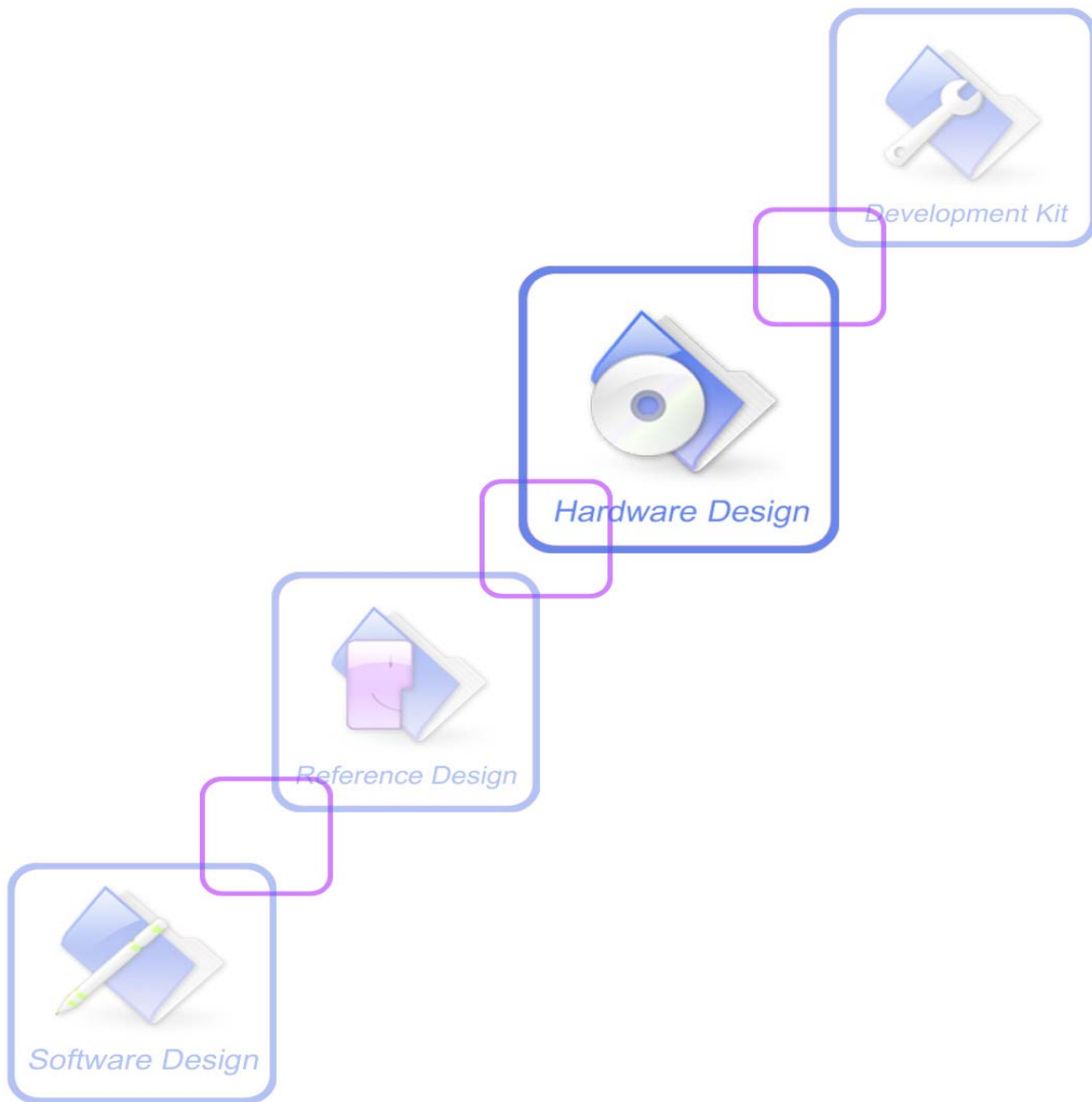




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1 Introduction

This document describes SIM900-DS hardware interface in great detail.

This document can help user to quickly understand SIM900-DS interface specifications, electrical and mechanical details. With the help of this document and other SIM900-DS application notes, users can use SIM900-DS to design various applications quickly.

2 SIM900-DS Overview

Designed for global market, SIM900-DS is a quad-band GSM/GPRS module that works on frequencies GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz. SIM900-DS features GPRS multi-slot class 10/class 8 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4.

SIM900-DS with special features, Dual-SIM Dual-Standby, which allows customers to use two SIM cards in one device simultaneously.

With a tiny configuration of 24*24*3mm, SIM900-DS can meet almost all the space requirements in user applications, such as M2M, smart phone, PDA and other mobile devices.

SIM900-DS has 68 SMT pads, and provides all hardware interfaces between the module and customers' boards.

- Serial port and debug port
- Two analog audio channels
- PCM interface
- Programmable general purpose input and output.
- The SPI display interface

SIM900-DS is designed with power saving technique so that the current consumption is as low as 1.5mA in sleep mode.

SIM900-DS 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 SIM900-DS Key Features

Table 1: SIM900-DS key features

Feature	Implementation
Power supply	3.2V ~ 4.8V
Power saving	Typical power consumption in sleep mode is 1.5mA (BS-PA-MFRMS=9)
Frequency bands	<ul style="list-style-type: none"> ● SIM900-DS Quad-band: GSM 850, EGSM 900, DCS 1800, PCS 1900. SIM900-DS can search the 4 frequency bands automatically. The frequency bands also can be set by AT command "AT+CBAND". For details, please refer to <i>document [1]</i>. ● Compliant to GSM Phase 2/2+

Transmitting power	<ul style="list-style-type: none"> ● Class 4 (2W) at GSM 850 and EGSM 900 ● Class 1 (1W) at DCS 1800 and PCS 1900
GPRS connectivity	<ul style="list-style-type: none"> ● GPRS multi-slot class 10 (default) ● GPRS multi-slot class 8 (option)
Temperature range	<ul style="list-style-type: none"> ● Normal operation: -30°C ~ +80°C ● Restricted operation: -40°C ~ -30°C and +80 °C ~ +85°C* ● Storage temperature -45°C ~ +90°C
Data GPRS	<ul style="list-style-type: none"> ● 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 ● Integrate the TCP/IP protocol. ● Support Packet Broadcast Control Channel (PBCCH)
CSD	<ul style="list-style-type: none"> ● Support CSD transmission
USSD	<ul style="list-style-type: none"> ● Unstructured Supplementary Services Data (USSD) support
SMS	<ul style="list-style-type: none"> ● 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	<p>Speech codec modes:</p> <ul style="list-style-type: none"> ● 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	<p>Serial port:</p> <ul style="list-style-type: none"> ● Full modem interface with status and control lines, unbalanced, asynchronous. ● 600bps to 460800bps. ● 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 600bps to 115200bps. <p>Debug port:</p> <ul style="list-style-type: none"> ● 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	GSM 11.14 Release 99
Real time clock	Support RTC
Physical characteristics	<p>Size: 24*24*3mm</p> <p>Weight: 3.4g</p>
Firmware upgrade	Firmware upgradeable by debug port.

*SIM900-DS does work at this temperature, but some radio frequency characteristics may deviate from the GSM specification.

Table 2: 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 Operating Modes

The table below summarizes the various operating modes of SIM900-DS.

Table 3: 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 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.
	GSM IDLE Software is active. Module 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 down	Normal power down by sending the 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, and only the power supply for the RTC is remained. Software is not active. The serial port is not accessible. Power supply (connected to VBAT) 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.

2.3 SIM900-DS Functional Diagram

The following figure shows a functional diagram of SIM900-DS:

- The GSM baseband engine
- Flash
- The GSM radio frequency part
- The antenna interface
- The other interfaces

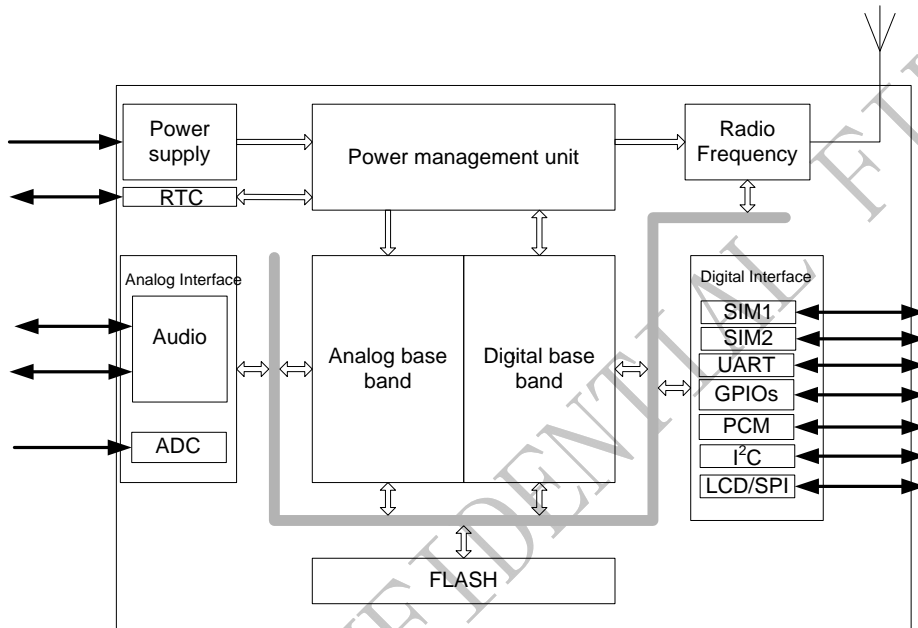


Figure 1: SIM900-DS functional diagram

3 Package Information

3.1 Pin out Diagram

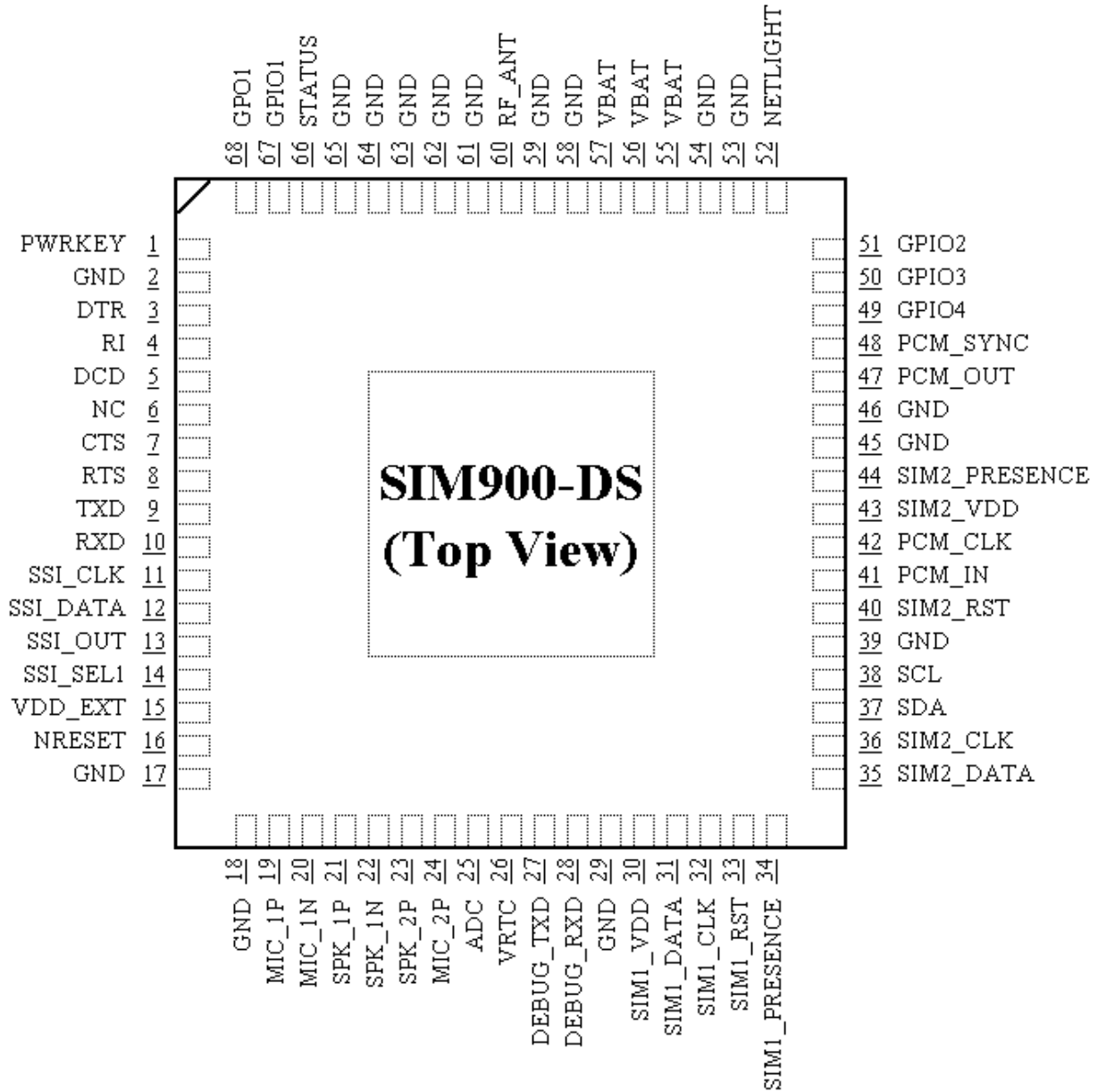


Figure 2: SIM900-DS pin out diagram (Top view)

3.2 Pin Description

Table 4: Pin description

Pin name	Pin number	I/O	Description	Comment
Power supply				
VBAT	55,56,57	I	Power supply	
VRTC	26	I/O	Power supply for RTC	It is recommended to connect with a battery or a capacitor (e.g. 4.7uF).
VDD_EXT	15	O	2.8V output power supply	If it is unused, keep open.
GND	2,17,18,29,39, 45,46,53,54, 58,59,61,62, 63,64,65		Ground	
Power on/down				
PWRKEY	1	I	PWRKEY should be pulled low at least 1 second and then released to power on/down the module.	Pulled up internally.
Audio interface				
MIC1_P	19	I	Differential audio input	If these pins are unused, keep open.
MIC1_N	20			
SPK1_P	21	O	Differential audio output	
SPK1_N	22			
SPK2_P	23		Single audio output	
MIC2_P	24		Single audio input	
Status				
STATUS	66	O	Power on status	If these pins are unused, keep open.
NETLIGHT	52	O	Network status	
SPI interface				
SSI_CLK	11	O	Display interface	If these pins are unused, keep open.
SSI_DATA	12	I/O		
SSI_OUT	13	O		
SSI_SEL1	14	O		
I²C interface				
SDA	37	O	I ² C serial bus data	If these pins are unused, keep open.
SCL	38	I/O	I ² C serial bus clock	
GPIOs				
GPO1	68	I/O	GPO1	If these pins are unused, keep open.
GPIO4	49		GPIO4	
GPIO3	50		GPIO3	
GPIO2	51		GPIO2	

GPIO1	67		GPIO1	
Serial port				
RXD	10	I	Receive data	
TXD	9	O	Transmit data	If these pins are unused, keep open.
RTS	8	I	Request to send	
CTS	7	O	Clear to send	
DCD	5	O	Data carrier detect	
RI	4	O	Ring indicator	
DTR	3	I	Data terminal ready	
Debug interface				
DBG_TXD	27	O	For debugging and upgrading firmware	If these pins are unused, keep open.
DBG_RXD	28	I		
SIM1 interface				
SIM1_VDD	30	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	31	I/O	SIM1 data input/output	
SIM1_CLK	32	O	SIM1 clock	
SIM1_RST	33	O	SIM1 reset	
SIM1_PRESENCE	34	I	SIM1 card detection	If it is unused, keep open.
SIM2 interface				
SIM2_VDD	43	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	35	I/O	SIM2 data input/output	
SIM2_CLK	36	O	SIM2 clock	
SIM2_RST	40	O	SIM2 reset	
SIM2_PRESENCE	44	I	SIM2 card detection	If it is unused, keep open.
ADC				
ADC	25	I	Input voltage range: 0V ~ 2.8V	If it is unused, keep open.
External reset				
NRESET	16	I	Reset input(Active low)	Recommend connecting a 100nF capacitor.
PCM interface				
PCM_SYNC	48	O	PCM sync	If these pins are unused, keep open.
PCM_OUT	47	O	PCM data output	
PCM_IN	41	I	PCM data input	
PCM_CLK	42	O	PCM CLK	
RF interface				
RF_ANT	60	I/O	Radio antenna connection	Impedence must be controlled to 50Ω.
Not connect				
NC	6	-		This pin should be kept open.

3.3 Package Dimensions

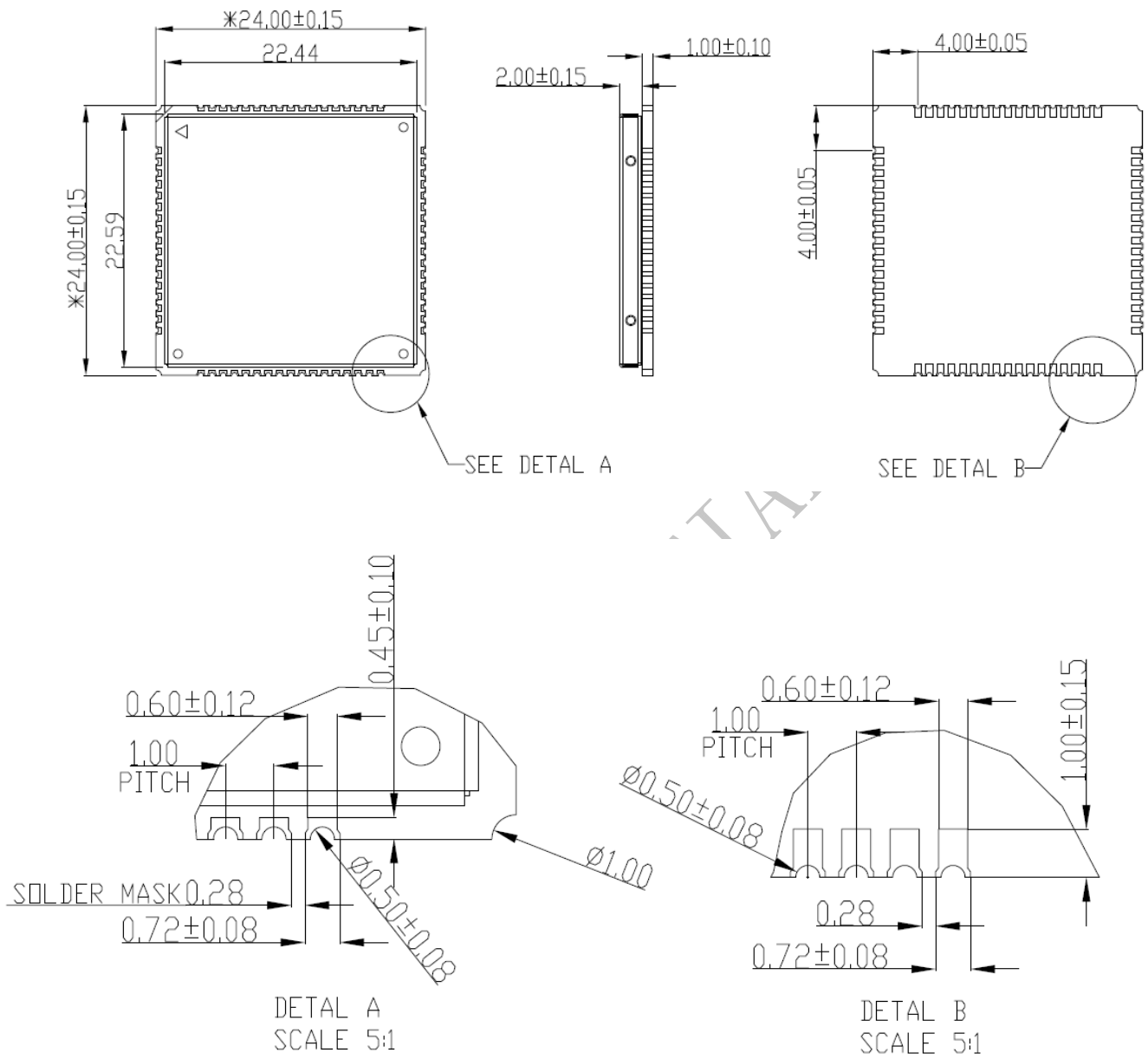


Figure 3: Dimensions of SIM900-DS (Unit: mm)

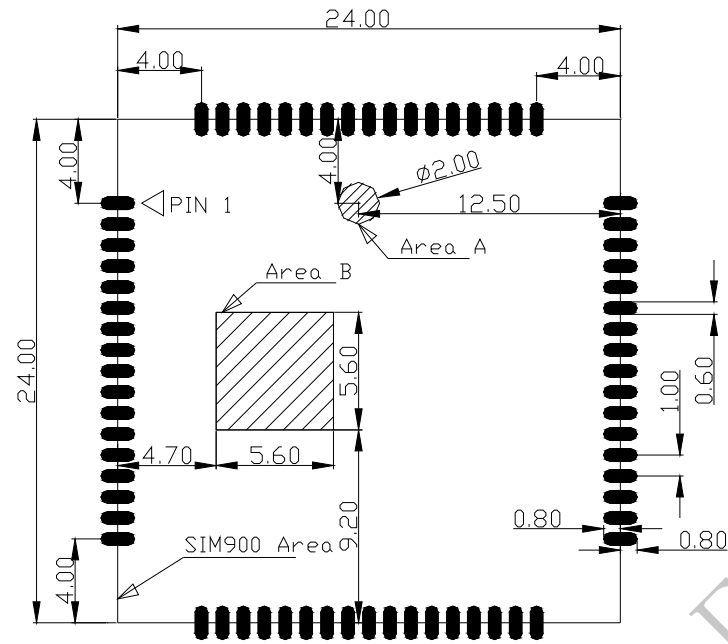


Figure 4: Recommended PCB footprint outline (Unit: mm)

Note: Keep copper out of area A. Do not place via in area B to avoid short circuit between the via on customer board and the test points on the bottom side of the module.

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4 Application Interface

4.1 Power Supply

The power supply range of SIM900-DS is from 3.2V to 4.8V. 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 μ F is strongly recommended; this capacitor should be placed as close as possible to SIM900-DS VBAT pins. The following figure is the reference design of +5V input power supply. The designed output for the power supply is 4.1V, thus a linear regulator can be used.

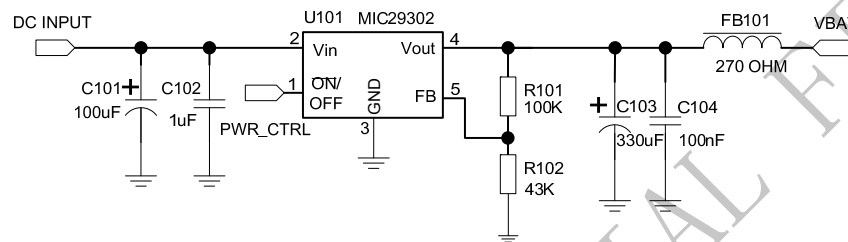


Figure 5: Reference circuit of the LDO power supply

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.

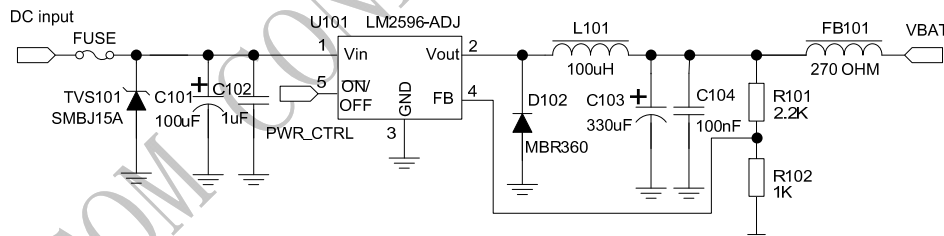


Figure 6: Reference circuit of the DC-DC power supply

The single 3.6V Li-ion cell battery can be connected to SIM900-DS 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 150m Ω . 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 $C_A=100\mu$ F tantalum capacitor (ESR=0.7 Ω),

Another VBAT bypass capacitor $C_B=1\mu$ F.

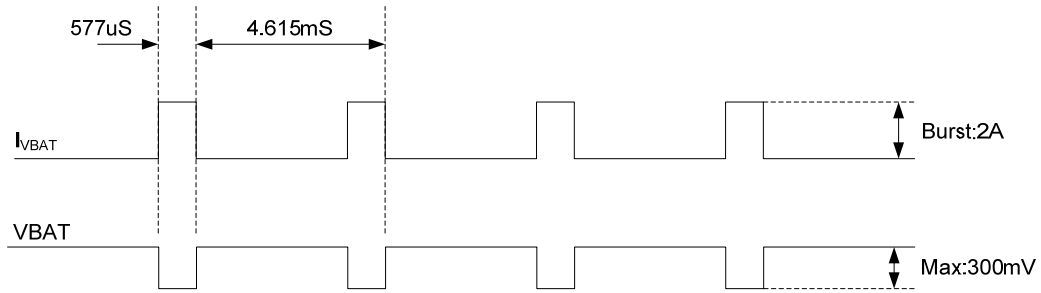


Figure 7: VBAT voltage drop during transmit burst

4.1.1 Minimizing Voltage Drop of VBAT

When designing the power supply in user’s application, pay special attention to power losses. Ensure that the input voltage never drops below 3.1V even when current consumption rises to 2A in the transmit burst. 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 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.

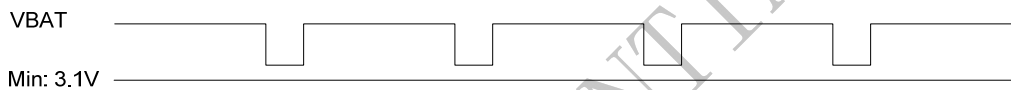


Figure 8: The minimal VBAT voltage requirement at VBAT drop

4.1.2 Monitoring Power Supply

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

4.2 Power on/down Scenarios

4.2.1 Power on SIM900-DS

User can power on SIM900-DS 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 circuit is shown as below.

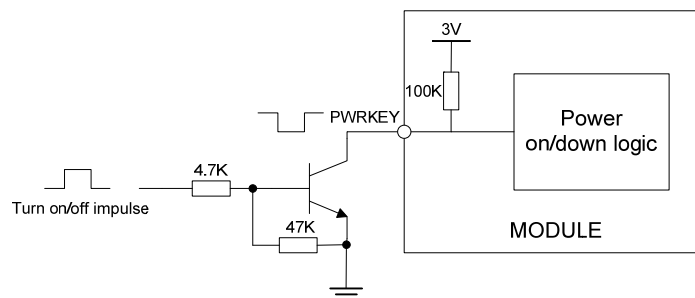


Figure 9: Powered on/down module using transistor

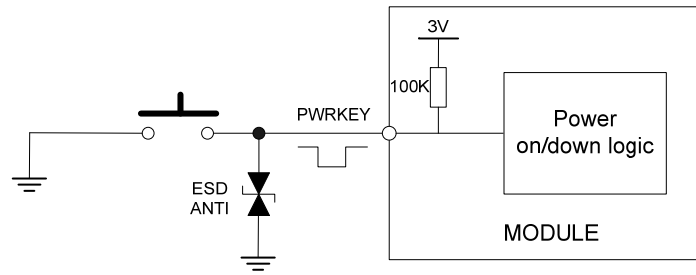


Figure 10: Powered on/down module using button

The power on scenarios is illustrated as following figure.

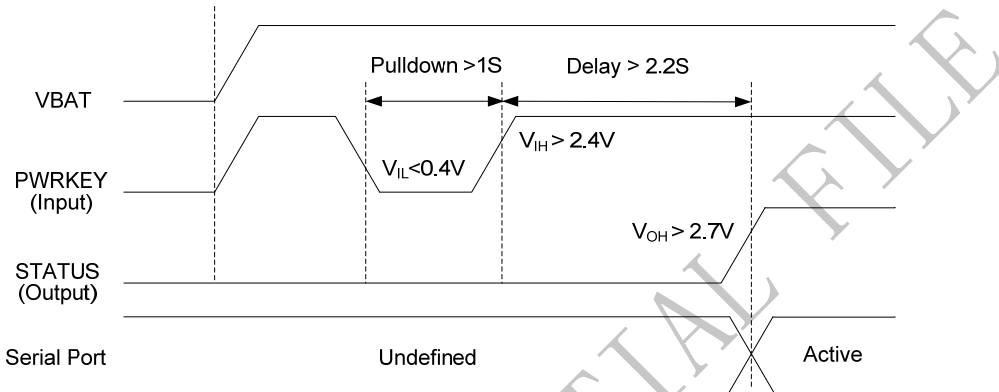


Figure 11: Timing of power on module

When power on procedure is completed, SIM900-DS 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: User 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 SIM900-DS is powered on. For details, please refer to the chapter “AT+IPR” in document [1].

4.2.2 Power down SIM900-DS

SIM900-DS will be powered down in the following situations:

- Normal power down procedure: power down SIM900-DS by the PWRKEY pin.
- Normal power down procedure: power down SIM900-DS by AT command “AT+CPOWD=1”.
- Abnormal power down: over-voltage or under-voltage automatic power down.
- Abnormal power down: over-temperature or under-temperature automatic power down.

4.2.2.1 Power down SIM900-DS by the PWRKEY Pin

User can power down SIM900-DS by pulling down the PWRKEY pin for at least 1 second and release. Please refer to the power on circuit. The power down scenario is illustrated in following figure.

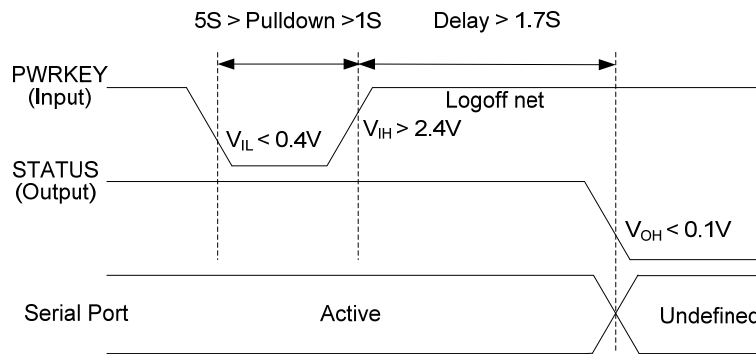


Figure 12: Timing of power down SIM900-DS by PWRKEY

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 down procedure, the module will send URC:

NORMAL POWER DOWN

At this moment, AT commands can not be executed any more, and only the RTC is still active. Power down mode can also be indicated by STATUS pin, which is at low level at this time.

4.2.2.2 Power down SIM900-DS by AT Command

SIM900-DS can be powered down 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 down procedure, the module will send URC:

NORMAL POWER DOWN

At this moment, AT commands can not be executed any more, and only the RTC is still active. Power down mode can also be indicated by STATUS pin, which is at low level at this time.

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

4.2.2.3 Over-voltage or Under-voltage Power down

The module software monitors the VBAT voltage constantly.

If the voltage $\leq 3.3V$, the following URC will be reported:

UNDER-VOLTAGE WARNING

If the voltage $\geq 4.7V$, the following URC will be reported:

OVER-VOLTAGE WARNING

If the voltage $< 3.2V$, the following URC will be reported, and the module will be automatically powered down.

UNDER-VOLTAGE POWER DOWN

If the voltage $> 4.8V$, the following URC will be reported, and the module will be automatically powered down.

OVER-VOLTAGE POWER DOWN

At this moment, AT commands can not be executed any more, and only the RTC is still active. Power down mode can also be indicated by STATUS pin, which is at low level at this time.

4.2.2.4 Over-temperature or Under-temperature Power down

The module will constantly monitor the temperature of the module,
If the temperature $> +80^{\circ}\text{C}$, the following URC will be reported:

+CMTE: 1

If the temperature $< -30^{\circ}\text{C}$, the following URC will be reported:

+CMTE:-1

If the temperature $> +85^{\circ}\text{C}$, the following URC will be reported, and the module will be automatically powered down.

+CMTE: 2

If the temperature $< -40^{\circ}\text{C}$, the following URC will be reported, and the module will be automatically powered down.

+CMTE:-2

At this moment, AT commands can not be executed any more, and only the RTC is still active. Power down mode can also be indicated by STATUS pin, which is at low level at this time.

The AT command “AT+CMTE” could be used to read the temperature when the module is running.
For details please refer to *document [1]*.

4.2.3 Restart SIM900-DS by PWRKEY Pin

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

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

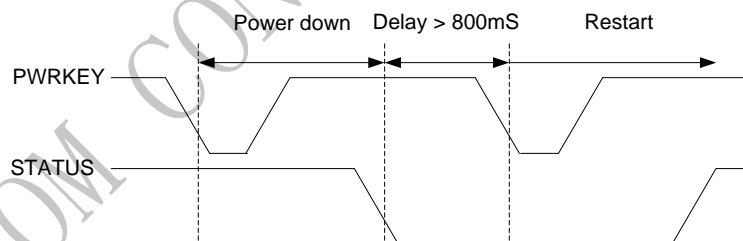


Figure 13: Timing of restart SIM900-DS

4.3 Power Saving Mode

SIM900-DS have two sleep modes: sleep mode 1 is enabled by hardware pin DTR; sleep mode 2 is only enabled by serial port regardless of the DTR. In sleep mode, the current of module is very low. The AT command “AT+CFUN=<fun>” can be used to set SIM900-DS into minimum functionality. When SIM900-DS is in sleep mode and minimum functionality, the current of module is lowest.

4.3.1 Minimum Functionality Mode

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

- 0: minimum functionality.
- 1: full functionality (default).
- 4: flight mode (disable RF function).

Minimum functionality mode minimizes the current consumption to the lowest level. If SIM900-DS 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 all AT commands correlative with RF function and SIM card function will not be accessible.

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

Table 5: The Current consumption of Minimum Functionality Mode

<fun>	Current consumption(uA) (sleep mode)
0	1030
1	1575
4	1100

4.3.2 Sleep Mode 1 (AT+CSCLK=1)

User can control SIM900-DS module to enter or exit the sleep mode 1 (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), SIM900-DS will enter sleep mode 1 automatically. In this mode, SIM900-DS can still receive paging or SMS from network but the serial port is not accessible.

Note: For SIM900-DS, it requests to set AT command “AT+CSCLK=1” and ensure DTR at high level to enable the sleep mode 1; the default value is 0, which can not make the module to enter sleep mode. For more details please refer to document [1].

4.3.3 Wake Up SIM900-DS from Sleep Mode 1 (AT+CSCLK=1)

When SIM900-DS 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.

4.3.4 Sleep Mode 2 (AT+CSCLK=2)

In this mode, SIM900-DS 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), SIM900-DS will enter sleep mode 2 automatically. In this mode, SIM900-DS can still receive paging or SMS from network but the serial port is not accessible.

Note: For SIM900-DS, It is requested to set AT command “AT+CSCLK=2” to enable the sleep mode 2; the default value is 0, which can not make the module to enter sleep mode. For more details please refer to document [1].

4.3.5 Wake Up SIM900-DS from Sleep Mode 2 (AT+CSCLK=2)

When SIM900-DS is in sleep mode 2 (AT+CSCLK=2), the following methods can wake up the module:

- Send data to SIM900-DS via serial port. *
- Receive a voice or data call from network.
- Receive a SMS from network.

*Note: The first byte of the user's data will not be recognized.

4.4 RTC Backup

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

- **External capacitor backup**

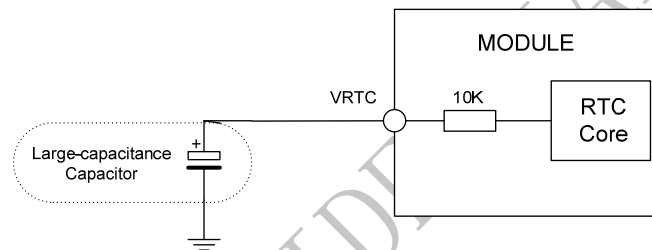


Figure 14: RTC supply from capacitor

- **Non-chargeable battery backup**

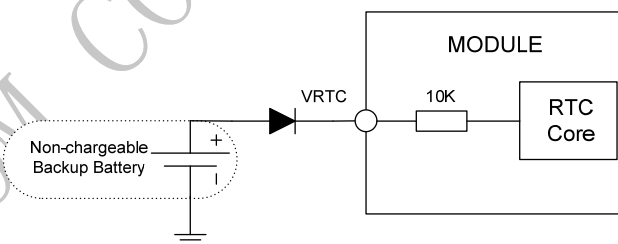


Figure 15: RTC supply from non-chargeable battery

- **Rechargeable battery backup**

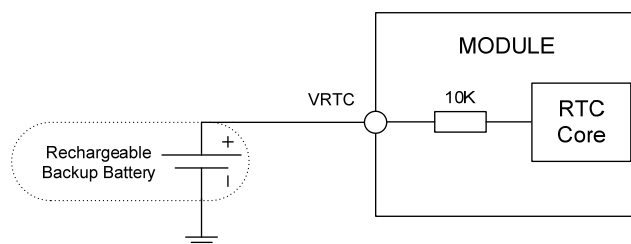


Figure 16: RTC supply from rechargeable battery

Coin-type rechargeable battery is recommended, such as XH414H-IV01E form Seiko can be used.

Typical charge-discharge curves for this battery are shown in the following figure.

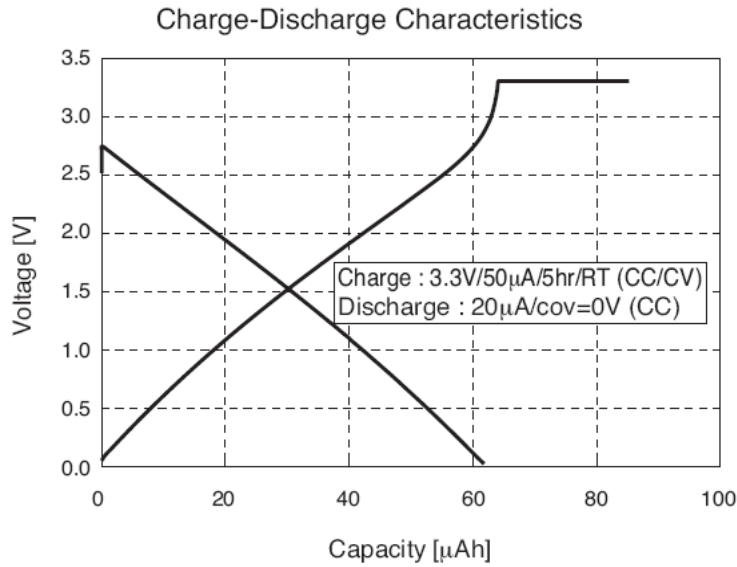


Figure 17: Seiko XH414H-IV01E Charge-Discharge Characteristic

4.5 Serial Interfaces

SIM900-DS provides two unbalanced asynchronous serial ports. One is the serial port and the other is the debug port. The module is designed as a DCE (Data Communication Equipment). The following figure shows the connection between module and client (DTE).

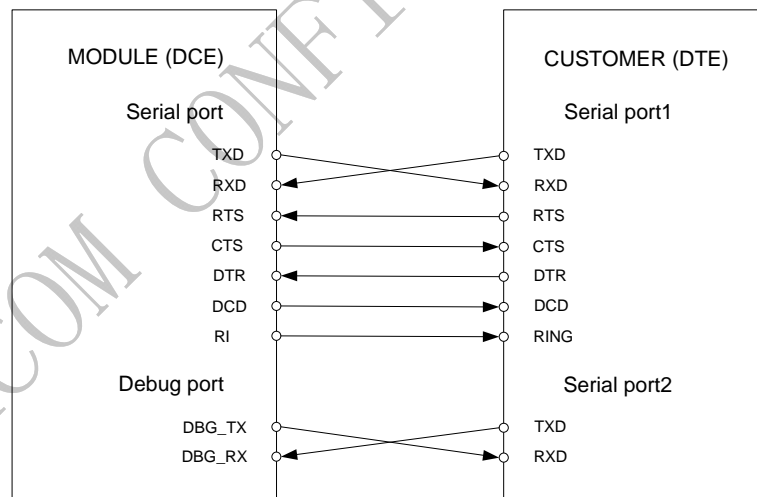


Figure 18: Connection of the serial interfaces

If only RXD and TXD are used in user's application, other serial pins should be kept open. Please refer to following figure.

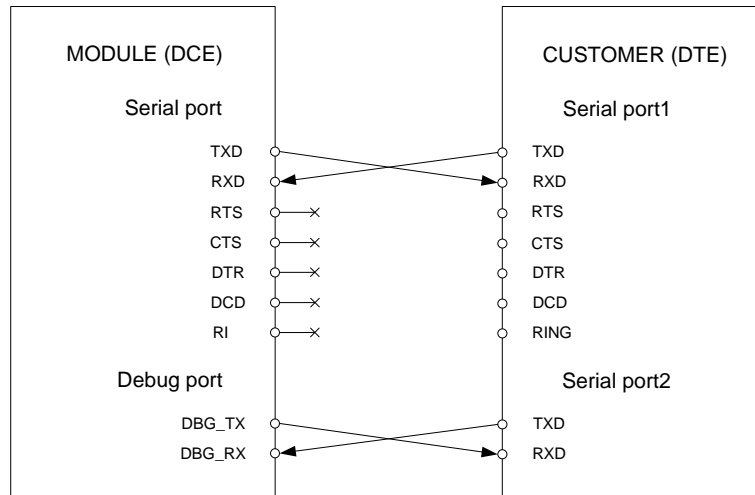


Figure 19: Connection of RXD and TXD only

4.5.1 Function of Serial Port and Debug Port

Serial port:

- Full modem device.
- Contains data lines TXD and RXD, hardware flow control lines RTS and CTS, status lines DTR, DCD and RI.
- Serial port can be used for CSD FAX, GPRS service and AT communication. It can also be used for multiplexing function. For details about multiplexing function, please refer to *document [3]*.
- Serial port supports the following baud rates:
600, 1200, 2400, 4800, 9600, 14400, 19200, 28800, 38400, 57600, 115200, 230400 and 460800bps
- Autobauding only supports the following baud rates:
600, 1200, 2400, 4800, 9600, 14400, 19200, 28800, 38400, 57600 and 115200bps
- The default setting is autobauding.

Autobauding allows SIM900-DS 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, user must firstly send character “A” to synchronize the baud rate. It is recommended to send “AT” until DTE receives the “OK” response, which means DTE and DCE are correctly synchronized. For more information please refer to the 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: User 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 SIM900-DS is powered on.

Debug port:

- Used for debugging and upgrading firmware.
- Debug port supports the baud rate of 115200bps.

4.5.2 Software Upgrade and Debug

Refer to the following figure for debugging and upgrading software.

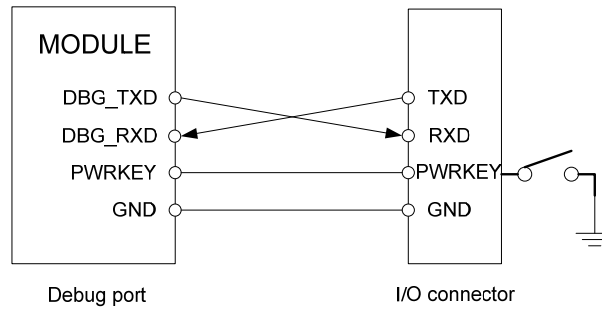


Figure 20: Connection for software upgrading and debugging

The serial port and the debug port support the CMOS level. If user connects the module to the computer, the level shifter should be added between the DCE and DTE.

For details about software upgrading, please refer to *document [4]*.

4.6 Audio Interfaces

SIM900-DS provides two analog input interfaces, MIC1P/1N and MIC2P, which could be used for electret microphone. The module also provides two analog output interfaces, SPK1P/1N and SPK2P, which can directly drive 32Ω receiver.

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]* and *document [5]*.

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. If user needs to use an amplifier circuit for audio, National Semiconductor Company’s LM4890 is recommended.

4.6.1 Speaker Interface Configuration

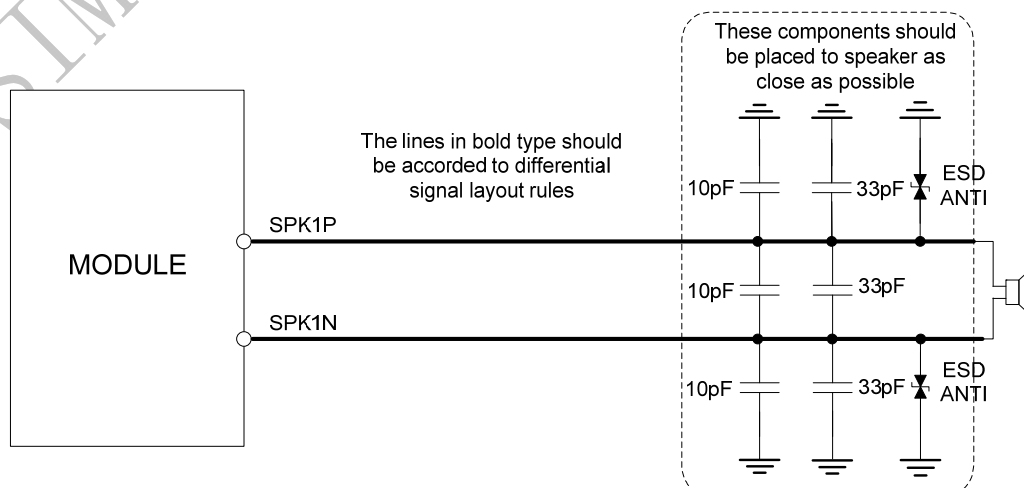


Figure 21: Speaker reference circuit

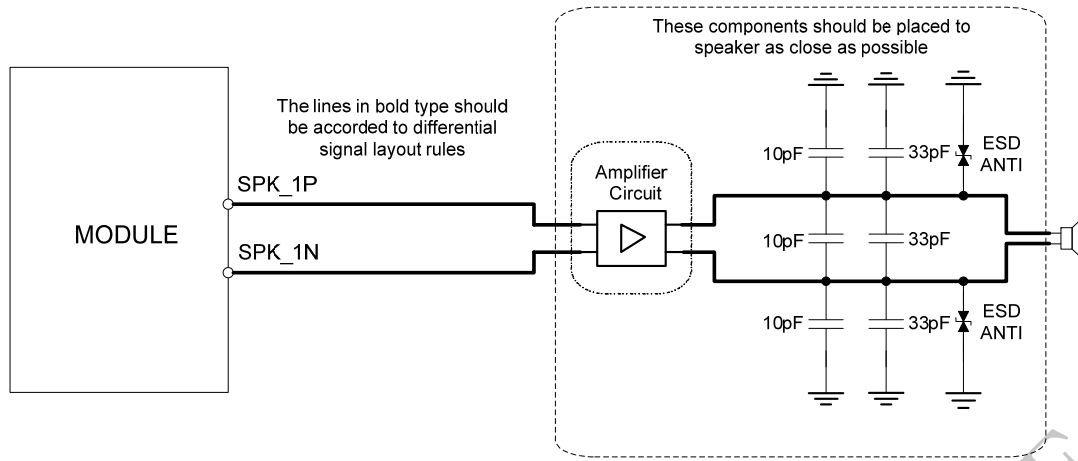


Figure 22: Speaker with amplifier reference circuit

4.6.2 Microphone Interfaces Configuration

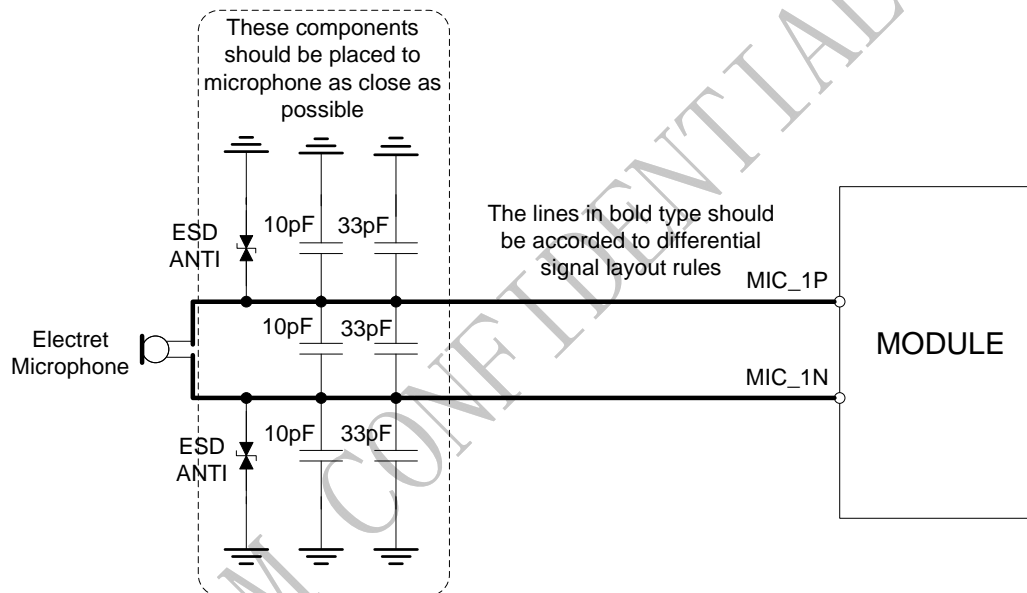


Figure 23 : Microphone reference circuit

Microphone input also could be used to LINE-IN input. For details, please refer to *document [6]*.

4.6.3 Earphone Interface Configuration

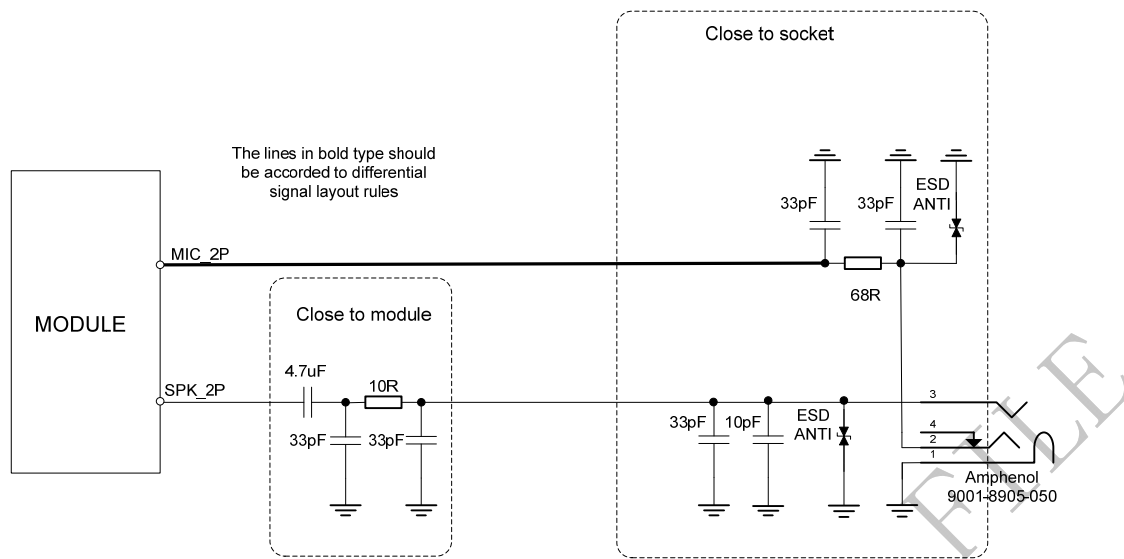


Figure 24: Earphone reference circuit

4.6.4 Audio Electronic Characteristics

Table 6: Microphone 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		kΩ
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

Table 7: Audio Output Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Normal Output (SPK)	RL=32Ω, THD=0.1%	-	91	-	mW
	RL=32Ω, THD=1%	-	96	-	mW
	Output swing voltage (single ended)			1.1	Vpp
	Output swing voltage (differential)			2.2	Vpp

4.7 SIM Card Interface

4.7.1 SIM Card Application

SIM900-DS provides two SIM card interfaces. The interface complies with the GSM Phase 1 specification and the new GSM Phase 2+ specification for FAST 64 kbps SIM card. Both 1.8V and 3.0V SIM card are supported. The SIM interface is powered from an internal regulator in the module.

It is recommended to use an ESD protection component such as ST (www.st.com) ESDA6V1W5 or ON SEMI (www.onsemi.com) SMF05C. The pull up resistors (15K Ω) on the SIM1_DATA and SIM2_DATA line are already added in the module internal. Note that the SIM peripheral circuit should be close to the SIM card socket. The reference circuit of the 8-pin SIM card holder is illustrated in the following figure.

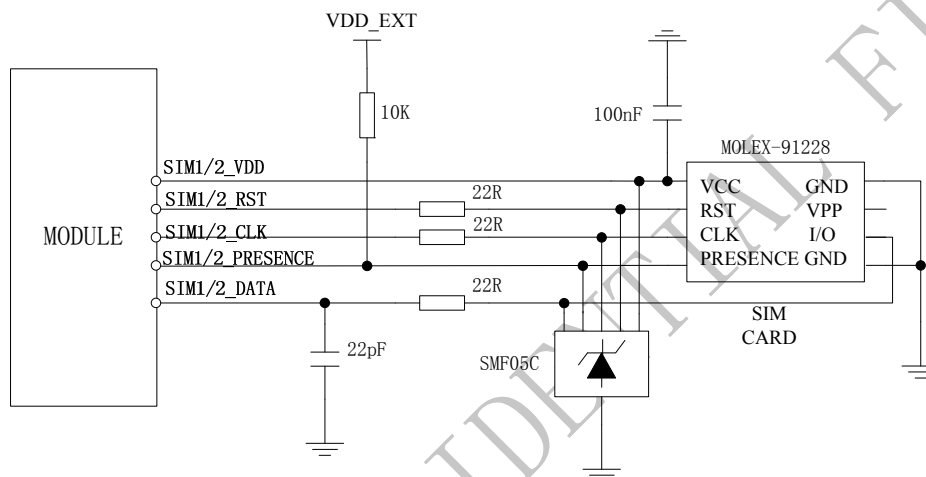


Figure 25: Reference circuit of the 8-pin SIM card holder

The SIM_PRESENCE pin is used for detection of the SIM card hot plug in. User 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, user can keep the SIM_PRESENCE pin open. The reference circuit of 6-pin SIM card holder is illustrated in the following figure.

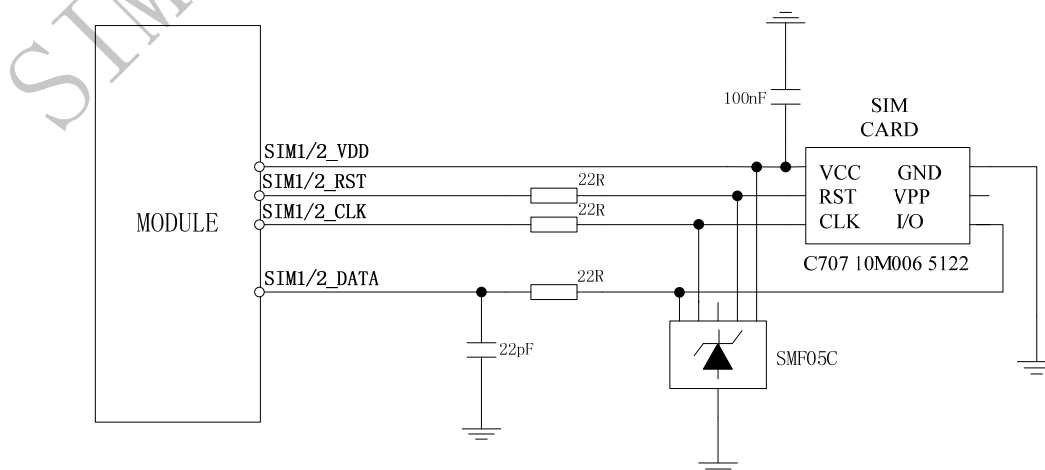


Figure 26: Reference circuit of the 6-pin SIM card holder

4.7.2 Design Considerations for SIM Card Holder

For 6-pin SIM card holder, SIMCom recommends to use Amphenol C707 10M006 5122 .User can visit <http://www.amphenol.com> for more information about the holder.

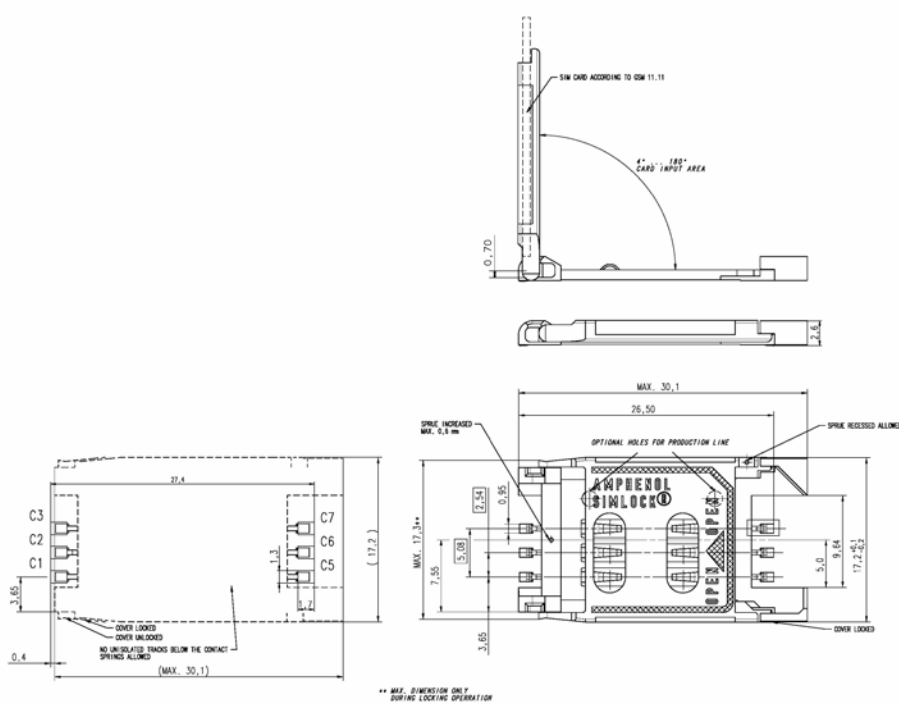


Figure 27: Amphenol C707 10M006 5122 SIM card holder

Table 8: 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

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

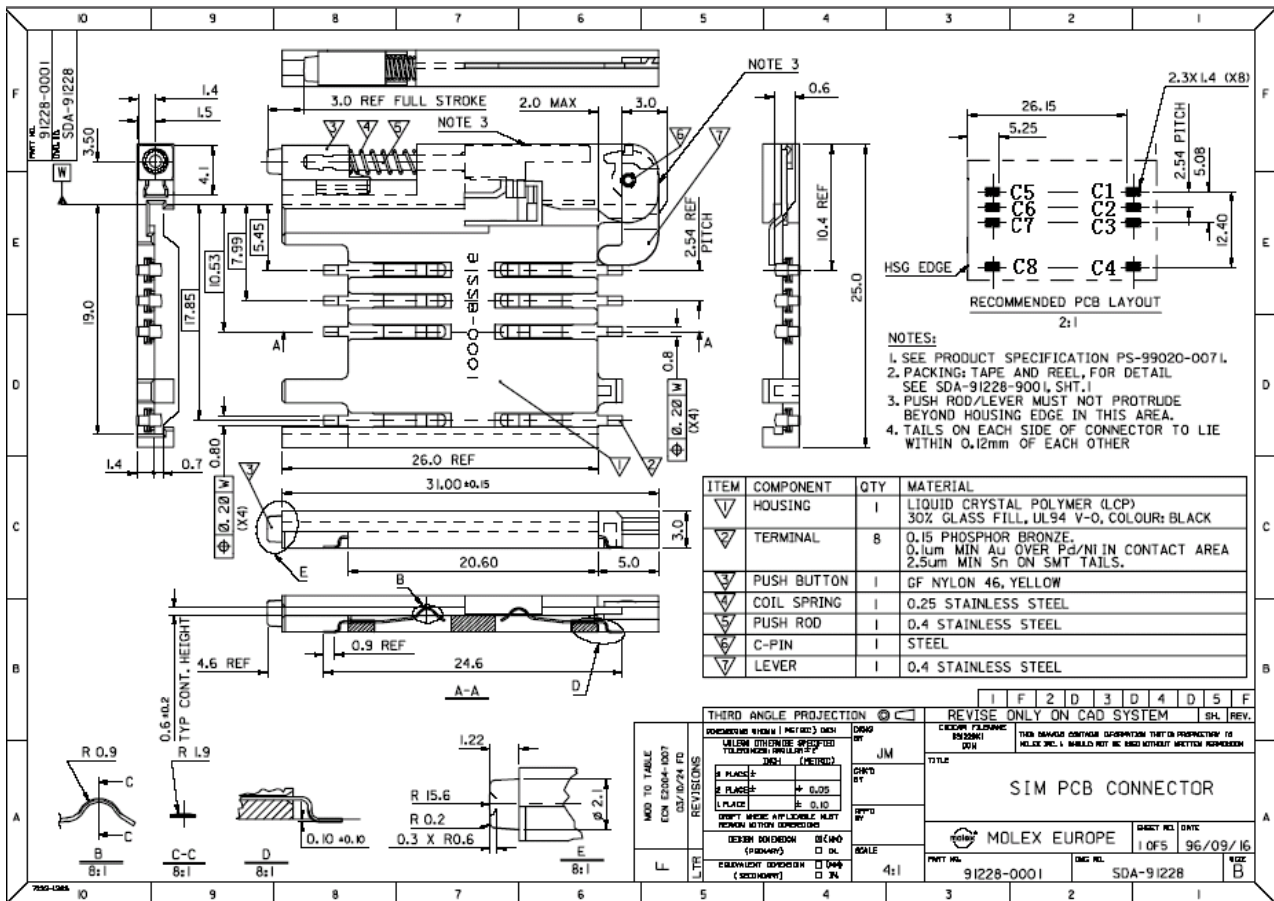


Figure 28: Molex 91228 SIM card holder

Table 9: 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_PRESENCE	Detect SIM card presence

4.8 LCD Display/SPI Interface

SIM900-DS provides a serial LCD display interface. It could also be used as SPI interface in the embedded AT application. For details about embedded AT application, please refer to *document [7]*.

Note: This function is not supported in the standard firmware. If user wants this function, the firmware must be customized. Please contact SIMCom for more details.

4.9 PCM Interface

SIM900-DS provides PCM interface, which can communicate with external digital audio interface, such as BT, CODEC. This interface only supports master mode.

The PCM interface provides a FIFO to handle the difference in clock rates to effectively decouple the two interfaces to ensure no data is lost.

PCM interface features include the following:

- Full duplex operation
- 8 or 16-bit selectable PCM data word length
- Configurable PCM bit clock rate of up to 1 MHz
- LSB or MSB first serial data configuration

4.10 ADC

SIM900-DS provides an auxiliary ADC, which can be used to measure the voltage. User can use AT command “AT+CADC” to read the voltage value. For details of this AT command, please refer to *document [1]*.

Table 10: ADC specification

Parameter	Min	Typ	Max	Unit
Voltage range	0	-	2.8	V
ADC Resolution	-	10	-	bits
Sampling rate	-	-	200K	Hz

4.11 RI Behaviors

Table 11: 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
Data 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.
URC	The pin is changed to low, and kept low for 120ms when some URCs are reported. Then it is changed to high. For more details, please refer to <i>document [8]</i> .

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

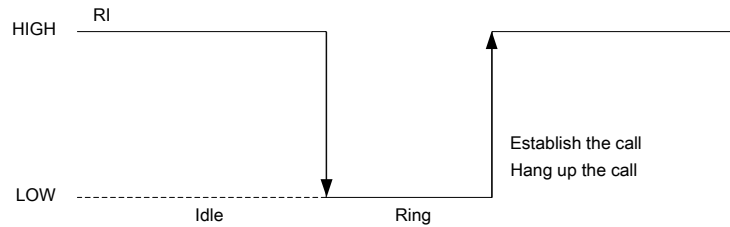


Figure 29: RI behaviour of voice calling as a receiver

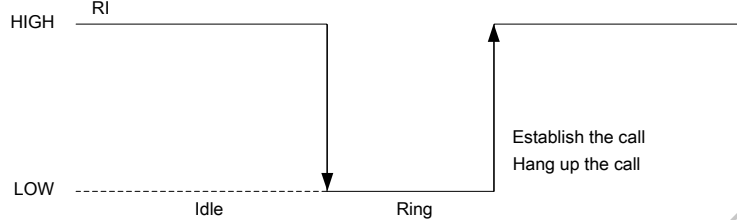


Figure 30: RI behaviour of data calling as a receiver

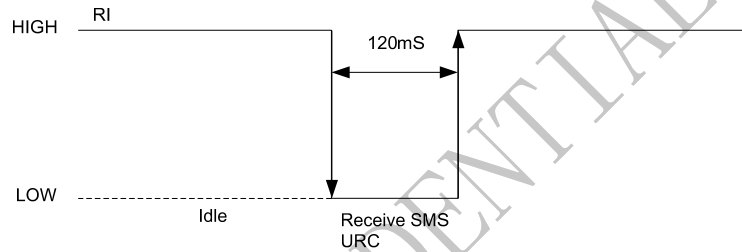


Figure 31: RI behaviour of URC or receive SMS

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

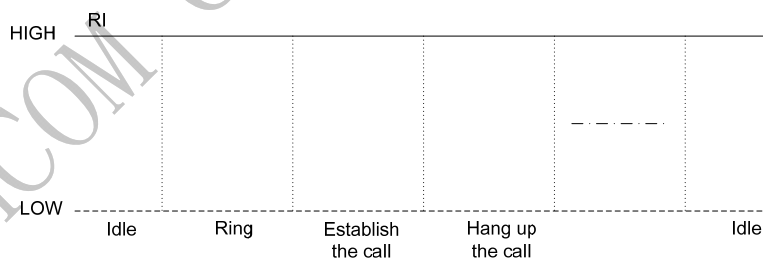


Figure 32: RI behaviour as a caller

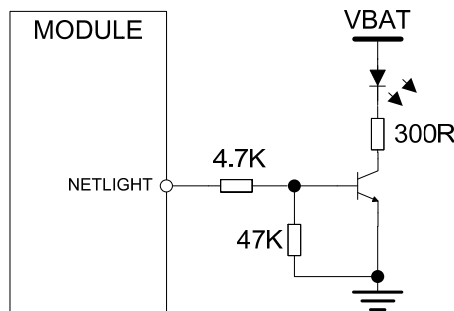
4.12 Network Status Indication

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

Table 12: Status of the NETLIGHT pin

Status	SIM900-DS behavior
Off	SIM900-DS is not running
64ms On/ 800ms Off	SIM900-DS not registered the network
64ms On/ 3000ms Off	SIM900-DS registered to the network
64ms On/ 300ms Off	GPRS communication is established

A reference circuit is recommended in the following figure:


Figure33: Reference circuit of NETLIGHT

4.13 General Purpose Input/Output (GPIO)

SIM900-DS provides up to 4 GPIO pins and 1 GPO pin. The output voltage level of the GPIO can be set by the AT command “AT+ SGPIO”. The input voltage level of the GPIO can also be read by the AT command “AT+ SGPIO”. For more details, please refer to *document [1]*.

Table 13: Pin definition of the GPIO interface

Pin name	Pin number	Default function	Default state
GPIO1	40	GPIO1	Output, pull down
GPIO2	41	GPIO2	Output, pull down
GPIO3	42	GPIO3	Output, pull down
GPIO4	43	GPIO4	Output, pull down
GPO1	44	GPO1	Output, pull down

4.14 External Reset

The external NRESET pin is used to reset the module. This function is used as an emergency reset only when AT command “AT+CPOWD=1” and the PWRKEY pin have no effect. The NRESET pin could be pulled down to reset the module. The reset timing is illustrated in the following figure.

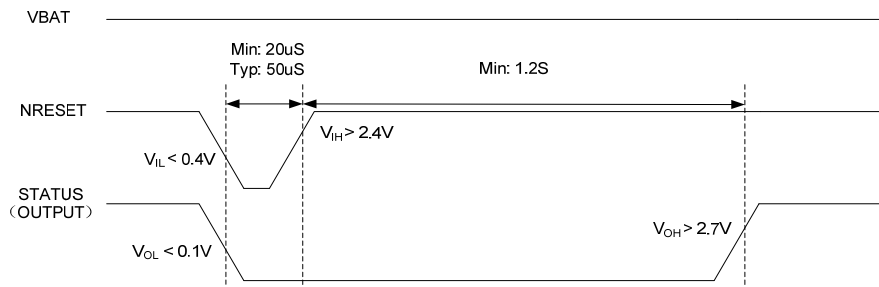


Figure 34: Reset timing

This pin is already pulled up in the module, so the external pull-up resistor is not necessary. A 100nF capacitor close to the NRESET pin is strongly recommended. A reference circuit is shown in the following figure.

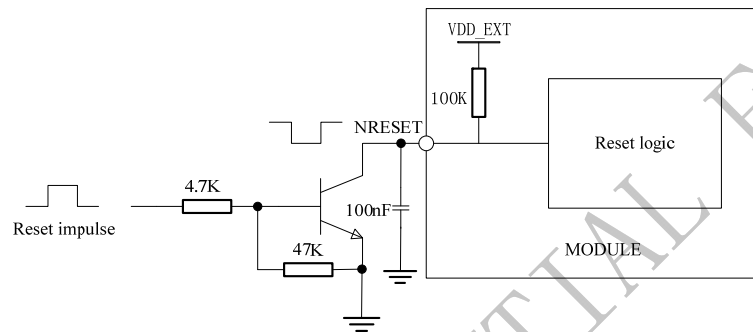


Figure 35: Reset reference design circuit

NOTE: It is recommended to cut off the VBAT power supply directly instead of using external reset pin when SIM900-DS can not respond to the AT command “AT+CPOWD=1” and PWRKEY pin.

4.15 I²C Bus

The SIM900-DS provides an I²C interface which is only used in the embedded AT application.

Note: This function is not supported in the standard firmware. If user wants this function, the firmware must be customized. Please contact SIMCom for more details.

4.16 Antenna Interface

SIM900-DS provides a RF antenna interface. The 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 impedance must be controlled in 50Ω. To facilitate the antenna tuning and certification test, a RF connector and an antenna matching circuit should be added. The following figure is the recommended circuit.

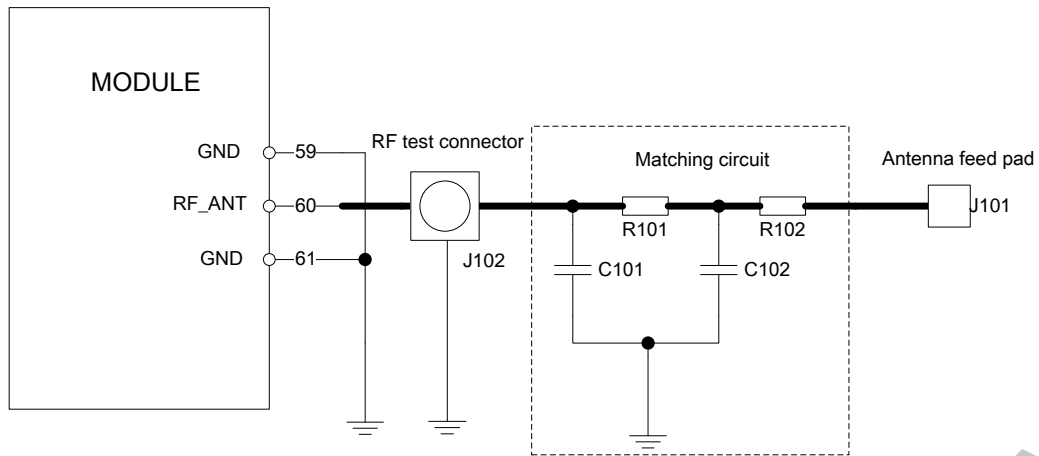


Figure 36: Antenna matching circuit

In this figure, the components R101, R102, C101 and C102 is used for antenna matching, the components' value only can be got after the antenna tuning. Usually, matching components' value is provided by antenna vendor, the default value of R101 and R102 are 0Ω , and reserve the place of C101 and C102 without soldering.

The RF test connector in above figure is used for conducted RF performance test, and should be placed as close as possible to the module's RF_ANT pin. The traces in bold type should be treated as 50Ω impedance controlled line in PCB layout. For details about radio frequency trace layout, please refer to *document [9]*.

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5 Electrical, Reliability and Radio Characteristics

5.1 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 SIM900-DS.

Table 14: Absolute maximum ratings

Symbol	Parameter	Min	Typ	Max	Unit
V _{BAT}	Power supply voltage	-	-	5.5	V
V _I *	Input voltage	-0.3	-	3.1	V
I _I *	Input current	-	-	10	mA
I _O *	Output current	-	-	10	mA

* These parameters are for digital interface pins, such as keypad, GPIO, I²C, UART, LCD, PWMs and DEBUG.

5.2 Recommended Operating Conditions

Table 15: Recommended operating conditions

Symbol	Parameter	Min	Typ	Max	Unit
V _{BAT}	Power supply voltage	3.2	4.0	4.8	V
T _{OPER}	Operating temperature	-40	+25	+85	°C
T _{STG}	Storage temperature	-45		+90	°C

5.3 Digital Interface Characteristics

Table 16: Digital interface characteristics

Symbol	Parameter	Min	Typ	Max	Unit
I _{IH}	High-level input current	-10	-	10	uA
I _{IL}	Low-level input current	-10	-	10	uA
V _{IH}	High-level input voltage	2.4	-	-	V
V _{IL}	Low-level input voltage	-	-	0.4	V
V _{OH}	High-level output voltage	2.7	-	-	V
V _{OL}	Low-level output voltage	-	-	0.1	V

* These parameters are for digital interface pins, such as keypad, GPIO, I²C, UART, LCD, PWMs and DEBUG.

5.4 SIM Card Interface Characteristics

Table 17: SIM card interface characteristics

Symbol	Parameter	Min	Typ	Max	Unit
I _{IH}	High-level input current	-10	-	10	uA
I _{IL}	Low-level input current	-10	-	10	uA
V _{IH}	High-level input voltage	1.4	-	-	V
		2.4	-	-	V
V _{IL}	Low-level input voltage	-	-	0.4	V
		-	-	2.4	V
V _{OH}	High-level output voltage	1.7	-	-	V
		2.7	-	-	V
V _{OL}	Low-level output voltage	-	-	0.1	V
		-	-	0.1	V

5.5 VDD_EXT Characteristics

Table 18: VDD_EXT characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V _O	Output voltage	2.70	2.80	2.95	V
I _O	Output current	-	-	10	mA

5.6 SIM1_VDD and SIM2_VDD Characteristics

Table 19: SIM1_VDD and SIM2_VDD characteristics

Symbol	Parameter	Min	Typ	Max	Unit
SIM1_VDD , SIM2_VDD	Output voltage	2.75	2.9	3.00	V
		1.65	1.80	1.95	
I _O	Output current	-	-	10	mA

5.7 VRTC Characteristics

Table 20: VRTC characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V _{RTC-IN}	VRTC input voltage	2.00	3.00	3.15	V
I _{RTC-IN}	VRTC input current	-	2	-	uA
V _{RTC-OUT}	VRTC output voltage	-	3.00	-	V
I _{RTC-OUT}	VRTC output current	-	10	-	uA

5.8 Current Consumption (VBAT = 3.8V)

Table 21: Current consumption*

Symbol	Parameter	Conditions	Value	Unit						
I _{VRTC}	VRTC current	VBAT disconnects. Backup battery is 3 V	2	uA						
I _{VBAT}	VBAT current	Power down mode	30	uA						
		SIM card1 and SIM card2 dual-standby	Sleep mode	BS-PA-MFRMS=9	1.5	mA				
				BS-PA-MFRMS=5	1.9					
				BS-PA-MFRMS=2	2.5					
		SIM card1 and SIM card2 dual-standby	Idle mode	GSM850	23	mA				
				EGSM900						
				DCS1800						
				PCS1900						
		SIM card1 or SIM card2 operates	Voice call	GSM850 EGSM900	PCL=5	250	mA			
					PCL=12	107				
					PCL=19	80				
				DCS1800 PCS1900	PCL=0	185				
					PCL=7	92				
					PCL=15	74				
				SIM card1 or SIM card2 operates	Data mode GPRS(4Rx,1 Tx)	GSM850 EGSM900		PCL=5	273	mA
								PCL=12	134	
		PCL=19	110							
		DCS1800 PCS1900	PCL=0			213	mA			
			PCL=7			123				
			PCL=15			107				
		SIM card1 or SIM card2 operates	Data mode GPRS(3Rx,2 Tx)	GSM850 EGSM900	PCL=5	445	mA			
					PCL=12	176				
					PCL=19	122				
				DCS1800 PCS1900	PCL=0	305	mA			
PCL=7	147									
PCL=15	115									
SIM card1 or SIM card2 operates	Data mode GPRS(1Rx,1 Tx)	GSM850 EGSM900	PCL=5	236	mA					
			PCL=12	100						
			PCL=19	73						

				DCS1800	PCL=0	167	mA
				PCS1900	PCL=7	85	
					PCL=15	68	
I _{VBAT-peak}	Peak current	During Tx burst				2	A

* 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.

5.9 Electro-Static Discharge

SIM900-DS is an ESD sensitive component, so more attention should be paid to the procedure of handling and packaging. The ESD test results are shown in the following table.

Table 22: The ESD characteristics (Temperature: 25°C, Humidity: 45 %)

Pin	Contact discharge	Air discharge
VBAT	±5KV	±10KV
GND	±4KV	±10KV
RXD, TXD	±3KV	±6KV
Antenna port	±5KV	±10KV
SPK1_P/ SPK1_N/SPK2_P MIC1_P/ MIC1_N/ MIC2_P	±2KV	±6KV
PWRKEY	±1KV	±6KV

5.10 Radio Characteristics

5.10.1 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 23: SIM900-DS GSM850 and EGSM900 conducted RF output power

GSM850 and EGSM900			
PCL	Nominal output power (dBm)	Tolerance (dB) for conditions	
		Normal	Extreme
0-2	39	±2	±2.5
3	37	±3	±4
4	35	±3	±4
5	33	±3	±4
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 24: SIM900-DS DCS1800 and PCS1900 conducted RF output power

DCS1800 and PCS1900			
PCL	Nominal output power (dBm)	Tolerance (dB) for conditions	
		Normal	Extreme
29	36	±2	±2.5
30	34	±3	±4
31	32	±3	±4
0	30	±3	±4
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
15-28	0	±5	±6

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

At GSM850 and EGSM900 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.

5.10.2 Module RF Receive Sensitivity

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

Table 25: SIM900-DS conducted RF receive sensitivity

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

5.10.3 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 26: SIM900-DS 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

6 Manufacturing

6.1 Top and Bottom View of SIM900-DS



Figure 37: Top and bottom view of SIM900-DS

Note: These test points are only used for module manufacturing and testing. They are not for customer using.

The following figure marked the information of SIM900-DS module.



Figure 38: Module information

Table 27: Illustration of module information

Item	Description
A	Logo of SIMCom
B	Module name
C	Module part number
D	Module serial number and bar code
E	Module IMEI1 and bar code
F	Module IMEI2 and bar code

6.2 Typical Solder Reflow Profile

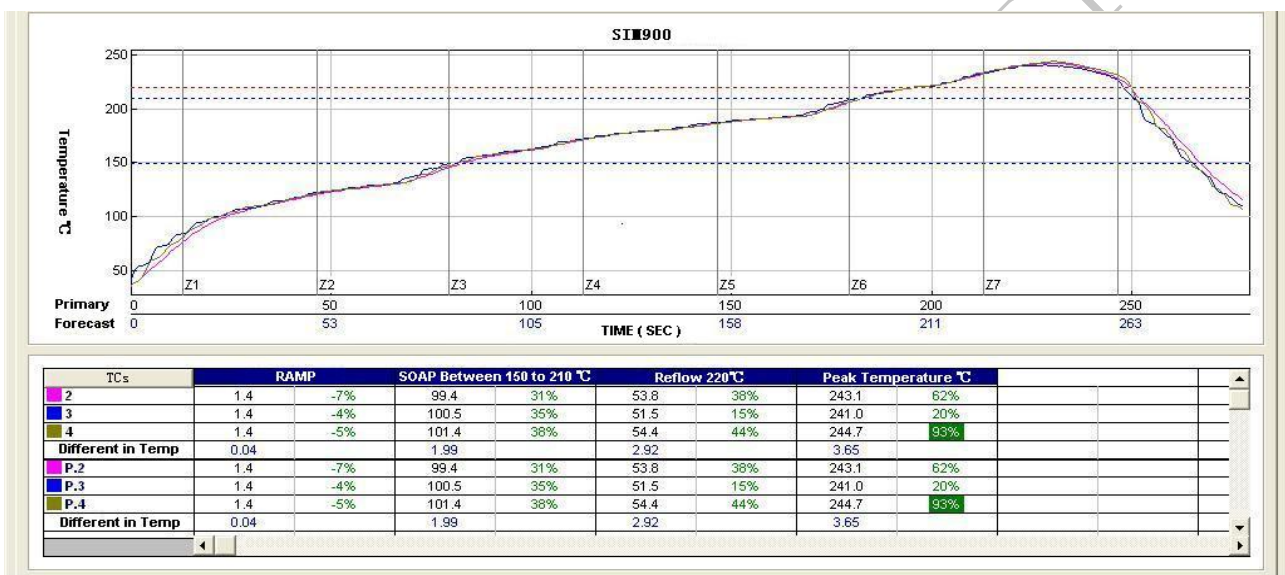


Figure 39: Typical Solder Reflow Profile

For details about secondary SMT, please refer to *document [10]*.

Appendix

A. Related Documents

Table 28: Related documents

SN	Document name	Remark
[1]	SIM900-DS_Application Note	SIM900-DS Application Note
[2]	AN_SIM900_TCPIP	TCP/IP Applications User Manual
[3]	SIM900_Multiplexer User Manual_Application Note	SIM900 Multiplexer User Manual Application Note
[4]	AN_SIM900 Series_Update Tool_UGD	SIM900 Series Update Tool User Guide
[5]	SIM900_Embedded AT Application Note	SIM900 Embedded AT Application Note
[6]	AN_Serial Port	Application Note About Serial Port
[7]	AN_SIM900-TE PCB Layout & Schematic for Reference	Application Note About SIM900-TE PCB Layout & Schematic
[8]	Module secondary-SMT-UGD	Module secondary SMT User Guide
[9]	ITU-T Draft new recommendation V.25ter:	Serial asynchronous automatic dialing and control
[10]	GSM 07.07:	Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)
[11]	GSM 07.10:	Support GSM 07.10 multiplexing protocol
[12]	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)
[13]	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
[14]	GSM 11.11:	Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[15]	GSM 03.38:	Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information
[16]	GSM 11.10	Digital cellular telecommunications system (Phase 2); Mobile Station (MS) conformance specification; Part 1: Conformance specification

B. Terms and Abbreviations







Table 29: Terms and Abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
AMR	Adaptive Multi-Rate
CS	Coding Scheme
CSD	Circuit Switched Data
CTS	Clear to Send
DTE	Data Terminal Equipment (typically computer, terminal, printer)
DTR	Data Terminal Ready
DTX	Discontinuous Transmission
DS	Dual SIM
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
IMEI	International Mobile Equipment Identity
Li-ion	Lithium-Ion
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)
RTC	Real Time Clock
RX	Receive Direction
SIM	Subscriber Identification Module
SMS	Short Message Service
TE	Terminal Equipment, also referred to as DTE
TX	Transmit Direction

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

C. Safety Caution

Table 30: 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.

Contact us:

Shanghai SIMCom Wireless Solutions Ltd.

Add: SIM Technology Building, No.633, Jinzhong Road, Changning District, Shanghai P.R. China
200335

Tel: +86 21 3235 3300

Fax: +86 21 3235 3301

URL: www.sim.com/wm

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