



A7670_SIM800F_SIM800 _Compatible Design

LTE Module

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Contents

Version History	3
Contents	4
Table Index	5
Figure Index	6
1 Introduction	7
1.1 Purpose of the document.....	7
1.2 Related documents.....	7
1.3 Conventions and abbreviations.....	7
2 Module Introduction	9
2.1 Module Overview.....	9
2.2 Features.....	9
3 Package Introduction	12
3.1 PIN Assignment Overview.....	12
3.2 PIN definition.....	13
4 Physical Size	17
4.1 Top and Bottom View.....	17
4.2 Recommended PCB footprint outline.....	18
5 Hardware Reference Design	21
5.1 Power Supply.....	21
5.1.1 Power requirements.....	21
5.1.2 Recommended external power circuit.....	22
5.2 USB Interface.....	23
5.3 Network Status Indication.....	24
5.4 Power on/off Circuit.....	24
5.5 Reset Circuit.....	25
5.6 USIM Interface.....	25
5.7 UART Interface.....	26
5.8 PCM Interface.....	28
5.9 RF Interface.....	29
5.10 USB_BOOT Interface.....	29
5.11 ADC Interface.....	30
5.12 I2C.....	30
5.13 Bluetooth.....	31

Table Index

Table 1: Module basic information comparison.....	9
Table 2: Module function comparison.....	9
Table 3: Pin type definition.....	13
Table 4: Module pin definition comparison.....	13
Table 5: Module recommended supply voltage comparison.....	21
Table 6: Electronic characteristic of the RESET Pin.....	25
Table 7: PCM interface parameters.....	28
Table 8: Recommended TVS.....	29
Table 9: ADC interface parameters.....	30

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Figure Index

Figure 1: A7670E, SIM800F and SIM800 pin assignment (Top view).....	12
Figure 2: A7670E and SIM800 series top and bottom view.....	17
Figure 3: Recommended PCB footprint outline for A7670E (Unit: mm).....	18
Figure 4: Recommended PCB footprint outline for SIM800F.....	19
Figure 5: Recommended PCB footprint outline for SIM800.....	20
Figure 6: Burst transmission power requirements.....	21
Figure 7: VBAT input reference circuit.....	22
Figure 8: Linear power supply recommended circuit.....	22
Figure 9: Recommended circuit for switching power supply.....	23
Figure 10: USB reference circuit.....	23
Figure 11: NETLIGHT/STATUS reference circuit.....	24
Figure 12: Power on/off reference circuit.....	24
Figure 13: A7670X Reset reference circuit.....	25
Figure 14: SIM interface reference circuit.....	26
Figure 15: UART Full modem.....	26
Figure 16: UART Null modem.....	27
Figure 17: Triode level conversion circuit.....	27
Figure 18: PCM recommended circuit.....	28
Figure 19: Antenna matching circuit.....	29
Figure 20: Forced download reference circuit.....	30
Figure 21: I2C reference circuit.....	31

1 Introduction

1.1 Purpose of the document

This document is targeted for customers to understand the differences between A7670E and SIM800. Users can use A7670E or SIM800 series module to design and develop applications quickly.

The SIM800 series include SIM800, and SIM800F.

1.2 Related documents

- [1] A7670 Series Hardware Design
- [2] SIM800 Hardware Design
- [3] SIM800F Hardware Design

1.3 Conventions and abbreviations

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




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2Module Introduction

2.1 Module Overview

The A7670E module supports LTE-FDD /GSM. SIM800series module supports GPRS/GSM. Users can choose different types of modules according to their demands to meet diversified market request.

Table 1: Module basic information comparison

Modules	Renderings	Package	Size	Description
A7670E		88 LGA pins	24*24*2.5 mm	LTE-FDD and 2G
SIM800 Series		68 LCC pins	24*24*3 mm	2G
				

2.2 Features

This chapter lists the functions supported by A7670E, SIM800 and SIM800F, the comparison is as follows:

Table 2: Module function comparison

Function	A7670E	SIM800 series
Power	Power supply range: 3.4V~4.2V Typical value: 3.8V	SIM800 series Power supply range: 3.4V~4.4V Typical value: 4V
Peak current	2A	2A
Sleep current	3mA(LTE-TDD)	SIM800: 1.3mA (GSM/GPRS) SIM800F: 1.2 mA (GSM/GPRS)
Frequency	GSM:DCS1800/EGSM900	GSM850/EGSM900/DCS1800/PCS19

band	LTE-FDD: 1/3/5/7/8/20	00.
GNSS	NA	NA
Bluetooth	NA	<ul style="list-style-type: none"> Fully compliant with Bluetooth specification 3.0 Support operation with GPS and GSM/GPRS worldwide radio systems Fully integrated PA provides 10dbm output power Up to 4 simultaneous active ACL links Support sniff mode Supports PCM interface and built-in programmable transcoders for liner voice with transmission
Temperature range	<p>Normal working temperature: -30°C ~ +80°C</p> <p>Extended operating temperature: -40°C ~ +85°C *</p> <p>Storage temperature: -45°C ~ +90°C</p>	<p>Normal working temperature: -40°C ~ +85°C</p> <p>Storage temperature: -45°C ~ +90°C</p>
UART interface	<p>Main serial port UART1:</p> <ul style="list-style-type: none"> For AT command transmission and data transmission Baud rate supports from 300bps to 3686400bps Support RTS and CTS hardware flow control Support serial port multiplexing function conforming to GSM 07.10 protocol <p>Debug serial port:</p> <ul style="list-style-type: none"> Support debug usage <p>UART3 serial port:</p> <ul style="list-style-type: none"> Ordinary two-wire serial port 	<p>Main serial port UART1:</p> <ul style="list-style-type: none"> Full modem serial port Can be used for AT commands or data stream Support RTS/CTS hardware handshake Comply with GSM 07.10 Multiplexer Protocol Support auto baud detect from 1200 bps to 115200bps
(U)SIM interface	Support SIM card: 1.8V, 3V	Support SIM card: 1.8V, 3V
PCM interface	<ul style="list-style-type: none"> For audio use, external Codec chip is required Support 16-bit linear encoding format Only supports master mode 	<p>SIM800: NA</p> <p>SIM800F:</p> <ul style="list-style-type: none"> Support 16-bit linear encoding format Only supports master mode
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
ADC interface	<ul style="list-style-type: none"> ● Provide an analog-to-digital conversion interface ● Voltage range: 0~1.3V ● Resolution: 12 bits 	<ul style="list-style-type: none"> ● Provide an analog-to-digital conversion interface ● Voltage range: 0~2.8V ● Resolution: 10 bits
Network indication	NETLIGHT: Network indication	NETLIGHT: Network indication
Diversity antenna interface	No	No
Antenna interface	Main antenna interface: RF_ANT	GSM antenna: GSM_ANT Bluetooth antenna: BT_ANT
Software upgrade	Upgrade software via USB	Upgrade software via USB and UART

NOTE

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

3 Package Introduction

3.1 PIN Assignment Overview

The following figure shows the pin assignment of A7670, SIM800F and SIM800.

A7670E VS SIM800F VS SIM800
(TOP VIEW)

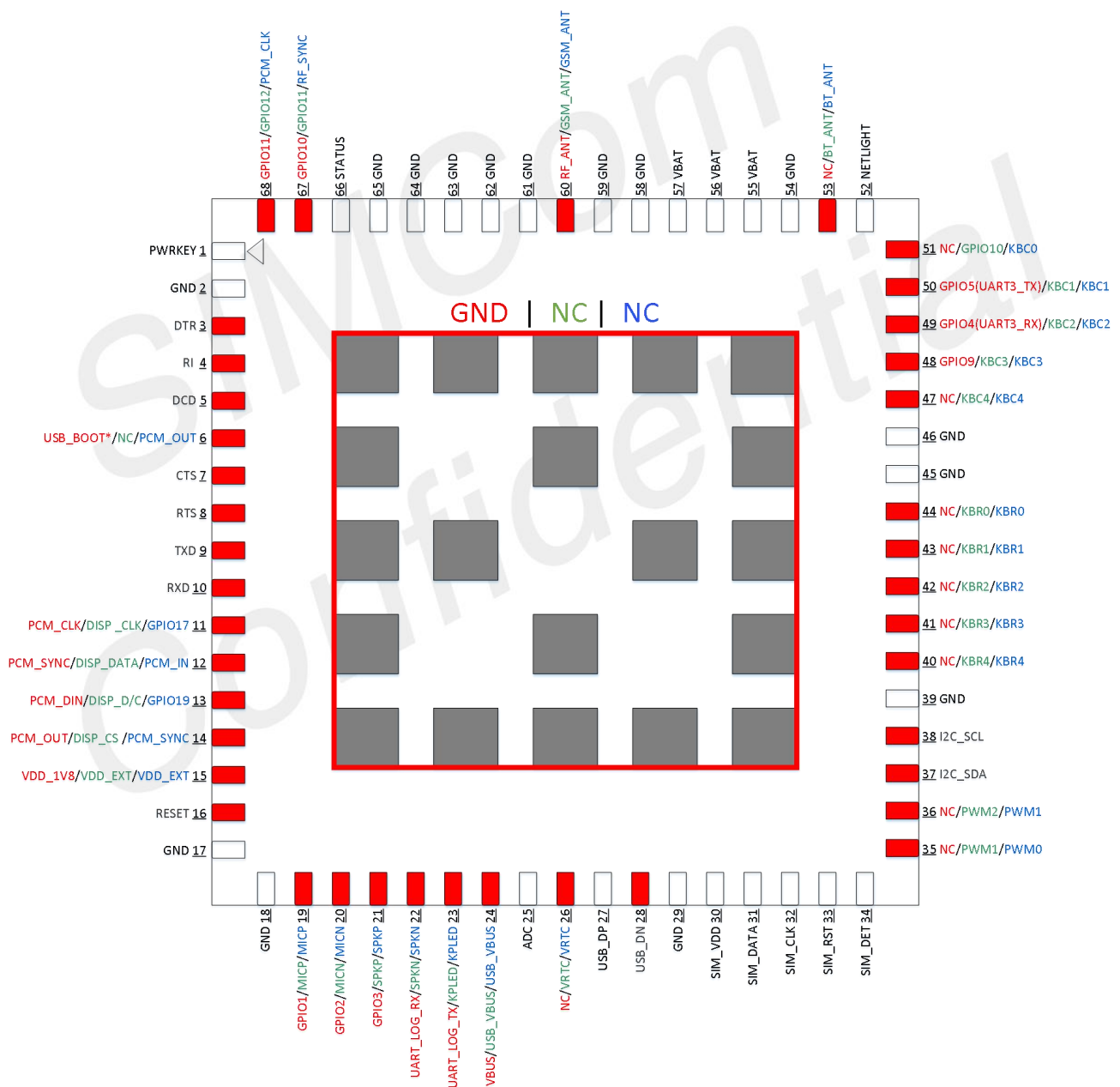


Figure 1: A7670E, SIM800F and SIM800 pin assignment (Top view)

3.2 PIN definition

This chapter describes the pin definition and comparison of A7670E, SIM800 and SIM800F. Table 3 provides the abbreviated definition of module pins:

Table 3: Pin type definition

abbreviation	description
Pin attributes	
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 A7670E, SIM800 and SIM800F.

Table 4: Module pin definition comparison

A7670E				SIM800F				SIM800			
Pin No.	Pin Name	I/O	Power domain	Pin No.	Pin Name	I/O	Power domain	Pin No.	Pin Name	I/O	Power domain
1	PWRKEY	DI	VBAT	1	PWRKEY	DI	3V	1	PWRKEY	DI	VBAT
2	GND	-	GND	2	GND	-	GND	2	GND	-	GND
3	DTR	DI	1.8V	3	UART1_DTR	DI	2.8V	3	DTR	I	2.8V
4	RI	DO	1.8V	4	UART1_RI	DO	2.8V	4	RI	O	2.8V
5	DCD	DO	1.8V	5	UART1_DCD	DO	2.8V	5	DCD	O	2.8V
6	USB_BOOT*	DI	1.8V	6	NC	-	2.8V	6	PCM_OUT	O	2.8V
7	CTS	DO	1.8V	7	UART1_CTS	DO	2.8V	7	CTS	O	2.8V
8	RTS	DI	1.8V	8	UART1_RTS	DI	2.8V	8	RTS	I	2.8V

9	TXD	DO	1.8V	9	UART1_TXD	DO	2.8V	9	TXD	O	2.8V
10	RXD	DI	1.8V	10	UART1_RXD	DI	2.8V	10	RXD	I	2.8V
11	PCM_CLK	IO	1.8V	11	DISP_CLK	O	2.8V	11	GPIO17	I/O	2.8V
12	PCM_SYNC	IO	1.8V	12	DISP_DATA	IO	2.8V	12	PCM_IN	I	2.8V
13	PCM_DIN	DI	1.8V	13	DISP_DATA	O	2.8V	13	GPIO19	I/O	2.8V
14	PCM_OUT	DO	1.8V	14	DISP_CS	O	2.8V	14	PCM_SYNC	O	2.8V
15	VDD_1V8	PO	1.8V	15	VDD_EXT	PO	2.8V	15	VDD_EXT		2.8V
16	RESET	DI	VBAT	16	NRESET	I	2.8V	16	RESET	I	2.8V
17	GND	-	GND	17	GND	-	GND	17	GND	-	GND
18	GND	-	GND	18	GND	-	GND	18	GND	-	GND
19	GPIO1	IO	1.8V	19	MICP	I	2.8V	19	MICP	I	2.8V
20	GPIO2	IO	1.8V	20	MICN		2.8V	20	MICN	I	2.8V
21	GPIO3	IO	1.8V	21	SPKP	O	2.8V	21	SPKP	O	2.8V
22	UART_LOG_RX	DI	1.8V	22	SPKN		2.8V	22	SPKN	O	2.8V
23	UART_LOG_TX	DO	1.8V	23	KPLED	I	2.8V	23	KPLED	I	2.8V
24	VBUS	AI	Typical:5V	24	USB_VBUS	AI	Typical:5V	24	USB_VBUS	I	Typical:5V
25	ADC	AI	0.1V-1.3V	25	ADC	AI	0V-2.8V	25	ADC	I	0V-2.8V
26	NC	-	-	26	VRTC	IO	2.8V	26	VRTC		2.8V
27	USB_DP	IO	-	27	USB_DP	IO	-	27	USB_DP	I/O	-
28	USB_DM	IO	-	28	USB_DM	IO	-	28	USB_DN	I/O	-
29	GND	-	GND	29	GND	-	GND	29	GND	-	GND
30	SIM_VDD	IO	1.8V/3.0V	30	SIM_VDD	IO	1.8V/3.0V	30	SIM_VDD	O	1.8V/3.0V
31	SIM_DATA	IO	1.8V/3.0V	31	SIM_DATA	IO	1.8V/3.0V	31	SIM_DATA	I/O	1.8V/3.0V
32	SIM_CLK	DO	1.8V/3.0V	32	SIM_CLK	DO	1.8V/3.0V	32	SIM_CLK	O	1.8V/3.0V
33	SIM_RST	IO	1.8V/3.0V	33	SIM_RST	IO	1.8V/3.0V	33	SIM_RST	O	1.8V/3.0V
34	SIM_DET	IO	1.8V/3.0V	34	SIM_DET	I	1.8V/3.0V	34	SIM_DET	I	1.8V/3.0V
35	NC	-	-	35	PWM1	O	2.8V	35	PWM0	O	2.8V
36	NC	-	-	36	PWM2	O	2.8V	36	PWM1	O	2.8V
37	I2C_SDA	IO	1.8V	37	I2C_SDA	IO	2.8V	37	SDA	I/O	2.8V

38	I2C_SCL	DO	1.8V	38	I2C_SCL	DO	2.8V	38	SCL	O	2.8V
39	GND	-	GND	39	GND	-	GND	39	GND	-	GND
40	NC	-	-	40	KBR4	IO	2.8V	40	KBR4	O	2.8V
41	NC	-	-	41	KBR3	IO	2.8V	41	KBR3	O	2.8V
42	NC	-	-	42	KBR2	IO	2.8V	42	KBR2	O	2.8V
43	NC	-	-	43	KBR1	IO	2.8V	43	KBR1	O	2.8V
44	NC	-	-	44	KBR0	IO	2.8V	44	KBR0	O	2.8V
45	GND	-	GND	45	GND	-	GND	45	GND	-	GND
46	GND	-	GND	46	GND	-	GND	46	GND	-	GND
47	NC	-	-	47	KBC4	-	2.8V	47	KBC4	I	2.8V
48	GPIO9	IO	1.8V	48	KBC3		2.8V	48	KBC3	I	2.8V
49	GPIO4(UART3_RX)	IO	1.8V	49	KBC2		2.8V	49	KBC2	I	2.8V
50	GPIO5(UART3_TX)	IO	1.8V	50	KBC1		2.8V	50	KBC1	I	2.8V
51	NC	-	-	51	GPIO10	-	2.8V	51	KBC0	I	2.8V
52	NETLIGHT	DO	1.8V	52	NETLIGHT	DO	2.8V	52	NETLIGHT	O	2.8V
53	NC	-	-	53	BT_ANT	IO	-	53	BT_ANT	IO	-
54	GND	-	GND	54	GND	-	GND	54	GND	-	GND
55	VBAT	PI	3.4V~4.2V	55	VBAT	PI	3.4V~4.4V	55	VBAT	PI	3.4V~4.4V
56	VBAT	PI	3.4V~4.2V	56	VBAT	PI	Same as above	56	VBAT	PI	3.4V~4.4V
57	VBAT	PI	3.4V~4.2V	57	VBAT	PI	Same as above	57	VBAT	PI	3.4V~4.4V above
58	GND	-	GND	58	GND	-	GND	58	GND	-	GND
59	GND	-	GND	59	GND	-	GND	59	GND	-	GND
60	RF_ANT	AIO	-	60	GSM_ANT	IO	-	60	GSM_ANT	IO	-
61	GND	-	GND	61	GND	-	GND	61	GND	-	GND
62	GND	-	GND	62	GND	-	GND	62	GND	-	GND
63	GND	-	GND	63	GND	-	GND	63	GND	-	GND
64	GND	-	GND	64	GND	-	GND	64	GND	-	GND
65	GND	-	GND	65	GND	-	GND	65	GND	-	GND
66	STATUS	DO	1.8V	66	STATUS	DO	2.8V	66	STATUS	O	2.8V
67	GPIO10	IO	1.8V	67	GPIO11		2.8V	67	RF_SYNC	O	2.8V
68	GPIO11	IO	1.8V	68	GPIO12		2.8V	68	PCM_CLK	I	2.8V
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

NOTE

The voltage level of the GPIO and UART of the A7670E module is 1.8V; When do compatible design with SIM800 series and A7670E module, a level conversion circuit should be needed.

4 Physical Size

This chapter introduces the external dimensions of the A7670E, SIM800 and SIM800F modules, and the recommended packaging.

4.1 Top and Bottom View

The following figures show top and bottom view of A7670E, SIM800 and SIM800F.

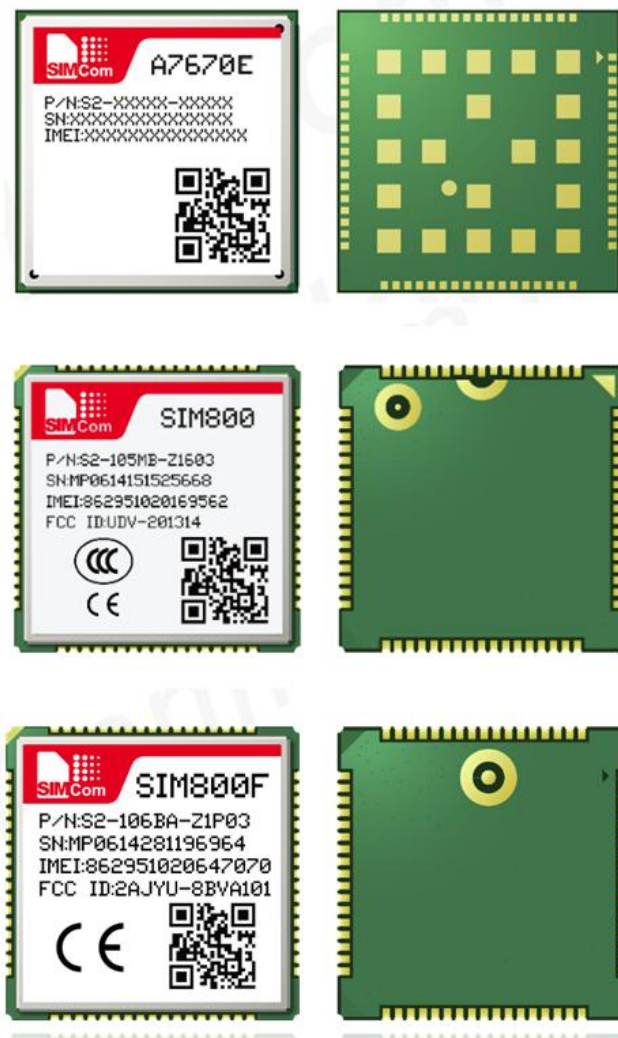


Figure 2: A7670E and SIM800 series top and bottom view

NOTE

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

prevail in kind.

4.2 Recommended PCB footprint outline

The recommended PCB footprint outline for A7670E and SIM800 series is shown as following.

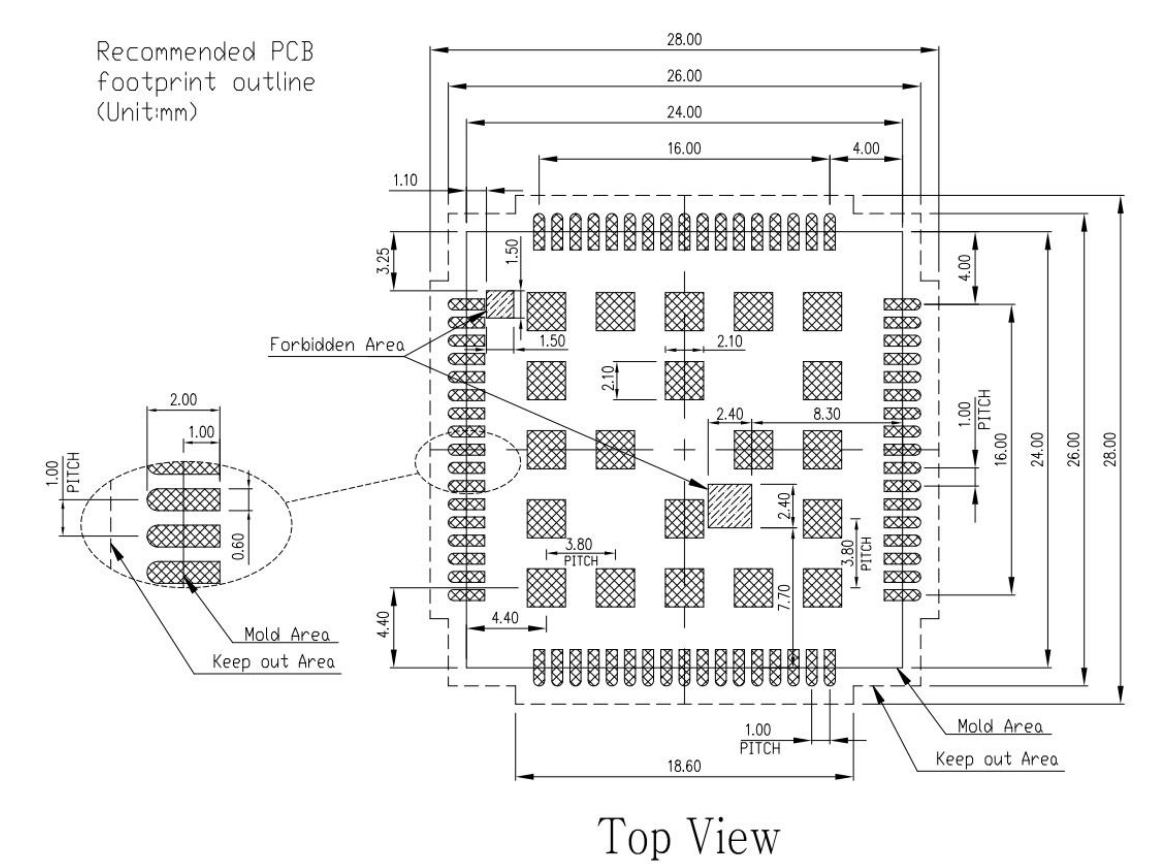


Figure 3: Recommended PCB footprint outline for A7670E (Unit: mm)

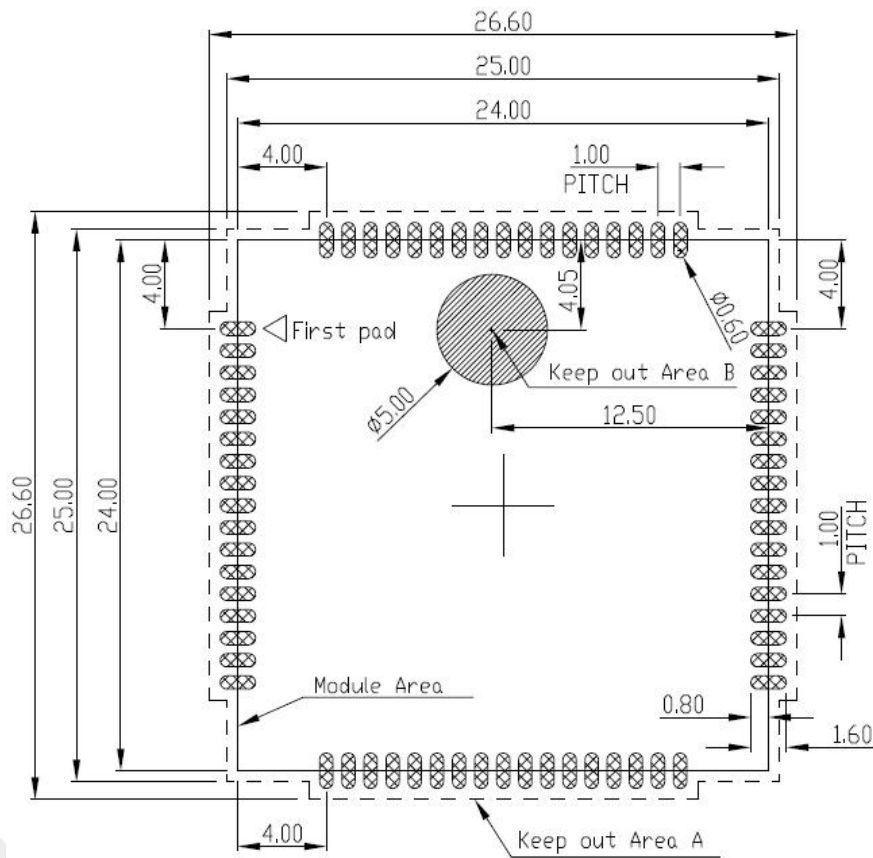


Figure 4: Recommended PCB footprint outline for SIM800F

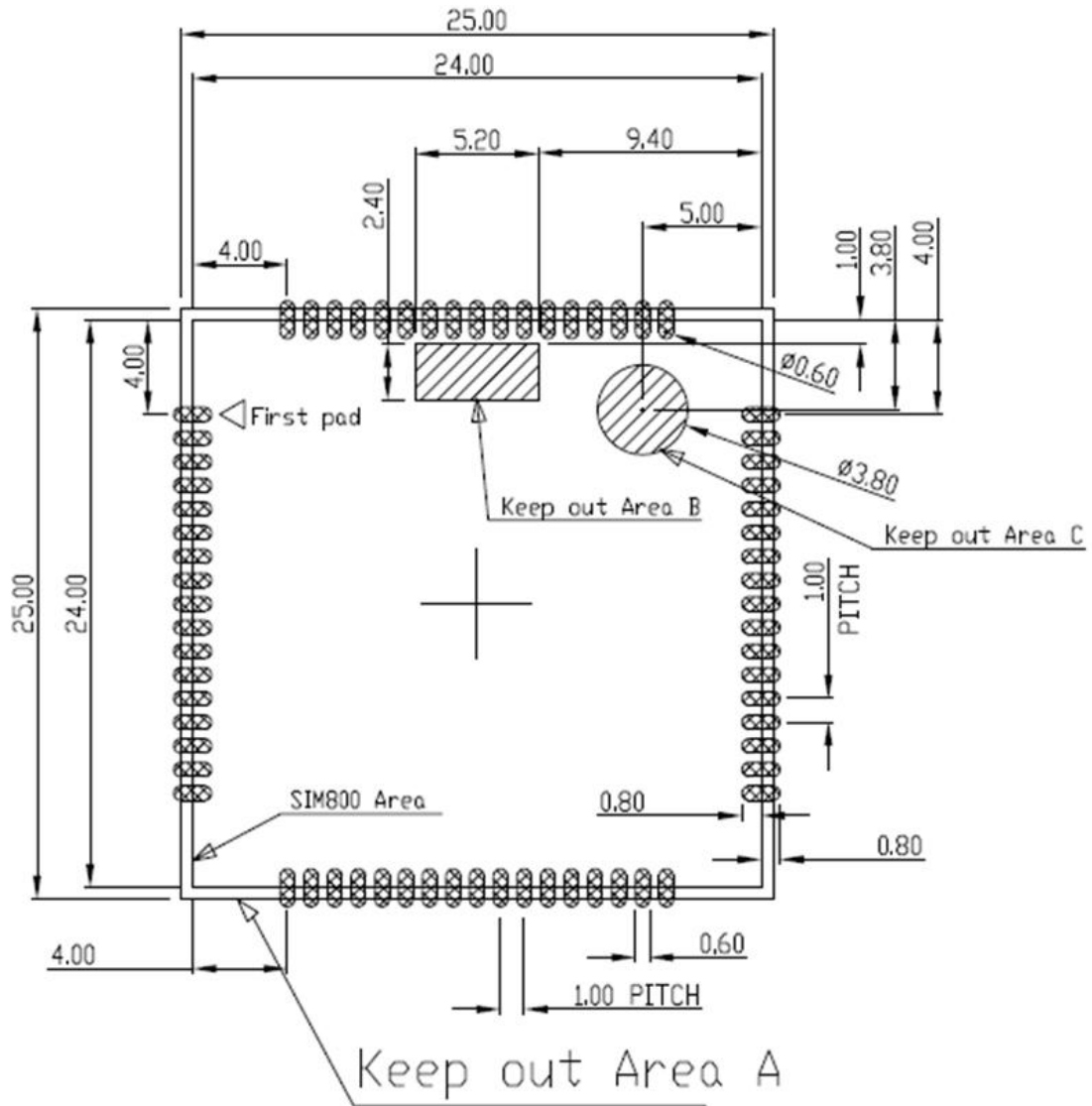


Figure 5: Recommended PCB footprint outline for SIM800

NOTE

For detailed information, please refer to HD for each module.

5 Hardware Reference Design

The user interface for A7670, SIM800 and SIM800F is showing in this chapter.

5.1 Power Supply

5.1.1 Power requirements

The following table shows the supply voltage range of A7670, SIM800 and SIM800F:

Table 5: Module recommended supply voltage comparison

Modules	Power Pin	Symbol description	Min	Typical	Max	unit
A7670E	VBAT	Power supply range	3.4	3.8	4.2	V
SIM800 series	VBAT	Power supply range	3.4	4	4.4	V

During 2G transmission, the peak current can be as high as 2A, and the battery terminal burst current and voltage drop model are shown in the figure below:

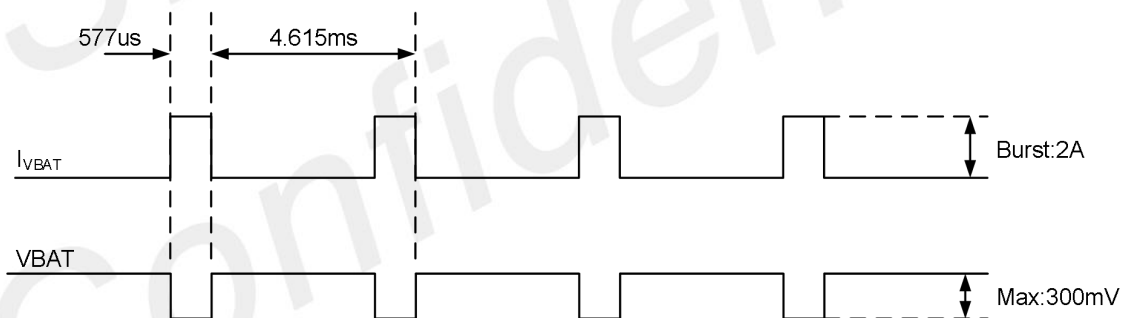


Figure 6: Burst transmission power requirements

In 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 2A, 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 2A, the total capacitance of the external power supply capacitor is recommended not to be less than 330uF.

It is recommended to place four ceramic capacitors of 33pf/10pf/0.1/1 μ 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.

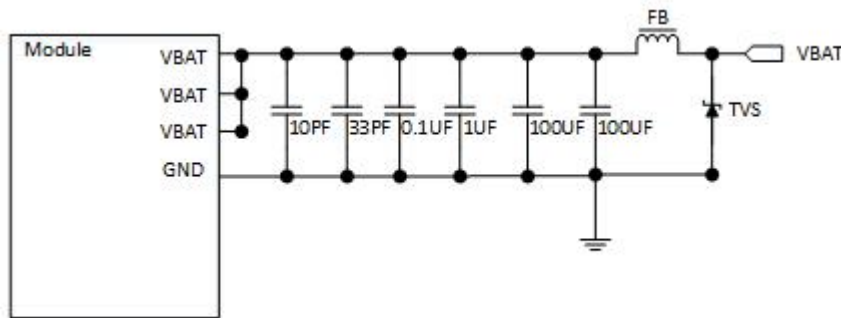


Figure 7: VBAT input reference circuit

5.1.2 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:

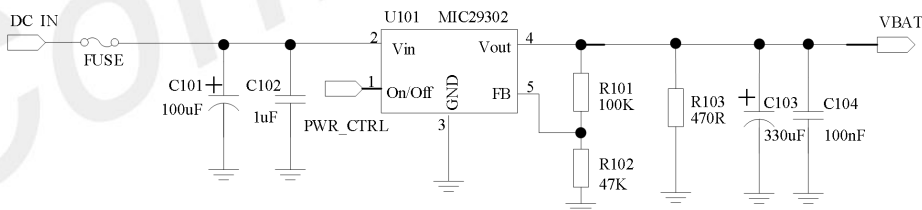


Figure 8: Linear power supply recommended circuit

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

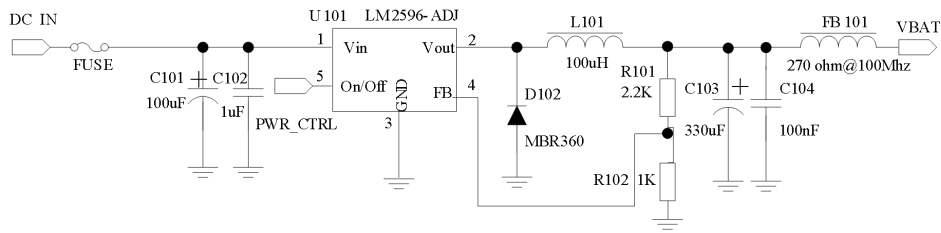


Figure 9: Recommended circuit for switching power supply

5.2 USB Interface

Both A7670 and SIM800 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.

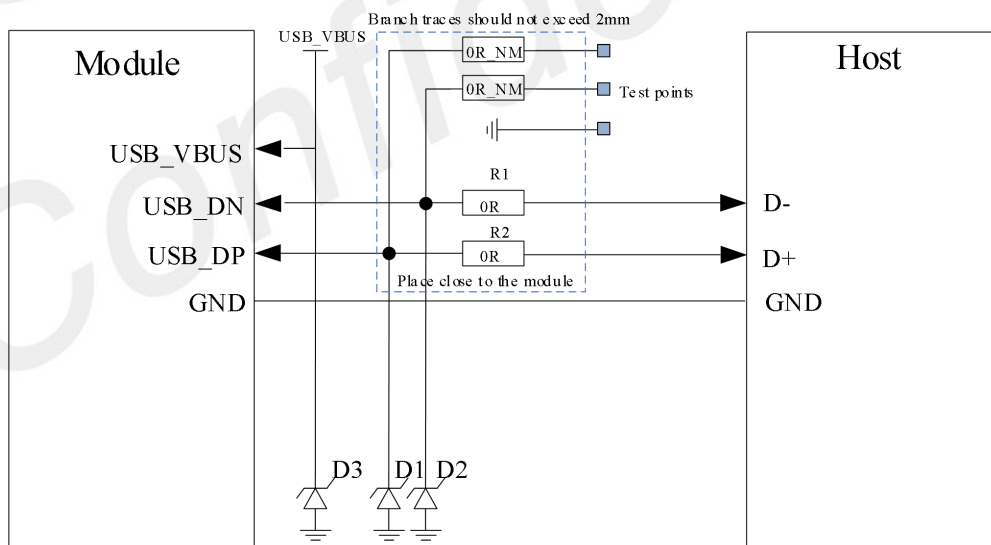


Figure 10: USB reference circuit

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 $90\ \Omega$ and covered with ground; D1/D2 select TVS tube with capacitance value $<1\text{pf}$.

5.3 Network Status Indication

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

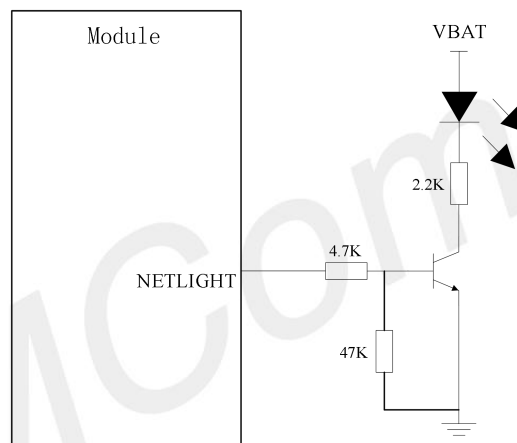


Figure 11: NETLIGHT/STATUS reference circuit

5.4 Power on/off Circuit

A7670 & SIM800 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.

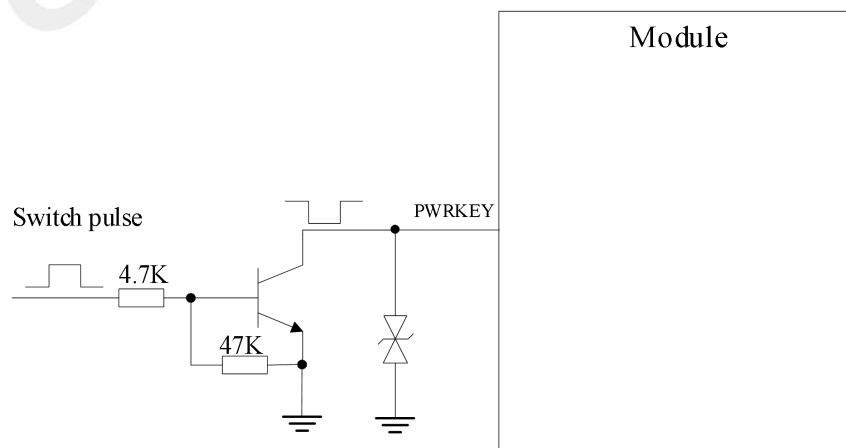


Figure 12: Power on/off reference circuit

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.

5.5 Reset Circuit

The A7670E and SIM800 series reset circuit is as follows, the user resets the module by pulling down the RESET pin.

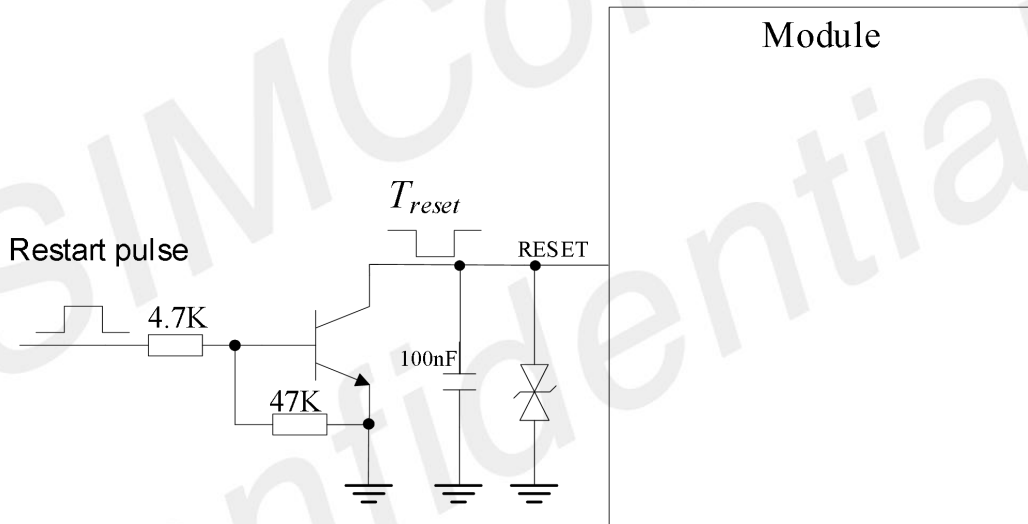


Figure 13: A7670X Reset reference circuit

Table 6: Electronic characteristic of the RESET Pin

Function	A7670E	SIM800
RESET	<ul style="list-style-type: none"> ● RESET pin is pulled up to VBAT internally ● The reset time is recommended to be 1.5s. ● Input low level voltage range:0-0.5V 	<ul style="list-style-type: none"> ● RESET pin is pulled up to 2.8V internally ● The reset time is recommended to be 105 mS. ● Input low level voltage range:0-0.6V

5.6 USIM Interface

A7670E and SIM800 series supports 1.8V/3.0V (U)SIM card by default and supports hot-swappable function. The recommended circuit is as follows:

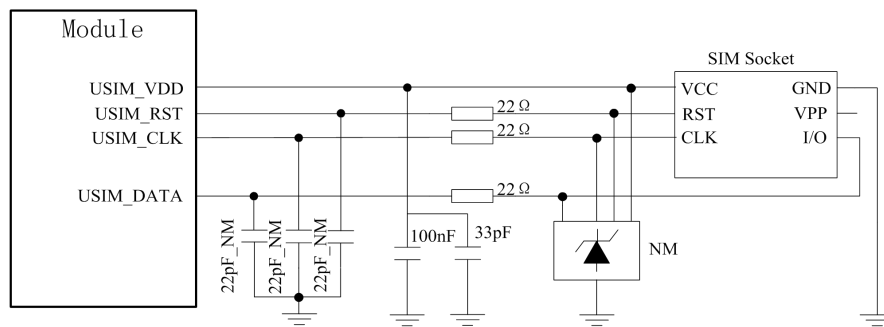


Figure 14: SIM interface reference circuit

NOTE

For details information, please refer to each HD guide

5.7 UART Interface

A7670E 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.

SIM800F provides 1 full function UART port.

SIM800 provides 1 full function UART port, and can be configured to two independent serial ports.

Below are the reference circuits.

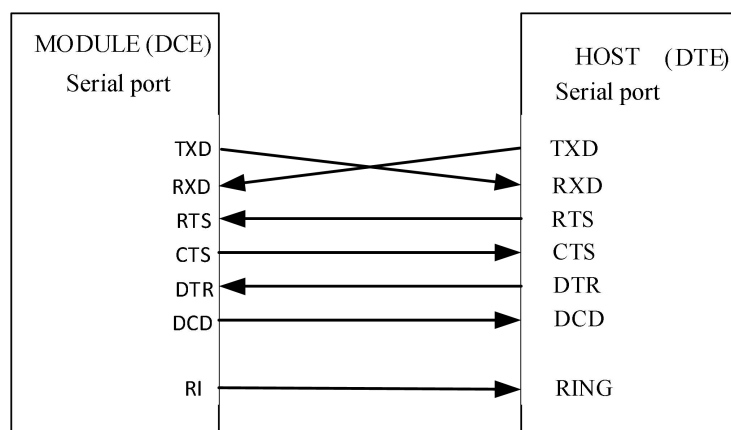


Figure 15: UART Full modem

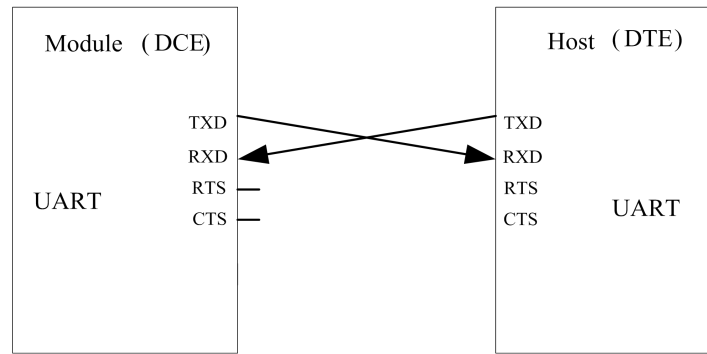


Figure 16: UART Null modem

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

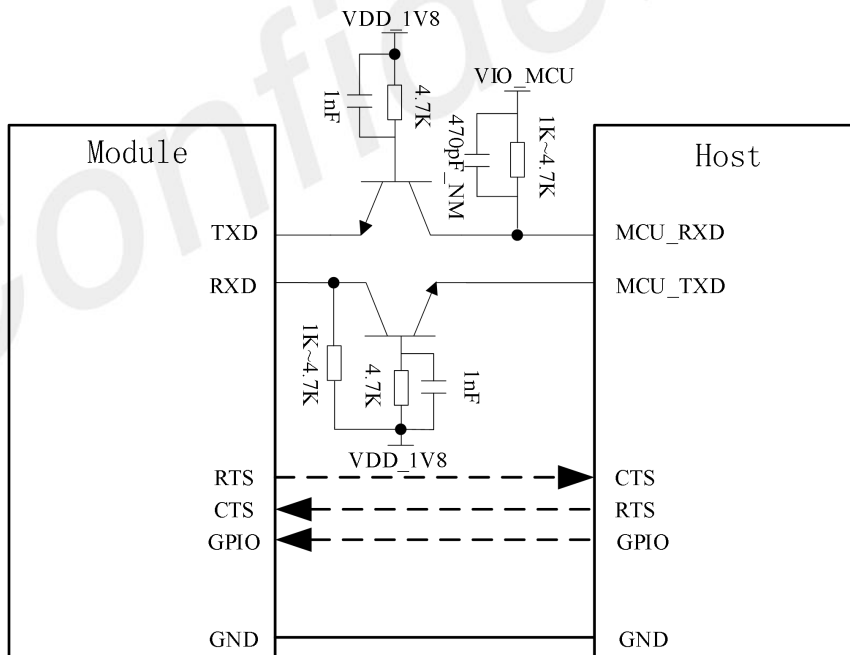


Figure 17: Triode level conversion circuit

NOTE

- The VDD_1V8 (VDD_EXT) of each project in the diagram is different. For details information, please refer to each HD guide.
- When the SIM800 series module is replaced with the A7670 module, the level conversion cannot use resistors to divide the voltage.

5.8 PCM Interface

SIM800F do not provide PCM interface. A7670 and SIM800 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 7: PCM interface parameters

Function	A7670E	SIM800
PCM Interface	<ul style="list-style-type: none"> • Support 16-bit linear encoding format • Support short frame mode • Support master mode 	<ul style="list-style-type: none"> • Support 16-bit linear encoding format • Support short frame mode • Support master mode

The recommended circuit of PCM is as follows:

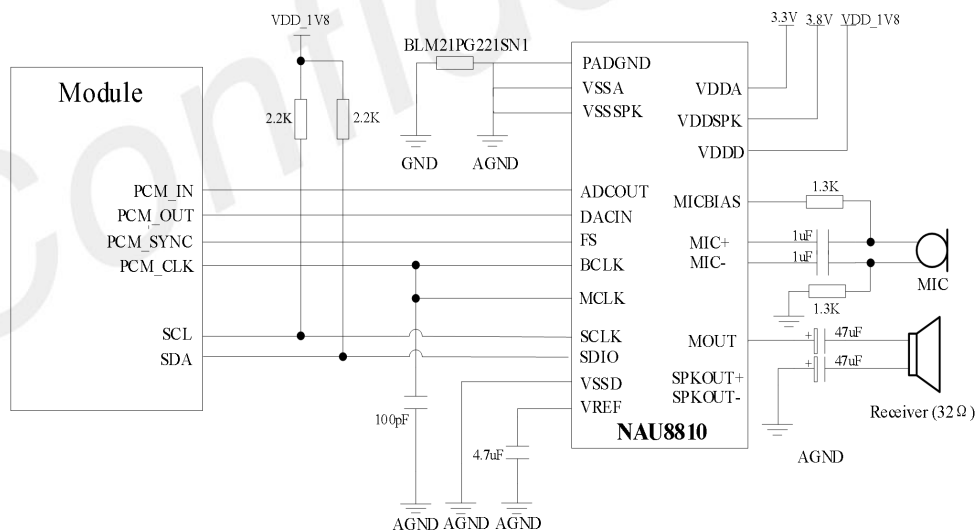


Figure 18: PCM recommended circuit

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

5.9 RF Interface

The reference circuit of ANT_MAIN antenna connection between A7670 and SIM800 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 π -type matching circuit, and the capacitor is not attached by default.

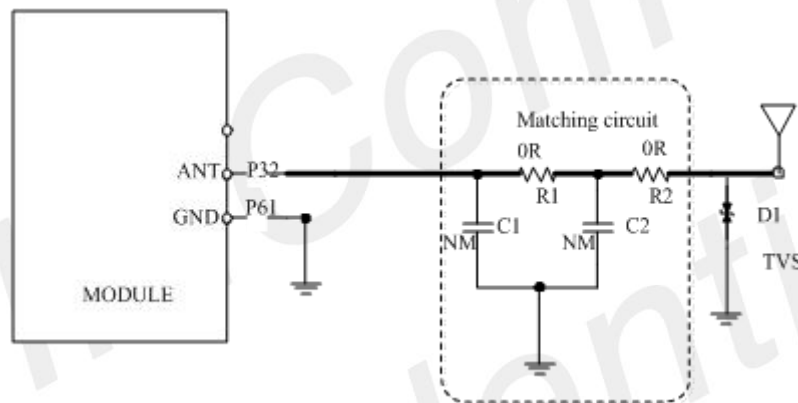


Figure 19: Antenna matching circuit

The capacitors (C1/C2) are not mounted and a 0 Ω 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 8: Recommended TVS

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

5.10 USB_BOOT Interface

SIM800 series do not support the USB force download function.

A7670E support the USB download function. 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.

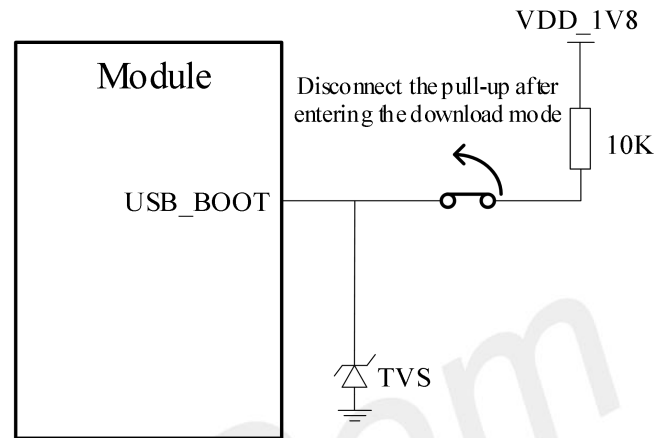


Figure 20: Forced download reference circuit

NOTE

The VDD_1V8 (VDD_EXT) of each project in the diagram is different. For details information, please refer to each HD guide.

5.11 ADC Interface

Both A7670E and SIM800 series provide 1 ADC interface. The electrical characteristics are compared as follows:

Table 9: ADC interface parameters

Function	A7670 series	SIM800 series
ADC Interface	-Resolution: 12bits -voltage range: 0~1.3V	-Resolution: 10bits -voltage range: 0~2.8V

5.12 I2C

A7670E provides two sets of I2C interfaces, support standard speed clock frequency 100Kbps, support high speed clock frequency 400Kbps, its operation voltage is 1.8V.

The SIM800 series provides an I2C interface, which supports the master role and conforms to the I2C specification. I2C has been pulled up to 2.8V via 4.7KΩ internally.

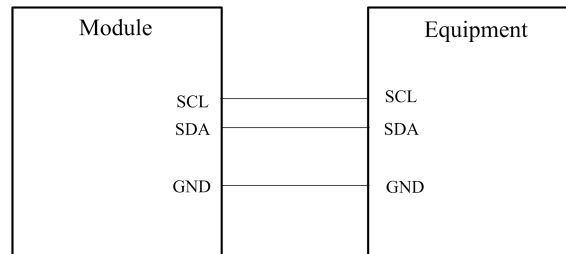


Figure 21: I2C reference circuit

NOTE

The voltage domain of the I2C interface of the A7670E module is 1.8V; when the SIM800 series module is compatible with the A7670E module, a level conversion circuit needs to be added.

5.13 Bluetooth

A7670E does not support Bluetooth function.

SIM800 series supports Bluetooth function which can be operated by AT commands conveniently. For detail commands about Bluetooth please refer to related documents.