



SIM7090G

User Manual

LPWA Module

SIMCom Wireless Solutions Limited

Building B, SIM Technology Building, No.633, Jinzhong Road

Changning District, Shanghai P.R. China

Tel: 86-21-31575100

support@simcom.com

www.simcom.com

Document Title:	SIM7090G User Manual
Version:	V1.01
Date:	2020-06-03
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

THIS DOCUMENT CONTAINS PROPRIETARY TECHNICAL INFORMATION WHICH IS THE PROPERTY OF SIMCOM WIRELESS SOLUTIONS LIMITED. COPYING, TO OTHERS AND USING THIS DOCUMENT, ARE FORBIDDEN WITHOUT EXPRESS AUTHORITY BY SIMCOM. OFFENDERS ARE LIABLE TO THE PAYMENT OF INDEMNIFICATIONS. ALL RIGHTS RESERVED BY SIMCOM IN THE PROPRIETARY TECHNICAL INFORMATION, INCLUDING BUT NOT LIMITED TO REGISTRATION GRANTING OF A PATENT, A UTILITY MODEL OR DESIGN. ALL SPECIFICATION SUPPLIED HEREIN ARE SUBJECT TO CHANGE WITHOUT NOTICE AT ANY TIME.

FCC Warning

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

Note: This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a

particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- ▶ -Reorient or relocate the receiving antenna.
- ▶ -Increase the separation between the equipment and receiver.
- ▶ -Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- ▶ -Consult the dealer or an experienced radio/TV technician for help.

RF warning:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

IC Caution:

This device complies with Industry Canada licence-exempt RSS standard(s). Operation is subject to the following two conditions:

- (1) This device may not cause interference, and
- (2) This device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

- (1) l'appareil ne doit pas produire de brouillage, et
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement

This equipment complies with ISED radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

Ce matériel est complété par une exposition de rayonnements IC pour un environnement naturel. Ce matériel doit être installé et se faire avec une distance minimale de 20cm entre les radiateurs et les autresYour body shop.

For a host manufacture's using a certified modular, if (1) the module's IC number is not visible when installed in the host, or (2) if the host is marketed so that end users do not have straightforward commonly used methods for access to remove the module so that the IC number of the module is visible; then an additional permanent label referring to the enclosed module: "Contains Transmitter Module IC: 23761-8VC0003" or "Contains IC: 23761-8VC0003" must be used.

This radio transmitter IC: 23761-8VC0003 has been approved by Innovation, Science and Economic Development Canada to operate with the antenna types listed below, with the maximum permissible gain indicated. Antenna types not included in this list that have gain greater than the maximum gain indicated for any type listed are strictly prohibited for use with this device.

SIMCom Wireless Solutions Limited

Building B, SIM Technology Building, No.633 Jinzhong 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

Copyright © 2020 SIMCom Wireless Solutions Limited All Rights Reserved.

SIMCom
Confidential

Version History

Date	Version	Description of change	Author
2020-01-22	1.00	Origin	Hongjun Tu Xianjing Zhao
2020-06-03	1.01	Modify the document content format.	Hongjun.Tu

SIMCom
Confidential

Contents

Contents.....	6
Table Index.....	8
Figure Index.....	9
1 Introduction.....	10
1.1 Product Outline.....	10
1.2 Hardware Interface Overview.....	11
1.3 Hardware Block Diagram.....	11
1.4 Functional Overview.....	12
2 Package Information.....	14
2.1. Pin Assignment Overview.....	14
2.2. Pin Description.....	16
2.3. Mechanical Information.....	20
2.4. Footprint Recommendation.....	21
3 Interface Application.....	22
3.1 Power Supply.....	22
3.1.1 Power Supply Design Guide.....	22
3.1.2 Voltage Monitor.....	23
3.2 Power on/Power off/Reset Function.....	24
3.2.1 Turn on Module Using the PWRKEY Pin.....	24
3.2.2 Turn off Module.....	26
3.2.3 Reset the Module.....	27
3.3 UART Interface.....	29
.....	30
3.3.1. UART Design Guide.....	30
3.3.2. RI Behavior.....	31
3.3.3. DTR Behavior.....	32
3.4 USB Interface.....	32
3.5 SIM Interface.....	34
3.5.1. SIM Application Guide.....	34
3.6 PCM Interface.....	35
3.7 I2C Interface.....	36
3.8 SPI Interface.....	37
3.9 Network status.....	39
3.10 ADC interface.....	40
3.11 LDO output.....	41
3.12 USB_BOOT Interface.....	41
3.13 GPIO Interface.....	42
3.14 RF control Interface.....	42
3.15 Force USB Download Interface.....	42
4 RF Specifications.....	44
4.1 LTE RF Specifications.....	44
4.2 LTE Antenna Design Guide.....	49
4.3 GNSS.....	50
4.3.1. GNSS Technical specification.....	50
4.3.2. GNSS Application Guide.....	51
4.4 RF traces note.....	52
4.4.1 RF traces layout.....	52
4.4.2 LTE ANT and other system ANT decoupling.....	53
5 Electrical Specifications.....	54
5.1 Absolute maximum ratings.....	54

5.2	Operating conditions.....	54
5.3	Operating Mode.....	56
5.3.1	Operating Mode Definition.....	56
5.3.2	Flight Mode.....	57
5.3.3	Sleep mode.....	57
5.3.4	Minimum functionality mode and Flight mode.....	57
5.3.5	Power Saving Mode (PSM).....	58
5.3.6	Extended Mode DRX (e-DRX).....	58
5.4	Current Consumption.....	59
5.5	ESD Notes.....	62
6	SMT Production Guide.....	63
6.1	Top and Bottom View of SIM7090G.....	63
6.2	Label Information.....	64
6.3	Typical SMT Reflow Profile.....	65
6.4	Moisture Sensitivity Level (MSL).....	66
6.5	Baking.....	67
6.6	Stencil Foil Design Recommendation.....	68
7	Packaging.....	69
7.1	Tray packaging.....	69
8	Appendix.....	72
8.1	Coding Schemes and Maximum Net Data Rates over Air Interface.....	72
8.2	Related Documents.....	73
8.3	Terms and Abbreviations.....	74
8.4	Safety Caution.....	77
8.5	Notes:.....	77

Table Index

TABLE 1 : SIM7090G FREQUENCY BANDS AND AIR INTERFACE.....	10
TABLE 2 : GENERAL FEATURES.....	12
TABLE 3 : PIN DEFINITION.....	15
TABLE 4 : IO PARAMETERS DEFINITION.....	16
TABLE 5 : PIN DESCRIPTION.....	16
TABLE 6 : VBAT PINS ELECTRONIC CHARACTERISTIC.....	22
TABLE 7 : POWER ON TIMING AND ELECTRONIC CHARACTERISTIC.....	25
TABLE 8 : POWER OFF TIMING AND ELECTRONIC CHARACTERISTIC.....	27
TABLE 9 : RESET PIN ELECTRONIC CHARACTERISTIC.....	28
TABLE 10 : PIN DEFINITION OF MAIN UART INTERFACE.....	29
TABLE 11 : PIN DEFINITION OF DEBUG UART INTERFACE.....	29
TABLE 12 : PIN DEFINITION OF GNSS UART INTERFACE.....	29
TABLE 13 : UART ELECTRONIC CHARACTERISTIC.....	30
TABLE 14 : PIN DEFINITION OF USB INTERFACE.....	32
TABLE 15 : SIM ELECTRONIC CHARACTERISTIC IN 1.8V MODE (SIM_VDD=1.8V).....	34
TABLE 16 : PIN DEFINITION OF PCM INTERFACES.....	36
TABLE 17 : PIN DEFINITION OF SPI INTERFACE.....	37
TABLE 18 : NETLIGHT PIN STATUS.....	39
TABLE 19 : PIN DEFINITION OF ADC INTERFACES.....	40
TABLE 20 : ADC ELECTRONIC CHARACTERISTICS.....	40
TABLE 21 : ELECTRONIC CHARACTERISTIC.....	41
TABLE 22 : PIN DEFINITION OF USB_BOOT INTERFACES.....	41
TABLE 23 : PIN DEFINITION OF GPIO INTERFACES.....	42
TABLE 24 : LOGIC LEVELS OF GPIO INTERFACES.....	42
TABLE 25 : CONDUCTED TRANSMISSION POWER.....	44
TABLE 26 : MAXIMUM POWER REDUCTION (MPR) FOR UE CATEGORY NB2&M1 POWER CLASS 5.....	45
TABLE 27 : OPERATING FREQUENCIES.....	46
TABLE 28 : E-UTRA OPERATING BANDS.....	46
TABLE 29 : CONDUCTED RECEIVE SENSITIVITY.....	46
TABLE 30 : CAT-M1 REFERENCE SENSITIVITY (QPSK).....	46
TABLE 31 : CAT-NB2 REFERENCE SENSITIVITY (QPSK).....	48
TABLE 32 : TRACE LOSS.....	49
TABLE 33 : RECOMMENDED TVS.....	50
TABLE 34 : ABSOLUTE MAXIMUM RATINGS.....	54
TABLE 35 : RECOMMENDED OPERATING RATINGS.....	54
TABLE 36 : 1.8V DIGITAL I/O CHARACTERISTICS*.....	55
TABLE 37 : OPERATING TEMPERATURE.....	55
TABLE 38 : OPERATING MODE DEFINITION.....	56
TABLE 39 : CURRENT CONSUMPTION ON VBAT PINS (VBAT=3.8V).....	59
TABLE 40 : THE ESD PERFORMANCE MEASUREMENT (TEMPERATURE: 25°C, HUMIDITY: 45%).....	62
TABLE 41 : THE DESCRIPTION OF LABEL INFORMATION.....	64
TABLE 42 : MOISTURE SENSITIVITY LEVEL AND FLOOR LIFE.....	66
TABLE 43 : BAKING CONDITIONS.....	67
TABLE 44 : TRAY SIZE.....	70
TABLE 45 : SMALL CARTON SIZE.....	70
TABLE 46 : BIG CARTON SIZE.....	71
TABLE 47 : CODING SCHEMES AND MAXIMUM NET DATA RATES OVER AIR INTERFACE.....	72
TABLE 48 : RELATED DOCUMENTS.....	73
TABLE 49 : TERMS AND ABBREVIATIONS.....	74
TABLE 50 : SAFETY CAUTION.....	77

Figure Index

FIGURE 1 : SIM7090G BLOCK DIAGRAM.....	12
FIGURE 2 : PIN ASSIGNMENT OVERVIEW.....	14
FIGURE 3 : DIMENSIONS (UNIT: MM).....	20
FIGURE 4 : FOOTPRINT RECOMMENDATION (UNIT: MM).....	21
FIGURE 5 : POWER SUPPLY APPLICATION CIRCUIT.....	23
FIGURE 6 : REFERENCE POWER ON/OFF CIRCUIT.....	24
FIGURE 7 : POWER ON TIMING SEQUENCE.....	25
FIGURE 8 : POWER OFF TIMING SEQUENCE.....	26
FIGURE 9 : REFERENCE RESET CIRCUIT.....	28
FIGURE 10 : UART FULL MODEM.....	30
FIGURE 11 : REFERENCE CIRCUIT OF LEVEL SHIFTER IC.....	31
FIGURE 12 : REFERENCE CIRCUIT WITH TRANSISTOR	31
FIGURE 13 : RI BEHAVIOUR (SMS AND URC REPORT)	32
FIGURE 14 : REFERENCE DESIGN OF USB PHY.....	33
FIGURE 15 : REFERENCE DESIGN OF USB INTERFACE.....	33
FIGURE 16 : SIM INTERFACE REFERENCE CIRCUIT.....	35
FIGURE 17 : REFERENCE CIRCUIT OF PCM APPLICATION WITH AUDIO CODEC.....	36
FIGURE 18 : I2C REFERENCE CIRCUIT.....	37
FIGURE 19 : SPI MASTER MODE CIRCUIT.....	38
FIGURE 20 : SPI SLAVE MODE CIRCUIT.....	38
FIGURE 21 : NETLIGHT REFERENCE CIRCUIT.....	39
FIGURE 22 : POWER ON SEQUENCE OF THE VDD_EXT.....	41
FIGURE 23 : RF CONTROL INTERFACE REFERENCE CIRCUIT.....	42
FIGURE 24 : REFERENCE CIRCUIT OF BOOT_CFG INTERFACE.....	43
FIGURE 25 : ANTENNA MATCHING CIRCUIT (MAIN_ANT).....	49
FIGURE 26 : ACTIVE ANTENNA CIRCUIT.....	51
FIGURE 27 : PASSIVE ANTENNA CIRCUIT (DEFAULT).....	51
FIGURE 28 : RF TRACE SHOULD BE FAR AWAY FROM OTHER HIGH SPEED SIGNAL LINES.....	52
FIGURE 29 : THE DISTANCE BETWEEN GND TO THE INNER CONDUCTOR OF SMA.....	53
FIGURE 30 : E-DRX DIAGRAMMATIC SKETCH.....	59
FIGURE 31 : TOP AND BOTTOM VIEW OF SIM7090G.....	63
FIGURE 32 : LABEL INFORMATION.....	64
FIGURE 33 : THE RAMP-SOAK-SPIKE REFLOW PROFILE OF SIM7090G.....	65
FIGURE 34 : STENCIL RECOMMENDATION (UNIT: MM).....	68
FIGURE 35 : PACKAGING DIAGRAM.....	69
FIGURE 36 : TRAY DRAWING.....	69
FIGURE 37 : SMALL CARTON DRAWING.....	70
FIGURE 38 : BIG CARTON DRAWING.....	71

1 Introduction

This document describes the electronic specifications, RF specifications, interfaces, mechanical characteristics and testing results of the SIMCom SIM7090G module. With the help of this document and other SIM7090G software application notes/user guides, users can understand and use SIM7090G module to design and develop applications quickly.

1.1 Product Outline

The SIM7090G modules support LTE CAT-M1, LTE CAT-NB1/NB2.
The physical dimension of SIM7090G is 14.8mm×12.8mm×2.0 mm.

Table 1: SIM7090G frequency bands and air interface

Network Type	Band	SIM7090G	
	Category	M1	NB1/NB2
LTE-FDD* 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	✓	✓
	LTE-FDD B71		✓
LTE-FDD B85	✓	✓	
GNSS	GPS		✓
	GLONASS		✓
	BeiDou		✓

Galileo

✓

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]

1.2 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
- RF control Interface
- GPIOs
- Antenna Interface

1.3 Hardware Block Diagram

The block diagram of the SIM7090G module is shown in the figure below.

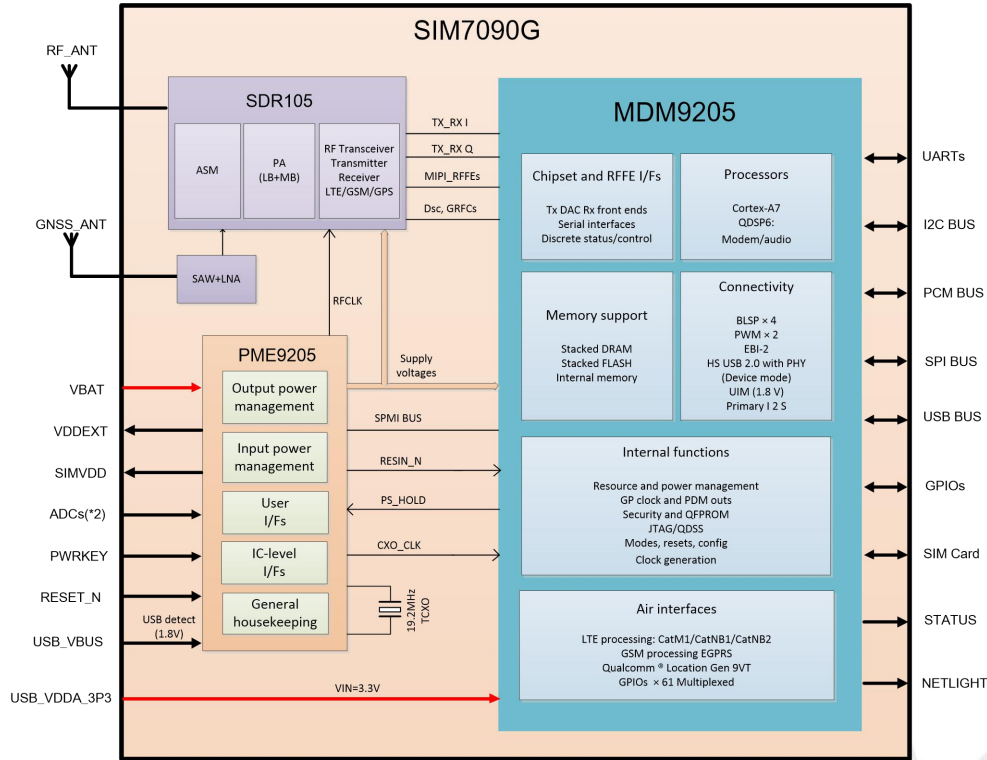


Figure 1: SIM7090G block diagram

1.4 Functional Overview

Table 2: General features

Feature	Implementation
Power supply	Power supply voltage 2.7V~4.8V. Default :3.8V
Power saving	Current in sleep mode: 0.78mA @DRX2.56S Current in PSM mode: 3uA
Radio frequency bands	Please refer to the table 1
Transmitting power	LTE power class: 5 (0.125W).
Data Transmission Throughput	LTE CAT M1: 589 Kbps (DL), 1119 Kbps (UL) LTE CAT NB2: 127Kbps (DL) ,158 Kbps (UL)
Antenna	LTE main antenna. GNSS antenna.
GNSS	GNSS engine (GPS, GLONASS, BD 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	<p>One channel full-function UART 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.</p> <p>Support RTS/CTS hardware handshake. DBG_UART can be used for software debug. GNSS_UART can also be configured as a GNSS NMEA data output port.</p>
USB	USB 2.0 high speed interface.
Firmware upgrade	Firmware upgrade over USB interface
Physical characteristics	<p>Size: 14.8×12.8×2.0 mm Weight: 0.8g ± 0.2g</p>
Temperature range	<p>operation temperature: -40°C ~ +85°C Storage temperature -45°C to + 90°C</p>

SIMCom
Confidential

2 Package Information

2.1. Pin Assignment Overview

The module has 77 pins and provides all the hardware interfaces of the module.

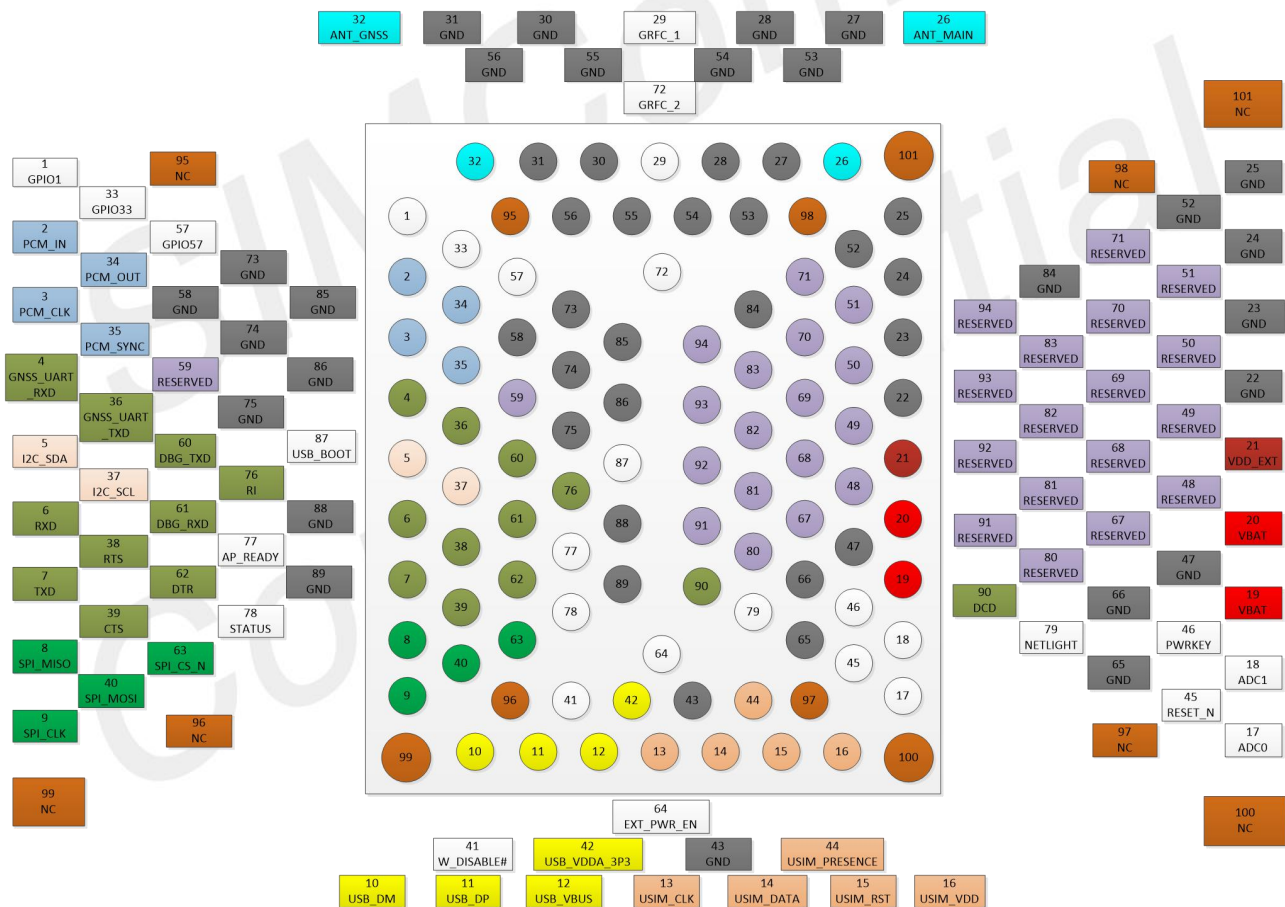


Figure 2: Pin assignment overview

Table 3: Pin definition

Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name
1	GPIO1	2	PCM_IN	3	PCM_CLK
4	GNSS_UART_RXD	5	I2C_SDA	6	RXD
7	TXD	8	SPI_MISO	9	SPI_CLK
10	USB_DM	11	USB_DP	12	USB_VBUS
13	USIM_CLK	14	USIM_DATA	15	USIM_RST
16	USIM_VDD	17	ADC0	18	ADC1
19	VBAT	20	VBAT	21	VDD_EXT
22	GND	23	GND	24	GND
25	GND	26	ANT_MAIN	27	GND
28	GND	29	GRFC_1	30	GND
31	GND	32	ANT_GNSS	33	GPIO33
34	PCM_OUT	35	PCM_SYNC	36	GNSS_UART_TX D
37	I2C_SCL	38	RTS	39	CTS
40	SPI_MOSI	41	W_DISABLE#	42	USB_VDDA_3P3
43	GND	44	USIM_PRESEN CE	45	RESET_N
46	PWRKEY	47	GND	48	RESERVED
49	RESERVED	50	RESERVED	51	RESERVED
52	GND	53	GND	54	GND
55	GND	56	GND	57	GPIO57
58	GND	59	RESERVED	60	DBG_TXD
61	DBG_RXD	62	DTR	63	SPI_CS_N
64	EXT_PWR_EN	65	GND	66	GND
67	RESERVED	68	RESERVED	69	RESERVED
70	RESERVED	71	RESERVED	72	GRFC_2
73	GND	74	GND	75	GND
76	RI	77	AP_READY	78	STATUS
79	NETLIGHT	80	RESERVED	81	RESERVED
82	RESERVED	83	RESERVED	84	GND
85	GND	86	GND	87	USB_BOOT
88	GND	89	GND	90	DCD
91	RESERVED	92	RESERVED	93	RESERVED
94	RESERVED	95	NC	96	NC
97	NC	98	NC	99	NC
100	NC	101	NC		

2.2. Pin Description

Table 4: IO parameters definition

Pin type	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
OD	Open Drain

Table 5: Pin description

Pin name	Pin No.	Default status	Description	Comment
Power supply				
VBAT	19,20	PI	Power supply, voltage range: 2.7V~4.8V.	
VDD_EXT	21	PO	LDO power output 1.8V for other external circuits with Max 50mA current output.	This power supply only use for external GPIO pulling up or level shift circuit. If unused, keep it open.
GND	22,23, 24,25, 27,28, 30,31, 43,52, 53,54, 55,56, 58,65, 66,73, 74,75, 84,85, 86,88, 89		Ground	
System Control				
PWRKEY	46	DI,PU	System power on/off control input, active low. The efficient input low level	The level is 1.5V when this PIN is floating;

			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 15S, the system will automatically reset. Therefore, long-term grounding is not recommended	PWRKEY should never be pulled down to GND permanently.
RESET_N	45	DI,PU	Reset the module $V_{ILmax}=0.4V$	1.8V power domain. If unused, keep this pin open.

SIM interface

USIM_DATA	14	I/O,PU	USIM Card data I/O, which has been pulled up via a 20KR resistor to USIM_VDD internally. Do not pull it up or down externally.	
USIM_RST	15	DO	USIM Reset	All lines of USIM interface should be protected against ESD.
USIM_CLK	13	DO	USIM clock	
USIM_VDD	16	PO	Power output for USIM card, its output Voltage depends on SIM card type automatically. Its output current is up to 50mA.	
USIM_PRESENCE	44	DI	USIM card insertion detection	1.8V power domain. If unused, keep this pin open.

USB

USB_VBUS	12	DI,PD	USB detection $V_{IHmax}=1.8V$ $V_{IHmin}=1.3V$	Software download interface. It is recommended to reserve interfaces or test points.
USB_DP	11	I/O	Positive line of the differential, bi-directional USB signal.	
USB_DM	10	I/O	Negative line of the differential, bi-directional USB signal.	
USB_VDDA_3P3	42	PI	Power for USB PHY circuit. $V_{norm}=3.3V$	USB_VDDA_3P3 and EXT_PWR_EN pins are used for USB PHY circuits.
EXT_PWR_EN	64	DO	USB_VDDA_3P3 voltage enable signal. 1.8V power domain	

UART interface

TXD	7	DOH	Transmit Data	
RXD	6	DI,PU	Receive Data	
RTS	38	DI,PU	Request to send	1.8V power domain. If unused, keep it open.
CTS	39	DOH	Clear to Send	
DCD	90	DOH	Carrier detects	
DTR	62	DI,PU	DTE get ready	
RI	76	DOH	Ring Indicator	
DBG_TXD	60	DOH	Debug UART, the boot log will be output during boot up.	1.8V power domain. If unused, keep them open.
DBG_RXD	61	DI,PU		
GNSS_UART_TXD	36	DOH	It can be configured as NMEA	1.8V power domain. If

GNSS_UART_RXD	4	DI,PU	data output for GNSS.	unused, keep them open.
I2C interface				
I2C_SDA	5	OD	I2C serial data. Used for external codec. External pull-up resistor is required.	If unused, keep open, or else pull them up via 1K Ω resistors to the VDD_EXT.
I2C_SCL	37	OD	I2C serial clock. Used for external codec. External pull-up resistor is required.	
PCM interface				
PCM_DIN	2	DI	PCM data input.	
PCM_OUT	34	DO	PCM data output.	1.8V power domain. If unused, keep this pin open.
PCM_CLK	3	DO	PCM data bit clock.	
PCM_SYNC	35	DO	PCM data frame sync signal.	
SPI interface				
SPI_CS_N	63	DO	Chip Select	1.8V power domain. If unused, please keep them open. SPI_MOSI DO NOT PULL UP DURING NORMAL POWER UP!
SPI_MOSI	40	DO	SPI master-out slave-in Note: It cannot be pulled up before booting. Otherwise it will affect the normal boot.	
SPI_CLK	9	DO	Bus clock output	
SPI_MISO	8	DI	SPI master-in slave-out	
GPIO				
NETLIGHT	79	DO	Indicate the module's network activity status.	1.8V power domain. If unused, keep them open.
STATUS	78	DO	Indicate the module's operation status. High level: Power on and firmware ready. Low level: Power off.	
GPIO1	1	IO	General-purpose input/output interface	1.8V power domain. If unused, keep them open.
GPIO33	33	IO	General-purpose input/output interface	
GPIO57	57	IO	General-purpose input/output interface	
RF interface				
ANT_GNSS	32	AI	GNSS antenna interface	50 Ω impedance. If unused, keep this pin open.
ANT_MAIN	26	AIO	MAIN antenna interface	50 Ω impedance
RF control interface				
GRFC_2	72	IO	GRFC dedicated signals lines VC2	1.8V power domain. It can be connected to external antenna tuner to enhance antenna performance. If not used, it can be suspended.
GRFC_1	29	IO	GRFC dedicated signals lines VC1	
Other interface				
W_DISABLE#	41	DI	Airplane mode control	1.8V power domain. Pulled up by default. When it is in low voltage level, the

				module can enter into airplane mode. If unused, keep this pin open. 1.8V power domain. If unused, keep this pin open.
AP_READY	77	DI	Application processor sleep state detection	
BOOT_CFG	87	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.	1.8V power domain. Reserve a test points for it. Keep it open. DO NOT PULL UP DURING NORMAL POWER UP!
ADC0	17	AI	Analog-digital converter input. voltage range: 0V~1.875V.	If unused, keep it open.
ADC1	18	AI		
RESERVED	48,49, 50,51, 59,67, 68,69, 70,71, 80,81, 82,83, 91,92, 93,94		Reserved	Keep it open
NC	95,96, 97,98, 99, 100, 101		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

The following figure shows the package outline drawing of SIM7090G.

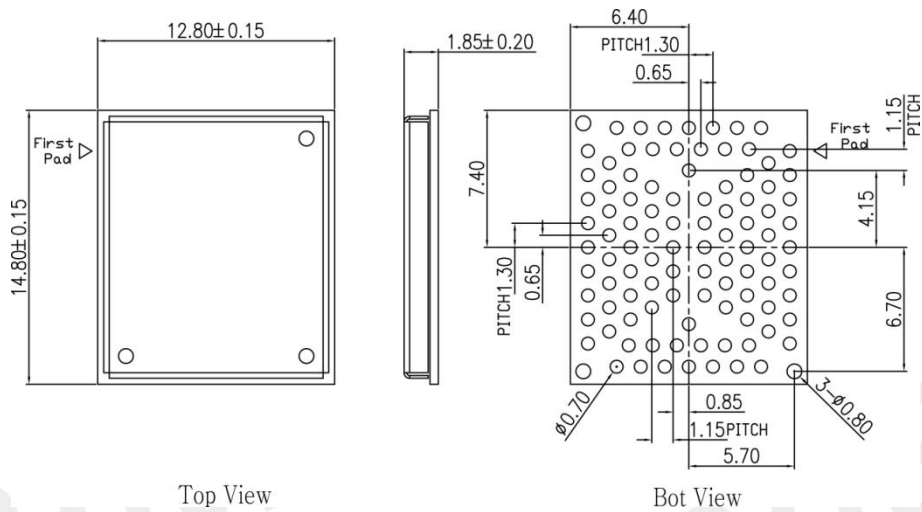
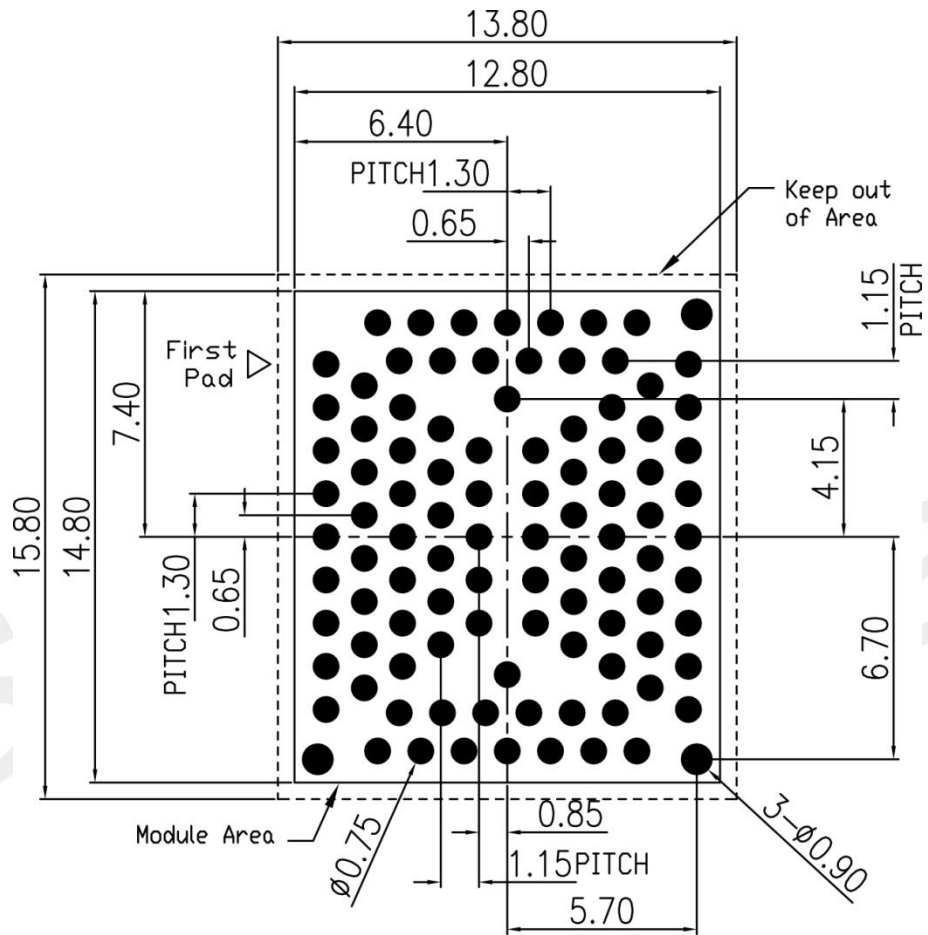


Figure 3: Dimensions (Unit: mm)

2.4. Footprint Recommendation



Top View

Figure 4: Footprint recommendation (Unit: mm)

3 Interface Application

3.1 Power Supply

Pin 19 and pin 20 are VBAT power input.

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

Table 6: VBAT pins electronic characteristic

Symbol	Description	Min.	Typ.	Max.	Unit
VBAT	Module power voltage	2.7	3.8	4.8	V
$I_{VBAT(peak)}$	Module power peak current in CAT-M1 and NB-IoT emission mode.	-	0.5	-	A
$I_{VBAT(average)}$	Module power average current in normal mode	Please refer to the chapter 5.4			
$I_{VBAT(sleep)}$	Power supply current in sleep mode	Please refer to the chapter 5.4			
$I_{VBAT(power-off)}$	Module power current in power off mode.	-	-	15	uA
$I_{VBAT(PSM)}$	Module power current in PSM mode.	-	3	-	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 to ensure that the drop of VBAT is not less than 2.5V even when the module's current consumption reaches the instantaneous maximum. If the voltage drop is less than 2.5V, the module may shut down due to the low voltage.

The following figure shows the recommended circuit.

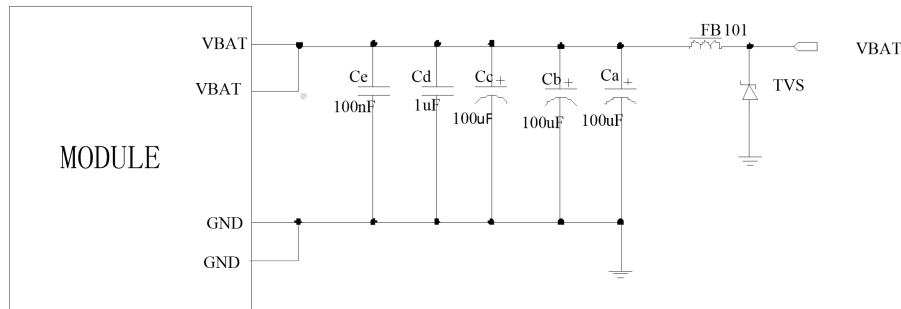


Figure 5: Power supply application circuit

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 1 mm to minimize PCB trace impedance.

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 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 overvoltage warning function and the under-voltage warning function. The default value of the overvoltage warning function in the software is 4.85V, and the default value of the under-voltage warning function is 2.8V. If the power supply for VBAT pins is up 4.85V or under 2.8V, module will be warning.

The AT command "AT+CBATCHK=1" also can be used to enable the overvoltage power-off function and the under-voltage power-off function. The default value of the overvoltage power-off function is 4.9V, and the default value of the under-voltage power-off function is 2.5V. If the VBAT voltage is up 4.9V or under 2.5V, module will be power off.

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 Turn on Module Using the PWRKEY Pin

SIM7090G can be powered on by briefly pulling the PWRKEY pin to ground.

The PWRKEY pin has been pulled up with a diode to 1.8V internally, so it does not need to be pulled up externally. 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 15 seconds). After the PWRKEY is pulled low, the module will be reset after 15 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.

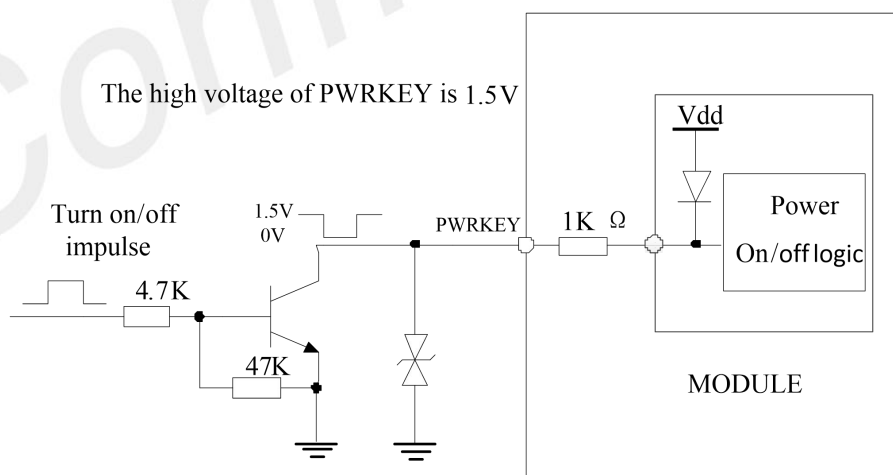


Figure 6: Reference power on/off circuit

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

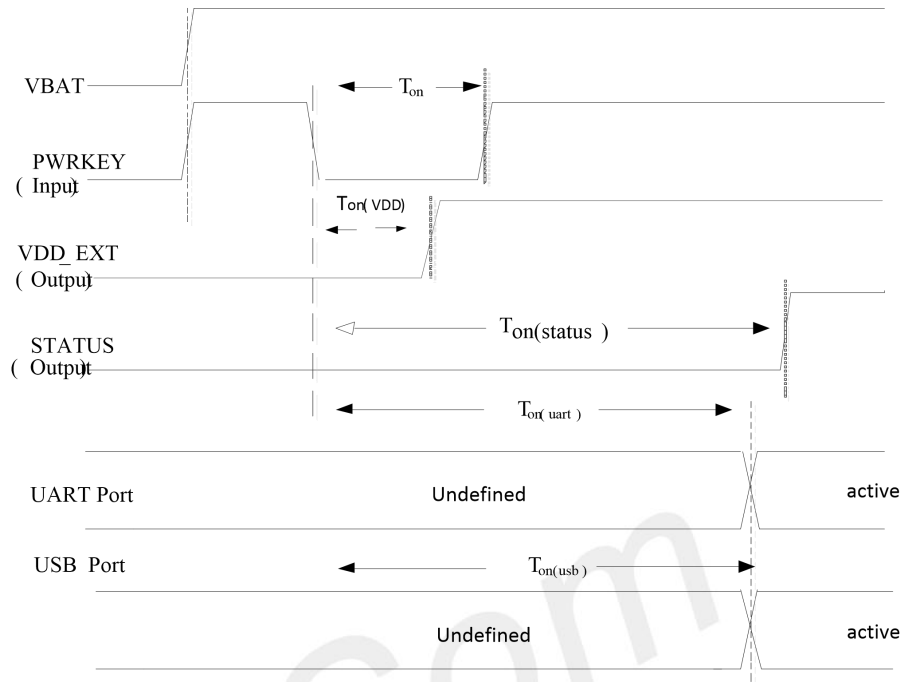


Figure 7: Power on timing sequence

Table 7: Power on timing and electronic characteristic

Symbol	Parameter	Min.	Typ.	Max.	Unit
T_{on}	The time of active low level impulse of PWRKEY pin to power on module	1	-	-	s
$T_{on(Vdd)}$	The time from power-on issue to VDD_EXT pin output high level.		64		ms
$T_{on(status)}$	The time from power-on issue to STATUS pin output high level(indicating power up ready)	6.9	-	-	s
$T_{on(uart)}$	The time from power-on issue to UART port ready	6.9	-	-	s
$T_{on(usb)}$	The time from power-on issue to USB port ready	7.2	-	-	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 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 Turn off Module

The following methods can be used to power off SIM7090G.

- Method 1: Power off SIM7090G by pulling the PWRKEY pin to ground.
- Method 2: Power off SIM7090G 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 following figure.

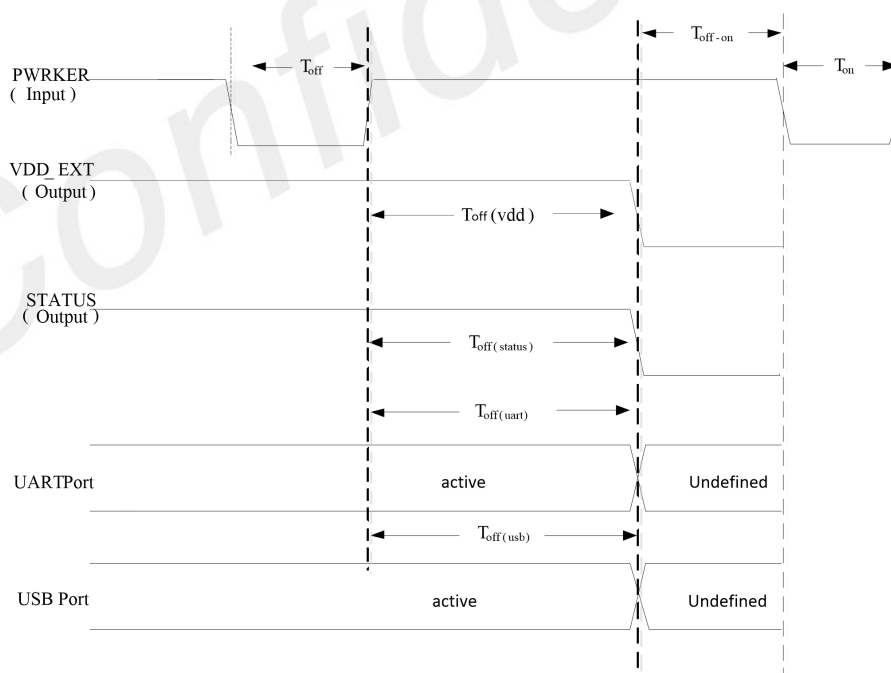


Figure 8: Power off timing sequence

Table 8: 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	1.8	-	-	s
$T_{off(status)}$	The time from power-off issue to STATUS pin output low level(indicating power off)*	1.8	-	-	s
$T_{off(uart)}$	The time from power-off issue to UART port off	1.8	-	-	s
$T_{off(usb)}$	The time from power-off issue to USB port off	1.8	-	-	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.

3.2.3 Reset the Module

RESET_N is used to reset the module. The module can be reset by driving RESET_N to a low level voltage for a period of time.

The RESET pin has been pulled up to 1.8V with a resistor internally. So it does not need to be pulled up externally. It is strongly recommended to put an ESD protection diode close to the RESET pin. Please refer to the following figure for the recommended reference circuit.

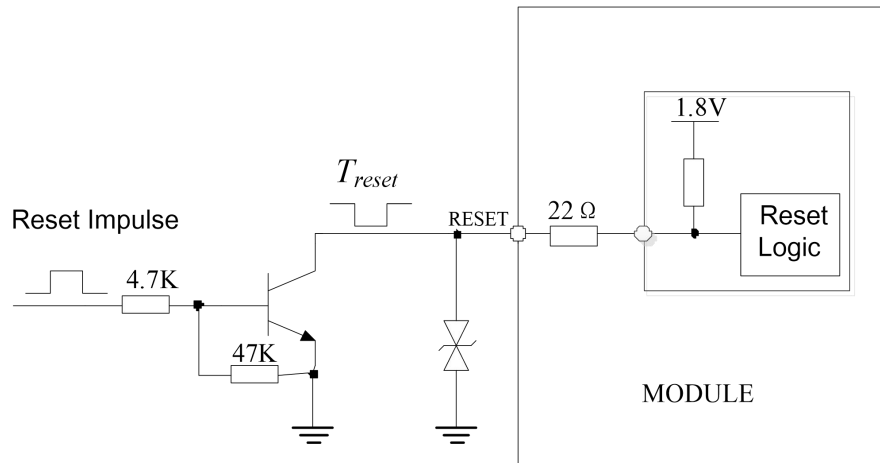


Figure 9: Reference reset circuit

Table 9: RESET pin electronic characteristic

Symbol	Description	Min.	Typ.	Max.	Unit
T_{reset}	The active low level time impulse on RESET pin to reset module	500			ms
V_{IH}	Input high level voltage	1.2	1.8	1.8	V
V_{IL}	Input low level voltage	-0.3	0	0.3	V

3.3 UART Interface

SIM7090G can provide 3 channels serial ports: Main UART, Debug UART and GNSS UART interfaces.

Features of them are illustrated below:

- The Main UART interface supports 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 the default is 115200bps. It is used for data transmission and AT command communication, and supports RTS and CTS hardware flow control. The default frame format is 8N1 (8 data bits, no parity, 1 stop bit).
- The Debug UART interface supports a fixed baud rate of 115200bps, and is used for software debugging and log output.
- The GNSS UART interface supports 115200bps baud rate by default, and is used for GNSS data and NMEA sentences output.

Table 10: Pin Definition of Main UART Interface

Pin Name	Pin No.	I/O	Description	Comment
DTR	62	DI	Data terminal ready. Sleep mode control.	1.8V power domain
RXD	6	DI	Receive data	1.8V power domain
TXD	7	DO	Transmit data	1.8V power domain
CTS	39	DO	Clear to send	1.8V power domain
RTS	38	DI	Request to send	1.8V power domain
DCD	90	DO	Data carrier detection	1.8V power domain
RI	76	DO	Ring indication signal	1.8V power domain

Table 11: Pin Definition of Debug UART Interface

Pin Name	Pin No.	I/O	Description	Comment
DBG_RXD	61	DI	Receive data	1.8V power domain
DBG_TXD	60	DO	Transmit data	1.8V power domain

Table 12: Pin Definition of GNSS UART Interface

Pin Name	Pin No.	I/O	Description	Comment
GNSS_UART_RXD	61	DI	Receive data	1.8V power domain
GNSS_UART_TXD	60	DO	Transmit data	1.8V power domain

3.3.1. UART Design Guide

The following figures show the reference design.

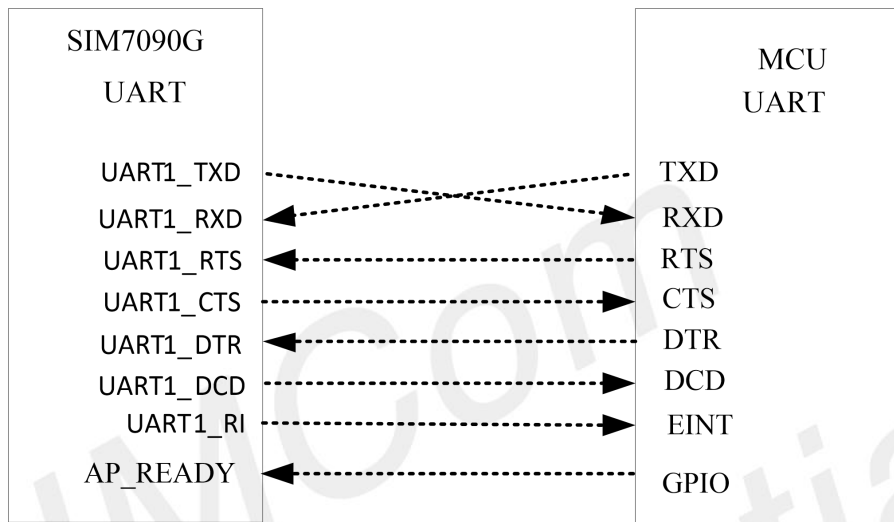


Figure 10: UART full modem

- Driving the host DTR to low level will wake up the module.
- AP_READY will detect the sleep state of the host (can be configured to high level or low level detection).

Table 13: 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 SIM7090G 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.

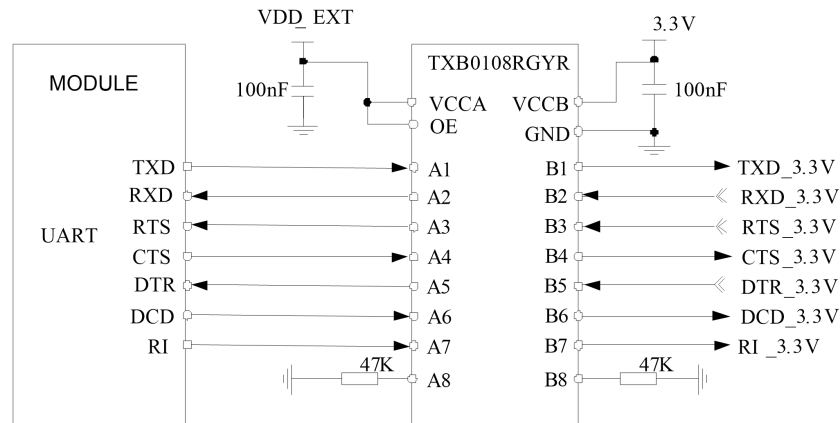


Figure 11: Reference circuit of level shifter IC

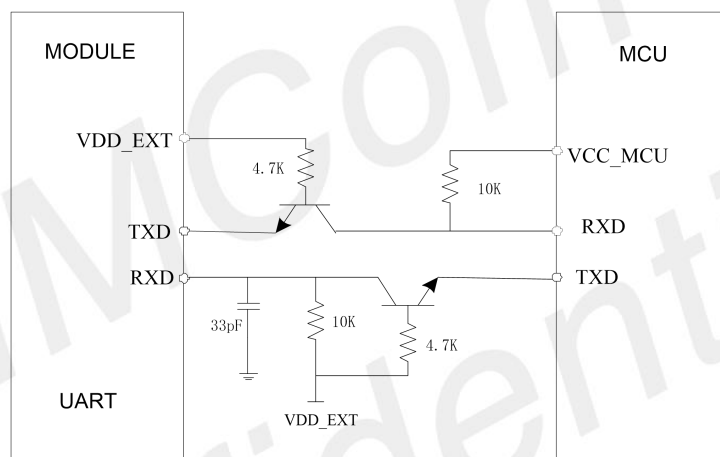


Figure 12: Reference circuit with Transistor

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 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.

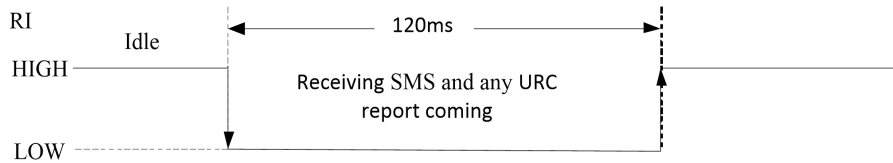


Figure 13: RI behaviour (SMS and URC report)

3.3.3. DTR Behavior

Perform the following operations in turn, and the module will enter sleep mode.

- Setting the AT command "AT+CSCLK=1".
- Drive DTR to high level.

In sleep mode, the UART is unavailable. And pulling down DTR can wake up module.

After setting the AT command "AT+CSCLK=0", SIM7090G 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

SIM7090G has a USB2.0 interface. The USB interface is used for AT command communication, data transmission, software debugging and firmware upgrade. The following table shows the pin definition of USB interface.

Table 14: Pin Definition of USB Interface

Pin Name	Pin No.	I/O	Description	Comment
USB_VBUS	12	PI	USB connection detection	The input range is 1.3V~1.8V
USB_DP	11	IO	USB differential data bus (+)	Require differential

USB_DM	10	IO	USB differential data bus (-)	impedance of 90Ω
USB_VDDA_3P3	42	PI	Power supply for USB PHY circuit	
EXT_PWR_EN	64	DO	External LDO enable of USB	1.8V power domain

The USB interface is recommended to be reserved for firmware upgrade in customers' design. The following figures illustrate reference designs of USB PHY and USB interface.

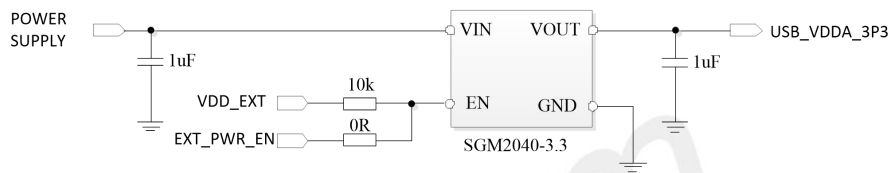


Figure 14: Reference Design of USB PHY

The reference circuit refers to the following figure.

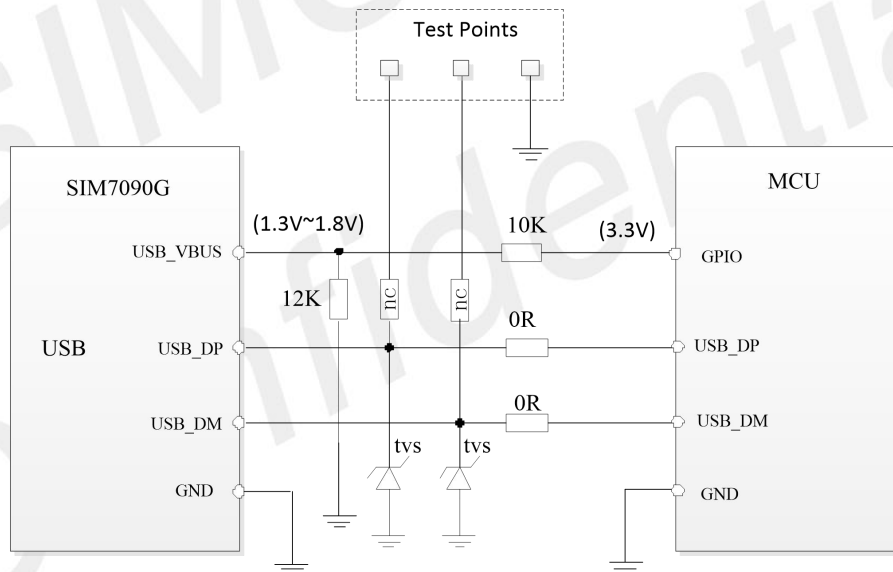


Figure 15: Reference Design of USB Interface

The following principles should be complied with when design the USB interface, so as to meet USB 2.0 specification.

- It is important to route the USB signal traces as differential pairs with total grounding. The impedance of USB differential trace is 90Ω.
- Do not route signal traces under crystals, oscillators, magnetic devices and RF signal traces. It is important to route the USB differential traces in inner-layer with ground shielding on not only upper and lower layers but also right and left sides.
- Pay attention to the influence of junction capacitance of ESD protection components on USB data

- lines. Typically, the capacitance value should be less than 3pF.
- Keep the ESD protection components as close to the USB connector as possible.

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 SIM Interface

SIM7090G only supports 1.8V SIM Cards.

Table 15: 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

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

3.5.1. SIM Application Guide

It is recommended to use an ESD protection component such as ESDA6V1W5 produced by ST (www.st.com) or SMF15C produced by ON SEMI (www.onsemi.com). 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.

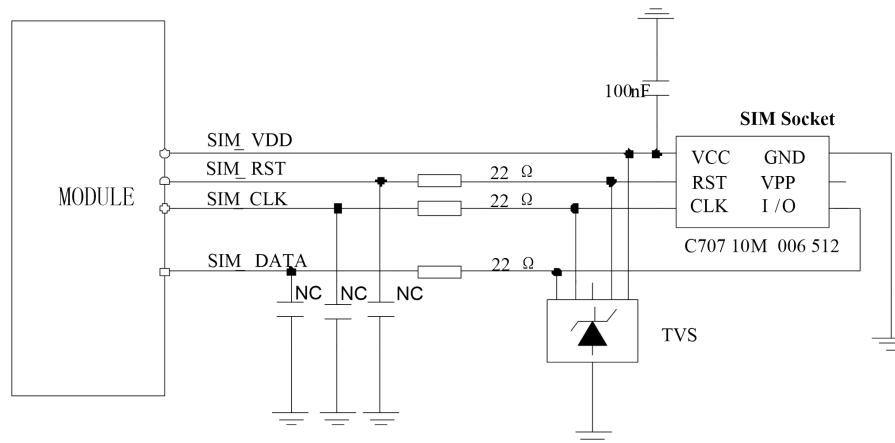


Figure 16: SIM interface reference circuit

SIM_DATA has been pulled up with a 20KΩ 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.

3.6 PCM Interface

SIM7090G provides a PCM interface for external codec, which can be used in master mode with short sync and 16 bits linear format.

Table 16: Pin Definition of PCM Interfaces

Pin Name	Pin No.	I/O	Description	Comment
PCM_CLK	3	DO	PCM clock output	1.8V power domain
PCM_SYNC	35	DO	PCM frame synchronization output	1.8V power domain
PCM_IN	2	DI	PCM data input	1.8V power domain
PCM_OUT	34	DO	PCM data output	1.8V power domain

The following figure shows the external codec reference design.

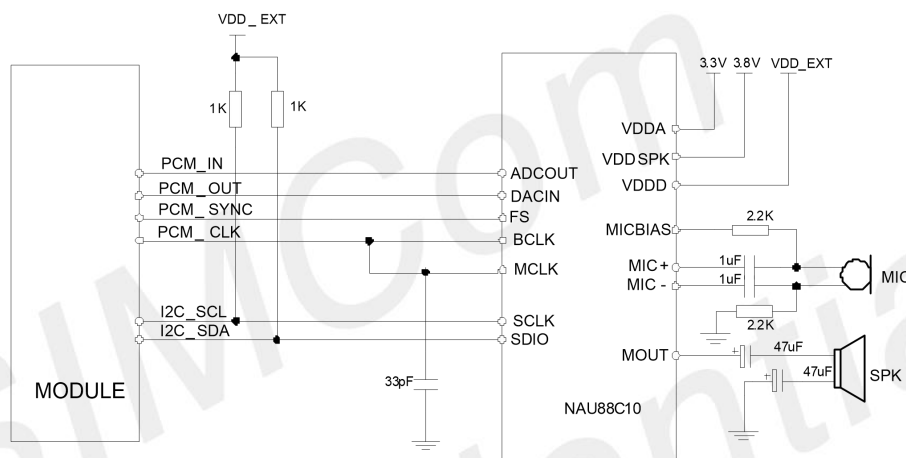


Figure 17: Reference Circuit of PCM Application with Audio Codec

3.7 I2C Interface

SIM7090G 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.

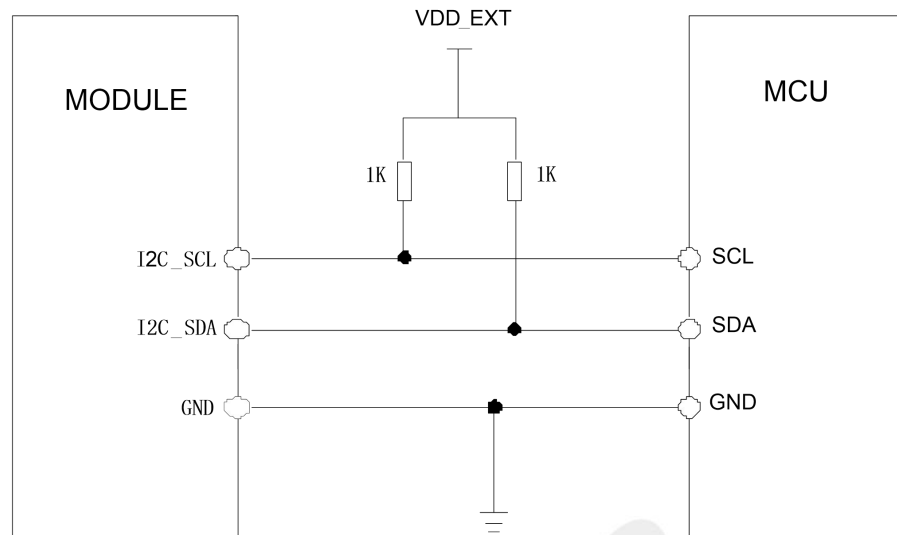


Figure 18: I2C reference circuit

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

3.8 SPI Interface

SIM7090G supports a set of 4-wire (MISO, MOSI, CS and CLK) SPI interfaces and supports both SPI master mode and SPI 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.

Table 17: Pin Definition of SPI Interface

Pin Name	Pin No.	I/O	Description	Comment
*SPI_MOSI	40	DO	SPI master-out slave-in	1.8V power domain
SPI_MISO	8	DI	SPI master-in slave-out	1.8V power domain
SPI_CS_N	63	DO	SPI chip select	1.8V power domain
SPI_CLK	9	DO	SPI clock	1.8V power domain

NOTE

SPI_MOSI 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.

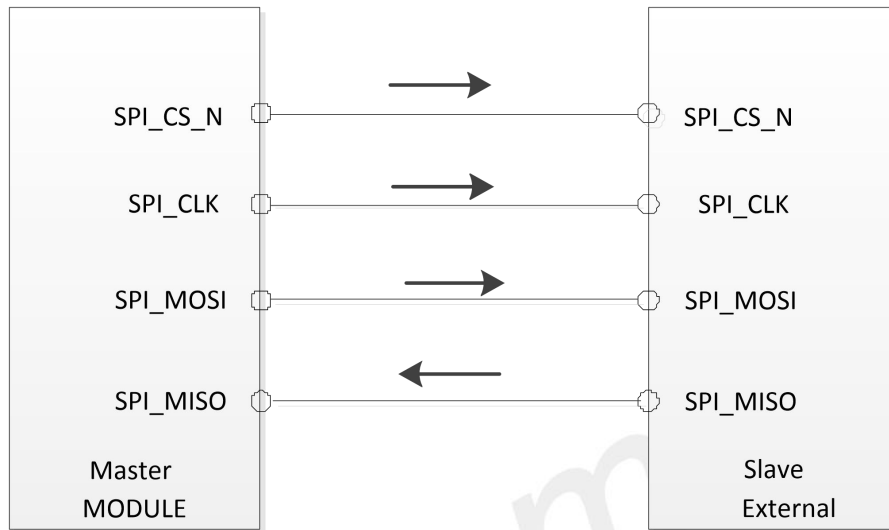


Figure 19: SPI master mode circuit

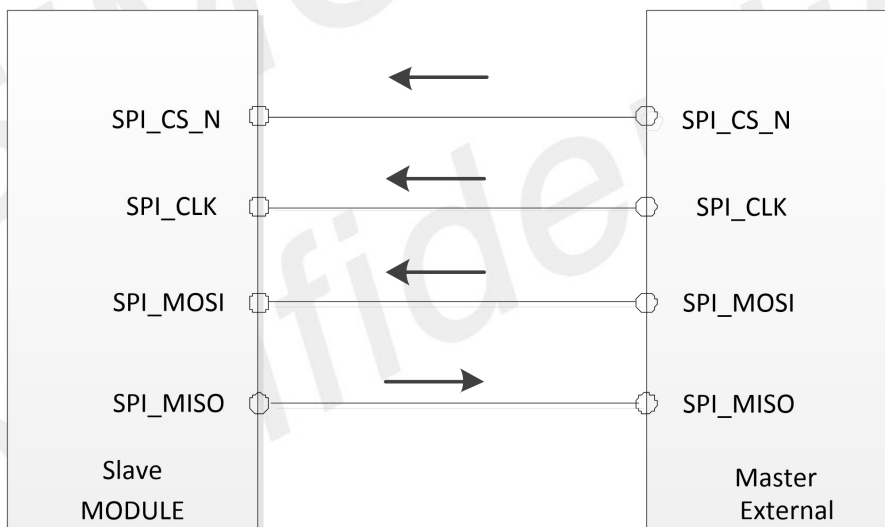


Figure 20: SPI slave mode circuit

NOTE

The SPI_MOSI (49 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.

3.9 Network status

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

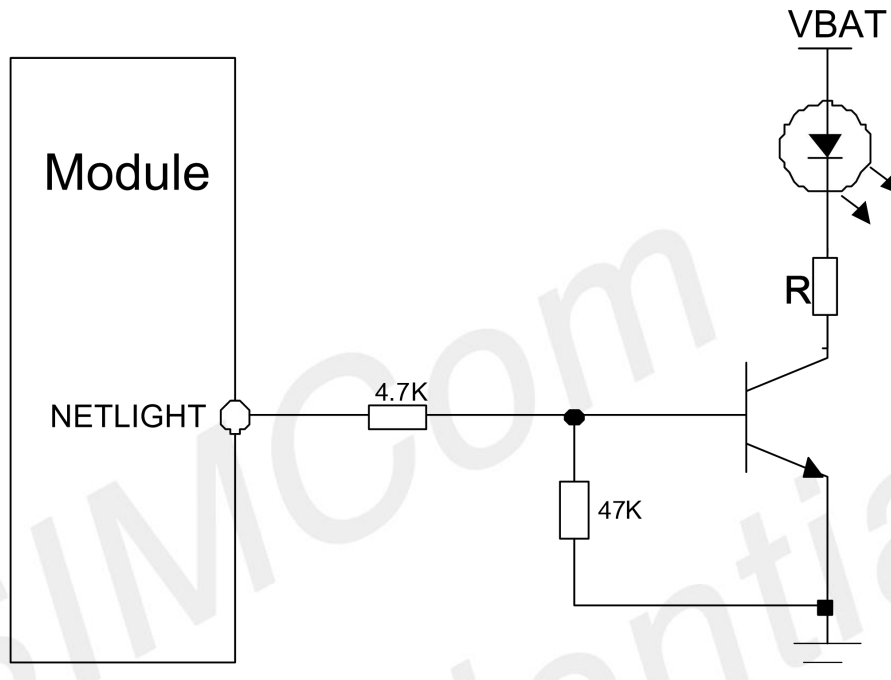


Figure 21: NETLIGHT reference circuit

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”.

3.10 ADC interface

SIM7090G has two dedicated ADC pins. They are available for digitizing analog signals such as battery voltage and so on. The 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

Table 19: Pin Definition of ADC Interfaces

Pin Name	Pin No.	I/O	Description	Comment
ADC0	17	AI	General purpose analog to digital converter interface.	1.8V power domain
ADC1	18	AI	General purpose analog to digital converter interface.	1.8V power domain

Table 20: 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].

3.11 LDO output

SIM7090G 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.

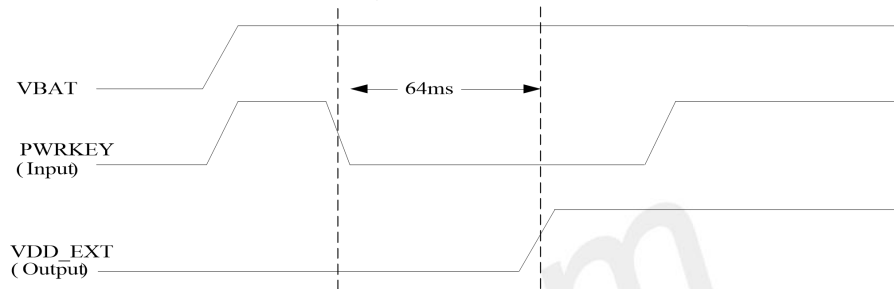


Figure 22: Power on sequence of the VDD_EXT

Table 21: 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.

3.12 USB_BOOT Interface

SIM7090G provides a USB_BOOT pin for firmware upgrade during development or factory production. Before the module powers up, pull USB_BOOT up to high level will force the module to boot from USB port.

Table 22: Pin Definition of USB_BOOT Interfaces

Pin Name	Pin No.	I/O	Description	Comment
USB_BOOT	87	DI	Force the module to enter into emergency download mode.	1.8V power domain. Active high. If unused, keep it open.

3.13 GPIO Interface

The module provides three general-purpose input and output (GPIO) interfaces.

Table 23: Pin Definition of GPIO Interfaces

Pin Name	Pin No.	I/O	Description	Comment
GPIO1	87	IO	General-purpose input and output interface	1.8V power domain.
GPIO33	33	IO	General-purpose input and output interface	1.8V power domain.
GPIO57	57	IO	General-purpose input and output interface	1.8V power domain.

Table 24: Logic Levels of GPIO Interfaces

Parameter	Min.	Max.	Unit
V _{IL}	-0.3	0.6	V
V _{IH}	1.2	2.0	V
V _{OL}	0	0.45	V
V _{OH}	1.35	1.8	V

3.14 RF control Interface

SIM7090G provides a set of antenna GRFC dedicated signals lines. It can be used to control the antenna tuner to improve antenna performance.

The reference circuit is shown in the following figure:

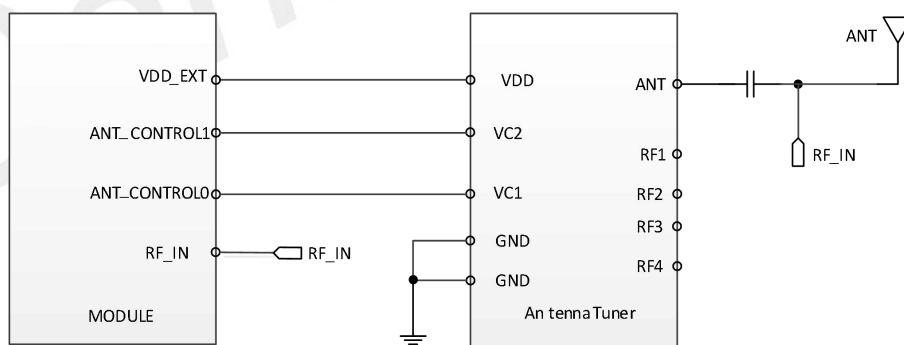


Figure 23: RF control interface reference circuit

3.15 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.

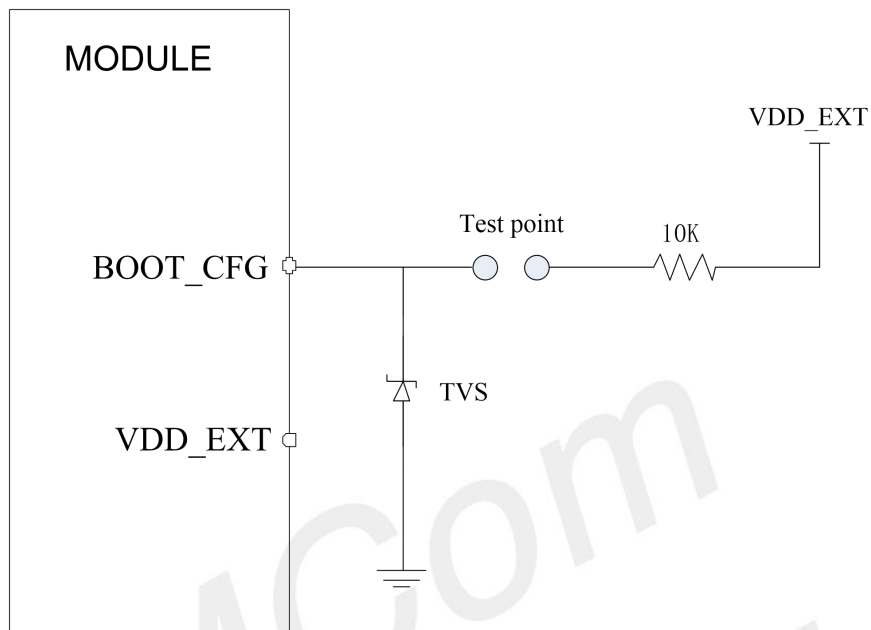


Figure 24: Reference circuit of BOOT_CFG interface

4 RF Specifications

4.1 LTE RF Specifications

Table 25: Conducted transmission power

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 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 +2.7/-3.2dB	<-40dBm
LTE-FDD B28	20dBm +/-2.7dB	<-40dBm
LTE-FDD B66	20dBm +/-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 26: Maximum Power Reduction (MPR) for UE category NB2&M1 Power Class 5

CAT-NB2

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

CAT-M1

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

Table 27: Operating frequencies

Frequency	Receiving	Transmission
BAND Information	Refers to Table 1	
GPS L1 BAND	1574.4 ~1576.44 MHz	-
GLONASS	1598 ~1606 MHz	-
BD	1559 ~1563 MHz	-
Galileo	1575.42±1.023MHz	-

Table 28: 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	2110~2155MHz	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
66	1710~1780MHz	2110~2180MHz	HD-FDD
71	663~698MHz	617~652MHz	HD-FDD
85	698~716MHzHz	728~746MHz	HD-FDD

Table 29: Conducted receive sensitivity

Frequency	Receive sensitivity(Typical)	Receive sensitivity(MAX)
LTE HD-FDD	Reference 【Table 30】 【Table 31】	3GPP

Table 30: CAT-M1 Reference sensitivity (QPSK)

E-UTRA Band	REFSENS MAX (dBm) 3GPP Request	REFSENS Typical (dBm)	Duplex Mode
1	-103	-109	HD-FDD
2	-101	-107	HD-FDD
3	-100	-107	HD-FDD
4	-103	-107	HD-FDD
5	-101.5	-107	HD-FDD
8	-100.5	-107	HD-FDD
12	-100	-106	HD-FDD
13	-100	-106	HD-FDD
14	-100	-103	HD-FDD
18	-103	-107	HD-FDD
19	-103	-107	HD-FDD
20	-100.5	-107	HD-FDD
25	-99.5	-103	HD-FDD
26	-101	-108	HD-FDD
27	-101.5	-108	HD-FDD
28	-101.5	-107	HD-FDD
66	NA	-107	HD-FDD
85	-100	-107	HD-FDD

SIMCom
Confidential

Table 31: CAT-NB2 Reference sensitivity (QPSK)

Operating band	REFSENS MAX(dBm) 3GPP Request	REFSENS Typical (dBm)	REFSENS Typical Repetition 12/ 7/1/128 [EPRE dbm/15KHz]
1	-108.2	-116	-131
2	-108.2	-115	-130
3	-108.2	-116	-131
4	-108.2	-116	-130
5	-108.2	-115	-129
8	-108.2	-115	-130
12	-108.2	-115	-130
13	-108.2	-115	-130
18	-108.2	-115	-129
19	-108.2	-114	-128
20	-108.2	-114	-128
25	-108.2	-115	-130
26	-108.2	-115	-129
28	-108.2	-116	-130
66	-108.2	-115	-129
71	-108.2	-113	-129
85	-108.2	-115	-130

NOTE

The 12/7/1/128 of the REFSENS Typical Repeated 12/ 7/1/128 [EPRE dbm/15KHz means Subcarriers=12, MCS.TBS=7, #SF/#RU=1, #Repetition=128.

4.2 LTE Antenna Design Guide

Users should connect antennas to SIM7090G's 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 32: 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.

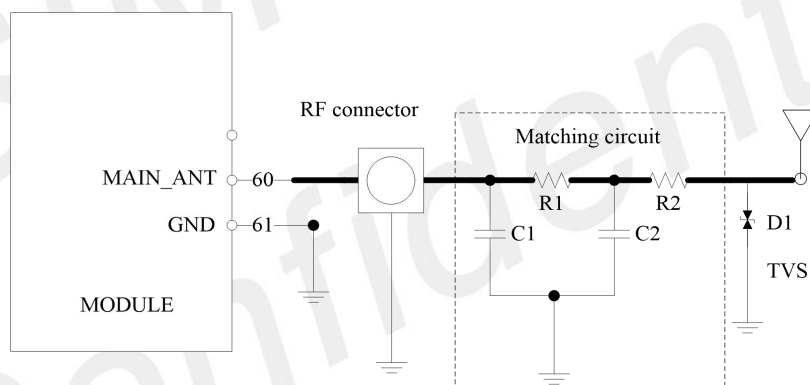


Figure 25: Antenna matching circuit (MAIN_ANT)

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 SIM7090G and antenna must be controlled in 50Ω.

Two TVS are recommended in the table below.

Table 33: Recommended TVS

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

4.3 GNSS

SIM7090G merges GNSS (GPS/GLONASS/BD) satellite and network information to provide a high-availability solution that offers industry-leading accuracy and performance. This solution performs well, even in very challenging environmental conditions where conventional GNSS receivers fail, and provides a platform to enable wireless operators to address both location-based services and emergency mandates.

4.3.1. GNSS Technical specification

- Tracking sensitivity: -159 dBm (GPS+GLONASS)/-159 dBm (GPS+BD)
- Cold-start sensitivity: -147 dBm
- Accuracy (Open Sky): 1 m (CEP50)
- TTFF (Open Sky) : Hot start < 1 s, Cold start< 31 s
- Receiver Type: 16-channel, C/A Code
- GNSS L1 Frequency: 1575.42±1.023MHz
- GLONASS: 1597.5~1605.8 MHz
- BD: 1559.05~1563.14 MHz
- 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 SIM7090G. The following figures are the reference circuits.

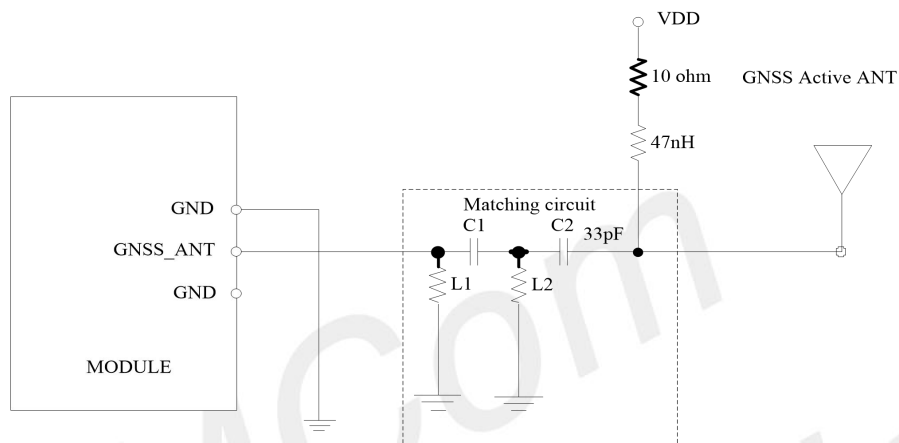


Figure 26: Active antenna circuit

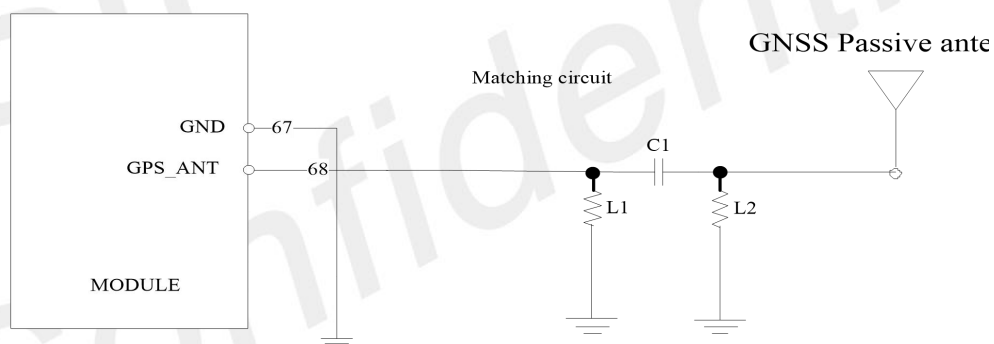


Figure 27: Passive antenna circuit (Default)

In the above figures, components C1, L1 and L2 are used for antenna matching. Usually, the value of the component can only be obtained after the antenna is tuned, and is usually provided by the antenna supplier. C2 is used for DC blocking. The active antenna's VDD requires an external power supply and should be considered according to the characteristics of the active antenna. It is recommended to use LDO/DCDC to turn off the active antenna when GNSS is not working to reduce current consumption.

GNSS can be tested through the NMEA port. NMEA sentences can be obtained automatically via UART or USB. NMEA sentences include GSV, GGA, RMC, GSA and VTG. Before using GNSS, users should configure SIM7090G to the correct working mode through AT commands. For more information, please refer to the relevant documentation. SIM7090G can also obtain location information directly through AT.

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 matching circuits 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 $50\ \Omega$ 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.

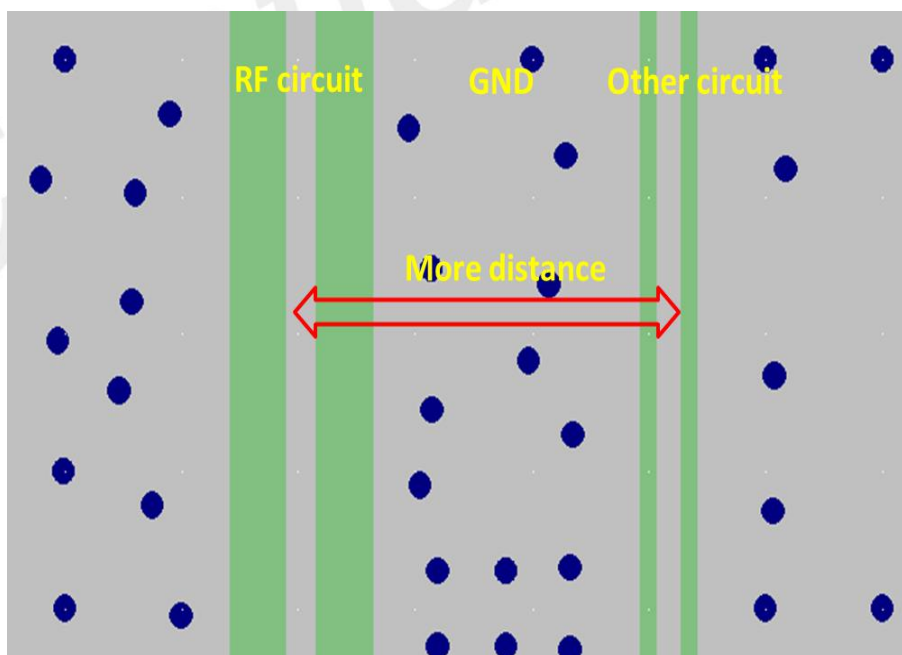


Figure 28: RF trace should be far away from other high speed signal lines

- Avoiding the paroling rout of other system antennas nearby.
- 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.
-

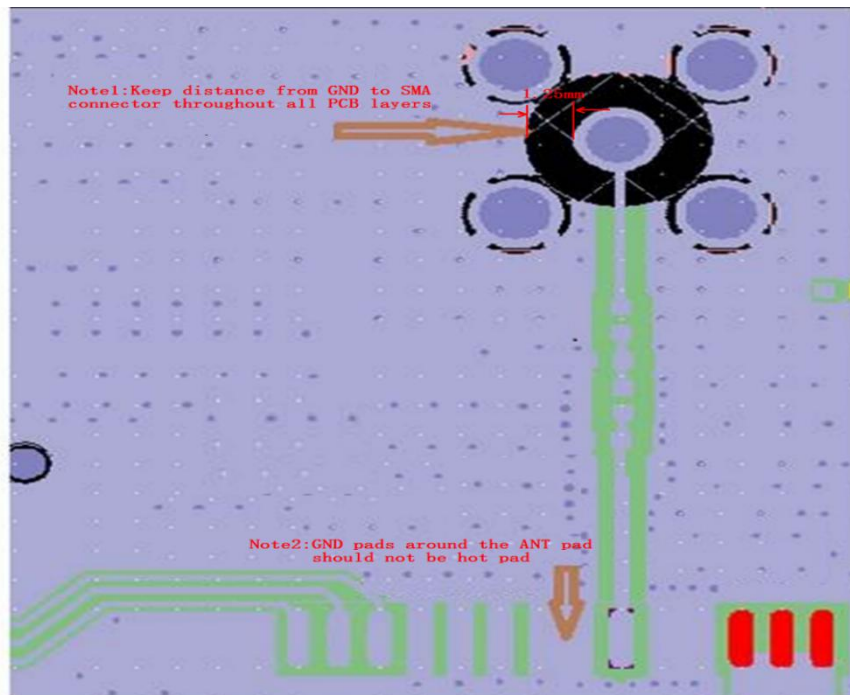


Figure 29: The distance between GND to the inner conductor of SMA

- 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 SIM7090G are listed in the following table:

Table 34: Absolute maximum ratings

Parameter	Min.	Typ.	Max.	Unit
Voltage on VBAT	-0.3	-	6.0	V
Voltage on USB_VBUS	-0.3	-	2.1	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

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 35: Recommended operating ratings

Parameter	Min.	Typ.	Max.	Unit
Voltage at VBAT	2.7	3.8	4.8	V
Voltage at USB_VBUS	0	1.8	2.1	V

Make sure that the voltage on the VBAT pins will never drop below 2.7V, even during a transmit burst. Otherwise, module will be power down.

Table 36: 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.

The operating temperature of SIM7090G is listed in the following table.

Table 37: Operating temperature

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

NOTE

Module is able to make and receive voice calls, data calls, SMS and make GPRS/LTE traffic in -40°C ~ +85°C. 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 SIM7090G product.

Table 38: 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" or W_DISABLE# pin 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 Flight Mode

When the module enters into flight mode, the RF function does not work, and all AT commands correlative with RF function will be inaccessible. This mode can be set via the following ways.

- Hardware: W_DISABLE#* is pulled up by default. Driving it to low level will let the module enter into flight mode.
- Software: AT+CFUN=4 can be used to set the module to flight mode without removing the power supply.

5.3.3 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 SIM7090G 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.

5.3.4 Minimum functionality mode and Flight mode

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

- AT+CFUN=0: Minimum functionality
- AT+CFUN=1: Full functionality (Default)
- AT+CFUN=4: Flight mode

If SIM7090G 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 SIM7090G 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 SIM7090G is in minimum functionality or flight mode, it can return to full functionality by the AT command "AT+CFUN=1".

5.3.5 Power Saving Mode (PSM)

SIM7090G 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.

5.3.6 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.

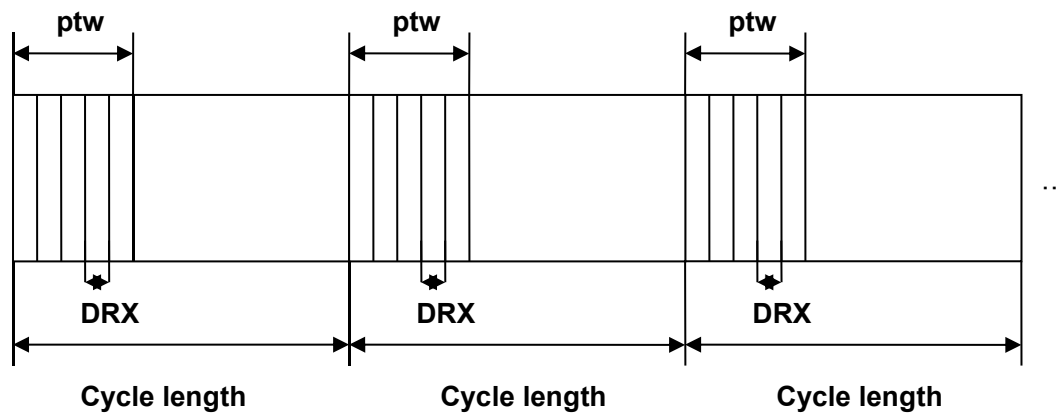


Figure 30: e-DRX diagrammatic sketch

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 39: 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 (GNSS off, without USB connection)	Sleep mode Typical: 0.78mA @DRX2.56S Idle mode Typical: 14mA
---	---

Power Saving Mode

PSM supply current		PSM mode Typical: 3uA
e-DRX		
e-DRX mode supply current :		@PTW=40.96s; eDRX=81.92s; DRX=2.56s
(AT+CSCLK=1;		Typical: 0.65mA
AT+CNETLIGHT=0;		@PTW=25.6s; eDRX=163.84s; DRX=2.56s,
AT+CEDRX=2,1,X,)		Typical: 0.46 mA
Data Transmission		
LTE Cat-M1 (Band Width: 10MHz)	LTE-FDD B1	@21dbm Typical: 114mA @10dbm Typical: 101mA @0dbm Typical: 91mA
	LTE-FDD B2	@21dbm Typical: 111mA @10dbm Typical: 102mA @0dbm Typical: 91mA
	LTE-FDD B3	@21dbm Typical: 109mA @10dbm Typical: 101mA @0dbm Typical: 90mA
	LTE-FDD B4	@21dbm Typical: 110mA @10dbm Typica : 100mA @0dbm Typical: 90mA
	LTE-FDD B5	@21dbm Typical: 112mA @10dbm Typical: 99mA @0dbm Typical: 91mA
	LTE-FDD B8	@21dbm Typical: 113mA @10dbm Typical: 99mA @0dbm Typical: 91mA
	LTE-FDD B12	@21dbm Typical: 110mA @10dbm Typical: 99mA @0dbm Typical: 91mA
	LTE-FDD B13	@21dbm Typical: 112mA @10dbm Typical: 99mA @0dbm Typical: 93mA
	LTE-FDD B14	@21dbm Typical: 112mA @10dbm Typical: 99mA @0dbm Typical: 91mA
	LTE-FDD B18	@21dbm Typical: 112mA @10dbm Typical: 99mA @0dbm Typical: 91mA
	LTE-FDD B19	@21dbm Typical: 111mA @10dbm Typical: 99mA @0dbm Typical: 91mA
	LTE-FDD B20	@21dbm Typical: 113mA @10dbm Typical: 99mA @0dbm Typical: 91mA
	LTE-FDD B25	@21dbm Typical: 111mA @10dbm Typical: 102mA @0dbm Typical: 91mA
	LTE-FDD B26	@21dbm Typical: 112mA @10dbm Typical: 100mA @0dbm Typical: 91mA
	LTE-FDD B27	@21dbm Typical: 110mA @10dbm Typical: 99mA @0dbm Typical: 91mA
	LTE-FDD B28	@21dbm Typical: 112mA @10dbm Typical: 99mA @0dbm Typical: 91mA

	LTE-FDD B66	@21dbm Typical: 162mA @10dbm Typical: 130mA @0dbm Typical: 102mA
	LTE-FDD B85	@21dbm Typical: 174mA @5dbm Typical: 106mA @0dbm Typical: 100mA
LTE Cat-NB1/NB2 (Band Width: 15KHz single tone)	LTE-FDD B1	@21dbm Typical: 130mA @10dbm Typical: 86mA @0dbm Typical: 54mA
	LTE-FDD B2	@21dbm Typical: 124mA @10dbm Typical: 84mA @0dbm Typical: 53mA
	LTE-FDD B3	@21dbm Typical: 115mA @10dbm Typical: 83mA @0dbm Typical: 53mA
	LTE-FDD B4	@21dbm Typical: 114mA @10dbm Typical: 83mA @0dbm Typical: 53mA
	LTE-FDD B5	@21dbm Typical: 125mA @10dbm Typical: 74mA @0dbm Typical: 53mA
	LTE-FDD B8	@21dbm Typical: 126mA @10dbm Typical: 77mA @0dbm Typical: 52mA
	LTE-FDD B12	@21dbm Typical: 119mA @10dbm Typical: 73mA @0dbm Typical: 51mA
	LTE-FDD B13	@21dbm Typical: 123mA @10dbm Typical: 74mA @0dbm Typical: 52mA
	LTE-FDD B18	@21dbm Typical: 121mA @10dbm Typical: 75mA @0dbm Typical: 53mA
	LTE-FDD B19	@21dbm Typical: 123mA @10dbm Typical: 76mA @0dbm Typical: 53mA
	LTE-FDD B20	@21dbm Typical: 127mA @10dbm Typical: 78mA @0dbm Typical: 53mA
	LTE-FDD B25	@21dbm Typical: 124mA @10dbm Typical: 73mA @0dbm Typical: 53mA
	LTE-FDD B26	@21dbm Typical: 121mA @10dbm Typical: 76mA @0dbm Typical: 53mA
	LTE-FDD B28	@21dbm Typical: 122mA @10dbm Typical: 75mA @0dbm Typical: 52mA
	LTE-FDD B66	@21dbm Typical: 115mA @10dbm Typical: 83mA @0dbm Typical: 53mA
	LTE-FDD B71	@21dbm Typical: 118mA @10dbm Typical: 73mA @0dbm Typical: 50mA
LTE-FDD B85	@21dbm Typical: 120mA @5dbm Typical: 55mA	

@0dbm Typical: 51mA

5.5 ESD Notes

SIM7090G is sensitive to ESD in the process of storage, transporting, and assembling. When SIM7090G 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 SIM7090G ESD measurement performance without any external ESD component.

Table 40: The ESD performance measurement (Temperature: 25°C, 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 SIM7090G



Figure 31: Top and bottom view of SIM7090G

6.2 Label Information

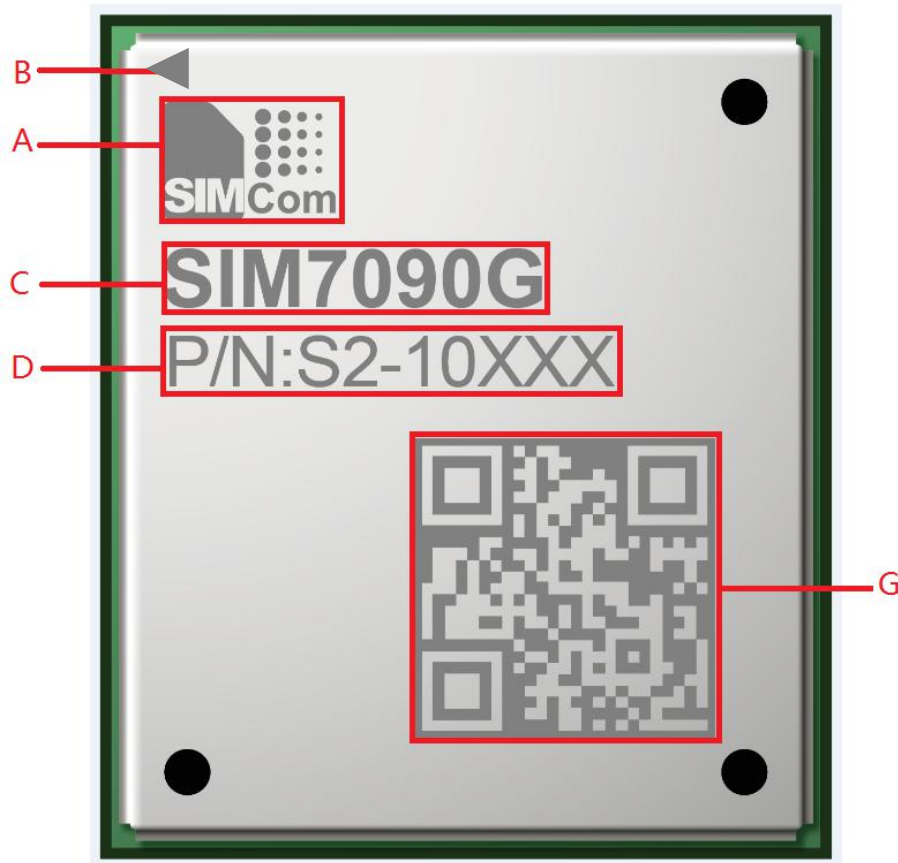


Figure 32: Label information

Table 41: The description of label information

No.	Description
A	LOGO
B	No.1 Pin
C	Project name
D	Product code
G	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.

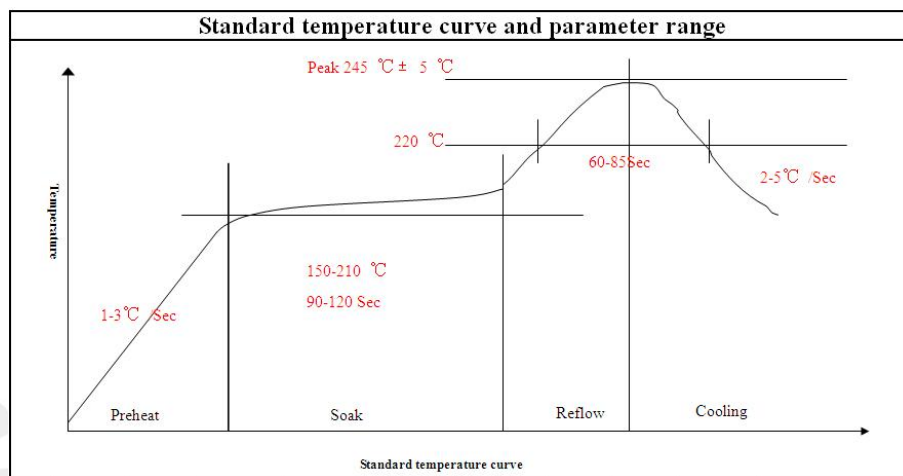


Figure 33: The ramp-soak-spike reflow profile of SIM7090G

NOTE

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

6.4 Moisture Sensitivity Level (MSL)

SIM7090G 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 42: Moisture Sensitivity Level and Floor Life

Moisture Sensitivity Level (MSL)	Floor Life (out of bag) at factory ambient $\leq 30^{\circ}\text{C}/60\% \text{ RH}$ or as stated
1	Unlimited at $\leq 30^{\circ}\text{C}/85\% \text{ RH}$
2	1 year at $\leq 30^{\circ}\text{C}/60\% \text{ RH}$
2a	4 weeks at $\leq 30^{\circ}\text{C}/60\% \text{ RH}$
3	168 hours at $\leq 30^{\circ}\text{C}/60\% \text{ RH}$
4	72 hours at $\leq 30^{\circ}\text{C}/60\% \text{ RH}$
5	48 hours at $\leq 30^{\circ}\text{C}/60\% \text{ RH}$
5a	24 hours at $\leq 30^{\circ}\text{C}/60\% \text{ RH}$
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 date of production is within six months has no use for baking. If the date of production is more than six months, the module must be baking.
- If the packaging had been opened or damaged, the module must be baking.

Table 43: Baking conditions

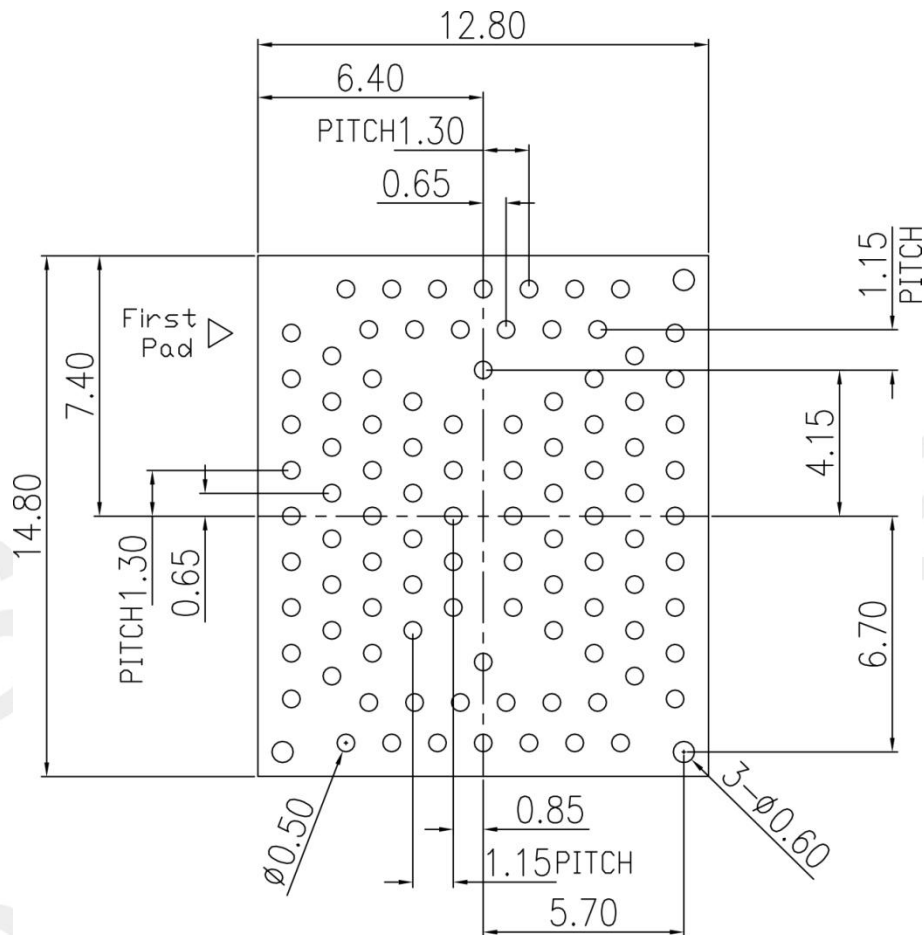
conditions	parameters
Baking temperature	120°C
Baking time	8 hours

NOTE

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

6.6 Stencil Foil Design Recommendation

The recommended thickness of stencil foil is 0.13mm.



Thickness of stencil: 0.13mm

Figure 34: stencil recommendation (Unit: mm)

7 Packaging

7.1 Tray packaging

SIM7090G module support tray packaging.

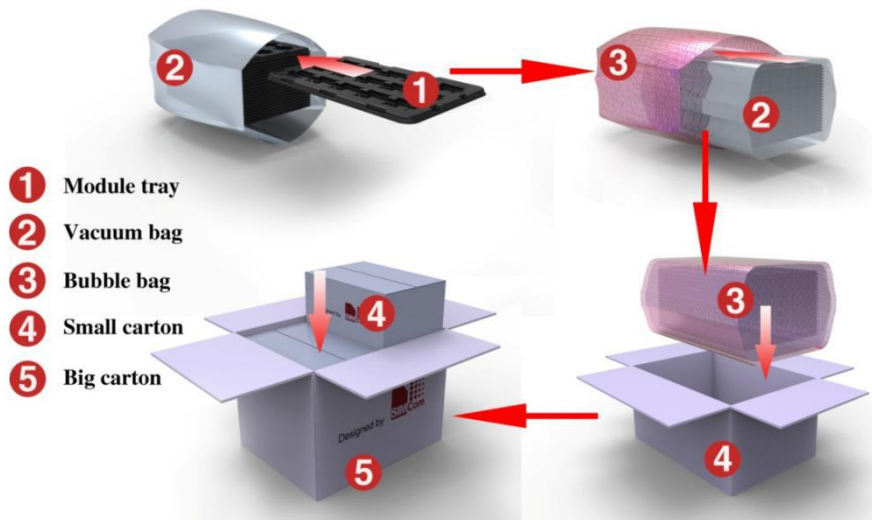


Figure 35: packaging diagram

Module tray drawing:

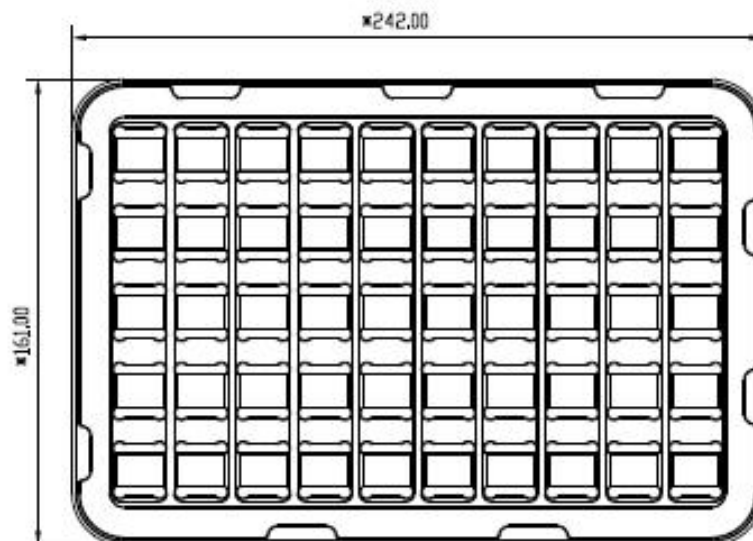


Figure 36: Tray drawing

Table 44: Tray size

Length ($\pm 3\text{mm}$)	Width ($\pm 3\text{mm}$)	Module number
242.0	161.0	50

Small carton drawing:

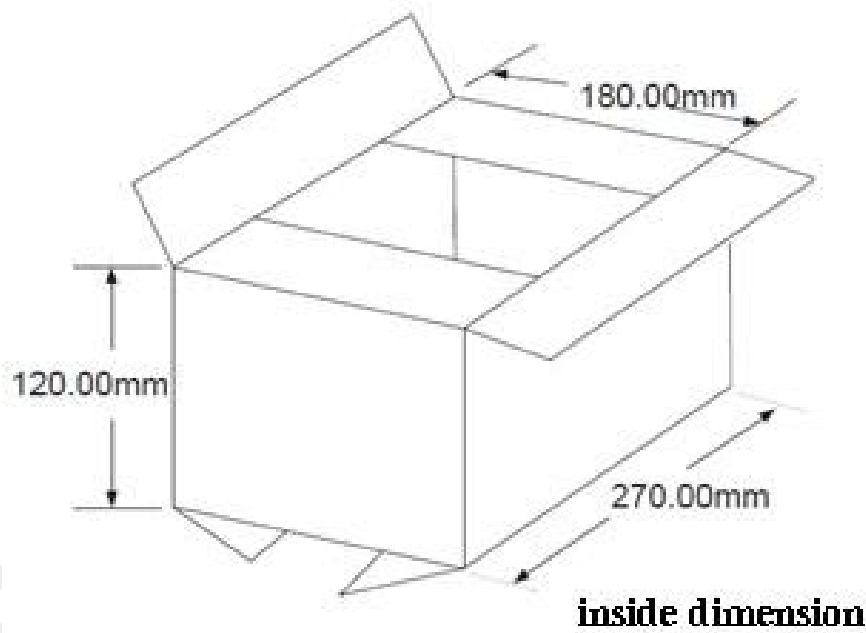


Figure 37: Small carton drawing

Table 45: Small Carton size

Length ($\pm 10\text{mm}$)	Width ($\pm 10\text{mm}$)	Height ($\pm 10\text{mm}$)	Module number
270	180	120	50*20=1000

Big carton drawing:

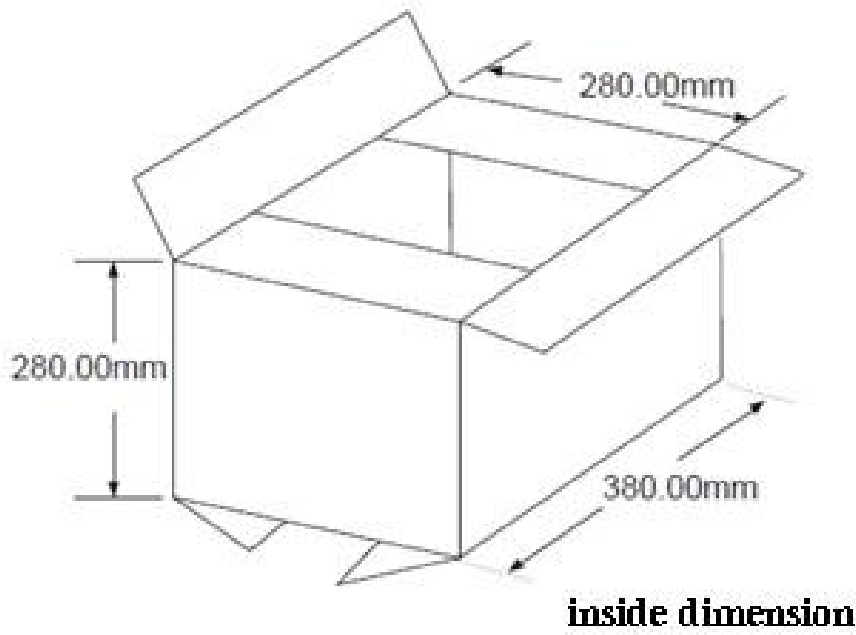


Figure 38: Big carton drawing

Table 46: Big Carton size

Length ($\pm 10\text{mm}$)	Width ($\pm 10\text{mm}$)	Height ($\pm 10\text{mm}$)	Module number
380	280	280	1000*4=4000

8 Appendix

8.1 Coding Schemes and Maximum Net Data Rates over Air Interface

Table 47: Coding Schemes and Maximum Net Data Rates over Air Interface

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

8.2 Related Documents

Table 48: Related Documents

NO.	Title	Description
[1]	SIM7080_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]	SIM7090G 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.

8.3 Terms and Abbreviations

Table 49: 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

SIMCom
Confidential

8.4 Safety Caution

Table 50: 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.

8.5 Notes:

Note that the module was assessed for use with cables of less than 3m length and not for use in automotive environments. For RF Exposure, the module was assessed for use at more than 20 cm from the body. When installing this module permanently into a host product to create a new Radio Equipment Directive device; the manufacturer responsible for the final product must assess if the combination of this module and the host equipment complies with the essential requirements of the RE Directive 2014/53/EU. EN 301 489 testing and transmitter spurious emissions tests should be not visible when installed in the host, these testing should be repeated at the final host system level.

RF Exposure Statement:

For the product, under normal use condition is at least 20cm away from the body of the user, the user must keep at least 20 cm distance to the product.

Antenna requirements

1. Antenna List:

Type: vehicle antenna with standard SMA connector(50ohm);

Model: MF25D

Antenna Gain: B2/B4/B25:3dBi B5/B12/B13/B26/B71: 2dBi



2. The user must match the MF25D antenna with the non-standard SMA connector and cannot change the antenna.

This device is intended only for OEM integrators under the following conditions: (For module device use)

- 1) The antenna must be installed such that 20 cm is maintained between the antenna and users, and
- 2) The transmitter module may not be co-located with any other transmitter or antenna.

As long as 2 conditions above are met, further transmitter test will not be required. However, the OEM integrator is still responsible for testing their end-product for any additional compliance requirements required with this module installed.

Radiation Exposure Statement

This equipment complies with IC radiation exposure limits set forth for an uncontrolled environment. This equipment should be installed and operated with minimum distance 20 cm between the radiator & your body.

Cet appareil est conçu uniquement pour les intégrateurs OEM dans les conditions suivantes:

(Pour utilisation de dispositif module)

- 1) L'antenne doit être installée de telle sorte qu'une distance de 20 cm est respectée entre l'antenne et les utilisateurs, et
- 2) Le module émetteur peut ne pas être coïmplanté avec un autre émetteur ou antenne. Tant que les 2 conditions ci-dessus sont remplies, des essais supplémentaires sur l'émetteur ne seront pas nécessaires. Toutefois, l'intégrateur OEM est toujours responsable des essais sur son produit final pour toutes exigences de conformité supplémentaires requis pour ce module installé.

Déclaration d'exposition aux radiations:

Cet équipement est conforme aux limites d'exposition aux rayonnements ISED établies pour un environnement non contrôlé. Cet équipement doit être installé et utilisé avec un minimum de 20 cm de distance entre la source de rayonnement et votre corps.

FCC Statement

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference, and
- (2) this device must accept any interference received, including interference that may cause undesired operation.

Any Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The modular can be installed or integrated in mobile or fix devices only. This modular cannot be installed in any portable device.

FCC Radiation Exposure Statement

This modular complies with FCC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This modular must be installed and operated with a minimum distance of 20 cm between the radiator and user body.

If the FCC identification number is not visible when the module is installed inside another device, then the outside of the device into which the module is installed must also display a label referring to the enclosed module. This exterior label can use wording such as the following: "Contains Transmitter Module FCC ID: 2AJYU-8VC0003 Or Contains FCC ID: 2AJYU-8VC0003"

When the module is installed inside another device, the user manual of the host must contain below warning statements;

1. This device complies with Part 15 of the FCC Rules. Operation is subject to the following two conditions:

- (1) This device may not cause harmful interference.
- (2) This device must accept any interference received, including interference that may cause undesired operation.

2. Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

The devices must be installed and used in strict accordance with the manufacturer's instructions as described in the user documentation that comes with the product.

Any company of the host device which install this modular with limit modular approval should perform the test of radiated emission and spurious emission according to FCC Part 22H and 24E, 47 CFR Part 2, 22H, 24(E), 27 and 47 CFR Part 2, 22H, 24(E), 27, 90 requirement, Only if the test result comply with FCC Part 22H and 24E, 47 CFR Part 2, 22H, 24(E), 27 and 47 CFR Part 2, 22H, 24(E), 27, 90 requirement, then the host can be sold legally.

IC Warning

This device complies with Industry Canada licence-exempt RSS standard(s).

Operation is subject to the following two conditions:

- (1) This device may not cause interference, and
- (2) This device must accept any interference, including interference that may cause undesired operation of the device.

The modular can be installed or integrated in mobile or fix devices only. This modular cannot be installed in any portable device.

IC Radiation Exposure Statement

This modular complies with IC RF radiation exposure limits set forth for an uncontrolled environment. This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter. This modular must be installed and operated with a minimum distance of 20 cm between the radiator and user body.

For a host manufacture's using a certified modular, if (1) the module's IC number is not visible when installed in the host, or (2) if the host is marketed so that end users do not have straightforward commonly used methods for access to remove the module so that the IC number of the module is visible; then an additional permanent label referring to the enclosed module: "Contains Transmitter Module IC: " 23761-8VC0003 " or "Contains IC: 23761-8VC0003 " must be used.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence. L'exploitation est autorisée aux deux conditions suivantes:

- (1) l'appareil ne doit pas produire de brouillage, et
- (2) l'utilisateur de l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement

Le modular peut être installé ou intégré dans un mobile ou réparer une seule chose Installation dans n'importe quel appareil portable.

Déclaration de rayonnement IC

Ce modular complies avec des radiations émettrices de rayonnement Environnement. Ceci ne doit pas être co-localisé ou opérer avec des autres Ce modular doit être installé et obtenu avec une distance minimale de 20 cm entre les radiateurs et le corps de l'utilisateur.

Pour un hôte, on utilise un modular, si (1) le numéro de module est non visible Quand on est installé dans le serveur, or (2) si le propriétaire est commercialisé Straightforward commonly used for the access to remove travail so that the number IC en vue Le module est visible; Ensuite, le label permanent a été attribué au module: "Contient le Module IC:" 23761-8VC0003" ou "contenu IC: 23761-8VC0003" doit" be used