SIM8400
Hardware Design

Smart Module

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Version History

Version	Name	release time	revision description
V1.1	Xi Chen；Jiayu Zhang	2022-12-14	First Edition
V1.2	Xi Chen	2023-02-16	Update the packaging

Contents

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1 Introduction

This document describes in detail the basic functions and main features of the SIM8400 wireless module, hardware interface and usage, structural characteristics, power consumption indicators and electrical characteristics, and guides users to embed the SIM8400 module in the design of various application terminals.

1.1 Product Outline

The SIM8400 Series is the LTE Cat 4 smart module with Liunx system, it adopts Unisoc Dual-core ARM Cortex-A53 as application processor , with frequency up to 1.3GHz and Mali T820 MP1 384MHz . It supports multi-standard multi-media accelerators and advanced audio subsystem,It supports single camera and single screen display, and has high data transfer and multimedia processing capability. With smart module operation system and high performance advantage, the module is ideal for rapid development of multimedia wireless communication products and applications。

The SIM8400 Series highly integrates wireless communication, short distance communication and multiple satellite positioning receiver function. It supports multiple communication modes such as GSM, WCDMA, LTE-FDD and LTE-TDD. It supports GNSS multi-mode satellite positioning and short distance communication including Wi-Fi 802.11 b/g/n and BT4.2.

The SIM8400 Series has abundant interfaces, it can be connected with camera, display screen, audio, sensors and other equipments. It supports multi-dimensional data collection and man-machine interaction. The interfaces including MIPI_DSI/CSI/UART/SPI/I2C/GPIO/USB greatly expand smart module applications, and make the module suitable for smart POS, automotive electronics, smart diagnostics, smart security devices and industry.

The SIM8400 module supports multiple formats and multiple frequency bands. The corresponding frequency bands and formats are as follows:

Table 1 Supported frequency bands

Standard	Frequency bands	Module		
		SIM8400CE	SIM8400EU	SIM8400SA
GSM	850MHz			✓
	900MHz	✓	✓	✓
	1800MHz	✓	✓	✓
WCDMA	B1	✓	✓	✓
	B5	✓	✓	✓
	B8	✓	✓	✓
LTE-FDD	B1	✓	✓	✓
	B3	✓	✓	✓

	B5	✓	✓	✓
	B7		✓	✓
	B8	✓	✓	✓
	B20		✓	
	B28			✓
LTE-TDD	B34	✓		
	B38	✓	✓	✓
	B39	✓		
	B40	✓	✓	✓
	B41	✓	✓	✓
Category	/	CAT4	CAT4	CAT4
GNSS	BEIDOU	✓	✓	✓
	GPS	✓	✓	✓
	GLONASS	✓	✓	✓
WLAN	2.4G 802.11 a/b/g/n	✓	✓	✓
BT	BT 4.2	✓	✓	✓

1.2 Main Feature

Table 2 List of main features of SIM8400 module

characteristic	illustrate
MCU	Dual Core 1.3G- Cortex™ A53
storage	4Gb nand+2Gb LPDDR2
powered by	Voltage range: 3.4V~4.2V
operating system	Linux (Yacto2.5)
TP	support
display	supports QVGA 320*240 Max supports MIPI 800*480 Max
Camera	Maximum support 2M pixels
button	Support, 3*3 array, others can be expanded by GPIO interrupt response
interface form	LCC+LGA

characteristic	illustrate
Band configuration	- LTE-TDD: Band 34/ 38/39/40/41 - LTE-FDD : Band 1/3/5/7/8/20/28 - WCDMA: Band 1/5/8 - GSM: 850/900/1800
Wi-Fi/WAPI	- Frequency band: 2.4GHz - Protocol: 802.11 a/b/g/n - Encryption method: WEP,WPA -TKIP,AES,WPA2,WAPI,WPS2.0, EAP- sim, Hotspot 2.0 - Support WiFi /BT/LTE coexistence - RF performance: 11b power 16dBm, EVM ≤35% 11g power 15dBm, EVM < -25dB 11n power 15dBm, EVM < -28dB
Bluetooth	- Support V2.1+EDR - Support V4.2 low power consumption - Support V2.1 and BLE coexistence
GNSS	- Support GPS L1/BDS B1/GLONASS G1/SBAS - Support GPS only; BDS only;GPS+BDS;GPS+GLONASS - Support QZSS/SBAS - Supports up to 64 channels
Antenna interface	- LTE-TDD/FDD/WCDMA/GSM master set - LTE-TDD/FDD/WCDMA diversity - WiFi /BT - GNSS
basic communication services	Voice/SMS/Phonebook
audio codec	- Support MP3/AAC/AAC+/AMR-NB/AMR-WB/PCM/ADPCM decoding - Support MP3/AMR/ACC format recording codec
SIM/USIM	Support, 1.8V/3V, support hot swap
TFLASH memory card expansion interface	Support, up to 32GB
U disk function / USB	support
UART	support, 3-way
SPI	support, 2-way
I2C	Support, 1 way
MIC	support, 2-way
RECEIVER	Support, 1 way
SPEAKER	Support, 1 way
headphone channel	Support, 1 channel (headphone MIC+stereo)
PCM	Support, 1 way
FM	Frequency range: 65MHz~108MHz
GPIO	Support, multi-channel, SPI/T card/key/UART/IIC and other interfaces

characteristic	illustrate
	can be multiplexed as GPIO
Vibrator	support
Sensors	Support, acceleration, geomagnetic, A&P, gyroscope, etc.
barcode reader	Support, optional external components, support UART port form
USB OTG	can support
charge control	Support (linear charging, switching charging)
reset	support
temperature range	Working temperature: -35℃~+75℃ Storage temperature: -40℃~+90℃
Module pins	168 PIN LCC+LGA
physical size	40 ×30 ×2. 65mm
software upgrade	USB upgrade

1.3 SIM8400 Module Working Mode

Table 3 SIM8400 working mode list

model	describe	
GSM mode	GSM IDLE	The module system is in an idle state, the module has been registered to the GSM network, and the module is ready to send and receive (SMS and voice services).
	GSM TALK	At this time, the module does voice call service, and the power consumption of the module depends on the network settings.
GPRS mode	GPRS IDLE	The module is ready for GPRS data transmission. But no data is sent or received at this time. The power consumption of the module depends on the network settings and GPRS related settings (such as multi-slot Class level settings).
	GPRS DATA	In GPRS data reception and transmission, the power consumption of the module depends on network settings (such as power control level), data uplink and downlink rates and GPRS related settings (such as multi-slot Class level settings).
GPRS mode	EDGE IDLE	The module is ready for EDGE data transmission. But no data is sent or received at this time. The power consumption of the module depends on the network settings and EDGE related settings (such as multi-slot Class level settings).
	EDGE DATA	During EDGE data transmission, module power

model	describe	
		consumption depends on network settings (such as power control level), data uplink and downlink rates, and EDGE related settings (such as multi-slot Class level settings).
HSPA mode	HSPA IDLE	The module is ready for HSPA data transfer. But no data is sent or received at this time. Module power consumption depends on network settings.
	HSPA DATA	In HSPA data transmission, the power consumption of the module depends on network settings (such as power control level), data uplink and downlink rates, and HSPA related settings.
LTE mode	LTE IDLE	The module is ready for LTE data transmission. But no data is sent or received at this time. Module power consumption depends on network settings.
	LTE DATA	In LTE data transmission, the power consumption of the module depends on network settings (such as power control level), data uplink and downlink rates, and LTE related settings.
minimal functional mode	VBAT continues to supply power. Use AT+CFUN=0 to make the module enter the minimum function mode. At this time, the RF transceiver of the module is turned off. Use the AT+CFUN=1 module to reopen the transceiver registration network to the normal function mode.	

2 Package Information

2.1 System Functional Block Diagram

The following figure lists the main functional parts of the module:

- SL8521E baseband main chip
- SC2721G Baseband PMIC Chip
- MCP(nand+LPDDR2)
- SR3593A
- RF front-end and back-end circuits

The main external interfaces are:

- power supply
- LCM interface
- PCM interface
- camera interface
- audio port
- USB interface
- USIM interface
- UART interface
- SDIO interface
- I2C interface
- ADC interface
- SPI interface

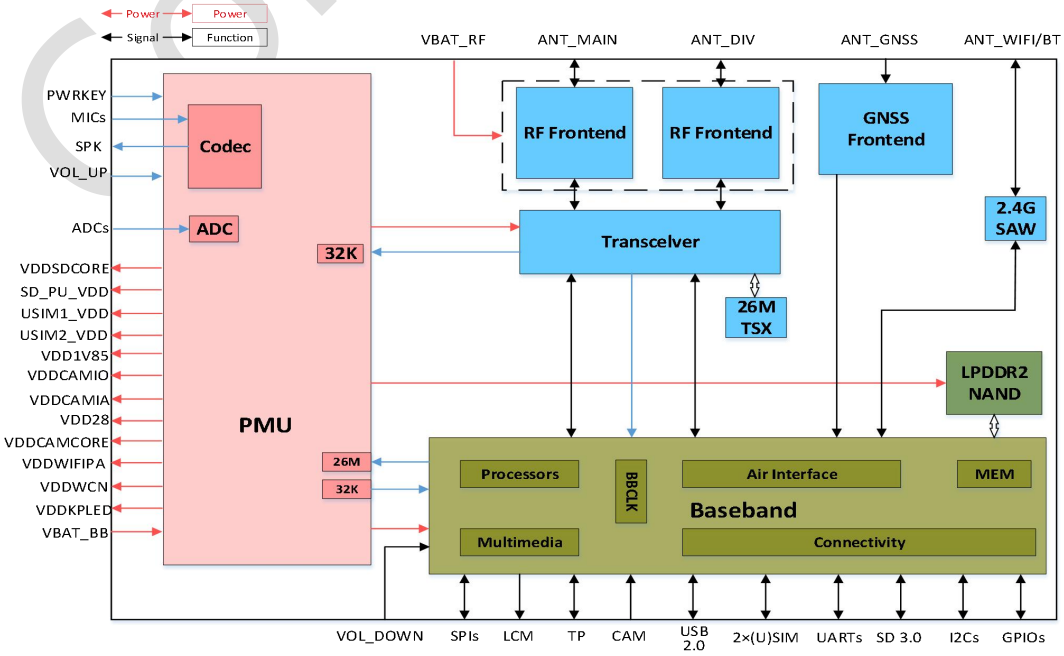


Figure 1 SIM8400 module system block diagram

2.2 Pin Assignment

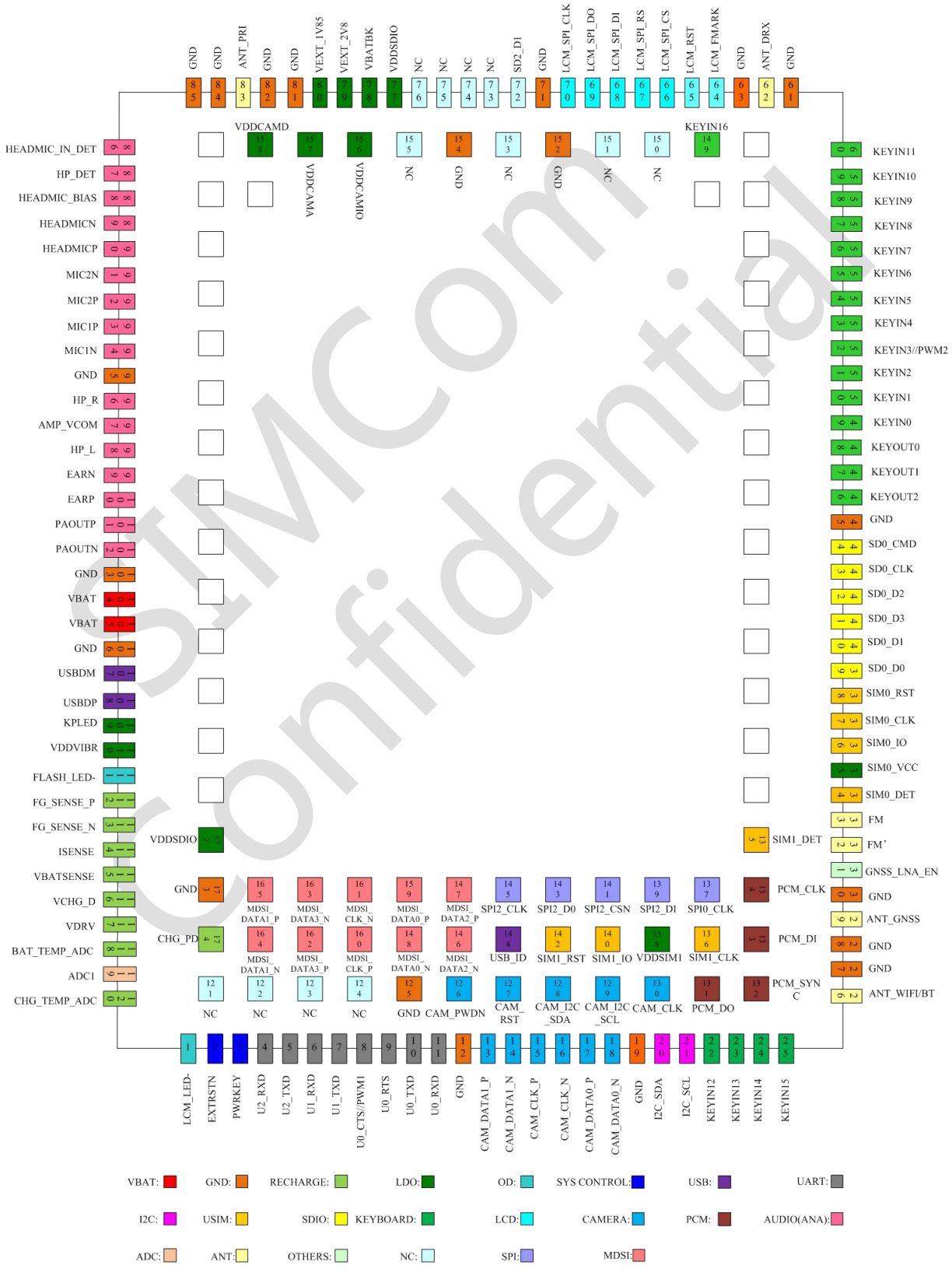


Figure 2 SIM8400 module pin assignment diagram

2.3 SMT Interface Definition

Table 4 SIM8400 pin attribute and direction description

type	describe
DI	digital input
DO	digital output
DI/O	Digital input/output
PI	power input
PO	Power Output
PI/O	Power input/output
AI	analog input
AO	Analog output
AI/O	Analog input and output
OD	open drain

Table 5 SIM8400 digital IO pin reset state description

type	describe
i	enter
o	output
wpd	Weak pulldown
wpu	weak pull-up
L	Low
H	high
Hiz	high resistance

Table 6 SIM8400 Pin Definition

PIN #	pin name	Voltage Domain (V)	Properties and Orientation	reset state		describe	Configurable function 1	Configurable function 2
				When reset	after reset			
1	LCM_LED-	-	OD	-		LCD LED backlight control		
2	EXTRSTN	VBAT	DI	-		System reset, the default is the button function.	RESET	
3	PWRKEY	VBAT	DI	-		boot signal		
4	U2_RXD	1.8	DI	i / wpd	i / wpd	UART2 data reception		GPIO 73
5	U2_TXD	1.8	DO	i / wpd	i / wpd	UART2 data transmission		GPIO 72
6	U1_RXD	1.8	DI	i / wpu	i / wpu	UART1 data reception, the default is the log port.		GPIO 71
7	U1_TXD	1.8	DO	i / wpu	o/H	UART1 data transmission, the default is the log port, U1_TXD can be pulled low before the system starts to control the system to enter the software download mode.		NBOOT
8	U0_CTS//PWM1	1.8	DI	i / wpd	i / wpd	UART0 hardware flow control, clear to send.	PWM	
9	U0_RTS	1.8	DO	i / wpd	i / wpd	UART0 hardware flow control, request to send.		GPIO 63
10	U0_TXD	1.8	DO	o/H	o/H	UART0 data transmission		GPIO 60
11	U0_RXD	1.8	DI	i / wpu	i / wpu	UART0 data reception		GPIO 61
12	GND	-	-			Ground		
13	CAM_DATA1_P	-	DI			Camera first group data differential positive		
14	CAM_DATA1_N	-	DI			Camera first group data differential negative		
15	CAM_CLK_P	-	DI			Camera clock differential positive		
16	CAM_CLK_N	-	DI			Camera clock differential positive		

17	CAM_DATA0_P	-	DI			The second set of data differential positive pole of the camera		
18	CAM_DATA0_N	-	DI			The second set of data differential positive pole of the camera		
19	GND	-	-			Ground		
20	I2C_SDA	1.8	OD	i / wpu	i / wpu	I2C data signal		GPIO 128
21	I2C_SCL	1.8	OD	i / wpu	i / wpu	I2C clock signal		GPIO 127
22	KEYIN12	1.8	DI	i / wpu	i / wpu	keyboard input 12	CTP_SDA	GPIO 147
23	KEYIN13	1.8	DI	i / wpu	i / wpu	keyboard input 13	CTP_SCL	GPIO 146
24	KEYIN14	1.8	DI	i / wpd	i / wpd	keyboard input 14	CTP_RST	GPIO 145 (EXTINT)
25	KEYIN15	1.8	DI	i / wpd	i / wpd	keyboard input 15	CTP_INT	GPIO 144 (EXTINT)
26	ANT_WIFI/BT	-	-			WiFi /BT antenna interface		
27	GND	-	-			Ground		
28	GND	-	-			Ground		
29	ANT_GNSS	-	AI			GNSS antenna interface		
30	GND	-	-			Ground		
31	GNSS_LNA_EN	1.8	O	i / wpu	i / wpu	GNSS external LNA enable		GPIO 69
32	FM'	-	-			FM reference ground		
33	FM	-	-			FM reception		
34	SIM0_DET	1.8	DI	i / wpd	i / wpd	(U) SIM card insertion and removal detection, the default is high and effective, indicating that the SIM card is inserted.		GPIO 31
35	VSIM0	-	PO			(U)SIM card power supply		

36	SIM0_IO	1.8/3.0	DI/O	i / wpd	i / wpd	(U)SIM data signal		GPIO 158
37	SIM0_CLK	1.8/ 3.0	DO	i / wpd	i / wpd	(U)SIM Clock		GPIO 157
38	SIM0_RST	1.8/3.0	DO	i / wpd	i / wpd	(U)SIM reset		GPIO 159
39	SD_D0	1.8/3.3	DI/O	i / wpd	i / wpd	SDIO interface data0		GPIO 151
40	SD_D1	1.8/3.3	DI/O	i / wpd	i / wpd	SDIO interface data1		GPIO 152
41	SD_D3	1.8/3.3	DI/O	i / wpd	i / wpd	SDIO interface data3		GPIO 148
42	SD_D2	1.8/3.3	DI/O	i / wpd	i / wpd	SDIO interface data2		GPIO 149
43	SD_CLK	1.8/3.3	DO	i / wpd	i / wpd	SDIO interface clock		GPIO 153
44	SD_CMD	1.8/3.3	DO	i / wpd	i / wpd	SDIO interface command signal		GPIO 150
45	GND	-	-			Ground		
46	KEYOUT2/PWM3	1.8	DO	i / wpd	i / wpd	Keyboard output 2, KEYOUT0~2 and KEYIN0~2 can form a 3*3 keyboard array.	PWM	GPIO 123
47	KEYOUT1	1.8	DO	Hiz / wpd	Hiz / wpd	Keyboard output 1, KEYOUT0~2 and KEYIN0~2 can form a 3*3 keyboard array.		GPIO 122 (EXTINT)
48	KEYOUT0	1.8	DO	o/L	o/L	Keyboard output 0, KEYOUT0~2 and KEYIN0~2 can form a 3*3 keyboard array.		GPIO 121 (EXTINT)
49	KEYIN0	1.8	DI	i / wpu	i / wpu	Keyboard input 0, KEYIN0 can be pulled low before the system starts to control the system to enter the software download mode; KEYOUT0~2 and KEYIN0~2 can form a 3*3 keyboard array.		
50	KEYIN1	1.8	DI	i / wpu	i / wpu	Keyboard input 1, KEYOUT0~2 and KEYIN0~2 can form a 3*3 keyboard array.		
51	KEYIN2	1.8	DI	i / wpd	i / wpd	Keyboard input 2, KEYOUT0~2 and KEYIN0~2 can form a 3*3 keyboard array.		GPIO 126 (EXTINT)
52	KEYIN3//PWM2	1.8	DI	i / wpd	i / wpd	keyboard input 3	PWM	GPIO 32

53	KEYIN4	1.8	DI	o/L	o/L	keyboard input 4		GPIO85 _
54	KEYIN5	1.8	DI	i / wpu	i / wpu	keyboard input 5		GPIO 88
55	KEYIN6	1.8	DI	i / wpu	i / wpu	keyboard input 6		GPIO 90 (EXTINT)
56	KEYIN7	1.8	DI	i / wpd	i / wpd	keyboard input 7		GPIO 91 (EXTINT)
57	KEYIN8	1.8	DI	i / wpd	i / wpd	keyboard input 8		GPIO 92 (EXTINT)
58	KEYIN9	1.8	DI	i / wpd	i / wpd	keyboard input 9	CLOCK_ AUX	GPIO 156
59	KEYIN10	1.8	DI	i / wpu	i / wpu	keyboard input 10		GPIO 83
60	KEYIN11	1.8	DI	i / wpd	i / wpd	keyboard input 11		GPIO 82
61	GND	-	-			Ground		
62	ANT_DRX	-	-			LTE/WCDMA/GSM diversity antenna interface		
63	GND	-	-			Ground		
64	LCM_FMARK	1.8	DI	i / wpd	i / wpd	LCD data synchronization control		GPIO 51
65	LCM_RST	1.8	DO	i / wpd	i / wpd	LCD reset		GPIO 50
66	LCM_SPI_CS	1.8	DO	i / wpu	i / wpu	LCD SPI Chip Select	SPI_CS	GPIO 139
67	LCM_SPI_RS	1.8	DO	i / wpu	i / wpu	LCD SPI data/command control		GPIO 138
68	LCM_SPI_DI	1.8	-	i / wpu	i / wpu	on hold	SPI_DI	GPIO 135
69	LCM_SPI_DO	1.8	DI/ O	i / wpu	i / wpu	LCD SPI number signal	SPI_DO	GPIO 136
70	LCM_SPI_CLK	1.8	DO	i / wpd	i / wpd	LCD SPI clock	SPI_CLK	GPIO 134
71	GND	-	-			Ground		
72	SD2_D1	-	-			SDIO2 interface data1		GPIO 137
73	NC	-	-			NC		
74	NC	-	-			NC		

75	NC	-	-			NC		
76	NC	-	-			NC		
77	VDDSD	-	PO			SDIO power output		
78	VBATBK	-	PI/O			System RTC power supply input/output, the typical value is 3.0V, the system is dedicated to power supply and cannot be powered externally.		
79	VEXT_2V8	-	PO			2.8V power supply output, < 200mA		
80	VEXT_1V85	-	PO			1.8V power supply output, < 50mA		
81	GND	-	-			Ground		
82	GND	-	-			Ground		
83	ANT_PRI	-	AI/O			LTE/WCDMA/GSM main set antenna interface		
84	GND	-	-			Ground		
85	GND	-	-			Ground		
86	HEADMIC_IN_DET	-	AI			Headphone wire-controlled button detection, cooperate with HP_DET to detect the plugging and unplugging of headphones.		
87	HP_DET	-	DI			Headphone plug-in detection		
88	HEADMIC_BIAS	-	PO			Headphone MIC paranoid power supply output		
89	HEADMICN	-	AI			Headphone MIC differential negative		
90	HEADMICP	-	AI			Headphone MIC differential positive		
91	MIC2N	-	AI			The second MIC channel differential negative		
92	MIC2P	-	AI			The second MIC channel differential positive		
93	MIC1P	-	AI			The first MIC channel differential positive		
94	MIC1N	-	AI			The first MIC channel differential negative		
95	GND	-	-			Ground		
96	HP_R	-	AO			Headphone stereo output right channel		

97	AMP_VCOM	-	AO			Headphone Stereo Reference Ground		
98	HP_L	-	AO			Headphone stereo output left channel		
99	EARN	-	AO			Earpiece differential negative		
100	EARP	-	AO			Earpiece differential positive		
101	PAOUTP	-	AO			Speaker differential positive, 800mW@internal class D power amplifier, 4.2V, 8 ohm speaker; 500mW@internal class AB power amplifier, 4.2V, 8 ohm speaker.		
102	PAOUTN	-	AO			Speaker differential negative, 800mW@internal class D power amplifier, 4.2V, 8 ohm speaker; 500mW@internal class AB power amplifier, 4.2V, 8 ohm speaker.		
103	GND	-	-			Ground		
104	VBAT	-	PI			Module power supply, 3.4V~4.2V		
105	VBAT	-	PI			Module power supply, 3.4V~4.2V		
106	GND	-	-			Ground		
107	USBDM	3.3	DI/O			USB data differential negative		
108	USBDP	3.3	DI/O			USB data differential positive		
109	KPLED	-	PO			Keyboard backlight power supply, maximum 50mA.		
110	VDDVIBR	-	PO			Motor power supply, max 100mA		
111	FLASH_LED-	-	OD			Camera flash control, max 200mA		
112	FG_SENSE_P	-	AI			Power detection differential positive		
113	FG_SENSE_N	-	AI			Power detection differential negative		
114	ISENSE	-	AI			Charge current detection		
115	VBATSENSE	-	AI			Battery voltage detection, connect to the positive pole of the battery.		

116	VCHG_D	-	AI			Charger Insertion Detection		
117	VDRV	-	AO			Linear charge control		
118	BAT_TEMP_ADC	-	AI			Battery temperature detection ADC input		
119	ADC1	-	AI			Universal ADC input, detection range 0.1~1.2V.		
120	CHG_TEMP_ADC	-	AI			Charge temperature detection ADC input		
121	NC	-	-			NC		
122	NC	-	-			NC		
123	NC	-	-			NC		
124	NC	-	-			NC		
125	GND	-	-			Ground		
126	CAM_PWDN	1.8	DO	i / wpd	i / wpd	Camera enable		GPIO47 _
127	CAM_RST	1.8	DO	i / wpd	i / wpd	Camera reset		GPIO45 _
128	CAM_I2C_SDA	1.8	DI/O	i / wpu	i / wpu	Camera I2C data signal		GPIO49 _
129	CAM_I2C_SCL	1.8	DO	i / wpu	i / wpu	Camera I2C Clock		GPIO48 _
130	CAM_MCLK	1.8	DO	o/L	o/L	Camera Master Clock	CLOCK_AUX	GPIO42 _
131	PCM_DO	1.8	DO	i / wpd	i / wpd	PCM number export		GPIOs 131
132	PCM_SYNC	1.8	DO	i / wpd	i / wpd	PCM walk together		GPIOs 133
133	PCM_DI	1.8	DIs	i / wpd	i / wpd	PCM data input		GPIO 130 (EXT INT)
134	PCM_CLK	1.8	DO	i / wpd	i / wpd	PCM clock		GPIO 132
135	SIM1_DET	1.8	DI	i / wpd	i / wpd	(U) SIM card insertion and removal detection, the default is high and effective, indicating that the SIM card is inserted.		GPIO 9

136	SIM1_CLK	1.8/3.0	DO	i / wpd	i / wpd	(U)SIM Clock		GPIO 160
137	SPI0_CLK	1.8	D O			SPI clock		GPIO 93
138	VSIM1	-	PO			(U)SIM card power supply		
139	SPI2_DI	1.8	-	i / wpu	i / wpu	SPI number signal	SPI_DI	GPIO 54
140	SIM1_IO	1.8/3.0	DI/O	i / wpd	i / wpd	(U)SIM number signal		GPIO 161
141	SPI2_CSN	1.8	DO	i / wpu	i / wpu	SPI chip select	SPI_CS	GPIO 52
142	SIM1_RST	1.8/3.0	DO	i / wpd	i / wpd	(U)SIM reset		GPIO 162
143	SPI2_DO	1.8	DI/O	i / wpu	i / wpu	SPI data signal	SPI_DO	GPIO 53
144	USB_ID	-	DI			USB ID detection		GPIO 78
145	SPI2_CLK	1.8	DO	i / wpd	i / wpd	SPI clock	SPI_CLK	GPIO 55
146	MDSI_DATA2_N		DI			MIPI data 2 (-)		
147	MDSI_DATA2_P		DI			MIPI data 2 (+)		
148	MDSI_DATA0_N		DI			MIPI data 0 (-)		
149	KEYIN16	1.8	DI	o/L	o/L	keyboard input 16		GPIO 89
150	NC	-	-			NC		
151	NC	-	-			NC		
152	GND	-	-			Ground		
153	NC	-	-			NC		
154	GND	-	-			Ground		
155	NC	-	-			NC		
156	VDDCAMIO		PO			Camera IO interface power supply output, 1.1V~1.9V, maximum 200mA.		
157	VDDCAMA	-	PO			Camera analog power output, 1.8V~3.3V, maximum 200mA.		
158	VDDCAMD	-	PO			Camera digital power output, 1.0V~1.4V, maximum 400mA.		

159	MDSI_DATA0_P		DI			MIPI data 0 (+)		
160	MDSI_CLK_P		DI			MIPI clock (+)		
161	MDSI_CLK_N		DI			MIPI clock (-)		
162	MDSI_DATA3_P		DI			MIPI data 3 (+)		
163	MDSI_DATA3_N		DI			MIPI data 3 (-)		
164	MDSI_DATA1_N		DI			MIPI data 1 (-)		
165	MDSI_DATA1_P		DI			MIPI data 1 (+)		
172	VDDSDIO		PO			SD card pull up power		
173	GND	-	-			Ground		
174	CHG_PD	1.8	DO			External charging IC enable control		

3 Application Interface

3.1 Power

This section describes the interfaces related to power supply and power on/off. The interfaces involved include the following:

Table 7 SIM8400 power supply related interface

Pin #	pin name	IO	describe	Remark
104	VBAT	PI	Module main power supply	Module power supply, 3.4~4.2, nominal value 3.8V, should be able to provide enough peak current to ensure up to 2A peak current consumption in GSM burst mode.
105	VBAT	PI		
12,19,27,28,30,45,61, 63,71,81,82,84,85,95, 103,106,125,152,154, 173	GND	-	Ground	

3.1.1 Power Supply

The voltage input range of module VBAT is 3.4V to 4.2V, and the recommended voltage is 3.8V. In the GSM frequency band, when the module transmits at the maximum power, the peak current can reach up to 2A instantaneously, resulting in a large VBAT ripple. If the instantaneous voltage drop causes the VBAT supply voltage to be too low, the module will shut down. In order to ensure the normal operation of the module, the power supply must have sufficient power supply capability.

On the premise that the power supply capacity of the VBAT power supply is sufficient (3.8V, 2A instantaneous load capacity), it is recommended to use the following circuit before the power supply enters the module. In order to ensure that the VBAT voltage will not drop below 3.4V, it is recommended to Place a 2200uF electrolytic capacitor (or 4 220uF tantalum capacitors with low ESR (ESR=0.7Ω) in parallel), and several filter capacitors such as 10uF, 100nF, 33pF, etc., and it is recommended that the PCB trace of VBAT be as short and wide as possible (larger than 2mm) to reduce the equivalent impedance of the VBAT trace and ensure that the power supply end of the

module will not produce too much voltage drop under high current at the maximum transmit power.

In order to suppress the impact of power supply fluctuations and ensure the stability of the output power supply, it is recommended to add a TVS with a rated power of more than 5.1V/0.5W to the front end of the power supply to play a role in voltage regulation.

If a lithium battery is used to power the module, and the length of the power trace from the battery to the module is less than 10cm, electrolytic capacitors or tantalum capacitors can be omitted. Instead, two 47uF ceramic capacitors should be placed close to the module.

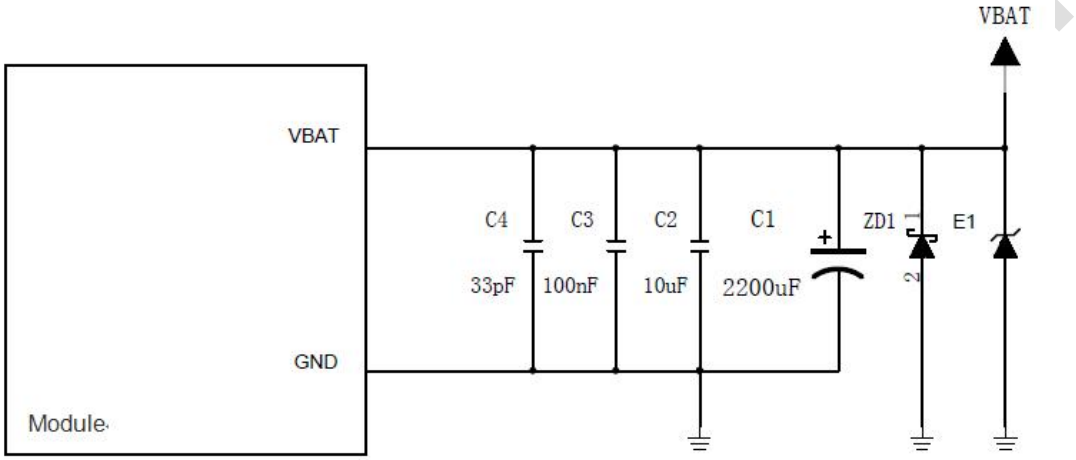


Figure 3 SIM8400 module VBAT input

Customers can directly use ion batteries to power the module, or use nickel-cadmium or nickel-manganese batteries to power the module, but please note that the maximum voltage of nickel-cadmium or nickel-manganese batteries cannot exceed the maximum allowable voltage of the module, otherwise the module will be damaged.

3.1.2 On/Off Control

Do not turn on the module when the temperature and voltage limits of the module are exceeded. In extreme cases such operations can lead to permanent damage to the module.

3.1.2.1. Power On

The user can turn on the module by pulling down PWRKEY (pin 3). Pull down for at least 2 seconds. This pin has been pulled up to the VBAT supply internally in the module. The recommended circuit is as follows:

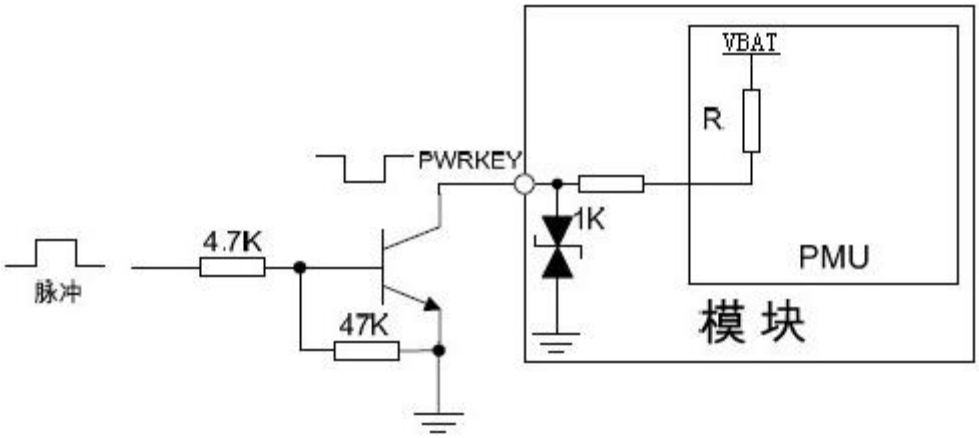


Figure 4 Use the PWRKEY drive circuit to power on

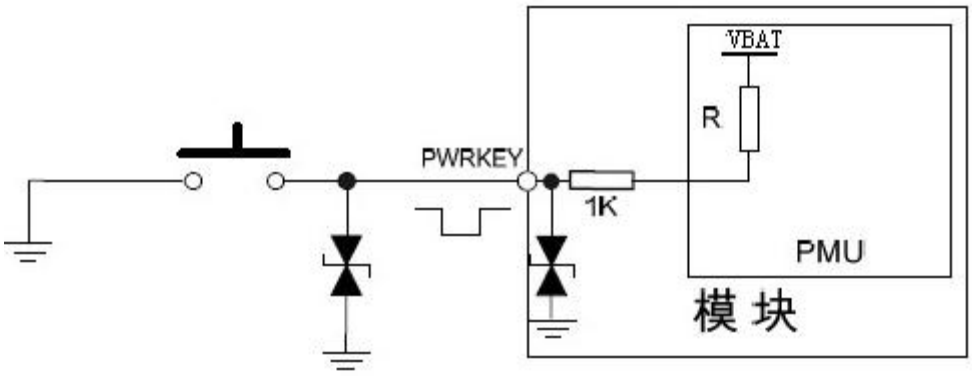


Figure 5 Use the PWRKEY button circuit to power on

The following figure shows the boot sequence description:

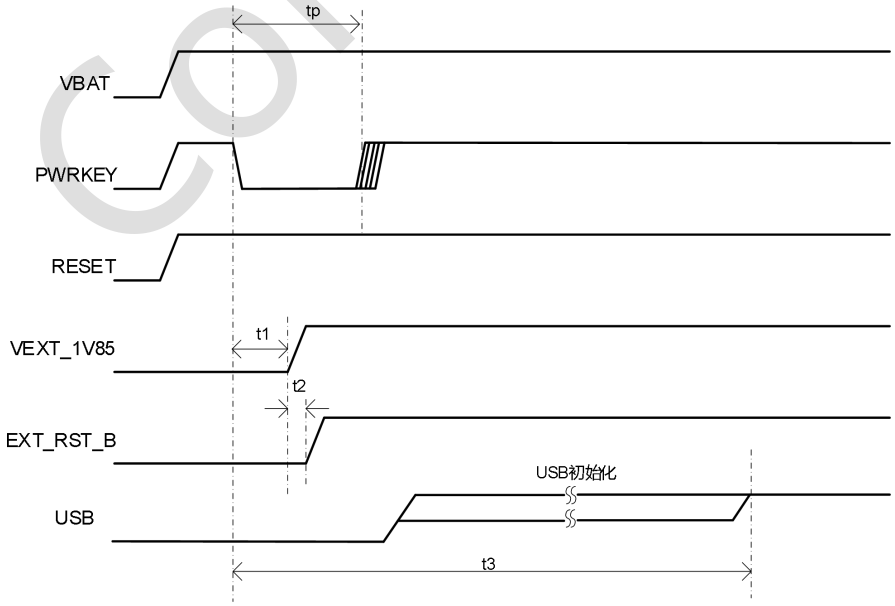


Figure 6 Boot sequence diagram using PWRKEY

Table 8 Boot sequence time definition

parameter	definition	duration
tp	PWRKEY valid hold time.	>2s
t1	The time from PWRKEY trigger boot to VEXT_1V85 output.	1.3s(typ.)
t2	Time from VEXT_1V85 output to EXT_RST_B being pulled high.	40ms(typ.)
t3	PWRKEY is pulled low until the USB initialization is complete.	22s(typ.)

3.1.2.2 Module Shutdown

Shutdown can be achieved by pulling down PWRKEY for more than 3 seconds.

3.1.2.3 Module Reset

Reset can be achieved by pulling down EXTRSTN.

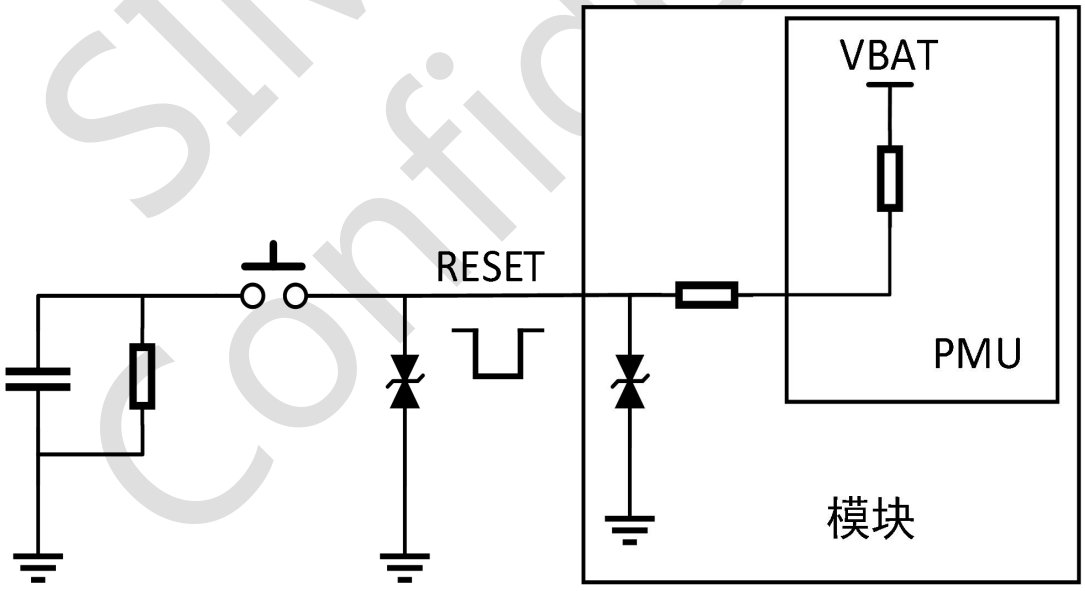


Figure 7 Use the RESET button circuit to power on

3.1.3 Power Output

SIM8400 has multiple power outputs. For LCD, Camera, touch panel and so on.

In application, it is recommended to add 1uF and 47 p F capacitors in parallel to each power supply to effectively remove high-frequency interference.

Table 9 Power interface pin definitions

Pin #	Signal	Programmable Range (V)	Default voltage (V)	Drive current (mA)
35	VSIM0	1.8~3.3	1.8/3.0	50
77	VDDSD	1.8~3.3	1.8/3.3	400
78	VBATBK	2.85~3.15	3.0	2
79	VDD2V8	1.8~3.3	2.8	200
80	VDD1V85	1.6~2.5	1.8	50
109	KPLED	1.8~3.3	-	50
110	VDDVIBR	1.8~3.3	-	100
156	VDDCAMIO	1.2~1.8	-	200
157	VDDCAMA	1.8~3.3	2.8	200
158	VDDCAMD	1.0-1.5	-	400

3.1.4 Low Power Consumption

the following three conditions are met, the SIM8400 will turn off most of the internal functions and enter a low power consumption mode to reduce the power consumption of the system.

- No network events (voice service, data service);
- The communication interface with peripherals is in an idle state;
- VCHG_D pin does not detect a valid level signal

The power consumption of the module in the sleep mode is related to the power consumption of the system in the standby state of the module, the network standard and the configuration. 4.5.1 to 4.5.3 describe the difference between the low power consumption under the three typical network standards of GSM, WCDMA and LTE respectively.

3.1.4.1 Low Power Consumption Under GSM Network

The sleep power consumption of the SIM8400 attached to the GSM network depends on the paging cycle of the base station.

The paging cycle of the base station can be calculated by the following formula:

t = 4.615 ms (TDMA frame duration) * 51 (number of frames) * DRX value.

DRX (Discontinuous Reception--Discontinuous Reception) is allocated by the mobile network operator. Generally, a number between 2 and 9 is taken and brought into the above formula to obtain a paging cycle of 0.47~2.12 seconds.

As shown in Figure 10, a paging cycle of the module consists of a fixed paging time and a

variable paging interval. During this paging interval, the module can enter a low power consumption mode.

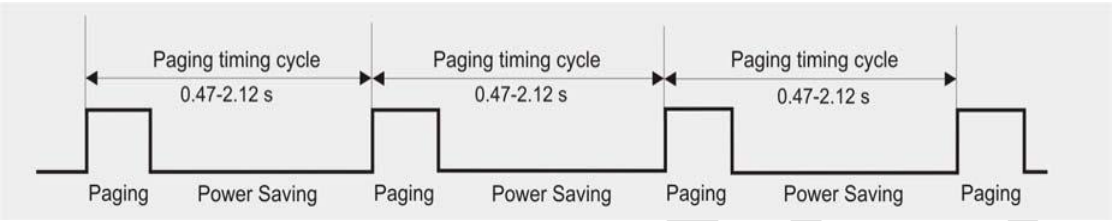


Figure 8 Sleep time and paging cycle under GSM network

The length of the paging interval determines the power consumption of the module in sleep mode. The longer the paging interval is, the lower the power consumption will be.

Generally, due to different application scenarios, the power consumption of the module in sleep mode will be different from the results of the above analysis. The sleep period of the module may be less than 0.47 seconds or more than 2.12 seconds.

3.1.4.2 Low Power Consumption Under WCDMA Network

The power consumption in sleep mode of the SIM8400 attached to the WCDMA network depends on the paging cycle of the base station.

Under the network standard of WCDMA, the paging cycle of the module is variable, which can be calculated using the following formula:

$$t = 2^{DRX\ value} * 10\ ms\ (WCDMA\ frame\ duration).$$

The value range of DRX (Discontinuous Reception--discontinuous reception) under the WCDMA network is 6-9, which is assigned by the WCDMA network operator. The paging cycle of the module calculated by bringing the DRX value to the above formula is 0.64~5.12 seconds.

As shown in Figure 11, a paging cycle of the module consists of a fixed paging time and a variable paging interval, during which the module can enter the sleep mode.

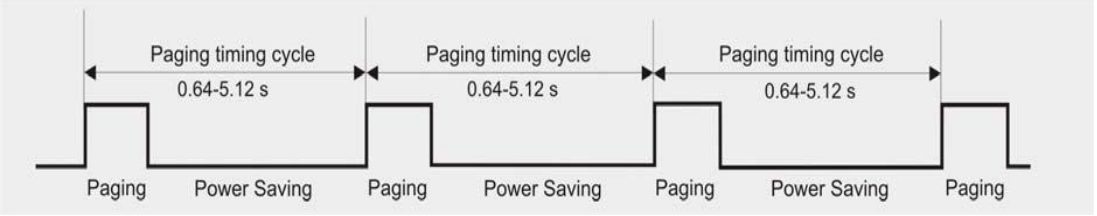


Figure 9 Sleep time and paging cycle in WCDMA network

The length of the paging interval determines the power consumption of the module in sleep mode. The longer the paging interval, the lower the power consumption.

Generally, due to different application scenarios, the power consumption in the sleep mode of the module will be different from the results of the above analysis, and the sleep period of the module may be less than 0.64 seconds or more than 5.12 seconds.

3.1.4.3 Low Power Consumption Under LTE Network

SIM8400 attached to the LTE network depends on the paging cycle of the base station.

Under the LTE network standard, the paging cycle of the module is variable and can be calculated using the following formula:

t = t = DRX Cycle Value * 10 ms.

The value of DRX (Discontinuous Reception--discontinuous reception) under the LTE network is one of 32, 64, 128, 256, etc., which is assigned by the mobile network operator, and the value of DRX is brought to the above formula to calculate The paging cycle of the module is 0.32~2.56 seconds.

As shown in Figure 12, a paging cycle of the module consists of a fixed paging time and a variable paging interval. During this variable paging interval, the module can enter the sleep mode.

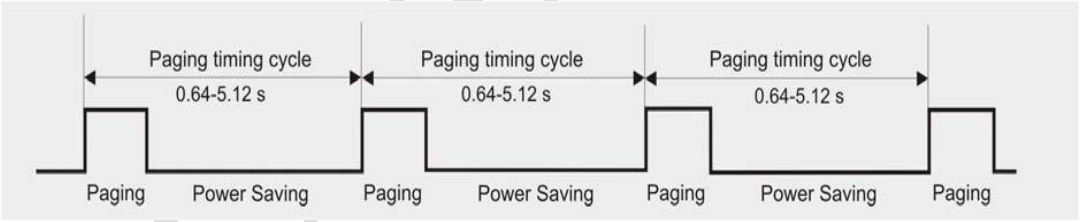


Figure 10 Sleep time and paging cycle under LTE network

The length of the paging interval determines the power consumption of the module in sleep mode. The longer the paging interval, the lower the power consumption.

Generally, due to different application scenarios, the power consumption in the sleep mode of the module will be different from the results of the above analysis, and the sleep period of the module may be less than 0.32 seconds or more than 2.56 seconds.

3.1.5 Charging and Battery Management

For linear charging, the SIM8400 module provides a charging control interface, but the charging

circuit needs to be implemented externally.

For the scheme using an external (switching) charging IC, the SIM8400 provides the IC's enable control and I2C interface to configure the charging parameters.

Table 10 Charge Control Interface Pin Definition

Pin #	pin name	IO	describe	Remark
20	I2C_SDA	DI/O	I2C data signal	Switch charging use: communication interface with external switch charging IC
twenty one	I2C_SCL	DO	I2C clock signal	Switch charging use: communication interface with external switch charging IC
112	FG_SENSE_P	AI	Power detection differential positive	
113	FG_SENSE_N	AI	Power detection differential negative	
114	ISENSE	AI	Charge current detection	Linear charging use
115	VBATSENSE	AI	Battery voltage detection	Linear charging use
116	VCHG_D	AI	Charger Insertion Detection	
117	VDRV	AO	Linear charge control	Linear charging use
118	BAT_TEMP_ADC	AI	Battery temperature detection ADC input	There is no need to follow the reference design, divide the VEXT_1V85 with a 47K and a 10K resistor, and connect the voltage divider to BAT_TEMP_ADC
120	CHG_TEMP_ADC	AI	Charge temperature detection ADC input	Can be left floating if not used
174	CHG_PD	DO	Control the enable of external charging IC	

The reference circuit of the switching charging scheme is as follows,

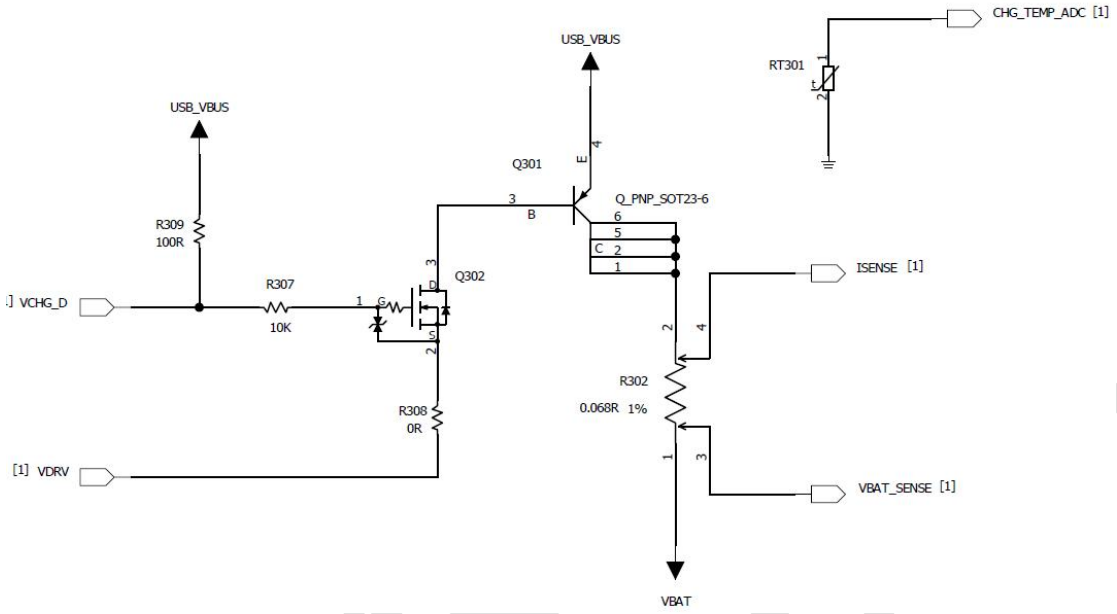


Figure 11 SIM8400 Linear Charge Reference Circuit

The battery charging connection diagram is shown in the following figure:

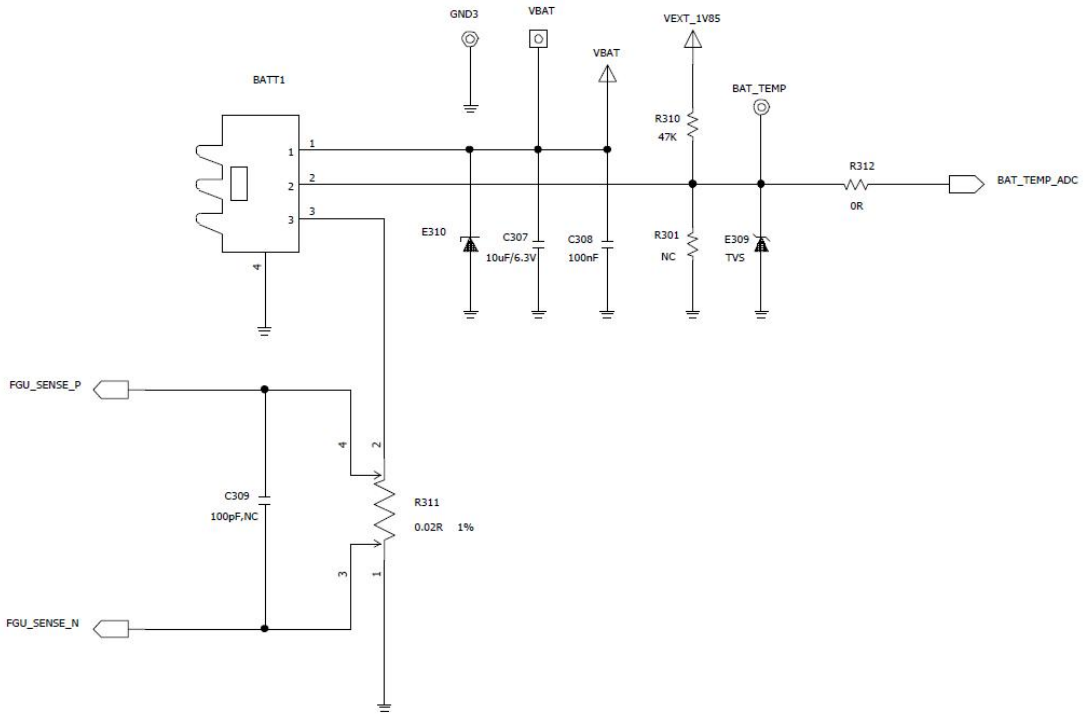


Figure 12 Schematic diagram of battery connection

NOTE

For this linear charging, it is necessary to select a suitable packaged PNP tube according to the charging current and heating conditions. Generally, it is recommended that the linear charging scheme can be used when the charging current is less than 700mA. If the charging current is

required to be large, it is necessary to consider selecting a switch charging management chip. BAT_TEMP_ADC If the battery does not need temperature detection, the R310 in the above picture must be mounted with a 47K resistor, and the ground R301 must be mounted with a 10K resistor.

3. 2 USB Interface

SIM8400 supports one USB 2.0 interface, the maximum transmission speed can reach 480Mbps, which can be used for AT command, data transmission, software debugging and software upgrade. Be sure to control the 90 ohm differential impedance during layout, and control the external trace length according to the trace length inside the module.
The following table defines the pin interface of USB:

Table 11 USB Interface pin definition

PIN#	pin name	IO	describe	Remark
116	VCHG_D	PI	USB power input	4.35~9.2V; Typical value: 5.0V
107	USBDM	DI/O	USB differential data negative	90Ω differential trace
108	USBDP	DI/O	USB differential data positive	
1 44	USB_ID _	D I	USB ID detection	Default high level. Leave empty if not used

The USB insertion detection of the module is realized by VCHG_D. When the VCHG_D voltage is detected, the system will judge whether there is data on the USB data line. If there is data, it will be considered as the USB data line. If there is no data, the system will judge it as charging device is inserted. Therefore, if the customer needs to use the USB function, please be sure to connect VCHG_D to the 5V power supply on the data line.

USB is in high-speed mode. It is recommended to connect a common mode inductor in series near the USB connector, which can effectively suppress EMI interference. At the same time, the USB interface is an external interface. It is recommended to add a TVS tube to prevent electrostatic damage caused by plugging and unplugging the data cable. When choosing TVS, customers should pay attention that the load capacitance should be less than 1pf. The connection diagram is as follows:

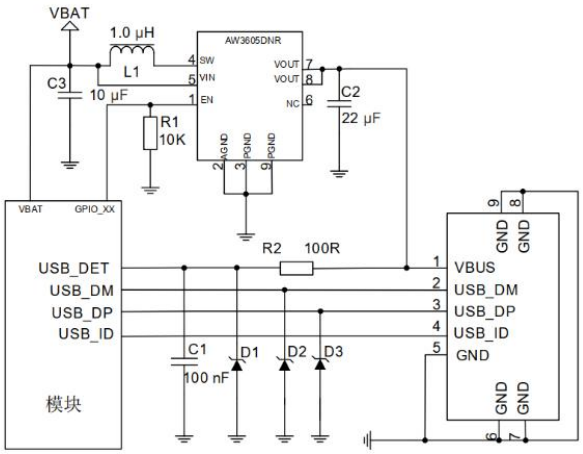


Figure 13 USB connection diagram

In the circuit design of the USB interface, in order to ensure the performance of the USB, it is recommended to follow the following design principles in the circuit design:

- The surrounding area of the USB data cable needs to be covered with wire, and the 90Ω impedance differential line should be used .
- Special attention should be paid to the selection of ESD devices on the USB data line, and the parasitic capacitance should not exceed 1pF.
- Do not run the USB cable under the crystal oscillator, oscillator, magnetic device and RF signal. It is recommended to use the inner layer and three-dimensional grounding.
- The USB ESD device should be placed as close as possible to the USB interface.
- The USB interface needs to reserve test points for the module software upgrade.

3.3 UART

SIM8400 provides three serial ports for communication. Among them, UART0 has hardware flow control, and UART1 is the Android debugging port. The pin definitions are as follows:

Table 12 UART interface pin definition

PIN#	pin name	IO	describe	Remark
4	U2_RXD	DI	UART2 data reception	
5	U2_TXD	DO	UART2 data transmission	
6	U1_RXD	DI	UART1 data reception, default is log port	
7	U1_TXD	DO	UART1 data transmission, default is log port	Pulling it low at power-on will trigger the module to enter software download mode.

8	U0_CTS//PWM1	DI	UART0 hardware flow control, clear to send
9	U0_RTS	DO	UART0 hardware flow control, request to send
10	U0_TXD	DO	UART0 data transmission
11	U0_RXD	DI	UART0 data reception

Please refer to the connection method below:

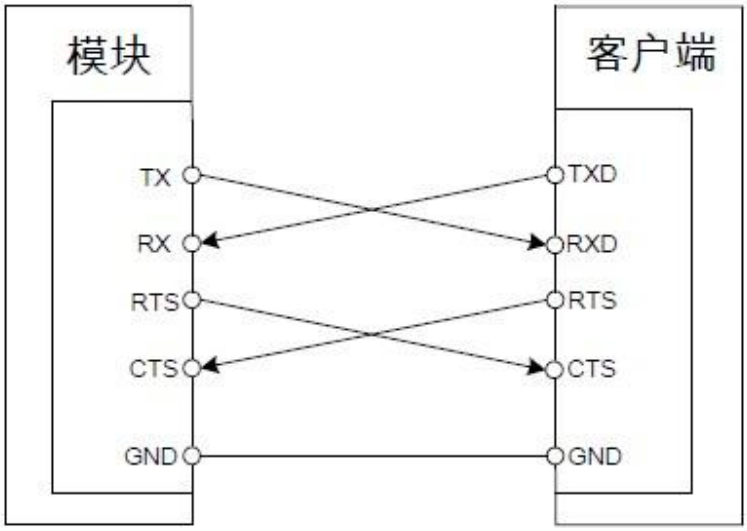


Figure 14 Serial port connection diagram

When the level of the serial port used by the customer does not match the module, the following figure can be used to achieve level matching. Only the matching circuits on TX and RX are listed here. The following figure is the reference design:

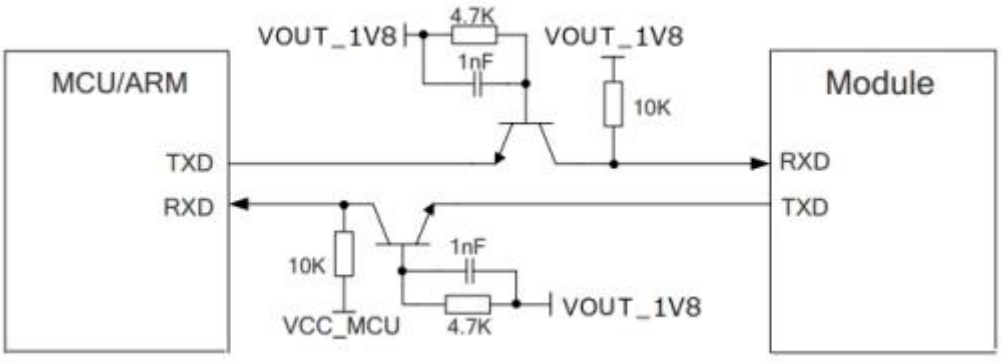


Figure 15 Level-shifting triode reference circuit

The module provides a 1.8V serial port. The customer needs to add a level converter in the 3.3V serial port application. It is recommended to use the TXS0104EPWR from TI. The following figure shows the reference design:

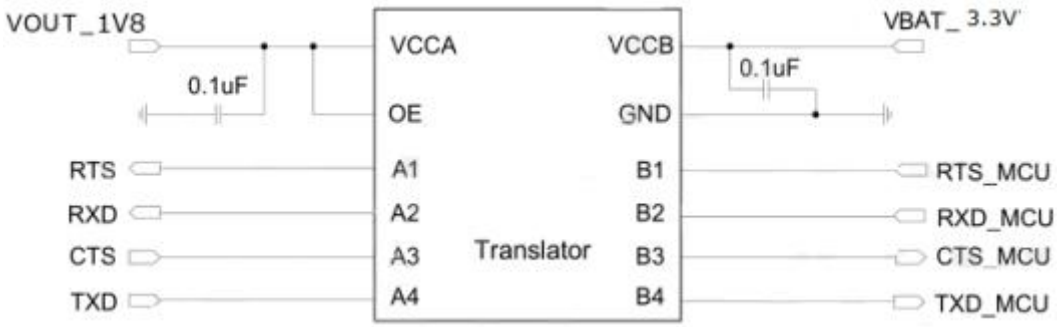


Figure 16 Level shift chip reference circuit

NOTE

1. The serial port of the module is a CMOS interface and cannot be directly connected to RS232 signals. If necessary, please use RS232 conversion chip;
2. If the 1.8V output of the module cannot meet the high level range of the client, please add a level conversion circuit.

3.4 (U)SIM Card Interface

SIM8400 can support one USIM card interface, and can automatically identify 1.8V and 2.95V cards.

Table 13 USIM card interface pin description

PIN#	pin name	IO	describe	Remark
34	SIM0_DET	DI	USIM card insertion and removal detection	External pull-up, active high, indicating (U)SIM card. Can be left floating
35	VSIM0	PO	USIM card power supply	Automatic recognition of 1.8V and 2.95V (U)SIM cards
36	SIM0_IO	DI/O	USIM card data signal	
37	SIM0_CLK	DO	USIM card clock signal	
38	SIM0_RST	DO	USIM card reset signal	
1 35	SIM1_DET	DI	USIM card insertion and removal detection	External pull-up, active high, indicating (U)SIM card. Can be left floating
1 38	VSIM1	PO	USIM card power supply	Automatic recognition of 1.8V

				and 2.95V (U)SIM cards
140	SIM1_IO	DI/O	USIM card data signal	
136	SIM1_CLK	DO	USIM card clock signal	
142	SIM1_RST	DO	USIM card reset signal	

The following figure is the recommended interface circuit of SIM card. In order to protect the SIM card, it is recommended to use the ESDA6V1-5W6 device from ST (www.st.com) for electrostatic protection. Devices of the peripheral circuit of the SIM card should be close to the SIM card holder.

The reference circuit is as follows:

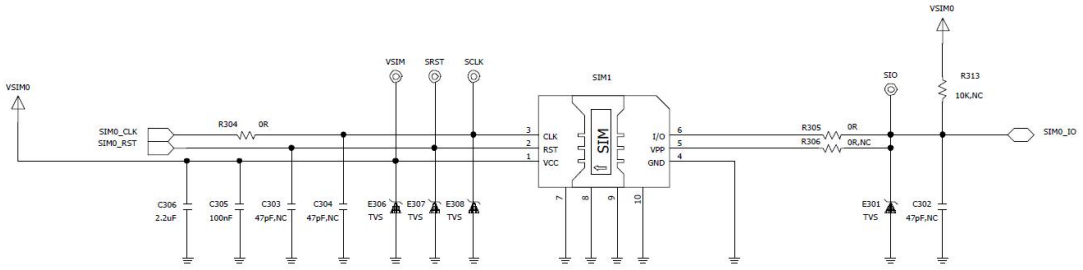


Figure 17 USIM card interface circuit

- SIM0_IO needs a pull-up resistor to VSIM0, this pull-up resistor is reserved and not attached;
- In order to improve the anti-static ability, add ESD protection devices on SIM_IO, VSIM0, SIM0_CLK and SIM0_RST lines;
- In order to make VSIM0 more stable, add a filter capacitor on the VSIM0 line, it is recommended to use 2.2uF and 100nF in parallel to the ground;
- In order to eliminate the influence of high-frequency interference signals, add filtering on the SIM0_RST line, and it is recommended to use a 33pF capacitor to ground.

NOTE

1.select the matching SIM card holder according to the effective level of SIM0_DET ;
2.-If the actual use does not require the SIM hot-swap function, SIM0_DET must be left floating.

3.5 SD Card Interface

The module supports SD cards with 4-bit data interface, or devices based on SDIO protocol, up to SDIO3.0. SD card connection pin definitions and characteristics are as follows:

Table 14 SD card interface pin description

PIN#	pin name	IO	describe	Remark
39	SD_D0	DI/O	High-speed bidirectional digital signal	The rate is high, it is recommended to use impedance line control
40	SD_D1	DI/O		
41	SD_D3	DI/O		
42	SD_D2	DI/O		
43	SD_CLK	DO	High-speed digital clock	
44	SD_CMD	IO	control line	
45	GND	-	Ground	
77	VDDSD	PO	SD card drive power	1.8/3.3V

The reference circuit is as follows:

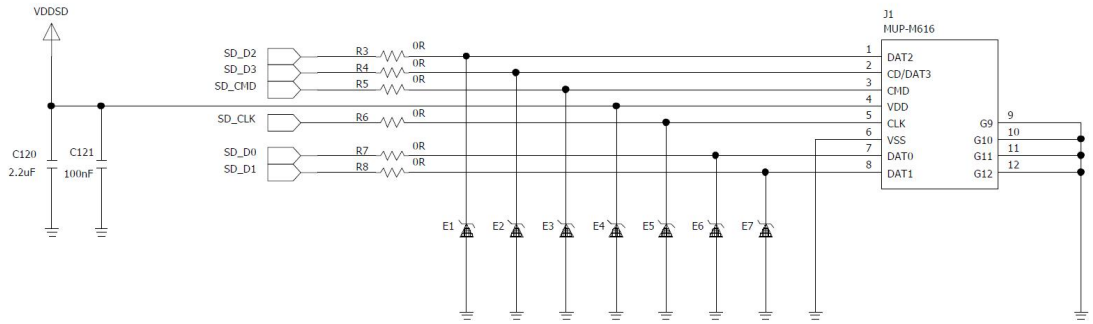


Figure 18 SD card interface circuit

NOTE

1. The distance from SD card to module should not exceed 50mm;
2.Due to the high rate of SDIO, the interface signal of SDIO should go to the inner layer of the PCB as much as possible, and the length should be matched < 5mm;
3.SD_ CLK is individually grounded;
4.VDDSD line width is greater than 0.4mm.

3.6 I2C Bus Interface

The SIM8400 module supports 1 hardware I2C bus interface by default, and only supports the master device mode. The I2C interface is an open-drain output, and the external circuit must be pulled. The maximum speed of the I2C interface can support 3.4Mbps, and the interface reference

high level is 1.8V.
The pin definitions and default functions are as follows:

Table 15 I2C interface

PIN#	pin name	IO	describe	Remark
20	I2C_SDA	DI/O	I2C data signal	The pull-up has been configured internally, and a pull-up resistor to the VEXT_1V85 power supply can be reserved externally.
twenty one	I2C_SCL	DO	I2C clock signal	The pull-up has been configured internally, and a pull-up resistor to the VEXT_1V85 power supply can be reserved externally.

3.7 Analog -to-Digital Converter (ADC)

The SIM8400 module provides 3 ADCs, and the pin definitions are shown in the table below. Among them, BAT_TEMP_ADC and CHG_TEMP_ADC can only be used for system power management, and are used for battery temperature and charging IC temperature detection respectively. The function of general ADC is not supported for the time being. ADC1 can support the maximum 12bit precision resolution, measuring range 0~1.2V.

Table 16 ADC interface

PIN#	pin name	IO	describe	Remark
118	BAT_TEMP_ADC	AI	Battery ADC detection	System specific
119	ADC1	AI	General purpose ADC	
120	CHG_TEMP_ADC	AI	Charging PNP/IC temperature detection	System specific

NOTE

BAT_TEMP_ADC is used for battery temperature detection, circuit refer to charging section 3.4

3.8 Motor Drive Interface

SIM8400 supports motor drive, the pin definitions are as follows:

Table 17 Motor Control Interface

pin name	pin number	IO	describe	Remark
VDDVIBR	110	PO	motor drive	

The motor circuit is driven by a dedicated circuit, the reference design circuit is as follows.

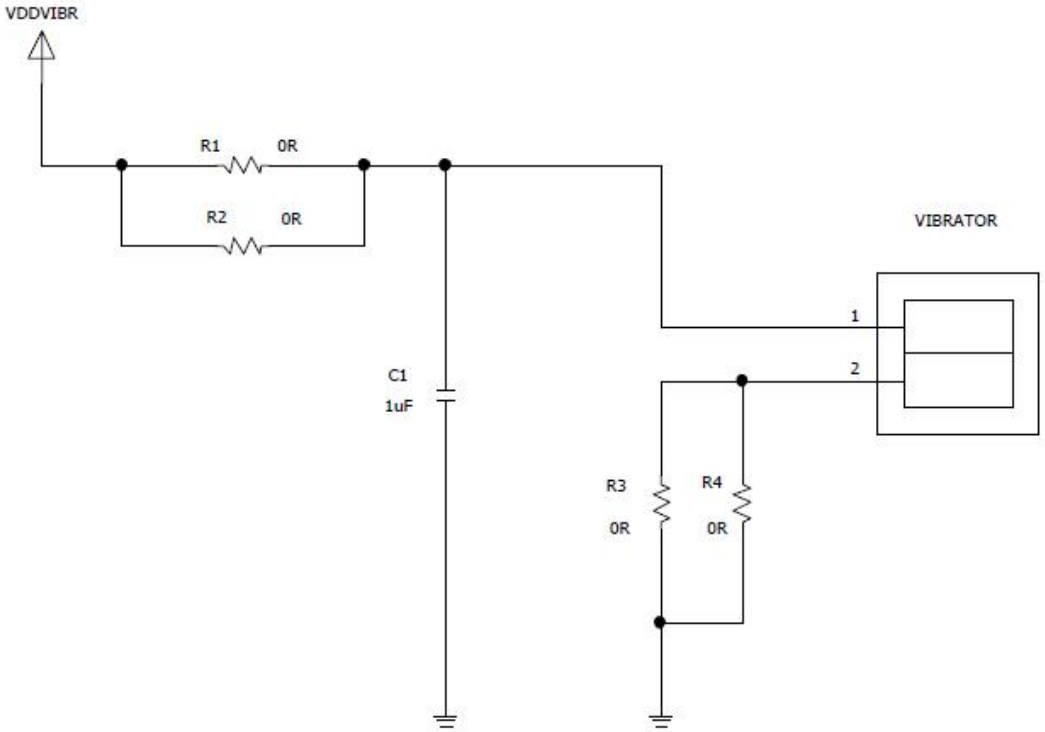


Figure 19 Motor interface circuit

3.9 LCD Interface

SIM8400 supports SPI serial screen, and the maximum resolution is QVGA 320*240.
Adopt SPI interface, support three-wire, four-wire SPI interface , and reserve MIPI interface for customers to choose.

Table 18 Definition of LCD interface

PIN#	pin name	IO	describe	Remark
1	LCM_LED-	OD	LCD backlight power supply negative	
104,105	VBAT	PI	LCD backlight power supply positive	

79	VEXT_2V8	PO	LCM power supply	
80	VEXT_1V85	PO	LCD IO interface power supply 1.8V	
64	LCM_FMARK	DI	LCD TE signal	
65	LCM_RST	DO	LCD REST signal	
66	LCM_SPI_CS	DO	LCD SPI interface chip select	
67	LCM_SPI_RS	DO	LCD SPI interface data/command control	
69	LCM_SPI_DO	DI/O	LCD SPI interface data signal	
70	LCM_SPI_CLK	DO	LCD SPI interface clock	

The reference circuit is as follows:

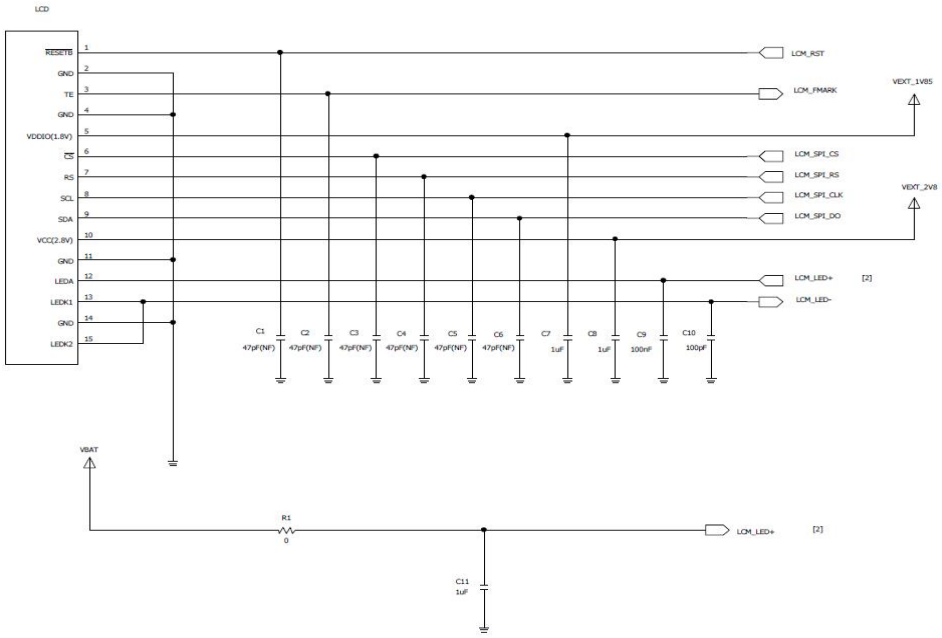


Figure 20 LCD circuit

NOTE

The 47pF capacitor on the signal line is reserved to suppress the interference of the digital signal to the radio frequency.

Table 19 Definition of MIPI interface

PIN #	管脚名称	IO	描述	备注
79	VEXT_2V8	PO	2.8V power supply output, < 200mA	
80	VEXT_1V85	PO	1.8V power supply output, < 50mA	

64	LCM_FMARK	DI	MIPI data synchronization control
65	LCM_RST	DO	MIPI reset
146	MDSI_DATA2_N	DI	MIPI data 2 (-)
147	MDSI_DATA2_P	DI	MIPI data 2 (+)
148	MDSI_DATA0_N	DI	MIPI data 0 (-)
159	MDSI_DATA0_P	DO	MIPI data 0 (+)
160	MDSI_CLK_P	DI	MIPI clock (+)
161	MDSI_CLK_N	DI	MIPI clock (-)
162	MDSI_DATA3_P	DI	MIPI data 3 (+)
163	MDSI_DATA3_N	DI	MIPI data 3 (-)
164	MDSI_DATA1_N	DI	MIPI data 1 (-)
165	MDSI_DATA1_P	DI	MIPI data 1 (+)

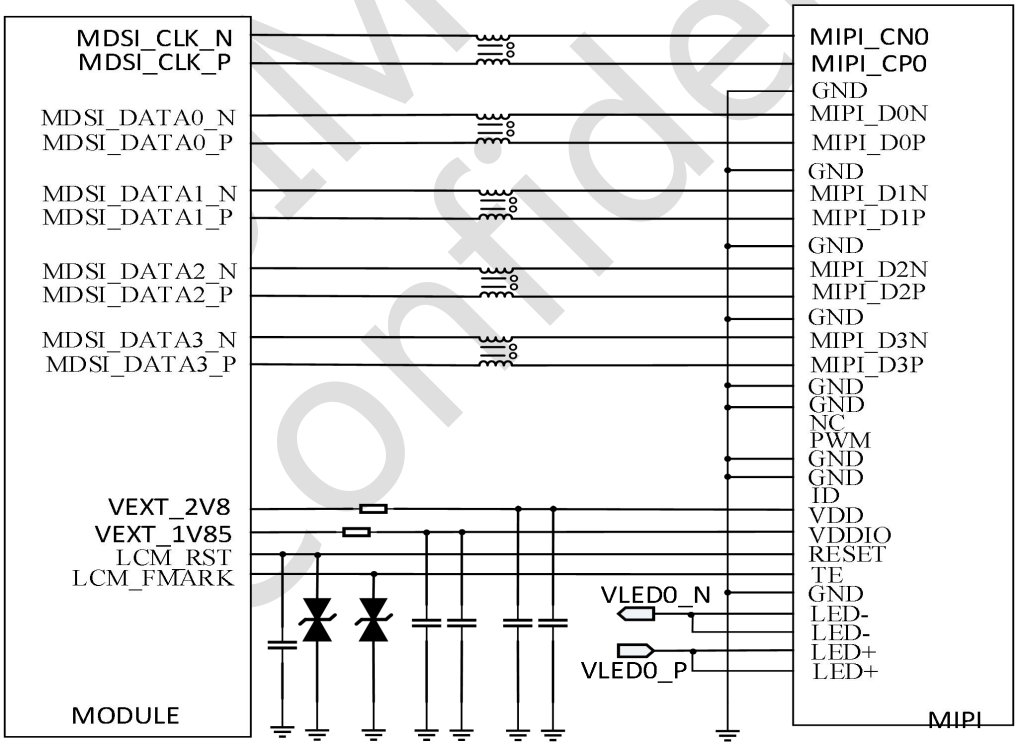


Figure 21 MIPI circuit

MIPI is a high-speed signal line, and it is recommended to improve electromagnetic radiation interference by series common mode inductance on the side near the LCM.

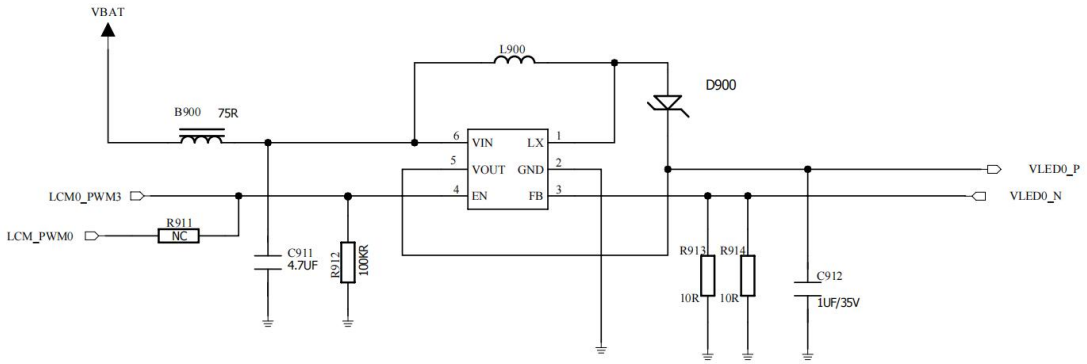


Figure 22 Backlit drive reference circuit

3.10 TP Interface

The module provides a set of I2C interfaces that can be used to connect capacitive touch, as well as the required power supply and interrupt pins. The default interface pins of the capacitive touch software are defined in the following table:

Table 20 TP interface definition

PIN#	pin name	IO	describe	Remark
22	CTP_I2CSDA	OD	TP's SDA signal	Externally reserved pull-up resistor to VEXT_1V85
23	CTP_I2CSCL	OD	TP's SCL signal	Externally reserved pull-up resistor to VEXT_1V85
24	CTP_RST	DO	TP reset signal	
25	CTP_INT	DI	TP interrupt signal	
79	VDD2V8	PO	TP drive power	

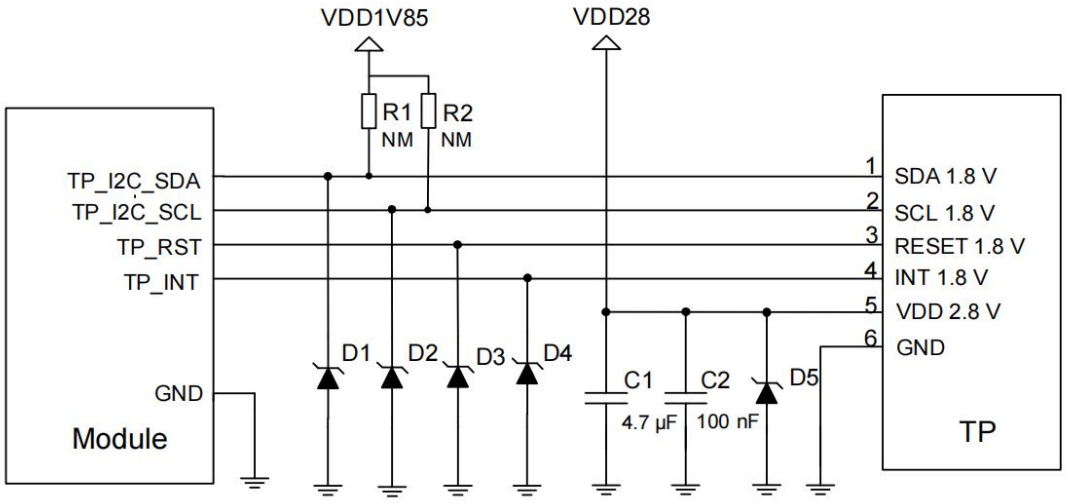


Figure 23 TP circuit

3.11 CAMERA Interface

The SIM8400 module supports MIPI interface Camera, and provides camera-specific power supply. Front camera is a CSI1 interface, supports two sets of data lines, and can support up to 2M pixels.

Table 21 MIPI Camera interface definition

PIN#	pin name	IO	describe	Remark
157	VDDCAMA	PO	CAMERA analog power supply	
158	VDDCAMD	PO	CAMERA digital power supply	
156	VDDCAMIO	PO	CAMERA IO powered	
130	CAM_MCLK	DO	CAMERA master clock	
126	CAM_PWDN	DO	CAMERA power control, active low closes CAMERA.	
127	CAM_RST	DO	CAMERA reset signal, active low reset.	
128	CAM_I2C_SDA	OD	I2C control bus	
129	CAM__I2C_SCL	OD		
15	CAM_CLK_P	DI	MIPI clock line for CAMERA	
16	CAM_CLK_N	DI		
17	CAM_DATA0_P	DI	DATA0 MIPI signal of CAMERA	
18	CAM_DATA0_N	DI		
13	CAM_DATA1_P	DI	CAMERA's DATA1 MIPI signal	
14	CAM_DATA1_N	DI		

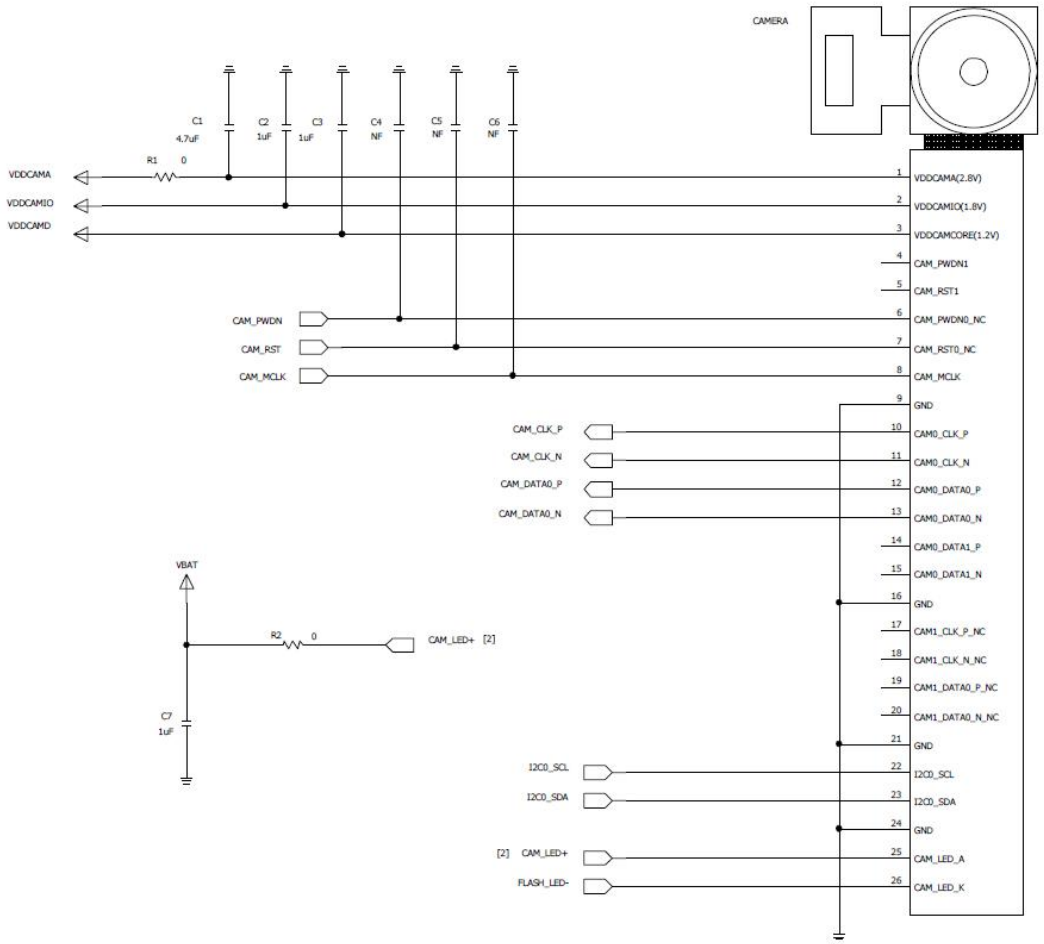


Figure 24 Mipi Camera Reference Circuit

NOTE

1.The MIPI interface rate is high, and the customer should control it by 100 ohm impedance during the wiring stage;

2. Each pair of MIPI signals should be covered with three-dimensional ground as much as possible. If the space cannot be satisfied, the ground cover of CLK should be considered limited;

3. MIPI line length matching: 0.5mm between each pair of signals P and N, +/- 2mm for each pair of signals based on CLK;

4. The total length of MIPI wiring should not exceed 70mm;

5. It is not recommended to add a small capacitor on the MIPI signal line, which may affect the rising edge time of the MIPI data, thus causing the MIPI data to be invalid.

3.12 PWM

SIM8400 supports 3-channel PWM, which can be used by peripherals such as LCD backlight IC and buzzer.

Table 22 PWM interface pin definition

PIN#	pin name	IO	describe	Remark
8	U0_CTS//PWM1	DO	PWM	Multiplexed with U0_CTS pin
46	KEYOUT2/PWM3	DO	PWM	Multiplexed with KEYOUT 2 pin
52	KEYIN3//PWM2	DO	PWM	Multiplexed with KEYIN3 pin

3.13 KEYBOARD

SIM8400 supports a 3*3 keyboard array. If you need more keys, you can only use GPIO to achieve it, refer to the pin definition.

Table 23 KEYBOARD interface definition

PIN#	pin name	IO	describe	Remark
2	EXTRSTN	DI	System reset, the default is the button function.	
3	PWRKEY	DI	switch control	
22	KEYIN12	DI	keyboard input 12	
23	KEYIN13	DI	keyboard input 13	
24	KEYIN14	DI	keyboard input 14	
25	KEYIN15	DI	keyboard input 15	
46	KEYOUT2/PWM3	DO	Keyboard output 2, KEYOUT0~2 and KEYIN0~2 can form a 3*3 keyboard array.	
47	KEYOUT1	DO	Keyboard output 1, KEYOUT0~2 and KEYIN0~2 can form a 3*3 keyboard array.	
48	KEYOUT0	DO	Keyboard output 0, KEYOUT0~2 and KEYIN0~2 can form a 3*3 keyboard array.	
49	KEYIN0	DI	Keyboard input 0, KEYOUT0~2 and KEYIN0~2 can form a 3*3 keyboard array.	Pulling KEYIN0 low before the system starts can control the system to enter the softwar

				e downlo ad mode.
50	KEYIN1	DI	Keyboard input 1, KEYOUT0~2 and KEYIN0~2 can form a 3*3 keyboard array.	
51	KEYIN2	DI	Keyboard input 2, KEYOUT0~2 and KEYIN0~2 can form a 3*3 keyboard array.	
52	KEYIN3//PWM2	DI	keyboard input 3	
53	KEYIN4	DI	keyboard input 4	
54	KEYIN5	DI	keyboard input 5	
55	KEYIN6	DI	keyboard input 6	
56	KEYIN7	DI	keyboard input 7	
57	KEYIN8	DI	keyboard input 8	
58	KEYIN9	DI	keyboard input 9	
59	KEYIN10	DI	keyboard input 10	
60	KEYIN11	DI	keyboard input 11	
149	KEYIN16	DI	keyboard input 16	

3.14 Audio Interface

The SIM8400 module provides 2 channels of analog audio upstream and downstream, and 1 channel of earphones. The analog audio interfaces include MIC1, MIC2, EAR, and SPK; the earphones include signals such as HEADMIC, HP_R/L, and earphone plug-in detection.
The SIM8400 also provides a set of digital audio interfaces that support PCM and IIS.
The audio pins are defined in the following table:

Table 24 Audio Interface Definition

PIN#	pin name	IO	describe	Remark
94	MIC1N	AI	MIC1	
93	MIC1P	AI		
92	MIC2P	AI	MIC2	
91	MIC2N	AI		
96	HP_R	AO	Headphone output right channel	

97	AMP_VCOM	-	Headphone reference ground	
98	HP_L	AO	Headphone output left channel	
88	HEADMIC_BIAS	PO	Headphone MIC Bias	
89	HEADMICN	AI	headphone mic	
90	HEADMICP	AI		
86	HEADMIC_IN_DET	AI	Headphone wire-controlled button detection, cooperate with HP_DET to detect the plugging and unplugging of headphones.	
87	HP_DET	AI	Headphone detection	
100	EARP	AO	earpiece	
99	EARN	AO		
101	PAOUTP	AO	trumpet	Built-in class D power amplifier or class AB power amplifier, 800mW@class D power amplifier, 4.2V, 8 ohm speaker; 500mW@AB class power amplifier, 4.2V, 8 ohm speaker.
102	PAOUTN	AO		
131	PCM_DO	DO	PCM data output	IISDO: IIS data output
132	PCM_SYNC	DO	PCM frame sync	IISLRCK: IIS frame synchronization clock
133	PCM_DI	DI	PCM data input	IISDI: IIS data input
134	PCM_CLK	DO	PCM clock	IISCLK: IIS clock

- The module has two sets of audio inputs, both of which are differential interfaces.
- The handset interface output adopts differential output.
- The output of the headphone interface is stereo left and right channel output, and the headphone has the function of insertion detection.

It is recommended that the user choose the following circuit according to the actual application to get better sound effect. The reference circuit is shown in the following figure:

3.14.1 MIC Interface

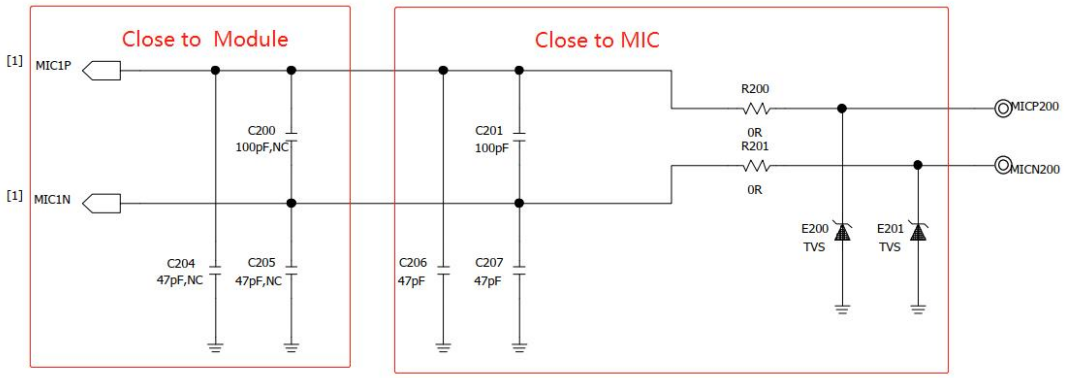


Figure 25 MIC Interface Reference Circuit

3.14.2 Handset Interface

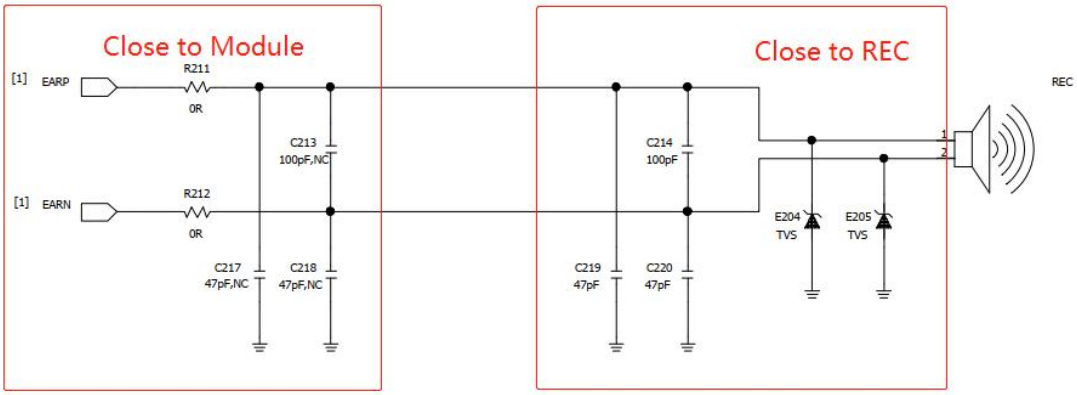


Figure 26 Reference circuit of handset interface

3.14.3 SPEAKER Interface

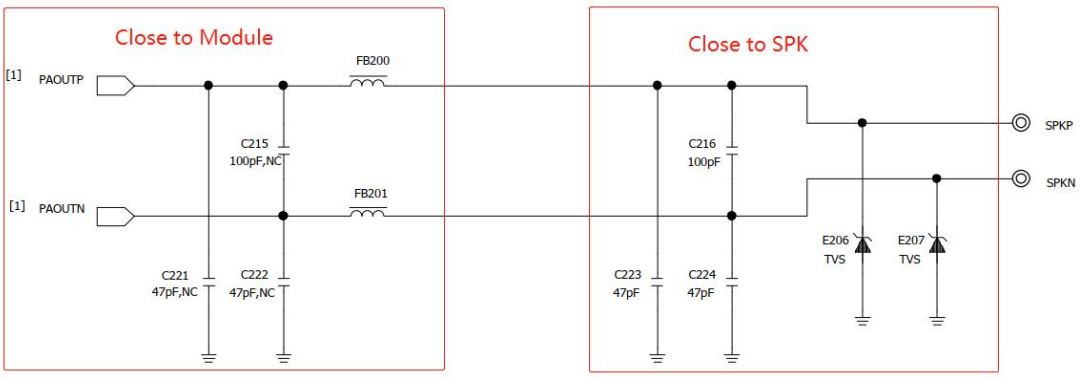


Figure 27 Reference circuit using the internal audio amplifier SPEKAER interface

NOTE

The overcurrent of FB201 and FB202 needs to be greater than 600mA.

3.14.4 Headphone Interface Circuit

The module integrates a stereo headphone jack. It is recommended that customers reserve ESD devices in the design stage to prevent ESD damage. The circuit design of the earphone part refers to the following figure, which includes the design of the FM.

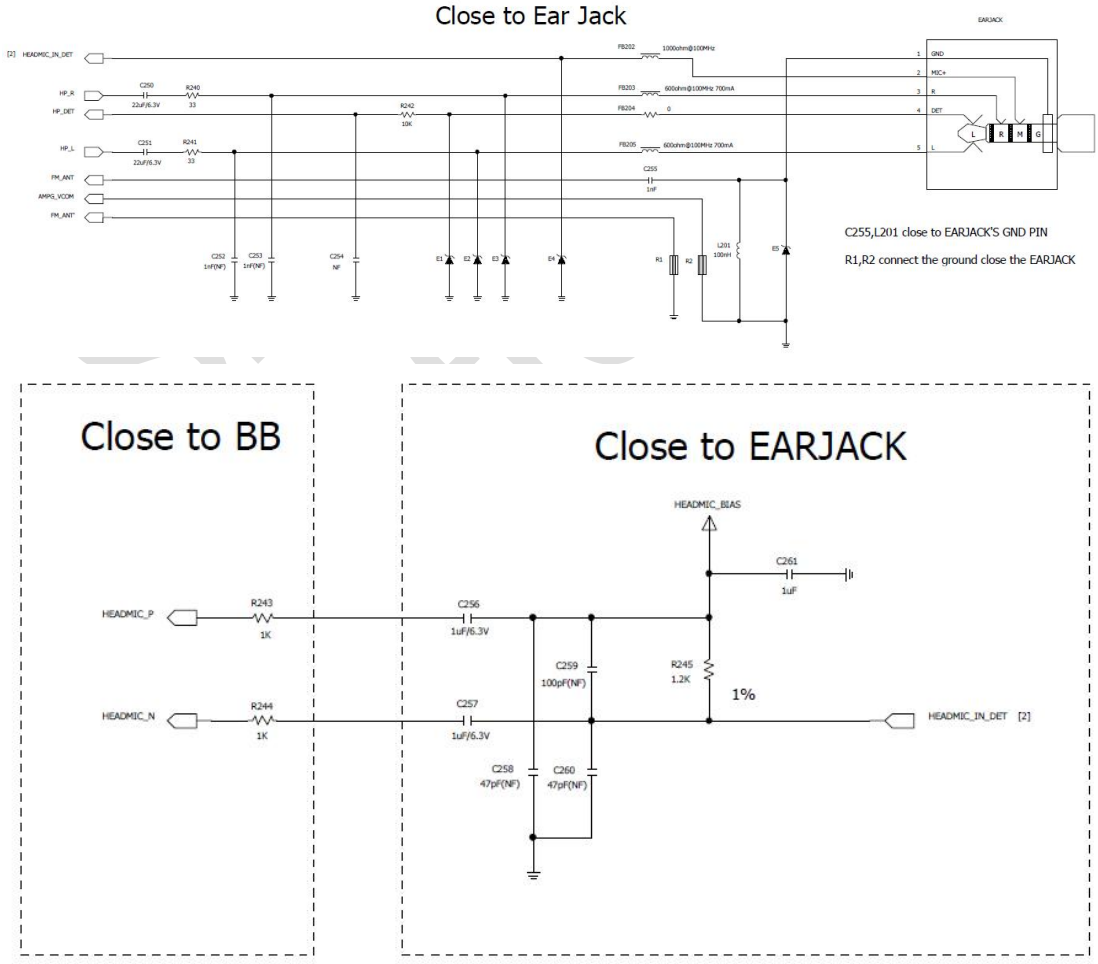


Figure 28 Headphone interface circuit

3.15 Software Download Control

U1_TXD is the firmware download and upgrade control interface. Short-circuit the U1_TXD pin to GND during startup to enter the emergency download mode. It is used for the final processing method when the product cannot start normally or runs due to a fault. In order to facilitate the subsequent software upgrade and debugging of the product, please Reserve this pin test point and place it in a convenient location.
In addition, if the product has multiple buttons, you can also use keyin0 to pull down to enter Firmware download and upgrade mode.

Table 25 Definition of software download control interface

PIN#	pin name	IO	describe	Remark
7	U1_TXD	DI	Software download control	When the system starts, it is detected that this signal is low, and the module enters the USB download mode.
49	KEYIN0	DI	Software download control	When the system starts, it is detected that this signal is low, and the module enters the USB download mode.

3.16 Antenna Interface

The module provides four antenna interfaces: PRI antenna, DRX antenna, GNSS antenna, WiFi /BT antenna. In order to ensure that the customer's product has good wireless performance, the antenna selected by the customer should meet the input impedance of 50 ohms in the working frequency band.

3.16.1 PRI/DRX/ WiFi Antenna Interface

Table 26 Antenna Interface Definition

PIN#	pin name	IO	describe	Remark
26	ANT_WiFi /BT	AI/O	WiFi /BT antenna interface	
29	ANT_GNSS	AI	GNSS antenna interface	
62	ANT_DRX	AI	Diversity Antenna Interface	
83	ANT_PRI	AI/O	Main set antenna	

			interface	

The antenna on the user's motherboard should be connected to the antenna pin of the module using a microstrip line or stripline with a characteristic impedance of 50 ohms. In order to facilitate antenna debugging and certification testing, an RF connector and antenna matching network should be added. The recommended circuit diagram is as follows:

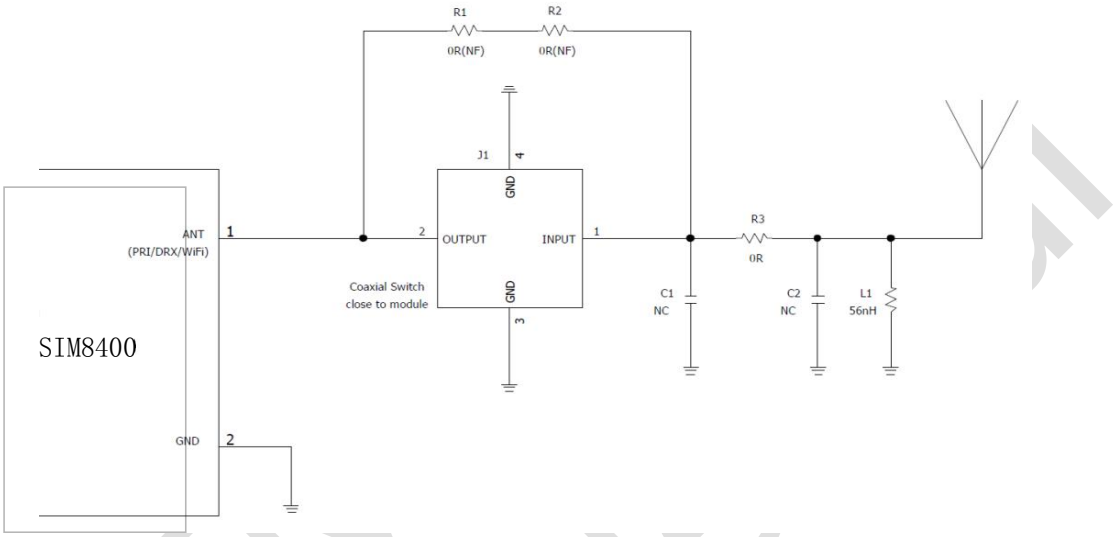


Figure 29 PRI/DRX/ WiFi antenna interface connection circuit

NOTE

1.The cable can be connected to the instrument through the coaxial switch to test and verify the RF index of the system. If the conduction is not tested during mass production, the coaxial switch J1 can be removed, and the antenna interface and antenna of the module can be connected through the two jumper resistors R1 and R2. circuit to connect;
2.The antenna matching network C 1, R 3, and C2 are placed close to the antenna, and the mounting is selected according to the result of antenna debugging;
3.The L1 inductor is used for electrostatic protection of the antenna interface, generally 56nH inductor is selected;
4.If it is a PCB stack of 4 or more layers, the adjacent layer under the antenna pad needs to be hollowed out to reduce the parasitic capacitance effect of the adjacent layer's ground to the antenna pad;
5.The RF line needs to be impedance controlled according to 50 ohms;

3.16.2 GNSS Antennas

GNSS needs to add SAW externally and decide whether to add LNA depending on whether the antenna is active or passive. The reference circuit is shown in the figure below.

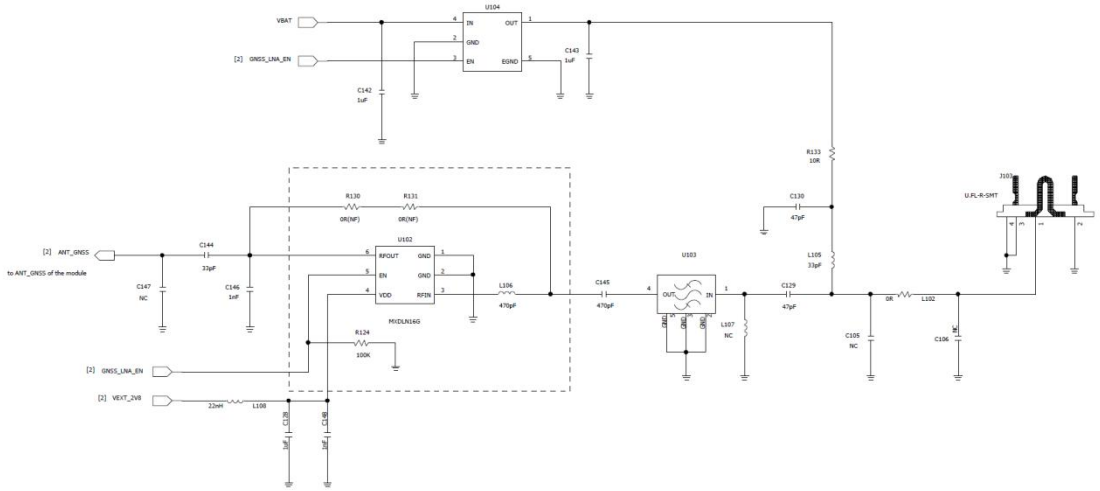


Figure 30 GNSS reference circuit

NOTE

1.If you use an active antenna, you can use R130 and R131 to skip the LNA;

2.R133 is a current-limiting resistor to prevent the power chip from being burned by a large current when the antenna interface is accidentally short-circuited to the ground. The power of the resistor needs to be selected according to the short-circuit current.

3.16.3 Reference Guide for RF Signal Line Layout

For the user PCB, the characteristic impedance of all RF signal lines should be controlled at 50Ω. In general, the impedance of an RF signal line is determined by the dielectric constant of the material, the trace width (W), the ground clearance (S), and the height (H) of the reference ground plane. The control of PCB characteristic impedance usually adopts two methods: microstrip line and coplanar waveguide. In order to reflect the design principle, the following figures show the structural design of the microstrip line and the coplanar waveguide when the impedance line is controlled to 50Ω.

- Microstrip line complete structure

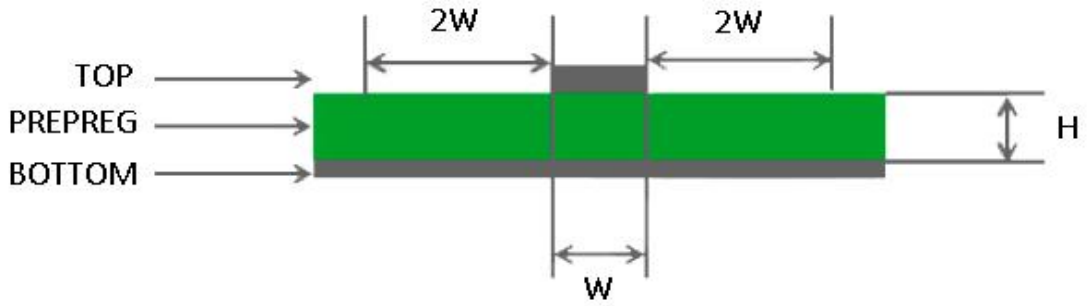


Figure 31 Two-layer PCB board microstrip line structure

- Coplanar waveguide complete structure

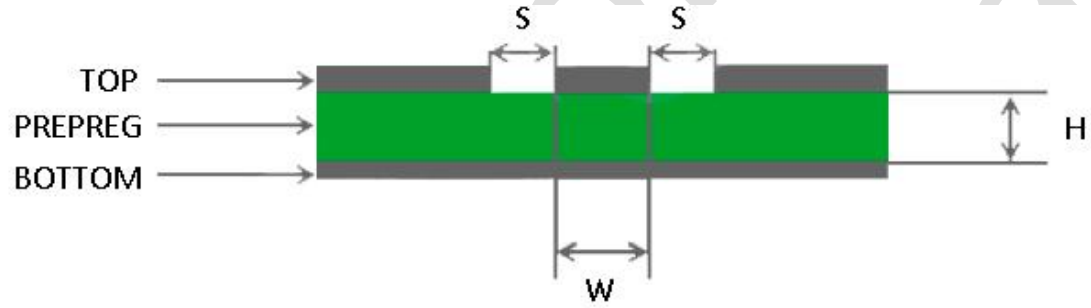


Figure 32 Two-layer PCB board coplanar waveguide structure

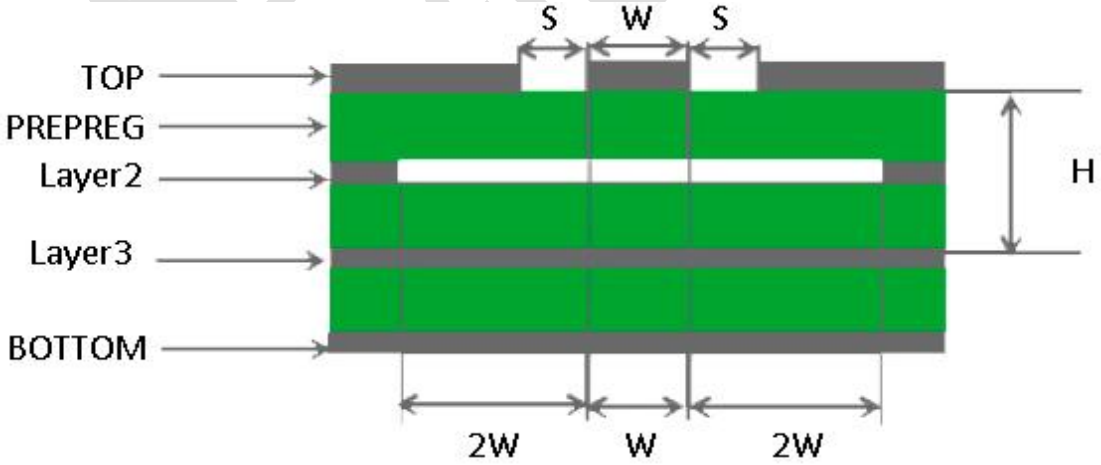


Figure 33 Four-layer PCB board coplanar waveguide structure (reference ground is the third layer)

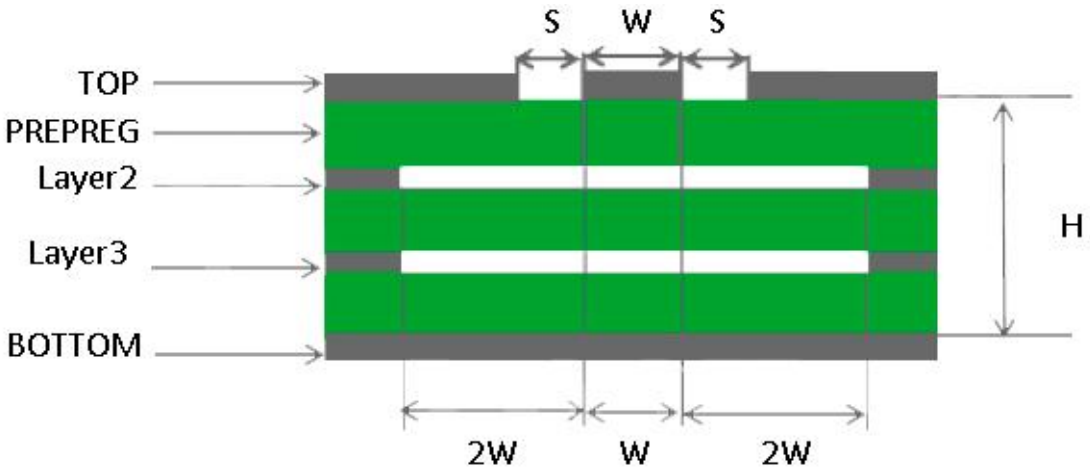


Figure 34 Four-layer PCB board coplanar waveguide structure (reference ground is the fourth layer)

In the circuit design of the RF antenna interface, in order to ensure the good performance and reliability of the RF signal, it is recommended to follow the following design principles in the circuit design:

- An accurate 50Ω impedance control of the RF signal lines should be performed using an impedance simulation calculation tool.
- The GND pin adjacent to the RF pin is not used as a thermal pad, and should be fully contacted with the ground.
- The distance between the RF pins and the RF connector should be as short as possible; at the same time, right-angle wiring should be avoided. The recommended wiring angle is 135 degrees.
- When connecting the device package, it should be noted that the signal pins should be kept a certain distance from the ground.
- The ground plane referenced by the RF signal line should be complete; adding a certain amount of ground holes around the signal line and the reference ground can help improve the RF performance; the distance between the ground hole and the signal line should be at least 2 times the line width (2*W) .

If the antenna uses the cable wire welding method, be sure to pay attention to the stripping method and welding method of the connecting wire, especially the ground should be fully welded. Please operate according to the correct welding method in the figure below to avoid increased wire loss due to poor welding.

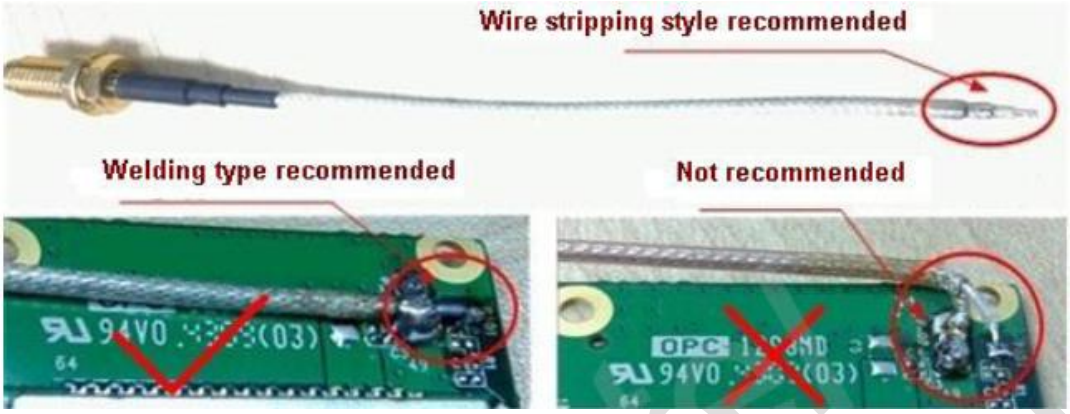


Figure 35 Schematic diagram of the antenna connector using welding

3.16.4 RF Performance Index

3.16.4.1 Operating Frequency

Table 27 SIM8400 operating frequency

Band	Transmit	Receive
GSM850	824～849 MHz	869～894 MHz
GSM900	880~915MHz	925~960MHz
DCS1800	1710~1785MHz	1805~1880MHz
B1	1920~1980MHz	2110~2170MHz
B3	1710~1785MHz	1805~1880MHz
B5	824~849MHz	869~894MHz
B7	2500~2569.9MHz	2620~2689.9MHz
B8	880~915MHz	925~960MHz
B20	832~861.9MHz	791~820.9MHz
B28	703~748 MHz	758~803 MHz
B34	2010~2024.9MHz	
B38	2570~2620MHz	
B39	1880~1920MHz	
B40	2300~2400MHz	
B41	2496~2690MHz	

3.16.4.2 RF Output Power

Table 28 RF output power of SIM8400

Band GSM/EDGE/GPRS	Max	Min
GSM850	33dBm±2dB	5dBm ± 5dB
GSM900	33dBm±2dB	5dBm ± 5dB
DCS1800	30dBm±2dB	0dBm ± 5dB
WCDMA		
B1/5/8	23dBm±2dB	≤ -50 dBm

Band LTE-FDD	Max	Min
B1/3/5/7/8/20/28	23dBm±2dB	≤ -40 dBm
LTE-TDD		
B34/38/39/40/41	23dBm±2dB	≤ -40 dBm

3.16.4.3 RF Receive Sensitivity

Table 29 RF Receive Sensitivity of SIM8400

Band GSM/EDGE/GPRS	Receive sensitivity
GSM850	<-106dBm
GSM900	<-106dBm
DCS1800	<-106dBm
WCDMA	
B1	<-108dBm
B5	<-108dBm
B8	<-108dBm
LTE-FDD(PRX+DRX BW 10MHz)	
B1	<-98dBm
B3	<-95dBm
B5	<-96dBm
B7	<-96dBm
B8	<-96dBm
B20	<-96dBm
B28	<-96dBm
LTE-TDD(PRX+DRX BW 10MHz)	
B34/38/39/40	<-98dBm
B41	<-97dBm

3.16.4.4 Antenna Requirements

Main/Diversity Antenna Requirements

Table 30 SIM8400 Antenna Specification Requirements

Band	VSWR	Gain		Efficiency	SAR	TRP	TIS
		Peak	Avg.			(dBm)	(dBm)
GSM850	<2.5:1	>0dBi	>-4dBi	>40%	<1.6 W/Kg	29	<-102
GSM900						29	<-102
DCS1800						26	<-102
B1 FDD						19	<-94
B1 WCDMA						19	<-106
B3 FDD						19	<-91
B5 FDD						19	<-93
B5 WCDMA						19	<-104
B8 FDD						19	<-93
B8 WCDMA						19	<-104

B7						19	<-93
B20						19	<-93
B28						19	<-93
B34						19	<-93
B38						19	<-93
B39						19	<-93
B40						19	<-93
B41						19	<-93

WiFi /BT Antenna Requirements

Table 31 SIM8400 WiFi /BT Antenna Requirements

project	Require
Frequency Range	2.412~2.484GHz
VSWR	<2:1 recommended
Gain(dBi)	1 typical
Max Input Power (W)	50
Input Impedance (Ω)	50
Polarization Type	Vertical

GNSS Antenna Requirements

Table 32 SIM8400 GNSS Antenna Requirements

Parameter	Requirements
Frequency range	1559MHz~1607MHz
Polarization	RHCP or linear
VSWR	< 2:1 (Typ.)
Passive antenna gain	> 0dBi
Active antenna noise figure	< 1.5dB
Active antenna gain	> -2dBi
Active antenna embedded LNA gain	20dB (Typ.)
Active antenna total gain	18dBi (Typ.)

4 PCB Layout

The quality of a product's performance largely depends on the PCB traces. As mentioned earlier, if the PCB layout is unreasonable, it may cause interference problems such as card dropping. The way to solve these interferences is often to redesign the PCB. If a good PCB layout can be planned in the early stage, so that the PCB routing is smooth, it can save a lot of time. , Of course, it can also save a lot of costs. This chapter mainly introduces some matters that customers should pay attention to in the PCB layout stage to minimize interference problems and shorten the customer's research and development cycle.

The SIM8400 module includes high-speed USB, MIPI and other sensitive data lines, and has strict requirements on the length and impedance of the signal lines. If the high-speed signal processing is not good, it will cause serious EMI problems, and even more serious will affect the USB Therefore, when using the SIM8400 module, the PCB design requirements are much higher than that of the previous 2G module. Please read this chapter carefully to reduce the subsequent hardware debugging cycle.

When using the SIM8400 module, the customer requires that the PCB should preferably use a 4 -layer through-hole design, which is convenient for impedance control and signal line shielding .

4.1 Module PIN Distribution

Before PCB layout, we must first understand the pin distribution of the module, and rationally layout related devices and interfaces according to the distribution defined by the pins.

4.2 PCB Layout Principles

There are several aspects to pay attention to in the PCB layout stage:

4.2.1 Antenna

Antenna part design, SIM8400 module has a total of 4 antenna interfaces, they are: ANT_PRI, ANT_DRX, ANT_GPS, ANT_WIFI. Attention should be paid to the placement of components and RF wiring:

- The RF test head is used to test the conducted RF performance and should be placed as close as possible to the antenna pins of the module;
- The antenna matching circuit needs to be placed close to the antenna end;
- The connection from the antenna pin of the module to the antenna matching circuit must be controlled by 50 ohm impedance;
- The components and connections between the antenna pins of the module and the antenna connector must be kept away from high-speed signal lines and strong interference sources, and avoid crossing or paralleling with any signal lines on adjacent layers.
- The length of the radio frequency line between the antenna pin of the module and the antenna

connector should be as short as possible, and the situation of crossing the entire PCB board should be absolutely avoided;

- If the antenna is connected by a coaxial radio frequency line, care should be taken to avoid making the coaxial radio frequency line straddle the SIM card, power supply circuit, and high-speed digital circuit to minimize mutual influence.

4.2.2 Power

The power trace should not only consider VBAT, but also the return GND of the power supply. The trace of the positive pole of VBAT must be short and thick, and the trace must first pass through a large capacitor, a Zener diode, and then to the power PIN of the module. It is necessary to ensure that the GND path of the power supply is the shortest and most unobstructed. In this way, the current path of the entire power supply can be guaranteed to be the shortest and the interference can be minimized.

4.2.3 SIM Card

The SIM card has a large area and has no anti-EMI interference device, so it is more susceptible to interference. Therefore, when laying out, first ensure that the SIM card is far away from the antenna and the antenna extension cable inside the product, and is placed as close to the module as possible. When routing the PCB, pay attention to To protect the SIM_CLK signal, the SIM_DATA, SIM_RST and SIM_VDD signals of the SIM card should be kept away from the power supply and high-speed signal lines. If it is not handled properly, it will easily cause the card not to recognize or drop the card, so please follow the following principles when designing:

- In the PCB layout stage, the SIM card holder must be kept away from the GSM antenna;
- The SIM card wiring should be as far away as possible from RF lines, VBAT and high-speed signal lines, and the SIM card wiring should not be too long;
- The GND of the SIM card holder should maintain good connectivity with the GND of the module, so that the two GNDs are equipotential;
- In order to prevent SIM_CLK from interfering with other signals, it is recommended to protect SIM_CLK;
- It is recommended to place a 100nF capacitor on the SIM_VDD signal line close to the SIM card holder;
- Place TVS near the SIM card holder, the parasitic capacitance of the TVS should not be greater than 50pF, and a 51Ω resistor in series with the module can enhance ESD protection;
- Add 22pf capacitance to ground for SIM card signal line to prevent radio frequency interference;
- The return path of VBAT has a large current passing through, so the SIM card wiring should avoid the return path of VBAT as much as possible.

4.2.4 MIPI

MIPI is a high-speed signal line. Customers must pay attention to protection during the layout stage to keep it away from the signal line that is easily disturbed. It is best to pack GND on the top, bottom, left and right. Impedance consistency, please do not bridge different GND planes.

When choosing an ESD device for the MIPI interface, please choose a TVS with a small capacitance value. It is recommended that the parasitic capacitance be less than 1pF.

MIPI routing requirements are as follows:

- It is required to control 100 ohm differential impedance, with an error of ±10%;
- The length error of the differential line within the group is controlled within 1mm;
- The length error between groups is controlled within 2mm.

4.2.5 USB

The module supports high-speed USB interface, and the rate reaches 480Mbps. The customer recommends adding a common mode inductor in the schematic design stage, which can effectively suppress EMI interference. If the customer needs to increase electrostatic protection, please choose a TVS tube with a parasitic capacitance less than 2pF. Please refer to the following precautions when Layout:

- Please keep the common mode inductor close to the side of the USB connector;
- It is required to control 90 ohm differential impedance with an error of ±10%;
- The length error of the differential line is controlled within 6mm;
- If the USB has a charging function, please pay attention to the VBUS trace as wide as possible;
- If there are test points, try to avoid bifurcation of the traces, and place the test points on the path of the traces .

4.2.6 Audio

Module analog signals are susceptible to interference from high-speed digital signals. So please stay away from high-speed digital signal lines. The module supports the GSM standard, and the GSM signal can interfere with the audio through coupling and conduction. Users can add 33pF and 10pF capacitors to the audio path to filter out coupling interference. The 33pF capacitor mainly filters out the interference in the GSM850/EGSM900 frequency band, and the 10pF capacitor mainly filters out the interference in the DCS1800/PCS1900 frequency band. The coupling interference of TDD has a lot to do with the user's PCB design. In some cases, TDD in the GSM850/EGSM900 frequency band is more serious, and in some cases, the TDD interference in the DCS1800/PCS1900 frequency band is serious. Therefore, users can select the required filter capacitors according to the actual test results, and sometimes even do not need to paste filter capacitors.

The GSM antenna is the main source of coupling interference for TDD, so users should pay

attention to keeping the audio traces away from the GSM antenna and VBAT during PCB layout and routing. It is best to place a set of audio filter capacitors close to the module end, and another set close to the interface end. The audio output should be routed according to the differential signal rules.

The conducted interference is mainly caused by the voltage drop of VBAT. If the Audio PA is directly powered by VBAT, it is easier to hear the "squeak" sound at the output end of the SPK. Therefore, it is best to connect the input end of the Audio PA in parallel in the schematic design. Some bulk capacitors and ferrite beads in series.

TDD and GND are also closely related. If the GND is not handled properly, many high-frequency interference signals will interfere with the MIC and Speaker through bypass capacitors and other devices. Therefore, the user should ensure the good performance of the GND in the PCB design stage.

4.2.7 Others

The serial port interface of the module should also keep the distance as short as possible.

5 Electrical Characteristics And Environmental Reliability

5.1 Absolute Maximum

The table below shows the absolute maximum values that the module can withstand, any time exceeding these limits may result in permanent damage to the module.

Table 33 SIM8400 Absolute Maximum

parameter	minimum	maximum value	unit
VBAT	-0.3	6	V
VBUS	-0.3	28	V
peak current	-	2	A

5.2 Recommended Working Voltage

Table 34 SIM8400 working voltage

parameter	minimum	Typical value	maximum value	unit
VBAT	3.4	3.8	4.2	V
VBUS	4.5	5	9.2	V

5.3 Operating Temperature

The following table shows the operating temperature range of the module:

Table 35 SIM8400 operating temperature

parameter	minimum	Typical value	maximum value	unit
Operating temperature	-25	-	60	°C

storage temperature	-40	-	90	°C

5.4 VSIM Features

Table 36 SIM8400 VSIM0, VSIM1 Features

parameter	describe	minimum	Typical value	maximum value	unit
V O	The output voltage	- -	3 1.8	- -	V
IO _	Output current	-	-	50	mA

5.5 VCOIN Characteristics

Table 37 SIM8400 VCOIN Features

parameter	describe	minimum	Typical value	maximum value	unit
VCOIN -IN	VCOIN input voltage	2.85	3	3.15	V
I RTC-IN	VCOIN current consumption	-	2.5		uA
VCOIN -OUT	VCOIN output voltage	-	3	-	V
I RTC-OUT	VCOIN output current	-		2	mA

5.6 Digital Interface Features

Table 38 SIM8400 digital interface characteristics (1.8V)

parameter	describe	minimum	Typical value	maximum value	unit
V IH	Input high level voltage	1.3	-	1.85	V
VIL _	Input low level	0	-	0.56	V

	voltage				
VOH _	output high level voltage	1.67	-	1.8	V
VOL _	output low level voltage	0	-	0.1	V

5.7 Power Consumption In Various Modes (VBAT=3.8V)

Table 39 SIM8400 power consumption

parameter	describe	condition	minimum	Typical value	maximum value	unit
VBAT	voltage	Voltage must be between maximum and minimum	3.4	3.8	4.2	V
Ivbat	Average current	shutdown mode	-	60		uA
		GSM standby power consumption@GSM 900,DRX =2	-	3		mA
		LTE standby power consumption @Band 40,DRX =256	-	2.3		mA
	Call consumption	GSM900@33dBm	-	250		mA
		LTE Band40@23dBm	-	350		mA
	data		-	-		mA
Imax	peak current	Power control at maximum output power	-		2	A

5.8 Environmental Reliability Requirements

Table 40 SIM8400 Wireless Module Environmental Reliability Requirements

Test items	Test Conditions
low temperature	Temperature -45℃±3℃, 24 hours in shutdown state

<table>
<tr><th>Test items</th><th>Test Conditions</th></tr>
<tr><td>storage test</td><td></td></tr>
<tr><td>High temperature storage test</td><td>Temperature +90℃±3℃, 24 hours in shutdown state</td></tr>
<tr><td>Temperature shock test</td><td>In the shutdown state, the temperature is -45°C and +90°C for 0.5h, the temperature conversion time is less than 3min, and a total of 24 cycles are performed</td></tr>
<tr><td>High temperature and high humidity test</td><td>Temperature +90℃±3℃, humidity 90~95%RH, 24 hours in shutdown state</td></tr>
<tr><td>Low temperature operation test</td><td>Temperature -25℃±3℃, 24 hours under working condition</td></tr>
<tr><td>High temperature running test</td><td>Temperature +60℃±3℃, continuous 24 hours under working condition</td></tr>
<tr><td>Vibration test</td><td>Vibration tests are performed according to the requirements shown in the table below:
<table><tr><td>frequency</td><td>Random Vibration ASD (Acceleration Spectral Density)</td></tr><tr><td>5~20Hz</td><td>0.96m ^{2}/s ^{3}</td></tr><tr><td>20~500Hz</td><td>0.96m ^{2}/s ^{3} (at 20Hz), other -3dB/octave</td></tr></table></td></tr>
</table>

5.9 ESD Characteristics

The SIM8400 wireless module is a consumer end product. Although the ESD problem has been considered in the module design and ESD protection has been done, it is considered that the SIM8400 module may also have ESD problems during transportation and secondary development, so developers should consider the protection of the final product ESD problems, please refer to Recommended circuits for interface design in the documentation. Refer to the table below for the ESD allowable discharge range of the SIM8400 wireless module .

Table 41 Anti -ESD Characteristics of SIM8400 Interface

pin	Air discharge	Contact discharge
VBAT, GND	±8KV	±4KV
Main set / WiFi (BT) / GNSS antenna interface	±8KV	±4KV
Diversity Antenna Interface	± 1.5 KV (HBM, JESD22-A114)	
Other interfaces	± 2kV (ESDA/JEDEC JDS-001-2014)	

6 Manufacturing

6.1 Top and Bottom View of SIM8400

The SIM8400 module is a PCBA with a single-sided layout, which is shielded and protected by a shield, as shown in Figure.

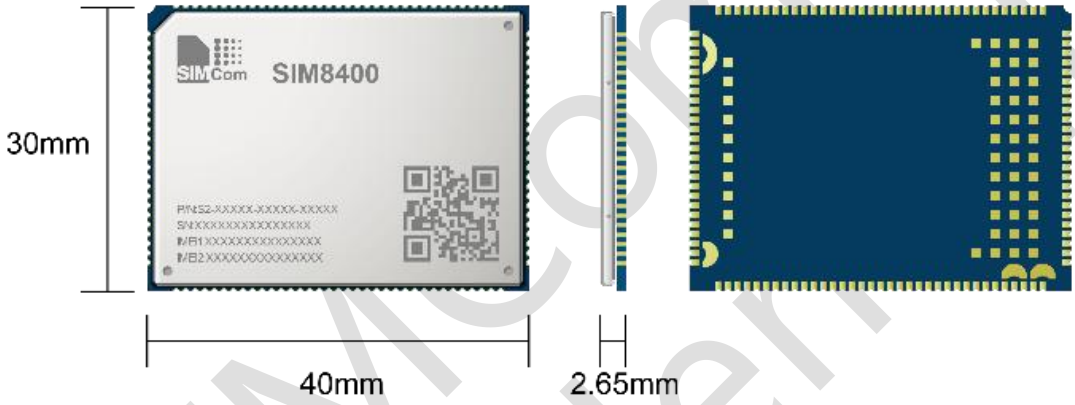


Figure 36 Top and bottom view of SIM8400

NOTE

Figure is the effect diagram of the module, for reference only. Please refer to the actual product for appearance.

6.2 Mechanical Properties

6.2.1 Module 3D Drawing

We provide complete structure diagrams. If you need 3D image modeling, please contact to request the 3D documentation of SIM8400 series wireless module.

6.2.2 Module 2D Structure Diagram

We provide complete structure diagrams. If necessary, please contact to request.

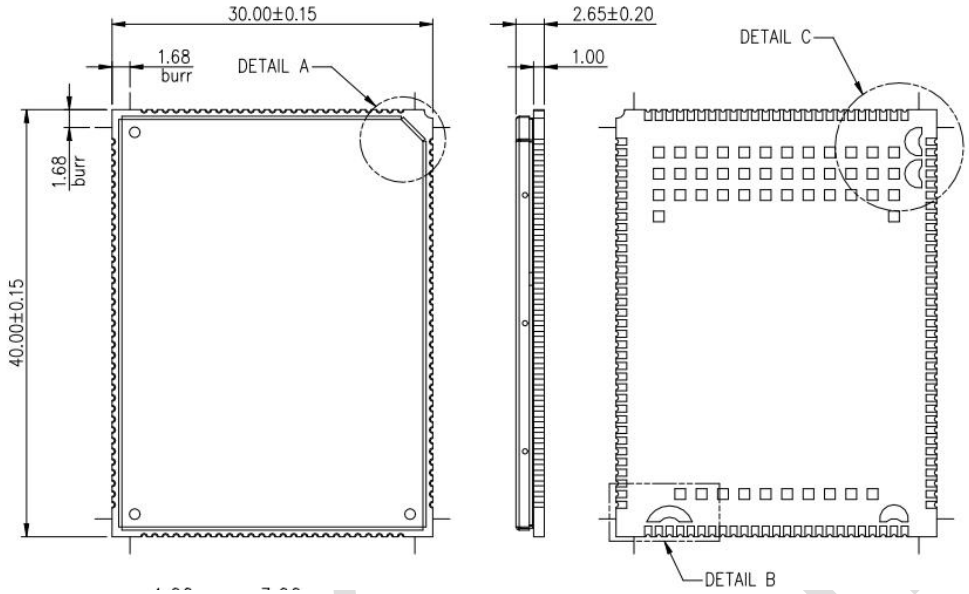


Figure 37 SIM8400 structure diagram

6.3 Recommended PCB Footprint

The following figure shows the PCB footprint of SIM8400 Series.

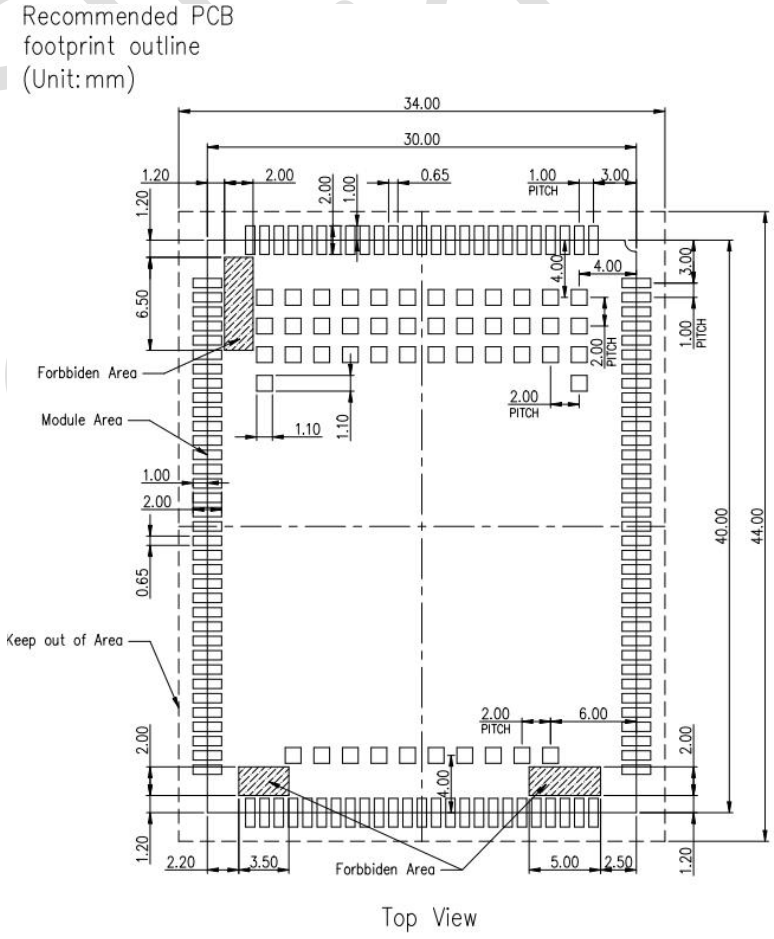


Figure 38 SIM8400 module recommended PCB package size and pad size

6.4 Recommended SMT Stencil

Recommended stencil design:

a partial positive stepped steel mesh of about 0.2mm at the module position ;

2. Expand the stencil at the PIN pin of the module by about 0.15mm, so that the solder paste can be collected on the PIN pin of the module when the module is reflowed, and the tin can be climbed;

3. On the inner side of the module PIN pin, the steel mesh opening should be parallel to the inner side of the module PIN pin at most, so as to avoid the solder paste being squeezed under the module and jacking up the module, resulting in floating high and virtual soldering.

At the same time, each SMT factory of the customer makes appropriate adjustments and supplements according to the equipment condition and process of the factory.

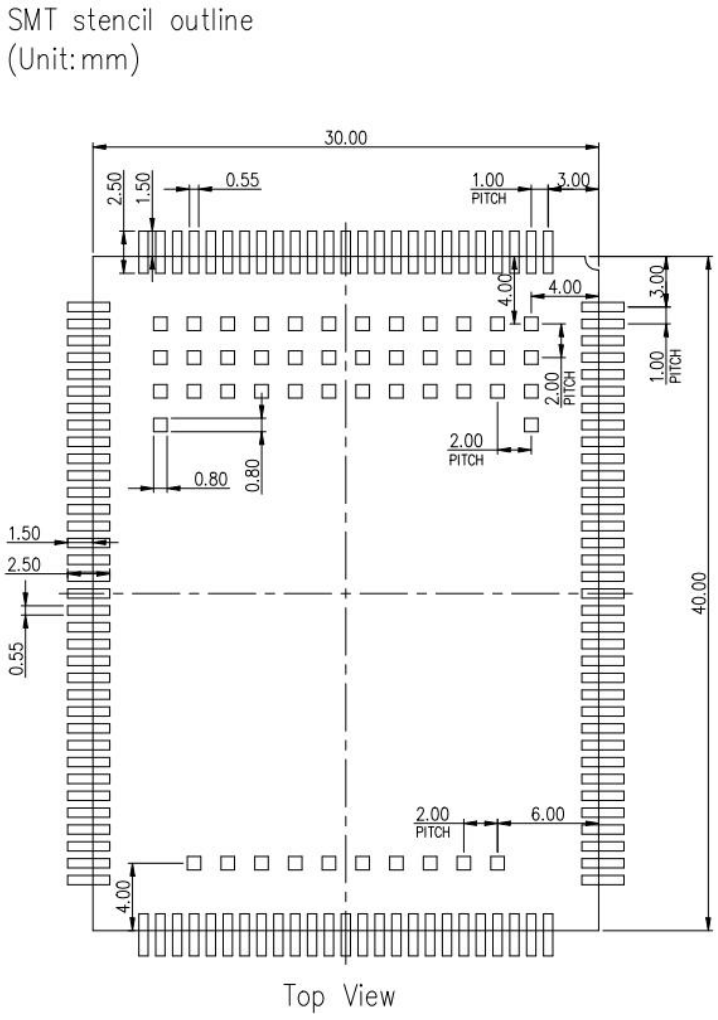


Figure 39 Recommended stencil file for SIM8400

6.5 SIM8400 Series Wireless Module Application Package Recommendation

Package files required by customers for design, including schematic package diagram and PCB package diagram. We have special recommendation materials, please contact us when you need them.

6.6 Storage conditions and baking requirements

The SIM8400 module has a moisture sensitivity level of 3, and the module is shipped in a vacuum-sealed bag. The storage of modules is subject to the following conditions:

1. When the ambient temperature is below 40 degrees Celsius and the air humidity is below 90%, the module can be stored in a vacuum sealed bag for 12 months.

2. When the vacuum seal bag is opened, if the following conditions are met, the module can be directly reflowed or other high temperature processes:

- Module storage air humidity is less than 10%.
- The ambient temperature of the module is less than 30 degrees Celsius, the air humidity is less than 60%, and the factory completes the patch within 72 hours.

3. If the module is under the following conditions, it needs to be baked before placement:

- When the ambient temperature is 23 degrees Celsius (the fluctuation of 5 degrees Celsius is allowed), the humidity indicator card shows that the humidity is greater than 10%.
- When the vacuum sealed bag was opened, the ambient temperature of the module was lower than 30 degrees Celsius and the air humidity was less than 60%, but the factory failed to complete the placement within 72 hours.
- When the vacuum seal bag is opened, the module storage air humidity is greater than 10%.

4. If the module needs to be baked, the baking conditions are as follows:

Table 42 SIM8400 Baking Requirements

Baking temperature	bake time	Remark
125±5℃	23~48 hours	The packaging tape and reel cannot withstand the high temperature of 125°C. If baking at 125°C, please remove the module packaging before the module is baked.
45±5℃	120~216 hours	

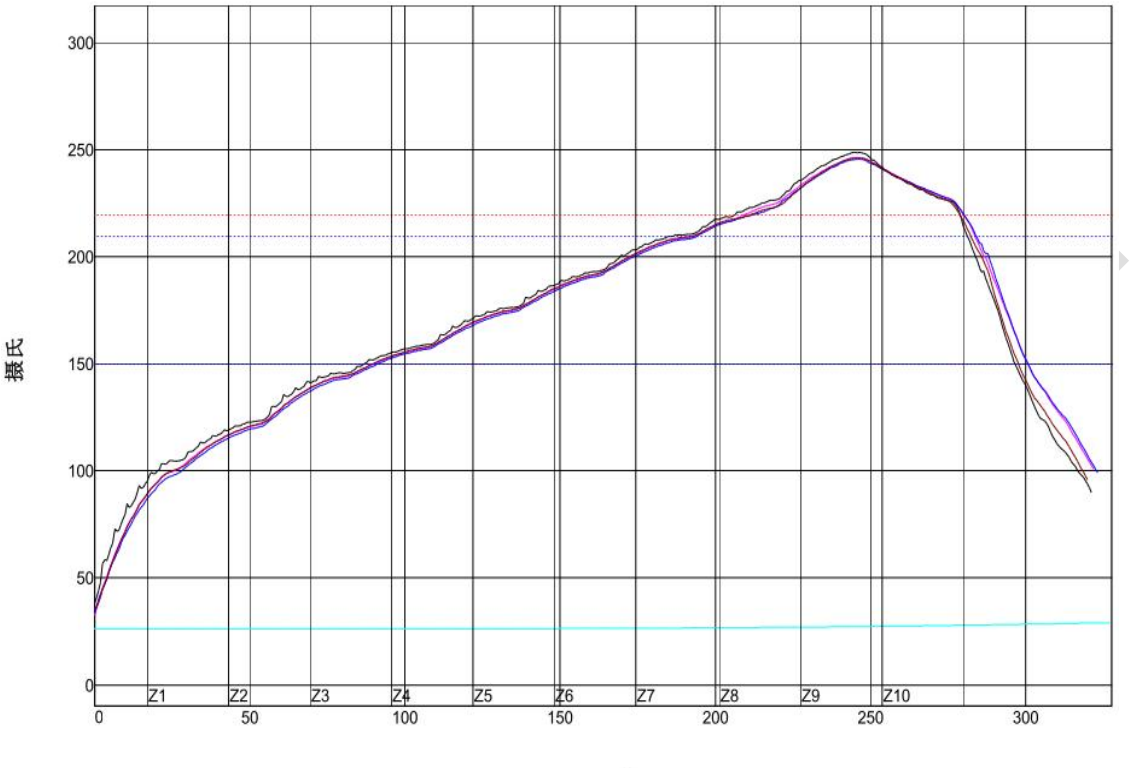
6.7 Panel Design

1. The double-sided imposition method is adopted, and the modules need to be unified on one side of the PCB. That is, when SMT is mounted, the module surface needs to be veneered at the back to prevent the solder paste from melting for the second reflow of the mold, which will cause virtual soldering or falling due to its own weight.
2. The edge of the board and the connecting ribs need to be able to support the module, so that the entire imposition can be evenly stressed, so as to avoid product deformation during printing and patching, resulting in poor patching.

6.8 Furnace Temperature Curve

Use a printing squeegee to print solder paste on the stencil, so that the solder paste is leaked onto the PCB through the opening of the stencil, and the printing squeegee strength needs to be adjusted appropriately. In order to avoid damage to the module due to repeated heating, it is recommended that customers attach the module after the reflow soldering of the first side of the PCB is completed. The recommended reflow curve temperature chart is shown below. The curve is related to the external environment such as soldering and the solder paste used. Please adjust the factory process engineer according to the actual situation.

Setpoints (摄氏)										
温区	1	2	3	4	5	6	7	8	9	10
上温区	100	120	140	160	180	200	215	230	260	220
下温区	100	120	140	160	180	200	215	230	255	220
Conveyor Speed (公分/分):	85.00									



PWI= 80%	最高上升斜率		最高下降斜率		恒温时间150至210C		回流时间 /220C		最高温度	
2	2.62	62%	-3.23	18%	103.87	-8%	70.54	-16%	246.56	31%
3	2.55	55%	-3.22	19%	103.42	-11%	67.24	-42%	245.83	17%
5	2.65	65%	-3.73	-15%	100.02	-33%	72.24	-2%	249.01	80%
6	2.56	56%	-3.50	0%	103.49	-10%	67.06	-43%	246.36	27%
温差	0.10		0.51		3.85		5.18		3.18	

制程界限:

锡膏:	M705-GRN360		
统计数名称	最低界限	最高界限	单位
最高温度上升斜率 (目标=2.0) (计算斜率的时间距离= 25 秒)	1	3	度/秒
最高温度下降斜率 (计算斜率的时间距离= 25 秒)	-5	-2	度/秒
恒温时间150-210摄氏度	90	120	秒
回流以上时间 - 220摄氏度	60	85	秒
最高温度	240	250	度 摄氏

Figure 40 Furnace temperature curve

NOTE

Refer to “Module secondary-SMT-UGD” for more information about the module shipping and manufacturing.

Table 43 Furnace temperature curve parameters

Profile Feature	Pb-Free Assembly
Initial temperature (T_I)	25 °C
Average temperature slope (T_I to T_{Smin})	0.5-2.0 °C /second
Preheat & Soak	
Temperature Minimum (T_{Smin})	150°C
Temperature Maximum (T_{Smax})	210°C
Time (t_{Smin} to t_{Smax}) (t_S)	90-120 seconds
Average ramp up rate (T_{Smax} to T_P)	3K/second max.
Liquidous temperature (T_{L1}) Time at liquidous (t_R)	217°C 30-90 seconds
Peak package body temperature (T_P)	245°C +0/-5°C
Time (t_P) within 5 °C of the peak package body temperature (T_P)	30 seconds max.
Average ramp-down rate (T_P to T_{Smax})	6K/second max.
Time of cold-down (T_P to T_{L2})	0-60 seconds
Time TI to maximum (T_I to T_P)	8 min max.

6.9 Packaging

module support tray packaging.

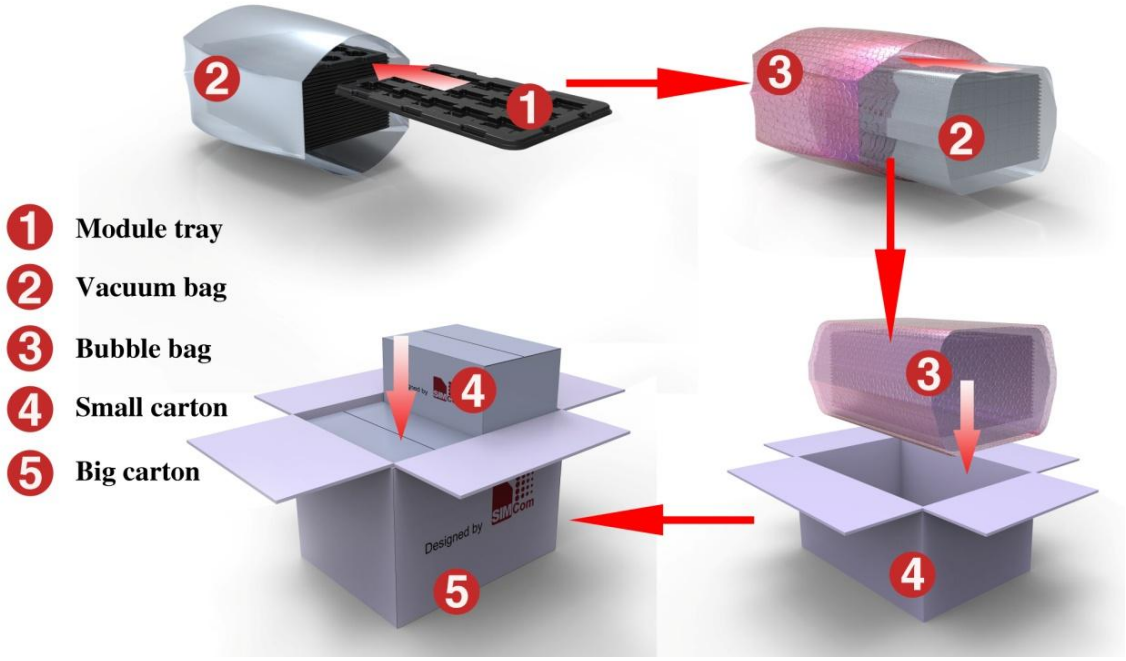


Figure 41 Packaging introduce

Module tray drawing：

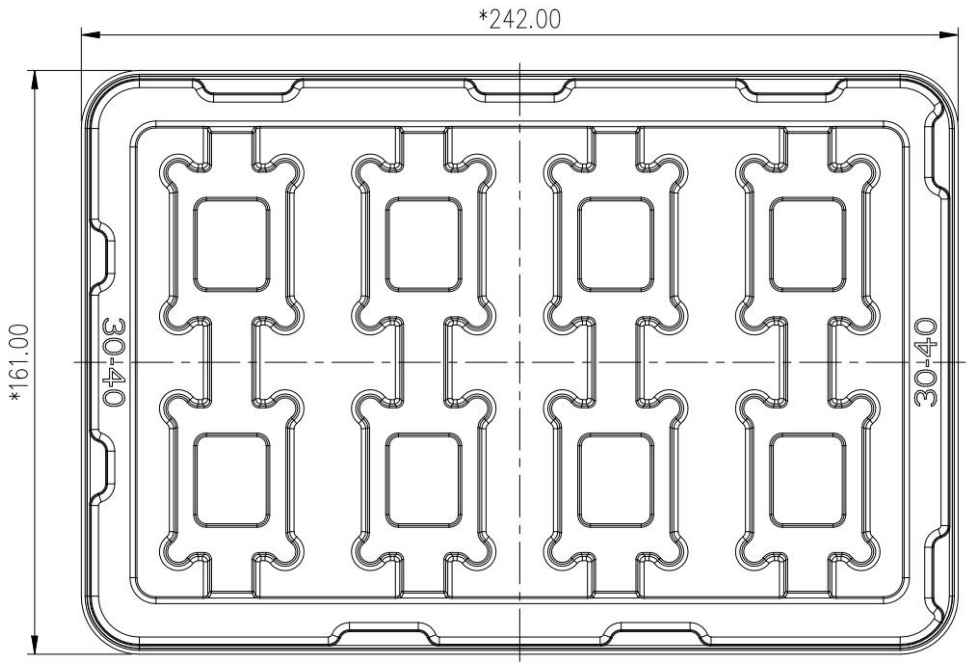


Figure 42 Module tray drawing introduce

Table 44 Tray size

Length（±3mm）	Width（±3mm）	Module number
242.0	161.0	8

Small carton drawing：

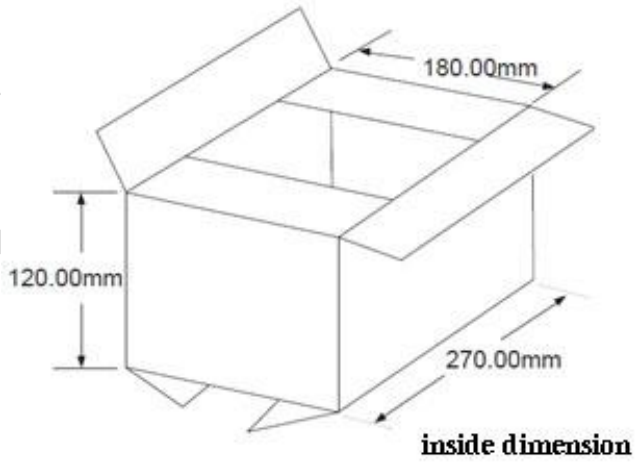


Figure 43 Small carton drawing introduce

Table 45 Small Carton size

Length（±10mm）	Width（±10mm）	Height（±10mm）	Module number
270	180	120	8*18+6=150

Big carton drawing：

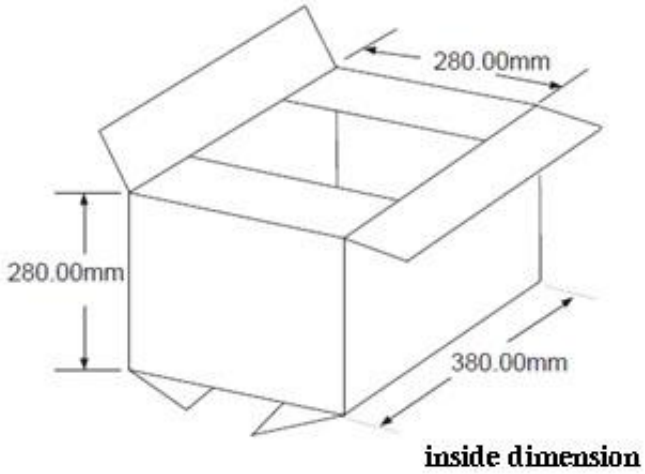


Figure 44 Big carton drawing introduce

Table 46 Big Carton size

Length（±10mm）	Width（±10mm）	Height（±10mm）	Module number
380	280	280	150*4=600

7 Appendix

7.1 Abbreviations

Table 44 Abbreviation description comparison table

abbreviation	describe	Chinese description
AMR	Adaptive Multi-rate	adaptive multi-rate
BDS	Beidou Navigation Satellite System	Beidou Navigation Satellite System
BER	Bit Error Rate	bit error rate
BLE	Bluetooth Low Energy	Bluetooth Low Energy
BTS	Base Transceiver Station	base transceiver station
PCI	Peripheral Component Interconnect	Peripheral Component Interconnect
CS	Circuit Switched (CS) domain	circuit domain
CSD	Circuit Switched Data	circuit switched data
DCE	Data communication equipment	Data Circuit Termination Equipment
DTE	Data terminal equipment	data terminal equipment
DTR	Data Terminal Ready	data terminal ready
EDGE	Enhanced Data rates for GSM Evolution	Enhanced GPRS
EFR	Enhanced Full Rate	Enhanced full rate
EGSM	Enhanced GSM	Enhanced GSM
EMC	Electromagnetic Compatibility	Electromagnetic Compatibility
ESD	Electrostatic Discharge	electrostatic discharge
FR	Frame Relay	Frame Relay
GLONASS	GLObalnaya NAvigatsionnaya Sputnikovaya Sistema	Global Navigation Satellite System
GMSK	Gaussian Minimum Shift Keying	Gaussian Minimum Shift Keying
GNSS	Global Navigation Satellite System	Global Navigation Satellite System
GPIO	General Purpose Input Output	General purpose input/output
GPS	Global Positioning System	Global Positioning System
GPRS	General Packet Radio Service	General Packet Radio System
GSM	Global Standard for Mobile Communications	Global Standard System for Mobile Communications
HR	Half Rate	half speed
HSDPA	High Speed Downlink Packet Access	High Speed Downlink Packet Access
HSUPA	High Speed Uplink Packet Access	High-speed uplink packet access
HSPA	HSPA High-Speed Packet Access	high-speed packet access
IEC	International Electro-technical Commission	International Electrotechnical Commission
IMEI	International Mobile Equipment Identity	International Mobile Equipment Identity
IO	Input/Output	input Output
ISO	International Standards Organization	International Organization for

abbreviation	describe	Chinese description
		Standardization
ITU	International Telecommunications Union	ITU
bps	bits per second	bits per second
led	Light Emitting Diode	led
LTE	Long Term Evolution	long term evolution technology
M2M	Machine to machine	machine to machine
MCU	Micro Control Unit	microprocessor unit
MO	Mobile Originated	mobile station
MT	Mobile Terminated	mobile terminated
NTC	Negative Temperature Coefficient	negative temperature coefficient
PC	Personal Computer	Personal computer
PCB	Printed Circuit Board	printed circuit board
PCS	Personal Cellular System	personal cellular system
PCI	Peripheral Component Interconnect	Peripheral Component Interconnect
PCM	Pulse Code Modulation	pulse code modulation
PCS	Personal Communication System	GSM1900
PDU	Packet Data Unit	Packet data unit
PPP	Point-to-point protocol	point-to-point protocol
PS	Packet Switched	packet switching
QPSK	Quadrate Phase Shift Keying	Quadrature Phase Shift Keying
QZSS	Quasi-Zenith Satellite System	Quasi-Zenith Satellite System
SBAS	Satellite-Based Augmentation System	satellite based augmentation system
SIM	Subscriber Identity Module	user identification module
TCP/IP	Transmission Control Protocol/ Internet Protocol	Transmission Control Protocol/Internet Protocol
UART	Universal asynchronous receiver-transmitter	Universal Asynchronous Receiver/Transmitter (Machine)
UMTS	Universal Mobile Telecommunications System	Universal Mobile Communication System
USB	Universal Serial Bus	Universal Serial Bus
USIM	Universal Subscriber Identity Module	Universal Subscriber Identity Module
WCDMA	Wideband Code Division Multiple Access	wideband code division multiple access

7.2 Safety Caution

Pay attention to the following safety precautions when using or repairing any terminal or mobile phone containing modules. The user shall be informed of the following security information on the terminal equipment. Otherwise SIMCom will not be liable for any consequences of the user failing to follow these warnings.

Table 45 Safety caution

Marks	Requirements
	When in a hospital or other health care facility, observe the restrictions about the use of mobiles. Switch the cellular terminal or mobile off, medical equipment may be sensitive and not operate normally due to RF energy interference.
	Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it is switched off. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. Forgetting to think much of these instructions may impact the flight safety, or offend local legal action, or both.
	Do not operate the cellular terminal or mobile in the presence of flammable gases or fumes. Switch off the cellular terminal when you are near petrol stations, fuel depots, chemical plants or where blasting operations are in progress. Operation of any electrical equipment in potentially explosive atmospheres can constitute a safety hazard.
	Your cellular terminal or mobile receives and transmits radio frequency energy while switched on. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment.
	Road safety comes first! Do not use a hand-held cellular terminal or mobile when driving a vehicle, unless it is securely mounted in a holder for hands free operation. Before making a call with a hand-held terminal or mobile, park the vehicle.
	Mobiles operate over radio frequency signals and cellular networks and cannot be guaranteed to connect in all conditions, especially with a mobile fee or an invalid (U)SIM card. While you are in this condition and need emergent help, please remember to use emergency calls. In order to make or receive calls, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength. Some networks do not allow for emergency call if certain network services or phone features are in use (e. g. lock functions, fixed dialing etc.). You may have to deactivate those features before you can make an emergency call. Also, some networks require that a valid (U)SIM card be properly inserted in the cellular terminal or mobile.