A7672X Secondary development hardware design manual

LTE Module

file name:	A7672X secondary development hardware design manual
Version:	V1.01
date:	2021-08-12
state:	Published

Preface

This module is mainly used for voice or data communication, and the company does not bear the responsibility for property loss or personal injury caused by the user's abnormal operation. Users are requested to develop corresponding products in accordance with the technical specifications and reference designs in the manual. At the same time, pay attention to the general safety issues that should be paid attention to when using mobile products.

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Version history

Date	Version	Change description	author
2021-04-27	1.00	First edition	Chen Zhongyou, Xia Yu
2021-06-17	1.01	Modify the default level state of GPIO_08 when it is powered on Modify the description of the serial port Modify the description of ADC part Added VDD_AUX adjustable voltage pin description	Chen Zhongyou
2021-07-20	1.02	Modify VDD_AUX adjustable voltage output range Added GSM frequency band description Modify the VBAT peak current of the module	Chen Zhongyou, Xia Yu
2021-8-10	1.03	Increase overseas frequency band products	Chen Zhongyou, Xia Yu

content

Table index

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1 introduction

This document describes the hardware interface of the module, which can help users quickly understand the detailed information of the module's interface definition, electrical performance and structural dimensions. Combining this document and other application documents, users can quickly use the module to design mobile communication applications. SIMCom provides a set of evaluation boards to facilitate the testing and use of A7670 R2 series modules. The evaluation board tools include EVB boards, USB cables, antennas, and other peripherals.

1.1 Module overview

A7672X module can supportLTE-TDD and LTE-FDD.Users can flexibly choose different types of modules to meet diversified market needs. For detailed frequency band description, please refer to the table below:

Table 1: A7672X module frequency band list

Network Type	Frequency band	A7672E-LASE	A7672E-FASE	A7672S-LASE	A7672S-FASE
GSM	850				
	900	✓	✓	✓	✓
	1800	✓	✓	✓	✓
	1900				
LTE-FDD	LTE-FDD B1	✓	✓	✓	✓
	LTE-FDD B2				
	LTE-FDD B3	✓	✓	✓	✓
	LTE-FDD B4				
	LTE-FDD B5	✓	✓	✓	✓
	LTE-FDD B7	✓	✓		
	LTE-FDD B8	✓	✓	✓	✓
	LTE-FDD B20	✓	✓		
	LTE-FDD B28				
	LTE-FDD B66				
LTE-TDD	LTE TDD B34			✓	✓

	LTE TDD B38			✓	✓
	LTE TDD B39			✓	✓
	LTE TDD B40			✓	✓
	LTE TDD B41			✓	✓
GNSS			✓		✓
BlueTooth			✓		✓
Category		CAT1	CAT1	CAT1	CAT1

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GNSS andBlueToothIt is an optional feature.

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

The A7672X module provides a total of 124 pins, including 80 LCC pins on the outer ring and 44 LGA pins on the inner ring. This article will introduce all the functional pins.

1.2 Interface overview

The A7672X module provides the following hardware interfaces:

●One power input

●One USB 2.0 interface

●Three-way UART interface, a set of full-function serial ports, a set of DEBUG serial ports, a set of two-wire serial ports

●Two-way USIM card interface

●Multiple programmable general-purpose input and output interfaces (GPIO)

●A set of SPI LCD interface (multiplexed)

●A set of 4*4 matrix keyboard interface (multiplexed)

●Universal all the wayADC interface

●One VBAT ADC interface

●Analog audio MIC input interface

●Analog audio SPK output interface

●One SPI interface

●Two-way power supply output

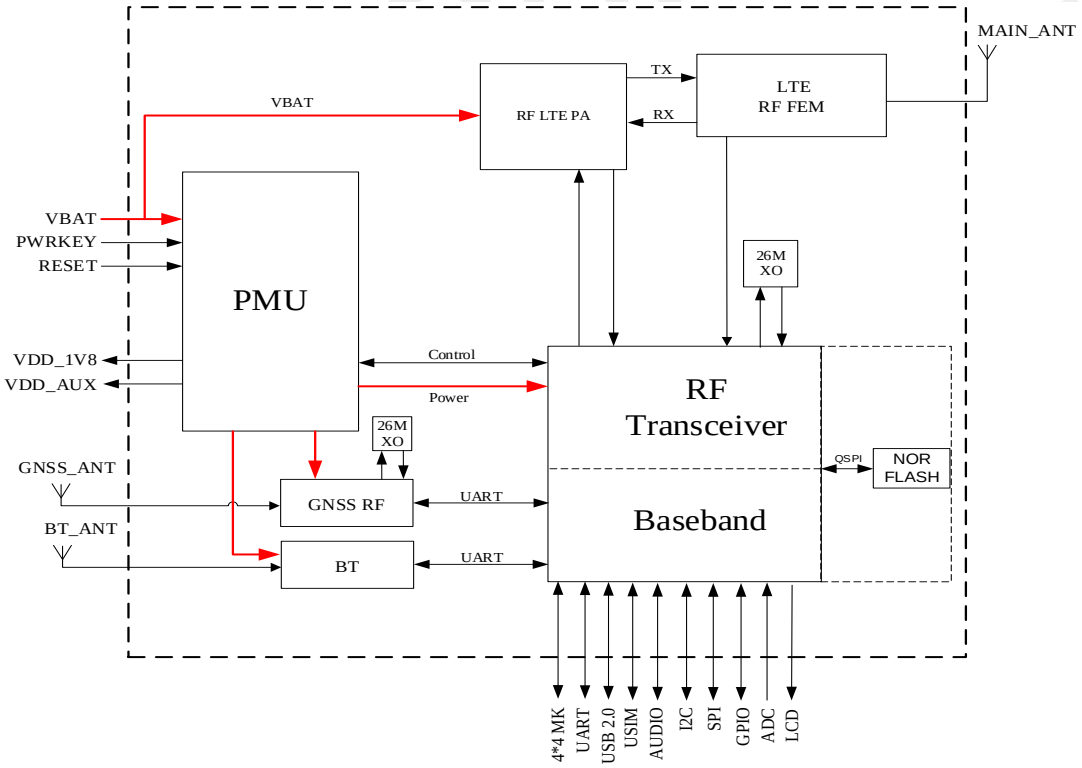
●One I2C interface

●All the way USB_BOOT download boot interface

●Three-way antenna interface

1.3 Block diagram

The following figure shows the main functional structure of the module:



picture1：Module block diagram

1.4 Main features

Table 2：The main features of the module

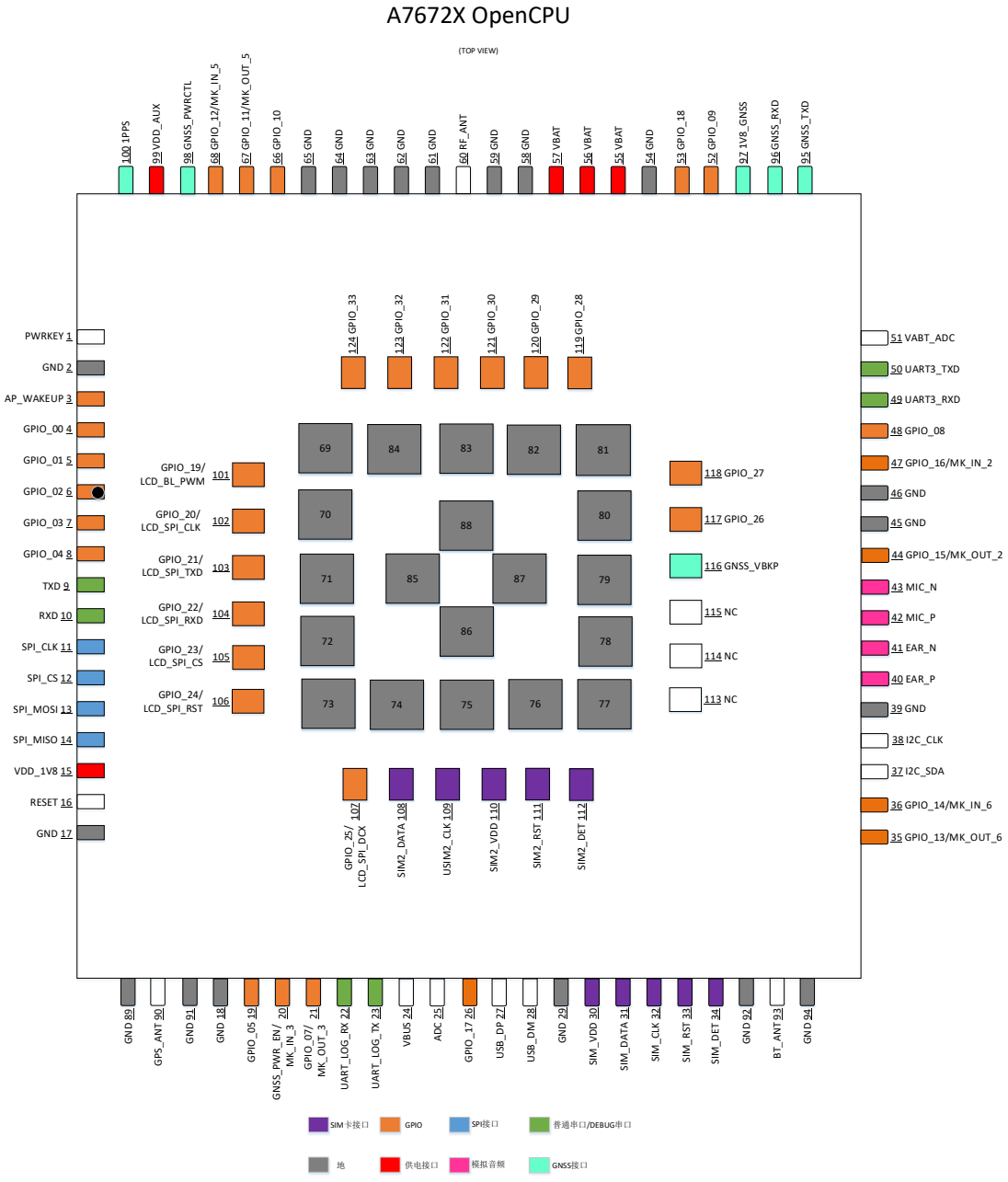
characteristic	instruction
powered by	voltage range:3.4V~4.2V, recommended value 3.8V
Sleep power consumption	Current consumption in sleep mode: <3mA
Frequency band	Please refer to the table 1
Transmit power	GSM/GPRS power level: --EGSM900: 4 (33dBm±2dB) --DCS1800: 1 (30dBm±2dB) EDGE power level: - EGSM900: E2 (27dBm±3dB) - DCS1800: E1 (26dBm+3dB/-4dB) LTE power level 3 (23dBm±2.7dB)
data transmission	GPRS multi-slot class 12 EDGE multi-slot level 12 TDD/FDD-LTE category 1: 10Mbps (downlink), 5 Mbps (uplink)
Antenna interface	GSM/LTE antennainterface GNSS antenna interface (optional) BlueToothAntenna interface (optional)
Short message (SMS)	MT, MO, CB, Text and PDU mode Short message (SMS) storage device: USIM card, CB does not support saving in USIM card Support CS domain and PS domain SMS
USIM card interface	Supported 1.8V/3V USIM card
USIM Application Toolkit	Support SAT level 3, GSM 11.14 version 99 support USAT
Address book management	SM/FD/ON/AP/SDN
audio port	Support one analog audio interface
Serial port	●Main serial port UART Baud rate support from 300bps to 3686400bps AT commands and data can be sent through the serial port Support RTS/CTS hardware flow control Support serial port multiplexing function in line with GSM 07.10 protocol ●Serial UART_LOG Support Debug purpose ●Serial UART3 Ordinary two-wire serial port
USB interface	Comply with USB 2.0 specification, support slave mode, not master mode Can be used for AT command sending, data transmission, software debugging and upgrading
software upgrade	Upgrade software via USB port
Physical size	Size: 24*24*2.4mm Weight: 2.8±0.1g
temperature range	Working temperature: -30° C~ +80° C Extended working temperature: -40° C~ +85° C* Storage temperature: -45° C~ +90° C

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

2 Package information

2.1 Pin layout

The pin distribution of the top view of the A7672X module is as follows:



picture2：A7672X module pin diagram (front view)

Table 3：Pin definition list

Pin number	Pin name	Pin number	Pin name
1	PWRKEY	2	GND
3	AP_WAKEUP	4	GPIO_00
5	GPIO_01	6	GPIO_02●
7	GPIO_03	8	GPIO_04
9	TXD	10	RXD
11	SPI_CLK	12	SPI_CS
13	SPI_MOSI	14	SPI_MISO
15	VDD _1V8	16	RESET
17	GND	18	GND
19	GPIO_05	20	GNSS_PWR_EN/MK_IN_3
21	GPIO_07/ MK_OUT_3	22	UART_LOG_RX
23	UART_LOG_TX	24	VBUS
25	ADC	26	GPIO_17
27	USB_DP	28	USB_DM
29	GND	30	USIM1_VDD
31	USIM1_DATA	32	USIM1_CLK
33	USIM1_RST	34	USIM1_DET
35	GPIO_13/ MK_OUT_6	36	GPIO_14/ MK_IN_6
37	I2C_SDA	38	I2C_SCL
39	GND	40	EAR_P
41	EAR_N	42	MIC_P
43	MIC_N	44	GPIO_15/ MK_OUT_2
45	GND	46	GND
47	GPIO_16/ MK_IN_2	48	GPIO_08
49	UART3_RXD	50	UART3_TXD
51	VBAT_ADC	52	GPIO_09
53	GPIO_18	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	GPIO_10
67	GPIO_11/ MK_OUT_5	68	GPIO_12/ 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	GPIO_19/LCD_BL_PWM	102	GPIO_20/LCD_SPI_CLK
103	GPIO_21/LCD_SPI_TXD	104	GPIO_22/LCD_SPI_RXD
105	GPIO_23/LCD_SPI_CS	106	GPIO_24/LCD_RST
107	GPIO_25/LCD_DCX	108	USIM2_DATA
109	USIM2_CLK	110	USIM2_VDD
111	USIM2_RST	112	USIM2_DET
113	NC	114	NC
115	NC	116	GNSS_VBKP
117	GPIO_26	118	GPIO_27
119	GPIO_28	120	GPIO_29
121	GPIO_30	122	GPIO_31
123	GPIO_32	124	GPIO_33

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●It means that these signals cannot be pulled down before power on, otherwise it will affect the normal power on of the module.

2.2 Pin description

Table 4: Abbreviation of pin parameter

abbreviation	describe
PI	power input
PO	Power Output
AI	Analog input
AO	Analog output
I/O	Input or output
DI	Digital input
DO	Digital output
DOH	Default output high level
DOL	Default output low level
PU	pull up
PD	drop down
OD	Open drain

Table 5：1.8V IO pin electrical characteristics

Pin voltage domain attributes	abbreviation	describe	Minimum	Typical value	Max
1.8V	DC input conditions (VCC=1.8V)				
	VIH	Input effective high level	VCC * 0.7	1.8V	VCC+0.2
	VIL	Input valid low level	-0.3V	0V	VCC *0.3
	Rpu	Module internal pull-up resistor	55K	79 K	121K
	Rpd	Module internal pull-down resistor	51K	87 K	169K
	DC input conditions (VCC = 1.8V Typical)				
	IIL	Input leakage current	-	-	10uA
	DC output conditions (VCC = 1.8V Typical)				
	VOH	Output level range	VCC-0.2	-	-
	VOL	Output level range	-	-	0.2V
	Iol	Low-level output current Vpad=0.2V	-	-	13mA
	Ioh	High level output current Vpad=VCC-0.2V	-	-	11mA

Table 6：3.3V IO pin electrical characteristics

Pin voltage domain attributes	abbreviation	describe	Minimum	Typical value	Max

3.3V	VIH	Input effective high level	2V	-	VCC+0.3
	VIL	Input valid low level	-0.3V	0V	0.8V
	Rpu	Module internal pull-up resistor	26K	47K	72K
	Rpd	Module internal pull-down resistor	27K	54K	267K
	IIL	Input leakage current	-	-	10uA
	VOH	Output level range	2.4V	-	-
	VOL	Output level range	-	-	0.4V
	Iol	Low-level output current Vpad=0.4V	-	-	7mA
	Ioh	High level output current Vpad=VCC-0.5V	-	-	7mA

Table 7: Pin description

Pin name	Pin number	Pin attributes		describe	Remark
		Voltaged omain	Types of		
powered by					
VBAT	55,56,57	-	PI	Module power supply input, the input voltage range is from 3.4V to 4.2V, typically 3.8V, and the power supply current requirement can reach 1A.	
VDD_1V8	15	-	PO	The internal 1.8V power output, the maximum output current is 50mA, can not supply power to high-power loads, and can provide power for level conversion circuits, etc.	It can provide 1V8 power supply for GNSS, if not in use, just leave it in the air.
VDD_AUX	99	-	PO	Adjustable voltage output, default 3V, maximum output	It can provide power for other peripherals, if not in use, just leave it

				current 50mA, can not supply power to high-power loads.	open.
GND	2,17,18,29, 39,45,46, 54,58,59, 61,62,63, 64,65,69, 70,71,72, 73,74,75, 76,77,78, 79,80,81, 82,83,84, 85,86,87, 88,89,91, 92,94	-	-	Grounded	
System control					
PWRKEY	1	-	DI,PU	Switch machine control input, active low The power button defaults to high level VIH: 0.7*VBAT VIL: 0.3*VBAT	The inside of the PMU has been pulled up through 50K (Typical) VBAT.
RESET	16	-	DI,PU	Hardware reset control input, active low VIH: 0.7*VBAT VIL: 0.3*VBAT	The inside of the PMU has been pulled up through 50K (Typical) VBAT.
USIM interface					
USIM1_DATA	31	1.8/ 3.0V	I/O, PU	USIM bus data, there is a 4.7KΩ resistor inside the module to pull 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 output, the output voltage can be dynamically changed according to the type of external card, the maximum output current is 50mA	
USIM1_DET	34	1.8V	DI,PU	The detection pin of USIM1 card can be set to high/low effective by AT command, refer to document [25]	
USIM2_DATA	108	1.8/ 3.0V	I/O, PU	The USIM bus data is not pulled up inside the module. Need to use a 4.7K resistor to pull up to USIM2_VDD outside the module	
USIM2_RST	111	1.8/ 3.0V	I/O, PU	USIM bus reset output	
USIM2_CLK	109	1.8/ 3.0V	I/O, PU	USIM bus clock output	

USIM2_VDD	110	1.8/ 3.0V	PO	USIM card power output, the output voltage can be dynamically changed according to the type of external card, the maximum output current is 50mA	
USIM2_DET	112	1.8V	DI, PD	The detection pin of USIM2 card can be set to high/low effective by AT command, refer to document [25]	
USB interface					
VBUS	24	-	AI	VBUS in-position detection input, high-level effective, the highest effective voltage is 3.0V, the highest identification voltage is 5.2V	
USB_DM	28	-	I/O	USB bus differential negative	
USB_DP	27	-	I/O	USB bus differential positive	
Main serial port					
RXD	10	1.8V	DI	Data reception	If not used, just leave it in the air
TXD	9	1.8V	DOH	Data sending	
Debug serial port					
UART_LOG_TXD	23	1.8V	DOH	UART output	It is used as the debug port by default.
UART_LOG_RXD	22	1.8V	DI	UART input	
Serial 3					
UART3_TXD	50	1.8V	DOH	UART3 output	If not used, just leave it in the air.
UART3_RXD	49	1.8V	DI	UART3 input	
I2C interface					
I2C_SCL	38	1.8V	DO	I2C bus clock output	If not used, just leave it in the air. Need to use external power supply VDD_1.8V power supply (module 15 feet) for pull-up.
I2C_SDA	37	1.8V	I/O	I2C bus data input/output	
Analog audio interface					
EAR_P	40	1.8V	AIO	Audio receiver output positive	If not used, just leave it in the air.
EAR_N	41	1.8V	AIO	Audio receiver output negative	
MIC_P	42	1.8V	AIO	Audio microphone input positive	
MIC_N	43	1.8V	AIO	Audio microphone input negative	
General SPI interface					
SPI_CLK	11	1.8V	I/O,	SPI bus clock output	If not used, just leave it

			PD		in the air.
SPI_CS	12	1.8V	I/O, PD	SPI bus chip select signal	
SPI_MOSI	13	1.8V	DO, PD	SPI bus host output	
SPI_MISO	14	1.8V	DI, PD	SPI bus host input	
Universal input and output interface					
GPIO_00	4	1.8V	IO,PU	Universal input/output port	If not used, just leave it in the air.
GPIO_01	5	1.8V	IO,PU	Universal input/output port	If not used, just leave it in the air.
GPIO_02●	6	1.8V	IO,PU	Universal input/output port	If not used, just leave it in the air.
GPIO_03	7	1.8V	IO,PU	Universal input/output port	If not used, just leave it in the air.
GPIO_04	8	1.8V	IO,PU	Universal input/output port	If not used, just leave it in the air.
GPIO_05	19	1.8V	IO,PU	Universal input/output port	If not used, just leave it in the air.
GPIO_07	21	1.8V	IO,PU	Universal input/output port	If not used, just leave it in the air.
GPIO_08	48	1.8V	IO,PU	Universal input/output port	If not used, just leave it in the air.
GPIO_09	52	1.8V	IO,PD	Universal input/output port	If not used, just leave it in the air.
GPIO_10	66	1.8V	IO,PD	Universal input/output port	If not used, just leave it in the air.
GPIO_11	67	1.8V	IO,PU	Universal input/output port	If not used, just leave it in the air.
GPIO_12	68	1.8V	IO,PU	Universal input/output port	If not used, just leave it in the air.
GPIO_13	35	1.8V	IO,PD	Universal input/output port	If not used, just leave it in the air.
GPIO_14	36	1.8V	IO,PD	Universal input/output port	If not used, just leave it in the air.
GPIO_15	44	1.8V	IO,PD	Universal input/output port	If not used, just leave it in the air.
GPIO_16	47	1.8V	IO,PD	Universal input/output port	If not used, just leave it in the air.
GPIO_17	26	1.8V	IO,PD	Universal input/output port	If not used, just leave it in the air.
GPIO_18	53	1.8V	IO,PU	Universal input/output port	If not used, just leave it in the air.
GPIO_19	101	1.8V	IO,PD	Universal input/output port	If not used, just leave it in the air.
GPIO_20	102	1.8V	IO,PU	Universal input/output port	If not used, just leave it in the air.
GPIO_21	103	1.8V	IO,PU	Universal input/output port	If not used, just leave it in the air.
GPIO_22	104	1.8V	IO,PU	Universal input/output port	If not used, just leave it in the air.
GPIO_23	105	1.8V	IO,PU	Universal input/output port	If not used, just leave it in the air.
GPIO_24	106	1.8V	IO,PD	Universal input/output port	If not used, just leave it in the air.
GPIO_25	107	1.8V	IO,PU	Universal input/output port	If not used, just leave it in the air.
GPIO_26	117	1.8V	IO,PU	Universal input/output	If not used, just leave it

				port	in the air.
GPIO_27	118	1.8V	IO,PU	Universal input/output port	If not used, just leave it in the air.
GPIO_28	119	1.8V	IO,PD	Universal input/output port	If not used, just leave it in the air.
GPIO_29	120	1.8V	IO,PD	Universal input/output port	If not used, just leave it in the air.
GPIO_30	121	1.8V	IO,PD	Universal input/output port	If not used, just leave it in the air.
GPIO_31	122	1.8V	IO,PD	Universal input/output port	If not used, just leave it in the air.
GPIO_32	123	1.8V	IO,PU	Universal input/output port	If not used, just leave it in the air.
GPIO_33	124	1.8V	IO,PD	Universal input/output port	If not used, just leave it in the air.
GNSS interface					
GNSS_PWRCTL	98	1.8V	DI	GNSS internal power supply enable	Active high
1V8_GNSS	97	-	PI	GNSS power supply input, the input voltage must be guaranteed not less than 1.8V	Can use VDD_1V8 power supply (Pin 15 of the module) for power supply
GNSS_VBKP	116	-	PI	GNSS backup power input, input voltage 1.4V~3.6V	If not used, just leave it in the air.
1PPS	100	1.8V	DO	1PPS pulse signal output	If not used, just leave it in the air.
GNSS_RXD	96	1.8V	DI	GNSS serial port reception	Connect to MCU UART_TX. Or 10K resistor series connection module UART3_TX (pin 50).
GNSS_TXD	95	1.8V	DO	GNSS serial port transmission	Connect to MCU UART_RX. Or 10K resistor series connection module UART3_RX (pin 49).
Antenna interface					
RF_ANT	60	-	AIO	Main antenna interface	
GNSS_ANT	90	-	AIO	GNSS antenna interface	
BT_ANT	93	-	AIO	Bluetooth antenna interface	
Other function pins					
ADC	25	-	AI	Universal analog to digital converter interface	
VBAT_ADC	51	-	AI	VBAT analog-digital converter interface	If not used, just leave it in the air.

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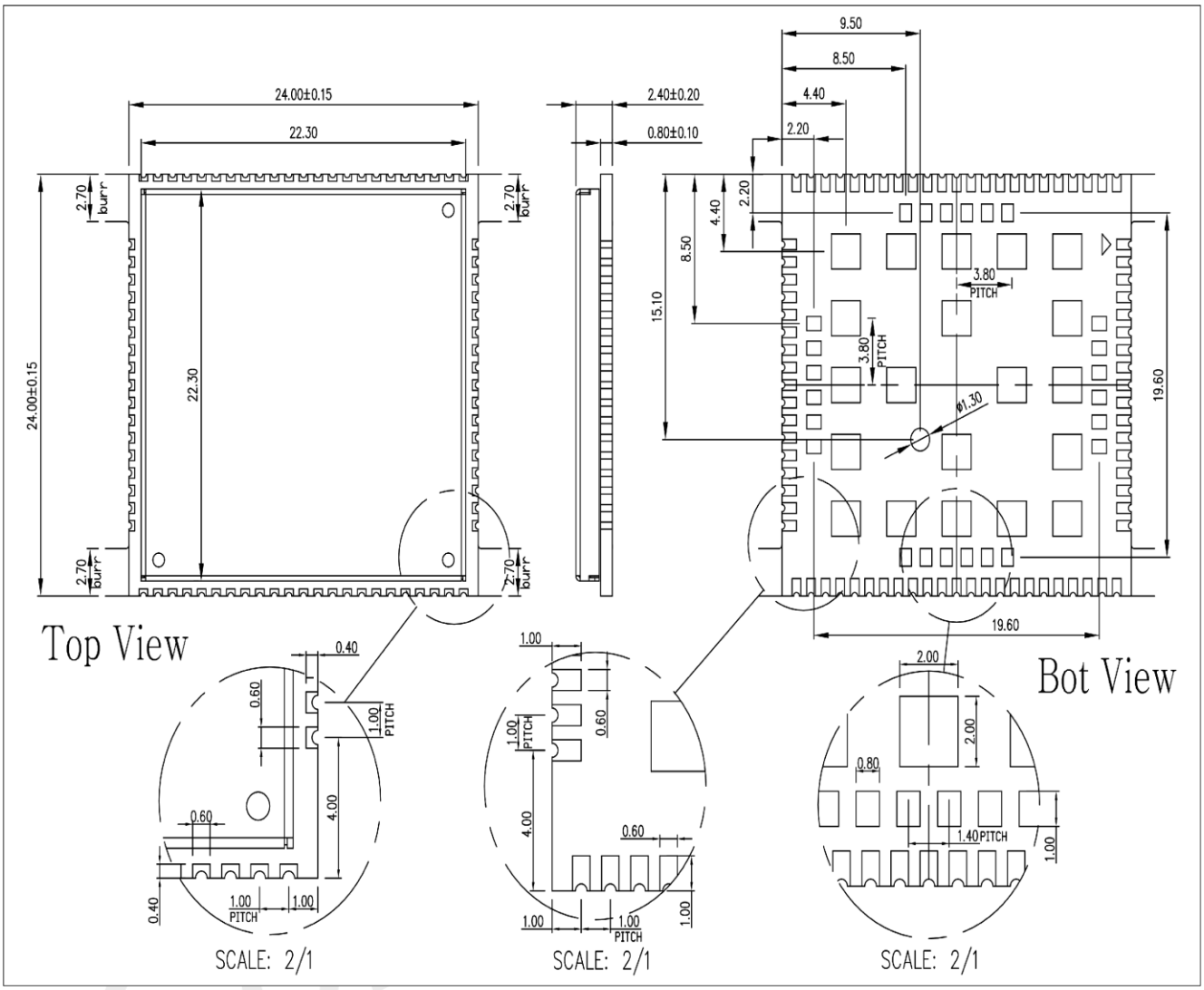
1. Please reserve test points for GPIO_02 (USB_BOOT), VDD_1V8 and UART_LOG_TX. If there is no USB connector, please reserve test points for USB_VBUS, USB_DP and USB_DM at the same time for firmware upgrade.

2. ●It means that these signals cannot be pulled down before power on, otherwise it will affect the normal power on of the module.

2.3 Mechanical Dimensions

The following picture describes the package size of the A7672X module.



picture3：Three-dimensional size (unit: mm)

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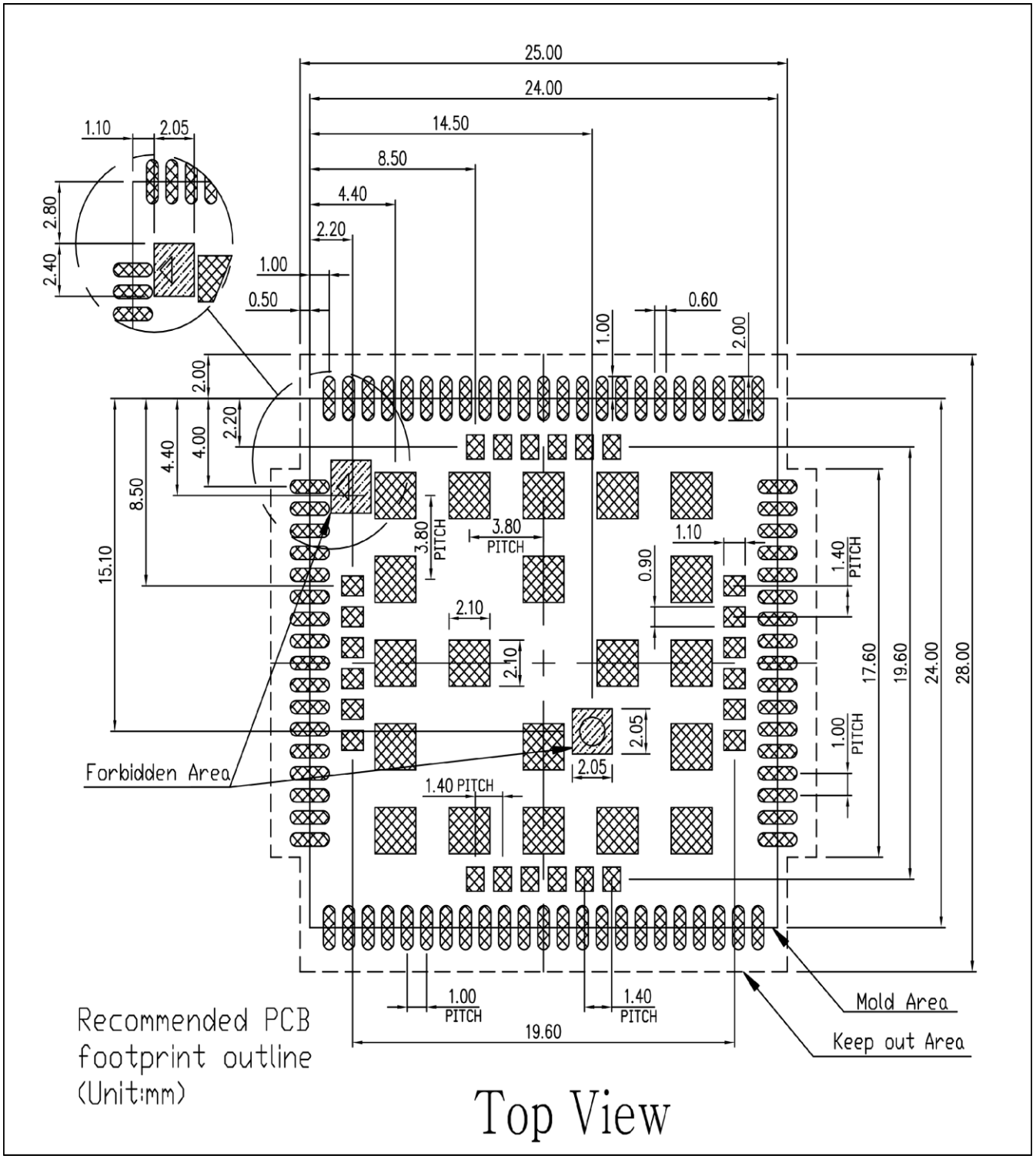
The side length dimension 24.00±0.15mm does not include the burr area.

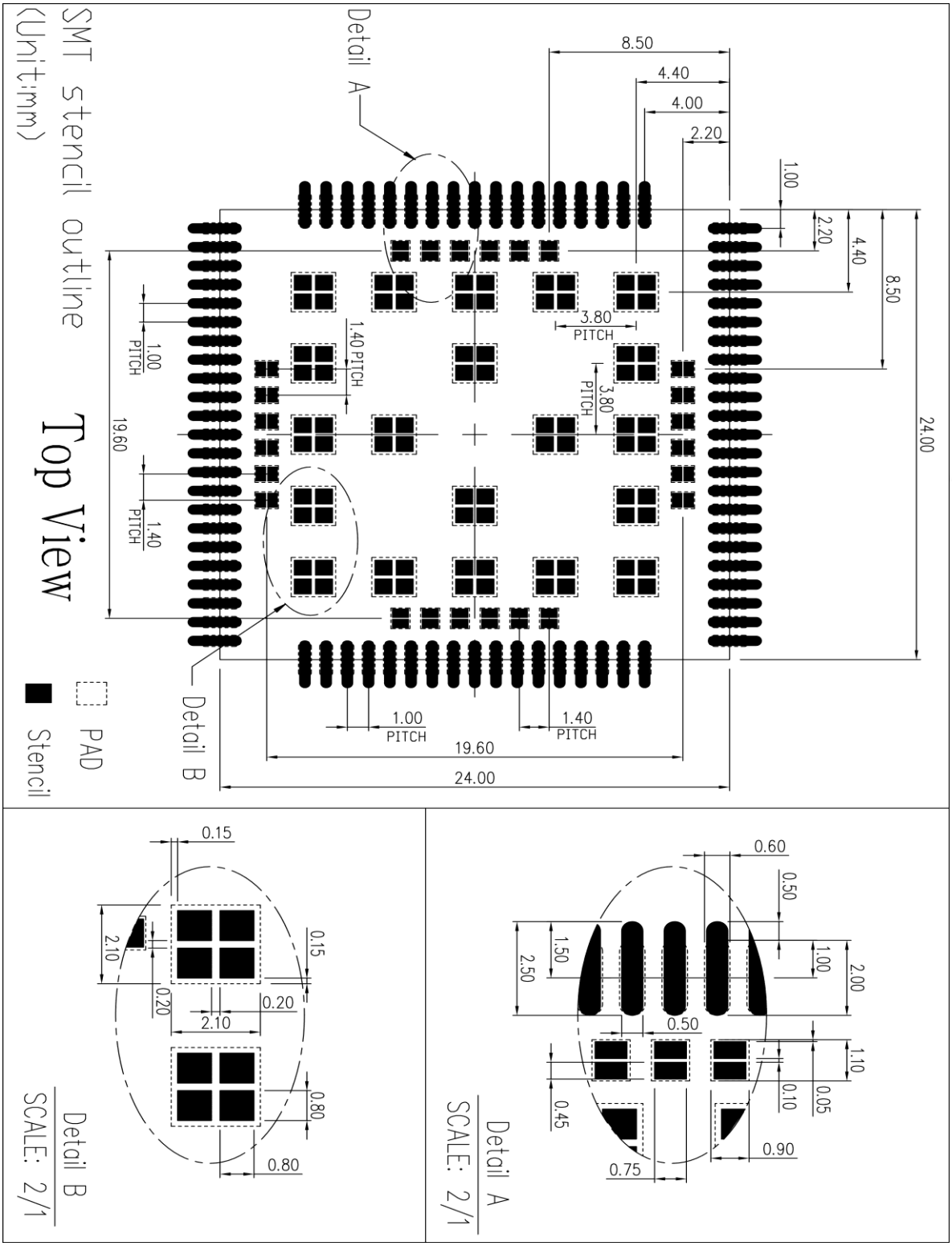
2.4 Recommended PCB package size



picture4：Recommended PCB package size (unit: mm)

2.5 Recommended stencil size

Recommended steel mesh thickness ≥ 0.12mm, ≤ 0.15mm.



picture5：Recommended steel mesh size (unit: mm)

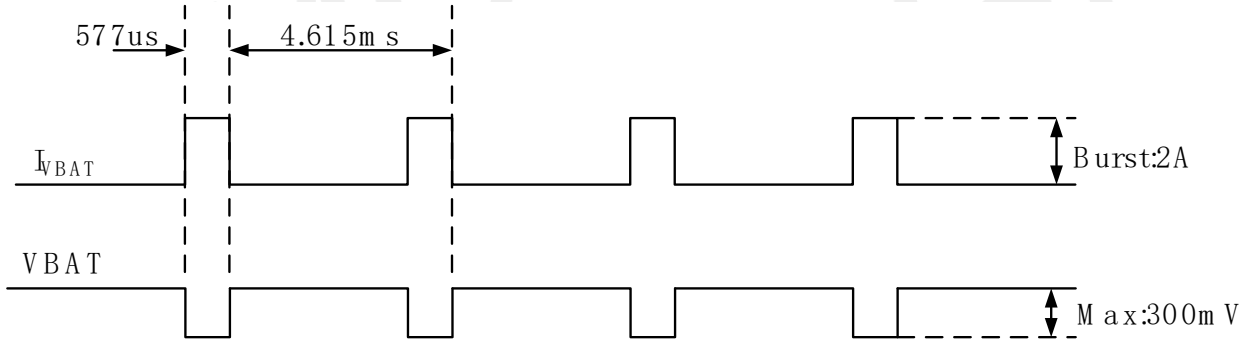
3 Application interface

3.1 Power input

The A7672X module uses a single power supply and has 3 pins (55, 56 and 57 pins) as the VBAT power input. A7672X supplies power to the internal RF and baseband circuits through these 3 pins.

When the module is transmitting at maximum power in GSM mode, the current peak value can reach 2A instantaneously, resulting in a large voltage drop on VBAT. In order to ensure that the voltage drop is less than 300mV, and the power supply voltage is not less than 3.4V during the maximum voltage drop, it is necessary to ensure that the external power supply capability is not less than 2A.

The following figure is a schematic diagram of the voltage drop of VBAT.



picture6：The drop of VBAT during a sudden current

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Test conditions: VBAT power supply is 3.8V, and the module is tested with TE board.

Table 8：VBAT pin electrical parameters

symbol	Symbol description	The smallest	typical	maximum	unit
VBAT	Module power supply input voltage	3.4	3.8	4.2	V
IVBAT(peak)	Peak module current consumption	-	2	-	A

IVBAT(average)	Average current consumption of the module (normal mode)	Please refer to Table 38			
IVBAT(sleep)	Average current consumption of the module (sleep mode)				
IVBAT(power-off)	Average current consumption of the module (shutdown state)	-	20	-	uA

3.1.1 Power supply reference design

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

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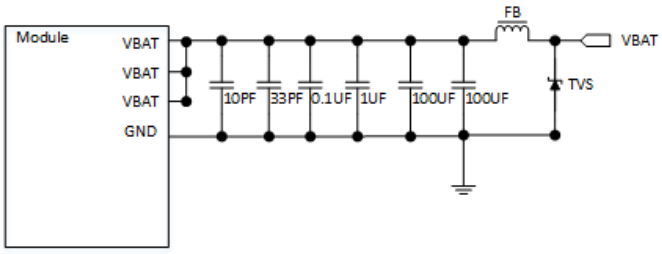
It is recommended that the total capacitance of the external capacitor is not less than 300uF to ensure that the voltage drop on the VBAT pin does not exceed 300mV at any time.

It is recommended to place four ceramic capacitors of 33pf/10pf/0.1/1μF close to VBAT to improve RF performance and system stability. At the same time, it is recommended that the width of the VBAT trace between the power supply on the PCB and the module be at least 3mm. The 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 models of magnetic beads are BLM21PG300SN1D and MPZ2012S221A.



picture7：VBAT input reference circuit

In addition, in order to prevent surge and overvoltage from damaging the A7672X module, it is recommended to connect a TVS tube in parallel to the VBAT pin of the module.

Table 9: List of recommended TVS tubes

serial number	factory	Part No	Operating Voltage	Encapsulation
1	Changdian	ESDBW5V0A1	5V	DFN1006-2L
3	Changyuan Wei'an	WS05DPF-B	5V	DFN1006-2L
4	Weir	ESD5611N	5V	DFN1006-2L
5	Weir	ESD56151W05	5V	SOD-323

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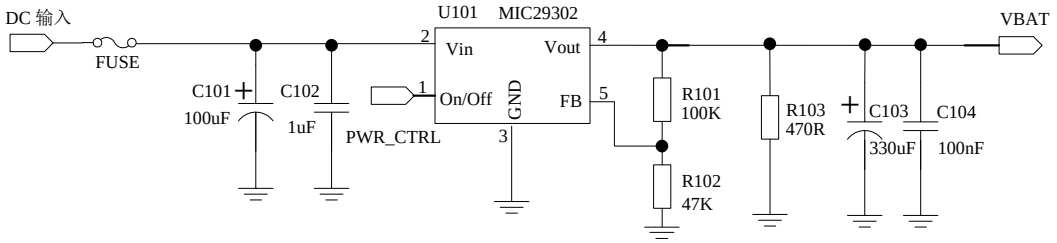
When customers choose TVS by themselves, they need to pay attention to the clamping voltage during surge protection, and the clamping voltage should not be higher than 10V during 100V surge input.

3.1.2 Recommended external power circuit

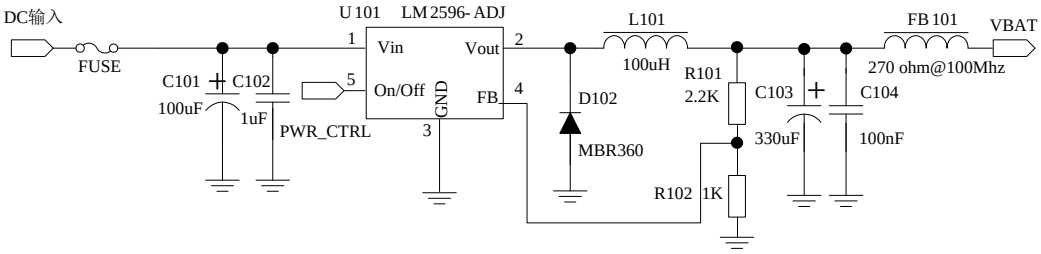
In the design, the MCU must have the function of powering off the module, but it is prohibited to use the module when it can be shut down or restarted normally. Only when the module fails to shut down or restart normally can the module be powered off. It is recommended to choose an LDO with an enable pin. Or DC-DC chip. When the input power is greater than 9V, it is recommended to use the DCDC chip; when the input is less than 9V, it is recommended to use the LDO power supply. If you use the OPEN LINUX secondary development function of the module, because there is no MCU, you can add a low-cost single-chip microcomputer to play the role of a hardware watchdog that can power on the POWERKEY and power off.

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



picture8：Recommended circuit for linear power supply

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



picture9：Recommended circuit for switching power supply

3.1.3 Power monitoring

The AT command "AT+CBC" can be used to monitor the VBAT power supply voltage.

The AT command "AT+CVALARM" can set the high/low voltage alarm voltage. When the actual voltage exceeds the preset value range, the warning information will be reported through the AT port.

Use "AT+CPMVT"The high/low voltage shutdown voltage can be set. When the actual voltage exceeds the preset value range, the module will directly shut down automatically.

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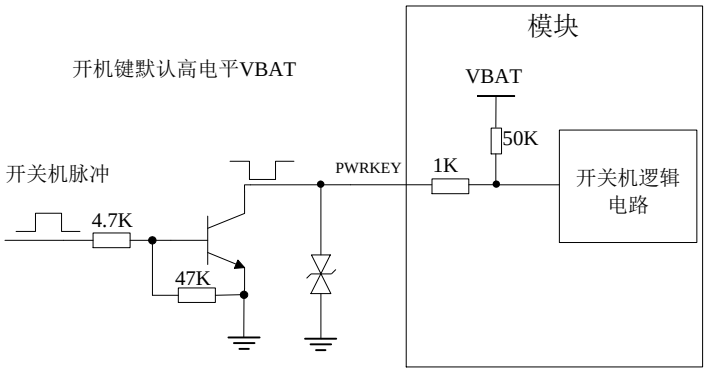
Power supply voltage monitoring function is being debugged,The over-voltage alarm and over-voltage shutdown functions are turned off by default. For detailed information about related AT commands, please refer to document [1].

3.2 Power on/off/reset

3.2.1 Module boot

The user can turn on the module by pulling down the PWRKEY pin. This pin has been pulled up to VBAT internally in the module.

It is recommended that customers add TVS tubes at the module pins to effectively enhance the anti-static ability of the module when designing. The recommended circuit is as follows:



picture10：Switch machine reference circuit

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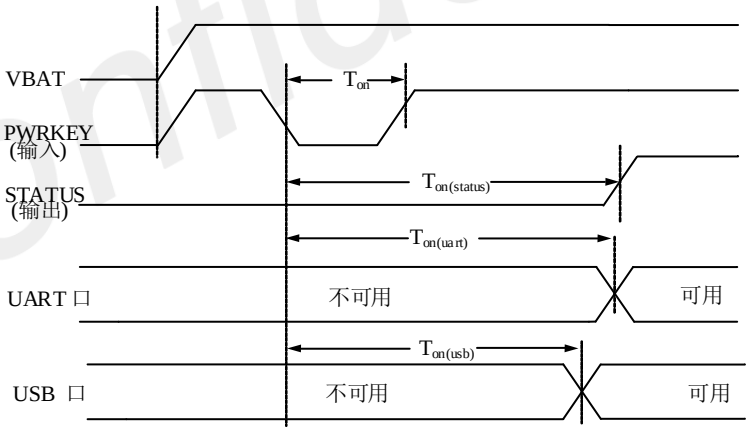
If the customer does not need to power on automatically, please do not PWRKEY and RESET Parallel over100nF.Otherwise, a low level will be detected when the module is powered on, which will cause the module to automatically turn on. Because PWRKEY and RESET All have the function of pulling down the power-on, which prohibits the power-on process within a short period of time. PWRKEY and RESET, Otherwise it may cause abnormal startup.



picture11：PWRKEY boot sequence

Table 10: Power-on timing parameters

symbol	describe	Minimum	Typical value	Max	unit

Ton	Power-on low-level pulse width	-	50	-	ms
Ton(status)	Power-on time (judged according to STATUS pin)	-	6	-	s
Ton(uart)	Power-on time (judged by UART)	-	8	-	s
Ton(usb)	Booting time (according to USB judgment)	-	9	-	s
VIH	PWRKEY pin input high level voltage	0.7*VBAT	-	VBAT	
VIL	PWRKEY pin input low-level voltage	0	0	0.3*VBAT	

3.2.2 Module shutdown

The A7672X module has the following shutdown methods:

- Shut down using PWRKEY pin
- Use "AT+CPOF" command to shut down
- High/low voltage overvoltage shutdown, use "AT+CPMVT"Set the voltage range.
- High and low temperature shutdown

It is strongly recommended that customers use PWRKEY or AT+CPOF to shut down, and then power off VBAT after shutting down (especially when the module does not need to work at all). In addition, it is not possible to shut down by disconnecting VBAT, which may damage FLASH.

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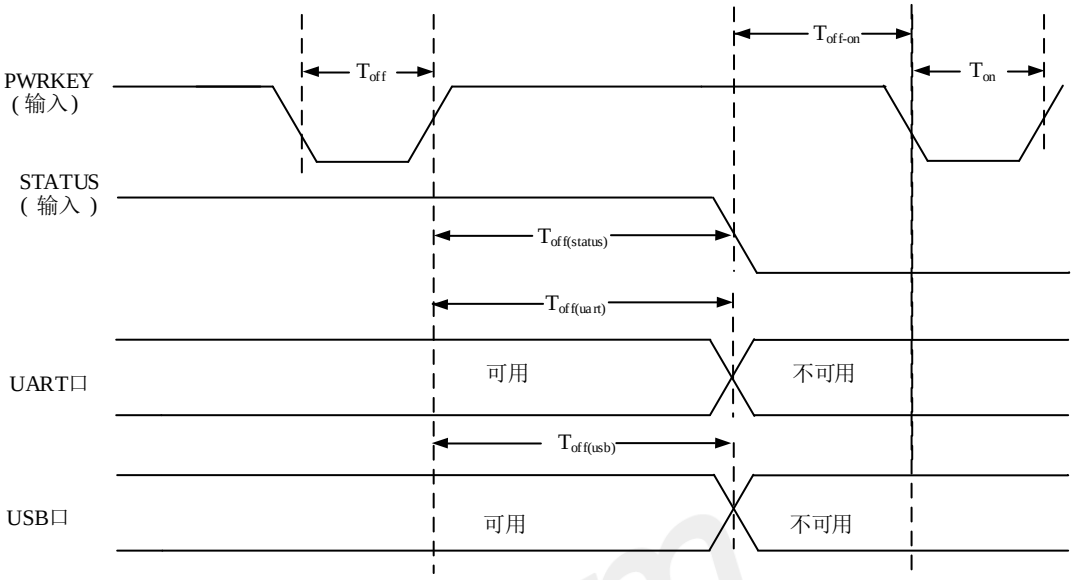
When the temperature exceeds -30~+80° CWhen it is in the range, the A7672X module will report warning information through the AT port. When the temperature exceeds -40~+85° CWhen it is in the range, the A7672X module automatically shuts down. "AT+CPOF"And "AT+CPMVT"For detailed description, please refer to document [1].

The user can shut down by pulling the PWRKEY signal low. The shutdown sequence diagram is shown in the figure below:



picture12：PWRKEY shutdown sequence

Table 11: Shutdown timing parameters

symbol	describe	Minimum	Typical value	Max	unit
Toff	Shutdown machine low-level pulse width	2.5	-	-	s
Toff(status)	Shutdown time (judged according to STATUS pin)	-	2	-	s
Toff(uart)	Shutdown time (judged by UART)	-	2	-	s
Toff(usb)	Shutdown time (according to USB judgment)	-	2	-	s
Toff-on	Shutdown-boot buffer time	2	-	-	s

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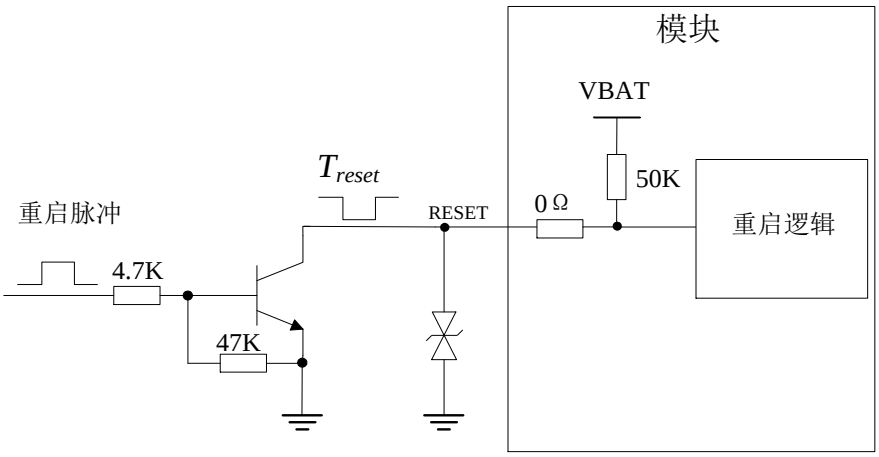
The STATUS pin can be used to determine whether it is powered on. When the module is powered on and the initialization is complete, STATUS outputs high level, otherwise it keeps low level.

3.2.3 ModuleReset

The A7672X module can restart the module by pulling down the RESET pin of the module. The RESET pin also has a low boot function (no computer function). The module only has the boot function when it is powered on for the first time. After booting, the PMU register will be rewritten to disable the boot function of the RESET key. Recommended UsePWRKEY is switched on and off, and RESET is only used as a reset function.

There is already a 50KΩ pull-up resistor inside the module, so there is no need to add a pull-up resistor externally. The recommended circuit is as follows:



picture13：Recommended circuit for reset

Table 12: RESET pin electrical parameters

parameter	describe	Minimum	Typical value	Max	unit
Treset	Restart low pulse width	2	2.5	-	S
VIH	RESET pin input high level voltage	0.7*VBAT	-	VBAT	V
VIL	RESET pin inputs low-level voltage	0	0	0.3*VBAT	V

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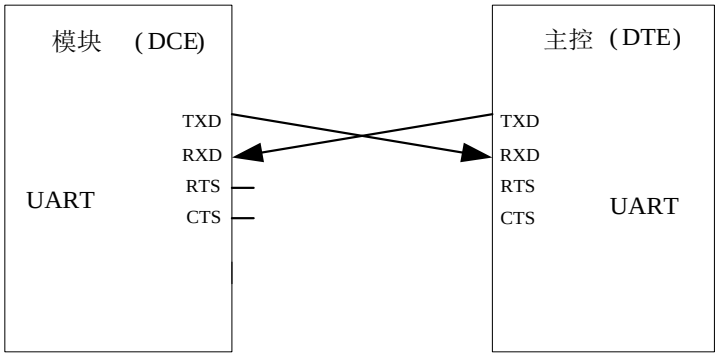
It is recommended to use the RESET pin only in emergency situations, such as when the module does not respond. The recommended reset time of RESET is 2.5s.

3.3 Serial port

The A7672X module provides three serial ports, the main communication serial port UART, the common serial port UART3 and one LOG serial port UART_LOG. The module is a DCE (Data Communication Equipment) device.

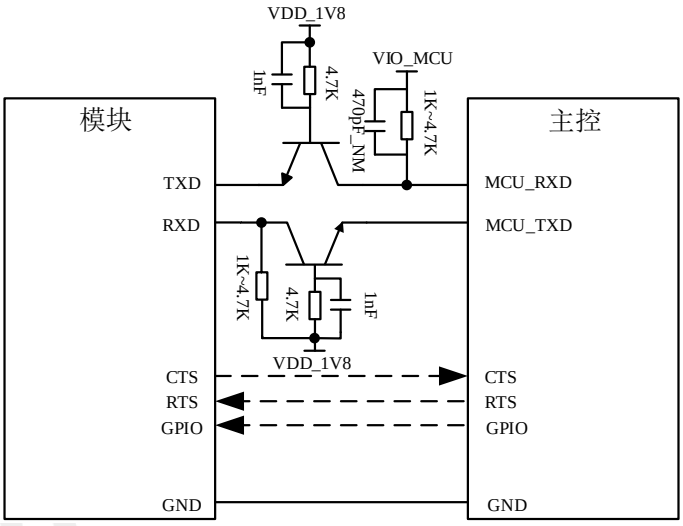
3.3.1 Serial reference design

When using the serial port, you can refer to the following connection method:



picture14：Serial connection diagram

The following figure shows the use of a transistor for circuit conversion. The circuit in the dotted line can refer to the circuit of the solid line TXD and RXD, and you need to pay attention to the direction of the signal. The recommended transistor model here is MMBT3904.



picture15: Triode level conversion circuit

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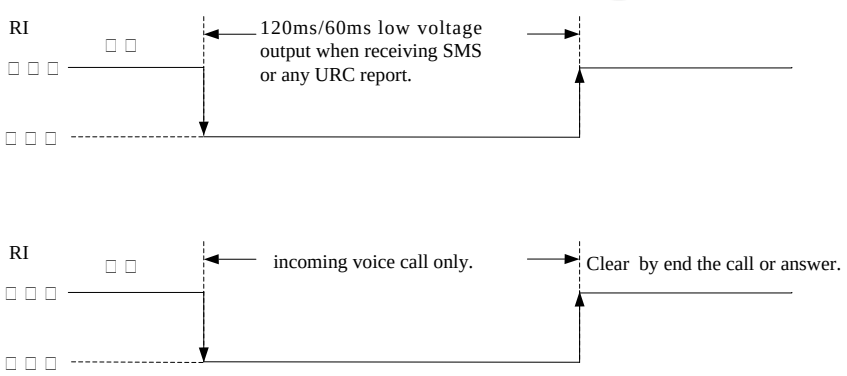
1.A7672X main serial port UARTThe following baud rates are supported:300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600, 1842000, 3686400.The default baud rate is 115200bps.

2. The maximum baud rate supported by A7672X common serial port UART3 is 921600.

3.Due to the existence of the parasitic capacitance of the triode, it will affect the edge of the high-speed digital signal, and the signal speed is higher than115200bpsIt is not recommended to use this circuit.

3.3.2 RIandDTRdescribe

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, RI outputs low level. After outputting low level, RI will remain low until the host accepts the call using the "ATA" command or the caller stops calling RI. Restore the output high level.



picture16: Level change on RI (SMS, URC)

DTR can be used as the sleep wake-up pin of the A7672X module. When the A7672X module enters the sleep mode, pull down DTR to wake up the A7672X module.

When the user sets "AT+CSCLK=1"After that, pull the DTR pin high and the module will automatically enter the sleep mode. The serial port function cannot communicate normally at this time. When A7672X enters sleep mode, pull down DTR to wake up the A7672X module.

In the setting "AT+CSCLK=0"In the mode, pull the DTR pin high, there will be no effect, and the normal communication of the serial port function will not be affected.

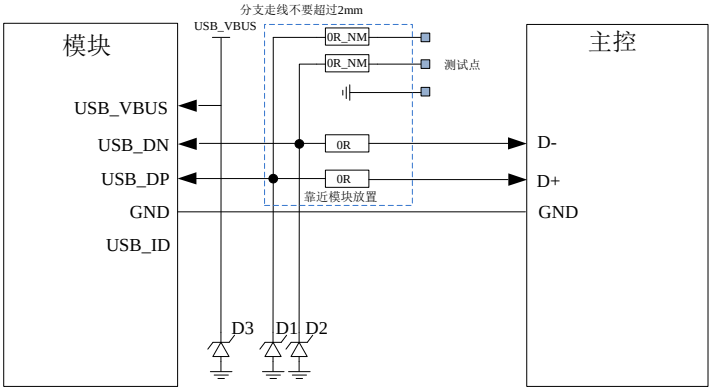
3.4 USB interface

The A7672X module has a USB2.0 interface, does not support USB charging function, does not support USB HOST mode. Support high speed (480Mbps) and full speed (12Mbps), the interface can be used for AT command transmission, data transmission, software debugging and upgrade. Map out ttyUSB1-ttyUSB2 under linux or android system (refer to linux or android debugging document for details).

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

3.4.1 USB reference design

The A7672X module can be used as a USB slave device and supports USB sleep and wake-up mechanisms. The recommended connection circuit diagram is as follows:



picture17：USB connection diagram

Customers should pay attention to the selection of the D3 device when using it. It is recommended to choose an anti-static and anti-surge two-in-one device, and a TVS tube can be placed. The recommended model is ESD5681N07.

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1. The USB data line must be routed strictly in 90Ω+/-10% differential form. The TVS devices D1 and D2 on the data line must have an equivalent capacitance value less than 1pF. The TVS device must be placed close to the USB connector or test point. It is recommended Models ESD73011N and WS05DUCFM.
2. The detection and determination of the USB2.0 rate is automatically completed by the USB protocol, and the customer does not need to pull up the DP externally, otherwise it may affect the device USB enumeration.

3.4.2 GPIO_02 (USB_BOOT) interface

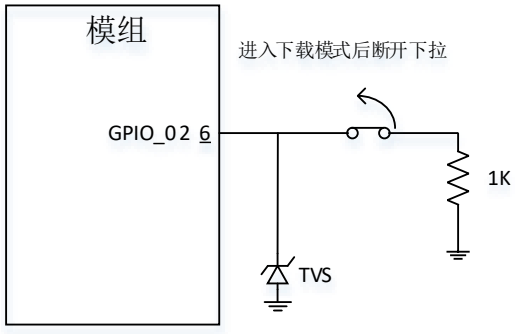
The module provides a mandatory download boot interface GPIO_02 (USB_BOOT).

Table 13：GPIO_02(USB_BOOT) description

Pin number	Pin name	I/O	Function description	Voltage domain	Default state	Remark
6	GPIO_02	DI	Force download boot port	1.8V	B-PU	

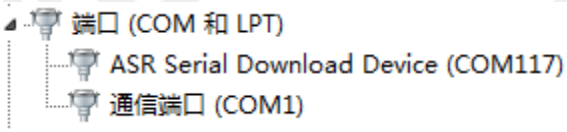
If the module cannot be turned on due to abnormal upgrade, you can force the upgrade through the USB_BOOT port.

Before the module is turned on, short-circuit the GPIO_02 pin to GND, then add VBAT power to the module, press RESET, and the module will enter the download mode. After entering the download mode, you need to release GPIO_02 and remove the short circuit.



picture18：GPIO_02 (USB_BOOT) connection diagram

Customers can view the download port in the device manager port of the widows system.



picture19: Mandatory download port

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GPIO_02 only has the function of compulsory download and boot before booting (not pull down), and it has other functions after booting.

3.5 USIM card interface

The A7672X module supports 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 is 3V or 1.8V.

Table 14：USIM interface electrical parameters in 1.8V mode (USIM_VDD=1.8V)

symbol	describe	Minimum	Typical value	Max	unit
USIM_VDD	Power supply voltage output to USIM card	1.62	1.8	1.98	V
VIH	Input high level voltage	0.7*USIM_VDD	-	USIM_VDD +0.4	V

VIL	Input low-level voltage	-0.4	0	0.25*USIM_VDD	V
VOH	Output high level voltage	USIM_VDD -0.4	-	USIM_VDD	V
VOL	Output low-level voltage	0	0	0.2	V

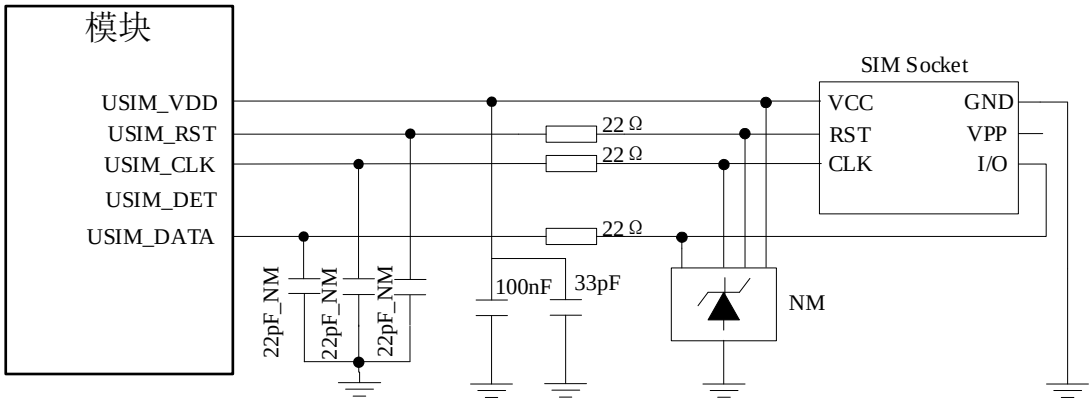
Table 15：USIM interface electrical parameters in 3.0V mode (USIM_VDD=3V)

symbol	describe	Minimum	Typical value	Max	unit
USIM_VDD	Power supply voltage output to USIM card	2.7	3	3.3	V
VIH	Input high level voltage	0.7*USIM_VDD	-	USIM_VDD +0.4	V
VIL	Input low-level voltage	-0.4	0	0.25*USIM_VDD	V
VOH	Output high level voltage	USIM_VDD -0.45	-	USIM_VDD	V
VOL	Output low-level voltage	0	0	0.3	V

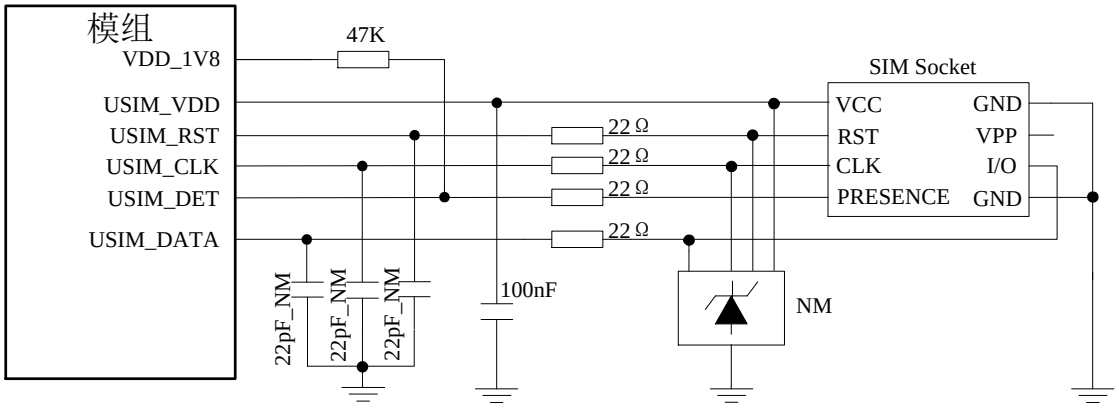
3.5.1 USIM reference design

The following figure is the recommended interface circuit for the USIM card. In order to protect the USIM card, it is recommended to use ST(www.st.com) The company's ESDA6V15W device or ON SEMI (www.onsemi.com) The company's SMF15C device is used for electrostatic protection. The peripheral circuit components of the USIM card should be placed close to the USIM card socket. The recommended circuit of the 8-pin USIM card socket is shown in the figure below.

The reference circuit is shown in the figure below.



picture20：Recommended circuit for USIM interface



picture21：Recommended circuit for USIM interface (8PIN)

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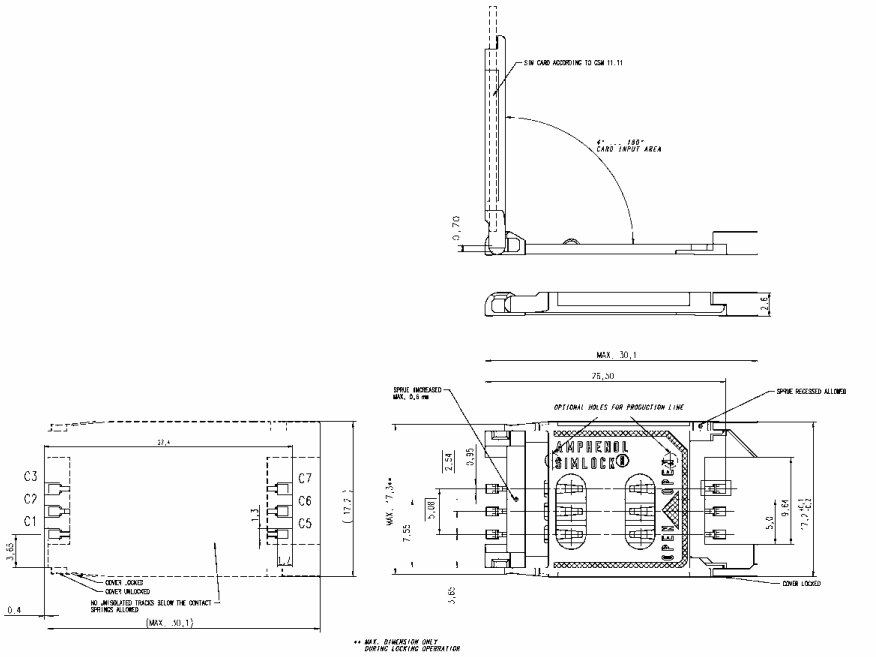
1. USIM1_DATA has been pulled up to USIM_VDD through a 4.7KΩ resistor, and the external circuit does not need to be pulled up. In addition, the 100nF decoupling capacitor on USIM_VDD is recommended to be retained. For more AT commands about USIM card operation, please refer to document [1].
2. USIM2_DATA does not have a pull-up resistor, so you need to add a pull-up resistor to USIM2_VDD in the external circuit.

The USIM card circuit is more susceptible to interference, which may cause the card not to be read or dropped, so please follow the following principles when designing:

- Be sure to keep the USIM card holder away from the main antenna during the PCB layout stage.
- The USIM card wiring should be as far away as possible from RF lines, VBAT and high-speed signal lines, and the USIM card wiring should not be too long.
- The GND of the USIM card socket should maintain good connectivity with the GND of the module, so that the GNDs of the two have the same potential.
- To prevent USIM_CLK from interfering with other signals, it is recommended to protect USIM_CLK separately.
- It is recommended to place a 220nF capacitor on the USIM_VDD signal line close to the USIM card socket.
- Place a TVS close to the USIM card socket. The parasitic capacitance of the TVS should not be greater than 50pF, such as ESD9L5.0ST5G.
- Connecting a 22Ω resistor in series between the USIM card socket and the module can enhance the ESD protection performance.
- In order to make the routing the most smooth, it is recommended to use a single-channel TVS, placed close to each pin of the card socket.
- The USIM_CLK signal is very important. Customers should ensure that the rising edge and falling edge time of the USIM_CLK signal are less than 40ns, otherwise, abnormal card recognition may occur.

3.5.2 Choice of USIM deck

The 6-pin USIM card holder is recommended to use C707 10M006 512 from Amphenol. Please browsehttp://www.amphenol.comLearn more on the web page!



picture22：Amphenol C707 10M006 512 USIM card socket size drawing

Table 16：Amphenol USIM card socket pin description

Pin name	Signal	describe
C1	USIM_VDD	USIM card power supply pin
C2	USIM_RST	USIM card reset pin
C3	USIM_CLK	USIM card clock pin
C5	GND	Grounded
C6	VPP	Not connected
C7	USIM_DATA	USIM card data input/output pin

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If the customer is designing an in-vehicle product, please choose a more reliable USIM card holder.

3.6 Analog audio interface

A670C R2The module provides a set of analog audio interfaces, integrated audio codec and audio front-end, providing1Analog audioMICInput interface and1Analog audioSPKThe output interface, the customer can make a voice call with an external handle.

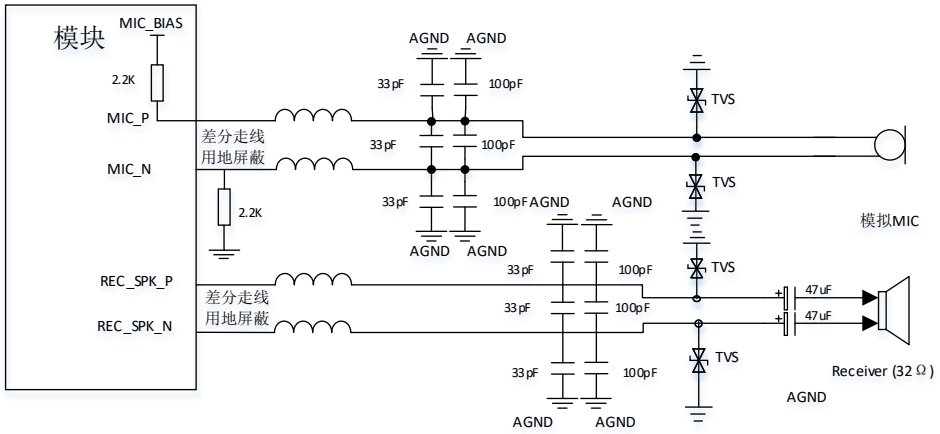
ADC: 90dB SNR@20 ~20kHz
DAC: 95dB SNR@20 ~20kHz
(Class-AB): THD< -85dB@32-ohm

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

parameter	condition	DR (typical value)	THD+N (typical value)	Maximum power
ADC	RL=10K	101dBA	-96dB(@vout -2dBv)	1.59Vp
Class-AB	Mono,32Ω Difference	100dBA	-90dB(0.00316%) (@20mW output)	37mW

3.6.1 Analog audio reference design

The recommended circuit for analog audio is shown in the figure below:



picture23：Recommended circuit for analog audio interface

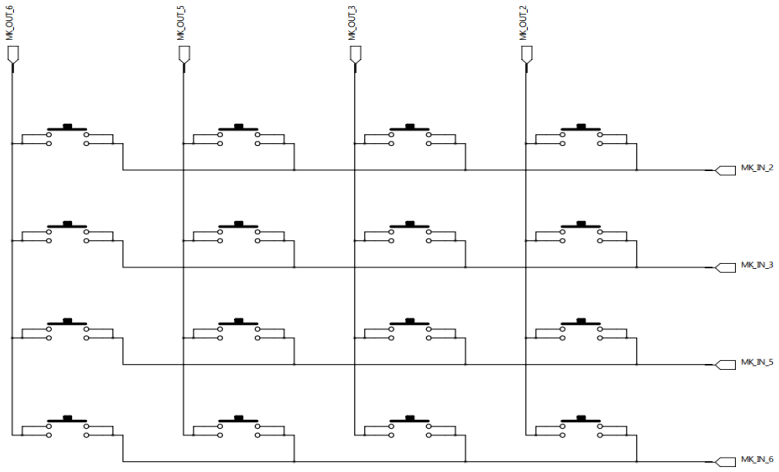
3.7 Keyboard interface

The module provides a set of 4×4 keyboard interfaces.

Table 18：Keyboard interface pin description

Module PIN name	Reuse function	Pin	I/O	describe
GPIO_16	MK_IN2	47	DI	Keyboard input signal
GNSS_PWR_EN	MK_IN3	20	DI	
GPIO_12	MK_IN5	68	DI	
GPIO_14	MK_IN6	36	DI	
GPIO_15	MK_OUT2	44	DO	Keyboard output signal
GPIO_07	MK_OUT3	twenty one	DO	
GPIO_11	MK_OUT5	67	DO	
GPIO_13	MK_OUT6	35	DO	

Keyboard interface reference design:



picture24: Keyboard reference design

3.8 GPIO interface operation instructions

The A7672X module provides customers with multiple GPIO usage.

Table 19：A7672X standard edition software GPIO resources

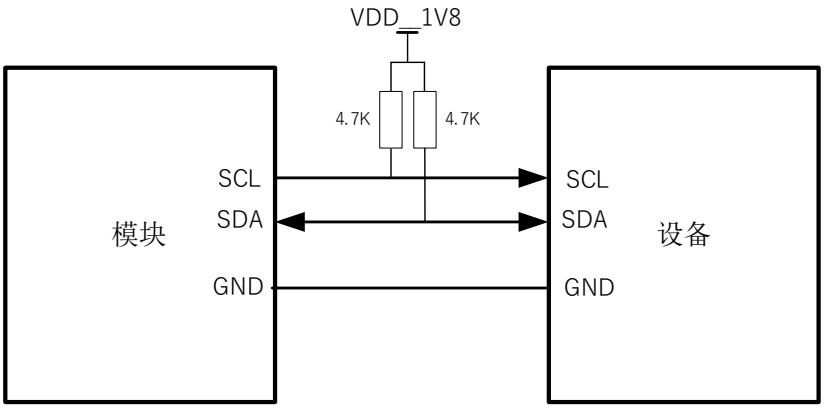
Pin	Pin name	Voltag	Power-	Default	Reuse function	Interrupt

number		e domai n	on state	function		function
4	GPIO_00	1.8V	PU	GPIO		support
5	GPIO_01	1.8V	PU	GPIO		support
6	GPIO_02●	1.8V	PU	GPIO	PWM2	support
7	GPIO_03	1.8V	PU	GPIO	UART_RTS	support
8	GPIO_04	1.8V	PU	GPIO	UART_CTS	support
19	GPIO_05	1.8V	PU	GPIO		support
20	GNSS_PWR_EN	1.8V	PD	GPIO	MK_IN_3	support
21	GPIO_07	1.8V	PU	GPIO	MK_OUT_3	support
48	GPIO_08	1.8V	PU	GPIO		not support
52	GPIO_09	1.8V	PD	GPIO		support
66	GPIO_10	1.8V	PD	GPIO	PWM1	support
67	GPIO_11	1.8V	PU	GPIO	MK_OUT_5	support
68	GPIO_12	1.8V	PU	GPIO	MK_IN_5	support
35	GPIO_13	1.8V	PD	GPIO	MK_OUT_6	support
36	GPIO_14	1.8V	PD	GPIO	MK_IN_6	support
44	GPIO_15	1.8V	PD	GPIO	MK_OUT_2	support
47	GPIO_16	1.8V	PD	GPIO	MK_IN_2	support
26	GPIO_17	1.8V	PD	GPIO		support
53	GPIO_18	1.8V	PU	GPIO		support
101	GPIO_19	1.8V	PD	GPIO	LCD_BL_PWM	not support
102	GPIO_20	1.8V	PU	GPIO	LCD_SPI_CLK	support
103	GPIO_21	1.8V	PU	GPIO	LCD_SPI_TXD	support
104	GPIO_22	1.8V	PU	GPIO	LCD_SPI_RXD	support
105	GPIO_23	1.8V	PU	GPIO	LCD_SPI_CS	support
106	GPIO_24	1.8V	PD	GPIO	LCD_RST	not support
107	GPIO_25	1.8V	PU	GPIO	LCD_DCX	support
117	GPIO_26	1.8V	PU	GPIO		support
118	GPIO_27	1.8V	PU	GPIO		support
119	GPIO_28	1.8V	PD	GPIO		not support
120	GPIO_29	1.8V	PD	GPIO		not support
121	GPIO_30	1.8V	PD	GPIO		support
122	GPIO_31	1.8V	PD	GPIO		support
123	GPIO_32	1.8V	PU	GPIO		support
124	GPIO_33	1.8V	PD	GPIO		support

3.9 I2C bus

The module provides a set of hardware I2C protocol interface, supports standard mode 100Kbps,

supports high-speed mode 400Kbps, and the working voltage is 1.8V.I2C is an open-drain output, and the reference circuit is shown in the figure below:



picture25：I2C interface reference circuit

※pay

SCL and SDA pins need pull-up resistors, and the pull-up power must be VDD_1V8 output by the module.

3.10 GNSS function interface

A7670 R2 is equipped with GNSS function. GNSS provides 2 power supply input interfaces, 1 GNSS power enable control switch, 1 2-wire UART interface and 1 pulse synchronization clock signal interface. The details are as follows.

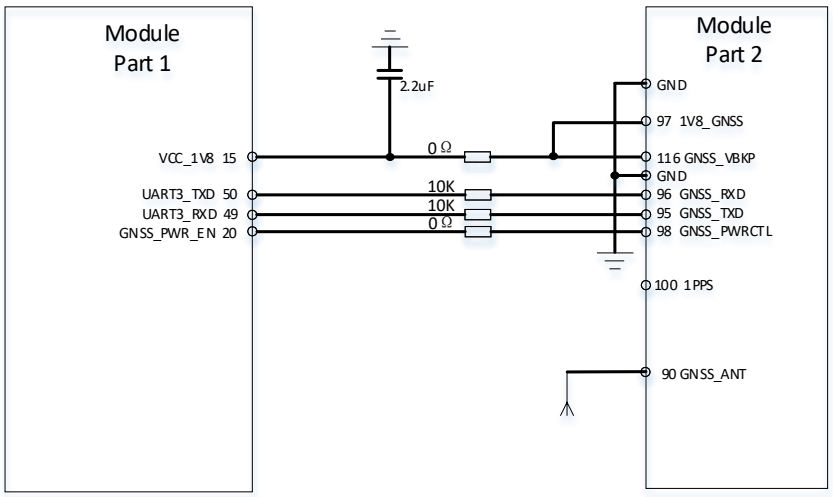
Table 20: GNSS functional interface description

PIN name	Pin	I/O	describe	Remark
GNSS_VBKP	116	PI	GNSS backup power input	The power supply range is 1.4V~3.6V.
1V8_GNSS	97	PI	GNSS Vcore, VDDIO power input	The power supply voltage is required to be no less than 1.8V. The trace should be as short as possible, and the line width should be above 0.5mm.
GNSS_PWRCTL	98	DI	GNSS Vcore, VDDIO power supply enable control switch	Active high. Solution 1: Connect the module GPIO, it is recommended to use MK_IN_3 (PIN20). Solution 2: Connect MCU GPIO.
GNSS_RXD	96	DI	GNSS serial port data reception in the module	1.8V power domain. Solution 1: 10K resistor series connection module

				UART3_TXD (PIN50). Solution 2: Connect MCU UART_TX.
GNSS_TXD	95	DO	GNSS serial data transmission in the module	1.8V power domain. Solution 1: 10K resistor series connection module UART3_RXD (PIN49). Solution 2: Connect MCU UART_RX.
1PPS	100	DO	GNSS pulse clock synchronization signal	The second pulse signal can be used for precise timing.

Wiring scheme one:

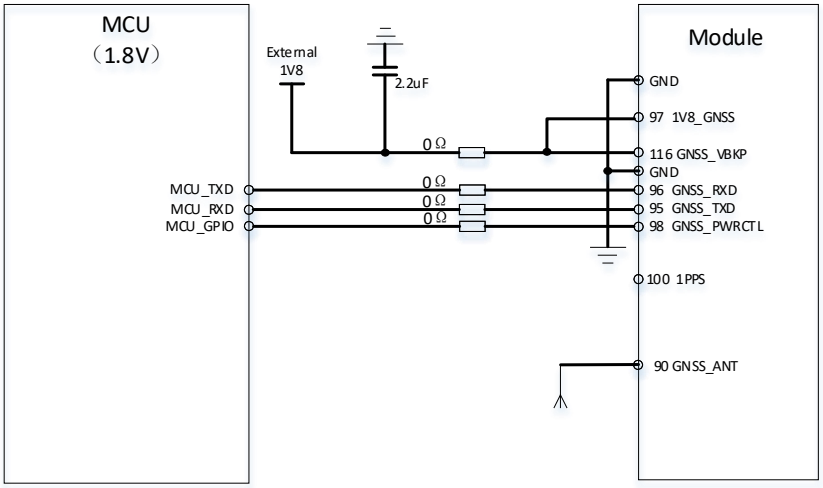
GNSS byThe non-independent GNSS reference design that the module itself provides power supply, power supply enable, and UART transparent transmission is as follows:



picture26: GNSS reference schematic diagram (non-independent GNSS solution)

Wiring scheme two:

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



picture27：GNSS reference schematic diagram (independent GNSS solution)

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1. It is recommended to connect a 10K resistor in series with the serial communication line of the non-independent GNSS solution to prevent the leakage current of the serial port of the GNSS chip.
2. The reference schematic diagram of the independent GNSS solution is only applicable to the 1.8V voltage domain MCU. If the MCU is not in the 1.8V voltage domain, a level conversion circuit needs to be added.
3. The main power input of GNSS, 1V8_GNSS, has higher power requirements. The PCB traces should be as short as possible, and the line width should be at least 0.5mm.

3.11 SPI LCD interface

The A7672X module provides a set of SPI LCD interface, which only supports 1 data line LCD module. The LCD interface of the module does not have a dedicated LCD_TE signal pin. If necessary, you can choose GPIO to simulate use. It is recommended to use the module's pin 44 (GPIO_15/ MK_OUT_2) is used as the LCD_TE signal.

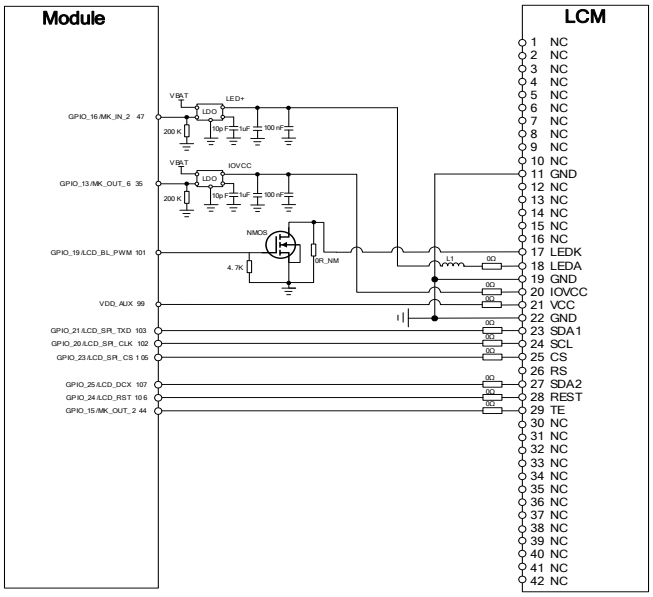
It is recommended to reserve a voltage stabilizing capacitor and a decoupling capacitor on the LCD power supply line, and reserve a series 0Ω resistor for debugging. At the same time, 0Ω is reserved in series on the data line to facilitate the adjustment of signal quality and prevent signal reflection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

surface21: SPI LCD

Module PIN name	Reuse function	Pin	I/O	describe
GPIO_19	LCD_BL_PWM	101	DO	LCD backlight PWM adjustment
GPIO_20	LCD_SPI_CLK	102	DO	SPI clock signal
GPIO_21	LCD_SPI_TXD	103	DO,DI	SPI data line (two-way)
GPIO_22	LCD_SPI_RXD	104	DI	SPI data line

GPIO_23	LCD_SPI_CS	105	DO	SPI chip select signal
GPIO_24	LCD_RST	106	DO	LCD reset signal
GPIO_25	LCD_DCX	107	DO	LCD command/parameter selection

The SPI LCD reference circuit is as follows:



picture28: SPI LCD interface reference schematic diagram

3.12 Bluetooth function

The A7672X module integrates Bluetooth function, and only one PIN pin (pin 93) of the Bluetooth antenna interface is left on the module interface. Support BT5.0 protocol specification, compatible with BLE low power consumption mode and traditional BT mode; only support Bluetooth data transmission, not VoiceOverPCM & VoHCI.

3.13 Other interfaces

3.13.1 Analog-to-digital converter(ADC)

The A7672X module provides 1 general GPADC interface and 1 VBAT_ADC interface.

The input voltage range of GPADC is 0~1.8V, and it is recommended that the external voltage division value should not exceed 10K during hardware design.

The input voltage range of VBAT_ADC is 0~4.2V. It is used to read the battery voltage by default. During hardware design, VBAT_ADC must use 680K_1% and 470K_1% resistors for voltage division.

Its electrical characteristics are as follows:

Table 22: General ADC electrical characteristics

characteristic	Minimum	Typical value	Max	unit
ADC resolution	-	9	-	bits
Input voltage range	0	-	1.8	V

Table 23：VBAT ADC electrical characteristics

characteristic	Minimum	Typical value	Max	unit
ADC resolution	-	9	-	bits
Input voltage range	0	-	4.2	V

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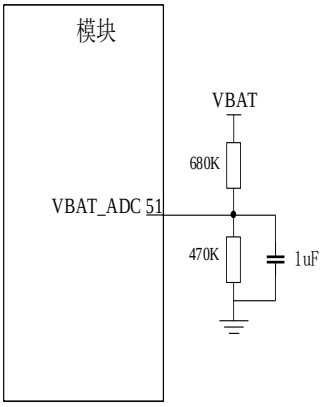
Use "AT+CADC=1"The voltage value (0~1.8V) on the general-purpose ADC pin can be read.

Use "AT+CBC"The voltage value of VBAT_ADC (0~4.2V) can be read, and it needs to be designed according to the reference schematic diagram of VBAT_ADC.
For more information, please refer to the document [1].

The reference schematic diagram of VBAT_ADC is as follows:



picture29: VABT_ADC reference schematic

3.13.2 LDO

The A7672X module provides two power outputs: VDD_1V8 and VDD_AUX

VDD_1V8 is the module's system IO power supply, which can only provide 50mA current capacity, and cannot be used as a large current drive source; it can provide 1.8V power supply for 1V8_GNSS (module 97 pins).

VDD_AUX is the adjustable voltage output power supply of the module. It is off by default. It can only provide 50mA current capability and cannot be used as a high-current drive source; it can provide power for active antennas, LCDs and other peripherals.

Table 24: VDD_1V8 electrical characteristics

symbol	describe	Minimum	Defaults	Max	unit
VVDD_1V8	The output voltage	-	1.8	-	V
IO	Output current	-	-	50	mA

※pay

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

Table 25: VDD_AUX electrical characteristics

symbol	describe	Minimum	Defaults	Max	unit
VVDD_AUX	The output voltage	2.5	3.0	3.0	V
IO	Output current	-	-	50	mA

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1. VDD_AUX is an 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, please pay attention to the usage scenarios.
3. Please refer to the document [1] for the voltage output adjustment method.

4 RF parameters

4.1 GSM/LTERF parameters

Table 26: Conducted emission power

frequency	power	Minimum
EGSM900(GMSK)	33dBm ±2dB	5dBm ± 5dB
DCS1800(GMSK)	30dBm ±2dB	0dBm ± 5dB
EGSM900 (8-PSK)	27dBm ±3dB	5dBm ± 5dB
DCS1800 (8-PSK)	26dBm +3/-4dB	0dBm ±5dB
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 27: GSM frequency band information

Frequency band	take over	emission
EGSM900	925～960MHz	880～915 MHz
DCS1800	1805～1880 MHz	1710～1785 MHz

Table 28: 4G frequency band information

E-UTRA Band number	Uplink operating frequency band	Downstream operating frequency band	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 29: Conduction sensitivity

Frequency band	Sensitivity(typical)	Sensitivity(maximum)
EGSM900	<-109dBm	3GPP
DCS1800	<-108dBm	3GPP
LTE FDD/TDD	Refer to Table 30	3GPP

Table 30: 4G Conducted Sensitivity (QPSK)

E-UTRA frequency band number	3GPP standard						Measured value	Duplex mode
	1.4 MHz	3MHz	5MHz	10MHz	15MHz	20MHz	5MHz	
1	-	-	-100	-97	-95.2	-94	-100	FDD
3	-101.7	-98.7	-97	-94	-92.2	-91	-97	FDD
5	-103.2	-100.2	-98	-95	-	-	-98	FDD
8	-102.2	-99.2	-97	-94	-	-	-97	FDD
34	-	-	-100	-97	-95.2	-	-100	TDD
38	-	-	-100	-97	-95.2	-94	-100	TDD
39	-	-	-100	-97	-95.2	-94	-100	TDD
40	-	-	-100	-97	-95.2	-94	-100	TDD
41	-	-	-98	-95	-93.2	-92	-99	TDD

4.2 GSM/LTE antenna requirements

Table 31: LTE antenna requirements

Antenna index	Index requirements
Working frequency	Reference table28
Directionality	Omni Directional
Gain	> -3dBi (Avg)
impedance	50 Ω
efficiency	>50%
Maximum input power	50W

VSWR	<2
Isolation	>20dB
PCB trace insertion loss (<1GHz)	<0.5dB
PCB trace insertion loss (1GHz~2.2GHz)	<1dB
PCB trace insertion loss (2.3GHz~2.7GHz)	<1.5dB

4.3 GNSS RF parameters

Table 32: GNSS frequency band

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

Table 33: GNSS performance

GNSS	GPS	BeiDou	GLONASS
Tracking sensitivity	-160dBm	-159.5dBm	-153dBm
Capture sensitivity	-154dBm	-154dBm	-152dBm
Hot Start TTFF	<1s		
Cold start TTFF	<40s		
positioning accuracy	<2m		

4.4 GNSS antenna requirements

Table 34: GNSS antenna requirements

Antenna index	Index requirements
Operating frequency	L1: 1559~1609MHZ
Directionality	Hemisphere, face to sky
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

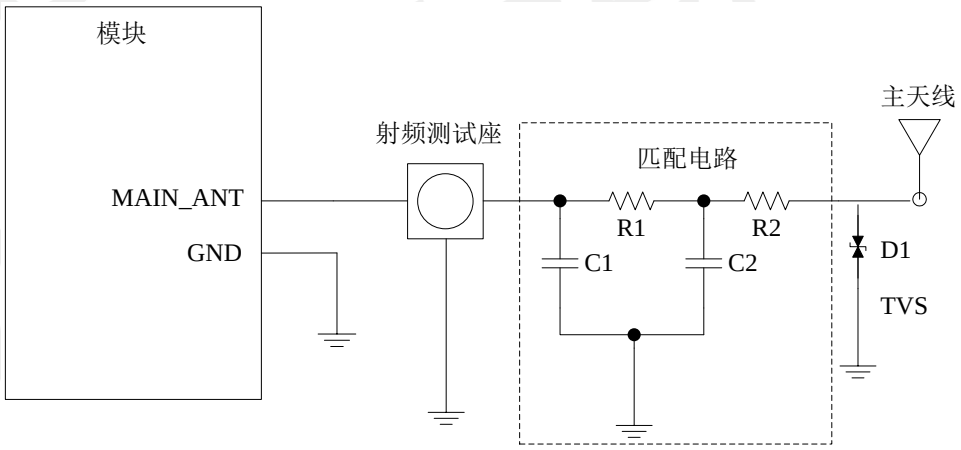
4.5 BlueTooth RF parameters

Table 35: BlueTooth performance

working frequency				
2.402GHz~2.483GHz				
Launch performance				
Transmit power	DH5	2DH5	3DH5	
	6	TBD	TBD	dBm
Receiving performance				
Receiving sensitivity	DH5	2DH5	3DH5	
	-93	-93	-87	dBm

4.6 Antenna reference design

4.6.1 GSM/LTE/GNSS/BlueTooth passive antenna



picture30：Passive antenna connection circuit

R1 in the matching circuit in the figure above,C1,C2andR2The specific value of is usually provided by the antenna factory and determined by the antenna optimization. in,R1andR2Default post0Ω,C1andC2defaultDo notpaste.D1Two-wayTVSDevice, it is recommended to choose to paste,

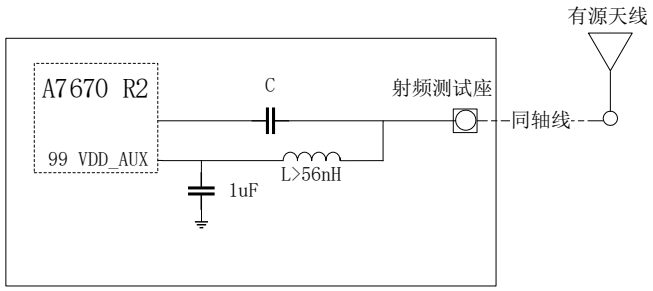
the capacitance value requirement is less than0.2pFTo avoid damage to the internal components of the module. Recommended TVS Models are as follows:

Table 36：TVS recommended model list

Encapsulation	model	supplier
0201	CE0201S05G01R	Shuoke
0402	PESD0402-03	PRISEMI

4.6.2 GNSS active antenna

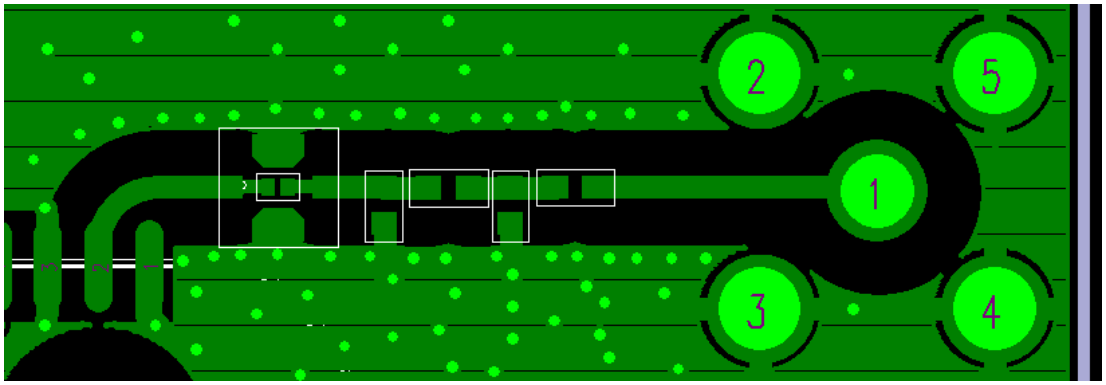
GNSS active antenna power supply can choose the 99th pin (VDD_AUX) of the module for power supply. The power supply defaults to 0V (off). The output voltage value can be controlled by AT+CVAUXV, and the power supply voltage value can be confirmed according to the customer's antenna selection. For example, through AT+CVAUXV=2800, set the output voltage to 2.8V. The AT command takes effect once it is set once. This voltage output cannot be shut down.



picture31: Active antenna connection circuit

4.7 PCB trace design

When wiring the PCB, the user should pay attention to the impedance design of the PCB trace from the ANT port of the module to the antenna connector. The trace length is recommended to be controlled within 20mm and away from interference signals such as power clocks. It is recommended to reserve a radio frequency test socket to facilitate conduction testing. The reference model of the radio frequency test socket is ECT: 818011998.



picture32: PCB trace reference

5 Electrical parameters

5.1 Limit parameters

The following table shows the state of the absolute maximum value under abnormal working conditions. Exceeding these limit values may cause permanent damage to the module.

Table 37：Limit parameters

parameter	Minimum	Typical value	Max	unit
VBAT pin limit voltage	-0.5	-	4.8	V
VBUS pin limit voltage	-0.5	-	5.4	V
IO port limit voltage: GPIO, UART	-0.3	-	2.0	V
IO port limit voltage: USIM	-0.3	-	2.0	V
	-0.3	-	3.9	V
PWRKEY, RESET	-0.3	-	4.8	V

5.2 Normal working conditions

Table 38：The recommended working voltage of the module

parameter	Minimum	Typical value	Max	unit
VBAT pin operating voltage	3.4	3.8	4.2	V
VBUS pin operating voltage	3.0	5.0	5.2	V

Table 39：1.8V digital interface characteristics

parameter	describe	Minimum	Typical value	Max	unit
VIH	Input high level voltage	VCC*0.7	1.8	VCC+0.2	V

VIL	Input low-level voltage	-0.3	0	VCC*0.3	V
VOH	Output high level voltage	VCC-0.2	-	-	V
VOL	Output low-level voltage	0	-	0.2	V
IOH	High-level output current (when the module is not equipped with a pull-down resistor)	-	-	13	mA
IOL	Low-level output current (when the module is not equipped with a pull-up resistor)	-	-	13	mA
IIH	High-level input current (when the module is not equipped with a pull-down resistor)	-	-	10	uA
IIL	Low-level input current (when the module is not equipped with a pull-up resistor)	-10	-	-	uA

※pay

The above parameters apply to: GPIO, I2C, UART and USB_BOOT.

Table 40: Module operating temperature

parameter	Minimum	Typical value	Max	unit
Normal working temperature	-30	25	80	° C
Extended operating temperature	-40	25	85	° C
storage temperature	-45	25	90	° C

※pay

When working at extended operating temperature, the module's RF specifications may not meet the 3GPP specifications.

5.3 Operating mode

5.3.1 Working mode definition

The following table briefly introduces the various working modes that will be mentioned in the following chapters.

Table 41: Working mode definition

Mode function		definition
Normal working mode	LTE sleep	In this state, the current consumption of the module will be minimized, and the module can still receive paging messages and SMS.

	LTE idle	The software runs normally, the module has been registered on the network, and can send and receive data at any time.
	LTE call	Two users are connected. In this case, the power consumption of the module is related to the network and the configuration of the module.
	LTE standby	The module is ready for data transmission at any time, but it is not currently sending or receiving data. In this case, power consumption depends on network conditions and configuration.
	LTE data transmission	The data is being transferred. In this case, the power consumption depends on the network conditions (for example: power control level), the data rate of the uplink and downlink data links, and the network configuration (for example: using a multi-slot configuration).
Minimal function mode		In the case of uninterrupted power, you can use "AT+CFUN=0" command configures the module to the minimum function mode. under these circumstances, The RF part and the USIM card part do not work, but the serial port and USB can still be used, and the power consumption is lower than in normal working mode.
Flight mode		In the case of uninterrupted power, use The "AT+CFUN=4" command or pull down the FLIGHTMODE pin can configure the module to flight mode. In this case, the RF part does not work, but the serial port and USB can still be used, and the power consumption is lower than in the normal working mode.
Shutdown mode		pass "The A7672X module can be turned off by the AT+CPOF" command or pull down the PWRKEY pin. At this time, all power supplies inside the module are turned off and the software stops running. The serial port and USB are unavailable.

5.3.2 Sleep mode

In sleep mode, the current consumption of the module will be reduced to a minimum, but the module can still receive paging messages and SMS.

When the module meets the following software and hardware conditions, the A7672X module can automatically enter the sleep mode:

- UART conditions
- USB conditions
- Software setting conditions

For more information about sleep mode, please refer to document [24].

5.3.3 Function mode

You can pass the command "AT+CFUN=<fun>" sets the module to this mode. This command provides three options for setting different functions.

●AT+CFUN=0: minimum function mode;

●AT+CFUN=1: Full function mode (default);

●AT+CFUN=4: Flight mode.

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

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

When the module enters the minimum function mode or enters the flight mode, it can be returned to the full function mode through the command "AT+CFUN=1".

For more information about "AT+CFUN" command, please refer to document [1].

5.4 Current consumption

Table 42：VBAT current consumption (VBAT=3.8V)

GSM sleep/idle	
GSM/GPRS current consumption (Without USB connection)	Sleep mode @BS_PA_MFRMS=2 Typical value: TBD Idle mode @BS_PA_MFRMS=2 Typical value: TBD
LTE sleep/idle	
Current consumption under CFUN=0, CSCLK=1	<2mA
LTE supply current (Without USB connection)	Sleep mode @DRX=0.32S Typical value: TBD Idle mode @DRX=0.32S Typical value: TBD
GSM call	
EGSM 900	@Power level #5 Typical value: TBD
DCS1800	@Power level #0 Typical value: TBD
GPRS data transmission	
EGSM 900 (1 receiving, 4 sending)	@Power level #5 Typical value: TBD
DCS1800 (1 receiving, 4 sending)	@Power level #0 Typical value: TBD
EGSM 900 (3 receiving, 2 sending)	@Power level #5 Typical value: TBD
DCS1800 (3 receiving, 2 sending)	@Power level #0 Typical value: TBD
EDGE data transmission	
EGSM 900 (1 receiving, 4 sending)	@Power level #8 Typical value: TBD
DCS1800 (1 receiving, 4 sending)	@Power level #2 Typical value: TBD
EGSM 900 (3 receiving, 2 sending)	@Power level #8 Typical value: TBD
DCS1800 (3 receiving, 2 sending)	@Power level #2 Typical value: TBD

LTE sleep/idle	
Current consumption under CFUN=0, CSCLK=1	<2mA
LTE supply current (Without USB connection)	Sleep mode @DRX=0.32S Typical value: TBD Idle mode @DRX=0.32S Typical value: TBD
LTE data transmission	
LTE-FDD B1	@5MHz 23.0dBm typical value:600mA @10MHz 23.0dBm typical value:600mA @20MHz 23.0dBm typical value:600mA
LTE-FDD B3	@5MHz 23.0dBm typical value:600mA @10MHz 23.0dBm typical value:600mA @20MHz23.0dBm Typical value:600mA
LTE-FDD B5	@5MHz23.0dBm Typical value:580mA @10MHz 23.0dBm typical value:580mA
LTE-FDD B8	@5MHz23.0dBm Typical value:600mA @10MHz 23.0dBm typical value:600mA
LTE-TDD B34	@5MHz 23.0dBm typical value: 260mA @20MHz 23.0dBm typical value: 260mA
LTE-TDD B38	@5MHz 23.0dBm typical value: 280mA @20MHz 23.0dBm typical value: 280mA
LTE-TDD B39	@5MHz 23.0dBm typical value: 250mA @20MHz 23.0dBm typical value: 250mA
LTE-TDD B40	@5MHz 23.0dBm typical value: 250mA @20MHz 23.0dBm typical value: 250mA
LTE-TDD B41	@5MHz 23.0dBm typical value: 280mA @20MHz 23.0dBm typical value: 280mA

5.5 Static Protection

The A7672X module is an electrostatic sensitive device. Therefore, users must pay attention to electrostatic protection when producing, assembling and operating the module. The electrostatic performance parameters of the module are as follows:

Table 43：ESD performance parameters (temperature: 25℃, humidity: 45%)

Pin	Contact discharge	Air discharge
VBAT, GND	+/-5K	+/-10K
Antenna port	+/-5K	+/-10K
USB interface	+/-4K	+/-8K
UART interface	+/-4K	+/-6K
Other pins	+/-1K	+/-2K

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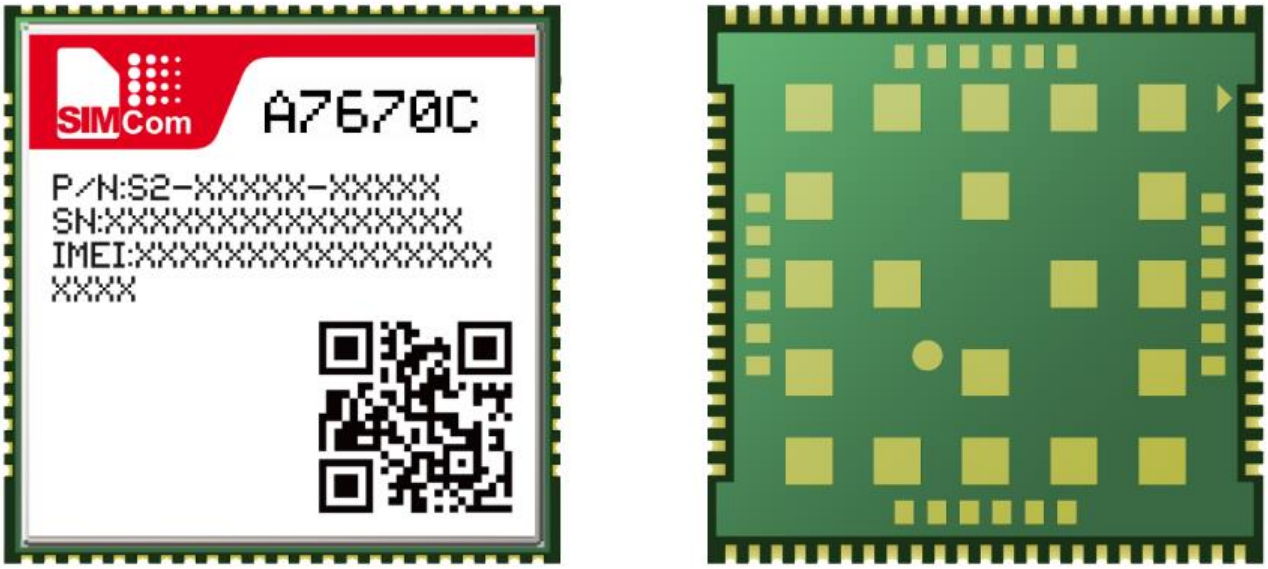
Test condition: The module is on the SIMCom development board (the development board with necessaryESDProtection device)

6 Patch production

6.1 Top and bottom views of the module



picture33: Top view and bottom view of the module

※pay

The above is the module design renderings for reference, and the actual appearance is subject to the actual product.

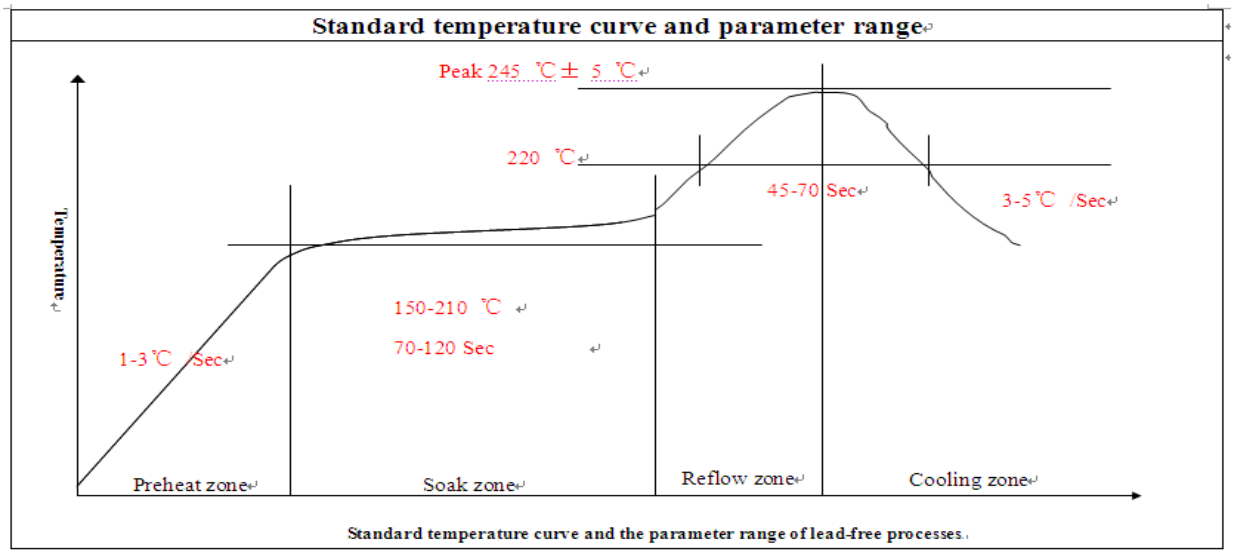
6.2 Label Information

picture34:Label Information

Table 44: Module information description

Item	describe
A	Project name
B	Module P/N number
C	Module SN
D	Module IMEI number
E	Module serial number
F	QR code

6.3 Typical welding furnace temperature curve



picture35：Recommended soldering furnace temperature curve diagram (lead-free process)

※pay

Please refer to the document [21] for more introduction to the second patch.

6.4 Humidity sensitive characteristics

The humidity sensitivity of the A7672X module is level 3.

If any of the following two conditions are met, the A7672X module should be fully baked before reflow soldering, otherwise the module may cause permanent damage during the reflow soldering process.

After unpacking or vacuum packaging is damaged and air leaks, the A7672X module needs to be SMT patched within 168 hours under environmental conditions of temperature <30 degrees and relative humidity <60%. If the above conditions are not met, bake is required.

If the vacuum package is not opened, but the shelf life has expired, baking is also required.

Baking conditions: 192 hours of baking under the conditions of humidity less than 5% and temperature of 40+5/-0°C; 72 hours of baking under conditions of humidity less than 5% and temperature of 85+5/-0°C (If using a tray, please pay attention to whether the tray is resistant to thermal deformation).

Table 45：Module humidity sensitivity characteristics

grade	Floor life (factory environment≦+30° C/60%RH)
1	Guaranteed indefinitely in the environment≦+30° C/85% RH condition
2	1 year

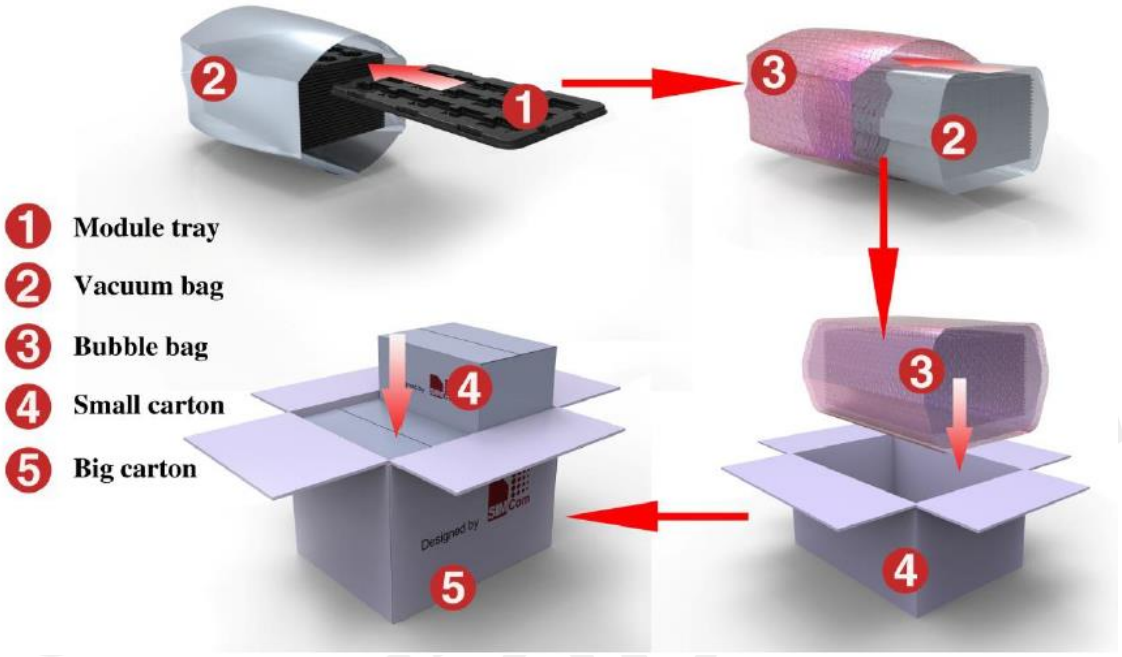
2a	4 weeks
3	168 hours
4	72 hours
5	48 hours
5a	24 hours
6	Use it after forced baking. After baking, the module must be patched within the time limit specified on the label.

※pay

Product handling, storage, and processing must be followed IPC/JEDEC J-STD-033.

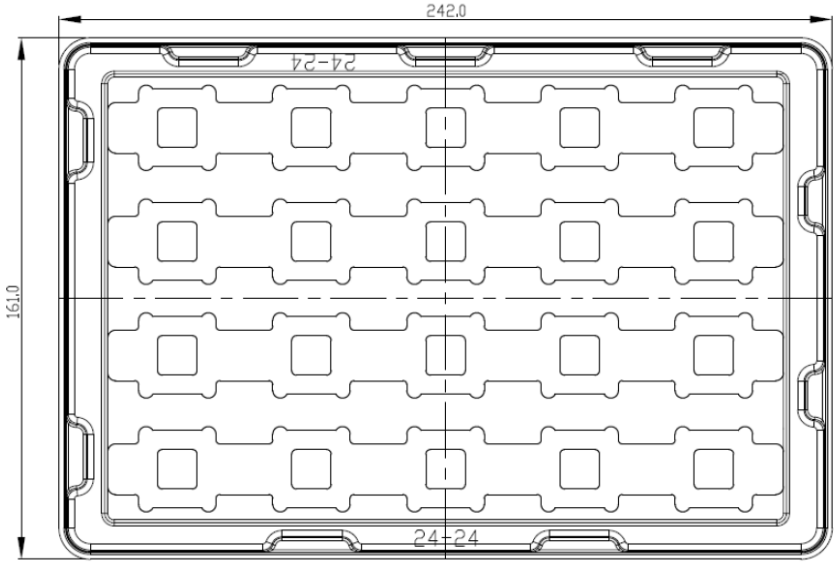
7 Package

The module supports pallet packaging.



picture36：Schematic diagram of module packaging

The following is the size drawing of the module tray:

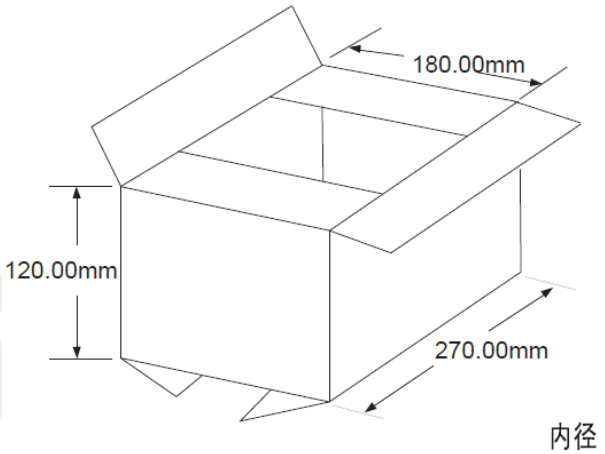


picture37：Tray size chart

Table 46: Pallet size information

Pallet length (±3mm)	Tray width (±3mm)	Number of standard packages
242.0	161.0	20

The following is the size drawing of the small carton pallet:

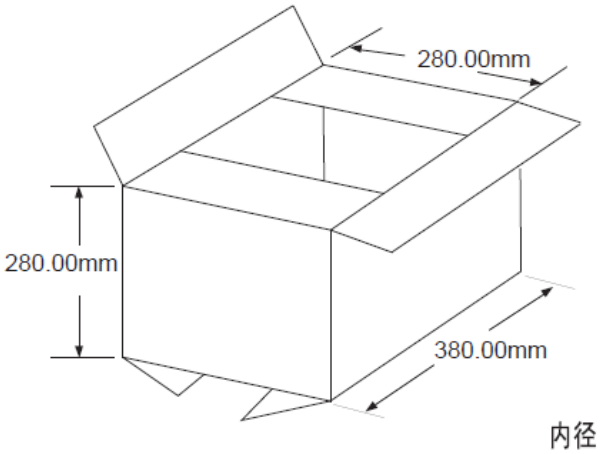


picture38：Small cartoon box size chart

Table 47：Small cartoon box size information

Box length (±10mm)	Box width (±10mm)	Box height (±10mm)	Number of standard packages
270	180	120	20*20=400

The following is the size drawing of the Big carton pallet:



picture39：Diagram of large cartoon box

Table 48：The size information of the big cartoon box

Box length (±10mm)	Box width (±10mm)	Box height (±10mm)	Number of standard packages
380	280	280	400*4=1600

8 appendix

8.1 Encoding method and maximum data rate

Table 49: Coding method and maximum data rate

Channel 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
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 Reference documents

Table 50: Reference documents

SNo	file name	Annotation
[1]	A7600 Series_AT Command Manual	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 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 CompatibilityEMC) for mobile terminals and ancillary equipment.
[12]	3GPP TS 34.121	Electromagnetic CompatibilityEMC) 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 Terminology and explanation

Table 51: Terminology and explanation

the term	explain
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
Phone book abbreviation	
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 warning

Pay attention to the following safety precautions when using or repairing any terminal or mobile phone that contains a module. The terminal equipment should inform the user of the following safety information. Otherwise, SIMCom will not bear any consequences arising from the user's failure to follow these warnings.

Table 52:safety warning

Logo	Require
	When in a hospital or next to medical equipment, observe the restrictions on the use of mobile phones. Please turn off the terminal or mobile phone if necessary, otherwise the medical equipment may cause misoperation due to radio frequency interference.
	Turn off the wireless terminal or mobile phone before boarding. In order to prevent interference with the communication system, the use of wireless communication equipment on the aircraft is prohibited. Ignoring the above matters will violate local laws and may lead to flight accidents.
	Do not use mobile terminals or cell phones in front of flammable gases. Turn off your mobile phone terminal when you are near explosive operations, chemical plants, fuel depots, or gas stations. It is very dangerous to operate a mobile terminal near any potentially explosive electrical equipment.
	The mobile phone terminal receives or emits radio frequency energy when it is turned on. When it is close to TV, radio, computer or other electrical equipment, it will cause interference.
	Road safety first! Do not use handheld terminals or mobile phones when driving vehicles, please use hands-free devices. Stop the car before using the handheld terminal or mobile phone.
	GSM mobile phone terminals operate under radio frequency signals and cellular networks, but there is no guarantee that they can be connected under all conditions. For example, no phone bill or invalid USIM card. When you need emergency services in this situation, remember to use the emergency phone. In order to be able to make and receive calls, the mobile terminal must be turned on and be in a service area where the mobile signal is strong enough. Emergency calls are not allowed when certain network services or phone functions are in use, such as function lock and keyboard lock. Before using the emergency phone, disable these functions. Some networks require valid USIM card support.