SIM7070 Series Hardware Design

LPWA Module

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Version History

Date	Version	Description of change	Author
2019-07-31	1.00	Original	XianjingZhao Sen Zhao
2020-01-05	V1.01	Recommended package for update module update module low power related current consumption Update 2G network data transmission flow Update CAT-M1, CAT-NB1 / NB2 part BAND data transmission current consumption Update GNSS current consumption Update CAT-M,CAT-NB,GSM conducted sensitivity	XianjingZhao Sen Zhao
2020-01-20	V1.02	Added SIM7070G-NG function description Modify CAT-M, CAT-NB2 high power transmission current consumption Update SIM7070G-NG CAT-NB,GSM sensitivity Update SIM7070G-NG band information	Xianjing Zhao Sen Zhao
2020-08-14	V1.03	Update document template Update data such as GNSS sensitivity Update module current consumption Update the default level status of UART port Update timing parameters Update the sensitivity of B31/B72	Zhiqiang Liu Hongjun Tu Xianjing Zhao

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1.Introduction

This document describes the electronic specifications, RF specifications, interfaces, mechanical characteristics and testing results of the SIMCom SIM7070 Series module. With the help of this document and other SIM7070 Series software application notes/user guides, users can understand and use SIM7070 Series module to design and develop applications quickly.

1.1 Product Outline

The SIM7070 Series modules support LTE CAT-M1, LTE CAT-NB1/CAT-NB2, GSM, GPRS and EDGE. The physical dimension of SIM7070 Series is 24mm×24mm×2.3 mm. And the physical dimension is compatible with the packaging of SIM7000, SIM800F and SIM900. It is designed for applications that need low latency, Low throughput data communication in a variety of radio propagation conditions. Due to the unique combination of performance, security and flexibility, this module is ideally suited for M2M applications, such as metering, asset tracking. Remote monitoring, E-health etc.

Table 1: SIM7070 Series frequency bands and air interface

Network Type	Band	SIM7070 Series				
		SIM7070G		SIM7070E		SIM7070G-NG
	Category	M1	NB2	M1	NB2	NB2
LTE-HD-FDD	LTE-FDD B1	✓	✓	✓	✓	✓
	LTE-FDD B2	✓	✓	✓	✓	✓
	LTE-FDD B3	✓	✓	✓	✓	✓
	LTE-FDD B4	✓	✓	✓	✓	✓
	LTE-FDD B5	✓	✓	✓	✓	✓
	LTE-FDD B8	✓	✓	✓	✓	✓
	LTE-FDD B12	✓	✓	✓	✓	✓
	LTE-FDD B13	✓	✓	✓	✓	✓
	LTE-FDD B14	✓		✓		
	LTE-FDD B18	✓	✓	✓	✓	✓
	LTE-FDD B19	✓	✓	✓	✓	✓
	LTE-FDD B20	✓	✓	✓	✓	✓
	LTE-FDD B25	✓	✓	✓	✓	✓
	LTE-FDD B26	✓	✓	✓	✓	✓
	LTE-FDD B27	✓		✓		
	LTE-FDD B28	✓	✓	✓	✓	✓
	LTE-FDD B31			✓	✓	
	LTE-FDD B66	✓	✓	✓	✓	✓
	LTE-FDD B71		✓			✓

	LTE-FDD B72			√		
	LTE-FDD B85	√	√	√	√	√
GSM/GPRS/EDGE	GSM850MHz		√		√	√
	EGSM900MHz		√		√	√
	DCS1800MHz		√		√	√
	PCS1900MHz		√		√	√
GNSS	GPS		√		√	
	GLONASS		√		√	
	BeiDou		√		√	
	Galileo		√		√	

1.2 Hardware Interface Overview

The interfaces are described in detail in the next chapters include:
● Power Supply
● USB Interface
● UART Interface
● SIM Interface
● ADC
● LDO Power Output
● PCM Interface
● I2C Interface
● SPI Interface
● GPIOs
● Antenna Interface

1.3 Hardware Block Diagram

The block diagram of the SIM7070 Series module is shown in the figure below.
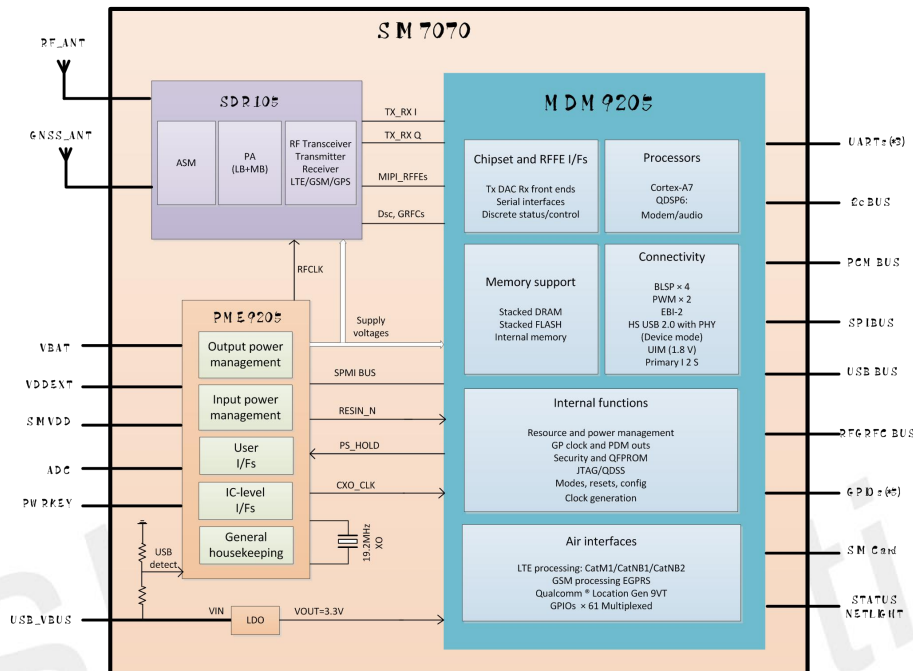
Figure 1: SIM7070 Series block diagram

1.4 Functional Overview

Table 2 describes the features of the SIM7070 series modules.

Table 2: General features

Feature	Implementation
Power supply	SIM 7070G Power supply voltage 3.0V～4.6V. Default :3.8V SIM 7070E Power supply voltage 3.2V～4.2V. Default :3.8V SIM 7070G-NG Power supply voltage 3.0V～4.6V. Default :3.8V
Power saving	Current in PSM mode: 3.5uA
Radio frequency bands	Please refer to the table 1
Transmitting power	GSM/GPRS power class: -- GSM850: 4 (2W) -- EGSM900: 4 (2W) -- DCS1800: 1 (1W) --PCS1900: 4 (1W) EDGE power class: -- GSM850: E2 (0.5W) -- EGSM900: E2 (0.5W)

	-- DCS1800: E1 (0.4W) --PCS1900: E1 (0.4W) LTE power class: 5 (0.125W).Band31/Band72 power class: 2(0.4W)
Data Transmission Throughput	GPRS: Uplink up to 85.6Kbps, Downlink up to 85.6Kbps. EDGE: Uplink up to 236.8Kbps, Downlink up to 236.8Kbps LTE CAT M1:589Kbps (DL). LTE CAT M1: 1119Kbps (UL). LTE CAT NB1/NB2: 136Kbps (DL). LTE CAT NB1/NB2: 150Kbps (UL).
Antenna	LTE main antenna. GNSS antenna.
GNSS	GNSS engine (GPS, GLONASS, BDS and Galileo). Protocol: NMEA.
SIM interface	Support identity card: 1.8V only.
Digital audio feature	Support PCM interface. Only support PCM master mode and short frame sync
SPI interface	Support for serial data bus SPI, only used during DAM application secondary development.
UART interface	One channel full-function UART1 by default can be used for AT communication. Baud rate: 300bps to 3686400bps. Default rate is 0bps (auto baud rate). Support auto baud rate, but only limited to 9600, 19200, 38400, 57600 and 115200 bps. Support RTS/CTS hardware handshake. Two channel 2-wire UART2 and UART3 only used as UART in DAM application when secondary development.
USB	USB 2.0 high speed interface.
Firmware upgrade	Firmware upgrade over USB interface
Physical characteristics	Size: 24×24×2.3mm Weight:2.9±0.2g
Temperature range	operation temperature: -40℃~ +85℃ Storage temperature -45°C to +90°C

2.Package Information

2.1 Pin Assignment Overview

All functions of the SIM7070 series will be provided through 68 pads that will be connected to the customers′ platform. The Figure 2 is the pin assignment of the SIM7070 series.
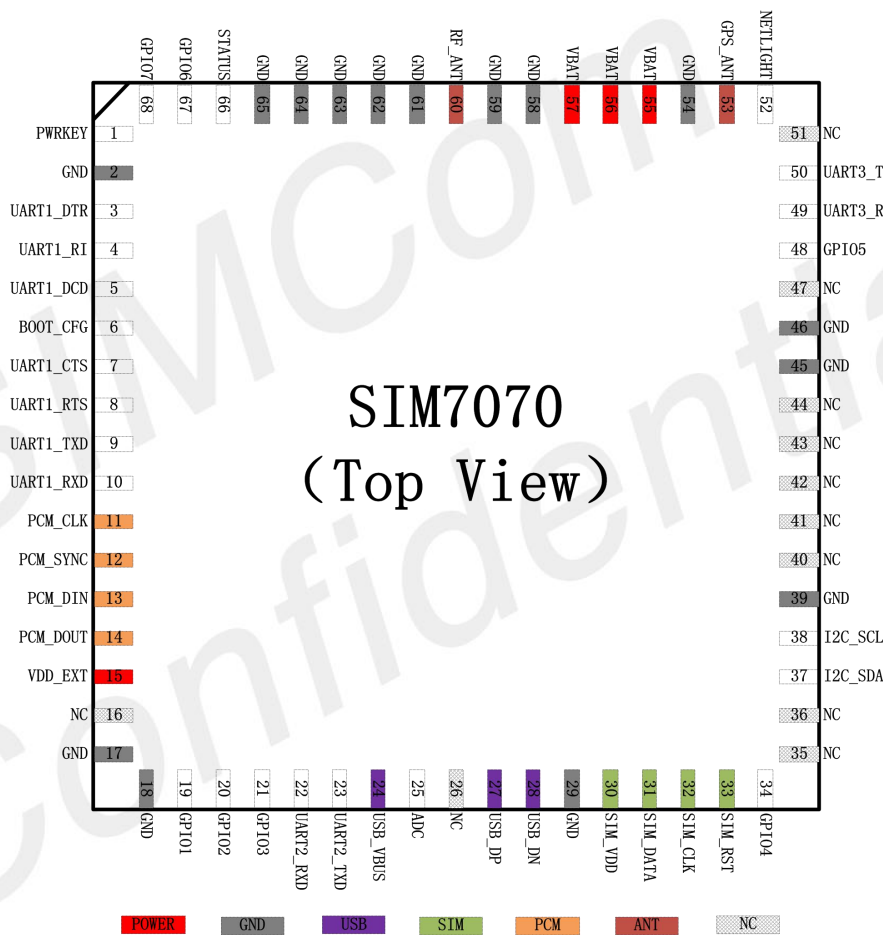
Figure 2: Pin assignment overview

Table 3 lists the SIM7070 series module pin numbers and pin definitions.

Table 3: Pin definition

Pin No.	Pin Name	Pin No.	Pin Name
1	PWRKEY	2	GND
3	UART1_DTR	4	UART1_RI
5	UART1_DCD	6	BOOT_CFG*
7	UART1_CTS	8	UART1_RTS

9	UART1_TXD	10	UART1_RXD
11	PCM_CLK	12	PCM_SYNC
13	PCM_DIN	14	PCM_DOUT
15	VDD_EXT	16	NC
17	GND	18	GND
19	GPIO1	20	GPIO2
21	GPIO3	22	DEBUG_RXD
23	DEBUG_TXD	24	USB_VBUS
25	ADC	26	NC
27	USB_DP	28	USB_DM
29	GND	30	SIM_VDD
31	SIM_DATA	32	SIM_CLK
33	SIM_RST	34	GPIO4
35	NC	36	NC
37	I2C_SDA	38	I2C_SCL
39	GND	40	NC
41	NC	42	NC
43	NC	44	NC
45	GND	46	GND
47	NC	48	GPIO5
49	UART3_RXD	50	UART3_TXD
51	NC	52	NETLIGHT
53	GNSS_ANT	54	GND
55	VBAT	56	VBAT
57	VBAT	58	GND
59	GND	60	RF_ANT
61	GND	62	GND
63	GND	64	GND
65	GND	66	STATUS
67	GPIO6	68	GPIO7

NOTE

Before the normal power up, BOOT_CFG and GPIO1 cannot be pulled up.

2.2 Pin Description

This section describes the SIM7070 series of pins and pin function definitions

Table 4: IO parameters definition

Pintype	Description
PI	Power input
PO	Power output
AI	Analog input
AIO	Analog input/output
I/O	Bidirectional input /output
DI	Digital input
DO	Digital output
DOH	Digital output with high level
DOL	Digital output with low level
PU	Pull up
PD	Pull down

Table 5: Pin description

Pin name	Pin No.	Default status	Description	Comment
Power supply				
VBAT	55,56 57	PI	Power supply, SIM7070G voltage range: 3.0～4.6V. SIM7070E voltage range: 3.2～4.2V. SIM7070G-NG voltage range: 3.0～4.6V.	
VDD_EXT	15	PO	LDO power output 1.8V for other external circuits with Max 50mA current output.	This power supple only use for external GPIO pulling up or level shift circuit. If unused, keep it open.
GND	2,17 18,29 39,45 46,54 58,59 61,62 63,64 65		Ground	
System Control				
PWRKEY	1	DI,PU	System power on/off control input, active low. The efficient input low level must be below 0.4V.	The level is 1.5V when this PIN is floating;

The efficient input high level must be higher than 1.0V.
After the PWRKEY continues to pull down more than 12.6S, the system will automatically reset. Therefore, long-term grounding is not recommended

SIM interface

SIM_VDD	30	PO	Power output for SIM card, its output Voltage depends on SIM card type automatically. Its output current is up to 50mA.	
SIM_DATA	31	I/O,PU	SIM Card data I/O, which has been pulled up via a 20KR resistor to SIM_VDD internally. Do not pull it up or down externally.	All lines of SIM interface should be protected against ESD.
SIM_CLK	32	DO	SIM clock	
SIM_RST	33	DO	SIM Reset	

USB*

USB_VBUS	24	DI,PD	Valid USB detection input with 3.5~5.25V detection voltage	
USB_DP	27	I/O	Positive line of the differential, bi-directional USB signal.	Software download interface. It is recommended to reserve interfaces or test points.
USB_DM	28	I/O	Negative line of the differential, bi-directional USB signal.	

UART interface

UART1_DTR	3	DI,PH	DTE get ready	
UART1_RI	4	DOH	Ring Indicator	
UART1_DCD	5	DOH	Carrier detects	
UART1_CTS	7	DOL	Clear to Send	If unused, keep them open.
UART1_RTS	8	DI,PL	Request to send	
UART1_TXD	9	DOH	Transmit Data	
UART1_RXD	10	DI,PL	Receive Data	
UART3_RXD	49	DI,PL	The default function is GPIO. It can't be used as AT communication port. But it can be used for software secondary development. It can also be configured as NMEA data output for GNSS.	If unused, keep them open.
UART3_TXD	50	DOL		
DEBUG_RXD	22	DI,PL	The default function is GPIO, and UART is only used for software secondary development. Cannot be used as AT communication port.	Debug UART, the boot log will be output during boot up. If unused, keep them open.
DEBUG_TXD	23	DOH		

I2C interface

I2C_SDA	37	I/O	I2C data input/output	If unused, keep open, or else pull them up via1KΩ resistors to the VDD_EXT.
I2C_SCL	38	DO	I2C clock output	
PCM interface				
PCM_CLK	11	DO	PCM data bit clock.	
PCM_SYNC	12	DO	PCM data frame sync signal.	If unused, please keep them open.
PCM_DIN	13	DI	PCM data input.	
PCM_DOUT	14	DO	PCM data output.	
SPI interface				
SPI_MOSI	19	DO	Main Controller DATA output. Multiplexed by GPIO1	
SPI_MISO	20	DO	Main Controller DATA input. Multiplexed by GPIO2	If unused, please keep them open.
SPI_CLK	21	DI	Bus clock output, Multiplexed by GPIO3	
SPI_CS	48	DO	Chip Select, Multiplexed by GPIO5	
GPIO				
NETLIGHT	52	DO	LED control output as network status indication.	
STATUS	66	DO	Operating status output. High level: Power on and firmware ready Low level: Power off	
GPIO1	19	IO	General purpose input/output, With interrupt function Configurable as SPI_MOSI Note: This chip pin has fast boot function. It cannot be pulled up before booting. Otherwise it will affect the normal boot.	If unused, keep them open.
GPIO2	20	IO	General purpose input/output, Without interrupt function. Configurable as SPI_MISO	
GPIO3	21	IO	General purpose input/output, Without interrupt function. Configurable as SPI_CLK	
GPIO4	34	IO	General purpose input/output, With interrupt function	
GPIO5	48	IO	General purpose input/output, With interrupt function Configurable as SPI_CS	
GPIO6	67	IO	General purpose input/output, With interrupt function	
GPIO7	68	IO	General purpose input/output, With interrupt function	
RF interface				
GNSS_ANT	53	AI	GNSS antenna soldering pad	
RF_ANT	60	AIO	MAIN antenna soldering pad	
Other interface				
BOOT_CFG	6	DI,PD	If it needs to enter into forced USB	Reserve a test points

			download mode, it must be pulling up this pin to VDD_EXT before press the PWRKEY. If it needs to boot up normally, please keep this pin open	for it. Keep it open.DO NOT PULL UP DURING NORMAL POWER UP!
ADC	25	AI	Analog-digital converter input. voltage range:0V～1.875V.	If unused, keep them open.
NC	16,26 35,36 40,41 42,43 44,47 51		No connection.	Keep it open

NOTE

Please reserve a test point for BOOT_CFG and VDD_EXT. If there is no USB connector, please also reserve a test point for USB_VBUS, USB_DP, and USB_DM for Firmware upgrade.

2.3 Mechanical Information

Figure 3 depicts the mechanical dimensions of the SIM7070 series and describes the length, width, height and tolerance of the SIM7070 series of modules.
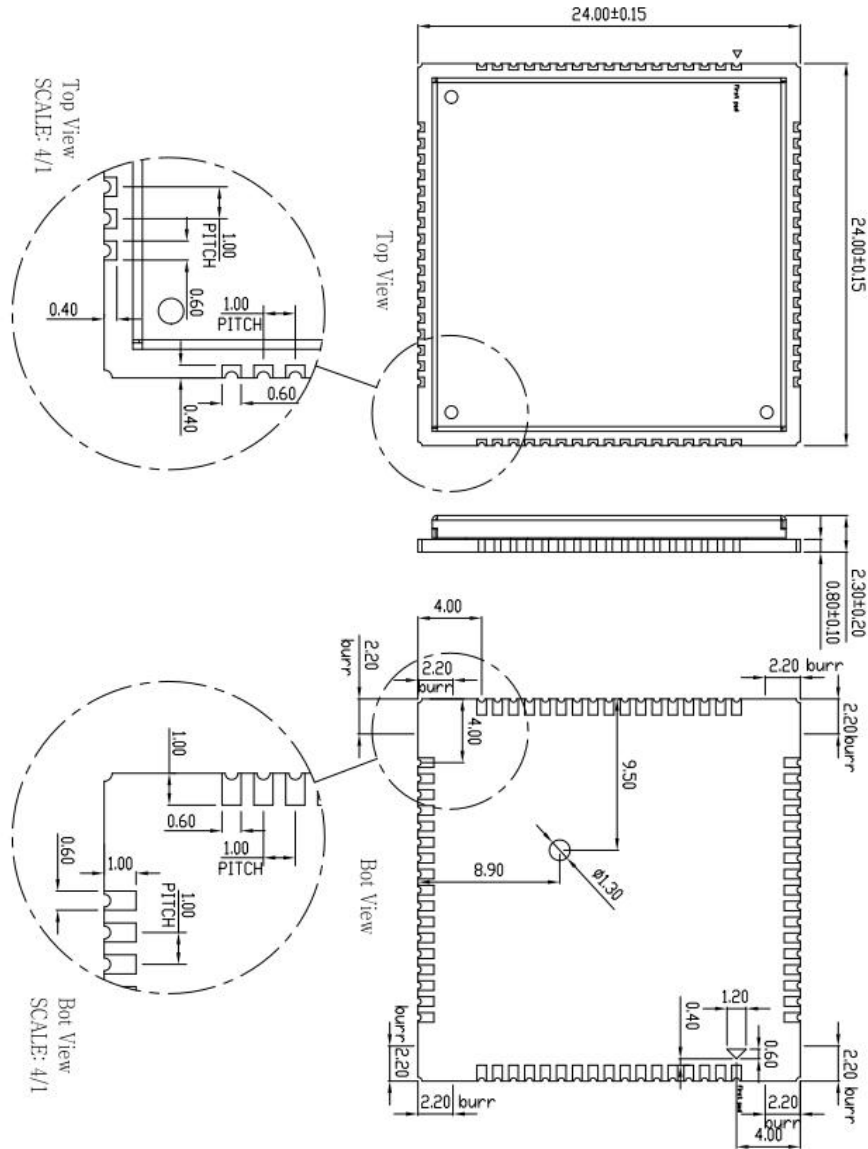
Figure 3: Dimensions (Unit: mm)

2.4 Footprint Recommendation

Figure 4 depicts the Foot printer commended of The SIM7070 series modules.
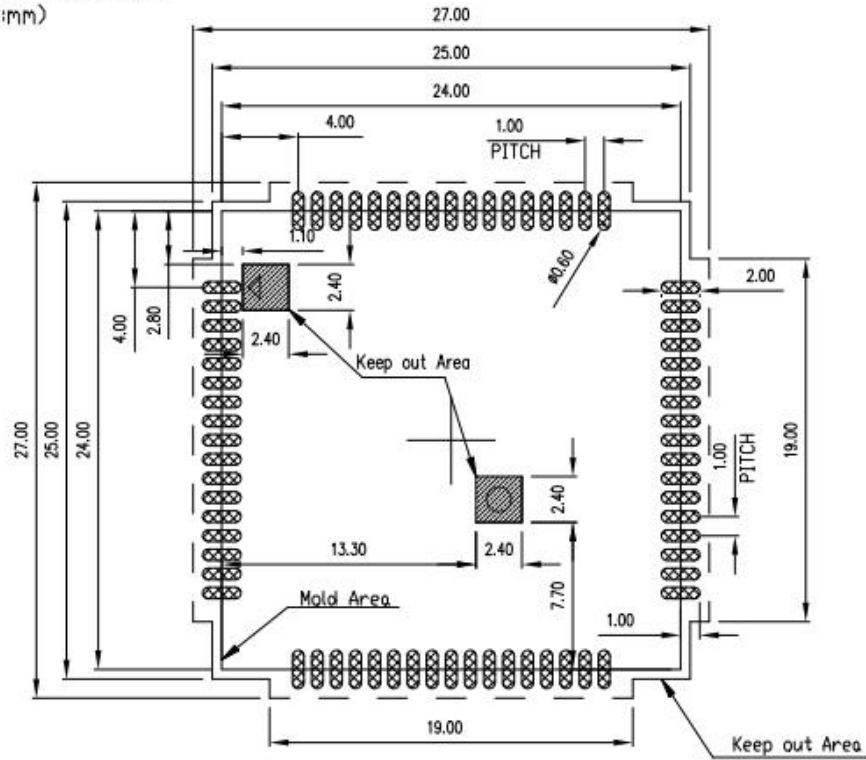
Figure 4: Footprint recommendation (Unit: mm)

3.Interface Application

3.1 Power Supply

Pin 55, pin 56 and pin 57 are VBAT power input.

On VBAT pads, when module works on CAT-M1 or NB-IoT mode, the ripple current is up to 0.6A typically. For steady voltage, the power supply capability must be up to 0.5A.

On VBAT pads, when module works on EDGE or GPRS mode, The ripple current is up to 2A typically. For steady voltage, the power supply capability must be up to 2A. in order to avoid the voltage dropped down more than 300mV, the load capacitor on VBAT pads must be up to 300uF.

The figure 5shows the VBAT voltage ripple wave at the maximum power transmit phase in EDGE/GPRS emission mode.
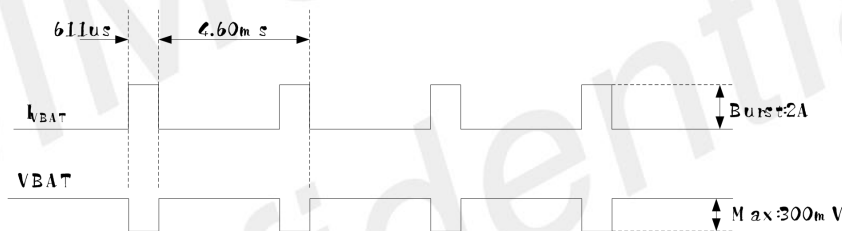
Figure 5: Voltage drop in EDGE or GPRS mode

Table 6 describes the electrical characteristics of the VBAT pin and the current consumption of the module in different modes.

Table 6: VBAT pins electronic characteristic

Symbol	Description		Min	Typ	Max	Unit
VBAT	Module power voltage	SIM7070G	3	3.8	4.6	V
		SIM7070E	3.2	3.8	4.2	V
		SIM7070G-NG	3	3.8	4.6	V
IVBAT(peak)	Module power peak current in CAT-M1 and NB-IoT emission mode.		-	0.5	-	A
IVBAT(average)	Module power average current in normal mode		Please refer to the chapter 5.4			
IVBAT(sleep)	Power supply current in sleep mode					
IVBAT(power-off)	Module power current in power off mode.		-	-	15	uA
IVBAT(PSM)	Module power current in PSM mode.		-	3.5	-	uA

3.1.1 Power Supply Design Guide

In the user's design, special attention must be paid to the design of the power supply section to ensure that the VBAT drop cannot be lower than the minimum voltage shown in Table 7 even when the module current consumption reaches the instantaneous maximum. If the VBAT voltage drops below the minimum input voltage, the module may shut down due to low voltage

Table 7: Minimum input voltage

Module	Minimum input voltage(V)
SIM7070G	3.0
SIM7070E	3.2
SIM7070G-NG	3.0

The figure 6 shows the recommended circuit.
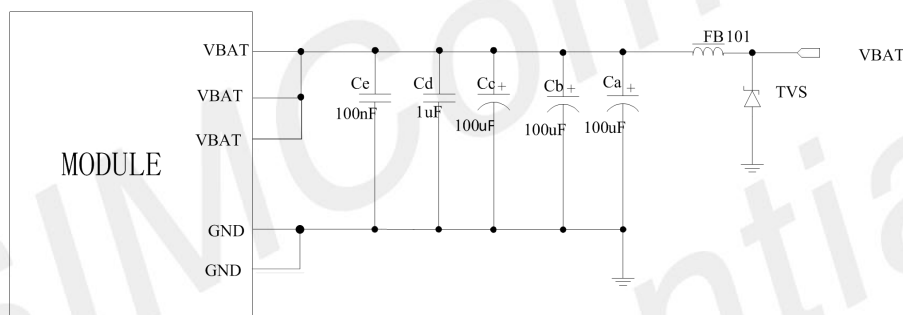
Figure 6: Power supply application circuit

In addition, for ESD protection, it is suggested to add a TVS diode near the VBAT PINs. These capacitors should be put as close as possible to VBAT pads. Also, users should keep VBAT trace on circuit board wider than 2 mm to minimize PCB trace impedance.

Table 8: Recommended TVS diode list

No.	Manufacturer	Part Number	Package
1	Prisemi	PESDHC2FD4V5B	DFN1006
2	Prisemi	PESDHC3D3V3U	SOD323
3	WILLsemi	ESD5651N-2/TR	DFN1006

> **NOTE**
>
> 1. The customer's circuit design must have the function that the master can control the power off of the module. The module can be shut down or restarted normally. Only when the module is abnormal and cannot be shut down or restarted normally can the power be turned off.
> 2. When the module is working normally, do not cut off the power supply of the module VBAT directly to avoid damage to the internal flash of the module. It is strongly recommended to turn off the module through PWRKEY or AT command before disconnecting the module VBAT power.

3.1.2 Recommended Power Supply Circuit

If the supply voltage exceeds the supply range of VBAT, the buck circuit should be used to meet the demand of power supply. When choosing buck chip, besides considering the maximum current output capability of IC to meet the demand of SIM7070 Series, it is also necessary to consider the low static power consumption of IC in PSM mode.
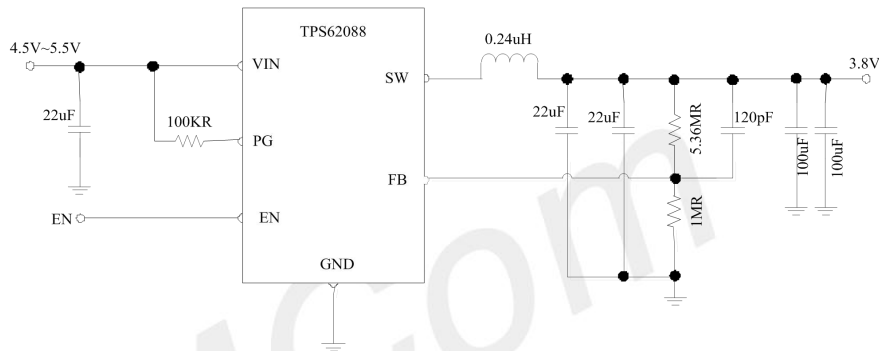
Figure 7: Power supply reference circuit

3.1.3 Voltage Monitor

To monitor the VBAT voltage, the AT command "AT+CBC" can be used.

AT command "AT+CBATCHK=1" can be used to enable the VBAT voltage monitoring function. When the VBAT voltage exceeds the preset alarm voltage range, a warning message will be reported through the AT port. When the VBAT voltage exceeds the preset shutdown voltage range, the module will automatically shut down. The default alarm voltage and shutdown voltage of the SIM7070 series are shown in Table 9.

Table 9: Alarm and Shutdown Voltage Range

Module	Low voltage shutdown(V)	Low voltage alarm(V)	High voltage shutdown(V)	High voltage alarm(V)
SIM7070G	2.9	3.1	4.65	4.7
SIM7070E	3.1	3.3	4.25	4.3
SIM7070G-NG	2.9	3.1	4.65	4.7

NOTE

Under-voltage warning function and under-voltage power-off function are disabled by default. For more information about these AT commands, please refer to Document [1].

3.2 Power on/Power off Function

3.2.1 Power on

The PWTRKEY pin has a default voltage of 1.5V. SIM7070 Series can be powered on by briefly pulling the PWRKEY pin to ground. It is strongly recommended to put an ESD protection diode close to the PWRKEY pin, as it would strongly enhance the ESD performance of PWRKEY pin.

The PWRKEY pin has its own reset function. The reset time is determined by the internal timer (default is 12.6 seconds). After the PWRKEY is pulled low, the module will be reset after 12.6 seconds. Therefore, it is not recommended to connect PWRKEY to GND all the time in external circuit design.

Please refer to the following figure for the recommended reference circuit.
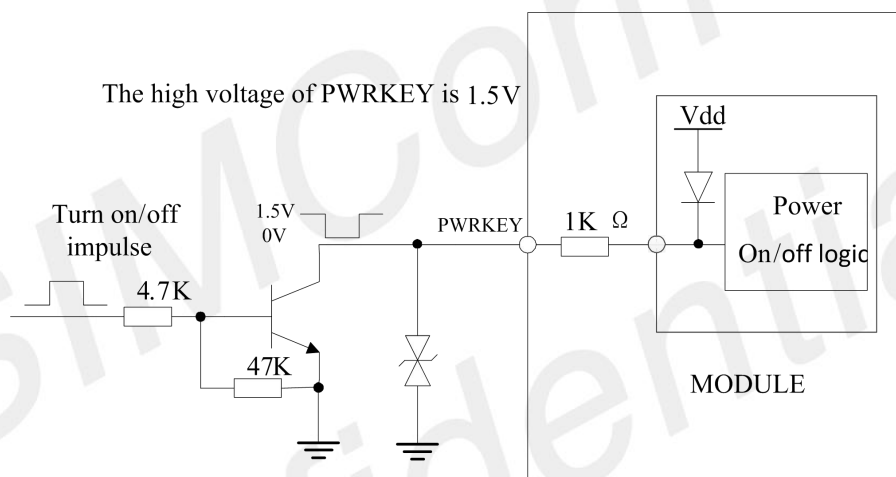
Figure 8: Reference power on/off circuit

The power-on scenarios are illustrated in the following figure.
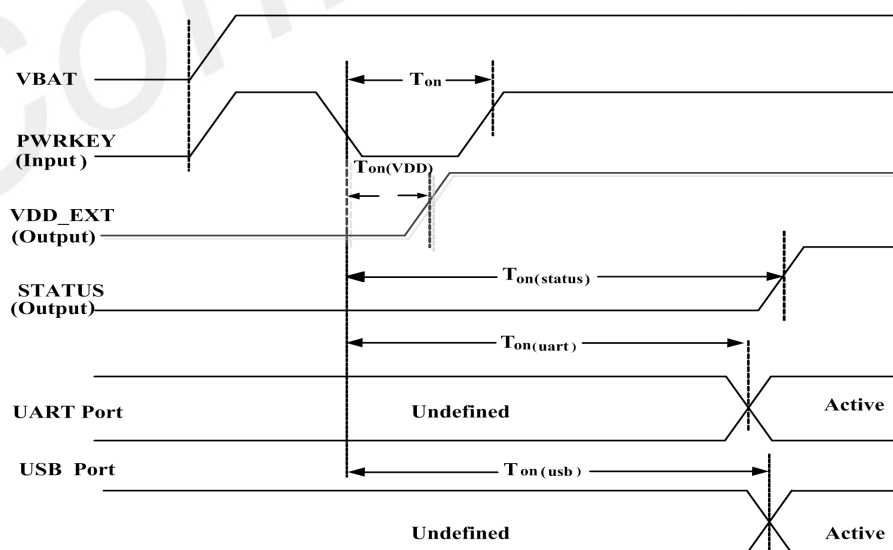
Figure 9: Power on timing sequence

Table 10: Power on timing and electronic characteristic

Symbol	Parameter	Min.	Typ.	Max.	Unit
Ton	The time of active low level impulse of PWRKEY pin to power on module	1	-	12.6	s
Ton(Vdd)	The time from power-on issue to VDD_EXT pin output high level.	-	64	-	ms
Ton(status)	The time from power-on issue to STATUS pin output high level(indicating power up ready)	1.8	-	-	s
Ton(uart)	The time from power-on issue to UART port ready	1.8	-	-	s
Ton(usb)	The time from power-on issue to USB port ready	1.8	-	-	s
VIH	Input high level voltage on PWRKEY pin	1.0	1.5	1.8	V
VIL	Input low level voltage on PWRKEY pin	-0.3	0	0.4	V

NOTE

1. PWRKEY cannot be shorted all the way to GND.
2. It is recommended to ensure that the VBAT voltage rises and stabilizes before pulling down the PWRKEY pin to start up.
3. Before turning on the module, be sure to pay attention to the maximum conditions (such as voltage and temperature range) allowed by the module, otherwise exceeding the absolute maximum value of the module may cause permanent damage to the module.

3.2.2 Power off

The following methods can be used to power offSIM7070 Series.
● Method 1: Power off SIM7070 Series by pulling the PWRKEY pin to ground.
● Method 2: Power off SIM7070 Series by AT command "AT+CPOWD=1".
● Method 3: over-voltage or under-voltage automatic power off. The function can be enabled by AT command "AT+CBATCHK=1". Default is disabled.

NOTE

For details about "AT+CPOWD" and "AT+CBATCHK", please refer to Document [1].
It is not recommended to turn off the module by disconnecting VBAT power. Otherwise, there is a risk of damage to the module file system.

These procedures will make modules disconnect from the network and allow the software to enter a safe state, and save data before module be powered off completely.

The power off scenario by pulling down the PWRKEY pin is illustrated in the figure 10.
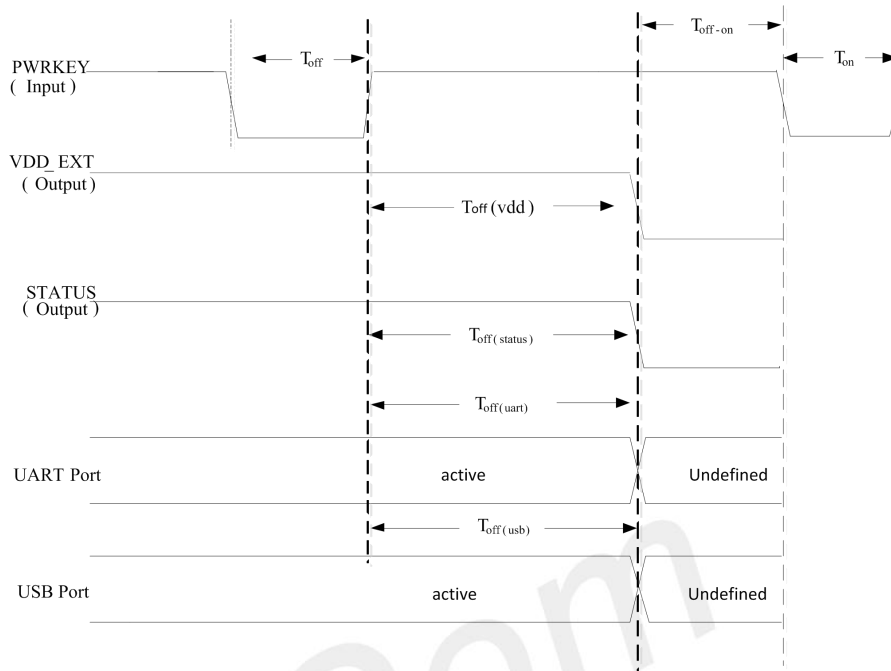
Figure 10: Power off timing sequence

Table 11: Power off timing and electronic characteristic

Symbol	Parameter	Time value			Unit
		Min.	Typ.	Max.	
Toff	The active low level time pulse on PWRKEY pin to power off module	1.2	-	-	s
Toff(vdd)	The time from power-off issue to VDD_EXT pin output low level	1.8	-	-	s
Toff(status)	The time from power-off issue to STATUS pin output low level(indicating power off)*	1.8	-	-	s
Toff(uart)	The time from power-off issue to UART port off	1.8	-	-	s
Toff(usb)	The time from power-off issue to USB port off	1.8	-	-	s
Toff-on	The buffer time from power-off issue to power-on issue	2	-	-	s

NOTE

The STATUS pin can be used to detect whether module is powered on or not. When module has been powered on and firmware goes ready, STATUS will be high level, or else STATUS will still low level.

3.3 UART Interface

SIM7070 Series can provide 3channels serial ports:

One channel full-function serial port UART1, it can be used for AT command communication between the

module and the peripheral MCU.

One channel 2-wire serial port UART3, the default function after booting is GPIO. It can be configured as a UART function, but it cannot be used for AT command communication. It is only used as UART in DAM (Downloadable Application Module) application when secondary development. It can also be configured as a GNSS NMEA data output port.

One channel serial port DEBUG_UART, the boot log will be output from hear during the system boot-up. The default function after booting is GPIO. It can be configured as a UART function, but it cannot be used for AT command communication. It is only used as UART in DAM (Downloadable Application Module) application when secondary development.

When the UART port is used as the AT communication port, it supports high speed mode, the baud rate is up to 4Mbps.

The communication baud rates include:
0,300,600,1200,2400,4800,9600,19200,38400,57600,115200,230400,921600,2000000,3000000,3200000 and 3686400 bps.

The rate 0bps marks auto baud rate. And it supports auto baud rate, but the rate only supported on 9600, 19200, 38400, 57600, 115200. If users need to change to other baud rate, it needs to switch via manual operation.

3.3.1 UART Design Guide

The following figures show the reference design.
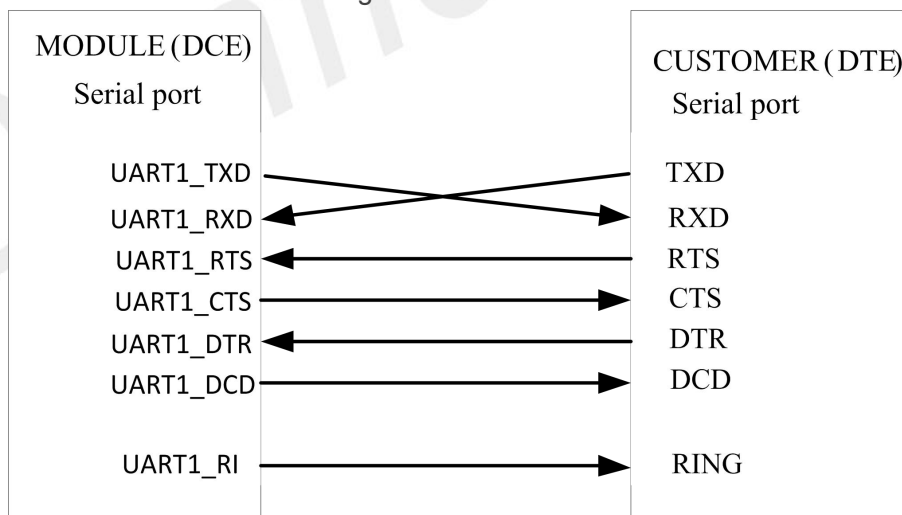
Figure 11: UART full modem
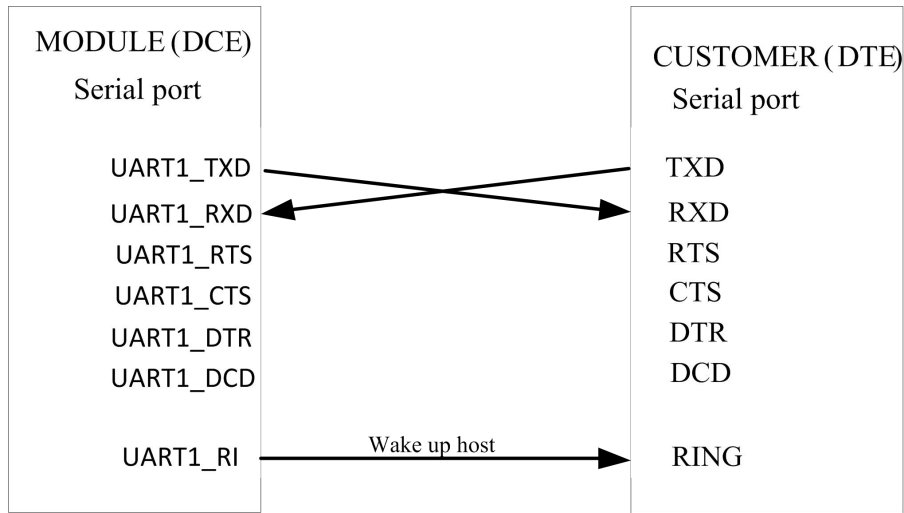
Figure 12: UART null modem

Table 12: UART electronic characteristic

Symbol	Description	Min.	Typ.	Max.	Unit
VIH	UART input high level voltage	1.17	1.8	2.1	V
VIL	UART input low level voltage	-0.3	0	0.63	V
VOH	UART output high level voltage	1.35	1.8	1.8	V
VOL	UART output low level voltage	0	0	0.45	V

The SIM7070 Series UART is 1.8V voltage interface. If user's UART application circuit is 3.3V voltage interface, the level shifter circuits should be used for voltage matching. The following figure shows the voltage matching reference design.
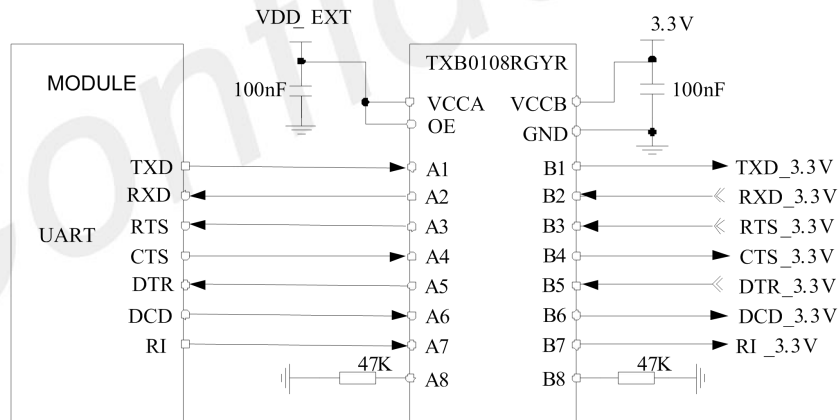
Figure 13: Reference circuit with level shifter IC
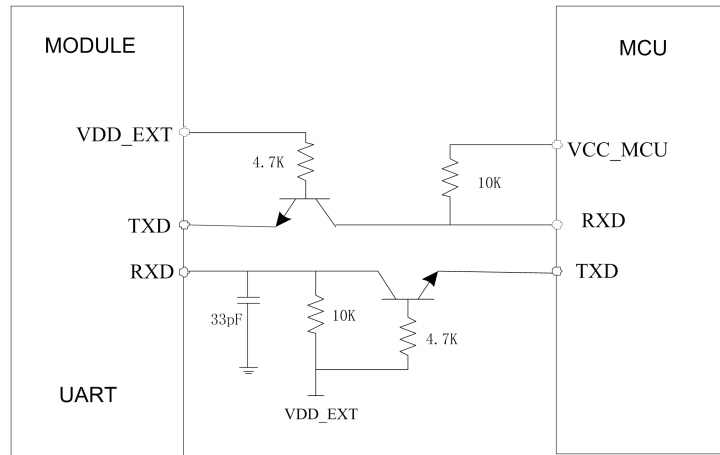
Figure 14: Reference circuit with Transistor

NOTE

When it uses the level shifter IC, the pull up resistance on TXD_3.3V, RTS_3.3V, DCD_3.3V and RI_3.3V should not be less than 47KΩ.
When it uses the transistor, the selection of the transistor must be a high-speed transistor, and the model MMBT3904 is recommended.

3.3.2 RI and DTR Behavior

The RI pin description:

The RI pin can be used to interrupt output signal to inform the host controller such as application CPU. Before that, users must use AT command "AT+CFGRI=1" to enable this function.

Normally RI will keep high level until certain conditions such as receiving SMS, or a URC report coming, then it will output a low level pulse 120ms, in the end, it will become high level.
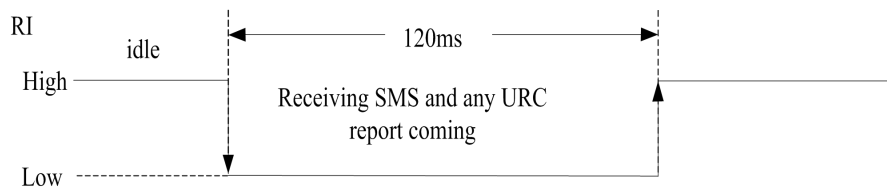
Figure 15: RI behaviour（SMS and URC report）

The DTR pin description:

After setting the AT command "AT+CSCLK=1", and then pulling up the DTR pin, Module will enter sleep mode when module is in idle mode. In sleep mode, the UART is unavailable. When SIM7070 enters sleep mode, pulling down DTR can wake up module.

After setting the AT command "AT+CSCLK=0", SIM7070 Series will do nothing when the DTR pin is pulling up.

NOTE

For more details of AT commands about UART, please refer to document [1] and [20].

3.4 USB Interface

SIM7070 Series has a USB2.0 interface. It can be used for software upgrade and software debugging.

The USB of the SIM7070 series only supports slave mode and does not support USB charging. USB does not support Suspend mode, the module will not be able to enter the minimum power mode when USB is connected.

USB_VBUS is the detecting signal for USB inserting. The input voltage range on the USB_VBUS pin is from 3.5V to 5.25V. If there is out of this range, it may be due to USB function unidentifiable, even damaging the module.

The reference circuit refers to the following figure.
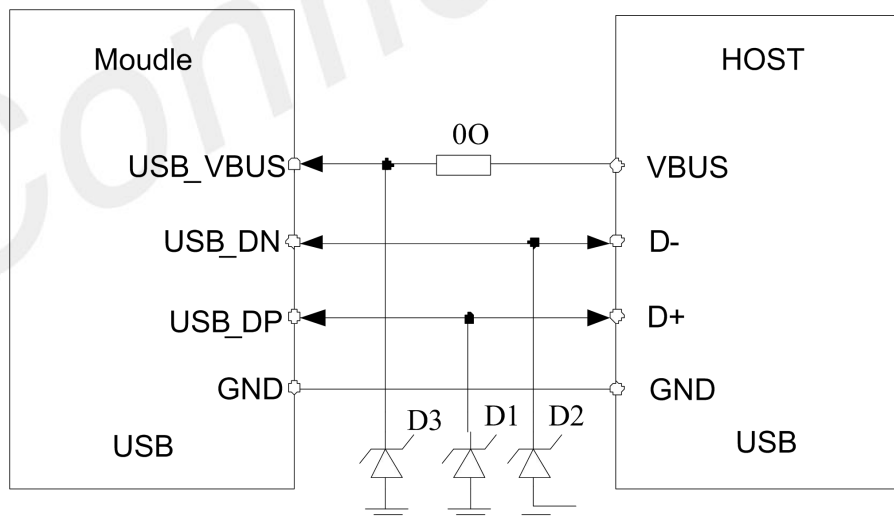
Figure 16: USB reference circuit

Because of the high speed on USB bus, more attention should be paid to the influence of the junction capacitance of the ESD component on USB data lines. Typically, the capacitance of the D1 and D2 should be less than 3pF.

D3 is suggested to select the diode with anti-ESD and voltage surge function, or customer could add a ZENER diode for surge clamping.

Table 13: Recommended TVS models

No.	Manufacturer	Part Number	Package
1	NXP	PESD5V0X1BCAL	0402
2	Willsemi	ESD5301N	0402
3	NXP	PESD5V0H1BSF	0201
4	Willsemi	ESD5311Z-2/TR	0201

NOTE

The USB interface is strongly recommended to reserve test points.
The USB_DM and USB_DP nets must be traced by 90Ohm+/-10% differential impedance.

3.5 Force USB Download Interface

The module can enter the USB forced download mode with pulling up the BOOT_CFG pin. The reference circuit refers to the following figure.
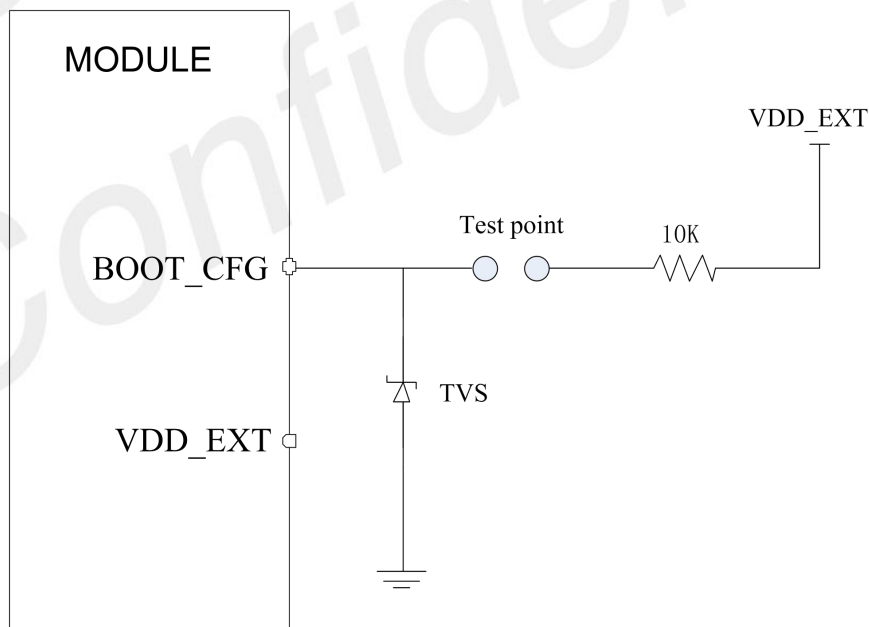
Figure 17: Reference circuit of BOOT_CFG interface

3.6 SIM Interface

SIM7070 Series only supports 1.8V SIM Cards. SIM_VDD is provided by LDO inside the module, the default value is 1.8V.

Table 14: SIM electronic characteristic in 1.8V mode (SIM_VDD=1.8V)

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

NOTE

1. The module does not support 3V SIM card.
2. The software does not support the SIM card hot swap function.

3.6.1 SIM Application Guide

Note that the SIM peripheral circuit should be close to the SIM card socket. The following figure shows the 6-pin SIM card holder reference circuit.
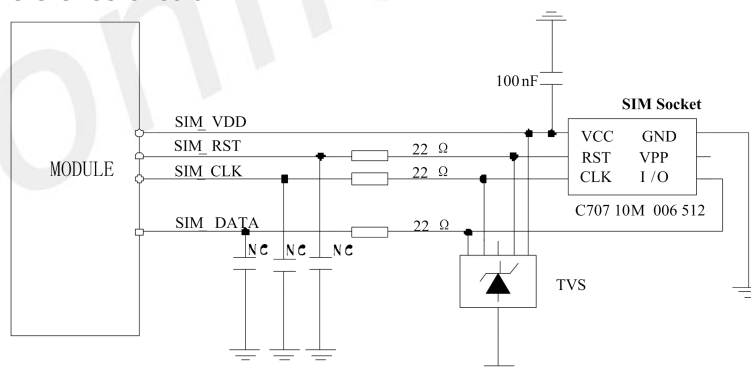
Figure 18: SIM interface reference circuit

SIM_DATA has been pulled up with a 20KR resistor to SIM_VDD in module, so it no need pulled up resistor anymore. SIM_VDD needs a 100nF capacitor close to SIM socket.

SIM_CLK is very important signal, the rise time and fall time of SIM_CLK should be less than 40ns. So the junction capacity of the TVS need to less 50pF.

In order to enhance the reliability and availability of the (U)SIM card in applications. Please follow the

guidelines below when designing.

- It is recommended to place a 100nF capacitor on the SIM_VDD signal line close to the SIM card holder.
- Place TVS near the SIM card holder. The junction capacity of the TVS should not exceed 50pF. The 22Ω resistor in series between the SIM card holder and the module can enhance the ESD protection performance.
- Keep SIM card signals away from RF and VBAT traces.
- SIM card signal line traces to avoid branch.
- To avoid cross-talk between SIM_DATA and SIM_CLK, keep them away from each other and shield them with surrounded ground. USIM_RST should also be ground shielded.

3.7 PCM Interface

SIM7070 Series provides a PCM interface for external codec, which can be used in master mode with short sync and 16 bits linear format.

Table 15: PCM format

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

NOTE

For more details about PCM AT commands, please refer to document [1].

3.7.1 PCM timing

SIM7070 Series supports 2.048 MHz PCM data and sync timing for 16 bits linear format codec.
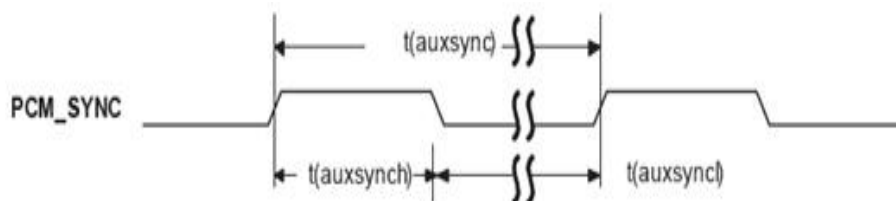
Figure 19: PCM_SYNC timing
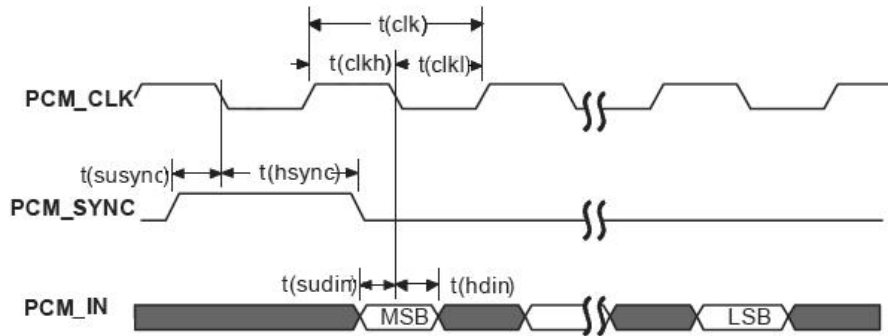
Figure 20: External codec to module timing
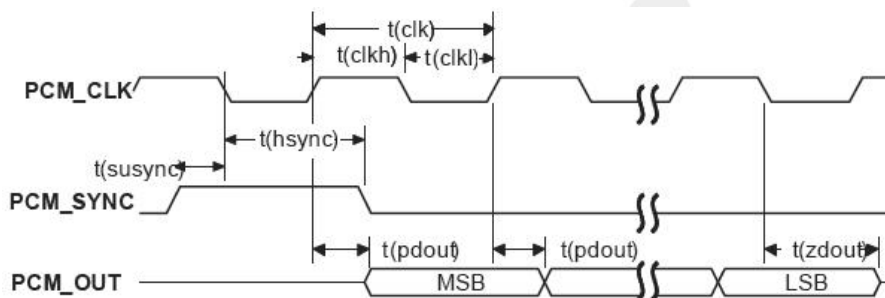
Figure 21: Module to external codec timing

Table 16: PCM timing parameters

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

3.7.2 PCM Application Guide

The following figure shows the external codec reference design.
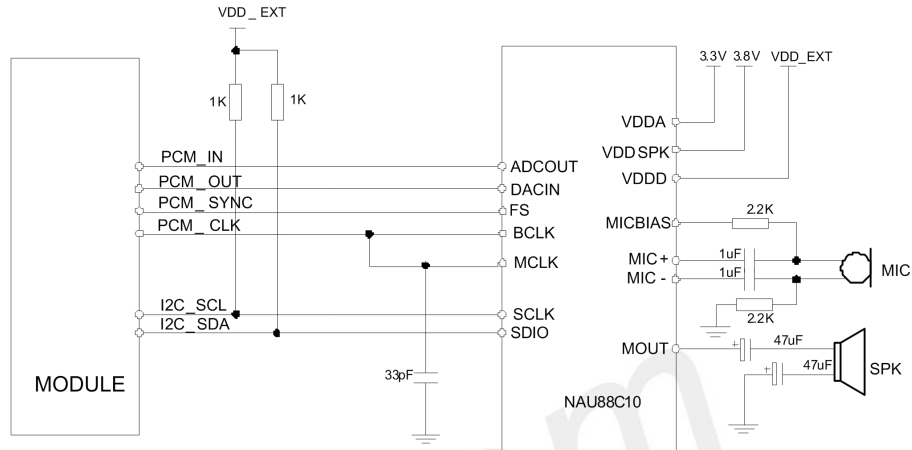
Figure 22: Audio codec reference circuit

3.8 I2C Interface

SIM7070 Series provides anI2C interface with clock rate up to 400 kbps. Its operation voltage is 1.8V.

The following figure shows the I2C bus reference design.
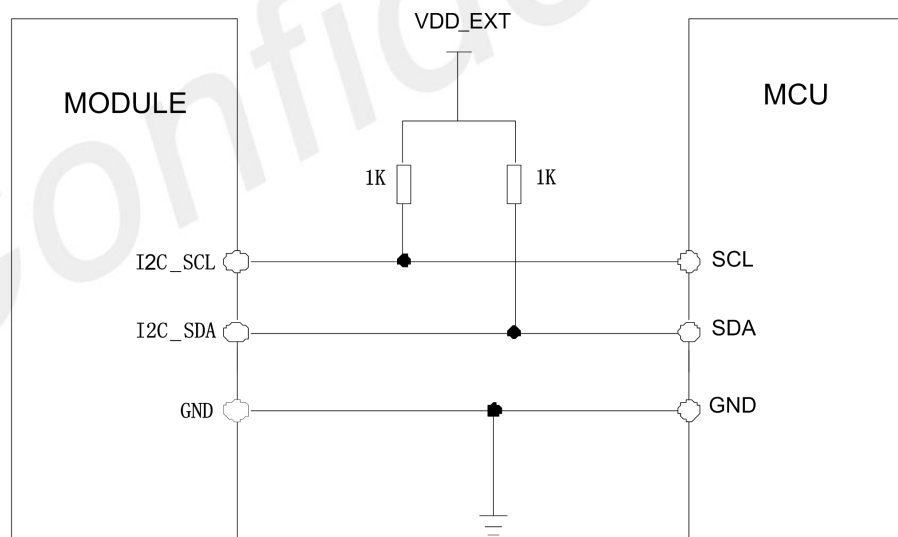
Figure 23: I2C reference circuit

The I2C signal has no pull-up resistors in module. So the pulling up resistors 1KΩ to VDD_EXT is necessary in application circuit.

3.9 SPI Interface

SIM7070 Series supports a set of 4-wire (MISO, MOSI, CS and CLK) SPI interface. The default function of the SPI interface is GPIO. The SPI function is only available in software secondary development.

The SPI supports both master mode and slave mode. The maximum clock frequency is up to 50MHz when operating in SPI master mode and up to 25MHz when operating in SPI Slave mode.

The SPI function of SIM7070 series is multiplexed by GPIO1, GPIO2, GPIO3 and GPIO5.
Table 17 describes the multiplex function of the SPI.

Table 17: Multiplex function of the SPI

Pin No.	Pin Name	multiplex function
19	GPIO1	SPI_MOSI
20	GPIO2	SPI_MISO
21	GPIO3	SPI_CLK
48	GPIO5	SPI_CS

> **NOTE**
>
> The GPIO1(19 pin) function is FAST BOOT function before system boot-up, so the level on this pin cannot be high before the system boot-up, otherwise the module will not start normally.

The following figure shows the SPI bus reference design.
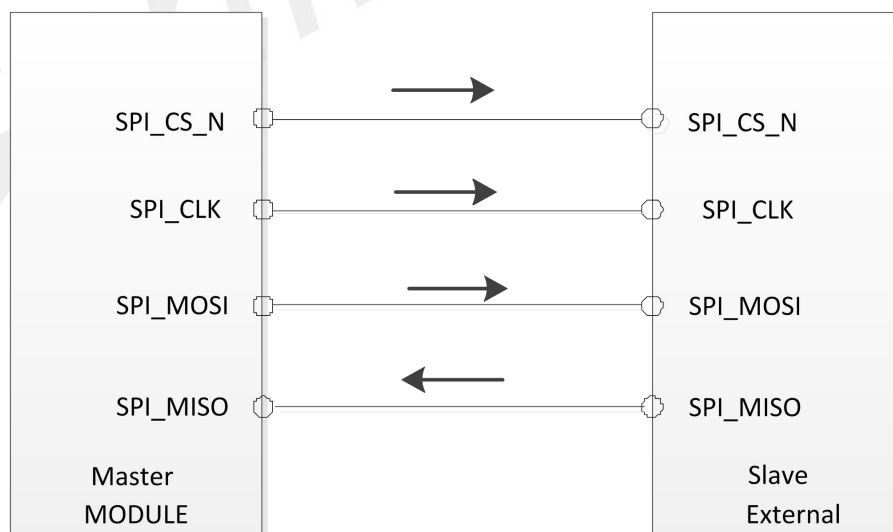
Figure 24: SPI master mode circuit
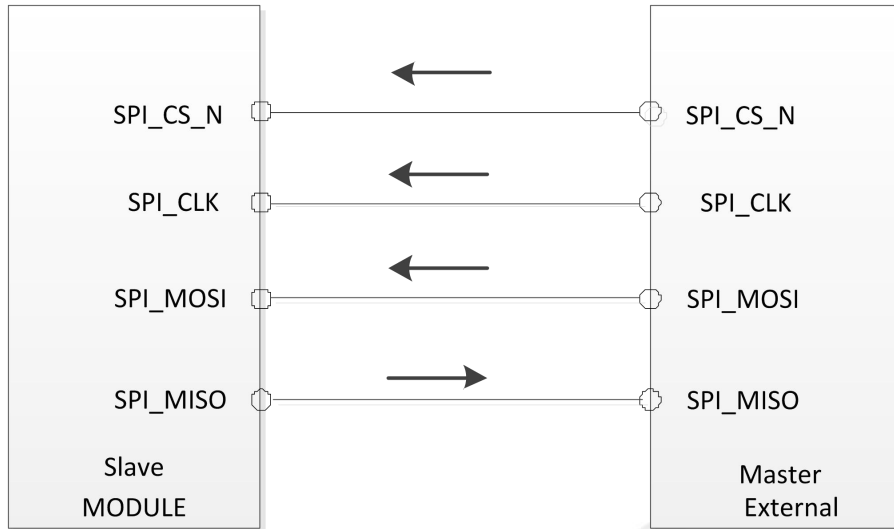
Figure 25: SPI slave mode circuit

3.10 Network status

The NETLIGHT pin is used to control Network Status LED, its reference circuit is shown in the following figure.
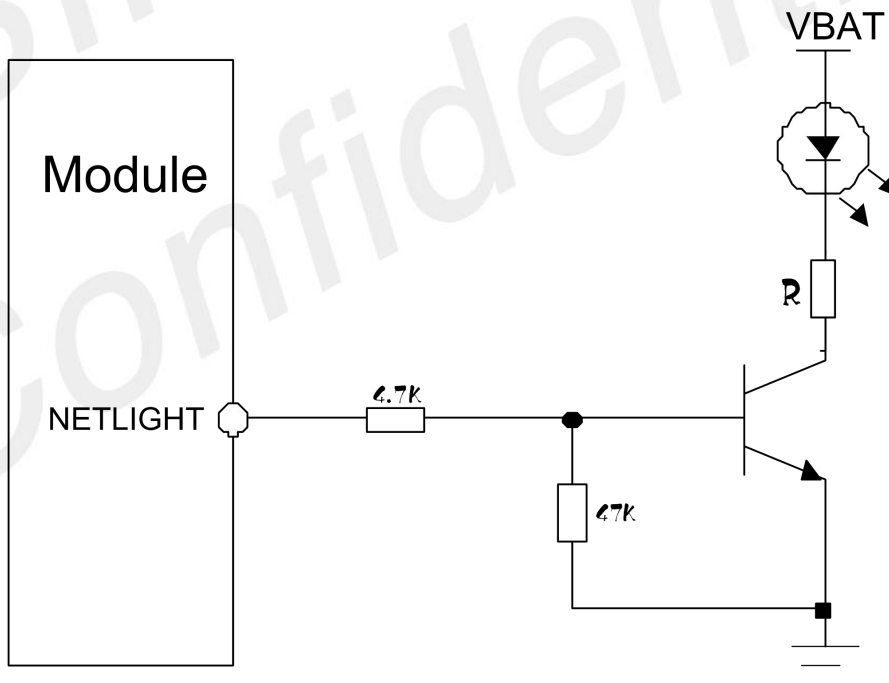
Figure 26: NETLIGHT reference circuit

NOTE

The value of the resistor named "R" depends on the LED characteristic.

Table 18: NETLIGHT pin status

NETLIGHT pin status	Module status
64ms ON, 800ms OFF	No registered network
64ms ON, 3000ms OFF	Registered network (PS domain registration success)
64ms ON, 300ms OFF	Data transmit (PPP dial-up state and use of data services such as internal TCP/FTP/HTTP)
OFF	Power off or PSM mode

NOTE

NETLIGHT output low level as "OFF" and high level as "ON".

3.11 ADC interface

SIM7070 Series module provides a 10-bit high sample rate (ADC) interfaces. It is available fordigitizing analog signals such as battery voltage and so on. Its input voltage range is from 0V to 1.8v. That is the maximum measurement range of ADC cannot exceed 1.8V. If the input voltage of ADC PIN exceeds its range, it is necessary to implement the resistance partial pressure on the hardware.
The electronic specifications are shown in the following table.

Table 19: ADC electronic characteristics

Characteristics	Min.	Typ.	Max.	Unit
Input Range	0		1.875	V
Internal pull-up resistor		400		KΩ
Input serial resistance	1	–	–	MΩ

NOTE

"AT+CADC" can be used to read the voltage of the ADC pin, for more details, please refer to document [1].

3.12 LDO output

SIM7070 Series has a LDO power output namedVDD_EXT. The output voltage is 1.8V. This voltage can only be pulled up for the external GPIO or power supply for the level conversion circuit.
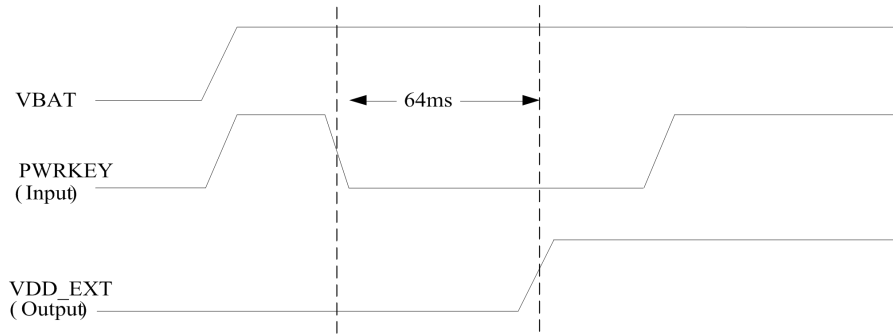
Figure 27: Power on sequence of the VDD_EXT

Table 20: Electronic characteristic

Symbol	Description	Min.	Typ.	Max.	Unit
VVDD_EXT	Output voltage	1.75	1.8	1.85	V
IO	Output current	-	-	50	mA

NOTE

The VDD_EXT is used to the IO power in the module. The Output voltage is not supported to adjust.

4.RF Specifications

4.1 LTE RF Specifications

Table 21: Conducted transmission power
GSM

GSM850, EGSM900			
PCL	Nominal output power (dBm)	Tolerance (dB) for conditions	
		Normal	Extreme
5	33	±2	±2.5
6	31	±3	±4
7	29	±3	±4
8	27	±3	±4
9	25	±3	±4
10	23	±3	±4
11	21	±3	±4
12	19	±3	±4
13	17	±3	±4
14	15	±3	±4
15	13	±3	±4
16	11	±5	±6
17	9	±5	±6
18	7	±5	±6
19-31	5	±5	±6

DCS1800/PCS1900			
PCL	Nominal output power (dBm)	Tolerance (dB) for conditions	
		Normal	Extreme
0	33	±2	±2.5
1	31	±3	±4
2	29	±3	±4
3	27	±3	±4
4	25	±3	±4
5	23	±3	±4
6	21	±3	±4
7	19	±3	±4

8	17	±3	±4
9	15	±3	±4
10	13	±3	±4
11	11	±5	±6
12	9	±5	±6
13	7	±5	±6
14	5	±5	±6

CAT-NB2

Frequency	Power	Min.
LTE-FDD B1	20dBm +/-2.7dB	<-40dBm
LTE-FDD B2	20dBm +/-2.7dB	<-40dBm
LTE-FDD B3	20dBm +/-2.7dB	<-40dBm
LTE-FDD B4	20dBm +/-2.7dB	<-40dBm
LTE-FDD B5	20dBm +/-2.7dB	<-40dBm
LTE-FDD B8	20dBm +/-2.7dB	<-40dBm
LTE-FDD B12	20dBm +/-2.7dB	<-40dBm
LTE-FDD B13	20dBm +/-2.7dB	<-40dBm
LTE-FDD B18	20dBm +/-2.7dB	<-40dBm
LTE-FDD B19	20dBm +/-2.7dB	<-40dBm
LTE-FDD B20	20dBm +/-2.7dB	<-40dBm
LTE-FDD B25	20dBm +/-2.7dB	<-40dBm
LTE-FDD B26	20dBm +/-2.7dB	<-40dBm
LTE-FDD B28	20dBm +/-2.7dB	<-40dBm
LTE-FDD B31	26dBm +/-2.7dB	<-40dBm
LTE-FDD B66	20dBm +/-2.7dB	<-40dBm
LTE-FDD B71	20dBm +/-2.7dB	<-40dBm
LTE-FDD B85	20dBm +/-2.7dB	<-40dBm

CAT-M1

Frequency	Power	Min.
LTE-FDD B1	20dBm +/-2.7dB	<-40dBm
LTE-FDD B2	20dBm +/-2.7dB	<-40dBm
LTE-FDD B3	20dBm +/-2.7dB	<-40dBm
LTE-FDD B4	20dBm +/-2.7dB	<-40dBm
LTE-FDD B5	20dBm +/-2.7dB	<-40dBm
LTE-FDD B8	20dBm +/-2.7dB	<-40dBm
LTE-FDD B12	20dBm +/-2.7dB	<-40dBm
LTE-FDD B13	20dBm +/-2.7dB	<-40dBm
LTE-FDD B14	20dBm +/-2.7dB	<-40dBm

LTE-FDD B18	20dBm +/-2.7dB	<-40dBm
LTE-FDD B19	20dBm +/-2.7dB	<-40dBm
LTE-FDD B20	20dBm +/-2.7dB	<-40dBm
LTE-FDD B25	20dBm +/-2.7dB	<-40dBm
LTE-FDD B26	20dBm +/-2.7dB	<-40dBm
LTE-FDD B27	20dBm +/-2.7dB	<-40dBm
LTE-FDD B28	20dBm +2.7/-3.2dB	<-40dBm
LTE-FDD B31	26dBm +/-2.7dB	<-40dBm
LTE-FDD B66	20dBm +/-2.7dB	<-40dBm
LTE-FDD B72	26dBm +/-2.7dB	<-40dBm
LTE-FDD B85	20dBm +/-2.7dB	<-40dBm

NOTE

The max power is tested result for 1RB in CAT-M1 and single-tone in CAT-NB2. MPR for CAT-M1 please refer to 6.2.3EA.5 part for 3GPP. Multi-tone test results please refer to part 6.2.3F.3 for CAT-NB2.

Table 22: Maximum Power Reduction (MPR) for UE category NB&M1 Power Class 5 CAT-NB1/CAT-NB2

Modulation	QPSK		
Tone positions for 3 Tones allocation	0-2	3-5 and 6-8	9-11
MPR	$\leq$ 0.5 dB	0 dB	$\leq$ 0.5 dB
Tone positions for 3 Tones allocation	0-5 and 6-11		
MPR		$\leq$ 1 dB	$\leq$ 1 dB
Tone positions for 3 Tones allocation	0-11		
MPR	$\leq$ 2 dB		

CAT-M1

Modulation	Channel bandwidth / Transmission bandwidth (NRB)						MPR (dB)
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
QPSK	>2	>2	>3	>5	-	-	$\leq$ 1
QPSK	>5	>5	-	-	-	-	$\leq$ 2
16 QAM	$\leq$ 2	$\leq$ 2	>3	>5	-	-	$\leq$ 1
16QAM	>2	>2	>5	-	-	-	$\leq$ 2

> **NOTE**
>
> For each sub-frame, the MPR is calculated per slot and is given by the maximum value transmitted within the slot; then the maximum MPR on both slots is applied to the entire sub-frame.

Table 23: Operating frequencies

Frequency	Receiving	Transmission
EGSM900	925～960MHz	880～915 MHz
GSM800	869~894MHz	824~849MHz
DCS1800	1805～1880 MHz	1710～1785 MHz
PCS1900	1930~1990MHz	1850~1910MHz
LTE BAND Information【Refers to Table 1】		
GPS L1 BAND	1574.4~1576.44 MHz	-
GLONASS	1598.0625 ~1605.375MHz	-
BDS	1559.052~1591.788MHz	-
Galileo	1574.4~1576.44 MHz	-

Table 24: E-UTRA operating bands

E-UTRA	UL Freq.	DL Freq.	Duplex Mode
1	1920 ~1980 MHz	2110 ~2170 MHz	HD-FDD
2	1850~1910MHz	1930~1990MHz	HD-FDD
3	1710 ~1785 MHz	1805 ~1880 MHz	HD-FDD
4	1710~1755MHz	2110~2155	HD-FDD
5	824 ~849 MHz	869 ~894 MHz	HD-FDD
8	880 ~915 MHz	925 ~960 MHz	HD-FDD
12	699~716MHz	729~746MHz	HD-FDD
13	777~787MHz	746~756MHz	HD-FDD
14	788~798MHz	758~768MHz	HD-FDD
18	815 ~830 MHz	860 ~875 MHz	HD-FDD
19	830 ~845 MHz	875 ~890 MHz	HD-FDD
20	832~862MHz	791~821MHz	HD-FDD
25	1850~1915MHz	1930~1995MHz	HD-FDD
26	814 ~849 MHz	859 ~894 MHz	HD-FDD
27	807~824MHz	852~869MHz	HD-FDD
28	703~748MHz	758~803MHz	HD-FDD
31	452.5~457.5MHz	462.5~467.5MHz	HD-FDD
66	1710~1780MHz	2110~2180MHz	HD-FDD
71	663~698MHz	617~652MHz	HD-FDD

| 72 | 451~456MHz | 461~466MHz | HD-FDD |
| 85 | 698~716MHzHz | 728~746MHz | HD-FDD |

Table 25: Conducted receive sensitivity

Frequency	Receive sensitivity(Typical)voice	Receive sensitivity(MAX)
EGSM900	107.9dBm	3GPP
GSM850	108.2dBm	3GPP
DCS1800	107.5dBm	3GPP
PCS1900	107.2dBm	3GPP
LTE HD-FDD	Reference【Table26】【Table27】	3GPP

Table 26: CAT-M1 Reference sensitivity (QPSK)

E-UTRA Band	REFSENS MAX(dBm) 3GPP Request	SIM7070G REFSENS Typical (dBm)	SIM7070E REFSENS Typical (dBm)	SIM7070G-NG REFSENS Typical (dBm)	Duplex Mode
1	-103	-108.1	-108.4	NA	HD-FDD
2	-101	-106.2	-106.6	NA	HD-FDD
3	-100	-107.5	-107.3	NA	HD-FDD
4	-103	-106.5	-106.2	NA	HD-FDD
5	-101.5	-108.2	-108.8	NA	HD-FDD
8	-100.5	-106.1	-106.5	NA	HD-FDD
12	-100	-107.4	-107.3	NA	HD-FDD
13	-100	-105.5	-106.1	NA	HD-FDD
14	-100	-106.5	-107.3	NA	HD-FDD
18	-103	-108.5	-109.5	NA	HD-FDD
19	-103	-108.1	-108.8	NA	HD-FDD
20	-100.5	-108.3	-107.8	NA	HD-FDD
25	-99.5	-103.2	-103.8	NA	HD-FDD
26	-101	-108.1	-108.3	NA	HD-FDD
27	-101.5	-106.2	-106.8	NA	HD-FDD
28	-101.5	-108.2	-108.8	NA	HD-FDD
31	-97.3	-102.4	-105.7	NA	HD-FDD
66	NA	-108.5	-108.4	NA	HD-FDD
72	NA	-102.4	-105.7	NA	HD-FDD
85	-100	-109.1	-109.4	NA	HD-FDD

Table 27: CAT-NB2Reference sensitivity (QPSK)

| Operating bands | REFSENS MAX(dBm) 3GPP Request | SIM7070G | | SIM7070E | | SIM7070G-NG | |
		REFSENS Typical(dBm)	REFSENS Typical Repetition 12/ 7/1/128 [EPRE dbm/15KHz][1]	REFSENS Typical(dBm)	REFSENS Typical Repetition 12/ 7/1/128 [EPRE dbm/15KHz][1]	REFSENS Typical(dBm)	REFSENS Typical Repetition 12/ 7/1/128 [EPRE dbm/15KHz][1]
1	-108.2	-115.1	-131	-115.1	-131	-115.1	-131
2	-108.2	-114.8	-130	-114.8	-130	-114.8	-130
3	-108.2	-115.4	-131	-115.4	-131	-115.4	-131
4	-108.2	-115.1	-130	-115.1	-130	-115.1	-130
5	-108.2	-114.3	-129	-114.3	-129	-114.3	-129
8	-108.2	-113.9	-130	-113.9	-130	-113.9	-130
12	-108.2	-116	-130	-116	-130	-116	-130
13	-108.2	-115.7	-130	-115.7	-130	-115.7	-130
18	-108.2	-114.9	-129	-114.9	-129	-114.9	-129
19	-108.2	-115.1	-128	-115.1	-128	-115.1	-128
20	-108.2	-114.1	-128	-114.1	-128	-114.1	-128
25	-108.2	-114.6	-130	-114.6	-130	-114.6	-130
26	-108.2	-114.6	-129	-114.6	-129	-114.6	-129
28	-108.2	-115.9	-130	-115.9	-130	-115.9	-130
31	-108.2			-114.7	-129		
66	-108.2	-114.8	-129	-114.8	-129	-114.8	-129
71	-108.2	-114.4	-129			-114.4	-129
85	-108.2	-115.7	-130	-115.7	-130	-115.7	-130

NOTE

The 12/7/1/128 of the REFSENS Typical Repeated 12/ 7/1/128 means Subcarriers=12, MCS.TBS=7, #SF/#RU=1, #Repetition=128.

4.2 LTE Antenna Design Guide

Users should connect antennas to SIM7070 Series antenna pads through micro-strip line or other types of RF trace and the trace impedance must be controlled in 50Ω. SIMCom recommends that the total insertion loss between the antenna pads and antennas should meet the following requirements:

Table 28: Trace loss

Frequency	Loss
700MHz-960MHz	<0.5dB
1710MHz-2170MHz	<0.9dB
2300MHz-2650MHz	<1.2dB

To facilitate the antenna tuning and certification test, a RF connector and an antenna matching circuit should be added. The following figure is the recommended circuit.
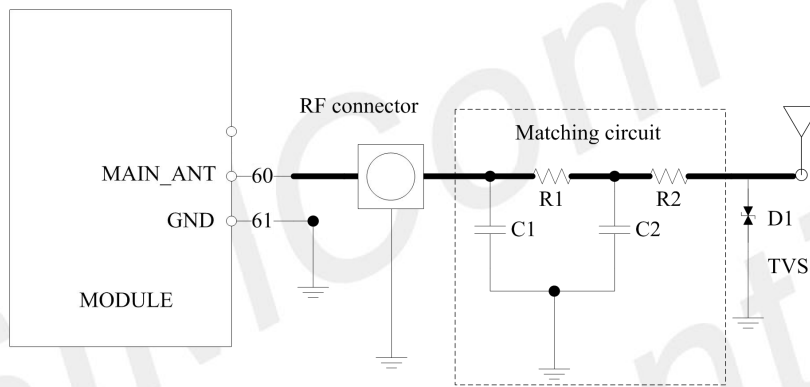
Figure 28: Antenna matching circuit (MAIN_ANT)

In above figure, the components R1, C1, C2 and R2 are used for antenna matching, the values of components can only be achieved after the antenna tuning and usually provided by antenna vendor. By default, the R1, R2 are 0Ω resistors, and the C1, C2 are reserved for tuning. The component D1 is a TVS for ESD protection, and it is optional for users according to application environment.

The RF test connector is used for the conducted RF performance test, and should be placed as close as to the module's MAIN_ANT pin. The traces impedance between SIM7070 Series and antenna must be controlled in 50Ω.

Two TVS are recommended in the table below.

Table 29: Recommended TVS

Package	Part Number	Vender
0201	LXES03AAA1-154	Murata
0402	LXES15AAA1-153	Murata

4.3 GNSS

SIM7070 Series merges GNSS (GPS/GLONASS/BD/Galileo) satellite and network information to provide a high-availability solution that offers industry-leading accuracy and performance. This solution performs well, even in very challenging environmental conditions where conventional GNSS receivers fail, and provides a platform to enable wireless operators to address both location-based services and emergency mandates.

4.3.1 GNSS Technical specification

- Tracking sensitivity: -159 dBm (GPS+GLONASS)/-159 dBm (GPS+BD)
- Cold-start sensitivity: -147.5 dBm
  Accuracy (Open Sky): 0.4 m(GPS+BD)
- TTFF (Open Sky) : Hot start < 1 s, Cold start< 31 s
- Receiver Type: 16-channel, C/A Code
- GPS L1 Frequency: 1575.42±1.023MHz
- GLONASS L1: 1598.0625 ~1605.375MHz
- BDS B1: 1559.052~1591.788MHz
- Galileo L1:1575.42±1.023MHz
- Update rate: Default 1 Hz
- GNSS data format: NMEA-0183
- GNSS Current consumption :54mA (AT+CFUN=0,without USB)
- GNSS antenna: Passive/Active antenna

NOTE

If the antenna is active type, the power should be given by main board because there is no power supply on the GNSS antenna pad. If the antenna is passive, it is suggested that the external LNA should be used.

4.3.2 GNSS Application Guide

Users can adopt an active antenna or a passive antenna to SIM7070 Series. If using a passive antenna, an external LNA is a must to get better performance. The following figures are the reference circuits.
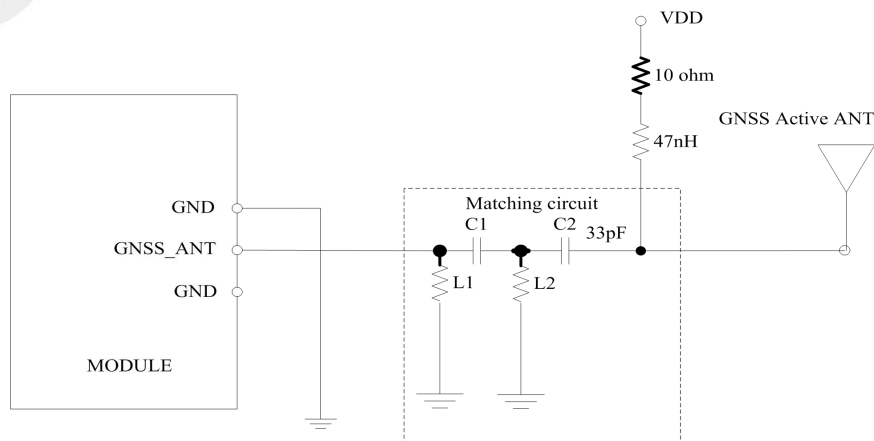

Figure 29: Active antenna circuit
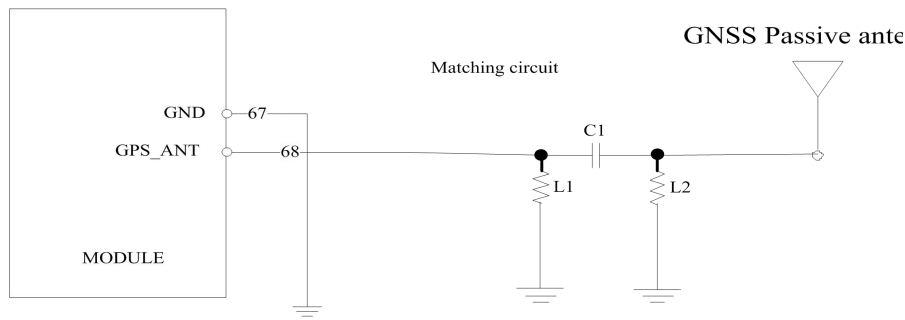
Figure 30: Passive antenna circuit (Default)

In above figures, the components C1, L1 and L2 are used for antenna matching. Usually, the values of the components can only be achieved after antenna tuning and usually provided by antenna vendor.C2 is used for DC blocking. L3 is the matching component of the external LNA, and the value of L3 is determined by the LNA characteristic and PCB layout. Both VDD of active antenna and V_LNA need external power supplies which should be considered according to active antenna and LNA characteristic. LDO/DCDC is recommended to get lower current consuming by shutting down active antennas and LNA when GNSS is not working.

GNSS can be tested by NMEA port. NMEA sentences can be obtained through UART or USB automatically. NMEA sentences include GSV, GGA, RMC, GSA, and VTG. Before using GNSS, user should configure SIM7070 Series in proper operating mode by AT command. Please refer to related documents for details. SIM7070 Series can also get position location information through AT directly.

NOTE

1. GNSS is closed by default and can be started by "AT+CGNSPWR=1". 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 [21] for more details.
2. If the passive antenna is used, put the LNA close to the antenna.
3. Make sure there are no noise signals around GNSS antenna.

4.4 RF traces note

4.4.1 RF traces layout

➢ Keep the RF trace from module ant pin to antenna as short as possible
➢ RF trace should be 50 Ω either on the top layer or in the inner layer
➢ RF trace should be avoided right angle and sharp angle.
➢ Put enough GND vias around RF traces.
➢ RF trace should be far away from other high speed signal lines.
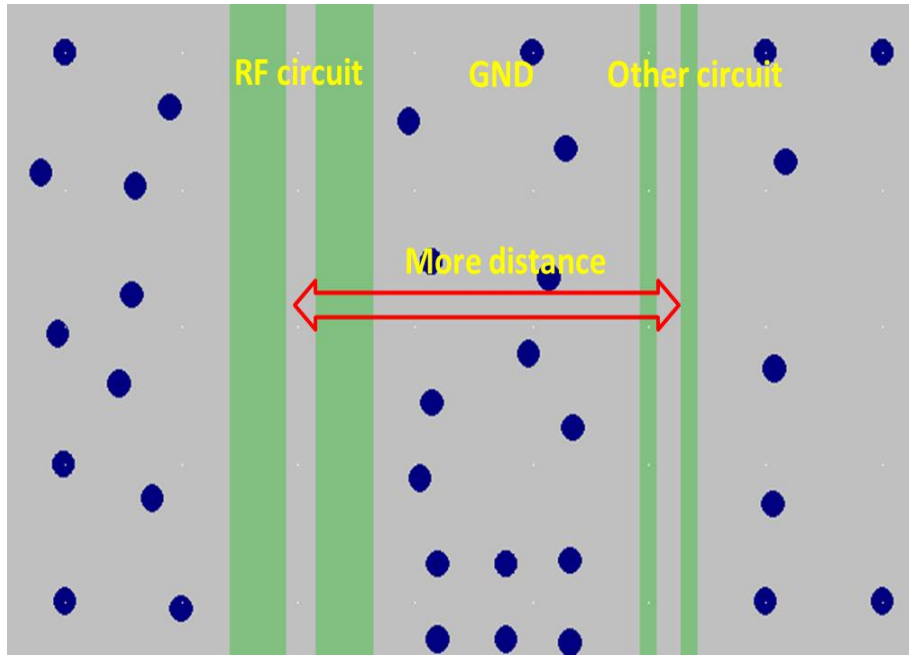
Figure 31: RF trace should be far away from other high speed signal lines

➢ Avoiding the paroling rout of other system antennas nearly.
➢ There should be some distance from The GND to the inner conductor of the SMA connector. It is better to keep out all the layers from inner to the outer conductor.
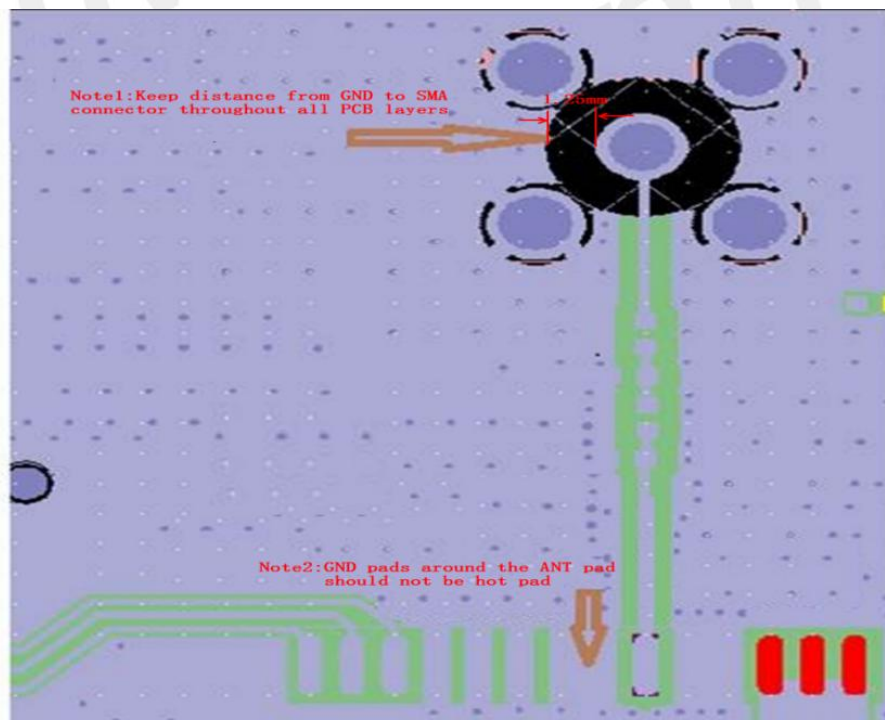
Figure 32: The distance between GND to the inner conductor of SMA

➢ GND pads around the ANT pad should not be hot pad to keep the GND complete.

4.4.2 LTE ANT and other system ANT decoupling

➢ Make sure the efficiency of LTE main ANT more than 40%
➢ Keep the decoupling of LTE main ANT to WLAN ANT more than 15dB
➢ Keep the decoupling of LTE main ANT to GNSS ANT more than 30dB

NOTE

The decoupling value can be provided by ANT adventure. More details can refer to the document [22].

5.Electrical Specifications

5.1 Absolute maximum ratings

Absolute maximum rating for digital and analog pins of SIM7070 Series are listed in the following table:

Table 30: Absolute maximum ratings

Parameter	Min.	Typ.	Max.	Unit
Voltage on VBAT	-0.3	-	6.0	V
Voltage on USB_VBUS	-0.3	-	6.0	V
Voltage at digital pins (RESET,GPIO,I2C,UART,PCM)	-0.3	-	2.1	V
Voltage at PWRKEY	-0.3	-	2.1	V
ADC	-0.3	-	1.875	V

NOTE

The absolute parameter is tested when VBAT has the power but the PWRKEY has no pulled down. If it is over the range, the module will be damage. If the power supply on VBAT pin had been shut down, and the other pin should not have the voltage. Otherwise, it may lead to abnormally boot up or damage the module.

5.2 Operating conditions

Table 31: 1.8V Digital I/O characteristics*

Parameter	Description	Min.	Typ.	Max.	Unit
VIH	High-level input voltage	1.17	1.8	2.1	V
VIL	Low-level input voltage	-0.3	0	0.63	V
VOH	High-level output voltage	1.35	-	1.8	V
VOL	Low-level output voltage	0	-	0.45	V
IOH	High-level output current(no pull down resistor)	-	2	-	mA
IOL	Low-level output current(no pull up resistor)	-	-2	-	mA
IIH	Input high leakage current (no	-	-	1	uA

	pull down resistor)				
IIL	Input low leakage current(no pull up resistor)	-1	-	-	uA

> **NOTE**
>
> These parameters are for digital interface pins, such as GPIOs (including NETLIGHT and STATUS), I2C, UART, PCM, SPI and BOOT_CFG.

Table 32: Recommended operating ratings

Parameter		Min.	Typ.	Max.	Unit
Voltage at VBAT	SIM7070G	3.0	3.8	4.6	V
	SIM7070E	3.2	3.8	4.2	
	SIM7070G-NG	3.0	3.8	4.6	V
Voltage at USB_VBUS		3.5	5.0	5.25	V

The operating temperature of SIM7070 Series is listed in the following table.

Table 33: Operating temperature

Parameter	Min.	Typ.	Max.	Unit
operation temperature	-40	25	85	℃
Storage temperature	-45	25	+90	℃

> **NOTE**
>
> Module is able to make and receive voice calls, data calls, SMS and make GPRS/LTE traffic in -40℃ ~ +85℃. The performance will be reduced slightly from the 3GPP specifications if the temperature is outside the normal operating temperature range and still within the extreme operating temperature range.

5.3 Operating Mode

5.3.1 Operating Mode Definition

The table below summarizes the various operating modes of SIM7070 Series product.

Table 34: Operating mode Definition

Mode		Function
Normal operation	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.
	Idle	Software is active. Module is registered to the network, and the module is ready to communicate.
	Cat-M1 Voice Call	Connection between two subscribers is in progress. In this case, the power consumption depends on network settings.
	Standby	Module is ready for data transmission, but no data is currently sent or received. In this case, power consumption depends on network settings.
	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=0" and "AT+CSCLK=1"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 and the SIM card will not be accessible, but the serial port and USB port are still accessible. The power consumption in this mode is lower than normal mode.
Flight mode		AT command "AT+CFUN=4"can be used to set the module to flight mode without removing the power supply. In this mode, the RF part of the module will not work, but the serial port and USB port are still accessible. The power consumption in this mode is lower than normal mode.
Power Saving Mode (PSM)		Setting AT command" AT+CPSMS=1" can be enable the PSM mode. In this mode, The mode is similar to power-off. But the module remains registered on the network and there is no need to re-attach or re-establish the network connections. And all of the functions will be unavailable except the RTC function. PWRKEY and timer expires can wake up the module.
Extended Mode DRX (e-DRX)		In idle or sleep mode, module and the network may negotiate over non-access stratum signaling the use of extended mode DRX for reducing power consumption.

5.3.2 Sleep mode

Module can enter into sleep mode for reducing its power consumption in idle module. In sleep mode, the current consumption of module will be reduced to very small level, and module can still receive paging message and SMS.

Several hardware and software conditions must be satisfied together in order to let SIM7070 Series enter sleep mode:

● USB condition: Connected USB can't enter into sleep mode. So if module wants to enter into sleep mode, it must disconnect the power supply for USB_VBUS first.
● Software condition: If module wants to enter into sleep mode, AT comment "AT+CSCLK=1" must be set to close some clock in the module. If the value "AT+CSCLK" is "0", module will never enter into sleep mode.
● UART condition: If module wants to enter into sleep mode, AT comment "AT+CSCLK=1" must be set to close some clock in the module. If the value "AT+CSCLK" is "0", module will never enter into sleep mode.

If it meets all the conditions at the same time, module will enter into sleep mode. In sleep mode, the UART is unavailable. If the host need to communicate with module, it need to pull down DTR can wake up module.

5.3.3 Minimum functionality mode and Flight mode

Minimum functionality mode ceases a majority function of the 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: Flight mode

If SIM7070 Series has been set to minimum functionality mode, the RF function and SIM card function will be closed. In this case, the serial port and USB are still accessible, but RF function and SIM card will be unavailable.

If SIM7070 Series has been set to flight mode, the RF function will be closed. In this case, the serial port and USB are still accessible, but RF function will be unavailable.

When SIM7070 Series is in minimum functionality or flight mode, it can return to full functionality by the AT command "AT+CFUN=1".

5.3.4 Power Saving Mode (PSM)

SIM7070 Series module can enter into PSM for reducing its power consumption. The mode is similar to power-off, but the module remains registered on the network and there is no need to re-attach or re-establish the network connections. So in PSM all the functions will be unavailable except the RTC function, module cannot immediately respond users' requests.

When the module wants to use the PSM, it can be enabled via "AT+CPSMS=1" command. The command takes effect after module reboot. If the network supports PSM and accepts that the module uses PSM, the network confirms usage of PSM by allocating an Active Time value to the module. Module will be into PSM according to the command from network.

Either of the following methods will wake up the module from PSM:

● Pulling PWRKEY pin to low level will wake up the module.
● When the timer expires, the module will be automatically woken up.

5.3.5 Extended Mode DRX (e-DRX)

In idle or sleep mode, module and the network may negotiate over non-access stratum signaling the use of extended mode DRX for reducing power consumption.
E-DRX diagrammatic sketch refer to the following figure.
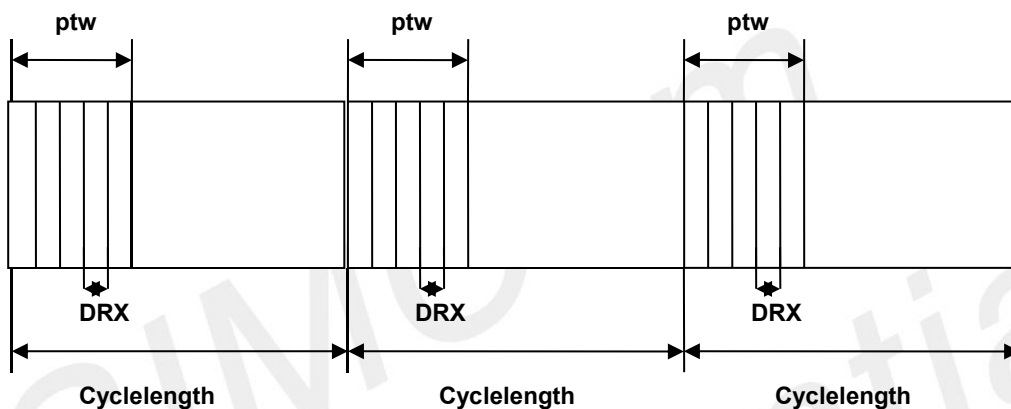
Figure 33: e-DRX diagrammatic sketch

When module and the network negotiate stratum signaling in idle mode or sleep mode, extended mode DRX can decrease the times of paging time window (PTW) and increase the cycle length. For this reason it had reduced the times of DRX, and had reduced the frequency of DRX between module and the network. So that can reduce power consumption for module.

If e-DRX is supported by the network, then it can be enabled by "AT+CEDRXS" command.

> **NOTE**
>
> For details about "AT+CEDRXS", please refer to Document [1]

5.4 Current Consumption

The current consumption is listed in the table below.

Table 35: Current consumption on VBAT Pins (VBAT=3.8V)

GNSS

GNSS supply current (AT+CFUN=0,without USB connection)	Tracking, typical:54mA	
Idle mode		
LTE supply current (AT+CSCLK=0；AT+CFUN=1, GNSS off, without USB connection）	GSM	typical:12mA
	CAT-M1	typical: 18mA
	NB1/NB2	typical:14mA
Sleep mode		
GSM supply current (AT+CSCLK=1；AT+CFUN=1, GNSS off, without USB connection）	GSM	typical:2.1mA
GSM supply current (AT+CSCLK=1；AT+CFUN=0, GNSS off, without USB connection）	GSM	typical:0.45mA
Power SavingMode		
PSM supply current	PSM mode Typical: 3.5uA	
e-DRX		
e-DRX mode supply current （Tested in sleep mode）	@PTW=40.96s；eDRX=81.92s；DRX=2.56s Typical:0.6mA	
	@PTW=25.6s；eDRX=163.84s；DRX=2.56s Typical:0.4mA	
GPRSdata transmission		
EGSM850(3DL,2UL)	@power class #5Typical:369mA	
DCS1800(3DL,2UL)	@power class #0Typical:274mA	
EGSM 850(1DL,4UL)	@power class #5Typical:500mA	
DCS1800 (1DL,4UL)	@power class #0Typical:401mA	
EDGEdata transmission		
EGSM850(3DL,2UL)	@power class #5 Typical: 210mA	
DCS1800(3DL,2UL)	@power class #0 Typical:172mA	
EGSM 850(1DL,4UL)	@power class #5 Typical: 311mA	
DCS1800 (1DL,4UL)	@power class #0 Typical: 285mA	
LTE Cat-M (10MHz) data transmission		
LTE-FDD B1	@21dbm Typical: 116mA @10dbm Typical: 103mA @0dbm Typical: 91mA	
LTE-FDD B2	@21dbm Typical: 115mA @10dbm Typical: 102mA @0dbm Typical:90mA	
LTE-FDD B3	@21dbm Typical: 114mA @10dbm Typical: 102mA @0dbm Typical: 90mA	
LTE-FDD B4	@21dbm Typical: 114mA @10dbm Typical: 102mA @0dbm Typical:91mA	

LTE-FDD B5	@21dbm Typical: 117mA @10dbm Typical: 100mA @0dbm Typical: 90mA
LTE-FDD B8	@21dbm Typical: 117mA @10dbm Typical: 101mA @0dbm Typical:91mA
LTE-FDD B12	@21dbm Typical: 116mA @10dbm Typical: 100mA @0dbm Typical: 90mA
LTE-FDD B13	@21dbm Typical: 118mA @10dbm Typical: 101mA @0dbm Typical:93mA
LTE-FDD B14	@21dbm Typical: 119mA @10dbm Typical: 101mA @0dbm Typical: 90mA
LTE-FDD B18	@21dbm Typical: 117mA @10dbm Typical: 100mA @0dbm Typical:90mA
LTE-FDD B19	@21dbm Typical: 117mA @10dbm Typical: 101mA @0dbm Typical: 90mA
LTE-FDD B20	@21dbm Typical: 118mA @10dbm Typical: 101mA @0dbm Typical: 91mA
LTE-FDD B25	@21dbm Typical: 115mA @10dbm Typical: 102mA @0dbm Typical:91mA
LTE-FDD B26	@21dbm Typical: 116mA @10dbm Typical: 100mA @0dbm Typical:90mA
LTE-FDD B27	@21dbm Typical: 117mA @10dbm Typical: 101mA @0dbm Typical:90mA
LTE-FDD B28	@21dbm Typical: 116mA @10dbm Typical: 100mA @0dbm Typical: 91mA
LTE-FDD B31	@27dbm Typical: 345mA @17dbm Typical: 185mA @8dbm Typical:137mA
LTE-FDD B66	@21dbm Typical: 167mA @10dbm Typical: 131mA @0dbm Typical: 103mA
LTE-FDD B72	@27dbm Typical: 348mA @17dbm Typical:178mA @8dbm Typical: 138mA
LTE-FDD B85	@21dbm Typical: 172mA @10dbm Typical: 126mA

	@0dbm Typical:103mA
LTE-FDD B1	@21dbm Typical: 137mA @10dbm Typical: 87mA @0dbm Typical: 55mA
LTE-FDD B2	@21dbm Typical: 140mA @10dbm Typical: 87mA @0dbm Typical: 53mA
LTE-FDD B3	@21dbm Typical: 142mA @10dbm Typical: 87mA @0dbm Typical: 53mA
LTE-FDD B4	@21dbm Typical: 141mA @10dbm Typical: 86mA @0dbm Typical: 53mA
LTE-FDD B5	@21dbm Typical: 146mA @10dbm Typical: 80mA @0dbm Typical: 53mA
LTE-FDD B8	@21dbm Typical: 143mA @10dbm Typical: 80mA @0dbm Typical: 52mA
LTE-FDD B12	@21dbm Typical: 139mA @10dbm Typical: 78mA @0dbm Typical: 51mA
LTE-FDD B13	@21dbm Typical: 153mA @10dbm Typical: 83mA @0dbm Typical: 52mA
LTE-FDD B18	@21dbm Typical: 147mA @10dbm Typical: 80mA @0dbm Typical: 53mA
LTE-FDD B19	@21dbm Typical: 147mA @10dbm Typical: 80mA @0dbm Typical: 53mA
LTE-FDD B20	@21dbm Typical: 147mA @10dbm Typical: 81mA @0dbm Typical: 52mA
LTE-FDD B25	@21dbm Typical: 140mA @10dbm Typical: 87mA @0dbm Typical: 54mA
LTE-FDD B26	@21dbm Typical: 147mA @10dbm Typical: 81mA @0dbm Typical: 53mA
LTE-FDD B28	@21dbm Typical: 143mA @10dbm Typical: 81mA @0dbm Typical: 53mA
LTE-FDD B31	@26dbm Typical: 302mA @17dbm Typical: 185mA @8dbm Typical:120mA

LTE-FDD B66	@21dbm Typical: 141mA @10dbm Typical: 87mA @0dbm Typical: 53mA
LTE-FDD B71	@21dbm Typical: 133mA @10dbm Typical: 76mA @0dbm Typical: 64mA
LTE-FDD B85	@21dbm Typical: 141mA @10dbm Typical: 78mA @0dbm Typical: 51mA

5.5 ESD Notes

SIM7070 Series is sensitive to ESD in the process of storage, transporting, and assembling. WhenSIM7070 Series is mounted on the users' mother board, the ESD components should be placed beside the connectors which human body may touch, such as SIM card holder, audio jacks, switches, keys, etc. The following table showsSIM7070 Series ESD measurement performance without any external ESD component.

Table 36: The ESD performance measurement table (Temperature: 25℃, Humidity: 45%.)

Part	Contact discharge	Air discharge
VBAT,GND	+/-6K	+/-12K
Antenna port	+/-5K	+/-10K
Other PADs	+/-1K	+/-3K

6.SMT Production Guide
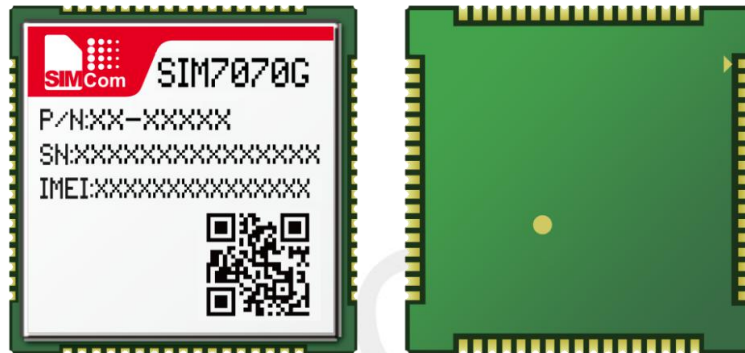
6.1 Top and Bottom View of SIM7070 Series

Figure 34: Top and bottom view of SIM7070 Seri

6.2 Label Information

Figure 35: Label information

Table 37: The description of label information

No.	Description
A	LOGO,No.1 Pin
B	Project name
C	Product code
D	Serial number
E	International mobile equipment identity
F	QR code

6.3 Typical SMT Reflow Profile

SIMCom provides a typical soldering profile. Therefore the soldering profile shown below is only a generic recommendation and should be adjusted to the specific application and manufacturing constraints.
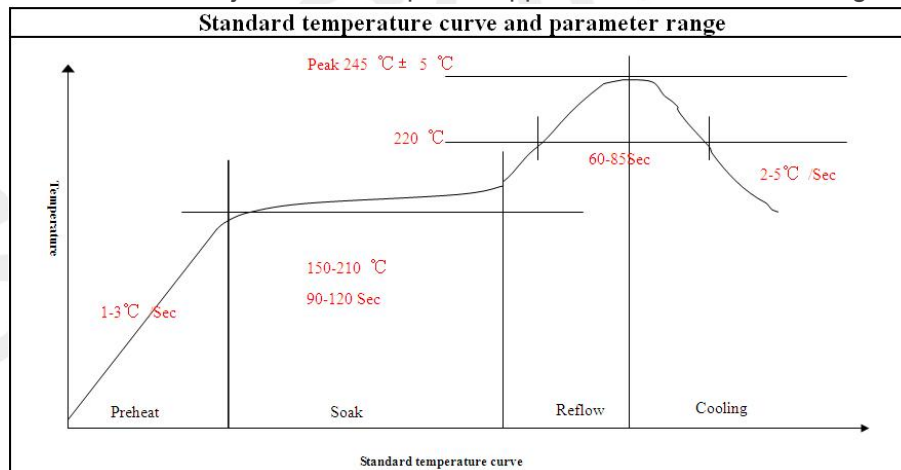

Figure 36: The ramp-soak-spike reflow profile of SIM7070 Series

NOTE

For more details about secondary SMT, please refer to the document [19].

6.4 Moisture Sensitivity Level (MSL)

SIM7070 Series is qualified to Moisture Sensitivity Level (MSL) 3 in accordance with JEDEC J-STD-033.

The following table shows the features of Moisture Sensitivity Level (MSL). After seal off, storage conditions must meet the following table. If the storage time was expired, module must be baking before SMT.

Table 38: Moisture Sensitivity Level and Floor Life

Moisture Sensitivity Level (MSL)	Floor Life (out of bag) at factory ambient≤30°C/60% RH or as stated
1	Unlimited at ≦30℃/85% RH
2	1 year at ≦30℃/60% RH
2a	4 weeks at ≦30℃/60% RH
3	168 hours at ≦30℃/60% RH
4	72 hours at ≦30℃/60% RH
5	48 hours at ≦30℃/60% RH
5a	24 hours at ≦30℃/60% RH
6	Mandatory bake before use. After bake, it must be reflowed within the time limit specified on the label.

6.5 Baking

In order to get better yield, the module need to bake before SMT.
● If the packaging is in perfect condition, the module which dateofproduction is within six months has no use for baking. If the dateofproduction is more thansix months, the module must be baking.
● If the packaging had been opened or damaged, the module must be baking.

Table 39: Baking conditions

conditions	parameters
Baking temperature	120℃
Baking time	8 hours

> **NOTE**
>
> IPC / JEDEC J-STD-033standard must be followed for production and storage.

6.6 Stencil Foil Design Recommendation

The recommended thickness of stencil foil is 0.15mm.
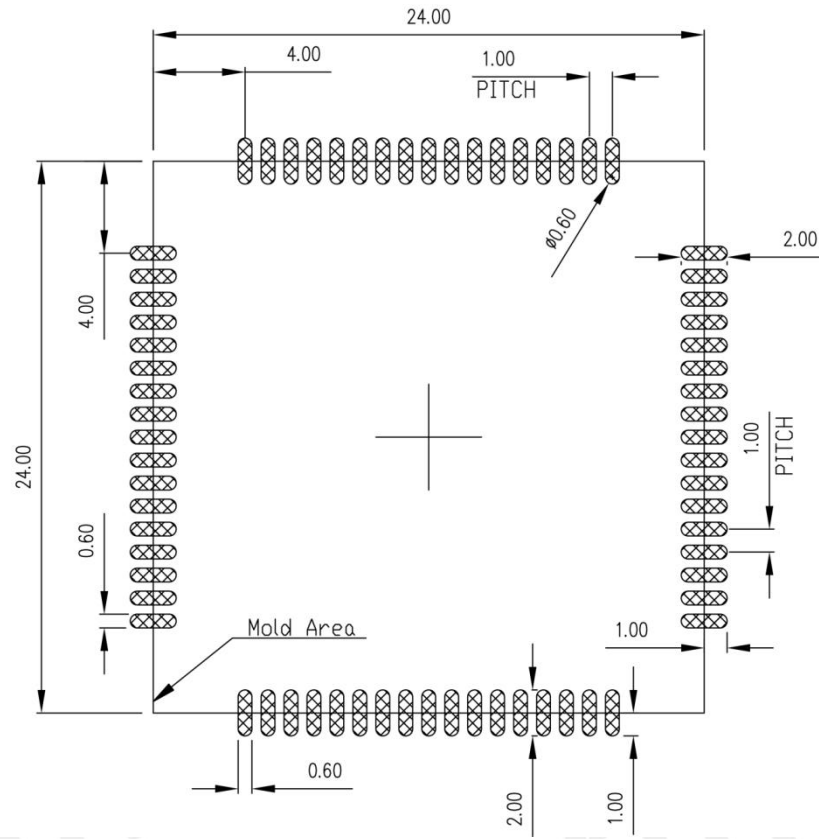
SMT stencil outline
(Unit:mm)

Figure 37: stencil recommendation (Unit: mm)

7.Packaging

7.1 Tray packaging

SIM7070 Series module support tray packaging.
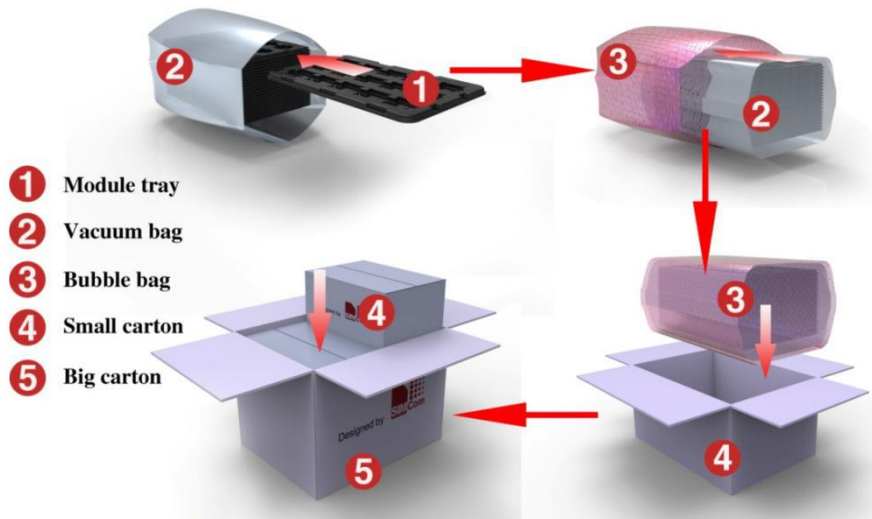
Figure 38: packaging diagram

Module tray drawing：
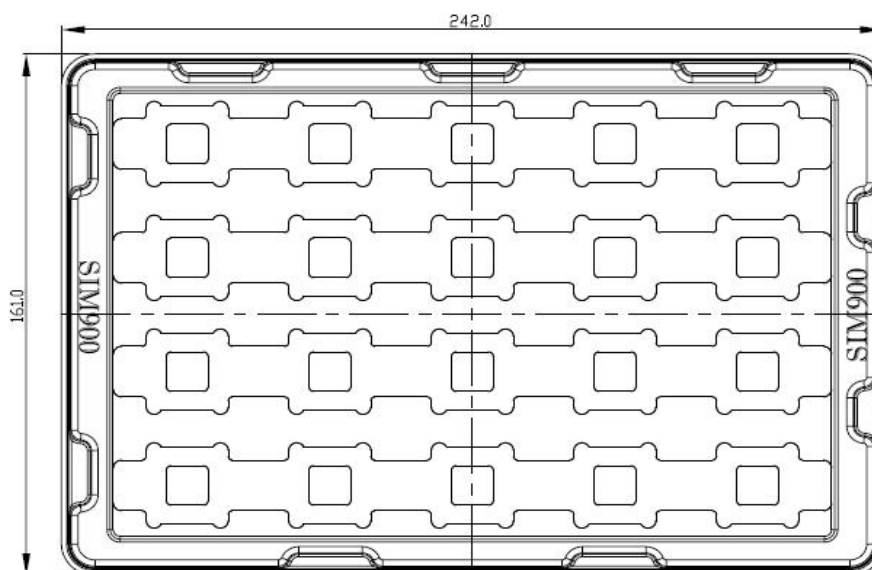
Figure 39: Tray drawing

Table 40: Tray size

Length（±3mm）	Width（±3mm）	Module number
242.0	161.0	20

Small carton drawing：
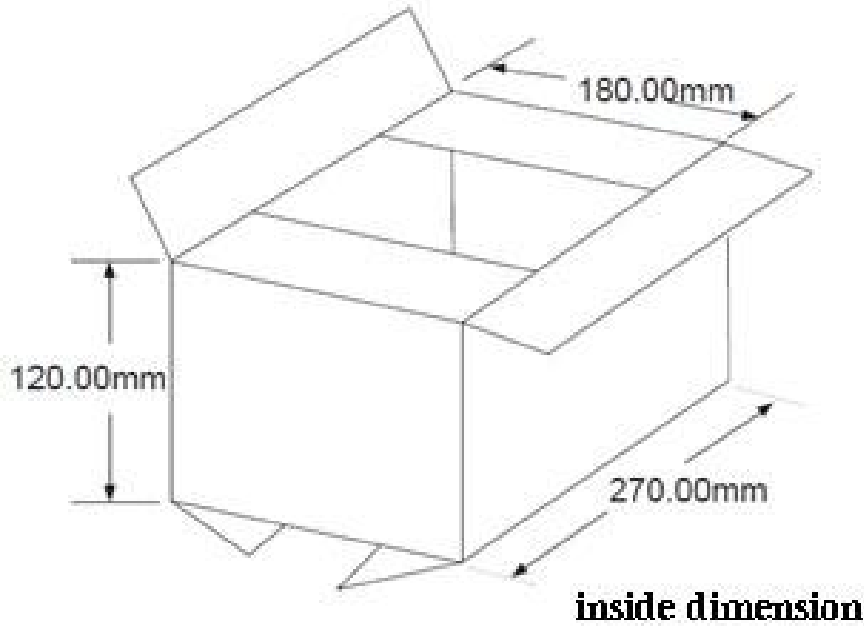
Figure 40: Small carton drawing

Table 41: Small Carton size

Length（±10mm）	Width（±10mm）	Height（±10mm）	Module number
270	180	120	20*20=400

Big carton drawing：
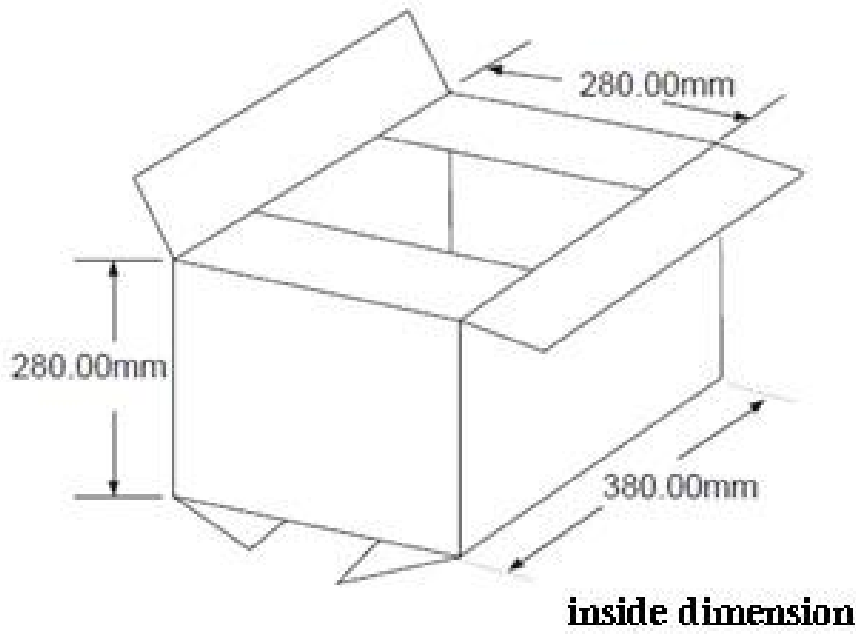
Figure 41: Big carton drawing

Table 42: Big Carton size

Length（±10mm）	Width（±10mm）	Height（±10mm）	Module number
380	280	280	400*4=1600

8.Appendix

A. Reference Design

Refer to <SIM7070 Series Reference Design V1.01> for the details.
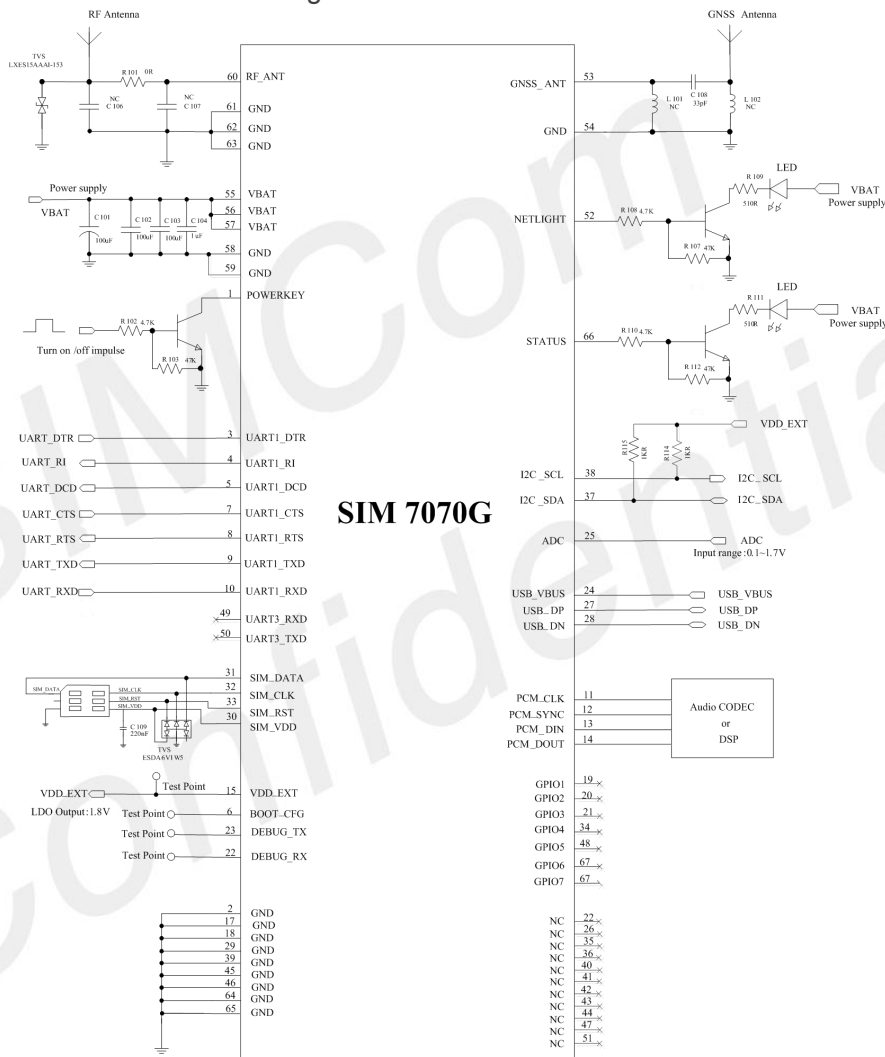
Figure 42: Reference design

B. Design check list

Table 43: Schematic Check List

NO.	Items
1	Insure the supply voltage for VBAT is withintherange

2	Insure the maximum supply current for VBAT is above its consumption when it is maximum power emission.
3	Insure the capacitor for VBAT is meet its request, in order to avoid the voltage drop exceed 300mV.
4	Insure the input signal for PWRKEY pin meet its electrical level match. It recommended use BJT to shift its level.
5	Insure the netconnections of UART be correctness according to signal direction. Insure the signal for UART pins meet its electrical level match. It recommended use BJT or level shift IC to shift its level.
6	Insure USB port had used TVS to protect signal. And the junction capacity of TVS for DP/DM must be less than 3pf.
7	Insure SIM card signal had used TVS to protect. And the junction capacity of TVS must be less than 50pf.
8	The power supply of the active antenna should be controlled and closed.
9	Insure I2C signal had used resistors 1Kohm pull up to VDD_EXT if used.
10	The electrical level of all GPIOs is 1.8V. Insure the signal for GPIO pins meet its electrical level match.
11	The input range of ADC is 0V~1.875V. Insure the input signal never exceed its range.
12	User must pull up DTR when module enters into sleep mode. Insure DTR can be controlled by host.
13	Suggesting to reserve test ports for VDD_EXT and BOOT_CFG. BOOT_CFG should keep open before boot up.
14	LTE main ANT should Keep TVS to prevent ESD destroyed. And the TVS should be Low junction capacitance.
15	LTE main ANT should have a PI type matching to debug antenna

Table 44: PCB Layout Check List

NO.	Items
1	Insure the capacitor placement for VBAT be near module pin.
2	Insure VBAT trace width be greater than 2mm. If NB only, insure VBAT trace width be greater than 1mm. And the VIA number must be enough for getting through the current.
3	Insure the return path GND of the power supply is good. Insure the connectivity between module GND and mother board GND is good.
4	Insure PCM trance is protected by GND, and keep it far from interference source, such as power supply trace, USB trace, RF trace and so on.
5	Insure USB trance is protected by GND, and keep it far from interference source, such as power supply trace, RF trace and so on. Insure DM/DP trace is differential routing, and differential impedance is 90 ohm.
6	Insure ADC trance is protected by GND.
7	Insure SIM card signal trance is protected by GND. Especially SIM_CLK must be protected alone. And avoid signal trace branched Routing.
8	Insure TVS avoid bypass. The trace must go through TVS pad first, and then arrived module pad.
9	There should be enough ground around the RF line. RF lines Routing prohibit right angles and sharp angles, trying to trace circular or obtuse angle line.
10	The RF line reference GND should be complete. And avoid high speed lines crossing below it.
11	the GND side of the RF output pin should be non hot welding disk
12	The routing which is RF output PIN to antenna should be isolated from other high-speed lines. And the routing should be 50Ωimpedance control.

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

Table 45: Coding Schemes and Maximum Net Data Rates over Air Interface

Channel defintion(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	
LTE-FDD device category (Downlink)	**Max data rate（peak）**	**Modulation type**	
Category M1	300 kbps	QPSK/16QAM	
Category NB2	20 kbps	BPSK/QPSK	
LTE-FDD device category (Uplink)	**Max data rate （peak）**	**Modulation type**	
Category M1	300 kbps	QPSK/16QAM	
Category NB2	10.3 kbps	BPSK/QPSK	

D. Related Documents

Table 46: Related Documents

NO.	Title	Description
[1]	SIM7070 Series AT Command Manual_V1.xx	AT Command Manual
[2]	GSM 07.07	Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)
[3]	GSM 07.10	Support GSM 07.10 multiplexing protocol
[4]	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)
[5]	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
[6]	GSM 11.11	Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module − Mobile Equipment (SIM − ME) interface
[7]	GSM 03.38	Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information
[8]	GSM 11.10	Digital cellular telecommunications system (Phase 2)；Mobile Station (MS) conformance specification；Part 1: Conformance specification
[9]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[10]	3GPP TS 34.124	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[11]	3GPP TS 34.121	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[12]	3GPP TS 34.123-1	Technical Specification Group Radio Access Network; Terminal conformance specification; Radio transmission and reception (FDD)
[13]	3GPP TS 34.123-3	User Equipment (UE) conformance specification; Part 3: Abstract Test Suites.
[14]	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
[15]	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
[16]	IEC/EN60950-1(2001)	Safety of information technology equipment (2000)
[17]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[18]	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

[19]	Module secondary-SMT-UGD-V1.xx	Module secondary SMT Guidelines
[20]	SIM7070 Series UART Application Note_V1.xx	This document describes how to use UART interface of SIMCom modules.
[21]	ETSI EN 301 908-13 (ETSI TS 136521-1 R13.4.0)	IMT cellular networks; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive; Part 13
[22]	ANTENNA DESIGN GUIDELINES FOR MULTI-ANTENNA SYSTEM V1 01	Design notice for multi-antenna.

(continued) substances in electrical and electronic equipment (RoHS)

E. Terms and Abbreviations

Table 47: Terms and Abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
ARP	Antenna Reference Point
BER	Bit Error Rate
BD	BeiDou
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
DAM	Downloadable Application Module
DPO	Dynamic Power Optimization
DRX	Discontinuous Reception
e-DRX	Extended Discontinuous Reception
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
GNSS	Global Navigation Satellite System
GPRS	General Packet Radio Service
GPS	Global Positioning System
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
NMEA	National Marine Electronics Association
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
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
SIM	Universal subscriber identity module

UMTS	Universal mobile telecommunications system
UART	Universal asynchronous receiver transmitter
PSM	Power saving mode
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

F. Safety Caution

Table 48: 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 and not operate normally due to 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. Forgetting to think much of these instructions may impact the flight safety, or offend local legal action, or both.
🔥	Do not operate the cellular terminal or mobile in the presence of flammable gases or fumes. Switch off the cellular terminal when you are near petrol stations, fuel depots, chemical plants or where blasting operations are in progress. Operation of any electrical equipment in potentially explosive atmospheres can constitute a safety hazard.
📺	Your cellular terminal or mobile receives and transmits radio frequency energy while switched on. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment.
🚗	Road safety comes first! Do not use a hand-held cellular terminal or mobile when driving a vehicle, unless it is securely mounted in a holder for hands free operation. Before making a call with a hand-held terminal or mobile, park the vehicle.
SOS	GSM cellular terminals or mobiles operate over radio frequency signals and cellular networks and cannot be guaranteed to connect in all conditions, especially with a mobile fee or an invalid SIM card. While you are in this condition and need emergent help, please remember to use emergency calls. In order to make or receive calls, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength. Some networks do not allow for emergency call if certain network services or phone features are in use (e.g. lock functions, fixed dialing etc.). You may have to deactivate those features before you can make an emergency call. Also, some networks require that a valid SIM card be properly inserted in the cellular terminal or mobile.