



# A7682E\_A7683E\_SIM800C\_ SIM868\_SIM7080G\_SIM7022 Compatible Design

LTE/GSM/LPWA Module

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# 1 Introduction

This document describes the differences between A7682E, A7683E, SIM800C, SIM868, SIM7080G and SIM7022. Customers can quickly design and develop applications using A7682E, A7683E, SIM800C, SIM868, SIM7080G and SIM7022 modules.

## 1.1 Module Overview

A7682E module supports GSM / LTE CAT1; A7683E module only supports LTE CAT1; SIM800C/SIM868 module supports GSM / GPRS; SIM7080G module supports LTE CAT-M1 and LTE CAT-NB1/NB2; SIM7022 module only supports CAT-NB1/NB2. Customers 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
A7682E		85 LGA pins	19.6*19.6*2.4 mm	LTE CAT-1 and GSM
A7683E		85 LGA pins	15.7*17.6*2.4mm	LTE CAT-1
SIM800C		42 LCC pins	17.6*15.7*2.3 mm	GSM
SIM868		42 LCC pins and 35 LGA pins	17.6*15.7*2.3mm	GSM

SIM7080G	 <p>SIM7080G P/N: S2-XXXX-XXXX IMEI: XXXXXXXXXXXXXXX FCC ID: 2AJYU-8VC0002 CE D19016003 A03-190198</p>	42 LCC pins and 35 LGA pins	17.5x15.7x2.4mm	LTE CAT-M1、LTE CAT-NB1/CAT-NB2
SIM7022	 <p>SIM7022 P/N: S2-XXXX-XXXX SN: XXXXXXXXXXXXXXX IMEI: XXXXXXXXXXXXXXX</p>	42 LCC pins	17.6x15.7x2.3mm	LTE CAT-NB1/NB2

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## 1.2 Features

This chapter lists the function parameters of A7682E, A7683E, SIM800C, SIM868, SIM7080G and SIM7022. The comparison is as follows:

Table 2: Module function comparison

Function	A7682E	A7683E	SIM800C	SIM868	SIM7080G	SIM7022
Power	Power supply range: 3.4V~4.2V Typical value: 3.8V	Power supply range: 3.4V~4.2V Typical value: 3.8V	Power supply range: 3.4V~4.4V Typical value: 4.0V	Power supply range: 3.4V~4.4V(GSM_V BAT) 2.9V~4.4V(GPS_VB AT) Typical value: 4.0V	Power supply range:2.7V~4.8V Typical value: 3.8V	Power supply range:2.2V~4.3V Typical value: 3.3V
Peak current	2A	700mA	2A	2A	The peak current of the module power in CAT-M1 and NB-IoT transmit mode is 0.5A	1A
Sleep current	<2mA (AT+CFUN=0)	<2mA (AT+CFUN=0)	0.6mA (AT+CFUN=0)	0.65mA (AT+CFUN=0)	1.2mA (AT+CFUN=0)	0.3mA
Frequency band	EGSM900/DCS1800 LTE:1/3/5/7/8/20	LTE:1/3/5/7/8/20/28	GSM850/EGSM900 /DCS1800/PCS1900	GSM850/EGSM900 /DCS1800/PCS1900	LTE:1/2/3/4/5/8/12/13/14/18/19/20/25/26/27/28/66/71/85	LTE: 1/2/3/4/5/8/12/13/14/17/18/19/20/25/26/28/66/70/85

GNSS	NA	NA	NA	GPS/GLONASS/Bei Dou	GPS/GLONASS/Bei Dou	NA
Bluetooth	NA	NA	Need software support	Bluetooth Specification 3.0	NA	NA
Temperature range	Operation temperature: -30°C ~ +80°C Extended operation temperature: -40°C ~ +85°C* Storage temperature: -45°C ~ +90°C	Operation temperature: -30°C ~ +75°C Extended operation temperature: -40°C ~ +85°C* Storage temperature: -45°C ~ +90°C	Operation temperature: -40°C ~ +85°C Storage temperature: -45°C ~ +90°C	Operation temperature: -40°C ~ +85°C Storage temperature: -45°C ~ +90°C	Operation temperature: -40°C ~ +85°C Storage temperature: -45°C ~ +90°C	Operation temperature: -40°C ~ +85°C Storage temperature: -45°C ~ +90°C
UART interface	<ul style="list-style-type: none"> <li>● <b>Main serial port</b> Baud rate support from 300bps to 3.6Mbps AT command and data can be sent through the serial port Support RTS/CTS Hardware flow control</li> <li>● <b>UART3</b> One ordinary two-wire serial port The default baud rate is 115200bps.</li> <li>● <b>Debug serial</b></li> </ul>	<ul style="list-style-type: none"> <li>● <b>Main serial port</b> Baud rate support from 300bps to 3.6Mbps AT command and data can be sent through the serial port Support RTS/CTS Hardware flow control</li> <li>● <b>UART3</b> One ordinary two-wire serial port The default baud rate is 115200bps.</li> <li>● <b>Debug serial</b></li> </ul>	<p><b>Serial port:</b></p> <ul style="list-style-type: none"> <li>● Default one Full modem serial port</li> <li>● It can be used for AT commands or data stream</li> <li>● Support RTS/CTS hardware handshake and software ON/OFF flow control</li> <li>● Multiplex ability according to GSM 07.10 Multiplexer Protocol</li> <li>● Adaptive baud rate support from</li> </ul>	<p><b>Serial port:</b></p> <ul style="list-style-type: none"> <li>● Default one full modem serial port</li> <li>● It can be used for AT commands or data stream</li> <li>● Support RTS/CTS hardware handshake and software ON/OFF flow control</li> <li>● Multiplex ability according to GSM 07.10 Multiplexer Protocol</li> <li>● Adaptive baud rate support from</li> </ul>	<ul style="list-style-type: none"> <li>● By default, a full-featured UART1 channel is available for AT communication.</li> <li>● The serial port baud rate supports 300bps to 3686400bps. The default rate is 0bps (adaptive baud rate).</li> <li>● Support auto baud rate, but only limited to 9600, 19200, 38400,</li> </ul>	<ul style="list-style-type: none"> <li>● <b>Main serial port</b> Baud rate support from 2400bps to 460800bps AT command and data can be sent through the serial port Support RTS/CTS Hardware flow control It can be used for firmware upgrade and calibration</li> <li>● <b>UART0</b></li> </ul>

	<b>port</b> Supports debug usage	<b>port</b> Supports debug usage	1200 bps to 115200bps ● Upgrading firmware	1200 bps to 115200bps ● Upgrading firmware	57600 and 115200 bps. ● Support RTS/CTS hardware handshake. ● Two-channel 2-wire UART2 and UART3 are only used as UART in DAM applications when secondary development.	Supports debug usage. The default baud rate is 3Mbps
USIM Card interface	Support 1.8V/3V USIM card	Support 1.8V/3V USIM card	Support 1.8V/3V USIM card	Support 1.8V/3V USIM card	Support 1.8V USIM card	Support 1.8V/3V USIM card
Audio feature	MAX:37mW(32Ω)	MAX:37mW(32Ω)	MAX:90mW(32Ω)	MAX:90mW(32Ω) MAX:1080mW(8Ω)	NA	NA
PCM interface	NA	NA	NA	NA	Support PCM interface. Only support PCM master mode and short frame sync	NA
SPI interface	NA	NA	NA	NA	Support for serial data bus SPI, only used during DAM application secondary development.	NA
USB interface	USB 2.0 compliant, host mode not supported.	USB 2.0 compliant, host mode not supported.	It can be used for debugging and upgrading firmware	It can be used for debugging and upgrading firmware	USB 2.0 compliant, Can be used for debugging and	NA

	This interface supports AT command sending, data transmission, software debugging and upgrading.	This interface supports AT command sending, data transmission, software debugging and upgrading.			upgrading firmware	
SD Card interface	NA	SD interface	NA	SDC Interface	NA	NA
ADC interface	<ul style="list-style-type: none"> <li>● Provide an analog-to-digital conversion interface</li> <li>● Voltage range: 0~1.8V</li> <li>● Resolution: 9 bits</li> </ul>	<ul style="list-style-type: none"> <li>● Provide an analog-to-digital conversion interface</li> <li>● Voltage range:0~1.2V</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: 0~2.8V</li> <li>● Resolution:10 bits</li> </ul>	<ul style="list-style-type: none"> <li>● Provide an analog-to-digital conversion interface</li> <li>● Voltage range: 0~2.8V</li> <li>● Resolution:10 bits</li> </ul>	<ul style="list-style-type: none"> <li>● Provide an analog-to-digital conversion interface</li> <li>● Voltage range: 0~1.8V</li> </ul>	<ul style="list-style-type: none"> <li>● Provide an analog-to-digital conversion interface</li> <li>● Voltage range: 0~3.3V</li> </ul>
Network indication	NETLIGHT: Network indication	NETLIGHT: Network indication	NETLIGHT: Network indication	NETLIGHT: Network indication	NETLIGHT: Network indication	NETLIGHT: Network indication
Antenna interface	Main antenna: RF_ANT	Main antenna: RF_ANT	Main antenna: RF_ANT Bluetooth antenna: BT_ANT	Main antenna: RF_ANT Bluetooth antenna: BT_ANT GNSS antenna: GNSS_ANT	LTE main antenna: RF_ANT GNSS antenna: GNSS_ANT	Main antenna: RF_ANT
Software upgrade	Upgrade software via USB	Upgrade software via USB	Upgrade software via USB or UART	Upgrade software via USB or UART	Upgrade software via USB	Upgrade software via UART1

**NOTE**

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

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# 2 Package Introduction

## 2.1 Pin Assignment Overview

The following figure shows the pin assignment of A7682E, A7683E, SIM800C, SIM868, SIM7080G and SIM7022.

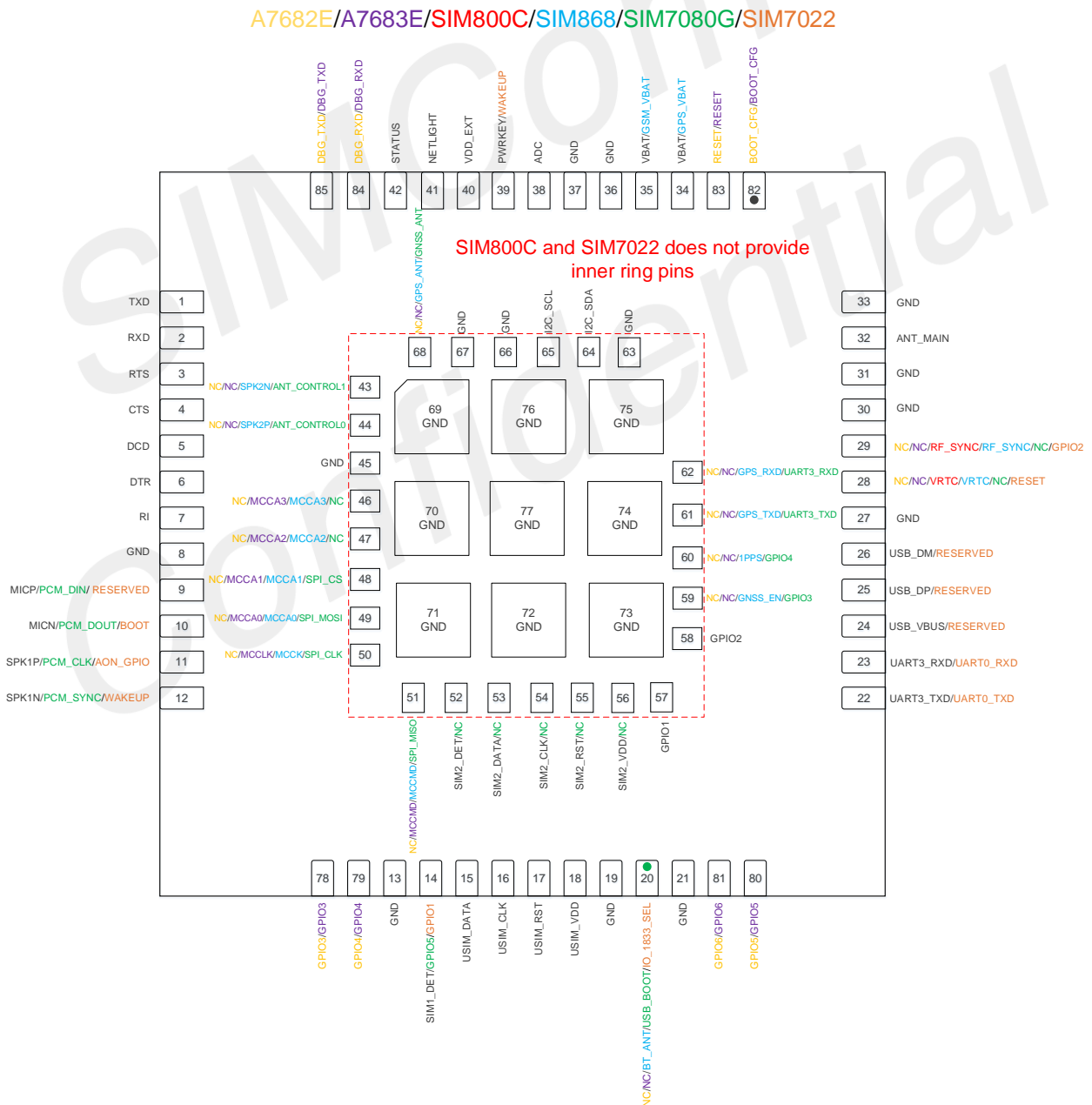


Figure 1: A7682E/A7683E/SIM800C/SIM868/SIM7080G/SIM7022 pin assignment (Top view)

**NOTE**

1. The SIM800C and SIM7022 module does not provide inner ring pins.
2. The A7682E and A7683E module has 8 more outer ring pins (78, 79, 80, 81, 82, 83, 84 and 85).
3. For details information, please refer to each HD guide.

## 2.2 PIN definition

This chapter describes the pin definition and comparison of A7682E, A7683E, SIM800C, SIM868, SIM7080G and SIM7022.

Table 3: Pin type definition

Abbreviation	Description
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	Pull down
OD	Open drain

Table 4: Module pin definition comparison

Pin No.	A7682E		A7683E		SIM800C		SIM868		SIM7080G		SIM7022	
	Pin Name	Power domain	Pin Name	Power domain	Pin Name	Power domain	Pin Name	Power domain	Pin Name	Power domain	Pin Name	Power domain
1	UART1_TXD	1.8V	UART1_TXD	1.8V	UART1_TXD	2.8V	UART1_TXD	2.8V	UART1_TXD	1.8V	UART1_TXD	1.8V/3.3V Default:1.8V
2	UART1_RXD	1.8V	UART1_RXD	1.8V	UART1_RXD	2.8V	UART1_RXD	2.8V	UART1_RXD	1.8V	UART1_RXD	1.8V/3.3V Default:1.8V
3	UART1_RTS	1.8V	UART1_RTS	1.8V	UART1_RTS	2.8V	UART1_RTS	2.8V	UART1_RTS	1.8V	UART1_RTS	1.8V/3.3V Default:1.8V
4	UART1_CTS	1.8V	UART1_CTS	1.8V	UART1_CTS	2.8V	UART1_CTS	2.8V	UART1_CTS	1.8V	UART1_CTS	1.8V/3.3V Default:1.8V
5	UART1_DCD	1.8V	UART1_DCD	1.8V	UART1_DCD	2.8V	UART1_DCD	2.8V	UART1_DCD	1.8V	UART1_DCD	1.8V/3.3V Default:1.8V
6	UART1_DTR	1.8V	UART1_DTR	1.8V	UART1_DTR	2.8V	UART1_DTR	2.8V	UART1_DTR	1.8V	UART1_DTR	1.8V/3.3V Default:1.8V
7	UART1_RI	1.8V	UART1_RI	1.8V	UART1_RI	2.8V	UART1_RI	2.8V	UART1_RI	1.8V	UART1_RI	1.8V/3.3V Default:1.8V
8	GND	-	GND	-	GND	-	GND	-	GND	-	GND	-
9	MICP	-	MICP	-	MICP	-	MICP	-	PCM_DIN	-	RESERVED	-
10	MICN	-	MICN	-	MICN	-	MICN	-	PCM_DOUT	-	BOOT •	-
11	SPK1P	-	SPK1P	-	SPKP	-	SPK1P	-	PCM_CLK	-	AON_GPIO	1.8V/3.3V Default:1.8V
12	SPK1N	-	SPK1N	-	SPKN	-	SPK1N	-	PCM_SYNC	-	WAKEUP	1.1V~1.4V Default:1.3V
13	GND	-	GND	-	GND	-	GND	-	GND	-	GND	GND





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14	SIM1_DET	1.8V	SIM1_DET	1.8V	SIM_DET	2.8V	SIM1_DET	2.8V	GPIO5	1.8V	GPIO1	1.8V/3.3V Default:1.8V
15	SIM1_DATA	1.8V/3.0V	SIM1_DATA	1.8V/3.0V	SIM_DATA	1.8V/3.0V	SIM1_DATA	1.8V/3.0V	SIM_DATA	1.8V	SIM_DATA	1.8V/3.0V
16	SIM1_CLK	1.8V/3.0V	SIM1_CLK	1.8V/3.0V	SIM_CLK	1.8V/3.0V	SIM1_CLK	1.8V/3.0V	SIM_CLK	1.8V	SIM_CLK	1.8V/3.0V
17	SIM1_RST	1.8V/3.0V	SIM1_RST	1.8V/3.0V	SIM_RST	1.8V/3.0V	SIM1_RST	1.8V/3.0V	SIM_RST	1.8V	SIM_RST	1.8V/3.0V
18	SIM1_VDD	1.8V/3.0V	SIM1_VDD	1.8V/3.0V	SIM_VDD	1.8V/3.0V	SIM1_VDD	1.8V/3.0V	SIM_VDD	1.8V	SIM_VDD	1.8V/3.0V
19	GND	-	GND	-	GND	-	GND	-	GND	-	GND	-
20	NC	-	NC	-	BT_ANT	-	BT_ANT	-	USB_BOOT★		IO_1833_SEL	1.1V
21	GND	-	GND	-	GND	-	GND	-	GND	-	GND	GND
22	UART3_TXD	1.8V	UART3_TXD	1.8V	UART2_TXD	2.8V	UART2_TXD	2.8V	UART2_TXD	1.8V	UART0_TXD	1.8V/3.3V Default:1.8V
23	UART3_RXD	1.8V	UART3_RXD	1.8V	UART2_RXD	2.8V	UART2_RXD	2.8V	UART2_RXD	1.8V	UART0_RXD	1.8V/3.3V Default:1.8V
24	USB_VBUS	3.0~5.2V	USB_VBUS	3.0~5.2V	USB_VBUS	4.3~7.0V	USB_VBUS	4.3~7.0V	USB_VBUS	3.5V~5.25V	RESERVED	-
25	USB_DP	-	USB_DP	-	USB_DP	-	USB_DP	-	USB_DP	-	RESERVED	-
26	USB_DM	-	USB_DM	-	USB_DN	-	USB_DN	-	USB_DM	-	RESERVED	-
27	GND	-	GND	-	GND	-	GND	-	GND	-	GND	-
28	NC	-	NC	-	VRTC	1.2~3.0V	VRTC	1.2~3.0V	NC	-	RESET	1.1V~1.4V Default:1.3V
29	NC	-	NC	-	RF_SYNC	2.8V	RF_SYNC	2.8V	NC	-	GPIO2	1.8V/3.3V Default:1.8V
30	GND	-	GND	-	GND	-	GND	-	GND	-	GND	-
31	GND	-	GND	-	GND	-	GND	-	GND	-	GND	-
32	RF_ANT	-	RF_ANT	-	GSM_ANT	-	GSM_ANT	-	RF_ANT	-	ANT	-



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33	GND	-	GND	-	GND	-	GND	-	GND	-	GND	-
34	VBAT	3.4~4.2V	VBAT	3.4~4.2V	VBAT	3.4~4.4V	GPS_VBAT	2.9~4.4V	VBAT	2.7V~4.8V	VBAT	2.2V~4.3V
35	VBAT	3.4~4.2V	VBAT	3.4~4.2V	VBAT	3.4~4.4V	GSM_VBAT	3.4~4.4V	VBAT	2.7V~4.8V	VBAT	2.2V~4.3V
36	GND	-	GND	-	GND	-	GND	-	GND	-	GND	-
37	GND	-	GND	-	GND	-	GND	-	GND	-	GND	-
38	ADC	0-1.8V	ADC	0-1.8V	ADC	0-2.8V	ADC	0-2.8V	ADC	0V~1.875V	ADC	0V~3.3V
39	PWRKEY	VBAT	PWRKEY	VBAT	PWRKEY	VBAT	PWRKEY	VBAT	PWRKEY	VBAT	WAKEUP	1.1V~1.4V Default:1.3V
40	VDD_EXT	1.8V	VDD_EXT	1.8V	VDD_EXT	2.8V	VDD_EXT	2.8V	VDD_EXT	1.8V	VDD_EXT	1.8V/3.3V Default:1.8V
41	NETLIGHT	1.8V	NETLIGHT	1.8V	NETLIGHT	2.8V	NETLIGHT	2.8V	NETLIGHT	1.8V	NETLIGHT	1.8V/3.3V Default:1.8V
42	STATUS	1.8V	STATUS	1.8V	STATUS	2.8V	STATUS	2.8V	STATUS	1.8V	STATUS	1.8V/3.3V Default:1.8V
43	NC	-	NC	-			SPK2N	-	ANT_CONTR OL1	-		
44	NC	-	NC	-			SPK2P	-	ANT_CONTR OL0	-		
45	GND	-	GND	-			GND	-	GND	-		
46	NC	-	MCCA3	-			MCCA3	-	NC	-		
47	NC	-	MCCA2	-			MCCA2	-	NC	-		
48	NC	-	MCCA1	-			MCCA1	-	SPI_CS	-		
49	NC	-	MCCA0	-			MCCA0	-	SPI_MOSI★	-		
50	NC	-	MCCLK	-			MCKK	-	SPI_CLK	-		
51	NC	-	MCCM0	-			MCCM0	-	SPI_MISO	-		
52	SIM2_DET	1.8V/3.0V	SIM2_DET	1.8V/3.0V			SIM2_DET	-	NC	-		



### A7682E\_A7683E\_SIM800C\_SIM868\_SIM7080G\_SIM7022 Compatible Design

53	SIM2_DATA	1.8V/3.0V	SIM2_DATA	1.8V/3.0V			SIM2_DATA	-	NC	-		
54	SIM2_CLK	1.8V/3.0V	SIM2_CLK	1.8V/3.0V			SIM2_CLK	-	NC	-		
55	SIM2_RST	1.8V/3.0V	SIM2_RST	1.8V/3.0V			SIM2_RST	-	NC	-		
56	SIM2_VDD	1.8V/3.0V	SIM2_VDD	1.8V/3.0V			SIM2_VDD	-	NC	-		
57	GPIO1	1.8V	GPIO1	1.8V			GPIO1	-	GPIO1	1.8V		
58	GPIO2	1.8V	GPIO2	1.8V			GPIO2	-	GPIO2	1.8V		
59	NC	-	NC	-			GNSS_EN	-	GPIO3	1.8V		
60	NC	-	NC	-			1PPS	-	GPIO4	1.8V		
61	NC	-	NC	-			GPS_TXD	-	UART3_TXD	1.8V		
62	NC	-	NC	-			GPS_RXD	-	UART3_RXD	1.8V		
63	GND	-	GND	-			GND	-	GND	-		
64	SDA	-	I2C_SDA	-			SDA	-	I2C_SDA	-		
65	SCL	-	I2C_SCL	-			SCL	-	I2C_SCL	-		
66	GND	-	GND	-			GND	-	GND	-		
67	GND	-	GND	-			GND	-	GND	-		
68	NC	-	NC	-			GPS_ANT	-	GNSS_ANT	-		
69	GND	-	GND	-			GND	-	GND	-		
70	GND	-	GND	-			GND	-	GND	-		
71	GND	-	GND	-			GND	-	GND	-		
72	GND	-	GND	-			GND	-	GND	-		
73	GND	-	GND	-			GND	-	GND	-		
74	GND	-	GND	-			GND	-	GND	-		
75	GND	-	GND	-			GND	-	GND	-		
76	GND	-	GND	-			GND	-	GND	-		

77	GND	-	GND	-			GND	-	GND	-		
78	GPIO3	1.8V	GPIO3	1.8V								
79	GPIO4	1.8V	GPIO4	1.8V								
80	GPIO5	1.8V	GPIO5	1.8V								
81	GPIO6	1.8V	GPIO6	1.8V								
82	BOOT_CFG●	1.8V	BOOT_CFG●	1.8V								
83	RESET	VBAT	RESET	VBAT								
84	DBG_RXD	1.8V	DBG_RXD	1.8V								
85	DBG_TXD	1.8V	DBG_TXD	1.8V								

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**NOTE**

1. Bold lines indicate different pin functions.
2. The PIN Marked "●" cannot be pulled down before the module powered up. Otherwise, it will affect the normal start-up of the module.
3. The PIN Marked "★" cannot be pulled up before the module powered up. Otherwise, it will affect the normal start-up of the module.
4. SIM7080G module only supports 1.8V SIM card (3V SIM card is not supported).
5. IO\_1833\_SEL is the GPIO level selection control pin of SIM7022. When this pin is floating, all GPIO levels of the module are 1.8V and the output voltage of VDD\_EXT is 1.8V; When this pin is connected to GND, all GPIO levels of the module are 3.3V and the output voltage of VDD\_EXT is 3.3V.
6. GPIO3 and GPIO4 of A7683E can be used as ANT tuner control (GRFC).
7. For details information, please refer to each HD guide.

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### 2.3 Top and Bottom View

The following figures show the top and bottom view of A7682E, A7683E, SIM800C, SIM868, SIM7080G and SIM7022.



Figure 2: A7682E/A7683E/SIM800C/SIM868/SIM7080G/SIM7022 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.

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## 2.4 Recommended PCB footprint outline

The recommended PCB footprint outline for A7682E, A7683E, SIM800C, SIM868, SIM7080G and SIM7022 is shown as follows.

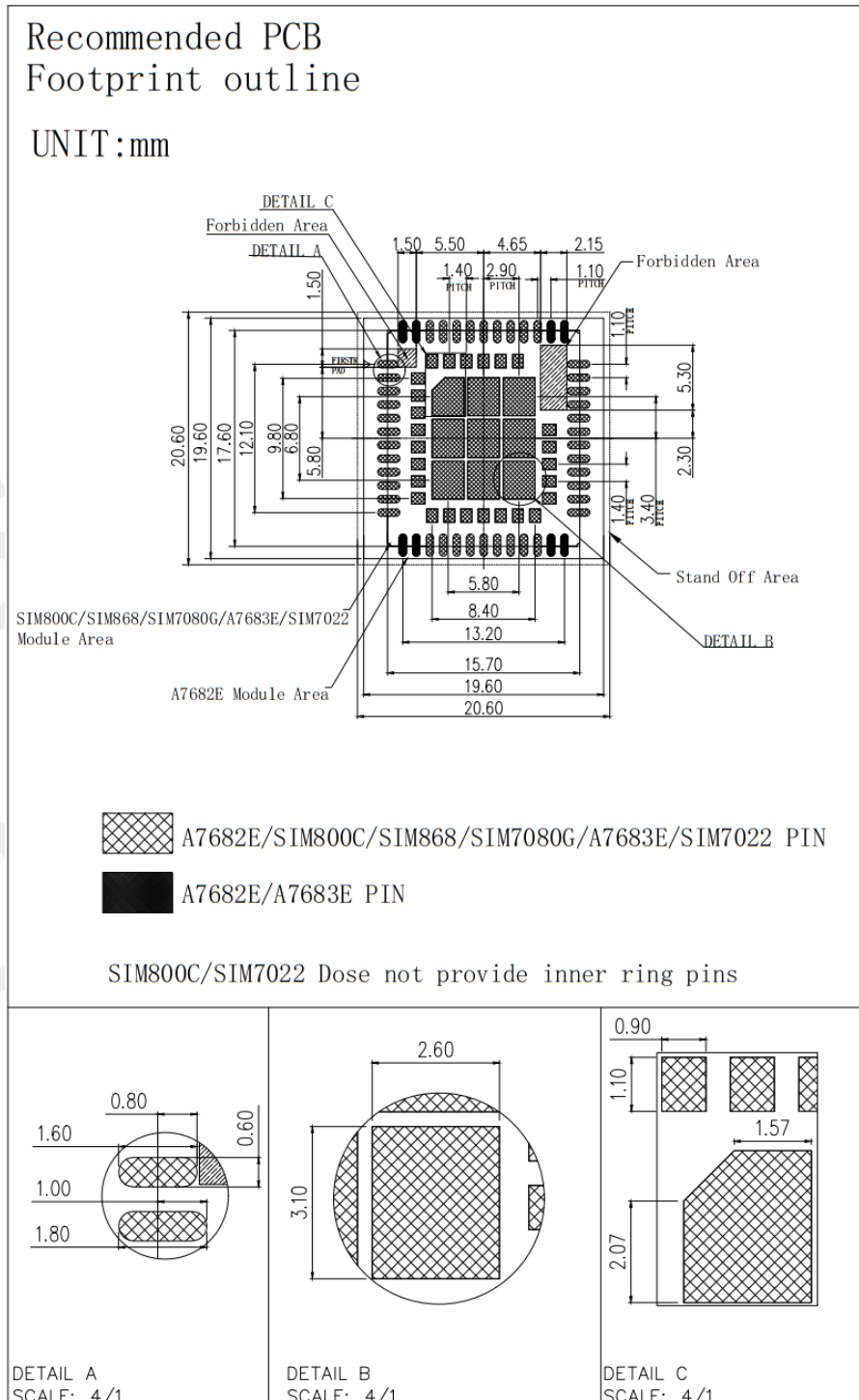


Figure 3: Recommended PCB footprint outline (Unit: mm)



**NOTE**

1. The A7682E and A7683E module has 8 more outer ring pins (78, 79, 80, 81, 82, 83, 84 and 85).
2. For more information, please refer to each HD guide.
3. If you encounter production technical doubts when using different models of modules that need to be compatible, please confirm with our engineering and technical personnel in a timely manner.

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## 2.5 Recommended SMT Stencil

The recommended SMT Stencil of A7682E, A7683E, SIM868 and SIM7080G is shown as follows.

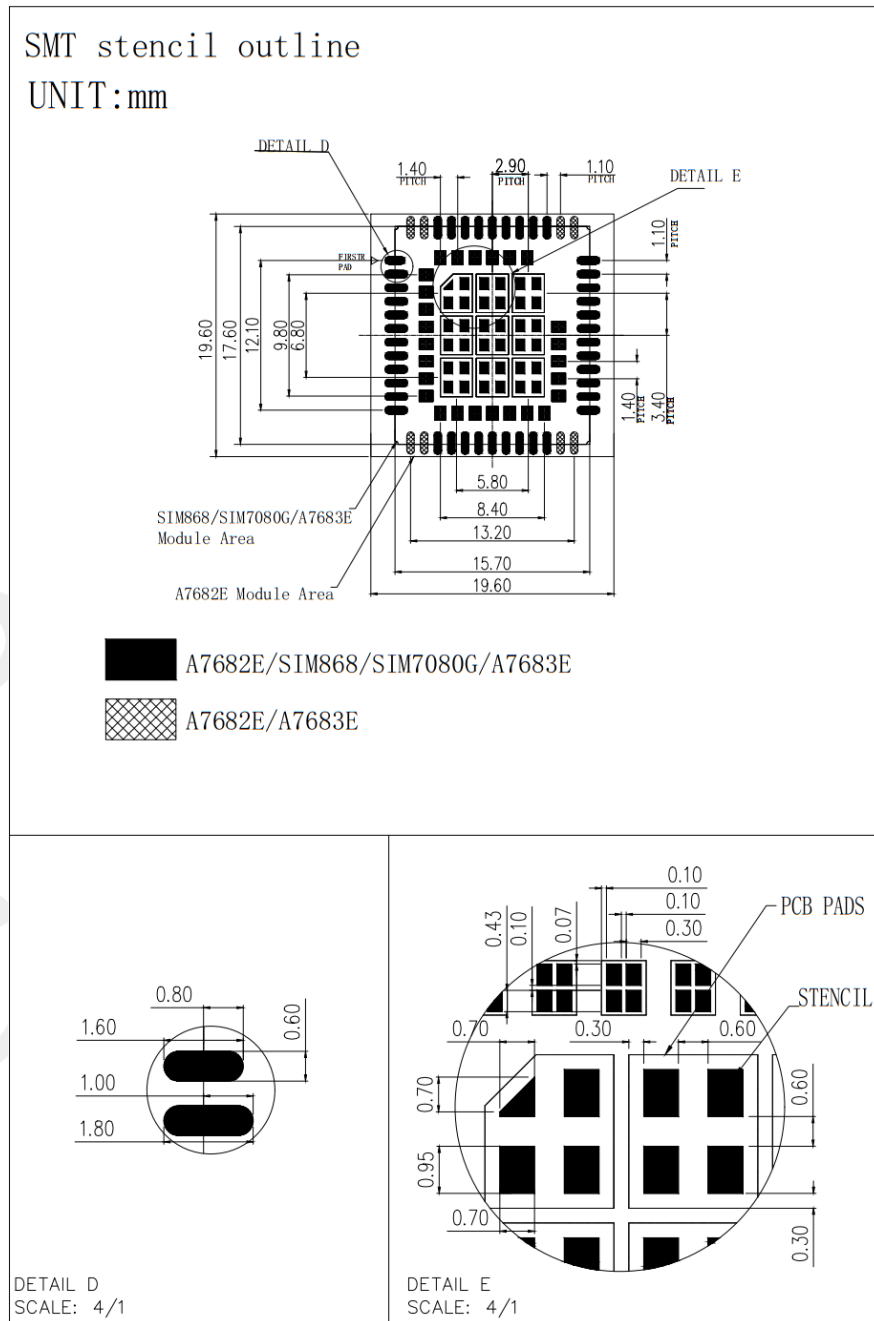


Figure 4: Recommended SMT stencil of A7682E, A7682E, SIM7080G and A7683E (Unit: mm)

The recommended SMT Stencil of SIM800C and SIM7022 is shown as follows.

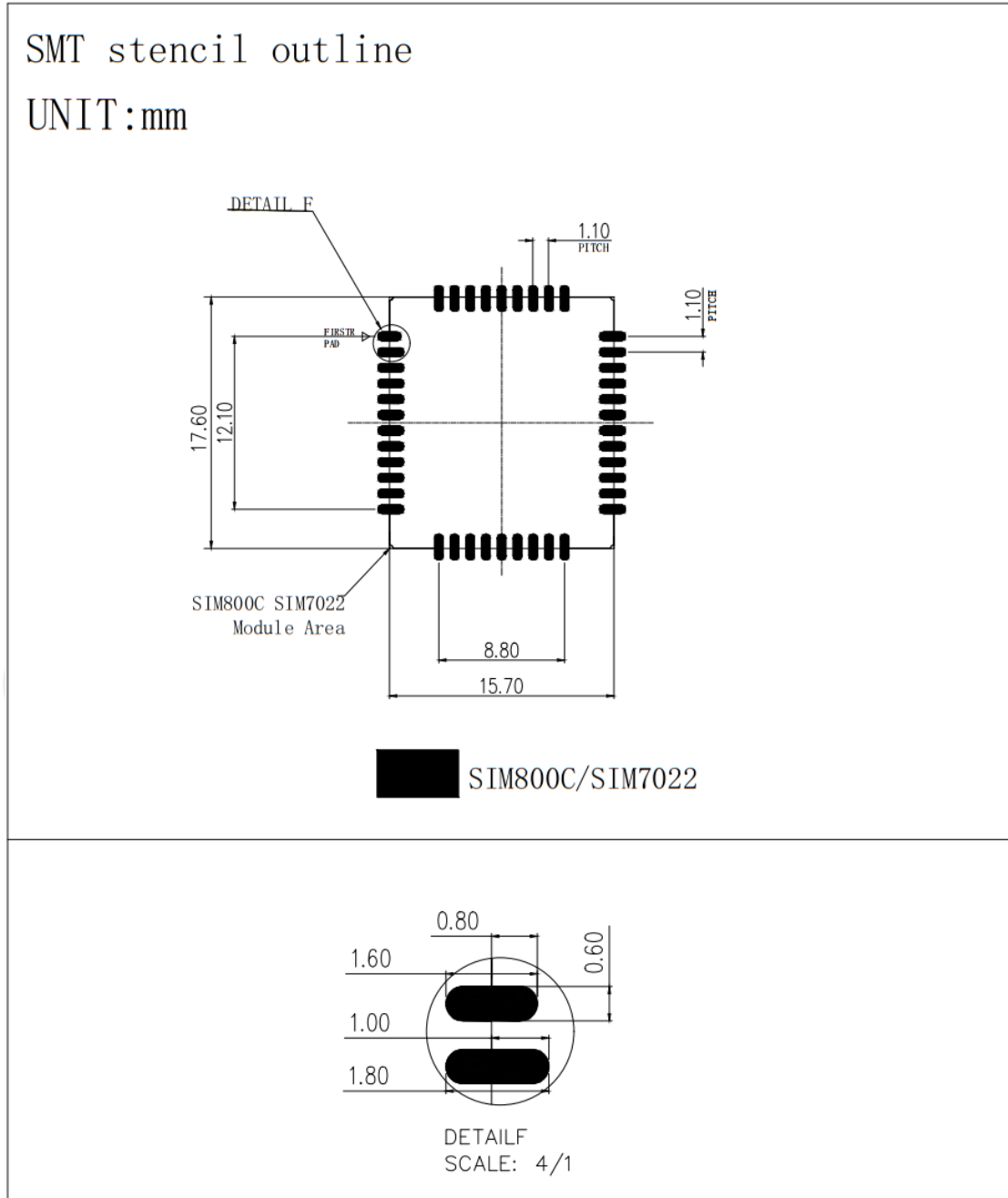


Figure 5: Recommended SMT stencil of SIM800C and SIM7022 (Unit: mm)

## 3 Hardware Reference Design

Customers using A7682E, A7683E, SIM800C, SIM868, SIM7080G and SIM7022 interface can refer to the design in this chapter.

### 3.1 Power Supply

The following table shows the power supply voltage range of A7682E, A7683E, SIM800C, SIM868, SIM7080G and SIM7022:

Table 5: Module recommended supply voltage comparison

Modules	Power Pin	Symbol Description	Min	Typical	Max	Unit
A7682E	VBAT	Power supply range	3.4	3.8	4.2	V
A7683E	VBAT	Power supply range	3.4	3.8	4.2	V
SIM800C	VBAT	Power supply range	3.4	4.0	4.4	V
SIM868	GSM_VBAT	Power supply range	3.4	4.0	4.4	V
	GPS_VBAT	Power supply range	2.9	4.0	4.4	V
SIM7080G	VBAT	Power supply range	2.7	3.8	4.8	V
SIM7022	VBAT	Power supply range	2.2	3.3	4.3	V

For better RF performance and system stability, it is suggested to position four ceramic capacitors (10pF/33pF/0.1uF/1uF) near VBAT. Additionally, it is advised to have a VBAT layout routing width of at least 2mm from the power supply on the PCB to the module. Please refer to the recommended design layout below.

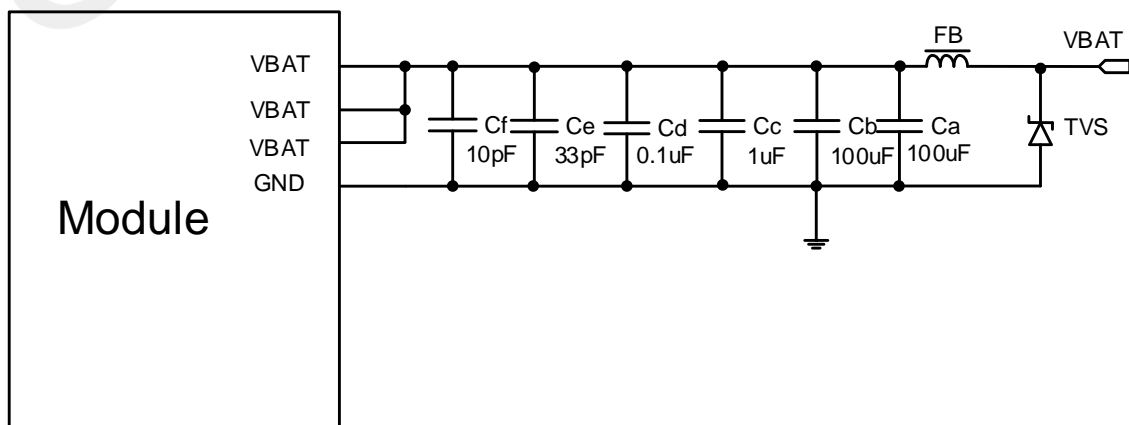


Figure 6: Power supply application circuit

### 3.1.1 A7682E

When the A7682E module is at the maximum power in GSM TX mode, the peak current can reach 2A (peak current), which results in a significant voltage drop on VBAT. To ensure that the voltage drop is less than 300mV, the power supply capacity of the external power supply must be no less than 2A.

In the customer's design, ensure that the voltage on the VBAT pins will never drop below 3.4V, even when the module current consumption reaches 2A. If the voltage drops below 3.4V, the RF performance of the module will be affected. Selecting an LDO or DC-DC chip with an enable pin is recommended, and the MCU controls the enable pin.

The following figure shows the VBAT voltage drop.

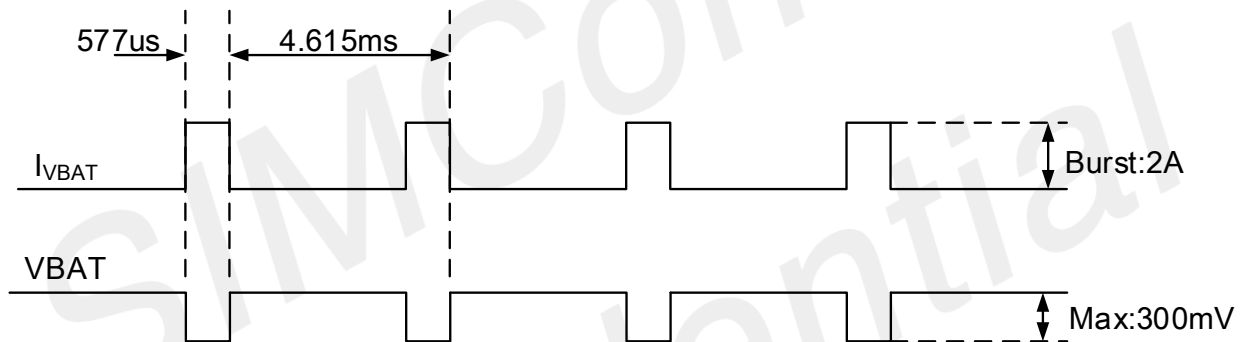


Figure 7: Burst current cause VBAT drop

### 3.1.2 A7683E

When the A7683E is transmitting at maximum power in LTE mode, the continuous current can reach up to 700mA, resulting in a significant voltage drop on the VBAT. In order to ensure that the voltage drop is less than 300mV, the power supply capacity of the external power supply must be no less than 700mA.

### 3.1.3 SIM800C/SIM868

SIM800C/SIM868 during 2G transmission, the instantaneous current is as high as 2A, and the battery terminal burst current, and voltage drop model are shown in the figure below:

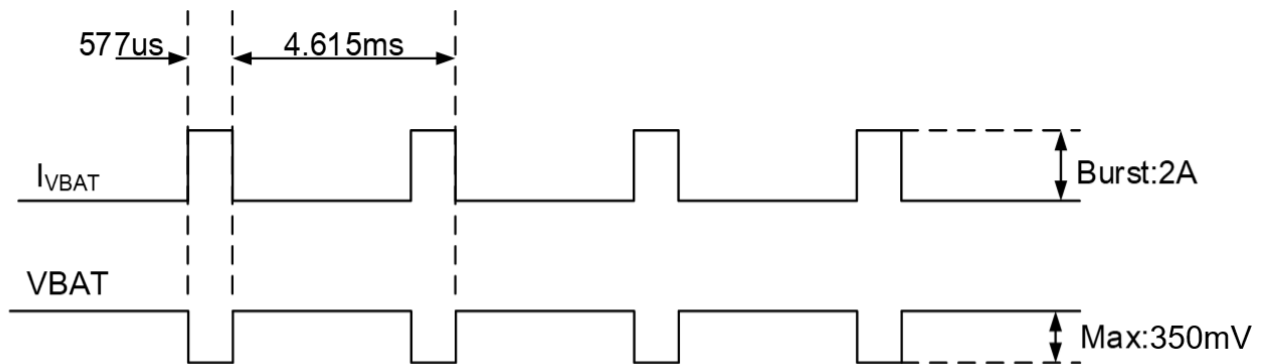


Figure 8: Burst transmission power requirements (SIM800C/SIM868)

When designing the power supply in customers' applications, pay special attention to power losses. Ensure the input voltage never drops below 3.0V, even when current consumption rises to 2A in the transmit burst. If the power voltage drops below 3.0V, the module may be shut down automatically. The PCB traces from the VBAT pins to the power supply must be wide enough (at least 60mil) to decrease voltage drops in the transmit burst. The power IC and the bypass capacitor should be placed on the module as close as possible.

### 3.1.4 SIM7080G

On VBAT pads, when the module works on CAT-M1 or NB-IoT mode, the ripple current is up to 0.5A typically. For steady voltage, the power supply capability must be up to 0.5A. In the customer's design, special attention must be paid to the design of the power supply to ensure that the drop of VBAT is not less than 2.5V even when the module's current consumption reaches the instantaneous maximum. If the voltage drop is less than 2.5V, the module may shut down due to the low voltage.

### 3.1.5 SIM7022

On VBAT pads, when the module works on NB-IoT mode, the ripple current is up to 1A typically. For steady voltage, the power supply capability must be up to 1A. In the customer's design, special attention must be paid to the design of the power supply to ensure that the drop of VBAT is not less than 2.2V even when the module's current consumption reaches the instantaneous maximum. If the voltage drop is less than 2.2V, the module may shut down due to the low voltage.

**NOTE**

1. The peak current of A7682E is 2A, and the power supply voltage cannot be lower than 3.4V.
2. The peak current of A7683E is 700mA, and the power supply voltage cannot be lower than 3.4V.
3. The peak current of SIM800C/SIM868 is 2A, and the power supply voltage cannot be lower than 3V.
4. The peak current of SIM7080G is 0.5A, and the power supply voltage cannot be lower than 2.5V. Customers should pay special attention to the choice of power chip.
5. The peak current of SIM7080G is 1A, and the power supply voltage cannot be lower than 2.2V. Customers should pay special attention to the choice of power chip.
6. For more information, please refer to each HD guide.

### 3.2 Power on/off and WAKEUP Circuit

The 39 pin of A7682E, A7683E, SIM800C, SIM868 and SIM7080G is PWRKEY, but it is WAKEUP for SIM7022. A7682E, A7683E, SIM800C, SIM868 and SIM7080G can be turned on by driving the PWRKEY pin to a low level for a certain time. However, SIM7022 does not have PWRKEY function, the module is automatically turned on after power on. The SIM7022 can be wakeup by driving the 39 pin to a low level. Using an open drain or collector driver is recommended to control the PWRKEY or WAKEUP. A reference circuit is shown below.

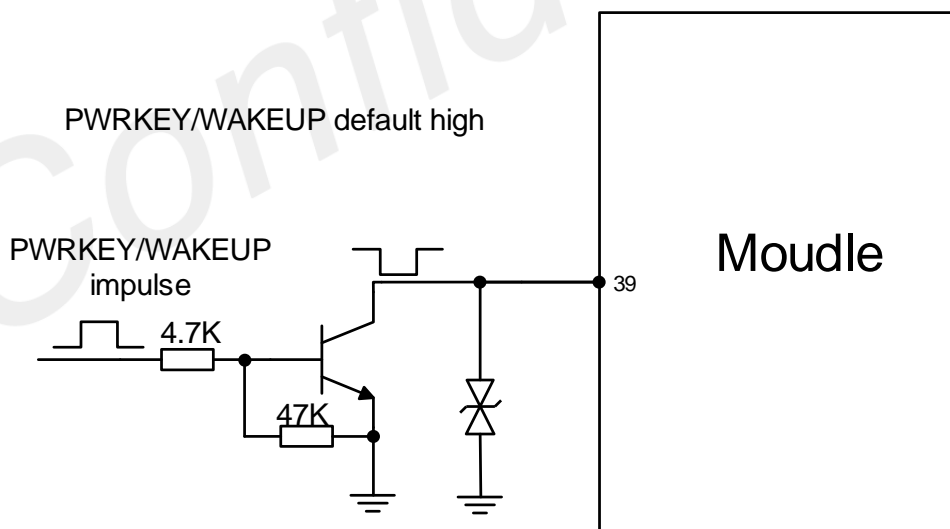


Figure 9: Power on/off and wakeup reference circuit

The module has the following shutdown methods:

- Power off by pulling the PWRKEY pin down to a low level
- Power off Module by AT command.

- Over-temperature or under-temperature automatic power off.
- Over-voltage or under-voltage automatic power off, 'AT+CPMVT' set voltage range (A7682E and A7683E).

Customers are strongly recommended to use PWRKEY or AT command to shut down, 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.

#### NOTE

1. The AT command to power off the module  
SIM800C/SIM868/SIM7080G: AT+CPOWD=1  
A7682E/A7683E: AT+CPOF
2. The customer's circuit design must have the function that the master can control the power on/off of the module.
3. When the temperature exceeds the range of  $-30 \sim +80^{\circ}\text{C}$ , A7682E/A7683E will report warning information through the AT port. When the temperature exceeds the range of  $-40 \sim +85^{\circ}\text{C}$ , A7682E/A7683E will shut down automatically. For a detailed description of 'AT+ CPOF' and 'AT+ CPMVT', please refer to each AT command manual.

### 3.3 Reset Circuit

The pin 83 of A7682E/A7683E is RESET pin but the pin 28 of SIM7022 is RESET pin. These reset circuit is as follows: the customers reset the module by pulling down the RESET pin.

Pay attention to that PIN 28 of SIM800C/SIM868 is VRTC function. Current input for RTC when the VBAT is not supplied for the system. Current output for backup battery when the VBAT power supply is in present and the backup battery is in low voltage state. The RTC power supply of module can be provided by an external capacitor or a battery (non-chargeable or rechargeable) through the VRTC. The following figures show various reference circuits for RTC back up.

The PWRKEY pin of SIM800C/SIM868/SIM7080G has a reset function. The module will reset the system when PWRKEY is pulled down for a certain period. Therefore, connecting PWRKEY to GND directly or to GND through a 0R resistor is not recommended when designing external circuits.

The recommended circuit of the pin 83 (A7682E/A7683E) is as follows:



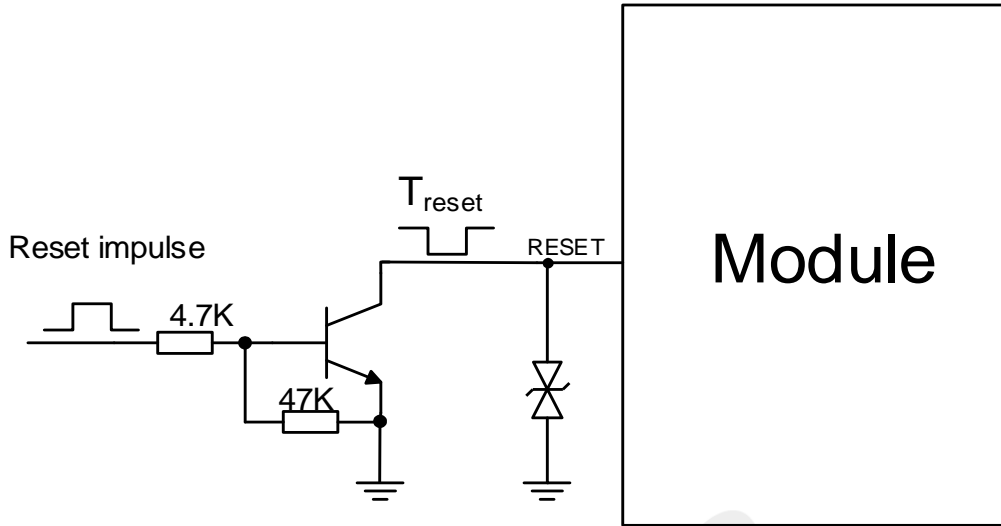


Figure 10: A7682E/A7683E Reset reference circuit

The recommended circuit of the pin 28 (SIM800C/SIM868/SIM7022) is as follows:

- External capacitor backup

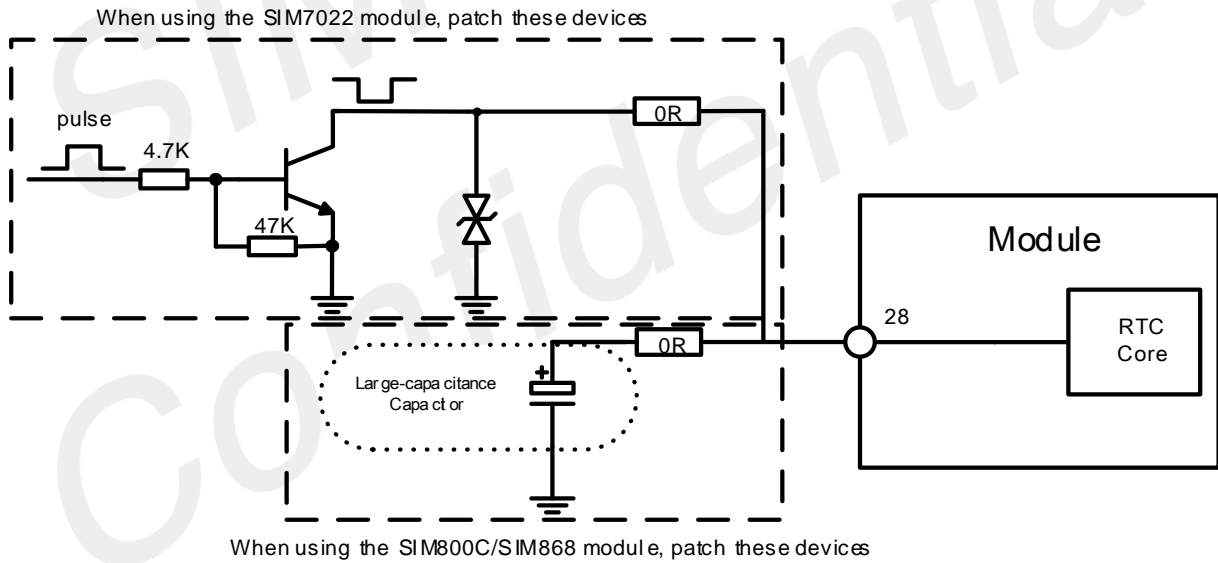


Figure 11: SIM800C/SIM868/SIM7022 PIN 28 reference circuits (RTC supply from capacitor)

- External capacitor backup

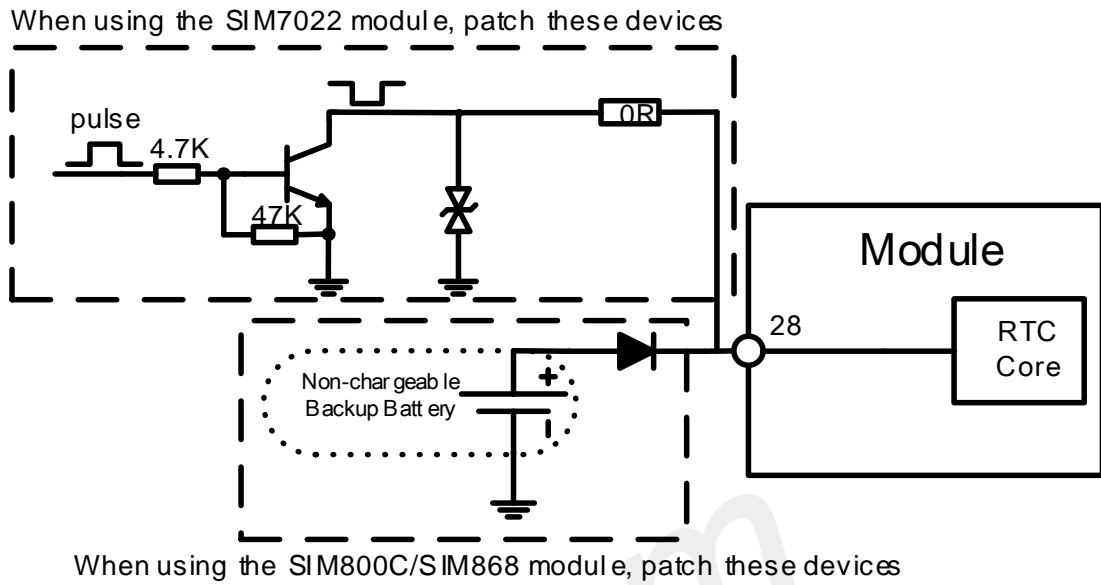


Figure 12: SIM800C/SIM868/SIM7022 PIN 28 reference circuits (non-chargeable battery)

● External capacitor backup

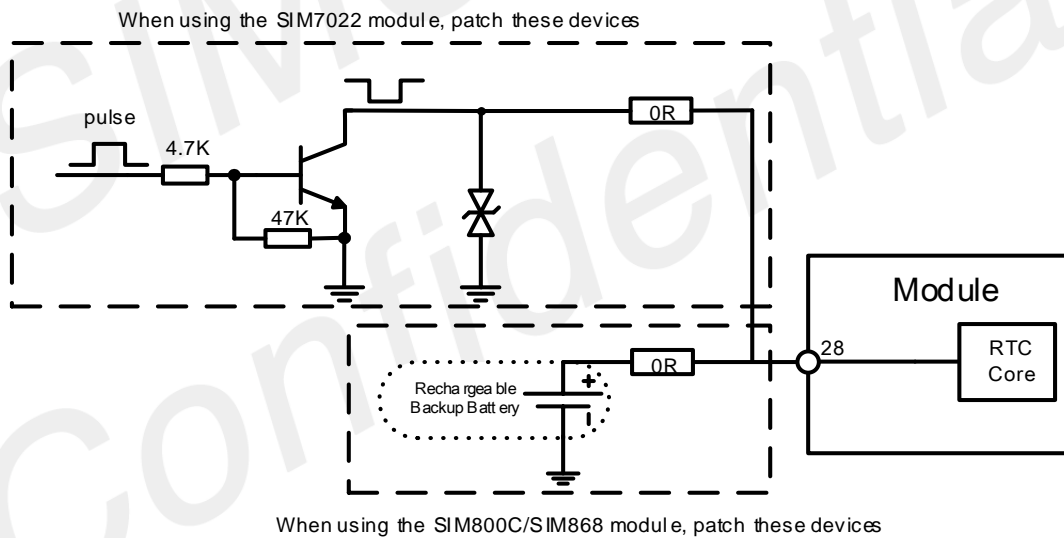


Figure 13: SIM800C/SIM868/SIM7022 PIN 28 reference circuits (rechargeable battery)

**NOTE**

1. When PWRKEY is pulled down ( $1.5S < T < 2S$ ), SIM800C/SIM868 module will reset. When PWRKEY is pulled down ( $T > 12.6S$ ), the SIM7080G module will reset.
2. For more information, please refer to each HD guide.

### 3.4 USB Interface

A7682E, A7683E, SIM800C, SIM868 and SIM7080G module provide a USB2.0 interface, supporting high-speed 480Mbps and full-speed mode 12Mbps, and do not support USB charging function; A7682E/A7683E/SIM7080G 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, reserving a 0R resistor for switching external test points during design, as shown in the figure below.

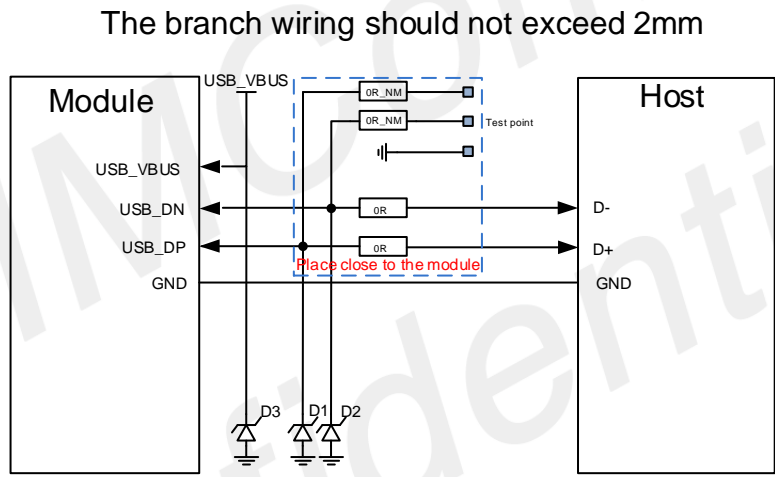


Figure 14: USB reference circuit

Customers should 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 AZ9707-01F. D+/D- trace impedance is controlled according to 90Ω and covered with ground; D1/D2 select TVS tube with capacitance value <1pf, and they should be placed near the USB connector or test point, recommended models ESD73131CZ and ESD9L5.0ST5G.

Table 6: TVS for USB part number list

Manufacturer	Part Number	V <sub>RWM</sub>	V <sub>Cmax</sub>	C <sub>Jmax</sub>	Package
WILL	ESD73131CZ-2/TR	5V	6.5V	0.45pF	DWN0603-2L
ON	ESD9L5.0ST5G	5V	9.8V	0.9pF	SOD-923
NXP	PESD5V0F1BSF	5V	10V	0.3pF	DSN0603-2
AMAZING	AZ9707-01F	7V	12.5V	950pF	DFN1610

### 3.5 UART Interface

A7682E/A7683E provides 3 serial ports, one main full-function communication serial port UART (RTS/CTS flow control function debugging), one ordinary two-wire serial port, one print LOG serial port, and the module is a DCE (Data Communication Equipment) device.

SIM800C/SIM868 provides two sets of serial ports: one main full-function communication serial port UART1 (support RTS/CTS flow control function debugging) and one set of ordinary serial ports, which can be used for external devices. The module is DCE (Data Communication Equipment).

SIM7080G can provide 3 channel serial ports, one main full-function communication serial port, one print LOG serial port, and one channel 2-wire serial port UART3. The default function of UART3 after power-on is GPIO, It can be configured as a UART function but cannot be used for AT command communication. It is only used as UART in DAM (Downloadable Application Module) application when secondary development. It can also be configured as a GNSS NMEA data output port.

SIM7022 provides two sets of serial ports: one main full-function communication serial port UART1 (support RTS/CTS flow control function debugging) and one set of DEBUG serial ports, which can be used for view the log information through the debug serial port for software debugging. The default baud rate of DBG\_UART is 3 Mbps.

Below are the reference circuits.

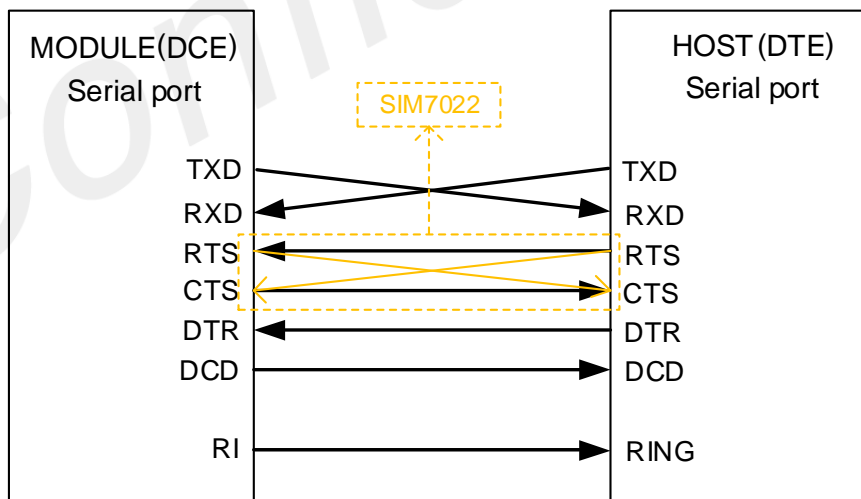


Figure 15: UART Full modem

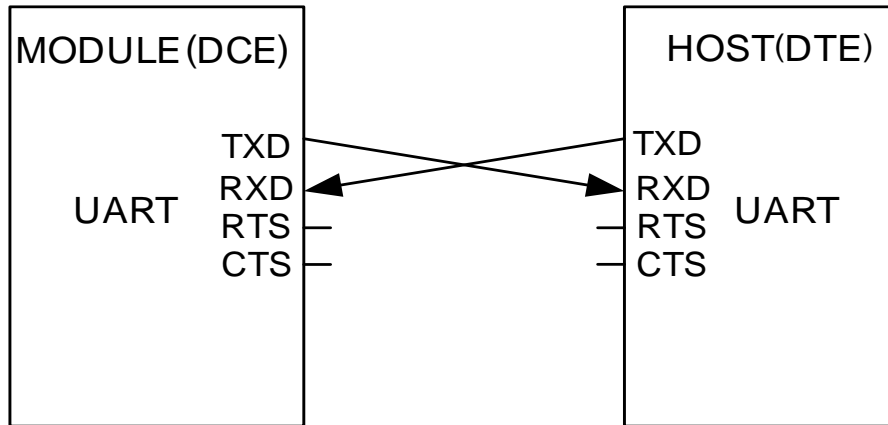


Figure 16: UART Null modem

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.

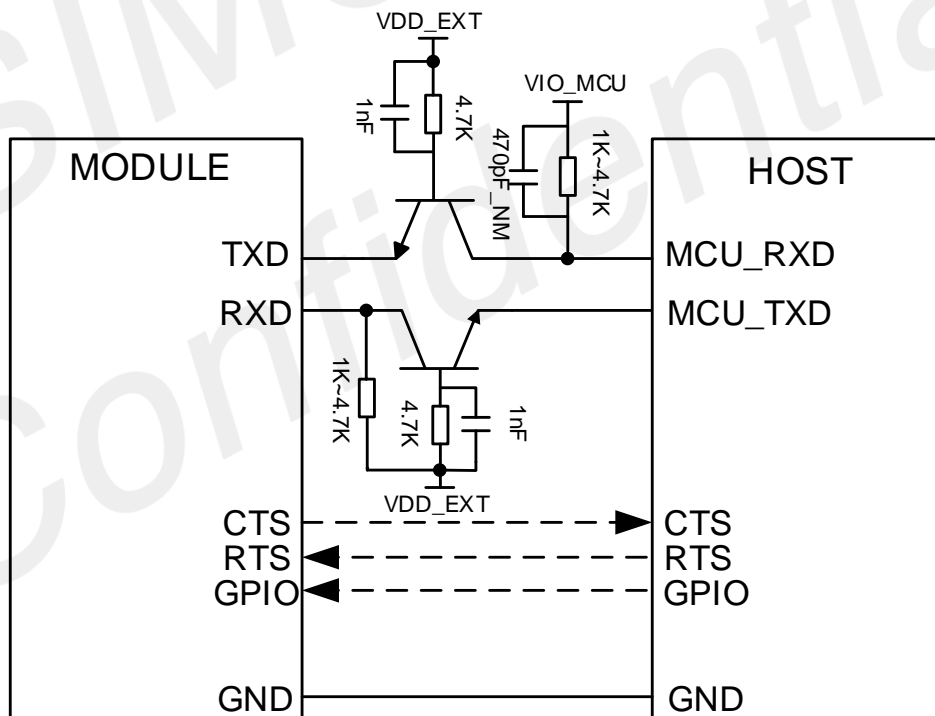


Figure 17: Triode level conversion circuit

**NOTE**

1. The pin sequence of SIM7022 RTS and CTS is opposite to that of A7682E, and requires a series resistor cross connection.
2. The VDD\_EXT of each project in the diagram is different. For more information, please refer to each HD guide.
3. For more information, please refer to each HD guide.

### 3.6 USIM Interface

A7682E, A7683E, SIM800C, SIM868 and SIM7022 support 1.8V/3.0V (U)SIM card by default and support hot-swappable function; SIM7080G only supports 1.8V SIM card and does not support hot swap function.

The recommended circuit is as follows:

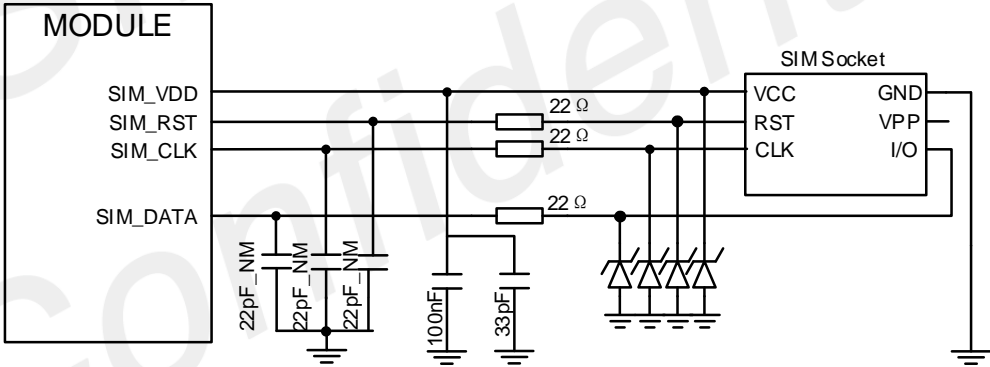


Figure 18: SIM interface reference circuit (6PIN)

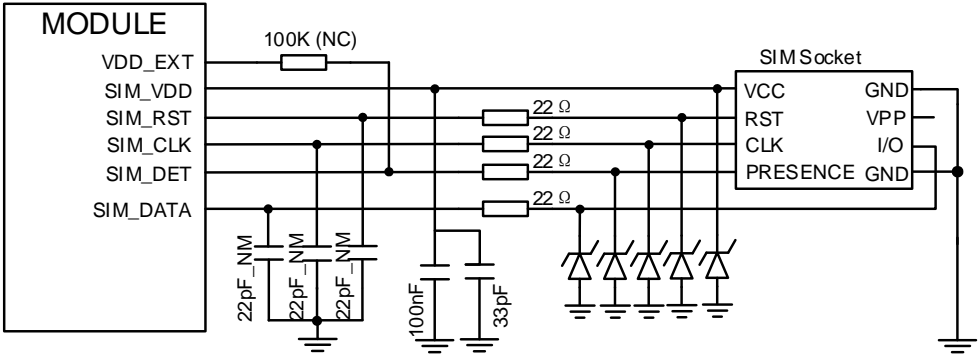


Figure 19: SIM interface reference circuit (8PIN)

Table 7: TVS for USIM socket part number list

Manufacturer	Part Number	$V_{RWM}$	$V_{Cmax}$	$P_{PPmax}$	$C_{jmax}$	Package
WAYON	WS03DTUMS-B	3.3V	8V	35W	0.7pF	DFN0603-2L
WILL	ESD9X5VU-2/TR	5V	8V	72W	0.9pF	DFN1006-2L

**NOTE**

1. A7682E and A7683E support two SIM card interfaces.
2. For more information, please refer to each HD guide.

### 3.7 SD/MMC Interface

A7683E and SIM868 provide SD/MMC interface. The recommended reference design is as follows:

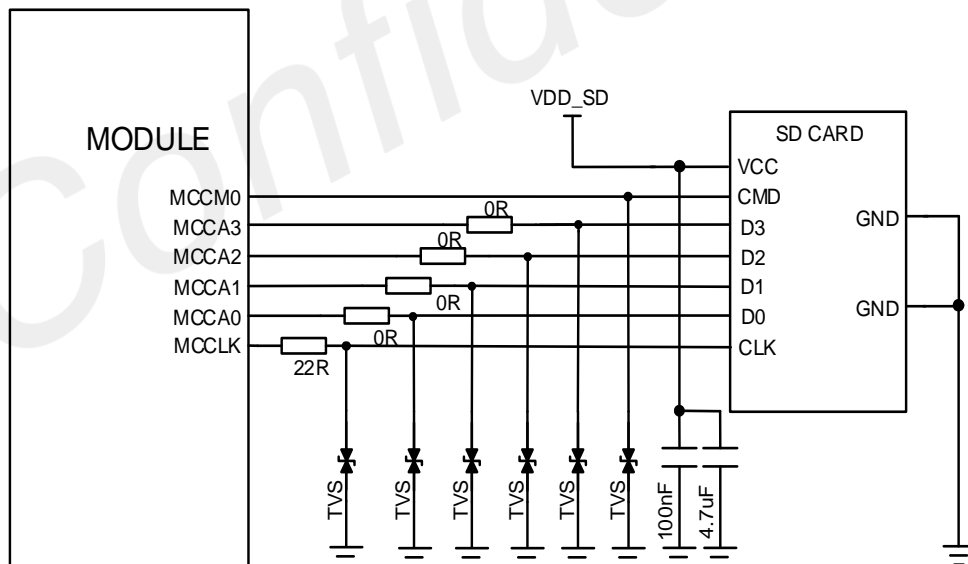


Figure 20: SD/MMC interface recommendation circuit for A7683E/SIM868

### 3.8 Audio Interface

A7682E/A7683E/SIM800C provides 1 channel of analog audio MIC input interface and 1 channel of analog audio SPK output interface. Customers can connect to the external phone handle for voice calls.

SIM868 provides an analog input (MICP; MICN), which could be connected to the electric microphone. The module also provides two analog audio outputs (SPK1P/1N; SPK2P/2N).

SIM7080G module does not support analog audio interface.

Table 8: Audio output characteristics

	A7682E	A7683E	SIM800C	SIM868
Conditions	Mono,32Ω,Differential	Mono,32Ω,Differential	RL=32 Ω receiver	SPK1P/1N:32Ω receiver. SPK2P/2N:8Ω speaker
Maximum power	37mW	37mW	90mW	90mW(32Ω) 1080mW(8Ω)

The following circuit is the reference design.

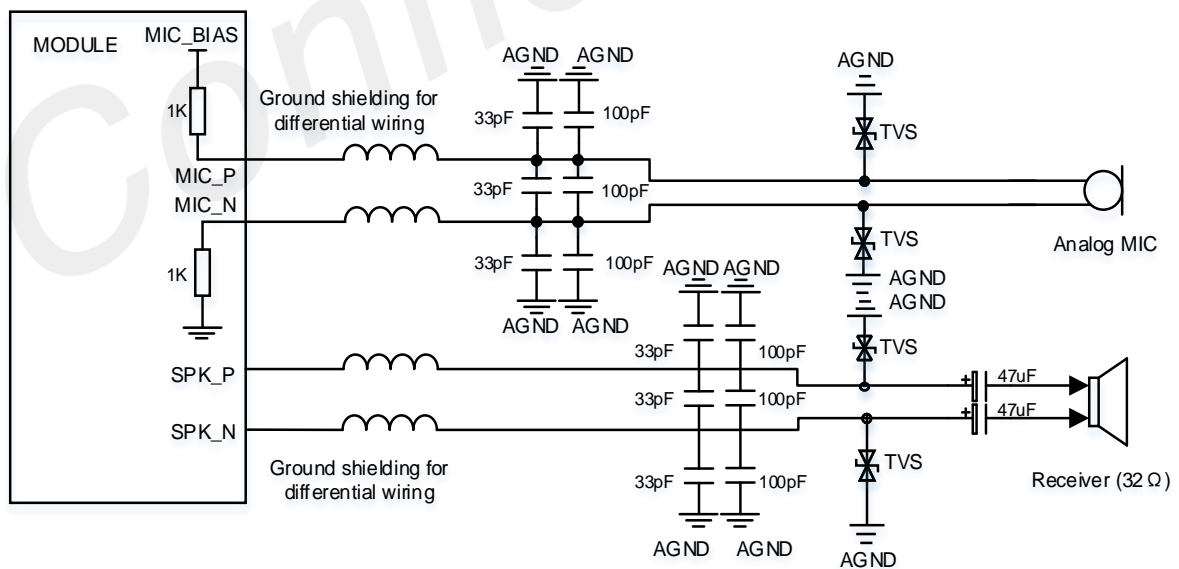


Figure 21: Analog audio recommendation circuit for A7683E/SIM800C/SIM868/SIM7080G



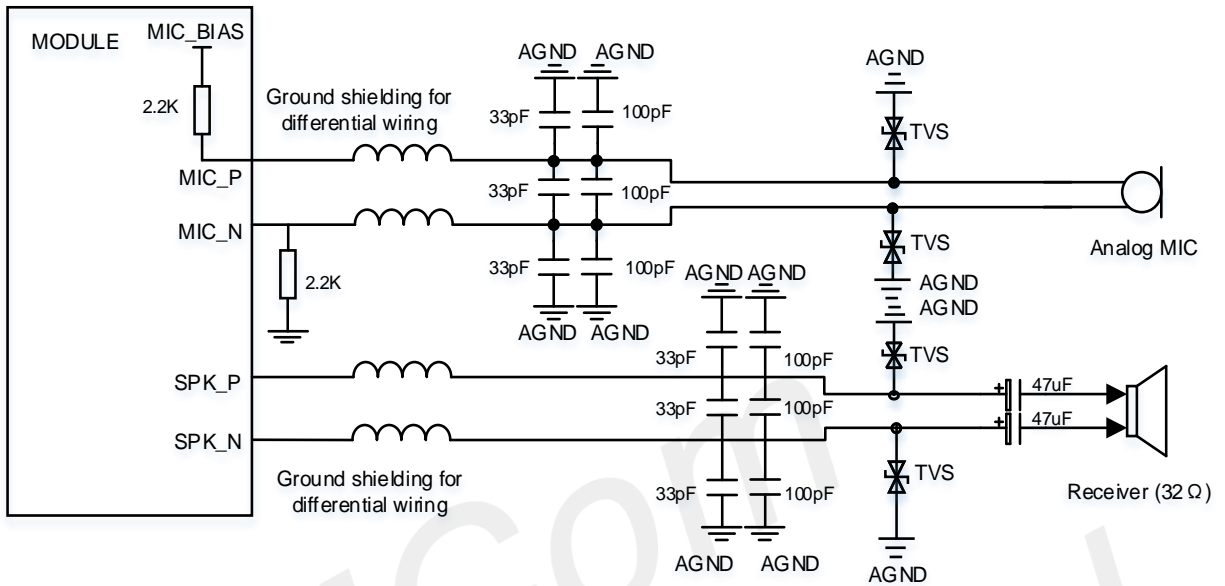


Figure 22: Analog audio recommendation circuit for A7682E

**NOTE**

1. The MICN circuit of A7682E requires an external resistor.
2. For more information, please refer to each HD guide.

### 3.9 Network/STATUS Indication

The NETLIGHT/STATUS pin drives the network status indication LED. The following circuit is the reference design.

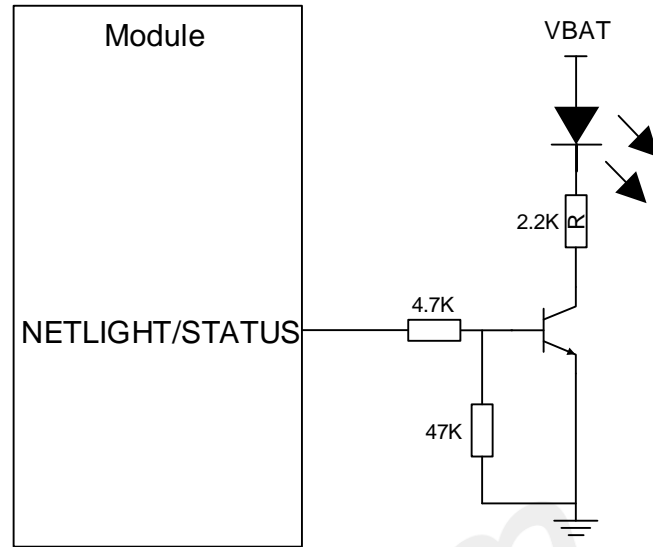


Figure 23: NETLIGHT/STATUS reference circuit

### 3.10 PCM Interface

A7682E/A7683E/SIM800C/SIM868/SIM7022 modules do not support the PCM interface.

SIM7080G provides a PCM interface for the external codec, which can be used in master mode with short sync and 16-bit linear format.

Table 9: PCM Format

Characteristics	Specification
Line Interface Format	Linear(Fixed)
Data length	16bits(Fixed)
PCM Clock/Sync Source	Master Mode(Fixed)
PCM Clock Rate	2048 KHz (Fixed)
PCM Sync Format	Short sync(Fixed)
Data Ordering	MSB

The following circuit is the reference design.

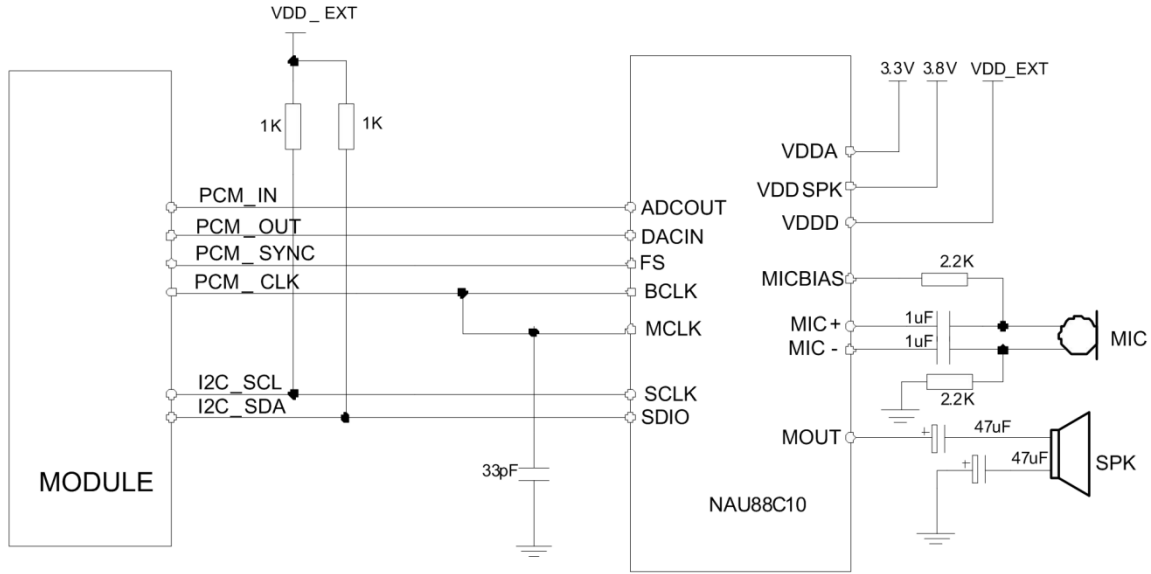


Figure 24: PCM recommended circuit

**NOTE**

For more details about PCM AT commands, please refer to the AT command manual.

### 3.11 ADC Interface

A7682E, A7683E, SIM800C, SIM868, SIM7080G and SIM7022 provide 1 ADC interface.

Table 10: ADC interface parameters

Function	A7682E	A7683E	SIM800C	SIM868	SIM7080G	SIM7022
ADC	9bits 0~1.8V	12bits 0~1.2V	10bits 0~2.8V	10bits 0~2.8V	10bits 0~1.8V	12bits 0~3.3V

### 3.12 RF Interface

The reference circuit of the RF\_ANT connection is shown in the figure below:

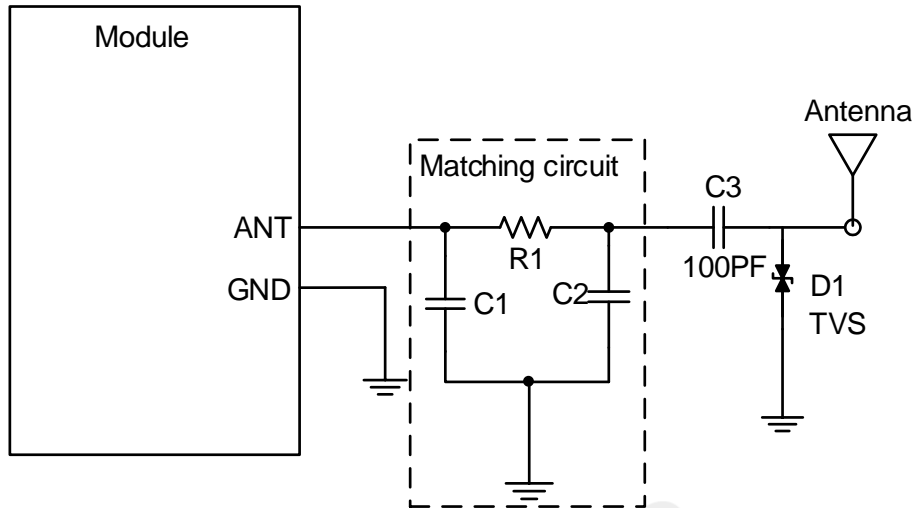


Figure 25: Antenna matching circuit

The component labeled as R1/C1/C2/C3 in the figure above serves as an antenna matching circuit. The values of these components can only be determined after tuning the antenna, a task typically undertaken by the antenna factory. Specifically, R1 should have a 0Ω value, C3 should be set at 100pF, while C1 and C2 are not initially populated.

The component denoted as D1 is a bidirectional ESD protection device, and it is advisable to include it in the protection circuit. The table below presents the recommended part numbers for TVS (Transient Voltage Suppression) devices intended for use with the RF main antenna:

Table 11: Recommended TVS

Package	Part Number	Vender
0201	CE0201S05G01R	SOCAY
0402	PESD0402-03	PRISEMI

## 4 Appendix

### 4.1 Related documents

Table 12: Related documents

SN	Document name	Remark
[1]	A7682E_Hardware Design	A7682E_Hardware Design
[2]	A7683E_Hardware Design	A7683E_Hardware Design
[3]	SIM800C_Hardware_Design	SIM800C_Hardware_Design
[4]	SIM868_Hardware_Design	SIM868_Hardware_Design
[5]	SIM7080G_Hardware Design	SIM7080G_Hardware Design
[6]	SIM7022_Hardware_Design	SIM7022_Hardware_Design

### 4.2 Terms and Abbreviation

Table 13: 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

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