A7672S
Hardware Design

LTE Module

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Version History

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1 Introduction

This document describes the hardware interface of the module, which can help users quickly understand the interface definition, electrical performance and structure size of the module. Combined with this document and other application documents, users can understand and use A7672S module to design and develop applications quickly. SIMCom provides a set of evaluation boards to facilitate A7672S module testing and use. The evaluation board tools include an EVB board, a USB cable, an antenna, and other peripherals.

1.1 Product Outline

Aimed at the global market, the module supports 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	FANS	MANS
LTE-FDD	LTE-FDD B1	✓	✓
	LTE-FDD B3	✓	✓
	LTE-FDD B5	✓	✓
	LTE-FDD B8	✓	✓
LTE-TDD	LTE TDD B34	✓	✓
	LTE TDD B38	✓	✓
	LTE TDD B39	✓	✓
	LTE TDD B40	✓	✓
	LTE TDD B41	✓	✓
GNSS		✓	✓
Blue Tooth		Option	
MMC			Option
Category		CAT1	CAT1

※ NOTE

1. There are many module function configurations,for detailed information please contact with SIMCom FAE.

The size of the module is only 24*24* 2.4mm, which can almost meet the space size requirements of all M2M applications, such as metering, security, routing, wireless POS, mobile computing devices, PDA, tablet computers, etc.

The A7672S module provides a total of 130 pins (124 pins for A7672S-FANS), including 80 LCC pins for the outer ring and 50 LGA pins for the inner ring (44 LGA pins for the inner ring of A7672S-FANS). This document will introduce all functional pins.

1.2 Hardware Interface Overview

The A7672S module provides the following hardware interfaces:

- Power Supply
- USB 2.0 Interface
- Three UART ports, one full-function serial port, one DEBUG serial port, and one two-line serial port
- Two USIM Interfaces
- Multiple programmable general input and output interfaces（GPIO）
- Two general ADC interfaces
- 4*4 matrix keyboard interface
- Analog audio MIC input interface
- Analog audio SPK output interface
- SPI Interface
- Three LDO power output (two power output for models that do not support MMC interfaces)
- I2C Interface
- SPI LCD Interface
- SPI Camera Interface
- USB_BOOT download boot interface
- MMC interfaces (optional)
- Network status indication interface
- Module operation status indication interface
- Three antenna interface (GNSS and Bluetooth optional)

1.3 Hardware Block Diagram

The block diagram of the A7672S module is shown in the figure below.

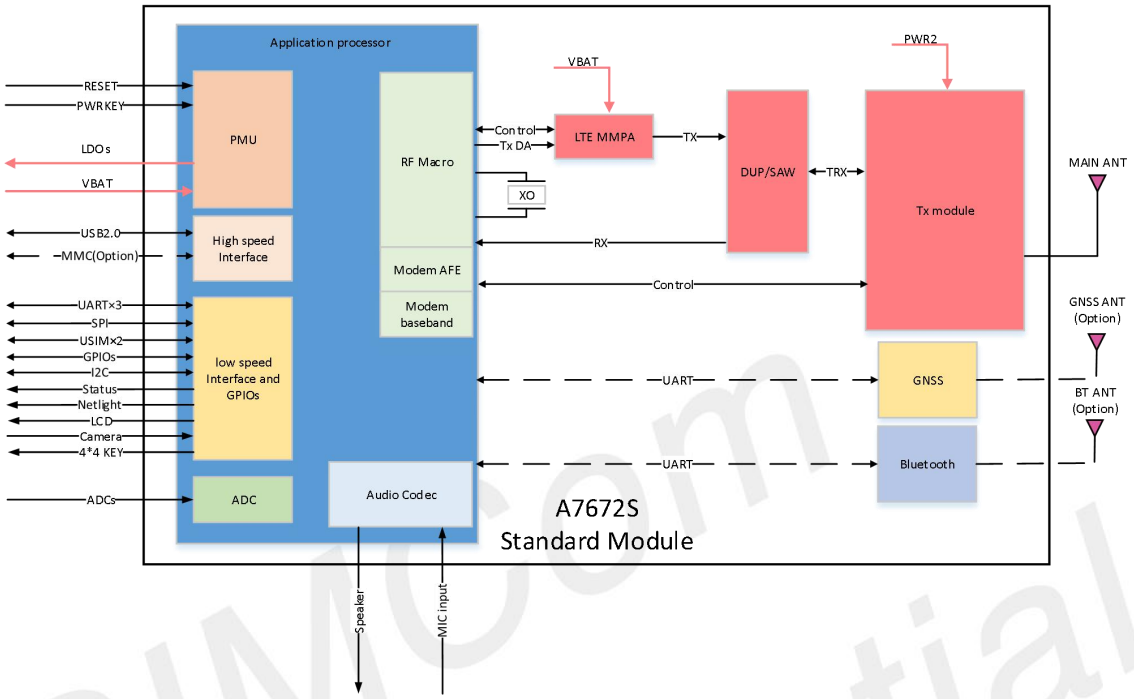

Figure 1: A7672S block diagram

1.4 Functional Overview

Table 2: General features

Feature	Implementation
Power supply	VBAT: 3.4V ~4.2V, Recommended VBAT: 3.8V
Power saving	Current in sleep mode:<2mA
Radio frequency bands	Please refer to the table 1
Transmitting power	LTE power level: 3 (23dBm±2.7dB)
Data Transmission Throughput	TDD/FDD-LTE category 1 : 10 Mbps (DL),5 Mbps (UL)
Antenna	LTE antenna interface GNSS antenna interface(optional) Bluetooth antenna interface(optional)
SMS	MT, MO, CB, Text, PDU mode Short Message (SMS)storage device: USIM Card, CB does not support saving in SIM Card Support CS domain and PS domain SMS
USIM interface	Support identity card: 1.8V/ 3V
USIM application toolkit	Support SAT class 3, GSM 11.14 Release 99 Support USAT

MMC interface	Support SD3.0 and MMC/eMMC 4.5.1(optional)
Phonebook management	SM/FD/ON/AP/SDN
Audio interface	Support analog audio interface
UART interface	●Full function serial port Baud rate support from 300bps to 3686400bps AT command and data can be sent through serial port Support RTS/CTS Hardware flow control Support serial port multiplexing function conforming to GSM 07.10 protocol ●Debug serial port Support debug usage ●UART3 serial port Ordinary two-wire serial port
USB	Complies with USB 2.0 specification, supports slave mode, host mode not supported. This interface can be used for AT command sending, data transmission, software debugging and upgrading.
Firmware upgrade	Firmware upgrade over USB interface
Physical characteristics	Size:24*24*2.4m Weight:2.8±0.1g
Temperature range	Normal operation temperature: -30°C to +75°C Extended operation temperature: -40°C to +85°C* Storage temperature -40°C to +90°C

※ NOTE

1. In the extended operating temperature range, the module can work normally, but is not guaranteed to fully comply with the 3GPP test specification.

2 Package Information

2.1 Pin Assignment Overview

Each model of A7672S module has different pin definitions. The detailed pin distribution is as follows:

A7672S-MANS Standard version pin definition

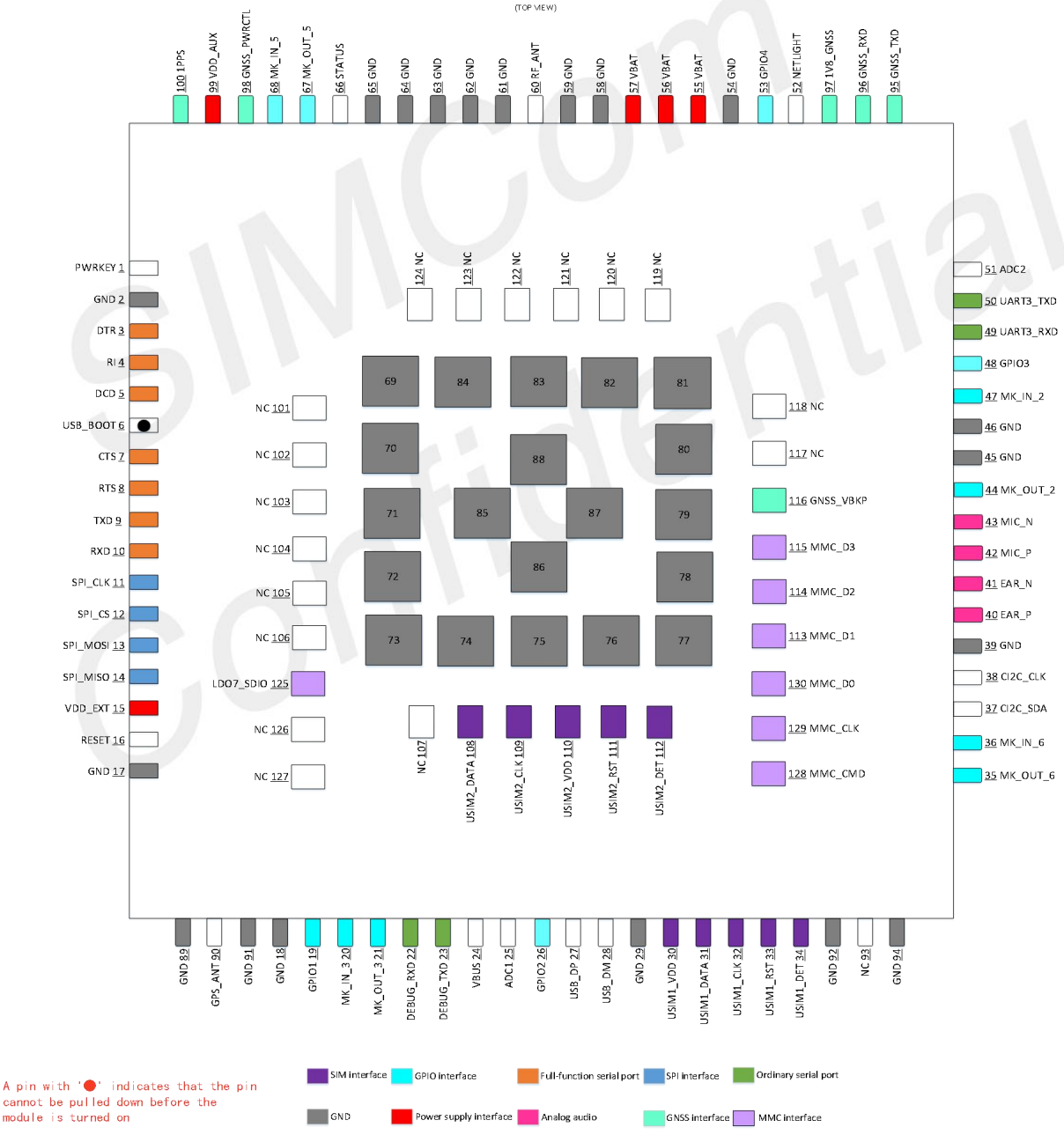

Figure 2: A7672S-MANS Standard Module Pin assignment (overview)

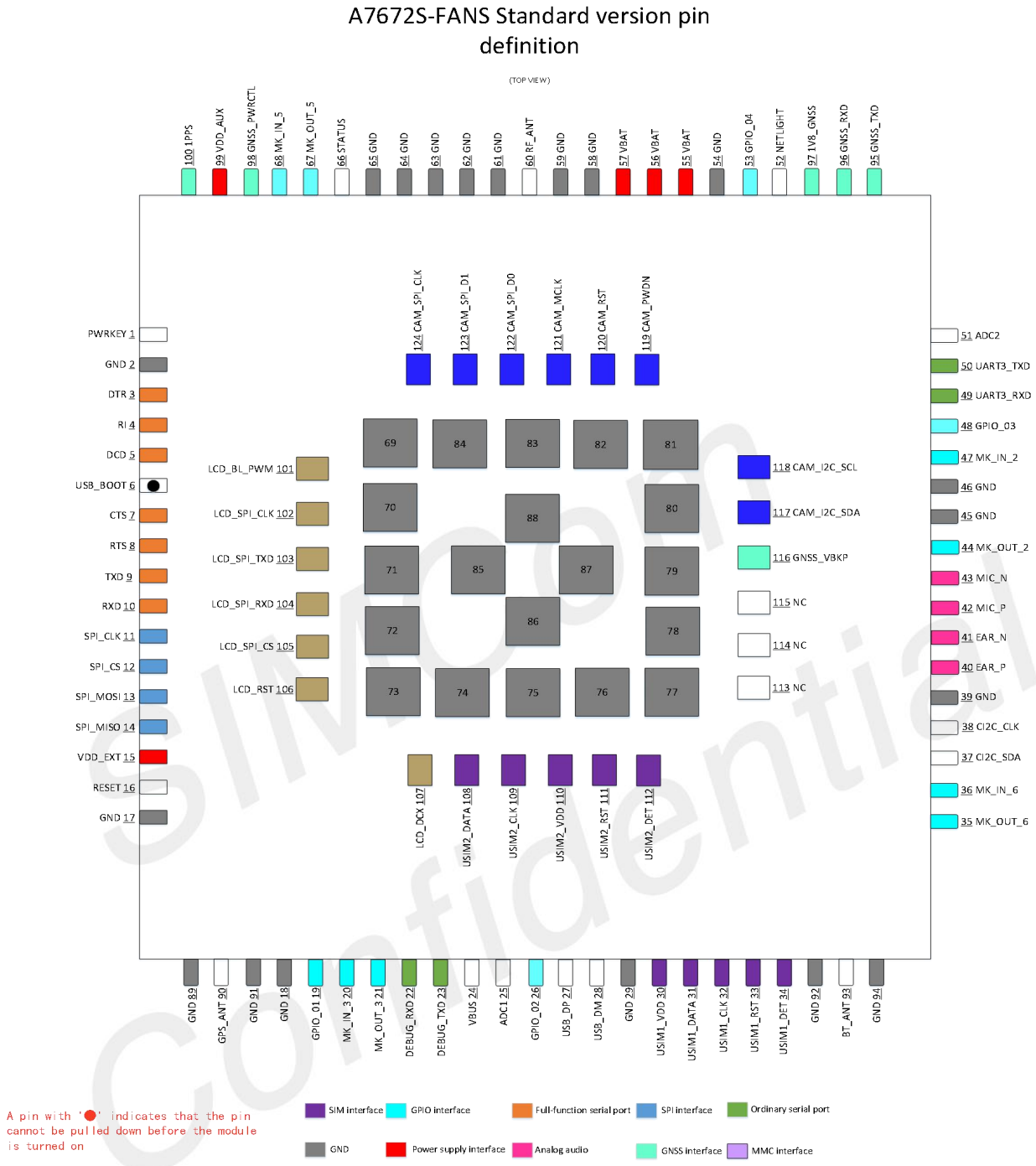

Figure 3: A7672S-FANS Standard Module Pin assignment (overview)

Table 3: Pin Description

Pin No	Pin Name	Pin No	Pin Name
1	PWRKEY	2	GND
3	DTR	4	RI
5	DCD	6●	USB_BOOT
7	CTS	8	RTS
9	TXD	10	RXD
11	SPI_CLK	12	SPI_CS
13	SPI_MOSI	14	SPI_MISO
15	VDD_EXT	16	RESET
17	GND	18	GND
19	GPIO_01	20	MK_IN_3
21	MK_OUT_3	22	DEBUG_RXD
23	DEBUG_TXD	24	VBUS
25	ADC1	26	GPIO_02
27	USB_DP	28	USB_DM
29	GND	30	USIM1_VDD
31	USIM1_DATA	32	USIM1_CLK
33	USIM1_RST	34	USIM1_DET
35	MK_OUT_6	36	MK_IN_6
37	CI2C_SDA	38	CI2C_SCL
39	GND	40	EAR_P
41	EAR_N	42	MIC_P
43	MIC_N	44	MK_OUT_2
45	GND	46	GND
47	MK_IN_2	48	GPIO_03
49	UART3_RXD	50	UART3_TXD
51	ADC2	52	NETLIGHT
53	GPIO_04	54	GND
55	VBAT	56	VBAT
57	VBAT	58	GND
59	GND	60	RF_ANT
61	GND	62	GND
63	GND	64	GND
65	GND	66	STATUS
67	MK_OUT_5	68	MK_IN_5
69	GND	70	GND
71	GND	72	GND

73	GND	74	GND
75	GND	76	GND
77	GND	78	GND
79	GND	80	GND
81	GND	82	GND
83	GND	84	GND
85	GND	86	GND
87	GND	88	GND
89	GND	90	GNSS_ANT
91	GND	92	GND
93	BT_ANT	94	GND
95	GNSS_TXD	96	GNSS_RXD
97	1V8_GNSS	98	GNSS_PWRCTL
99	VDD_AUX	100	1PPS
101	LCD_BL_PWM	102	LCD_SPI_CLK
103	LCD_SPI_TXD	104	LCD_SPI_RXD
105	LCD_SPI_CS	106	LCD_RST
107	LCD_DCX	108	USIM2_DATA
109	USIM2_CLK	110	USIM2_VDD
111	USIM2_RST	112	USIM2_DET
113	MMC_D1	114	MMC_D2
115	MMC_D3	116	GNSS_VBKP
117	CAM_I2C_SDA	118	CAM_I2C_SCL
119	CAM_PWDN	120	CAM_RST
121	CAM_MCLK	122	CAM_SPI_D0
123	CAM_SPI_D1	124	CAM_SPI_CLK
125	LDO7_SDIO	126	NC
127	NC	128	MMC_CMD
129	MMC_CLK	130	MMC_D0

※ NOTE

1. '●' Indicates that these Pins cannot be pulled down before the module powered up, otherwise it will affect the normal start-up of the module.

2.2 Pin Description

Table 4: Pin parameter abbreviation

Pin Type	Description
PI	Power input
PO	Power output
AI	Analog input
AO	Analog output
I/O	Bidirectional input /output
DI	Digital input
DO	Digital output
DOH	Digital output with high level
DOL	Digital output with low level
PU	Pull up
PD	Pull down
OD	Open drain

Table 5: 1.8V IO parameters definition

Power Domain	Parameter	Description	Min.	Typ.	Max.
1.8V	Dc input condition (VCC=1.8V)				
	VIH	High level input	VCC * 0.7	1.8V	VCC+0.2
	VIL	Low level input	-0.3V	0V	VCC *0.3
	Rpu	Pull up resistor	55K	79 K	121K
	Rpd	Pull down resistor	51K	87 K	169K
	Dc input condition (VCC=1.8V Typical)				
	IIL	Input leakage current	-	-	10uA
	Dc input condition (VCC=1.8V Typical)				
	VOH	Output level range	VCC-0.2	-	-
	VOL	Output low range	-	-	0.2V
	LOL	Maximum current driving capacity at low level output Vpad=0.2V Iol DCS[1:0]= 00		13 mA	

		01 10 11	25 mA 37 mA 49 mA -
	LOH	Maximum current driving capacity at high level output Vpad=VCC-0.2 V Ioh DCS[1:0]= 00 01 10 11	 11 mA 21 mA 32 mA 42 mA

Table 6: 3.0V IO parameters definition

Power Domain	Parameter	Description	Min.	Typ.	Max.
3.0V	VIH	High level input	2V	-	VCC+0.3
	VIL	Low level input	-0.3V	0V	0.8V
	Rpu	Pull up resistor	26K	47K	72K
	Rpd	Pull down resistor	27K	54K	267K
	IIL	Input leakage current	-	-	10uA
	VOH	Output level range	2.4V	-	-
	VOL	Output low range	-	-	0.4V
	LOL	Maximum current driving capacity at low level output Vpad=0.4V Iol DS[2:0]= 000 001 010 011 100 101 110 111		 7 mA 10 mA 14 mA 18 mA 21 mA 24 mA 28 mA 31 mA	
	LOH	Maximum current driving capacity at high level			

		output Vpad=VCC-0.5V Ioh DS[2:0]= 000 001 010 011 100 101 110 111	 7 mA 10 mA 13 mA 16 mA 19 mA 23 mA 26 mA 29 mA

Table 7: Pin description

Pin Name	Pin No	Pin Parameter		Description	Note
		Power Domain	Type		
Power Supply					
VBAT	55,56,57	-	PI	Module input voltage ranges from 3.4V to 4.2V, typical value is 3.8V,and the peak current value can reach 1A.	
VDD_EXT	15	-	PO	1.8V power output, output current up to 50 mA. Cannot provide to high power load, can provide power for level conversion circuit, etc.	Can provide 1V8 power supply for GNSS. If unused, keep it open.
VDD_AUX	99	-	PO	The default output voltage is 3V. The maximum output current is 50mA. Cannot provide to high power load.	Can provide power for other peripherals, If unused, keep it open.
GND	2,17,18,29, 39,45,46, 54,58,59, 61,62,63, 64,65,69, 70,71,72, 73,74,75,	-	-	Ground	

	76,77,78, 79,80,81, 82,83,84, 85,86,87, 88,89,91, 92,94				
System Control					
PWRKEY	1	-	DI,PU	Power ON/OFF input, active low. Power button defaults high VIH：0.7*VBAT VIL：0.3*VBAT	PMU has been internally pulled up to the VBAT with 50K (Typical).
RESET	16	-	DI,PU	System reset control input, active low. VIH: 0.7*VBAT VIL: 0.3*VBAT	PMU has been internally pulled up to the VBAT with 50K (Typical).
USIM Interface					
USIM1_DATA	31	1.8/ 3.0V	I/O,PU	USIM bus data, module internal 4.7KΩ resistor pulled up to USIM1_VDD.	
USIM1_RST	33	1.8/ 3.0V	I/O,PU	USIM bus reset output.	
USIM1_CLK	32	1.8/ 3.0V	I/O,PU	USIM bus clock output.	
USIM1_VDD	30	1.8/ 3.0V	PO	USIM card power supply output, output voltage can be dynamically changed according to the type of external card, output current maximum 50mA	
USIM1_DET	34	1.8V	DI,PU	USIM insert detect, it can be set to high/low active with the AT command, refer to Document [25]	
USIM2_DATA	108	1.8/ 3.0V	I/O,PU	USIM2 bus data with a 4.7KΩ resistor inside the module pulled up to USIM2_VDD	
USIM2_RST	111	1.8/ 3.0V	I/O,PU	USIM2 bus reset output.	
USIM2_CLK	109	1.8/ 3.0V	I/O,PU	USIM2 bus clock output.	
USIM2_VDD	110	1.8/ 3.0V	PO	USIM2 card power supply output, output voltage can	

				be dynamically changed according to the type of external card, output current maximum 50mA	
USIM2_DET	112	1.8V	DI,PD	USIM2 insert detect, it can be set to high/low active with the AT command, refer to Document [25]	
USB Interface					
VBUS	24	-	AI	Valid USB detection input. Active high.	Minimum identification voltage 3.0V, the highest identification voltage 5.2V.
USB_DM	28	-	I/O	USB bus differential negative terminal	
USB_DP	27	-	I/O	USB bus differential positive terminal	
Full Function UART Interface					
RTS	8	1.8V	DI	RTS input	If unused, keep it open.
CTS	7	1.8V	DO	CTS output	
RXD	10	1.8V	DI	Data input	
TXD	9	1.8V	DOH	Data output	
RI	4	1.8V	DO	Ringing indicator	
DCD	5	1.8V	DO	Carrier detection	
DTR	3	1.8V	DI	DTE Ready	
Debug UART					
DBG_TXD	23	1.8V	DOH	UART output	Default used as debug port.
DBG_RXD	22	1.8V	DI	UART input	
Serial Port UART3					
UART3_TXD	50	1.8V	DOH	UART3 output	If unused, keep it open.
UART3_RXD	49	1.8V	DI	UART3 input	
I2C Interface					
CI2C_SCL	38	1.8V	DO	I2C clock output	If unused, keep it open. External VDD_EXT power supply (pin 15 of the module) is used for pull-up.
CI2C_SDA	37	1.8V	I/O	I2C data input/output	
Analog Audio Interface					
EAR_P	40	1.8V	AIO	Audio receiver output positive	If unused, keep it open.

EAR_N	41	1.8V	AIO	Audio receiver output negative	
MIC_P	42		AIO	MIC input positive	
MIC_N	43		AIO	MIC input negative	
MMC Interface					
MMC_DAT3	115	1.8/3.0V	IO	MMC and SD data	
MMC_DAT2	114	1.8/3.0V	IO	MMC and SD data	
MMC_DAT1	113	1.8/3.0V	IO	MMC and SD data	
MMC_DAT0	128	1.8/3.0V	IO	MMC and SD data	
MMC_CLK	129	1.8/3.0V	DO	MMC and SD clock	
MMC_CMD	130	1.8/3.0V	IO	MMC and SD commands	
LDO7_SDIO	125	1.8/3.0V	PO	DATA cable Digital pull-up power supply	The power supply is not for the SD card
SPI Interface					
SPI_CLK	11	1.8V	I/O,PD	SPI clock	If unused, keep it open.
SPI_CS	12	1.8V	I/O,PD	SPI chip selection	
SPI_MOSI	13	1.8V	DO,PD	SPI Main output slave input	
SPI_MISO	14	1.8V	DI,PD	SPI Main input slave output	
GPIO					
GPIO_01	19	1.8V	IO,PU	General purple I/O	If unused, keep it open.
GPIO_02	26	1.8V	IO,PD	General purple I/O	If unused, keep it open.
GPIO_03	48	1.8V	IO,PU	General purple I/O	If unused, keep it open.
GPIO_04	53	1.8V	IO,PU	General purple I/O	If unused, keep it open.
GNSS Interface					
GNSS_PWRCTL	98	1.8V	DI	The enable control PIN of GNSS power supply.	Active high.
1V8_GNSS	97	-	PI	The power input for GNSS, Voltage range not less than 1.8V, but not higher than 1.9V	Module VDD_EXT (PIN 15) can be used for this power supply
GNSS_VBKP	116	-	PI	GNSS standby power input, input voltage 1.4V~3.6V	If unused, keep it open.
1PPS	100	1.8V	DO	1PPS pulse signal	If unused, keep it

				output	open.
GNSS_RXD	96	1.8V	DI	GNSS UART RX	Connect to MCU UART_TX; Or use 1K resistors in series in module UART3_TX (pin 50).
GNSS_TXD	95	1.8V	DO	GNSS UART TX	Connect to MCU UART_RX; Or use 1K resistors in series in module UART3_RX (pin 49).
SPI LCD Interface					
LCD_BL_PWM	101	1.8V	DO	LCD backlight adjusting PWM	If unused, keep it open.
LCD_SPI_CLK	102	1.8V	DO	SPI clock	
LCD_SPI_TXD	103	1.8V	DI，DO	SPI DATA(Bidirectional)	
LCD_SPI_RXD	104	1.8V	DI	SPI DATA	
LCD_SPI_CS	105	1.8V	DO	SPI CS	
LCD_RST	106	1.8V	DO	LCD Reset	
LCD_DCX	107	1.8V	DO	LCD Command/parameter selection	
SPI Camera Interface					
CAM_I2C_SDA	117	1.8V	DI, DO	CAM special I2C data	If unused, keep it open.
CAM_I2C_SCL	118	1.8V	DO	CAM special I2C clock	
CAM_PWDN	119	1.8V	DO	CAM power down	
CAM_RST	120	1.8V	DO	Camera reset	
CAM_MCLK	121	1.8V	DO	Camera main clock	
CAM_SPI_D0	122	1.8V	DI	Camera SPI D0	
CAM_SPI_D1	123	1.8V	DI	Camera SPI D1	
CAM_SPI_CLK	124	1.8V	DO	Camera SPI clock	
ANT Interface					
RF_ANT	60	-	AIO	Main antenna	
GNSS_ANT	90	-	AIO	GNSS antenna	
BT_ANT	93	-	AIO	Bluetooth antenna	
Keyboard Interface					
MK_IN2	47	1.8V	DI	Keyboard input	If unused, keep it open.
MK_IN3	20	1.8V	DI	Keyboard input	If unused, keep it open.

MK_IN5	68	1.8V	DI	Keyboard input	If unused, keep it open.
MK_IN6	36	1.8V	DI	Keyboard input	If unused, keep it open.
MK_OUT2	44	1.8V	DO	Keyboard output	If unused, keep it open.
MK_OUT3	21	1.8V	DO	Keyboard output	If unused, keep it open.
MK_OUT5	67	1.8V	DO	Keyboard output	If unused, keep it open.
MK_OUT6	35	1.8V	DO	Keyboard output	If unused, keep it open.
Other Pins					
ADC1	25	-	AI	General Purpose ADC	Voltage input range 0 ~ 1.2 V.
ADC2	51	-	AI	General Purpose ADC	
NETLIGHT	52	1.8V	DO	Network registration status indicator(LED) .The driving scheme is described in Section 3.10	
STATUS	66	1.8V	DO	Module status indicator (LED).	
USB_BOOT●	6	1.8V	DI	Force the download interface. Connect to GND and then power on the module. The module will enter the USB download mode.	It is recommended to place a test point for easy debugging and upgrade. Do not pull down before normal boot.

※ NOTE

1. Please reserve a test point for USB_BOOT, VDD_EXT and UART_LOG_TX. If there is no USB connector, please also reserve a test point for USB_VBUS, USB_DP, and USB_DM for Firmware upgrade.
2. '●' Indicates that these signals cannot be pulled down before starting. Otherwise, the module will be affected

2.3 Mechanical Information

The following picture depicts the package dimensions of the A7672S module.

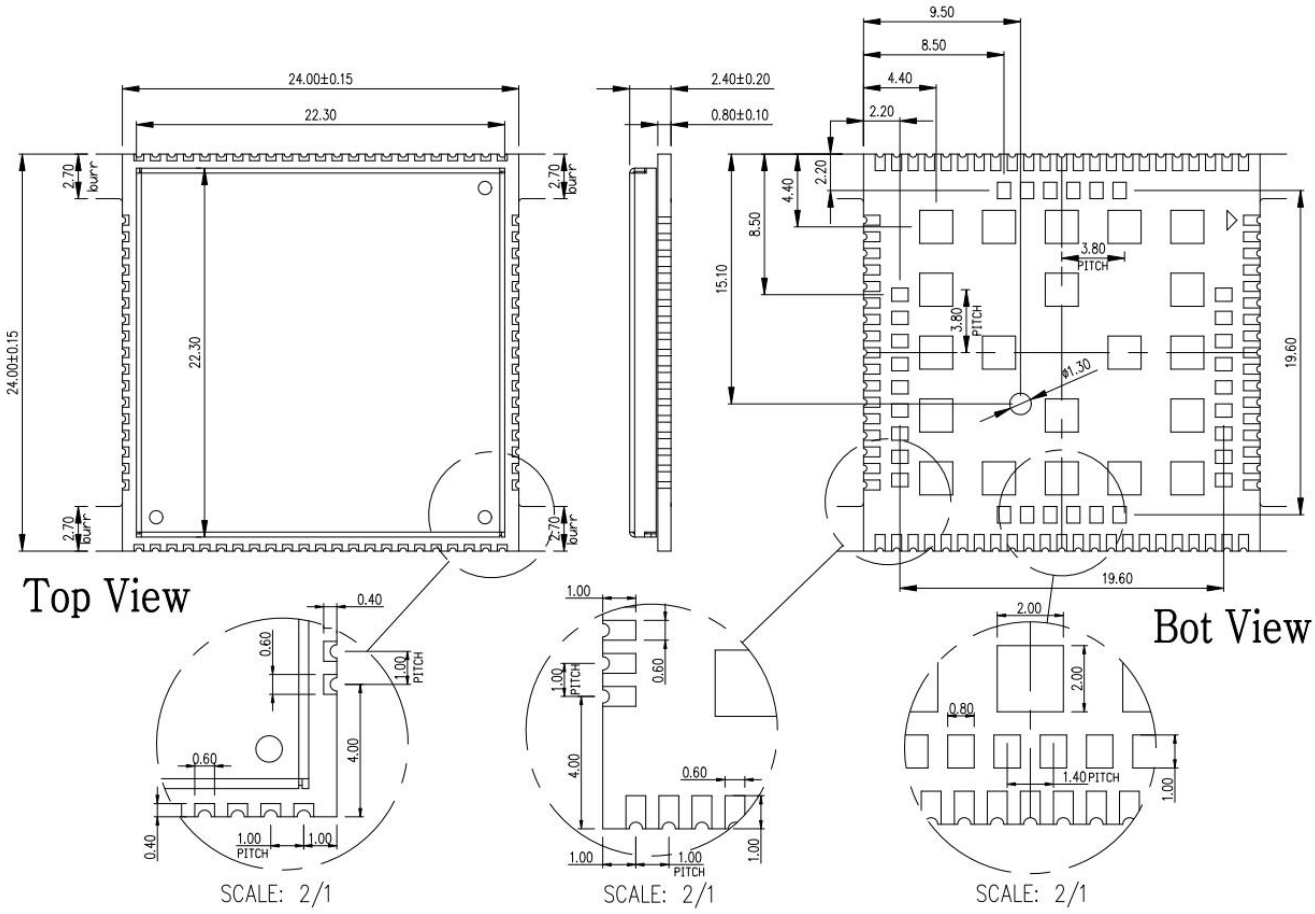

Figure 4: A7672S-MANS 3D dimensions (Unit: mm)

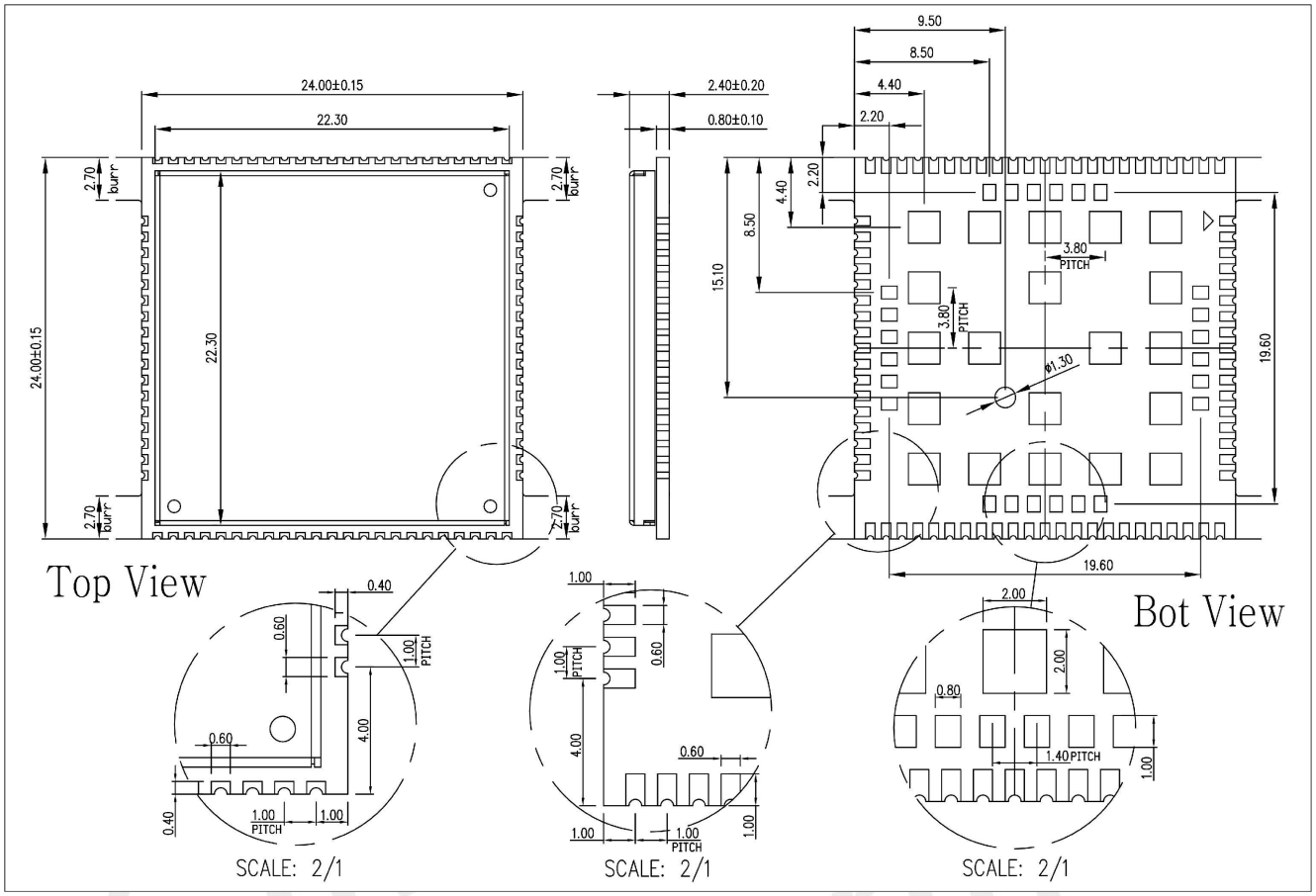

Figure 5: A7672S-FANS 3D dimensions (Unit: mm)

※ NOTE

1. The side length dimension is 24.00±0.15mm excluding the burr area.

2.4 Footprint Recommendation

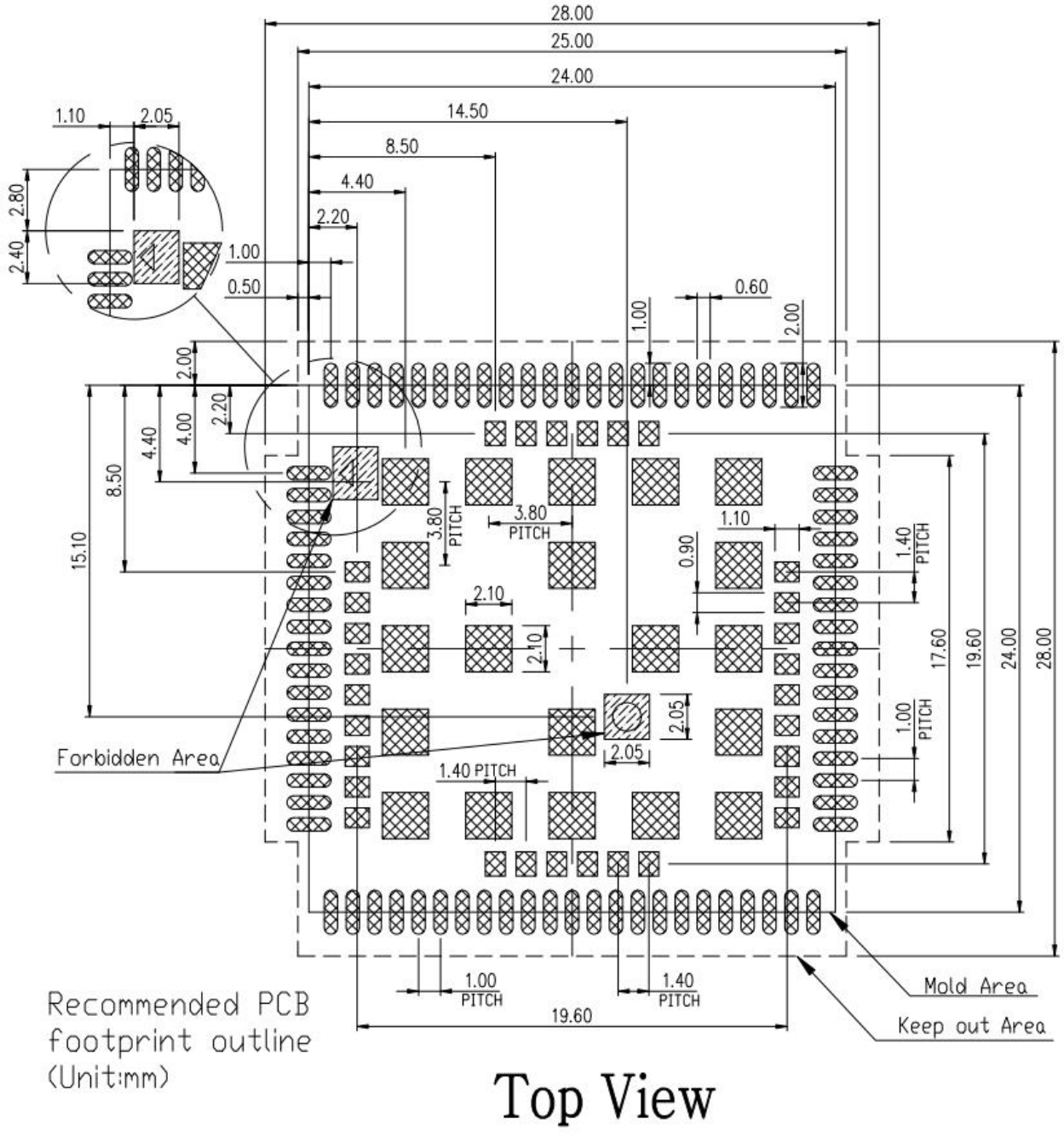

Figure 6: A7672S-MANS Footprint Recommendation (Unit: mm)

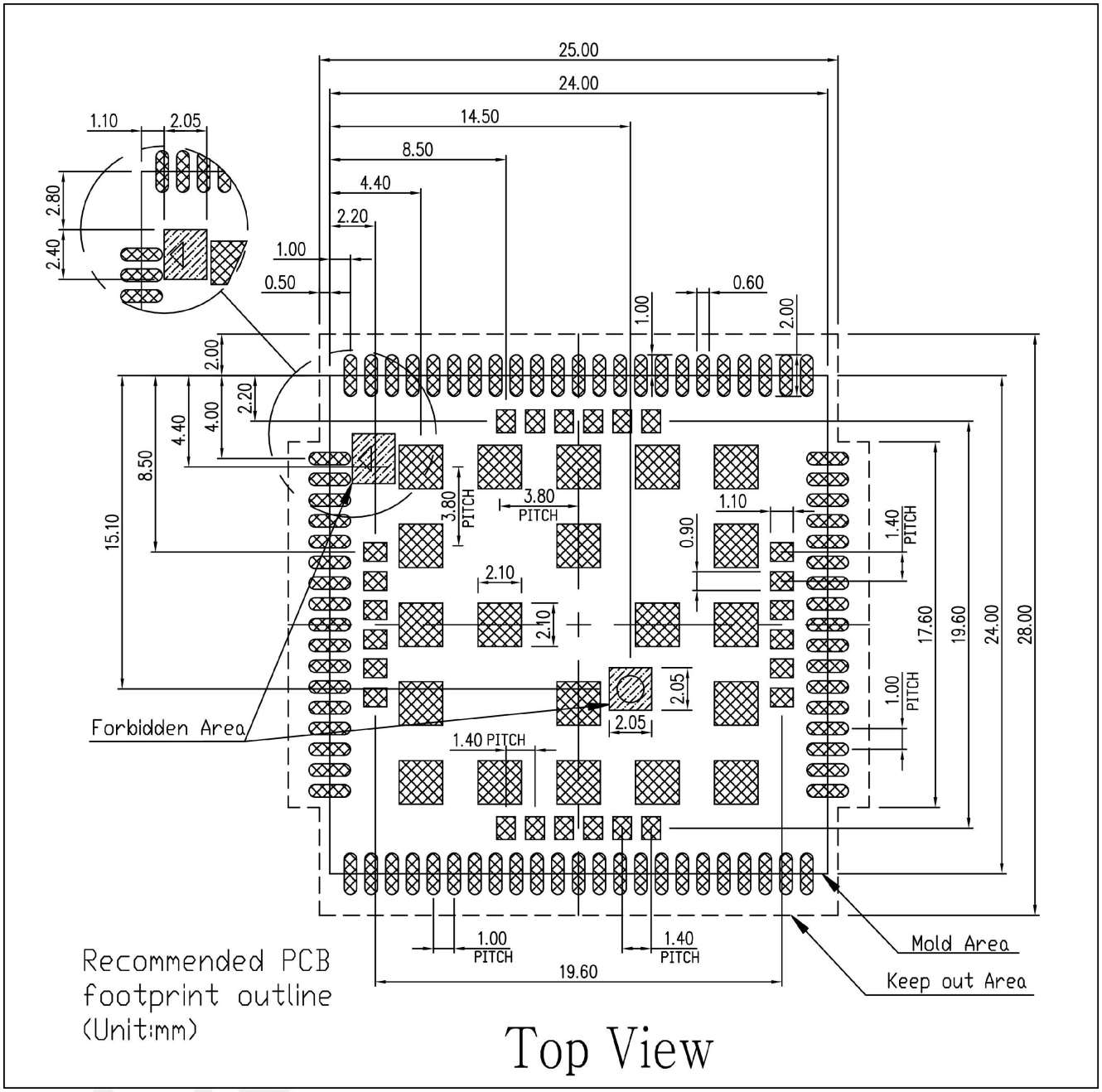

Figure 7: A7672S-FANS Footprint Recommendation (Unit: mm)

2.5 Recommend Stencil Size

Recommend stencil thickness≥0.12mm and <0.15mm.

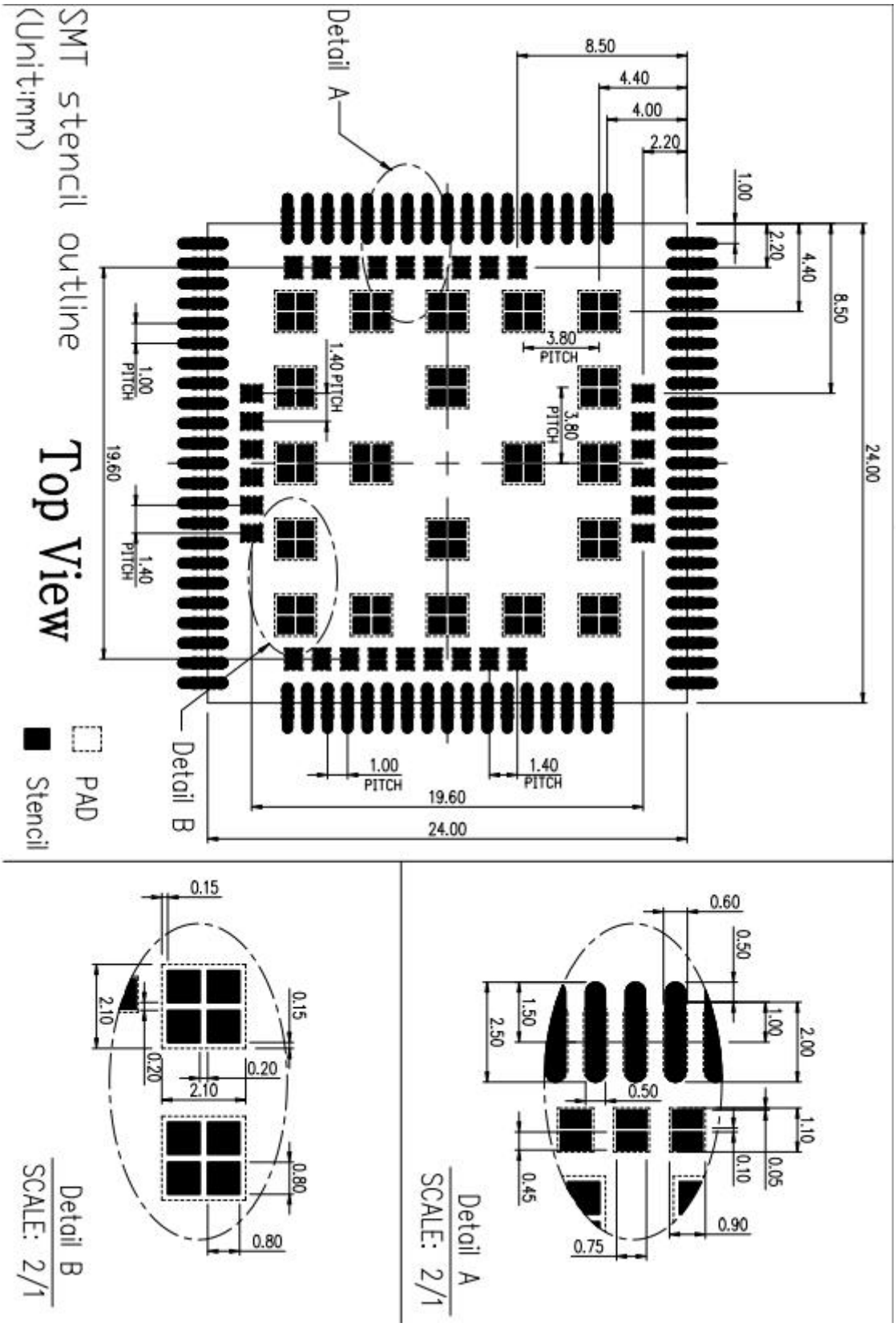

Figure 8: A7672S-MANS Recommend stencil dimension (Unit: mm)

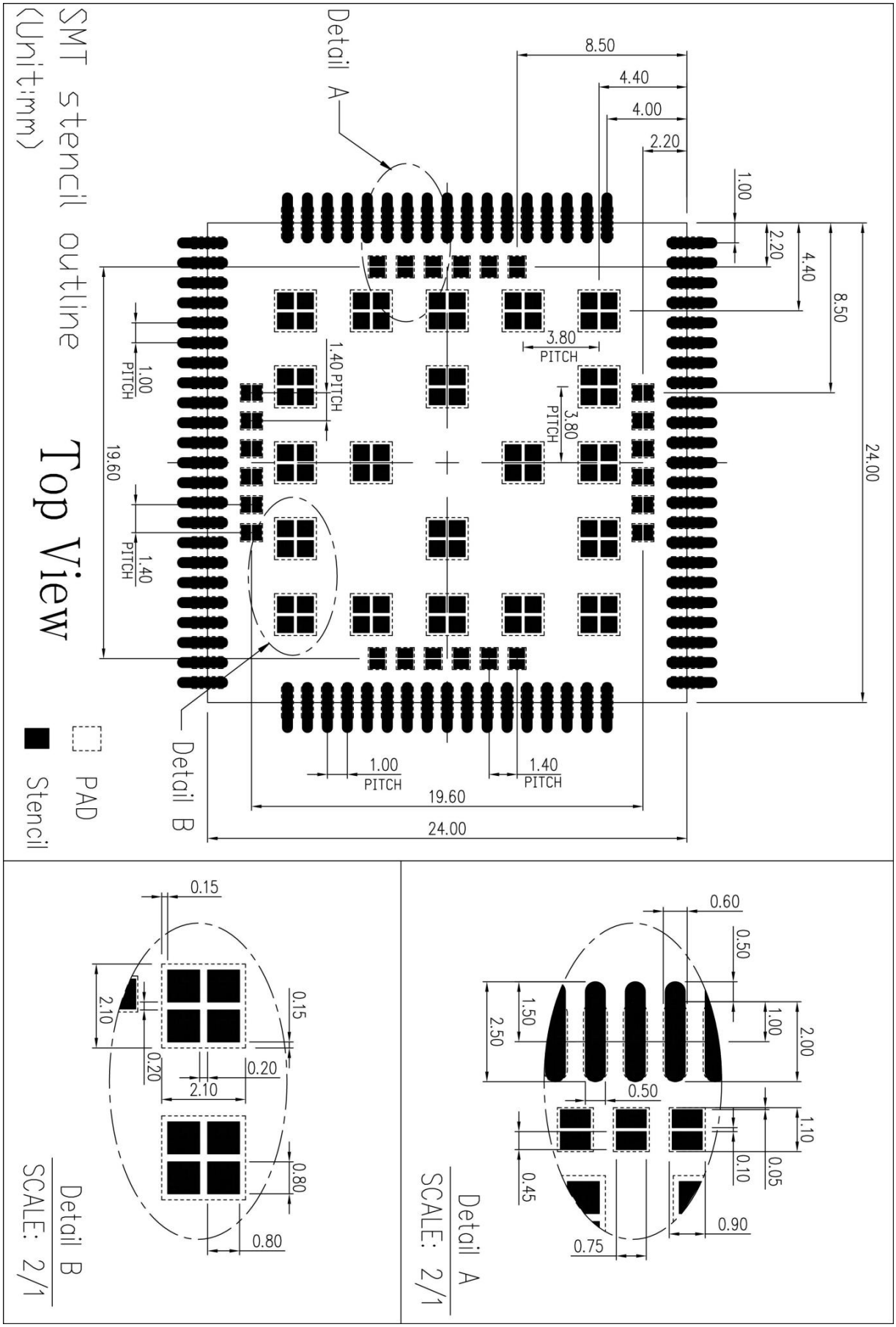

Figure 9: A7672S-FANS Recommend stencil dimension (Unit: mm)

3 Interface Application

3.1 Power Supply

A7672S module is powered by a single power supply with three pins (55,56,57) as the VBAT power input.A7672S use these three pins supply the internal RF and base-band circuit.

When the module is transmitted at maximum power in LTE mode, the peak current can reach as high as 1A instantaneously, resulting in a large voltage sag on the VBAT. To ensure that the voltage sag is less than 300mV, ensure that the external power supply capacity is no less than 1A.

Table 8: VBAT pins electronic characteristic

Parameter	Description	Min.	Typ.	Max.	Unit
VBAT	Module supply voltage	3.4	3.8	4.2	V
IVBAT(peak)	Module consumption peak current	-	1	-	A
IVBAT(average)	Module average consumption current (normal mode)	Refer to Table 44			
IVBAT(sleep)	Module average consumption current (sleep mode)				
IVBAT(power-off)	Module average consumption current (off leakage current)	-	35	-	uA

※ NOTE

1. Test condition: VBAT power supply 3.8V, the module is tested on SIMCom EVB board, and the power input has a 330UF tantalum capacitor.
2. IVBATT data in the preceding table is the overall data consumption of the module。

3.1.1 Power Supply Design Guide

In the user's design, special attention must be paid to the design of the power supply. If the voltage drops below 3.4V, the RF performance of the module will be affected, the module will shut down if the voltage is too low. It is recommended to select an LDO or DC-DC chip with an enable pin, and the enable pin is controlled by the MCU.

※ NOTE

1. When the power supply can provide a continuous current of 1A, the total capacity of the external power supply capacitor is recommended to be no less than 200uF. If a continuous current of 1A cannot be provided, it is recommended that the total external capacitance should not be less than 600uF to ensure that the voltage sag on the VBAT does not exceed 300mV at any time.

It is recommended to place four 33PF/10PF/0.1UF/1UF ceramic capacitors near VBAT to improve RF performance and system stability. At the same time, it is recommended that the VBAT layout routing width from the power supply on the PCB to the module be at least 2mm. Reference design recommendations are as follows:

If the VBAT input contains high-frequency interference, it is recommended to add magnetic beads for filtering. The recommended types of magnetic beads are BLM21PG300SN1D and MPZ2012S221A.

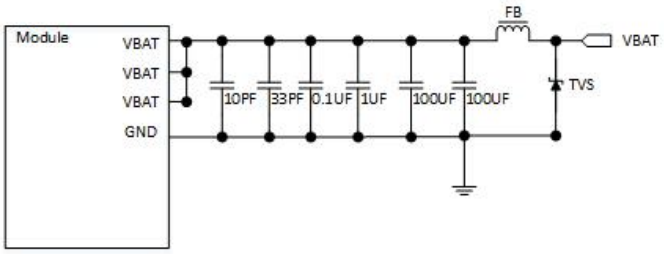

Figure 10: VBAT input reference circuit

In addition, in order to prevent the damage of A7672S caused by surge and overvoltage, it is recommended to parallel one TVS on the VBAT pin of the module.

Table 9: Recommended TVS diode list

No.	Manufacturer	Part Number	VRWM	Package
1	WAYON	WS2057KP	5V	DFN1610-2L
2	WILL	ESD56301D05	5V	DFN1610-2L
3	WILL	ESD56301D04-2/TR	4.85V	DFN1610-2L
4	WAYON	WS4.5DPHXM	4.85V	DFN1610-2L

※ NOTE

1. When selecting TVS by customer, it is necessary to pay attention to the clamping voltage in the case of surge protection. The clamping voltage should not be higher than 10V when 100V surge input.

3.1.2 Recommended External Power Supply Circuit

In terms of design, MCU must have the function of powering off the module, but it is forbidden to power off the module in the normal use process. Only after the module is normally shut down or cannot be normally shut down or restarted due to abnormalities, can the module be powered off. LDO or DC-DC chip with enabling foot is recommended. When the input power is greater than 9V, it is recommended to use DCDC chip. When the input is less than 9V, use the LDO power supply. If the OPEN LINUX secondary development function of the module is used, since there is no MCU, a low-cost MCU can be added to play the role of the hardware watchdog that can pull POWERKEY to start up and power off.

The recommended circuit for linear power supply is shown in the following figure, where PWR_CTRL is the control pin.

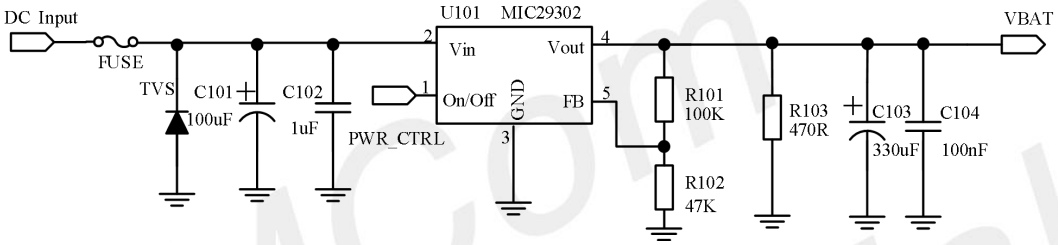

Figure 11: Linear power supply recommended circuit

The recommended circuit of switching power supply is shown in the following figure, where PWR_CTRL is the control pin:

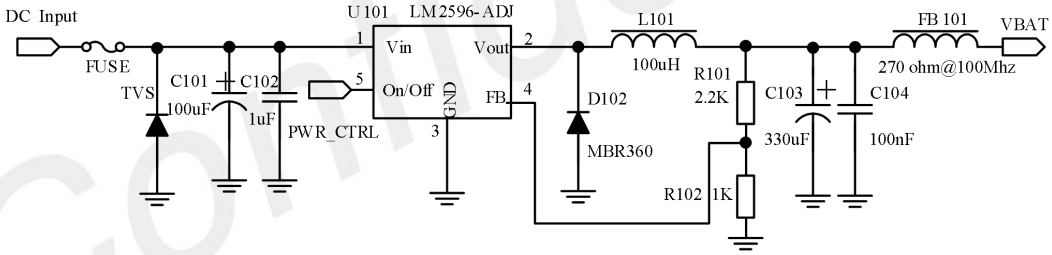

Figure 12: power supply reference circuit

When the VBAT power supply is disconnected, the voltage should drops rapidly within 50 ms. To avoid abnormal voltage, when the VBAT is lower than the minimum value, the system must power on the VBAT to lower than 100mV for at least 1 second to restart the system.

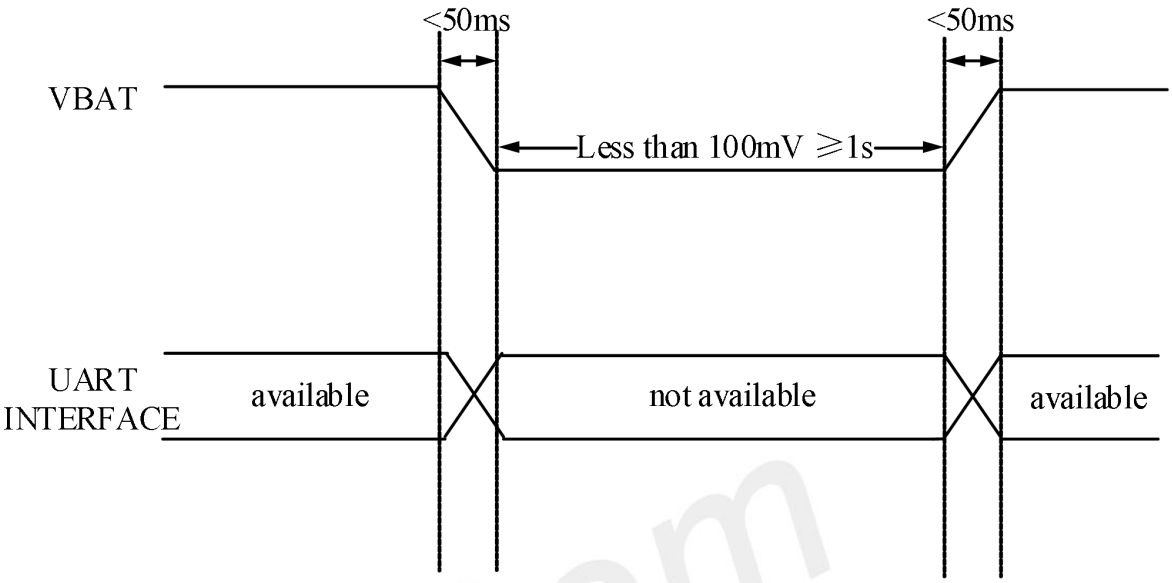

Figure 13: Power-off and power-on restart timing

3.1.3 Voltage Monitor

AT command 'AT+CBC' can be used to monitor VBAT voltage.

AT command 'AT+CVALARM' can be used to set high/low voltage alarm, When the actual voltage exceeds the preset range, a warning message will be reported through the AT port.

AT command 'AT+CPMVT' can be used to set high/low voltage power off, When the actual voltage exceeds the preset range, the module will shut down automatically.

※ NOTE

1. Voltage monitor function under debugging, Over-voltage alarm and over-voltage shutdown are off by default. For details of at commands, please refer to document [1].

3.2 Power On/ Off and Reset

3.2.1 Power on

Customer can power on the module by pulling down the PWRKEY pin. This pin has been pulled up inside the module to VBAT.

It is recommended that when using the module, adding TVS diode at the module pin can effectively enhance the ESD performance.

The recommended circuit is as follows:

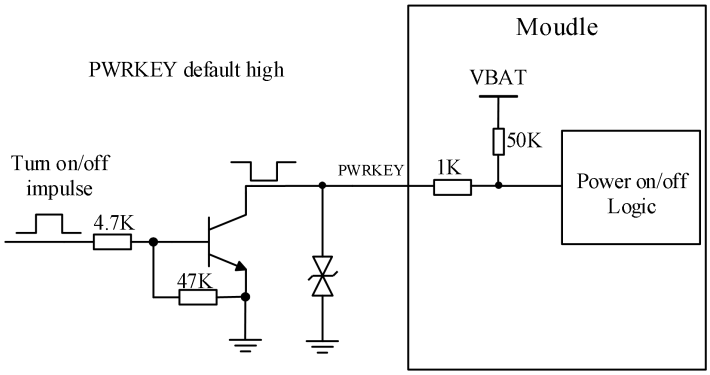

Figure 14: Reference power on/off circuit

※ NOTE

1. If the customer does not need to start the PWRKEY automatically, do not connect a capacitor larger than 10pF on the PWRKEY and RESET. Otherwise, the module will start automatically if the low level is detected during the power-on.
2. Do not pull down PWRKEY and RESET in a short period of time during the startup process. Otherwise, the startup may fail.

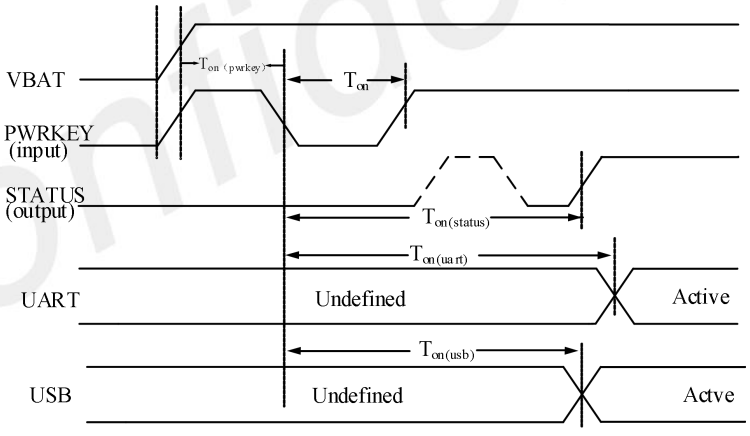

Figure 15: Power on timing sequence

Table 10: Startup timing parameters

Symbol	Parameter	Min.	Typ.	Max.	Unit
$T_{on(pwrkey)}$	Power on to PWRKEY low time (the module can be started normally)	-	30	-	ms
T_{on}	Power-on low pulse width	-	50	-	ms
$T_{on(status)}$	Startup time (according to the STATUS pin)	-	7	-	s
$T_{on(uart)}$	Startup time (according to the UART pin)	-	8	-	s
$T_{on(usb)}$	Startup time (according to the USB pin)	-	9	-	s
V_{IH}	Input high level voltage on PWRKEY pin	0.7*VBAT	-	VBAT	
V_{IL}	Input low level voltage on PWRKEY pin	0	0	0.3*VBAT	

3.2.2 Power off

A7672S has the following shutdown methods:

- Power off by pulling the PWRKEY# pin down to a low level.
- Power off Module by AT command 'AT+CPOF'.
- Over-voltage or under-voltage automatic power off, Use "AT+CPMVT" to set the voltage range.
- Over-temperature or under-temperature automatic power off.

It is strongly recommended that the customer use PWRKEY or 'AT+CPOF' to shut down, and then power off VBAT (especially when the module does not need to work). In addition, the customer cannot shut down VBAT by disconnecting it, which may cause damage to flash.

※ NOTE

1. when the temperature exceeds the range of - 30 ~ + 75 ℃, A7672S will report warning information through AT port. When the temperature exceeds the range of - 40 ~ + 85 ℃, A7672S will shut down automatically. For a detailed description of 'AT+ CPOF' and 'AT+ CPMVT', please refer to document [1].

PWRKEY can be used to power off the module, power off sequence see the following figure:

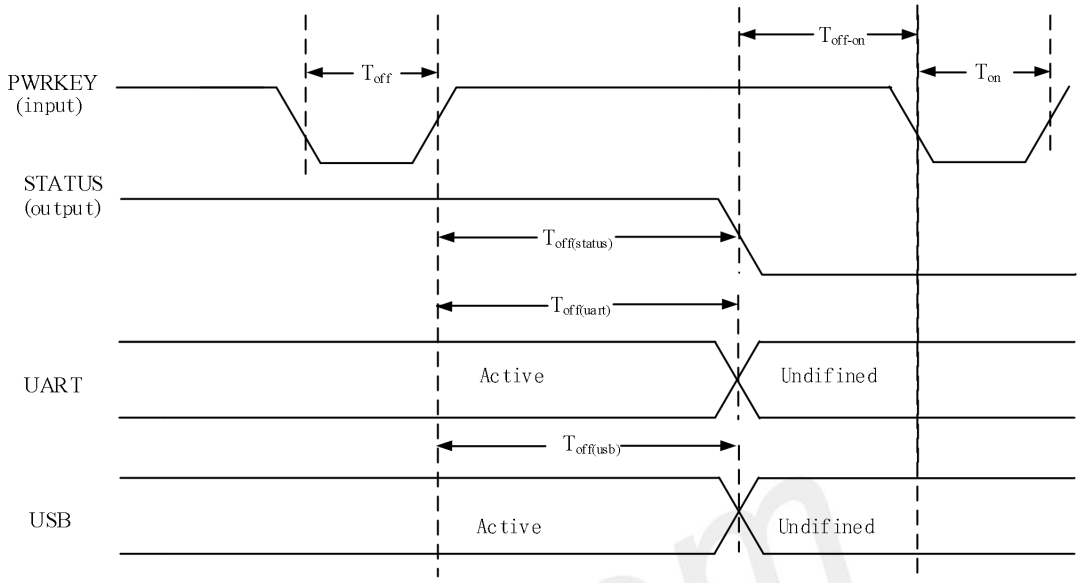

Figure 16: Power off timing sequence

Table 11: Power off sequence parameters

Symbol	Parameter	Min.	Typ.	Max.	Unit
T_{off}	Power off low level pulse width	2.5	-	-	s
$T_{off(status)}$	Power off time (according to status interface)	-	2.5	-	s
$T_{off(uart)}$	Power off time (according to UART interface)	-	2.5	-	s
$T_{off(usb)}$	Power off time (according to USB interface)	-	2.5	-	s
T_{off-on}	Power off - power on buffer time	2	-	-	s

※ NOTE

1. The status pin can be used to judge whether the module is powered on or not. When the module is powered on and initialization is completed, the status outputs a high level, otherwise the low level will be maintained all the time.

3.2.3 Reset Function

A7672S can restart the module by pulling down the reset pin of the module. RESET pin also has the function of pulling down the boot (irrelevant machine function). The PMU has the power on function only when the module is powered on for the first time. After the PMU is powered on, the register is changed to disable the RESET button, so it is recommended to use PWRKEY to power on the module and RESET key only used as reset function.

A 50K Ω resistor is used to pull-up to VBAT inside the module, so it is no need to add pull-up resistor outside. The recommended circuit is showed as follows:

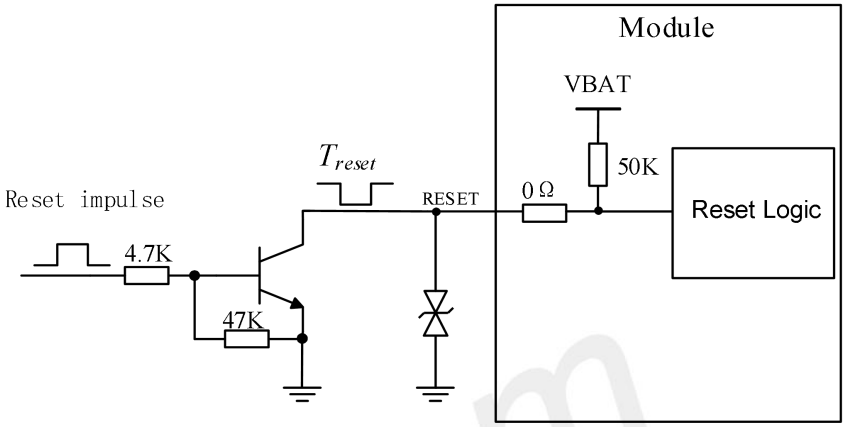

Figure 17: Reference reset circuit

Table 12: RESET pin electronic characteristic

Symbol	Description	Min.	Typ.	Max.	Unit
T_{reset}	Restart low pulse width	2	2.5	-	S
V_{IH}	RESET pin input high level voltage	0.7*VBAT	-	VBAT	V
V_{IL}	RESET pin input low level voltage	0	0	0.3*VBAT	V

※ NOTE

1. It is recommended to use the reset pin only in case of emergency, such as the module is not responding. The reset time is recommended to be 2.5s.

3.3 UART Interface

The A7672S module provides three serial ports: the main full-function communication serial port UART, one common two-cable serial port, and one DBG serial port UART for printing LOG. The module is a Data Communication Equipment (DCE).

3.3.1 UART Design Guide

When the user uses full-function serial port, please refer to the following connection mode:

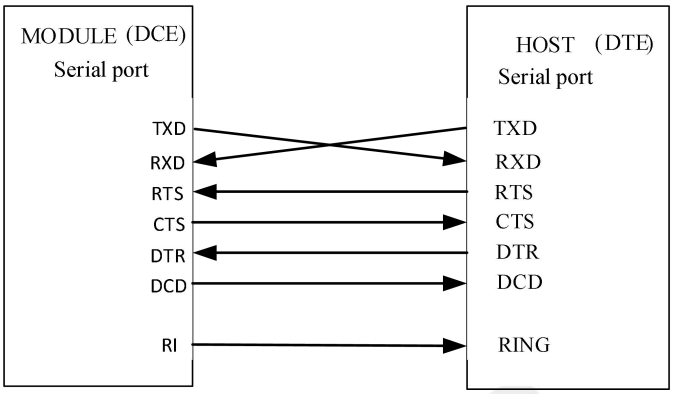

Figure 18: Serial port connection diagram (full-function mode)

When using 2-wire serial port, please refer to the following connection mode:

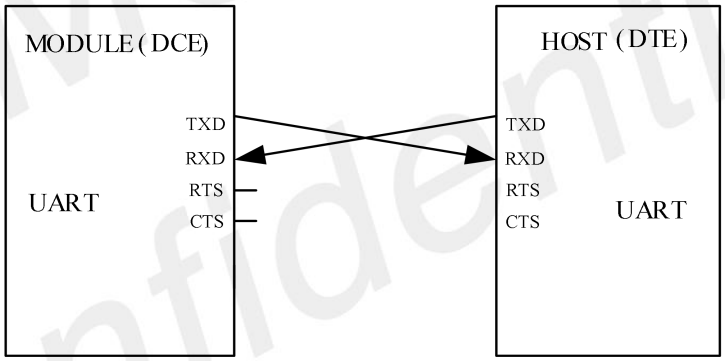

Figure 19: Serial port connection diagram (NULL mode)

The following figure shows the use of triode for level shifter circuits. The circuit with dotted line can refer to the circuit with solid line TXD and RXD, and attention shall be paid to the direction of signal.
The recommended triode model is MMBT3904.

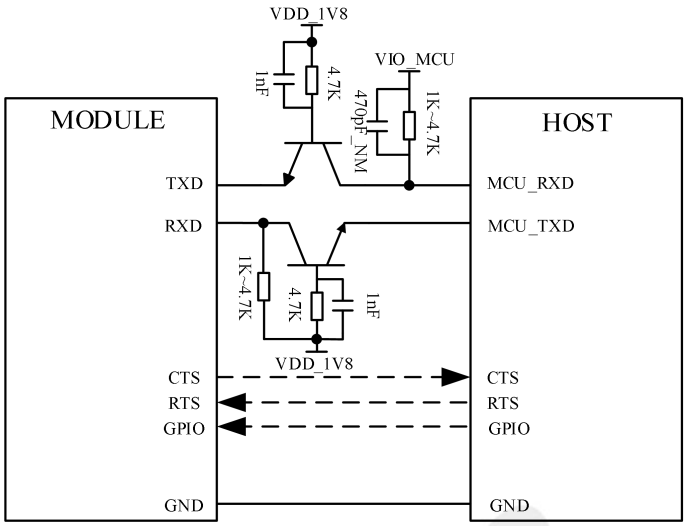

Figure 20: Triode level conversion circuit

※ NOTE

1. A7672S Main UART supports the following baud rates: 300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600, 1842000, 3686400. The default baud rate is 115200bps.
2. The maximum baud rate supported by A7672S UART2 and UART3 is 921600.
3. The parasitic capacitance of the transistor will affect the edge of the high-speed digital signal. It is not recommended to use this circuit when the signal speed is higher than 115200bps.

3.3.2 RI and DTR Behavior

RI usually keeps high level output. When receiving a short message or URC report, RI outputs a low level for 120ms (short message)/60ms (URC), and then returns to a high-level state; RI will output a low level, when receiving a phone call as the called party. After outputting low level, RI will remain low until the host accepts the call using the "ATA" command or the caller stops calling RI, in the end, it will become high level.

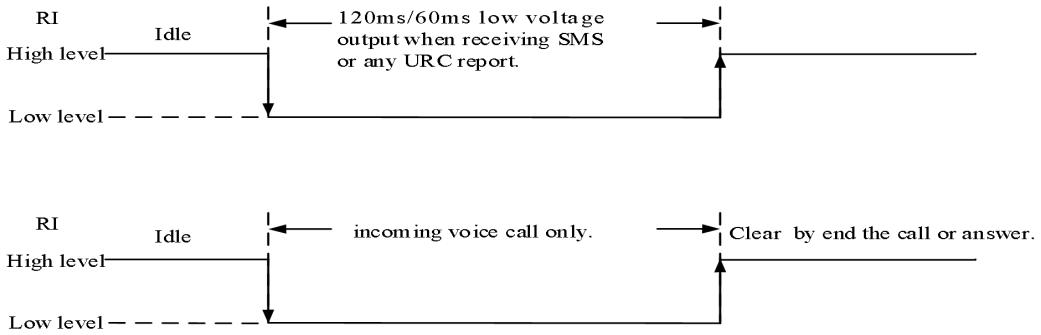

Figure 21: Level change on RI (SMS and URC report)

The DTR can be used as the sleep wake pin of the A7672S module. After the A7672S module enters sleep mode, lower the DTR to wake up the A7672S module.

After setting the AT command “AT+CSCLK=1”, and then pulling up the DTR pin, Module will enter sleep mode when module is in idle mode. In sleep mode, the UART is unavailable. When A7672S enters sleep mode, pulling down DTR can wake-up module.

After setting the AT command “AT+CSCLK=0”, A7672S Series will do nothing when the DTR pin is pulling up.

3.4 USB Interface

A7672S module has one USB2.0 port and does not support USB charging or USB HOST mode. Support high speed (480Mbps) and full speed (12Mbps), the interface can be used for AT instruction sending, data transmission, software debugging and upgrade. Map ttyUSB1-ttyUSB2 on Linux or android (see Linux or android debugging documentation for details).

USB is the main debugging port and software upgrade interface. It is recommended that customers reserve USB test points during design. If a main control chip is connected, 0R resistors must be reserved for switching external test points during design.

3.4.1 USB Reference Design

A7672S can be used as a USB slave device and supports USB sleep and wake up mechanisms. The recommended connection circuit diagram is as follows:

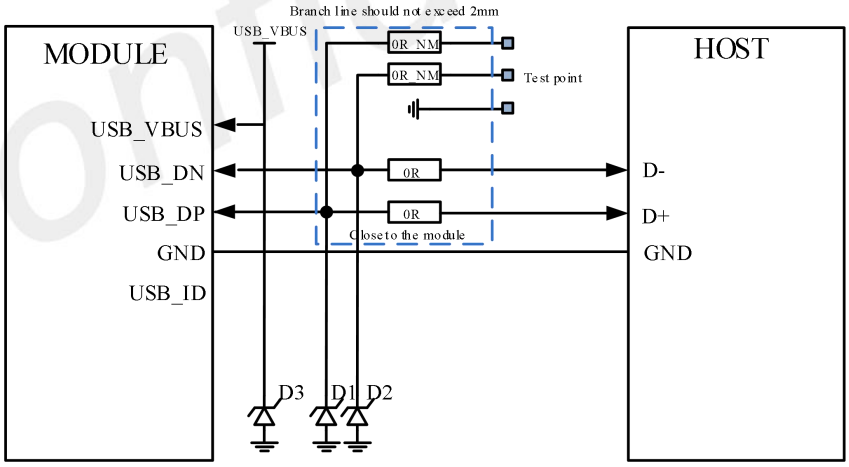

Figure 22: USB connection diagram

Customers should pay attention to the selection of D3 devices when using them. It is recommended to choose anti-static and anti-surge devices. A TVS tube can be placed, and the recommended model is ESD5681N07.

※ NOTE

1. The USB data cable must be strictly routed in 90Ω +/- 10% differential. The TVS devices D1 and D2 on the data line must be selected with equivalent capacitance less than 1pF. The TVS device should be placed near the USB connector or test point, recommended models ESD73011N and WS05DUCFM.
2. The detection of USB2.0 speed is determined automatically by the USB protocol. The customer does not need to pull up the DP external, otherwise it may affect the device USB enumeration.

3.4.2 USB_BOOT Interface

A7672S provides one forced download boot interface 'USB_BOOT'.

Table 13: USB_BOOT description

Pin Number	Pin Name	I/O	Description	Power Domain	Default State	Remark
6	USB_BOOT	DI	Force downloads boot port	1.8V	B-PU	

If the module upgrade fails to boot, you can force upgrade through the USB_BOOT port.

Before the module is powered on, pull the USB_BOOT pin to GND, then apply VBAT power to the module, and press RESET to enter the download mode. After entering the download mode, you need to release USB_BOOT and remove the pull-up.

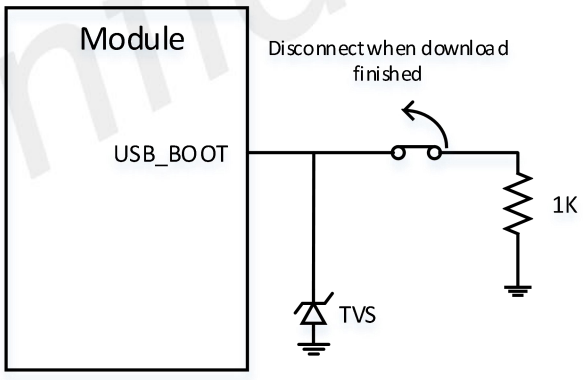

Figure 23: USB_BOOT connection circuit

Customers will see the download port in the device manager port of the windows system.

Figure 24: Force-download port

※ NOTE

1. USB_BOOT only has the forced download boot function before booting (cannot be pulled down), and other functions after powering on.

3.4.3 USIM Interface

A7672S supports both 1.8V and 3.0V USIM Cards. The interface power of the USIM card is provided by the voltage regulator inside the module, and the normal voltage value is 3V or 1.8V.

Table 14: USIM electronic characteristic in 1.8V mode (USIM_VDD=1.8V)

Symbol	Parameter	Min.	Typ.	Max.	Unit
USIM_VDD	Output power supply voltage to USIM card	1.62	1.8	1.98	V
V_{IH}	High-level input voltage	0.7*USIM_VDD	-	USIM_VDD +0.4	V
V_{IL}	Low-level input voltage	-0.4	0	0.25*USIM_VDD	V
V_{OH}	High-level output voltage	USIM_VDD -0.4	-	USIM_VDD	V
V_{OL}	Low-level output voltage	0	0	0.2	V

Table 15: USIM electronic characteristic 3.0V mode (USIM_VDD=3V)

Symbol	Parameter	Min.	Typ.	Max.	Unit
USIM_VDD	Output power supply voltage to USIM card	2.7	3	3.3	V
V_{IH}	High-level input voltage	0.7*USIM_VDD	-	USIM_VDD +0.4	V
V_{IL}	Low-level input voltage	-0.4	0	0.25*USIM_VDD	V
V_{OH}	High-level output voltage	USIM_VDD -0.45	-	USIM_VDD	V
V_{OL}	Low-level output voltage	0	0	0.3	V

3.4.4 USIM Hot swap function

SIM card has a physical detection point SIM_DET. After the SIM card is inserted, SIM_DET changes from high level to low level. The falling edge indicates that a SIM card is inserted. After the SIM card is removed, SIM_DET changes from low level to high level. The rising edge indicates that the SIM card is removed.

Use the "AT + UIMHOTSWAPON = 0 or 1" and "AT + UIMHOTSWAPLEVEL = 0 or 1" AT commands to set the SIM card hot-swap function and SIM card detection level for more details. Refer to the A7600 Series_AT command manual documentation.

If the SIM card hot-swap function is not used, the customer can keep the SIM_DET pin disconnected.

3.4.5 SIM Application Guide

The following figure shows the recommended interface circuit of USIM card. To protect USIM card, it is recommended to use ST (www.st.com) ESDA6V15W device or ON SEMI (www.onsemi.com) SMF15C device as electrostatic protection. The peripheral circuit components of the USIM card should be placed close to the USIM card holder. The recommended circuit for the 8-pin USIM station is shown below.

The reference circuit is shown in the following figure.

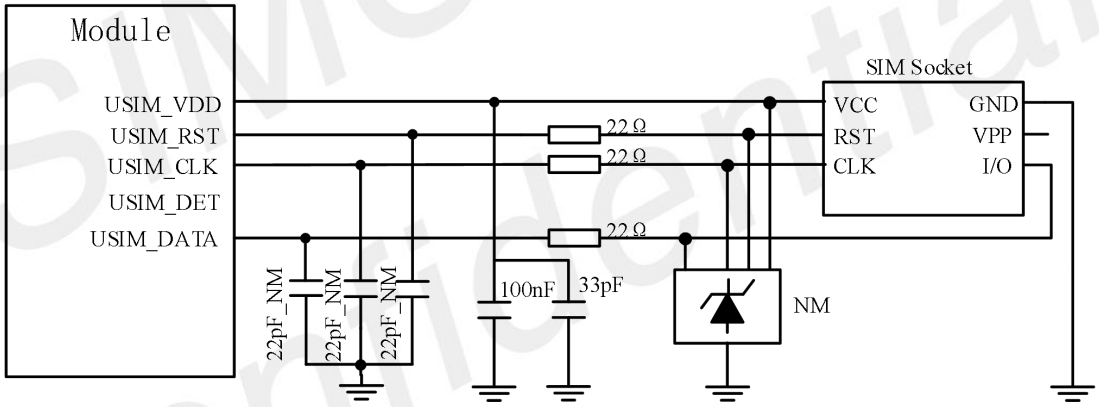

Figure 25: USIM interface reference circuit

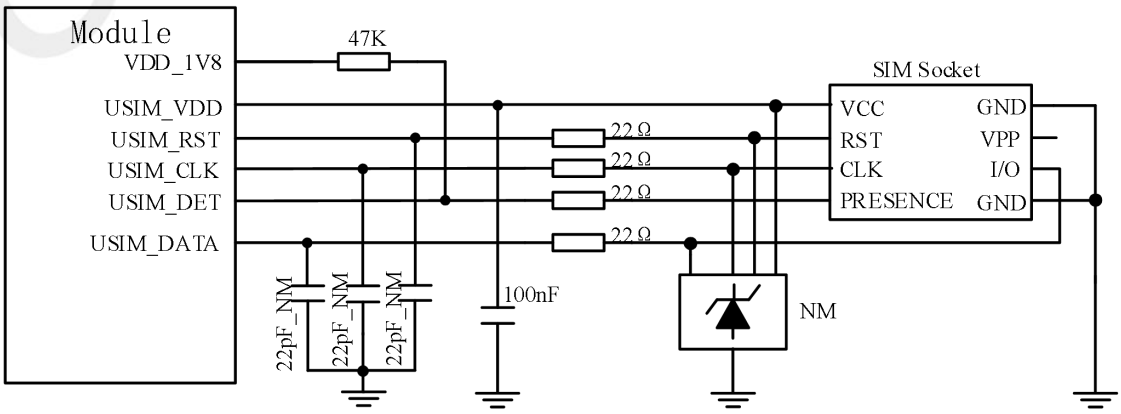

Figure 26: USIM interface reference circuit (8PIN)

※ NOTE

1. USIM_DATA is pulled up to the USIM_VDD through a 4.7KΩ resistor. The external circuit does not need to be pulled up. In addition, the 100nF decoupling capacitor recommendation on USIM_VDD must be retained. For more AT commands on USIM card operation, refer to the documentation [1].

USIM card circuit is easy to be interfered with, causing card recognition or card drop, so please follow the following principles when designing:

- Always place the USIM booth away from the main antenna during the PCB layout phase.
- USIM card should be kept away from RF cables, VBAT cables, and high-speed signal cables. The USIM card should not be too long.
- GND of the USIM card should be well connected with the GND of the module so that the two GND potentials are equal.
- To prevent USIM_CLK from interfering with other signals, you are advised to use USIM_CLK as a separate packet protection.
- It is recommended to place a 220nF capacitor on the USIM_VDD signal cable near the USIM card.
- Place TVS near USIM booth, and the parasitic capacitance of TVS should not be greater than 33pF, such as ESD9L5.0ST5G.
- A 22Ω resistor in series between the USIM card holder and the module can enhance ESD protection.
- For the smoothest routing, it is recommended to use single-channel TVS, which are placed near each pin of the booth.
- USIM_CLK signal is very important. The customer must ensure that the time between the rising edge and falling edge of the USIM_CLK signal is less than 40ns. Otherwise, abnormal card identification may occur.

3.4.6 Recommend USIM Card Holder

Amphenol C707 10M006 512 is recommended for the 6-pin USIM booth. Please visit http://www.amphenol.com for more information!

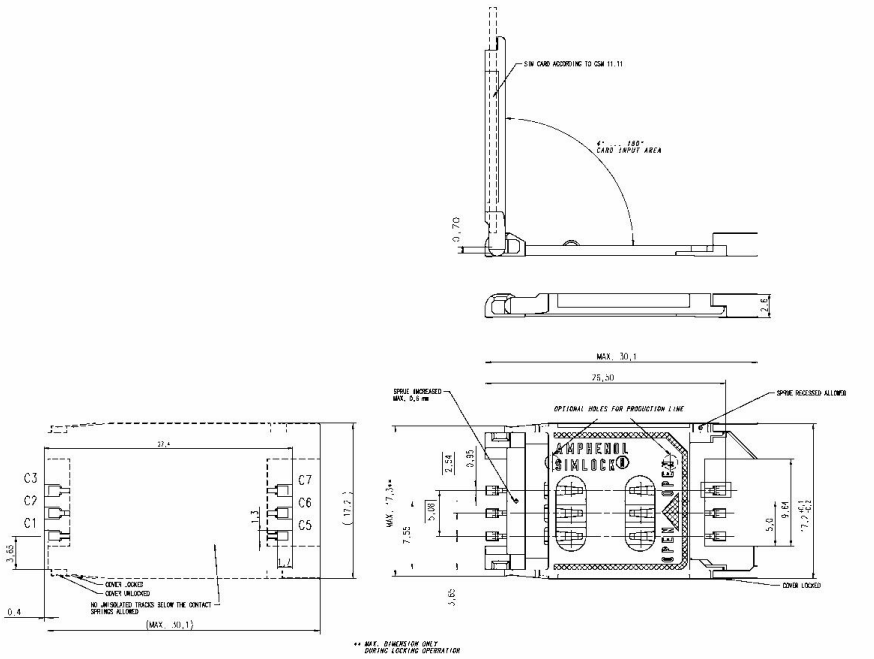

Figure 27: Amphenol C707 10M006 512 USIM Holder size diagram

Table 16: 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 input/output pins

※ NOTE

1. If the customer designs a vehicle-mounted product, please choose the USIM booth with better reliability.

3.5 Analog audio interface

A7672S modules integrate audio codec and audio front end, provide 1 channel of analog audio MIC input interface and 1 channel of analog audio SPK output interface, customers can connect to the external phone handle for voice calls.

ADC: 90dB SNR@20~20kHz

DAC: 95dB SNR@20~20kHz

(Class-AB): THD<-85dB@32-ohm

Table 17: Analog audio output (AVDD_AUD=1.8V, T=25°C)

Parameter	Conditions	DR（Typ.）	THD+N（Typ.）	Max Power
DAC	RL=10K	101dBA	-96dB (@vout -2dBv)	1.59Vp
Class-AB	Mono,32Ω Difference	100dBA	-90dB (0.00316%) (@20mW output)	37mW

3.6 Analog audio reference design

The analog audio recommendation circuit is as follows:

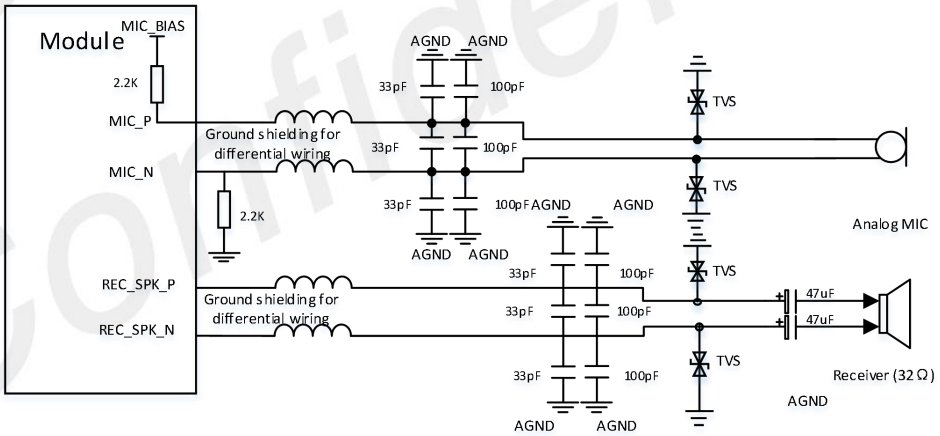

Figure 28: Analog audio interface reference circuit

3.7 Matrix keyboard interface

A7672S provides a 4*4 matrix keyboard interface.

Table18: matrix keyboard PIN description

Pin Name	Pin No.	I/O	Description	Note
MK_IN2	47	DI	Matrix keyboard input	If unused, keep it open.
MK_IN3	20	DI		
MK_IN5	68	DI		
MK_IN6	36	DI		
MK_OUT2	44	DO	Matrix keyboard output	If unused, keep it open.
MK_OUT3	21	DO		
MK_OUT5	67	DO		
MK_OUT6	35	DO		

The matrix keyboard interface recommendation circuit is as follows:

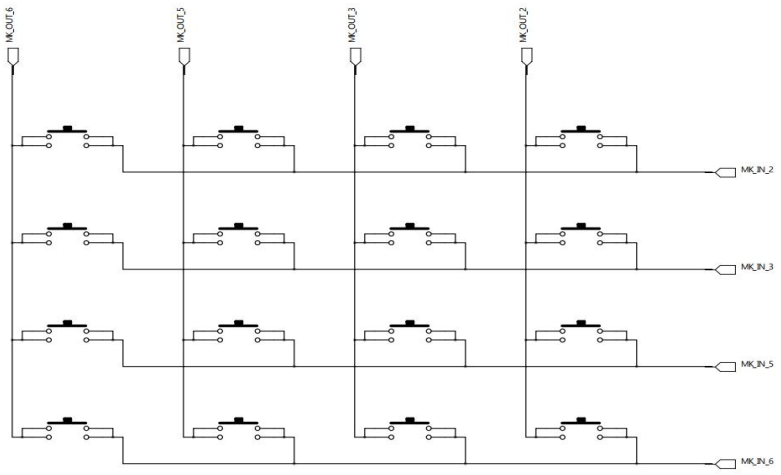

Figure 29: Matrix keyboard interface reference circuit

3.8 GPIO Interface

A7672S module provides multiple GPIOs.

Table 19: Standard GPIO Resources of A7672S

Pin No.	Pin Name	AT Command Operation GPIO Number	Pin Type	Power Domain	Default State	Default Function	Pad Edge Wakeup
19	GPIO_01	GPIO_01	IO	1.8V	PU	Common input/output	Yes
26	GPIO_02	GPIO_02	IO	1.8V	PD	Common input/output	Yes

48	GPIO_03	GPIO_03	IO	1.8V	PU	Common input/output	No
53	GPIO_04	GPIO_04	IO	1.8V	PU	Common input/output	Yes

3.9 I2C Bus

Module provides a group of hardware I2C protocol interface, support standard mode 100Kbps, support high-speed mode 400Kbps, working voltage of 1.8V. I2C is open-drain output, and the reference circuit is shown below:

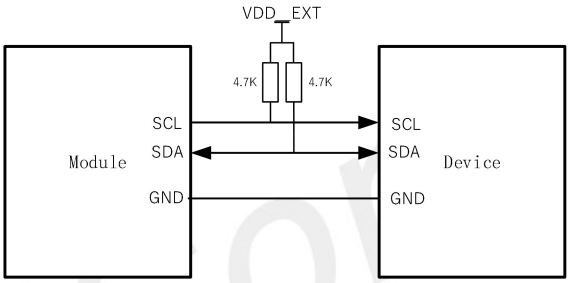

Figure 30: I2C reference circuit

※ NOTE

1. The SCL and SDA pins require pull-up resistors, and the pull-up power supply must be VDD_EXT of the module output.

3.10 Network status

NETLIGHT can indicate the current network status. It is usually used to drive the LED light indicating the network status. The reference circuit is shown below:

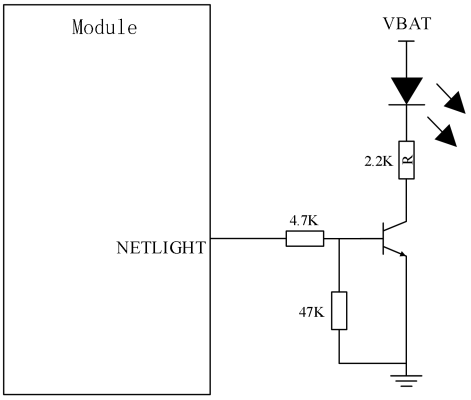

Figure 31: NETLIGHT reference circuit

※ NOTE

1. The resistance value of R in the figure above depends on the specific parameters of VBAT and LED.

The NETLIGHT signal is used to control the LED lights that indicate the status of the network. The working status of this pin is shown in the table below:

Table 20: LTE mode NETLIGHT pin status

NETLIGHT Pin Status	Module Status
Always On	Searching Network
200ms ON, 200ms OFF	Data Transmit/Registered
OFF	Power off, or condition AT+CSCLK=1, and DTR is pulled up。

3.11 GNSS interface

A7672S support GNSS function interface. GNSS provides 2 power supply input interfaces, 1 GNSS power enable control switch, 1 UART interface and 1 pulse synchronous clock signal interface, which are described in detail as follows.

Table 21: GNSS interface description

Pin Name	Pin No	I/O	Description	Note
GNSS_VBKP	116	PI	GNSS backup power input	Power supply ranges from 1.4V to 3.6V. If you need to use hot start when the module is shut down, you are advised to use an external normal power supply.
1V8_GNSS	97	PI	GNSS Vcore、VDDIO input	The power supply voltage must be no less than 1.8V and no more than 1.9V. The cable must be as short as possible, with a cable width of more than 0.3mm.
GNSS_PWRCTL	98	DI	GNSS Vcore、VDDIO power enable control	Active high. Solution 1: Use 10K resistor to Connect to GPIO, MK_IN_3 (PIN20) is recommended. Solution 2: Use 10K resistor to Connect to MCU

				GPIO.
GNSS_RXD	96	DI	GNSS UART RX	1.8V power domain. Solution 1：Use 1K resistor to connect UART3_TXD（PIN50）of the module in series. Solution2: Use 1K resistor to Connect to MCU UART_TX.
GNSS_TXD	95	DO	GNSS UART TX	1.8V power domain. Solution 1 : Use 1K resistor to connect UART3_RXD（PIN49）of the module in series. Solution2：Use 1K resistor to Connect to MCU UART_RX.
1PPS	100	DO	GNSS pulse synchronous clock signal	Second pulse signal can be used for accurate timing.

GNSS recommended reference design solution 1:

The reference design of GNSS, which is independent and powered by the module itself and enabled by the power supply and UART transparent transmission, is as follows:

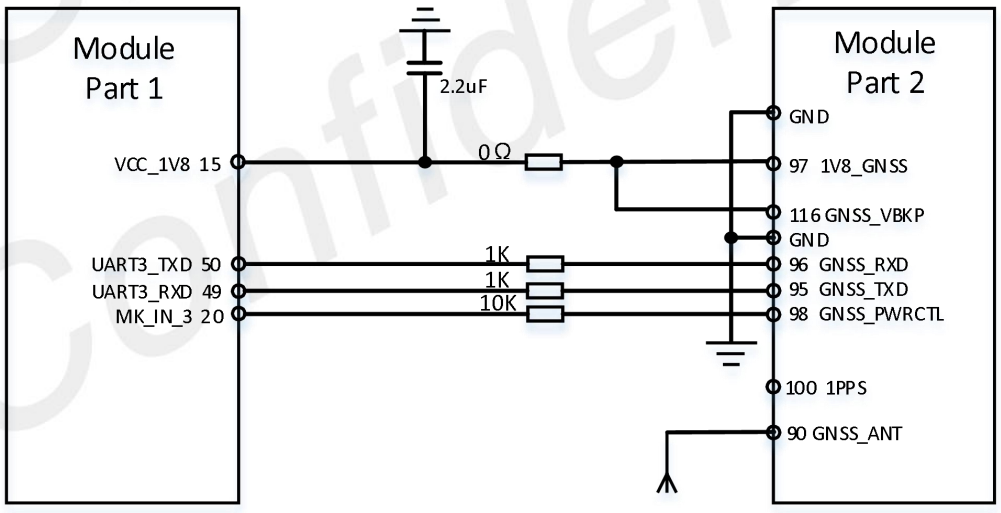

Figure 32: GNSS reference design (Non-standalone GNSS solution)

GNSS recommended reference design solution 2:

The reference design of independent GNSS, which is powered by the external module and transparently transmitted by MCU UART, is as follows. This wiring method is used in scenarios where GNSS can work independently without the module being powered on:

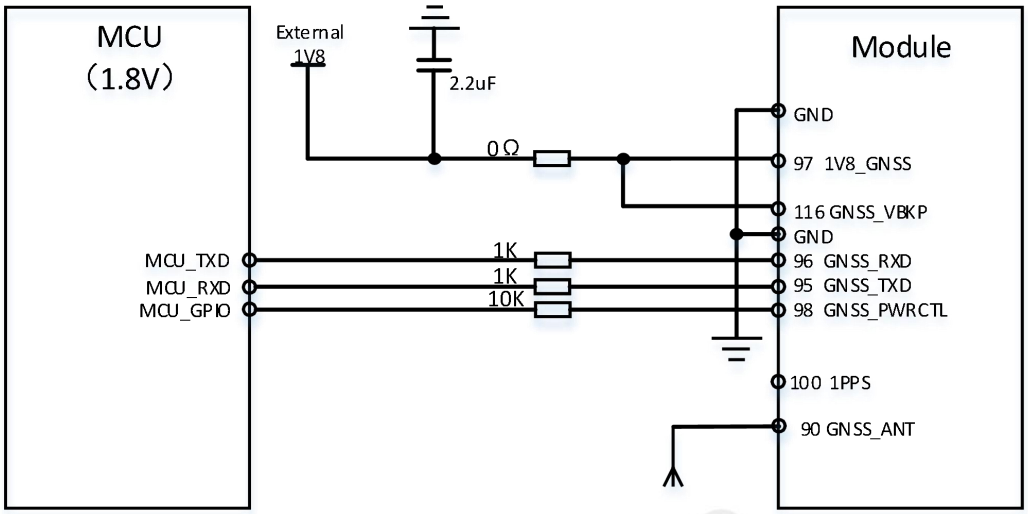

Figure 33: GNSS reference design (standalone GNSS solution)

※ NOTE

1. Please series in 1K resistors for serial communication lines with GNSS to prevent leakage current to the serial ports of GNSS chip.
2. The standalone GNSS reference design is only applicable to 1.8V power domain MCU. If the MCU is not 1.8V power domain, a level shift circuit should be added.
3. GNSS main power input 1V8_GNSS has high requirements on power supply. The PCB cable should be as short as possible, and the cable width should be at least 0.3mm.
4. The GNSS_VBKP backup power is a necessary condition for hardware hot boot to ensure that the GNSS hot boot performance reaches the optimal state. When the VDD_EXT of the GNSS module is used as the GNSS backup power, the module is shut down, resulting in a power failure of the VDD_EXT, and the hot boot performance cannot be guaranteed. If the customer needs to shut down the module and start the GNSS_VBKP hot at the same time, it is recommended to use an external power source to power GNSS_VBKP.
5. Make sure to connect a 10K resistor to the GNSS_PWRCTL pin in series and then to the external enable signal.

3.12 SPI LCD interface

A7672S module provides a set of SPI LCD interface, which only supports LCD module of 1 data line. The LCD interface of the module does not have specified LCD_TE signal pin. If necessary, you can choose GPIO to simulate the use of LCD_TE signal. It is recommended to use module pin 44 (MK_OUT_2) as the LCD_TE signal.

It is recommended to reserve decoupling capacitor on the power supply for LCD, and reserve 0 Ω resistor in series for debugging. At the same time, 0 Ω in series is reserved on the data line to facilitate the adjustment of signal quality and prevent signal reflection, overshoot.

Table 22: SPI LCD interface description

Pin Name	Pin No	I/O	Description	Note
LCD_BL_PWM	101	DO	LCD backlight PWM signal	
LCD_SPI_CLK	102	DO	SPI clock	
LCD_SPI_TXD	103	DO,DI	SPI data (Bidirectional)	
LCD_SPI_RXD	104	DI	SPI data	
LCD_SPI_CS	105	DO	SPI CS	
LCD_RST	106	DO	LCD reset	
LCD_DCX	107	DO	LCD command/parameter selection	

The recommended reference design of SPI LCD as follow:

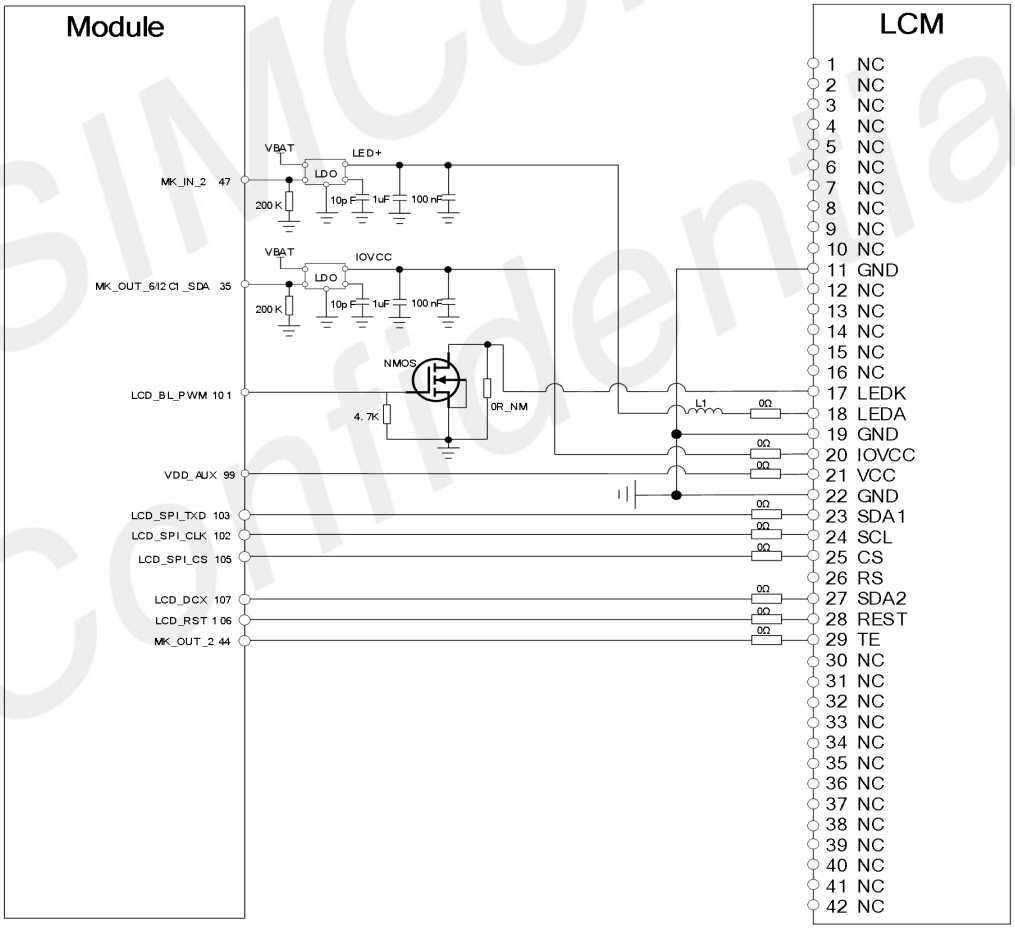

Figure 34: SPI LCD reference design

3.13 SPI camera interface

A7672S only supports SPI camera interface, supports up to 0.3MP pixel encoding, does not support video mode.

Table 23: SPI camera interface description

Pin Name	Pin No	I/O	Description	Note
CAM_I2C_SDA	117	DI, DO	CAM I2C data	
CAM_I2C_SCL	118	DO	CAM I2C clock	
CAM_PWDN	119	DO	CAM power down	
CAM_RST	120	DO	CAM reset	
CAM_MCLK	121	DO	CAM main clock	
CAM_SPI_D0	122	DI	CAM SPI DATA 0	
CAM_SPI_D1	123	DI	CAM SPI DATA 1	
CAM_SPI_CLK	124	DO	CAM SPI clock	

The recommended reference design of SPI camera as follow:

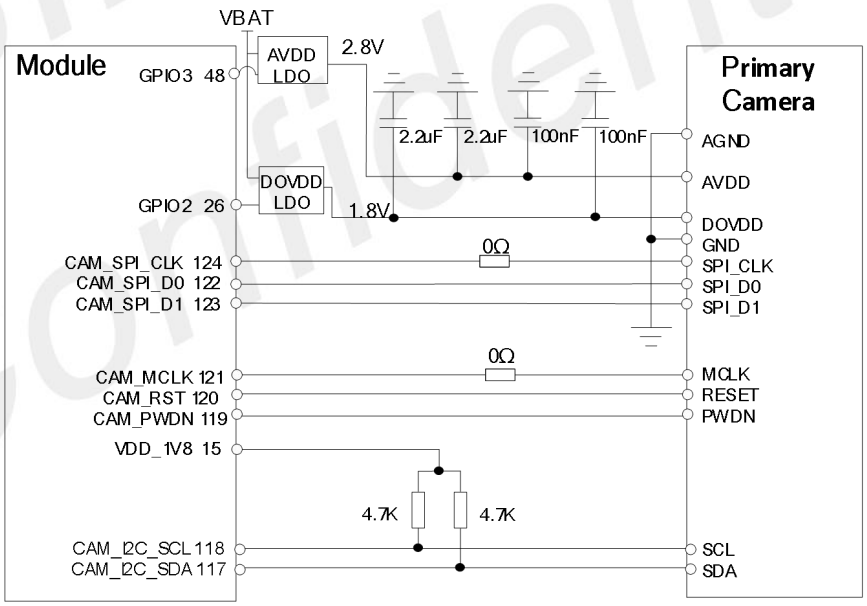

Figure 35: SPI camera reference design

3.14 MMC interface

A7672S provides a 4-bit SD/MMC interface, only supports the host mode, clock frequency up to 208MHz SDR and 50MHZ DDR, maximum capacity support 128GB, interface support dual voltage domain 1.8V/3.0V.
The supported modes are DS, HS, HS200, SDR12, SDR25, SDR50, SDR104, and DDR50.
Conforming to specifications:
SDIO Card Specification, version 3.0
eMMC Specification, version 4.5

Table 24: Electrical parameters of the MMC interface（MMC_DAT0-MMC_DAT3,MMC_CLK and MMC_CMD）

Parameter	Description	Min.	Typ.	Max.	Unit
VDD_SD	SD card power supply voltage, requires external power supply	2.7	3.0	3.3	V
1.8V Voltage Domain					
V_{IH}	Input high level voltage	VCC*0.7	1.8	VCC+0.2	V
V_{IL}	Input low level voltage	-0.3	0	0.3*VCC	V
V_{OH}	Output high level voltage	VCC-0.2V	1.8	-	V
V_{OL}	Output low level voltage	0	0	0.2V	V
3.0V Voltage Domain					
V_{IH}	Input high level voltage	2	-	VCC+0.3	V
V_{IL}	Input low level voltage	-0.3	0	0.8	V
V_{OH}	Output high level voltage	2.4	-	-	V
V_{OL}	Output low level voltage	0	-	0.4	V

※ NOTE

1. Except MMC_DAT0-MMC_DAT3, MMC_CLK and MMC_CMD, SD_DET's power domain is 1.8V.
2. VDD_SD needs to be provided externally by the customer, and the continuous flow capacity of 350mA needs to be guaranteed.

The following figure shows the reference circuit diagram of the SD card. The SD card uses 3V power supply, and external VDD_SD power supply is required

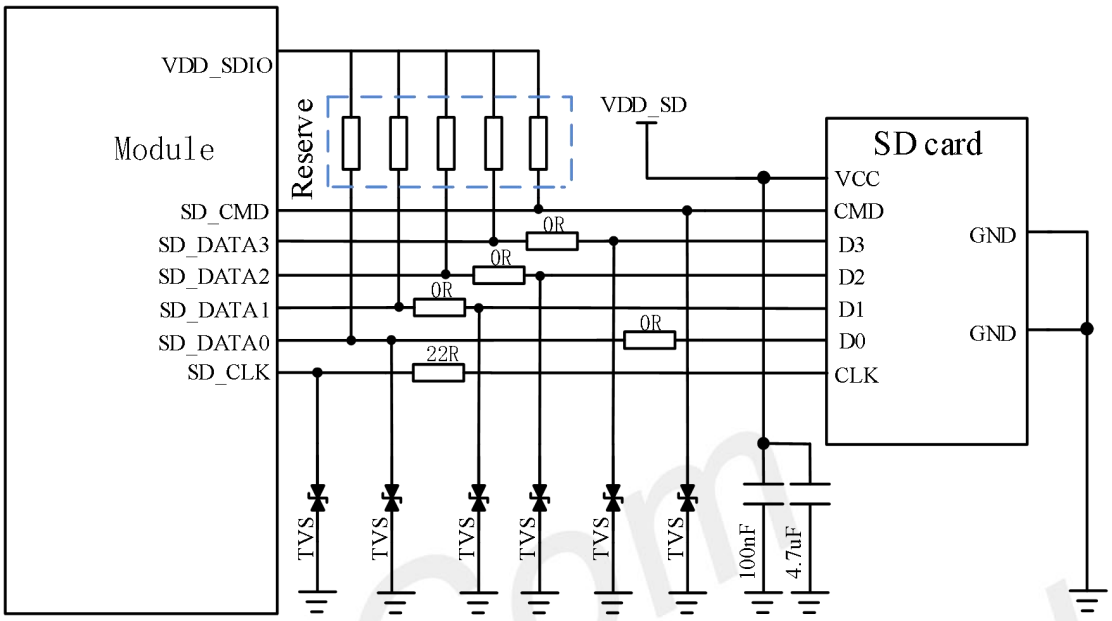

Figure 36: SD card reference circuit diagram

Precautions for SD card cabling:

- Protect other sensitive signal cables away from SD card signals.
- Protect SD card signal line away from other signals that may cause interference (e.g. clock signal, switching power supply light).
- The clock frequency of the SD card is up to 200MHZ, and 50 ohm impedance control is required for wiring.
- The difference between the length of the CLK signal of the SD card and the length of the DATA/CMD signal must be less than 1mm.
- Series in a 15-24 ohm resistor to the clock signal, near the module end.
- The cable length should be less than 50mm.
- The distance between signal cables must be twice the cable width.
- The load capacitance of signal cables must be less than 15pf.

3.15 Bluetooth interface

A7672S module has integrated Bluetooth function inside, and only one BT antenna is left on the module interface (PIN 93). Support BT5.0 protocol specification, compatible with BLE low power mode and traditional BT mode; It only supports Bluetooth data transmission and does not support VoiceOverPCM & VoHCI.

3.16 Other interface

3.16.1 Analog to digital converter（ADC）

A7672S module provides two general purpose ADC interfaces. The input voltage of ADC ranges from 0 to 1.2V. Its electrical characteristics are as follows:

Table 25: ADC Electrical characteristics

Characteristics	Min.	Typ.	Max.	Unit
ADC resolution	–	12	–	bits
Input voltage range	0	–	1.2	V
Input impedance		Hi-Z		

※ NOTE

1. “AT+CADC=2” can be used to read the voltage of the ADC1 pin.
2. “AT+CADC2=2” can be used to read the voltage of the ADC2 pin.
3. For more details, please refer to document [1].

3.16.2 LDO

A7672S module provides three power outputs: VDD_EXT, VDD_AUX, and LDO7_SDIO.

VDD_EXT is the module's system IO power supply, which can only provide a current capacity of 50mA. It cannot be used as a high current drive source. It can be used as a power supply for module 1V8_GNSS (PIN97).

VDD_AUX is the adjustable voltage output power supply of the module, the default output is 3V, can only provide 50mA current capacity, cannot be used as a large current driver source; It can provide power for other peripherals such as active antenna and LCD.

LDO7_SDIO is the digital IO port voltage domain power supply of MMC interface, which can only be used as the pull-up power supply of SD/MMC data line, and the output voltage is set as 1.8V or 3.0V according to the software.

Table 26: VDD_EXT Electrical characteristics

Symbol	Description	Min.	Typ.	Max.	Unit
VDD_EXT	Output voltage	-	1.8	-	V
I_O	Output current	-	-	50	mA

※ NOTE

1. VDD_EXT is the system power supply. If the damage will affect the system startup, it is recommended that customers add TVS protection. The recommended model is ESD56051N.

Table 27: VDD_AUX Electrical characteristics

Symbol	Description	Min.	Typ.	Max.	Unit
VDD_AUX	Output voltage	2.5	3.0	3.0	V
I_O	Output current	-	-	50	mA

※ NOTE

1. VDD_AUX is the adjustable voltage output, the default output is 3.00V.The adjustable voltage values are: 2.50V, 2.60V, 2.70V, 2.80V, 2.90V, 3.00V.
2. VDD_AUX cannot be turned off. Pay attention to the application scenario.
3. For the voltage output regulation method, please refer to the document [1].

Table 28: LDO7_SDIO Electrical characteristics

Symbol	Description	Min.	Typ.	Max.	Unit
LDO7_SDIO	Output voltage	-	1.8/3.0	-	V
I_O	Output current	-	-	20	mA

※ NOTE

1. LDO7_SDIO is the pull-up power supply for the digital I/O port of the MMC, not powered by an SD card.

4 RF Specifications

4.1 LTE radio frequency parameters

Table 29: Conducted transmission power

Frequency	Power	Min.
LTE-FDD B1	23dBm +/-2.7dB	<-40dBm
LTE-FDD B3	23dBm +/-2.7dB	<-40dBm
LTE-FDD B5	23dBm +/-2.7dB	<-40dBm
LTE-FDD B8	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 30: E-UTRA operating bands

E-UTRA Band	UL Freq.	DL Freq.	Duplex Mode
1	1920~1980 MHz	2110~2170 MHz	FDD
3	1710~1785 MHz	1805~1880 MHz	FDD
5	824～849 MHz	869～894MHz	FDD
8	880~915 MHz	925~960 MHz	FDD
34	2010～2025 MHz	2010～2025 MHz	TDD
38	2570 ~2620 MHz	2570 ~2620 MHz	TDD
39	1880 ~1920 MHz	1880 ~1920 MHz	TDD
40	2300 ~2400 MHz	2300 ~2400 MHz	TDD
41	2535 ~2655 MHz	2535 ~2655 MHz	TDD

Table 31: Conducted receive sensitivity

Frequency	Receive Sensitivity(Typical)	Receive Sensitivity(Max)
LTE FDD/TDD	Reference table 33	3GPP

Table 32: Reference sensitivity (QPSK)

E-UTRA Band	3GPP Standard						Actual	Duplex Mode
	1.4 MHz	3MHz	5MHz	10MHz	15MHz	20MHz	10MHz	
1			-100	-97	-95.2	-94	-98	FDD
3	-101.7	-98.7	-97	-94	-92.2	-91	-98	FDD
5	-103.2	-100.2	-98	-95			-98.5	FDD
8	-102.2	-99.2	-97	-94			-99	FDD
34			-100	-97	-95.2		-101	TDD
38			-100	-97	-95.2	-94	-98.5	TDD
39			-100	-97	-95.2	-94	-101	TDD
40			-100	-97	-95.2	-94	-100	TDD
41			-98	-95	-93.2	-92	-98.5	TDD

4.2 LTE Antenna Requirements

Table 33: LTE antenna requirements

Passive	Recommended Standard
operating band	See table 29 and table 30
Direction	Omni Directional
Gain	> -3dBi (Avg)
Input impedance	50 Ω
Efficiency	>50 %
Maximum input power	50W
VSWR	< 2
Isolation	>20dB
PCB insertion loss(<1GHz)	<0.5dB
PCB insertion loss(1GHz~2.2GHz)	<1dB
PCB insertion loss(2.3GHz~2.7GHz)	<1.5dB

4.3 GNSS Specifications

Table 34: GNSS operating bands

Type	Frequecy
GPS	1575.42±1.023MHz
GLONASS	1597.5~1605.8MHz
BeiDou	1561.098±2.046MHz

Table 35: GNSS performance

GNSS	GPS	GPS + BeiDou
Tracking sensitivity	-162dBm	-161dBm
Capture sensitivity	-158dBm	-158dBm
Hot start TTFF	TBD	
Cold start TTFF	<40s	
Accuracy	<2m	

4.4 GNSS Antenna Requirements

Table 36: Recommended Antenna Characteristics (GNSS)

Passive	Recommended Standard
operating band	L1: 1559~1609MHZ
Direction	Hemisphere, face to sky
Input impedance	50 Ω
Maximum input power	50W
VSWR	< 2
Plan category	RHCP or Linear
Passive antenna gain	0dBi
Active antenna gain	-2dBi
Active antenna noise figure	< 1.5
Built-in antenna LNA gain	20dB(Typ.)
Total antenna gain	< 18 dB
Coaxial insertion loss	<1.5dB

4.5 Bluetooth specifications

Table 37: Bluetooth performance

Frequency				
2.402GHz~2.483GHz				
TX Performance(Channel 0)				
	DH5	2DH5	3DH5	Unit
TX Max Power(GFSK)	TBD	6.76	6.76	dBm
TX Min Power(GFSK)	TBD	-12.47	-12.47	dBm
TX Max Power(DPSK)	TBD	5.92	5.92	dBm
TX Min Power(DPSK)	TBD	-13.31	-13.31	dBm
RX Performance				
RX sensitivity	DH5	2DH5	3DH5	
	TBD	TBD	TBD	dBm

4.6 Antenna Reference Design

4.6.1 Passive Antenna for GSM/LTE/GNSS/Bluetooth

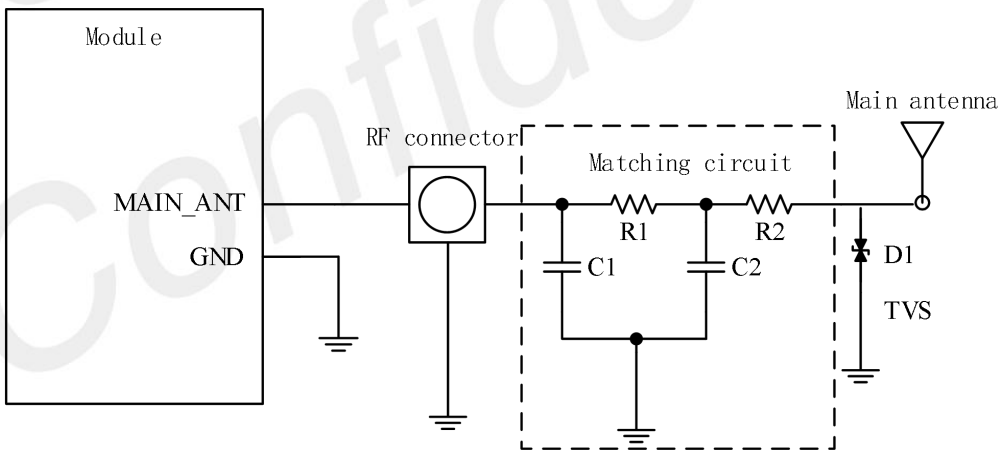

Figure 37: Passive antenna reference

The specific values of R1, C1, C2 and R2 in the matching circuit in the figure above are usually provided by the antenna factory and are determined by the antenna optimization. R1 and R2 are tagged with 0Ω by default, and C1 and C2 do not paste by default. D1 is a bidirectional TVS device. It is recommended to select it. The capacitance value should be less than 0.2pF to avoid damage to internal components of the module. Recommended TVS models are as follows:

Table 38: TVS part number list

Package	Type	Supplier
0201	CE0201S05G01R	SOCAY
0402	PESD0402-03	PRISEMI

4.6.2 Active Antenna for GNSS

The default output of GNSS active antenna power supply is 3V. The output voltage can be controlled by AT+CVAUXV, and the supply voltage value can be confirmed according to the customer's antenna selection. For example, by AT+CVAUXV=2800, set the output voltage to 2.8V. The AT instruction takes effect once it is set. This voltage output cannot be turned off.

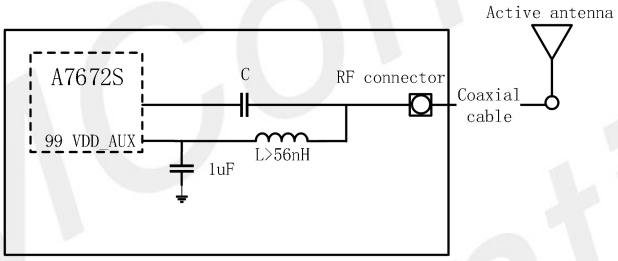

Figure 38: Active antenna reference

※ NOTE

1. GNSS adopts the active antenna design scheme by default, and C uses 100pF by default. For customers using the passive antenna scheme, it is recommended to disconnect the power supply path to avoid chip damage caused by passive antenna installation.

4.7 PCB layout

Users should pay attention to the impedance design of PCB layout from the module ANT port to the antenna connector, and the length of the PCB trance should be within 20 mm, and far away from interference signals such as power & clock. It is recommended to reserve RF Switch Connector for conduction test. The reference model of RF Switch Connector is: ECT 818011998.

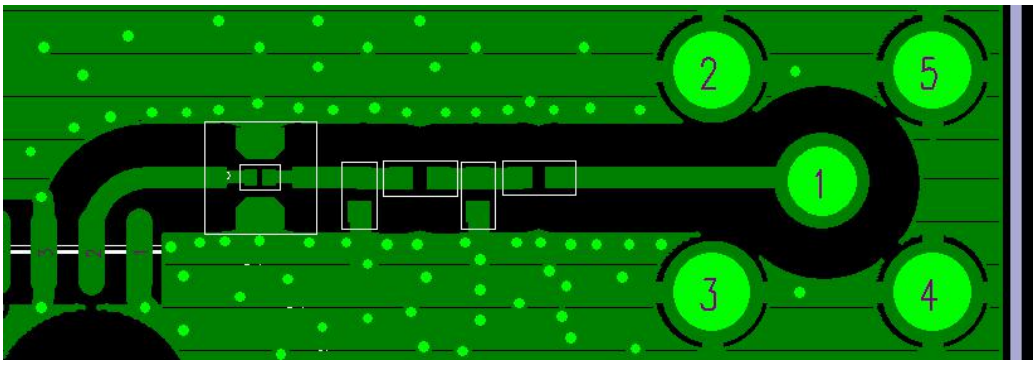

Figure 39: Reference PCB layout

5 Electrical Specifications

5.1 Absolute maximum ratings

The following table shows the absolute maximum in the case of abnormal operation. Exceeding these limits may result in permanent module damage.

Table 39: Absolute maximum ratings

Parameter	Min.	Typ.	Max.	Unit
Voltage on VBAT	-0.5	-	4.8	V
Voltage on USB_VBUS	-0.5	-	5.4	V
Voltage at digital pins GPIO，UART	-0.3	-	2.0	V
Voltage at IO pins	-0.3	-	2.0	V
USIM	-0.3	-	3.9	V
PWRKEY、RESET	-0.3	-	4.8	V

5.2 Operating conditions

Table 40: 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	5.2	V

Table 41: 1.8V Digital I/O characteristics

Parameter	Description	Min.	Typ.	Max.	Unit
VIH	High-level input voltage	VCC*0.7	1.8	VCC+0.2	V
VIL	Low-level input voltage	-0.3	0	VCC*0.3	V
VOH	High-level output voltage	VCC-0.2	-	-	V
VOL	Low-level output voltage	0	-	0.2	V
IOH	High-level output current (no pull down resistor)	-	-	13	mA
IOL	Low-level output current (no pull up resistor)	-	-	13	mA
IIH	Input high leakage current (no pull-down resistor)	-	-	10	uA
IIL	Input low leakage current (no pull up resistor)	-10	-	-	uA

※ NOTE

1. The preceding parameters are applicable to GPIO, I2C, UART, and USB_BOOT.

Table 42: Operating temperature

Parameter	Min.	Typ.	Max.	Unit
Normal operation temperature	-30	25	75	℃
Extended operation temperature	-40	25	85	℃
Storage temperature	-40	25	90	℃

※ NOTE

1. When operating at extended operating temperatures, the module RF index may not meet the 3GPP specification.

5.3 Operating Mode

5.3.1 Operating Mode Definition

The following table briefly describes the various working modes that will be mentioned in subsequent sections.

Table 43: Operating mode Definition

Mode		Function
Normal operation	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.
	LTE Idle	Software is active. Module is registered to the network, and the module is ready to communicate.
	LTE Talk	Two users are connected. In this case, the power consumption of the module depends on the network and module configuration.
	LTE Data transmission	The data is being transmitted. In this case, the power consumption depends on the network condition (for example, the power control level), the data rates of the upstream and downstream data links, and the network configuration (for example, using a multi-slot configuration).
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 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.

A7672S module automatically enters sleep mode when the following software and hardware conditions are met:

- UART condition
- USB condition
- Software condition

Refer to the documentation [24] for more information on sleep modes.

5.3.3 Function mode

You can do this by running the command "AT+CFUN=<fun>" To set the module to this mode, this command provides three options for setting different functions.

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

After setting AT+CFUN=0, the module enters the minimum function mode, and turns off the RF function and USIM card function. In this case, the serial port and USB can still be used, but functions related to the RF and USIM cards and some AT commands cannot be used.

After setting "AT+CFUN=4", the module enters flight mode and turns off the RF function. In this case, the module's serial port and USB can still be used, but radio-frequency related functions and some AT commands cannot be used.

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

For details on the "AT+CFUN" command, refer to the documentation [1].

5.4 Current Consumption

Table 44: Current consumption on VBAT Pins (VBAT=3.8V)

Flight Mode Hibernation	
Flight mode sleep consumption (without USB connection)	Flight mode @AT+CFUN=0, AT+CSCLK=1 Typical values：1mA
LTE Sleep/Idle Mode	
LTE supply current (without USB connection)	Sleep mode@DRX=0.32S Typical values: 2mA Idle mode@DRX=0.32S Typical values: 17mA
LTE Cat1	
LTE-FDD B1	@5MHz 23.0dBm Typical：582mA @10MHz 23.0dBm Typical：585mA
LTE-FDD B3	@5MHz 23.0dBm Typical：623mA @10MHz 23.0dBm Typical：609mA

LTE-FDD B5	@5MHz 23.0dBm Typical：647mA @10MHz 23.0dBm Typical：639mA
LTE-FDD B8	@5MHz 23.0dBm Typical：585mA @10MHz 23.0dBm Typical：583mA
LTE-TDD B34	@5MHz 23.0dBm Typical：300mA @10MHz 23.0dBm Typical：296mA
LTE-TDD B38	@5MHz 23.0dBm Typical：309mA @20MHz 23.0dBm Typical：314mA
LTE-TDD B39	@5MHz 23.0dBm Typical：270mA @20MHz 23.0dBm Typical：270mA
LTE-TDD B40	@5MHz 23.0dBm Typical：254mA @20MHz 23.0dBm Typical：258mA
LTE-TDD B41	@5MHz 23.0dBm Typical：312mA @20MHz 23.0dBm Typical：315mA

5.5 ESD Notes

A7672S module is electrostatic sensitive. Therefore, user must take ESD protection precautions when producing, assembling, and operating the module. The following table describes the electrostatic performance parameters of the module：

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

Part	Contact Discharge	Air Discharge
VBAT, GND	+/-5K	+/-10K
Antenna port	+/-5K	+/-10K
USB interface	+/-4K	+/-8K
UART interface	+/-4K	+/-6K
Other PINS	+/-1K	+/-2K

※ NOTE

1. Test conditions: The module is on the SIMCom development board (the development board has the necessary ESD protection devices)

6 SMT Production Guide

6.1 Top and Bottom View of A7672S

Figure 40: Top and bottom view of A7672S-MANS

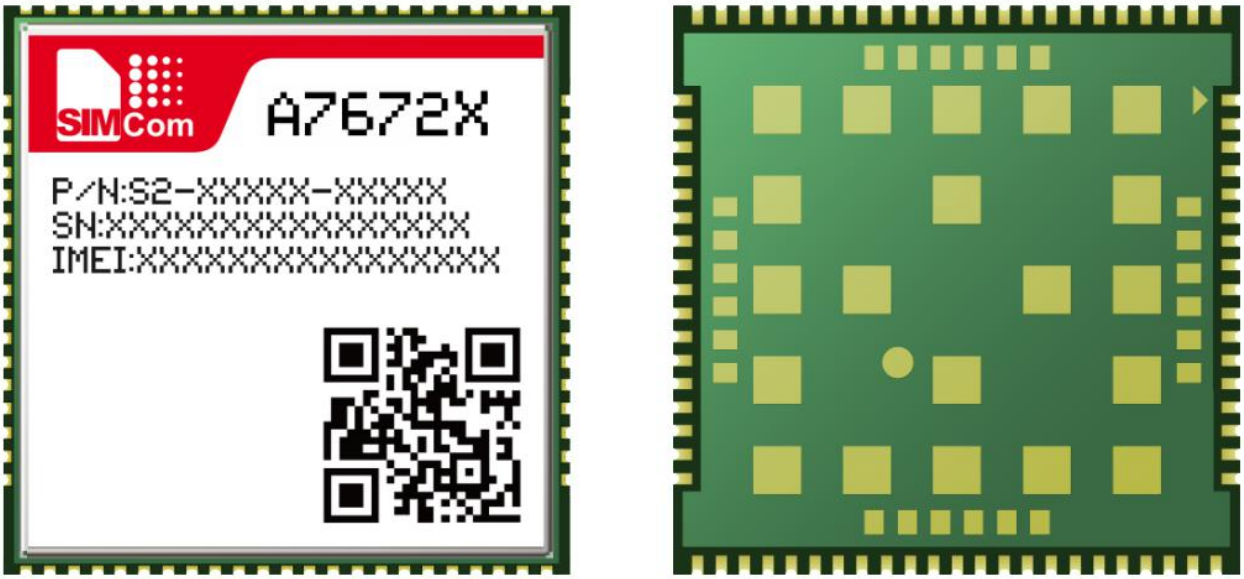

Figure 41: Top and bottom view of A7672S-FANS

※ NOTE

1. 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 42: Label information for A7672X

Table 46: The description of label information

No.	Description
A	Project name
B	Part number
C	Serial number
D	IMEI number
E	QR code

6.3 Typical SMT Reflow Profile

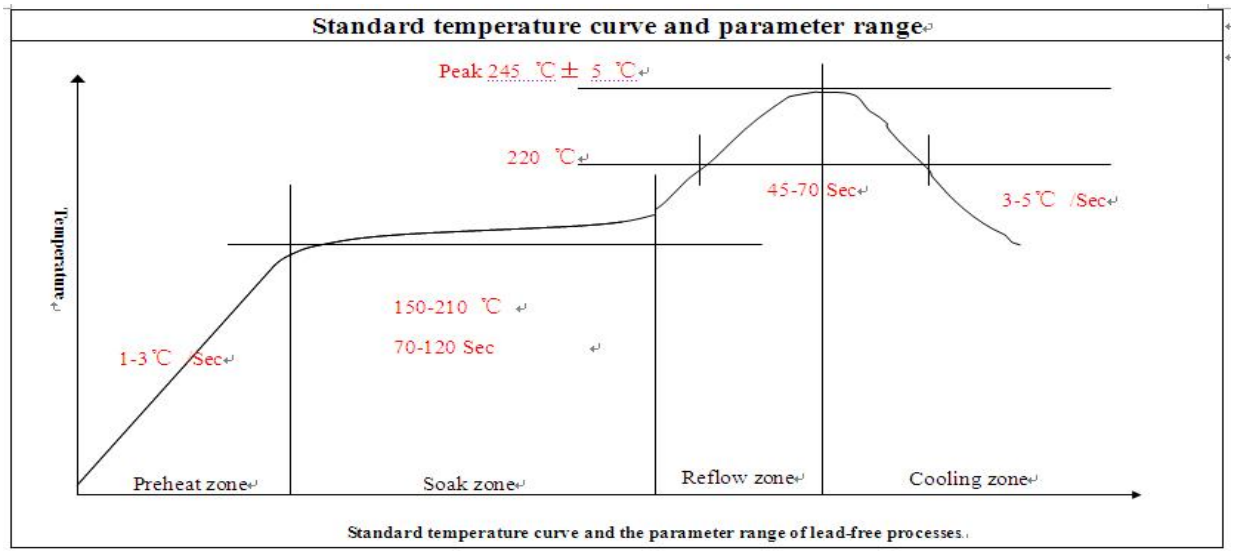

Figure 43: Recommended welding furnace temperature curve (lead-free process)

※ NOTE

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

6.4 Moisture Sensitivity Level (MSL)

The A7672S module provides level-3 moisture sensitivity.

If any of the following conditions are met, the A7672S MODULE shall be fully baked before reflow soldering, otherwise the module may be permanently damaged during reflow soldering.

After unpacking or vacuum packing damage and air leakage, the temperature < 30 degrees and relative humidity < The A7672S module needs to be SMT mounted within 168 hours under 60% environment conditions. If the above conditions are not met, bake.

Vacuum packaging unopened, but beyond the shelf life, also need to be baked.

Baking conditions: under the condition of humidity less than 5%, temperature 40+5/-0°C need to bake 192 hours; Bake for 72 hours at a humidity of less than 5% and a temperature of 85+5/-0°C (if using a tray, please note that the tray is resistant to heat deformation).

Table 47: Humidity sensitivity of the module

Moisture Sensitivity Level (MSL)	Workshop Life (Factory environment ≦+30℃/60%RH)
1	Unlimited at ≦30℃/85% RH
2	1 year at≦30℃/60% RH
2a	4 weeks at ≦30℃/60% RH
3	168 hours at ≦30℃/60% RH
4	72 hours at ≦30℃/60% RH
5	48 hours at ≦30℃/60% RH
5a	24 hours at ≦30℃/60% RH
6	Mandatory bake before use. After bake, it must be reflowed within the time limit specified on the label.

※ NOTE

1. Product handling, storage and processing must follow IPC/JEDEC J-STD-033.

7 Packaging

Module support tray packaging.

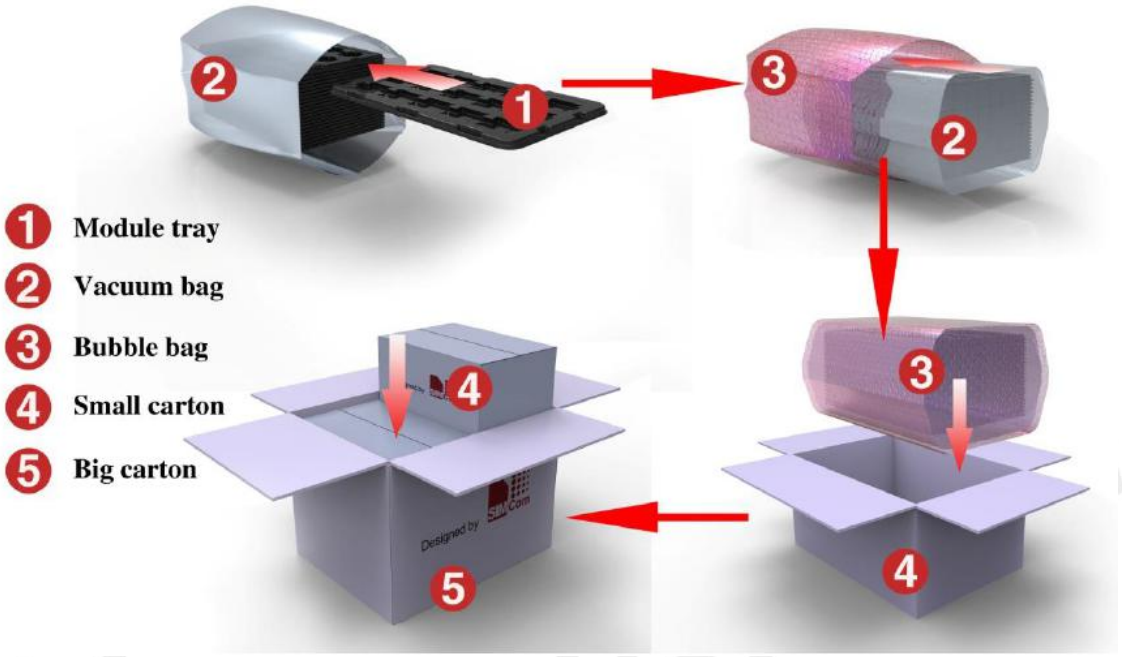

Figure 44: packaging diagram

Module tray drawing：

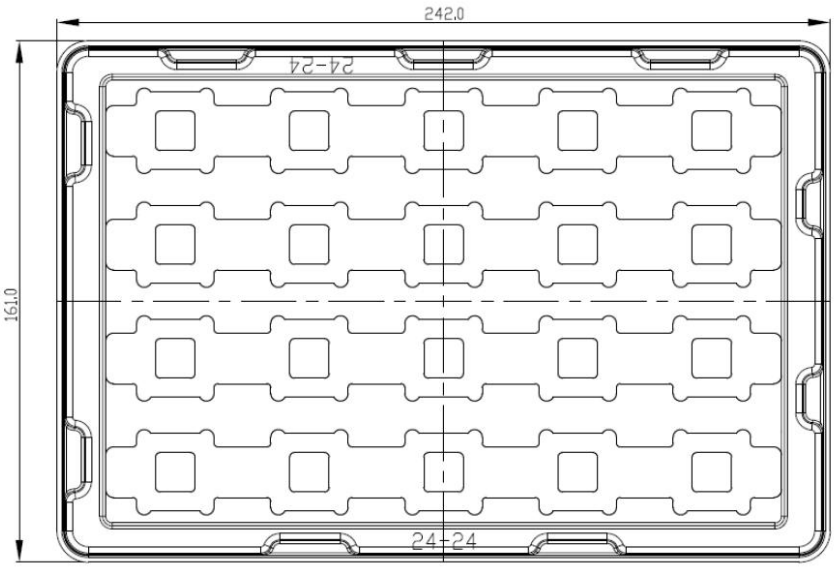

Figure 45: Tray drawing

Table 48: Tray size

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

Small carton drawing：

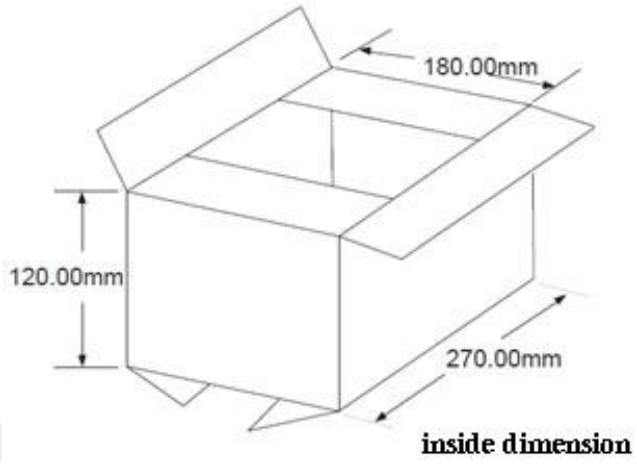

Figure 46: Small carton drawing

Table 49: Small Carton size

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

Big carton drawing：

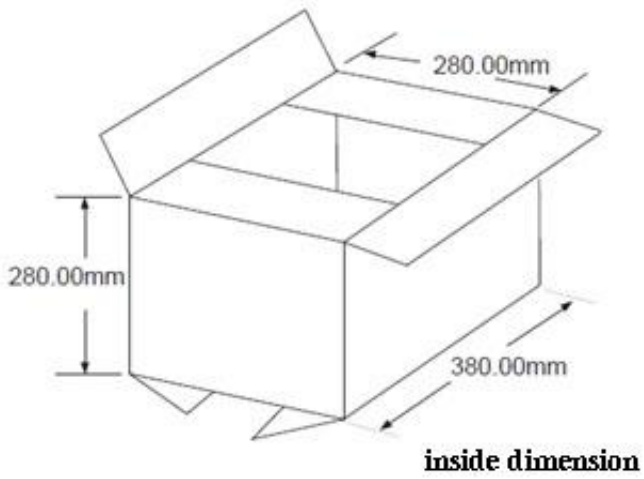

Figure 47: Big carton drawing

Table 50: Big Carton size

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

8 Appendix

8.1 Encoding method and maximum data rate

Table 51: Encoding method and maximum data rate

Multislot Definition(GPRS/EDGE)			
Slot Class	**DL Slot Number**	**UL Lot 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
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

8.2 Related Documents

Table 52: Related Documents

No.	Title	Description
[1]	A7600 Series_AT Command Manual	AT Command Manual
[2]	ITU-T Draft new recommendation V.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 USIM Application Toolkit for the Subscriber Identity Module – Mobile Equipment (USIM – ME) interface
[7]	GSM 11.11	Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (USIM – 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]	A7600Series_UART_Application Note_V1.xx	This document describes how to use UART interface of SIMCom modules.
[23]	Antenna design guidelines for diversity receiver system	Antenna design guidelines for diversity receiver system
[24]	A7600 Series_SleepMode_Application Note_V1.xx	Sleep Mode Application Note
[25]	A7600 Series_UIM HOT SWAP_Application Note_V1.00	This document introduces UIM card detection and UIM hot swap.

8.3 Terms and Abbreviations

Table 53: Terms and Abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
AMR	Adaptive Multi-Rate
CS	Coding Scheme
CSD	Circuit Switched Data
CTS	Clear to Send
DTE	Data Terminal Equipment (typically computer, terminal, printer)
DTR	Data Terminal Ready
DTX	Discontinuous Transmission
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
FR	Full Rate
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
HR	Half Rate
IMEI	International Mobile Equipment Identity
Li-ion	Lithium-Ion
MO	Mobile Originated
MS	Mobile Station (GSM engine), also referred to as TE
MT	Mobile Terminated
PAP	Password Authentication Protocol
PBCCH	Packet Broadcast Control Channel

PCB	Printed Circuit Board
PCL	Power Control Level
PCS	Personal Communication System, also referred to as GSM 1900
PDU	Protocol Data Unit
PPP	Point-to-point protocol
RF	Radio Frequency
RMS	Root Mean Square (value)
RTC	Real Time Clock
RX	Receive Direction
USIM	Subscriber Identification Module
SMS	Short Message Service
TE	Terminal Equipment, also referred to as DTE
TX	Transmit Direction
UART	Universal Asynchronous Receiver & Transmitter
URC	Unsolicited Result Code
USSD	Unstructured Supplementary Service Data
Abbreviation of telephone book	
FD	USIM fix dialing phonebook
LD	USIM last dialing phonebook (list of numbers most recently dialed)
MC	Mobile Equipment list of unanswered MT calls (missed calls)
ON	USIM (or ME) own numbers (MSISDNs) list
RC	Mobile Equipment list of received calls
SM	USIM phonebook
NC	Not connect

8.4 Safety Caution

Pay attention to the following safety precautions when using or repairing any terminal or cell phone containing modules. The terminal device shall inform the user of the following safety information. Otherwise, SIMCom will not be liable for any consequences arising from the user's failure to act on these warnings.

Table 54: 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.