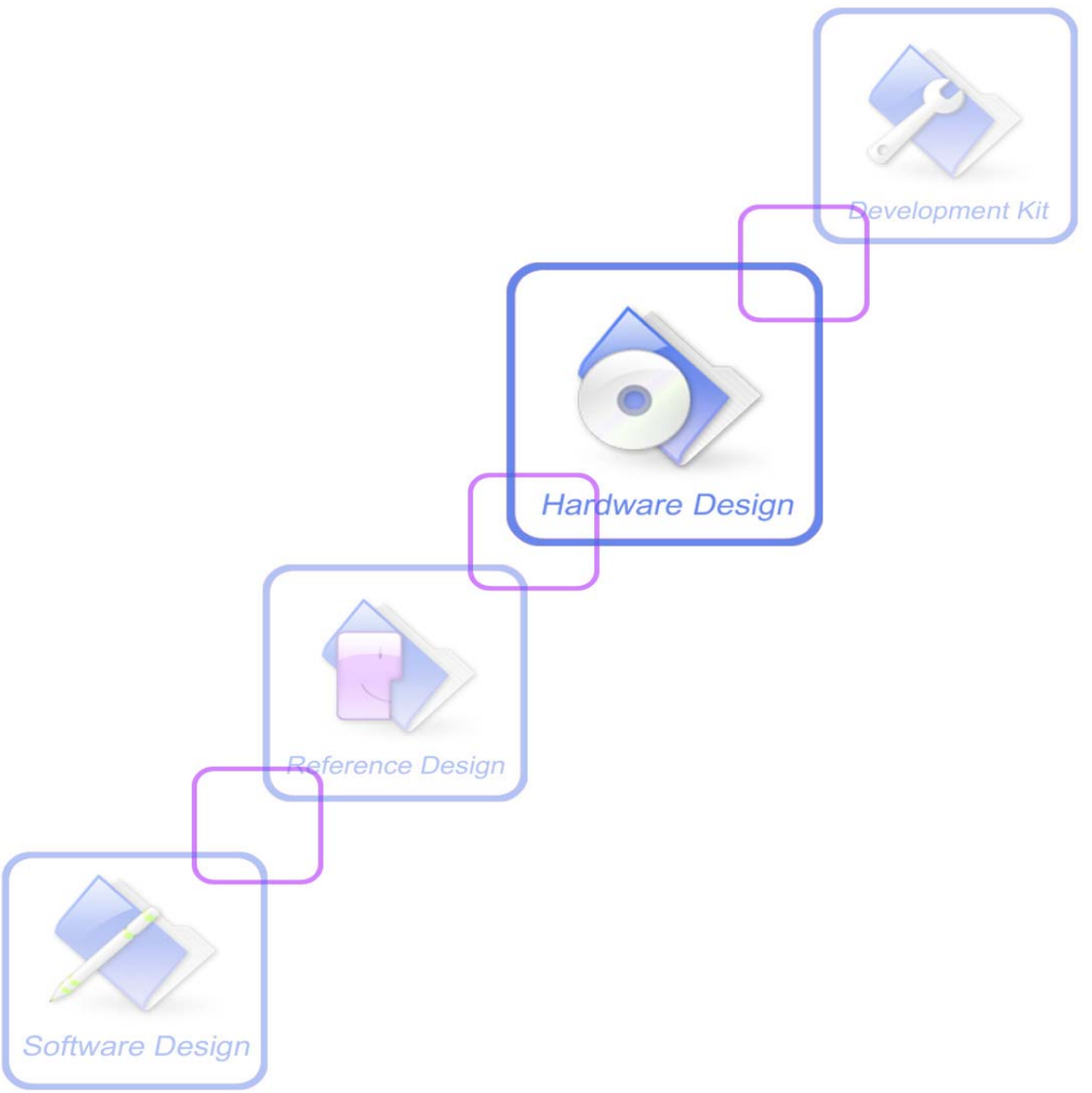
SIM900D_Hardware Design_V1.04



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Version history

Date	Version	Description of change	Author
2010-03-31	1.01	Origin	Jing.zhou
2010-04-09	1.02	Changed GHOST mode to Charge-only mode §3.4.1.1Update the Figure8: Timing of turn on system using PWRKEY §3.4.2.1Update the Figure9: Timing of turn off system using PWRKEY §4.2Update the Table25: SIM900D conducted RF receive sensitivity	Jing.zhou
2010-06-24	1.03	§3.8, Modify the VRTC pin connection when backup is not needed. §2.1, §3.3. §3.4 Modify the power supply range from 3.4V~4.5V to 3.1V~4.8V. §3.4.1.1Update the Figure8: Timing of turn on system using PWRKEY	Jing.zhou
2010-10-09	1.04	Modify the power supply range to 3.2V~4.8V. §3.3.2 Add Figure6: The minimal VBAT voltage at VBAT drop §3.4 Modified figure7，figure8，figure11. §3.6 Add 3.6.4 and 3.6.5 description. §3.11.1 Update the Figure25 §3.7 Update the Figure13	Jing.zhou

1 Introduction

This document describes the hardware interface of the SIMCom SIM900D module that connects to the specific application and the air interface. As SIM900D can be integrated into a wide range of applications, all functional components of SIM900D are described in great detail.

This document can help usres quickly understand SIM900D interface specifications, electrical and mechanical details. With the help of this document and other SIM900D application notes, user guide, users can use SIM900D module to design and set-up mobile applications quickly.

1.1 Related Documents

Table1: Related documents

SN	Document name	Remark
[1]	SIM900_ATC	SIM900_ATC
[2]	ITU-T Draft new recommendation V.25ter:	Serial asynchronous automatic dialing and control
[3]	GSM 07.07:	Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)
[4]	GSM 07.10:	Support GSM 07.10 multiplexing protocol
[5]	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)
[6]	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
[7]	GSM 11.11:	Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[8]	GSM 03.38:	Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information
[9]	GSM 11.10	Digital cellular telecommunications system (Phase 2)； Mobile Station (MS) conformance specification； Part 1: Conformance specification
[10]	AN_Serial Port	AN_Serial Port

1.2 Terms and Abbreviations

Table2: Terms and Abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
AMR	Adaptive Multi-Rate
ARP	Antenna Reference Point
ASIC	Application Specific Integrated Circuit
BER	Bit Error Rate
BTS	Base Transceiver Station
CHAP	Challenge Handshake Authentication Protocol
CS	Coding Scheme
CSD	Circuit Switched Data
CTS	Clear to Send
DAC	Digital-to-Analog Converter
DRX	Discontinuous Reception
DSP	Digital Signal Processor
DTE	Data Terminal Equipment (typically computer, terminal, printer)
DTR	Data Terminal Ready
DTX	Discontinuous Transmission
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
FCC	Federal Communications Commission (U.S.)
FDMA	Frequency Division Multiple Access
FR	Full Rate
GMSK	Gaussian Minimum Shift Keying
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
HR	Half Rate
I/O	Input/Output
IC	Integrated Circuit
IMEI	International Mobile Equipment Identity
kbps	Kilo bits per second
LED	Light Emitting Diode
DDLO	Deep Discharge Lock Out
Li-Ion	Lithium-Ion
MO	Mobile Originated
MS	Mobile Station (GSM engine), also referred to as TE

Abbreviation	Description
MT	Mobile Terminated
PAP	Password Authentication Protocol
PBCCH	Packet Switched Broadcast Control Channel
PCB	Printed Circuit Board
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)
RTC	Real Time Clock
RX	Receive Direction
SIM	Subscriber Identification Module
SMS	Short Message Service
TDMA	Time Division Multiple Access
TE	Terminal Equipment, also referred to as DTE
THD	Total Harmonic Distortion
TX	Transmit Direction
UART	Universal Asynchronous Receiver & Transmitter
URC	Unsolicited Result Code
USSD	Unstructured Supplementary Service Data
UVLO	Under Voltage Lock Out
VSWR	Voltage Standing Wave Ratio
Vmax	Maximum Voltage Value
Vnorm	Normal Voltage Value
Vmin	Minimum Voltage Value
VIHmax	Maximum Input High Level Voltage Value
VIHmin	Minimum Input High Level Voltage Value
VILmax	Maximum Input Low Level Voltage Value
VILmin	Minimum Input Low Level Voltage Value
VImax	Absolute Maximum Input Voltage Value
VImin	Absolute Minimum Input Voltage Value
VOHmax	Maximum Output High Level Voltage Value
VOHmin	Minimum Output High Level Voltage Value
VOLmax	Maximum Output Low Level Voltage Value
VOLmin	Minimum Output Low Level Voltage Value
Inorm	Normal Current

Abbreviation	Description
Imax	Maximum Load Current
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

1.3 Safety Precautions

The following safety precautions must be observed during all phases of the operation. Usage, service or repair of any cellular terminal or mobile incorporating SIM900D modules, manufactures of the cellular terminal should send words of the following safety information to users and operating personnels and to incorporate these guidelines into all manuals supplied with the product. If not so, SIMCom does not take any liability for customer failure to comply with these precautions.

Observe the restrictions of the usage of mobiles in a hospital or other health care facility. Switch the cellular terminal or mobile off, since medical equipment may be sensitive not to 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 of these instructions may lead to the flight safety or offending 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 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.

Cellular terminal or mobile handset receives and transmits radio frequency energy while they are switched on. RF interference can occur if it is used near 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 available or with an invalid SIM card. While users are in this kind of 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.). User may have to deactivate those features before user can make an emergency call.

Also, some networks require a valid SIM card to be properly inserted into the cellular terminal or mobile.

2 SIM900D Overview

Designed for global market, SIM900D is a quad-band GSM/GPRS engine that works on frequencies GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz. SIM900D features GPRS multi-slot class 10/ class 8 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4.

With a tiny configuration of 33mm x 33mm x 3mm, SIM900D can meet almost all the space requirements in your applications, such as M2M, smart phone, PDA, FWP, and other mobile devices.

The physical interface to the mobile application is a 48-pin SMT pad, which provides all hardware interfaces between the module and customers' boards.

- Serial port and Debug port can help user easily develop user's applications.
- The charge interface is very suitable for the battery power application.
- Two audio channels including two microphone inputs and two speakers' outputs can be easily built into handset, headset and handfree channel.
- The SPI display interface and two Programmable General Purpose Input & Output will give users the flexibility to develop customized applications.

SIM900D is designed with power saving technique so that the current consumption is as low as 1.2mA in SLEEP mode.

SIM900D is integrated with the TCP/IP protocol. Extended TCP/IP AT commands are developed for customers to use TCP/IP protocol easily, which is very useful for data transfer applications.

The modules complied with RoHS directive 2002/95/EC

2.1 SIM900D Key Features

Table3: SIM900D key features

Feature	Implementation
Power supply	Single supply voltage 3.2V – 4.8V
Power saving	Typical power consumption in SLEEP mode is 1.5mA (BS-PA-MFRMS=2)
Frequency Bands	● SIM900D Quad-band: GSM 850, EGSM 900, DCS 1800, PCS 1900. The SIM900D can search the 4 frequency bands automatically. The frequency bands also can be set by AT command. ● Compliant to GSM Phase 2/2+
GSM class	Small MS
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 10 （default） ● GPRS multi-slot class 8 (option) ● GPRS mobile station class B
Temperature range	● Normal operation: -30°C to +80°C ● Restricted operation: -40°C to -30°C and +80 °C to +85°C(1) ● Storage temperature -45°C to +90°C
DATA GPRS: CSD:	● GPRS data downlink transfer: max. 85.6 kbps ● GPRS data uplink transfer: max. 42.8 kbps ● Coding scheme: CS-1, CS-2, CS-3 and CS-4 ● Supports the protocols PAP (Password Authentication Protocol) usually used for PPP connections. ● Integrates the TCP/IP protocol. ● Support Packet Switched Broadcast Control Channel (PBCCH) ● CSD transmission rates: 2.4, 4.8, 9.6, 14.4 kbps, non-transparent ● Unstructured Supplementary Services Data (USSD) support
SMS	● MT, MO, CB, Text and PDU mode ● SMS storage: SIM card
FAX	Group 3 Class 1
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 Debug port	Serial Port: ● 7-wire modem interface with status and control lines, unbalanced, asynchronous. ● 1.2kbps to 115.2kbps. ● Serial Port can be used for AT commands or data stream. ● Supports 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 57600bps. Debug port: ● 2-wire null modem interface DBG_TXD and DBG_RXD. ● Can be used for debugging and upgrading firmware.
Phonebook management	Support phonebook types: SM, FD, LD, RC, ON, MC.
SIM Application Toolkit	Support SAT class 3, GSM 11.14 Release 99
Real time clock	Implemented

Timer function	Programmable via AT command
Physical characteristics	Size: 33x 33 x 3 mm Weight: 6.2g
Firmware upgrade	Firmware upgradeable by debug port.

(1) SIM900D does work, but deviations from the GSM specification may occur.

Table4: 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

2.2 SIM900D Functional Diagram

The following figure shows a functional diagram of the SIM900D and illustrates the mainly functional part:

- The GSM baseband engine
- Flash and SRAM
- The GSM radio frequency part
- The antenna interface
- The Other interfaces

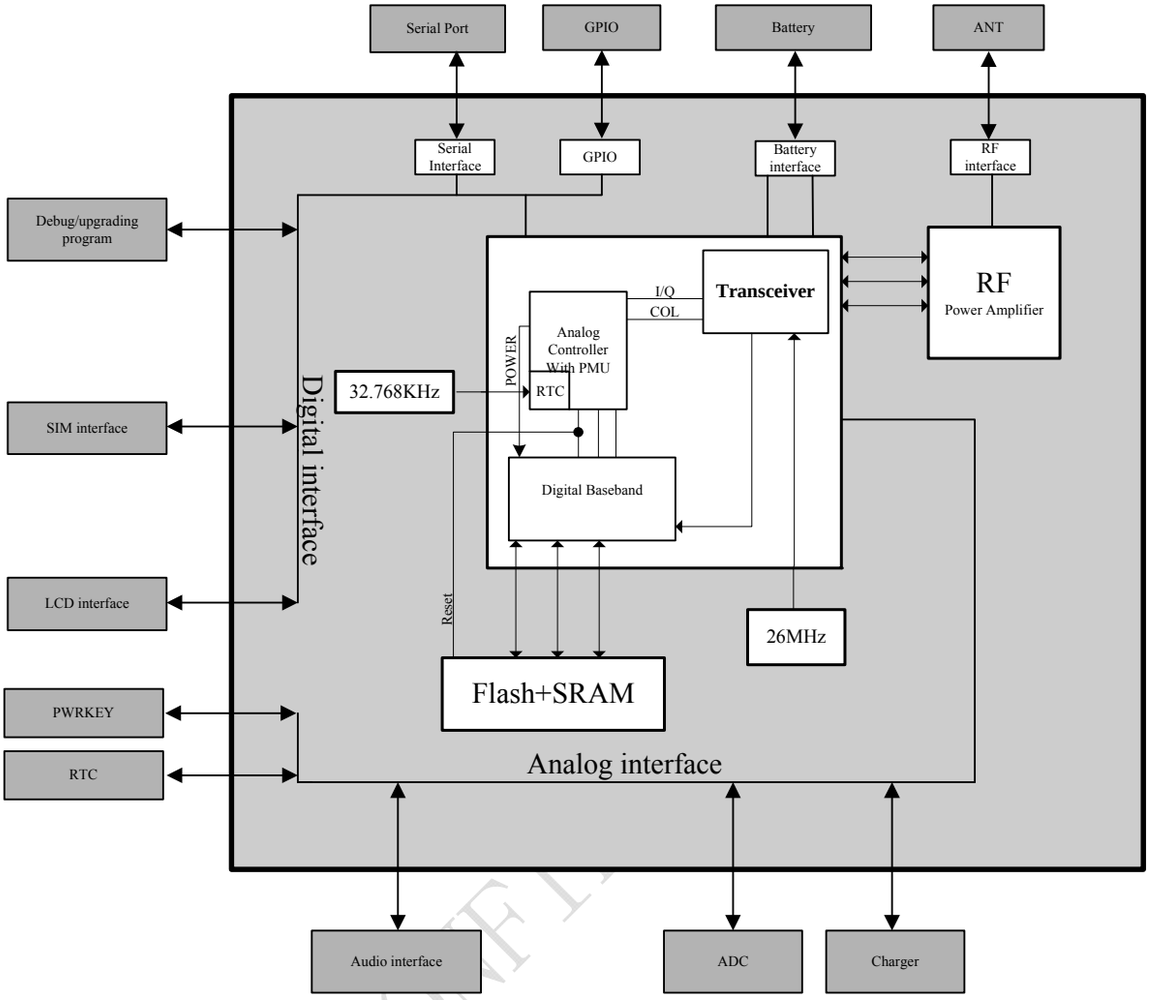


Figure1: SIM900D functional diagram

2.3 SIM900D Evaluation Board

In order to help users with the application of SIM900D, SIMCom can supply an Evaluation Board (EVB) that interfaces SIM900D directly with appropriate power supply, SIM card holder, RS232 serial port, handset port, earphone port, antenna and all GPIO of the SIM900D.

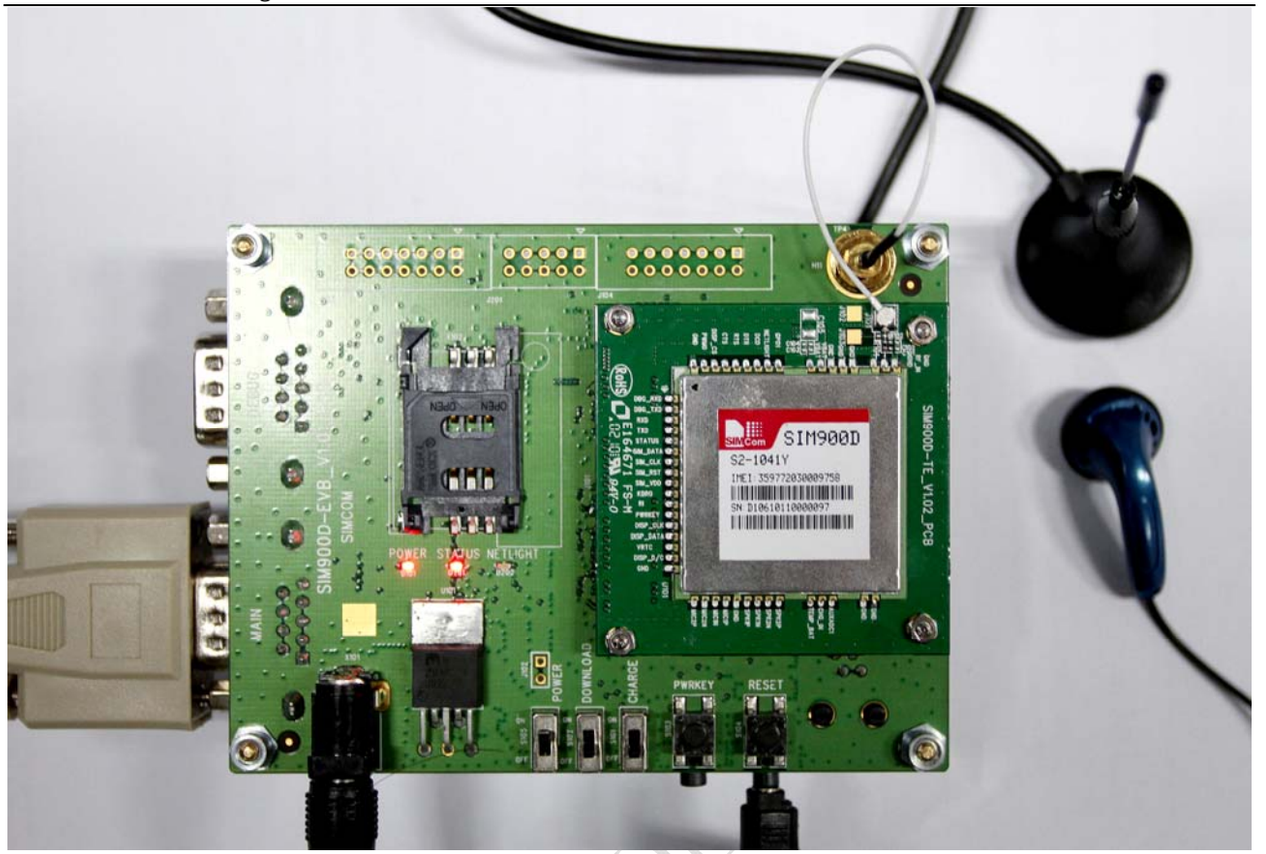


Figure2: Top view of SIM900D EVB

For details please refer to the *SIM900D-EVB_UGD* document.

3 Application Interface

SIM900D is equipped with a 48-pin SMT pad that connects to the cellular application platform. Sub-interfaces included in these SMT pads are described in detail in following chapters:

- Power supply and charging control *(please refer to Chapter 3.3 and 3.5)*
- Serial interface and Debug interface *(please refer to chapter3.9)*
- Two analog audio interfaces *(please refer to Chapter 3.10)*
- SIM interface *(please refer to Chapter 3.11)*

Electrical and mechanical characteristics of the SMT pad are specified in *Chapter 5.*

3.1 SIM900D Pin Description

Table5: Pin description

Power Supply				
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS	COMMENT
VBAT	I	2 VBAT pins are dedicated to connect the supply voltage. The power supply of SIM900D has to be a single voltage source of VBAT= 3.2V...4.8V. It must be able to provide sufficient current in a transmit burst which typically rises to 2A	Vmax= 4.8V Vmin=3.2V Vnorm=4.0V	
VRTC	I/O	Current input for RTC when the battery is not supplied for the system. Current output for backup battery when the main battery is present and the backup battery is in low voltage state.	Vmax=3.15V Vmin=2.0V Vnorm=3.0V Iout(max)= 200uA Iin= 3uA	Do not keep pin open, it should be connected to a battery or a capacitor.
VCHG	I	Voltage input for the charge circuit, as the signal to detect the charger insertion。	Vmax=7.5V Vmin=4.5V Vnorm=5.0V	If unused keep open.
GND		Ground		
Power on or power off				

PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS	
PWRKEY	I	Voltage input for PWRKEY. PWRKEY should be pulled low to power on or power off the system. The user should drive the PWRKEY to low level voltage for a short time when power on or power off the system because the system need margin time in order to assert the software.	VILmax=1.2V VIHmin=2.6V VIHmax=3.3V VILmin= 0V	It is already pulled up

Audio interfaces

PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS	COMMENT
MIC1P MIC1N	I	Positive and negative voice band input	Audio DC Characteristics refer to chapter 3.10	If unused keep open.
MIC2P MIC2N	I	Auxiliary positive and negative voice band input		If unused keep open.
SPK1P SPK1N	O	Positive and negative voice band output		If unused keep open.
SPK2P SPK2N	O	Auxiliary positive and negative voice band output		If unused keep open.
AGND		Analog ground		Separate ground connection for external audio circuits. If unused keep open.

GERNERAL PURPOSE input/output

PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS	COMMENT
STATUS	O	Indicate status of module 's working	VILmax=0.4V VIHmin=2.4V VILmin= 0V VIHmax= 2.95 VOHmin= 2.7V VOLmax=0.1V VOHmax= 2.95V VOLmin= 0V	If unused keep open
NETLIGHT	O	Indicate status of module's network		If unused keep open
DISP_DATA	I/O	Display interface		If unused keep open
DISP _CLK	O			
DISP _CS	O			
DISP _D/C	O			
GPO1	O	Normal Output Port		If unused keep open
KBR0	I/O	Normal Output/Input Port		KBR0 pin can be configured as

				sim card present detection pin,by “AT+CSDT”, If unused keep open
Serial port				
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS	COMMENT
RXD	I	Receive data	VILmax=0.4V VIHmin=2.4V VILmin= 0V VIHmax= 3V VOHmin= 2.7V VOLmax=0.1V VOHmax= 3V VOLmin= 0V	1. DTR Pin has been pulled up. 2. If RXD pin not used, it should be pulled up to 3V through a 10k resistor. 3. Other unused pins keep open.
TXD	O	Transmit data		
RTS	I	Request to send		
CTS	O	Clear to send		
RI	O	Ring indicator		
DCD	O	Data carry detect		
DTR	I	Data terminal Ready		
Debug interface				
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS	COMMENT
DBG_TXD	O	Serial interface for debugging and firmware upgrade	VILmax=0.4V VIHmin=2.4V VILmin= 0V VIHmax= 3V VOHmin= 2.7V VOLmax=0.1V VOHmax= 3V VOLmin= 0V	If unused keep open.
DBG_RXD	I			
SIM interface				
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS	COMMENT
SIM_VDD	O	Voltage supply for SIM card	The voltage can be select by software automatically either 1.8V or 3V	
SIM_DATA	I/O	SIM data input/output	VILmax=0.15 *SIM_VDD VIHmin=0.85*SIM_VDD VILmin= 0V VIHmax= SIM_VDD VOHmin= SIM_VDD-0.1V VOLmax=0.1V VOHmax= SIM_VDD VOLmin= 0V	All signals of SIM interface are protected against ESD with a TVS diode array.
SIM_CLK	O	SIM clock		
SIM_RST	O	SIM reset		
ADC				
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS	COMMENT
ADC0	I	General purpose analog to	Input voltage range: 0V ~ 2.8V	If unused keep

		digital converter.		open
TEMP_BAT	I	For measure the battery temperature		If unused keep open.
Pulse Width Modulation				
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS	COMMENT
PWM	O	PWM Output	VOHmin= 2.7V VOLmax=0.1V VOHmax= 3V VOLmin= 0V	If unused keep open

3.2 Operating Modes

The table below briefly summarizes the various operating modes referred in the following chapters.

Table6: Overview of operating modes

Mode	**Function**	
Normal operation	GSM/GPRS SLEEP	Module will automatically go into SLEEP mode if DTR is set to high level and there is no on air and no 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 from the system normally.
	GSM IDLE	Software is active. Module has registered to the GSM network, and the module is ready to send and receive.
	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 down	Normal shutdown by sending the “AT+CPOWD=1” command or using the PWRKEY. The power management ASIC disconnects the power supply from the baseband part of the module, and only the power supply for the RTC is remained. Software is not active. The serial port is not accessible. Operating voltage (connected to VBAT) remains applied.	
Minimum	Use the “AT+CFUN” command can set the module to a minimum functionality mode	

functionality mode (without remove power supply)	without removing the power supply. In this case, 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 case is very low.
Charge-only mode	The module will systematically enter Charge-only mode when a charger and battery are connected to a switched-off SIM900D. In the mode, the module does not search for network and has limited AT commands available. The module also can enter Charge-only mode from Charge mode during normal operation by normally shutdown the module.
Charge mode during normal operation	The module will automatically go to this mode when a charger is connected to a Normal operation mode module of which battery voltage is not lower than 3.2V. Normal operation mode includes: SLEEP, IDLE, TALK, GPRS IDLE and GPRS DATA.

3.3 Power Supply

The power supply of SIM900D is from a single voltage source of VBAT= 3.2V...4.8V. In some case, the ripple in a transmitting burst may cause voltage drops when current consumption rises to typical peaks of 2A. So the power supply must be able to provide sufficient current up to 2A.

For the VBAT input, a local bypass capacitor (about 100 μF, low ESR) is recommended. Multi-layer ceramic chip (MLCC) capacitors can provide the best combination of low ESR and small size but may not be cost effective. A lower cost choice may be a 100 μF tantalum capacitor (low ESR) with a small (0.1μF to 1μF) ceramic in parallel, which is illustrated as following figure. The capacitors should be placed as close as possible to the SIM900D VBAT pins. The following figure is the recommended circuit.

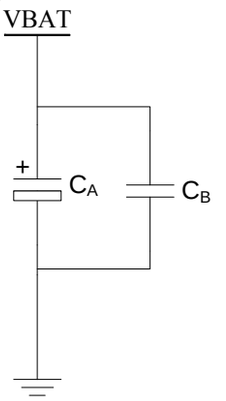


Figure3: Reference circuit of the VBAT input

The circuit design of the power supply depends strongly upon the power source where this power is drained. The following figure is the reference design of +5V input source power supply. The designed output for the power supply is 4.1V, thus a linear regulator can be used. If there is a big difference between the input source and the desired output (VBAT), a switching converter power supply will be preferable because of its better efficiency especially with the 2A peak current in burst mode of the module.

The single 3.6V Li-Ion cell battery type can be connected to the power supply of the SIM900D VBAT directly.

But the Ni_Cd or Ni_MH battery types must be used carefully, since their maximum voltage can rise over the absolute maximum voltage for the module and damage it.

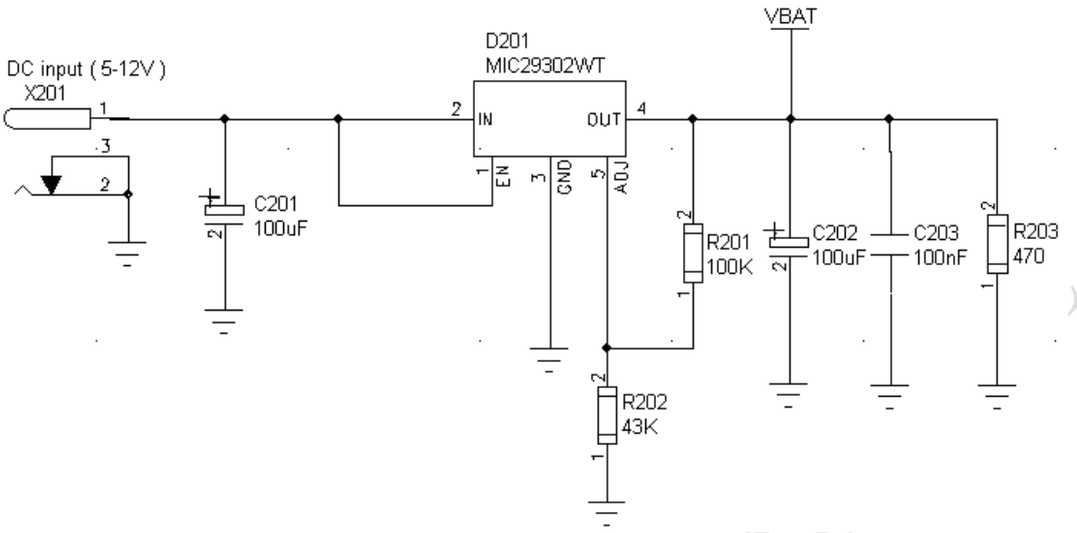


Figure4: Reference circuit of the source power supply input

The following figure is the VBAT voltage ripple wave at the maximum power transmit phase, the test condition is VBAT=4.0V, VBAT maximum output current =2A, C_A=100μF tantalum capacitor (ESR=0.7Ω) and C_B=1μF.

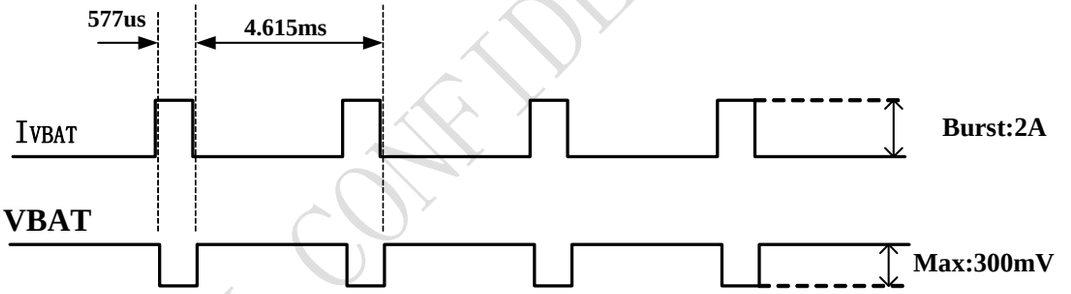


Figure5: VBAT voltage drop during transmit burst

3.3.1 Power Supply Pins

Two VBAT pins are dedicated to connect the supply voltage and nine GND pins are dedicated to connect ground. VRTC pin can be used to back up the RTC.

3.3.2 Minimizing Power Losses

When users design the power supply for their application, specific attention need to be paid to power losses. Ensure that the input voltage VBAT never drops below 3.1V even in a transmit burst where current consumption can rise to typical peaks of 2A. If the power voltage drops below 3.1V, the module may be shut down automatically. The PCB traces from the VBAT pins to the power source must be wide enough to decrease heat energy in the transmitting burst mode.

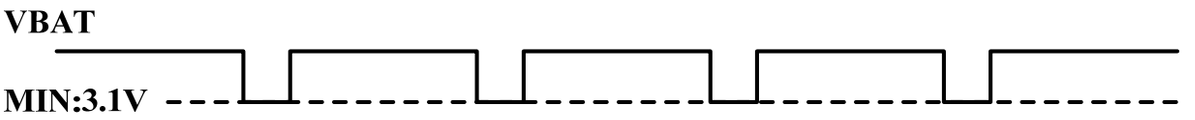


Figure6: The minimal VBAT voltage at VBAT drop

3.3.3 Monitoring Power Supply

To monitor the supply voltage, user can use the "AT+CBC" command. It returns charging state, 1-100 percent of remaining battery capacity and voltage value measured at VBAT pin.

The voltage is continuously measured at intervals depending on the operating mode. The displayed voltage (in mV) is averaged over the last measuring period before the AT command "AT+CBC" is executed.
For detail information about "AT+CBC", please refer to ***related document [1]***

3.4 Power Up and Power Down Scenarios

In general, be sure not to turn on SIM900D while it is beyond the safety limits of voltage and temperature stated in Chapter 3.4.2. SIM900D would immediately power down as soon as the module detects these inappropriate conditions. In extreme cases this can cause permanent damage to the module.

3.4.1 Turn on SIM900D

SIM900D can be turned on by two ways, which are described in the following chapters:

- Via PWRKEY pin: starts normal operating mode *(please refer to chapter 3.4.1.1)*;
- Via VCHG Pin: starts Charge-only mode *(please refer to chapter 3.4.1.2)*;

Note: The "AT" command must be set after the SIM900D is powered on and Unsolicited Result Code "RDY" is received from the serial port. However if the SIM900D is set to autobauding, the serial port will receive nothing. The AT commands can be set after the SIM900D is powered on. Use 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 all the time that the SIM900D is powered on. Please refer to the chapter AT+IPR in related document [1].

3.4.1.1 Turn on SIM900D Using the PWRKEY Pin (Power on)

User can turn on the SIM900D by driving the PWRKEY to a low level voltage for a short time, then release. This pin has pulled up to 3V in the module. The simple circuit illustrates as the following figures.

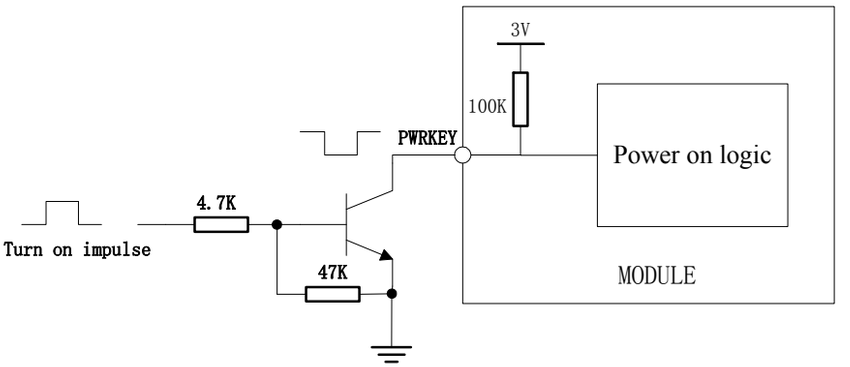


Figure7: Turn on SIM900D using driving circuit

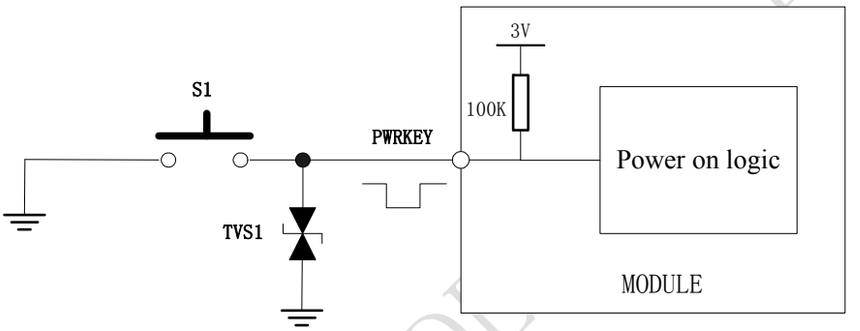


Figure8: Turn on SIM900D using button

The power on scenarios illustrates as following figure.

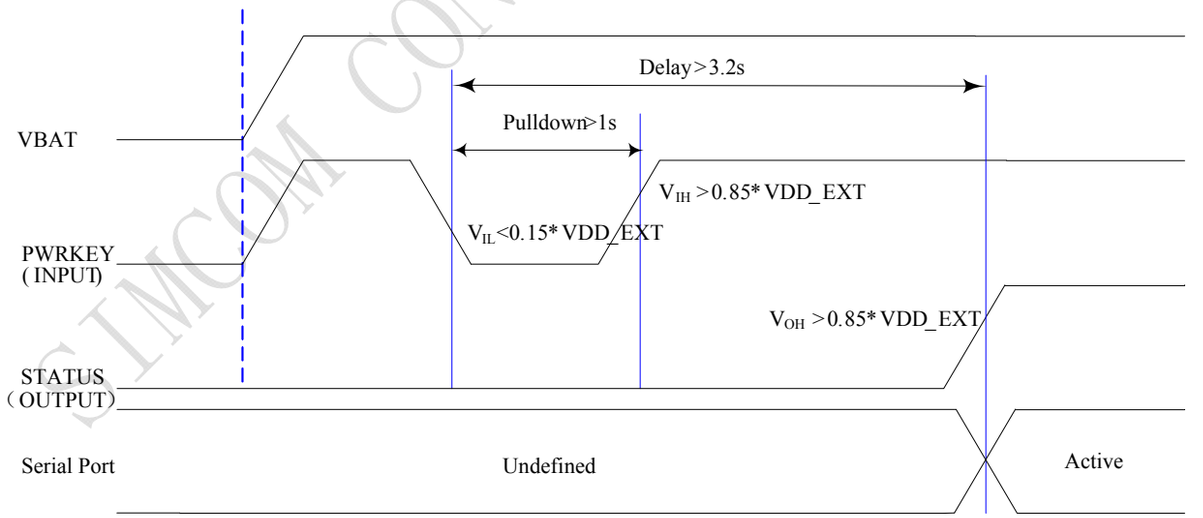


Figure9: Timing of turn on system using PWRKEY

When power on procedure completes, the SIM900D will send out following result code to indicate the module is ready to operate when set as fixed baud rate.

RDY

This result code does not appear when autobauding is active.

3.4.1.2 Turn on the SIM900D using the VCHG signal

The SIM900D will be automatically turned on when a charger is connected to the switched-off SIM900D of which VBAT pin voltage is greater than 3.3V. SIM900D will go into the Charge-only Mode. In this mode, the module does not register to the network, and has only a few AT commands available. For detailed information please refer to chapter 3.5.

When module is powered on using the VCHG signal, SIM900D sends out result code as following when fixed baud rate set:

RDY

CHARGE-ONLY MODE

When user drives the PWRKEY of Charge-only mode SIM900D to a low level voltage for a period of time (please refer to ***Figure 9 Timing of turn on system using PWRKEY***), the SIM900D will power up and go into Charge mode during normal operation. In this case, SIM900D sends out result code as following:

From CHARGE-ONLY MODE to NORMAL MODE

In Charge mode during normal operation, all operations and AT commands are available.

3.4.2 Turn Off SIM900D

Following ways can be used to turn off the SIM900D:

- Normal power down procedure: Turn off SIM900D using the PWRKEY pin
- Normal power down procedure: Turn off SIM900D using AT command
- Over-voltage or under-voltage automatic shutdown: Take effect if over-voltage or under-voltage is detected
- Over-temperature or under-temperature automatic shutdown: Take effect if over-temperature or under-temperature is detected.

3.4.2.1 Turn Off SIM900D Using the PWRKEY Pin (Power down)

User can turn off the SIM900D by driving the PWRKEY to a low level voltage for a short time and then release (Please refer to the turn on circuit).

This procedure lets the module log off from the network and allows the software to enter into a secure state and save data before completely disconnecting the power supply.

Before the completion of the switching off procedure the module will send out result code:

NORMAL POWER DOWN

After this moment, the AT commands can not be executed. The module enters the POWER DOWN mode, only the RTC is still active. POWER DOWN can also be indicated by STATUS pin, which is a low level voltage in this mode.

The power down scenario illustrates as following figure.

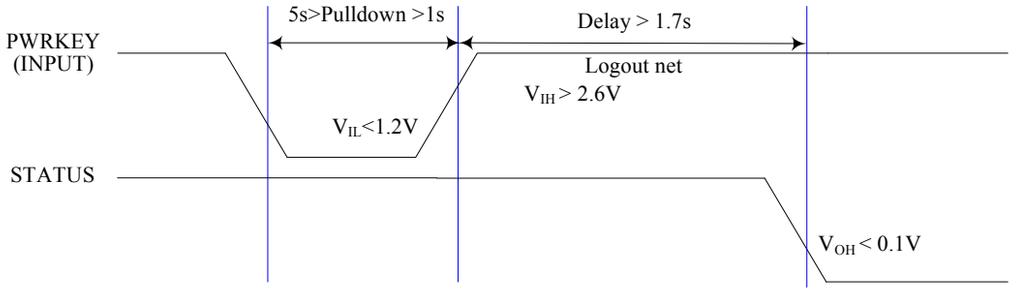


Figure10: Timing of turn off system using PWRKEY

3.4.2.2 Turn Off SIM900D Using AT Command

User can use the AT command "AT+CPOWD=1" to turn off the module. This command lets the module log off from the network and allows the module to enter into a secure state and save data before completely disconnecting the power supply.

Before the completion of the switching off procedure the module will send out result code:

NORMAL POWER DOWN

After this moment, the AT commands can not be executed. The module enters the POWER DOWN mode, only the RTC is still active. POWER DOWN can also be indicated by STATUS pin, which is a low level voltage in this mode.

Please refer to ***related document [1]*** for detail about the AT command of "AT+CPOWD".

3.4.2.3 Over-voltage or Under-voltage Automatic Shutdown

The module will constantly monitor the voltage applied on the VBAT. If the voltage ≤ 3.3V, the following URC will be presented:

UNDER-VOLTAGE WARNNING

If the voltage ≥ 4.7V, the following URC will be presented:

OVER-VOLTAGE WARNNING

The uncritical voltage range is 3.2V to 4.8V. If the voltage > 4.8V or < 3.2V, the module will be automatic shut down soon.

If the voltage < 3.2V, the following URC will be presented:

UNDER-VOLTAGE POWER DOWN

If the voltage > 4.8V, the following URC will be presented:

OVER-VOLTAGE POWER DOWN

AT commands can not be executed. The module logs off from network and enters POWER DOWN mode, and only the RTC is still active. POWER DOWN can also be indicated by STATUS pin, which is a low level voltage in this mode.

3.4.2.4 Over-temperature or Under-temperature Automatic Shutdown

The module will constantly monitor the temperature of the module, if the temperature > +80℃, the following

URC will be presented:

+CMTE:1

If the temperature < -30℃, the following URC will be presented:

+CMTE:-1

The uncritical temperature range is -40℃ to +85℃. If the temperature >+ 85℃ or < -40℃, the module will be automatic shutdown soon.

If the temperature > +85℃, the following URC will be presented:

+CMTE:2

If the temperature < -40℃, the following URC will be presented:

+CMTE:-2

After this moment, the AT commands can not be executed. The module logs off from network and enters POWER DOWN mode, and only the RTC is still active. POWER DOWN can also be indicated by STATUS pin, which is a low level voltage in this mode.

To monitor the temperature, you can used the "AT+CMTE" command to read the temperature when the module is power on.

For details please refer to ***related document [1]***

3.4.3 Restart SIM900D Using the PWRKEY Pin

User can restart SIM900D by driving the PWRKEY to a low level voltage for a short time and then release, the same as turning on SIM900D using the PWRKEY pin. Before restarting the SIM900D, user need delay at least 800ms from detecting the STATUS low level on. The restarting scenario illustrates as the following figure.

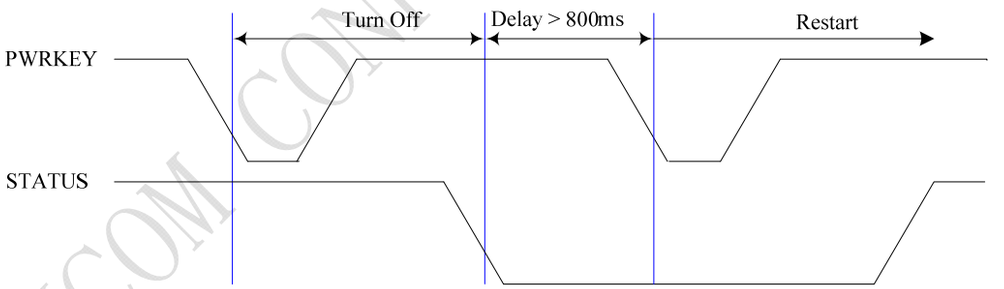


Figure11: Timing of restart SIM900D

3.5 Charging interface

SIM900D has integrated a charging circuit inside the module for Li-Ion batteries charging control, which make it very convenient for applications which support battery charging. A common connection is shown in the following figure:

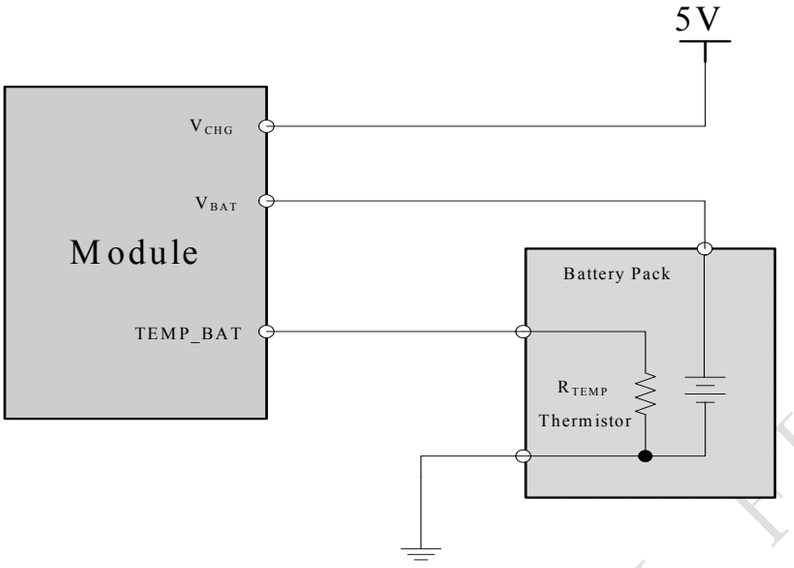


Figure12: SIM900D with battery charger and pack connection

Battery temperature measurement is a customization function which is supported by the software in the module. In above figure, the R_{TEMP} is a NTC thermistor, MURATA NCP15XH103F03RC is recommended to use. Its impedance is 10Kohm at 25℃. Please refer to the above figure for the reference circuit.

3.5.1 Battery pack characteristics

SIM900D has optimized the charging algorithm for the Li-Ion battery that meets the characteristics listed below.

- The maximum charging voltage of the Li-Ion battery pack is 4.2V and the recommended capacity is 1100mAh. The Battery packs with more than 1100 mAh capacity will cost more time for charging.
- The pack should have a protection circuit to avoid overcharging, deep discharging and over-current, and the circuit should be insensitive to pulsed current.
- The internal resistance of the battery pack including protection circuit should be as low as possible. Its recommended value does not exceed 150mΩ.
- The battery pack must be protected from reverse pole connection.

It is recommended that the battery pack user integrated into the application is compliant with these specifications. The battery pack compliant with these specifications is also important for the AT command “AT+CBC”, 1-100 percent of remaining battery capacity returned by “AT+CBC” is related to battery capacity.

On the SIM900D, the build-in circuit of the power management chipset monitors the supply voltage constantly. Once the Under-voltage is detected, the SIM900D will be powered down automatically.

3.5.2 Recommended battery pack

Following is the specification of recommended battery pack:

Table7: Specification of recommended battery pack

Items	Description
Battery type	Li-ion
Manufacturer	Jiade Energy Technology
Normal voltage	3.7V
Capacity	NORMAL 1100mAh
Charge Voltage	4.200±0.050V
Max Charge Current	1.0C
Charge Method	CC / CV (Constant Current / Constant Voltage)
Max Discharge Current	1.0C (for continuous discharging mode)
Discharge Cut-off Voltage	3.0V/ cell
Internal resistance	Initial≤130mΩ

3.5.3 Implemented charging technique

SIM900D has battery charging function. There are three pins related to the battery charging function: VCHG, VBAT and TEMP_BAT/ADC0 pins. The VCHG Pin is driven by an external voltage, system can use this Pin to detect a charger supply and provide most charging current through SIM900D module to battery when charging is in fast charge state. The VBAT gives out charging current from SIM900D module to external battery. TEMP_BAT Pin is for user to measure the battery temperature. Just let this Pin open if battery temperature measurement is not your concern.

So it is very simple to implement charging technique, user just needs to connect the charger to the VCHG Pin and connect the battery to the VBAT Pin.
SIM900D battery charging happens after detecting charger supply and the battery present. If there is no charger supply or no battery present, charging will not be enabled.

Normally, there are three main states in whole charging procedure.

- DDLO charge (Pull-up mode) and UVLO charge (Pre-charge mode);
- Fast charge;

DDLO charge and UVLO charge:
DDLO is the state of battery when its voltage is under 1.5V. And UVLO means the battery voltage less than 3.3V and more than 1.5V. The battery is not suitable for fast charging when its condition is DDLO or UVLO. The SIM900D provides a small constant current to the battery when the battery is between DDLO and UVLO. In DDLO charging, SIM900D gives out 1mA current to the battery. And in UVLO charging, SIM900D provides about less than 200mA current to the battery.

DDLO charging terminates when the battery voltage reaches 1.5V. UVLO charging terminates when the battery voltage is up to 3.3V. Both DDLO and UVLO charge are controlled by the SIM900D hardware only.

Fast charge:

If there is a charger supply and battery present and the battery is not in DDLO and UVLO, SIM900D will enter fast charge state. Fast charge is controlled by the software to make the current/voltage regulation. The charging scheme for the Li-Ion battery is constant current (about 550mA) first, followed by constant voltage charging once 4.2V is reached. Charging is stopped when the charging current at constant voltage has decreased down to the pre-set current.

3.5.4 Operating modes during charging

The battery can be charged during various operating mode. That means that charging can be in progress while SIM900D is in Normal mode (SLEEP, IDLE, TALK, GPRS IDLE or GPRS DATA mode). In this case the voltage supply should be sufficient. Here Charging in Normal mode is named as Charge mode.

If the charger is connects to the module's VCHG Pin and the battery is connected to the VBAT Pin while SIM900D is in POWER DOWN mode, SIM900D will go into the Charge-only Mode .

The following table gives the difference between Charge mode and Charge-only mode：

Table8: Charge operating modes

	How to activate mode	Features
Charge Mode	Connect charger to module's VCHG Pin and connect battery to VBAT Pin of module while SIM900D is in Normal operating mode, including: IDLE, TALK mode; SLEEP mode etc;	● GSM remains operational and registers GSM network while charging is in progress; ● The serial interfaces are available in IDLE, TALK mode, the AT command set can be used fully in this case; In SLEEP mode, the serial interfaces are not available. Once the serial port is connected and there is data in transfer. SIM900D will exit the SLEEP mode.
Charge-only Mode	Connect charger to module's VCHG Pin while SIM900D is in POWER DOWN mode. IMPORTANT: Here Charge-only mode is charging when power down, it means that not all software tasks are running.	● Battery can be charged when GSM engine is not registered to GSM network; ● Only a few AT commands is available, as listed below.

Note: VBAT can not provide more than 5mA current while SIM900D module is during the DDLO charge state. In other words it is strongly recommended that VBAT should not be the main power supply in the application subsystem if SIM900D DDLO charging state occurs.

Table9: AT Command usually used in Charge-only mode

AT command	Function
AT+CCLK	Set data and time of RTC
AT+CPOWD	Power down
AT+CBC	Indicated charge state and voltage
AT+CFUN	Start or close the protocol Set AT command **"AT+CFUN =1**", module can be transferred from Charge-only mode to Charging in normal mode. In Charge-only mode, the default value is 0.

3.5.5 Charger requirements

Following is the requirements of charger for SIM900D.

- Simple transformer power plug
- Output voltage: 5.0V-6V
- Minimum supply current: 750mA
- A 10V peak voltage is allowed for maximum 1ms when charging current is switched off.
- A 1.6A peak current is allowed for maximum 1ms when charging current is switched on

3.6 Summary of State Transitions (except SLEEP mode)

The following figure shows how module enters one mode from another mode.

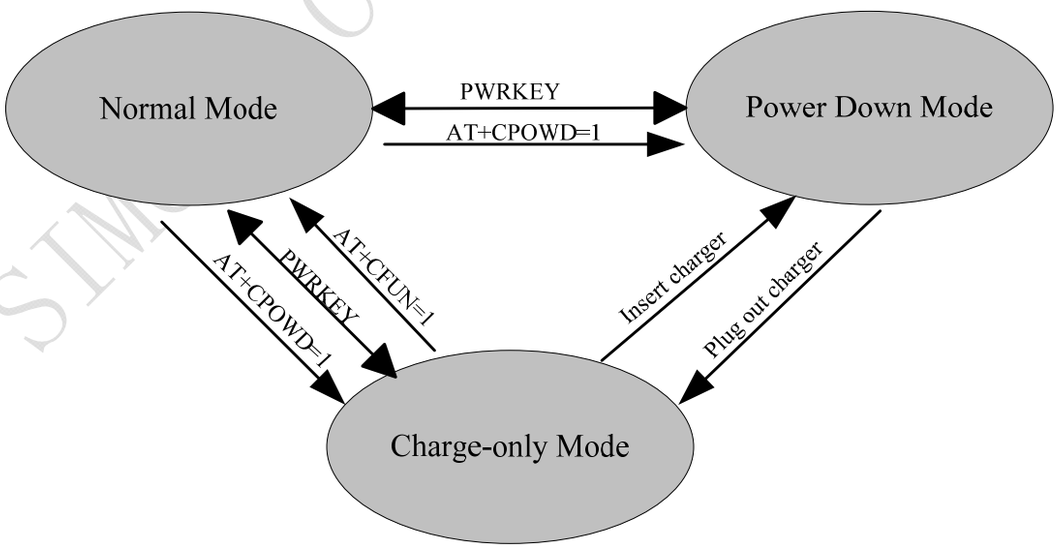


Figure13: Charge State Transition

3.7 Power Saving

There are two methods for the module to enter into low current consumption status. “AT+CFUN” is used to set module into minimum functionality mode and DTR hardware interface signal can be used to lead system to be in SLEEP mode (or slow clocking mode).

3.7.1 Minimum Functionality Mode

Minimum functionality mode reduces the functionality of the module to a minimum and, thus, minimizes the current consumption to the lowest level. This mode is set with the “AT+CFUN” command which provides the choice of the functionality levels <fun>=0，1，4

- 0: minimum functionality;
- 1: full functionality (default);
- 4: disable phone both transmit and receive RF circuits;

Table10: The Current consumption of different configuration of AT+CFUN

MODE	SLEEP		
AT+CFUN	1	4	0
Current Consumption	1.306mA	0.967mA	0.897mA

If SIM900D has been set to minimum functionality by “AT+CFUN=0”, the RF function and SIM card function will be closed. In this case, the serial port is still accessible, but all AT commands correlative with RF function or SIM card function will not be accessible.
If SIM900D has been set by “AT+CFUN=4”, the RF function will be closed, the serial port is still active. In this case all AT commands correlative with RF function will not be accessible.
After SIM900D has been set by “AT+CFUN=0” or “AT+CFUN=4”, it can return to full functionality by “AT+CFUN=1”.
For detailed information about “AT+CFUN”, please refer to ***related document [1].***

3.7.2 Sleep Mode I (CSCLK=1)

User can control SIM900D module to enter or exit the SLEEP mode (CSCLK=1) in customer applications through DTR signal.
When DTR is in high level，and there is no data on air and hardware interrupt (such as GPIO interrupt or data in serial port), SIM900D will enter SLEEP mode automatically. In this mode, SIM900D can still receive paging or SMS from network but the serial port is not accessible.

Note: For SIM900D, it requests to set AT command “AT+CSCLK=1” to enable the sleep mode. The default value is 0, which can not make the module enter SLEEP mode. For more details please refer to related document [1].

3.7.3 Wake Up SIM900D from SLEEP Mode (CSCLK=1)

When SIM900D is in SLEEP mode, the following methods can wake up the module.

- Enable DTR pin to wake up SIM900D.
  If DTR pin is pulled down to a low level，this signal will wake up SIM900D from power saving mode. The serial port will be active after DTR changed to low level for about 50ms.
- Receiving a voice or data call from network to wake up SIM900D.
- Receiving a SMS from network to wake up SIM900D.

3.7.4 Sleep Mode II (CSCLK=2)

In this mode, the SIM900D will continuously monitor the main serial port data signal. When there is no data transferred exceed 5 seconds on the RXD signal and there is no data on air and hardware interrupt (such as GPIO interrupt or data in serial port), SIM900 will enter SLEEP mode automatically. In this mode, SIM900D can still receive paging or SMS from network but the serial port is not accessible.

Note: For SIM900, it requests to set AT command "AT+CSCLK=2" to enable the SLEEP mode. The default value is 0, which can not make the module enter SLEEP mode. For more details please refer to related document [1].

3.7.5 Wake Up SIM900D from SLEEP Mode (CSCLK=2)

When SIM900D is in SLEEP mode (CSCLK=2), the following methods can wake up the module.

- User can send data to SIM900D using main serial port, when SIM900D detects the change on the RXD. The first byte data of user will not be sent via module.
- Receiving a voice or data call from network to wake up SIM900D.
- Receiving a SMS from network to wake up SIM900D.

3.8 RTC Backup

The RTC power supply of module can be provided by an external capacitor or a battery (rechargeable or non-chargeable) through the VRTC.

Note: The VRTC could not be designed to a NC pin in user's circuit. User should connect the VRTC pin to a battery or a capacitor.

The following figures show various sample circuits for RTC backup.

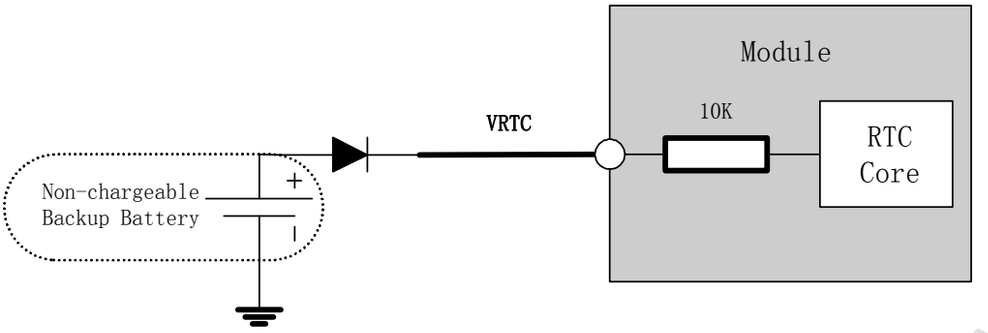


Figure14: RTC supply from non-chargeable battery

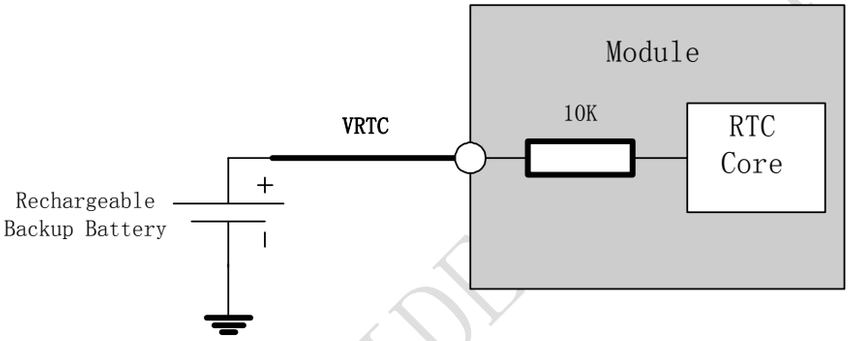


Figure15: RTC supply from rechargeable battery

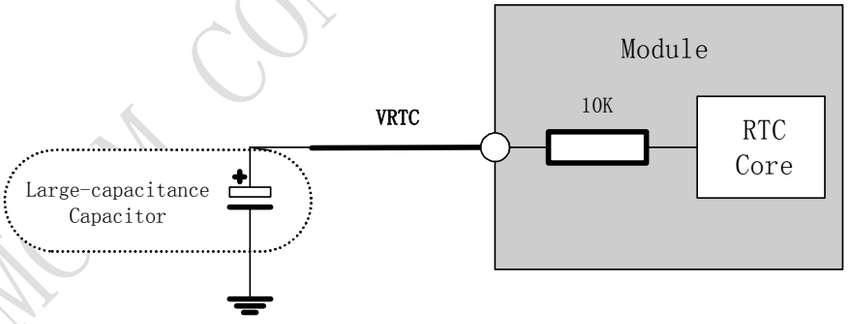


Figure16: RTC supply from capacitor

- **Li-battery backup**

Coin-type Rechargeable Capacitor such as XH414H-IV01E form Seiko can be used.

Typical charge curves for each cell type are shown in following figures. Note that the rechargeable Lithium type coin cells generally come pre-charged from the vendor.

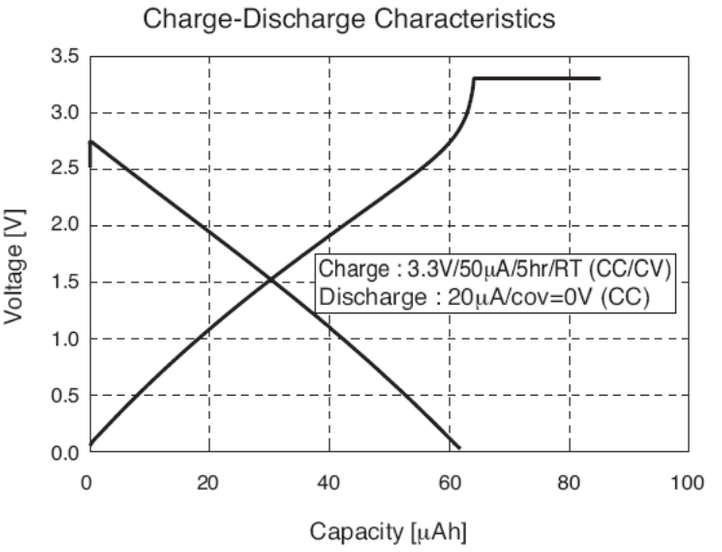


Figure17: Seiko XH414H-IV01E Charge Characteristics

3.9 Serial Interfaces

Table11: Pin definition of the serial interfaces

	Name	Pin	Function
Serial port	DTR	43	Data terminal ready
	RI	11	Ring indicator
	DCD	42	Data carrier detection
	CTS	45	Clear to send
	RTS	44	Request to send
	TXD	4	Transmit data
	RXD	3	Receive data
Debug port	DBG_RXD	1	Receive data
	DBG_TXD	2	Transmit data

SIM900D provides two unbalanced asynchronous serial ports. One is the serial port and the other is the debug port. The GSM module is designed as a DCE (Data Communication Equipment), following the traditional DCE-DTE (Data Terminal Equipment) connection. The module and the client (DTE) are connected through the following signal (as following figure shows). Autobauding supports baud rate from 1200bps to 57600bps.
When the RXD, TXD, DBG_RXD, DBU_TXD are used, it should be pull up 10k to 3V.
Serial port

- TXD: Send data to the RXD signal line of the DTE
- RXD: Receive data from the TXD signal line of the DTE

Debug port

- DBG_TXD: Send data to the RXD signal line of the DTE

- DBG_RXD: Receive data from the TXD signal line of the DTE

The logic levels are described in following table.

Table12: Logic levels of the serial port and debug port

Parameter	Min	Max	Unit
V_{IL}	0	0.4	V
V_{IH}	2.4	3	V
V_{OL}	0	0.1	V
V_{OH}	2.7	3	V

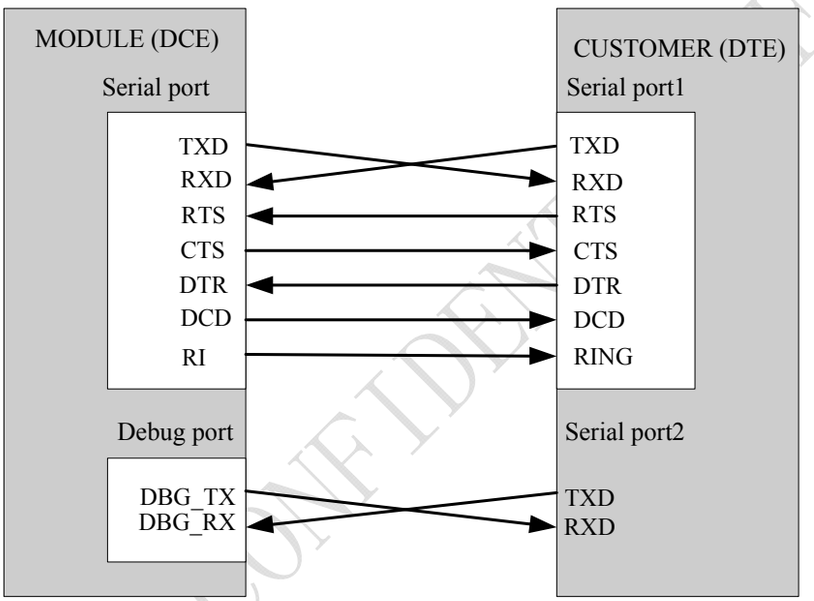


Figure18: Connection of the serial interfaces

3.9.1 Function of serial port & debug port supporting

Serial port

- Modem device.
- Contains data lines TXD and RXD, State lines RTS and CTS, Control lines DTR, DCD and RI.
- Serial port can be used for CSD FAX, GPRS service and send AT command of controlling module. Also serial port can be used for multiplexing function. SIM900D supports only basic mode of multiplexing so far.
- Serial port supports the communication rates as following:
  1200,2400, 4800, 9600, 19200, 38400, 57600, 115200bps
- Autobauding supports baud rates as following:
  1200, 2400, 4800, 9600, 19200, 38400, and 57600bps, the default setting is autobauding.

Autobauding allows the GSM engine to automatically detect the baud rate configured in the host application. The serial port of the GSM engine supports autobauding for the following baud rates: 1200, 2400, 4800, 9600, 19200,

38400, 57600bps. Factory setting is autobauding enabled. This gives you the flexibility to put the GSM engine into operation no matter what baud rate user host application is configured to. To take advantage of autobauding mode, specific attention should be paid to the following requirements:

Synchronization between DTE and DCE:

When DCE powers on with the autobauding enabled, user must first send “AT” to synchronize the baud rate. It is recommended to wait 2 to 3 seconds before sending “AT” character. After receiving the “OK” response, DTE and DCE are correctly synchronized. The more information please refer to the AT command “AT+IPR”.

Restrictions on autobauding operation

- The serial port has to be operated at 8 data bits, no parity and 1 stop bit (factory setting).
- The Unsolicited Result Codes like "RDY", "+CFUN: 1" and "+CPIN: READY” are not indicated when user starts up the ME while autobauding is enabled. This is due to the fact that the new baud rate is not detected unless DTE and DCE are correctly synchronized as described above.

Note: User can use “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 Unsolicited Result Codes like "RDY" should be received from the serial port all the time that the SIM900D is power on.

Debug port

- Only contain Data lines TXD and RXD
- Debug Port used for debugging and upgrading firmware. It cannot be used for CSD call, FAX call. And the Debug port can not use multiplexing function. It does not support autobauding function.
- The communication rate of debug port is 115200bps

3.9.2 Software Upgrade and Software Debug

The DBG_TXD, DBG_RXD and GND must be connected to the IO connector when user needs to upgrade software and debug software, the DBG_TXD, DBG_RXD should be used for software upgrade and for software debugging. The TXD and RXD also should be connected to the IO connector, if user wants to send AT command or data stream to SIM900D. The PWRKEY pin is recommended to connect to the IO connector. The user also can add a switch between the PWRKEY and the GND. The PWRKEY should be connected to the GND when SIM900D is upgrading software. Please refer to the following figure.

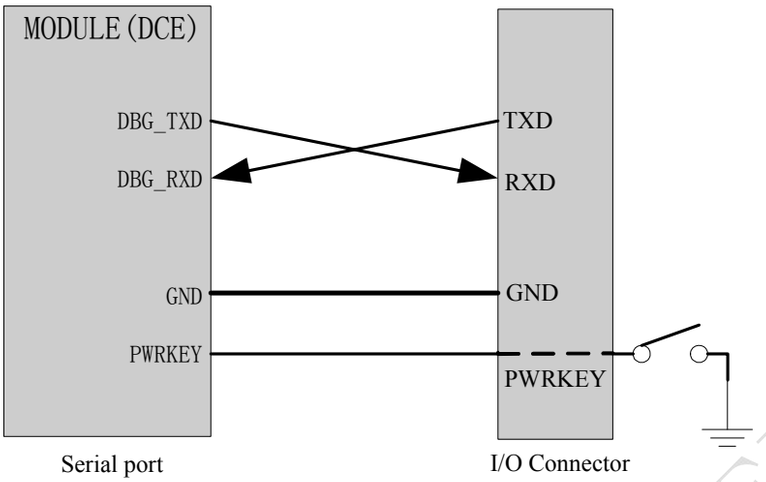


Figure19: Connection of software upgrade and software debug

The serial port and the debug port do not support the RS_232 level and it only supports the CMOS level. Please refer to the table 12 for details about the voltage level. User should add the level converter IC between the DCE and DTE, if user uses it with the computer. Please refer to the following figure.

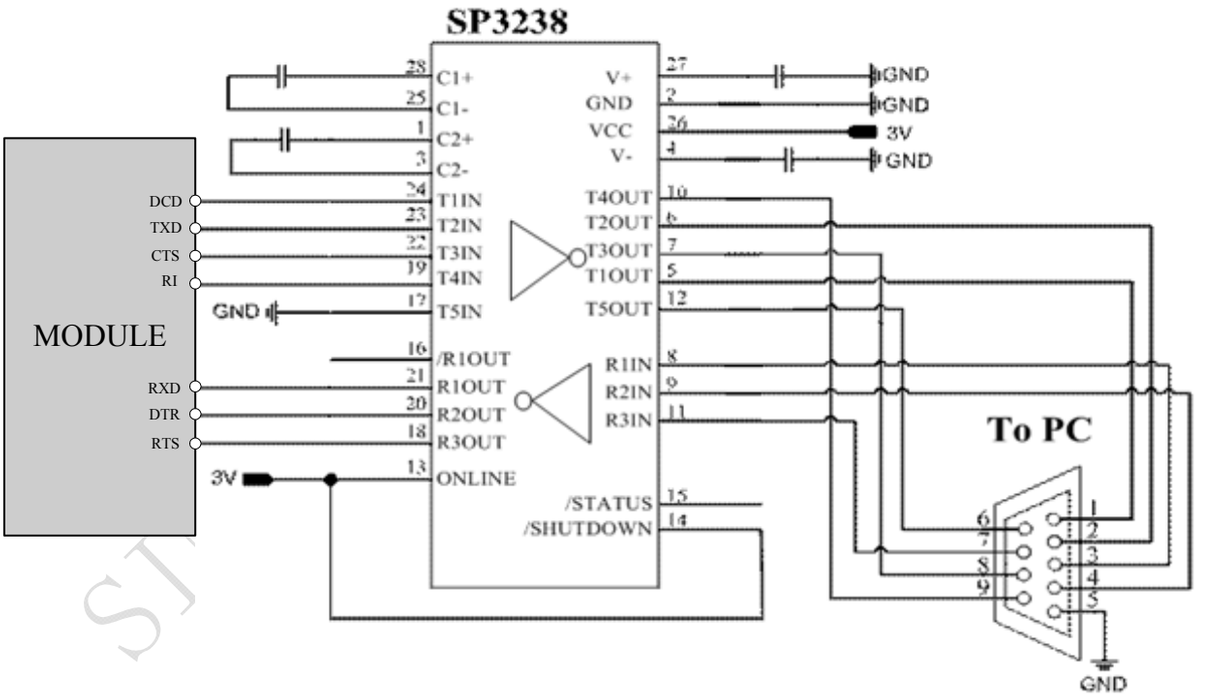


Figure20: RS232 level converter circuit

3.10 Audio Interfaces

Table13: Pin definition of the Audio interfaces

	Pin Name	Pin Number	Function
(AIN1/AOUT1)	MIC1P	21	Microphone1 input +
	MIC1N	20	Microphone1 input -
	SPK1P	23	Audio1 output+
	SPK1N	24	Audio1 output-
(AIN2/AOUT2)	MIC2P	18	Microphone2 input +
	MIC2N	19	Microphone2 input -
	SPK2P	26	Audio2 output+
	SPK2N	25	Audio2 output-

The module provides two analog input channels, AIN1 and AIN2, which may be used for both microphone and line inputs. The AIN1 and AIN2 channels are identical. One of the two channels is typically used with a microphone built into a handset. The other channel is typically used with an external microphone built into a handfree MIC or headset.

For each channels, user can use “AT+CMIC” to adjust the input gain level of microphone, use “AT+SIDET” to set the side-tone level. In addition, user can also use “AT+CLVL” to adjust the output gain level and use “AT+CHFA” to swap the audio channels among different channels. For more details, please refer to ***related document [1].***

It is suggested that user should adopt one of the following two matching circuits in order to improve audio performance. The difference audio signals have to be layout according to different signal layout rules. As shown in the following figures ***(Note: all components package are 0603.)*** If user wants to adopt an amplifier circuit for audio, SIMCom recommends National Company’s LM4890. Of course users can select it according to their own requirement.

3.10.1 Speaker Interface Configuration

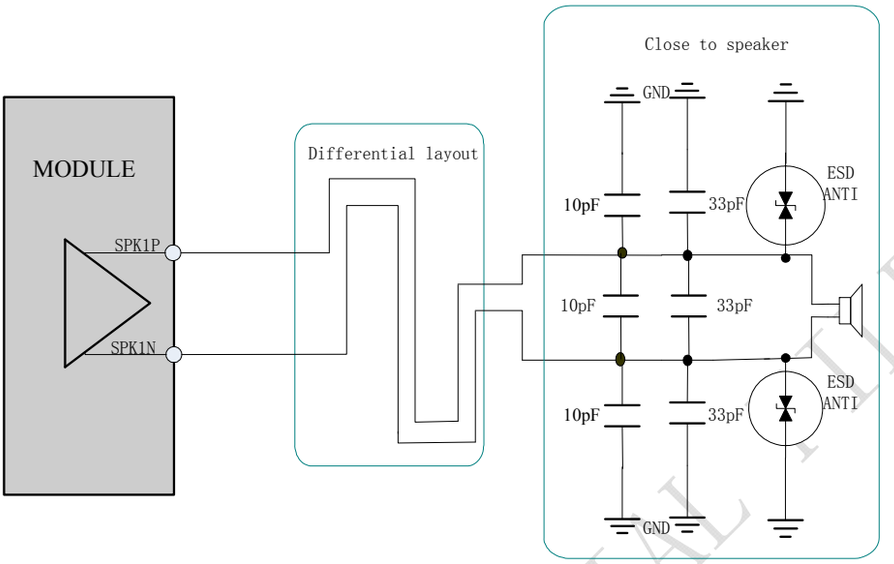


Figure21: Speaker interface configuration

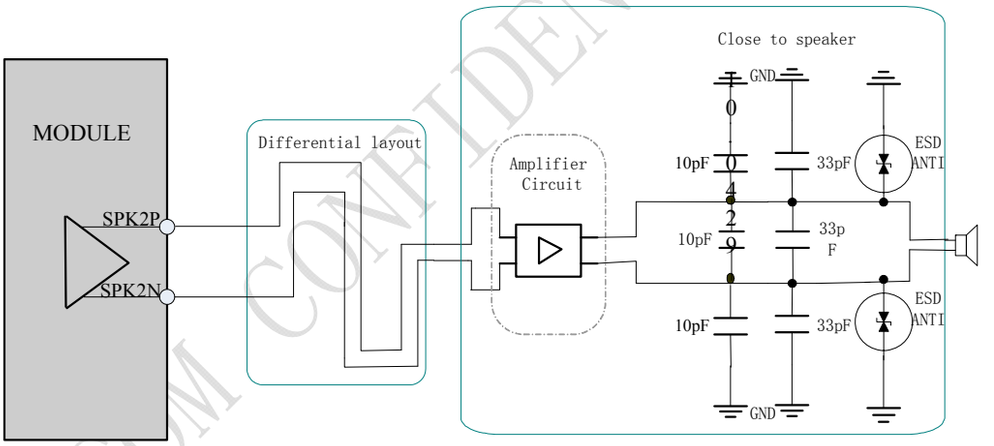


Figure22: Speaker interface with amplifier configuration

3.10.2 Microphone Interfaces Configuration

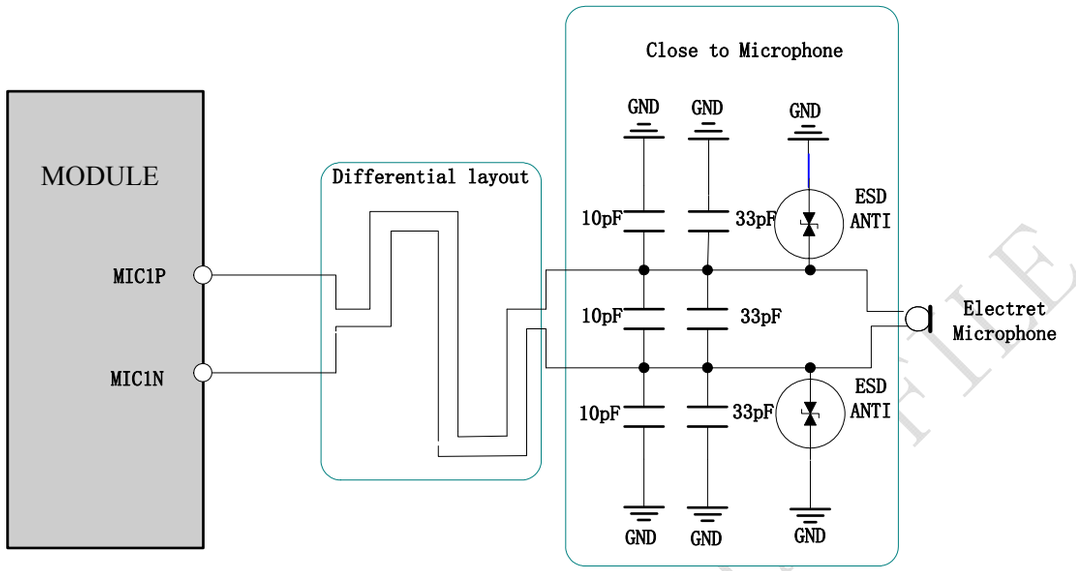


Figure23: Microphone interface configuration

3.10.3 Earphone Interface Configuration

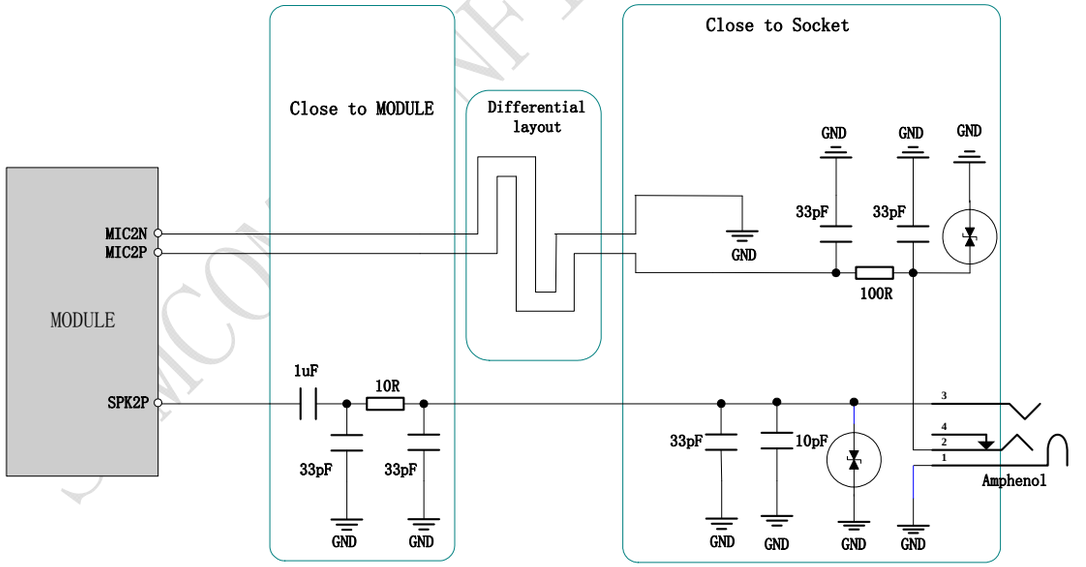


Figure24: Earphone interface configuration

3.10.4 Referenced Electronic Characteristics

Table14: MIC Input Characteristics

Parameter		Min	Typ	Max	Unit
Working Voltage		1.2	1.5	2.0	V
Working Current		200		500	uA
External Microphone Load Resistance		1.2	2.2		k Ohms
Internal biasing DC Characteristics				2.5	V
Differential input voltage	THD <1% at F=1KHz; pre-amp gain = 20 dB; PGA gain = 14 dB		15.9		mVrms
	THD <5% at F=1KHz; pre-amp gain = 0 dB; PGA gain = 0 dB		740		mVrms

Table15: Audio Output Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Normal Output(SPK1P/1N)	load Resistance	27	32	-	Ohm
	Biasing voltage		1.4		V
	Output swing Voltage(single)			1.1V	Vpp
	Output swing Voltage(differential)			2.2	Vpp
	RL=32 Ohm THD=0.1%	-	91	-	mW
	RL=32 Ohm THD=1%	-	96	-	mW
Normal Output(SPK2P/2N)	load Resistance	27	32	-	Ohm
	Biasing voltage		1.4		V
	Output swing Voltage(single)			1.1V	V
	Output swing Voltage(differential)			2.2	V
	RL=32 Ohm THD=0.1%	-	91	-	mW
	RL=32 Ohm THD=1%	-	96	-	mW

3.11 SIM Card Interface

3.11.1 SIM Card Application

User can use AT Command to get information in SIM card. For more information, please refer to ***related document [1]***

.

The SIM interface complies to the GSM Phase 1 specification and the new GSM Phase 2+ specification for FAST 64 kbps SIM (intended for use with a SIM application Tool-kit). Both 1.8V and 3.0V SIM Cards are supported. The SIM interface is powered from an internal regulator in the module. All pins are described in the following table.

Table16: Pin definition of the SIM interface

Pin Name	Pin Number	Function
SIM_VDD	9	SIM Card Power output automatic output on SIM mode，one is 3.0V±10%, another is 1.8V±10%. Current is about 10mA.
SIM_DATA	6	SIM Card data I/O
SIM_CLK	7	SIM Card Clock
SIM_RST	8	SIM Card Reset

Following figure is the reference circuit about SIM interface. SIMCom recommends an Electro-Static discharge device ST (www.st.com) ESDA6V1W5 or ON SEMI (www.onsemi.com) SMF05C for “ESD ANTI”. The 22Ω resistors showed in the following figure should be added in series on the IO line between the module and the SIM card for protecting the SIM I/O port. The pull-up resistor (about 15KΩ) on the SIM_DATA line is already added in the module. Note that the SIM peripheral circuit should be close to the SIM card socket.

The KBR0 pin is used for detecting the SIM card insert or removal. User can use the AT command “AT+CSDT” to switching on or off SIM card detection function. For details of this AT command, please refer to *related document [1]*。User can select the 8-pin SIM card holder to implement SIM card detection function. The reference circuit of the 8-pin SIM card holder is illustrated as following figure.

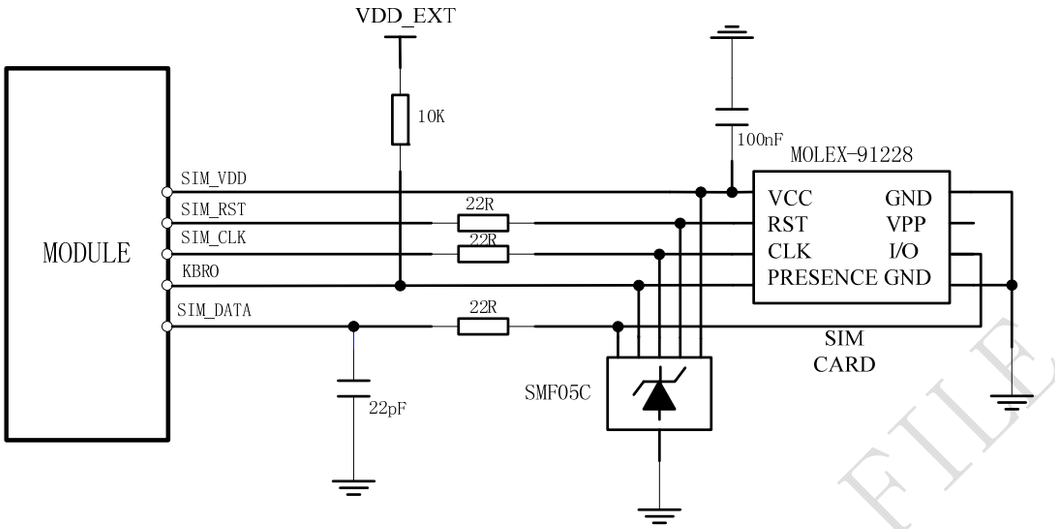


Figure25: Reference circuit of the 8-pin SIM card holder

If user don not use the SIM card detection function, user can leave the KBR0 pin open. The reference circuit about 6-pin SIM card holder is illustrated as following figure.

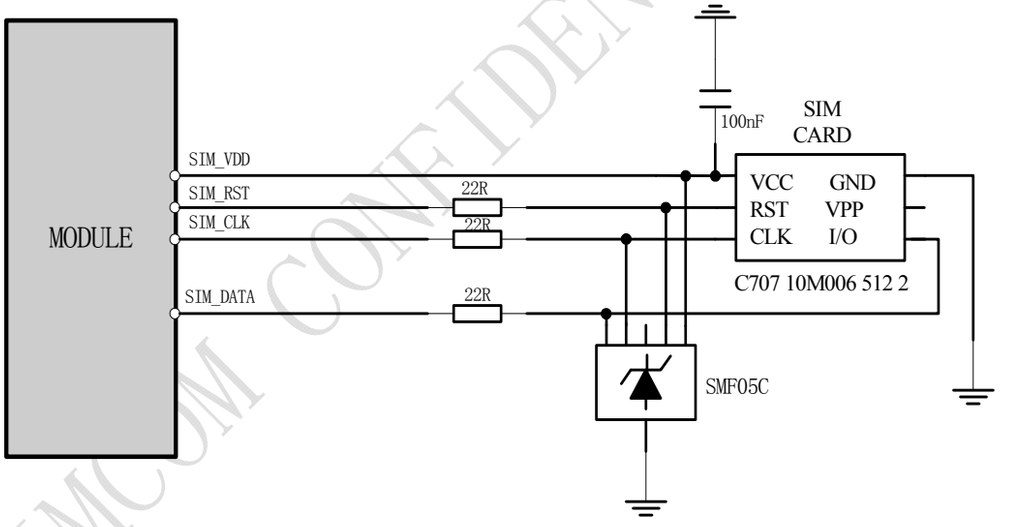


Figure26: Reference circuit of the 6-pin SIM card holder

3.11.2 Design Considerations for SIM Card Holder

For 6-pin SIM card holder, SIMCom recommends to use Amphenol C707 10M006 512 2 .User can visit http://www.amphenol.com for more information about the holder.

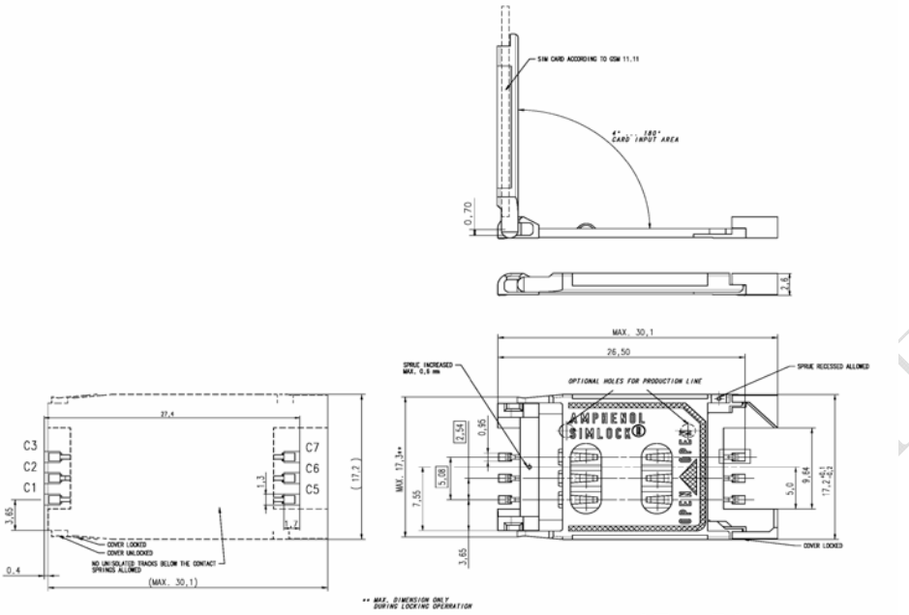


Figure27: Amphenol C707 10M006 512 2 SIM card holder

Table17: Pin description (Amphenol SIM card holder)

Pin Name	Signal	Description
C1	SIM_VDD	SIM Card Power supply, it can identify automatically the SIM Card power mode，one is 3.0V±10%, another is 1.8V±10%. Current is about 10mA.
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.

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

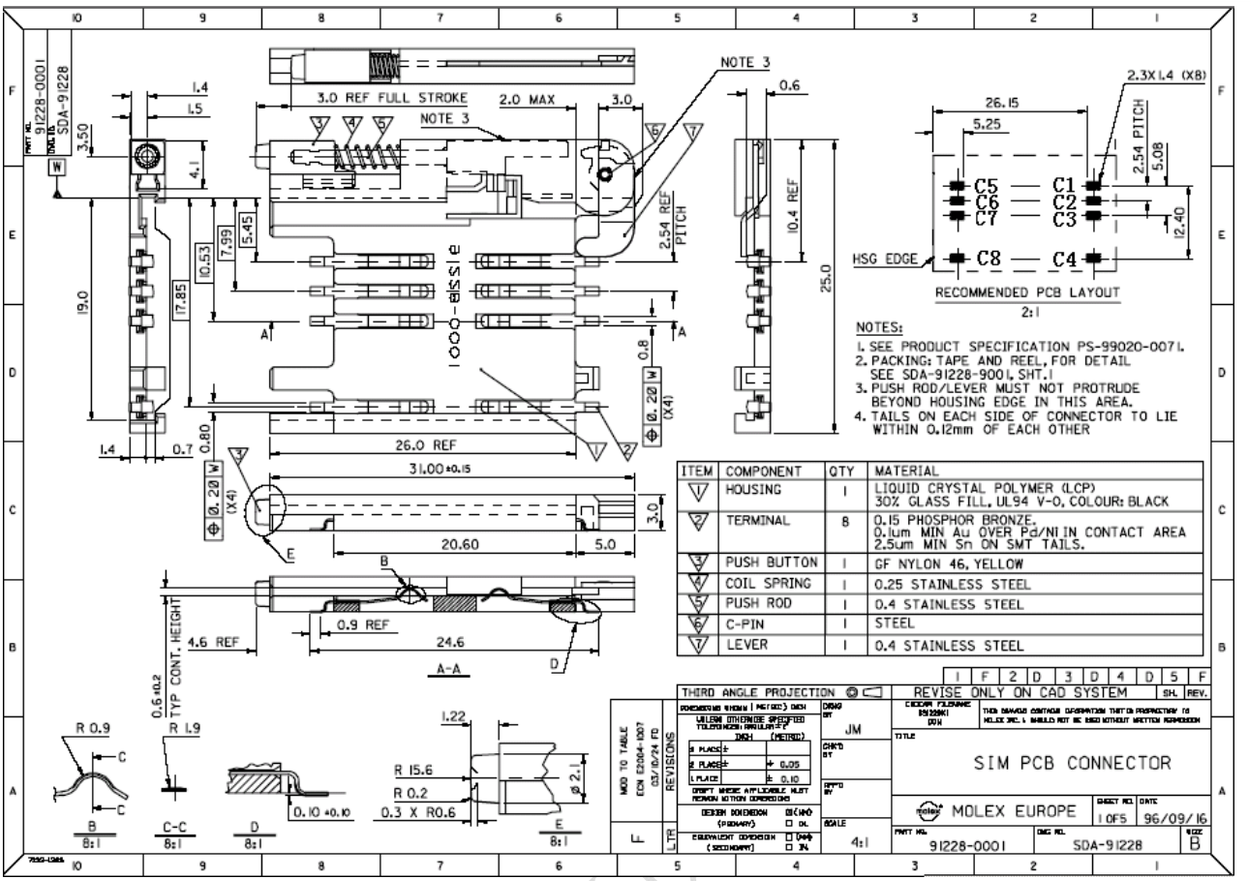


Figure28: Molex 91228 SIM card holder

Table18: Pin description (Molex SIM card holder)

Pin Name	Signal	Description
C1	SIM_VDD	SIM Card Power supply, it can identify automatically the SIM Card power mode，one is 3.0V±10%, another is 1.8V±10%. Current is about 10mA.
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_PRESENCE	Detect SIM Card Presence

3.12 LCD Display Interface

SIM900D provides a serial LCD display interface that supports serial communication with LCD device. When used as LCD interface, the following table is the pin definition. LCD interface timing should be united with the LCD device.

Table19: Pin Definition of the LCD interface

Pin Name	Pin Number	Function
DISP_CLK	13	Display clock for LCD
DISP_DATA	14	Display data output
DISP_D/C	16	Display data or command select
DISP_CS	46	Display enable

Note: This function is not supported in the default firmware. There must be some customized firmware if user wants. Please contact SIMCom for more details.

The DISP_RST can select the KBR0 or GPO0, when KBR0 or GPO0 is not used for another function.

3.13 ADC

SIM900D provides one auxiliary ADC0 (General purpose analog to digital converter) as voltage input pin, which can be used to detect the values of some external items such as voltage, temperature etc. User can use AT command “AT+CADC” to read the voltage value on ADC. For details of this AT command, please refer to ***related document [1]***.

Table20: ADC specification

	MIN	Type	MAX	Units
Voltage range	0	-	2.8	V
ADC Resolution	-	10	-	bits
Sampling rate	-	-	200K	Hz

3.14 Behaviors of the RI

Table21: Behaviours of the RI

State	RI respond
Standby	HIGH
Voice calling	Change LOW, then: （1）Change to HIGH when the call is established. （2）Use AT command ATH, the RI pin will be changed to HIGH. （3）When sender hangs up, it will be changed to HIGH.
Data calling	Change LOW, then： （1）Change to HIGH when the call is established. （2）Use AT command ATH, the RI will be changed to HIGH.
SMS	Change to low and hold low level for about 120 ms when the module receive a SMS, and then it is changed to HIGH.
URC	Some URCs triggers 120ms low level on RI. ***For more details, please refer to related document [10]***

If the module is used as caller, the RI will maintain high. However, when it is used as receiver, following is timing of the ring.

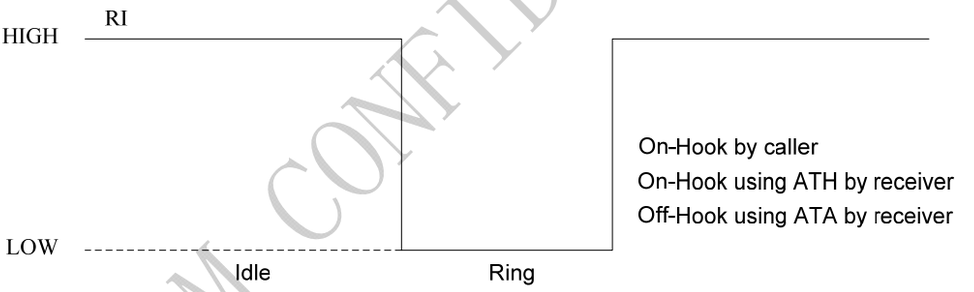


Figure29: RI behaviour of voice calling as a receiver

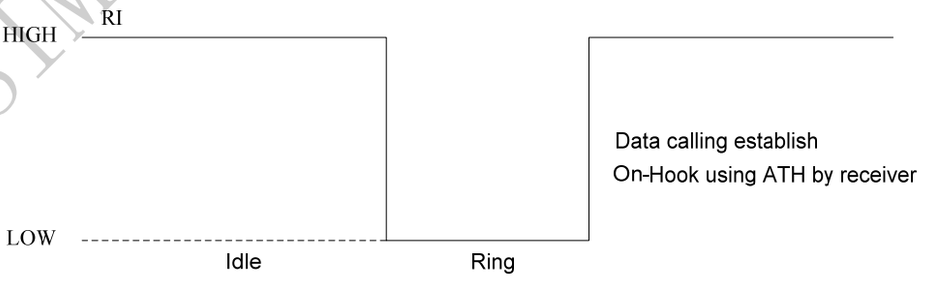


Figure30: RI behaviour of data calling as a receiver

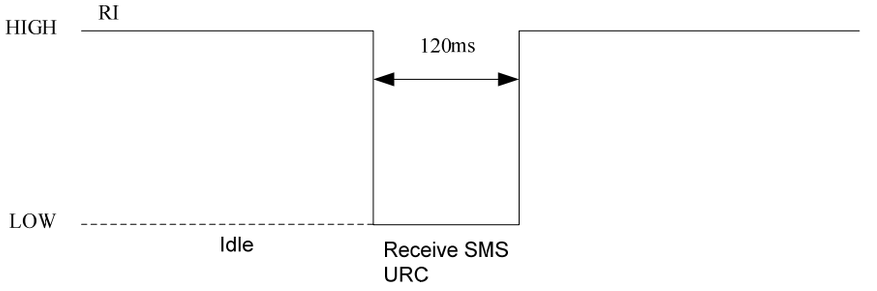


Figure31: RI behaviour of URC or receive SMS

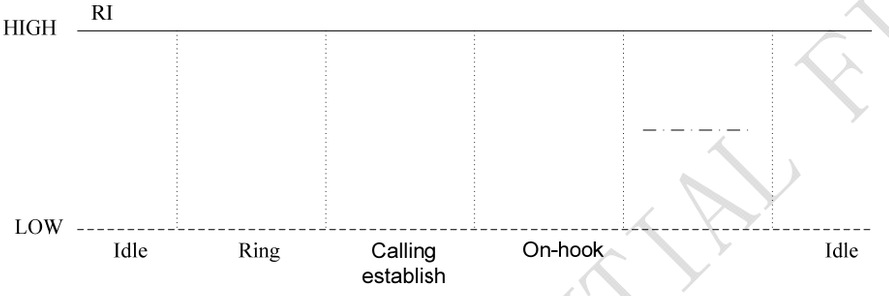


Figure32: RI behaviour as a caller

3.15 Network Status Indication

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

Table22: Working state of the NETLIGHT

State	SIM900D function
Off	SIM900D is not running
64ms On/ 800ms Off	SIM900D does not find the network
64ms On/ 3000ms Off	SIM900D find the network
64ms On/ 300ms Off	GPRS communication

Provide a reference circuit for user, shown as following figure:

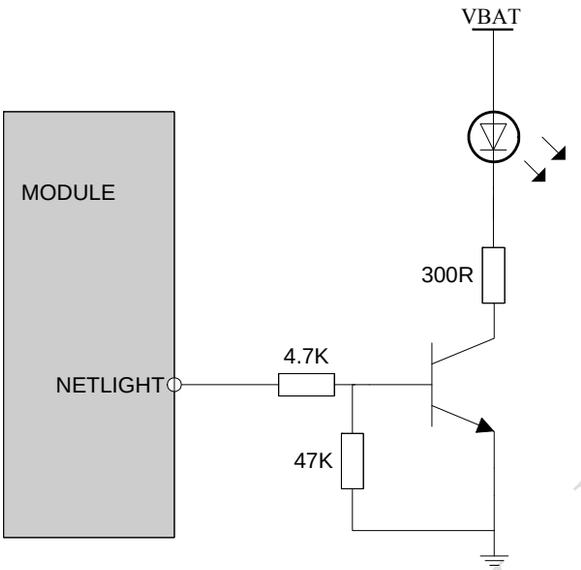


Figure33: Reference circuit of NETLIGHT

3.16 General Purpose Input Output (GPIO)

SIM900D provides a limited number of General Purpose Input/Output signal pin. The output and input voltage level of the GPIO can be set by AT command. For more details, please refer to ***related document [1]***

Table23: Pin definition of the GPIO interface

Pin Name	Pin Number	Default Function	Second Function	Default State
KBR0	10	GPIO8	SIM card detection	Output Pull down
GPO1	40	GPIO1		Output Pull down

The SIM card detection function can be implemented, please refer to 3.11 SIM interface for more details.

3.17 PWM

SIM900D contains one Pulse-Width Modulators (PWM) which can be used for controlling a buzzer.

Features of buzzer PWM:
10-bit resolution for buzzer tone frequency generation from 200 Hz to 5 kHz
Tone frequency error < 1 % for all standard piano notes from 200 Hz to 5 kHz
Tone level control from 0 dB down to −24 dB in +4 dB steps
Audio mute

The PWM for the buzzer outputs a square wave at the desired tone frequency. The tone frequencies are programmable from 200 Hz to 5 kHz and can be re-programmed on-the-fly to generate monophonic audio

ringtones or alert tones. The tone level can be adjusted over a 24 dB range in 4 dB steps, or it can be muted.

Table24: Pin definition of the PWM

Pin Name	Pin Number	
PWM	47	Pulse-Width Modulator Signal

4 Antenna Interface

SIM900D provides RF antenna interface. And customer's antenna should be located in the customer's main board and connect to module's antenna pad through microstrip line or other type RF trace which impendence must be controlled in 50Ω. The Pin 33 is the RF antenna pad.
SIM900D material properties:
SIM900D PCB Material: FR4
Antenna pad: Gold plated pad

4.1 Module RF Output Power

Table25: SIM900D conducted RF output power

Frequency	Max	Min
GSM850	33dBm ±2db	5dBm±5db
EGSM900	33dBm ±2db	5dBm±5db
DCS1800	30dBm ±2db	0dBm±5db
PCS1900	30dBm ±2db	0dBm±5db

4.2 Module RF Receive Sensitivity

Table26: SIM900D conducted RF receive sensitivity

Frequency	Receive sensitivity（Typical）	Receive sensitivity(MAX)
GSM850	-109dBm	-107dBm
EGSM900	-109dBm	-107dBm
DCS1800	-109dBm	-107dBm
PCS1900	-109dBm	-107dBm

4.3 Module Operating Frequencies

Table27: SIM900D operating frequencies

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

5 Electrical, Reliability and Radio Characteristics

5.1 Absolute Maximum Ratings

The absolute maximum ratings stated in Table 28 are stress ratings under non-operating conditions. Stresses beyond any of these limits will cause permanent damage to SIM900D.

Table28: Absolute maximum ratings

Parameter	Min	Max	Unit
VBAT	-	5.5	V
Peak current of power supply	0	3.0	A
Voltage at digit pins*	-0.3	3.1	V
I_I*	-	10	mA
I_O*	-	10	mA

*For digital interface pins, such as GPIO, UART, LCD and PWM.

5.2 Operating Temperatures

The operating temperature is listed in following table:

Table29: SIM900D operating temperature

Parameter	Min	Typ	Max	Unit
Ambient temperature	-30	+25	+80	℃
Restricted operation*	-40 to -30		+80 to+ 85	℃
Storage temperature	-45		+90	℃

* The SIM900D does work, but deviations from the GSM specification may occur.

5.3 Power Supply Ratings

Table30: SIM900D power supply ratings

Parameter	Description	Conditions	Min	Typ	Max	Unit
VBAT	Supply voltage	Voltage must stay within the min/max values, including voltage drop, ripple, and spikes.	3.2	4.0	4.8	V
	Voltage drop during transmit burst	Normal condition, power control level for Pout max			300	mV
	Voltage ripple	Normal condition, power control level for Pout max @ f<200kHz @ f>200kHz			 50 2	 mV
I_{VBAT}	Average supply current	POWER DOWN mode SLEEP mode(BS-PA-MFRMS=2) (BS-PA-MFRMS=5) (BS-PA-MFRMS=9)		30	 1.5 1.2 1.0	uA mA mA mA
		IDLE mode GSM 850 EGSM 900 DCS1800 PCS1900		 22 22 22 22		 mA
		TALK mode GSM 850 EGSM 900 DCS1800 PCS1900		 235 252 176 176		 mA
		DATA mode, GPRS (3 Rx,2Tx) GSM 850 EGSM 900 DCS1800 PCS1900		 425 454 307 309		 mA
		DATA mode, GPRS (4 Rx,1Tx) GSM 850 EGSM 900 DCS1800 PCS1900		 262 280 208 205		 mA
	Peak supply current (during Tx burst)	Power control level for Pout max.		2.0		A

5.4 Current Consumption

Please refer to the following table for the values of current consumption.

Table31: SIM900D current consumption (VBAT=3.8V)

Voice Call	
GSM 850/EGSM 900	@power level #5 <300mA,Typical 250mA @power level #10,Typical 110mA @power level #19,Typical 80mA
DCS 1800/PCS 1900	@power level #0 <200mA,Typical 175mA @power level #10,Typical 95mA @power level #15,Typical 75mA
GPRS Data	
DATA mode, GPRS (1 Rx,1 Tx) CLASS 8	
GSM 850/EGSM 900	@power level #5 <300mA,Typical 240mA @power level #10,Typical 117mA @power level #19,Typical 88mA
DCS 1800/PCS 1900	@power level #0 <200mA,Typical 170mA @power level #10,Typical 88mA @power level #15,Typical 80mA
DATA mode, GPRS (3 Rx, 2 Tx) CLASS 10	
GSM 850/EGSM 900	@power level #5 <450mA,Typical 440mA @power level #10,Typical 202mA @power level #19,Typical 143mA
DCS 1800/PCS 1900	@power level #0 <350mA,Typical 300mA @power level #10,Typical 139mA @power level #15,Typical 126mA
DATA mode, GPRS (4 Rx,1 Tx) CLASS 8	
GSM 850/EGSM 900	@power level #5 <300mA,Typical 270mA @power level #10,Typical 155mA @power level #19,Typical 125mA
DCS 1800/PCS 1900	@power level #0 <300mA,Typical 205mA @power level #10,Typical 126mA @power level #15,Typical 119mA

Class 10 is default set when the module works at data translation mode, the module can also work at class 8 set by AT command.

5.5 Electro-Static Discharge

The GSM engine is not protected against Electrostatic Discharge (ESD) in general. Therefore, it is subject to ESD handing precautions that typically apply to ESD sensitive components. Proper ESD handing and packaging procedures must be applied throughout the processing, handing and operation of any application using a

SIM900D module.

The measured values of SIM900D are shown as the following table:

Table32: The ESD endure statue measured table (Temperature: 25℃, Humidity:45%)

Part	Contact discharge	Air discharge
VBAT	±5KV	±10KV
GND	±5KV	±10KV
RXD, TXD	±2KV	±8KV
ANT	±5KV	±10KV
SPK1P/1N SPK2P/2N MIC1P/1N MIC2P/2N	±3KV	±8KV
PWRKEY	±2KV	±8KV
Other port	TBD	TBD

****Note: The PWRKEY is recommended to use the ESD protection component.***

6 Mechanics

This chapter describes the mechanical dimensions of SIM900D.

6.1 Mechanical Dimensions of SIM900D

Following shows the Mechanical dimensions of SIM900D (top view, side view and bottom view).

Dimensions shown in millimeters

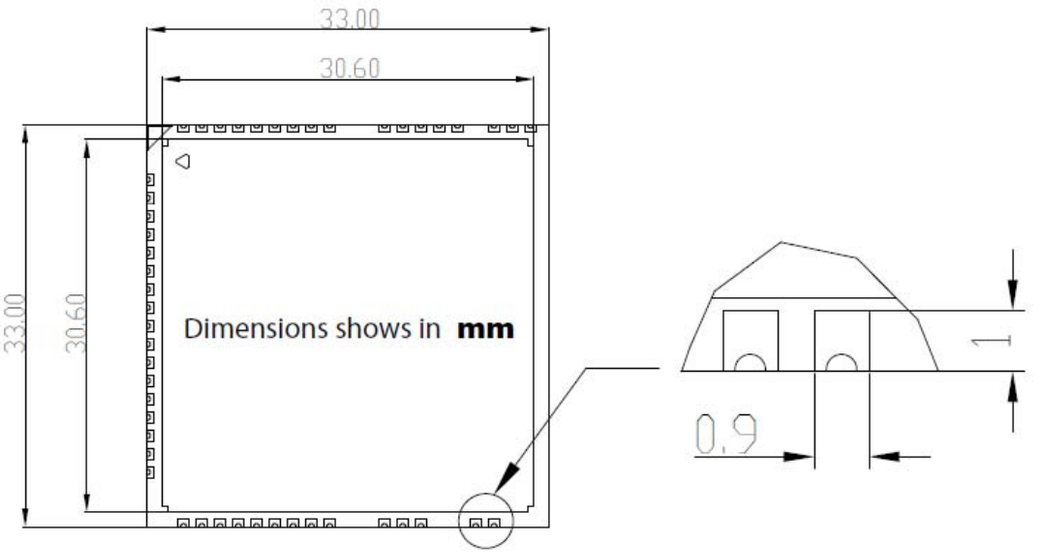


Figure34: SIM900D top mechanical dimensions

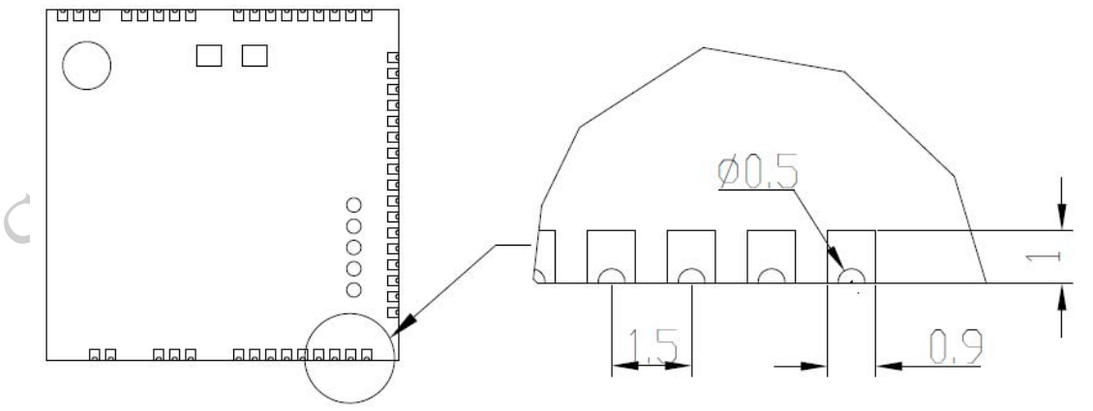


Figure35: SIM900D bottom mechanical dimensions

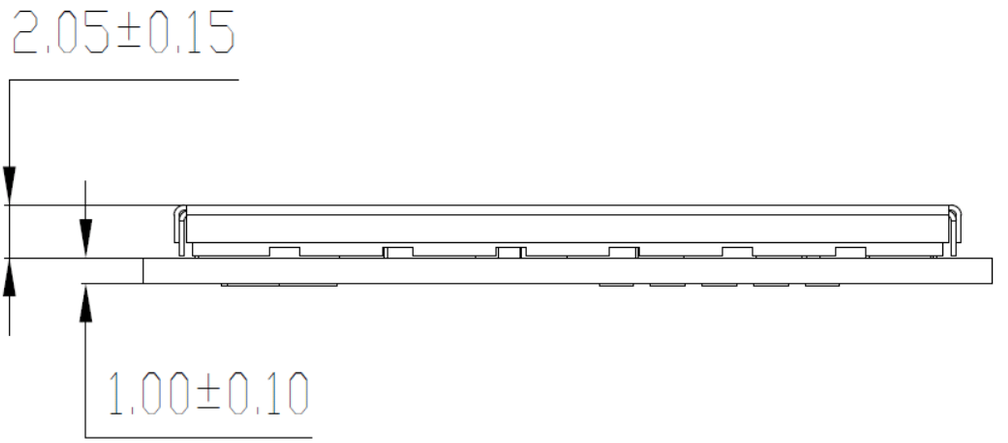


Figure36: SIM900D side mechanical dimensions

FOOT PRINT RECOMMENDATION:

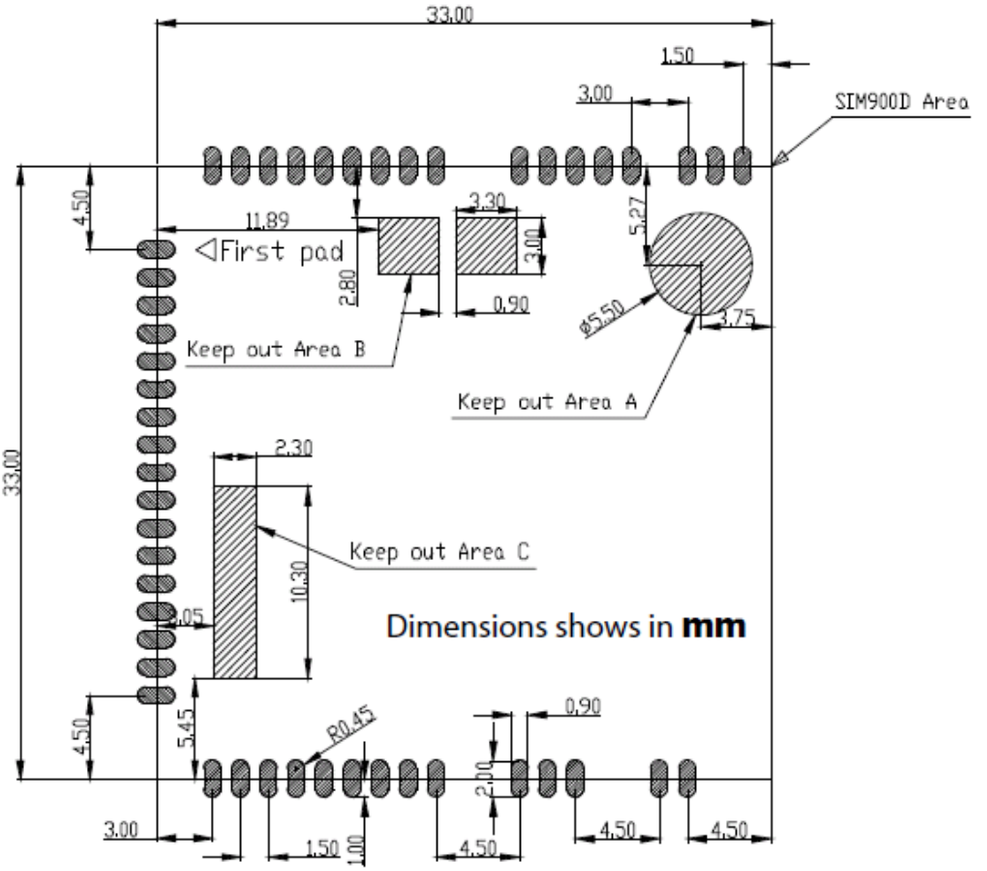


Figure37: Recommended PCB decal (Unit: mm)

6.2 Top and Bottom View of the SIM900D

Figure38: Top and Bottom view of the SIM900D

6.3 PIN Assignment of SIM900D

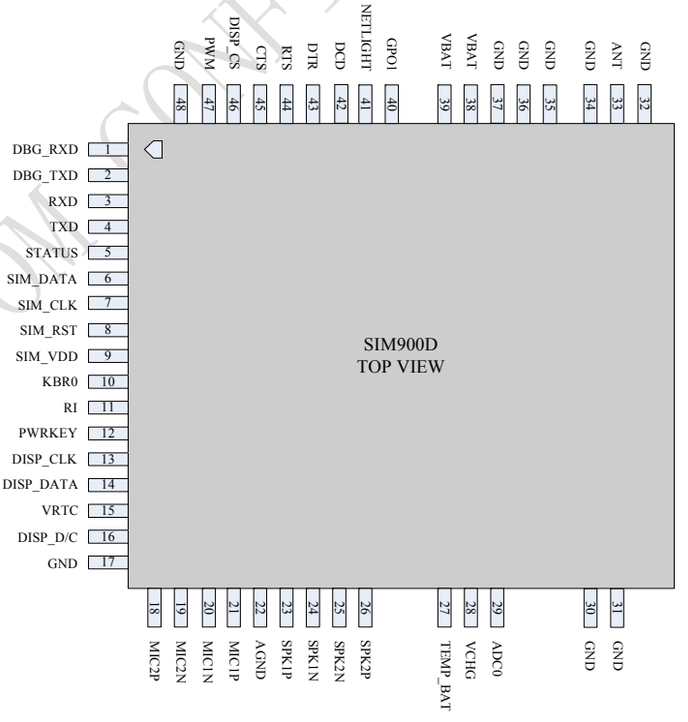
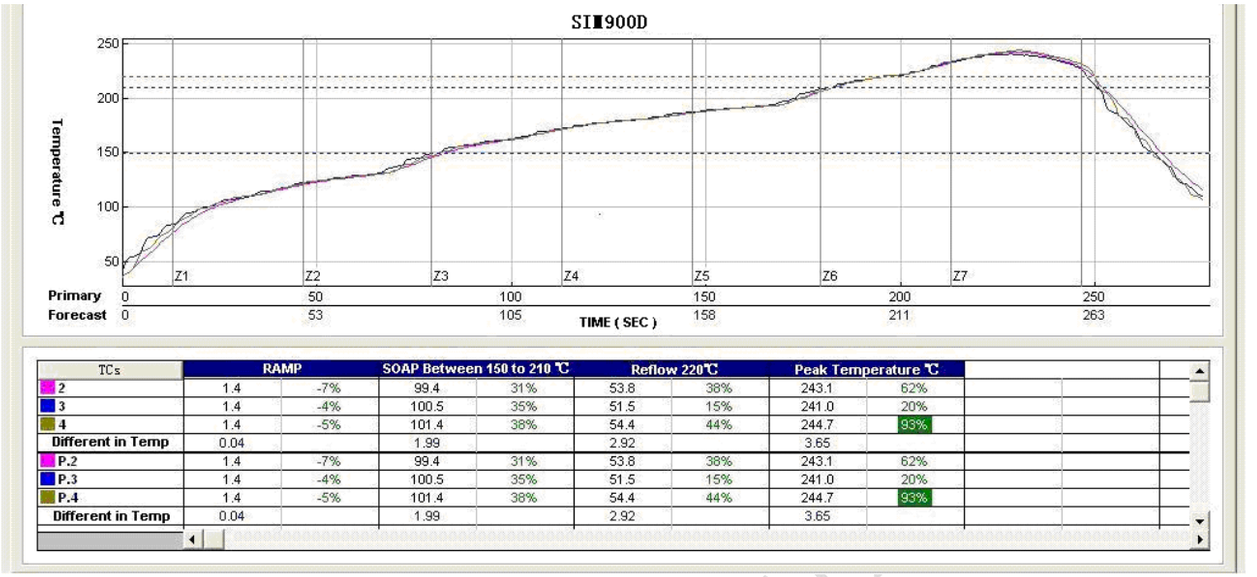


Figure39: SIM900D pin out diagram (Top View)

Table33: PIN Assignment

Pin NUM	NAME	Pin NUM	NAME
1	DBG_RXD	2	DBG_TXD
3	RXD	4	TXD
5	STATUS	6	SIM_DATA
7	SIM_CLK	8	SIM_RST
9	SIM_VDD	10	KBR0
11	RI	12	PWRKEY
13	DISP_CLK	14	DISP_DATA
15	VRTC	16	DISP_D/C
17	GND	18	MIC2P
19	MIC2N	20	MIC1N
21	MIC1P	22	AGND
23	SPK1P	24	SPK1N
25	SPK2N	26	SPK2P
27	TEMP_BAT	28	VCHG
29	ADC0	30	GND
31	GND	32	GND
33	ANT	34	GND
35	GND	36	GND
37	GND	38	VBAT
39	VBAT	40	GPO1
41	NETLIGHT	42	DCD
43	DTR	44	RTS
45	CTS	46	DISP_CS
47	PWM	48	GND

6.4 The Ramp-Soak-Spike Reflow Profile of SIM900D



TCs	RAMP		SOAP Between 150 to 210 ℃		Reflow 220℃		Peak Temperature ℃	
2	1.4	-7%	99.4	31%	53.8	38%	243.1	62%
3	1.4	-4%	100.5	35%	51.5	15%	241.0	20%
4	1.4	-5%	101.4	38%	54.4	44%	244.7	93%
Different in Temp	0.04		1.99		2.92		3.65	
P.2	1.4	-7%	99.4	31%	53.8	38%	243.1	62%
P.3	1.4	-4%	100.5	35%	51.5	15%	241.0	20%
P.4	1.4	-5%	101.4	38%	54.4	44%	244.7	93%
Different in Temp	0.04		1.99		2.92		3.65	

Figure40: The ramp-soak-spike reflow profile of SIM900D

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