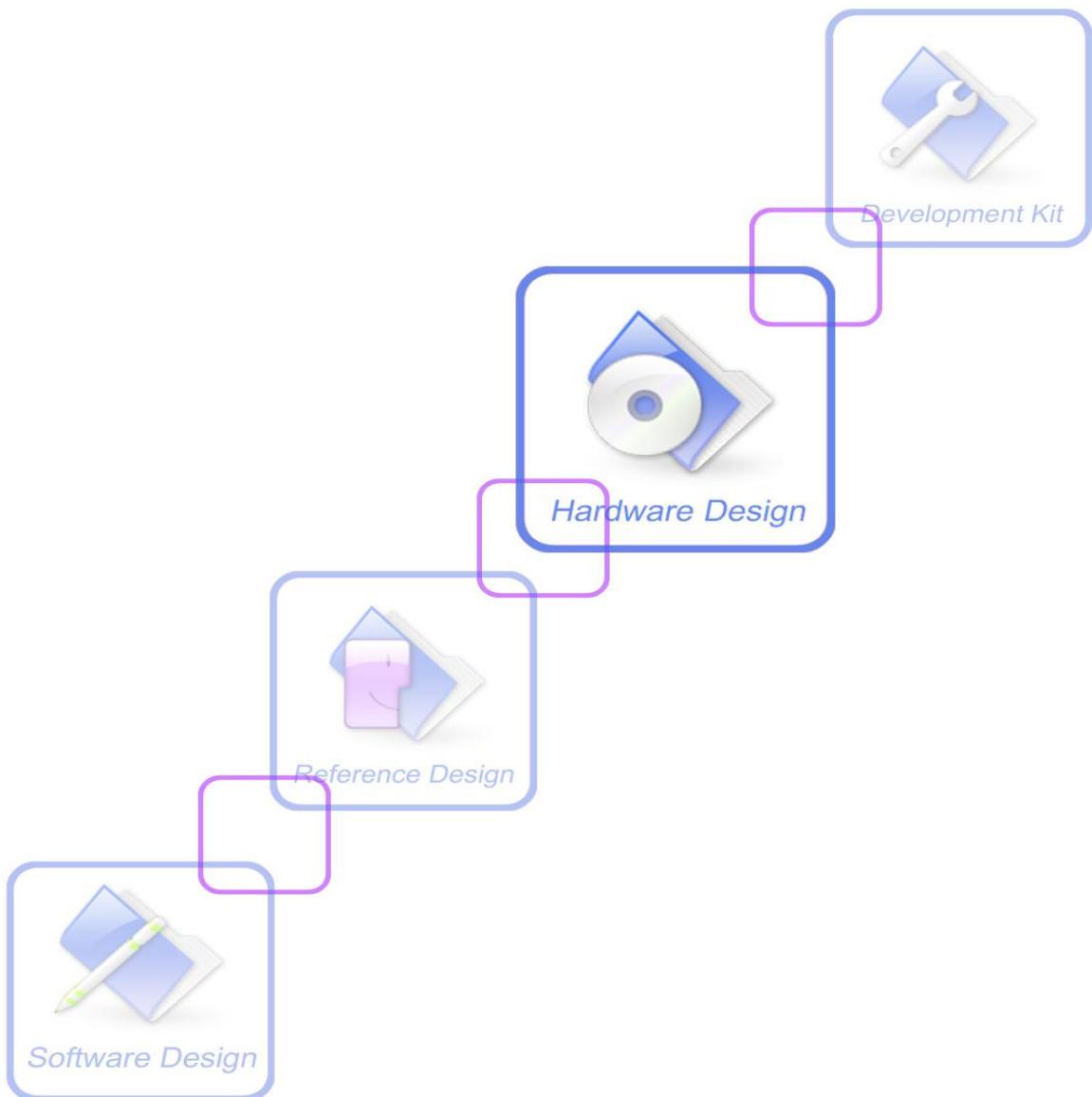




a SUNSEALMOT company

# **SIM7600G\_SIM7600G-H\_Hardware Design\_V1.02**



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## Revision History

Data	Version	Description of change	Author
2019-3-29	1.00	Original	Xutao.Jiang
2019-10-21	1.01	Update current consumption	Xutao.Jiang
2022-04-12	1.02	Update Figure 16: level matching circuit	Lei.Tian

# 1 Introduction

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

## 1.1 Product Outline

Aimed at the global market, the MODULE support GSM, WCDMA, LTE-TDD and LTE-FDD. Users can choose the MODULE according to the wireless network configuration. The supported radio frequency bands are described in the following table.

**Table 1: Module frequency bands**

Standard	Frequency	SIM7600G	SIM7600G-H
GSM	850MHz	√	√
	900MHz	√	√
	1800M Hz	√	√
	1900M Hz	√	√
WCDMA	B1	√	√
	B2	√	√
	B4	√	√
	B5	√	√
	B6	√	√
	B8	√	√
	B19	√	√
LTE	FDD B1	√	√
	FDD B2	√	√
	FDD B3	√	√
	FDD B4	√	√
	FDD B5	√	√
	FDD B7	√	√
	FDD B8	√	√
	FDD B12	√	√
	FDD B13	√	√
	FDD B18	√	√

		CAT1	CAT4
	FDD B19	√	√
	FDD B20	√	√
	FDD B25	√	√
	FDD B26	√	√
	FDD B28	√	√
	FDD B66	√	√
	TDD B34	√	√
	TDD B38	√	√
	TDD B39	√	√
	TDD B40	√	√
	TDD B41	√	√
Category		CAT1	CAT4

With a small physical dimension of 30\*30\*2.9 mm and with the functions integrated, the MODULE can meet almost any space requirement in users' applications, such as smart phone, PDA, industrial handheld, machine-to-machine and vehicle application, etc.

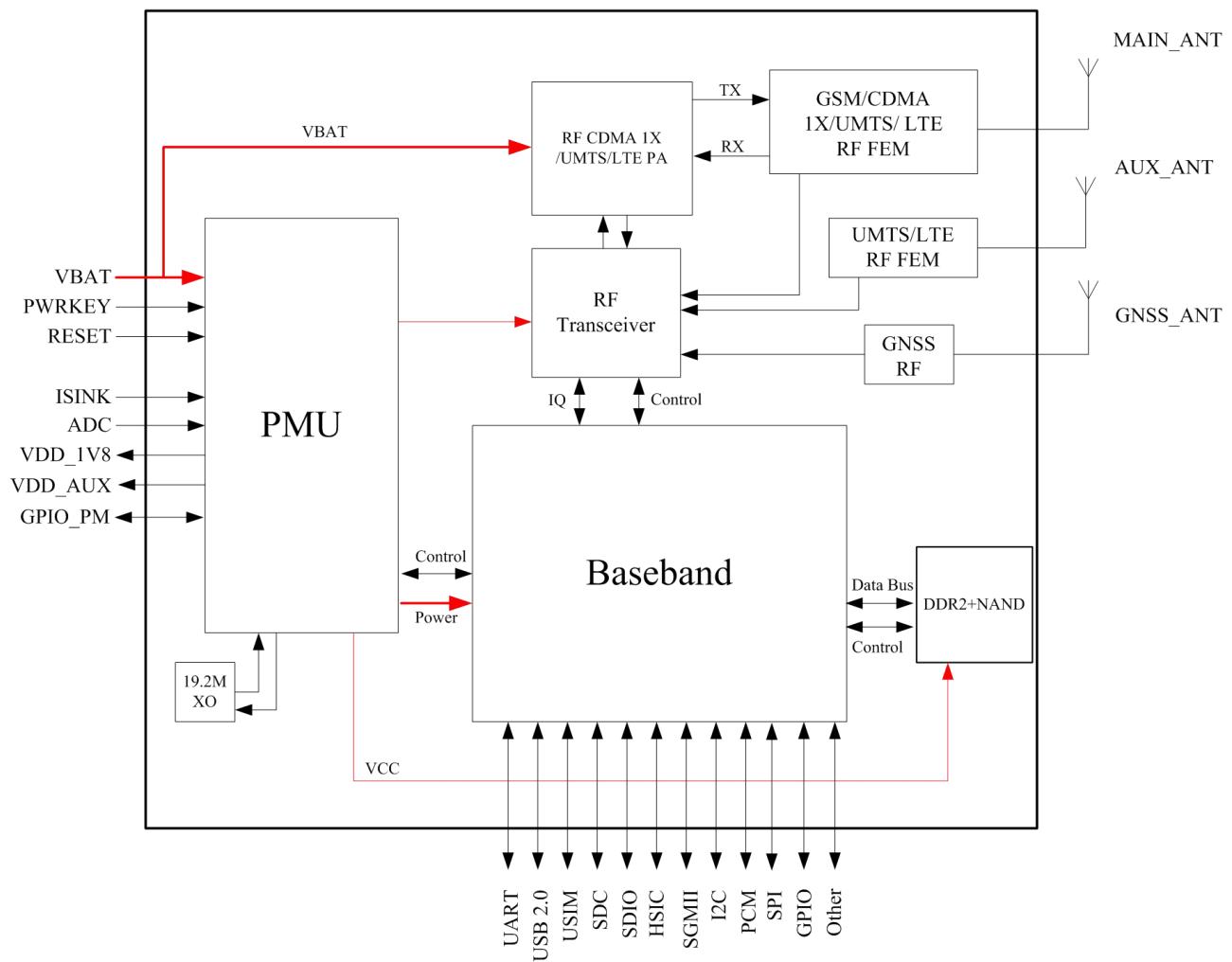
## 1.2 Hardware Interface Overview

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

- Power Supply
- USB2.0 Interface
- UART Interface
- MMC/SD Interface
- SDIO Interface
- USIM Interface
- SPI Interface
- GPIO
- ADC
- LDO Power Output
- Current Sink Source
- PCM Interface
- SPI Interface
- I2C Interface
- HSIC Interface
- SGMII Interface

### 1.3 Hardware Block Diagram

The block diagram of the MODULE is shown in the figure below.



**Figure 1: MODULE block diagram**

## 1.4 Functional Overview

**Table 2: General features**

Feature	Implementation
Power supply	Single supply voltage 3.4~4.2V, Recommend supply voltage 3.8V
Power saving	Current in sleep mode : <5mA
Radio frequency bands	Please refer to the table 1
Transmitting power	GSM/GPRS power class: --GSM850: 4 (2W) --EGSM900: 4 (2W) --DCS1800: 1 (1W) --PCS1900: 1 (1W) EDGE power class: --GSM850: E2 (0.5W) --EGSM900: E2 (0.5W) --DCS1800: E1 (0.4W) --PCS1900: E1 (0.4W) UMTS power class: --WCDMA :3 (0.25W) LTE power class: 3 (0.25W)
Data Transmission Throughput	GPRS multi-slot class 12 EDGE multi-slot class 12 UMTS R99 speed: 384 kbps DL/UL HSPA+: 5.76 Mbps(UL), 42 Mbps(DL) HSDPA/HSUPA: 2.2 Mbps(UL), 2.8 Mbps(DL) LTE CAT 1: 10 Mbps(DL) 5 Mbps(UL) LTE CAT 4 :150 Mbps (DL) 50 Mbps (UL)
Antenna	GSM/UMTS/LTE main antenna. UMTS/LTE auxiliary antenna GNSS antenna
GNSS	GNSS engine (GPS,GLONASS and BD) Protocol: NMEA 0183
SMS	MT, MO, CB, Text and PDU mode SMS storage: USIM card or ME(default) Transmission of SMS alternatively over CS or PS.
USIM interface	Support identity card: 1.8V/ 3V
USIM application toolkit	Support SAT class 3, GSM 11.14 Release 98 Support USAT
Phonebook management	Support phonebook types: DC,MC,RC,SM,ME,FD,ON,LD,EN

Audio feature	Support PCM interface Only support PCM master mode and short frame sync, 16-bit linear data formats
UART interface	A full modem serial port by default Baud rate: 300bps to 4Mbps(default:115200bps) Autobauding baud rate: 9600,19200,38400,57600,115200bps Can be used as the AT commands or data stream channel Support RTS/CTS hardware handshake Multiplex ability according to GSM 07.10 Multiplexer Protocol
MMC/SD	Support MMC and SD cards with 2.85 V on SD port
SDIO	Support SDIO with 1.8 V only on SDIO port
USB	USB 2.0 high speed interface, Can used be send AT command, Software update, GNSS NMEA,USB voice function etc.
Firmware upgrade	Firmware upgrade over USB interface or FOTA
Physical characteristics	Size:30*30*2.9m Weight:5.7 g
Temperature range	Normal operation temperature: -30°C to +80°C Extended operation temperature: -40°C to +85°C* Storage temperature -45°C to +90°C

**\*Note: Module is able to make and receive voice calls, data calls, SMS and make GPRS/UMTS/HSPA+/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.**

## 2 Package Information

### 2.1 Pin Assignment Overview

All functions of the MODULE will be provided through 135 pads that will be connected to the users' platform. The following Figure is a high-level view of the pin assignment of the MODULE.

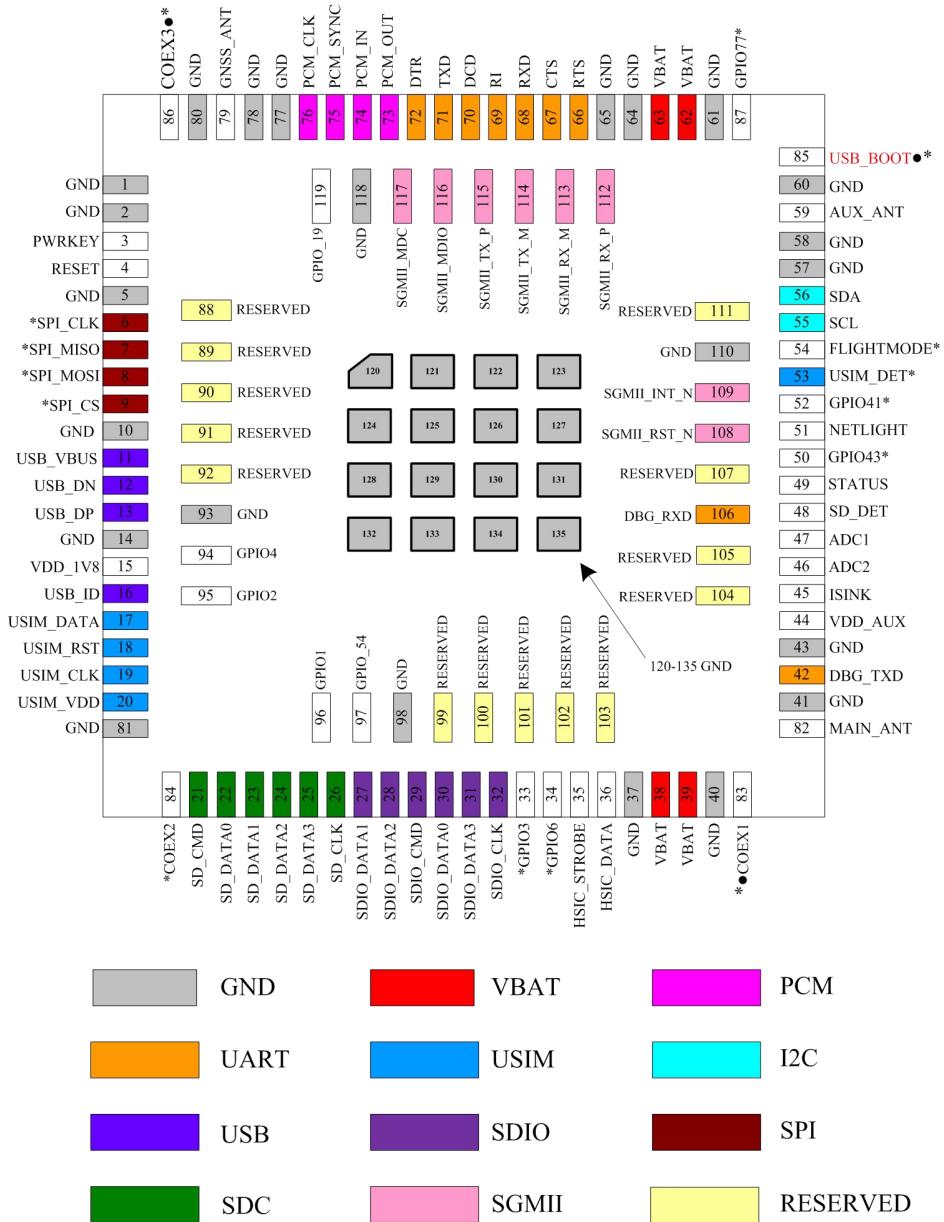


Figure 2: Pin assignment overview

**Table 3: Pin definition**

<b>Pin No.</b>	<b>Pin name</b>	<b>Pin No.</b>	<b>Pin name</b>
1	GND	2	GND
3	PWRKEY	4	RESET
5	GND	6	SPI_CLK*
7	SPI_MISO*	8	SPI_MOSI*
9	SPI_CS*	10	GND
11	USB_VBUS	12	USB_DN
13	USB_DP	14	GND
15	VDD_1V8	16	USB_ID
17	USIM_DATA	18	USIM_RST
19	USIM_CLK	20	USIM_VDD
21	SD_CMD	22	SD_DATA0
23	SD_DATA1	24	SD_DATA2
25	SD_DATA3	26	SD_CLK
27	SDIO_DATA1	28	SDIO_DATA2
29	SDIO_CMD	30	SDIO_DATA0
31	SDIO_DATA3	32	SDIO_CLK
33	GPIO3*	34	GPIO6*
35	HSIC_STROBE	36	HSIC_DATA
37	GND	38	VBAT
39	VBAT	40	GND
41	GND	42	DBG_TXD
43	GND	44	VDD_AUX
45	ISINK	46	ADC2
47	ADC1	48	SD_DET
49	STATUS	50	GPIO43*
51	NETLIGHT	52	GPIO41*
53	USIM_DET*	54	FLIGHTMODE*
55	SCL	56	SDA
57	GND	58	GND
59	AUX_ANT	60	GND
61	GND	62	VBAT
63	VBAT	64	GND
65	GND	66	RTS
67	CTS	68	RXD

69	RI	70	DCD
71	TXD	72	DTR
73	PCM_OUT	74	PCM_IN
75	PCM_SYNC	76	PCM_CLK
77	GND	78	GND
79	GNSS_ANT	80	GND
81	GND	82	MAIN_ANT
83	COEX1•*	84	COEX2*
85	BOOT_CFG0•*	86	COEX3•*
87	GPIO77	88	RESERVED
89	RESERVED	90	RESERVED
91	RESERVED	92	RESERVED
93	GND	94	GPIO4
95	GPIO2	96	GPIO1
97	GPIO_54	98	GND
99	RESERVED	100	RESERVED
101	RESERVED	102	RESERVED
103	RESERVED	104	RESERVED
105	RESERVED	106	DBG_RXD
107	RESERVED	108	SGMII_RST_N
109	SGMII_INT_N	110	GND
111	RESERVED	112	SGMII_RX_P
113	SGMII_RX_M	114	SGMII_TX_M
115	SGMII_TX_P	116	SGMII_MDIO
117	SGMII_MDC	118	GND
119	GPIO_19	120	GND
121	GND	122	GND
123	GND	124	GND
125	GND	126	GND
127	GND	128	GND
129	GND	130	GND
131	GND	132	GND
133	GND	134	GND
135	GND		

**NOTE:** • Means Before the normal power up, COEX1, COEX3 or BOOT\_CFG0 cannot be pulled up, otherwise module will not be powered up normally.

\* Means that pins has MUX function.

## 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

**Table 5: Pin description**

Pin name	Pin No.	Default status	Description	Comment
<b>Power supply</b>				
VBAT	38,39, 62,63	PI	Power supply, voltage range: 3.4~4.2V.	
VDD_AUX	44	PO	LDO power output for other external circuits with Max 150mA current output. Its output voltage is 2.85V by default.(The voltage can be configured from 1.7V to 3.05V by AT command).	If used SGMII function ,this pin used for SGMII function. If unused, keep it open.
VDD_1V8	15	PO	1.8 output with Max 50mA current output for external circuit, such as level shift circuit.	If unused, keep it open.
GND	1,2,5, 10,14,37 ,40,41,4 3,57,58, 60,61,64 ,65,77,7 8,80,81, 93,96,11 0,118,12 0,121,12 2,123,12 4,125,12 6,127,12 8,129,13 0,131,13		Ground	

	2,133,13 4135				
<b>System Control</b>					
PWRKEY	3	DI,PU	System power on/off control input, active low.	The high voltage is 0.8V;	
RESET	4	DI, PU	System reset control input, active low.	RESET has been pulled up to 1.8V via 40Kohm resistor internally.	
<b>SD interface</b>					
SD_CMD	21	I/O,PD	SDIO command	If unused, keep them open.	
SD_DATA0	22	I/O,PD	SDIO data		
SD_DATA1	23	I/O,PD			
SD_DATA2	24	I/O,PD			
SD_DATA3	25	I/O,PD			
SD_CLK	26	DO	SDIO clock		
SD_DET	48	DI,PU	SD card insertion detect H: SD card is removed L: SD card is inserted		
<b>USIM interface</b>					
USIM_DATA	17	I/O,PU	USIM Card data I/O, which has been pulled up via a 10KR resistor to USIM_VDD internally. Do not pull it up or down externally.	All lines of USIM interface should be protected against ESD.	
USIM_RST	18	DO,PD	USIM Reset		
USIM_CLK	19	DO,PD	USIM clock		
USIM_VDD	20	PO,PD	Power output for USIM card, its output Voltage depends on USIM card type automatically. Its output current is up to 50mA.		
<b>SPI interface</b>					
SPI_CLK*	6	DO	SPI clock output	Default SPI Optional: BT uart function	
SPI_MISO*	7	DI	SPI master in/slave out data		
SPI_MOSI*	8	DO	SPI master out/slave in data		
SPI_CS*	9	DO	SPI chip-select output		
<b>USB</b>					
USB_VBUS	11	AI	Valid USB detection input with 3.0~5.25V detection voltage		
USB_DN	12	AI, AO	Negative line of the differential, bi-directional USB signal.		

USB_DP	13	AI, AO	Positive line of the differential, bi-directional USB signal.	
USB_ID	16	AI	High-speed USB ID input	Keep it open.
<b>SGMII interface</b>				
SGMII_RX_P	112	AI	SGMII receive – positive	
SGMII_RX_M	113	AI	SGMII receive - negative	
SGMII_TX_M	114	AO	SGMII transmit - negative	
SGMII_TX_P	115	AO	SGMII transmit– positive	
SGMII_RST_N	108	DO	Ethernet PHY reset	
SGMII_INT_N	109	DI,PU	Ethernet PHY interrupt	
SGMII_MDIO	116	DIO	Management data input/output-data	External 1.5K pull-up resistor from 3.3V/2.5V to MDIO_DATA and 10K pull-up resistor from VDD_1V8 to ETH_INT_N are needed when the Ethernet PHY is connected. If unused, please keep them open.
SGMII_MDC	117	DO	Management data input/output-clock	
<b>UART interface</b>				
RTS	66	DOH	Request to send	
CTS	67	DI	Clear to Send	
RXD	68	DI	Receive Data	
RI	69	DOH	Ring Indicator	
DCD	70	DOH	Carrier detects	
TXD	71	DOH	Transmit Data	
DTR	72	DI,PU	DTE get ready	
<b>DBG_UART</b>				
DBG_TXD	42	DO	Log output	
DBG_RXD	106	DI	Log input	If unused, keep them open.
<b>I2C interface</b>				
SCL	55	OD	I2C clock output	If unused, keep open, or else pull them up via 2.2KΩ resistors to 1.8V.
SDA	56	OD	I2C data input/output	
<b>SDIO interface</b>				
SDIO_DATA1	27	I/O	SDIO data1	
SDIO_DATA2	28	I/O	SDIO data2	
SDIO_CMD	29	I/O	SDIO command	It can be used for WLAN function. If unused, please

SDIO_DATA0	30	I/O	SDIO data0	keep them open.
SDIO_DATA3	31	I/O	SDIO data3	
SDIO_CLK	32	DO	SDIO clock	
<b>HSIC interface</b>				
HSIC_STROBE	35	I/O	HSIC strobe wakeup	<i>If use, please refer to document [27]</i>
HSIC_DATA	36	I/O	HSIC data	Otherwise please keep them open.
<b>PCM interface</b>				
PCM_OUT	73	DO,PD	PCM data output.	If unused, please keep them open.
PCM_IN	74	DI,PD	PCM data input.	
PCM_SYNC	75	I/O,PD	PCM data frame sync signal.	
PCM_CLK	76	I/O,PU	PCM data bit clock.	
<b>GPIO</b>				
NETLIGHT	51	DO,PU	LED control output as network status indication.	If unused, keep them open.
STATUS	49	DO,PU	Operating status output. High level: Power on and firmware ready Low level: Power off	
GPIO4	94	IO,PD	Default: GPIO	
GPIO2	95	IO,PD	Default: GPIO	
GPIO1	96	IO,PD	Default: GPIO	
GPIO_54	97	IO,PD	Default: GPIO	
GPIO_19	119	IO,PD	Default: GPIO	
<b>RF interface</b>				
MAIN_ANT	82	AO	MAIN antenna soldering pad	
GNSS_ANT	79	AI	GNSS antenna soldering pad	
AUX_ANT	59	AI	Auxiliary antenna soldering pad	
<b>Other interface</b>				
ISINK	45	PI	Ground-referenced current sink.	If unused, please keep them open.
ADC1	47	AI	Analog-digital converter input 1	
ADC2	46	AI	Analog-digital converter input 2	
RESERVED	88,89,90 ,91,92,9 9,100,10 1,102,10 3,104,10 5,107,11 1		Reserved for future use	Please keep them open.
<b>Mux function interface</b>				
COEX1●*	83	I/O	RF synchronizing between Wi-Fi and LTE.	Default:COEX1●* Option:WLAN_EN●

COEX2*	84	I/O	RF synchronizing between Wi-Fi and LTE.	Default:COEX2* Option: WoWWAN●
COEX3●*	86	I/O	RF synchronizing between Wi-Fi and LTE.	Default:COEX3* Option:BT_PCM_CLK●
BOOT_CFG0●*	85	DI,PD	Boot configuration input. Module will be forced into USB download mode by connect 85 pin to VDD_1V8 during power up.	Default: BOOT_CFG0●* Option:COEX_RXD● Do place 2 test points for debug. <b>DO NOT PULL UP BOOT_CFG0 DURING NORMAL POWER UP!</b>
FLIGHTMODE*	54	DI,PU	Flight Mode control input. High level(or open): Normal Mode Low level: Flight Mode	Default: FLIGHTMODE* Option:BT_PCM_IN●
GPIO3*	33	IO	GPIO	Default:GPIO3* Option:WL_PWR_EN●
GPIO6*	34	IO	GPIO	Default:GPIO6* Option:WL_SLP_CLK●
USIM_DET*	53	IO	Default: GPIO Optional: USIM card detecting input. H: USIM is removed L: USIM is inserted	Default:USIM_DET* Option:BT_EN●
GPIO77*	87	IO	GPIO	Default:GPIO77* Option:BT_PCM_OUT●
GPIO43*	50	I/O,PD	GPIO	Default:GPIO43* Option:COEX_TXD●
GPIO41*	52	I/O,PD	GPIO	Default:GPIO41* Option:BT_PCM_SYNC●

### 2.3 Mechanical Information

The following figure shows the package outline drawing of MODULE.

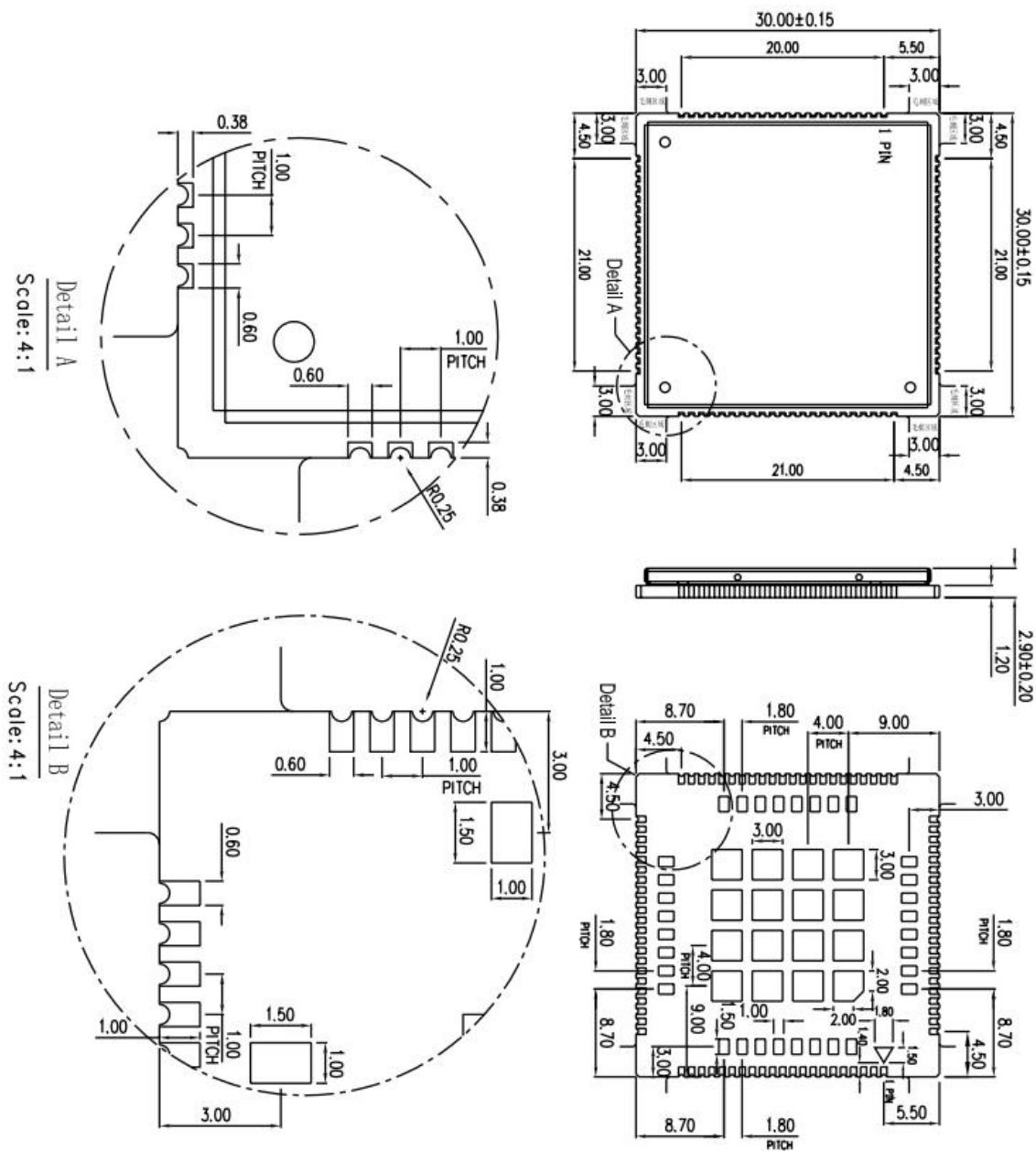


Figure 3: Dimensions (Unit: mm)

## 2.4 Footprint Recommendation

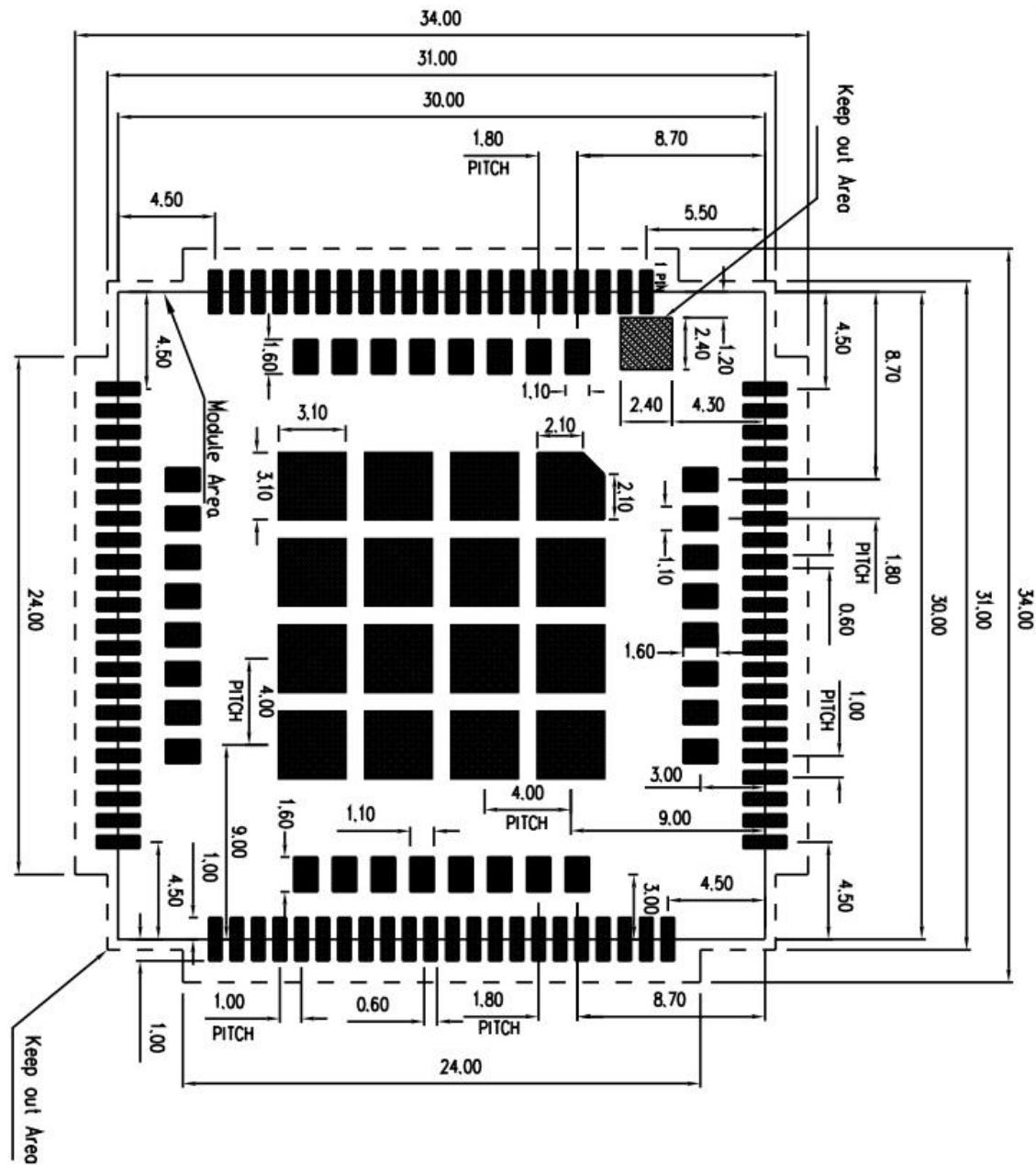


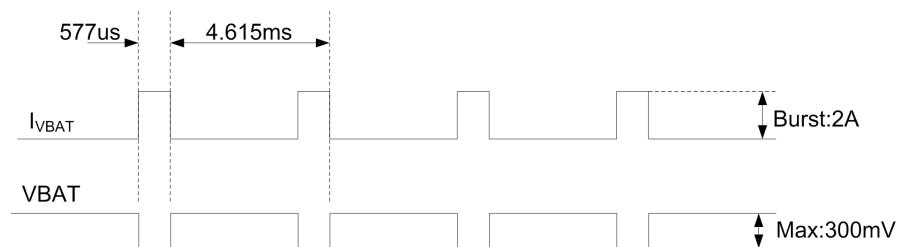
Figure 4: Footprint recommendation (Unit: mm)

### 3 Interface Application

#### 3.1 Power Supply

The power supply pins of MODULE include 4 pins (pin 62&63, pin 38&39) named VBAT. The 4 VBAT pads supply the power to RF and baseband circuits directly. On VBAT pads, the ripple current up to 2A typically, due to GSM/GPRS emission burst (every 4.615ms), may cause voltage drop. So the power supply for these pads must be able to provide sufficient current up to more than 2A in order to avoid the voltage drop is more than 300mV.

The following figure shows the VBAT voltage ripple wave at the maximum power transmit phase.



**Figure 5: VBAT voltage drop during burst emission (GSM/GPRS)**

**Note: The test condition:** The voltage of power supply for VBAT is 3.8V,  $C_d=100 \mu F$  tantalum capacitor ( $ESR=0.7\Omega$ ) and  $C_f=100nF$  (Please refer to Figure 6—Application circuit).

**Table 6: VBAT pins electronic characteristic**

Symbol	Description	Min.	Typ.	Max.	Unit
VBAT	Module power voltage	3.4	3.8	4.2	V
$I_{VBAT(\text{peak})}$	Module power peak current in normal mode.	-	2	-	A
$I_{VBAT(\text{average})}$	Module power average current in normal mode	Please refer to the table 34			
$I_{VBAT(\text{sleep})}$	Power supply current in sleep mode				
$I_{VBAT(\text{power-off})}$	Module power current in power off mode.	-	-	20	$\mu A$

### 3.1.1 Power Supply Design Guide

Make sure that the voltage on the VBAT pins will never drop below 3.4V, even during a transmit burst, when current consumption may rise up to 2A. If the voltage drops below 3.4V, the RF performance may be affected.

**Note:** If the power supply for VBAT pins can support up to 2A, more than 300uF capacitors are recommended. Otherwise users must use a total of 1000uF capacitors typically, in order to avoid of the voltage drop more than 300mV.

Some multi-layer ceramic chip (MLCC) capacitors (0.1/1uF) with low ESR in high frequency band can be used for EMC.

These capacitors should be put as close as possible to VBAT pads. Also, users should keep VBAT trace on circuit board wider than 2 mm to minimize PCB trace impedance. The following figure shows the recommended circuit.

Recommend Bead for vbat filter are BLM21PG300SN1D and MPZ2012S221A.

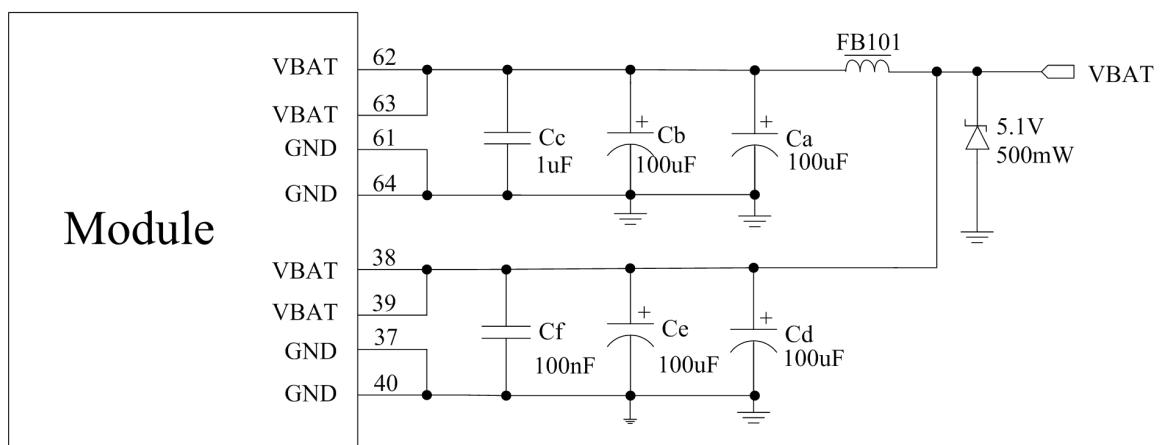


Figure 6: Power supply application circuit

In addition, in order to guard for over voltage protection, it is suggested to use TVS.

**Note:** user could only power pin 62, 63 or only power pin 38, 39, for these pins are connected inside the MODULE.

**Table 7: Recommended TVS list**

No.	Manufacturer	Part Number	Power dissipation	Package
1	JCET	ESDBW5V0A1	5V	DFN1006-2L
2	WAYON	WS05DPF-B	5V	DFN1006-2L
3	WILLSEMI	ESD5611N	5V	DFN1006-2L
4	WILLSEMI	ESD56151W05	5V	SOD-323
5*	PRISEMI	PESDH2FD4V5BH	4.5V	DFN1006-2L
6*	WAYON	WS4.5DPV	4.5V	DFN1610-2L

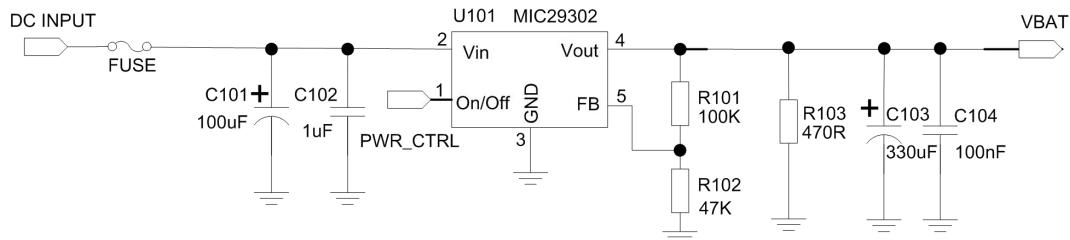
Note: If user chooses TVS, please pay attention to Clamping Voltage in your datasheet . For example when the surge input is 100V, the Clamping Voltage is less than 10V.

\*If vbat is higher than 3.8V, do not choose 5 and 6.

### 3.1.2 Recommended Power Supply Circuit

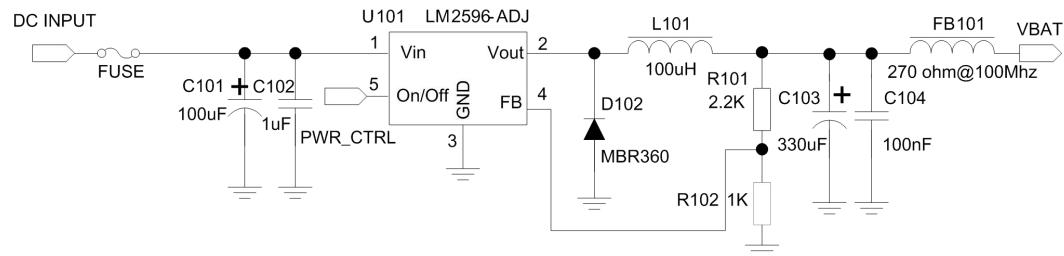
It is recommended that a switching mode power supply or a linear regulator power supply is used. It is important to make sure that all the components used in the power supply circuit can resist a peak current up to 2A.

The following figure shows the linear regulator reference circuit with 5V input and 3.8V output.



**Figure 7: Linear regulator reference circuit**

If there is a big voltage difference between input and output for VBAT power supply, or the efficiency is extremely important, then a switching mode power supply will be preferable. The following figure shows the switching mode power supply reference circuit.



**Figure 8: Switching mode power supply reference circuit**

**Note:** The Switching Mode power supply solution for VBAT must be chosen carefully against Electro Magnetic Interference and ripple current from degrading RF performance.

### 3.1.3 Voltage Monitor

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

For monitoring the VBAT voltage outside or within a special range, the AT command “AT+CVALARM” can be used to enable the under-voltage warning function.

If users need to power off MODULE, when the VBAT voltage is out of a range, the AT command “AT+CPMVT” can be used to enable under-voltage power-off function.

**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

MODULE can be powered on by pulling the PWRKEY pin down 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 a 100nF capacitor, an ESD protection diode, close to the PWRKEY pin as it would strongly enhance the ESD performance of PWRKEY pin. Please refer to the following figure for the recommended reference circuit.

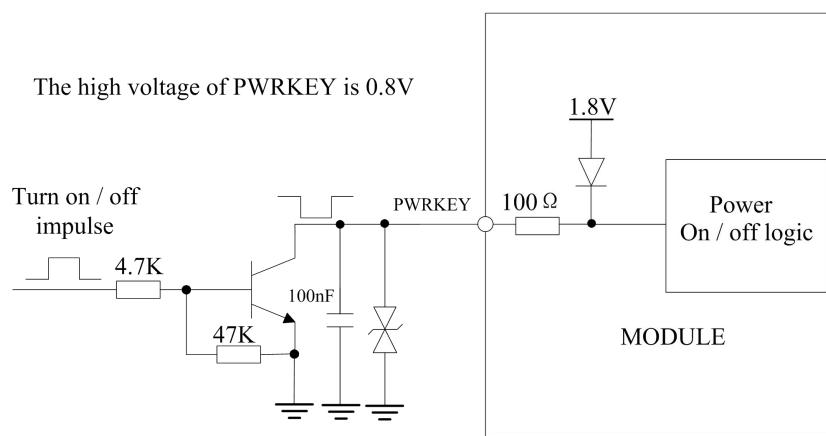


Figure 9: Reference power on/off circuit

**Note:** Module could be automatically power on by connecting PWRKEY pin to ground via 0R resistor directly.

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

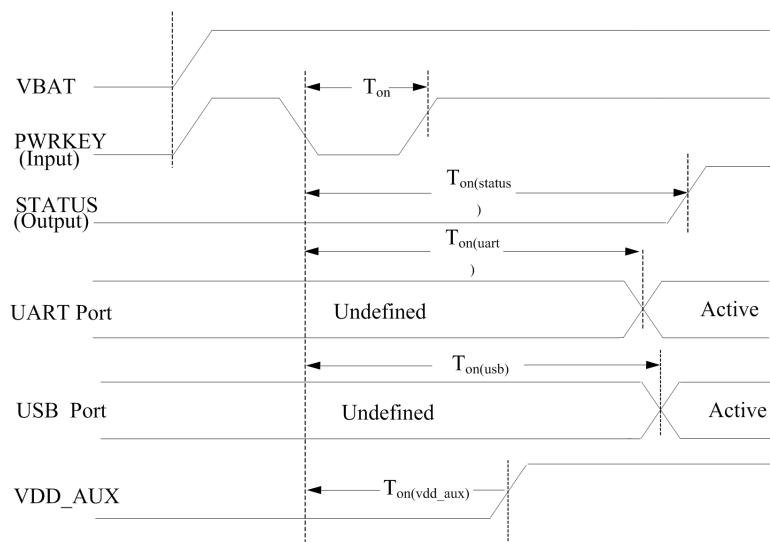


Figure 10: Power on timing sequence

**Table 8: Power on timing and electronic characteristic**

Symbol	Parameter	Min.	Ty p.	Max.	Unit
$T_{on}$	The time of active low level impulse of PWRKEY pin to power on MODULE	100	500	-	ms
$T_{on(status)}$	The time from power-on issue to STATUS pin output high level(indicating power up ready )	15	16	-	s
$T_{on(uart)}$	The time from power-on issue to UART port ready	13	14	-	s
$T_{on(vdd_aux)}$	The time from power-on issue to VDD_AUX ready		2.5	-	s
$T_{on(usb)}$	The time from power-on issue to USB port ready	11	12	-	s
$V_{IH}$	Input high level voltage on PWRKEY pin	0.6	0.8	1.8	V
$V_{IL}$	Input low level voltage on PWRKEY pin	-0.3	0	0.5	V

### 3.2.2 Power off

The following methods can be used to power off MODULE.

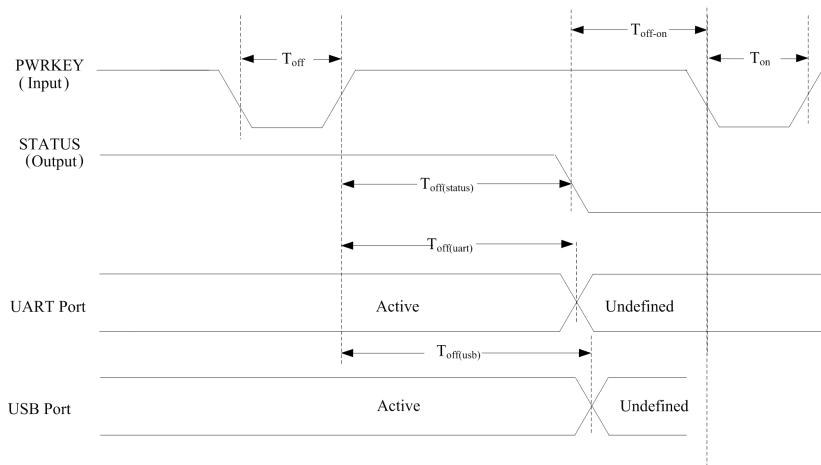
- Method 1: Power off MODULE by pulling the PWRKEY pin down to ground.
- Method 2: Power off MODULE by AT command “AT+CPOF”.
- Method 3: over-voltage or under-voltage automatic power off. The voltage range can be set by AT command “AT+CPMVT”.
- Method 4: over-temperature or under-temperature automatic power off.

*Note: If the temperature is outside the range of -30~+80 °C, some warning will be reported via AT port. If the temperature is outside the range of -40~+85 °C, MODULE will be powered off automatically.*

*For details about “AT+CPOF” and “AT+CPMVT”, please refer to Document [1].*

These procedures will make MODULE 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 11: Power off timing sequence**
**Table 9: 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	--	2.5	--	s
$T_{off(status)}$	The time from power-off issue to STATUS pin output low level(indicating power off )*	25	26	-	s
$T_{off uart}$	The time from power-off issue to UART port off	14	15	-	s
$T_{off usb}$	The time from power-off issue to USB port off	27	28	-	s
$T_{off-on}$	The buffer time from power-off issue to power-on issue	0	-	-	s

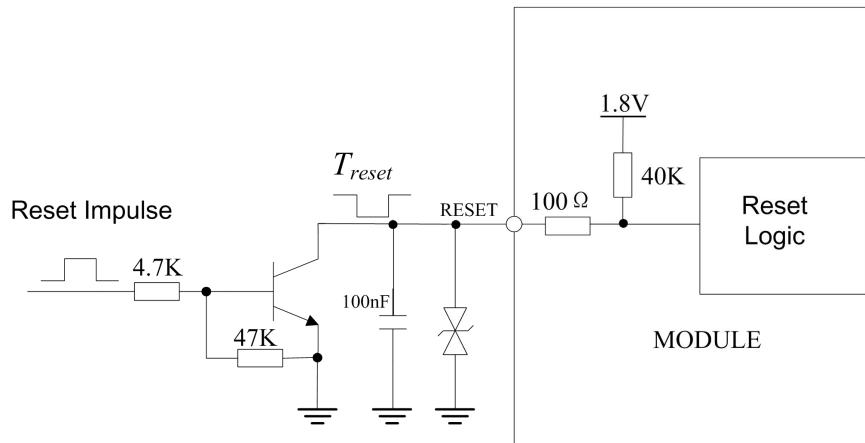
**\*Note:** The STATUS pin can be used to detect whether MODULE is powered on or not. When MODULE has been powered on and firmware goes ready, STATUS will be high level, or else STATUS will still low level.

### 3.2.3 Reset Function

MODULE can be reset by pulling the RESET pin down to ground.

**Note:** This function is only used as an emergency reset, when AT command “AT+CPOF” and the PWRKEY pin all have lost efficacy.

The RESET pin has been pulled up with a 40KΩ resistor to 1.8V internally, so it does not need to be pulled up externally. It is strongly recommended to put a 100nF capacitor and an ESD protection diode close to the RESET pin. Please refer to the following figure for the recommended reference circuit.



**Figure 12: Reference reset circuit**

**Table 10: RESET pin electronic characteristic**

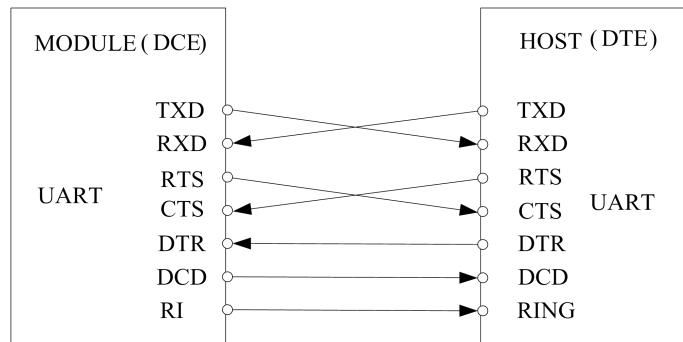
Symbol	Description	Min.	Typ.	Max.	Unit
$T_{reset}$	The active low level time impulse on RESET pin to reset MODULE	100	200	500	ms
$V_{IH}$	Input high level voltage	1.17	1.8	2.1	V
$V_{IL}$	Input low level voltage	-0.3	0	0.8	V

### 3.3 UART Interface

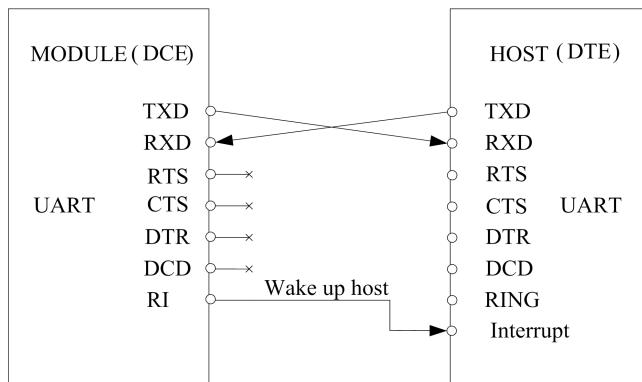
MODULE provides a 7-wire UART (universal asynchronous serial transmission) interface as DCE (Data Communication Equipment). AT commands and data transmission can be performed through UART interface.

#### 3.3.1 UART Design Guide

The following figures show the reference design.

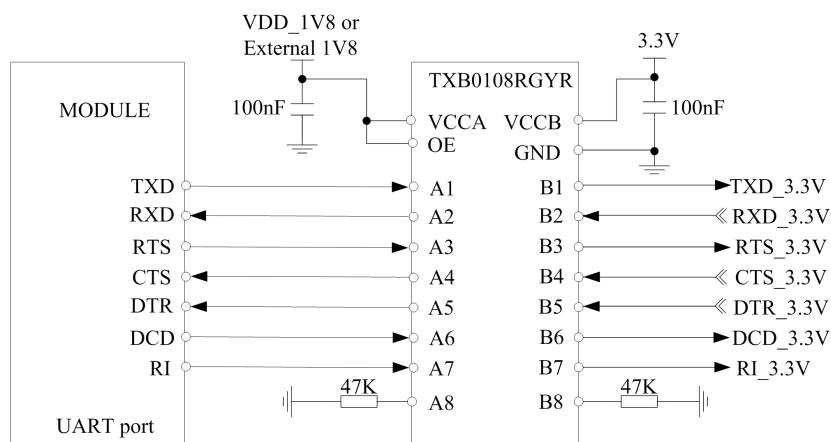


**Figure 13: UART full modem**



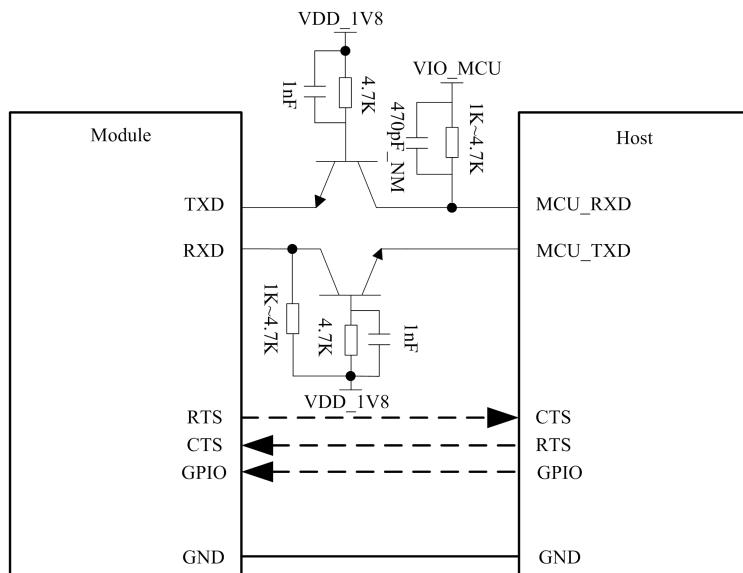
**Figure 14: UART null modem**

The MODULE 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 TXB0108RGYR provided by Texas Instruments is recommended. The following figure shows the voltage matching reference design.



**Figure 15: Reference circuit of level shift**

User can use another level shifter circuits as follow



**Figure 16: level matching circuit**

To comply with RS-232-C protocol, the RS-232-C level shifter chip should be used to connect MODULE to the RS-232-C interface, for example SP3238ECA, etc.

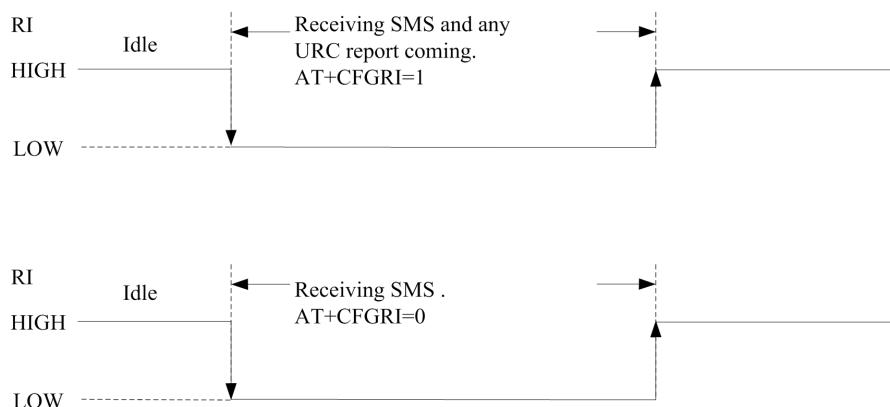
**Note1:** User needs to use high speed transistors such as MMBT3904.

**Note2:** MODULE supports the following baud rates: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600, 3200000, 3686400, 4000000bps. The default band rate is 115200bps.

### 3.3.2 RI and DTR Behavior

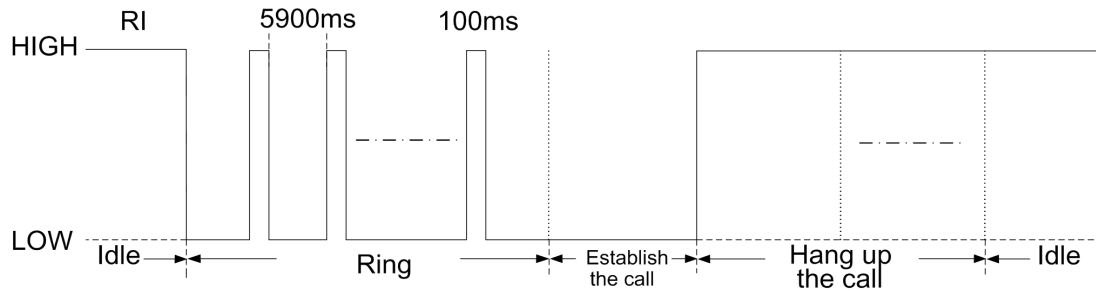
The RI pin can be used to interrupt output signal to inform the host controller such as application CPU.

Normally RI will keep high level until certain conditions such as receiving SMS, or a URC report coming, and then it will change to low level.



**Figure 17: RI behaviour (SMS and URC report)**

Normally RI will be kept at a high level until a voice call, then it will output periodic rectangular wave with 5900ms low level and 100ms high level. It will output this kind of periodic rectangular wave until the call is answered or hung up.



**Figure 18 : RI behaviour (voice call)**

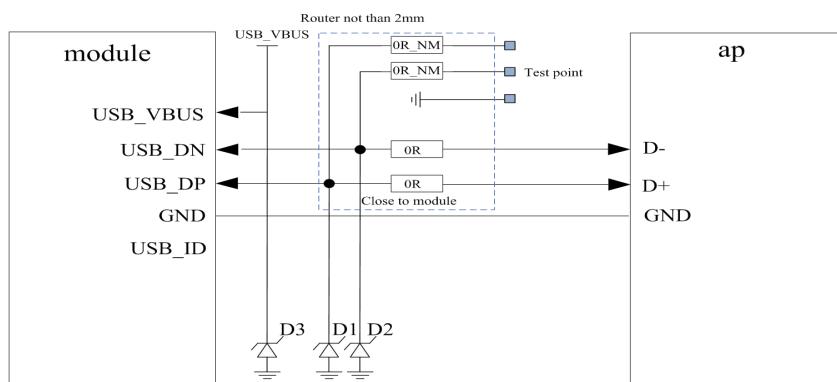
*Note: For more details of AT commands about UART, please refer to document [1] and [22].*

DTR pin can be used to wake MODULE from sleep. When MODULE enters sleep mode, pulling down DTR can wake MODULE.

### 3.4 USB Interface

The MODULE contains a USB interface compliant with the USB2.0 specification as a peripheral, but the USB charging function is not supported.

MODULE can be used as a USB device. MODULE supports the USB suspend and resume mechanism which can reduce power consumption. If there is no data transmission on the USB bus, MODULE will enter suspend mode automatically, and will be resumed by some events such as voice call, receiving SMS, etc.



**Figure19: USB reference circuit**

Because of the high bit rate 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 should be less than 1pF. It is recommended to use an ESD protection component such as ESD9L5.0ST5G provided by On Semiconductor ([www.onsemi.com](http://www.onsemi.com) ).

D3 is suggested to select the diode with anti-ESD and voltage surge function, or user could add a TVS for surge clamping. The recommend TVS please refer to table 7.

**Note:** *The USB\_DN and USB\_DP nets must be traced by 90Ohm+/-10% differential impedance.*

### 3.5 HSIC interface

HSIC is a 2-signal source synchronous serial interface which uses 240MHz DDR signaling to provide High-Speed 480Mbps USB transfers which are 100% host driver compatible with traditional USB cable-connected topologies. Full-Speed (FS) and Low-Speed (LS) USB transfers are not directly supported by the HSIC interface (a HSIC enabled hub can provide FS and LS support, as well as IC\_USB support)

The differences between HSIC and USB2.0 are listed below:

**Table 11: Key differences between HSIC and HS-USB**

HSIC	USB2.0
Signal-ended signaling at 1.2 V	Differential signaling
Two signals – STROBE, DATA	Four wires – Ground, D+, D-, VBUS
Double data rate signaling	Data inferred from differential signaling
HS-USB 480 Mbps only	HS/FS/LS support
Maximum trace length of 10 cm	Maximum cable length of 5 m
No HS chirp protocol	HS chirp protocol
Lower power consumption (digital)	Higher power consumption (analog)
No concept of disconnect	Hot plug/play support

module implements a HSIC interface compliant with the HSIC1.0 specification which can be used to connect to the external IC.

**Note:** *The module HSIC default work as HSIC to LAN function, if user have any other questions , please contact simcom for more details.*

### 3.6 SGMII Interface

MODULE provides a SGMII interface with an Ethernet MAC embedded, users could add a PHY to connect to the Ethernet, and the PHY device could be controlled by the MDIO interface and other dedicated signals.

Two Ethernet PHY are supported: AR8031/AR8033 (Qualcomm) and BCM89820 (Broadcom). The AR8031/AR8033 is used for the industrial field and the BCM89820 is dedicated for the automotive field.

Main features of SGMII:

- Ethernet Mac integrated in the module
- IEEE 802.3 Ethernet 10/100/1000Mbps, SGMII IF
- Supports IEEE 1588, Precision Time Protocol (PTP)

- Full duplex rated to 1 Gbps
- Half/full duplex for 10/100 Mbps
- Can be connected to external Ethernet PHY like AR8031/AR8033(industrial 10/100/1000Mbps), BCM89820(automotive 10/100Mbps)
- Uses 8B10B encoding of data with effective baud data rate of 1 Gbps, data rate is always 1.25 Gbps (or DDR clock is always at 625 MHz)

Main features of MDIO:

- Host mode only
- Dual voltage: 1.8 V or 2.85 V operation
- Default signal frequency: 6.25MHz
- MDIO\_DATA is OD-gate, and requires an external 1.5 kΩ pull-up resistor to VMDIO.

For the AR8031/AR8033, User should provide 3.3V to power the external Ethernet PHY system and the current should be more than 200mA.

### 3.6.1 Reference schematic with AR8033

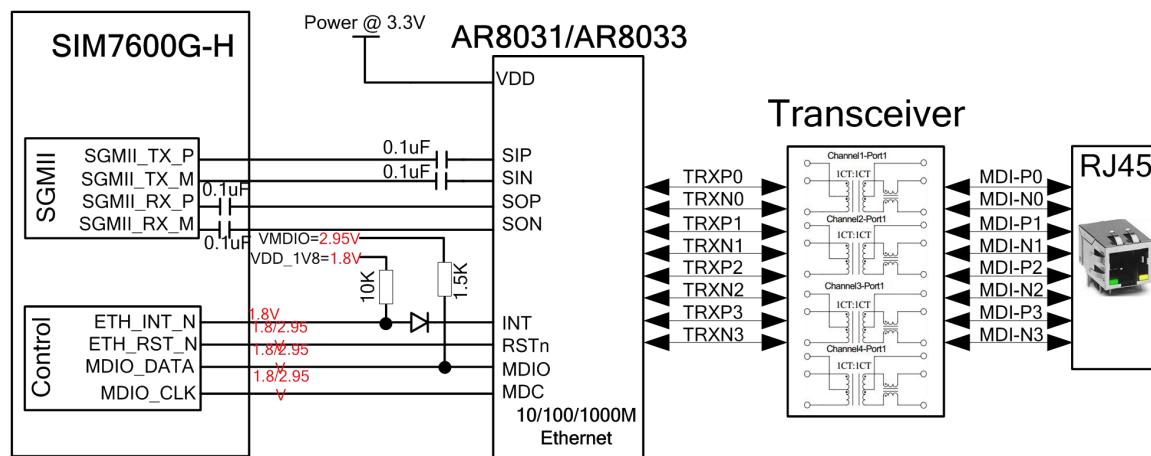


Figure20: Reference SGMII circuit with AR8033

For the BCM89820, Users should provide 3.3V and 1.2V to power the external Ethernet PHY system and the data interface of PHY. The current of 3.3V and 1.2V should be more than 100mA and 150mA.

### 3.6.2 Reference schematic with BCM89820

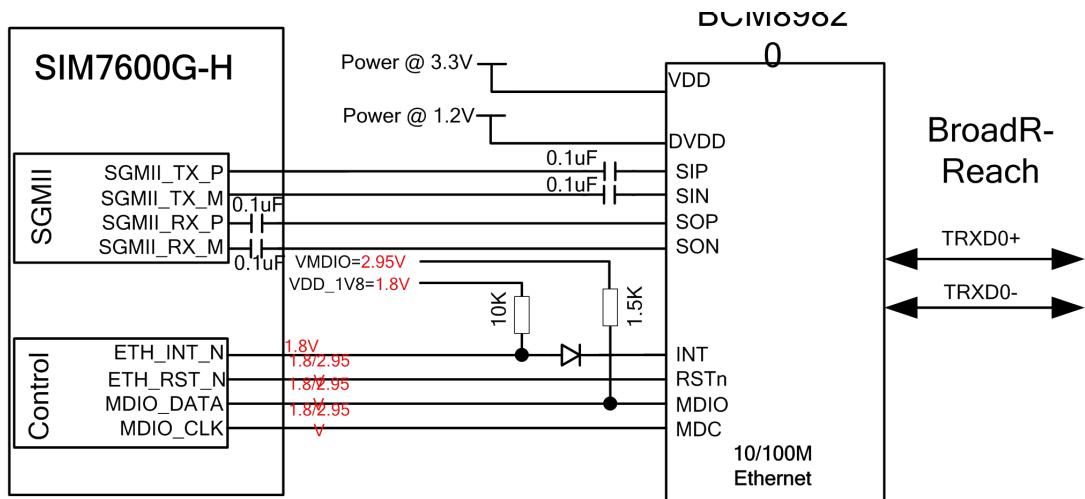


Figure21: Reference SGMII circuit with BCM89820

*Note: The module SGMII function default closed. If user need, please contact SIMCom for more details or refer to [document \[28\]](#)*

### 3.7 USIM Interface

MODULE supports both 1.8V and 3.0V USIM Cards.

**Table 12: USIM electronic characteristic in 1.8V mode (USIM\_VDD=1.8V)**

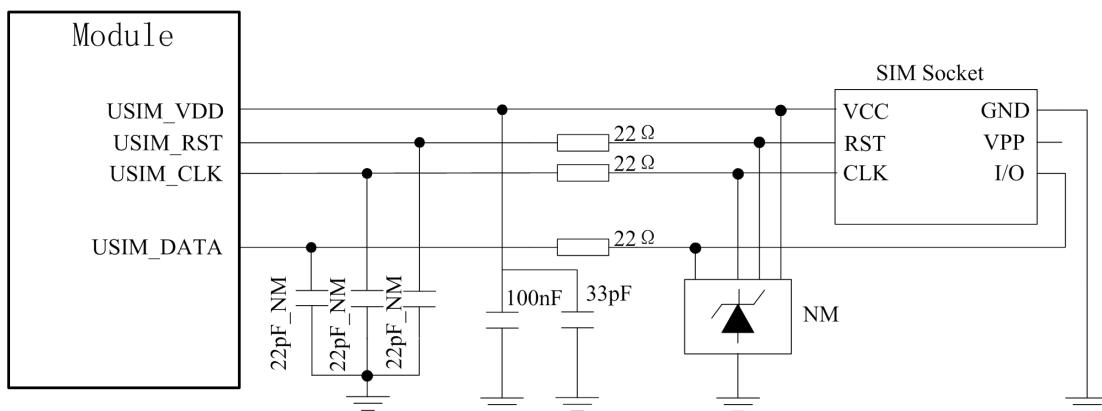
Symbol	Parameter	Min.	Typ.	Max.	Unit
USIM_VDD	LDO power output voltage	1.75	1.8	1.95	V
V <sub>IH</sub>	High-level input voltage	0.65*USIM_VDD	-	USIM_VDD +0.3	V
V <sub>IL</sub>	Low-level input voltage	-0.3	0	0.35*USIM_VDD	V
V <sub>OH</sub>	High-level output voltage	USIM_VDD -0.45	-	USIM_VDD	V
V <sub>OL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

**Table 13: USIM electronic characteristic 3.0V mode (USIM\_VDD=2.95V)**

Symbol	Parameter	Min.	Typ.	Max.	Unit
USIM_VDD	LDO power output voltage	2.75	2.95	3.05	V
V <sub>IH</sub>	High-level input voltage	0.65*USIM_VDD	-	USIM_VDD +0.3	V
V <sub>IL</sub>	Low-level input voltage	-0.3	0	0.25*USIM_VDD	V
V <sub>OH</sub>	High-level output voltage	USIM_VDD -0.45	-	USIM_VDD	V
V <sub>OL</sub>	Low-level output voltage	0	0	0.45	V

#### 3.7.1 USIM Application Guide

It is recommended to use an ESD protection component such as ESDA6V1W5 produced by ST ([www.st.com](http://www.st.com)) or SMF15C produced by ON SEMI ([www.onsemi.com](http://www.onsemi.com)). Note that the USIM peripheral circuit should be close to the USIM card socket. The following figure shows the 6-pin SIM card holder reference circuit.

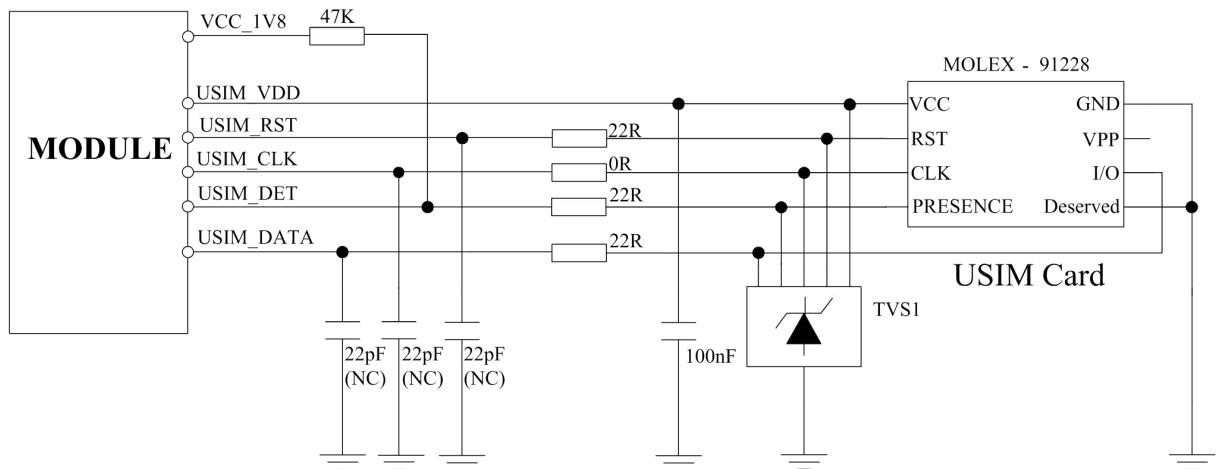


**Figure 22: USIM interface reference circuit**

**Note:** *USIM\_DATA has been pulled up with a 10KΩ resistor to USIM\_VDD in MODULE. A 100nF capacitor on USIM\_VDD is used to reduce interference. For more details of AT commands about USIM, please refer to document [1]. USIM\_CLK is very important signal, the rise time and fall time of USIM\_CLK should be less than 40ns, otherwise the USIM card might not be initialized correctly.*

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

The following figure shows the 8-pin SIM card holder reference circuit.



**Figure 23: USIM interface reference circuit with USIM\_DET**

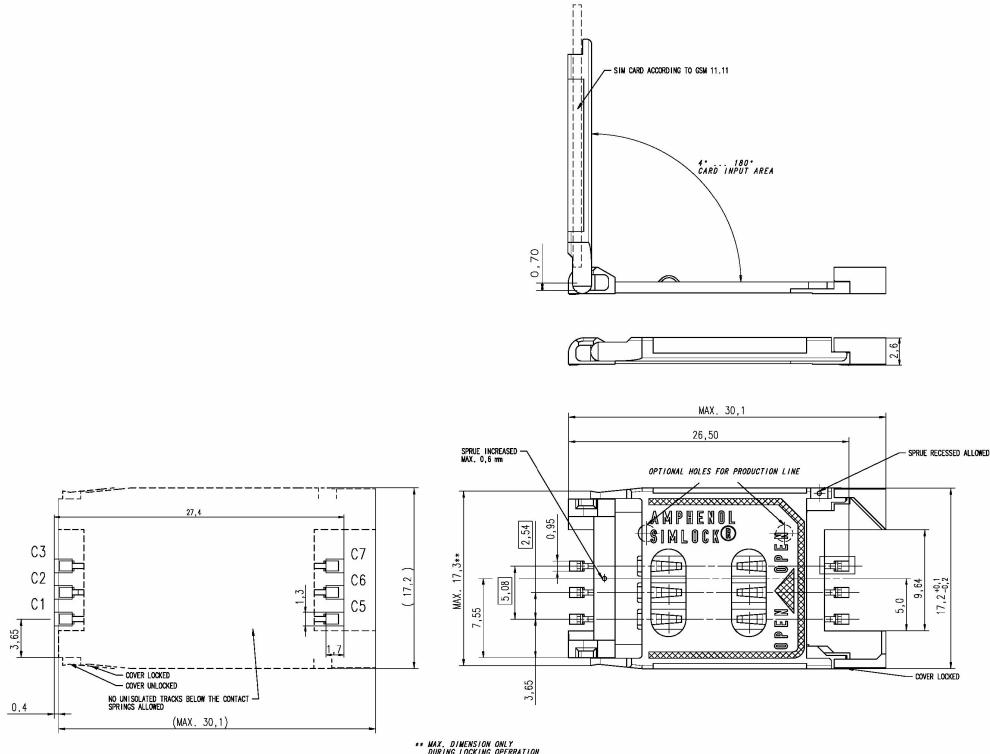
If the USIM card detection function is not used, user can keep the USIM\_DET pin open.

SIM card circuit is susceptible, the interference may cause the SIM card failures or some other situations, so it is strongly recommended to follow these guidelines while designing:

- Make sure that the SIM card holder should be far away from the antenna while in PCB layout.
- SIM traces should keep away from RF lines, VBAT and high-speed signal lines.
- The traces should be as short as possible.
- Keep SIM holder's GND connect to main ground directly.
- Shielding the SIM card signal by ground.
- Recommended to place a 0.1~1uF capacitor on USIM\_VDD line and keep close to the holder.
- The rise/fall time of USIM\_CLK should not be more than 40ns.
- Add some TVS and the parasitic capacitance should not exceed 60pF.

## Recommended USIM Card Holder

It is recommended to use the 6-pin USIM socket such as C707 10M006 512 produced by Amphenol. User can visit <http://www.amphenol.com> for more information about the holder.



**Figure 24: Amphenol SIM card socket**

**Table 14: Amphenol USIM socket pin description**

Pin	Signal	Description
C1	USIM_VDD	USIM Card Power supply.
C2	USIM_RST	USIM Card Reset.
C3	USIM_CLK	USIM Card Clock.
C5	GND	Connect to GND.
C6	VPP	NC
C7	USIM_DATA	USIM Card data I/O.

### 3.8 PCM Interface

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

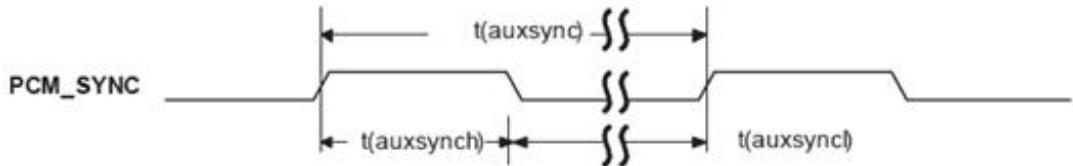
**Table 15: PCM format**

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

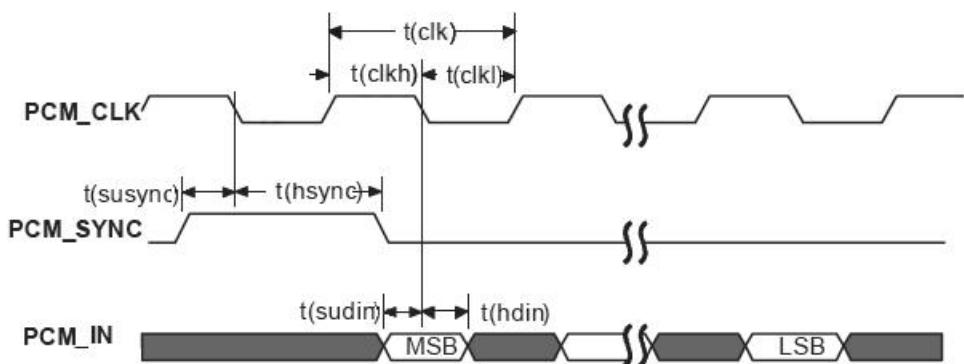
*Note: For more details about PCM AT commands, please refer to document [1].*

#### 3.8.1 PCM timing

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



**Figure 25: PCM\_SYNC timing**



**Figure 26: EXT codec to MODULE timing**

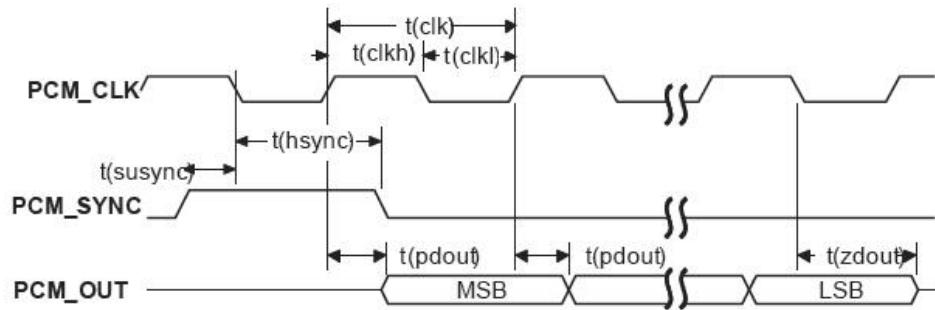


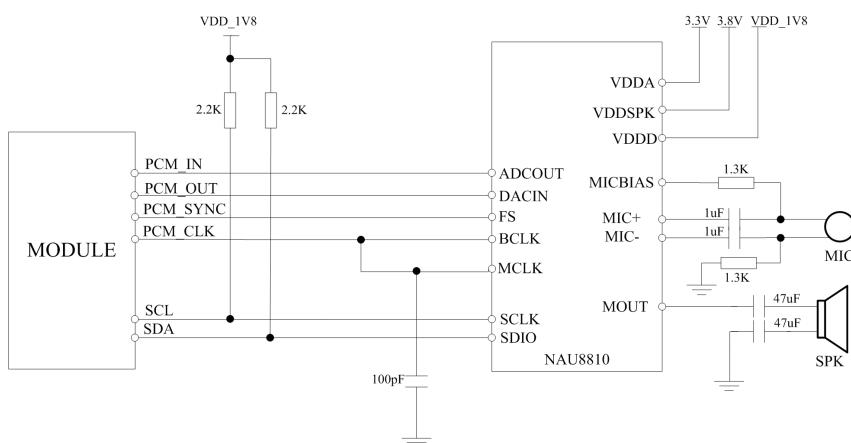
Figure 27: Module to EXT codec timing

Table 16: PCM timing parameters

Parameter	Description	Min.	Typ.	Max.	Unit
T(sync)	PCM_SYNC cycle time	—	125	—	μs
T(synch)	PCM_SYNC high level time	—	488	—	ns
T(syncl)	PCM_SYNC low level time	—	124.5	—	μs
T(clk)	PCM_CLK cycle time	—	488	—	ns
T(clkh)	PCM_CLK high level time	—	244	—	ns
T(clkl)	PCM_CLK low level time	—	244	—	ns
T(susync)	PCM_SYNC setup time high before falling edge of PCM_CLK	—	244	—	ns
T(hsync)	PCM_SYNC hold time after falling edge of PCM_CLK	—	244	—	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	10	—	—	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	—	160	—	ns

### 3.8.2 PCM Application Guide

The following figure shows the external codec reference design.



**Figure 28: Audio codec reference circuit**

### 3.9 SD Interface

MODULE provides a 4-bit SD/MMC/eMMC interface with clock rate up to 200 MHz.

When connected to a SD or MMC card, the voltage of SD interface is 1.8/2.85V, which is compatible with Secure Digital Physical Layer Specification version 3.0 and SDIO Card Specification version 3.0. It supports up to 128GB SD cards.

When connected to a eMMC card, the interface voltage will be a single 1.8V, which is compatible with eMMC Specification, version 4.5. It supports up to 128GB eMMC cards.

**Table 17: SD/MMC electronic characteristic as 2.85V (SD\_DATA0-3 , SD\_CLK and SD\_CMD)**

Symbol	Parameter	Min.	Typ.	Max.	Unit
V <sub>IH</sub>	High-level input voltage	0.65*2.85	-	2.85+0.3	V
V <sub>IL</sub>	Low-level input voltage	-0.3	0	0.25*2.85	V
V <sub>OH</sub>	High-level output voltage	0.75*2.85	2.85	2.85	V
V <sub>OL</sub>	Low-level output voltage	0	0	0.15*2.85	V

**Table 18: SD/MMC/eMMC electronic characteristic as 1.8V (SD\_DATA0-3, SD\_CLK and SD\_CMD)**

Symbol	Parameter	Min.	Typ.	Max.	Unit
V <sub>IH</sub>	High-level input voltage	0.7*1.8	-	1.8+0.2	V
V <sub>IL</sub>	Low-level input voltage	-0.3	0	0.3*1.8	V
V <sub>OH</sub>	High-level output voltage	1.8-0.4	1.8	1.8	V
V <sub>OL</sub>	Low-level output voltage	0	0	0.45	V

Users should provide 2.85V to power SD card system and the current should more than 350mA, which is showed below as VCC\_SD. ESD/EMI components should be arranged beside SD card socket. Refer to the following application circuit.

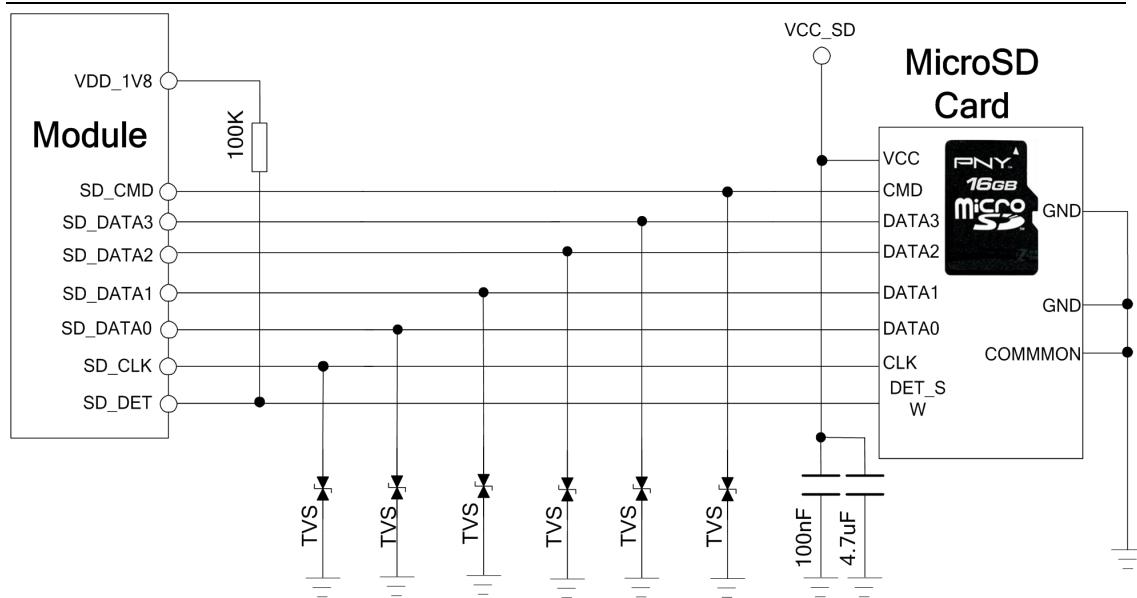


Figure29: SD reference circuit

Users should provide 2.85V to power eMMC card system and 1.8V to power the SDIO\_DATA/CMD/CLK signals. The source of 2.85V should be able to provide more than 500mA\* which showed below as VCC\_eMMC, as the source of 1.8V should be able to provide more than 300mA\* which showed below as VCCQ\_1V8. ESD/EMI components should be arranged close to the eMMC card. Refer to the following application circuit.

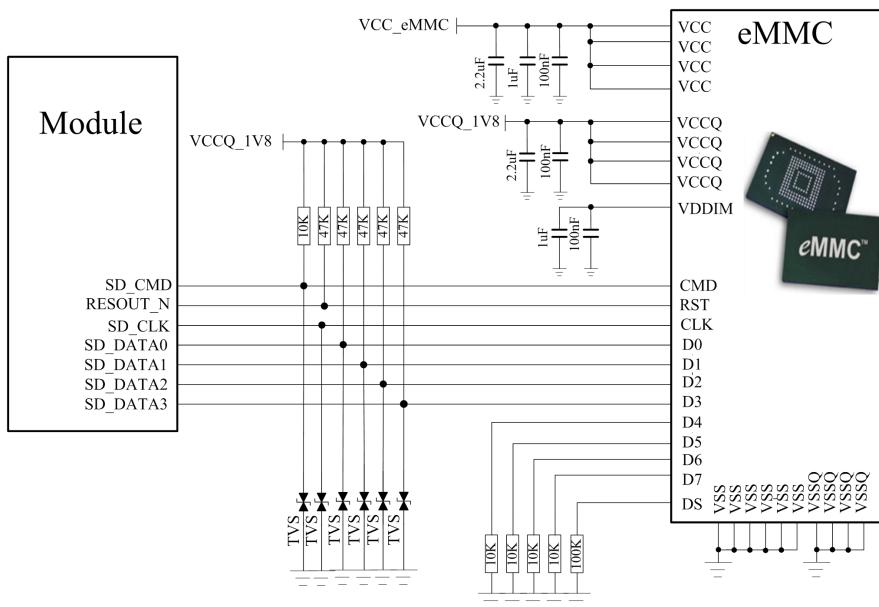


Figure 30: eMMC reference circuit

**\*NOTE: For the current of VCC\_eMMC and VCCQ\_1V8, users should better refer to the related datasheet of eMMC which is used. The listed current of 500mA and 300mA are just for your reference.**

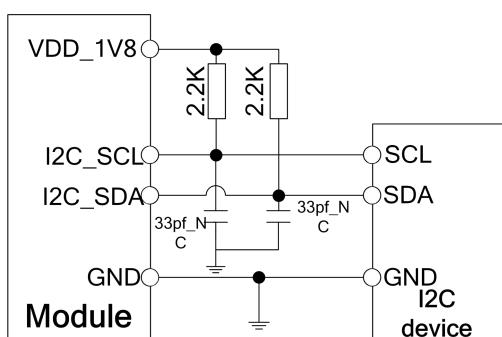
SD/MMC/eMMC card layout guide lines:

- Protect SD card signals from noisy signals (clocks, SMPS, etc.).
- Up to 200 MHz clock rate,  $50\ \Omega$  nominal,  $\pm 10\%$  trace impedance
- CLK to DATA/CMD length matching < 1 mm
- Total routing length < 50 mm
- Spacing to all other signals = 2x line width
- Bus capacitance < 10 pF

### 3.10 I2C Interface

MODULE provides a I2C interface compatible with I2C specification, version 5.0, with clock rate up to 400 kbps. Its operation voltage is 1.8V.

The following figure shows the I2C bus reference design.



**Figure31: I2C reference circuit**

**Note:** *SDA and SCL do not have pull-up resistors in MODULE. So, 2 external pull up resistors are needed in application circuit.*

**"AT+CRIIC and AT+CWIIC"** AT commands could be used to read/write register values of the I2C peripheral devices. For more details about AT commands please refer to document [1].

### 3.11 SDIO Interface

MODULE provides a 4 bit 1.8V SDIO interface for WLAN solution with W58 module. The SDIO interface can be used for WLAN solution.

**Note:** *Special software version for CAT4 MODULEs supports this function.*

### 3.12 SPI Interface

SIM7600G provides a SPI interface as a master only. It provides a duplex, synchronous, serial

communication link with peripheral devices. Its operation voltage is 1.8V, with clock rates up to 50 MHz

**Note:** For more details of the AT commands about the SPI, please refer to document [1].

### 3.13 Network status

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

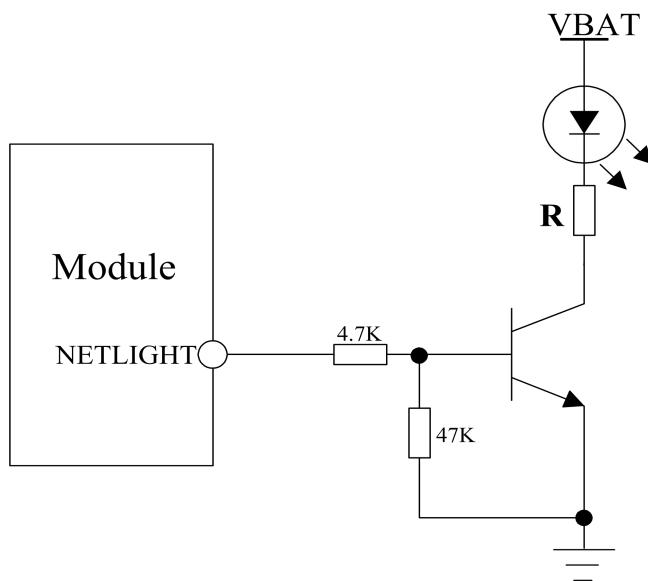


Figure32: NETLIGHT reference circuit

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

Table 19: NETLIGHT pin status

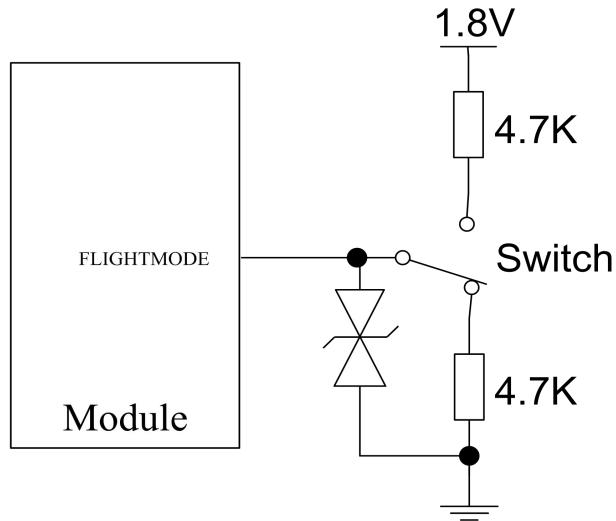
NETLIGHT pin status	Module status
Always On	Searching Network; Call Connect(include VOLTE,SRLTE)
200ms ON, 200ms OFF	Data Transmit; 4G registered;
800ms ON, 800ms OFF	2G/3G registered network
OFF	Power off ,Sleep

**Note:** NETLIGHT output low level as “OFF”, and high level as “ON”.

### 3.14 Flight Mode Control

The FLIGHTMODE pin can be used to control MODULE to enter or exit the Flight mode. In Flight mode, the RF circuit is closed to prevent interference with other equipments and minimize

current consumption. Bidirectional ESD protection component is suggested to add on FLIGHTMODE pin, its reference circuit is shown in the following figure.



**Figure 33: Flight mode switch reference circuit**

**Table 20: FLIGHTMODE pin status**

FLIGHTMODE pin status	Module operation
Input Low Level	Flight Mode: RF is closed
Input High Level	AT+CFUN=0: RF is closed AT+CFUN=1:RF is working

### 3.15 Other interface

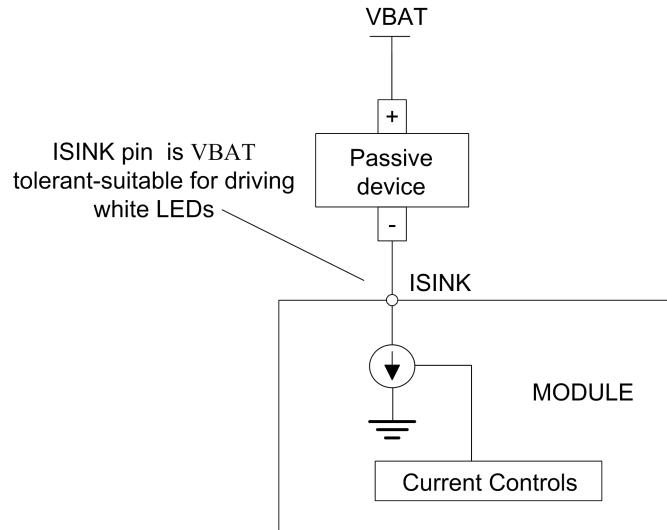
#### 3.15.1 Sink Current Source

The ISINK pin is VBAT tolerant and intended to drive some passive devices, such as LCD backlight and white LED, etc. Its output current can be up to 40mA and be set by the AT command “AT+ CREDITST”.

**Table 21: Sink current electronic characteristic**

Symbol	Description	Min.	Typ.	Max.	Unit
V <sub>ISINK</sub>	Voltage tolerant	0.5	-	VBAT	V
I <sub>ISINK</sub>	Current tolerant	0	-	40	mA

ISINK is a ground-referenced current sink. The following figure shows its reference circuit.



**Figure34: ISINK reference circuit**

**Note:** The sinking current can be adjusted to meet the design requirement through the AT command “AT+ CREDITST =<0>, <value>”. The “value” ranges from 0 to 8, on behalf of the current from 0mA to 40mA by 5mA step.

### 3.15.2 ADC

MODULE has 2 dedicated ADC pins named ADC1 and ADC2. They are available for digitizing analog signals such as battery voltage and so on. These electronic specifications are shown in the following table.

**Table 22: ADC1 and ADC2 electronic characteristics**

Characteristics	Min.	Typ.	Max.	Unit
Resolution	–	15	–	Bits
Conversion time	–	442	–	ms
Input Range	0.1		1.7	V
Input serial resistance	1	–	–	MΩ

**Note:** “AT+CADC” and “AT+CADC2” can be used to read the voltage of the ADC1 and ADC2 pins, for more details, please refer to document [1].

### 3.15.3 LDO

MODULE has a LDO power output, named VDD\_AUX. its output voltage is 2.85V by default, Users can switch the LDO on or off by the AT command “AT+CVAUXS” and configure its output voltage by the AT command “AT+CVAUXV”.

**Table 23: Electronic characteristic**

Symbol	Description	Min.	Typ.	Max.	Unit
V <sub>VDD_AUX</sub>	Output voltage	1.7	2.85	3.05	V
I <sub>O</sub>	Output current	-	-	150	mA

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

## 4 RF Specifications

### 4.1 GSM/UMTS/LTE RF Specifications

**Table 24: Conducted transmission power**

Frequency	Power	Min.
GSM850	33dBm ±2dB	5dBm ± 5dB
EGSM900	33dBm ±2dB	5dBm ± 5dB
DCS1800	30dBm ±2dB	0dBm ± 5dB
PCS1900	30dBm ±2dB	0dBm ± 5dB
GSM850 (8-PSK)	27dBm ±3dB	5dBm ± 5dB
EGSM900 (8-PSK)	27dBm ±3dB	5dBm ± 5dB
DCS1800 (8-PSK)	26dBm +3/-4dB	0dBm ±5dB
PCS1900 (8-PSK)	26dBm +3/-4dB	0dBm ±5dB
WCDMA B1	24dBm +1/-3dB	<-50dBm
WCDMA B2	24dBm +1/-3dB	<-50dBm
WCDMA B4	24dBm +1/-3dB	<-50dBm
WCDMA B5	24dBm +1/-3dB	<-50dBm
WCDMA B6	24dBm +1/-3dB	<-50dBm
WCDMA B8	24dBm + 1/-3dB	<-50dBm
WCDMA B19	24dBm +1/-3dB	<-50dBm
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 B7	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
LTE-TDD B34	23dBm +/-2.7dB	<-40dBm
LTE-TDD B38	23dBm +/-2.7dB	<-40dBm
LTE-TDD B39	23dBm +/-2.7dB	<-40dBm
LTE-TDD B40	23dBm +/-2.7dB	<-40dBm
LTE-TDD B41	23dBm +/-2.7dB	<-40dBm

**Table 23: Operating frequencies**

Frequency	Receiving	Transmission
GSM850	869~894MHz	824~849 MHz
EGSM900	925~960MHz	880~915 MHz

DCS1800	1805~1880 MHz	1710~1785 MHz
PCS1900	1930~1990 MHz	1850~1910 MHz
WCDMA B1	2110~2170 MHz	1920~1980 MHz
WCDMA B2	1930~1990 MHz	1850~1910 MHz
WCDMA B4	2110~2155MHz	1710~1755MHz
WCDMA B5	869~894 MHz	824~849 MHz
WCDMA B6	877~882MHz	832~837MHz
WCDMA B8	925~960 MHz	880~915 MHz
WCDMA B19	875~890MHz	835~845MHz

The LTE Operating frequencies are shown in the following table 24.

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

GPS	1574.4 ~1576.44 MHz	-
GLONASS	1598 ~1606 MHz	-
BD	1559 ~1563 MHz	

**Table 24: E-UTRA operating bands**

E-UTRA Operating Band	Uplink (UL) operating band	Downlink (DL) operating band	Duplex Mode
1	1920 ~1980 MHz	2110 ~2170 MHz	FDD
2	1850~1910 MHz	1930~1990 MHz	FDD
3	1710 ~1785 MHz	1805 ~1880 MHz	FDD
4	1710~1755MHz	2110~2155MHz	FDD
5	824~849 MHz	869~894MHz	FDD
7	2500~2570MHz	2620~2690MHz	FDD
8	880 ~915 MHz	925 ~960 MHz	FDD
12	699~716MHz	728~746MHz	FDD
13	777~787MHz	746~757MHz	FDD
18	815~830MHz	860~875MHz	FDD
19	830~845MHz	875~890MHz	FDD
20	832~862MHz	791~ 821MHz	FDD
25	1850~1915MHz	1930~1995MHz	FDD
26	814~849MHz	859~894MHz	FDD
28	703~748MHz	758~803MHz	FDD
66	1710~1780MHz	2110~2200MHz	FDD
34	2010~2025MHz	2010~2025MHz	TDD
38	2570 ~2620 MHz	2570 ~2620 MHz	TDD
39	1880~1920MHz	1880~1920MHz	TDD
40	2300 ~2400 MHz	2300 ~2400 MHz	TDD
41	2496~2696 MHz	2496~2696 MHz	TDD

**Table 25: Conducted receive sensitivity**

Frequency	Receive sensitivity(Typical)	Receive sensitivity(MAX)
GSM850	< -109dBm	3GPP
EGSM900	< -109dBm	3GPP
DCS1800	< -109dBm	3GPP
PCS1900	< -109dBm	3GPP
WCDMA B1	< -110dBm	3GPP
WCDMA B2	< -110dBm	3GPP
WCDMA B4	< -110dBm	3GPP
WCDMA B5	< -110dBm	3GPP
WCDMA B6	< -110dBm	3GPP
WCDMA B8	< -110dBm	3GPP
WCDMA B19	< -110dBm	3GPP
LTE FDD/TDD	See table 26.	3GPP

**Table 26: Reference sensitivity (QPSK)**

E-UTR A band	1.4 MHz Standard	3 MHz Standard	5 MHz Standard	10 MHz Standard	15 MHz Standard	20 MHz Standard	Duplex Mode
1	-	-	-100	-97	-95.2	-94	FDD
2	-102.7	-99.7	-98	-95	-93.2	-92	FDD
3	-101.7	-98.7	-97	-94	-92.2	-91	FDD
4	-104.7	-101.7	-100	-97	-95.2	-94	FDD
5	-103.2	-100.2	-98	-95			FDD
7			-98	-95	-93.2	-92	FDD
8	-102.2	-99.2	-97	-94			FDD
12	-101.7	-98.7	-97	-94			FDD
13			-97	-94			FDD
18			-100	-97	-95.2		FDD
19			-100	-97	-95.2		FDD
20			-97	-94	-91.2	-90	FDD
25	-101.2	-98.2	-96.5	-93.5	-91.7	-90.5	FDD
26	-102.7	-99.7	-97.5	-94.5	-92.7		FDD
28		-100.2	-98.5	-95.5	-93.7	-91	FDD
66	-104.7	-101.7	-100	-97	-95.2	-94	FDD
34			-100	-97	-95.2		TDD
38	-	-	-100	-97	-95.2	-94	TDD
39			-100	-97	-95.2		TDD
40	-	-	-100	-97	-95.2	-94	TDD
41	-	-	-99	-96	-94.2	-93	TDD

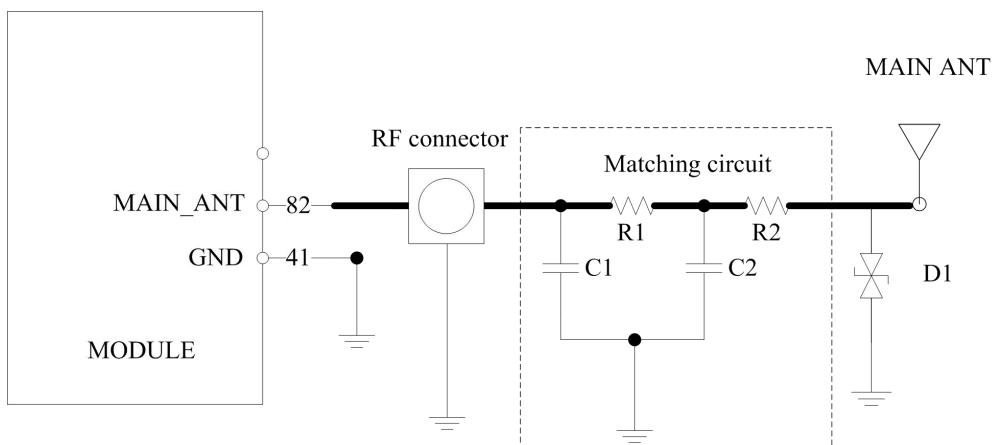
## 4.2 GSM /UMTS/LTE Antenna Design Guide

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

**Table 27: Trace loss**

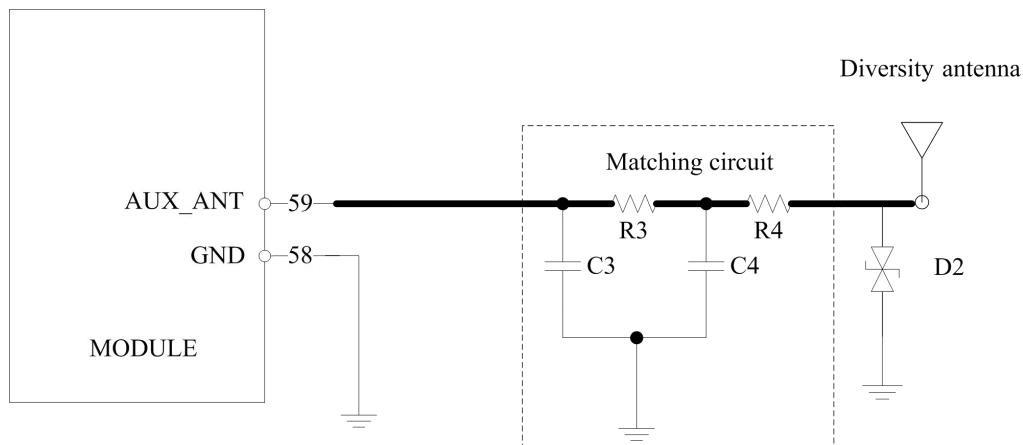
Frequency	Loss
700MHz-960MHz	<0.5dB
1710MHz-2170MHz	<0.9dB
2300MHz-2650MHz	<1.2dB

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.



**Figure35: 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  $0\ \Omega$  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 MODULE and antenna must be controlled in  $50\ \Omega$ .



**Figure 36: Antenna matching circuit (AUX\_ANT)**

In above figure, R3, C3, C4 and R4 are used for auxiliary antenna matching. By default, the R3, R4 are  $0\ \Omega$  resistors, and the C3, C4 are reserved for tuning. D2 is a TVS for ESD protection, and it is optional for users according to application environment.

Two TVS are recommended in the table below.

**Table 28: Recommended TVS**

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

*Note : SIMCom suggests the LTE auxiliary antenna to be kept on, since there are many high bands in the designing of LTE-TDD, such as band38, band40 and band41. Because of the high insert loss of the RF cable and layout lines, the receiver sensitivity of these bands above will have risk to meet the authentication without the diversity antenna. For more details about auxiliary antenna design notice, please refer to document [25].*

### 4.3 GNSS

MODULE 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) /-158 dBm (GLONASS) /-159 dBm (BD)
- Cold-start sensitivity: -148 dBm
- Accuracy (Open Sky): 2.5m (CEP50)
- TTFF (Open Sky) : Hot start <1s, Cold start<35s
- Receiver Type: 16-channel, C/A Code
- GPS L1 Frequency:  $1575.42 \pm 1.023\text{MHz}$
- GLONASS: 1597.5~1605.8 MHz
- BD: 1559.05~1563.14 MHz
- Update rate: Default 1 Hz
- GNSS data format: NMEA-0183
- GNSS Current consumption : 100mA (GSM/UMTS/LTE Sleep ,in total on VBAT pins)
- GNSS antenna: Passive/Active antenna

*Note: If the antenna is active type, the power should be given by main board because there is no power supply on the GPS 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 MODULE. If using a passive antenna, an external LNA is a must to get better performance.

The following figures are the reference circuits.

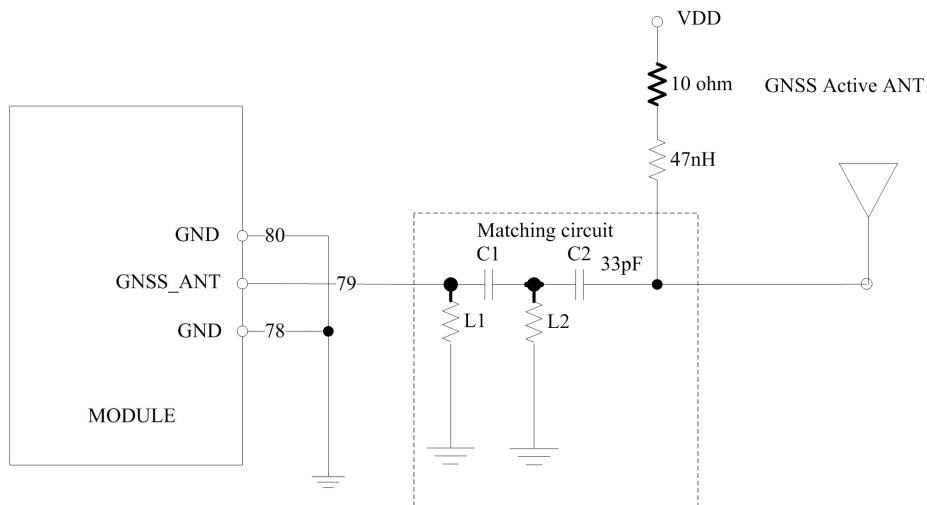
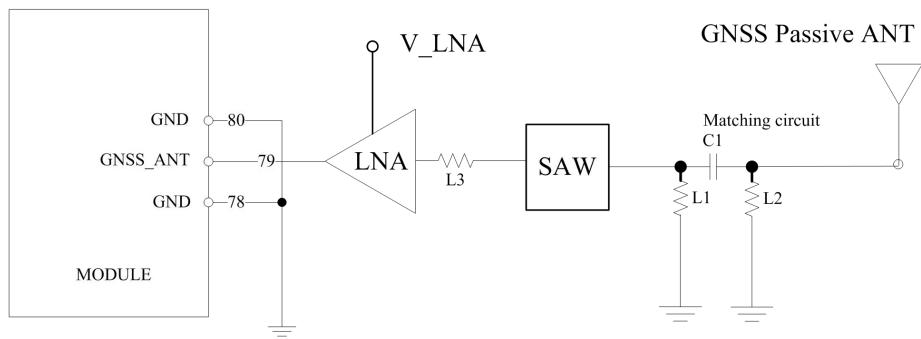


Figure 37: Active antenna circuit



**Figure 38: 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 MODULE in proper operating mode by AT command. Please refer to related documents for details. MODULE can also get position location information through AT directly.

**Note:** *GNSS is closed by default and can be started by AT+CGPS. The AT command has two parameters, the first is on/off, and the second is GNSS mode. Default mode is standalone mode. AGPS mode needs more support from the mobile telecommunication network. Please refer to document [24] for more details.*

## 5 Electrical Specifications

### 5.1 Absolute maximum ratings

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

**Table 29: Absolute maximum ratings**

Parameter	Min.	Typ.	Max.	Unit
Voltage at VBAT	-0.5	-	6.0	V
Voltage at USB_VBUS	-0.5	-	5.85	V
Voltage at digital pins (RESET,SPI,Keypad,GPIO,I2C,UART,PCM)	-0.3	-	2.1	V
Voltage at digital pins (SD,USIM)	-0.3	-	3.05	V
Voltage at PWRKEY	-0.3	-	1.8	

### 5.2 Operating conditions

**Table 30: Recommended operating ratings**

Parameter	Min.	Typ.	Max.	Unit
Voltage at VBAT	3.4	3.8	4.2	V
Voltage at USB_VBUS	3.0	5.0	5.25	V

**Table 31: 1.8V Digital I/O characteristics\***

Parameter	Description	Min.	Typ.	Max.	Unit
V <sub>IH</sub>	High-level input voltage	1.17	1.8	2.1	V
V <sub>IL</sub>	Low-level input voltage	-0.3	0	0.63	V
V <sub>OH</sub>	High-level output voltage	1.35	-	1.8	V
V <sub>OL</sub>	Low-level output voltage	0	-	0.45	V
I <sub>OH</sub>	High-level output current(no pull down resistor)	-	2	-	mA
I <sub>OL</sub>	Low-level output current(no pull up resistor)	-	-2	-	mA
I <sub>IH</sub>	Input high leakage current (no pull down resistor)	-	-	1	uA
I <sub>IL</sub>	Input low leakage current(no pull up resistor)	-1	-	-	uA

**\*Note: These parameters are for digital interface pins, such as SPI, GPIOs (NETLIGHT, FLIGHTMODE, STATUS, USIM\_DET, SD\_DET), SDIO, I2C, UART, PCM, COEXn, and BOOT\_CFG0.**

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

**Table 32: Operating temperature**

Parameter	Min.	Typ.	Max.	Unit
Normal operation temperature	-30	25	80	°C
Extended 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 GSM/UMTX/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 MODULE product.

**Table 33: Operating mode Definition**

Mode	Function
Normal operation	GSM /UMTS/LTE Sleep
	GSM/UMTS/LTE Idle
	GSM/UMTS/LTE Talk
	GPRS/EDGE/ UMTS/LTE Standby
	GPRS/EDGE/ UMTS/LTE Data transmission
Minimum functionality mode	AT command “AT+CFUN=0” 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 USIM 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 pulling down the FLIGHTMODE 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 off	Module will go into power off mode by sending the AT command “AT+CPOF” or pull down the PWRKEY pin, normally. In this mode the power management unit shuts down the power supply, and software is not active. The serial port and USB are is not accessible.

### 5.3.2 Sleep mode

In sleep mode, the current consumption of MODULE will be reduced to the minimal level, and MODULE can still receive paging message and SMS.

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

1. UART condition
2. USB condition
3. Software condition

**Note:** Before designing, pay attention to how to realize sleeping/waking function and refer to Document [26] for more details.

### 5.3.3 Minimum functionality mode and Flight mode

Minimum functionality mode ceases a majority function of MODULE, thus minimizing the power consumption. This mode is set by the AT command which provides a choice of the functionality levels.

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

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

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

## 5.4 Current Consumption

The current consumption is listed in the table below.

**Table 34: Current consumption on VBAT Pins (VBAT=3.8V)**

GNSS		
GNSS supply current (AT+CFUN=0,with USB connection)		@ -140dBm, Tracking Typical:38ma
GSM sleep/idle mode		
GSM/GPRS supply current (GNSS off, without USB connection)	Sleep mode@ BS_PA_MFRMS=2	Typical: 2.307ma
	Idle mode@ BS_PA_MFRMS=2	Typical: 17ma
UMTS sleep/idle mode		
WCDMA supply current (GNSS off, without USB connection)	Sleep mode @DRX=1.28S	Typical: 1.819ma
	Idle mode @DRX=1.28S	Typical: 16.845ma
LTE sleep/idle mode		
LTE supply current (GNSS off, without USB connection)	Sleep mode Typical:	2.04ma
	Idle mode Typical:	17.3ma
GSM Talk		
GSM850	@power level #5 Typical: 307ma	
EGSM900	@ power level #5 Typical: 295ma	
DCS1800	@power level #5 Typical: 200 ma	
PCS1900	@power level #5 Typical: 227 ma	
UMTS Talk		
WCDMA B1	@Power 24dBm	Typical: 661ma
WCDMA B2	@Power 24dBm	Typical: 668 ma
WCDMA B4	@Power 24dBm	Typical: 599 ma
WCDMA B5	@Power 24dBm	Typical: 558 ma
WCDMA B6	@Power 24dBm	Typical: 554 ma
WCDMA B8	@Power 24dBm	Typical: 634ma
WCDMA B19	@Power 24dBm	Typical: 561 ma
GPRS		
GSM850( 1 Rx,4 Tx )	@power level #5 Typical: 586 ma	
EGSM900( 1 Rx,4 Tx )	@power level #5 Typical: 540 ma	
DCS1800( 1 Rx,4 Tx )	@power level #0 Typical: 382 ma	
PCS1900( 1 Rx,4 Tx )	@power level #0 Typical: 416 ma	
GSM850( 3Rx, 2 Tx )	@power level #5 Typical: 438 ma	
EGSM900( 3Rx, 2 Tx )	@power level #5 Typical: 419 ma	
DCS1800( 3Rx, 2 Tx )	@power level #0 Typical: 291 ma	
PCS1900( 3Rx, 2 Tx )	@power level #0 Typical: 328 ma	
EDGE		
GSM850( 1 Rx,4 Tx )	@power level #8 Typical: 523ma	
EGSM900( 1 Rx,4 Tx )	@power level #8 Typical: 477ma	
DCS1800( 1 Rx,4 Tx )	@power level # 2 Typical: 380ma	
PCS1900( 1 Rx,4 Tx )	@power level #2 Typical: 414ma	
GSM850( 3Rx, 2 Tx )	@power level #8 Typical: 298ma	
EGSM900( 3Rx, 2 Tx )	@power level #8 Typical: 273ma	

DCS1800( 3Rx, 2 Tx )	@power level #2 Typical: 246ma		
PCS1900( 3Rx, 2 Tx )	@power level #2 Typical: 268ma		
<b>LTE data</b>			
LTE-FDD B1	@5MHz	22.3dBm	Typical: 711 ma
	@10MHz	22.4dBm	Typical: 718 ma
	@20MHz	22.4dBm	Typical: 756 ma
LTE-FDD B2	@5MHz	22.1dBm	Typical: 676 ma
	@10MHz	22.4dBm	Typical: 723 ma
	@20MHz	22.3dBm	Typical: 759 ma
LTE-FDD B3	@5MHz	22.2dBm	Typical: 666 ma
	@10MHz	22.1dBm	Typical: 662 ma
	@20MHz	22.1dBm	Typical: 682 ma
LTE-FDD B4	@5MHz	22.0dBm	Typical: 709 ma
	@10MHz	22.1dBm	Typical: 769 ma
	@20MHz	22.6dBm	Typical: 896 ma
LTE-FDD B5	@5MHz	22.2dBm	Typical: 619 ma
	@10MHz	22.1dBm	Typical: 628 ma
LTE-FDD B7	@5MHz	22.2dBm	Typical: 599 ma
	@10MHz	22.1dBm	Typical: 611 ma
	@20MHz	22.1dBm	Typical: 680ma
LTE-FDD B8	@5MHz	22.8dBm	Typical: 699 ma
	@10MHz	22.8dBm	Typical: 751 ma
LTE-FDD B12	@5MHz	22.7dBm	Typical: 600 ma
	@10MHz	22.7dBm	Typical: 607 ma
LTE-FDD B13	@5MHz	21.9dBm	Typical: 685 ma
	@10MHz	22.0dBm	Typical: 653 ma
LTE-FDD B18	@5MHz	21.3dBm	Typical: 702 ma
	@10MHz	22.5dBm	Typical: 711 ma
	@15MHz	22.6dBm	Typical: 747 ma
LTE-FDD B19	@5MHz	22.4dBm	Typical: 616 ma
	@10MHz	22.3dBm	Typical: 622 ma
	@15MHz	22.5dBm	Typical: 679 ma
LTE-FDD B20	@5MHz	21.8dBm	Typical: 658 ma
	@10MHz	21.8dBm	Typical: 668 ma
	@20MHz	21.8dBm	Typical: 767 ma
LTE-FDD B25	@5MHz	22dBm	Typical: 634 ma
	@10MHz	22dBm	Typical: 702 ma
	@20MHz	22dBm	Typical: 781 ma
LTE-FDD B26	@5MHz	22.4dBm	Typical: 615 ma
	@10MHz	22.7dBm	Typical: 664 ma
	@15MHz	22.3dBm	Typical: 713 ma
LTE-FDD B28	@5MHz	22.4dBm	Typical: 811ma
	@10MHz	22.5dBm	Typical: 879 ma
	@20MHz	22.4dBm	Typical: 773 ma
LTE-FDD B66	@5MHz	22dBm	Typical: 707ma
	@10MHz	22dBm	Typical: 728ma
	@20MHz	22dBm	Typical: 795 ma
LTE-TDD B34	@5MHz	22dBm	Typical: 555 ma
	@10MHz	22dBm	Typical: 546 ma
LTE-TDD B38	@5MHz	21.8dBm	Typical: 799ma
	@10MHz	21.8dBm	Typical: 759ma
	@20MHz	21.8dBm	Typical: 779ma
LTE-TDD B39	@5MHz	22dBm	Typical:575 ma

	@10MHz	22dBm	Typical: 627 ma
	@20MHz	22dBm	Typical: 681 ma
LTE-TDD B40	@5MHz	21.5dBm	Typical: 727 ma
	@10MHz	21.7dBm	Typical: 715 ma
	@20MHz	21.7dBm	Typical: 703 ma
LTE-TDD B41	@5MHz	21.6dBm	Typical: 803 ma
	@10MHz	21.7dBm	Typical: 771 ma
	@20MHz	21.7dBm	Typical: 793 ma

## 5.5 ESD Notes

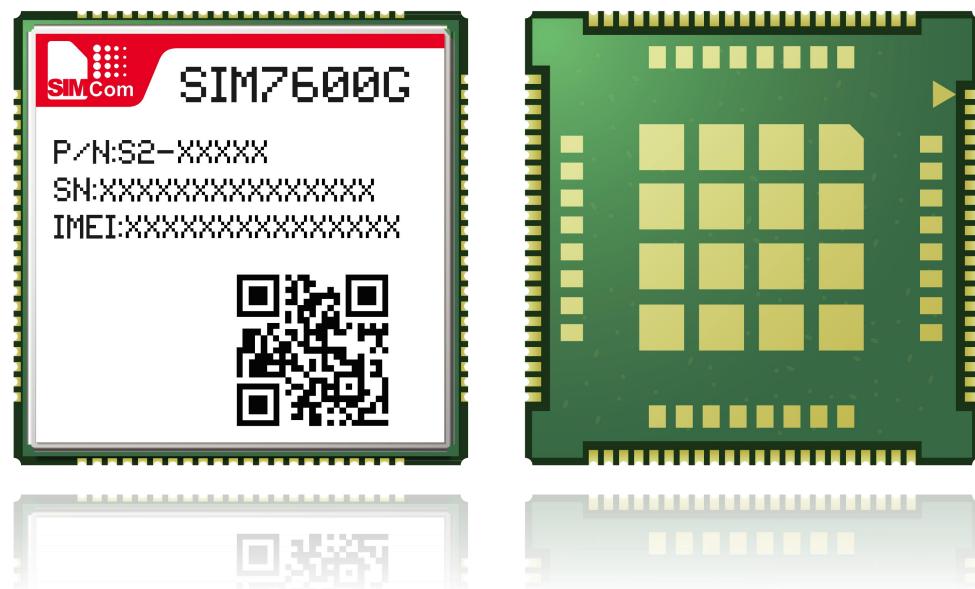
MODULE is sensitive to ESD in the process of storage, transporting, and assembling. When MODULE is mounted on the users' mother board, the ESD components should be placed beside the connectors which human body may touch, such as USIM card holder, audio jacks, switches, keys, etc. The following table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

**Table 35: The ESD performance measurement table (Temperature: 25°C, Humidity: 45%)**

Part	Contact discharge	Air discharge
VBAT,GND	+/-5K	+/-10K
Antenna port	+/-4K	+/-8K
Other PADs	+/-0.5K	+/-1K

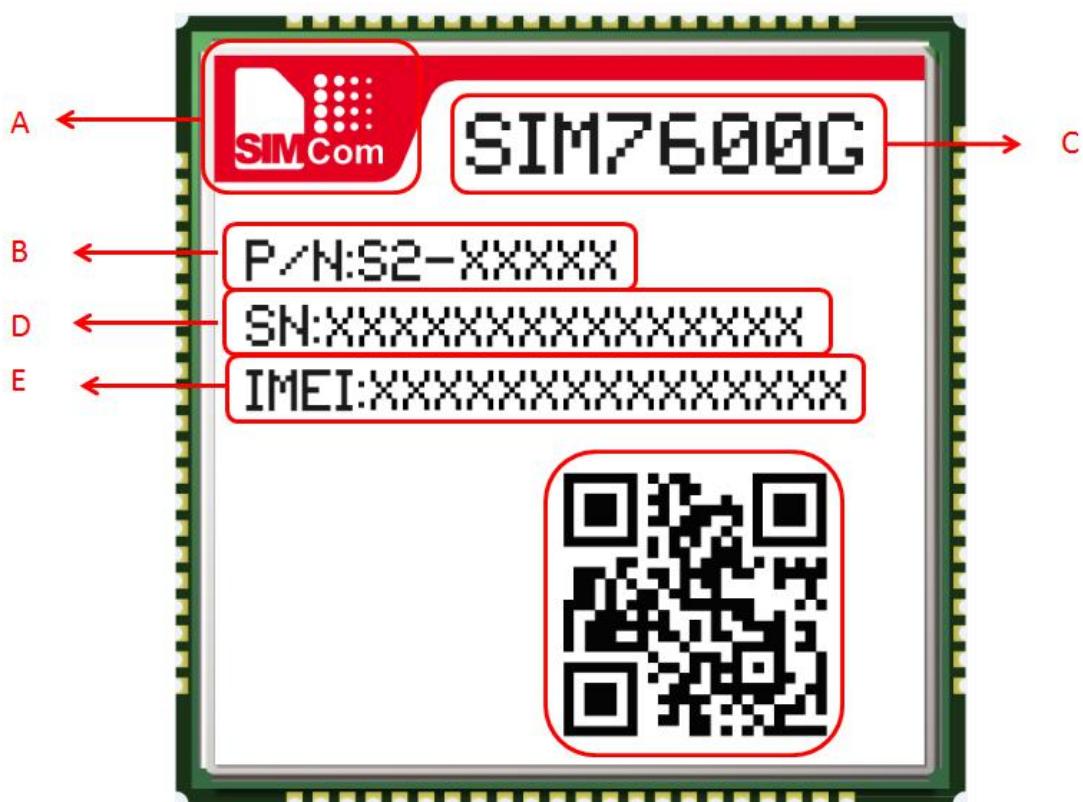
## 6 SMT Production Guide

### 6.1 Top and Bottom View of MODULE



**Figure 39: Top and bottom view of MODULE**

## 6.2 Label Information



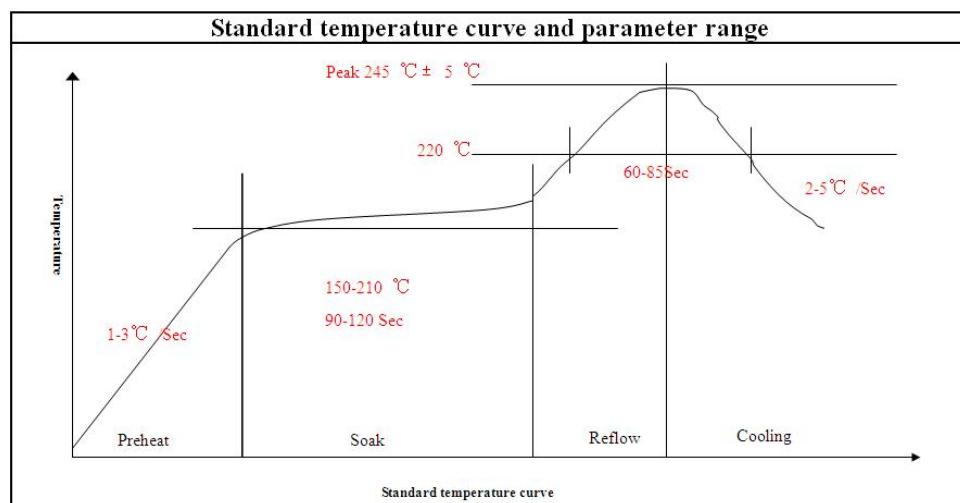
**Figure 40: Label information**

**Table 36: The description of label information**

No.	Description
A	LOGO
B	Module part number
C	Project name
D	Serial number
E	International mobile equipment identity

### 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.



**Figure41: The ramp-soak-spike reflow profile of MODULE**

*Note: For more details about secondary SMT, please refer to the document [21].*

### 6.4 Moisture Sensitivity Level (MSL)

MODULE is qualified to Moisture Sensitivity Level (MSL) 3 in accordance with JEDEC J-STD-033. If the prescribed time limit is exceeded, users should bake MODULE for 192 hours in drying equipment (<5% RH) at  $40+5/-0^{\circ}\text{C}$ , or 72 hours at  $85+5/-5^{\circ}\text{C}$ . Note that plastic tray is not heat-resistant, and only can be baked at  $45^{\circ}\text{C}$ .

**Table 37: Moisture Sensitivity Level and Floor Life**

Moisture Sensitivity Level (MSL)	Floor Life (out of bag) at factory ambient $\leq 30^{\circ}\text{C}/60\%$ RH or as stated
1	Unlimited at $\leq 30^{\circ}\text{C}/85\%$ RH
2	1 year
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.

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

## 6.5 Stencil Foil Design Recommendation

The recommended thickness of stencil foil is more than 0.15mm.

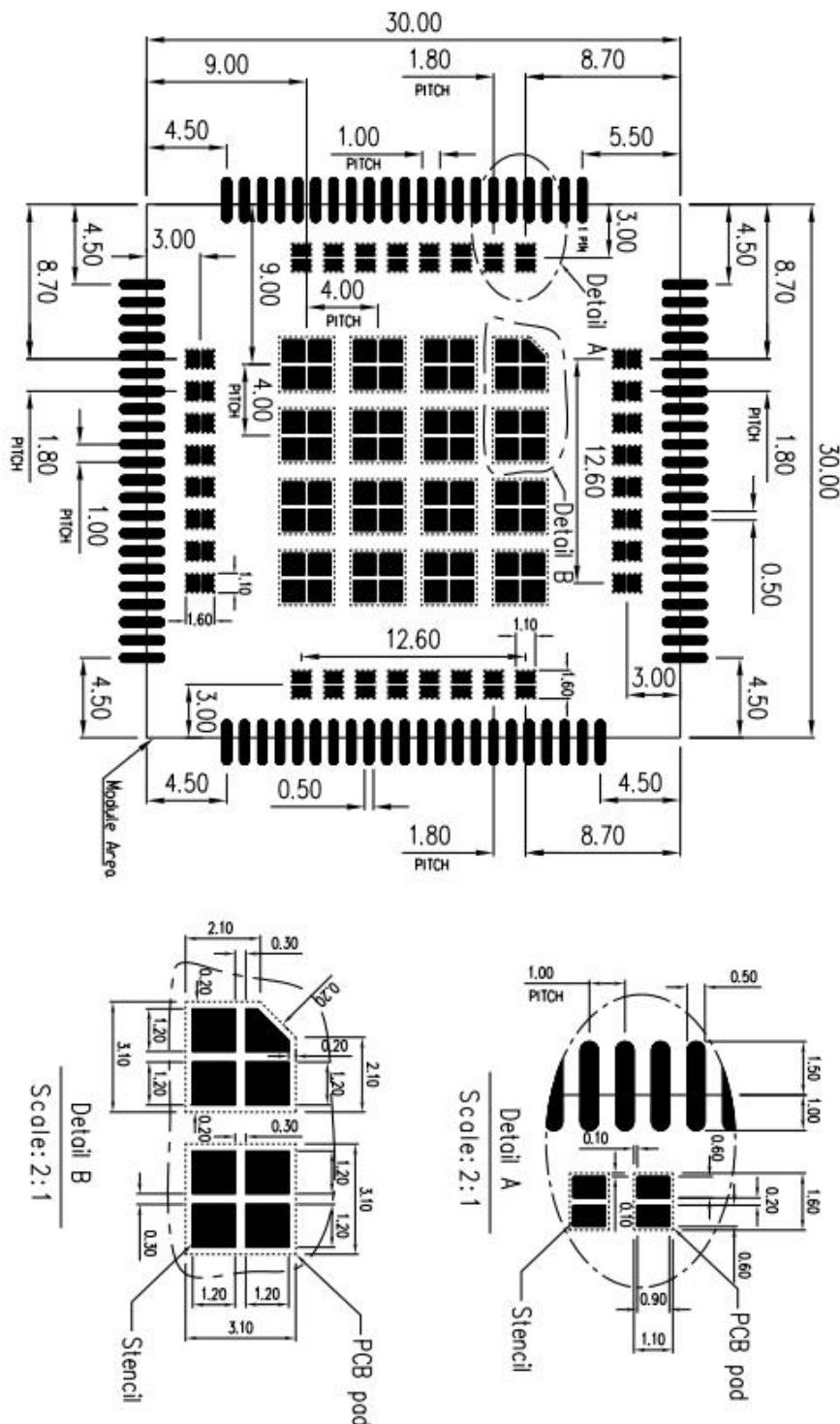


Figure 42 : Stencil Foil

## 7 Packaging

MODULE support tray packaging.

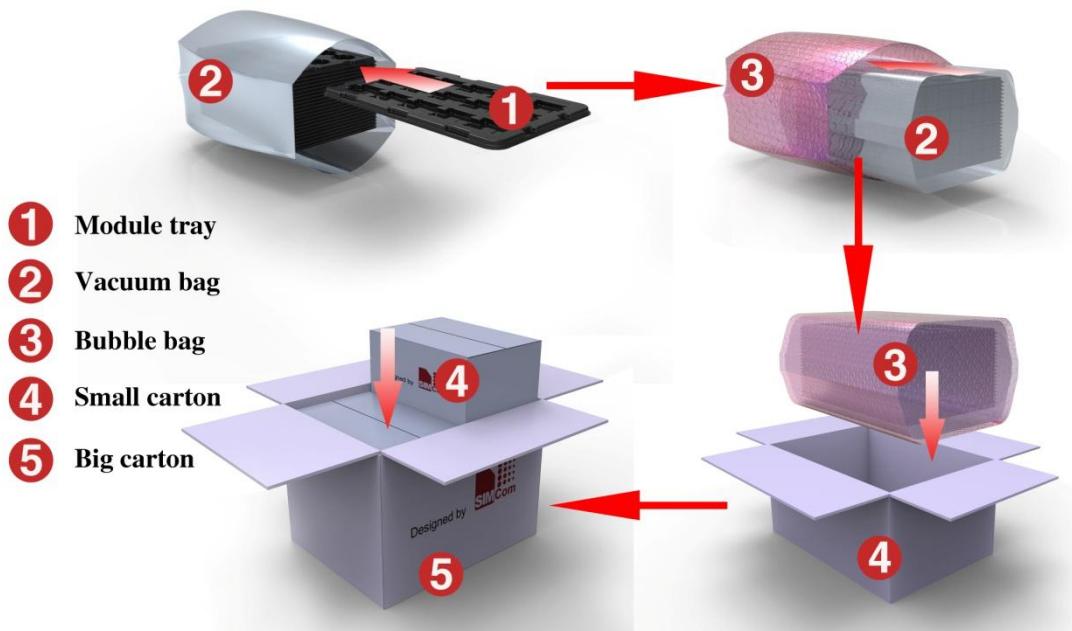


Figure43: packaging diagram

Module tray drawing:

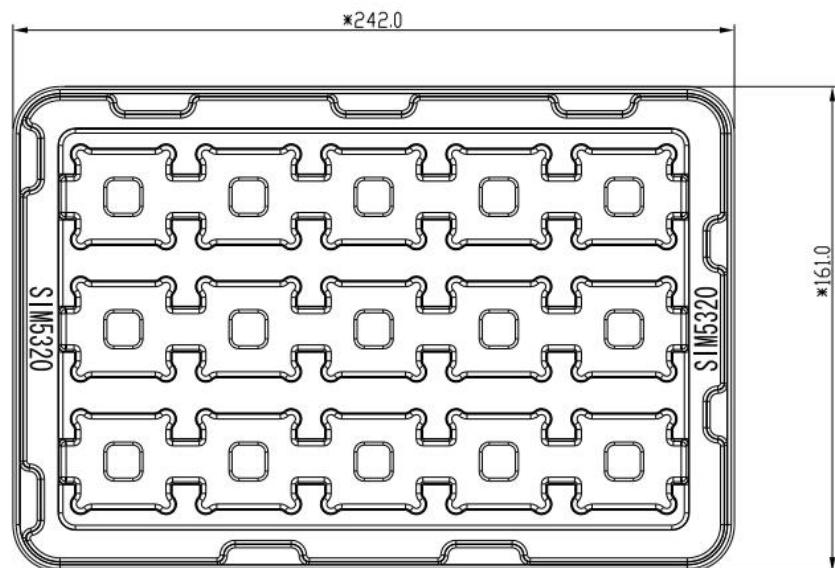
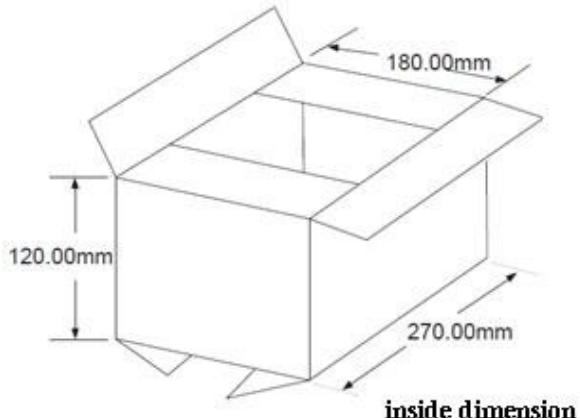


Figure 44: Tray drawing

**Table 38: Tray size**

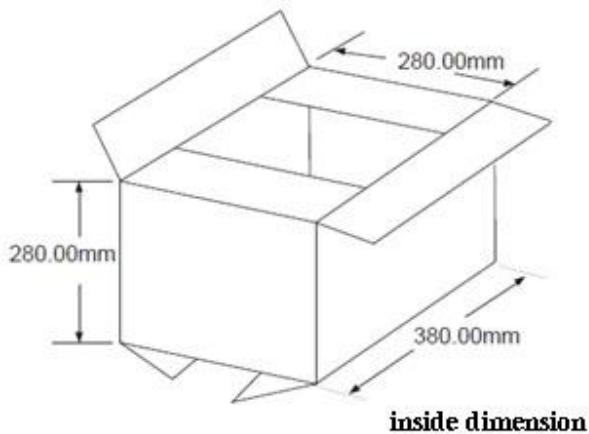
Length ( $\pm 3\text{mm}$ )	Width ( $\pm 3\text{mm}$ )	Number
242.0	161.0	15

Small carton drawing:


**Figure 45: Small carton drawing**
**Table 39: Small Carton size**

Length ( $\pm 10\text{mm}$ )	Width ( $\pm 10\text{mm}$ )	Height ( $\pm 10\text{mm}$ )	Number
270	180	120	15*20=300

Big carton drawing:


**Figure 46: Big carton drawing**
**Table 40: Big Carton size**

Length ( $\pm 10\text{mm}$ )	Width ( $\pm 10\text{mm}$ )	Height ( $\pm 10\text{mm}$ )	Number

380	280	280	300*4=1200
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## Appendix

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

**Table 41: Coding Schemes and Maximum Net Data Rates over Air Interface**

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

<b>Smart Machine Smart Decision</b>		
Category 4	1.8Mbps	16QAM,QPSK
Category 5	3.6Mbps	16QAM,QPSK
Category 6	3.6Mbps	16QAM,QPSK
Category 7	7.2Mbps	16QAM,QPSK
Category 8	7.2Mbps	16QAM,QPSK
Category 9	10.2Mbps	16QAM,QPSK
Category 10	14.4Mbps	16QAM,QPSK
Category 11	0.9Mbps	QPSK
Category 12	1.8Mbps	QPSK
Category 13	17.6Mbps	64QAM
Category 14	21.1Mbps	64QAM
Category 15	23.4Mbps	16QAM
Category 16	28Mbps	16QAM
Category 17	23.4Mbps	64QAM
Category 18	28Mbps	64QAM
Category 19	35.5Mbps	64QAM
Category 20	42Mbps	64QAM
Category 21	23.4Mbps	16QAM
Category 22	28Mbps	16QAM
Category 23	35.5Mbps	64QAM
Category 24	42.2Mbps	64QAM
HSUPA device category	Max data rate (peak)	Modulation type
Category 1	0.96Mbps	QPSK
Category 2	1.92Mbps	QPSK
Category 3	1.92Mbps	QPSK
Category 4	3.84Mbps	QPSK
Category 5	3.84Mbps	QPSK
Category 6	5.76Mbps	QPSK
LTE-FDD device category (Downlink)	Max data rate (peak)	Modulation type
Category 1	10Mbps	QPSK/16QAM/64QAM
Category 2	50Mbps	QPSK/16QAM/64QAM
Category 3	100Mbps	QPSK/16QAM/64QAM
Category 4	150Mbps	QPSK/16QAM/64QAM
LTE-FDD device category (Uplink)	Max data rate (peak)	Modulation type
Category 1	5Mbps	QPSK/16QAM
Category 2	25Mbps	QPSK/16QAM
Category 3	50Mbps	QPSK/16QAM

Category 4	50Mbps	QPSK/16QAM
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## II. Related Documents

**Table 42: Related Documents**

NO.	Title	Description
[1]	SIM7500_SIM7600 Series_AT Command Manual V1.xx	AT Command Manual
[2]	ITU-T Draft new recommendationV.25ter	Serial asynchronous automatic dialing and control
[3]	GSM 07.07	Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)
[4]	GSM 07.10	Support GSM 07.10 multiplexing protocol
[5]	GSM 07.05	Digital cellular telecommunications (Phase 2+); Use of Data Terminal Equipment – Data Circuit terminating Equipment (DTE – DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)
[6]	GSM 11.14	Digital cellular telecommunications system (Phase 2+); Specification of the SIM Application Toolkit for the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[7]	GSM 11.11	Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[8]	GSM 03.38	Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information
[9]	GSM 11.10	Digital cellular telecommunications system (Phase 2) ; Mobile Station (MS) conformance specification ; Part 1: Conformance specification
[10]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[11]	3GPP TS 34.124	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[12]	3GPP TS 34.121	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[13]	3GPP TS 34.123-1	Technical Specification Group Radio Access Network; Terminal conformance specification; Radio transmission and reception (FDD)
[14]	3GPP TS 34.123-3	User Equipment (UE) conformance specification; Part 3: Abstract Test Suites.
[15]	EN 301 908-02 V2.2.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS) and User Equipment (UE) for IMT-2000. Third Generation cellular networks; Part 2: Harmonized EN for IMT-2000, CDMA Direct Spread (UTRA FDD) (UE) covering essential requirements of article 3.2 of the R&TTE Directive
[16]	EN 301 489-24 V1.2.1	Electromagnetic compatibility and Radio Spectrum Matters

		(ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 24: Specific conditions for IMT-2000 CDMA Direct Spread (UTRA) for Mobile and portable (UE) radio and ancillary equipment
[17]	IEC/EN60950-1(2001)	Safety of information technology equipment (2000)
[18]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[19]	GCF-CC V3.23.1	Global Certification Forum - Certification Criteria
[20]	2002/95/EC	Directive of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)
[21]	Module secondary-SMT-UGD-V1.xx	Module secondary SMT Guidelines
[22]	SIM7X00 Series_UART_Application Note_V1.xx	This document describes how to use UART interface of SIMCom modules.
[23]	SIM7100_SIM7500_SIM7600 Series_USB AUDIO_Application Note_V1.xx	USB AUDIO Application Note
[24]	SIM7X00 Series_GPS_Application Note_V1.xx	GPS Application Note
[25]	Antenna design guidelines for diversity receiver system	Antenna design guidelines for diversity receiver system
[26]	SIM7100_SIM7500_SIM7600 _Sleep Mode_Application Note_V1.xx	Sleep Mode Application Note
[27]	7600CE-LAN-Reference Design V1.0	HSIC Application Note
[28]	SIM7600_Series_SGMII-Reference_Design_V1.00	SGMII Reference Design

### III. Terms and Abbreviations

**Table 43: Terms and Abbreviations**

Abbreviation	Description
ADC	Analog-to-Digital Converter
ARP	Antenna Reference Point
BER	Bit Error Rate
BTS	Base Transceiver Station
CS	Coding Scheme
CSD	Circuit Switched Data
CTS	Clear to Send
DAC	Digital-to-Analog Converter
DRX	Discontinuous Reception
DSP	Digital Signal Processor
DTE	Data Terminal Equipment (typically computer, terminal, printer)
DTR	Data Terminal Ready
DTX	Discontinuous Transmission
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
EVDO	Evolution Data Only
FCC	Federal Communications Commission (U.S.)
FD	SIM fix dialing phonebook
FDMA	Frequency Division Multiple Access
FR	Full Rate
GMSK	Gaussian Minimum Shift Keying
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
SPI	serial peripheral interface
SMPS	Switched-mode power supply
TDMA	Time Division Multiple Access
TE	Terminal Equipment, also referred to as DTE
TX	Transmit Direction
UART	Universal Asynchronous Receiver & Transmitter
VSWR	Voltage Standing Wave Ratio
SM	SIM phonebook
NC	Not connect
EDGE	Enhanced data rates for GSM evolution
HSDPA	High Speed Downlink Packet Access
HSUPA	High Speed Uplink Packet Access
ZIF	Zero intermediate frequency
WCDMA	Wideband Code Division Multiple Access
VCTCXO	Voltage control temperature-compensated crystal oscillator
USIM	Universal subscriber identity module
UMTS	Universal mobile telecommunications system
UART	Universal asynchronous receiver transmitter

## IV. Safety Caution

**Table 44: 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.

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