SIM7500V
Hardware Design

LTE Module

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Date	Version	Description of change	Author
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1 Introduction

This document describes the electronic specifications, RF specifications, interfaces, mechanical characteristics and testing results of the SIMCom SIM7500V . With the help of this document and other software application notes/user guides, users can understand and use modules to design and develop applications quickly. The SIM7500V module has passed FCC and IC certification, FCC ID: UDV-201606; IC ID: 23761-8PYA003.

1.1 Product Outline

The SIM7500V support many air-interface standards, refer to the following table.

Table 1: Module frequency bands

Standard	Frequency	SIM7500V
	FDD B4	√
	FDD B13	√
Category		CAT1
GNSS		√

With a small physical dimension of 24*27*2.75 mm and with the functions integrated, the Module can meet almost any space requirement in users' applications, such as smart phones, PDA's, industrial handhelds, machine-to-machine, vehicle applications, etc.

1.2 Hardware Interface Overview

The interfaces are described in detail in the next chapters include:
- Power Supply
- USB Interface
- UART Interface
- SIM Interface
- GPIO
- ADC

- Power Output
- Current Sink Source
- PCM Interface
- I2C Interface

1.3 Hardware Block Diagram

The block diagram of the Module is shown in the figure below.
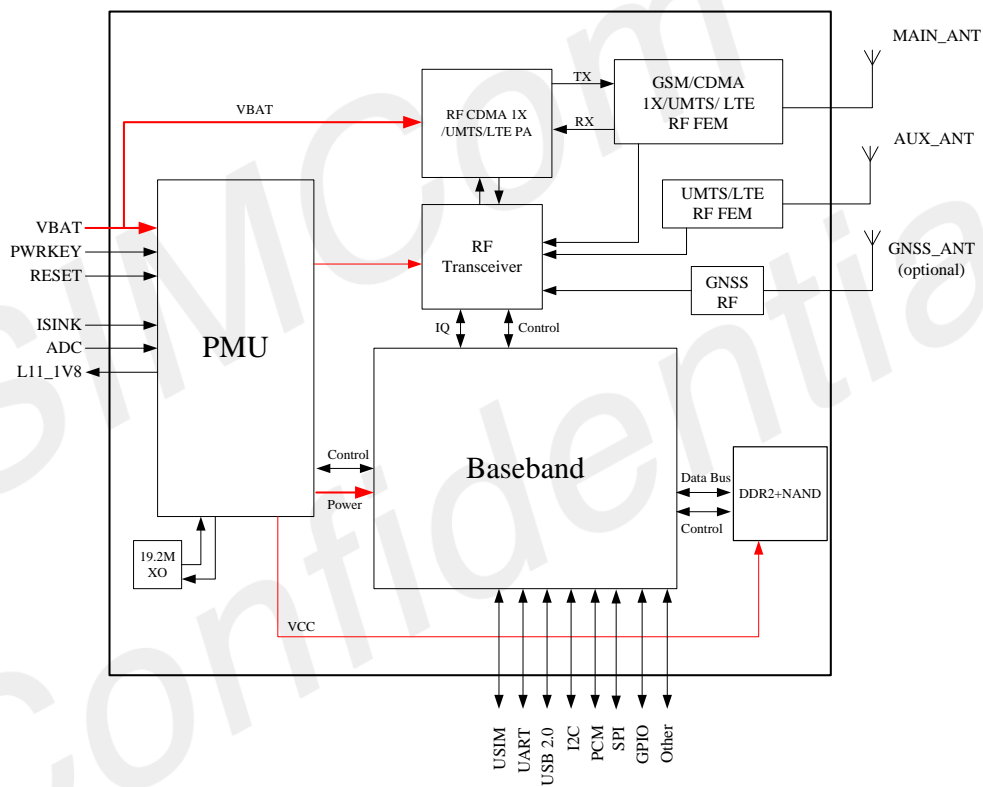
Figure 1: SIM7500V Block Diagram

1.4 Functional Overview

Table 2: General features

Feature	Implementation
Power supply	Single supply voltage 3.4～4.2V
Power saving	Current in sleep mode : <5mA
Radio frequency bands	Please refer to the table 1
Transmitting power	LTE: Class 3 (23dBm)
Data Transmission Throughput	LTE CAT 1：Support MIMO in DL Direction FDD-LTE CAT 1：10 Mbps (DL), 5 Mbps (UL)
Antenna	LTE main antenna LTE auxiliary antenna GNSS antenna
GNSS	GNSS engine (GPS,GLONASS , BD and QZSS GALILEO) Protocol: NMEA
SMS	MT, MO, CB, Text and PDU mode SMS storage: SIM card or ME(default) Transmission of SMS alternatively over CS or PS.
SIM interface	Support identity card: 1.8V/ 3V
SIM 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 3.6Mbps(default: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.
USB	USB 2.0 specification-compliant as a peripheral
Firmware upgrade	Firmware upgrade over USB interface USB 2.0 specification-compliant as a peripheral
Physical characteristics	Weight:4.0 g Size:24*27*2.75mm
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 WCDMA/HSPA+/LTE traffic in -40℃ ～ +85℃. The performance will be reduced slightly from the 3GPP specifications if the temperature is outside the normal operating temperature range and still within the extreme operating temperature range.

2 Package Information

2.1 Pin Assignment Overview
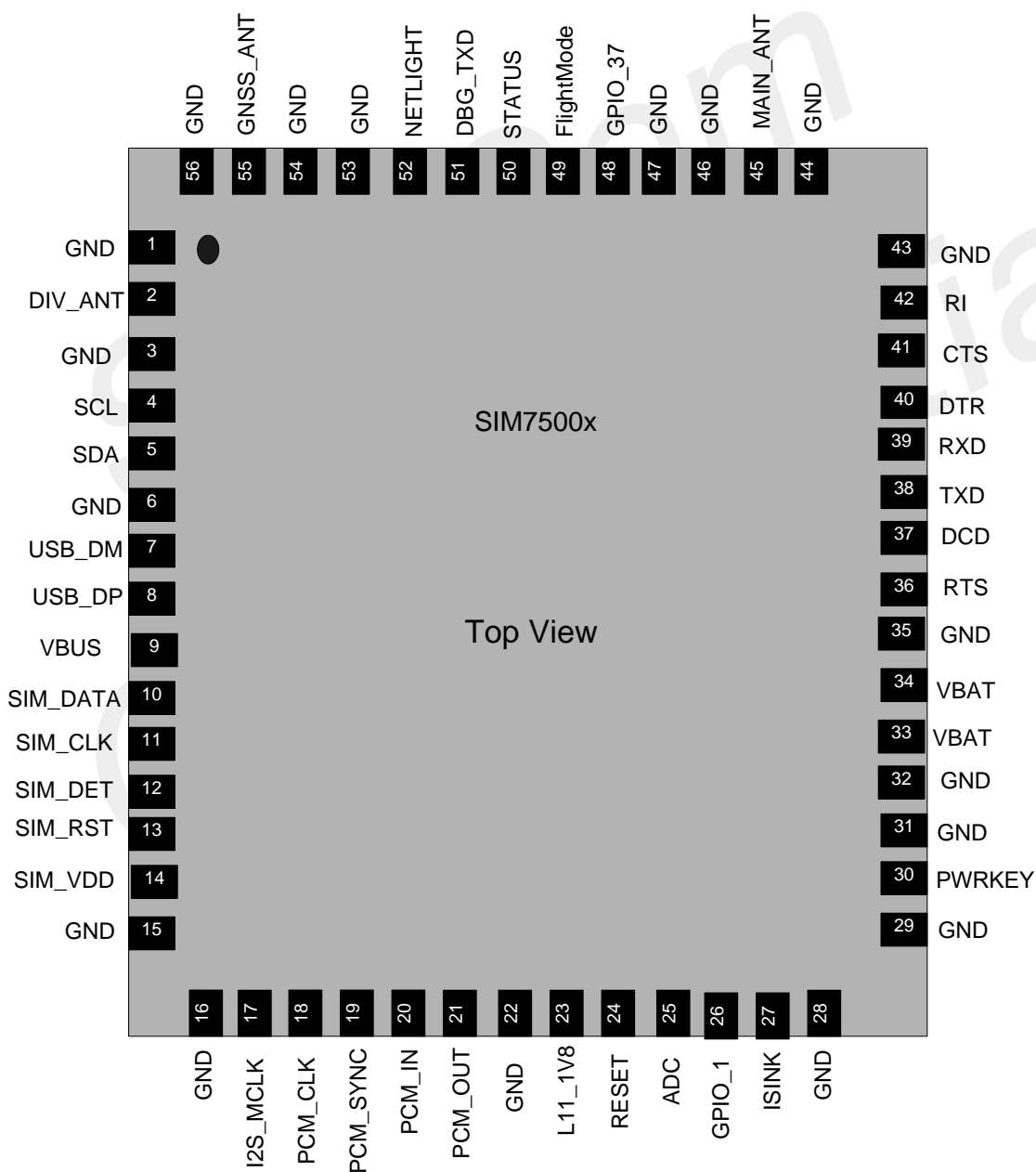
All functions of the SIM7500V will be provided through 56 pads that will be connected to the customers' platform. The following Figure is a high-level view of the pin assignment of the SIM7500V .

Figure 2: Pin assignment overview

Table 3: Pin Definitions

Pin No.	Pin name	Pin No.	Pin name
1	GND	2	DIV_ANT
3	GND	4	SCL
5	SDA	6	GND
7	USB_DM	8	USB_DP
9	VBUS	10	SIM_DATA
11	SIM_CLK	12	SIM_DET
13	SIM_RST	14	SIM_VDD
15	GND	16	GND
17	I2S_MCLK	18	PCM_CLK
19	PCM_SYNC	20	PCM_IN
21	PCM_OUT	22	GND
23	L11_1V8	24	RESET
25	ADC	26	GPIO_1
27	ISINK	28	GND
29	GND	30	PWRKEY
31	GND	32	GND
33	VBAT	34	VBAT
35	GND	36	RTS
37	DCD	38	TXD
39	RXD	40	DTR
41	CTS	42	RI
43	GND	44	GND
45	MAIN_ANT	46	GND
47	GND	48*	GPIO_37
49	FlightMode	50	STATUS
51	DBG_TXD	52	NETLIGHT
53	GND	54	GND
55	GNSS_ANT	56	GND

NOTE

Before the normal power up, pin48 cannot be pulled up.

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
Power supply				
VBAT	33,34	PI	Power supply, voltage range: 3.4～4.2V.	
L11_1V8	23	PO	1.8V output with Max. 50ma current output for external circuit, such as level shift circuit.	If unused, keep it open.
GND	1, 3, 6, 15,16,22,28, 29,31,32,35, 43,44,46,47, 53,54,56		Ground	
System Control				
PWRKEY	30	DI,PU	System power on/off control input, active low.	Default 0.8V
RESET	24	DI, PU	System reset control input, active low.	RESET has been pulled up to 1.8V via a resistor internally.
SIM interface				
SIM_DATA	10	I/O,PU	SIM Card data I/O, which has been pulled up via a 10KR resistor to SIM_VDD internally.	All lines of SIM interface should be protected against ESD.
SIM_RST	13	DO	SIM Reset	
SIM_CLK	11	DO	SIM clock	

SIM_VDD	14	PO	Power output for SIM card, its output Voltage depends on SIM card type automatically. Its output current is up to 50ma.	
USB				
VBUS	9	DI,PD	Valid USB detection input with 3.0～5.25V detection voltage	
USB_DM	7	I/O	Negative line of the differential, bi-directional USB signal.	
USB_DP	8	I/O	Positive line of the differential, bi-directional USB signal.	
UART interface				
RTS	36	DOL	Request to send	If unused, keep them open.
CTS	41	DI,PU	Clear to Send	
RXD	39	DI,PU	Receive Data	
RI	42	DOH	Ring Indicator	
DCD	37	DOH	Carrier detects	
TXD	38	DOH	Transmit Data	
DTR	40	DI,PU	DTE get ready	
I2C interface				
SCL	4	DO	I2C clock output	If unused, keep them open.
SDA	5	I/O	I2C data input/output	
PCM interface				
PCM_OUT	21	DO	PCM data output.	If unused, please keep them open.
PCM_IN	20	DI	PCM data input.	
PCM_SYNC	19	DO	PCM data frame sync signal.	
PCM_CLK	18	DO	PCM data bit clock.	
I2S_MCLK	17	DO	Audio Master clock	
GPIO				
NETLIGHT	52	DO	LED control output as network status indication.	If unused, please keep them open. FlightMode Can't be used when Module is in sleep mode.
STATUS	50	DO	Operating status output. High level: Power on and firmware ready Low level: Power off	
GPIO_1	26	IO	GPIO	
Flight Mode	49	DI,PU	Flight Mode control input. High level(or open): Normal Mode Low level: Flight Mode	
SIM_DET	12	IO	Default: GPIO Optional: SIM card detecting input. H: SIM is removed L: SIM is inserted	
GPIO_37	48	IO	Boot configuration input. Module will be forced into USB down load mode by connect 23 pin to VDD_1V8 during power up.	
RF interface				
MAIN _ANT	45	AIO	MAIN antenna soldering pad	

DIV_ANT	2	AI	Auxiliary antenna soldering pad	
GNSS_ANT	55	AI	GNSS antenna soldering pad	
Other interface				
ISINK	27	AI	Ground-referenced current sink.	If unused, please keep them open.
DGB_TXD	51	DO	Use for debug	
ADC	25	AI	Analog-digital converter input	

2.3 Mechanical Information

The following figure shows the package outline drawing of Module.
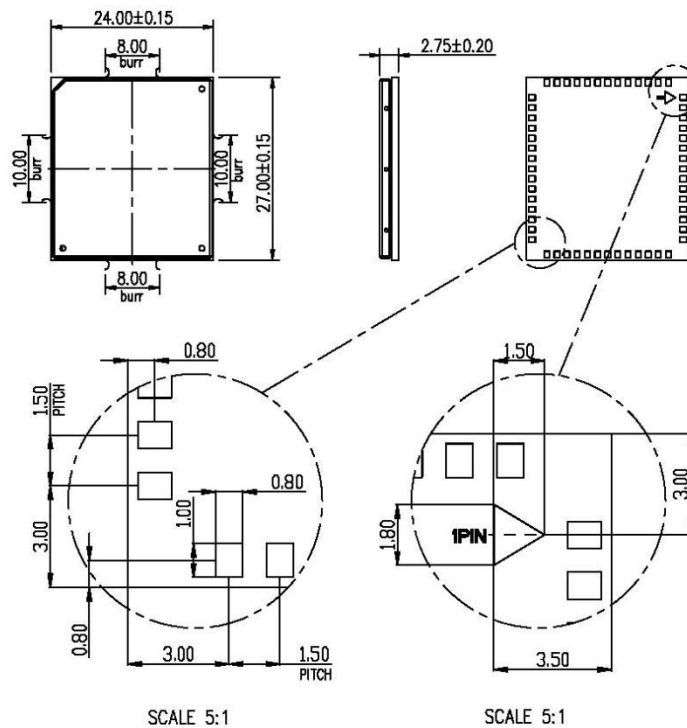
Figure 3: Dimensions (Unit: mm)

NOTE

The burr areas aren't included in the tolerance, and customers ought to avoid the burr areas when making fixtures.

2.4 Footprint Recommendation
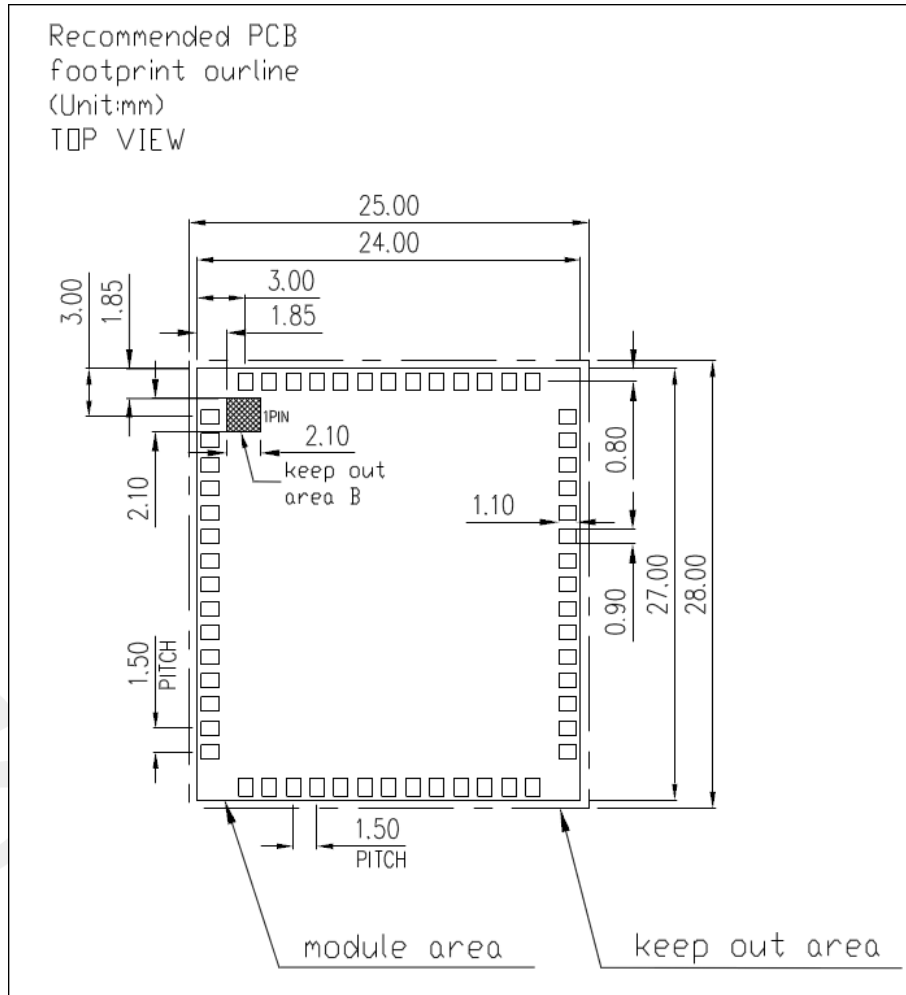
Figure 4: Footprint recommendation (Unit: mm)

3 Interface Application

3.1 Power Supply

On VBAT pads, a ripple current up to 2A typically, may cause voltage drop. Therefore, 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 of more than 300mV.

Table 6: VBAT Pins electronic characteristic

Symbol	Parameter	Min	Type	Max	Unit
VBAT	Module power voltage	3.4	3.8	4.2	V
$I_{VBAT(peak)}$	Module power peak current in normal mode.	1.0	-	2	A
$I_{VBAT(average)}$	Module power average current in normal mode	Please refer to the table 35			
$I_{VBAT(sleep)}$	Power supply current in sleep mode				
$I_{VBAT(power-off)}$	Module power current in power off mode.	-	-	20	uA

3.1.1 Power supply Design Guide

Make sure that the voltage on the VBAT pins will never drop below 3.4V.

> **NOTE**
>
> If the power supply for BAT pins can support up to 2A, using a total of more than 220uF capacitors is recommended, or else users must use a total of 1000uF capacitors, in order to avoid the voltage drop of 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, user should keep VBAT trace on the circuit board wider than 2 mm to minimize PCB trace impedance. The following figure shows the

recommended circuit.
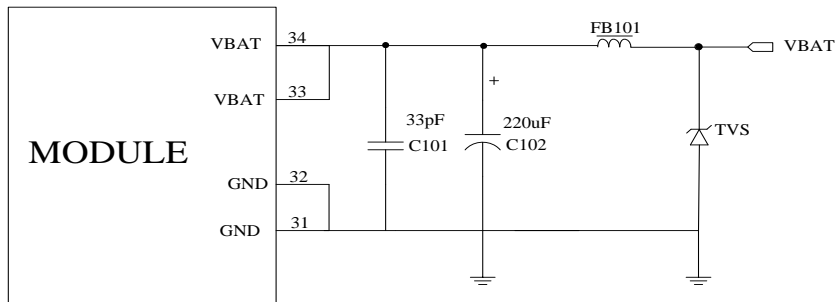
Figure 5: Power supply application circuit

In addition, in order to guard for ESD or surge protection, it is suggested to use a TVS to protect the module.

Table 7: Recommended TVS list

No	Manufacturer	Part Number	Reverse Stand-Off Voltage	Package
1	Js-ele	ESDBW5V0A1	5V	DFN1006-2L
2	Prisem	PESDHC2FD4V5BH	4.5V	DFN1006-2L
3	Way-on	WS05DPF-B	5V	DFN1006-2L
4	Will semi	ESD5611N	5V	DFN1006-2L
5	Will semi	ESD56151W05	5V	SOD-323
6	Way-on	WS4.5DPV	4.5V	DFN1610-2L

3.1.2 Recommended Power Supply Circuit

It is recommended that a switching mode power supply or 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.
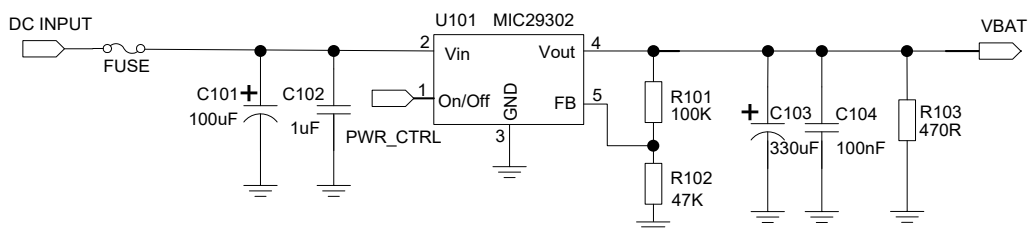
Figure 6: Linear regulator reference circuit

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.
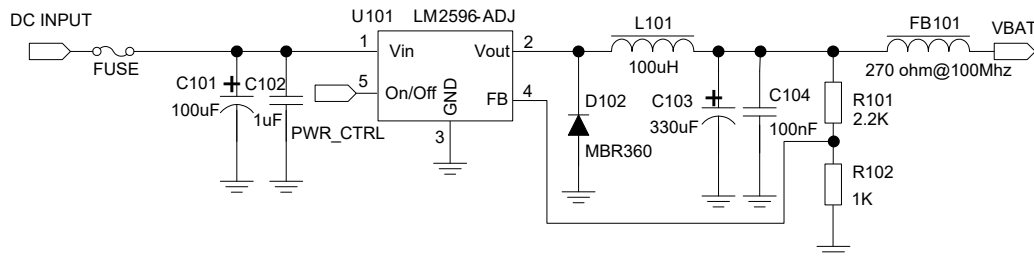
Figure 7: Switching mode power supply reference circuit

> **NOTE**
>
> The Switching Mode power supply solution for VBAT must be chosen carefully against Electro Magnetic Interference and ripple current from depraving 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 a100nF 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.
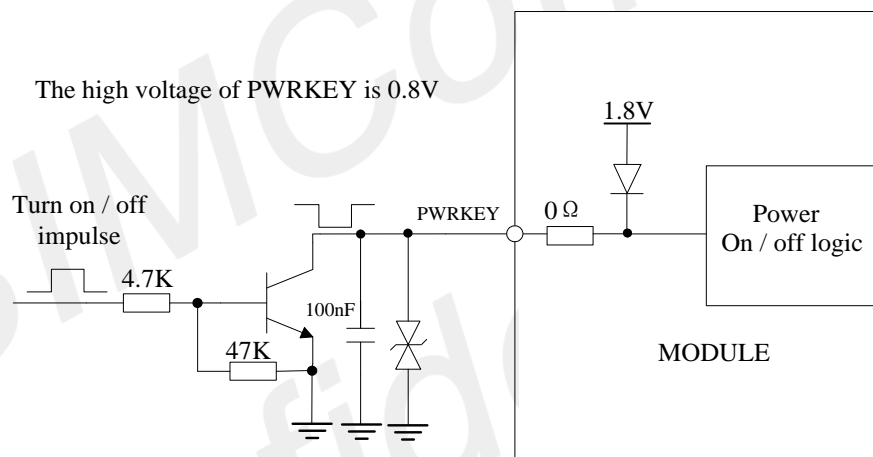
Figure 8: Reference Power on/off Circuit

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.
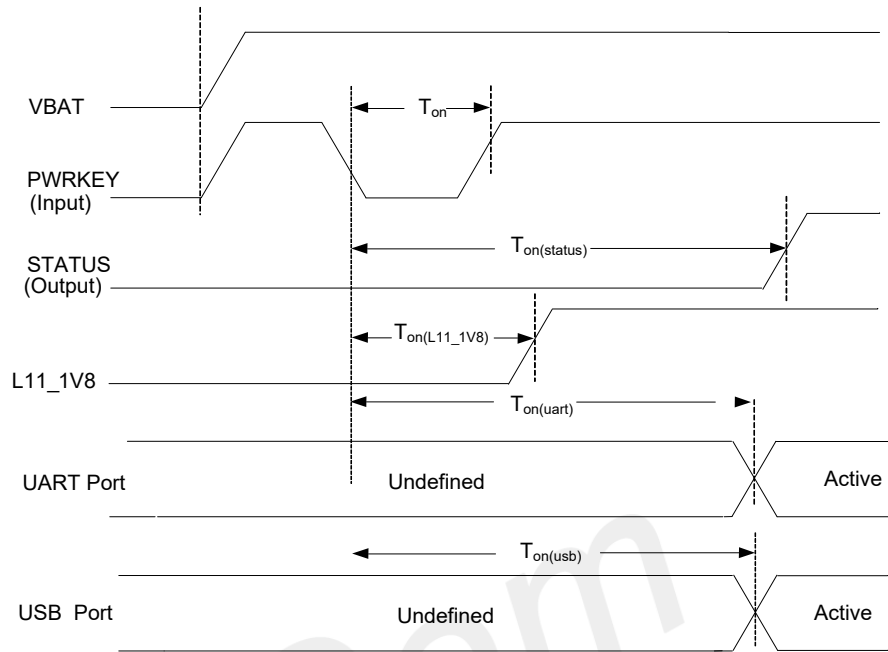
Figure 9: Power on timing sequence

Table 8: Power on timing and Electronic Characteristic

Symbol	Parameter	Min	Type	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)	12	13	-	s
$T_{on(L11\_1V8)}$	The time from power-on issue to L11_1V8 ready	100	-	-	ms
$T_{on(uart)}$	The time from power-on issue to UART port ready	11	12		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℃, some warning will be reported via AT port. If the temperature is outside the range of -40~+85℃, Module will be powered off automatically.
> For details about "AT+CPOF" and "AT+CPMVT", please refer to Document [1].

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

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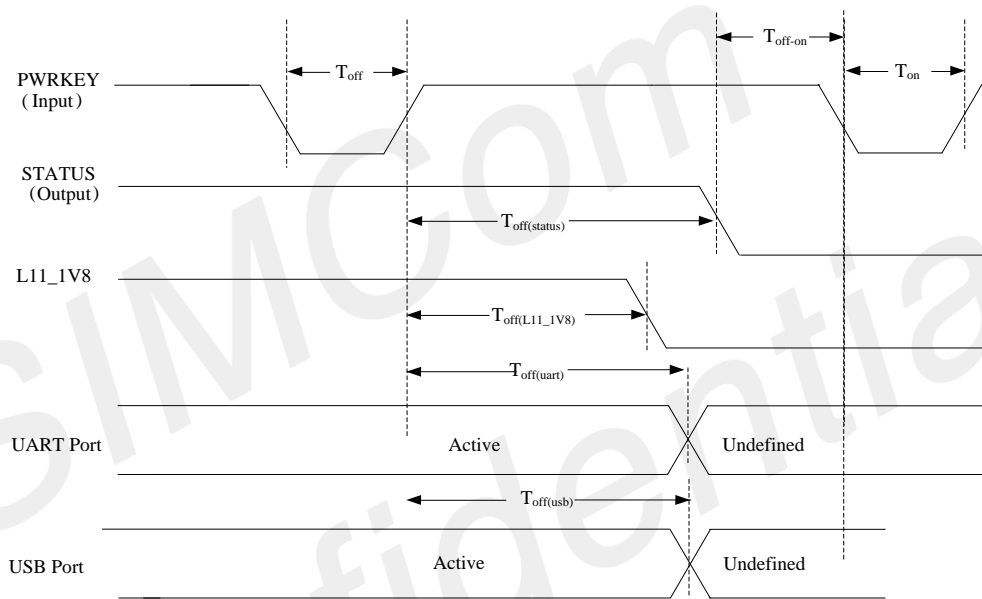
Figure 10: Power off timing sequence

Table 9: Power off timing and Electronic Characteristic

Symbol	Parameter	Time value			Unit
		Min	Type	Max	
Toff	The active low level time pulse on PWRKEY pin to power off module	2.5	--	5.0	s
Toff(status)	The time from power-off issue to STATUS pin output low level(indicating power off)*	25	26	-	s
$T_{off(L11\_1V8)}$	The time from power-off issue to L11_1V8	20	-	-	s
Toff(uart)	The time from power-off issue to UART port off	14	15	-	s
Toff(usb)	The time from power-off issue to USB port off	27	28	-	s
Toff-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.
>
> It is suggested that the host can cut off the power off the module, when the module could not switch off by PWRKEY of RESET interface, customer could cut off the power to restart the module.
>
> If the PWERKY and RESET key works normally, it is not suggested to switch off module by remove the power supply for that might damage the flash.
>
> The power off time may vary for the local net status.

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 to 1.8V internally, so it does not need to be pulled up externally. It is strongly recommended to put a100nF capacitor and an ESD protection diode close to the RESET pin. Please refer to the following figure for the recommended reference circuit.
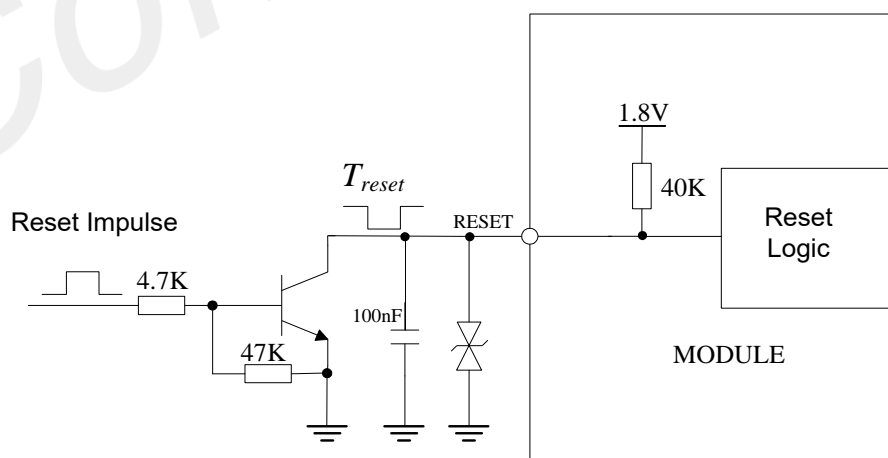
Figure 11: Reference reset circuit

Table 10: RESET pin electronic characteristic

Symbol	Parameter	Min	Type	Max	Unit
T_{reset}	The active low level time impulse on RESET pin to reset module	100			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.
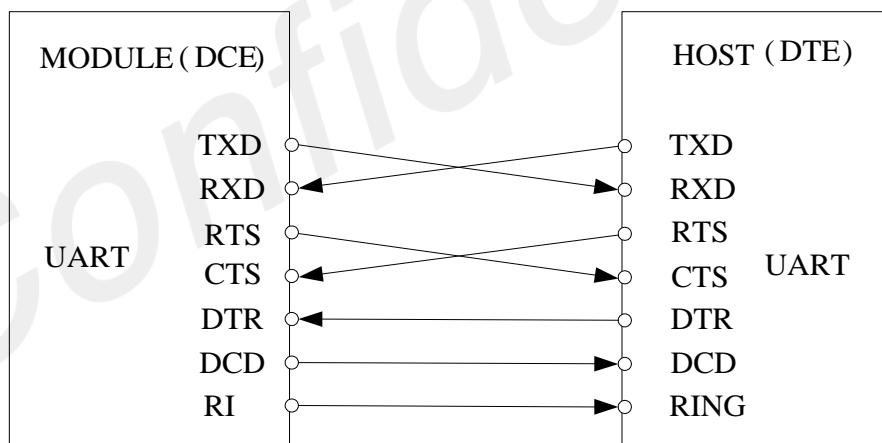
Figure 12: UART Full modem
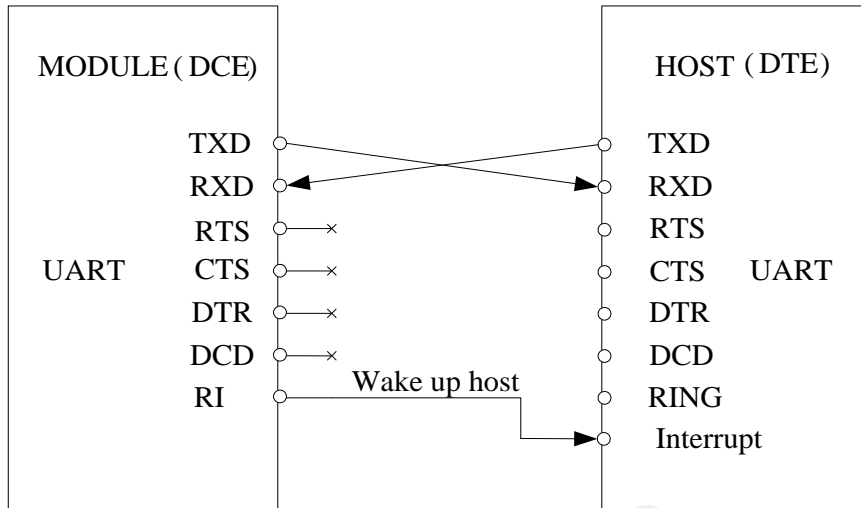
Figure 13: UART Null modem

The Module UART is 1.8V voltage interface. If user's UART application circuit is a 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.
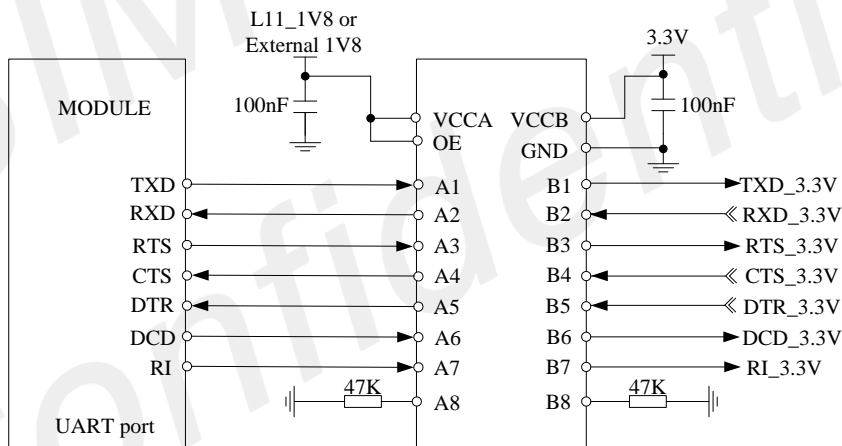
Figure 14: Reference circuit of level shift

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.

> **NOTE**
>
> Module supports the following baud rates: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600, 3200000, 3686400. 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 stay at high level until certain conditions such as receiving SMS, or a URC report come in. It will then change to low level. It will stay low until the host controller clears the interrupted event with "AT+CRIRS" AT command.
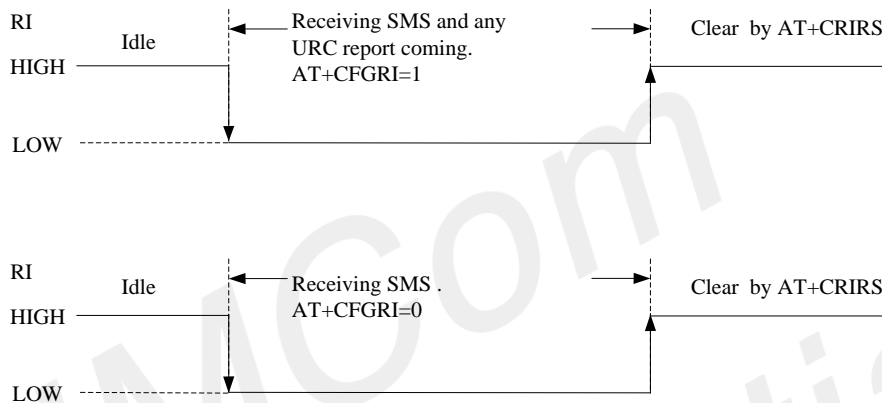
Figure 15: RI behaviour（SMS and URC report）

Normally RI will be kept high 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.
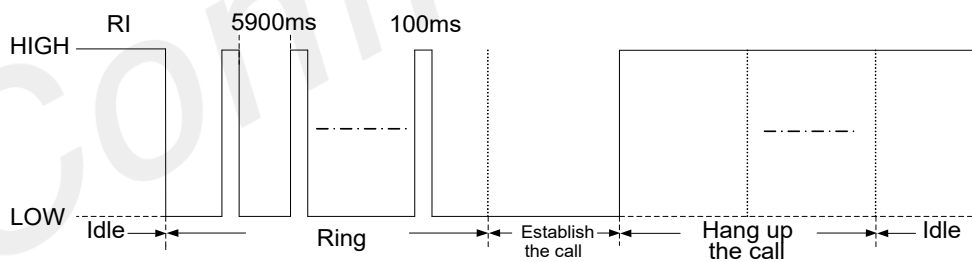
Figure 16: RI behaviour（voice call）

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.
The USB interface is a frequency used debug port; it is suggested to reserved test point.
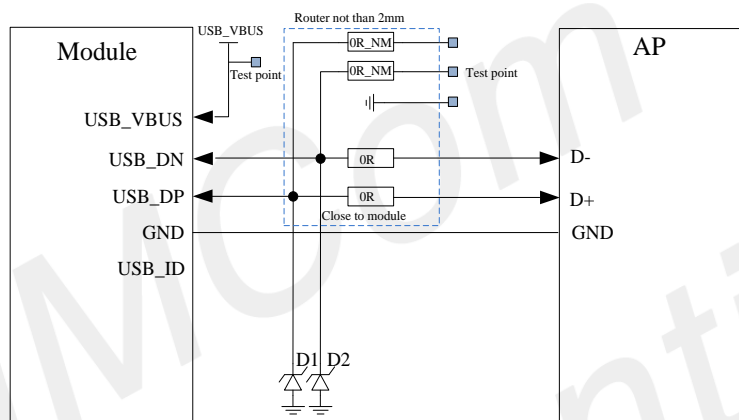
Figure 17: USB reference circuit

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).

NOTE

1. The USB_DM and USB_DP nets must be traced by 90Ohm+/-10% differential impedance.
2. Must reserve USB interfaces or test points to for software debug.
3. Must reserve pin51(DBG_TXD) and PIN23(L11_1V8) interface or test point to for software debug.

3.5 SIM Interface

Module supports both 1.8V and 3.0V SIM Cards.

Table 11: SIM Electronic characteristic in 1.8V mode (SIM_VDD =1.8V)

Symbol	Parameter	Min	Type	Max	Unit
SIM_VDD	LDO power output voltage	1.75	1.8	1.95	V
VIH	High-level input voltage	0.65*SIM_VDD	-	SIM_VDD +0.3	V
VIL	Low-level input voltage	-0.3	0	0.35*SIM_VDD	V
VOH	High-level output voltage	SIM_VDD -0.45	-	SIM_VDD	V
VOL	Low-level output voltage	0	0	0.45	V

Table 12: SIM Electronic characteristic 3.0V mode (SIM_VDD =2.95V)

Symbol	Parameter	Min	Type	Max	Unit
SIM_VDD	LDO power output voltage	2.75	2.95	3.05	V
VIH	High-level input voltage	0.65*SIM_VDD	-	SIM_VDD +0.3	V
VIL	Low-level input voltage	-0.3	0	0.25*SIM_VDD	V
VOH	High-level output voltage	SIM_VDD -0.45	-	SIM_VDD	V
VOL	Low-level output voltage	0	0	0.45	V

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 8-pin SIM card holder reference circuit.
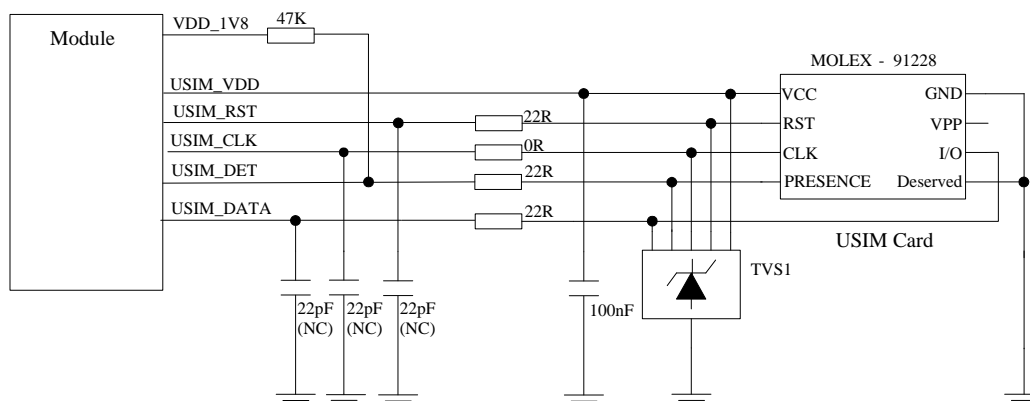
Figure 18: Reference circuit of the 8-pin SIM card holder

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

If the SIM card detection function is not used, user can keep the SIM_DET pin open. The reference circuit of 6-pin SIM card holder is illustrated in the following figure.
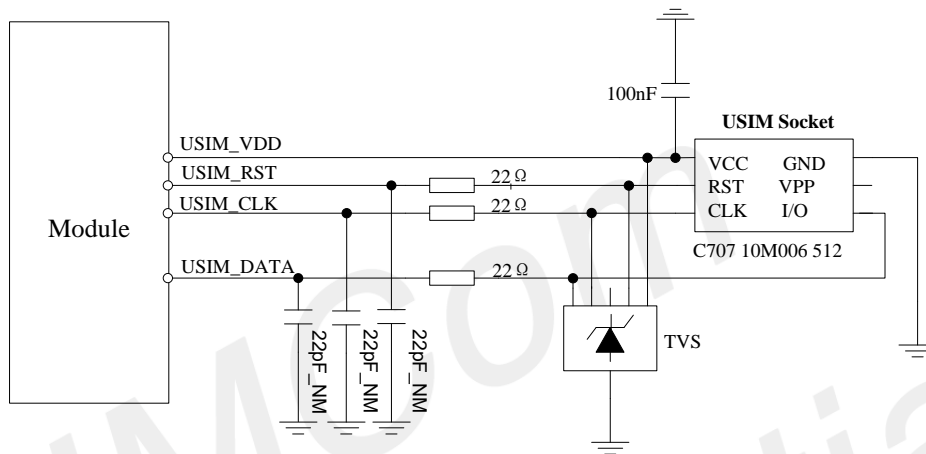
Figure 19: SIM interface reference circuit

NOTE

SIM_DATA has been pulled up with a 10KΩ resistor to SIM_VDD in module. A 100nF capacitor on SIM_VDD is used to reduce interference. For more details of AT commands about SIM, please refer to document [1].

3.5.2 SIM Card Design Guide

SIM card signal could be interferenced by some high frequency signal, it is strongly recommended to follow these guidelines while designing:

- SIM card holder should be far away from main antenna
- SIM traces should keep away from RF lines, VBAT and high-speed signal lines
- The traces should be as short as possible
- Keep SIM card holder's GND connect to main ground directly
- Shielding the SIM card signal by ground well
- Recommended to place a 100nF capacitor on SIM_VDD line and keep close to the SIM card holder
- Add some TVS which parasitic capacitance should not exceed 50pF
- Add 22Ω resistor to (SIM_RST/SIM_CLK/SIM_DATA) signal could enhance ESD protection

- Mount 22pF capacitor to (SIM_RST/SIM_CLK/SIM_DATA) signal if having RF signal interference

3.5.3 Recommended SIM Card Holder

It is recommended to use the 6-pin SIM socket such as C707 10M006 512 produced by Amphenol. User can visit http://www.amphenol.com for more information about the holder.
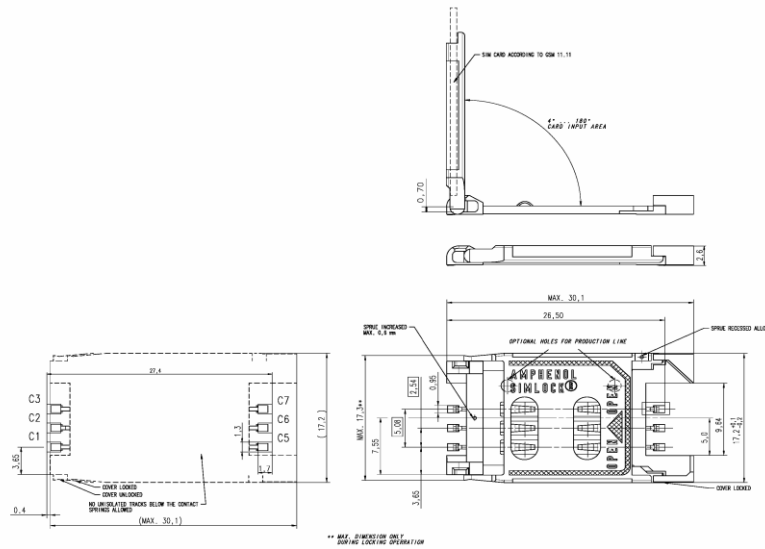
Figure 20: Amphenol SIM card socket

Table 13: Amphenol SIM Socket Pin Description

Pin	Signal	Description
C1	SIM_VDD	SIM Card Power supply.
C2	SIM_RST	SIM Card Reset.
C3	SIM_CLK	SIM Card Clock.
C5	GND	Connect to GND.
C6	VPP	
C7	SIM_DATA	SIM Card data I/O.

3.6 PCM Interface

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

Table 14: 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].

3.6.1 PCM Timing

Module supports 2.048 MHz PCM data and sync timing for 16 bits linear format codec.
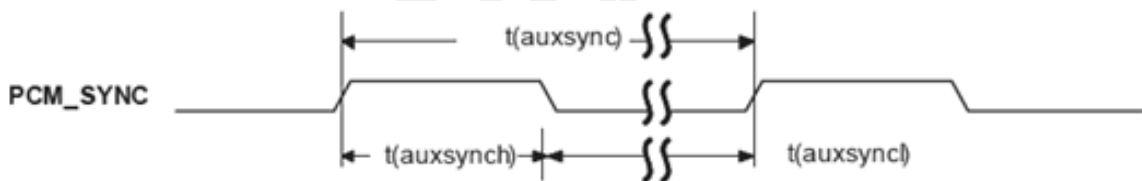
Figure 21: PCM_SYNC timing
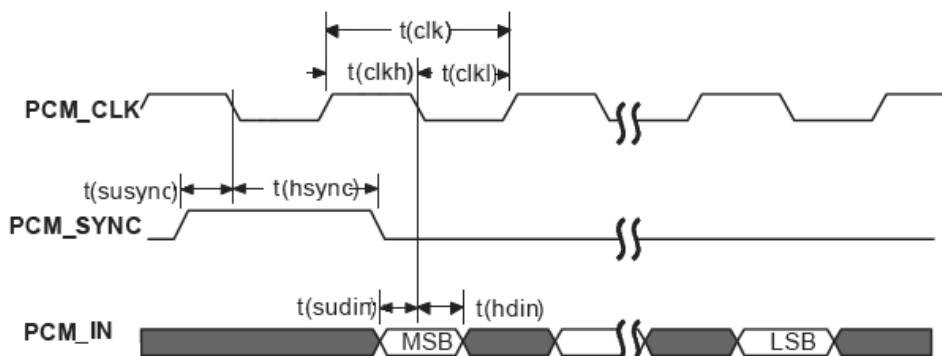
Figure 22: EXT CODEC to MODULE timing
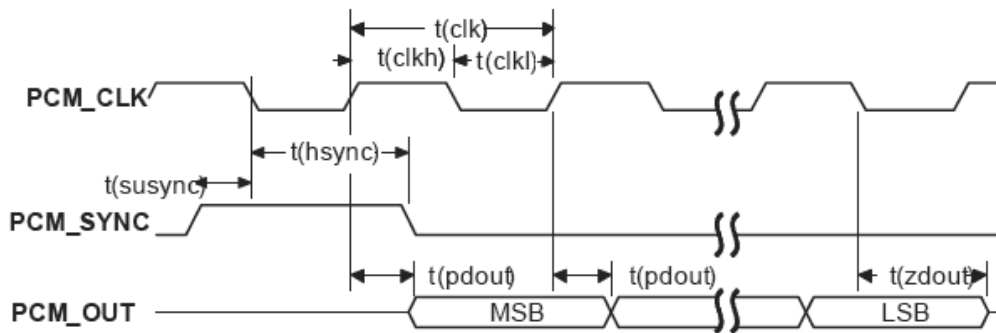
Figure 23: MODULE to EXT CODEC timing

Table 15: PCM Timing parameters

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

3.6.2 PCM Application Guide

The following figure shows the external codec reference design.
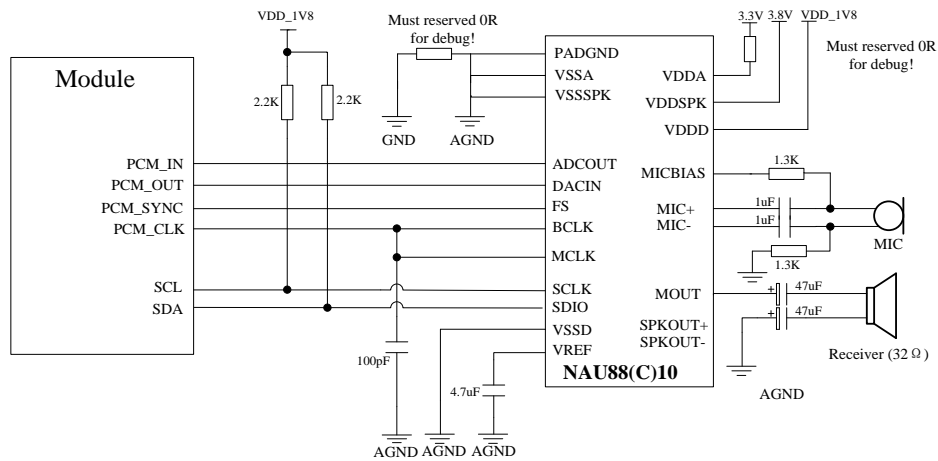
Figure 24: Audio Codec Reference Circuit

NOTE

Module can transmit PCM data by the USB port besides the PCM interface. For more details please refer to documents [1] and [23].

3.7 I2C Interface

Module provides a I2C interface compatible with I2C specification, version 2.1, with clock rate up to 400 kbps. Its operation voltage is 1.8V.

3.7.1 I2C Design Guide

The following figure shows the I2C bus reference design.
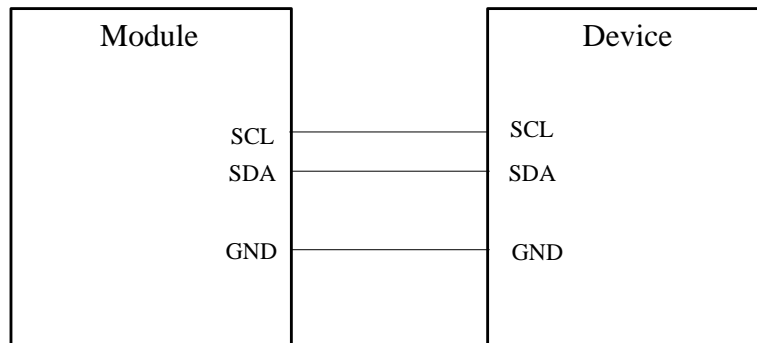
Figure 25: I2C reference circuit

> **NOTE**
>
> SDA and SCLhave pull-up resistors in module. So, 2 external pull up resistors are not 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].

3.8 Network Status

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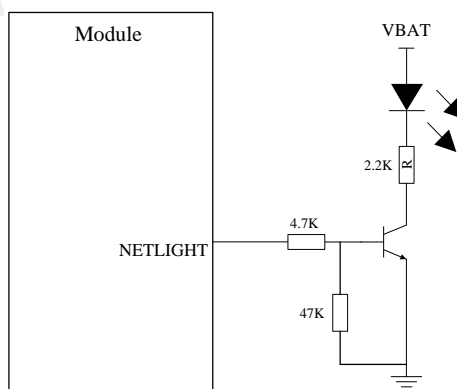
Figure 26: NETLIGHT reference circuit

> **NOTE**

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

Table 16: 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".

3.9 Operating Status Indication

The pin50 is for operating status indication of the module. The pin output is high when module is powered on, and output is low when module is powered off.

Table 17: Pin definition of the STATUS

Pin name	Pin number	Description
STATUS	50	Operating status indication

NOTE

For timing about STATUS, please reference to the chapter "3.2 power on/down scenarios"

3.10 Flight Mode Control

The FLIGHTMODE pin can be used to control SIM7500Vx to enter or exit the Flight mode. In Flight mode, the RF circuit is closed to prevent interference with other equipment's and minimize current consumption.

Bidirectional ESD protection component is suggested to add on FLIGHTMODE pin, its reference circuit is shown in the following figure.
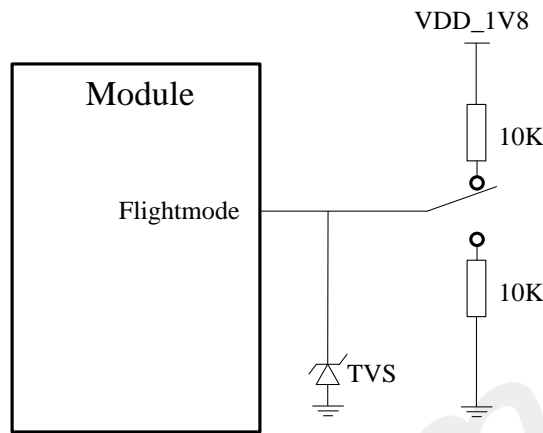
Figure 27: Flight Mode Switch Reference Circuit

Table 18: 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

NOTE

FlightMode Can't be used when Module is in sleep mode.

3.11 Pin Multiplex Function

Some pins of Module could be used for alternate function besides default function.

Table 19: Pin multiplex function list

Pin Number	Pin Name	Default Function	Alternate Function
4	SCL	SCL	GPIO11
5	SDA	SDA	GPIO10
12	SIM_DET	GPIO34	SIM_DET
18	PCM_CLK	PCM_CLK	GPIO23,SPI_CLK

			I2C_SCL
19	PCM_SYNC	PCM_SYNC	GPIO20,SPI_MOSI
20	PCM_IN	PCM_IN,	GPIO21,SPI_MISO
21	PCM_OUT	PCM_OUT	GPIO22,SPI_CS_N I2C_SDA

NOTE

For more details of AT commands about GPIO multiplex function, please refer to document [1].

3.12 Other interface

3.12.1 Sink Current Source

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

Table 20: Sink current electronic characteristic

Symbol	Description	Min.	Typ.	Max.	Unit
V_{ISINK}	Voltage tolerant	0.5	-	VBAT	V
I_{ISINK}	Current tolerant	0	-	40	mA

ISINK is a ground-referenced current sink. The following figure shows its reference circuit.
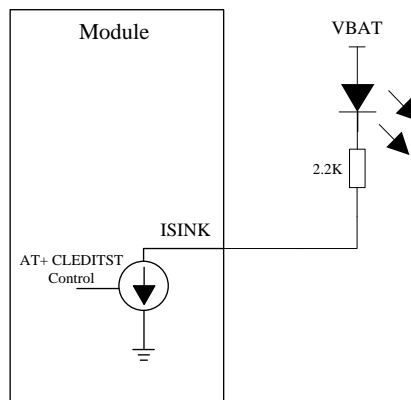
Figure 28: ISINK reference circuit

NOTE

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

3.12.2 ADC

Module has 1 dedicated ADC pins named ADC. They are available for digitizing analog signals such as battery voltage and so on. These electronic specifications are shown in the following table.

Table 21: ADC Electronic Characteristics

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

NOTE

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

4 RF Specifications

4.1 LTE RF Specifications

Table 22: Conducted transmission power

Frequency	Power	Min.
LTE-FDD B4	23dBm +/-2.7dB	<-40dBm
LTE-FDD B13	23dBm +/-2.7dB	<-40dBm

Table 23: Operating frequencies

Frequency	Receiving	Transmission
LTE-FDD B4	2110~2155 MHz	1710 ~1755 MHz
LTE-FDD B13	746~756MHz	777~787MHz
GPS	1574.4 ～1576.44 MHz	-
GLONASS	1598 ～1606 MHz	-
BD	1559 ～1563 MHz	

Table 24: Conducted receive sensitivity

Frequency	Receive sensitivity(Typical)	Receive sensitivity(MAX)
LTE FDD/TDD	See table 21.	3GPP

Table 25: Reference sensitivity (QPSK)

E-UTRA band	3GPP standard						Test value@ 10 MHz
	1.4 MHz	3MHz	5MHz	10MHz	15 MHz	20 MHz	
FDD B4	-104.7	-101.7	-100	-97	-95.2	-94	-102
LTE-FDD B13			-97	-94			-99

4.2 LTE Antenna Design Guide

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

Table 26: Recommended Passive Antenna Characteristics

Passive	Recommended standard
Direction	Omnidirectional
Gain	External Antenna LTE FDD Band 4: 5.0 dBi LTE FDD Band 13: 4.0 dBi
Input impedance	50 ohm
Efficiency	>50%
VSWR	<2

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.
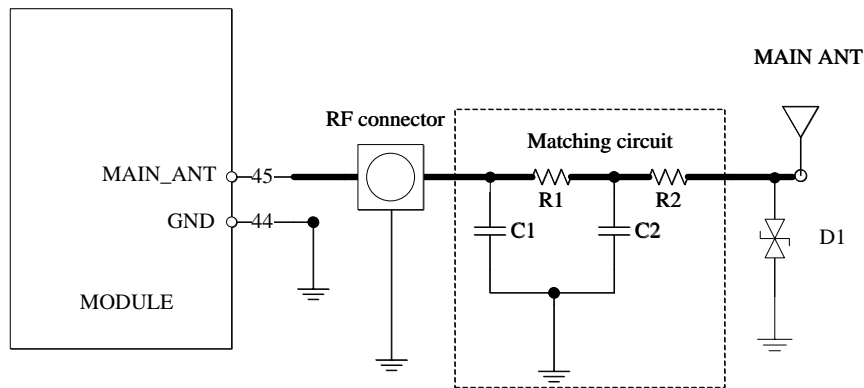
Figure 29: Antenna matching circuit (MAIN_ANT)

In above figure, the components R1,C1,C2 and R2 are used for antenna matching, the value 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 Module and antenna must be controlled in 50Ω.
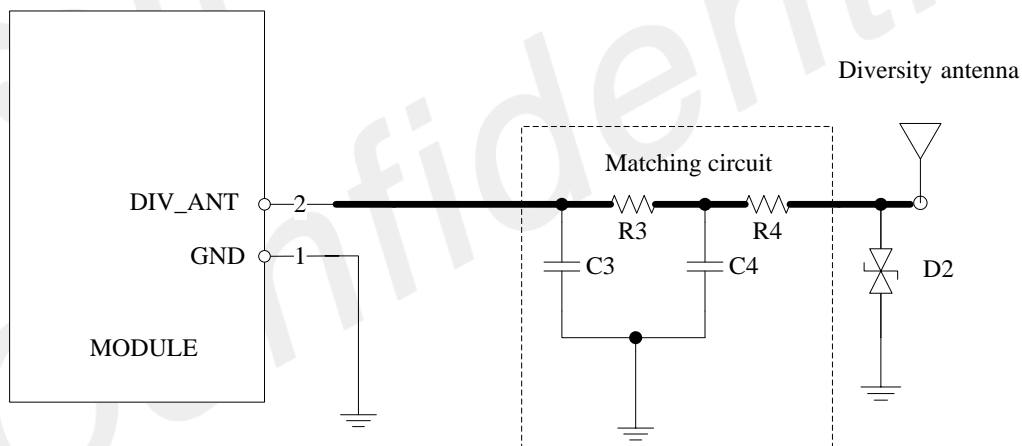
Figure 30: Antenna matching circuit (DIV_ANT)

In above figure, R3, C3, C4 and R4 are used for auxiliary antenna matching. By default, the R3, R4 are 0Ωresistors, 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	WE05DGCMS-BH	CYGWAYON
0402	PESD0402-03	PRISEMI
0402	PESD0402-12	PRISEMI

NOTE

SIMCom suggests the LTE auxiliary antenna to be kept on, since there are many high bands in the designing of FDD-LTE. 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 [24]

4.3 GNSS

SIM7500V merges GNSS 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）/-159dBm(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±1.023MHz
- 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 ((WCDMA/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 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 as GNSS signal transceiver. In this document, all GNSS specification mentioned is from passive antenna. The following is the reference circuit.
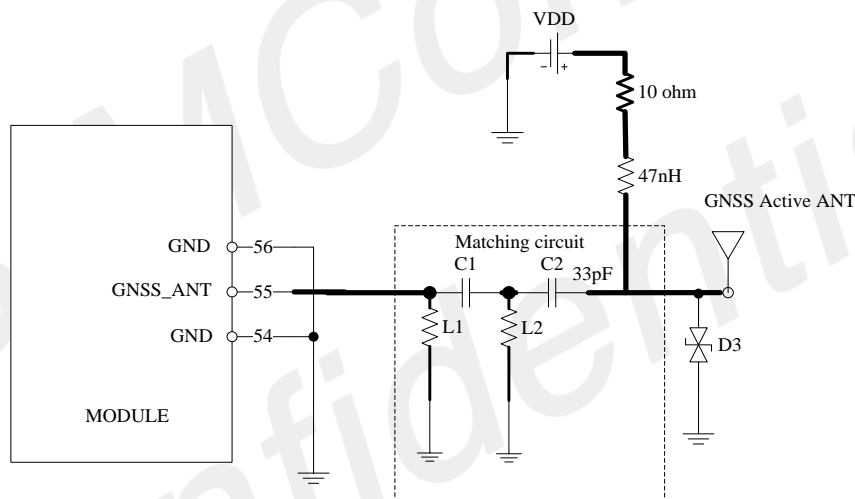
Figure 31: Active antenna circuit

NOTE

If customer need save the power when the GNSS function is disabled, then customer should design a switch circuit to cut off the active antenna power to get a lower power consumption.
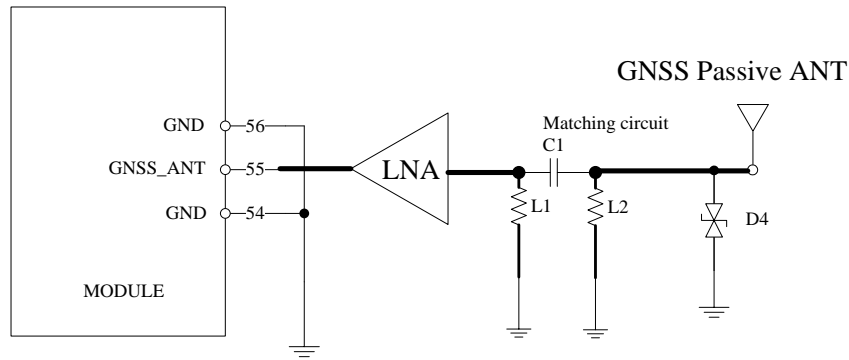
Figure 32: Passive antenna circuit (Default)

In above figures, the components C1 and L1, L2 are used for antenna matching, the values of the components can only be obtained after the antenna tuning and usually provided by antenna vendor. C2 in Figure 29 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.

LNA should apply the following requirements as table 28. LNA is also suggested to put near the passive antenna.

Table 29: LNA requirements

Parameter	Min	Max	Unit
Vdd	1.5	3.3	V
Idd		3	mA
LNA_EN	1.3		V
Gain	14	17	dB
VSWR		2	

GNSS can be used by NMEA port. User can select NMEA as output through UART or USB. NMEA sentences are automatic and no command is provided. NMEA sentences include GSV, GGA, RMC, GSA, and VTG. Before using GNSS, user should configure SIM7500V in proper operating mode by AT command. Please refer to related document for details. SIM7500V can also get position location information through AT directly.

> **NOTE**
>
> GNSS is closed by default, it could 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 30: Absolute maximum ratings

Parameter	Min	Max	Unit
Voltage at VBAT	-0.5	4.7	V
Voltage at VBUS	-0.5	5.5	V
Voltage at digital pins (RESET,SPI,GPIO,I2C,UART,PCM)	-0.3	2.1	V
Voltage at digital pins :SIM	-0.3	3.05	V
Voltage at PWRKEY	-0.3	1.8	V

5.2 Operating Conditions

Table 31: Recommended operating ratings

Parameter	Min.	Typ.	Max.	Unit
Voltage at VBAT	3.4	3.8	4.2	V
Voltage at VBUS	3.0	5	5.25	V

Table 32: 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 SPI, GPIOs (NETLIGHT), I2C, UART, PCM.

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

Table 33: Operating temperature

Parameter	Min	Type	Max	Unit
Normal operation temperature	-30	25	80	℃
Extended operation temperature*	-40	25	85	℃
Storage temperature	-45	25	+90	℃

NOTE

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

5.3 Operating Mode

5.3.1 Operating Mode Definition

The table below summarizes the various operating modes of Module products.

Table 34: Operating Mode Definitions

Mode		Function
Normal operation	WCDMA / LTE 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 and TCP/UDP.
	WCDMA / LTE Idle	Software is active. Module is registered to the network, and the module is ready to communicate.
	WCDMA / LTE Talk	Connection between two subscribers is in progress. In this case, the power consumption depends on network settings such as DTX off/on, FR/EFR/HR, hopping sequences, antenna.
	WCDMA/LTE Standby	Module is ready for data transmission, but no data is currently sent or received. In this case, power consumption depends on network settings.
	/WCDMA / LTE 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" 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 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 by pulling 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, SMS and TCP/UDP.

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 [25] 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 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 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 35: Current consumption on VBAT Pins (VBAT=3.8V)

GNSS	
GNSS supply current	@-140dBm，Tracking Typical:35mA

(AT+CFUN=0,with USB connection)	
LTE Sleep/Idle mode	
LTE supply current (without USB connection)	Sleep mode @DRX=9 Typical: 2.3mA Idle mode @DRX=9 Typical: 17.5mA
LTE Data	
LTE-FDD B4	@5 MHz 23.1dBm Typical: 519mA @10 MHz 23.0dBm Typical: 556mA @20 MHz 22.8dBm Typical: 600mA
LTE-FDD B13	@5MHz 21.9dBm Typical: 505mA @10MHz 22.0dBm Typical: 497mA

5.5 ESD Notes

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

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

Part	Contact discharge	Air discharge
GND	+/-4K	+/-8K
VBAT	+/-4K	+/-8K
Antenna port	+/-4K	+/-8K
USB	+/-1K	+/-2K
UART	+/-1K	+/-2K
PCM	+/-1K	+/-2K
Other PADs	+/-1K	+/-2K

6 SMT Production Guide

6.1 Top and Bottom View of Module

Figure 33: Top and bottom view of Module

NOTE

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

6.2 Label Information
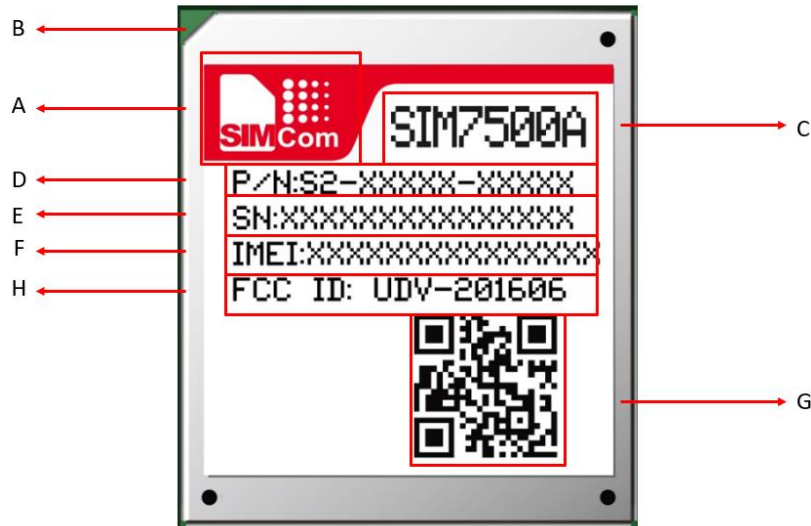
Figure 34: Label Information

Table 37: The Description of Label Information

No.	Description
A	LOGO
B	No.1 Pin
C	Project Name
D	Product Code
E	Serial Number
F	International Mobile Equipment Identity
G	QR code
H	Federal Communications Commission

6.3 Recommended SMT stencil

The following figure shows the SMT stencil of the module.

The recommended thickness of stencil foil is 0.13mm.
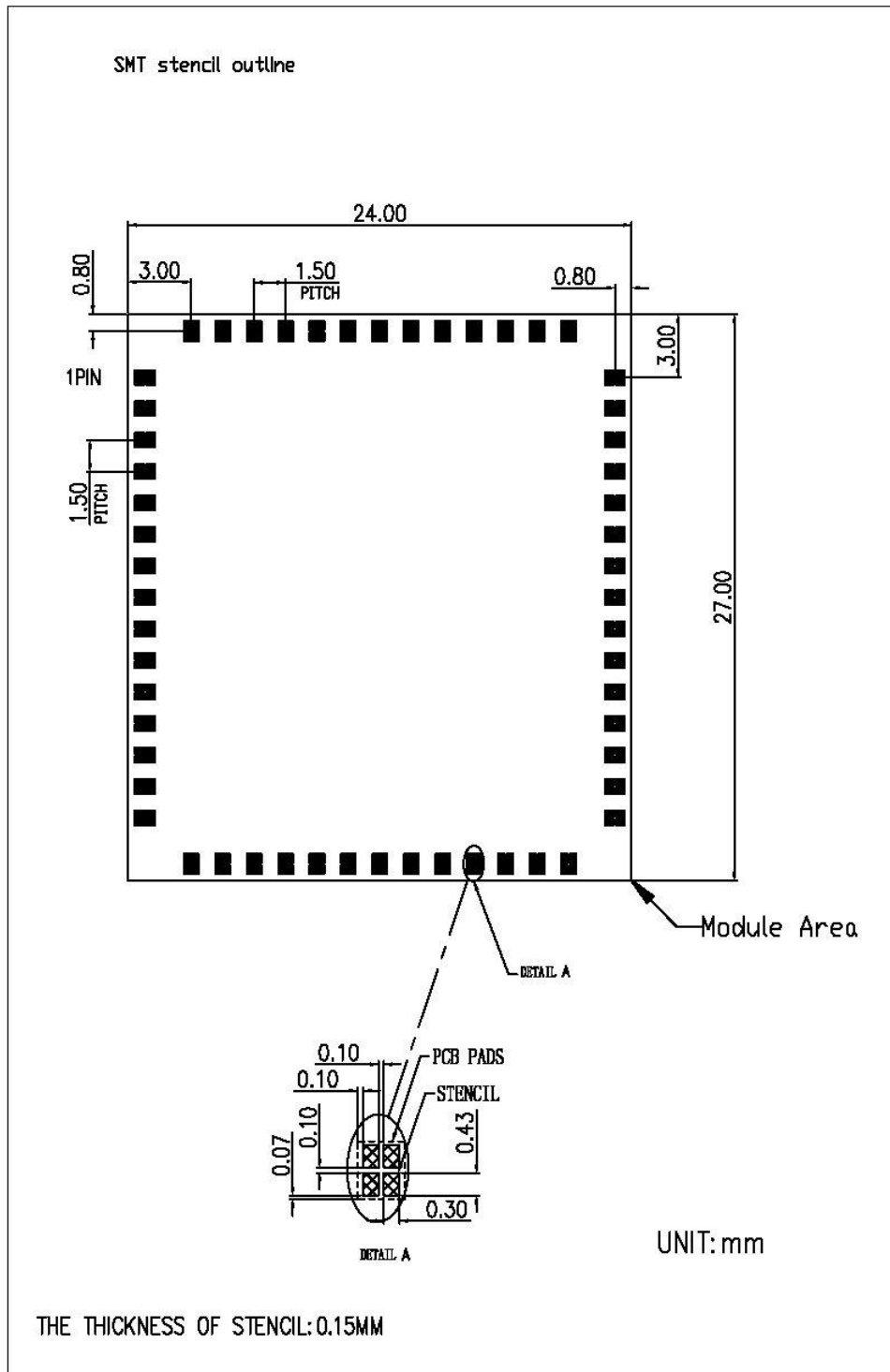
Figure 35: Recommended SMT stencil

6.4 Recommended reflow furnace temperature curve

SIMCom provides a typical soldering profile. Therefore the soldering profile shown below is only a generic recommendation and should be adjusted to the specific application and manufacturing constraints.
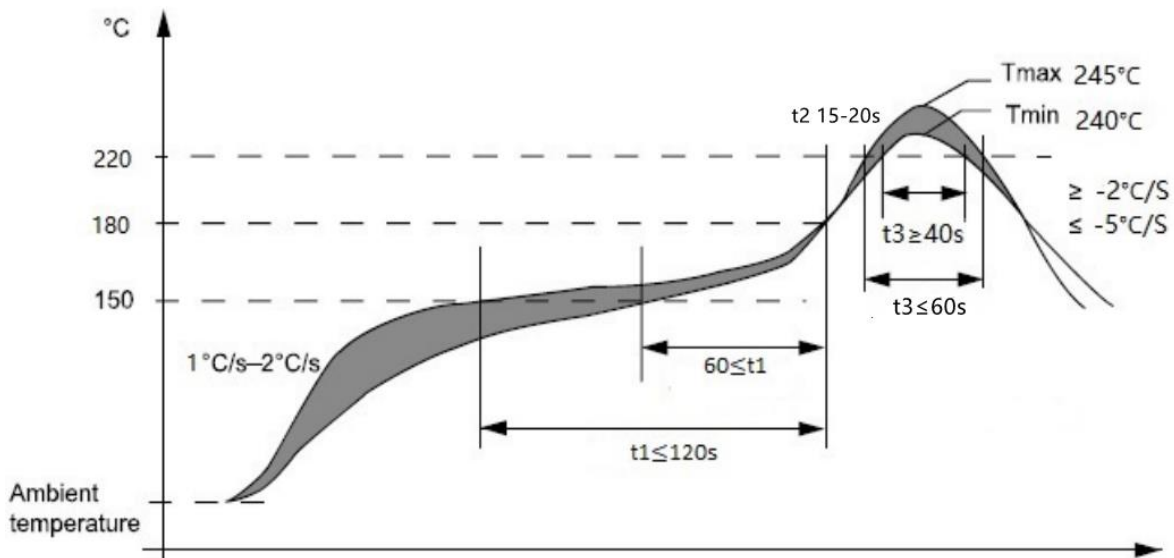
Figure 36: Recommended reflow furnace temperature curve (lead-free)

The maximum times of refluxes for this module is once.

Table 38: The main board reflux temperature curve requirements (lead-free)

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

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

6.5 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 modules for 192 hours in drying equipment (<5% RH) at 40+5/-0°C, or 72 hours at 85+5/-5°C. Note that plastic tray is not heat-resistant, and only can be baked at 45° C.

Table 39: Moisture Sensitivity Level and Floor Life

Moisture Sensitivity Level (MSL)	Floor Life (out of bag) at factory ambient≤30°C/60% RH or as stated
1	Unlimited at ≦30℃/85% RH
2	1 year
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.

7 Packaging

Module support tray packaging.
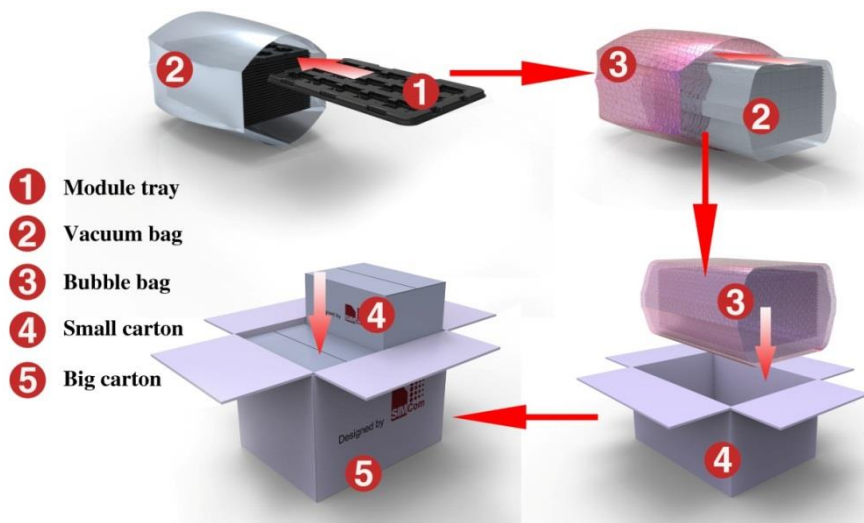
Figure 37: Packaging introduce

Module tray drawing:
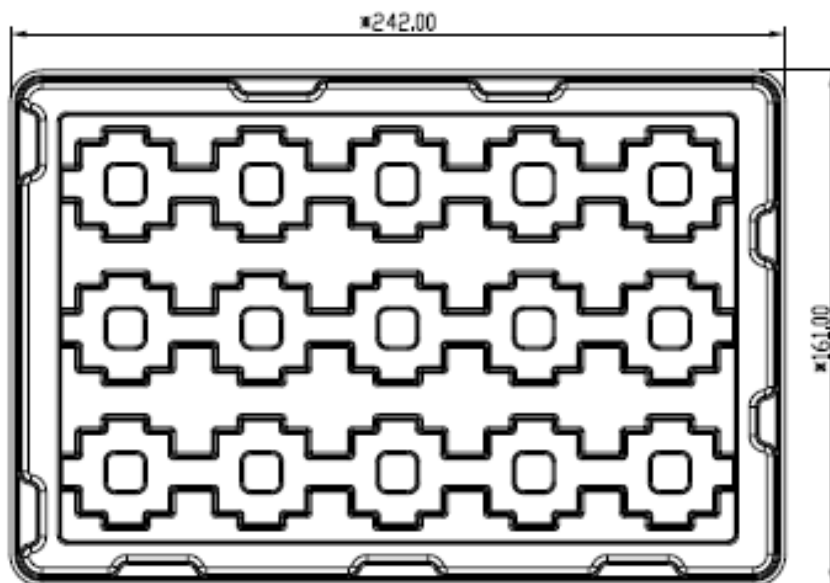
Figure 38: Tray drawing

Table 40: Tray size

Length（±3mm）	Width（±3mm）	Number
242.0	161.0	15

Small carton drawing:
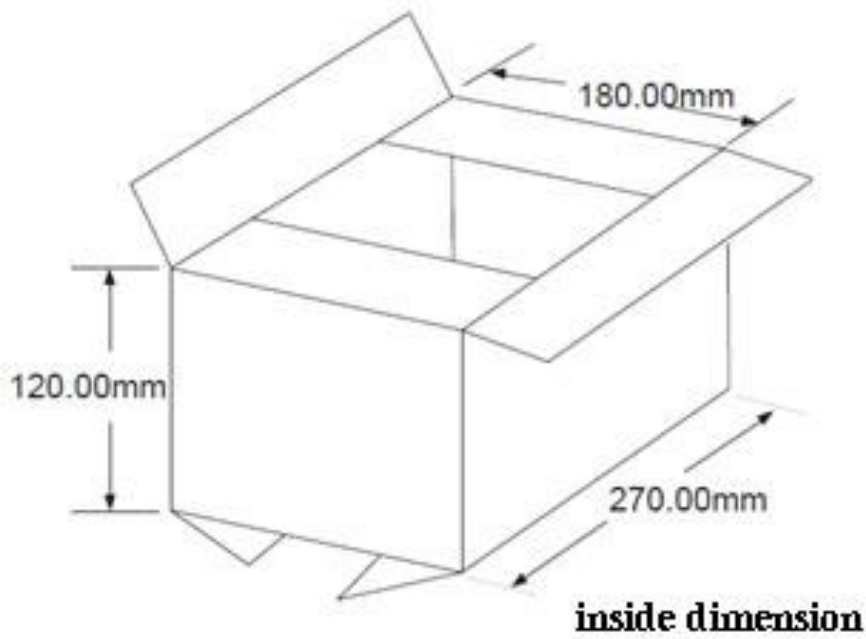
Figure 39: Small carton drawing introduce

Table 41: Small Carton size

Length（±10mm）	Width（±10mm）	Height（±10mm）	Number
270	180	120	15*20=300

Big carton drawing:
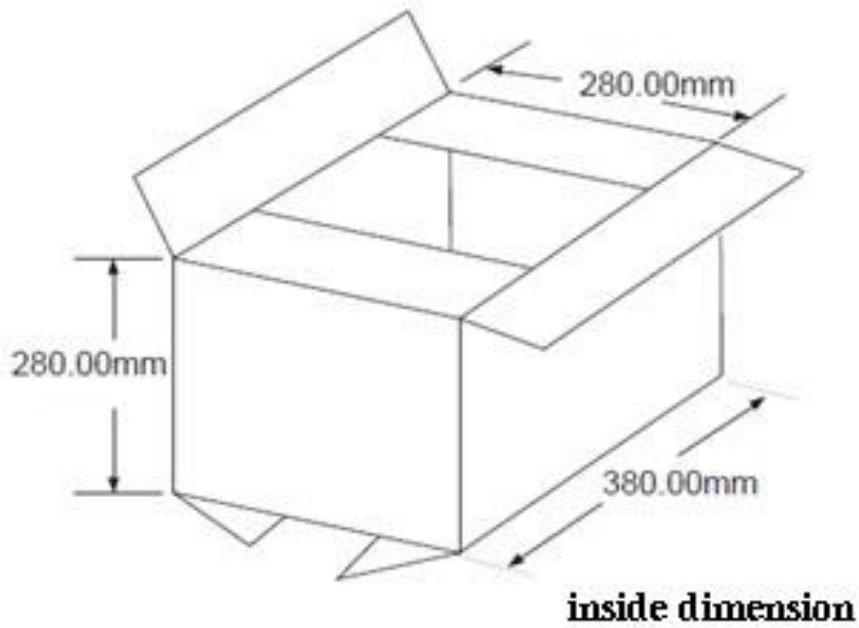
Figure 40: Big carton drawing introduce

Table 42: Big Carton size

Length（±10mm）	Width（±10mm）	Height（±10mm）	Number
380	280	280	300*4=1200

8 Appendix

8.1 Reference Design
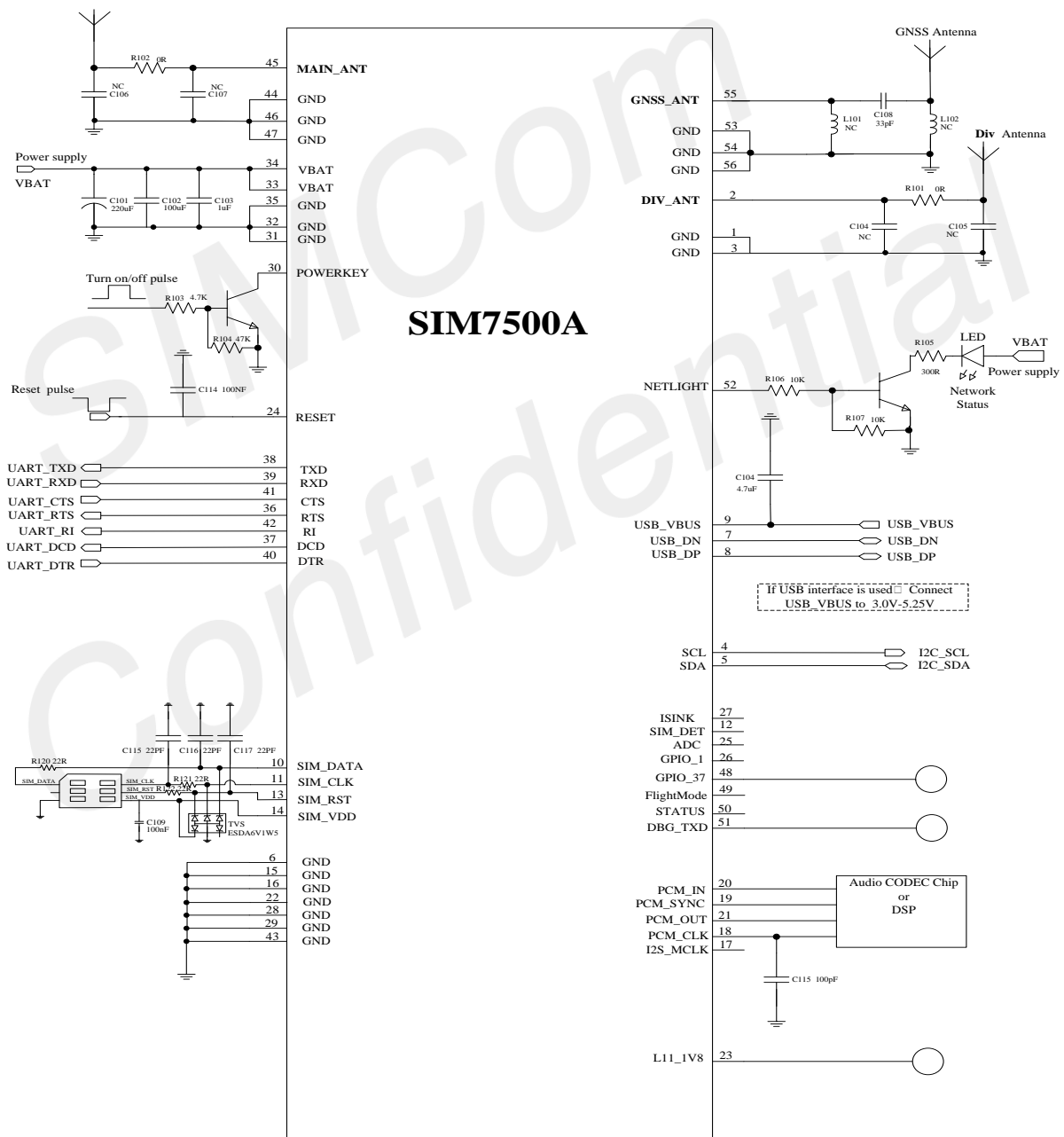
Figure 41: Reference design

> **NOTE**
>
> 1.The UART port suggests to be used by isolated circuit.
> 2. C115 must be mounted.

8.2 Coding Schemes and Maximum Net Data Rates over Air Interface

Table 43: Coding schemes and maximum net data rates over air interface

Multislot definition(GPRS/EDGE)			
Slot class	**DL slot number**	**UL slot number**	**Active slot number**
1	1	1	2
2	2	1	3
3	2	2	3
4	3	1	4
5	2	2	4
6	3	2	4
7	3	3	4
8	4	1	5
9	3	2	5
10	4	2	5
11	4	3	5
12	4	4	5
GPRS coding scheme	**Max data rata（4 slots）**	**Modulation type**	
CS 1 = 9.05 kb/s / time slot	36.2 kb/s	GMSK	
CS 2 = 13.4 kb/s / time slot	53.6 kb/s	GMSK	
CS 3 = 15.6 kb/s / time slot	62.4 kb/s	GMSK	
CS 4 = 21.4 kb/s / time slot	85.6 kb/s	GMSK	
EDGE coding scheme	**Max data rata（4 slots）**	**Modulation type**	
MCS 1 = 8.8 kb/s/ time slot	35.2 kb/s	GMSK	
MCS 2 = 11.2 kb/s/ time slot	44.8 kb/s	GMSK	
MCS 3 = 14.8 kb/s/ time slot	59.2 kb/s	GMSK	
MCS 4 = 17.6 kb/s/ time slot	70.4 kb/s	GMSK	
MCS 5 = 22.4 kb/s/ time slot	89.6 kb/s	8PSK	
MCS 6 = 29.6 kb/s/ time slot	118.4 kb/s	8PSK	
MCS 7 = 44.8 kb/s/ time slot	179.2 kb/s	8PSK	

MCS 8 = 54.4 kb/s/ time slot	217.6 kb/s	8PSK
MCS 9 = 59.2 kb/s/ time slot	236.8 kb/s	8PSK
HSDPA device category	**Max data rate（peak）**	**Modulation type**
Category 1	1.2Mbps	16QAM,QPSK
Category 2	1.2Mbps	16QAM,QPSK
Category 3	1.8Mbps	16QAM,QPSK
Category 4	1.8Mbps	16QAM,QPSK
Category 5	3.6Mbps	16QAM,QPSK
Category 6	3.6Mbps	16QAM,QPSK
Category 7	7.2Mbps	16QAM,QPSK
Category 8	7.2Mbps	16QAM,QPSK
Category 9	10.2Mbps	16QAM,QPSK
Category 10	14.4Mbps	16QAM,QPSK
Category 11	0.9Mbps	QPSK
Category 12	1.8Mbps	QPSK
Category 13	17.6Mbps	64QAM
Category 14	21.1Mbps	64QAM
Category 15	23.4Mbps	16QAM
Category 16	28Mbps	16QAM
Category 17	23.4Mbps	64QAM
Category 18	28Mbps	64QAM
Category 19	35.5Mbps	64QAM
Category 20	42Mbps	64QAM
Category 21	23.4Mbps	16QAM
Category 22	28Mbps	16QAM
Category 23	35.5Mbps	64QAM
Category 24	42.2Mbps	64QAM
HSUPA device category	**Max data rate（peak）**	**Modulation type**
Category 1	0.96Mbps	QPSK
Category 2	1.92Mbps	QPSK
Category 3	1.92Mbps	QPSK
Category 4	3.84Mbps	QPSK
Category 5	3.84Mbps	QPSK
Category 6	5.76Mbps	QPSK
LTE-FDD device category (Downlink)	**Max data rate（peak）**	**Modulation type**
Category 1	10Mbps	QPSK/16QAM/64QAM
Category 2	50Mbps	QPSK/16QAM/64QAM
Category 3	100Mbps	QPSK/16QAM/64QAM
Category 4	150Mbps	QPSK/16QAM/64QAM
LTE-FDD device category (Uplink)	**Max data rate（peak）**	**Modulation type**

Category 1	5Mbps	QPSK/16QAM
Category 2	25Mbps	QPSK/16QAM
Category 3	50Mbps	QPSK/16QAM
Category 4	50Mbps	QPSK/16QAM

8.3 Related Documents

Table 44: Related Documents

SN	Title	Description
[1]	SIM7500V_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	SIM7X00 Series_UART_Application Note
[23]	SIM7X00 Series_USBAUDIO_Application Note_V1.xx	SIM7X00 Series_USBAUDIO_Application Note
[24]	Antenna design guidelines for diversity receiver system	Antenna design guidelines for diversity receiver system
[25]	SIM7X00 Series_Sleep Mode_ Application Note_V1.xx	SIM7X00 Series_Sleep Mode_ Application Note

8.4 Terms and Abbreviations

Table 45: 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
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
GNSS	Global Navigation Satellite System
HR	Half Rate
HSPA	High Speed Packet Access
I2C	Inter-Integrated Circuit
IMEI	International Mobile Equipment Identity
LTE	Long Term Evolution
MO	Mobile Originated
MS	Mobile Station (GSM engine), also referred to as TE
MT	Mobile Terminated
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
SIM	Universal subscriber identity module
UMTS	Universal mobile telecommunications system
UART	Universal asynchronous receiver transmitter

8.5 Safety Caution

Table 46: Safety Caution

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

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.

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.

Important Note:

Radiation Exposure Statement

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 and your body.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Country Code selection feature to be disabled for products marketed to the US/Canada.

This device is intended only for OEM integrators under the following conditions:

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 the conditions above are met, further transmitter testing 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.

Important Note:

In the event that these conditions cannot be met (for example certain laptop configurations or co-location with another transmitter), then the FCC authorization is no longer considered valid and the FCC ID cannot be used on the final product. In these circumstances, the OEM integrator will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

End Product Labeling

The final end product must be labeled in a visible area with the following" Contains FCC ID: 2AJYU-8PYA00D ".

Manual Information to the End User

The OEM integrator has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module.

The end user manual shall include all required regulatory information/warning as show in this manual.

Integration instructions for host product manufacturers according to KDB 996369 D03 OEM Manual v01

2.2 List of applicable FCC rules

FCC Part 27

2.3 Specific operational use conditions

The module is a SIMCom LTE Cat 1 Module with LTE Function

Operation Frequency:

Band	Tx (MHz)	Rx (MHz)
LTE FDD Band 4	1710 ~ 1755	2110 ~ 2155
LTE FDD Band 13	777 ~ 787	746 ~ 756

Modulation Type: QPSK/16QAM

Antenna Type: External Antenna

Antenna Gain:

LTE FDD Band 4: 5.0dBi

LTE FDD Band 13: 4.0dBi

The module can be used for mobile applications with a maximum 5dBi for Band 4 and 4dBi for Band 13 antenna. The host manufacturer installing this module into their product must ensure that the final composit product complies with the FCC requirements by a technical assessment or evaluation to the FCC rules, including the transmitter operation. The host manufacturer has to be aware not to provide information to the end user regarding how to install or remove this RF module in the user's manual of the end product which integrates this module. The end user manual shall include all required regulatory information/warning as show in this manual.

2.4 Limited module procedures

Not applicable. The module is a Single module and complies with the requirement of FCC Part 15.212.

2.5 Trace antenna designs

Not applicable. The module has its own antenna, and doesn't need a host's printed board microstrip trace antenna etc.

2.6 RF exposure considerations

The module must be installed in the host equipment such that at least 20cm is maintained between the antenna and users' body; and if RF exposure statement or module layout is changed, then the host product manufacturer required to take responsibility of the module through a change in FCC ID or new application. The FCC ID of the module cannot be used on the final product. In these circumstances, the host manufacturer will be responsible for re-evaluating the end product (including the transmitter) and obtaining a separate FCC authorization.

2.7 Antennas

Antenna Specification are as follows:

Type: External Antenna

Gain: LTE FDD Band 4: 5.0dBi; LTE FDD Band 13: 4.0dBi

This device is intended only for host manufacturers under the following conditions:

The transmitter module may not be co-located with any other transmitter or antenna;

The module shall be only used with the internal antenna(s) that has been originally tested and certified with this module. The antenna must be either permanently attached or employ a 'unique' antenna coupler.

As long as the conditions above are met, further transmitter test will not be required. However, the host manufacturer is still responsible for testing their end-product for any additional compliance requirements required with this module installed (for example, digital device emissions, PC peripheral requirements, etc.).

2.8 Label and compliance information

Host product manufacturers need to provide a physical or e-label stating "Contains FCC ID: **2AJYU-8PYA00D**" with their finished product.

2.9 Information on test modes and additional testing requirements

Operation Frequency:

Band	Tx (MHz)	Rx (MHz)
LTE FDD Band 4	1710 ~ 1755	2110 ~ 2155
LTE FDD Band 13	777 ~ 787	746 ~ 756

Modulation: QPSK/16QAM

Host manufacturer must perform test of radiated & conducted emission and spurious emission, etc according to the actual test modes for a stand-alone modular transmitter in a host, as well as for multiple simultaneously transmitting modules or other transmitters in a host product.

Only when all the test results of test modes comply with FCC requirements, then the end product can be sold legally.

2.10 Additional testing, Part 15 Subpart B disclaimer

The modular transmitter is **only** FCC authorized for FCC Part 27 and that the host product manufacturer is responsible for compliance to any other FCC rules that apply to the host not covered by the modular transmitter grant of certification. If the grantee markets their product as being Part 15 Subpart B compliant (when it also contains unintentional-radiator digital circuity), then the grantee shall provide a notice stating that the final host product still requires Part 15 Subpart B compliance testing with the modular transmitter installed.