SIM7070G-HP Series Hardware Design

LPWA Module

SIMCom Wireless Solutions Limited
SIMCom Headquarters Building, Building 3, No. 289 Linhong Road, Changning District, Shanghai P.R. China
Tel: 86-21-31575100
support@simcom.com
www.simcom.com

Document Title:	SIM7070G-HP Series Hardware Design
Version:	1.02
Date:	2024-11-05
Status:	Released

GENERAL NOTES

SIMCOM OFFERS THIS INFORMATION AS A SERVICE TO ITS CUSTOMERS, TO SUPPORT APPLICATION AND ENGINEERING EFFORTS THAT USE THE PRODUCTS DESIGNED BY SIMCOM. THE INFORMATION PROVIDED IS BASED UPON REQUIREMENTS SPECIFICALLY PROVIDED TO SIMCOM BY THE CUSTOMERS. SIMCOM HAS NOT UNDERTAKEN ANY INDEPENDENT SEARCH FOR ADDITIONAL RELEVANT INFORMATION, INCLUDING ANY INFORMATION THAT MAY BE IN THE CUSTOMER'S POSSESSION. FURTHERMORE, SYSTEM VALIDATION OF THIS PRODUCT DESIGNED BY SIMCOM WITHIN A LARGER ELECTRONIC SYSTEM REMAINS THE RESPONSIBILITY OF THE CUSTOMER OR THE CUSTOMER'S SYSTEM INTEGRATOR. ALL SPECIFICATIONS SUPPLIED HEREIN ARE SUBJECT TO CHANGE.

COPYRIGHT

SIMCom Wireless Solutions Limited
SIMCom Headquarters Building, Building 3, No. 289 Linhong Road, Changning District, Shanghai P.R. China
Tel: +86 21 31575100
Email: simcom@simcom.com

For more information, please visit:
https://www.simcom.com/download/list-863-en.html

For technical support, or to report documentation errors, please visit:
https://www.simcom.com/ask/ or email to: support@simcom.com

Version History

Date	Version	Description of change	Author
2021-04-09	V1.00	Original	Xin Zhou Meihao Li
2022-12-12	V1.01	Update part of the content	Yifan Sun
2024-11-05	V1.02	1. Update the document format. 2. Update baking standards. 3. Add the applicable model SIM7070G-HP-S 4. Update current consumption data in section 5.4 5. Update the timing parameters in section 3.2 6. Add RTC Mode section	Xin Zhou Meihao Li

Contents

Table Index

Figure Index

1 Introduction

This document describes the electronic specifications, RF specifications, interfaces, mechanical characteristics and testing results of the modules. With the help of this document and other software application notes/user guides, users can understand and use SIM7070G-HP Series modules to design and develop applications quickly.

1.1 Documentation Overview

Technical information for the module is primarily covered by the documents listed in Table 1. All documents must be studied for a thorough understanding of the device and its applications.

Table 1: Documents Overview

No.	Document	Description
[1]	SIM7070G-HP_Series_Hardware_Design_V1.02 (This document)	Mainly introducing interface functions, Recommend circuit, PCB layout guideline, packaging and other hardware components, as well as the use of AT commands
[2]	SIM7070_SIM7080_SIM7090 Series_AT Command Manual_V1.07	SIM7070G Series AT Command Manual
[3]	SIM7070 Series-TE kit User Guide_V1.01	SIM7070 Series-TE User Guide Document
[4]	SIMCOM_EVB KIT_User Guide_V1.01	SIMCOM-EVB User Guide Document
[5]	SIM7070 Series reference Design V1.01	Reference circuit applications and reference BOM
[6]	MOD_SIM7070G-HP-S_84_sch & PCB	Reference Package
[7]	8VC000-SIM7070G-TE_V1.01_sch & PCB	SIM7070_SeriesTE SCH&PCB Document

NOTE

This current revision is an early release to support initial product developers. The content is subject to change without advance notice.

1.2 Product Outline

SIM7070G-HP series are embedded IoT (LTE Cat M1, LTE Cat NB2, IoT-NTN and GNSS) wireless communication modules. The physical dimension of the module is 24mm*24mm*2.3mm. 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 and etc.

Table 2: Different Selections of the series modules

Model	Cat M1	Cat NB2	GNSS	IoT-NTN
SIM7070G-HP	✓	✓	✓	
SIM7070G-HP-S	✓	✓	✓	✓

Table 3: Frequency bands and air interface of the series modules

Network Type	Band	SIM7070G-HP Series			
		SIM7070G-HP		SIM7070G-HP-S	
	Category	M1	NB2	M1	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 B66	✓	✓	✓	✓
IoT-NTN	S-Band B23			✓	
	S-Band B256			✓	
	L-Band B255			✓	
GNSS	Galileo			✓	
	GPS			✓	
	GLONASS			✓	
	BeiDou			✓	

NOTE

Galileo is default closed in software. But users can open it via AT command “AT+CGNSMOD”. For more information about these AT commands, please refer to Document [1]

1.3 Hardware Interface Overview

The interfaces are described in detail in the next chapters include:

- One power supply (One main power supply)
- One USB2.0 interface
- Three UART interfaces
- One USIM interface
- GPIOs
- One ADC interface
- LDO power output
- A set of PCM interfaces
- A set of SPI Interfaces
- A set of I2C Interfaces
- Two antenna Interfaces

1.4 Hardware Block Diagram

The block diagram of the SIM7070G-HP is shown in the figure below.

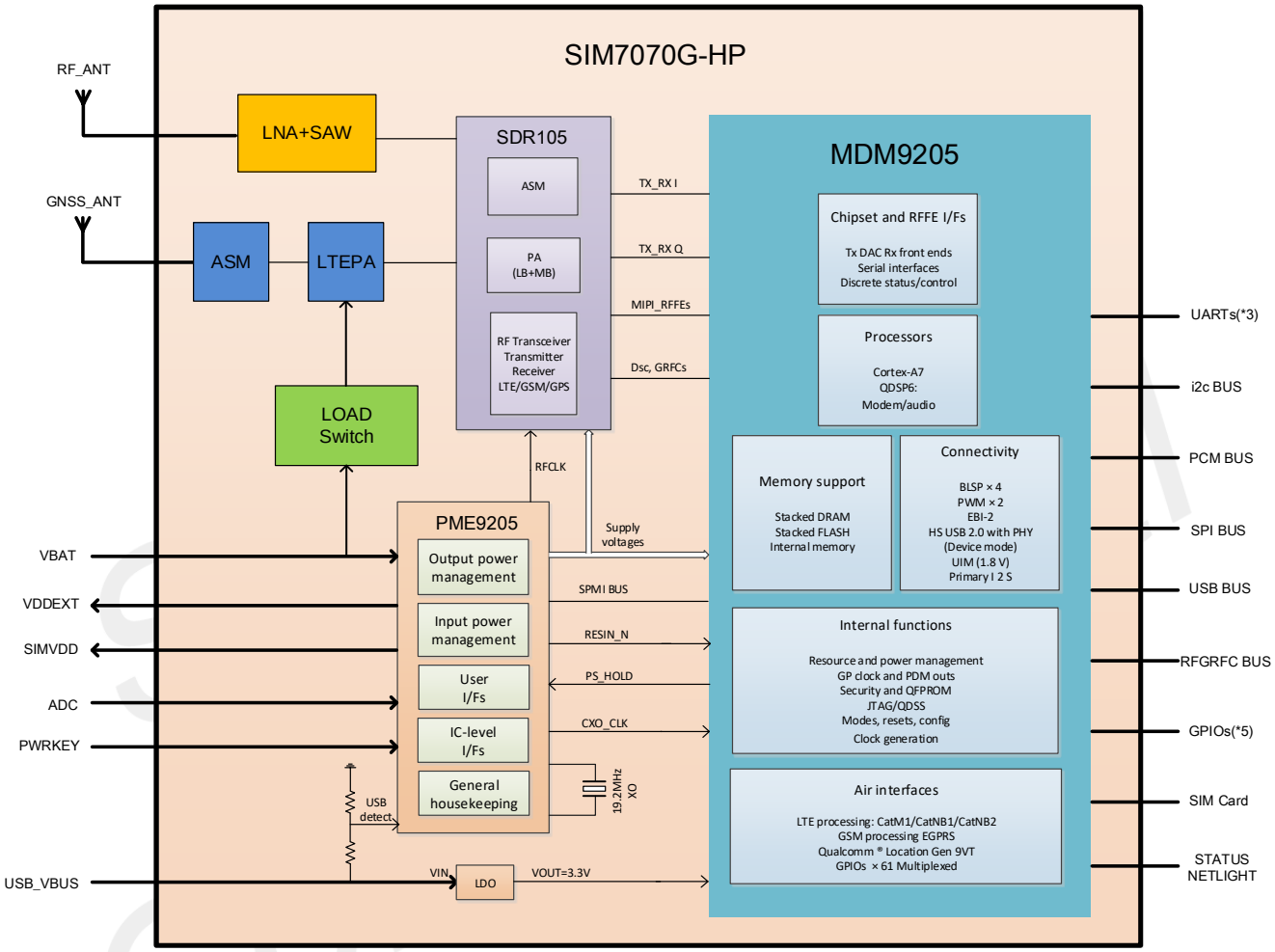

Figure 1: SIM7070G-HP block diagram

The block diagram of the SIM7070G-HP-S is shown in the figure below.

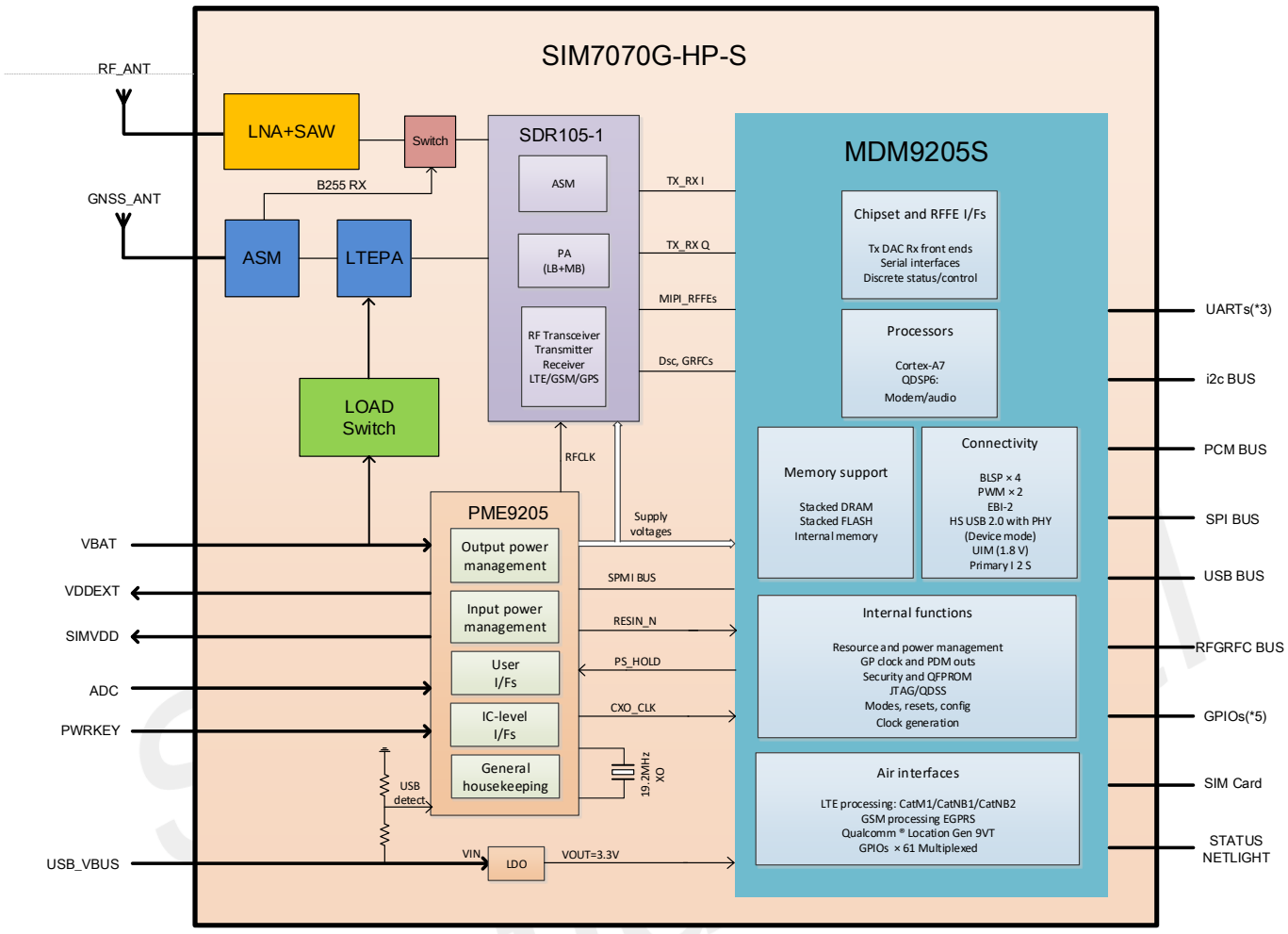

Figure 2: SIM7070G-HP-S block diagram

1.5 Functional Overview

Table 4 describes the features of the module.

Table 4: General features

Feature	Implementation
Power supply	Power supply voltage 3.0V～4.5V. Default :3.8V
Power saving mode	Current in PSM mode: 3.8uA
Radio frequency bands	Please refer to the table 1

Transmitting power	LTE power class: 3(23dBm +/-2.7dB)
Data Transmission Throughput	LTE CAT M1:589Kbps (DL). LTE CAT M1: 1119Kbps (UL). LTE CAT NB2: 127Kbps (DL) LTE CAT NB2: 158.5Kbps (UL) IoT-NTN: TBD
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 DEBUG-UART 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	SIM7070G-HP Size: 24*mm24mm*2.3mm Weight: TBD SIM7070G-HP-S Size: 24*mm24mm*2.3mm Weight: TBD
Temperature range	operation temperature: -40℃~ +85℃ Storage temperature -45℃ to +90℃

2 Package Information

2.1 Pin Assignment Overview

All functions of the series modules will be provided through 84 pads that will be connected to the customers' platform. The Figure 3 is the pin assignment of the series modules.

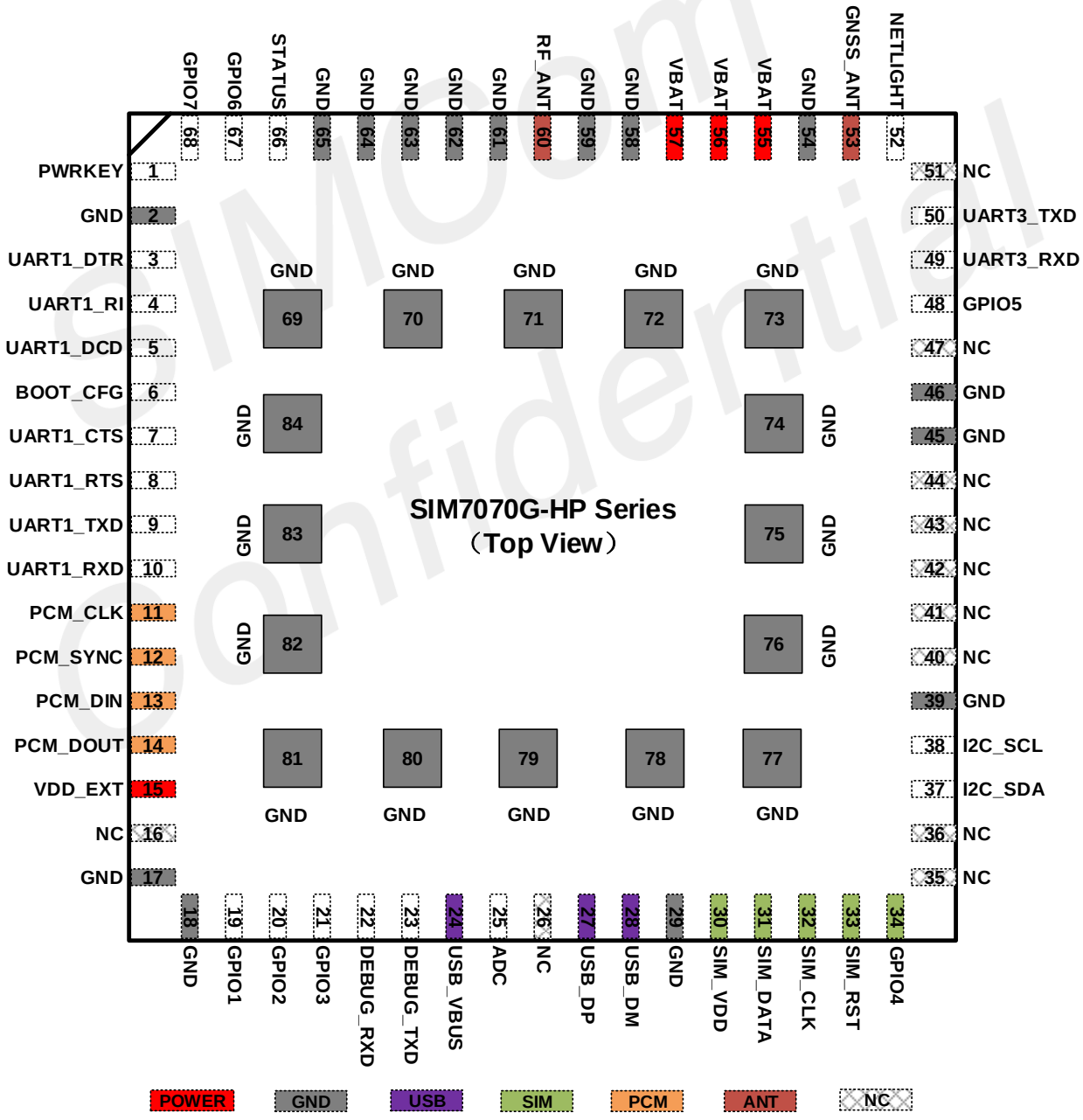

Figure 3: Pin assignment overview

Table 5 lists the series modules pin numbers and pin definitions.

Table 5: 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
69	GND	70	GND
71	GND	72	GND

73	GND	74	GND
75	GND	76	GND
77	GND	78	GND
79	GND	80	GND
81	GND	82	GND
83	GND	84	GND
85	GND	86	GND

NOTE

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

2.2 Pin Description

This section describes the module of pins and pin function definitions

Table 6: 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 7: Pin description

Pin name	Pin No.	Default status	Description	Comment
Power supply				
VBAT	55,56 57	PI	Power supply, Voltage range: 3.0～4.5V. Type voltage: 3.8V	
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 65,69,70,7 1,72,73,74 ,75,76,77, 78,79,80,8 1,82,83,84		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 efficient input high level must be higher than 1.0V. After the PWRKEY continues to pull down more than 12S, the system will automatically reset. Therefore, long-term grounding is not recommended	The level is 1.5V when this PIN is floating;
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.	All lines of SIM interface should be protected against ESD.
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.	
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	Software download interface. It is recommended to reserve interfaces or test points.
USB_DP	27	I/O	Positive line of the differential, bi-directional USB signal.	
USB_DM	28	I/O	Negative line of the differential, bi-directional USB signal.	
UART interface				
UART1_DTR	3	DI,PH	DTE get ready	If unused, keep them open.
UART1_RI	4	DOH	Ring Indicator	
UART1_DCD	5	DOH	Carrier detects	
UART1_CTS	7	DOL	Clear to Send	
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.	If unused, please

PCM_SYNC	12	DO	PCM data frame sync signal.	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	If unused, please keep them open.
SPI_MISO	20	DO	Main Controller DATA input. Multiplexed by GPIO2	
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.	If unused, keep them open.
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.	
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 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	Reserve a test points for it. Keep it open.DO NOT PULL UP DURING NORMAL POWER UP!
ADC	25	AI	Analog-digital converter input. voltage range:0V～1.8V.	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 SIM7070G-HP series module and describes the length, width, height and tolerance of the SIM7070G-HP series module.

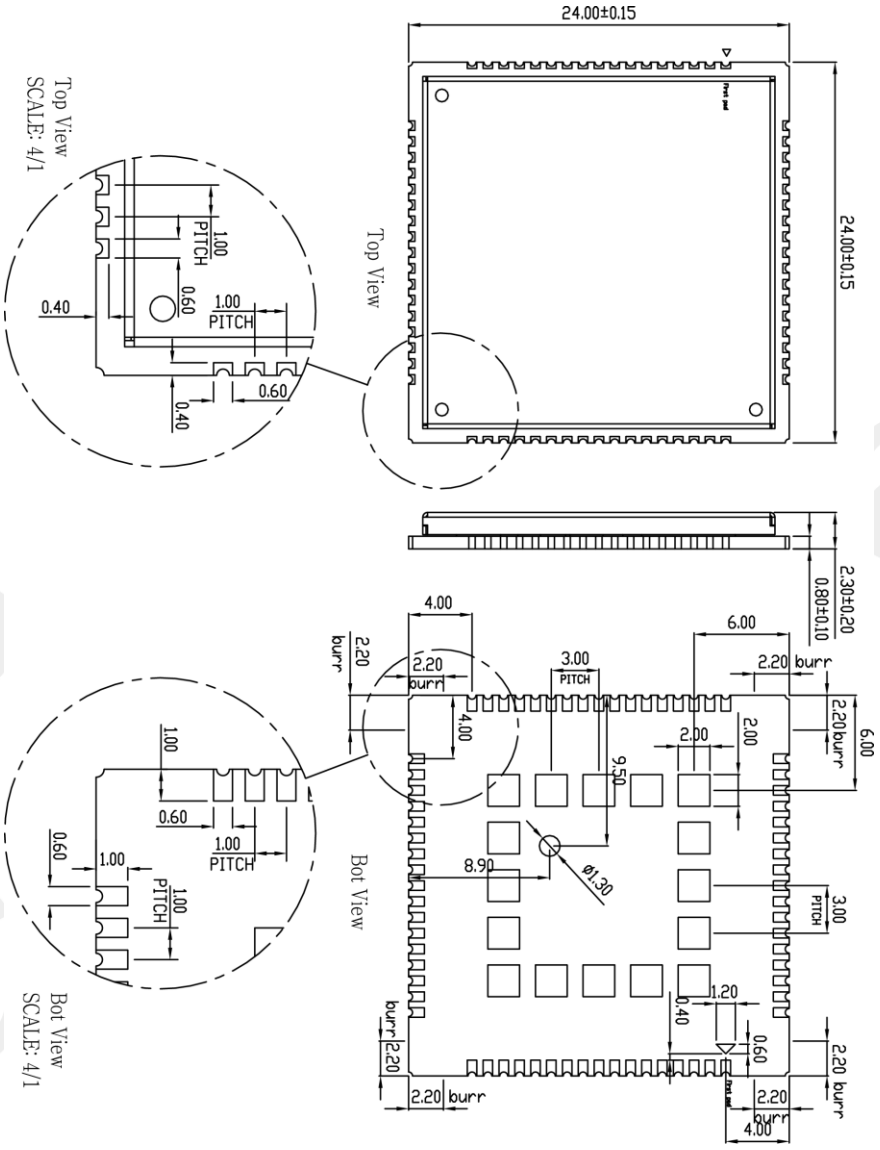

Figure 4: Dimensions (Unit: mm)

NOTE

The above tolerance dimensions do not include burr areas.

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-NB2 and CAT-M1 mode, the ripple current is up to 0.7A typically. For steady voltage, the power supply capability must be up to 0.7A.

Table 8 describes the electrical characteristics of the VBAT pin and the current consumption of the module in different modes.

Table 8: VBAT pins electronic characteristic

Symbol	Description	Min	Typ	Max	Unit
VBAT	Module power voltage	3.0	3.8	4.5	V
$I_{VBAT(peak)}$	The series modules consumption peak current	-	0.7	-	A
$I_{VBAT(average)}$	The series modules power average current in normal mode	Please refer to the chapter 5.4			
$I_{VBAT(sleep)}$	The series modules power current in sleep mode				
$I_{VBAT(power-off)}$	The series modules power current in power off mode.	-	-	15	uA
$I_{VBAT(PSM)}$	The series modules power current in PSM mode.	-	3.8	-	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 9 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 9: Minimum input voltage

Module	Minimum input voltage(V)
SIM7070G-HP Series modules	3.0

The figure 5 shows the recommended circuit.

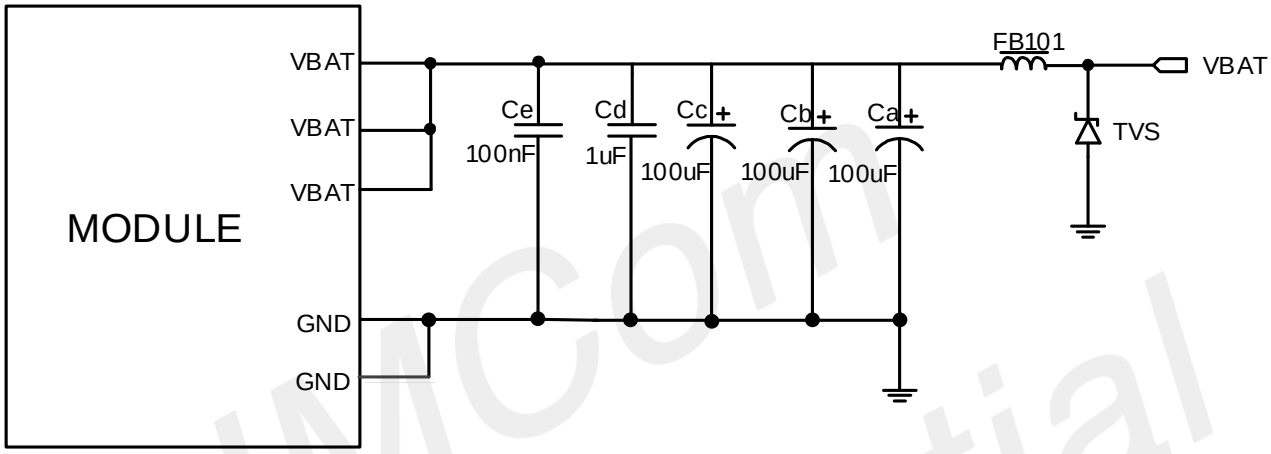

Figure 5: Power supply application circuit

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 0.8 mm to minimize PCB trace impedance.

Table 10: Recommended TVS diode list

No.	MFR.	Part Num.	V_{RWM}	V_C(MAX)	P_{PP}(max)	C_J(max)	Package
1	WILL	ESD56301D05	5V	9.5V	1500W	700pF	DFN1610
2	WILL	ESD56301D04-2/TR	4.85V	11V	2000W	480pF	DFN1610
3	WAYON	WS2057KP	5V	12V	2040W	700pF	DFN1610
4	WAYON	WS4.5DPHXM	4.85V	11V	2255W	700pF	DFN1610

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 the series modules, it is also necessary to consider the low static power consumption of IC in PSM mode.

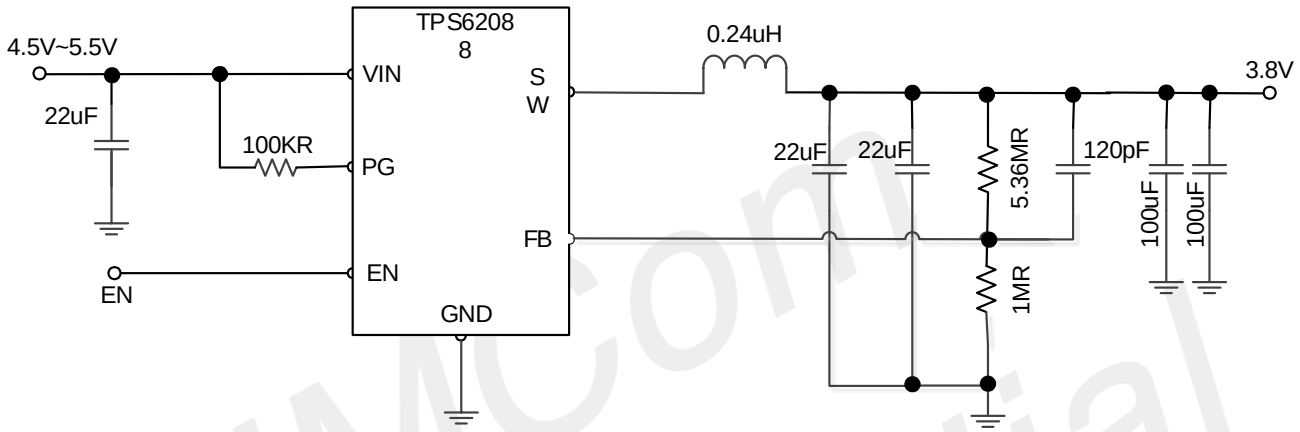

Figure 6: Power supply reference circuit

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 series modules are shown in Table 11.

Table 11: Alarm and Shutdown Voltage Range

Module	Low voltage shutdown(V)	Low voltage alarm(V)	High voltage shutdown(V)	High voltage alarm(V)
SIM7070G-HP series	2.8	3.0	4.7	4.6

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/Reset Function

3.2.1 Power on

The PWRKEY pin has a default voltage of 1.5V. The module 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 seconds). After the PWRKEY is pulled low, the module will be reset after 12 seconds. Therefore, it is not recommended to connect PWRKEY to ground all the time in external circuit design.

Please refer to the following figure for the recommended reference circuit.

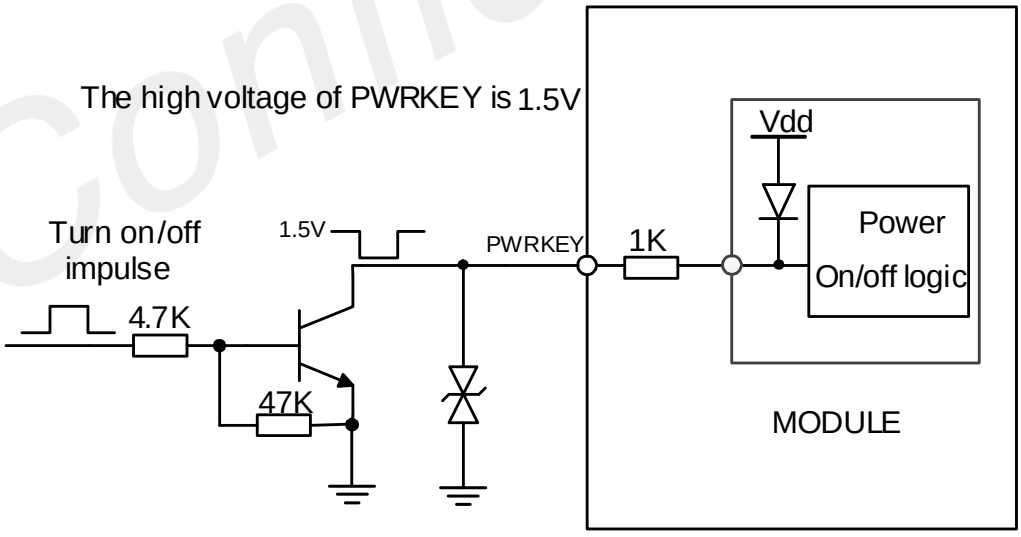

Figure 7: Reference power on/off circuit

The power-on scenarios are illustrated in the following figure.

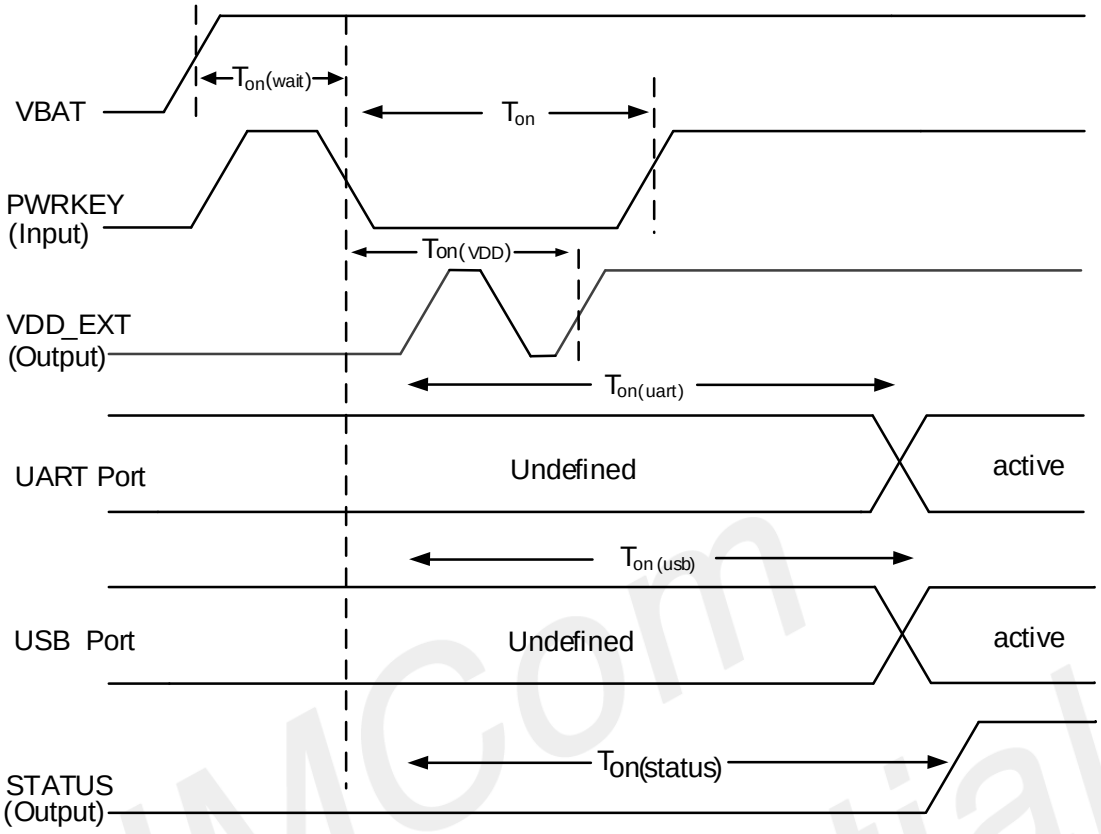

Figure 8: Power on timing sequence

Table 12: Power on timing and electronic characteristic

Symbol	Parameter	Min.	Typ.	Max.	Unit
$T_{on(wait)}$	The time from VBAT power-on stabilization to PWRKEY pin pull-down validity	1	-	-	s
T_{on}	The time of active low level impulse of PWRKEY pin to power on module	0.5	-	12	s
$T_{on(Vdd)}$	The time from power-on issue to VDD_EXT pin output high level	-	220	250	ms
$T_{on(status)}$	The time from power-on issue to STATUS pin output high level(indicating power up ready)	-	3	4	s
$T_{on(uart)}$	The time from power-on issue to UART port ready	-	3	4	s
$T_{on(usb)}$	The time from power-on issue to USB port ready	-	3	4	s
V_{IH}	Input high level voltage on PWRKEY pin	1.0	1.5	1.8	V
V_{IL}	Input low level voltage on PWRKEY pin	-0.3	0	0.4	V

NOTE

1. PWRKEY cannot be shorted all the way to ground.
2. It is recommended to ensure that the VBAT voltage rises and stabilizes before pulling down the PWRKEY pin to start up.
3. After the PWRKEY pull down, the VDD_EXT has a software reset action during the startup process.
4. 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 off the module.

- Method 1: Power off the module by pulling the PWRKEY pin to ground.
- Method 2: Power off the module 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

1. For details about “AT+CPOWD” and “AT+CBATCHK”, please refer to Document [1].
2. 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 9.

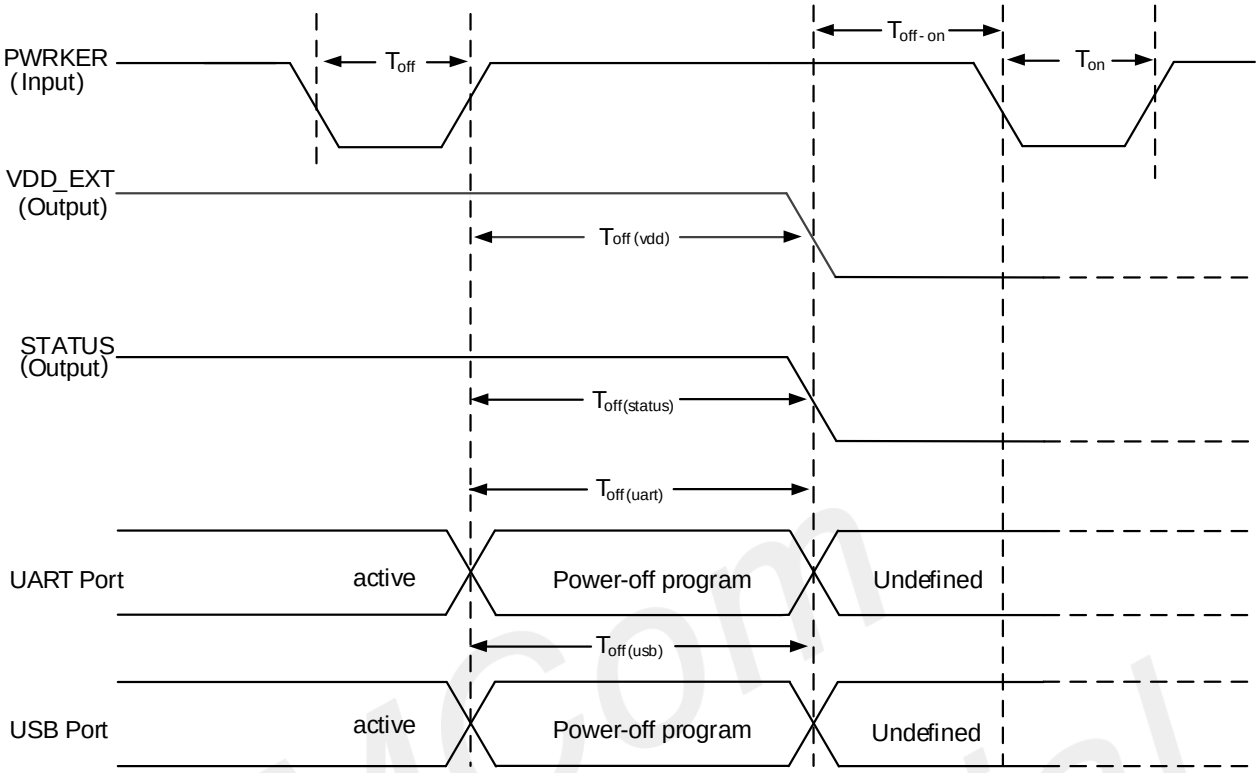

Figure 9: Power off timing sequence

Table 13: Power off timing and electronic characteristic

Symbol	Parameter	Time value			Unit
		Min.	Typ.	Max.	
T_{off}	The active low level time pulse on PWRKEY pin to power off module	1.2	-	-	s
$T_{off(vdd)}$	The time from power-off issue to VDD_EXT pin output low level	-	5	-	s
$T_{off(status)}$	The time from power-off issue to STATUS pin output low level(indicating power off)*	-	5	-	s
$T_{off(uart)}$	The time from power-off issue to UART port off	-	5	-	s
$T_{off(usb)}$	The time from power-off issue to USB port off	-	5	-	s
T_{off-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

The module can provide 3 channels 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 here 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 supports 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.

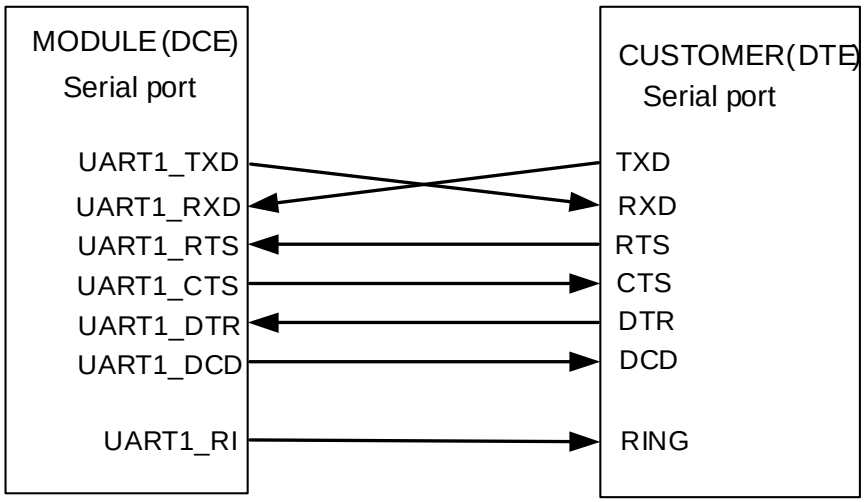

Figure 10: UART full modem

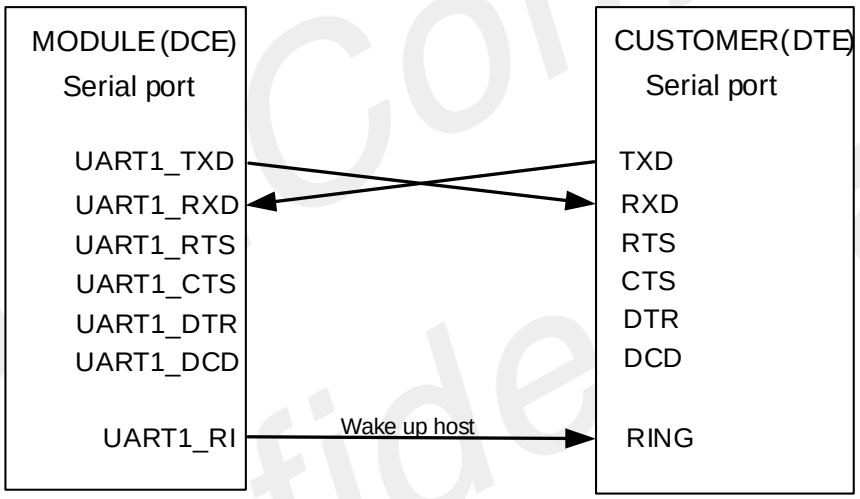

Figure 11: UART null modem

Table 14: UART electronic characteristic

Symbol	Description	Min.	Typ.	Max.	Unit
V_{IH}	UART input high level voltage	1.17	1.8	2.1	V
V_{IL}	UART input low level voltage	-0.3	0	0.63	V
V_{OH}	UART output high level voltage	1.35	1.8	1.8	V
V_{OL}	UART output low level voltage	0	0	0.45	V

The module provides 1.8V UART 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.

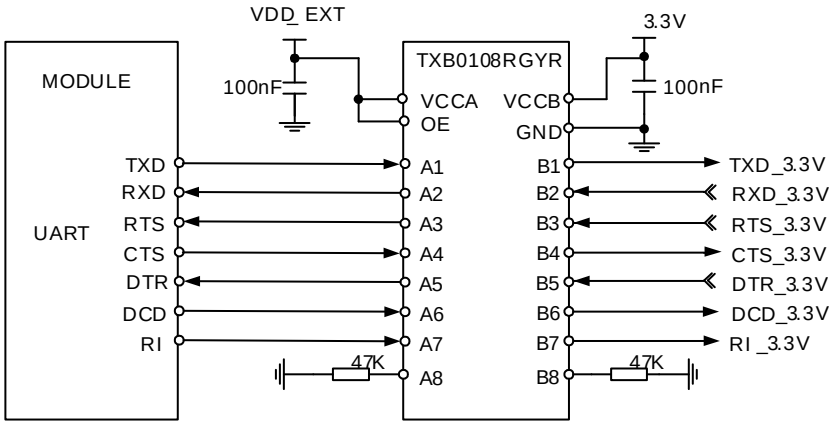

Figure 12: Reference circuit with level shifter IC

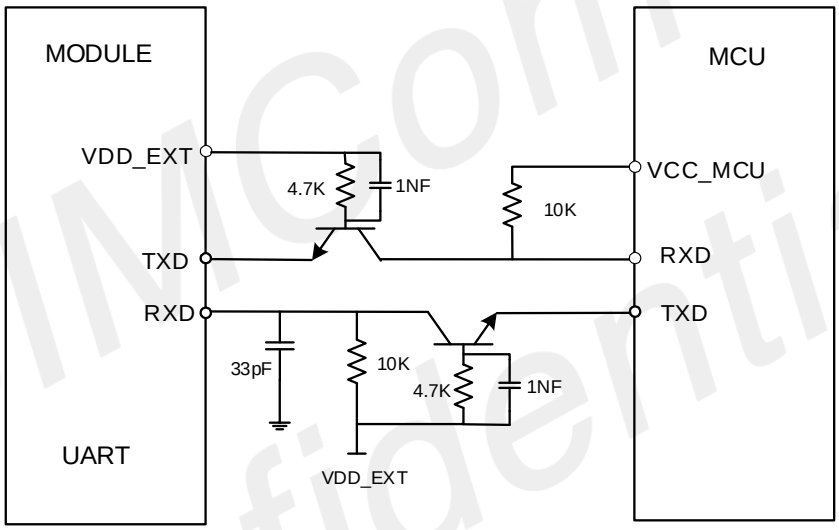

Figure 13: Reference circuit with Transistor

NOTE

1. 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.
2. When it uses the transistor, the selection of the transistor must be a high-speed transistor, and the model MMBT3904 is recommended.
3. In order to ensure the stability of UART data transmission, it is recommended that the baud rate of the serial port should not exceed 38400bps when the continuous transmission is set (without inserting delay) and the flow control function is not enabled. When the baud rate does not exceed 460800bps, it is recommended to insert 50ms delay for every 256 bytes sent, and whether to add flow control can be decided according to requirements. When the baud rate is greater than or equal to 921600bps, it is recommended to insert 50ms delay for every 256 bytes sent, and adopt UART hardware flow control design.

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.

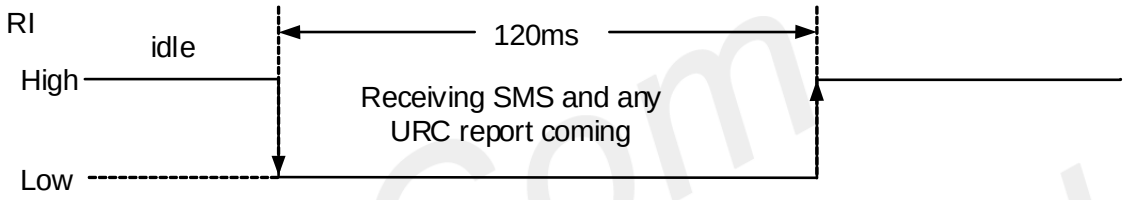

Figure 14: RI behavior（SMS and URC report）

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 the module enters sleep mode, pulling down DTR can wake up the module.

After setting the AT command "AT+CSCLK=0", the module 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

The module provides one USB2.0 interface witch supports operation at low-speed (1.5 Mbps), full-speed (12 Mbps) and high-speed (480 Mbps) modes. It can be used for software upgrade and software debug.

The USB of the module 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 damage the module.

The reference circuit refers to the following figure.

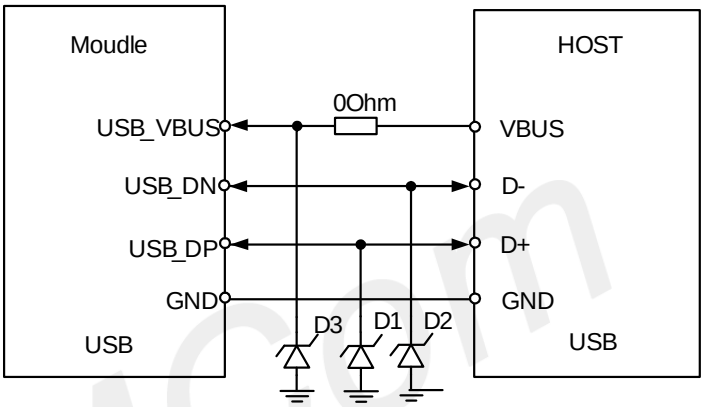

Figure 15: USB reference circuit

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 15: Recommended TVS model for USB signal cable

No.	MFR.	Part Num.	V_{RWM}	V_C(MAX)	P_{PP}(max)	C_J(max)	Package
1	WILL	ESD73131CZ	5V	6.5V	78W	0.45pF	DWN0603-2L
2	ONSEMI	ESD9L5.0ST5G	5V	9.8V	NA	0.9pF	SOD-923
3	nexperia	PESD5V0F1BSF	5V	12.8V	28W	0.3pF	DSN0603-2

NOTE

1. The USB interface is strongly recommended to reserve test points.
2. 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.

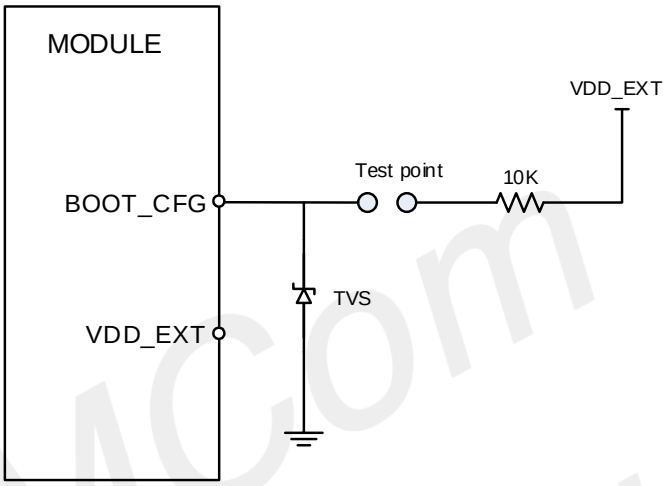

Figure 16: Reference circuit of BOOT_CFG interface

3.6 SIM Interface

The series module only supports 1.8V SIM cards. SIM_VDD is provided by LDO inside the module, the default value is 1.8V.

Table 16: 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

It is recommended to use an ESD protection component. 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.

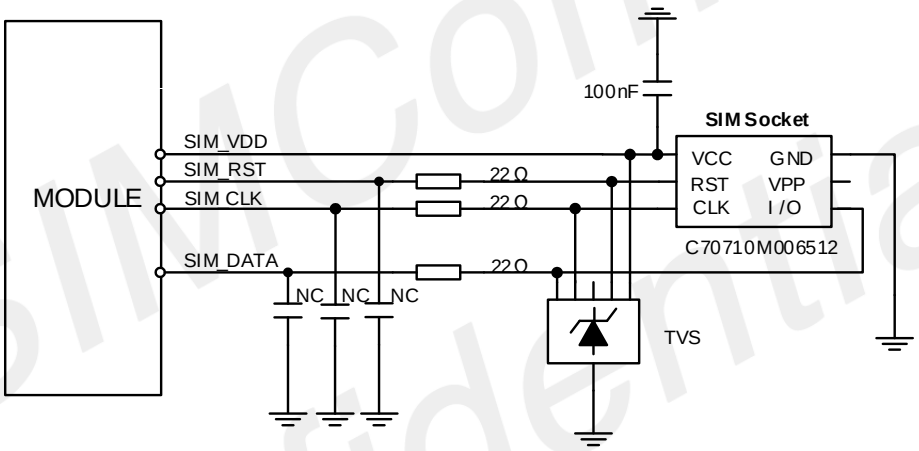

Figure 17: SIM interface reference circuit

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 needs to less 15pF.

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 15pF. 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.

3.7 PCM Interface

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

Table 17: 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

The module supports 2.048 MHz PCM data and sync timing for 16 bits linear format codec.

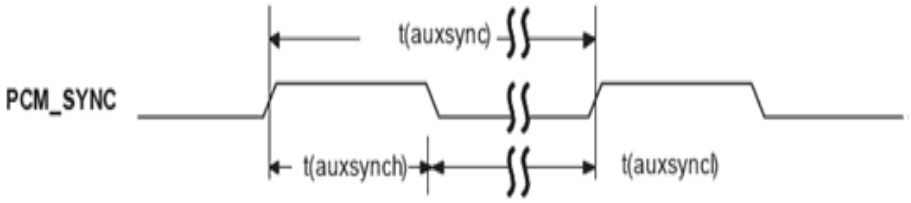

Figure 18: PCM_SYNC timing

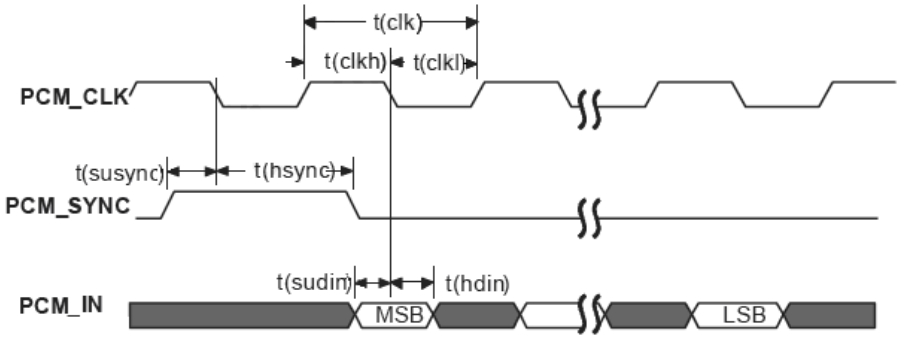

Figure 19: External codec to module timing

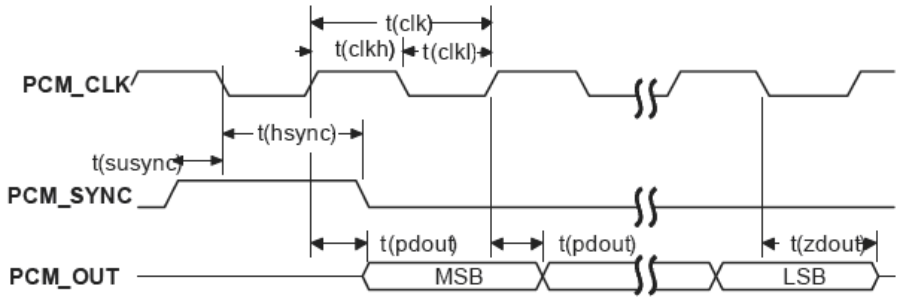

Figure 20: Module to external codec timing

Table 18: 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.

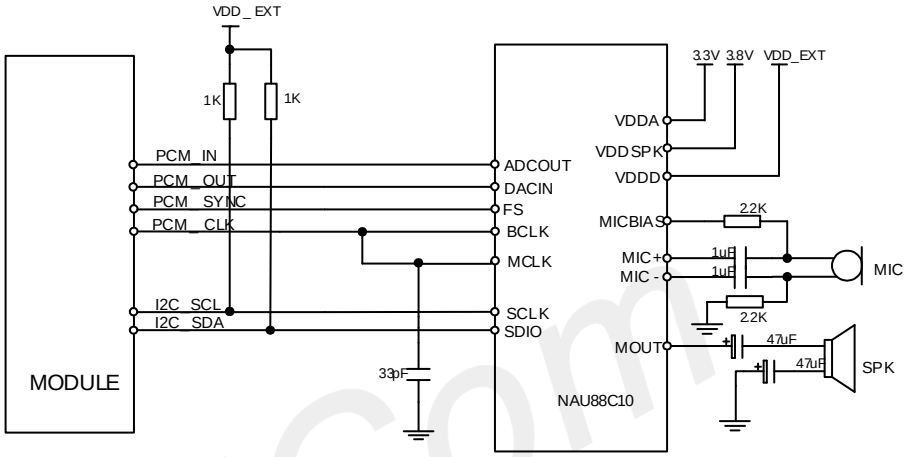

Figure 21: Audio codec reference circuit

3.8 I2C Interface

The module provides an I2C interface with clock rate up to 400 kbps. Its operation voltage is 1.8V.

The following figure shows the I2C bus reference design.

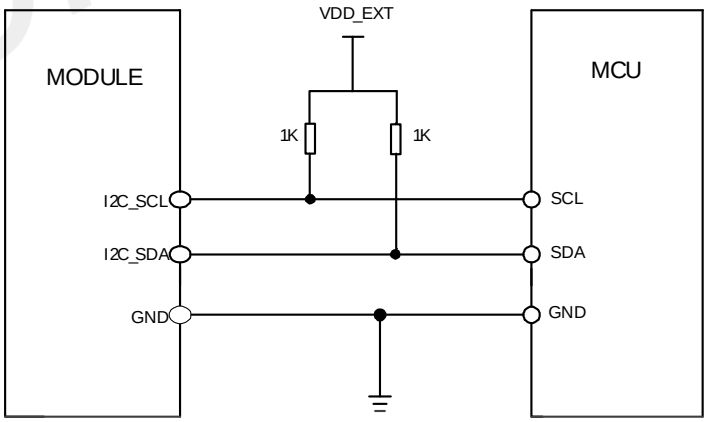

Figure 22: I2C reference circuit

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

The module 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 the module is multiplexed by GPIO1, GPIO2, GPIO3 and GPIO5.

Table 19 describes the multiplex function of the SPI.

Table 19: 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.

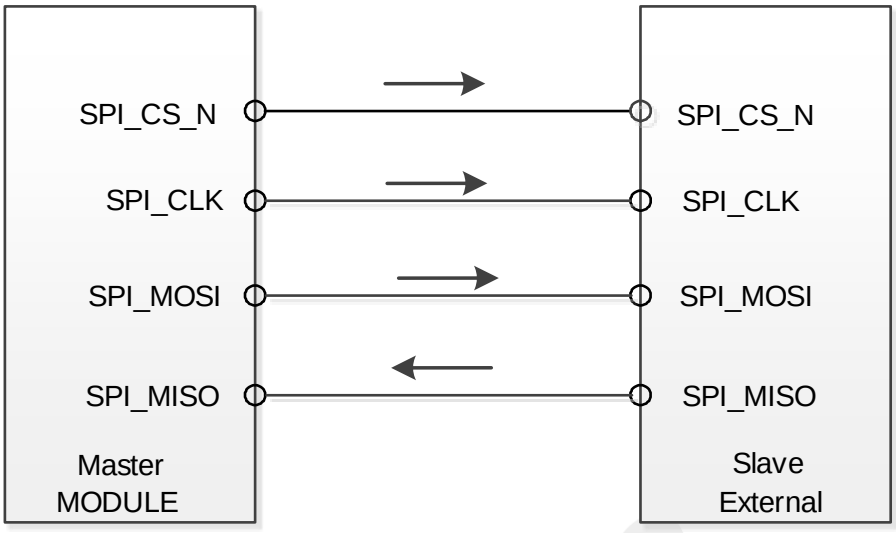

Figure 23: SPI master mode circuit

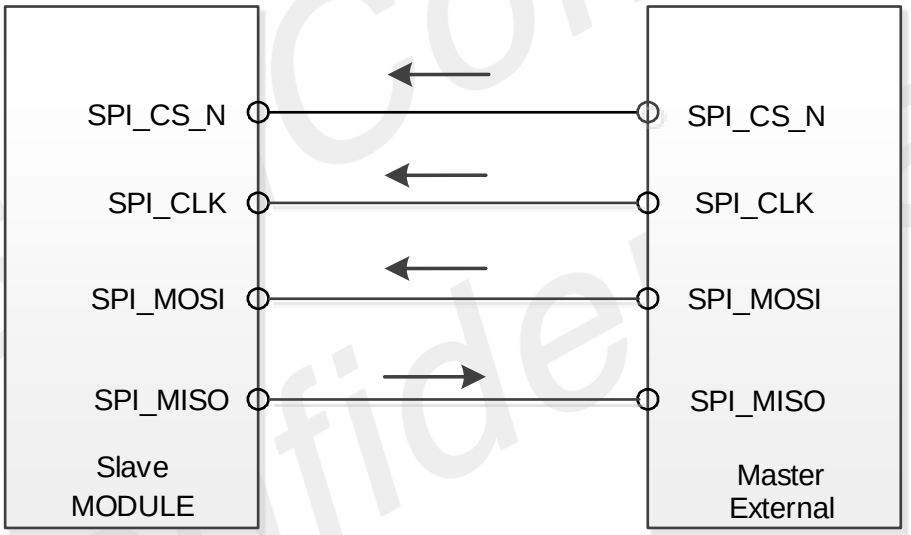

Figure 24: SPI slave mode circuit

3.10 Network Status

The NETLIGHT pin is used to control network status LED, its reference circuit is shown in the following figure.

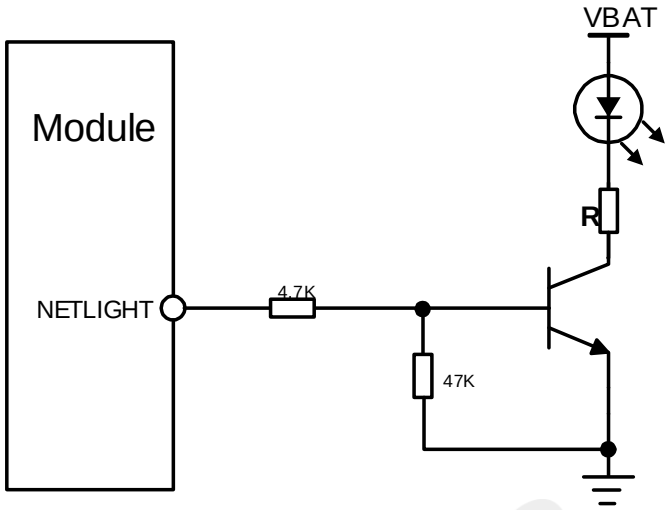

Figure 25: NETLIGHT reference circuit

NOTE

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

Table 20: 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

The module provides a 10-bit high sample rate (ADC) interfaces. It is available for digitizing 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 21: 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

The module has a LDO power output named VDD_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.

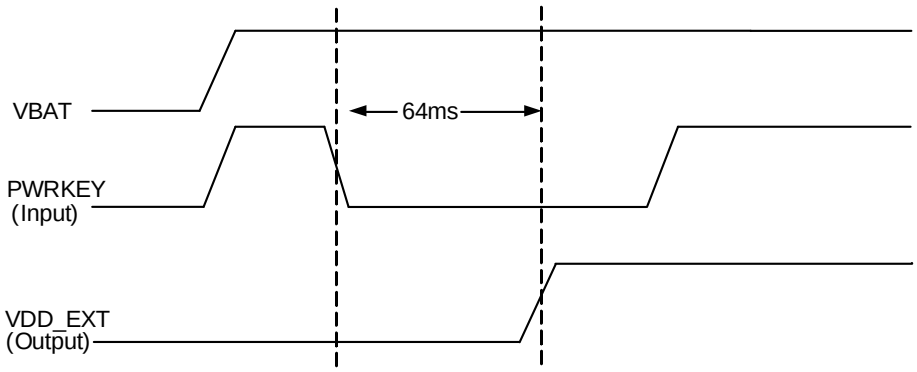

Figure 26: Power on sequence of the VDD_EXT

Table 22: Electronic characteristic

Symbol	Description	Min.	Typ.	Max.	Unit
V_{VDD_EXT}	Output voltage	1.75	1.8	1.85	V
I_O	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 23: Conducted transmission power

CAT-M1

Frequency	Power	Min.
LTE-FDD B1	23dBm +/-2.7dB	<-40dBm
LTE-FDD B2	23dBm +/-2.7dB	<-40dBm
LTE-FDD B3	23dBm +/-2.7dB	<-40dBm
LTE-FDD B4	23dBm +/-2.7dB	<-40dBm
LTE-FDD B5	23dBm +/-2.7dB	<-40dBm
LTE-FDD B8	23dBm +/-2.7dB	<-40dBm
LTE-FDD B12	23dBm +/-2.7dB	<-40dBm
LTE-FDD B13	23dBm +/-2.7dB	<-40dBm
LTE-FDD B14	23dBm +/-2.7dB	<-40dBm
LTE-FDD B18	23dBm +/-2.7dB	<-40dBm
LTE-FDD B19	23dBm +/-2.7dB	<-40dBm
LTE-FDD B20	23dBm +/-2.7dB	<-40dBm
LTE-FDD B25	23dBm +/-2.7dB	<-40dBm
LTE-FDD B26	23dBm +/-2.7dB	<-40dBm
LTE-FDD B27	23dBm +/-2.7dB	<-40dBm
LTE-FDD B28	23dBm +2.7/-3.2dB	<-40dBm
LTE-FDD B66	23dBm +/-2.7dB	<-40dBm

CAT-NB2

Frequency	Power	Min.
LTE-FDD B1	23dBm +/-2.7dB	<-40dBm
LTE-FDD B2	23dBm +/-2.7dB	<-40dBm
LTE-FDD B3	23dBm +/-2.7dB	<-40dBm
LTE-FDD B4	23dBm +/-2.7dB	<-40dBm
LTE-FDD B5	23dBm +/-2.7dB	<-40dBm

LTE-FDD B8	23dBm +/-2.7dB	<-40dBm
LTE-FDD B12	23dBm +/-2.7dB	<-40dBm
LTE-FDD B13	23dBm +/-2.7dB	<-40dBm
LTE-FDD B18	23dBm +/-2.7dB	<-40dBm
LTE-FDD B19	23dBm +/-2.7dB	<-40dBm
LTE-FDD B20	23dBm +/-2.7dB	<-40dBm
LTE-FDD B25	23dBm +/-2.7dB	<-40dBm
LTE-FDD B26	23dBm +/-2.7dB	<-40dBm
LTE-FDD B28	23dBm +/-2.7dB	<-40dBm
LTE-FDD B66	23dBm +/-2.7dB	<-40dBm

IOT-NTN

Frequency	Power	Min.
IOT-NTN B23	23dBm +/-2.7dB	<-40dBm
IOT-NTN B255	23dBm +/-2.7dB	<-40dBm
IOT-NTN B256	23dBm +/-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 24: Maximum Power Reduction (MPR) for UE category NB2&M1&IOT-NTN Power Class 3

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	-	-	≤ 1
QPSK	>5	>5	-	-	-	-	≤ 2
16QAM	≤ 2	≤ 2	>3	>5	-	-	≤ 1
16QAM	>2	>2	>5	-	-	-	≤ 2

CAT-NB1/CAT-NB2/IOT-NTN

Modulation	QPSK		
Tone positions for 3 Tones allocation	0-2	3-5 and 6-8	9-11

MPR	≤ 0.5 dB	0 dB	≤ 0.5 dB
Tone positions for 3 Tones allocation	0-5 and 6-11		
MPR	≤ 1 dB		≤ 1 dB
Tone positions for 3 Tones allocation	0-11		
MPR	≤ 2 dB		

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 25: GNSS operating frequencies

Frequency	Receiving
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 26: 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
23	2000~2020MHz	2180~2200MHz	IOT-NTN
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
66	1710~1780MHz	2110~2180MHz	HD-FDD
255	1626.5~1660.5MHz	1525~1559MHz	IOT-NTN
256	1980~2010MHz	2180~2200MHz	IOT-NTN

Table 27: CAT-M1 Reference sensitivity (QPSK)

E-UTRA Band	REFSENS MAX(dBm) 3GPP Request	SIM7070G-HP REFSENS Typical (dBm)	SIM7070E-HP-S REFSENS Typical (dBm)	Duplex Mode
1	-103	-108.3	TBD	HD-FDD
2	-101	-106.8	TBD	HD-FDD
3	-100	-107.5	TBD	HD-FDD
4	-103	-106.8	TBD	HD-FDD
5	-101.5	-108.3	TBD	HD-FDD
8	-100.5	-107.3	TBD	HD-FDD
12	-100	-108.3	TBD	HD-FDD
13	-100	-108.3	TBD	HD-FDD
14	-100	-107.3	TBD	HD-FDD
18	-103	-108.5	TBD	HD-FDD
19	-103	-107.8	TBD	HD-FDD
20	-100.5	-108.3	TBD	HD-FDD
25	-99.5	-108.8	TBD	HD-FDD
26	-101	-107.8	TBD	HD-FDD
27	-101.5	-108.3	TBD	HD-FDD
28	-101.5	-107.8	TBD	HD-FDD
66	-100	-107.6	TBD	HD-FDD

Table 28: CAT-NB2 Reference sensitivity (QPSK)

Operating bands	REFSENS MAX(dBm) 3GPP Request	SIM7070G-HP		SIM7070G-HP-S	
		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	TBD	TBD
2	-108.2	-114.5	-130	TBD	TBD
3	-108.2	-114	-131	TBD	TBD
4	-108.2	-113.5	-130	TBD	TBD
5	-108.2	-114.5	-129	TBD	TBD
8	-108.2	-114	-130	TBD	TBD

12	-108.2	-114.5	-130	TBD	TBD
13	-108.2	-114.5	-130	TBD	TBD
18	-108.2	-115	-129	TBD	TBD
19	-108.2	-114.5	-128	TBD	TBD
20	-108.2	-114.5	-128	TBD	TBD
25	-108.2	-114.5	-130	TBD	TBD
26	-108.2	-114.5	-129	TBD	TBD
28	-108.2	-115.9	-130	TBD	TBD
66	-108.2	-113.5	-129	TBD	TBD

Table 29: IOT-NTN Reference sensitivity (QPSK)

Operating bands	REFSENS MAX (dBm) 3GPP Request	SIM7070G-HP	SIM7070G-HP-S
		REFSENS Typical(dBm)	REFSENS Typical(dBm)
23	-108.2	NA	TBD
255	-108.2	NA	TBD
256	-108.2	NA	TBD

4.2 LTE Antenna Design Guide

Table 30: CATM&NB&IOT-NTN antenna requirements

Passive	Recommended Standard
Operating band	See table 1
Direction	Omni Directional
Gain	> -3dBi (Avg)
Input impedance	50 Ω
Efficiency	>50 %
Maximum input power	50W
VSWR	< 2
Isolation	>20dB
PCB insertion loss(<1GHz)	<0.5dB
PCB insertion loss(1GHz~2.2GHz)	<1dB
PCB insertion loss(2.3GHz~2.7GHz)	<1.5dB

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.

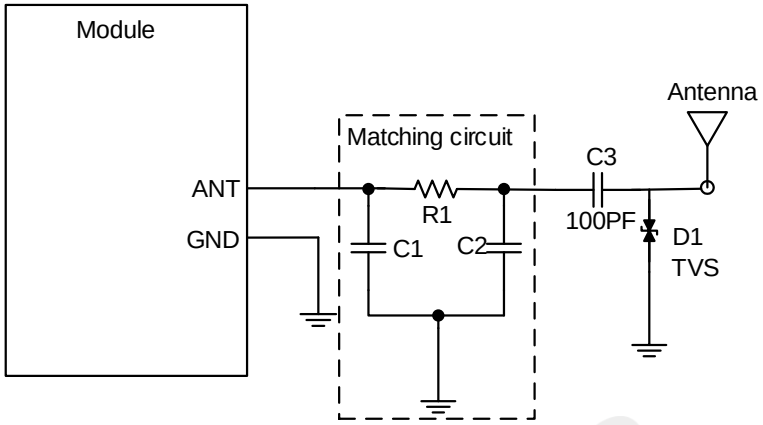

Figure 27: Antenna matching circuit (MAIN_ANT)

The matching circuit R1 is labeled 0Ω by default, and C1 and C2 are reserved by default, and the specific value is determined by the antenna optimization, usually provided by the antenna manufacturer.

The antenna port is easy to introduce static electricity, to avoid the internal components of the module being damaged by static electricity; C3 is pasted with a 100pF capacitor by default to enhance ESD protection capability.

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 the module and antenna must be controlled in 50Ω.

One TVS is recommended in the table below.

Table 31: Recommended TVS

Manufacturer	Part Number	V_{RWM}	V_C(Max)	C_J(Max)	Package
BilLSEMI	BLE5V0CR05UB	5V	40V	0.05pF	DFN1006-2L

4.3 GNSS

The series module 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: -160 dBm (GPS+GLONASS)/-160 dBm (GPS+BD)
- Cold-start sensitivity: -147 dBm
  Accuracy (Open Sky): 0.4 m (GPS+BD)
- TTFF (Open Sky) : Hot start < 1 s, Cold start< 35 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 the module. If using a passive antenna, an external LNA is a must to get better performance. The following figures are the reference circuits.

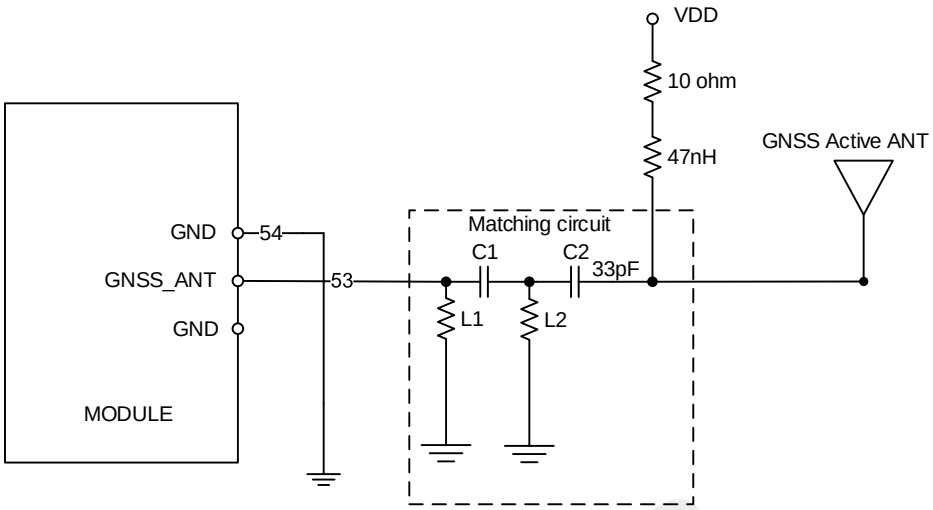

Figure 28: Active antenna circuit

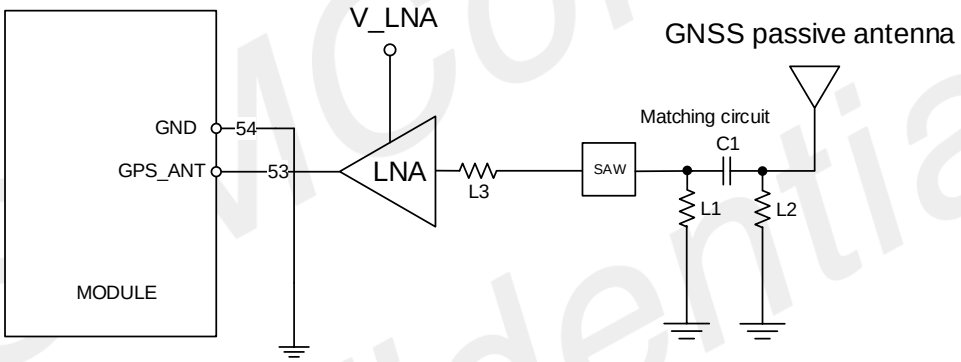

Figure 29: Passive antenna circuit (Default)

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 the module in proper operating mode by AT command. Please refer to related documents for details. SIM7070G-HP 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 via around RF traces.
- RF trace should be far away from other high speed signal lines.

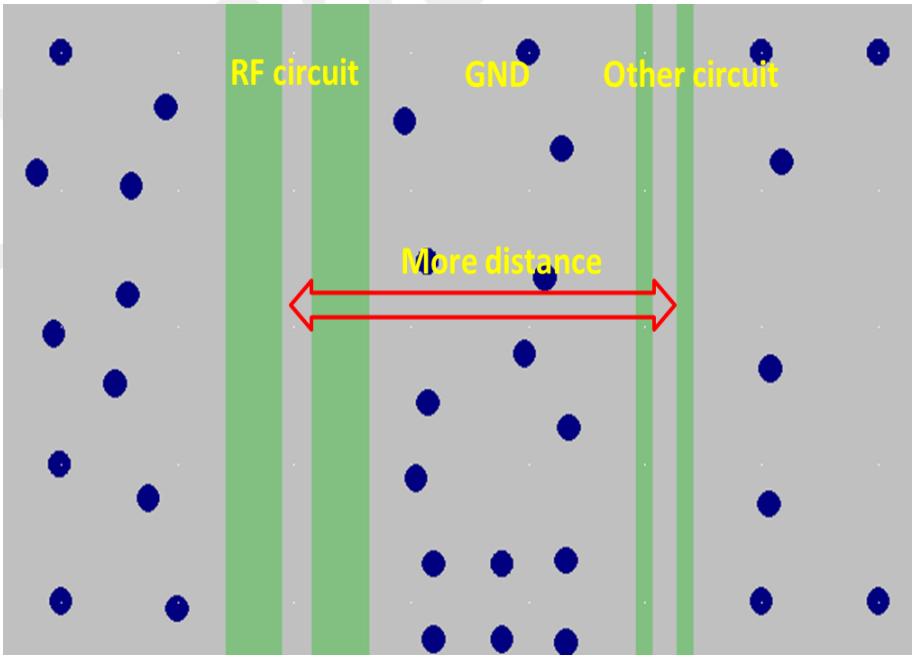

Figure 30: RF trace should be far away from other high speed signal lines

- 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.

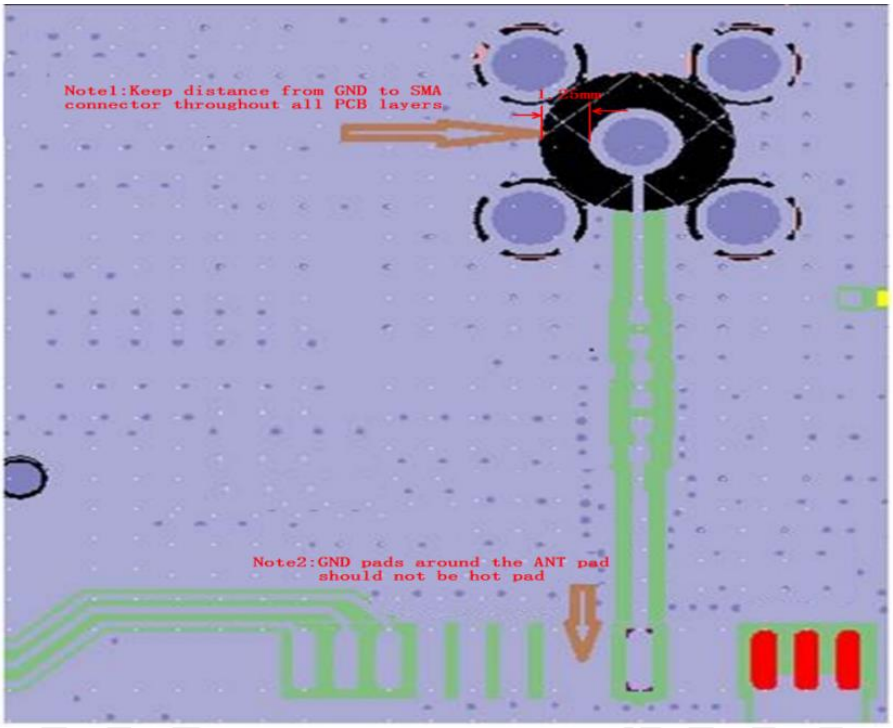

Figure 31: The distance between GND to the inner conductor of SMA

- 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 [15].

5 Electrical Specifications

5.1 Absolute Maximum Ratings

Absolute maximum rating for digital and analog pins of the module is listed in the following table:

Table 32: 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 33: 1.8V Digital I/O characteristics*

Parameter	Description	Min.	Typ.	Max.	Unit
V_{IH}	High-level input voltage	1.17	1.8	2.1	V
V_{IL}	Low-level input voltage	-0.3	0	0.63	V

V_{OH}	High-level output voltage	1.35	-	1.8	V
V_{OL}	Low-level output voltage	0	-	0.45	V
I_{OH}	High-level output current(no pull down resistor)	-	2	-	mA
I_{OL}	Low-level output current(no pull up resistor)	-	-2	-	mA
I_{IH}	Input high leakage current (no pull down resistor)	-	-	1	uA
I_{IL}	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 34: Recommended operating ratings

Parameter	Min.	Typ.	Max.	Unit
VBAT	3.0	3.8	4.5	V
Voltage at USB_VBUS	3.5	5.0	5.25	V

The operating temperature of the module is listed in the following table.

Table 35: 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 the series product.

Table 36: 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 the module 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 the module 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 the module 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 the module 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)

The 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.

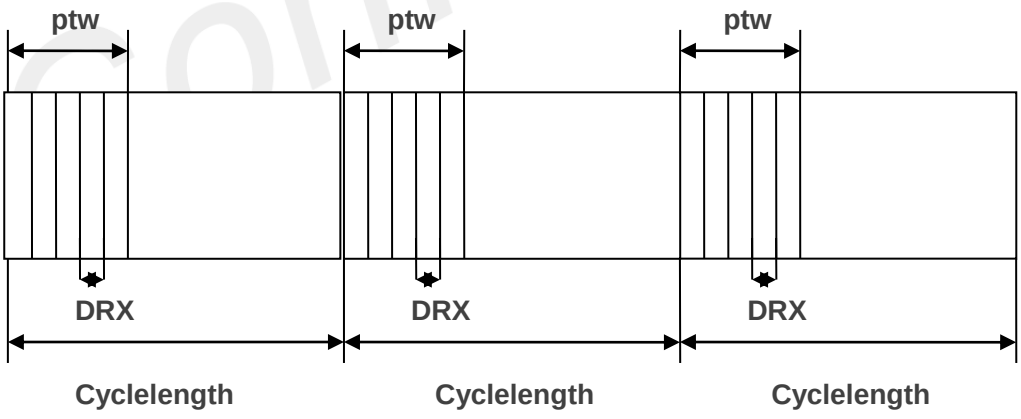

Figure 32: e-DRX diagrammatic sketch

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]

5.3.6 RTC Mode*

Module supports RTC mode for alarm clock, timer or other functions, it can track or record the current date and time by sending AT command. There is no independent RTC backup power supply for RTC clock inside the module, and the RTC logic requires VBAT power supply to PMU to generate the RTC clock, so the power supply for VBAT should not be turned off. Module can enter the RTC mode even in shutdown or sleep mode as long as the correct power supply connected to VBAT.

RTC clock is generated by the frequency divider; and LDO of the 19.2M XO will up regularly every ~10 seconds briefly, so this will increase some current consumption. The RTC block diagram is shown as follow.

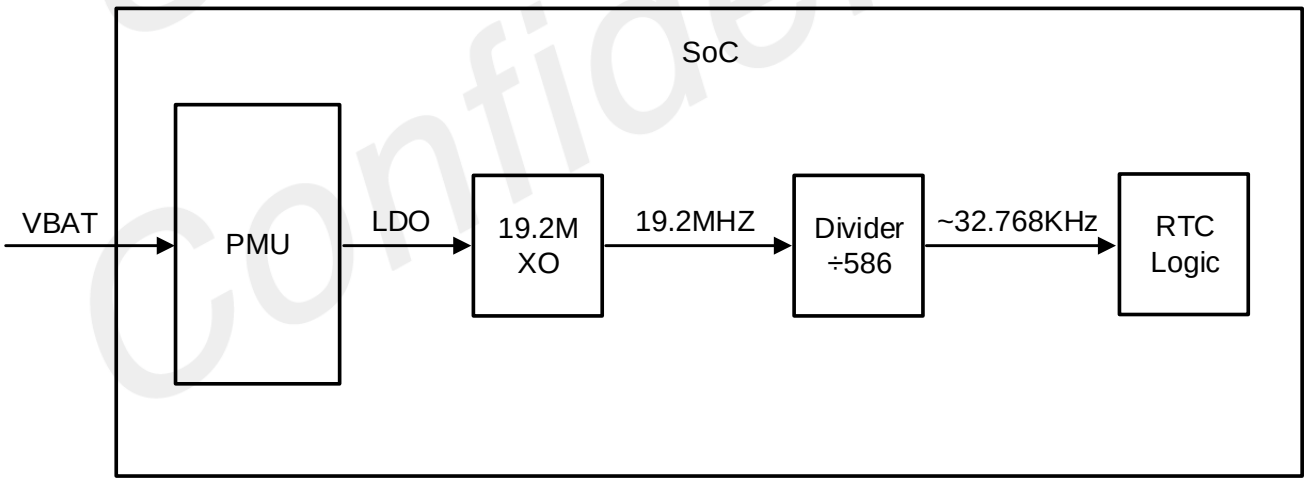

Figure 33: RTC Block Diagram

Table 37: RTC Characteristics

Operating Conditions	RTC Time Accuracy	VBAT Current Consumption
VBAT=3.8V Module shutdown	TBD	TBD

NOTE

This function is under software development.

5.4 Current Consumption

The current consumption of the series modules is listed in the table below.

Table 38: SIM7070G-HP 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）	CAT-M1	Typical: 18mA
	NB1/NB2	Typical: 14mA
Power Saving Mode		
PSM supply current	PSM mode Typical: 3.8uA	
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	
LTE Cat-M (15KHz) data transmission		
LTE-FDD B1	@23dbm Typical:128.8 mA @10dbm Typical: 108.5mA @0dbm Typical: 101.8mA	
LTE-FDD B2	@23dbm Typical: 128.9mA @10dbm Typical: 108.3mA @0dbm Typical: 101.7mA	
LTE-FDD B3	@23dbm Typical: 132.7mA @10dbm Typical: 108.5mA @0dbm Typical: 101.5mA	
LTE-FDD B4	@23dbm Typical: 135.9mA @10dbm Typical: 109.6mA	

	@0dbm Typical: 102.7mA
LTE-FDD B5	@23dbm Typical: 126.5mA @10dbm Typical: 105.1mA @0dbm Typical: 101.3mA
LTE-FDD B8	@23dbm Typical: 128.8mA @10dbm Typical: 106.3mA @0dbm Typical: 103.1mA
LTE-FDD B12	@23dbm Typical: 134.1mA @10dbm Typical: 105.8mA @0dbm Typical: 102.4mA
LTE-FDD B13	@23dbm Typical: 126.6mA @10dbm Typical: 103.1mA @0dbm Typical: 104.1mA
LTE-FDD B14	@23dbm Typical: 126.4mA @10dbm Typical: 106.1mA @0dbm Typical: 102.5mA
LTE-FDD B18	@23dbm Typical: 125.0mA @10dbm Typical: 101.9mA @0dbm Typical: 99.7mA
LTE-FDD B19	@23dbm Typical: 123.5mA @10dbm Typical: 101.8mA @0dbm Typical: 98.5mA
LTE-FDD B20	@23dbm Typical: 126.6mA @10dbm Typical: 104.5mA @0dbm Typical: 101.5mA
LTE-FDD B25	@23dbm Typical: 130.3mA @10dbm Typical: 109.3mA @0dbm Typical: 102.5mA
LTE-FDD B26	@23dbm Typical: 118.9mA @10dbm Typical: 101.2mA @0dbm Typical: 99.1mA
LTE-FDD B27	@23dbm Typical: 123.8mA @10dbm Typical: 105.7mA @0dbm Typical: 102.2mA
LTE-FDD B28	@23dbm Typical: 132.4mA @10dbm Typical: 112.8mA @0dbm Typical: 101.6mA
LTE-FDD B66	@23dbm Typical: 129.5mA @10dbm Typical: 107.1mA @0dbm Typical: 104.4mA
LTE Cat-NB (10MHz) data transmission	
LTE-FDD B1	@23dbm Typical: 188.4mA @10dbm Typical: 112.4mA @0dbm Typical: 86.7mA
LTE-FDD B2	@23dbm Typical: 183mA @10dbm Typical: 109.9mA @0dbm Typical: 86.7mA

LTE-FDD B3	@23dbm Typical: 205.2mA @10dbm Typical: 111.7mA @0dbm Typical: 86.8mA
LTE-FDD B4	@23dbm Typical: 209.3mA @10dbm Typical: 113.2mA @0dbm Typical: 79.5mA
LTE-FDD B5	@23dbm Typical: 183.8mA @10dbm Typical: 117.6mA @0dbm Typical: 88.3mA
LTE-FDD B8	@23dbm Typical: 206.7mA @10dbm Typical: 118.9mA @0dbm Typical: 88.6mA
LTE-FDD B12	@23dbm Typical: 223.4mA @10dbm Typical: 122.2mA @0dbm Typical: 87.9mA
LTE-FDD B13	@23dbm Typical: 188mA @10dbm Typical: 119.6mA @0dbm Typical: 88.1mA
LTE-FDD B18	@23dbm Typical: 183.9mA @10dbm Typical: 117.5mA @0dbm Typical: 87.8mA
LTE-FDD B19	@23dbm Typical:178 mA @10dbm Typical: 117.5mA @0dbm Typical: 87.8mA
LTE-FDD B20	@23dbm Typical: 178.5mA @10dbm Typical: 118.1mA @0dbm Typical: 88.1mA
LTE-FDD B25	@23dbm Typical: 184.1mA @10dbm Typical: 112.8mA @0dbm Typical: 86.9mA
LTE-FDD B26	@23dbm Typical: 180.4mA @10dbm Typical: 116.4mA @0dbm Typical: 87.6mA
LTE-FDD B28	@23dbm Typical: 204.7mA @10dbm Typical: 119.9mA @0dbm Typical: 88.7mA
LTE-FDD B66	@23dbm Typical: 211.8mA @10dbm Typical: 112.7mA @0dbm Typical: 86.3mA

Table 39: SIM7070G-HP-S Current consumption on VBAT Pins (VBAT=3.8V)

GNSS	
GNSS supply current (AT+CFUN=0,without USB connection)	Tracking, typical: 54mA
Sleep/ Idle mode	

LTE supply current (AT+CSCLK=0；AT+CFUN=1, GNSS off, without USB connection）	CAT-M1	Typical: 18Ma
	NB1/NB2	Typical: 14mA
Power Saving Mode		
PSM supply current	PSM mode Typical: 3.8uA	
e-DRX		
e-DRX mode supply current （Tested in sleep mode）	@PTW=40.96s；eDRX=81.92s；DRX=2.56s Typical: 1.4mA	
	@PTW=25.6s；eDRX=163.84s；DRX=2.56s Typical: 1.2mA	
LTE Cat-M (10MHz) data transmission		
LTE-FDD B1	@23dbm Typical: 144.1mA @10dbm Typical: 135.7mA @0dbm Typical: 92.7mA	
LTE-FDD B2	@23dbm Typical: 144.1mA @10dbm Typical: 135.1mA @0dbm Typical: 91.8mA	
LTE-FDD B3	@23dbm Typical: 150.1mA @10dbm Typical: 136.5mA @0dbm Typical: 92.8mA	
LTE-FDD B4	@23dbm Typical: 152.2mA @10dbm Typical: 136.1mA @0dbm Typical: 93.5mA	
LTE-FDD B5	@23dbm Typical: 135.9mA @10dbm Typical: 128.1mA @0dbm Typical: 126.8mA	
LTE-FDD B8	@23dbm Typical: 135.7mA @10dbm Typical: 129.2mA @0dbm Typical: 126.7mA	
LTE-FDD B12	@23dbm Typical: 135.1mA @10dbm Typical: 129.1mA @0dbm Typical: 126.6mA	
LTE-FDD B13	@23dbm Typical: 139.9mA @10dbm Typical: 129.3mA @0dbm Typical: 129.3mA	
LTE-FDD B14	@23dbm Typical: 136.1mA @10dbm Typical: 128.2mA @0dbm Typical: 127.4mA	
LTE-FDD B18	@23dbm Typical: 127mA @10dbm Typical: 118.1mA @0dbm Typical: 117.1mA	
LTE-FDD B19	@23dbm Typical: 127.4mA @10dbm Typical: 118.1mA @0dbm Typical: 116.2mA	
LTE-FDD B20	@23dbm Typical: 139.7mA @10dbm Typical: 128.1mA	

	@0dbm Typical: 126.9mA
LTE-FDD B25	@23dbm Typical: 145mA @10dbm Typical: 135.8mA @0dbm Typical: 92.9mA
LTE-FDD B26	@23dbm Typical: 132.7mA @10dbm Typical: 121.1mA @0dbm Typical: 120mA
LTE-FDD B27	@23dbm Typical: 137.7mA @10dbm Typical: 129.2mA @0dbm Typical: 127.1mA
LTE-FDD B28	@23dbm Typical: 139.8mA @10dbm Typical: 129.3mA @0dbm Typical: 126.9mA
LTE-FDD B66	@23dbm Typical: 294.3mA @10dbm Typical: 242.4mA @0dbm Typical: 108.7mA
LTE Cat-NB (10MHz) data transmission	
LTE-FDD B1	@23dbm Typical: 258.7mA @10dbm Typical: 216.6mA @0dbm Typical: 58.9mA
LTE-FDD B2	@23dbm Typical: 260.4mA @10dbm Typical: 220.4mA @0dbm Typical: 58.2mA
LTE-FDD B3	@23dbm Typical: 287.9mA @10dbm Typical: 218.8mA @0dbm Typical: 62.4mA
LTE-FDD B4	@23dbm Typical: 294mA @10dbm Typical: 222.9mA @0dbm Typical: 59.6mA
LTE-FDD B5	@23dbm Typical: 225mA @10dbm Typical: 177.9mA @0dbm Typical: 173.5mA
LTE-FDD B8	@23dbm Typical: 213.5mA @10dbm Typical: 178.7mA @0dbm Typical: 175.3mA
LTE-FDD B12	@23dbm Typical: 221.6mA @10dbm Typical: 177mA @0dbm Typical: 173.8mA
LTE-FDD B13	@23dbm Typical: 234.5mA @10dbm Typical: 178.6mA @0dbm Typical: 175.6mA
LTE-FDD B18	@23dbm Typical: 228.2mA @10dbm Typical: 176.1mA @0dbm Typical: 174.8mA
LTE-FDD B19	@23dbm Typical: 229.7mA @10dbm Typical: 178.1mA @0dbm Typical: 173.6mA

LTE-FDD B20	@23dbm Typical: 231.8mA @10dbm Typical: 176.6mA @0dbm Typical: 174.8mA
LTE-FDD B25	@23dbm Typical: 255.6mA @10dbm Typical: 219.8mA @0dbm Typical: 59.6mA
LTE-FDD B26	@23dbm Typical: 228.5mA @10dbm Typical: 176.7mA @0dbm Typical: 176.3mA
LTE-FDD B28	@23dbm Typical: 233.7mA @10dbm Typical: 178.9mA @0dbm Typical: 174mA
LTE-FDD B66	@23dbm Typical: 280.3mA @10dbm Typical: 219.6mA @0dbm Typical: 58.8mA
IoT-NTN data transmission	
LTE-FDD B23	@23dbm Typical: TBD @10dbm Typical: TBD @0dbm Typical: TBD
LTE-FDD B255	@23dbm Typical: TBD @10dbm Typical: TBD @0dbm Typical: TBD
LTE-FDD B256	@23dbm Typical: TBD @10dbm Typical: TBD @0dbm Typical: TBD

5.5 ESD Notes

The module is sensitive to ESD in the process of storage, transporting, and assembling. When the module 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 shows the module ESD measurement performance without any external ESD component.

Table 40: The ESD performance measurement table (Temperature: 25℃, Humidity: 45%.)

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

NOTE

Test conditions:
1. The external of the module has surge protection diodes and ESD protection diodes.
2. The data in Table 40 was tested using SIMCom EVB.

6 Manufacturing

6.1 Top and Bottom View of SIM7070G-HP Series Module

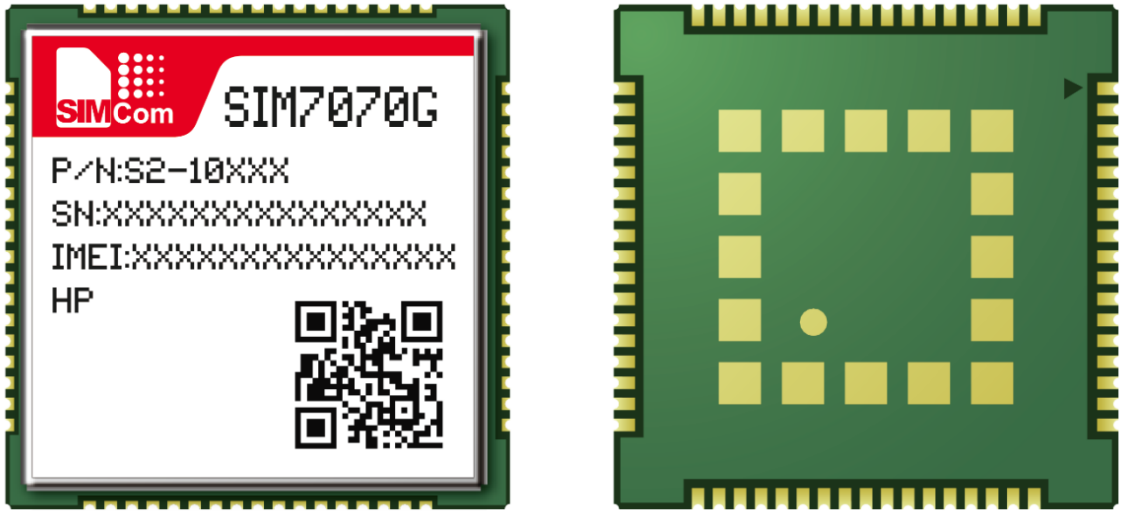

Figure 34: Top and bottom view of SIM7070G-HP

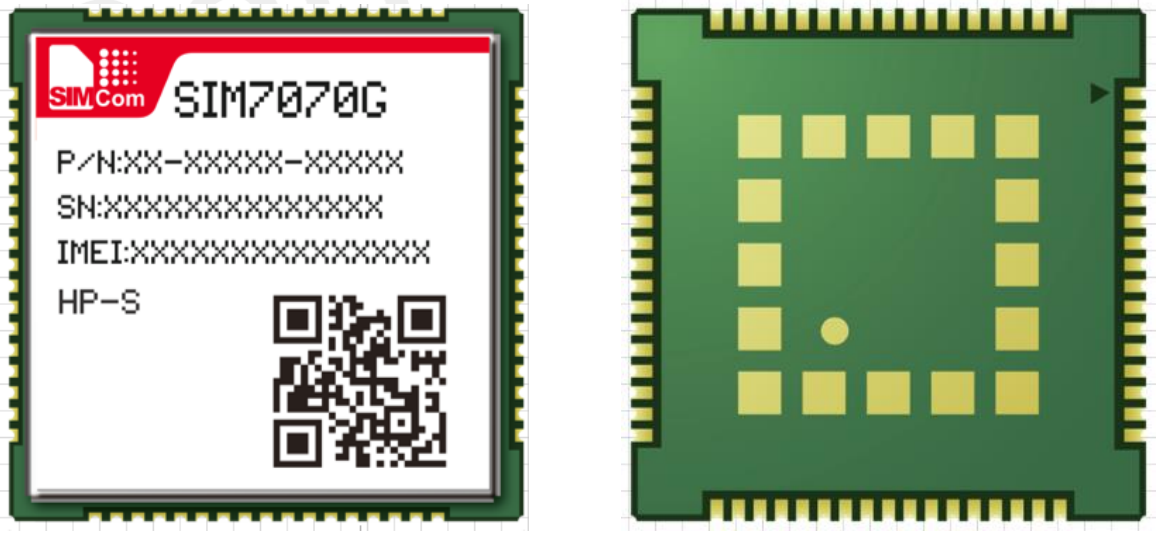

Figure 35: Top and bottom view of SIM7070G-HP-S

NOTE

The above is the design effect diagram of the module for reference. The actual appearance is subject to the actual product.

6.2 Label Description Information

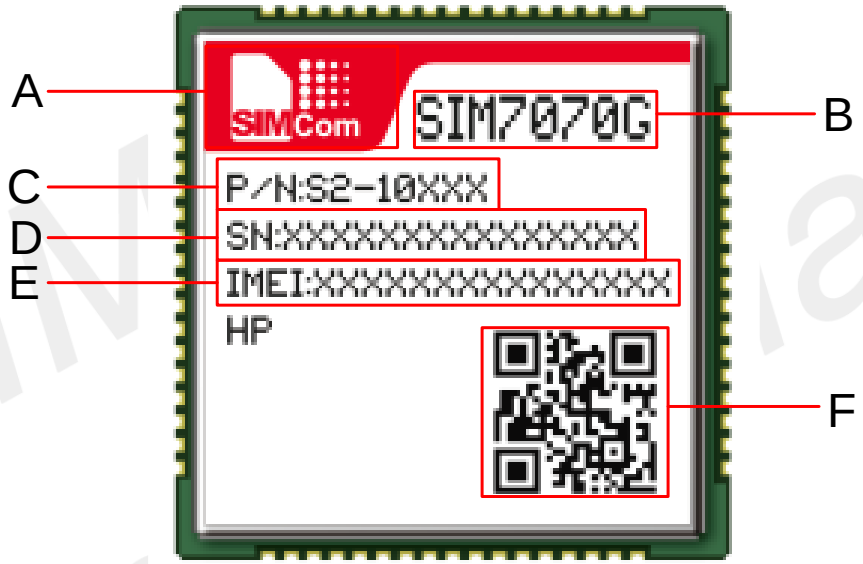

Figure 36: Label information

Table 41: 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 Recommended PCB Footprint

The following figure shows the PCB footprint of the series module.

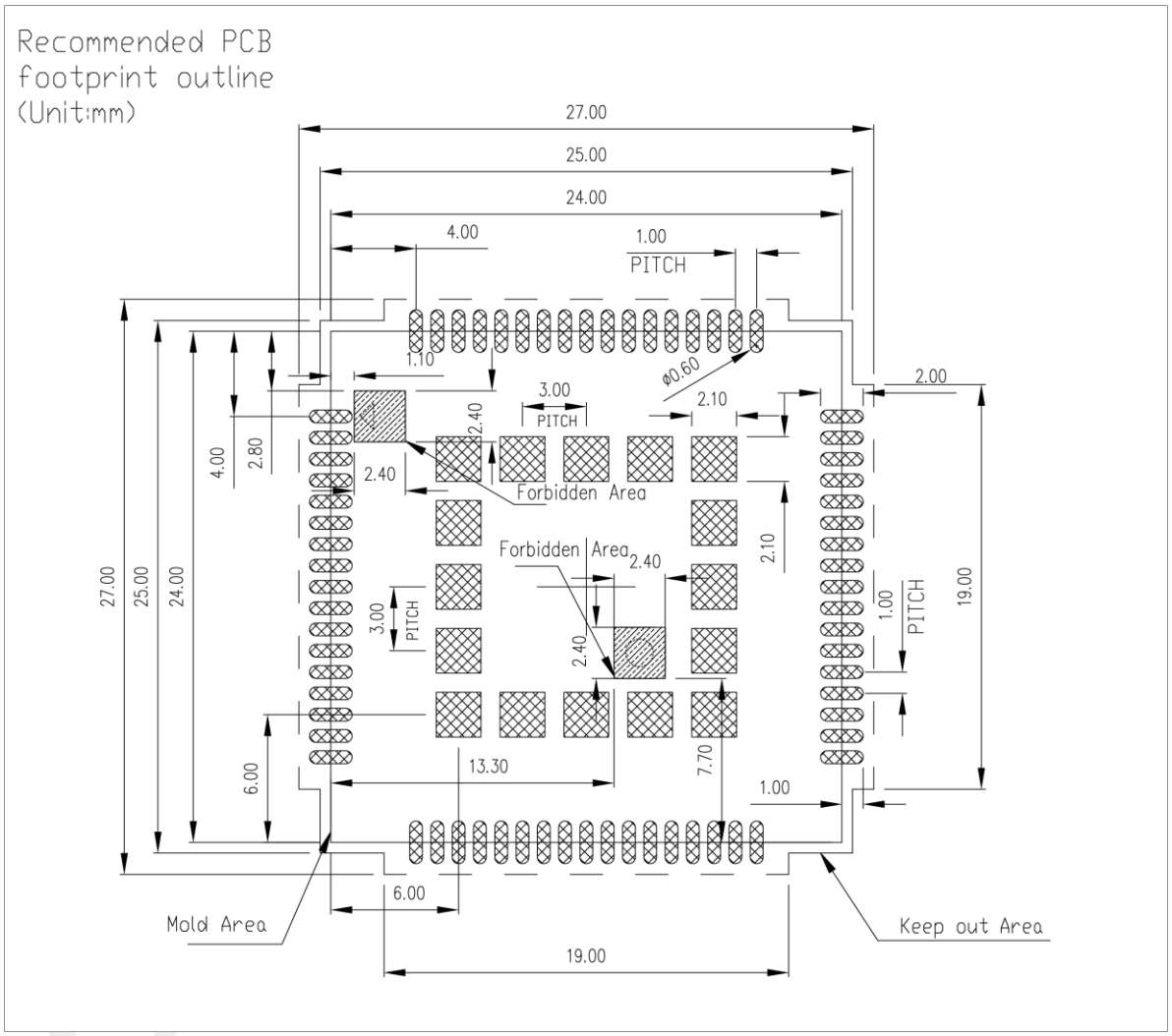

Figure 37: Recommended PCB footprint (Unit: mm)

6.4 Recommended SMT Stencil

The recommended thickness of stencil foil is 0.15mm.

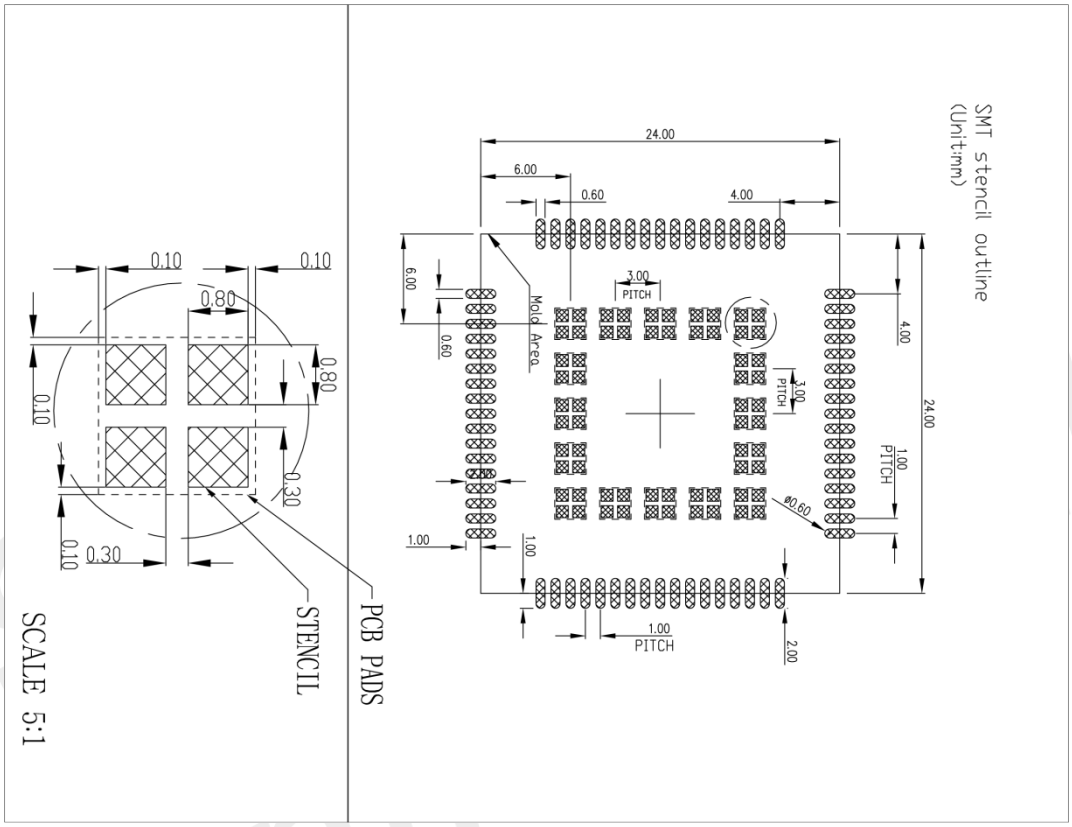

Figure 38: stencil recommendation (Unit: mm)

6.5 Typical SMT Reflow Profile

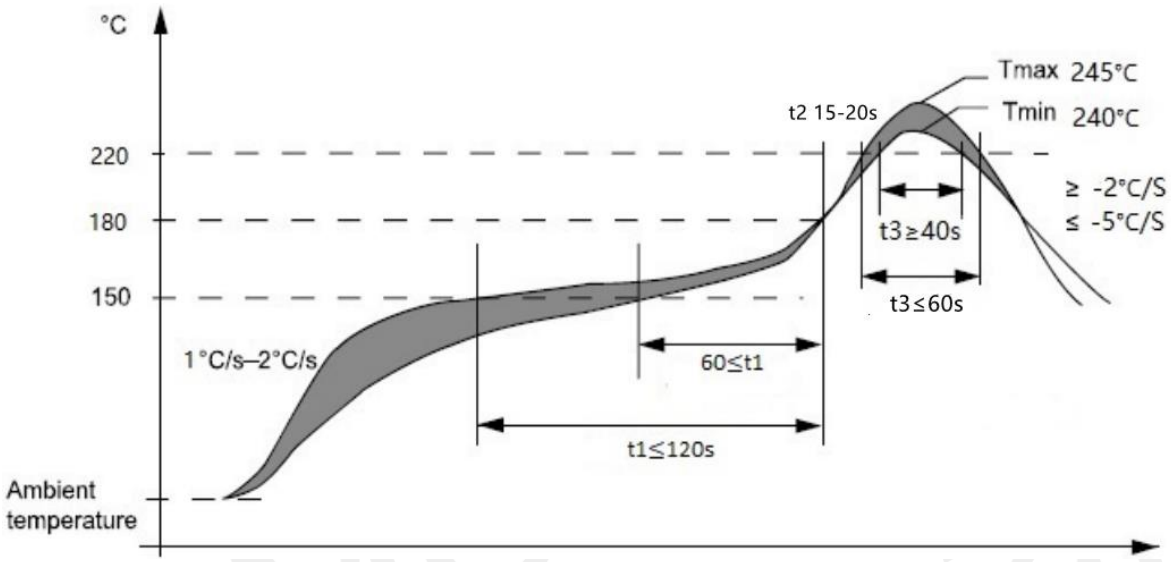

Figure 39: Recommended reflow furnace temperature curve (lead-free)

Table 42: The main board reflux temperature curve requirements (lead-free)

Zone	Time	Parameter
Preheat Zone (Room temperature~150℃)	NA	Heating rate: 1~2℃/s
T1 (150~180℃)	60~120s	/
T2 (180~220℃)	15~20s	/
T3 (≥220℃)	40~60s	Peak temperature: 240~245℃
Cooling Zone	NA	Cooling rate: -2~-5℃/s

NOTE

- The maximum times of refluxes for the module are once.
- Recommended lead-free process.
- In the table above, the temperature testing location includes the solder mask of the module MCU pins, bottom LGA pins, and external LCC pins.
- The actual welding temperature is affected by other external factors, such as the presence of furnace carriers, solder paste, size and thickness of the substrate, and component resistance. Thermal requirements and panel design, etc. Please confirm with our engineering and technical personnel in time if the recommended parameters cannot be reached. Otherwise, the module may be damaged.
- For boards with thickness less than 1.2mm, it is recommended to use board supported by furnace carrier or materials with high Tg to prevent warping when heated. Deformation, thus affecting module welding. For modules larger than 35.0 mm *35.0 mm and 5G products, it is recommended to use the furnace carrier to pass through the furnace to reduce the cause of the bottom plate and mold. Due to the difference of Tg value of block, the phenomenon of unbalanced thermal stress appears in the process of high temperature welding reflow, resulting in the defect rate of virtual welding and little tin.
- After the module is welded, X-ray and optical inspection methods shall be used to check the welding quality. For specific standards, please refer to relevant standards of IPC-A-610H.
- For more information about shipping and manufacturing, please refer to Module Secondary SMT Process User Guide.
- Due to the complexity of the SMT process, in case of uncertainty or processes not mentioned in this document (such as selective wave soldering, ultrasonic welding), please contact SIMCom support team before SMT process starts.

6.6 Moisture Sensitivity Level and Storage conditions

Modules are shipped in vacuum-sealed aluminum foil bag bags, vacuum packaging according to IPC/JEDEC standard J-STD-020C specification.

- Recommended storage conditions: temperature 23℃± 5℃, and relative humidity 35%~60%.
- Storage period: 12 months (Under recommended storage conditions and in sealed vacuum packaging).

The module meets the humidity sensitivity level 3 (MSL-3), and the storage period after unpacking is shown in table below.

The out-of-bag floor life of the module with MSL-3 is 168 hours. If the workshop temperature is 23℃±5℃ and the relative humidity is less than 60%, the module needs to be unpacked within 168 hours of reflux production or other high temperature operations. Otherwise, the module shall be stored in an environment with relative humidity less than 10% (for example, a moisture-proof cabinet) to keep the product dry.

Table 43: MSL levels

MSL	Out-of-bag floor life	Comment
1	Unlimited	≤+30℃/85% RH
2	1 year	≤+30℃/60% RH
2a	4 weeks	
3	168 hours	
4	72 hours	
5	48 hours	
5a	24 hours	
6	Mandatory bake before use. After bake, it must be reflowed within the time limit specified on the label.	

Before use, it is necessary to confirm whether the package is in good condition; After unpacking, check the status of humidity indicator card in vacuum bag (Figure 40). The module needs to be baked before use if any of the following conditions occur.

- Explanation Humidity indicator card: 30%, 40%, and 50% of any indicator circle has discolouring
- The module has been un-packed and the module exceeds the humidity sensitivity level corresponding to the exposed workshop time. For example, MSL=3 is 168.
- Packed，but the Shelf Life exceeds 12 months；
- Exceeds the Floor Life；
- Unable to track and determine the status of the module;

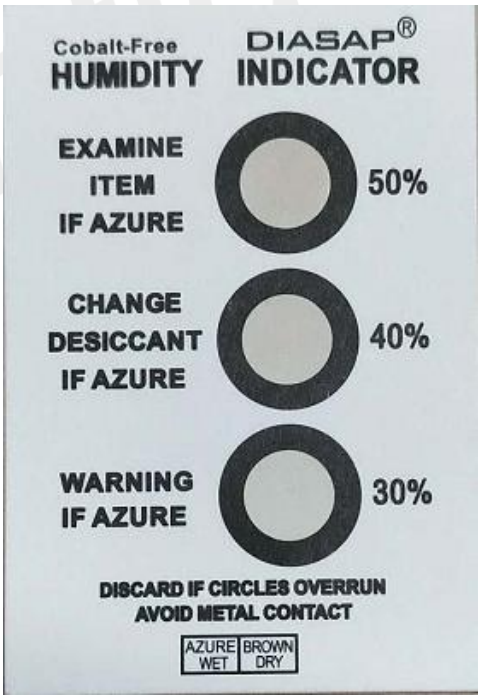

Figure 40: Humidity card

The following conditions also need to be pre-baked.

- The storage temperature and humidity do not meet the recommended storage conditions.
- Vacuum sealed bag leak, bulk materials
- Before repairing the module.
- After unpacking, the module failed to complete production or storage under the control of humidity sensitive level 3.

6.7 Baking Requirements

If baking is required, proceed according to the requirements in the table below. Preferentially choose a nitrogen-filled oven.

Table 44: Baking requirements

Baking conditions	Baking time	Comment
120°C±5°C, <5% RH	8 hours	Not applicable to original packaging pallets

NOTE

- In order to prevent and reduce the occurrence of poor welding caused by moisture, such as foaming and delamination, the module should be strictly controlled. It is not recommended to expose the module to air for a long time after unpacking the vacuum package.
- Before baking, it is necessary to remove the module from the package and place the bare module on the high temperature resistant device to avoid high temperature damage to the plastic tray or coil; The modules for secondary baking must be welded within 24 hours after baking, otherwise they need to be stored in vacuum packaging or in a drying oven.
- Please pay attention to ESD protection when unpacking and placing modules, such as wearing anti-static gloves.

7 Packaging

7.1 Tray packaging

The series module support tray packaging.

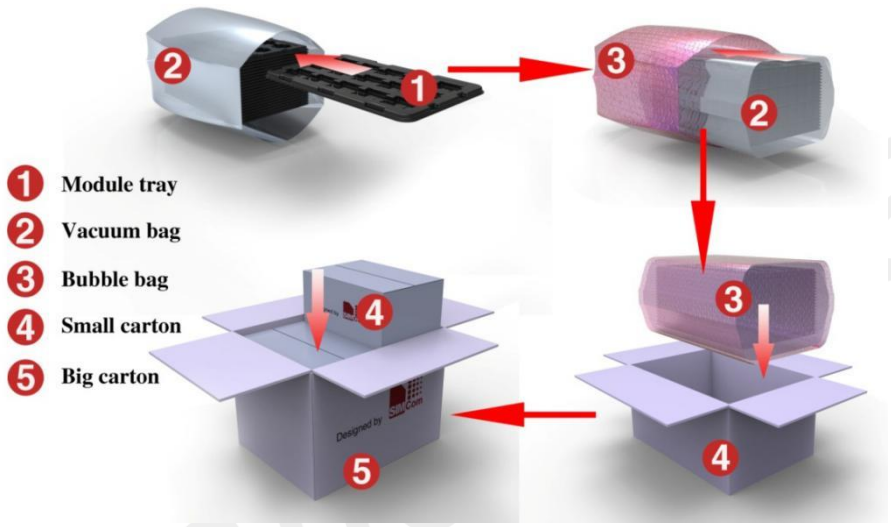

Figure 41: packaging diagram

Module tray drawing：

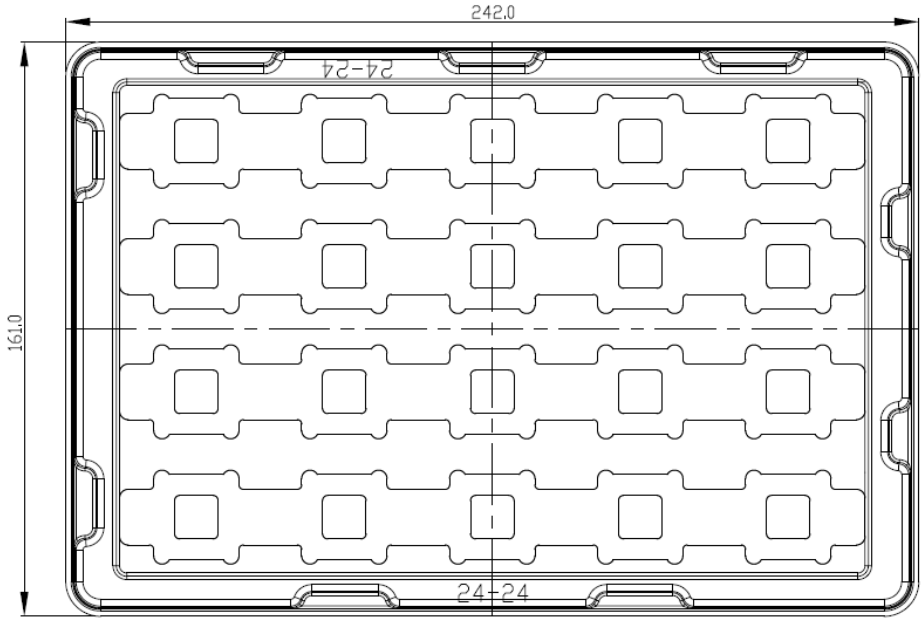

Figure 42: Tray drawing

Table 45: Tray size

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

Small carton drawing：

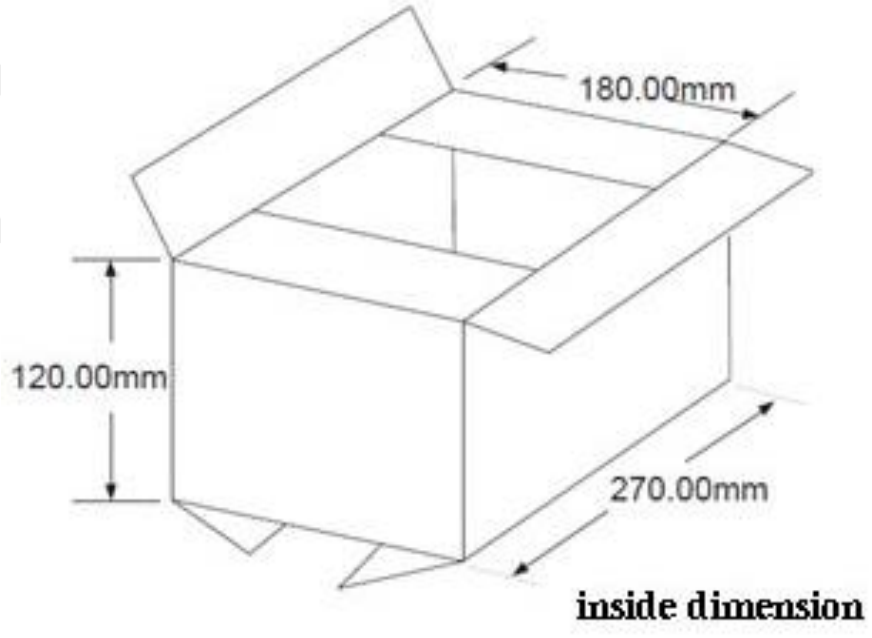

Figure 43: Small carton drawing

Table 46: Small Carton size

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

Big carton drawing：

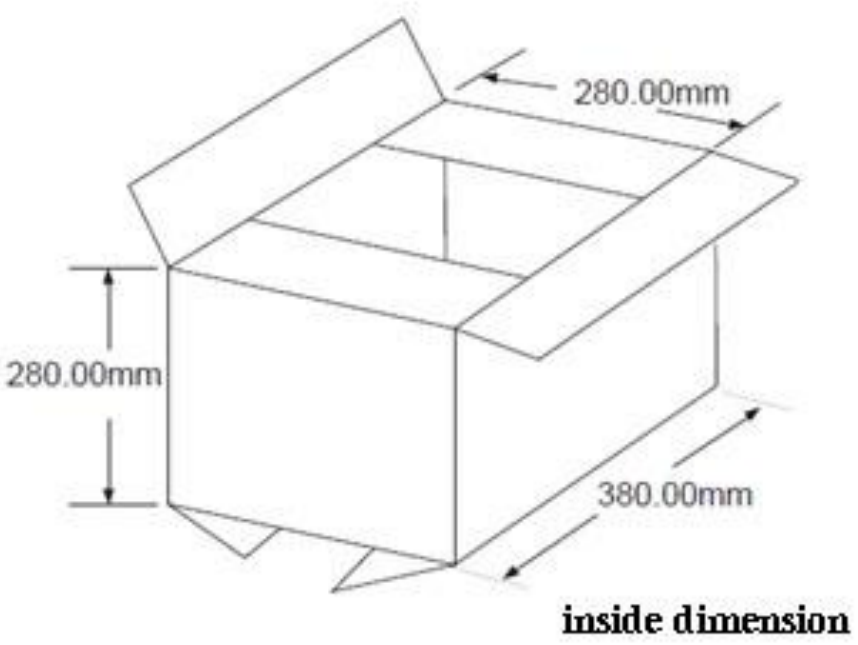

Figure 44: Big carton drawing

Table 47: Big Carton size

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

8 Appendix

8.1 Reference Design

Refer to < SIM7070G-HP_Series Reference Design V1.01> for the details.

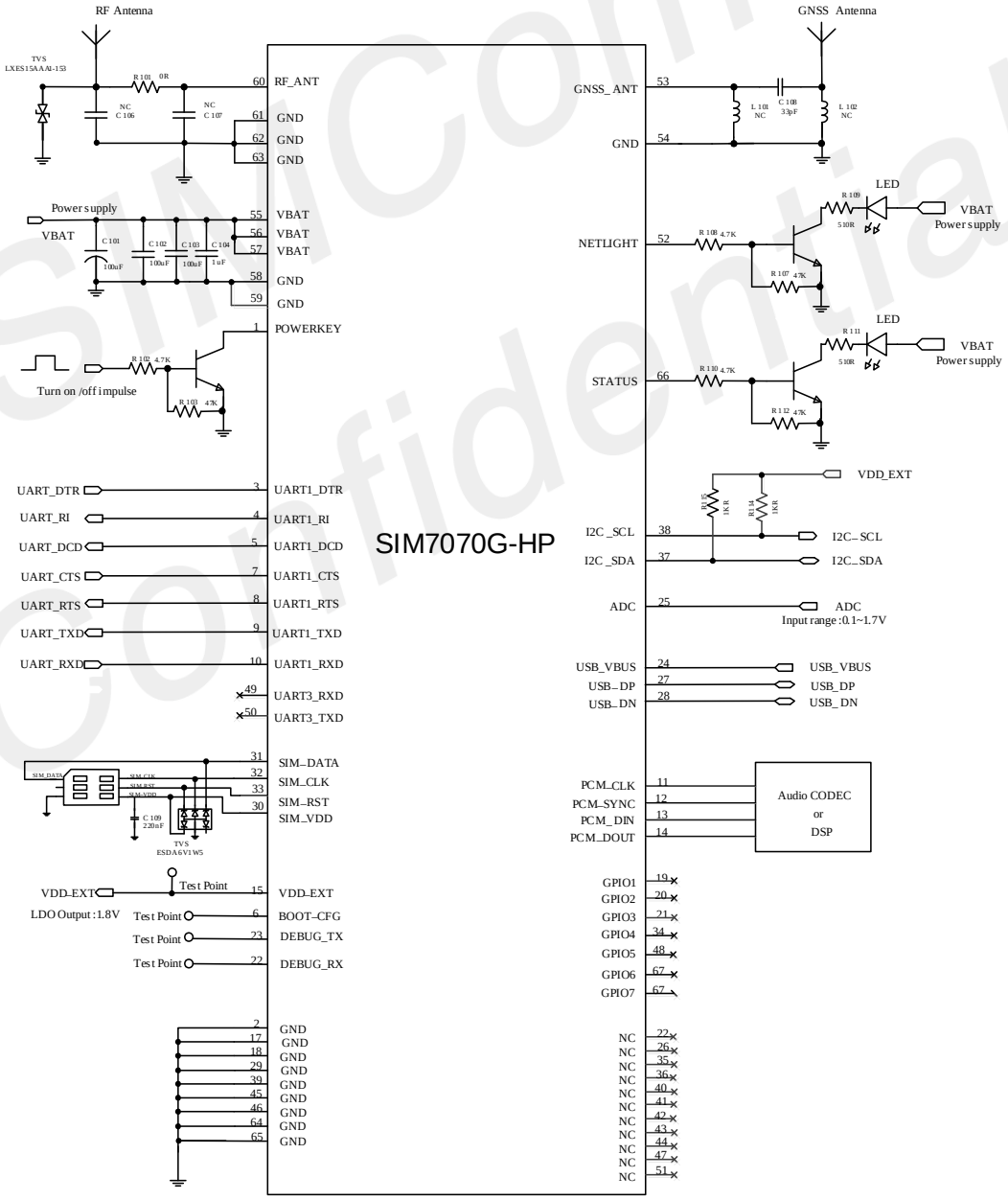

Figure 45: Reference design

8.2 Design check list

Table 48: 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 49: 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 0.6mm. 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 50Ω impedance control.

8.3 Coding Schemes and Maximum Net Data Rates over Air Interface

Table 50: Coding Schemes and Maximum Net Data Rates over Air Interface

LTE-FDD device category (Downlink)	Max data rate（peak）	Modulation type
Category M1	187 Mbps	QPSK/16QAM
LTE-FDD device category (Uplink)	Max data rate（peak）	Modulation type
Category M1	60 Mbps	QPSK/16QAM

8.4 Related Documents

Table 51: Related Documents

NO.	Title	Description
[1]	SIM7070G-HP SERIES AT Command Manual_V1.xx	AT Command Manual
[2]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[3]	3GPP TS 34.124	Electromagnetic Compatibility (EMC) for mobile terminals and

		ancillary equipment.
[4]	3GPP TS 34.121	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[5]	3GPP TS 34.123-1	Technical Specification Group Radio Access Network; Terminal conformance specification; Radio transmission and reception (FDD)
[6]	3GPP TS 34.123-3	User Equipment (UE) conformance specification; Part 3: Abstract Test Suites.
[7]	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
[8]	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
[9]	IEC/EN60950-1(2001)	Safety of information technology equipment (2000)
[10]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[11]	2002/95/EC	Directive of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)
[12]	Module secondary-SMT-UGD-V1.xx	Module secondary SMT Guidelines
[13]	SIM7070G-HP SERIES UART Application Note_V1.xx	This document describes how to use UART interface of SIMCom modules.
[14]	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
[15]	ANTENNA DESIGN GUIDELINES FOR MULTI-ANTENNA SYSTEM V1 01	Design notice for multi-antenna.

8.5 Terms and Abbreviations

Table 52: 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
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
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

8.6 Safety Caution

Table 53: 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.
	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.