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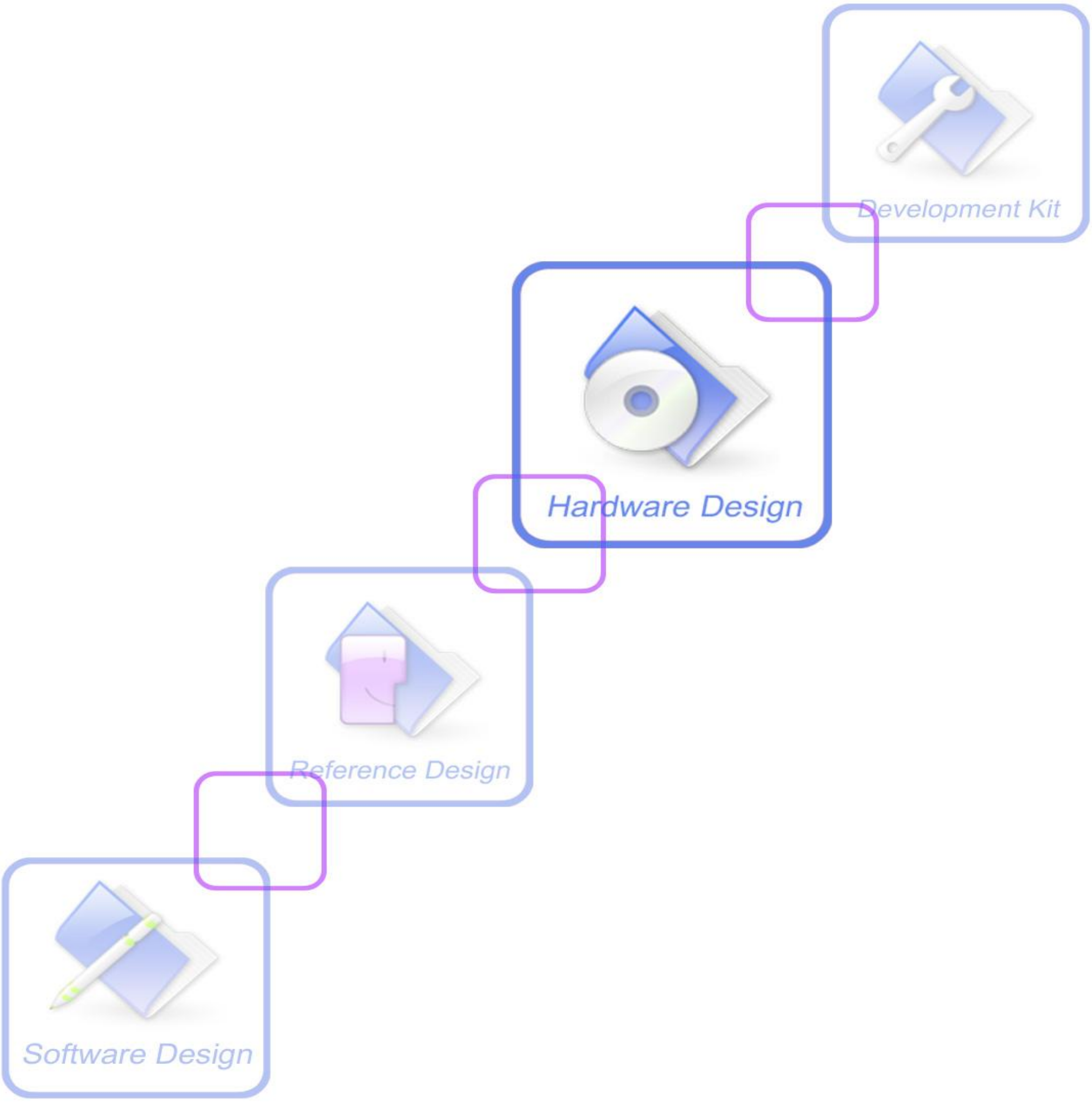
SIM868_Hardware_Design_V1.01



Document Title	SIM868 Hardware Design
Version	V1.01
Date	2016-08-01
Status	Release
Document Control ID	SIM868_Hardware_Design_V1.01

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Version History

Date	Version	Description of change	Author
2016-06-20	1.00	Origin	Yanwu.Wang; Xiaoxu.Chen
2016-08-01	1.01	1. Update figure 1 2. Add voltage range of GPS_VBAT 3. Add voltage range of VRTC 4. Add voltage range of GNSS_EN 5. Add Recommenced SMT stencil footprint 6. Delete Over-Temperature or Under- Temperature Power off 7. Change PWRKEY pin from at least 1 second to 1.5 second for power off the module 8. Add GNSS software update part 9. Delete Multiplexing function 10. Add BPF component in GNSS part	Yanwu.Wang; Xiaoxu.Chen

1. Introduction

This document describes SIM868 hardware interface in great detail. The document can help customer to quickly understand SIM868 interface specifications, electrical and mechanical details. With the help of this document and other SIM868 application notes, customer guide, customers can use SIM868 to design various applications quickly.

2. SIM868 Overview

Designed for global market, SIM868 is integrated with a high performance GSM/GPRS engine and a GNSS engine. SIM868 is a quad-band GSM/GPRS module that works on frequencies GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz. SIM868 features GPRS multi-slot class 12/class 10 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4.

The GNSS solution offers best-in-class acquisition and tracing sensitivity, Time-To-First-Fix (TTFF) and accuracy. With built-in LNA, SIM868 doesn't need external LNA. SIM868 can track as low as -167dBm signal even without network assistance. The SIM868 has excellent low power consumption characteristic (acquisition 24mA, tracking 21mA). SIM868 supports various location and navigation applications, including autonomous GPS, GLONASS, BEIDOU, QZSS, SBAS (WAAS, EGNOS, GAGAN, MSAS) and A-GPS.

With a tiny configuration of 17.6*15.7*2.3mm, SIM868 can meet almost all the space requirements in customers' applications, such as smart phone, PDA and other mobile devices.

SIM868 is a SMT+LGA package with 77 pads, and provides all hardware interfaces between the module and customers' boards.

- One 3 lines serial port and one full modem serial port;
- GNSS Serial port
- USB interface which can be used for debugging and upgrading firmware;
- Audio channels which include a microphone input and two speakers output;
- Programmable general purpose input and output;
- Two SIM cards interface;
- Support GNSS function;
- 33tracking/99 acquisition-channel GNSS receiver
- SD card interface;
- I2C interface;
- ADC interface.

SIM868 is designed with power saving technique so that the current consumption is as low as 0.65 mA in sleep mode (with GNSS engine powered down).
SIM868 integrates TCP/IP protocol and extended TCP/IP AT commands which are very useful for data transfer applications. For details about TCP/IP applications, please refer to document [2].

2.1. SIM868

Table 1: Module Information

Information	**SIM868**
GSM	850,900,1800 and 1900MHz
GNSS	GNSS interface
FLASH	32Mbit
RAM	32Mbit

2.2. SIM868 Key Features

Table 2: SIM868 Key Features

Feature	**Implementation**
Power supply	3.4V ~4.4V
Power saving	Typical power consumption in sleep mode is 0.65 mA (AT+CFUN=0)
Frequency bands	● Quad-band: GSM 850, EGSM 900, DCS 1800, PCS 1900. SIM868 can search the 4 frequency bands automatically. The frequency bands can also be set by AT command "AT+CBAND". For details, please refer to ***document [1]***. ● Compliant to GSM Phase 2/2+
Transmitting power	● Class 4 (2W) at GSM 850 and EGSM 900 ● Class 1 (1W) at DCS 1800 and PCS 1900
GPRS connectivity	● GPRS multi-slot class 12（default） ● GPRS multi-slot class 1~12 (option)
Temperature range	● Normal operation: -40 ℃ ~ +85 ℃ ● Storage temperature -45 ℃ ~ +90 ℃
Data GPRS	● GPRS data downlink transfer: max. 85.6 kbps ● GPRS data uplink transfer: max. 85.6 kbps ● Coding scheme: CS-1, CS-2, CS-3 and CS-4 ● PAP protocol for PPP connect ● Integrate the TCP/IP protocol. ● Support Packet Broadcast Control Channel (PBCCH)
USSD	● Unstructured Supplementary Services Data (USSD) support
SMS	● MT, MO, CB, Text and PDU mode ● SMS storage: SIM card
SIM interface	Support SIM card: 1.8V, 3V
External antenna	Antenna pad
Audio features	Speech codec modes: ● Half Rate (ETS 06.20) ● Full Rate (ETS 06.10) ● Enhanced Full Rate (ETS 06.50 / 06.60 / 06.80) ● Adaptive multi rate (AMR) ● Echo Cancellation ● Noise Suppression
Serial port and	**Serial port:**

USB port	● Default one Full modem serial port ● Can be used for AT commands or data stream ● Support RTS/CTS hardware handshake and software ON/OFF flow control ● Multiplex ability according to GSM 07.10 Multiplexer Protocol ● Autobauding supports baud rate from 1200 bps to 115200bps ● upgrading firmware **USB port:** ● Can be used for debugging and upgrading firmware
Phonebook management	Support phonebook types: SM, FD, LD, RC, ON, MC
SIM application toolkit	GSM 11.14 Release 99
Physical characteristics	● Size:17.6*15.7*2.3mm ● Weight:1.5g
Firmware upgrade	Full modern serial port or USB interface (recommend to use USB port)

Table 3: GNSS engine Performance

Parameter	Description	Performance			
		Min	Type	Max	Unit
Horizontal Position Accuracy(1)	Autonomous		<2.5		m
Velocity Accuracy(2)	Without Aid		0.1		m/s
Acceleration Accuracy	Without Aid		0.1		m/s^2
Timing Accuracy			10		nS
Backup batter voltage	V_RTC	2.3		4.3	V
Dynamic Performance	Maximum Altitude			18000	m
	Maximum Velocity			515	m/s
	Maximum Acceleration			4	G
TTFF with GPS only(3)	Hot start		0.7		s
	Warm start		21.4		s
	Cold start		22.3		s
TTFF with GLONASS only(3)	Hot start		0.7		s
	Warm start		21.2		s
	Cold start		21.68		s
TTFF with GPS and GLONASS (3)	Hot start		0.6		s
	Warm start		21.54		s
	Cold start		21.67		s
A-GPS TTFF(EPO in flash mode)	Hot start		0.6		s
	Warm start		21.32		s
	Cold start		22.17		s
Sensitivity with GPS only mode	Autonomous acquisition(cold start)		-148		dBm
	Re-acquisition		-158		dBm
	Tracking		-166		dBm
Sensitivity with	Autonomous		-147		dBm

GLONASS only mode	acquisition(cold start)				
	Re-acquisition		-155		dBm
	Tracking		-160		dBm
Sensitivity with GPS and GLONASS	Autonomous acquisition(cold start)		-149		dBm
	Re-acquisition		-157		dBm
	Tracking		-162		dBm
Receiver	Channels		22/66		
	Update rate			5	Hz
	Tracking L1, CA Code				
	Protocol support NMEA				
Power consumption With GPS only mode(4)	Acquisition		23.4		mA
	Continuous tracking		22.6		mA
	Sleep current		650		uA
Power consumption With GLONASS only mode(4)	Acquisition		24		mA
	Continuous tracking		21		mA
	Sleep current		650		uA
Power consumption With GPS and GLONASS (4)	Acquisition		31		mA
	Continuous tracking		26		mA
	Sleep current		650		uA

(1) 50% 24hr static, -130dBm

(2) 50% at 30m/s

(3) GPS signal level: -130dBm

(4) Single Power supply 3.8V@-130dBm,GSM IDLE

Table 4: Coding schemes and maximum net data rates over air interface

Coding scheme	1 timeslot	2 timeslot	4 timeslot
CS-1	9.05kbps	18.1kbps	36.2kbps
CS-2	13.4kbps	26.8kbps	53.6kbps
CS-3	15.6kbps	31.2kbps	62.4kbps
CS-4	21.4kbps	42.8kbps	85.6kbps

2.3. Operating Mode

The table below summarizes the various operating modes of SIM868.

Table 5: Overview of operating modes

Mode	Function	
Normal operation	GSM/GPRS SLEEP	Module will automatically go into sleep mode if the conditions of sleep mode are enabling and there aren't on air and hardware interrupt (such as GPIO interrupt or data on serial port). In this case, the current consumption of module will reduce to the minimal

		level. In sleep mode, the module can still receive paging message and SMS.
	GSM IDLE	Software is active. Module is registered to the GSM network, and the module is ready to communicate.
	GSM TALK	Connection between two subscribers is in progress. In this case, the power consumption depends on network settings such as DTX off/on, FR/EFR/HR, hopping sequences, antenna.
	GPRS STANDBY	Module is ready for GPRS data transfer, but no data is currently sent or received. In this case, power consumption depends on network settings and GPRS configuration.
	GPRS DATA	There is GPRS data transfer (PPP or TCP or UDP) in progress. In this case, power consumption is related with network settings (e.g. power control level); uplink/downlink data rates and GPRS configuration (e.g. used multi-slot settings).
Power off	Normal power off by sending AT command “AT+CPOWD=1” or using the PWRKEY. The power management unit shuts down the power supply for the baseband part of the module. Software is not active. The serial port is not accessible. Power supply (connected to 3V) remains applied.	
Minimum functionality mode	AT command “AT+CFUN” can be used to set the module to a minimum functionality mode without removing the power supply. In this mode, the RF part of the module will not work or the SIM card will not be accessible, or both RF part and SIM card will be closed, and the serial port is still accessible. The power consumption in this mode is lower than normal mode.	

2.4. Functional Diagram

The following figure shows a functional diagram of SIM868:

- GSM baseband
- PMU
- The GSM Radio Frequency part
- Antenna interface
- GNSS interface
- Other interface

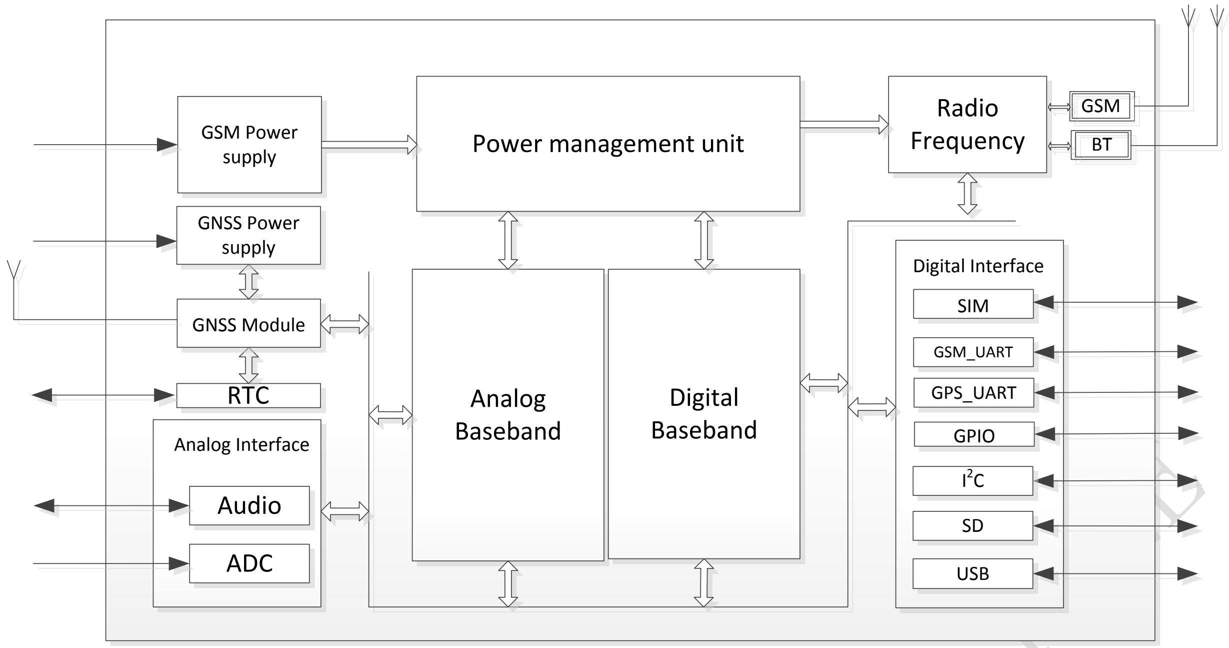


Figure 1: SIM868 functional diagram

3. Package Information

3.1. Pin Out Diagram

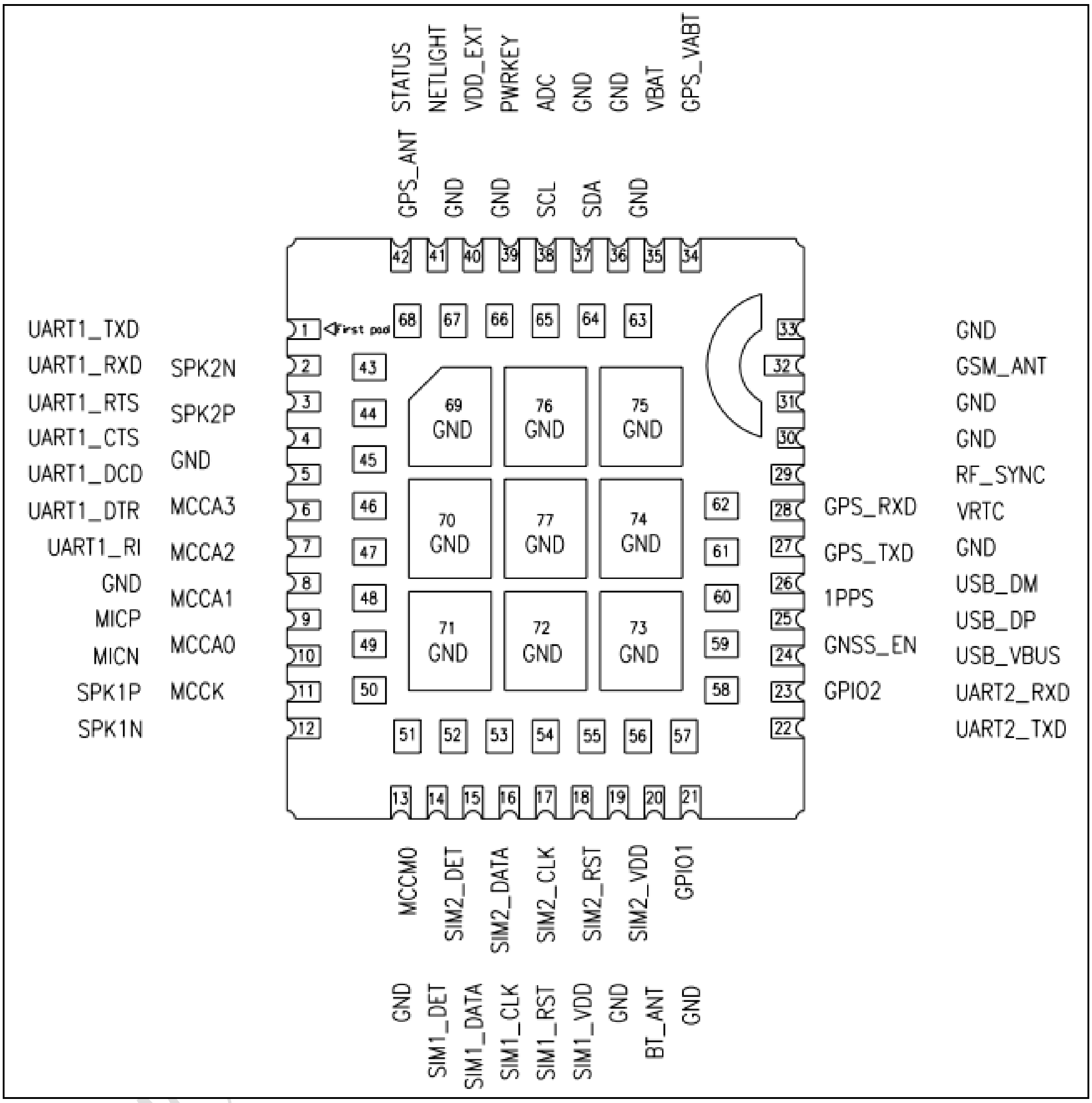


Figure 2: Pin out Diagram (Top view)

3.2. Pin Description

Table 6: Pin description

Pin name	Pin number	I/O	Description	Comment
Power supply				
GPS_VBAT	34	I	Power supply for GNSS	2.8V ~4.4V
VBAT	35	I	Power supply for GSM	3.4V ~4.4V
VDD_EXT	40	O	2.8V power output	If these pins are unused, keep open.

GND	8,13,19,21,27,30,31,33,36,37,45,63,66,67,69,70,71,72,73,74,75,76,77		Ground	GND for VBAT recommend to use 36,37pin
Power on/down				
PWRKEY	39	I	PWRKEY should be pulled low and then released to power on/down the module.	Internally pulled up to 3V.
Audio interfaces				
MICP	9	I	Differential audio input	If these pins are unused, keep open.
MICN	10			
SPK1P	11	O	Differential audio output	
SPK1N	12			
SPK2P	44			
SPK2N	43			
GNSS interface				
GPS_RXD	62	I	Receive data	If these pins are unused, keep open.
GPS_TXD	61	O	Transmit data	
1PPS	60	O	Time Mark outputs timing pulse related to receiver time	
GPS_EN	59	I	GNSS power enable	
VRTC	28	I/O	Power supply for GNSS RTC	It is recommended to connect with a battery.
SD interface				
MCCA3	46	I/O	SD serial data I/O	If these pins are unused, keep open.
MCCA2	47	I/O		
MCCA1	48	I/O		
MCCA0	49	I/O		
MCCK	50	I/O	SD serial clock	
MCCM0	51	I/O	SD command output	
GPIO				
NETLIGHT	41	O	Network status	If these pins are unused, keep open.
STATUS	42	O	Power on status	
GPIO1	57	I/O	Programmable general purpose input and output.	
GPIO2	58	I/O		
Serial port				
UART1_DTR	6	I	Data terminal ready	If these pins are unused, keep open.
UART1_RI	7	O	Ring indicator	
UART1_DCD	5	O	Data carrier detect	
UART1_CTS	4	O	Clear to send	
UART1_RTS	3	I	Request to send	
UART1_TXD	1	O	Transmit data	

UART1_RXD	2	I	Receive data	
UART2_TXD	22	O	Transmit data	
UART2_RXD	23	I	Receive data	
Debug interface				
USB_VBUS	24	I	Debug and download	If these pins are unused, keep open.
USB_DP	25	I/O		
USB_DM	26	I/O		
ADC				
ADC	38	I	10bit general analog to digital converter	If these pins are unused, keep open.
I2C				
SDA	64	I/O	I2C serial bus data	Internal pulled up to 2.8V via 4.7KΩ
SCL	65	O	I2C serial bus clock	
SIM card interface				
SIM1_VDD	18	O	Voltage supply for SIM card. Support 1.8V or 3V SIM card	All signals of SIM interface should be protected against ESD with a TVS diode array.
SIM1_DATA	15	I/O	SIM data input/output	
SIM1_CLK	16	O	SIM clock	
SIM1_RST	17	O	SIM reset	
SIM1_DET	14	I	SIM card detection	If these pins are unused, keep open.
SIM2_VDD	56	O	Voltage supply for SIM card. Support 1.8V or 3V SIM card	All signals of SIM interface should be protected against ESD with a TVS diode array.
SIM2_DATA	53	I/O	SIM data input/output	
SIM2_CLK	54	O	SIM clock	
SIM2_RST	55	O	SIM reset	
SIM2_DET	52	I	SIM card detection	If these pins are unused, keep open.
Antenna interface				
GSM_ANT	32	I/O	Connect GSM antenna	If these pins are unused, keep open.
BT_ANT	20	I/O	Connect Bluetooth antenna	
GPS_ANT	68	I	Connect GNSS antenna	
Synchronizing signal of RF				
RF_SYNC	29	O	Synchronizing signal of RF	

3.3. Package Dimensions

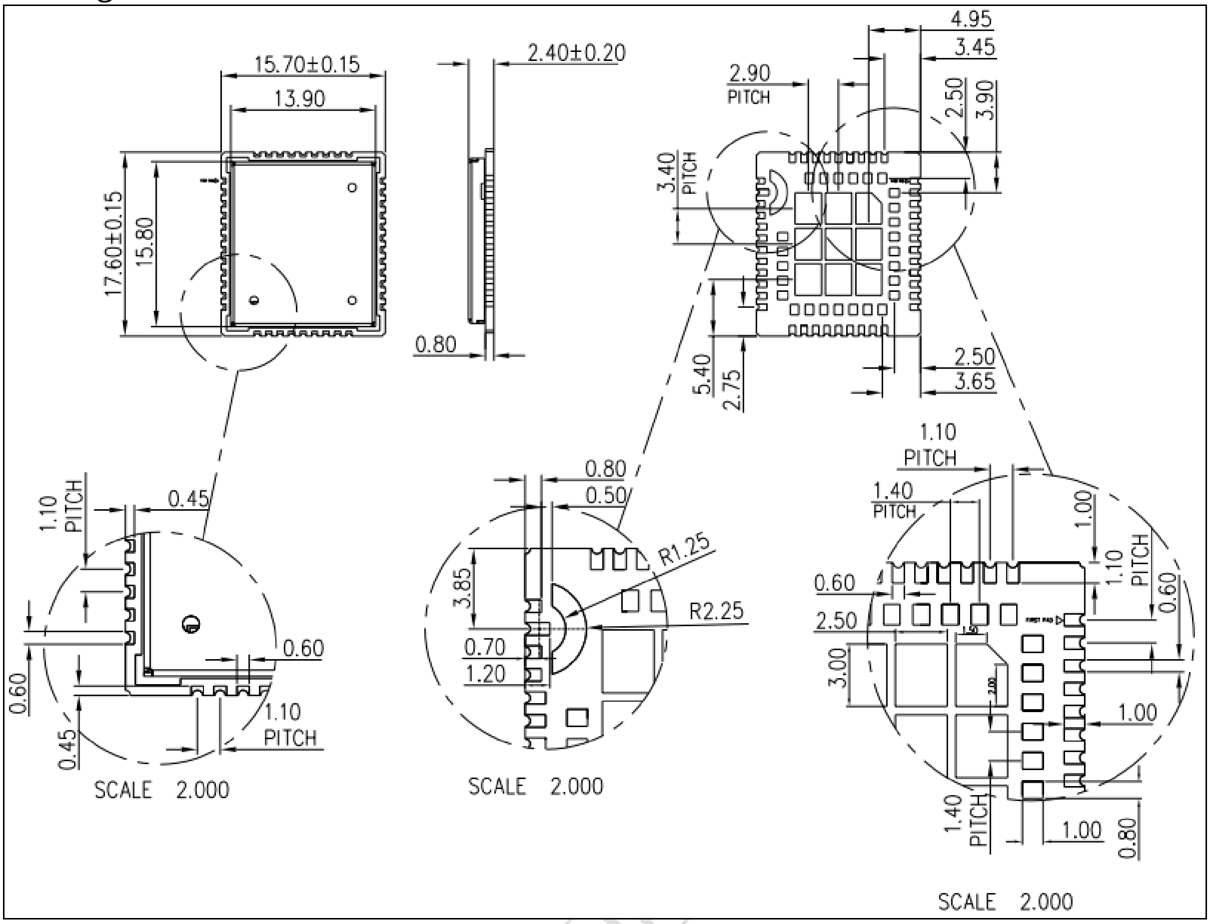


Figure 3: Dimensions of SIM868 (Unit: mm)

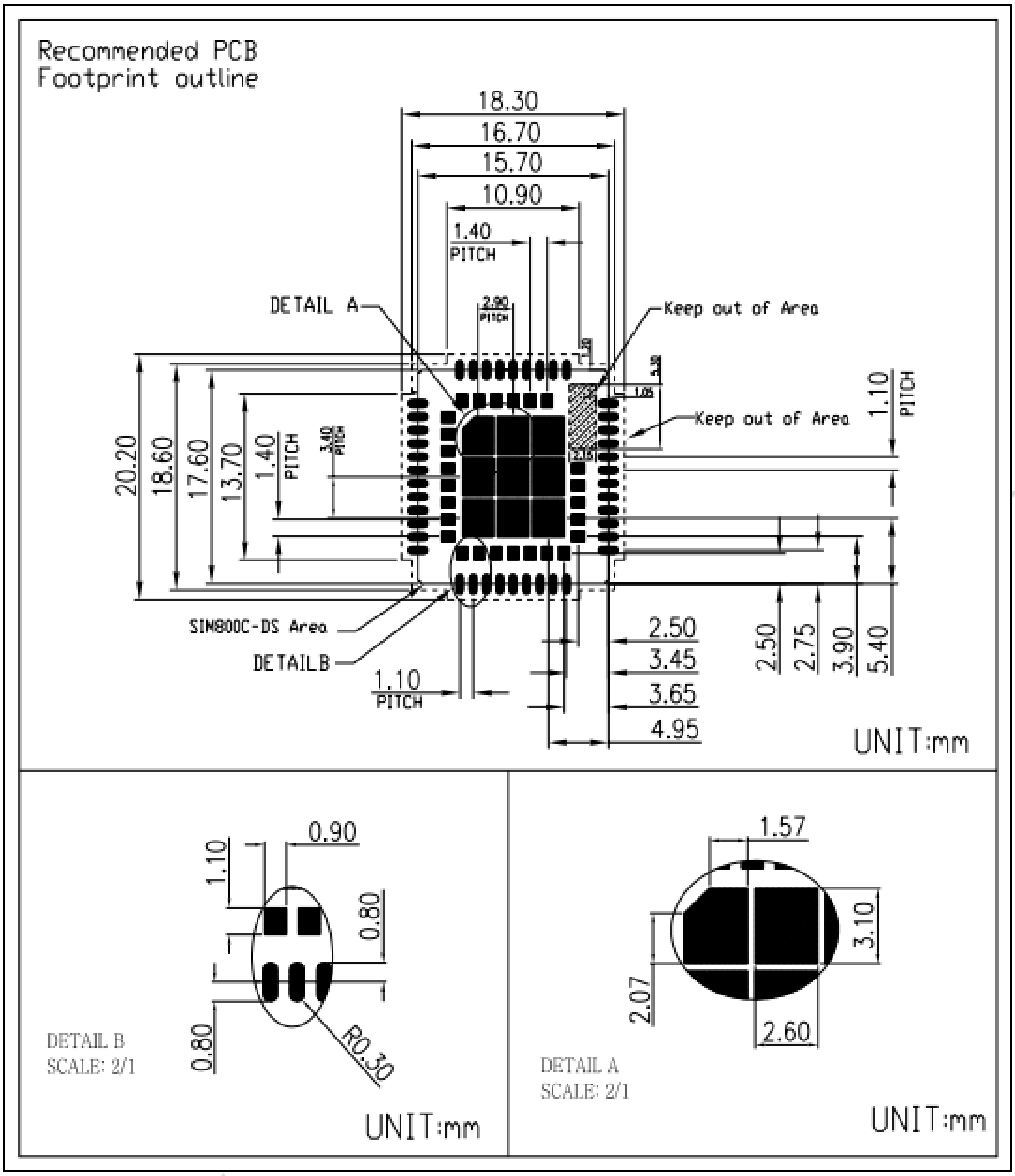


Figure 4: Recommended PCB footprint outline (Unit: mm)

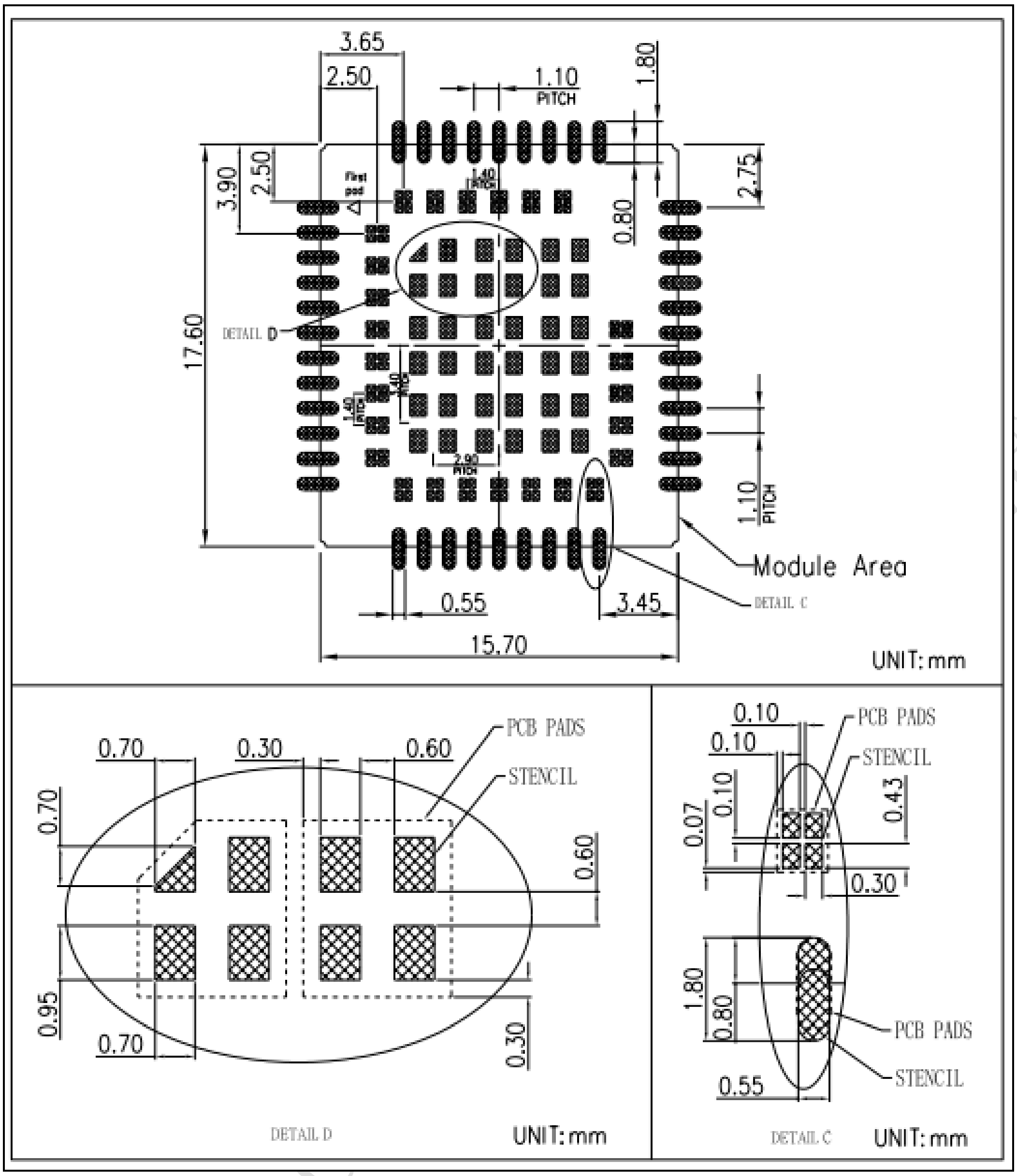


Figure 5: Recommended SMT stencil footprint outline (Unit: mm)

4. Application Interface

4.1. Power Supply

The power supply range of SIM868 is from 3.4V to 4.4V. Recommended voltage is 4.0V. The transmitting burst will cause voltage drop and the power supply must be able to provide sufficient current up to 2A. For the VBAT input, a bypass capacitor (low ESR) such as a 100 µF is strongly recommended.

For the VBAT input, a 100uF Tantalum capacitor (CA low ESR) and a 1uF~10uF Ceramics capacitor CB are strongly recommended. Increase the 33pF and 10pF capacitors can effectively eliminate the high frequency interference. A 5.1V/500mW Zener diode is strongly recommended, the diode can prevent chip from damaging by the voltage surge. These capacitors and Zener diode should be placed as close as possible to SIM868 VBAT pins.

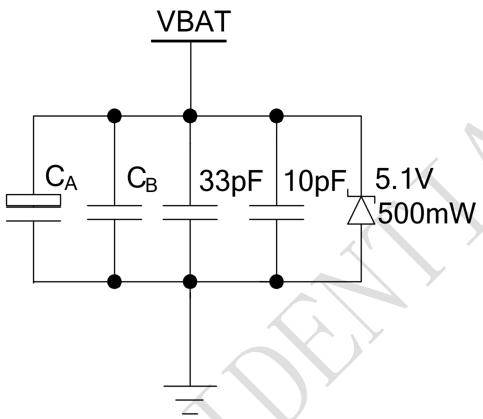


Figure 6: Reference circuit of the VBAT input

Table 7: Recommended zener diode

	Vendor	Part number	Power(watts)	Packages
1	On semi	MMSZ5231BT1G	500mW	SOD123
2	Prisemi	PZ3D4V2H	500mW	SOD323
3	Vishay	MMSZ4689-V	500mW	SOD123
4	Crownpo	CDZ55C5V1SM	500mW	0805

The following figure is the reference design of +5V input power supply. The output power supply is 4.1V, thus a linear regulator can be used.

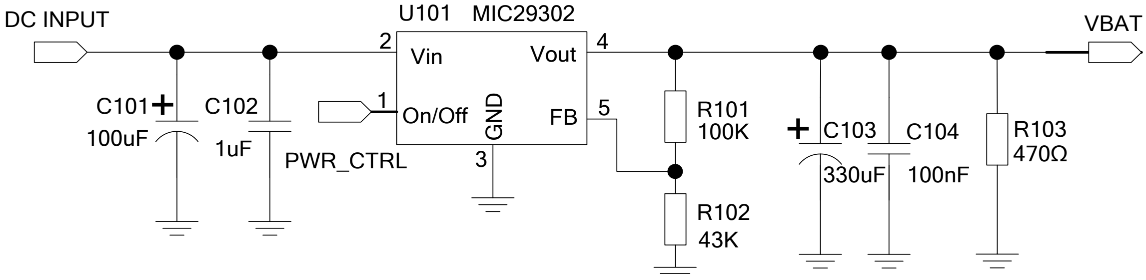


Figure 7: Reference circuit of the LDO power supply

If there is a high drop-out between the input and the desired output (VBAT), a DC-DC power supply will be preferable because of its better efficiency especially with the 2A peak current in burst mode of the module. The following figure is the reference circuit.

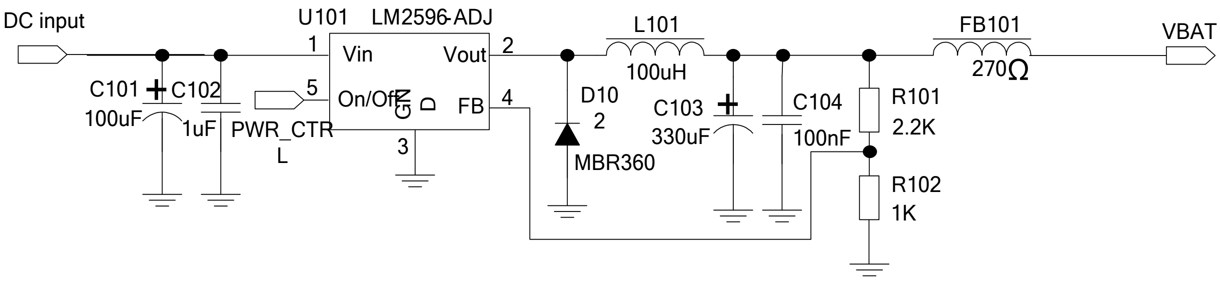


Figure 8: Reference circuit of the DC-DC power supply

The single 3.7V Li-ion cell battery can be connected to SIM868 VBAT pins directly. But the Ni-Cd or Ni-MH battery must be used carefully, since their maximum voltage can rise over the absolute maximum voltage of the module and damage it.

When battery is used, the total impedance between battery and VBAT pins should be less than 150mΩ.
The following figure shows the VBAT voltage drop at the maximum power transmit phase, and the test condition is as following:

VBAT=4.0V,
A VBAT bypass capacitor C_A=100µF tantalum capacitor (ESR=0.7Ω),
Another VBAT bypass capacitor C_B=1uF~10uF.

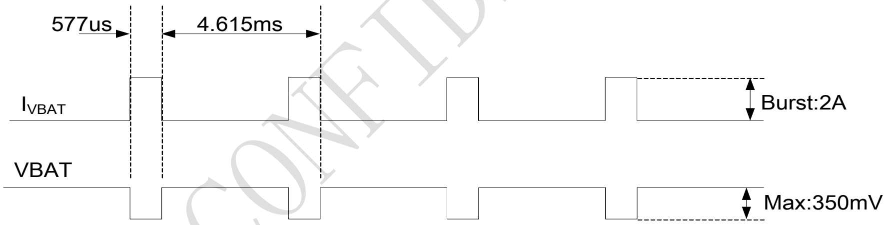


Figure 9: VBAT voltage drop during transmit burst

4.1.1. Power Supply Pin

Pin35 is VBAT input; Pin36 and Pin37 are GND of power supply. VDD_EXT output 2.8V when module is in normal operation mode.

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

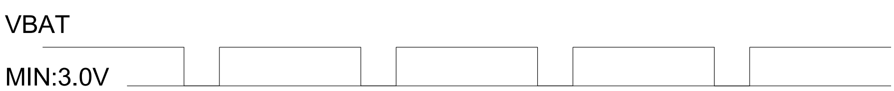


Figure 10: The minimal VBAT voltage requirement at VBAT drop

Note: Hardware power off voltage is 3.0V.

4.1.2. Monitoring Power Supply

AT command “AT+CBC” can be used to monitor the VBAT voltage. For detail, please refer to ***document [1]***.

4.2. Power on/off SIM868

4.2.1. Power on SIM868

Customer can power on SIM868 by pulling down the PWRKEY pin for at least 1 second and release. This pin is already pulled up to 3V in the module internal, so external pull up is not necessary. Reference circuits are shown as below.

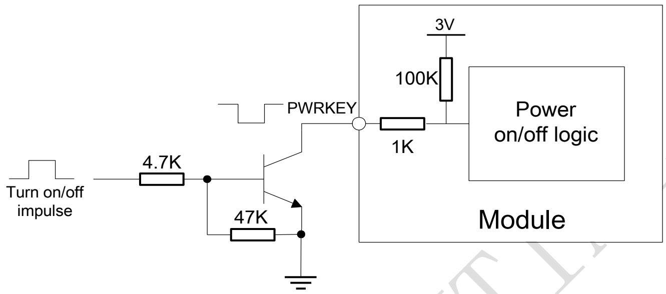


Figure 11: Powered on/down module using transistor

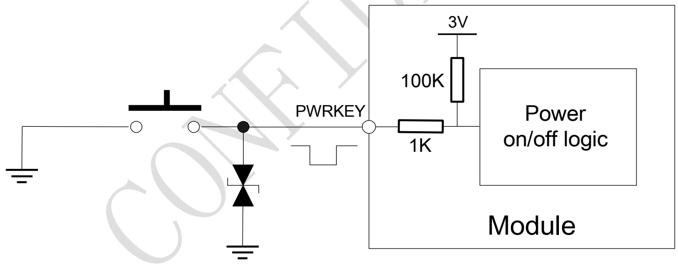


Figure 12: Powered on/down module using button

The power on timing is illustrated as in the following figure.

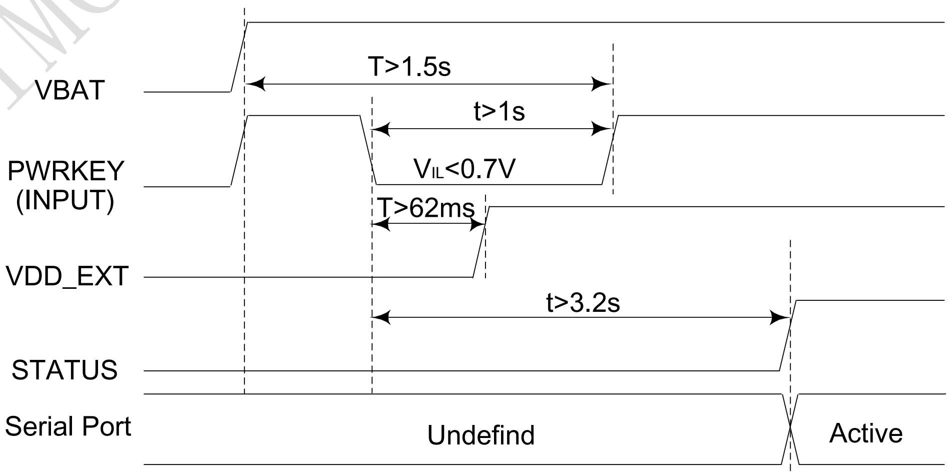


Figure 13: Timing of power on module

When power on procedure is completed, SIM868 will send following URC to indicate that the module is ready to operate at fixed baud rate.

RDY

This URC does not appear when autobauding function is active.

Note: Customer can use AT command "AT+IPR=x" to set a fixed baud rate and save the configuration to non-volatile flash memory. After the configuration is saved as fixed baud rate, the Code "RDY" should be received from the serial port every time when SIM868 is powered on. For details, please refer to the chapter "AT+IPR" in document [1].

4.2.2. Power off SIM868

SIM868 will be powered off in the following situations:

- Normal power off procedure: power off SIM868 by the PWRKEY pin.
- Normal power off procedure: power off SIM868 by AT command "AT+CPOWD=1".

4.2.2.1. Power off SIM868 by the PWRKEY Pin

Customer can power off SIM868 by pulling down the PWRKEY pin for at least 1.5 second and release. Please refer to the power on circuit. The power off timing is illustrated in the following figure.

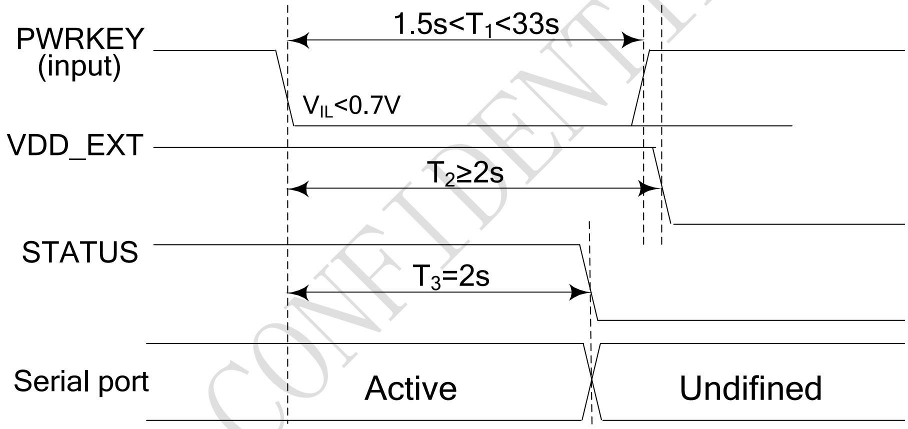


Figure 14: Timing of power off SIM868 by PWRKEY

Note:

1. ***The module will restart after pull down the pwrkey over 33 seconds.***
2. ***VDD_EXT will power off after STATUS change into low level and the PWRKEY release 55ms.***
   If $1.5s<T_1<2s$***,*** $T_2>2s$***;***
   If $2s\le T_1<33s$***,*** $T_2>T_1+55ms$

This procedure makes the module log off from the network and allows the software to enter into a secure state to save data before completely shut down.

Before the completion of the power off procedure, the module will send URC:

NORMAL POWER OFF

At this moment, AT commands can't be executed any more. Power off mode can also be indicated by STATUS pin, which is at low level at this time.

4.2.2.2. Power off SIM868 by AT Command

SIM868 can be powered off by AT command “AT+CPOWD=1”. This procedure makes the module log off from the network and allows the software to enter into a secure state to save data before completely shut down.
Before the completion of the power off procedure, the module will send URC:

NORMAL POWER OFF

At this moment, AT commands can’t be executed any more. Power off mode can also be indicated by STATUS pin, which is at low level at this time.

For detail about AT command “AT+CPOWD”, please refer to ***document [1]***.

4.2.2.3. Restart SIM868 by PWRKEY Pin:

When the module works normally, if the customer wants to restart the module, follow the procedure below:

1) Power off the module.
2) Wait for at least 800ms after STATUS pin changed to low level.
3) Power on the module.

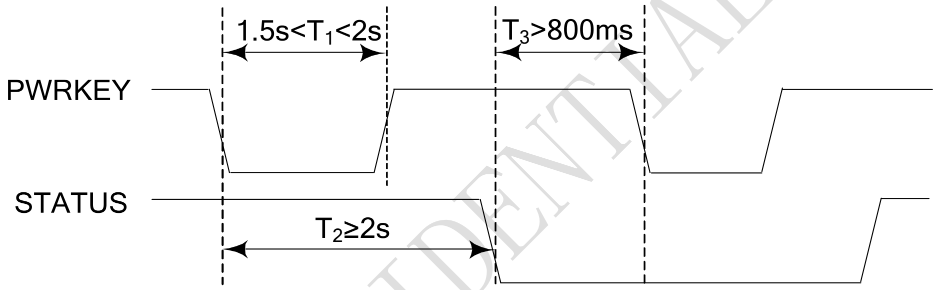


Figure 15: Timing of restart SIM868

4.3. Power Saving Mode

SIM868 has two power saving modes: Minimum functionality mode and sleep mode. AT command “AT+CSCLK=1”can be used to set SIM868 into sleep mode. AT command “AT+CFUN=<fun>“can be used to set SIM868 into minimum functionality. When SIM868 is in sleep mode and minimum functionality mode, the current of module is lowest.

4.3.1. Minimum Functionality Mode

There are three functionality modes, which could be set by AT command “AT+CFUN=<fun>“. The command provides the choice of the functionality levels <fun>=0, 1, 4.

- AT+CFUN=0： Minimum functionality.
- AT+CFUN=1： Full functionality (default).
- AT+CFUN=4： Flight mode (disable RF function).

Table 8: The current consumption of Function Mode

<fun>	BS-PA-MFRMS	Current consumption(mA)
0	/	0.65

1	9	0.86
	5	1.02
	2	1.42
4	/	0.69

Minimum functionality mode minimizes the current consumption to the lowest level. If SIM868 is set to minimum functionality by “AT+CFUN=0”, the RF function and SIM card function will be disabled. In this case, the serial port is still accessible, but partial AT commands and correlative to RF function and SIM card function will not be accessible.

For detailed information about AT command “AT+CFUN=<fun>“, please refer to ***document [1]***.

4.3.2. Sleep Mode 1 (AT+CSCLK=1)

Customer can control SIM868 module to enter or exit the sleep mode (AT+CSCLK=1) by DTR signal. When DTR is in high level and without interrupt (on air and hardware such as GPIO interrupt or data in serial port), SIM868 will enter sleep mode automatically. In this mode, SIM868 can still receive paging or SMS from network but the serial port is not accessible.

4.3.3. Wake Up SIM868 from Sleep Mode 1

When SIM868 is in sleep mode 1(AT+CSCLK=1), the following methods can wake up the module:

- Pull down DTR pin.
  The serial port will be active after DTR pin is pulled to low level for about 50ms.
- Receive a voice or data call from network.
- Receive a SMS from network.
- Receive external interrupt.

Note: After module has received incoming call or new SMS, serial port can report URC, but the serial port cannot input AT command. Only after the DTR pin is pulled to low level for 50ms, the serial port can input AT command.

4.3.4. Sleep Mode 2 (AT+CSCLK=2)

In this mode, SIM868 will continuously monitor the serial port data signal. When there is no data transfer over 5 seconds on the RXD signal and there is no on air and hardware interrupts (such as GPIO interrupt), SIM868 will enter sleep mode 2 automatically. In this mode, SIM868 can still receive paging or SMS from network.

4.3.5. Wake Up SIM868 from Sleep Mode 2

When SIM868 is in sleep mode 2 (AT+CSCLK=2), the following methods can wake up the module:

- Send data to SIM868 via main serial port (the first character will lose).
- Receive a voice or data call from network.
- Receive a SMS from network.

Note: Autobauding is default. It cannot enter sleep mode in the absence of synchronous serial port baud rate after module power on.

4.4. Power Saving Mode

Current input for GNSS RTC when the GPS_VBAT is not supplied for the GNSS power system. Current output for backup battery when the GPS_VBAT power supply is in present and the backup battery is in low voltage state. The RTC power supply of GNSS can be provided by an external capacitor or a battery (non-chargeable or rechargeable) through the VRTC. The following figures show various reference circuits for RTC back up.

- **External capacitor backup**

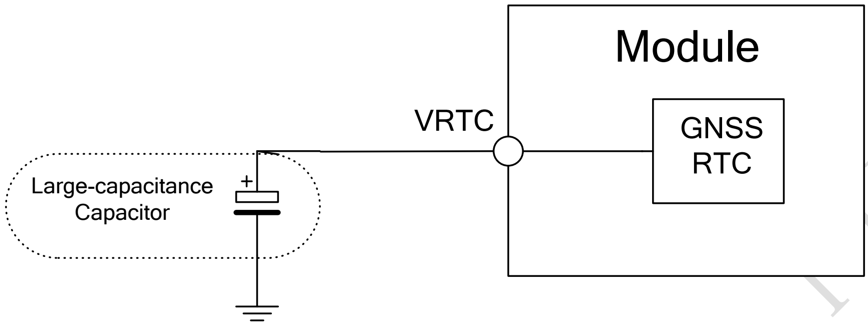


Figure 16: RTC supply from capacitor

- **Non-chargeable battery backup**

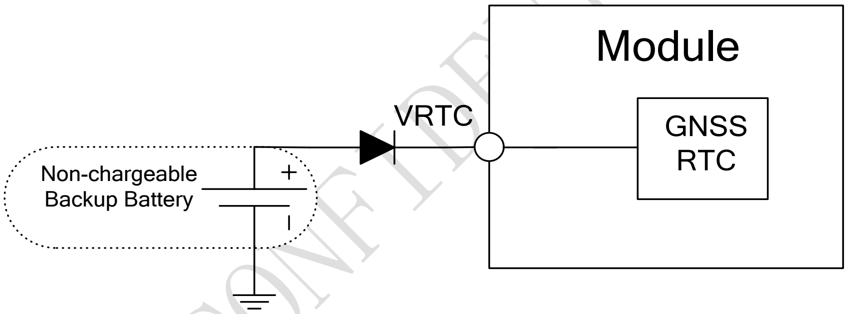


Figure 17: RTC supply from non-chargeable battery

- **Rechargeable battery backup**

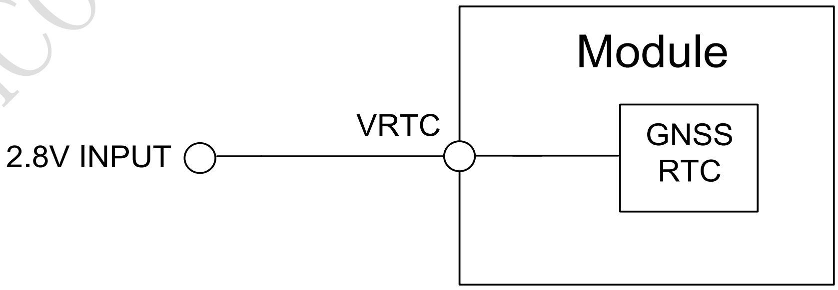


Figure 18: RTC supply from rechargeable battery

4.5. Serial Port and USB Interface

SIM868 default provides one unbalanced asynchronous serial ports. The module is designed as a DCE (Data Communication Equipment). The following figure shows the connection between module and client (DTE).

Table 9: Serial port and USB pin definition

	Pin name	Pin number	Function
Serial port	UART1_DTR	6	Data terminal ready
	UART1_RI	7	Ring indicator
	UART1_DCD	5	Data carrier detect
	UART1_CTS	4	Clear to send
	UART1_RTS	3	Request to send
	UART1_TXD	1	Transmit data
	UART1_RXD	2	Receive data
	UART2_TXD	22	Transmit data
	UART2_RXD	23	Receive data
	GPS_TXD	61	Transmit data
	GPS_RXD	62	Receive data
Debug port	USB_VBUS	24	USB power supply
	USB_DP	25	D+ data input/output
	USB_DM	26	D- data input/output

Note: Hardware flow control is disabled by default. AT command "AT+IFC=2, 2"can enable hardware flow control. AT command "AT+IFC=0,0"can disable hardware flow control. For more details please refer to document [1].

Table 10: Serial port characteristics

Symbol	Min	Max	Unit
V_{IL}	-0.3	0.7	V
V_{IH}	2.1	3.0	V
V_{OL}	-	0.4	V
V_{OH}	2.4	-	V

4.5.1 Function of Serial Port

Serial port:

- Full mode device.
- Contain data lines UART1_TXD/UART1_RXD, hardware flow control lines UART1_RTS/UART1_CTS, status lines UART1_DTR、UART1_DCD and UART1_RI.
- Serial port can be used for GPRS service and AT communication.
- Autobauding supports the following baud rates:
  1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200bps

Autobauding allows SIM868 to automatically detect the baud rate of the host device. Pay more attention to the following requirements:

- **Synchronization between DTE and DCE:**
  When DCE powers on with autobauding enabled, it is recommended to send "AT" or "at" or "aT" or "At" to synchronize the baud rate, until DTE receives the "OK" response, which means DTE and DCE are

correctly synchronized. For more information please refer to AT command "AT+IPR".

- **Restrictions of autobauding operation:**

  The DTE serial port must be set at 8 data bits, no parity and 1 stop bit.

  The URC such as "RDY", "+CFUN: 1" and "+CPIN: READY" will not be reported.

Note: Customer can use AT command "AT+IPR=x" to set a fixed baud rate and the setting will be saved to non-volatile flash memory automatically. After the configuration is set as fixed baud rate, the URC such as "RDY", "+CFUN: 1" and "+CPIN: READY" will be reported when SIM868 is powered on.

4.5.2 Serial Interfaces

The following figure shows the connection between module and client (DTE).

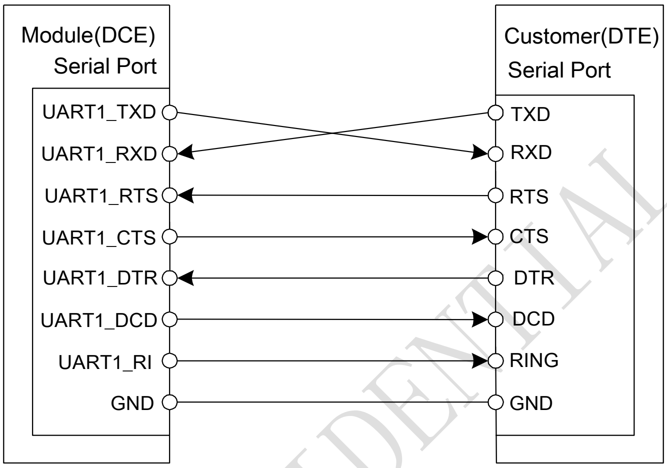


Figure 19: Connection of the serial interfaces

If the voltage of UART is 3.3V, the following reference circuits are recommended. If the voltage is 3.0V, please change the resistors in the following figure from 5.6K to 14K.

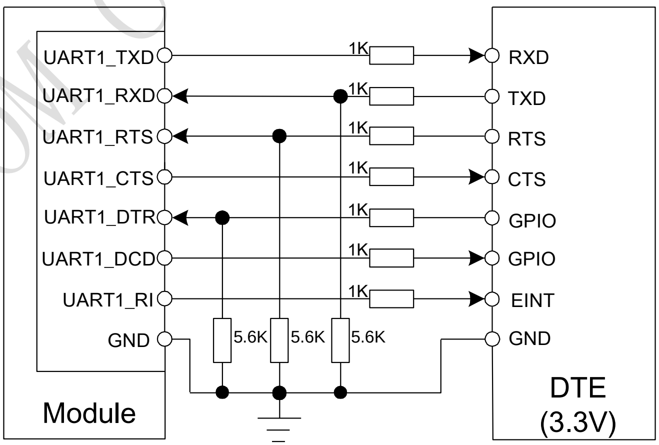


Figure 20: Resistor matching circuit

If the voltage of UART is 3V or3.3V, the following reference circuits are recommended:

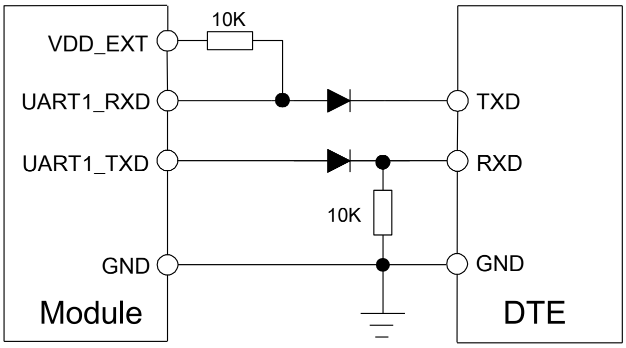


Figure 21 : Diode isolation circuit

Note: please make sure the minimum of client high limit should be less than 2.8V minus the diode drop.

If the voltage of UART is 5V, the following reference circuits are recommended:

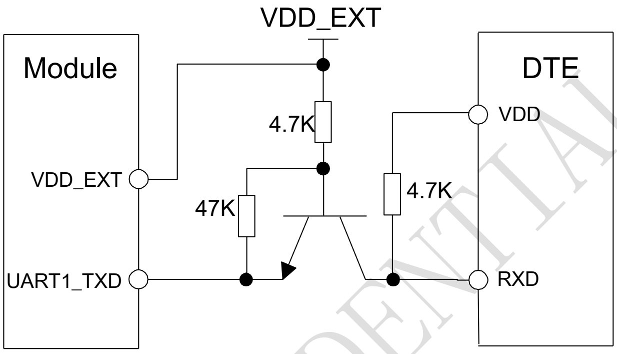


Figure 22: TX level matching circuit

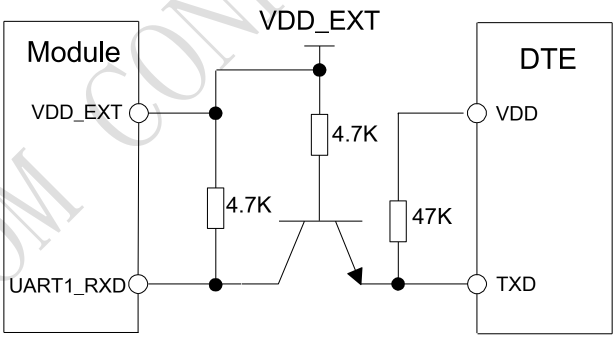


Figure 23: RX level matching circuit

4.5.3 Debug Interface

SIM868 could achieve software debug function through USB interface. When powering on the module, connect USB_VBUS, USB_DP, USB_DM, and GND to PC, then install the driver following the prompts, a COM port could be recognized by PC, customer could achieve the software Debug with this COM port.

SIMCom recommended the following connected diagram:

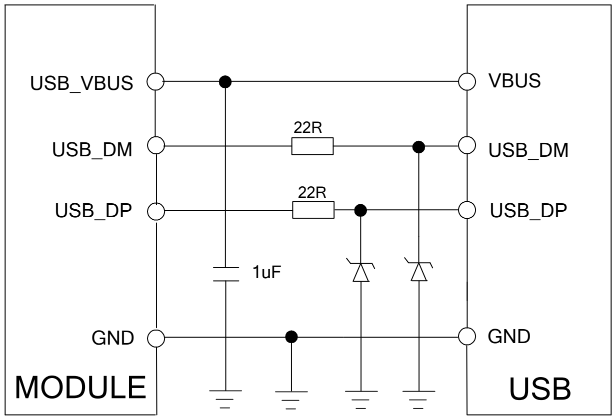


Figure 24: USB reference circuit

The TVS on USB data line should be less than 5pF, and traced by differential forms.

Note: please reserve the USB interface or test point for the further debugging

Table 11: USB_VBUS operation voltage

Pin	Min	Typ	Max	Unit
USB_VBUS	4.3	5.0	7.0	V

4.5.4 Software Upgrade

Customer could upgrade module’s GSM part firmware through USB or UART interface.

If upgrading GSM part through USB interface, it is necessary to connect USB_VBUS, USB_DP, USB_DM, and GND to PC. There is no need to operate PWRKEY pin in the whole procedure, when SIM868 detects USB_VBUS and could communicate normally with USB_DP and USB_DM, it will enter USB download mode automatically.

If customer upgrades GSM part through UART interface, it is strongly recommended to lead the UART1_TXD, UART1_RXD, GND and PWRKEY pin to IO connector for the upgrading, and PWRKEY pin should connect to GND while upgrading. Refer to the following figure for debugging and upgrading software.

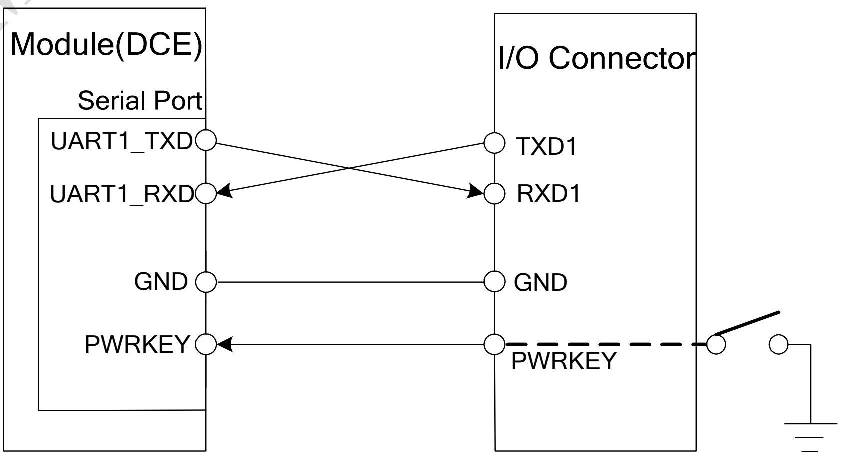


Figure 25: Connection for software upgrading and debugging

Customer could upgrade module's GNSS part firmware through UART interface.

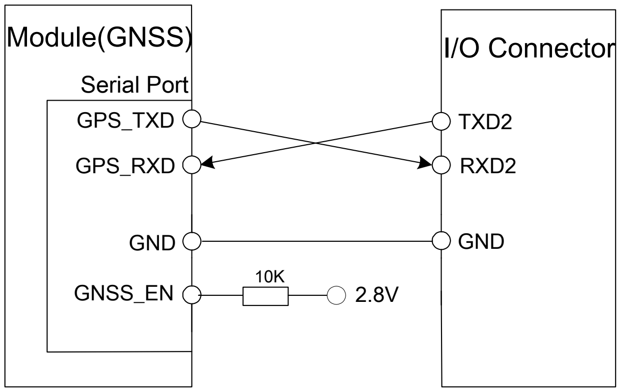


Figure 26: Connection for software upgrading and debugging

The UART interface supports the CMOS level. If customer connects the module to the computer, the level shift should be added between the DCE and DTE.

4.6. UART1_RI Behaviors

Table 12: RI behaviors

State	RI response
Standby	High
Voice call	The pin is changed to low. When any of the following events occur, the pin will be changed to high: （1） Establish the call （2） Hang up the call
SMS	The pin is changed to low, and kept low for 120ms when a SMS is received. Then it is changed to high.
Others	For more details, please refer to *document [2]*.

The behavior of the RI pin is shown in the following figure when the module is used as a receiver.

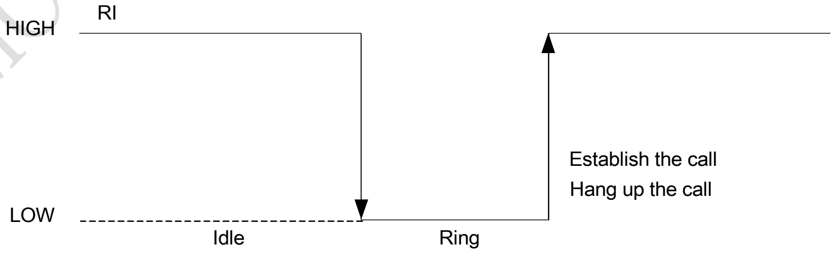


Figure 27: UART1_RI behaviour of voice calling as a receiver

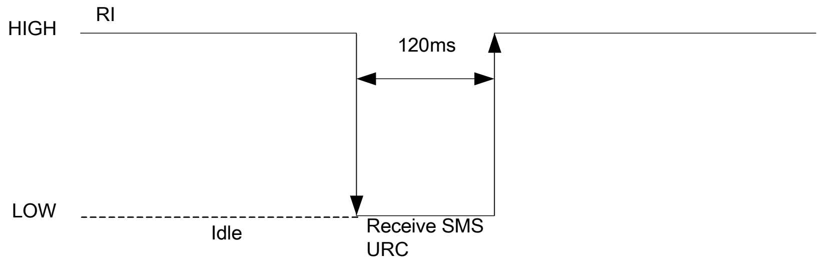


Figure 28: UART1_RI behaviour of URC or receive SMS

However, if the module is used as caller, the UART1_RI will remain high. Please refer to the following figure.

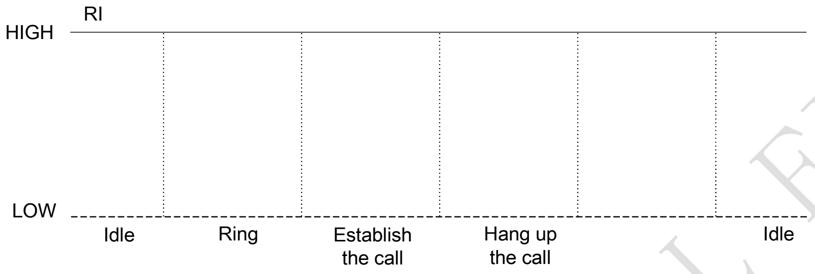


Figure 29: UART1_RI behaviour as a caller

4.7. Audio Interfaces

SIM868 provides an analog input (MICP; MICN), which could be used for electret microphone. The module also provides two analog outputs (SPK1P/2P; SPK1N/2N).

Table 13: Audio interface definition

Pin name	Pin number	Function
MICP	9	Audio input positive
MICN	10	Audio input negative
SPK1P	11	Audio output positive
SPK1N	12	Audio output negative
SPK2P	44	Audio output positive
SPK2N	43	Audio output negative

SPK1P/1N output can directly drive 32Ω receiver.

SIM868 internal has class-AB audio amplifier, the following table is class-AB performance:

Table 14: Performance of audio amplifier

Test Conditions	Class-AB AMP
4.2V 8Ω THD+N=1%	0.87W
3.3V 8Ω THD+N=1%	0.53W
4.2V 8Ω THD+N=10%	1.08W
3.3V 8Ω THD+N=10%	0.65W

SPK2P/2N output can directly drive 8Ω speaker.

AT command "AT+CMIC" is used to adjust the input gain level of microphone. AT command "AT+SIDET" is used to set the side-tone level. In addition, AT command "AT+CLVL" is used to adjust the output gain level. For more details, please refer to ***document [1]***.

In order to improve audio performance, the following reference circuits are recommended. The audio signals have to be layout according to differential signal layout rules as shown in following figures.

4.7.1. Speaker Interfaces Configuration

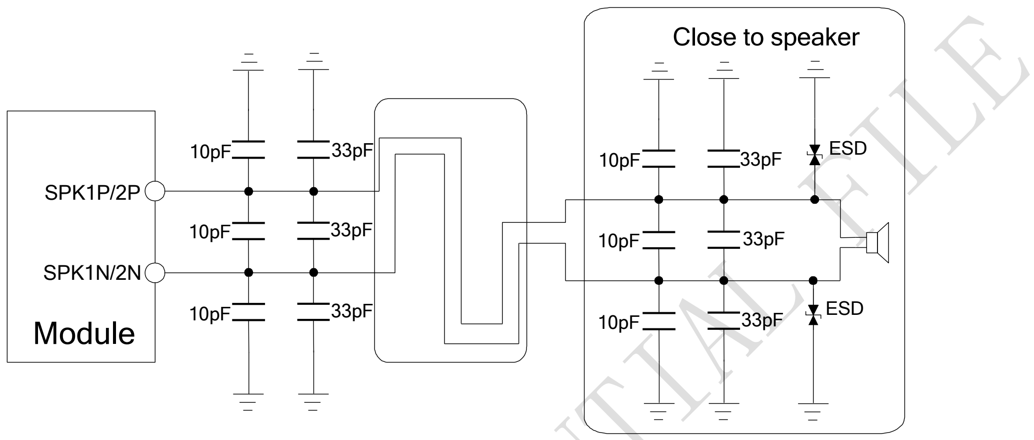


Figure 30: Speaker reference circuit

4.7.2. Microphone Interfaces Configuration

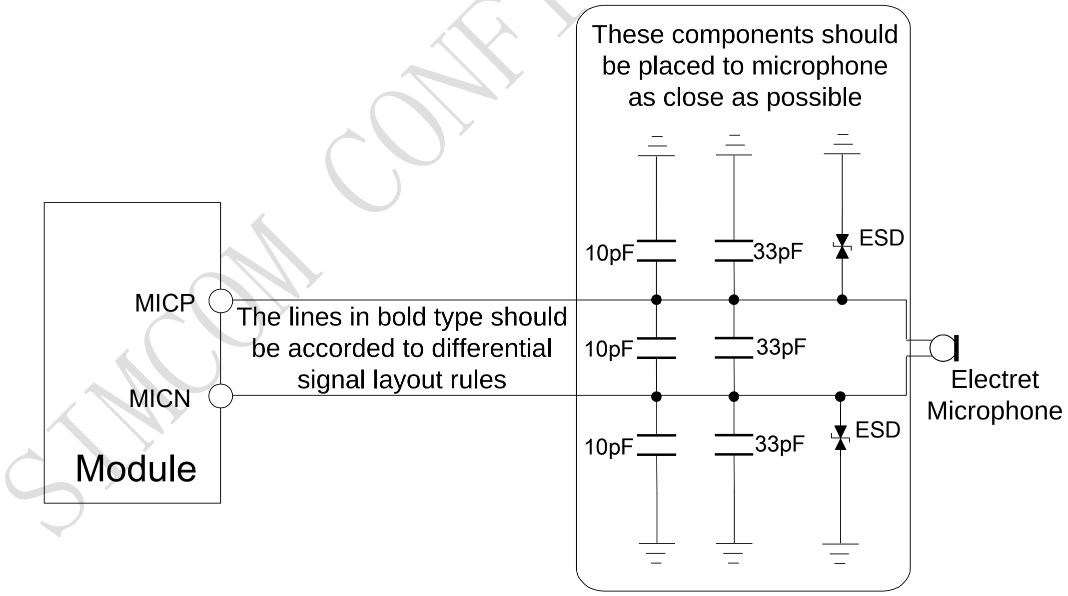


Figure 31: Microphone reference circuit

4.7.3. Audio Electronic Characteristic

Table 15: Microphone input characteristics

Parameter	Min	Typ	Max	Unit
Microphone biasing voltage	-	1.9	2.2	V

Working current		-	-	2.0	mA
Input impedance(differential)		13	20	27	KΩ
Idle channel noise		-	-	-67	dBm0
SINAD	Input level:-40dBm0	29	-	-	dB
	Input level:0dBm0	-	69	-	dB

Table 16: Audio output characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Normal output	R_L=32 Ω receiver	-	15	90	mW
	R_L=8 Ω speaker	-	-	1080	mW

4.7.4. TDD

Audio signal could be interferenced by RF signal. Coupling noise could be filtered by adding 33pF and 10pF capacitor to audio lines. 33pF capacitor could eliminate noise from GSM850/EGSM900MHz, while 10pF capacitor could eliminate noise from DCS1800/PCS1900Mhz frequency. Customer should develop this filter solution according to field test result.

GSM antenna is the key coupling interfering source of TDD noise. Thereat, pay attention to the layout of audio lines which should be far away from RF cable, antenna and VBAT pin. The bypass capacitor for filtering should be placed near module and another group needs to be placed near to connector.

Conducting noise is mainly caused by the VBAT drop. If audio PA was powered by VBAT directly, then there will be some cheep noise from speaker output easily. So it is better to put big capacitors and ferrite beads near audio PA input.

TDD noise has something to do with GND signal. If GND plane is not good, lots of high-frequency noises will interference microphone and speaker over bypass capacitor. So a good GND during PCB layout could avoid TDD noise.

4.8. SIM Card Interface

The SIM interface complies with the GSM Phase 1 specification and the new GSM Phase 2+ specification for FAST 64kbps SIM card. Both 1.8V and 3.0V SIM card are supported. The SIM interface is powered from an internal regulator in the module.

4.8.1. SIM Card Application

Table 17: SIM pin definition

Pin name	Pin number	Function
SIM1_VDD	18	Voltage supply for SIM card. Support 1.8V or 3V SIM card

SIM1_DATA	15	SIM data input/output
SIM1_CLK	16	SIM clock
SIM1_RST	17	SIM reset
SIM1_DET	14	SIM card detection
SIM2_VDD	56	Voltage supply for SIM card. Support 1.8V or 3V SIM card
SIM2_DATA	53	SIM data input/output
SIM2_CLK	54	SIM clock
SIM2_RST	55	SIM reset
SIM2_DET	52	SIM card detection

It is recommended to use an ESD protection component such as ST (www.st.com) ESDA6V1-5W6 or ON SEMI (www.onsemi.com) SMF05C. The SIM card peripheral components should be placed close to the SIM card holder. The reference circuit of the 8-pin SIM card holder is illustrated in the following figure.

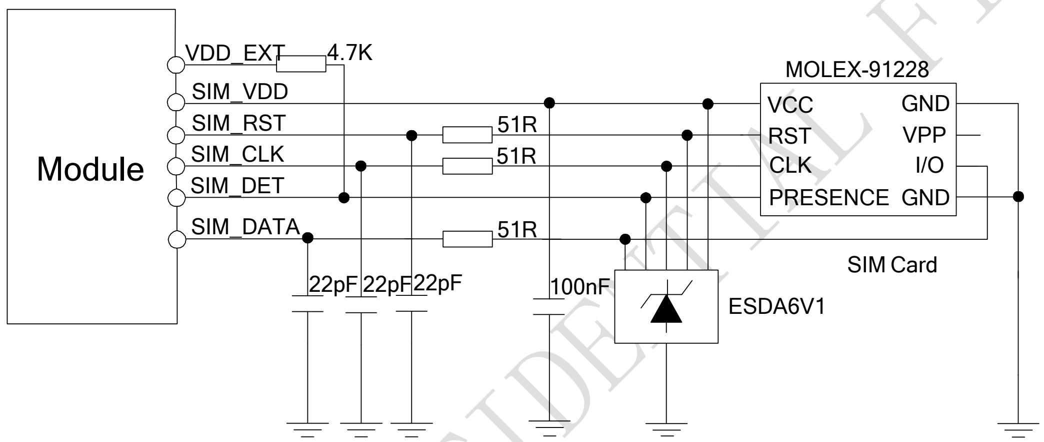


Figure 32: Reference circuit of the 8-pin SIM card holder

The SIM_DET pin is used for detection of the SIM card hot plug in. Customer can select the 8-pin SIM card holder to implement SIM card detection function. AT command "AT+CSDT" is used to enable or disable SIM card detection function. For details of this AT command, please refer to ***document [1]***.

If the SIM card detection function is not used, customer can keep the SIM_DET pin open. The reference circuit of 6-pin SIM card holder is illustrated in the following figure.

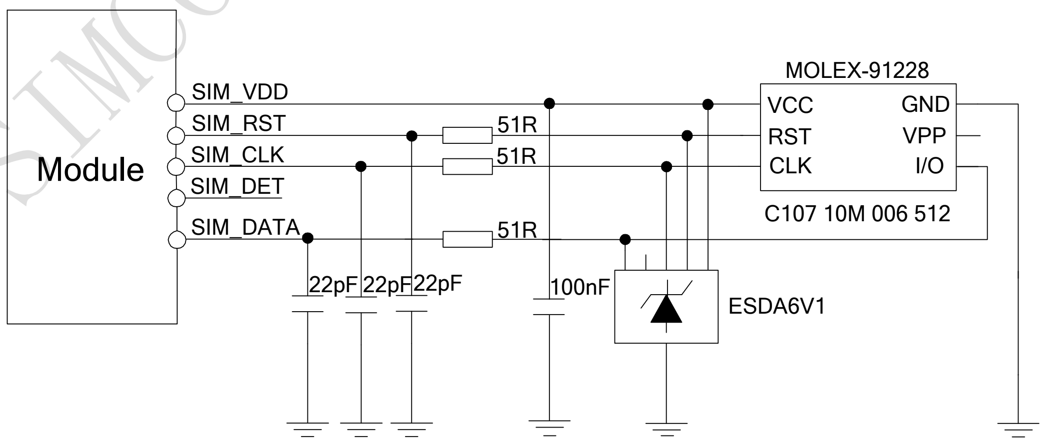


Figure 33: Reference circuit of the 6-pin SIM card holder

4.8.2. SIM Card Design Guide

SIM card signal could be interferenced by some high frequency signal, it is strongly recommended to follow these guidelines while designing:

- SIM card holder should be far away from GSM antenna
- SIM traces should keep away from RF lines, VBAT and high-speed signal lines
- The traces should be as short as possible
- Keep SIM card holder's GND connect to main ground directly
- Shielding the SIM card signal by ground well
- Recommended to place a 100nF capacitor on SIM_VDD line and keep close to the SIM card holder
- Add some TVS which parasitic capacitance should not exceed 50pF
- Add 51Ω resistor to (SIM_RST/SIM_CLK/SIM_DATA) signal could enhance ESD protection
- Add 22pf capacitors to (SIM_RST/SIM_CLK/SIM_DATA) signal to reduce RF interference

4.8.3. Design Considerations for SIM Card Holder

For 8 pins SIM card holder, SIMCom recommends to use Molex 91228.Customer can visit http://www.molex.com for more information about the holder.

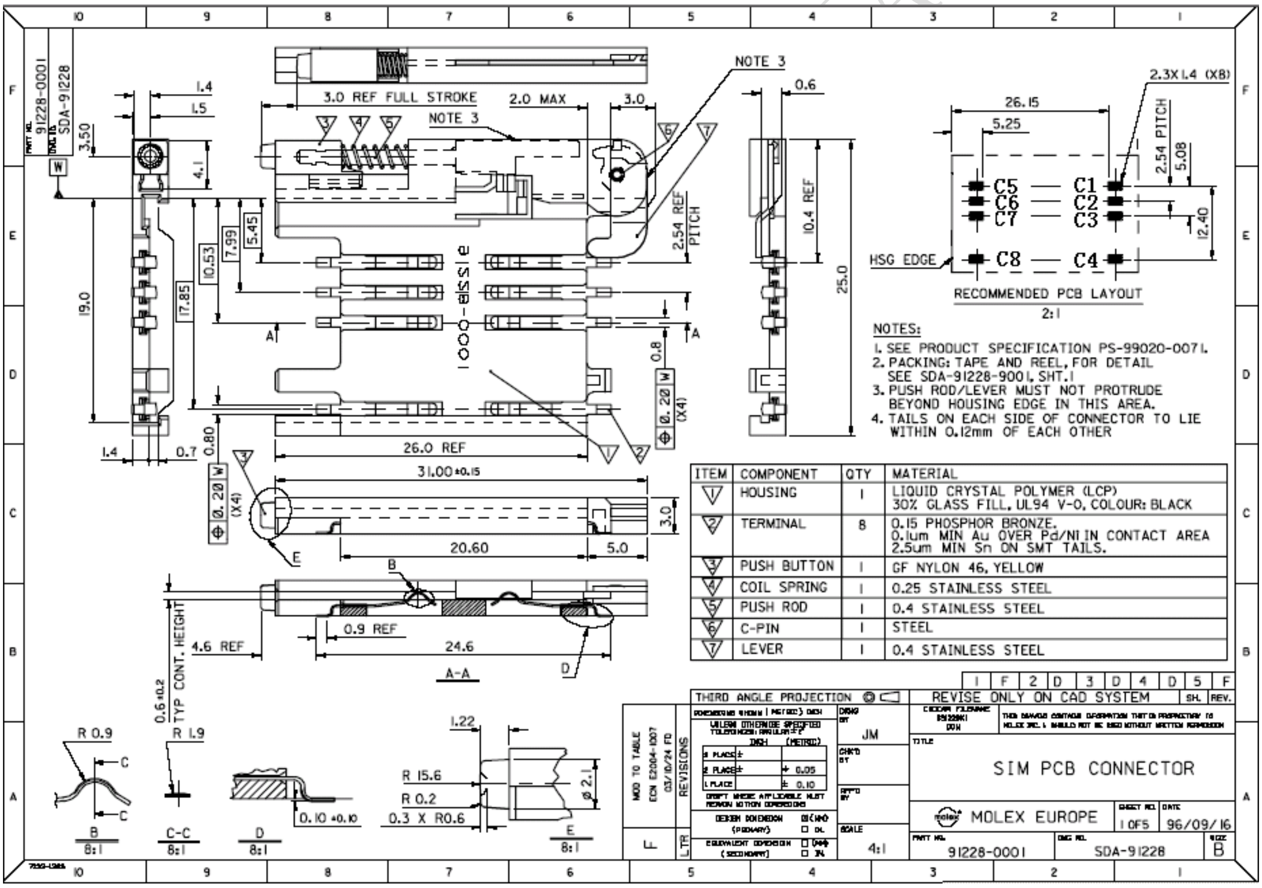


Figure 34: Molex 91228 SIM card holder

Table 18: Pin description (Molex SIM card holder)

Pin name	Signal	Description
C1	SIM_VDD	SIM card power supply
C2	SIM_RST	SIM card reset

C3	SIM_CLK	SIM card clock
C4	GND	Connect to GND
C5	GND	Connect to GND
C6	VPP	Not connect
C7	SIM_DATA	SIM card data I/O
C8	SIM_DET	Detect SIM card presence

For 6-pin SIM card holder, SIMCom recommends to use Amphenol C707 10M006 512 .Customer can visit http://www.amphenol.com for more information about the holder.

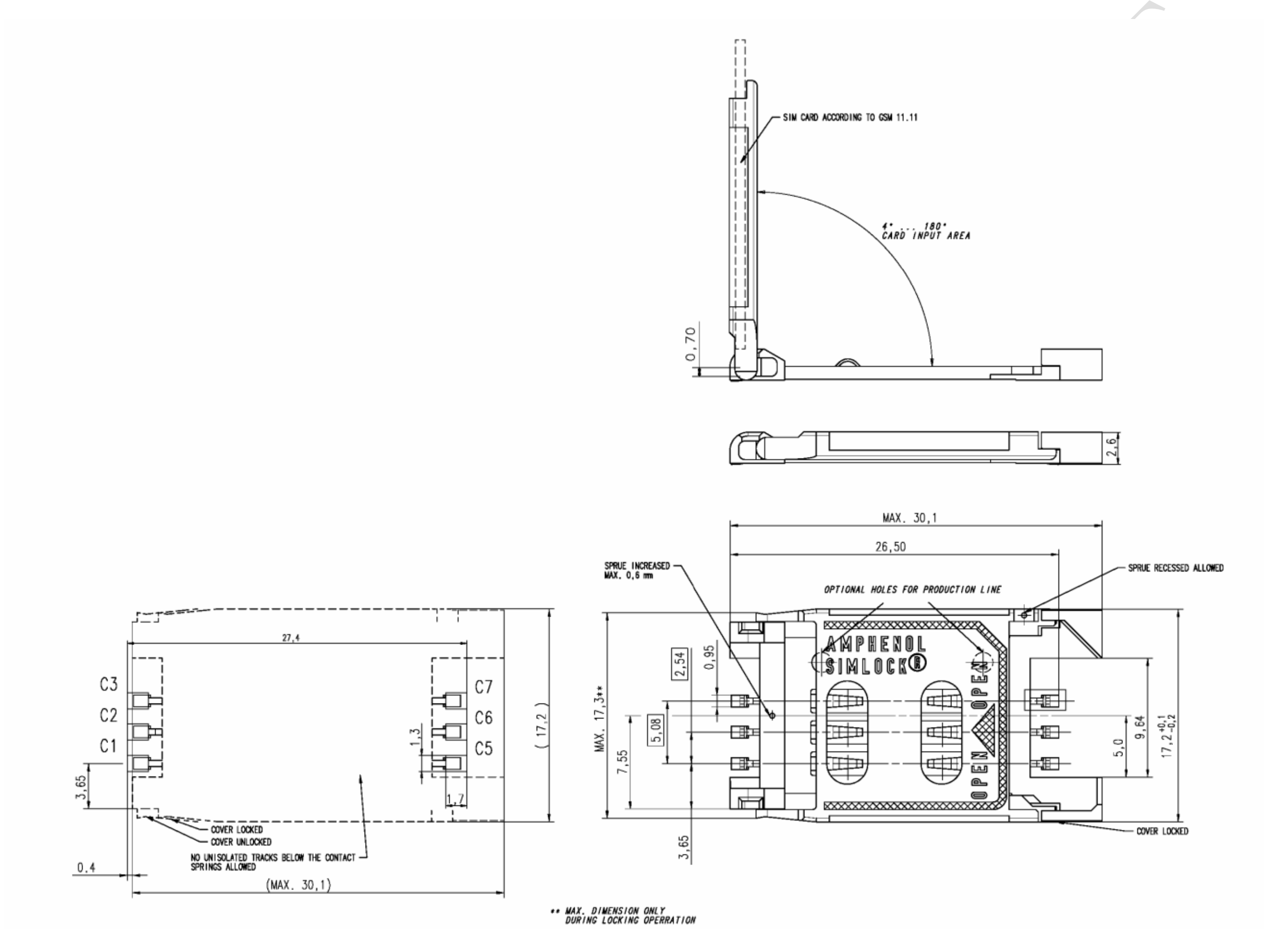


Figure 35: Amphenol C707 10M006 512 SIM card holder

Table 19: Pin description (Amphenol SIM card holder)

Pin name	Signal	Description
C1	SIM_VDD	SIM card power supply
C2	SIM_RST	SIM card reset
C3	SIM_CLK	SIM card clock
C5	GND	Connect to GND
C6	VPP	Not connect
C7	SIM_DATA	SIM card data I/O

Note: Every time plug SIM card interval advice is greater than 2s. Otherwise may not be able to correct detection.

4.9. SD Interface

SIM868 provides a hardware SD interface:

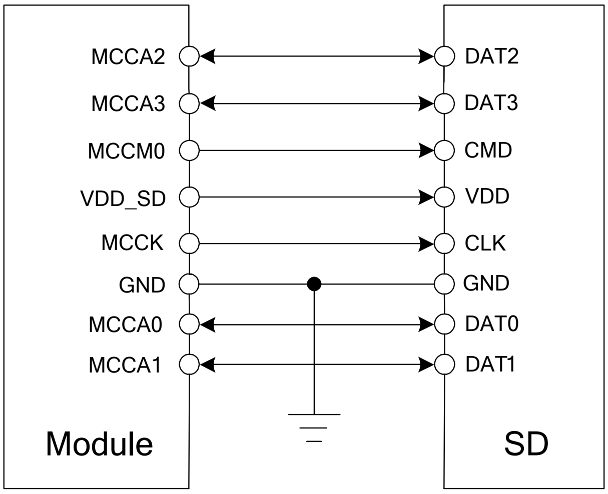


Figure 36: SD reference circuit

If power supply is 2.8V for SD card, customer can use VDD_EXT; if power supply is 3.3V, please use external design LDO.

4.10. I2C Bus

The SIM868 provides an I2C interface which is only used in the embedded AT application.

Table 20: Pin definition of the I2C

Pin name	Pin number	Description
SCL	65	I2C serial bus clock(open drain output)
SDA	64	I2C serial bus data(open drain output)

Note:

1. ***I2C should be pulled up to 2.8V via 4.7K externally.***
2. ***I2C function is not supported in the standard firmware. If you need, please contact SIMCom.***

4.11. ADC

Table 21: Pin definition of the ADC

Pin name	Pin number	Description
ADC	38	Analog voltage input

SIM868 provides an auxiliary ADC, which can be used to measure the voltage. Customer can use AT command "AT+CADC" to read the voltage value.

Note: Customer can use AT command set mode. For detail, please refer to document t[1].

Table 22: ADC specification

Parameter		Min	Typ	Max	Unit
Voltage range		0	-	2.8	V
ADC Resolution		-	10	-	bits
RIN	Input resistance				
	Unselected channel		400		M
	Selected channel		1		M
CIN	Input capacitance				
	Unselected channel			50	fF
	Selected channel			4	pF
Sampling rate		-	-	1.08	MHz
ADC precision			10	30	mV

4.12. Network Status Indication

Table 23: Pin definition of the NETLIGHT

Pin name	Pin number	Description
NETLIGHT	41	Network Status Indication

The NETLIGHT pin can be used to drive a network status indication LED. The status of this pin is listed in following table:

Table 24: Status of the NETLIGHT pin

Status	SIM868 behavior
Off	Powered off
64ms On/ 800ms Off	Not registered the network
64ms On/ 3000ms Off	Registered to the network
64ms On/ 300ms Off	GPRS communication is established

Reference circuit is recommended in the following figure:

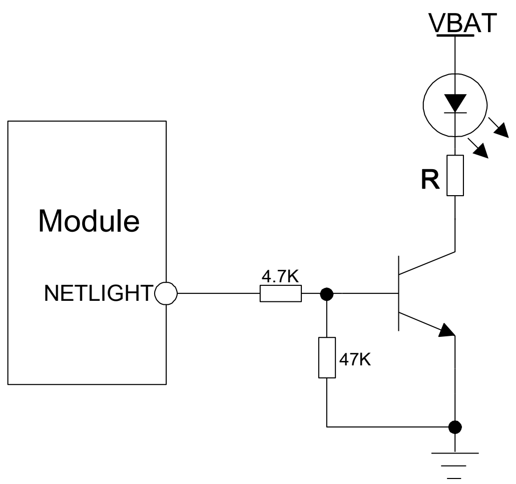


Figure 37: Reference circuit of NETLIGHT

Note: Customer can use AT command set mode. For detail, please refer to document t[1].

4.13. Operating Status Indication

The pin42 is for operating status indication of the module. The pin output is high when module is powered on, and output is low when module is powered off.

Table 25: Pin definition of the STATUS

Pin name	Pin number	Description
STATUS	42	Operating status indication

Note: For timing about STATUS, please reference to the chapter "4.2 power on/down scenarios"

4.14. RF Synchronization Signal

The synchronization signal serves to indicate growing power consumption during the transmit burst.

Table 26: Definition of the RF_SYNC pin

Pin name	Pin number	Description
RF_SYNC	29	Transmit synchronization signal

The timing of the synchronization signal is shown in the following figure. High level of the RF_SYNC signal indicates increased power consumption during transmission.

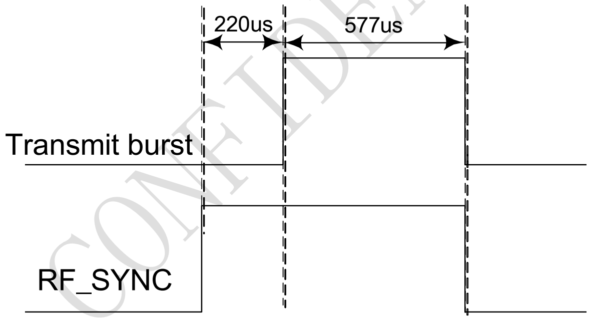


Figure 38: RF_SYNC signal during transmit burst

4.15. GNSS

4.15.1. GNSS Overview

SIM868 provide a high-performance L1 GNSS solution for cellular handset applications. The solution offers best-in-class acquisition and tracking sensitivity, Time-To-First-Fix (TTFF) and accuracy. The GNSS engine supports both fully-autonomous operations for use in handheld consumer navigation devices and other standalone navigation systems.
GNSS engine Performance, please refer to Table 3.

GNSS NMEA information is output by serial port. The default baud rate is 115200bps.

4.15.2. Power on/down GNSS

The GNSS engine is controlled by GNSS_EN PIN, so when it is necessary to run GNSS，the GNSS_EN must be series 10k resistance pulled up to high . When it is necessary to power off GNSS， the GNSS_EN must be pulled down to GND.

4.15.3. 1PPS Output

The 1PPS pin outputs pulse-per-second (1PPS) pulse signal for precise timing purposes. It will come out after successfully positioning .The 1PPS signal can be provided through designated output pin for many external applications.

4.16. Antenna Interface

There are two antenna interfaces, GSM_ANT、GPS_ANT.

- The input impendence of the two antenna should be 50Ω, and the VSWR should be less than 2.
- It is recommended that the GSM antenna should be placed as far as possible.
- The isolations of the two antenna should be bigger than 30dB

NOTE：About the RF trace layout please refer to "AN_SMT Module_RF_Reference Design Guide".

4.16.1. GSM Antenna Interface

There is a GSM antenna pad named GSM_ANT to connect an external GSM antenna, the connection of the antenna must be decoupled from DC voltage. This is necessary because the antenna connector is DC coupled to ground via an inductor for ESD protection. The external antenna must be matched properly to achieve the best performance, so the matching circuit is necessary.
It is recommended to reserve the matching circuit as following:

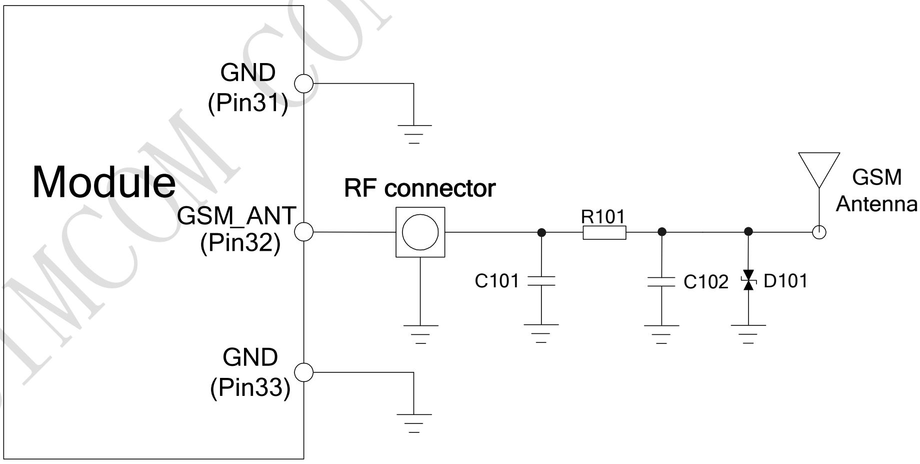


Figure 39: GSM antenna matching circuit

The RF connector is used for conduction test. If the space between RF pin and antenna is not enough, the matching circuit should be designed as in the following figure:

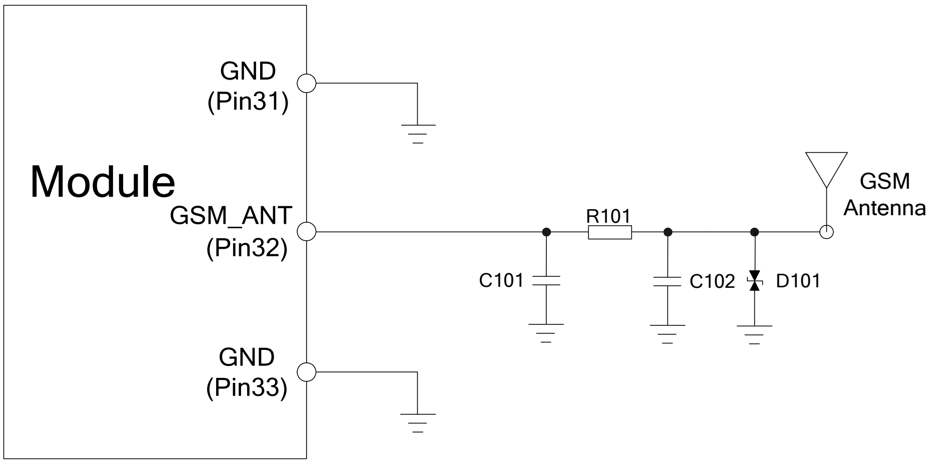


Figure 40: GSM antenna matching circuit without RF connector

In above figure, the components R101, C101 and C102 are used for antenna matching, the value of components can only be got after the antenna tuning, usually, they are provided by antenna vendor. By default, the R101 is 0Ω resistors, and the C101, C102 are reserved for tuning.

The RF test connector in the figure is used for the conducted RF performance test, and should be placed as close as to the module's antenna pin. The traces impedance between components must be controlled in 50Ω. The component D101 is a bidirectional TVS component, which is used for ESD protection, the recommended part numbers of the TVS are listed in the following table:

Table 27: Recommended TVS component

Package	Type	Supplier
0201	LXES03AAA1-154	Murata
0402	LXES15AAA1-153	Murata

4.16.2. GNSS Antenna Interface

The module also provides a GNSS antenna interface named GPS_ANT to connect the antenna on the customer's application board. To obtain excellent GNSS reception performance, a good antenna will always be required. Proper choice and placement of the antenna will ensure that satellites at all elevations can be seen, and therefore, accurate fix measurements are obtained. There are two normal options: passive antenna and active antenna. GNSS antenna choice should be based on the designing product and other conditions. For detailed Antenna designing consideration, please refer to related antenna vendor's design recommendation. The antenna vendor will offer further technical support and tune their antenna characteristic to achieve successful GNSS reception performance.

The external antenna must be matched properly to achieve best performance, so the matching circuit is necessary, the connection is recommended as the following figure:

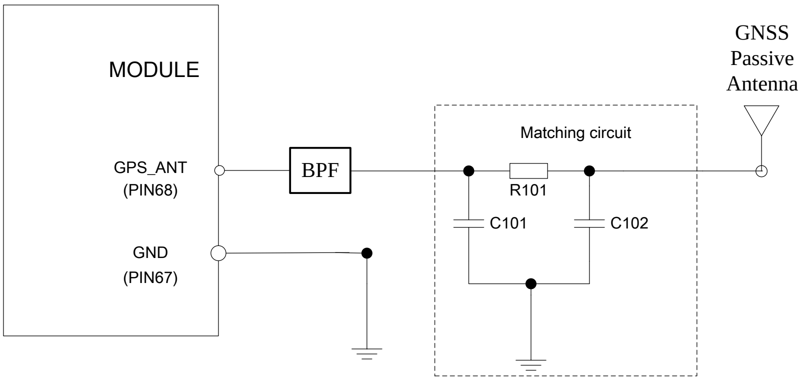


Figure 41: GNSS passive antenna matching circuit

The components R101, C101 and C102 are used for antenna matching, the BPF is used for out of band noise signal suppression. the components' value only can be got after the antenna tuning. Normally R101 is 0Ω , C101 and C102 are not mounted.

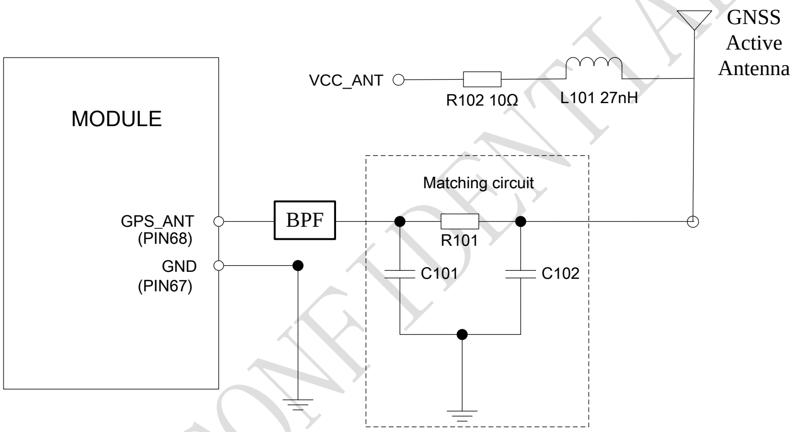


Figure 42: GNSS active antenna matching circuit

Active antennas have an integrated Low-Noise Amplifier (LNA). VCC_ANT is needed on customer's application board for the active antenna power input, as shown in Figure 42. The inductor L101 is used to prevent the RF signal from leaking into the VCC_ANT pass and route the bias supply to the active antenna, the recommended value of L101 is no less than 27nH. R102 can protect the whole circuit in case the active antenna is shorted to ground.

Table28: Recommended BPF component

Package	Type	Supplier
1.35*1.05	SAFEB1G57KE0F00	Murata

5. PCB Layout

This section will give some guidelines on PCB layout, in order to eliminate interfere or noise.

5.1 Pin Assignment

Before PCB layout, we should learn about pin assignment in order to get reasonable layout with so many external components. Following figure is the overview of pin assignment of the module.

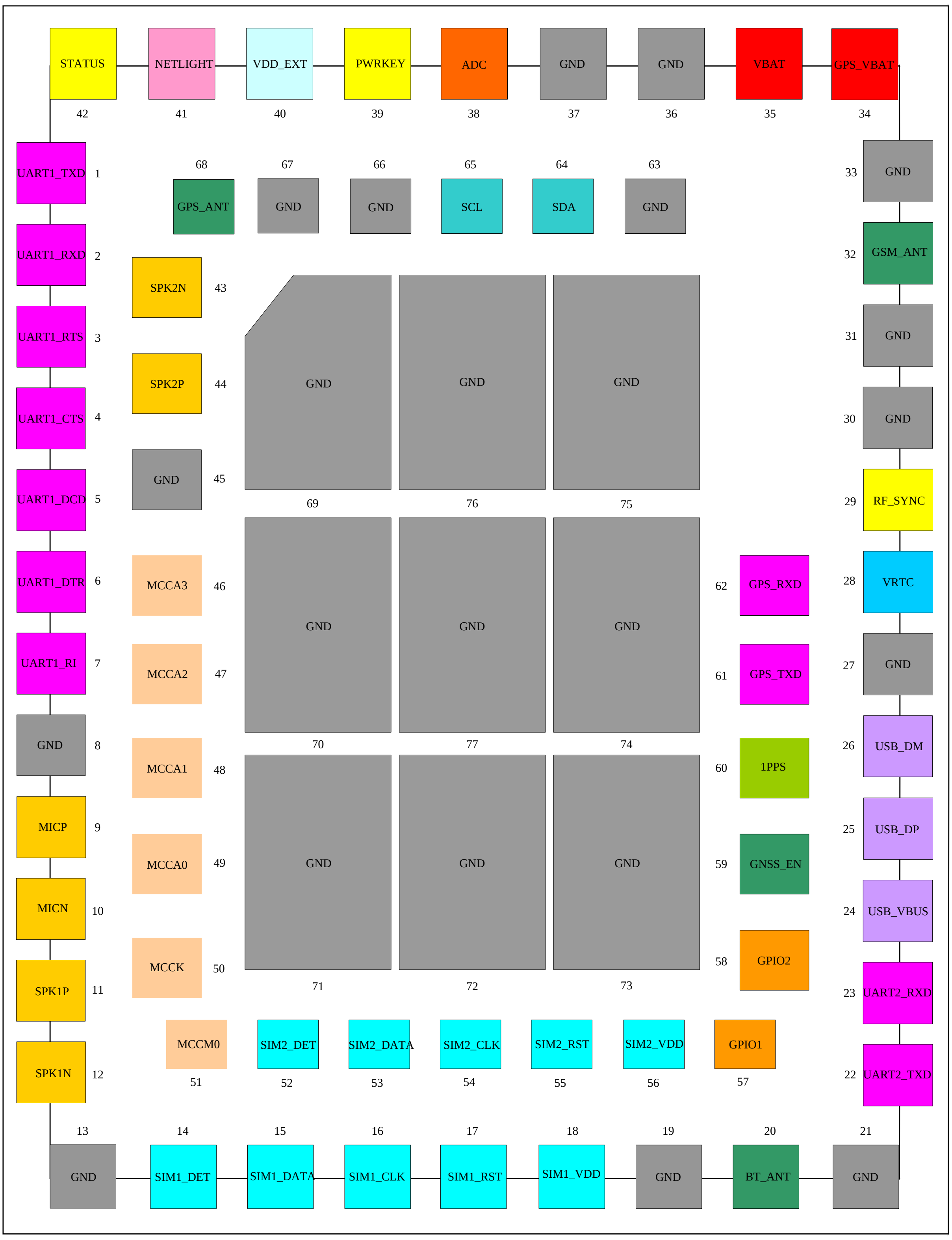


Figure 43: PIN assignment

5.2 Principle of PCB Layout

During layout, attention should be paid to the following interfaces, like Antenna, power supply, SIM card interface, audio interface, and so on.

5.2.1 Antenna Interface

- The length of trace between pin output and connector should be as short as possible;
- Do not trace RF signal over across the board;
- The RF signal should be far away from SIM card, power ICs.

5.2.2 Power Supply

- VBAT and return GND are very important in layout;
- The positive line of VBAT should be as short and wide as possible;
- The correct flow from source to VBAT pin should go though Zener diode then huge capacitor;
- Pin 36 and Pin37 are GND signals, and shortest layout to GND of power source should be designed;
- There are 23 GND pads in the module; these pads could enhance the GND performances. On the upper layer of these pads, do not trace any signal if possible.

5.2.3 SIM Card Interface

- SIM card holder has no anti-EMI component inside. Thus SIM card interface maybe interfered, please pay more attention on this interface during layout;
- Ensure SIM card holder is far way from antenna or RF cable inside;
- Put SIM card holder near the module, as nearer as possible;
- Add ESD component to protect SIM_CLK, SIM_DATA, SIM_RST and SIM_VDD signals which should be far away from power and high-speed-frequency signal.

5.2.4 Audio Interface

- The signal trace of audio should far away from antenna and power;
- The audio signal should avoid paralleling with VBAT trace.

5.2.5 Others

- It is better to trace signal lines of UART bunched, as well as signals of USB.

6. Electrical, Reliability and Radio Characteristics

6.1 Absolute Maximum Ratings

The absolute maximum ratings stated in following table are stress ratings under non-operating conditions. Stresses beyond any of these limits will cause permanent damage to SIM868.

Table 28: Absolute maximum ratings

Symbol	Min	Typ	Max	Unit
VBAT	-	-	4.5	V
GPS_VBAT	-	-	4.5	
VRTC	-	-	4.5	
GNSS_EN	-	-	4.5	
Current	0	-	2.0	A
USB_VBUS	-	-	7	V
I_I*	-	4	16	mA
I_O*	-	4	16	mA

These parameters are for digital interface pins, GPIO, and UART.

6.2 Recommended Operating Conditions

Table 30: Recommended operating conditions

Symbol	Parameter	Min	Typ	Max	Unit
VBAT	GSM power supply voltage	3.4	4.0	4.4	V
GPS_VBAT	GPS power supply voltage	2.8	4.0	4.4	
VRTC	Backup battery voltage	2.3		4.3	
GNSS_EN (V_{OH})	GPS enable	1.5	2.8	4.4	V
GNSS_EN (V_{OL})	GPS disable	-	-	0.3	V
T_{OPER}	Operating temperature	-40	+25	+85	℃
T_{STG}	Storage temperature	-45		+90	℃

6.3 Digital Interface Characteristics

Table 29: Digital interface characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V_{IH}	High-level input voltage	2.1	-	3.0	V
V_{IL}	Low-level input voltage	-0.3	-	0.7	V
V_{OH}	High-level output voltage	2.4	-	-	V
V_{OL}	Low-level output voltage	-	-	0.4	V

Note: These parameters are for digital interface pins, such as keypad, GPIO and UART.

6.4 SIM Card Interface Characteristics

Table 30: SIM card interface characteristics

Symbol	Parameter	Min	Typ	Max	Unit
I_{IH}	High-level input current	-1.0	-	1.0	uA
I_{IL}	Low-level input current	-1.0	-	1.0	uA
V_{IH}	High-level input voltage	1.4	-	-	V
		2.4	-	-	V
V_{IL}	Low-level input voltage	-	-	0.27	V
				0.4	V
V_{OH}	High-level output voltage	1.62	-	-	V
		2.7	-	-	V
V_{OL}	Low-level output voltage	-	-	0.36	V
		-	-	0.4	V

6.5 SIM_VDD Characteristics

Table 31: SIM_VDD characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V_O	Output voltage	-	3.0	-	V
		-	1.8	-	
I_O	Output current	-	-	10	mA

6.6 VDD_EXT Characteristics

Table 32: VDD_EXT characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V_O	Output voltage	2.7	2.8	2.9	V
I_O	Output current	-	-	50	mA

6.7 Current Consumption（VBAT=4.0V）

Table 33: Current consumption

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
VBAT	Voltage			4.0		V
	Power drop	PCL=5			350	mV
	Voltage ripple	PCL=5 @ f<200kHz @ f>200kHzss			 50 2.0	 mV mV
I_{VBAT}	Average current	Power off mode		130	150	uA

		Sleep mode (AT+CFUN=1): (BS-PA-MFRMS=9) (BS-PA-MFRMS=5) (BS-PA-MFRMS=2)		 0.86 1.02 1.42		 mA mA mA
		Idle mode (AT+CFUN=1): GSM850 EGSM900 DCS1800 PCS1900		 13.7 13.7 13.7 13.7		 mA mA mA mA
		Voice call (PCL=5): GSM850 EGSM900 Voice call (PCL=0): DCS1800 PCS1900		 223 234 162 170		 mA mA mA mA
		Data mode GPRS (1Rx,4Tx): GSM850 EGSM900 DCS1800 PCS1900		 378 414 270 308		 mA mA mA mA
		Data mode GPRS (3Rx,2Tx): GSM850 EGSM900 DCS1800 PCS1900		 323 340 212 236		 mA mA mA mA
		Data mode GPRS (4Rx,1Tx): GSM850 EGSM900 DCS1800 PCS1900		 217 223 153 163		 mA mA mA mA
I_{MAX}	Peak current	During Tx burst			2.0	A

Note: In above table the current consumption value is the typical one of the module tested in laboratory. In the mass production stage, there may be differences among each individual.

6.8 Electro-Static Discharge

SIM868 is an ESD sensitive component, so attention should be paid to the procedure of handling and packaging. The ESD test results are shown in the following table.

Table 34: The ESD characteristics (Temperature: 25℃, Humidity: 45 %)

Pin name	Contact discharge	Air discharge
VBAT	±5KV	±10KV
GND	±5KV	±10KV
UART1_TXD /UART1_RXD	±4KV	±8KV
Antenna port	±5KV	±10KV

SPKP/SPKN/MICP/MICN	±4KV	±8KV
PWRKEY	±4KV	±8KV

6.9 Radio Characteristics

6.9.1 Module RF Output Power

The following table shows the module conducted output power, it is followed by the 3GPP TS 05.05 technical specification requirement.

Table 35: GSM850 and EGSM900 conducted RF output power

GSM850,EGSM900			
PCL	Nominal output power (dBm)	Tolerance (dB) for conditions	
		Normal	Extreme
5	33	±2	±2.5
6	31	±3	±4
7	29	±3	±4
8	27	±3	±4
9	25	±3	±4
10	23	±3	±4
11	21	±3	±4
12	19	±3	±4
13	17	±3	±4
14	15	±3	±4
15	13	±3	±4
16	11	±5	±6
17	9	±5	±6
18	7	±5	±6
19-31	5	±5	±6

Table 36: DCS1800 and PCS1900 conducted RF output power

DCS1800,PCS1900			
PCL	Nominal output power (dBm)	Tolerance (dB) for conditions	
		Normal	Extreme
0	30	±2	±2.5
1	28	±3	±4
2	26	±3	±4
3	24	±3	±4
4	22	±3	±4
5	20	±3	±4
6	18	±3	±4

7	16	±3	±4
8	14	±3	±4
9	12	±4	±5
10	10	±4	±5
11	8	±4	±5
12	6	±4	±5
13	4	±4	±5
14	2	±5	±6
15	0	±5	±6

For the module's output power, the following should be noted:

At GSM900 and GSM850 band, the module is a class 4 device, so the module's output power should not exceed 33dBm, and at the maximum power level, the output power tolerance should not exceed +/-2dB under normal condition and +/-2.5dB under extreme condition.

At DCS1800 and PCS1900 band, the module is a class 1 device, so the module's output power should not exceed 30dBm, and at the maximum power level, the output power tolerance should not exceed +/-2dB under normal condition and +/-2.5dB under extreme condition.

6.9.2 Module RF Receive Sensitivity

The following table shows the module's conducted receiving sensitivity, it is tested under static condition.

Table 37: Conducted RF receive sensitivity

Frequency	Receive sensitivity（Typical）	Receive sensitivity(Max)
GSM850,EGSM900	< -109dBm	< -107dBm
DCS1800,PCS1900	< -109dBm	< -107dBm

6.9.3 Module Operating Frequencies

The following table shows the module's operating frequency range; it is followed by the 3GPP TS 05.05 technical specification requirement.

Table 40: Operating frequencies

Frequency	Receive	Transmit
GSM850	869 ～ 894MHz	824 ～ 849MHz
EGSM900	925 ～ 960MHz	880 ～ 915MHz
DCS1800	1805 ～ 1880MHz	1710 ～ 1785MHz
PCS1900	1930 ～ 1990MHz	1850 ～ 1910MHz

7. Manufacturing

7.1. Top and Bottom View of SIM868

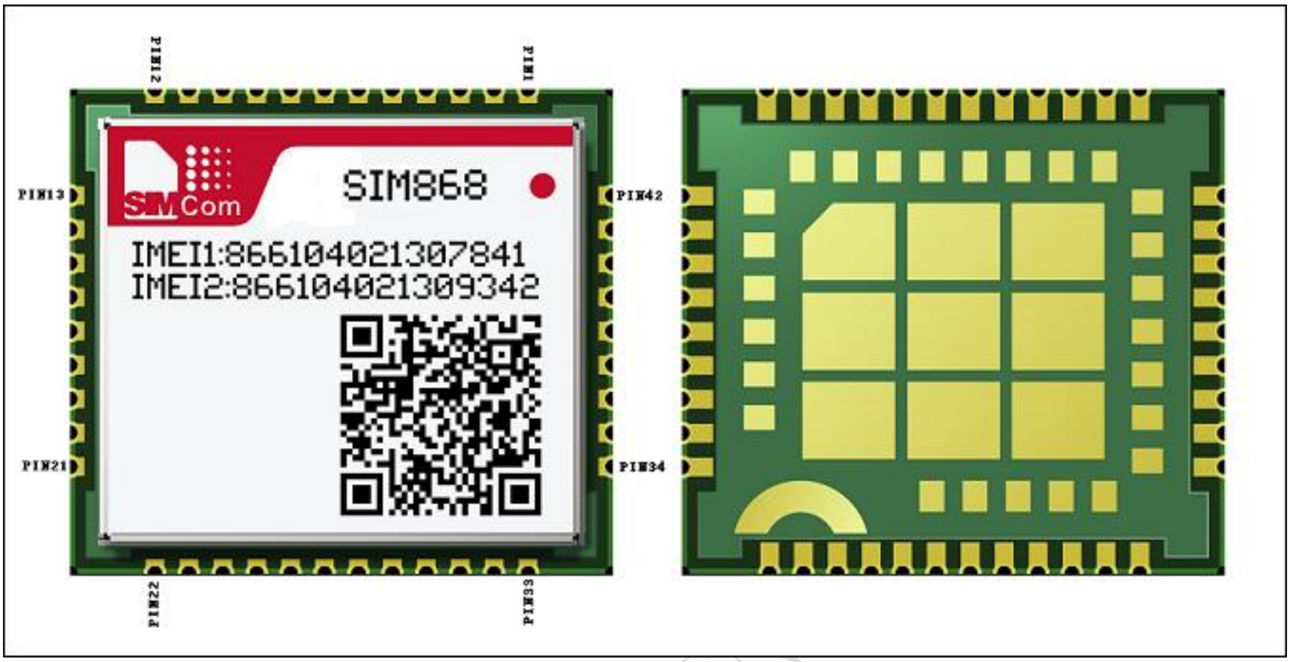


Figure 44: Top and bottom view of SIM868

7.2. Typical Solder Reflow Profile

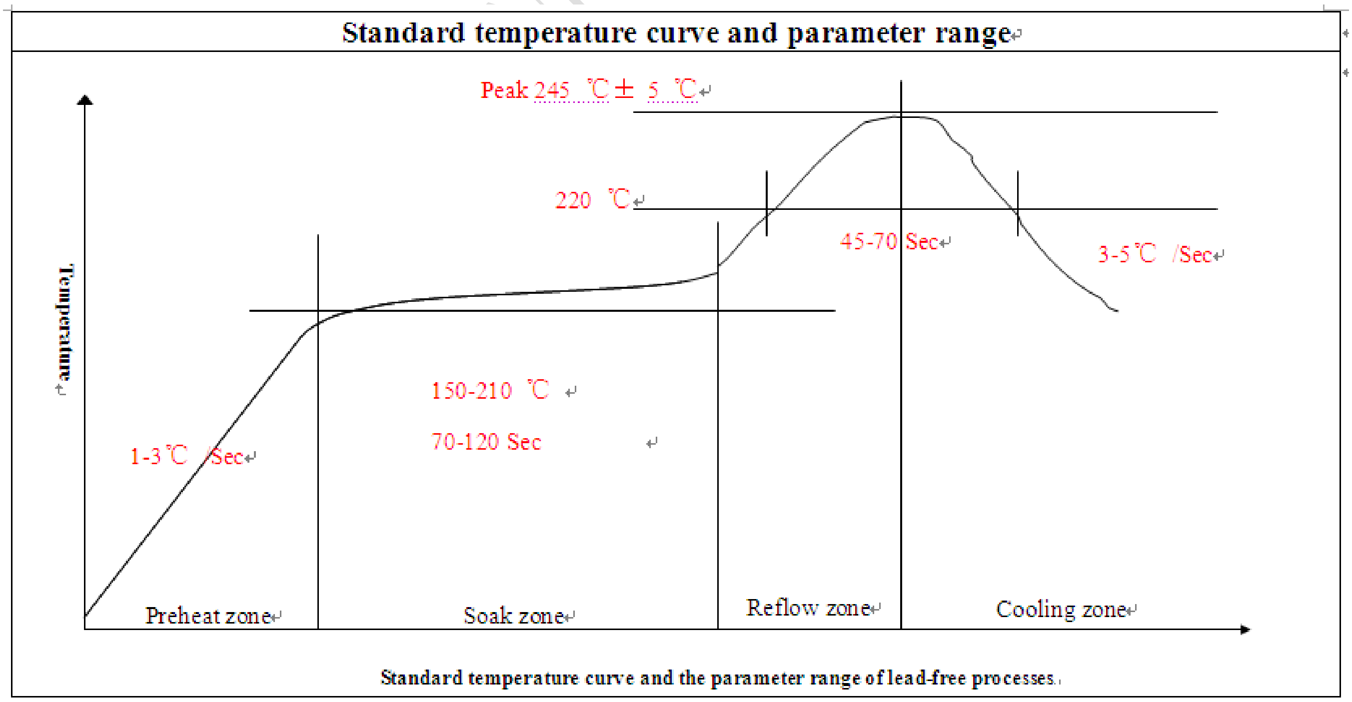


Figure 45: Typical solder reflow profile of lead-free process

7.3. The Moisture Sensitivity Level

The moisture sensitivity level of SIM868 module is 3. The modules should be mounted within 168 hours after unpacking in the environmental conditions of temperature <30℃ and relative humidity of <60% (RH). It is necessary to bake the module if the above conditions are not met:

Table 38: Moisture sensitivity level and floor life

Moisture Sensitivity Level (MSL)	Floor Life (out of bag) at factory ambient≤30°C/60% RH or as stated
1	Unlimited at ≦30℃/85% RH
2	1 year
2a	4 weeks
3	168 hours
4	72 hours
5	48 hours
5a	24 hours
6	Mandatory bake before use. After bake, it must be reflowed within the time limit specified on the label.

NOTES:

1. If the vacuum package is not open for 3 months or longer than the packing date, baking is also recommended before re-flow soldering.

2. For product handling, storage, processing, IPC / JEDEC J-STD-033 must be followed.

7.4. Baking Requirements

SIM868 modules are vacuum packaged, and guaranteed for 6 months storage without opening or leakage under the following conditions: the environment temperature is lower than 40℃, and the air humidity is less than 90%.

If the condition meets one of the following ones shown below, the modules should be baked sufficiently before re-flow soldering, and the baking condition is shown in below table; otherwise the module will be at the risk of permanent damage during re-flow soldering.

- If the vacuum package is broken or leakage;
- If the vacuum package is opened after 6 months since it's been packed;
- If the vacuum package is opened within 6 months but out of its Floor Life at factory ambient≦30℃ /60%RH or as stated.

Table 39: Baking requirements

Baking temperature	Moisture	Time
40℃ ±5℃	<5%	192 hours
120℃ ±5℃	<5%	4 hours

Note: Care should be taken if that plastic tray is not heat-resistant, the modules should be taken out for preheating, and otherwise the tray may be damaged by high-temperature heating.

8. Appendix

I. Related Documents

Table 40: Related documents

SN	Document name	Remark
[1]	SIM800_Series_AT_Command_Manual	
[2]	SIM800 Series Port Application Note_V1 02.doc	
[3]	ITU-T Draft new recommendation V.25ter:	Serial asynchronous automatic dialing and control
[4]	GSM 07.07:	Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)
[5]	GSM 07.10:	Support GSM 07.10 multiplexing protocol
[6]	GSM 07.05:	Digital cellular telecommunications (Phase 2+); Use of Data Terminal Equipment – Data Circuit terminating Equipment (DTE – DCE) interface for Short Message Service (SMS) and Cell Broadcast Service (CBS)
[7]	GSM 11.14:	Digital cellular telecommunications system (Phase 2+); Specification of the SIM Application Toolkit for the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[8]	GSM 11.11:	Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[9]	GSM 03.38:	Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information
[10]	GSM 11.10	Digital cellular telecommunications system (Phase 2); Mobile Station (MS) conformance specification; Part 1: Conformance specification
[11]	AN_Serial Port	AN_Serial Port
[12]	SIM868_GNSS_Application Note	

II. Terms and Abbreviations

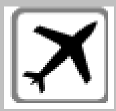
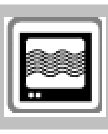
Table 41: Terms and abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
AMR	Adaptive Multi-Rate
CS	Coding Scheme
CTS	Clear to Send
DTE	Data Terminal Equipment (typically computer, terminal, printer)
DTR	Data Terminal Ready
DTX	Discontinuous Transmission
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
FR	Full Rate
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
HR	Half Rate
MO	Mobile Originated
MS	Mobile Station (GSM engine), also referred to as TE
MT	Mobile Terminated
PAP	Password Authentication Protocol
PBCCH	Packet Broadcast Control Channel
PCB	Printed Circuit Board
PCL	Power Control Level
PCS	Personal Communication System, also referred to as GSM 1900
PDU	Protocol Data Unit
PPP	Point-to-point protocol
RF	Radio Frequency
RMS	Root Mean Square (value)
RX	Receive Direction
SIM	Subscriber Identification Module
SMS	Short Message Service
TE	Terminal Equipment, also referred to as DTE
TX	Transmit Direction
SINAD	Signal to Noise and Distortion Ratio
UART	Universal Asynchronous Receiver & Transmitter
URC	Unsolicited Result Code
USSD	Unstructured Supplementary Service Data
Phonebook abbreviations	

FD	SIM fix dialing phonebook
LD	SIM last dialing phonebook (list of numbers most recently dialed)
MC	Mobile Equipment list of unanswered MT calls (missed calls)
ON	SIM (or ME) own numbers (MSISDNs) list
RC	Mobile Equipment list of received calls
SM	SIM phonebook
NC	Not connect

III. Safety Caution

Table 42: 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 to not operate normally for 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. Forget to think much of these instructions may lead to the flight safety or offend against 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.
	GSM cellular terminals or mobiles operate over radio frequency signals and cellular networks and cannot be guaranteed to connect in all conditions, for example no mobile fee or a invalid SIM card. While you are in this condition and need emergent help, please remember using 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 SIM card be properly inserted in the cellular terminal or mobile.

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