QPSK
Category 5	3.84Mbps	QPSK
Category 6	5.76Mbps	QPSK
LTE-FDD device category (Downlink)	Max data rate (peak)	Modulation type
Category 1	10Mbps	QPSK/16QAM/64QAM
Category 2	50Mbps	QPSK/16QAM/64QAM
Category 3	100Mbps	QPSK/16QAM/64QAM
Category 4	150Mbps	QPSK/16QAM/64QAM
LTE-FDD device category (Uplink)	Max data rate (peak)	Modulation type
Category 1	5Mbps	QPSK/16QAM
Category 2	25Mbps	QPSK/16QAM
Category 3	50Mbps	QPSK/16QAM
Category 4	50Mbps	QPSK/16QAM

2.2. Operating Mode

The table below summarizes the various operating modes of SIM7100-PCIE.

Table 4: Operating Mode

Mode	Status	Function
Normal operation	Sleep	<p>GSM/GPRS/EDGE/WCDMA/TD-SCDMA/LTE</p> <p>Module will automatically go into sleep mode if the conditions of sleep mode are enabling and there is no on air and no hardware interrupt (such as USB wake-up operation or data on serial port).</p> <p>In this case, the current consumption of module will be reduced to the minimal level.</p> <p>In sleep mode, the module can still receive paging message and SMS.</p>
	Idle	<p>GSM/WCDMA/TD-SCDMA/LTE</p> <p>Software is active. Module is registered to the GSM/WCDMA/LTE network, and the module is ready to communicate.</p>
	Talk	<p>GSM/WCDMA/TD-SCDMA/LTE</p> <p>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.</p>
	Standby	<p>EDGE/HSPA+/LTE</p> <p>Module is ready for EDGE/HSPA+/LTE data transfer, but no data is currently sent or received. In this case, power consumption depends on network settings and EDGE/HSPA+/LTE configuration.</p>
	Data transfer	<p>EDGE/HSPA+/LTE</p> <p>There is EDGE/HSPA+/LTE data transfer in progress. In this case, power consumption is related to network settings (e.g. power control level); uplink/downlink data rates and GPRS configuration (e.g. used multi-slot settings).</p>
Minimum functionality mode		<p>AT command “AT+CFUN” can be used to set the module to a minimum functionality mode without removing the power supply. In this mode, the RF part of the module will not work or the USIM card will not be accessible, or both RF part and USIM card will be closed, and the serial port is still accessible. The power consumption in this mode is lower than normal mode.</p>

2.3. Functional Diagram

The following figure is SIM7100-PCIE(A) functional diagram.

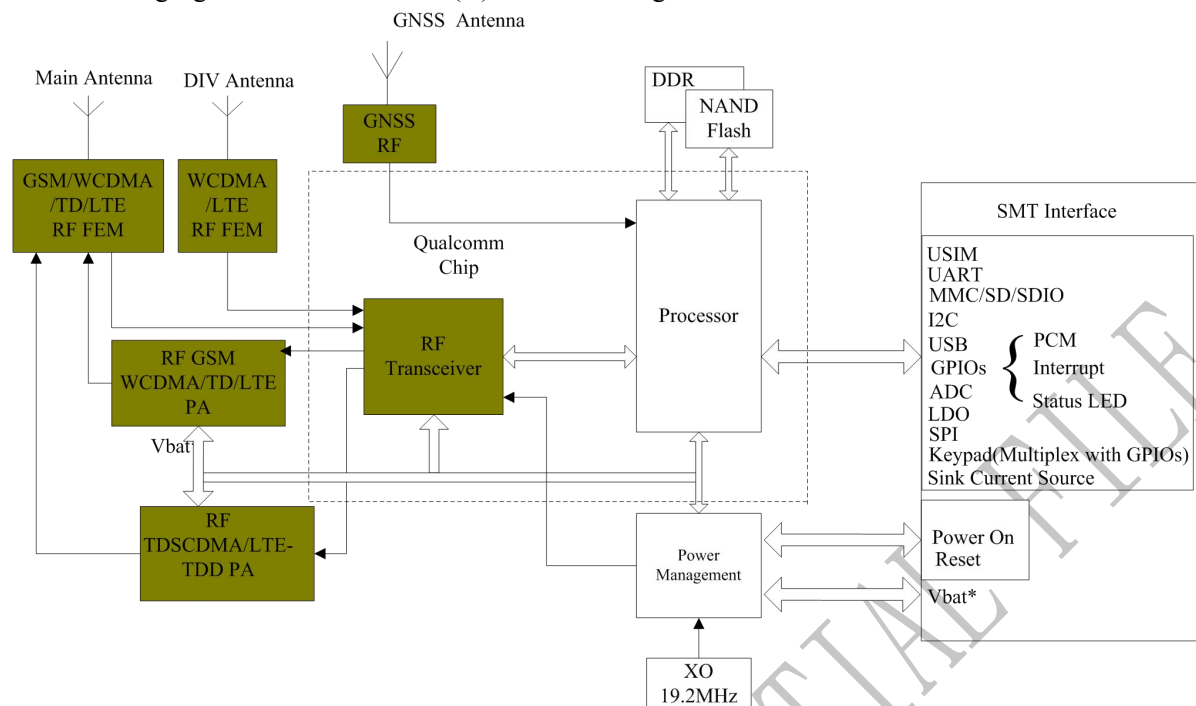


Figure 1: SIM7100-PCIE(A) Functional Diagram

3 Package Information

3.1. Pin Out Diagram

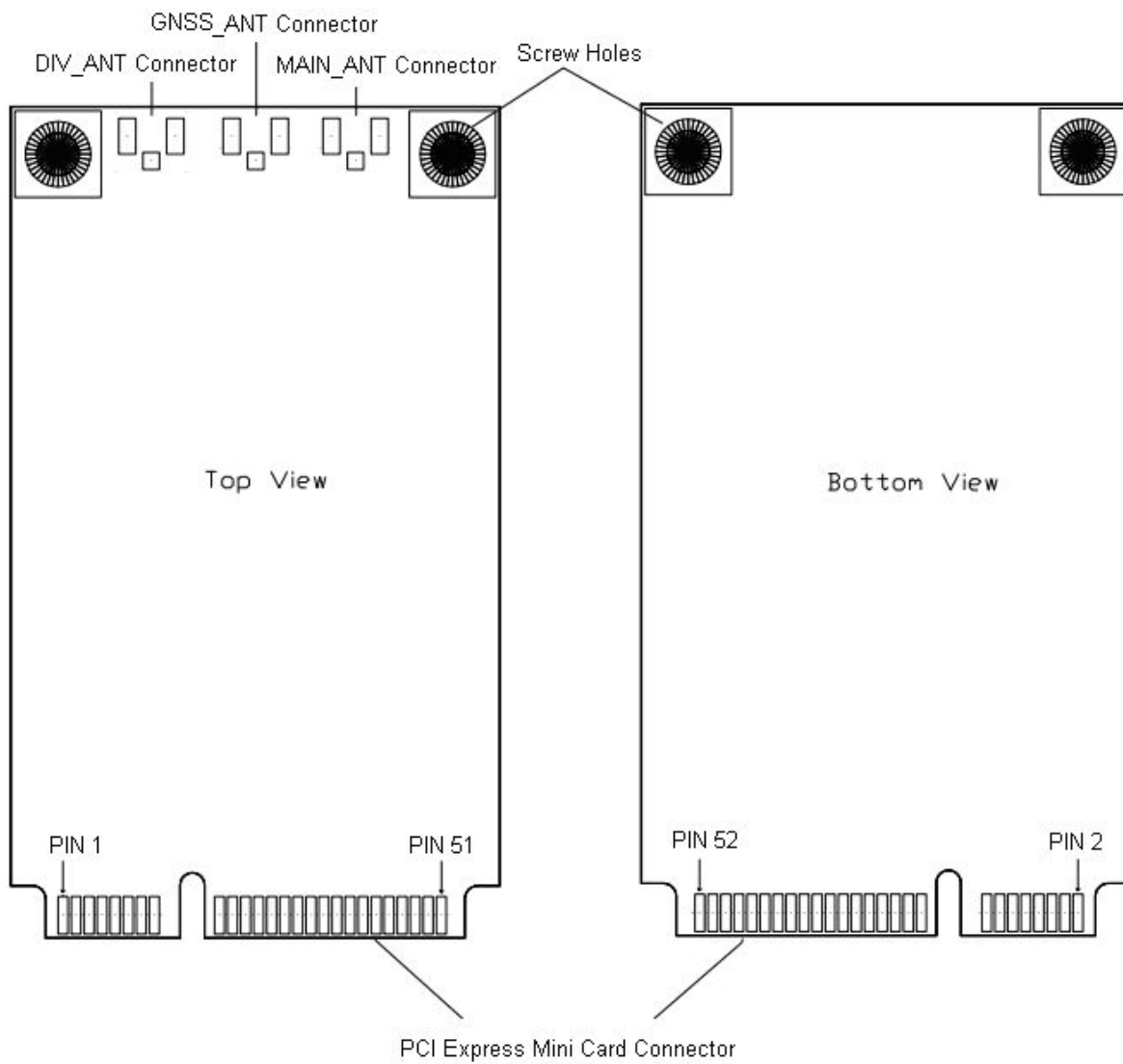


Figure 2: SIM7100-PCIE(A) Pin Out Diagram

3.2. PCI Express Mini Card Connector Pin Description

Table 5: PCI Express Mini Card Connector Pin Description

Pin name	Pin number	I/O	Description	Comment
Power supply				
VCC	2,24,39,41,52	I	3.3 Power supply for module	-
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 this pin is 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 this pin is unused, keep open.
USB_DN	36			
SIM card interface				
USIM_VDD	8	O	1.8/3.0V Configurable LDO output, default 1.8V output, maximum output current is 30mA	-
USIM_DATA	10	I/O	SIM data input/output	-
USIM_CLK	12	O	SIM clock	-
USIM_RST	14	O	SIM reset	-
PCM interface				
PCM_CLK	45	O	PCM clock	If these pins are unused, keep open. <i>The PCM interface can be used only on SIM7100X-PCIE.</i>
PCM_OUT	47	O	PCM data output	
PCM_IN	49	I	PCM data input	
PCM_SYNC	51	O	PCM synchrony	
UART interface				
UART_CTS	11	I	Clear to Send	If these pins are 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	
GPIO interface				
GPIO9	30	I/O	General input/output PIN.	If these pins are unused, keep open
GPIO6	32	I/O	General input/output PIN.	

GPIO42	16	I/O	General input/output PIN.	
others				
WAKE#/MIC1P	1	I	Default: Wake up host Optional: MIC positive input *	<i>If these pins are unused, keep open. If Analog audio is available, wake up function is invalid. Analog audio is only available on SIM7100X-PCIEA</i>
MIC1N	3	I	Default: NC Optional: MIC negative input *	
EAR1P	5	O	Default: NC Optional: Receiver positive output *	
EAR1N	7	O	Default: NC Optional: Receiver negative output *	
W_DISABLE#	20	I	RF Control Input	If this pin is unused, keep open.
LED_WWAN#	42	O	Network Status Indication output	If this pin is unused, keep open.
NC	6,23,25,28,31,33,48	--	No connection	Keep open

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3.3. Package Dimensions

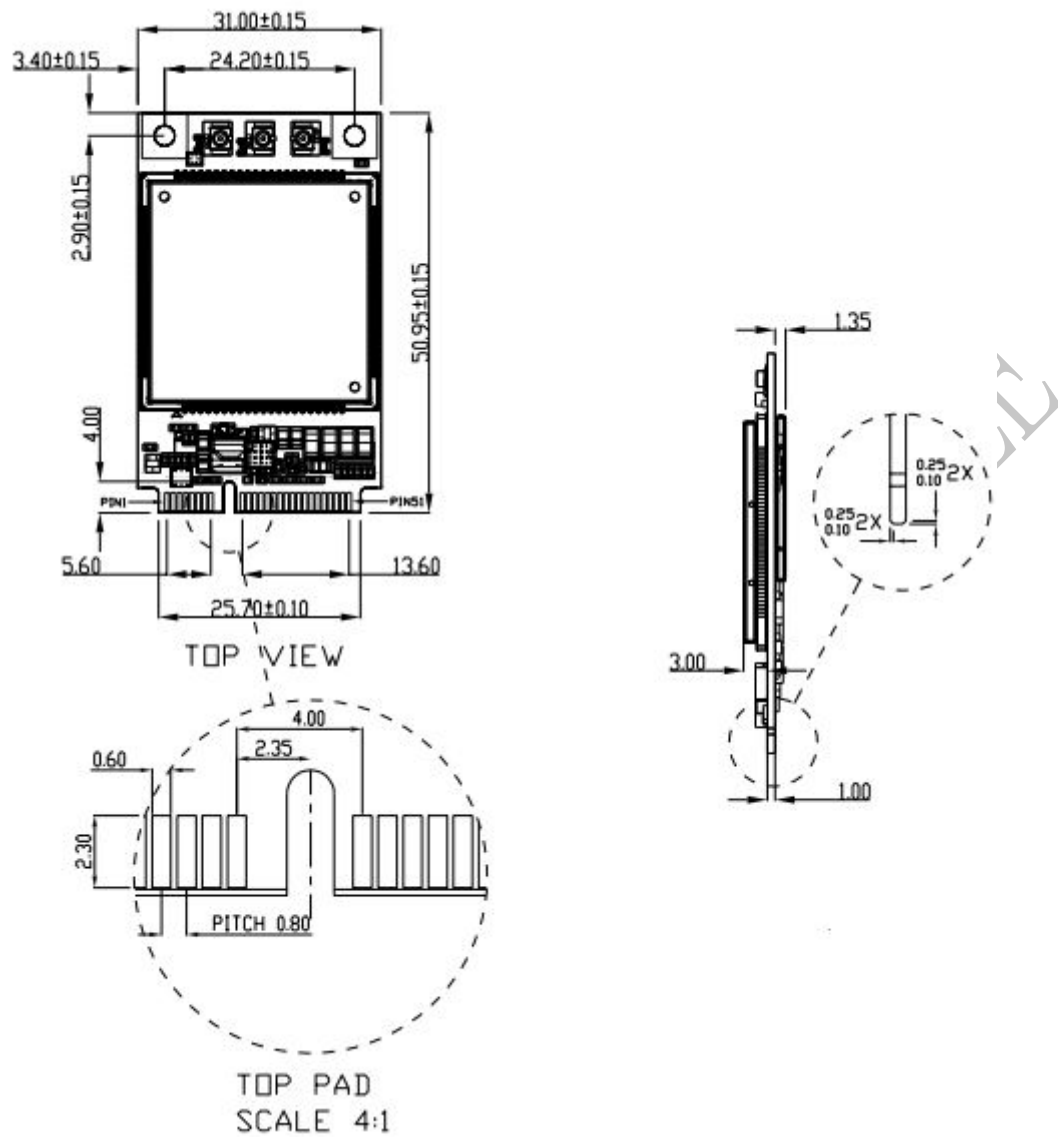


Figure 3: Dimensions of SIM7100-PCIE(Unit: mm)

Note: Please refer to appendix for package dimension details.

4 Application Interface

4.1 Power Supply

The recommended power supply voltage of SIM7100-PCIE(A) is 3.3V.

Table 6: Recommended 3.3V Power Supply Characteristics

Symbol	Parameter	Min	Type	Max	Unit
V _O	Power supply voltage	3.2	3.3	3.6	V
I _O	Supply current capability	2000	-	-	mA

4.2 Power Saving Mode

SIM7100-PCIE(A) has two power saving modes: minimum functionality mode and sleep mode. When SIM7100-PCIE(A) is in sleep mode and minimum functionality mode, the current of module is lowest.

4.2.1 Minimum Functionality Mode and Sleep Mode

The AT command “AT+CFUN=<fun>” can be used to set SIM7100-PCIE(A) into minimum functionality.

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

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

Table 7: The Current Consumption of Minimum Functionality Mode (BS-PA-MFRMS=5)

<fun>	Current consumption(mA) (sleep mode)
0	1.4
1	1.6
4	1.4

Minimum functionality mode minimizes the current consumption to the lowest level. If SIM7100-PCIE(A) is set to minimum functionality by “AT+CFUN=0”, the RF function and SIM card function will be disabled. In this case, the serial port and USB port are still accessible, but all AT commands correlative with RF function and SIM card function will not be accessible.

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

If USB HOST sends USB suspend request, SIM7100-PCIE(A) will enter sleep mode automatically for reducing power consume, when peripheral equipment of SIM7100-PCIE(A) stops working, and module has no on air or audio activity required. In sleep mode, SIM7100-PCIE(A) can still receive paging or SMS from network.

Note: *SIM7100-PCIE(A) could enter sleep mode when the host CPU supports USB suspend mode, otherwise it could not enter sleep mode.*

4.2.2 Wake Up SIM7100-PCIE(A) from Sleep Mode

When SIM7100-PCIE(A) is in sleep mode, the following methods can wake up the module:

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

4.3 USB 2.0

SIM7100-PCIE(A) is compliant with USB 2.0 specification. It supports full-speed and high-speed when acting as a peripheral device.

4.3.1 USB Port Specification

SIM7100-PCIE(A) could achieve data transfer, voice call, debug and software download, etc, through USB interface. When module is powered on, and connected USB_DP, USB_DN and GND to PC, and driver installed successfully, then 5 COM port, “**SIMTECH HS-USB Modem 9001**”, “**SIMTECH HS-USB NMEA 9001**”, “**SIMTECH HS-USB AT port 9001**”, “**SIMTECH HS-USB Diagnostics 9001**” and “**SIMTECH Wireless HS-USB Ethernet Adapter 9001**” could be recognized by the USB HOST.

Table 8: USB port Specification

Port Name	Description
SIMTECH HS-USB AT port 9001	Module could be controlled by sending AT command via USB Application Port.
SIMTECH HS-USB Diagnostics 9001	Module could be debugged by grabbing log through USB Debug Port.
SIMTECH HS-USB NMEA 9001	GPS data could be achieved through SIMTECH NMEA Device port. SIM7100-PCIE(A) has not this function.
SIMTECH HS-USB Modem 9001	Module could transfer data through Modem.
SIMTECH Wireless HS-USB Ethernet Adapter 9001	/

4.3.2 Firmware Update

If users need to upgrade through USB port, it is necessary to power on SIM7100-PCIE(A) first, and then connect USB_DP, USB_DN and GND to USB HOST.

4.4 SIM Card Interface

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

It is recommended to use an ESD protection component such as ST (www.st.com) ESDA6V1W5. Note that the SIM peripheral circuit should be close to the SIM card socket. The reference circuit of the 6-pin SIM card holder is illustrated in the following figure.

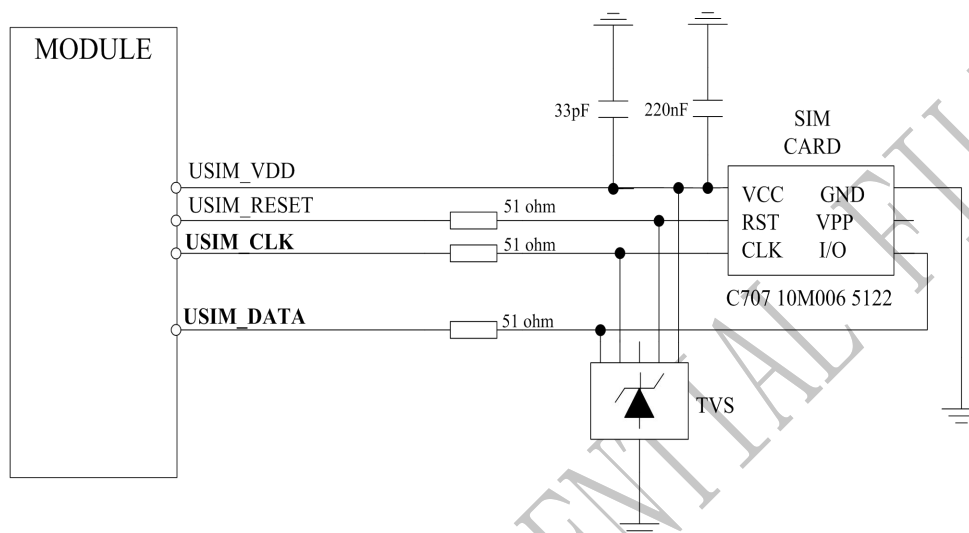


Figure 4: SIM Card Holder Reference Circuit

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

- Make sure that SIM card holder should stay away from GSM antenna while in PCB layout;
- SIM traces should keep away from RF lines, VBAT and high-speed signal lines, and the shorter the better;
- Keep good connectivity between SIM holder GND and module GND;
- It is recommended to do some protection on USIM_CLK to keep away from interference;
- Recommended to place a 1uF capacitor on USIM_VDD line and keep close to the holder;
- Place some TVS, the parasitic capacitance should not exceed 50pF, and cascade 51Ohm resistor to enhance ESD protection.

4.5 PERST#

The PERST# pin could be used as an emergency reset. SIM7100-PCIE(A) has power-up reset function, so power-up reset pulse is not necessary. When the PERST# pin is pulled to ground, the module will be reset. The PERST# pin is already pulled up in module, so the external pull-up resistor is not necessary.

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

Table 9: PERST# Electrical Characteristic

Symbol	Parameter	Min	Type	Max	Unit
V _{IH}	High-level input voltage	1.7	1.8	3.6	V
V _{IL}	Low-level input voltage	-	-	0.3	V
T _{high-hold}	After power up AND-NOT operation time(keep high level or keep open)	250	-	-	ms
T _{low-hold}	Reset low level hold on time	TBD	-	-	us

The low level pulse time must be longer than 300us. The following figure is the timing of reset function.

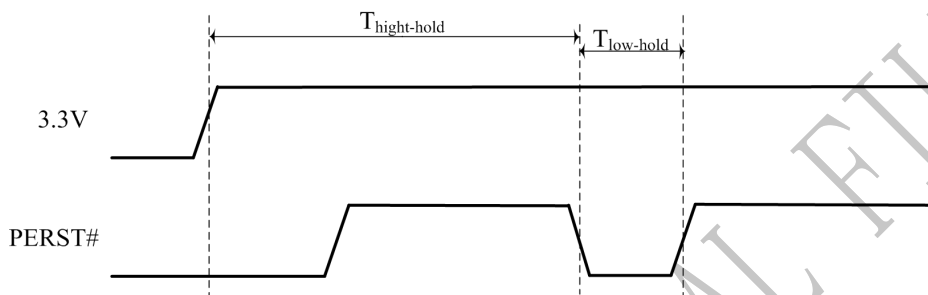


Figure 5: Reset Timing

4.6 W_DISABLE#

The W_DISABLE# pin controls SIM7100-PCIE(A) to enter or exit the Flight mode by default. In Flight mode, RF function is closed to prevent interference with other equipments or minimize current consumption.

Table 10: Flight mode control Function

W_DISABLE# status	Module operation
Low Level	Flight Mode: RF is closed.
High Level	Normal Mode: RF is working.

Table 11: W_DISABLE# Electrical Characteristic

Symbol	Parameter	Min	Type	Max	Unit
V _{IH}	High-level input voltage	3.0	3.3	3.6	V
V _{IL}	Low-level input voltage	-	-	0.3	V
T _{low-hold}	low level hold on time	300	-	-	us

4.7 LED_WWAN#

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

Table 12: Network Status Indication Pin Status

LED_WWAN# Status	Working Status
On	Searching Network/Call Connect
200ms On, 200ms Off	Data Transmit
800ms On, 800ms Off	Registered network
Off	Power off / Sleep

Reference circuit is recommended in the following figure:

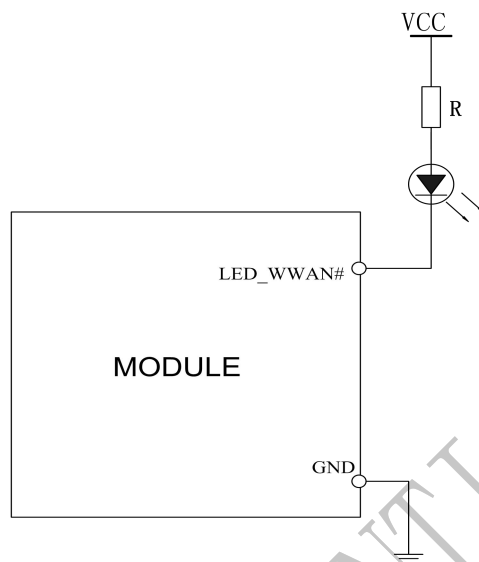


Figure 6: LED_WWAN# Reference Circuit

4.8 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.

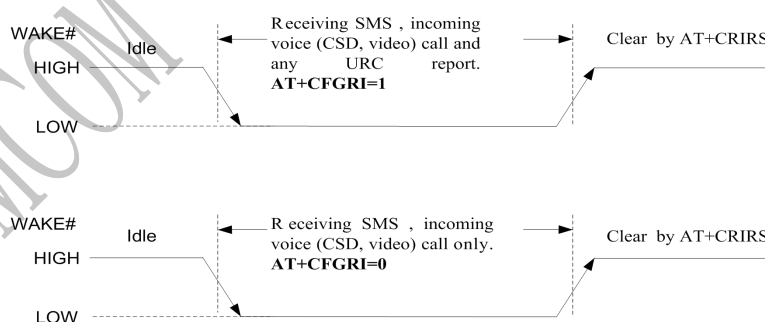


Figure 7: WAKE# behaviour

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

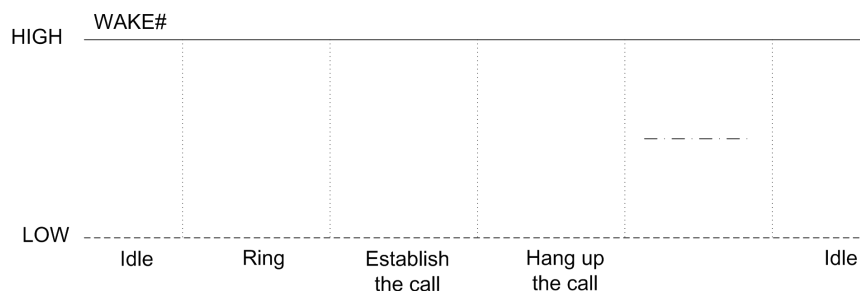


Figure 8: WAKE# behavior as a caller

WAKE# Reference circuit is recommended in the following figure:

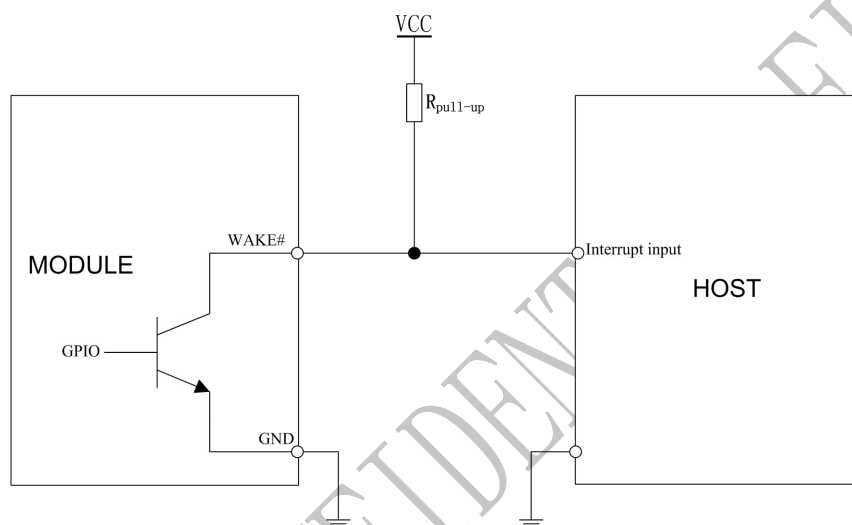


Figure 9: WAKE# Reference Circuit

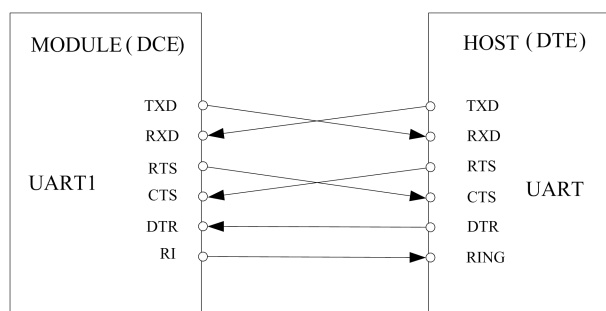
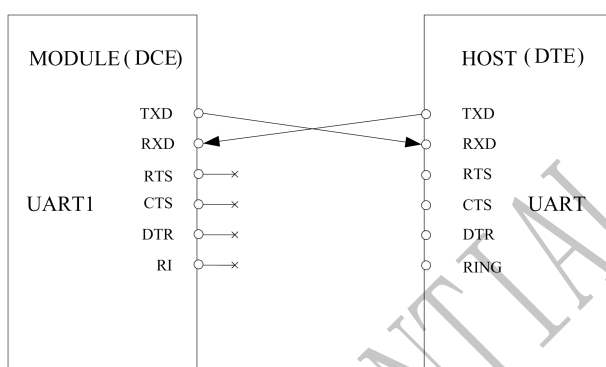
Note: If Analog audio is available, wake up function is invalid. Please consult our sales staff, for more information.

4.9 UART Interface

SIM7100-PCIE(A) 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.

In order to prevent the UART signals of the module damaged due to voltage spikes or ESD, series resistors can be used on UART signals.

The application circuit is in the following figures.


Figure 10: UART1 Full modem

Figure 11: Null modem
Table 13: UART Electrical Characteristic

Symbol	Parameter	Min	Typ	Max	Unit
V _{IH}	High-level input voltage	1.26	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 SIM7100-PCIE(A) 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.

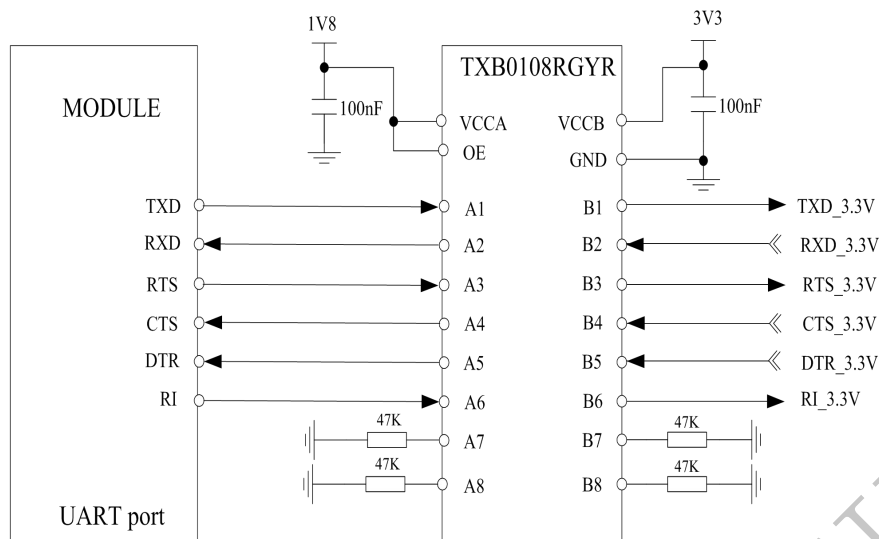


Figure 12: Reference circuit of level shift

To comply with RS-232-C protocol, the RS-232-C level shifter chip should be used to connect SIM7100-PCIE(A) 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: SIM7100-PCIE(A) supports the baud rate: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600, 3200000, 3686400, 4000000bps. Default rate is 115200bps.

4.10 PCM/Analog Audio Interface

4.10.1 PCM Interface

SIM7100-PCIE(A) provides hardware PCM interface for external codec by default. The PCM interface enables communication with an external codec to support hands-free applications. SIM7100-PCIE(A) PCM interface can be used in two modes: the default mode is auxiliary PCM (8 KHz short sync mode at 2048 KHz PCM CLK); the other mode is primary PCM (8 KHz long sync mode at 128 KHz PCM CLK). In short-sync (primary PCM) mode, SIM7100-PCIE(A) can be a master or a slave. In long-sync (auxiliary PCM) mode, SIM7100-PCIE(A) is always a master. SIM7100-PCIE(A) also supports 3 kinds of coding formats: 8 bits (u-law or A-law) and 16 bits (linear).

Note: The PCM interface can not be used, if WM8960 CODEC chip is mounted on PCIE board.

Table 14: PCM Specification

Characteristics	Specification
Line Interface Format	Linear or 8 bits (u-law or A-law)
Data length	16bits or 8 bits
PCM Clock/Sync Source	Master or a slave Mode(2048 KHz) / Master Mode(128 KHz)
PCM Clock Rate	2048 KHz / 128Khz
PCM Sync Format	Short sync/Long sync both support

Note: PCM interface can be control by AT command. For more details please refer to document [1] and document [2]

Table 15: PCM DC Characteristics

Symbol	Parameter	Min	Type	Max	Unit
V _{IH}	High-level input voltage	1.26	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

4.10.2 Analog Audio Interface

SIM7100-PCIE(A) provides one analog signal output and one analog input optionally. MIC1P/N is used as microphone, EAR1P/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
Working Voltage		1.80		V
Working Current	70		400	uA
External Microphone Load Resistance	1.2	2.2		k Ohms

Table 17: Audio output characteristics

Parameter	Min	Typ	Max	Unit
Normal (EAR_P,EAR_N)				
Differential Load resistance	27	32	-	Ohm
Output power	-	70	-	mW

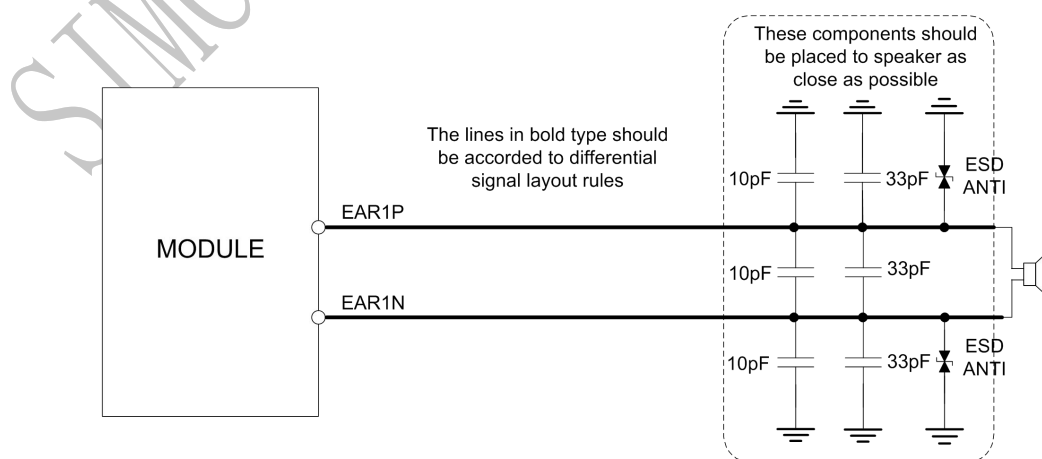


Figure 13: Receiver interface configuration

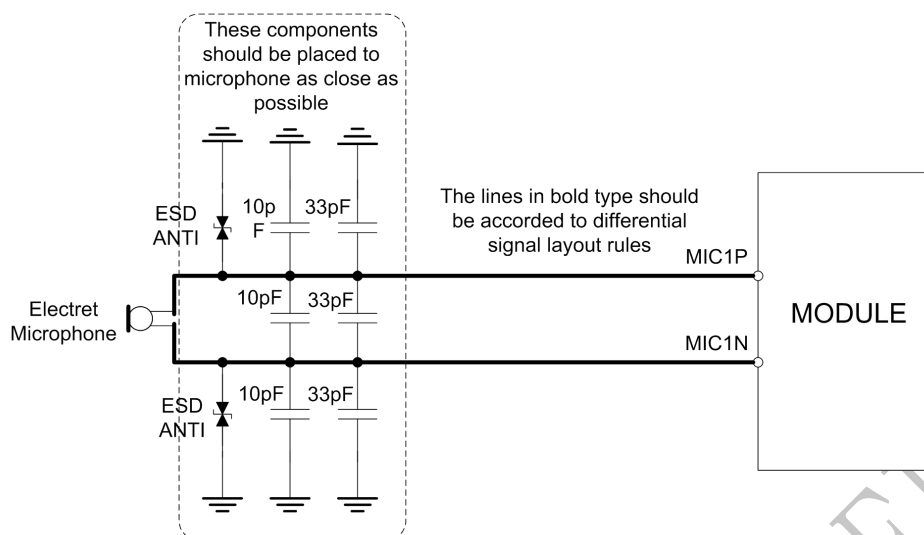


Figure 14: Microphone interface configuration

Note: SIM7100-PCIE(A) has integrated MIC bias circuit. There is no need to pull the MIC1P and MIC1N up to the external power, just connect it to microphone. MIC1P and MIC1N must be differential lines.

Main audio parameters can be changed to satisfy users' requirement. Here primary register parameters and related description are listed. User can adjust them through AT command. For more detail please refers to Audio Application Document.

Table 18: Audio parameter

Parameter	Influence to	Range	Gain range	Calculation	AT command
txVol	Digital gain of input signal after ADC	0, 1...65535	Mute, -84...+12dB	$20 * \log (txVol / 16384)$	AT+CTXVOL
txFilter	Input PCM 13-tap filter parameters, 7 values	0...65535	---	MATLAB calculate	AT+CTXFTR
rxVol	Digital Volume of output signal after speech decoder, before summation of sidetone and DAC	-300...300	dbm	-300...300dbm	AT+CLVL AT+CVLVL AT+CRXVOL
stGain	Digital attenuation of sidetone	0, 1...65535	Mute, -96...0dB	$20 * \log (stGain / 16384) - 12$	AT+SIDET
rxFilter	Output PCM 13-tap filter parameters, 7 values	0...65535	---	MATLAB calculate	AT+CRXFTR

Note: If users require better experience on audio, users should modify these parameters according to their

own electronic and mechanical design.

4.11 GNSS (GPS and GLONASS)

SIM7100-PCIE(A) merges GNSS (GPS/GLONASS) 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.

Technical specification

Tracking sensitivity	-159 dBm (GPS) -158 dBm (GLONASS)
Cold-start sensitivity	-148 dBm
Accuracy (Open Sky)	2.5m (CEP50)
TTF (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
Update rate	Default 1 Hz
GNSS data format	NMEA-0183
GNSS Current consumption (WCDMA/GSM Sleep mode)	100mA (Total supply current)
GNSS antenna	Passive antenna

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

4.12 RF Antenna Connector

SIM7100-PCIE(A) have 3 antenna connectors, one of which is the main GSM/WCDMA antenna connector, the other is WCDMA diversity and GNSS antenna connector. Recommended antenna characteristics of SIM7100-PCIE(A) are described by 2 following tables.

Table 19: Recommended Passive Antenna Characteristics

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

Table 20: Recommended Active Antenna Characteristics

Band	Performance	
	TRP	TIS

GSM850	$\geq 29\text{dBm}$	$\leq -104\text{dBm}$
EGSM900	$\geq 29\text{dBm}$	$\leq -104\text{dBm}$
DCS1800	$\geq 26\text{dBm}$	$\leq -104\text{dBm}$
PCS1900	$\geq 26\text{dBm}$	$\leq -104\text{dBm}$
WCDMA B1	$\geq 19\text{dBm}$	$\leq -104\text{dBm}$
WCDMA B2	$\geq 19\text{dBm}$	$\leq -104\text{dBm}$
WCDMA B5	$\geq 19\text{dBm}$	$\leq -104\text{dBm}$
WCDMA B8	$\geq 19\text{dBm}$	$\leq -104\text{dBm}$

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5 Electrical, Reliability and Radio Characteristics

5.1. Absolute Maximum Ratings

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

Table 21: Absolute maximum ratings

Symbol	Parameter	Min	Type	Max	Unit
V _{VCC}	VCC input voltage	0	-	3.6	V
I _{VCC}	VCC total peak current	0	-	2.0	A
I _I *	Input current	-	-	4	mA
I _O *	Output current	-	-	4	mA
V _{IO}	Voltage at digital pins (1.8v digital I/O)	-0.3	-	2.1	V

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

5.2. Recommended Operating Conditions

Please refer to the follow table for recommended operating conditions.

Table 22: Operating Conditions

Symbol	Parameter	Min	Type	Max	Unit
V _{VCC}	3.3V Input voltage	3.2	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	°C
T _{STG}	Storage temperature	-45	+25	+90	°C

5.3. SIM Card Interface Characteristics

Table 23: SIM Card Interface Characteristics

Symbol	Parameter	Min	Type	Max	Unit
UIM_RST	V _{OH} USIM_VDD=1.8V	1.62	-	-	V

	V _{OL}	USIM_VDD=3.0V	2.7	-	-	V
		USIM_VDD=1.8V	-	-	0.36	V
		USIM_VDD=3.0V	-	-	0.36	V
USIM_CLK	V _{OH}	USIM_VDD=1.8V	1.62	-	-	V
		USIM_VDD=3.0V	2.7	-	-	V
	V _{OL}	USIM_VDD=1.8V	-	-	0.216	V
		USIM_VDD=3.0V	-	-	0.4	V
USIM_DATA	V _{IH}	USIM_VDD=1.8V	1.4	-	-	V
		USIM_VDD=3.0V	2.6	-	-	V
	V _{IL}	USIM_VDD=1.8V	-	-	0.27	V
		USIM_VDD=3.0V	-	-	0.4	V
	V _{OH}	USIM_VDD=1.8V	1.4	-	-	V
		USIM_VDD=3.0V	2.6	-	-	V
	V _{OL}	USIM_VDD=1.8V	-	-	0.27	V
		USIM_VDD=3.0V	-	-	0.4	V

5.4. USIM_VDD Characteristics

Table 24: USIM_VDD Characteristics

Symbol	Parameter	Min	Type	Max	Unit
V _O	Output voltage	2.85	3.0	3.15	V
		1.7	1.80	1.9	
I _O	Output current	-	-	30	mA

5.5. Current Consumption (VCC =3.3V+0.3V/-0.1V)

Table 25: Current Consumption

GSM Sleep Mode (with USB suspended)	
GSM/GPRS supply current	Sleep @DRX=2 4.5mA
	Sleep @DRX=5 2.7mA
	Sleep @DRX=9 2.3mA
Voice Call	
GSM850	@power level #5 <300mA, Typical 263mA
GSM 900	@power level #5 <300mA, Typical 261mA
DCS1800	@power level #0 <250mA, Typical 218mA
PCS1900	@power level #0 <260mA, Typical 257mA
GPRS Data	
DATA mode, GPRS (1 Rx,4 Tx) CLASS 12	
GSM 850	@power level #5 <660mA, Typical 525mA
GSM 900	@power level #5 <660mA, Typical 480mA

DCS1800	@power level #0 <530mA, Typical 420mA
PCS1900	@power level #0 <530mA, Typical 420mA
DATA mode, GPRS (3Rx, 2 Tx) CLASS 12	
GSM 850	@power level #5 <460mA, Typical 360mA
GSM 900	@power level #5 <440mA, Typical 325mA
DCS1800	@power level #0 <400mA, Typical 285mA
PCS1900	@power level #0 <300mA, Typical 295mA
EDGE Data	
DATA mode, EDGE(1 Rx, 4 Tx) CLASS 12	
GSM 850	@power level #8 <500mA, Typical 370mA
GSM 900	@power level #8 <500mA, Typical 365mA
DCS1800	@power level #2 <450mA, Typical 350mA
PCS1900	@power level #2 <450mA, Typical 350mA
DATA mode, EDGE(3Rx, 2 Tx) CLASS 12	
GSM 850	@power level #8 <330mA, Typical 250mA
GSM 900	@power level #8 <330mA, Typical 250mA
DCS1800	@power level #2 <300mA, Typical 225mA
PCS1900	@power level #2 <300mA, Typical 225mA
UMTS Sleep/Idle Mode (with USB suspended)	
WCDMA supply current	Sleep mode @DRX=9 1.8 mA
	Sleep mode @DRX=8 2.3 mA
	Sleep mode @DRX=6 3.6 mA
	Idle mode @DRX=6 32 mA
UMTS Talk	
WCDMA 2100	@Power 23dBm Typical 460 mA
	@Power 21dBm Typical 410 mA
	@Power 10dBm Typical 245 mA
WCDMA 1900	@Power 23dBm Typical 460 mA
	@Power 21dBm Typical 440 mA
	@Power 10dBm Typical 280 mA
WCDMA 850	@Power 23dBm Typical 440 mA
	@Power 21dBm Typical 400 mA
	@Power 10dBm Typical 250 mA
WCDMA 900	@Power 23dBm Typical 400 mA
	@Power 21dBm Typical 355 mA
	@Power 10dBm Typical 230 mA
HSDPA Data	
WCDMA 2100	@Power 23dBm CQI=22 Typical 520 mA
WCDMA 1900	@Power 23dBm CQI=22 Typical 510 mA
WCDMA 850	@Power 23dBm CQI=22 Typical 460 mA
WCDMA 900	@Power 23dBm CQI=22 Typical 450 mA

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

5.6. Electro-Static Discharge

SIM7100-PCIE(A) 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 26: ESD characteristics (Temperature: 25°C, Humidity: 45 %)

Pin	Contact discharge	Air discharge
VCC	±5KV	±10KV
GND	±5KV	±10KV
Antenna port	±5KV	±10KV
USB_DP,USB_DN	±4KV	±8KV

5.7. Radio Characteristics

5.7.1. Conducted Output Power

The following table shows SIM7100-PCIE's conducted output power, comply with 3GPP TS 05.05and TS 34.121.

Table 27: Conducted Output Power

Frequency	Max	Min
GSM850	33dBm ±2dB	5dBm ± 5dB
E-GSM900	33dBm ±2dB	5dBm ± 5dB
DCS1800	30dBm ±2dB	0dBm ± 5dB
PCS1900	30dBm ±2dB	0dBm ± 5dB
GSM850 (8-PSK)	27dBm ±3dB	5dBm ± 5dB
E-GSM900 (8-PSK)	27dBm ±3dB	5dBm ± 5dB
DCS1800 (8-PSK)	26dBm +3/-4dB	0dBm ±5dB
PCS1900(8-PSK)	26dBm +3/-4dB	0dBm ±5dB
WCDMA 2100	24dBm +1/-3dB	-56dBm ±5dB
WCDMA 1900	24dBm +1/-3dB	-56dBm ±5dB
WCDMA 850	24dBm +1/-3dB	-56dBm ±5dB
WCDMA 900	24dBm + 1/-3dB	-56dBm ±5dB
TDSCDMA A	24dBm + 1/-3dB	-56dBm ±5dB
TDSCDMA B	24dBm + 1/-3dB	-56dBm ±5dB
LTE-FDD B1	23dBm +2.7dB	-50dBm ±5dB
LTE-FDD B2	23dBm +2.7dB	-50dBm ±5dB
LTE-FDD B3	23dBm +2.7dB	-50dBm ±5dB
LTE-FDD B4	23dBm +2.7dB	-50dBm ±5dB
LTE-FDD B5	23dBm +2.7dB	-50dBm ±5dB
LTE-FDD B7	23dBm +2.7dB	-50dBm ±5dB
LTE-FDD B8	23dBm +2.7dB	-50dBm ±5dB
LTE-FDD B13	23dBm +2.7dB	-50dBm ±5dB
LTE-FDD B17	23dBm +2.7dB	-50dBm ±5dB
LTE-FDD B20	23dBm +2.7dB	-50dBm ±5dB
LTE-TDD B38	23dBm +2.7dB	-50dBm ±5dB
LTE-TDD B39	23dBm +2.7dB	-50dBm ±5dB
LTE-TDD B40	23dBm +2.7dB	-50dBm ±5dB
LTE-TDD B41	23dBm +2.7dB	-50dBm ±5dB

5.7.2. Conducted Receive Sensitivity

The following table shows conducted receiving sensitivity of SIM7100-PCIE.

Table 28: Conducted Receive Sensitivity

Frequency	Receive sensitivity
GSM850	< -109dBm
E-GSM900	< -109dBm
DCS1800	< -109dBm
DCS1800	< -109dBm
WCDMA 2100	< -110dBm
WCDMA 1900	< -110dBm
WCDMA 850	< -110dBm
WCDMA 900	< -110dBm
TDSCDMA 1900	< -110dBm
TDSCDMA 2000	< -110dBm
LTE FDD/TDD	See table 36.

Remark: The data in above table get at static condition.

5.7.3. Supported Band

The following table shows SIM7100-PCIE(A) supported band, and complies with 3GPP spec.

Table 29: Supported Band

Frequency	Receiving	Transmission
GSM850	869 ~894 MHz	824 ~849 MHz
E-GSM900	925 ~960 MHz	880 ~915 MHz
DCS1800	1805~1880 MHz	1710~1785 MHz
PCS1900	1930~1990 MHz	1850~1910 MHz
WCDMA 2100	2110~2170 MHz	1920~1980 MHz
WCDMA1900	1930~1990 MHz	1850~1910 MHz
WCDMA 850	869 ~894 MHz	824 ~849 MHz
WCDMA 900	925 ~960 MHz	880 ~915 MHz
TDSCDMA 1900	1880~1920 MHz	1880~1920 MHz
TDSCDMA 2000	2010~2025 MHz	2010~2025 MHz
LTE Operating frequencies are shown in following table 34.		
Note: Operating frequencies of LTE TDD B41 for SIM7100C is 100MHz BW, 2555~2655 MHz		
GPS L1 BAND	1574.4 ~1576.44 MHz	-
GLONASS	1598 ~1606 MHz	-

Appendix

I. SIM7100-PCIE(A) Top and Bottom View

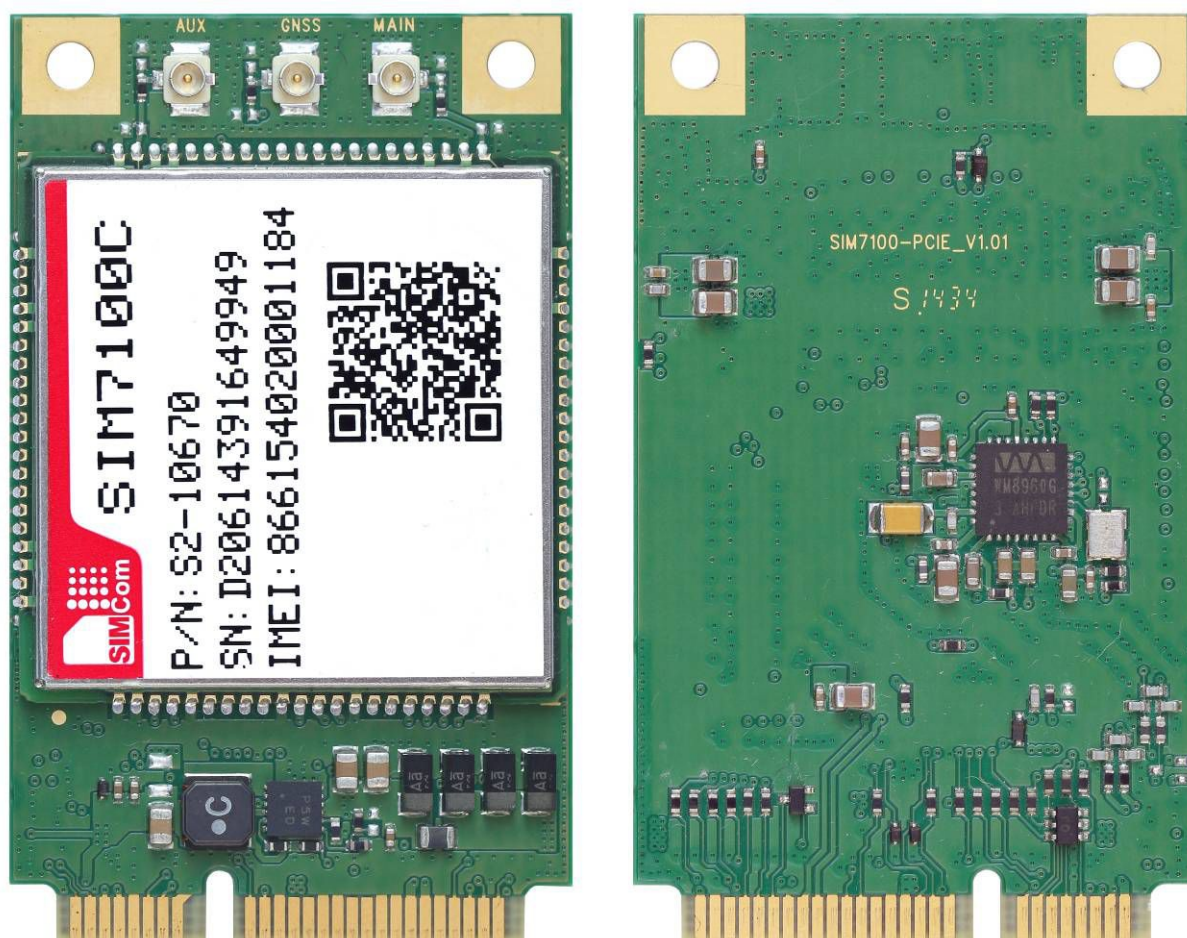


Figure 15: SIM7100-PCIE(A) Top and Bottom View

II. Dimensions of SIM7100-PCIE

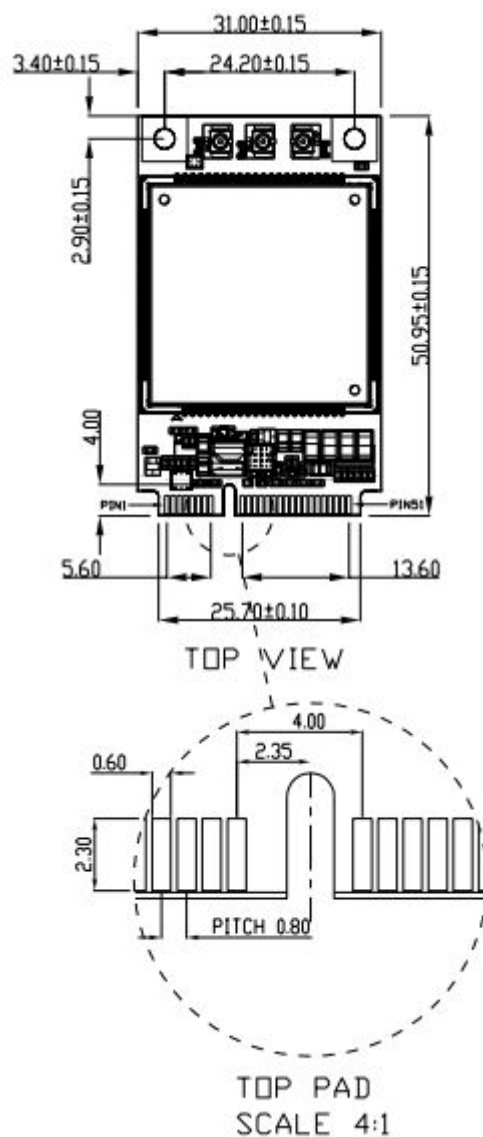


Figure 16: Dimensions of SIM7100-PCIE(A) (Unit: mm Top view)

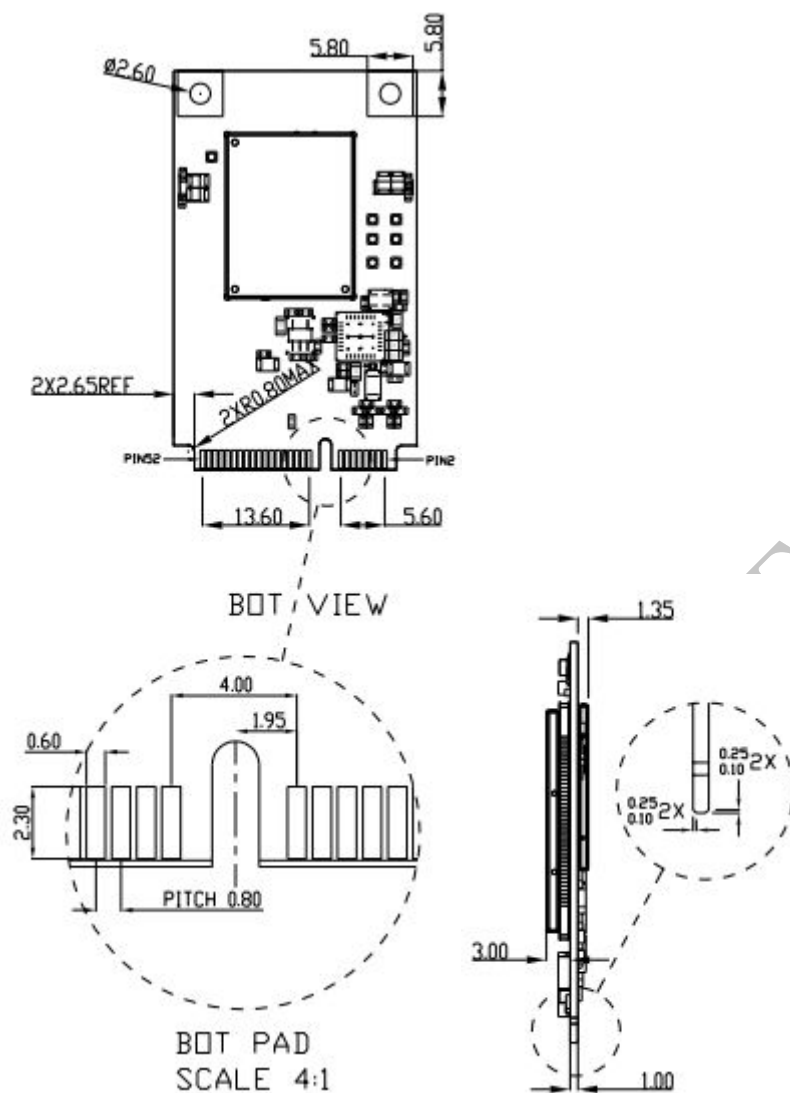


Figure 17: Dimensions of SIM7100-PCIE(A) (Unit: mm Bottom and Side view)

III.Related Documents

Table 30: Related Documents

SN	Document name	Remark
[1]	SIMCOM_SIM7100_ATC_EN_V1.XX.doc	
[2]	SIM7100_Audio_Application_Note	SIM7100_Audio_Application_Note
[3]	ITU-T Draft new recommendation V.25ter:	Serial asynchronous automatic dialing and control
[4]	GSM 07.07:	Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)
[5]	GSM 07.10:	Support GSM 07.10 multiplexing protocol
[6]	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)
[7]	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
[8]	GSM 11.11:	Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[9]	GSM 03.38:	Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information
[10]	GSM 11.10	Digital cellular telecommunications system (Phase 2); Mobile Station (MS) conformance specification; Part 1: Conformance specification
[11]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[12]	3GPP TS 34.124	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[13]	3GPP TS 34.121	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[14]	3GPP TS 34.123-1	Technical Specification Group Radio Access Network; Terminal conformance specification; Radio transmission and reception (FDD)
[15]	3GPP TS 34.123-3	User Equipment (UE) conformance specification; Part 3: Abstract Test Suites.
[16]	SIM7100_Hardware_Design	Hardware Design document of SIM7100 module

IV. Terms and Abbreviations

Table 31: Terms and Abbreviations







Abbreviation	Description
ADC	Analog-to-Digital Converter
AMR	Adaptive Multi-Rate
CS	Coding Scheme
CSD	Circuit Switched Data
CTS	Clear to Send
DTE	Data Terminal Equipment (typically computer, terminal, printer)
DTR	Data Terminal Ready
DTX	Discontinuous Transmission
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
FR	Full Rate
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
HR	Half Rate
IMEI	International Mobile Equipment Identity
Li-ion	Lithium-Ion
MO	Mobile Originated
MS	Mobile Station (GSM engine), also referred to as TE
MT	Mobile Terminated
PAP	Password Authentication Protocol
PBCCH	Packet Broadcast Control Channel
PCB	Printed Circuit Board
PCL	Power Control Level
PCS	Personal Communication System, also referred to as GSM 1900
PDU	Protocol Data Unit
PPP	Point-to-point protocol
RF	Radio Frequency
RMS	Root Mean Square (value)
RTC	Real Time Clock
WCDMA	Wideband Code Division Multiple Access
HSDPA	High Speed Downlink Packet Access
HSUPA	High Speed Uplink Packet Access
RX	Receive Direction
SIM	Subscriber Identification Module
SMS	Short Message Service

TE	Terminal Equipment, also referred to as DTE
TX	Transmit Direction
UART	Universal Asynchronous Receiver & Transmitter
URC	Unsolicited Result Code
USSD	Unstructured Supplementary Service Data
Phonebook abbreviations	
FD	SIM fix dialing phonebook
LD	SIM last dialing phonebook (list of numbers most recently dialed)
MC	Mobile Equipment list of unanswered MT calls (missed calls)
ON	SIM (or ME) own numbers (MSISDNs) list
RC	Mobile Equipment list of received calls
SM	SIM phonebook
NC	Not connect

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V. Safety Caution

Table 32: 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.
	<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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