



# A7670 & SIM7070 Series Compatible Design

LTE Module

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# 1. Introduction

This document is targeted for customers to understand the differences between A7670 and SIM7070. Users can use A7670 or SIM7070 series module to design and develop applications quickly.



The A7670 series include A7670C, A7670E, and A7670SA.

The SIM7070 series include SIM7070G, SIM7070E, SIM7070G-MN, and SIM7070G-M.

## 1.1. Module Overview

The A7670 series module supports LTE-TDD/LTE-FDD/EDGE/GPRS/GSM. SIM7070 series module supports LTE-FDD/EDGE/GPRS/GSM. Users can choose different types of modules according to their needs to meet diversified market demands.

**Table 1 Module basic information comparison**

Modules	Renderings	Package	Size	Description
A7670X		88 LGA pins	24*24*2.5 mm	LTE CAT-1 and 2G
SIM7070X		68 LCC pins	24*24*2.3 mm	LPWA Module

## 1.2. Features

This chapter lists the function parameters of A7670 and SIM7070, the comparison is as follows:

**Table 2 Module function comparison**

Function	A7670 series	SIM7070 series
Power	Power supply range: 3.4V~4.2V Typical value: 3.8V	SIM7070G Power supply range: 3.0V~4.6V SIM7070E Power supply range: 3.2V~4.2V Typical value: 3.8V
Peak current	2.4A	2A
Sleep current	3mA(LTE-TDD)	4.6 mA (LTE-FDD)
Frequency band	A7670C: GSM:DCS1800/EGSM900 LTE-FDD: 1/3/5/8 LTE-TDD:34/38/39/40/41 A7670E: GSM:DCS1800/EGSM900 LTE-FDD: 1/3/5/8/20 A7670SA: GSM:DCS1800/EGSM900/GSM850/ PCS1900 LTE-FDD: 1/2/3/4/5/7/8/28/66	SIM7070G: GSM:DCS1800/EGSM900/GSM850/ PCS1900 LTE-FDD:1/2/3/4/5/8/12/13/18/19/20/25/26/ 28/66/71/85 SIM7070E: GSM:DCS1800/EGSM900/GSM850/ PCS1900 LTE-FDD:1/2/3/4/5/8/12/13/18/19/20/25/26/ 28/31/66/85
GNSS	NA	GNSS (GPS/GLONASS/BeiDou) protocol: NMEA
Temperature range	Normal working temperature: -30°C ~ +80°C Extended operating temperature: -40°C ~ +85°C * Storage temperature: -45°C ~ +90°C	Normal working temperature: -40°C ~ +85°C Storage temperature: -45°C ~ +90°C
UART interface	<b>Main serial port UART1:</b> <ul style="list-style-type: none"> <li>For AT command transmission and data transmission</li> <li>Baud rate supports from 300bps to 3686400bps, the default is 115200bps</li> <li>Support RTS and CTS hardware flow control</li> </ul> <b>Debug serial port UART_LOG:</b> <ul style="list-style-type: none"> <li>Debug port, output log information, default 115200bps</li> </ul> <b>Debug serial port UART3:</b> <ul style="list-style-type: none"> <li>Ordinary two-wire serial port</li> </ul>	<b>Main serial port UART1:</b> <ul style="list-style-type: none"> <li>For AT command transmission and data transmission</li> <li>Baud rate supports from 300bps to 3686400bps, the default is 115200bps</li> <li>Support RTS and CTS hardware flow control</li> </ul> <b>Debug serial port UART2:</b> <ul style="list-style-type: none"> <li>Only used in secondary software development</li> </ul> <b>Debug serial port UART3</b> <ul style="list-style-type: none"> <li>Only used in secondary software development</li> </ul>
(U)SIM interface	Support (U)SIM card: 1.8V/3.0V	Support (U)SIM card: 1.8V
PCM interface	<ul style="list-style-type: none"> <li>For audio use, external Codec chip is required</li> <li>Support 16-bit linear encoding format</li> <li>Support short frame mode</li> </ul>	<ul style="list-style-type: none"> <li>For audio use, external Codec chip is required</li> <li>Support 16-bit linear encoding format</li> <li>Support short frame mode</li> </ul>



	<ul style="list-style-type: none"> <li>Only supports master mode</li> </ul>	<ul style="list-style-type: none"> <li>Only supports master mode</li> </ul>
USB interface	USB2.0, only supports slave mode, the maximum data transfer rate is 480Mbps	USB2.0, only supports slave mode, the maximum data transfer rate is 480Mbps
SD Card interface	NA	NA
SGMII interface	NA	NA
WLAN/BT interface	NA	NA
ADC interface	<ul style="list-style-type: none"> <li>Provide an analog-to-digital conversion interface</li> <li>Voltage range: 0~1.3V</li> <li>Resolution: 12 bits</li> </ul>	<ul style="list-style-type: none"> <li>Provide an analog-to-digital conversion interface</li> <li>Voltage range: 0~1.875V</li> <li>Resolution: 10 bits</li> </ul>
Network indication	NETLIGHT:Network indication	NETLIGHT:Network indication
Diversity antenna interface	No	No
Antenna interface	Main antenna interface: (RF_ANT)	Main antenna interface: (RF_ANT) GNSS antenna interface: (GNSS_ANT)
Software upgrade	Upgrade software via USB	Upgrade software via USB

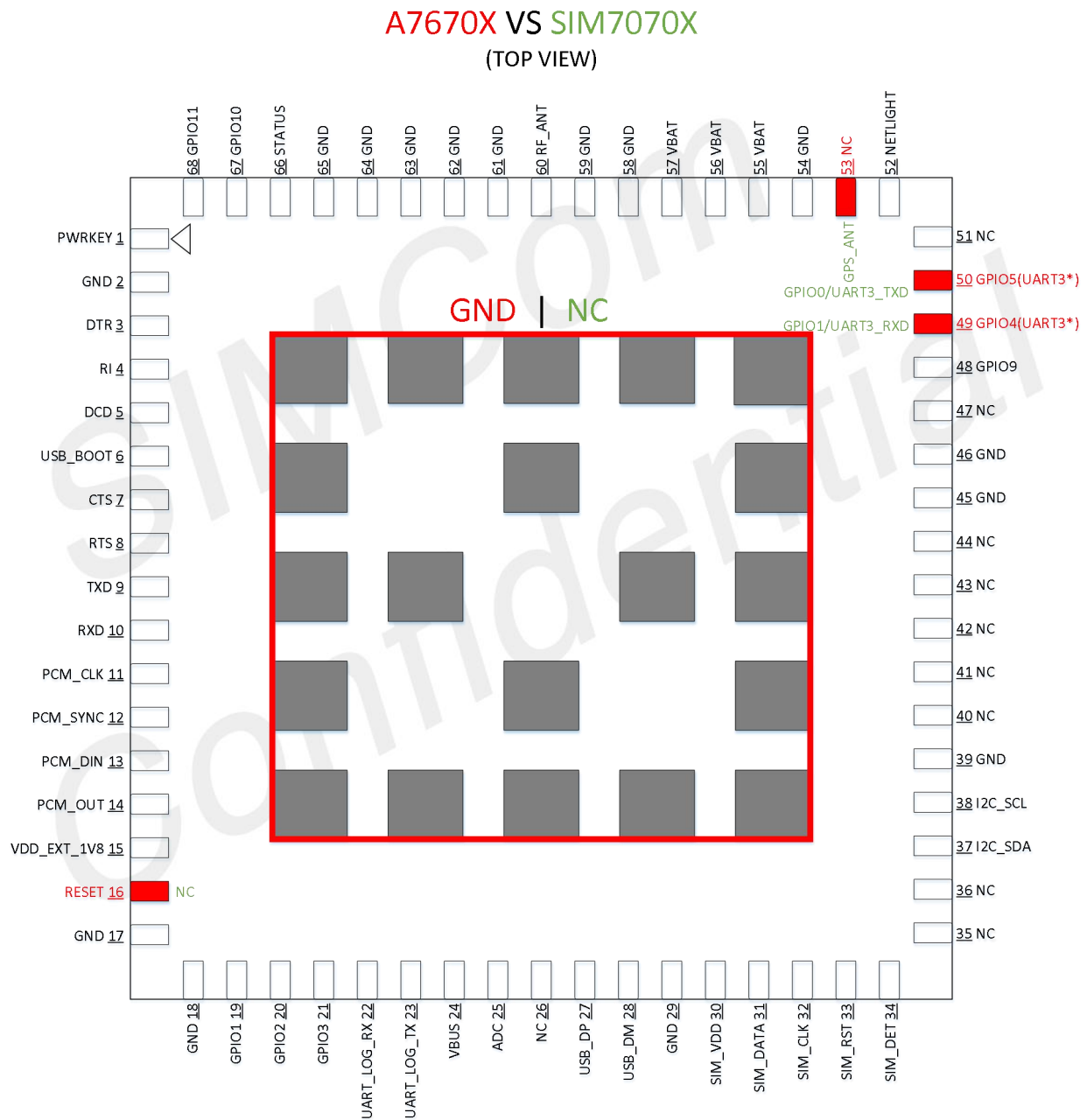
**NOTE**

In the extended operating temperature range, the module can work normally, but does not guarantee full compliance with 3GPP test specifications.

## 2. Package Introduction

### 2.1 Pin Assignment Overview

The following figure shows the pin assignment of A7670 and SIM7070.



**Figure 1: A7670X and SIM7070X pin assignment (Top view)**

## 2.2 PIN definition

This chapter describes the pin definition and comparison of A7670 and SIM7070 series.

Table 3 provides the abbreviated definition of module pins:

**Table 3 Pin type definition**

abbreviation	description
<b>Pin attributes</b>	
PI	Power Input
PO	Power Output
AI	Analog Input
AO	Analog Output
I/O	Input or Output
DI	Digital Input
DO	Digital Output

Table 4 lists all pin names, IO types and power domains of A7670X and SIM7070X

**Table 4 Module pin definition comparison**

A7670X				SIM7070X			
Pin No.	Pin Name	I/O	Power domain	Pin No.	Pin Name	I/O	Power domain
1	PWRKEY	DI	VBAT	1	PWRKEY	DI	1.5V
2	GND	-	GND	2	GND	-	GND
3	DTR	DI	1.8V	3	UART1_DTR	DI	1.8V
4	RI	DO	1.8V	4	UART1_RI	DO	1.8V
5	DCD	DO	1.8V	5	UART1_DCD	DO	1.8V
6	USB_BOOT*	DI	1.8V	6	BOOT_CFG*	DI	1.8V
7	CTS	DO	1.8V	7	UART1_CTS	DO	1.8V
8	RTS	DI	1.8V	8	UART1_RTS	DI	1.8V
9	TXD	DO	1.8V	9	UART1_TXD	DO	1.8V
10	RXD	DI	1.8V	10	UART1_RXD	DI	1.8V
11	PCM_CLK	IO	1.8V	11	PCM_CLK	IO	1.8V
12	PCM_SYNC	IO	1.8V	12	PCM_SYNC	IO	1.8V
13	PCM_DIN	DI	1.8V	13	PCM_DIN	DI	1.8V
14	PCM_OUT	DO	1.8V	14	PCM_DOUT	DO	1.8V
15	VDD_1V8	PO	1.8V	15	VDD_EXT	PO	1.8V
16	RESET	DI	VBAT	16	NC	-	-
17	GND	-	GND	17	GND	-	GND
18	GND	-	GND	18	GND	-	GND
19	GPIO1	IO	1.8V	19	GPIO1	IO	1.8V

20	GPIO2	IO	1.8V	20	GPIO2	IO	1.8V
21	GPIO3	IO	1.8V	21	GPIO3	IO	1.8V
22	UART_LOG_RX	DI	1.8V	22	DEBUG_RXD	DI	1.8V
23	UART_LOG_TX	DO	1.8V	23	DEBUG_TXD	DO	1.8V
24	VBUS	AI	Typical:5V	24	USB_VBUS	AI	Typical:5V
25	ADC	AI	0.1V-1.3V	25	ADC	AI	0V-1.875V
26	NC	-	-	26	NC	-	-
27	USB_DP	IO	-	27	USB_DP	IO	-
28	USB_DM	IO	-	28	USB_DM	IO	-
29	GND	-	GND	29	GND	-	GND
30	SIM_VDD	IO	1.8V/3.0V	30	SIM_VDD	IO	1.8V
31	SIM_DATA	IO	1.8V/3.0V	31	SIM_DATA	IO	1.8V
32	SIM_CLK	DO	1.8V/3.0V	32	SIM_CLK	DO	1.8V
33	SIM_RST	IO	1.8V/3.0V	33	SIM_RST	IO	1.8V
34	SIM_DET	IO	1.8V/3.0V	34	GPIO4	IO	1.8V
35	NC	-	-	35	NC	-	-
36	NC	-	-	36	NC	-	-
37	I2C_SDA	IO	1.8V	37	I2C_SDA	IO	1.8V
38	I2C_SCL	DO	1.8V	38	I2C_SCL	DO	1.8V
39	GND	-	GND	39	GND	-	GND
40	NC	-	-	40	NC	-	-
41	NC	-	-	41	NC	-	-
42	NC	-	-	42	NC	-	-
43	NC	-	-	43	NC	-	-
44	NC	-	-	44	NC	-	-
45	GND	-	GND	45	GND	-	GND
46	GND	-	GND	46	GND	-	GND
47	NC	-	-	47	NC	-	-
48	GPIO9	IO	1.8V	48	GPIO5	IO	1.8V
49	GPIO4(UAR T3_RX)	IO	1.8V	49	UART3_RXD	IO	1.8V
50	GPIO5(UAR T3_TX)	IO	1.8V	50	UART3_TXD	IO	1.8V
51	NC	-	-	51	NC	-	-
52	NETLIGHT	DO	1.8V	52	NETLIGHT	DO	1.8V
53	NC	-	-	53	GNSS_ANT	AI	-
54	GND	-	GND	54	GND	-	GND
55	VBAT	PI	3.4V~4.2V	55	VBAT	PI	SIM7070G Power supply range: 3.0V~4.6V SIM7070E Power supply range: 3.2V~4.2V

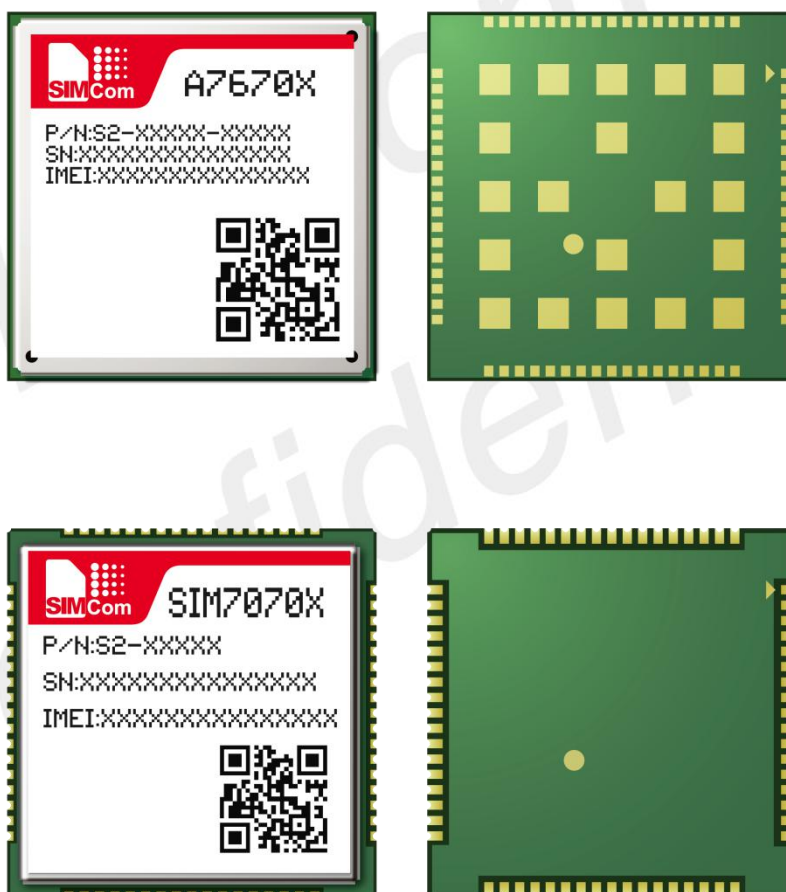
56	VBAT	PI	3.4V~4.2V	56	VBAT	PI	Same as above
57	VBAT	PI	3.4V~4.2V	57	VBAT	PI	Same as above
58	GND	-	GND	58	GND	-	GND
59	GND	-	GND	59	GND	-	GND
60	RF_ANT	AIO	-	60	RF_ANT	AIO	-
61	GND	-	GND	61	GND	-	GND
62	GND	-	GND	62	GND	-	GND
63	GND	-	GND	63	GND	-	GND
64	GND	-	GND	64	GND	-	GND
65	GND	-	GND	65	GND	-	GND
66	STATUS	DO	1.8V	66	STATUS	DO	1.8V
67	GPIO10	IO	1.8V	67	GPIO6	IO	1.8V
68	GPIO11	IO	1.8V	68	GPIO7	IO	1.8V
69	GND	-	GND				
70	GND	-	GND				
71	GND	-	GND				
72	GND	-	GND				
73	GND	-	GND				
74	GND	-	GND				
75	GND	-	GND				
76	GND	-	GND				
77	GND	-	GND				
78	GND	-	GND				
79	GND	-	GND				
80	GND	-	GND				
81	GND	-	GND				
82	GND	-	GND				
83	GND	-	GND				
84	GND	-	GND				
85	GND	-	GND				
86	GND	-	GND				
87	GND	-	GND				
88	GND	-	GND				

## 3. Physical Size

This chapter introduces the external dimensions of the A7670 and SIM7070 series modules, and the recommended packaging.

### 3.1 Top and Bottom View

The following figures show top and bottom view of A7670 and SIM7070.



**Figure 2: A7670X and SIM7070X top and bottom view**

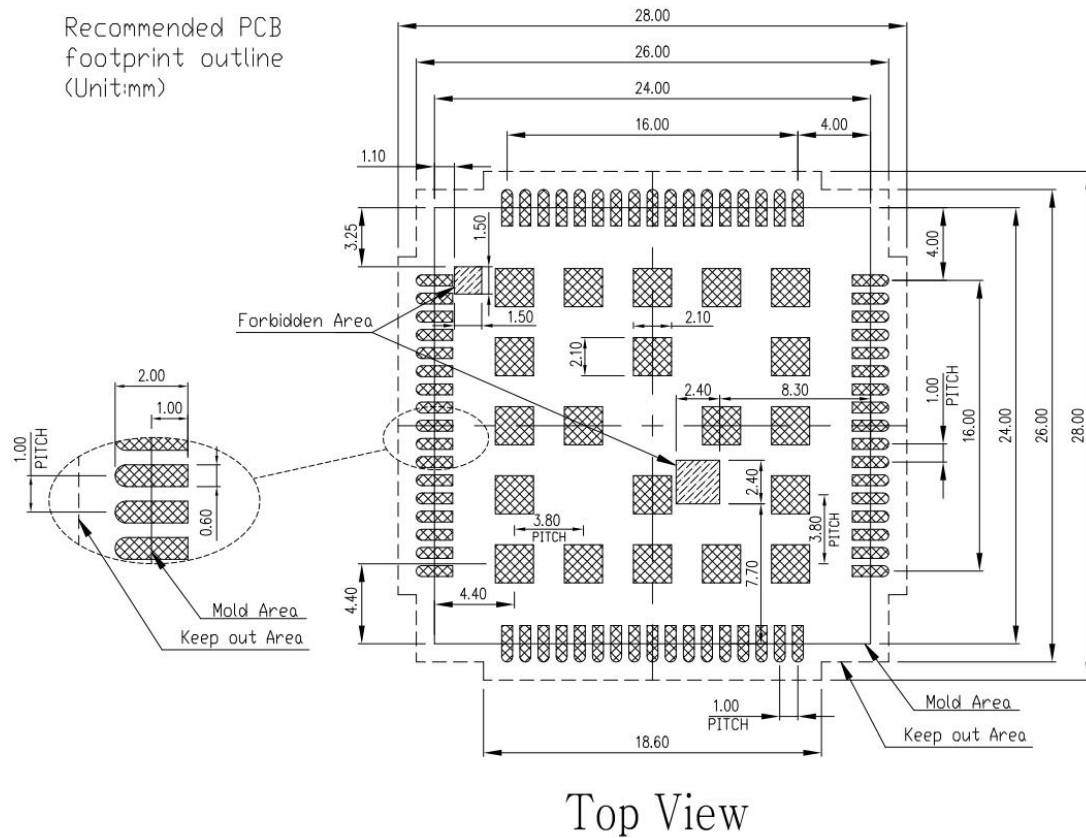
#### NOTE

The above is the design effect drawing of the module for reference, and the actual appearance shall prevail in kind.

## 3.2 Recommended PCB footprint outline

A7670 and SIM7070 series have the same Recommended PCB footprint outline.

The recommended PCB footprint outline for A7670 and SIM7070 series is shown as below.



**Figure 3: Recommended PCB footprint outline for A7670X and SIM7070X (Unit: mm)**

### NOTE

For details information, please refer to each HD guide

## 4. Hardware Reference Design

Users using A7670 and SIM7070 user interface can refer to the design in this chapter.

### 4.1 Power Supply

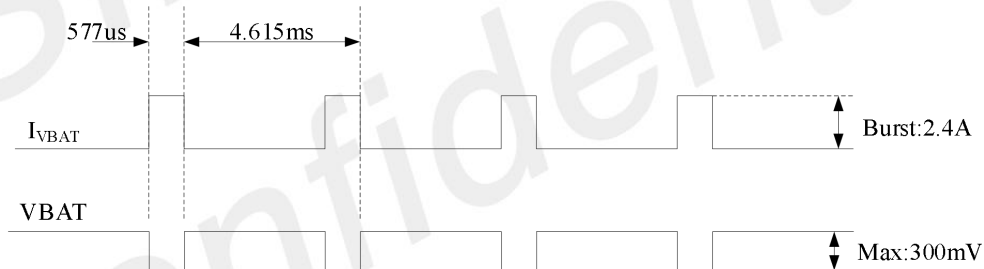
#### 4.1.1 Power requirements

The following table shows the supply voltage range of A7670 and SIM7070 series:

**Table 5 Module recommended supply voltage comparison**

Modules	Power Pin	Symbol description	Min	Typical	Max	unit
A7670 series	VBAT	Power supply range	3.4	3.8	4.2	V
SIM7070G	VBAT	Power supply range	3	3.8	4.6	V
SIM7070E	VBAT	Power supply range	3.2	3.8	4.2	V

During 2G transmission, the instantaneous current is as high as 2.4A, and the battery terminal burst current and voltage drop model are shown in the figure below:



**Figure 4: Burst transmission power requirements**

In the user's design, special attention must be paid to the design of the power supply section to ensure that even when the current consumption of the module reaches 2.4A, the drop of VBAT does not fall below 3.4V. If the voltage drops below 3.4V, the RF performance of the module will be affected.

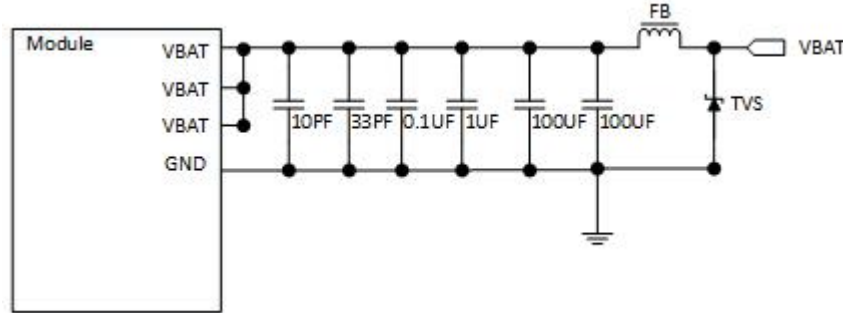
#### NOTE

When the power supply can provide a peak current of 2.4A, the total capacitance of the external power supply capacitor is recommended not to be less than 300uF; if it cannot provide a peak current of 2.4A, it is recommended that the total capacitance of the external capacitor is not less than 1000uF to ensure that the VBAT pin at any time The upper voltage drop does not exceed 300mV.



It is recommended to place four ceramic capacitors of 33pf/10pf/0.1/1 $\mu$ F 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 is 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.

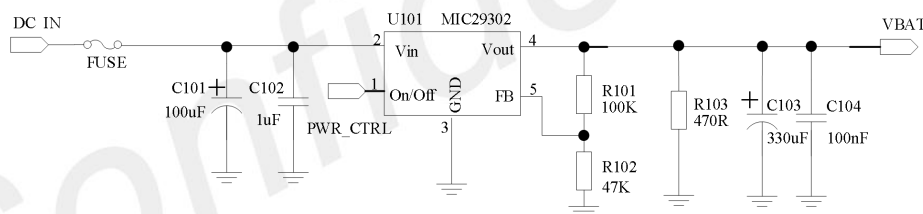


**Figure 5: VBAT input reference circuit**

#### 4.1.2 Recommended external power circuit

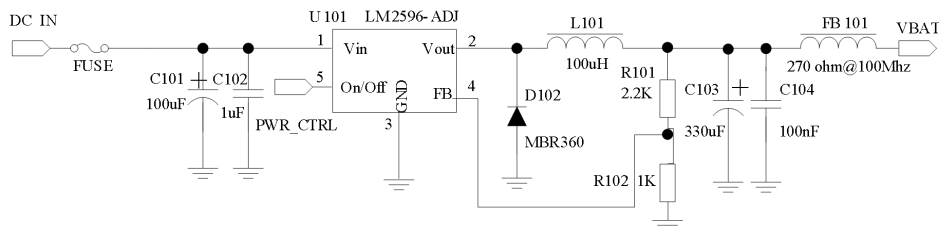
The module power supply design is the basis for the stable performance of the module. When choosing a power supply, it is necessary to ensure that it has a load capacity of at least 3A. Users can choose LDO or DC-DC power supply according to their needs.

The recommended circuit of linear power supply is shown in the figure below:



**Figure 6: Linear power supply recommended circuit**

The recommended circuit of switching power supply is shown in the figure below:

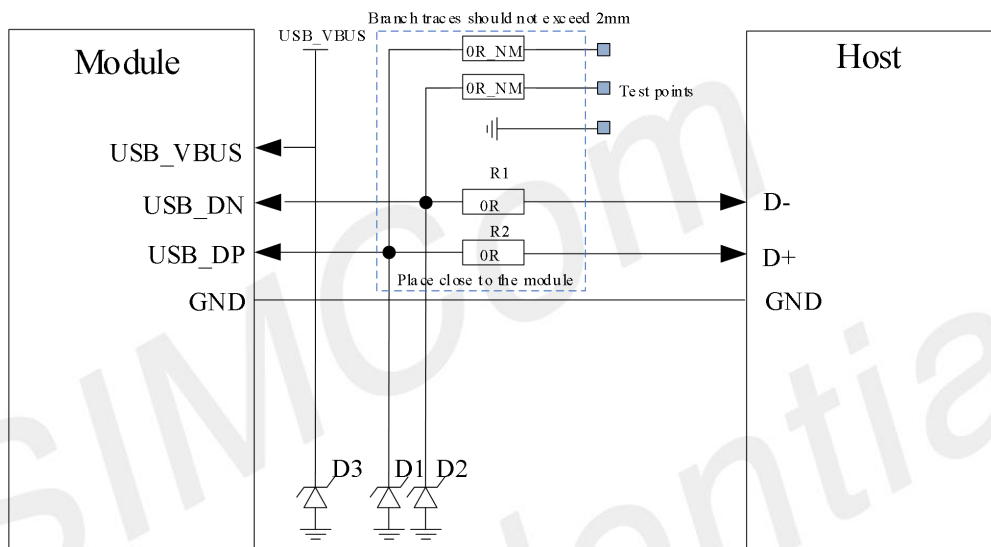


**Figure 7: Recommended circuit for switching power supply**

## 4.2 USB Interface

Both A7670 and SIM7070 series module provide a USB2.0 interface, supporting high-speed 480Mbps and full-speed mode 12Mbps, and do not support USB charging function; A7670 series does not support USB HOST mode.

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 should be reserved for switching external test points during design, as shown in the figure below.

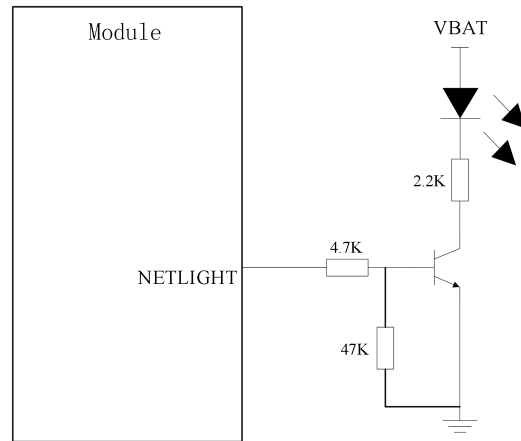


**Figure 8: USB reference circuit**

Customers can replace R1 and R2 with a common mode inductor to prevent EMI interference, and pay attention to the selection of D3 devices. It is recommended to choose anti-static and anti-surge two-in-one devices, and one TVS tube can be placed. Recommended model ESD5681N07. D+/D- trace impedance is controlled according to 90Ω and covered with ground; D1/D2 select TVS tube with capacitance value <1pf.

## 4.3 Network Status Indication

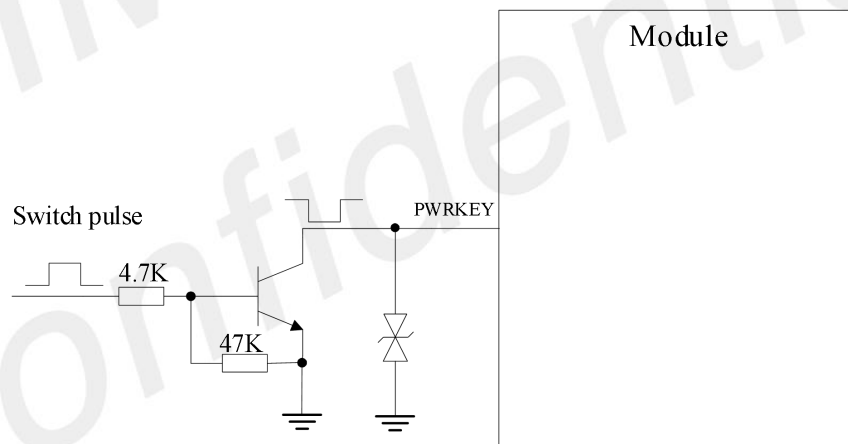
The NETLIGHT/STATUS pins can be used to drive a network status indicator LED. The following circuit is the reference design.



**Figure 9: NETLIGHT/STATUS reference circuit**

## 4.4 Power on/off Circuit

A7670 & SIM7070 series can be turned on by driving the PWRKEY pin to a low level for a certain time. It is recommended use an open drain or collector driver to control the PWRKEY. A reference circuit is shown below.



**Figure 10: Power on/off reference circuit**

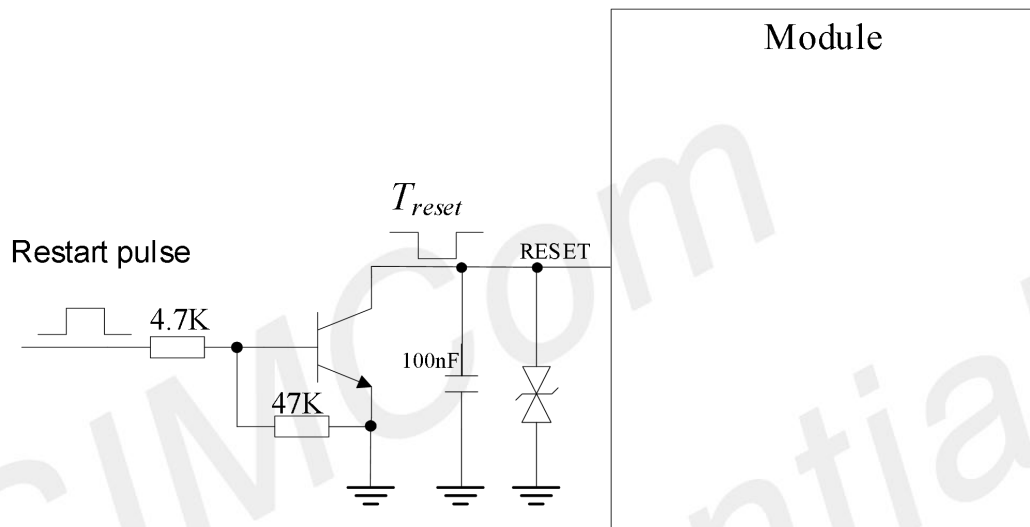
The module has the following shutdown methods:

- Use PWRKEY pin to shut down
- Use "AT+CPOF" command to shut down
- High/low voltage overvoltage shutdown, use "AT+CPMVT" (A7670 series) to set the voltage range.
- Shutdown at high and low temperature

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, turning off the VBAT directly by disconnecting the VBAT may cause damage to the FLASH.

## 4.5 Reset Circuit

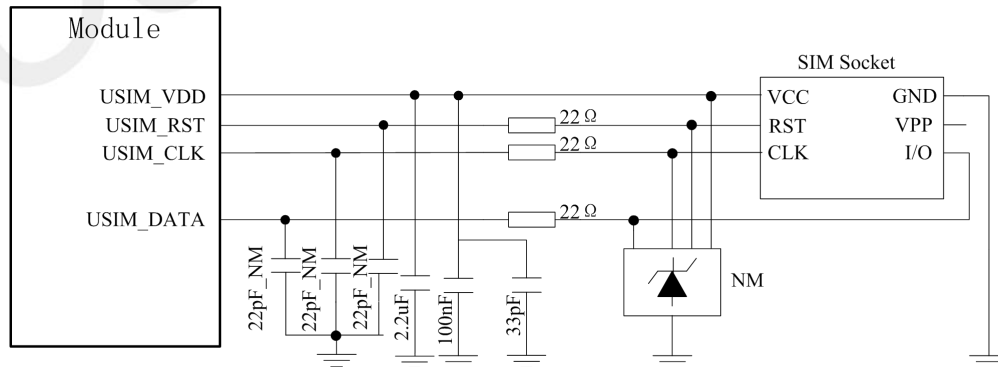
The A7670 series reset circuit is as follows, the user resets the module by pulling down the RESET pin. The PWRKEY pin of SIM7070 series has its own reset function. The reset time defaults to 12S. When PWRKEY is pulled low, the module will reset the system after 12S. Therefore, it is not recommended to connect PWRKEY to GND directly or to GND through a 0R resistor when designing external circuits. The recommended (A7670 series) circuit is as follows:



**Figure 11: A7670X Reset reference circuit**

## 4.6 USIM Interface

A7670 series supports 1.8V/3.0V (U)SIM card by default and supports hot-swappable function; SIM7070 series only supports 1.8V (U)SIM card and does not support hot-swappable function. The recommended circuit is as follows:



**Figure 12: SIM interface reference circuit**

**NOTE**

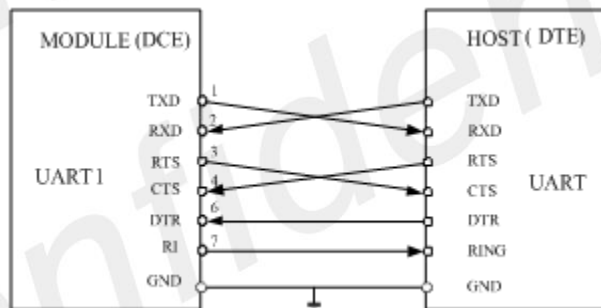
For details information, please refer to each HD guide

## 4.7 UART Interface

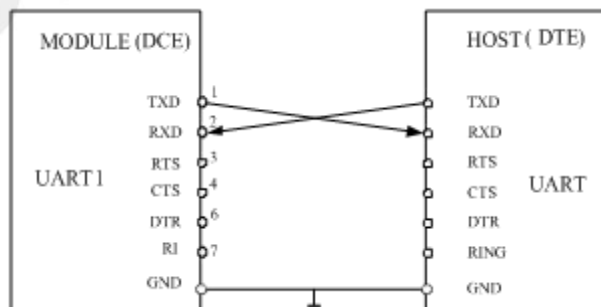
A7670 series provides 3 serial ports, 1 main full-function communication serial port UART (RTS/CTS flow control function debugging), 1 ordinary two-wire serial port, 1 print LOG serial port, and the module is a DCE (Data Communication Equipment) device.

SIM7070 series can provide 3 serial ports, 1 full-function communication serial port, 1 2-wire serial port UART3, the default function after booting is GPIO; it can be configured as UART function, this UART cannot be used for AT command communication, only used for software two UART communication during the second development, this port can also be configured as a GNSS NMEA data output port. 1 DEBUG serial port, it will output the boot log during module startup. The default function after booting is GPIO, which can be configured as UART function. This UART cannot be used for AT command communication and is only used for UART communication during software secondary development.

Below are the reference circuits.



**Figure 13: UART Full modem**

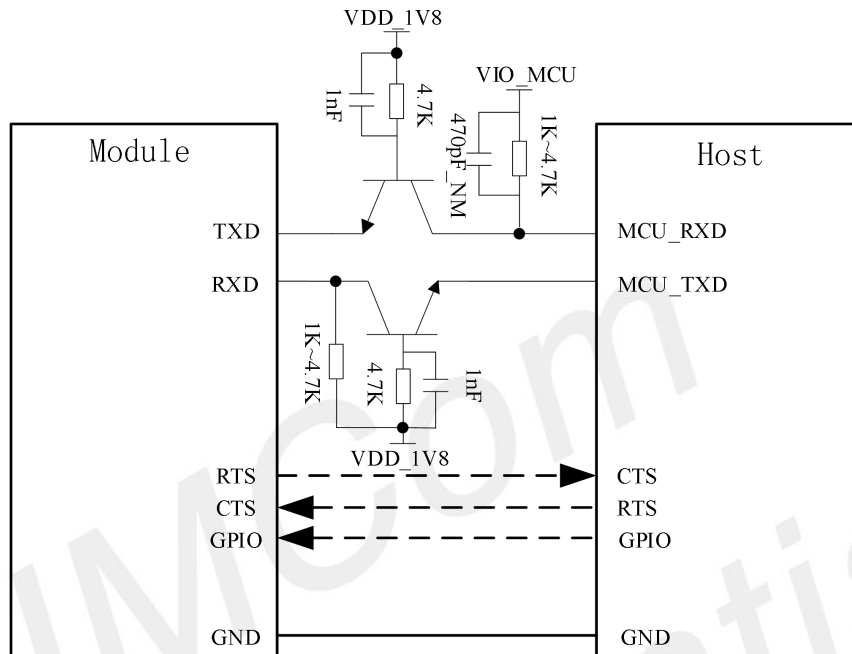


**Figure 14: UART Null modem**

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.

**NOTE**

For details information, please refer to each HD guide



**Figure 15: Triode level conversion circuit**

**NOTE**

The VDD\_1V8 (VDD\_EXT) of each project in the diagram is different. For details information, please refer to each HD guide

## 4.8 PCM Interface

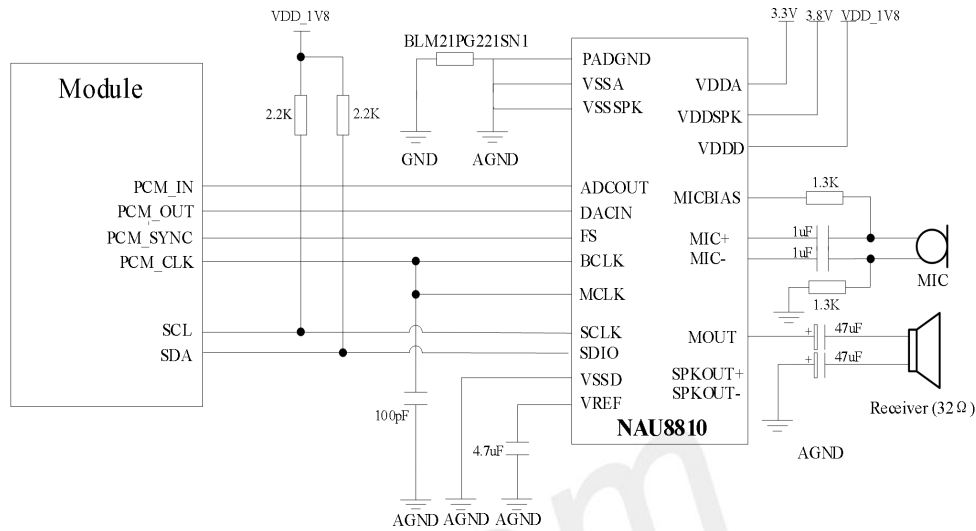
Both A7670 and SIM7070 series provide a set of PCM audio interfaces, which can be connected to an audio codec chip. Support voice function, customers can plug-in codec on PCM to make voice calls.

The following circuit is the reference design.

**Table 6 PCM interface parameters**

Function	A7670 series	SIM7070 series
PCM Interface	<ul style="list-style-type: none"> <li>Support 16-bit linear encoding format</li> <li>Support short frame mode</li> <li>Support main mode</li> <li>Support 16K sampling rate</li> </ul>	<ul style="list-style-type: none"> <li>Support 16-bit linear encoding format</li> <li>Support short frame mode</li> <li>Support main mode</li> <li>Support 16K sampling rate</li> </ul>

The recommended circuit of PCM is as follows:



**Figure 16: PCM recommended circuit**

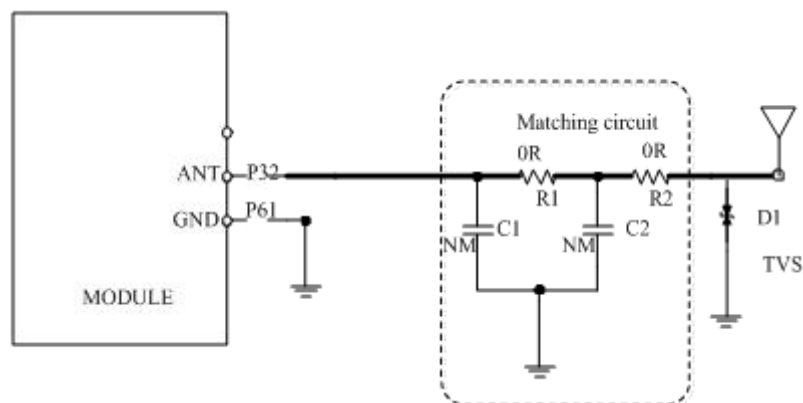
Codec supports the model number NAU8810. The audio output MOUT and SPKOUT can be switched by AT command.

**NOTE**

For details information, please refer to each HD guide

## 4.9 RF Interface

The reference circuit of ANT\_MAIN antenna connection between A7670 and SIM7070 series is shown in the figure below. In order to ensure the best performance of the output radio frequency, it is recommended to reserve a  $\pi$ -type matching circuit, and the capacitor is not attached by default.



**Figure 17: Antenna matching circuit**

The capacitors (C1/C2) are not mounted and a 0Ω resistor is mounted on R1 and R2 by default. The component D1 is a TVS for ESD protection, and it is optional for users according to application environment. The RF test connector is used for the conducted RF performance test, and should be placed as close as to the module's RF\_ANT pin. Two TVS are recommended in the table below.

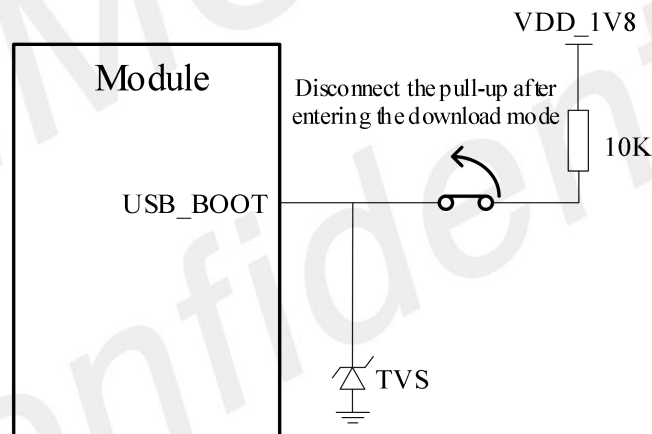
**Table 7 Recommended TVS**

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

## 4.10 USB\_BOOT Interface

A7670 and SIM7070 series support the USB mandatory download function at the same time. The user can pull up the USB\_BOOT pin to 1.8V before powering on, and press the power button to enter the emergency download mode. At this time, the module can download software through the USB port.

The reference circuit is as follows. It is recommended that users connect these two signals to test points.



**Figure 18: Forced download reference circuit**

## 4.11 ADC Interface

Both A7670 and SIM7070 series provide 1 ADC interface. The electrical characteristics are compared as follows:

**Table 8 ADC interface parameters**

Function	A7670 series	SIM7070 series
ADC Interface	-Resolution: 12bits -voltage range: 0~1.3V	-Resolution: 10bits -voltage range: 0~1.875V



## 5. Appendix

### 5.1 Related documents

**Table 9 Related documents**

SN	Document name	Remark
[1]	A7670 Series Hardware Design	A7670 Hardware Design Document
[2]	SIM7070 Hardware Design	SIM7070 Hardware Design Document

### 5.2 Terms and Abbreviation

**Table 10 Terms and Abbreviation**

Abbreviation	Description
ESD	Electrostatic Discharge
GSM	Global Standard for Mobile Communications
I2C	Inter-Integrated Circuit
PCB	Printed Circuit Board
PCS	Personal Communication System, also referred to as GSM 1900
RF	Radio Frequency
RTC	Real Time Clock
RX	Receive Direction
SIM	Subscriber Identification Module
UART	Universal Asynchronous Receiver & Transmitter
NC	Not connect
EDGE	Enhanced data rates for GSM evolution
HSDPA	High Speed Downlink Packet Access HSUPA
USIM	Universal subscriber identity module
UMTS	Universal mobile telecommunications system
SMPS	Switch Mode Power Supply