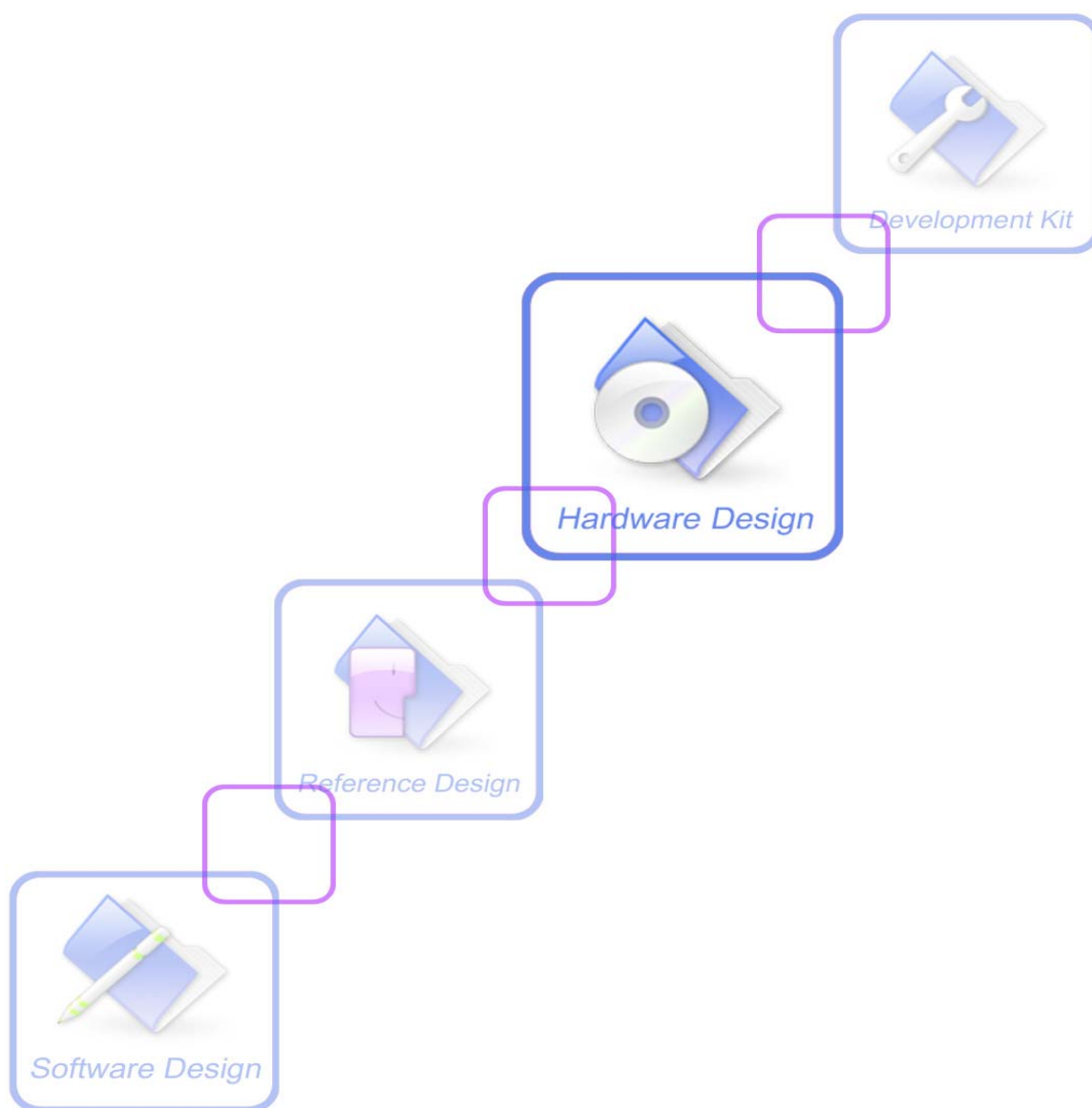




A company of SIM Tech

## SIM908\_Hardware Design\_V1.05



|                            |                              |
|----------------------------|------------------------------|
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## Version History

| Date       | Version | Description of change                                 | Author      |
|------------|---------|---|-------------|
| 2011-06-28 | 1.00    | Origin  | LiGang      |
| 2011-08-26 | 1.01    | Correct the NC pins;<br>Correct the name of table 19; | Ma Honggang |
| 2011-08-29 | 1.02    | Modify antenna design guide                           | Ye haibing  |
| 2011-09-02 | 1.03    | Correct the figure 21                                 | MA Honggang |
| 2011-09-09 | 1.04    | Add NC PIN53  | MA Honggang |
| 2011-09-22 | 1.05    | Correct the pin44 name in figure 2                    | MA Honggang |

SIMCOM CONFIDENTIAL FILE

## 1 Introduction

This document describes SIM908 hardware interface in great detail.

This document can help user to quickly understand SIM908 interface specifications, electrical and mechanical details. With the help of this document and other SIM908 application notes, user guide, users can use SIM908 to design various applications quickly.

## 2 SIM908 Overview

Designed for global market, SIM908 is integrated with a high performance GSM/GPRS engine and a GPS engine. The GSM/GPRS engine is a quad-band GSM/GPRS module that works on frequencies GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz. SIM908 features GPRS multi-slot class 10/ class 8 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4. The GPS solution offers best- in-class acquisition and tracing sensitivity, Time-To-First-Fix (TTFF) and accuracy.

With a tiny configuration of 30\*30\*3.2mm, SIM908 can meet almost all the space requirements in user applications, such as M2M, smart phone, PDA, tracker and other mobile devices.

SIM908 has 80 SMT pads, and provides all hardware interfaces between the module and customers' boards.

- Serial port and debug port can help user easily develop user's applications.
- GPS Serial port.
- Two audio channels include two audio inputs and two audio outputs. These can be easily configured by AT command.
- Charging interface.
- Programmable general purpose input and output.
- The keypad and SPI display interfaces will give users the flexibility to develop customized applications.
- RF pad and connector interface.

SIM908 is designed with power saving technique so that the current consumption is as low as 1.0mA in sleep mode (GPS engine is powered down).

SIM908 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 SIM908 Key Features

**Table 1: SIM908 GSM/GPRS engine key features**

| Feature         | Implementation   |
|-----------------|--|
| Power supply    | 3.2V ~ 4.8V  |
| Power saving    | Typical power consumption in sleep mode is 1.0mA ( BS-PA-MFRMS=9, GPS engine is powered down ) |
| Charging        | Supports charging control for Li-Ion battery   |
| Frequency bands | ● SIM908 Quad-band: GSM 850, EGSM 900, DCS 1800, PCS 1900. SIM908                              |



|                            |  |
|----------------------------|--|
|                            | <p>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>.</p> <ul style="list-style-type: none"> <li>● Compliant to GSM Phase 2/2+</li> </ul>   |
| Transmitting power         | <ul style="list-style-type: none"> <li>● Class 4 (2W) at GSM 850 and EGSM 900</li> <li>● Class 1 (1W) at DCS 1800 and PCS 1900</li> </ul>  |
| GPRS connectivity          | <ul style="list-style-type: none"> <li>● GPRS multi-slot class 10 ( default )</li> <li>● GPRS multi-slot class 8 (option)</li> </ul>   |
| Temperature range          | <ul style="list-style-type: none"> <li>● Normal operation: -30°C ~ +80°C</li> <li>● Restricted operation: -40°C ~ -30°C and +80 °C ~ +85°C*</li> <li>● Storage temperature -45°C ~ +90°C</li> </ul>  |
| Data GPRS                  | <ul style="list-style-type: none"> <li>● GPRS data downlink transfer: max. 85.6 kbps</li> <li>● GPRS data uplink transfer: max. 42.8 kbps</li> <li>● Coding scheme: CS-1, CS-2, CS-3 and CS-4</li> <li>● Integrate the TCP/IP protocol.</li> <li>● Support Packet Broadcast Control Channel (PBCCH)</li> </ul>   |
| CSD                        | <ul style="list-style-type: none"> <li>● Support CSD transmission</li> </ul>   |
| USSD                       | <ul style="list-style-type: none"> <li>● Unstructured Supplementary Services Data (USSD) support</li> </ul>  |
| SMS                        | <ul style="list-style-type: none"> <li>● MT, MO, CB, Text and PDU mode</li> <li>● SMS storage: SIM card</li> </ul>   |
| 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"> <li>● Half Rate (ETS 06.20)</li> <li>● Full Rate (ETS 06.10)</li> <li>● Enhanced Full Rate (ETS 06.50 / 06.60 / 06.80)</li> <li>● Adaptive multi rate (AMR)</li> <li>● Echo Cancellation</li> <li>● Noise Suppression</li> </ul>   |
| Serial port and debug port | <p><b>Serial port:</b></p> <ul style="list-style-type: none"> <li>● Full modem interface with status and control lines, unbalanced, asynchronous.</li> <li>● 1200bps to 115200bps.</li> <li>● Can be used for AT commands or data stream.</li> <li>● Support RTS/CTS hardware handshake and software ON/OFF flow control.</li> <li>● Multiplex ability according to GSM 07.10 Multiplexer Protocol.</li> <li>● Autobauding supports baud rate from 1200 bps to 57600bps.</li> </ul> <p><b>Debug port:</b></p> <ul style="list-style-type: none"> <li>● Null modem interface GPS/DBG_TXD and GPS/DBG_RXD.</li> <li>● Can be used for debugging and upgrading firmware.</li> </ul> |
| 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: 30*30*3.2mm</p> <p>Weight: 5.2g</p>   |

Firmware upgrade

Firmware upgradeable by debug port.

\* SIM908 does work at this temperature, but some radio frequency characteristics may deviate from the GSM specification.

**Table 2: GPS engine Performance**

| Parameter                                   | Description               | Performance |      |       |      |
|---|---------------------------|-------------|------|-------|------|
|   |                           | Min         | Typ  | Max   | Unit |
| Horizontal Position Accuracy <sup>(a)</sup> | Autonomous                |             | 2.5  |       | m    |
| Velocity Accuracy <sup>(b)</sup>            | Speed                     | -           | 0.01 | -     | m/s  |
|   | Heading                   | -           | 0.01 | -     | °    |
| Time To First Fix <sup>(c)</sup>            | Hot start                 | -           | 1    | -     | s    |
|   | Cold start                | -           | 30   | -     | s    |
| Sensitivity                                 | Autonomous acquisition    |             | -143 |       | dBm  |
|   | Tracking                  |             | -160 |       | dBm  |
| Receiver                                    | Channels                  |             | 42   |       |      |
|   | Update rate               |             | 1    |       | Hz   |
|   | Altitude                  |             |      | 18288 | km   |
|   | Velocity                  |             |      | 1850  | km/h |
|   | Tracking L1, CA Code      |             |      |       |      |
|   | Protocol support NMEA,OSP |             |      |       |      |
| Power consumption <sup>(d)</sup>            | Continuous tracking       |             | 76   |       | mA   |
|   | acquisition               |             | 77   |       |      |
|   | Power down current        |             | 0.03 |       | uA   |

**Table 3: 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 SIM908.

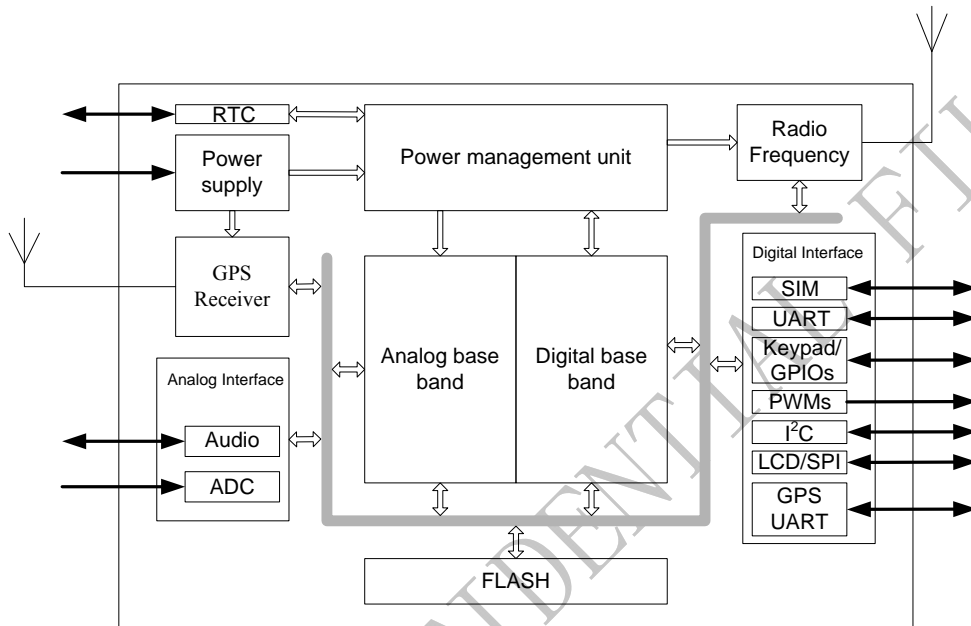
**Table 4: Overview of operating modes**

| 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).<br>In this case, the current consumption of module will reduce to the minimal level.<br>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. |   |
| Charge-only mode                    | The module will enter Charge-only mode automatically when a charger and battery are connected to a switched-off SIM908. In this mode, the module does not search for network and has limited access to available AT commands available. The module can also enter Charge-only mode from Charge mode during normal operation by normally powered down 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 when battery voltage is not lower than 3.2V. Normal operation mode includes: SLEEP, IDLE, TALK, GPRS IDLE and GPRS DATA.  |   |

## 2.3 SIM908 Functional Diagram

The following figure shows a functional diagram of SIM908:

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



**Figure 1: SIM908 functional diagram**

### 3 Package Information

#### 3.1 Pin out Diagram

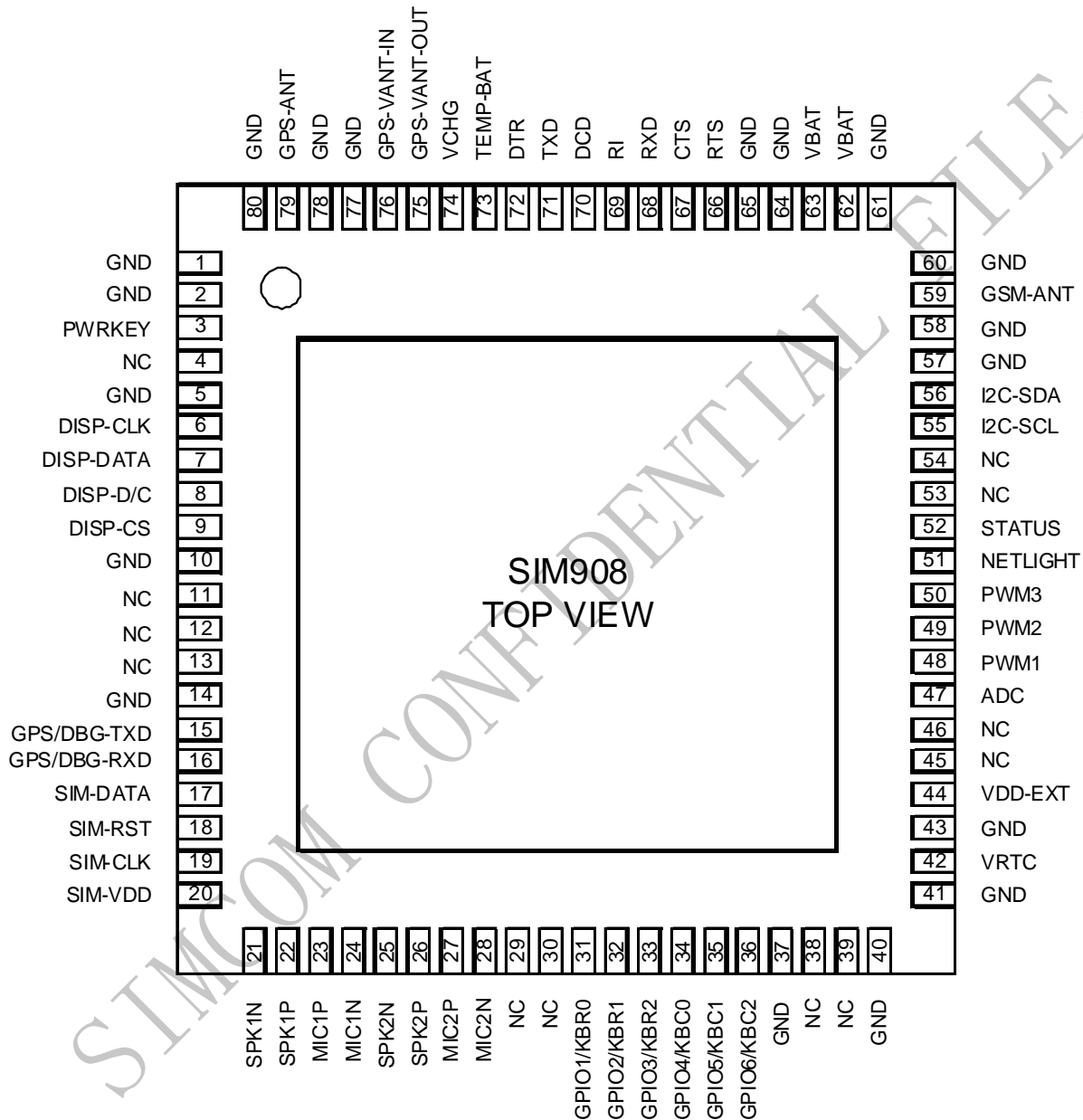


Figure 2: SIM908 pin out diagram (Top view)

## 3.2 Pin Description

**Table 5: Pin description**

| Pin name         | Pin number  | I/O | Description  | Comment  |
|------------------|---|-----|--|--|
| Power supply     |   |     |  |  |
| VBAT             | 62, 63  | I   | Power supply   | 3.2V ~ 4.8V  |
| VRTC             | 42  | I/O | Power supply for RTC   | It is recommended to connect with a battery or a capacitor (e.g. 4.7uF). |
| VDD-EXT          | 44  | O   | 2.8V output power supply   | If it is unused, keep open.  |
| GPS-VANT-OUT     | 75  | O   | 2.8V output for GPS active antenna   | If it is unused, keep open.  |
| GPS-VANT-IN      | 76  | I   | GPS active antenna power supply  | If it is unused, keep open.  |
| GND              | 1, 2, 5, 10, 14, 37, 40, 41, 43, 57, 58, 60, 61, 64, 65, 77, 78, 80 |     | Ground   |  |
| Charge interface |   |     |  |  |
| VCHG             | 74  | I   | Charger input  |  |
| TEMP_BAT         | 73  | I   | Battery temperature sensor   |  |
| Power on/down    |   |     |  |  |
| PWRKEY           | 3   | I   | PWRKEY should be pulled low at least 1 second and then released to power on/down the module. | Pulled up internally.  |
| Audio interfaces |   |     |  |  |
| MIC1P            | 23  | I   | Differential audio input   | If these pins are unused, keep open.                                     |
| MIC1N            | 24  |     |  |  |
| SPK1P            | 22  | O   | Differential audio output  |  |
| SPK1N            | 21  |     |  |  |
| MIC2P            | 27  | I   | Differential audio input   |  |
| MIC2N            | 28  |     |  |  |
| SPK2N            | 25  | O   | Differential audio output  |  |
| SPK2P            | 26  |     |  |  |
| Status           |   |     |  |  |
| STATUS           | 52  | O   | Power on status  | If these pins are unused, keep open.                                     |
| NETLIGHT         | 51  | O   | Network status   |  |
| LCD interface    |   |     |  |  |
| DISP -CLK        | 6   | O   | Display interface  | If these pins are unused, keep open.                                     |
| DISP-DATA        | 7   | I/O |  |  |
| DISP -D/C        | 8   | O   |  |  |
| DISP -CS         | 9   | O   |  |  |

| I <sup>2</sup> C interface    |                                    |     |  |   |
|-------------------------------|------------------------------------|-----|--|---|
| I2C-SDA                       | 56                                 | O   | I <sup>2</sup> C serial bus data                                   | If these pins are unused, keep open.  |
| I2C-SCL                       | 55                                 | I/O | I <sup>2</sup> C serial bus clock                                  |   |
| Keypad interface / GPIOs      |                                    |     |  |   |
| GPIO1/KBR0                    | 31                                 | I/O | GPIO1/keypad row 0   | If these pins are unused, keep open.  |
| GPIO2/KBR1                    | 32                                 |     | GPIO2/keypad row 1   |   |
| GPIO3/KBR2                    | 33                                 |     | GPIO3/keypad row 2   |   |
| GPIO4/KBC0                    | 34                                 |     | GPIO4/keypad column 0  |   |
| GPIO5/KBC1                    | 35                                 |     | GPIO5/keypad column 1  |   |
| GPIO6/KBC2                    | 36                                 |     | GPIO6/keypad column 3  |   |
| Serial port                   |                                    |     |  |   |
| RXD                           | 68                                 | I   | Receive data   | If only TXD and RXD are used, it is suggested to pull down DTR, and others pins can be kept open. |
| TXD                           | 71                                 | O   | Transmit data  |   |
| RTS                           | 66                                 | O   | Request to send  |   |
| CTS                           | 67                                 | I   | Clear to send  |   |
| DCD                           | 70                                 | O   | Data carrier detect  |   |
| RI                            | 69                                 | O   | Ring indicator   |   |
| DTR                           | 72                                 | I   | Data terminal ready  |   |
| GPS/Debug interface           |                                    |     |  |   |
| GPS/DBG-TXD                   | 15                                 | O   | For GPS NMEA information output , debugging and upgrading firmware | If these pins are unused, keep open.  |
| GPS/DBG-RXD                   | 16                                 | I   |  |   |
| SIM interface                 |                                    |     |  |   |
| SIM-VDD                       | 20                                 | 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.              |
| SIM-DATA                      | 17                                 | I/O | SIM data input/output  |   |
| SIM-CLK                       | 19                                 | O   | SIM clock  |   |
| SIM-RST                       | 18                                 | O   | SIM reset  |   |
| ADC                           |                                    |     |  |   |
| ADC                           | 47                                 | I   | Input voltage range: 0V ~ 2.8V                                     | If it is unused, keep open.   |
| Pulse width modulation( PWM ) |                                    |     |  |   |
| PWM1                          | 48                                 | O   | PWM  | If these pins are unused, keep open.  |
| PWM2                          | 49                                 | O   | PWM  |   |
| PWM3                          | 50                                 | O   | PWM  |   |
| GSM/GPS RF interface          |                                    |     |  |   |
| GSM-ANT                       | 59                                 | I/O | GSM radio antenna connection                                       | Impendence must be controlled to 50Ω.   |
| GPS-ANT                       | 79                                 | I   | GPS radio antenna connection                                       | Impendence must be controlled to 50Ω.   |
| Not connect                   |                                    |     |  |   |
| NC                            | 4,11,12,13,29,30,38,39,45,46,53,54 | -   |  | These pins should be kept open.   |

### 3.3 Package Dimensions

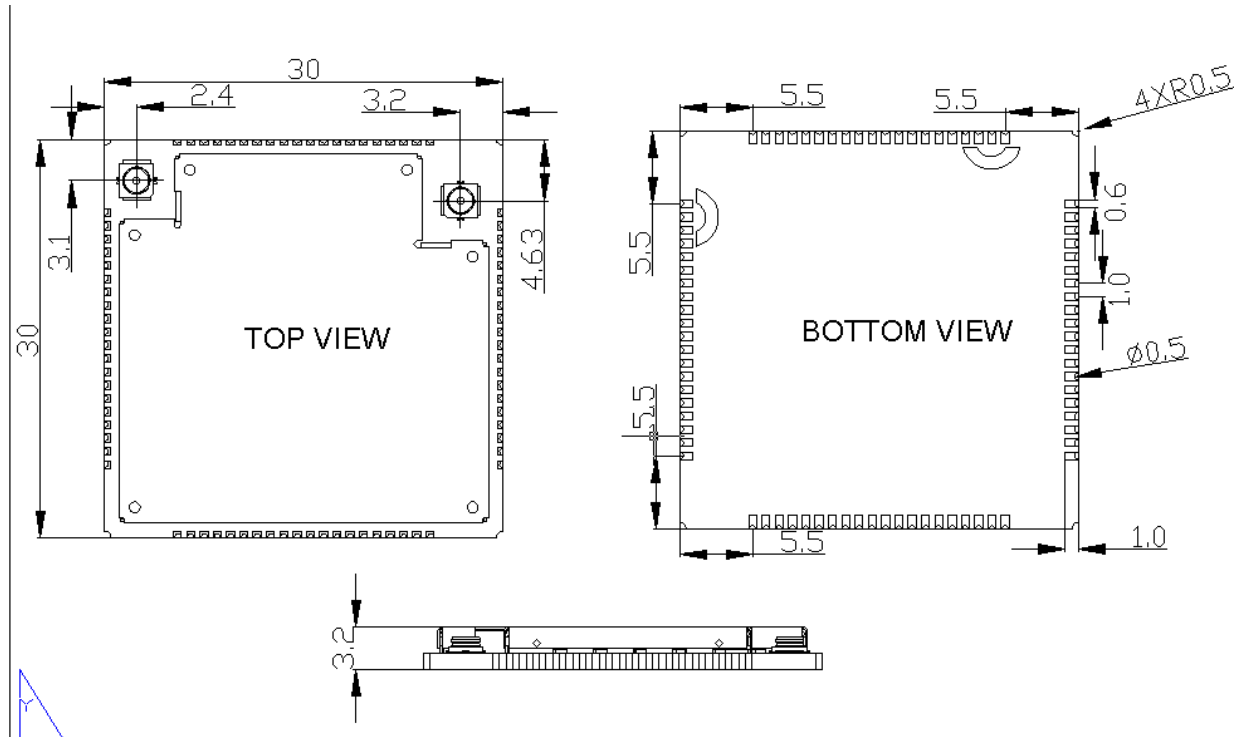


Figure 3: Dimensions of SIM908 (Unit: mm)

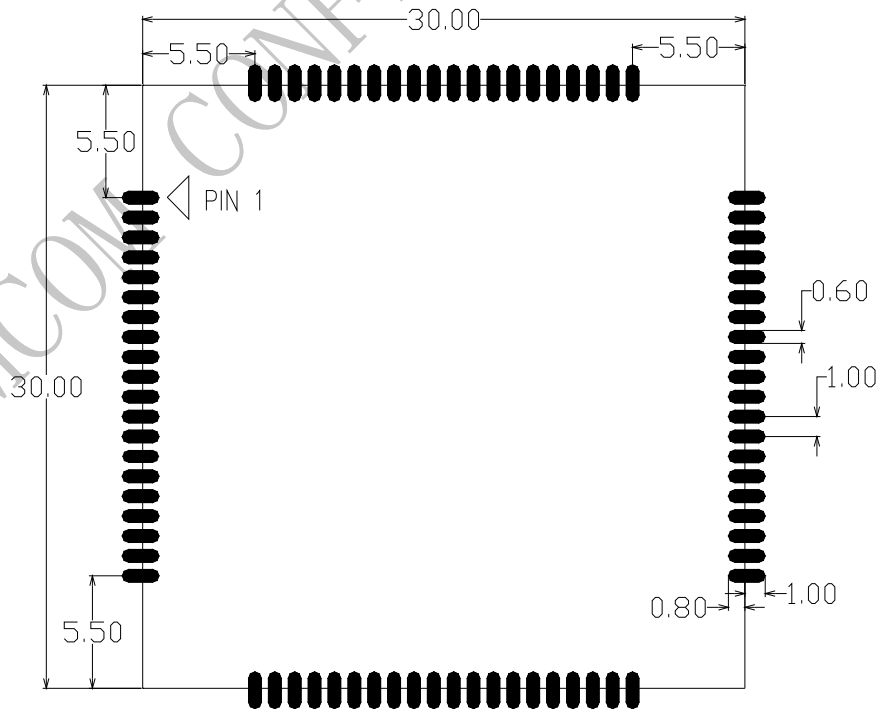


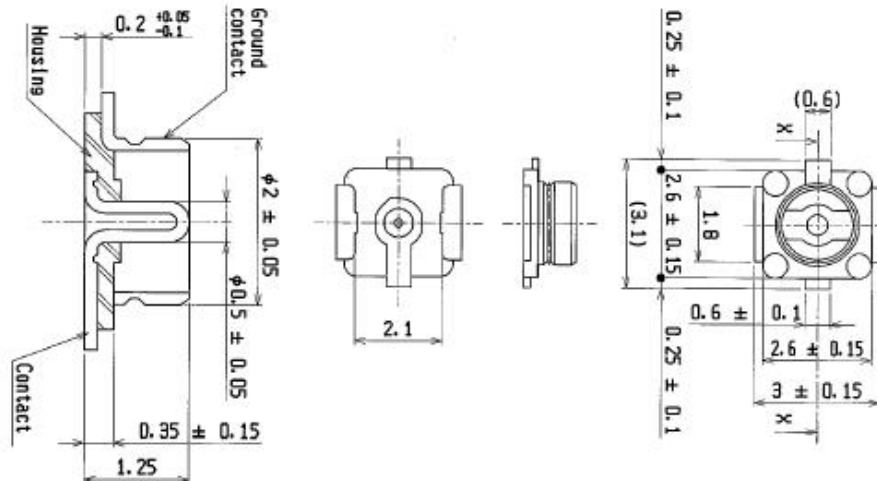
Figure 4: Recommended PCB footprint outline (Unit: mm)



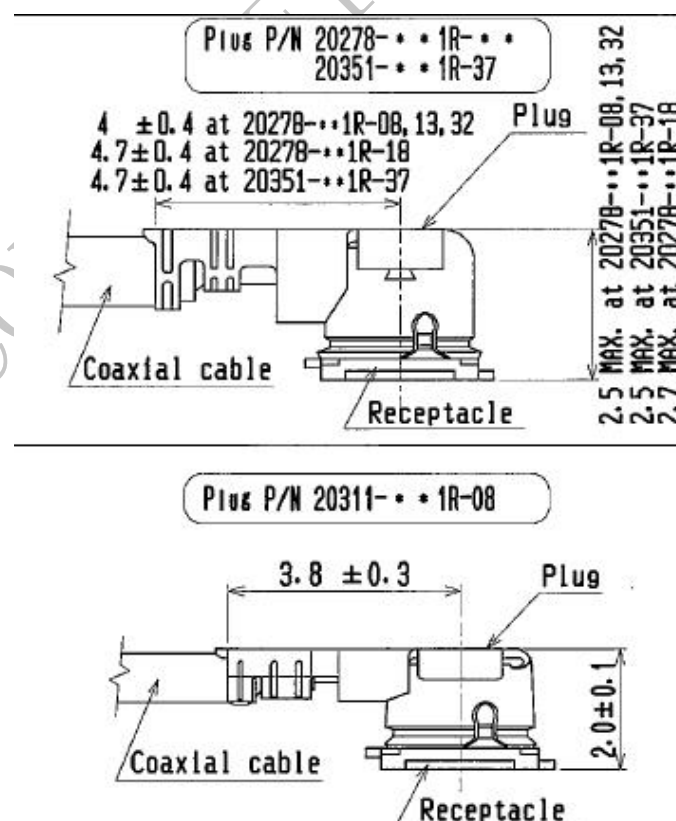
### 3.4 Mechanical Dimensions of the RF Connector

The RF connector in the module side is an ultra small surface mount coaxial connectors (Part Number: U.FL-R-SMT, vended by HRS). It has high performance with wide frequency range, surface mountable and reflows solderable. Following figure are the related parameters. Certainly user can visit <http://www.hirose-connectors.com/> for more information.

To get good RF performance in user's design, SIMCom suggests user to use the matching RF adapter cable which is also supplied by HRS (Part Number: U.FL-LP(V)-040), the following figure is the dimensions of U.FL series RF adapter cable. User can contact SIMCom for more information.



**Figure 5: U.FL-R-SMT (Unit:mm)**

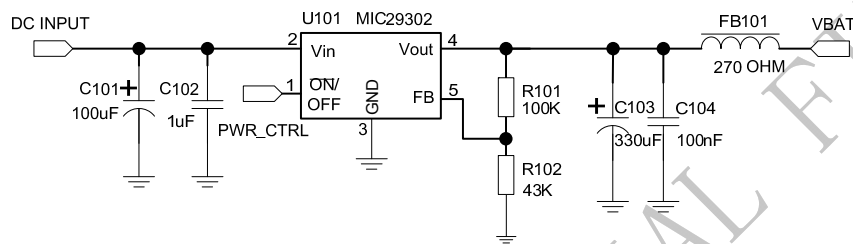


**Figure 6: U.FL series RF adapter cable (Unit:mm)**

## 4 GSM Application Interface

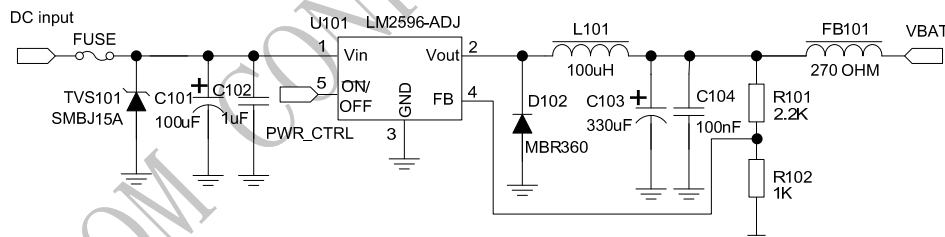
### 4.1 Power Supply

The power supply range of SIM908 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  $\mu$ F is strongly recommended; this capacitor should be placed as close as possible to SIM908 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 7: Reference circuit of the LDO power supply**

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



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

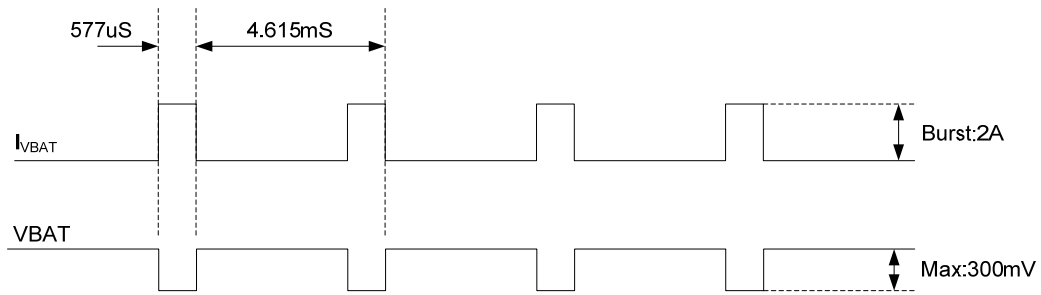
The single 3.7V Li-ion cell battery can be connected to SIM908 VBAT pins directly. But the Ni-Cd or Ni-MH battery must be used carefully, since their maximum voltage can rise over the absolute maximum voltage of the module and damage it.

When battery is used, the total impedance between battery and VBAT pins should be less than 150m $\Omega$ . 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 $\Omega$ ),

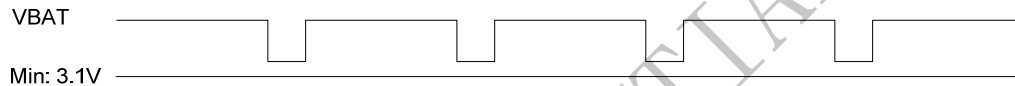
Another VBAT bypass capacitor  $C_B$ =1 $\mu$ F.



**Figure 9: 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 10: The minimal VBAT voltage requirement at VBAT drop**

#### 4.1.2 Monitoring Power Supply

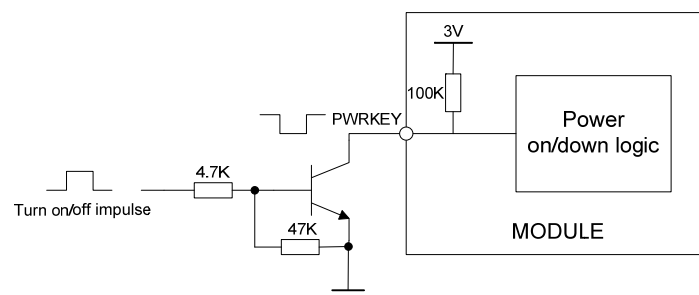
The AT command "AT+CBC" can be used to monitor the VBAT voltage. For detail, please refer to *document [1]*.

### 4.2 Power on/down Scenarios

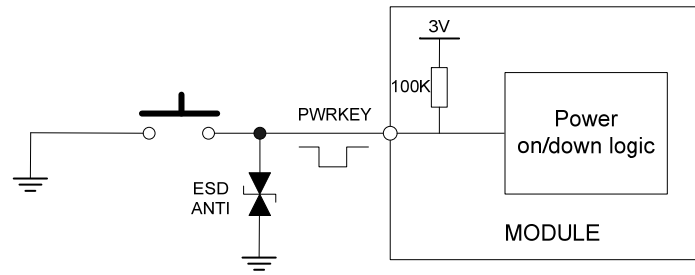
#### 4.2.1 Power on SIM908

##### 4.2.1.1 Turn on SIM900 Using the PWRKEY Pin (Power on)

User can power on SIM908 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.

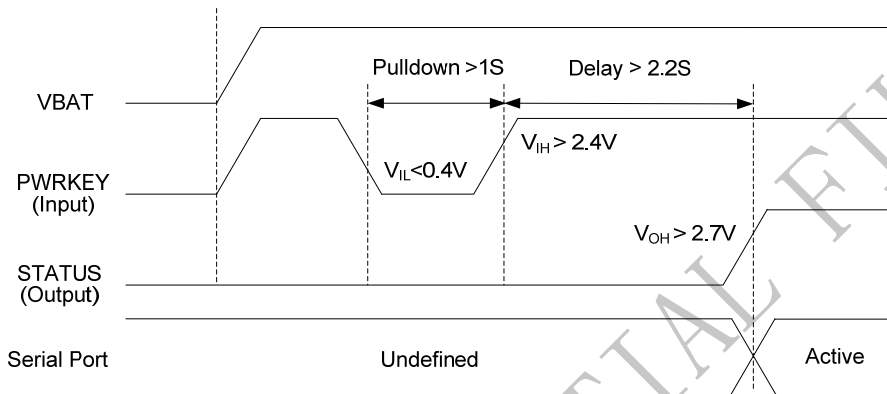


**Figure 11: Powered on/down module using transistor**



**Figure 12: Powered on/down module using button**

The power on scenarios is illustrated as following figure.



**Figure 13: Timing of power on module**

When power on procedure is completed, SIM908 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 SIM908 is powered on. For details, please refer to the chapter “AT+IPR” in document [1].*

#### 4.2.1.2 Turn on the SIM908 using the VCHG Signal

The SIM908 will be automatically turned on when a charger is connected to the switched-off SIM908 of which VBAT pin voltage is greater than 3.2V. SIM908 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.

When module is powered on using the VCHG signal, SIM908 sends out result code as following when fixed baud rate set:

**RDY**

**CHARGE-ONLY MODE**

When user drives the PWRKEY of Charge-only mode SIM908 to a low level voltage for a period of time (please refer to **Figure 13 Timing of power on module**), the SIM908 will power up and go into Charge mode during normal operation. In this case, SIM908 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.

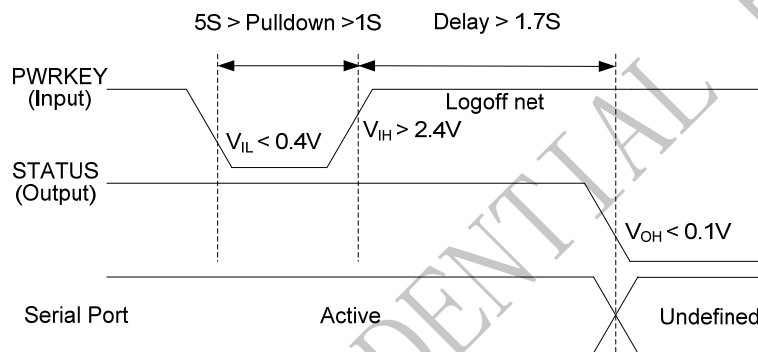
## 4.2.2 Power down SIM908

SIM908 will be powered down in the following situations:

- Normal power down procedure: power down SIM908 by the PWRKEY pin.
- Normal power down procedure: power down SIM908 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 SIM908 by the PWRKEY Pin

User can power down SIM908 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 14: Timing of power down SIM908 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 SIM908 by AT Command

SIM908 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  $\leq 3.3\text{V}$ , the following URC will be reported:

**UNDER-VOLTAGE WARNING**

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

**OVER-VOLTAGE WARNING**

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

**UNDER-VOLTAGE POWER DOWN**

If the voltage  $> 4.8\text{V}$ , 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 SIM908 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.

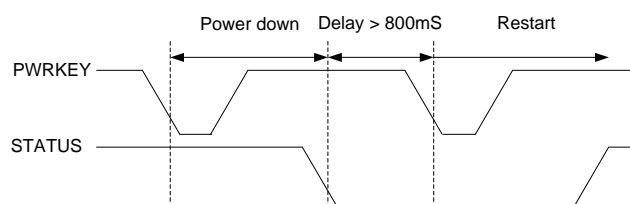


Figure 15: Timing of restart SIM908

### 4.3 Power Saving Mode

SIM908 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 SIM908 into minimum functionality. When SIM908 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.

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

Minimum functionality mode minimizes the current consumption to the lowest level. If SIM908 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 6: The current consumption of Minimum Functionality Mode**

| <fun> | Current consumption(uA) (sleep mode) |
|-------|--------------------------------------|
| 0     | 651                                  |
| 1     | 1500                                 |
| 4     | 715                                  |

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

User can control SIM908 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), SIM908 will enter sleep mode 1 automatically. In this mode, SIM908 can still receive paging or SMS from network but the serial port is not accessible.

*Note: For SIM908, 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 SIM908 from Sleep Mode 1 (AT+CSCLK=1)

When SIM908 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, SIM908 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), SIM908 will enter sleep mode 2 automatically. In this mode, SIM908 can still receive paging or SMS from network but the serial port is not accessible.

*Note: For SIM908, 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 SIM908 from Sleep Mode 2 (AT+CSCLK=2)

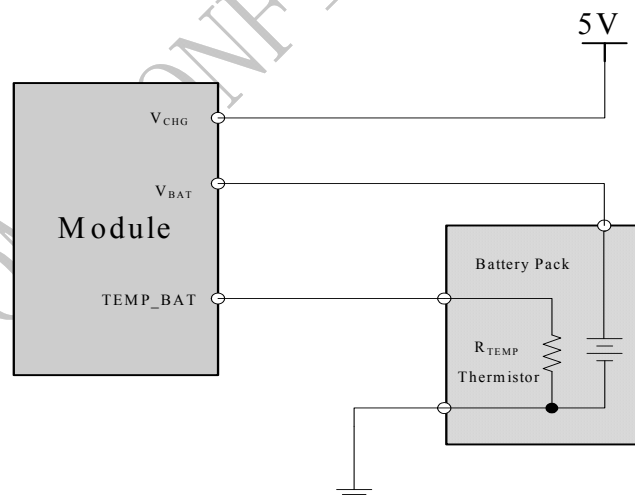
When SIM908 is in sleep mode 2 (AT+CSCLK=2), the following methods can wake up the module:

- Send data to SIM908 via main 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 Charging Interface

SIM908 has integrated a charging circuit inside the module for Li-Ion batteries charging control, which make it very convenient for user’s applications that support battery charging. A common connection is shown in the following figure:



**Figure 16: SIM908 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, and it is recommended to use MURATA NCP15XH103F03RC. Its impedance is 10Kohm at 25°C. Refer to the above figure for the reference circuit.

#### 4.4.1 Battery Pack Characteristics

SIM908 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 take more time for charging.
- The battery 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.

On the SIM908, the build-in circuit of the power management chipset monitors the supply voltage constantly. Once the Under-voltage is detected, the SIM908 will be powered down automatically.

#### 4.4.2 Recommended Battery Pack

Following is the specification of recommended battery pack:

**Table 7: 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                                 |

#### 4.4.3 Implemented Charging Technique

SIM908 has battery charging function. There are three pins related to the battery charging function: there are 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 SIM908 module to battery when charging is in fast charge state. VBAT pin gives charging current to external battery from SIM908 module. TEMP\_BAT Pin is for user to measure the battery temperature. Let this Pin open if battery temperature measurement is not user's design concern.

It is very simple to implement charging function, user just needs to connect the charger to the VCHG Pin and connect the battery to the VBAT Pin.

SIM908 battery charging happens after detecting charger supply and the presence of battery. If there is no charger supply or no battery present, charging function will not be enabled.

Normally, there are three main states in the 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 is 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 SIM908 provides a small constant current to the battery when the battery is between DDLO and UVLO. In DDLO charging state, SIM908 gives out 1mA current to the battery. And in UVLO charging state, SIM908 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 SIM908 hardware only.

### Fast charge:

If there is a charger supply and battery present and the battery is not in DDLO and UVLO, SIM908 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.

#### 4.4.4 Operating Modes during Charging

The battery can be charged during various operating mode. That means that charging can be in progress while SIM908 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 connected to the module's VCHG Pin and the battery is connected to the VBAT Pin while SIM908 is in POWER DOWN mode, SIM908 will go into the Charge-only mode.

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

**Table 8: 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 SIM908 is in Normal operating mode, including: IDLE, TALK mode; SLEEP mode etc;                           | <ul style="list-style-type: none"> <li>GSM remains operational and registers to GSM network while charging is in progress;</li> <li>The serial interfaces are available in IDLE, TALK mode, the AT command set can be used fully in this case;</li> </ul> <p>In SLEEP mode, the serial interfaces are not available. Once the serial port is connected and there is data in transferring. SIM908 will exit the SLEEP mode.</p> |
| Charge-only Mode | Connect charger to module's VCHG Pin while SIM908 is in POWER DOWN mode.<br>IMPORTANT: Here Charge-only mode is charging when power is down, it means that not all software tasks are running. | <ul style="list-style-type: none"> <li>Battery can be charged when GSM engine is not registered to GSM network;</li> <li>Only a few AT commands is available, as listed below.</li> </ul>  |

*Note: VBAT can not provide more than 5mA current while SIM908 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 SIM908 DDLO charging state occurs.*

**Table 9: 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<br>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. |

#### 4.4.5 Charger Requirements

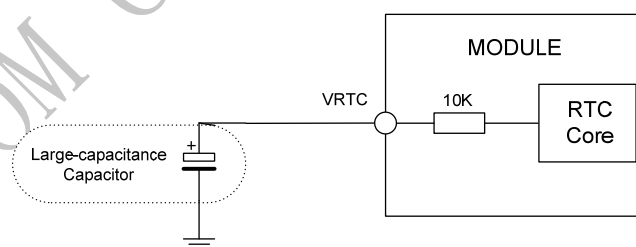
Following is the requirements of charger for SIM908:

- 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.

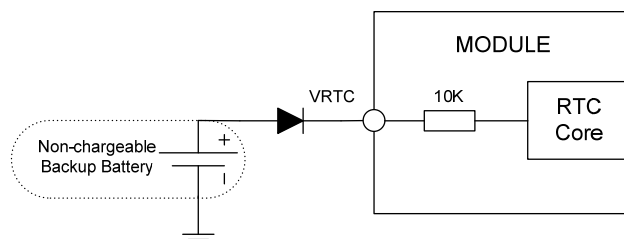
#### 4.5 RTC Backup

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

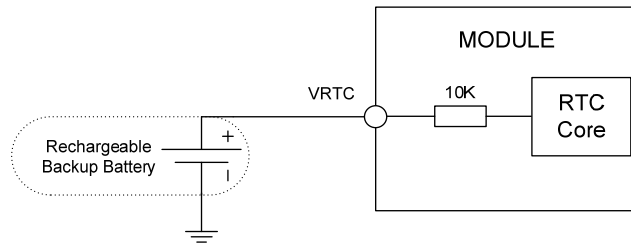
##### ● External capacitor backup


**Figure 17: RTC supply from capacitor**

##### ● Non-chargeable battery backup

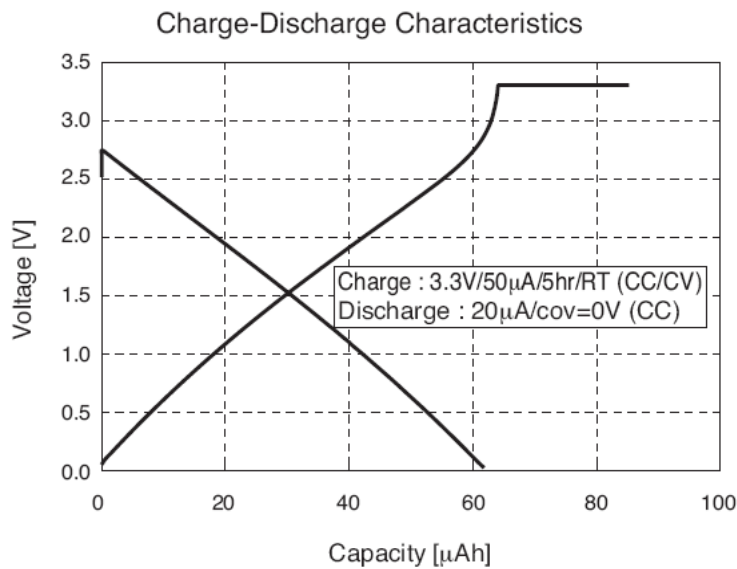

**Figure 18: RTC supply from non-chargeable battery**

## ● Rechargeable battery backup



**Figure 19: RTC supply from rechargeable battery**

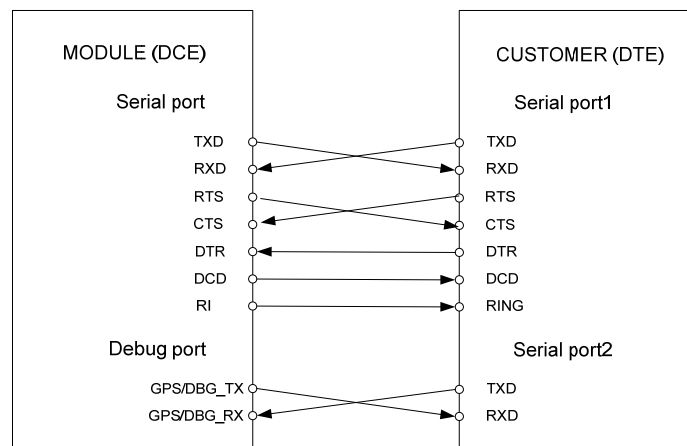
Coin-type rechargeable battery is recommended, such as XH414H-IV01E from Seiko can be used. Typical charge-discharge curves for this battery are shown in the following figure.



**Figure 20: Seiko XH414H-IV01E charge-discharge characteristic**

## 4.6 Serial Interfaces

SIM908 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 21: 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.

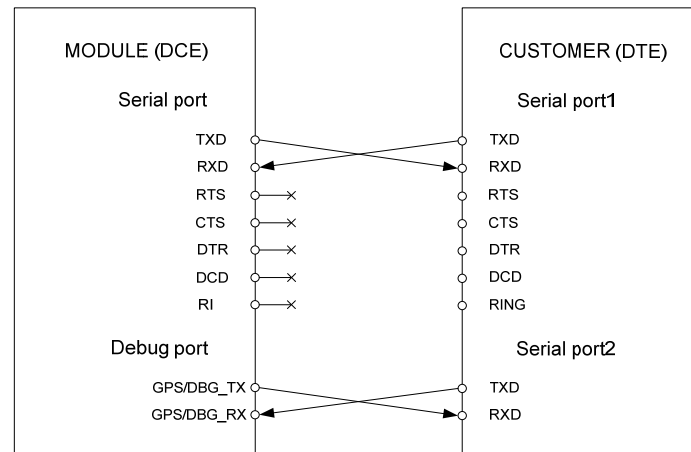


Figure 22: Connection of RXD and TXD only

#### 4.6.1 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:  
1200, 2400, 4800, 9600, 19200, 38400, 57600 and 115200bps
- Autobauding only supports the following baud rates:  
1200, 2400, 4800, 9600, 19200, 38400 and 57600bps
- The default setting is autobauding.

Autobauding allows SIM908 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.

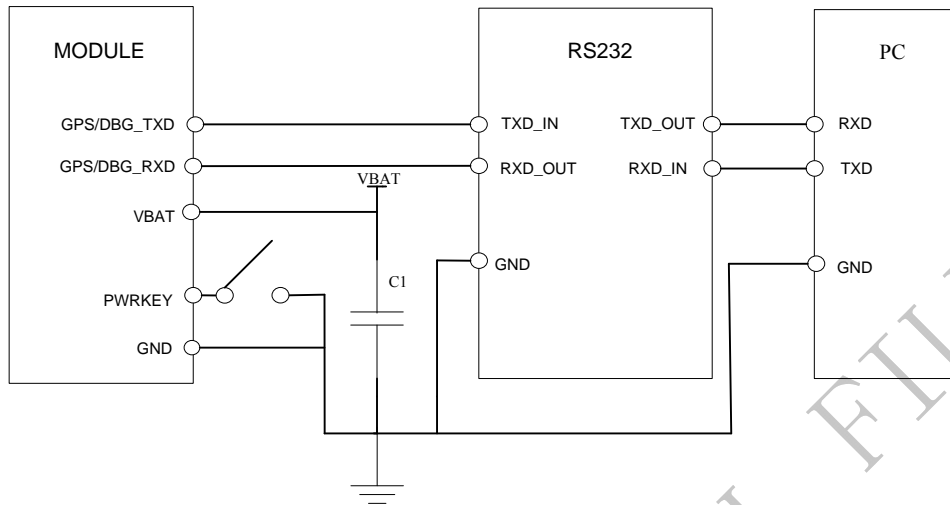
*Note: User can use AT command "AT+IPR=x" to set a fixed baud rate and the setting will be saved to non-volatile flash memory automatically. After the configuration is set as fixed baud rate, the URC such as "RDY", "+CFUN: 1" and "+CPIN: READY" will be reported when SIM908 is powered on.*

Debug port:

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

## 4.6.2 Software Upgrade and Debug

Refer to the following figure for debugging and upgrading software.



**Figure 23: 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]*.

## 4.7 Audio Interfaces

SIM908 provides two analog inputs, MIC1P/1N and MIC2P/2N, which could be used for electret microphone. The module also provides two analog outputs, SPK1P/1N and SPK2P/2N. The output 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.

### 4.7.1 Speaker Interface Configuration

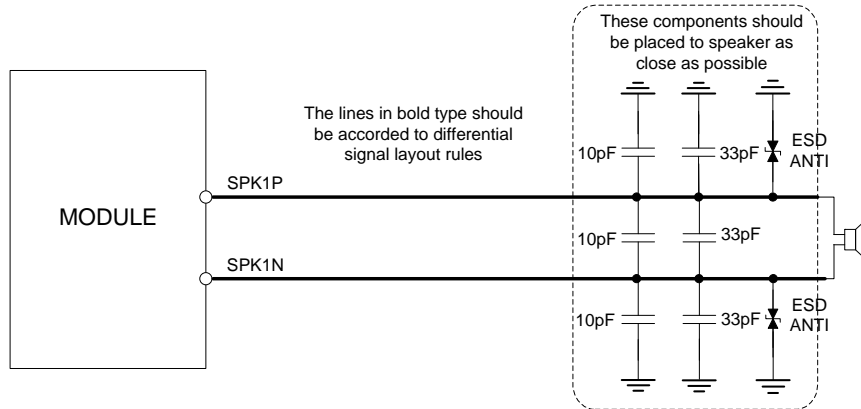


Figure 24: Speaker reference circuit

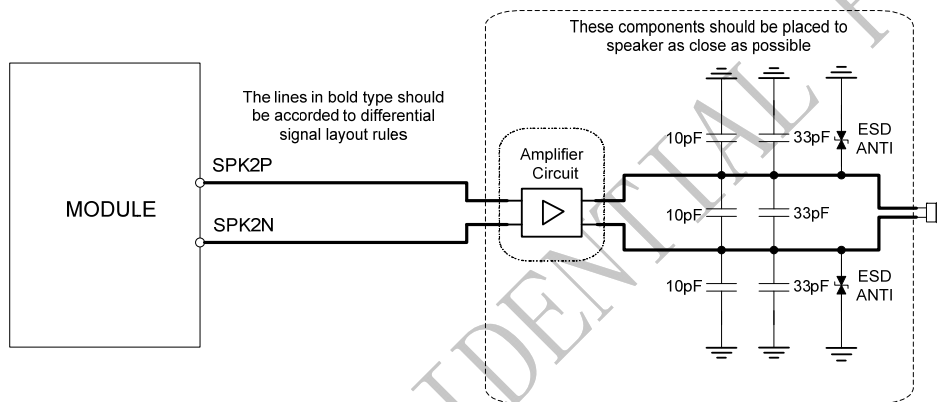


Figure 25: Speaker with amplifier reference circuit

### 4.7.2 Microphone Interfaces Configuration

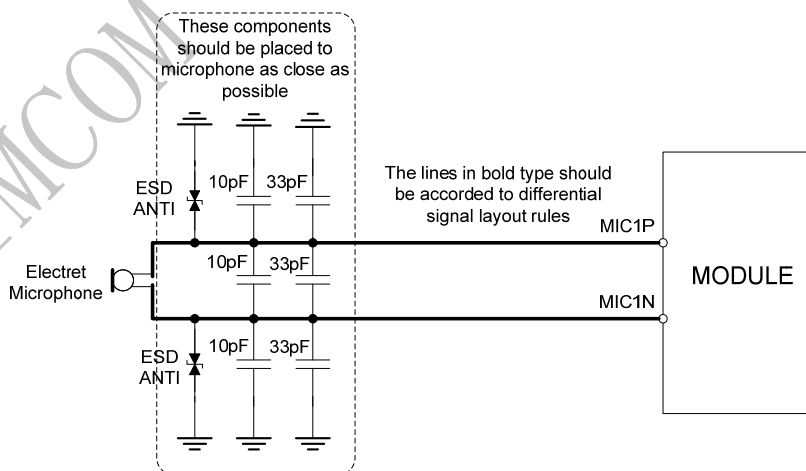


Figure 26 : Microphone reference circuit

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

### 4.7.3 Earphone Interface Configuration

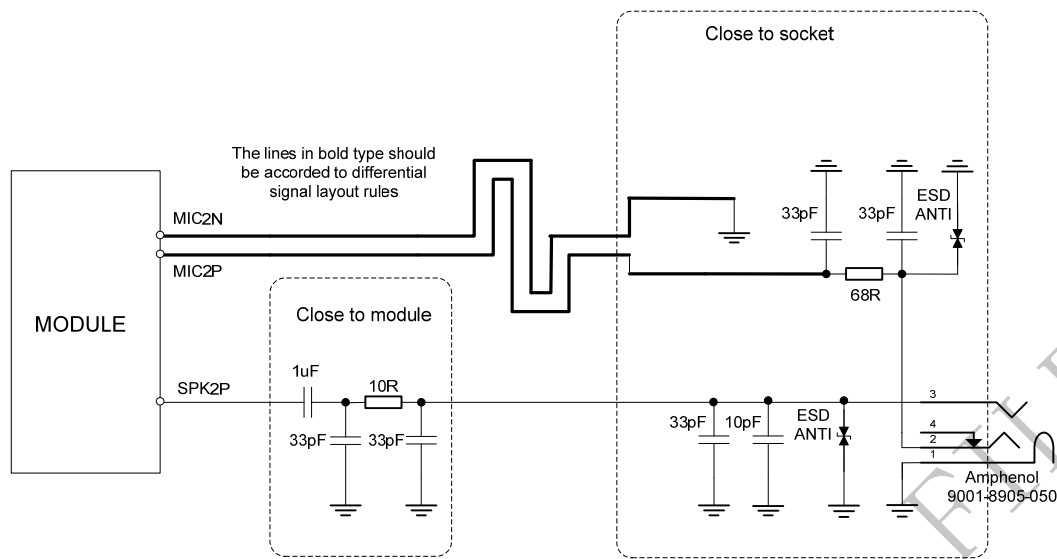


Figure 27: Earphone reference circuit

### 4.7.4 Audio Electronic Characteristics

Table 10: 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;<br>pre-amp gain = 20 dB;<br>PGA gain = 14 dB | 15.9 |     | mVrms |
|                                     | THD <5% at F=1KHz;<br>pre-amp gain = 0 dB;<br>PGA gain = 0 dB   | 740  |     | mVrms |

Table 11: Audio output characteristics

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

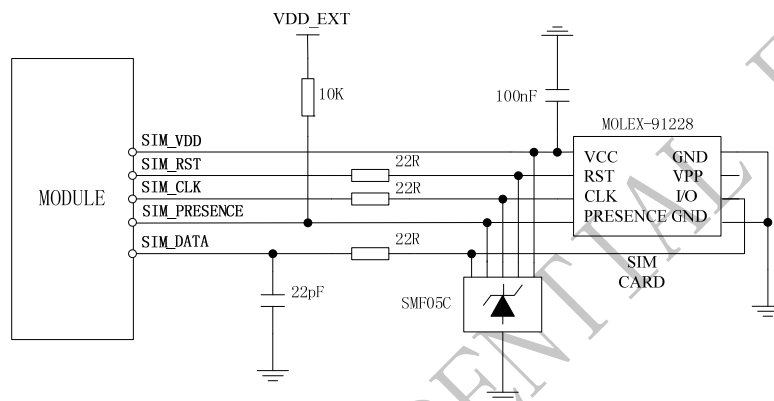


## 4.8 SIM Card Interface

### 4.8.1 SIM Card Application

The SIM 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.

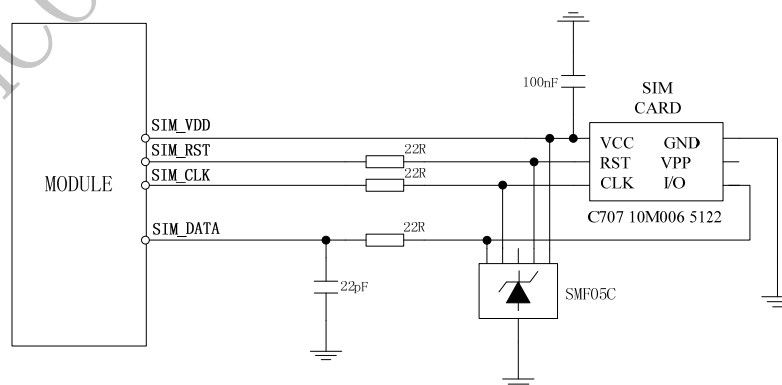
It is recommended to use an ESD protection component such as ST ([www.st.com](http://www.st.com)) ESDA6V1W5 or ON SEMI ([www.onsemi.com](http://www.onsemi.com)) SMF05C. The pull up resistor (15K $\Omega$ ) on the SIM\_DATA line is already added in the module internal. Note that the SIM peripheral circuit 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 28: 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 29: Reference circuit of the 6-pin SIM card holder**

## 4.8.2 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.

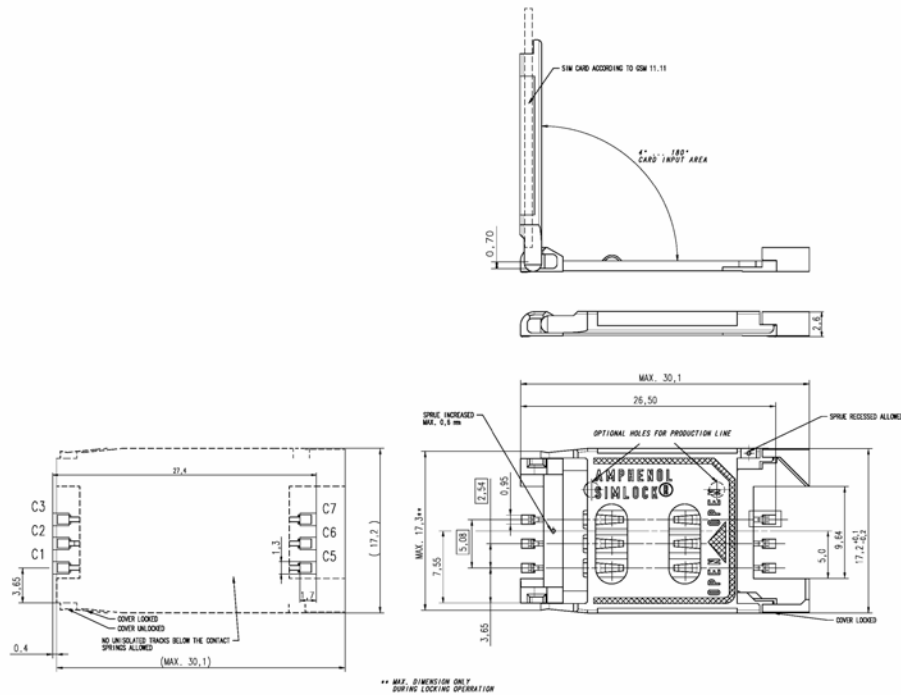


Figure 30: Amphenol C707 10M006 5122 SIM card holder

Table 12: 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.

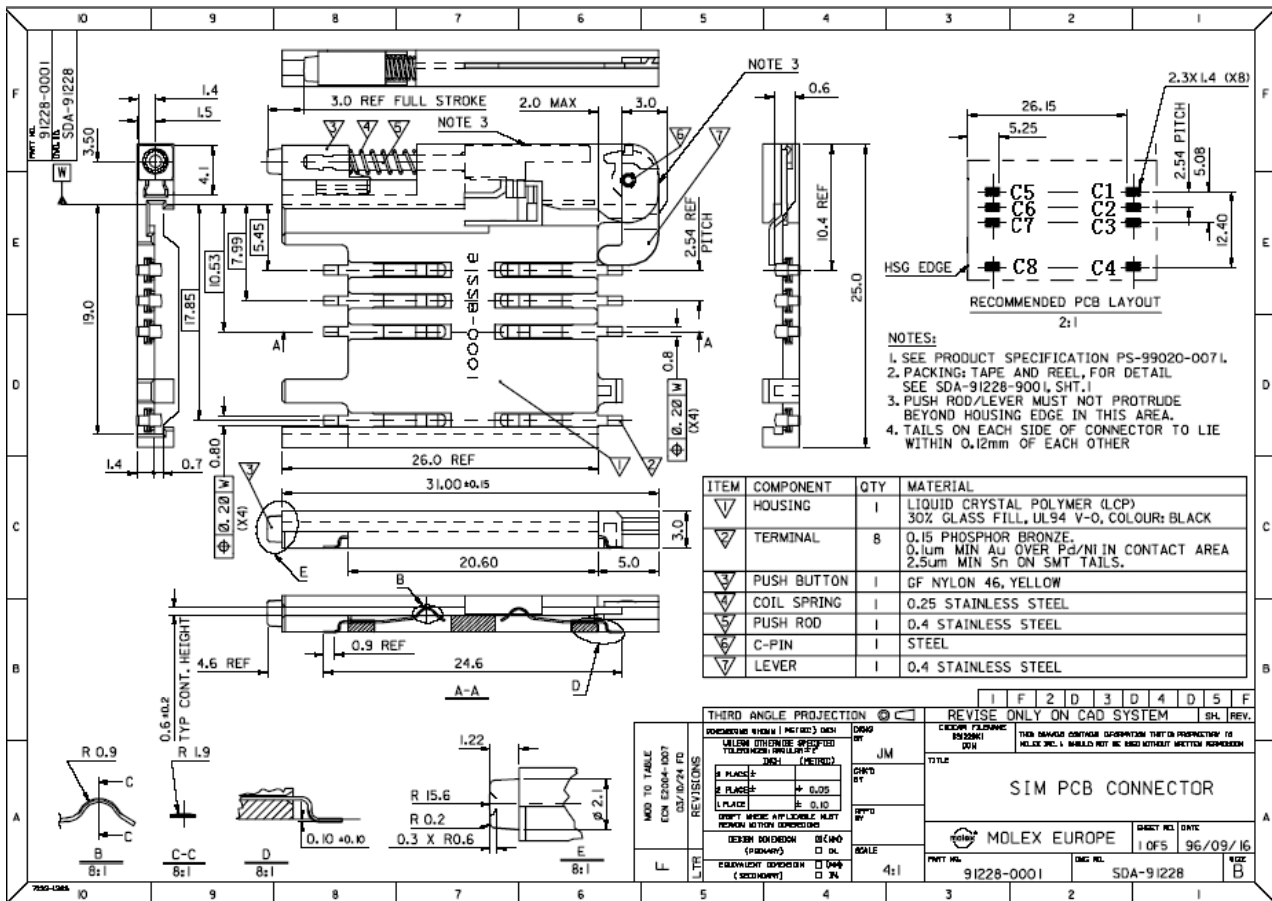


Figure 31: Molex 91228 SIM card holder

Table 13: 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 |

#### 4.9 LCD Display/SPI Interface

SIM908 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.*

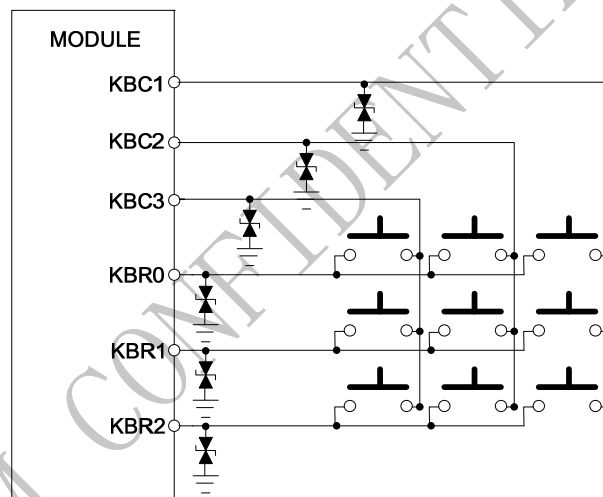
## 4.10 Keypad Interface

The keypad interface consists of 3 keypad column outputs and 3 keypad row inputs. The basic configuration is 3 keypad columns and 3 keypad rows, total 9 keys.

**Table 14: Pin definition of the keypad interface**

| Pin name    | Pin number | Default function | Second function | Default state     |
|-------------|------------|------------------|-----------------|-------------------|
| GPIO1/ KBR0 | 31         | GPIO1            | Keypad matrix   | Output, Pull down |
| GPIO2/ KBR1 | 32         | GPIO2            |                 | Output, Pull down |
| GPIO3/ KBR2 | 33         | GPIO3            |                 | Output, Pull down |
| GPIO4/ KBC0 | 34         | GPIO4            |                 | Output, Pull down |
| GPIO5/ KBC1 | 35         | GPIO5            |                 | Output, Pull down |
| GPIO6/ KBC2 | 36         | GPIO6            |                 | Output, Pull down |

The keypad interface allows a direct external matrix connection. A typical recommended circuit of the keypad is shown in the following figure.



**Figure 32: Reference circuit of the keypad interface**

*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.*

## 4.11 ADC

SIM908 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 15: ADC specification**

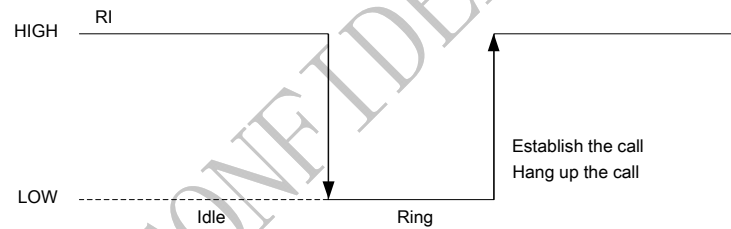
| Parameter      | Min | Typ | Max  | Unit |
|----------------|-----|-----|------|------|
| Voltage range  | 0   | -   | 2.8  | V    |
| ADC Resolution | -   | 10  | -    | bits |
| Sampling rate  | -   | -   | 200K | Hz   |

## 4.12 RI Behaviors

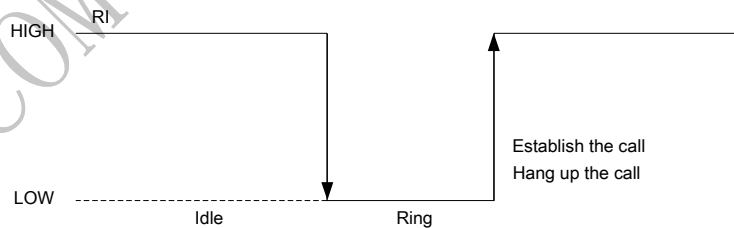
**Table 16: RI behaviors**

| 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:<br>(1) Establish the call<br>(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:<br>(1) Establish the call<br>(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> . |

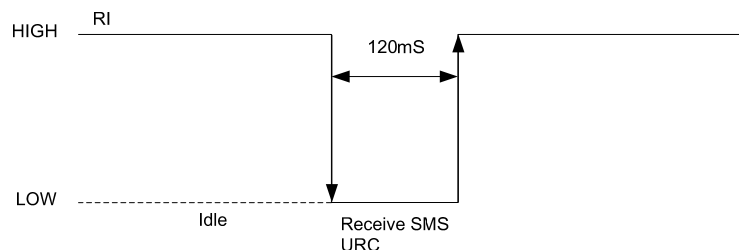
The behavior of the RI pin is shown in the following figure when the module is used as a receiver.



**Figure 33: RI behaviour of voice calling as a receiver**

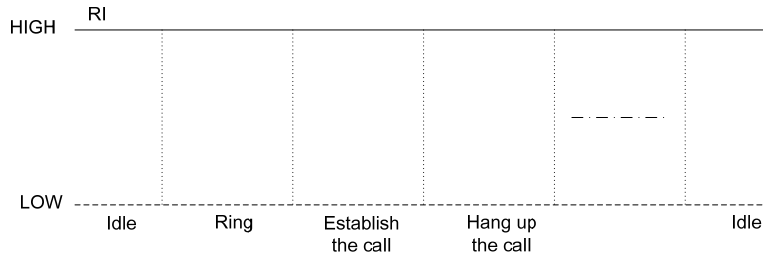


**Figure 34: RI behaviour of data calling as a receiver**



**Figure 35: 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 36: RI behaviour as a caller**

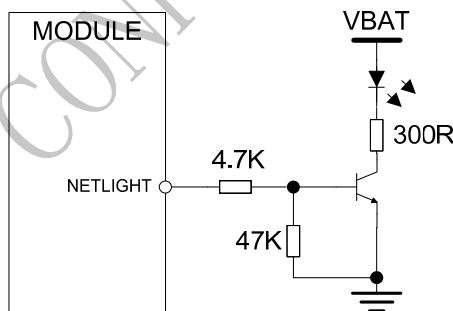
### 4.13 Network Status Indication

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

**Table 17: Status of the NETLIGHT pin**

| Status              | SIM908 behavior                       |
|---------------------|---------------------------------------|
| Off                 | SIM908 is not running                 |
| 64ms On/ 800ms Off  | SIM908 not registered the network     |
| 64ms On/ 3000ms Off | SIM908 registered to the network      |
| 64ms On/ 300ms Off  | PPP GPRS communication is established |

A reference circuit is recommended in the following figure:



**Figure 37: Reference circuit of NETLIGHT**

### 4.14 General Purpose Input/Output (GPIO)

SIM908 provides up to 6 GPIO pins. 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 18: Pin definition of the GPIO interface**

| Pin name    | Pin number | Default function | Second function | Default state     |
|-------------|------------|------------------|-----------------|-------------------|
| GPIO1/ KBR0 | 31         | GPIO1            | KBR0            | Output, pull down |
| GPIO2/ KBR1 | 32         | GPIO2            | KBR1            | Output, pull down |
| GPIO3/ KBR2 | 33         | GPIO3            | KBR2            | Output, pull down |
| GPIO4/ KBC0 | 34         | GPIO4            | KBC0            | Output, pull down |
| GPIO5/ KBC1 | 35         | GPIO5            | KBC1            | Output, pull down |
| GPIO6/ KBC2 | 36         | GPIO6            | KBC2            | Output, pull down |

#### 4.15 PWM

SIM908 provides 3 PWMs which can be used to drive a vibrator, and a backlight LED for display or keyboard. Each PWM1 and PWM2 output frequency varies from 25.6KHz to 3.25MHz. Two 7-bit unsigned binary parameters are used for the output period and for the duty cycle. The PWM3 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 ring tones or alert tones. The tone level can be adjusted over a 24 dB range in 4 dB steps, or it can be muted.

The AT command “AT + SPWM” is used to set the output period and duty cycle of the PWM. For details, please refer to *document [1]*.

#### 4.16 I<sup>2</sup>C Bus

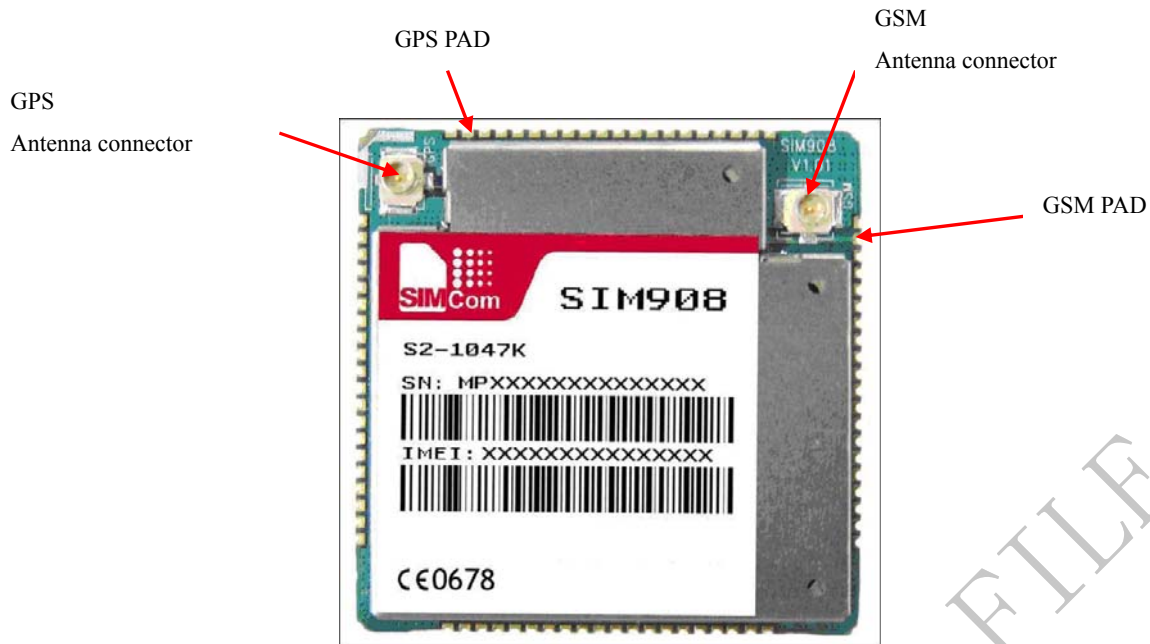
The SIM908 provides an I<sup>2</sup>C interface which is only used in the embedded AT application.

*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.*

#### 4.17 GSM Antenna Interface

The RF interface has an impedance of 50Ω. To suit the physical design of individual applications, SIM908 offers alternatives

- Recommended approach: GSM RF connector
- GSM ANT pad.

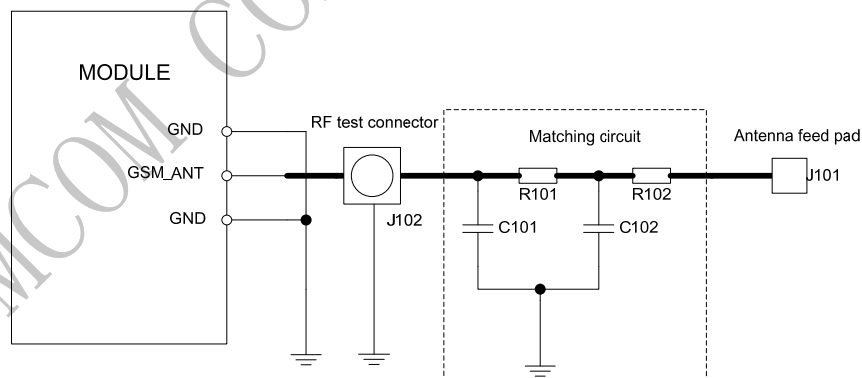


**Figure 38: The RF interface of module**

If the GSM RF connector is used, the customer's main board under the antenna pad should be copper keep out. To minimize the loss on the RF cable, it need be very careful to choose RF cable. SIMCom recommends the insertion loss should be meet following requirements:

- GSM900<1dB
- DCS1800 <1.5dB

The customer's antenna also can 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  $50\Omega$ . 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 39: GSM 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  $0\Omega$ , and reserve the place of C101 and C102 without soldering.

The RF test connector in figure 39 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  $50\Omega$  impedance controlled line in PCB layout. For details about radio frequency trace layout, please refer to *document [9]*.



## 5 GPS Application Interface

SIM908 provide a high-performance L1 GPS solution for cellular handset applications. The solution offers best-in-class acquisition and tracking sensitivity, Time-To-First-Fix (TTFF) and accuracy. The GPS engine supports both fully-autonomous operations for use in handheld consumer navigation devices and other standalone navigation systems.

The GPS NMEA information is output by DEBUG port. The default baud rate is 115200bps.

The GPS engine is controlled by GSM engine, so when it is necessary to run GPS, the GSM engine must be powered on and not in SLEEP mode.

All the GPS function is controlled by AT command via serial port. The GPS function AT commands are listed in the following table.

**Table 19: AT Commands for GPS function**

| Command       | Description                    |
|---------------|--------------------------------|
| AT+CGPSPWR    | GPS power control              |
| AT+CGPSRST    | GPS mode reset (hot/warm/cold) |
| AT+CGPSSTATUS | Get current GPS status         |
| AT+CGPSOUT    | GPS NMEA data output control   |
| AT+CGPSINF    | Get current GPS location info  |
| AT+CGPSIPR    | Set GPS NMEA output uart bps   |

For details of these AT command, please refer to *document [1]*.

### 5.1 GPS Operating Modes

GPS has two operating modes which can be controlled by AT command.

**Active mode:** GPS is active as a GPS receiver. The GPS engine will automatically acquire and track GPS satellites.

**Power down mode:** The GPS engine will be set into this mode by sending AT command “AT+CGPSPWR=0”. In this mode the internal power supply for GPS will be shutdown, and the current consumption is very low. The last position, current time and ephemeris data will be stored in the GSM host memory.

## 5.2 GPS Power on/down Scenarios

### 5.2.1 Power on GPS engine

User can power on GPS engine by sending AT command “AT+CGPSPWR=1”.

### 5.2.2 Power down GPS engine

User can power down GPS engine by sending AT command “AT+CGPSPWR=0”.

## 5.3 GPS-VANT-OUT and GPS-VANT-IN

GPS-VANT-OUT is a 2.8V output for active external antenna, if the active external antenna works at 2.8V voltage supply domain, user can connect the GPS-VANT-OUT and GPS-VANT-IN directly. If the antenna's power is not 2.8V, a proper voltage should be provided to the pin GPS-VANT-IN depending on the active antenna, and the pin GPS-VANT-OUT should be kept open. For passive antennas, both the pin GPS-VANT-OUT and the pin GPS-VANT-IN should be kept open.

## 5.4 GPS Antenna Interface

### 5.4.1 GPS Antenna Interface

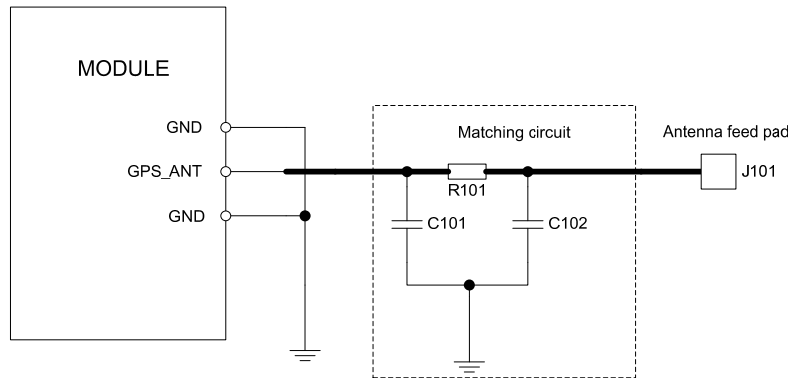
The RF interface has an impedance of 50Ω. To suit the physical design of individual applications, SIM908 offers alternatives

- Recommended approach: GPS RF connector
- GPS Ant pad.

If the antenna connector is used, the customer's main board under the antenna pad should be copper keep out. To minimize the loss on the RF cable, it need be very careful to choose RF cable. SIMCom recommend the insertion loss should be meet following requirements:

- GPS < 0.9dB

The customer's antenna also can 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 40: GPS antenna matching circuit**

In this figure, the components R101, 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 is  $0\Omega$ , and users need to reserve the place of C101 and C102 without soldering.

The traces in bold type should be treated as  $50\Omega$  impedance controlled line in PCB layout.

#### 5.4.2 GPS Antenna Choice Consideration

To obtain excellent GPS reception performance, a good antenna will always be required. The antenna is the most critical item for successful GPS reception in a weak signal environment. Proper choice and placement of the antenna will ensure that satellites at all elevations can be seen, and therefore, accurate fix measurements are obtained.

Most customers contract with antenna design houses to properly measure the radiation pattern of the final mounted configuration in a plastic housing with associated components near the antenna. Linear antennas are becoming more popular, and the gain is reasonable, since a smaller ground plane can be used.

User can consider following factors as:

- Choose a linear antenna with a reasonably uniform hemispherical gain pattern of  $>-4\text{dBi}$ .
- Use of an antenna with lower gain then this will give less than desirable results. Please note that a RHCP antenna with a gain of  $3\text{dBi}$ , equates to a linear polarized antenna of  $0\text{dBi}$ .
- Proper ground plane sizing is a critical consideration for small GPS antennas.
- Proper placement of the GPS antenna should always be the FIRST consideration in integrating the SIM18 GPS Module.

If the customer's design will allow for a ceramic RHCP patch antenna with an appropriately sized ground plane, and the patch is normally oriented towards the sky, then that particular solution usually works the best. Note that if the patch antenna ground plane is less than  $60\times 60\text{mm}$ , then compromises to the beam width and gain pattern could result. Usually the gain becomes very directional, and loses several dB of performance. Since results can vary, measuring the antenna radiation pattern in the final housing in an appropriate anechoic chamber is required.

Some customers do not have the size availability to implement a patch antenna approach. In that instance, use of a Linear Polarized (LP) antenna is the next best alternative. There are new ceramic LP antennas on the market that exhibit reasonable gain characteristics once properly mounted in the housing, and when matched to an appropriate sized ground. Generally the ground plane requirements are smaller for a LP antenna when compared to a patch, but once again, proper testing in an anechoic chamber is a mandatory requirement. These ceramic elements will

need to be located near the end of the ground plane, and will require several millimeters of clearance between the closest component. It is important to note that use of a LP antenna will result in a minimum of 3dB of gain loss when compared to a RHCP antenna at a defined elevation. This is due to the right hand gain rule of antenna propagation.

Use of PIFA antenna is another LP possibility, but the PIFA usually exhibits a considerable amount of gain nulls, or “holes” in the radiation pattern. This will be undesirable for obtaining a low circular error probability (CEP), since the antenna may not allow the receiver to capture the desired satellite at the ideal orientation due to these noted gain nulls. Once again, careful testing in an appropriate anechoic chamber is required.

If the customer’s design is for automotive applications, then an active antenna can be used and located on top of the car in order for guarantee the best signal quality. GPS antenna choice should be based on the designing product and other conditions.

For detailed Antenna designing consideration, please refer to related antenna vendor’s design recommendation. The antenna vendor will offer further technical support and tune their antenna characteristic to achieve successful GPS reception performance depending on the customer’s design.

## 6 Electrical, Reliability and Radio Characteristics

### 6.1 Absolute Maximum Ratings

The absolute maximum ratings stated in following table are stress ratings under non-operating conditions. Stresses beyond any of these limits will cause permanent damage to SIM908.

**Table 20: Absolute maximum ratings**

| Symbol                      | Parameter            | Min  | Typ | Max | Unit |
|-----------------------------|----------------------|------|-----|-----|------|
| V <sub>BAT</sub>            | Power supply voltage | -    | -   | 5.5 | V    |
| V <sub>I</sub> <sup>*</sup> | Input voltage        | -0.3 | -   | 3.1 | V    |
| I <sub>I</sub> <sup>*</sup> | Input current        | -    | -   | 10  | mA   |
| I <sub>O</sub> <sup>*</sup> | Output current       | -    | -   | 10  | mA   |

\* These parameters are for digital interface pins, such as keypad, GPIO, I<sup>2</sup>C, UART, LCD, PWMs and DEBUG.

### 6.2 Recommended Operating Conditions

**Table 21: Recommended operating conditions**

| Symbol            | Parameter             | Min | Typ | Max | Unit |
|-------------------|-----------------------|-----|-----|-----|------|
| V <sub>BAT</sub>  | Power supply voltage  | 3.2 | 4.0 | 4.8 | V    |
| T <sub>OPER</sub> | Operating temperature | -40 | +25 | +85 | °C   |
| T <sub>STG</sub>  | Storage temperature   | -45 |     | +90 | °C   |

### 6.3 Digital Interface Characteristics

Table 22: Digital interface characteristics

| Symbol          | Parameter                 | Min | Typ | Max | Unit |
|-----------------|---------------------------|-----|-----|-----|------|
| I <sub>IH</sub> | High-level input current  | -10 | -   | 10  | uA   |
| I <sub>IL</sub> | Low-level input current   | -10 | -   | 10  | uA   |
| V <sub>IH</sub> | High-level input voltage  | 2.4 | -   | -   | V    |
| V <sub>IL</sub> | Low-level input voltage   | -   | -   | 0.4 | V    |
| V <sub>OH</sub> | High-level output voltage | 2.7 | -   | -   | V    |
| V <sub>OL</sub> | Low-level output voltage  | -   | -   | 0.1 | V    |

\* These parameters are for digital interface pins, such as keypad, GPIO, I<sup>2</sup>C, UART, LCD, PWMs and DEBUG.

### 6.4 SIM Card Interface Characteristics

Table 23: SIM card interface characteristics

| Symbol          | Parameter                 | Min | Typ | Max | Unit |
|-----------------|---------------------------|-----|-----|-----|------|
| I <sub>IH</sub> | High-level input current  | -10 | -   | 10  | uA   |
| I <sub>IL</sub> | Low-level input current   | -10 | -   | 10  | uA   |
| V <sub>IH</sub> | High-level input voltage  | 1.4 | -   | -   | V    |
|                 |                           | 2.4 | -   | -   | V    |
| V <sub>IL</sub> | Low-level input voltage   | -   | -   | 0.4 | V    |
|                 |                           | -   | -   | 2.4 | V    |
| V <sub>OH</sub> | High-level output voltage | 1.7 | -   | -   | V    |
|                 |                           | 2.7 | -   | -   | V    |
| V <sub>OL</sub> | Low-level output voltage  | -   | -   | 0.1 | V    |
|                 |                           | -   | -   | 0.1 | V    |

### 6.5 VDD\_EXT Characteristics

Table 24: VDD\_EXT characteristics

| Symbol         | Parameter      | Min  | Typ  | Max  | Unit |
|----------------|----------------|------|------|------|------|
| V <sub>O</sub> | Output voltage | 2.70 | 2.80 | 2.95 | V    |
| I <sub>O</sub> | Output current | -    | -    | 10   | mA   |

### 6.6 SIM\_VDD Characteristics

**Table 25: SIM\_VDD characteristics**

| Symbol         | Parameter      | Min  | Typ  | Max  | Unit |
|----------------|----------------|------|------|------|------|
| V <sub>O</sub> | Output voltage | 2.75 | 2.9  | 3.00 | V    |
|                |                | 1.65 | 1.80 | 1.95 |      |
| I <sub>O</sub> | Output current | -    | -    | 10   | mA   |

## 6.7 VRTC Characteristics

**Table 26: VRTC characteristics**

| Symbol               | Parameter           | Min  | Typ  | Max  | Unit |
|----------------------|---------------------|------|------|------|------|
| V <sub>RTC-IN</sub>  | VRTC input voltage  | 2.00 | 3.00 | 3.15 | V    |
| I <sub>RTC-IN</sub>  | VRTC input current  | -    | 2    | -    | uA   |
| V <sub>RTC-OUT</sub> | VRTC output voltage | -    | 3.00 | -    | V    |
| I <sub>RTC-OUT</sub> | VRTC output current | -    | 10   | -    | uA   |

## 6.8 Current Consumption (VBAT = 3.8V, GPS engine is powered down)

**Table 27: GSM current consumption**

| Symbol            | Parameter    | Conditions                              |                      | Value  | Unit |    |
|-------------------|--------------|---|----------------------|--------|------|----|
| I <sub>VRTC</sub> | VRTC current | VBAT disconnects. Backup battery is 3 V |                      | 2      | uA   |    |
| I <sub>VBAT</sub> | VBAT current | Power down mode                         |                      | 50     | uA   |    |
|                   |              | Sleep mode                              | BS-PA-MFRMS=9        | 1.2    | mA   |    |
|                   |              |   | BS-PA-MFRMS=5        | 1.5    |      |    |
|                   |              |   | BS-PA-MFRMS=2        | 1.7    |      |    |
|                   |              | Idle mode                               | GSM 850              | 21     | mA   |    |
|                   |              |   | EGSM 900             |        |      |    |
|                   |              |   | DCS 1800             |        |      |    |
|                   |              |   | PCS 1900             |        |      |    |
|                   |              | Voice call                              | GSM 850<br>EGSM 900  | PCL=5  | 240  | mA |
|                   |              |   |                      | PCL=12 | 110  |    |
|                   |              |   |                      | PCL=19 | 76   |    |
|                   |              |   | DCS 1800<br>PCS 1900 | PCL=0  | 180  |    |
|                   |              |   |                      | PCL=7  | 89   |    |
|                   |              |   |                      | PCL=15 | 76   |    |
|                   |              | Data mode<br>GPRS(1Rx,1Tx)              | GSM 850<br>EGSM 900  | PCL=5  | 240  | mA |
|                   |              |   |                      | PCL=12 | 110  |    |
|                   |              |   |                      | PCL=19 | 83   |    |
|                   |              |   | DCS 1800<br>PCS 1900 | PCL=0  | 170  | mA |
|                   |              |   |                      | PCL=7  | 95   |    |

|                         |              |                            |                      |        |     |    |
|-------------------------|--------------|----------------------------|----------------------|--------|-----|----|
|                         |              |                            |                      | PCL=15 | 80  |    |
|                         |              | Data mode<br>GPRS(4Rx,1Tx) | GSM 850<br>EGSM 900  | PCL=5  | 270 | mA |
|                         |              |                            |                      | PCL=12 | 150 |    |
|                         |              |                            |                      | PCL=19 | 120 |    |
|                         |              |                            | DCS 1800<br>PCS 1900 | PCL=0  | 210 | mA |
|                         |              |                            |                      | PCL=7  | 130 |    |
|                         |              |                            |                      | PCL=15 | 115 |    |
|                         |              | Data mode<br>GPRS(3Rx,2Tx) | GSM 850<br>EGSM 900  | PCL=5  | 435 | mA |
|                         |              |                            |                      | PCL=12 | 185 |    |
|                         |              |                            |                      | PCL=19 | 130 |    |
|                         |              |                            | DCS 1800<br>PCS 1900 | PCL=0  | 320 | mA |
|                         |              |                            |                      | PCL=7  | 155 |    |
|                         |              |                            |                      | PCL=15 | 122 |    |
| I <sub>V</sub> BAT-peak | Peak current | During Tx burst            |                      |        | 2   | A  |

## 6.9 Electro-Static Discharge

SIM908 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 28: 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         |
| SPKP/ SPKN<br>MICP/ MICN | ±3KV              | ±8KV          |
| PWRKEY                   | ±3KV              | ±8KV          |

## 6.10 Radio Characteristics

### 6.10.1 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 29: SIM908 GSM 900 and GSM 850 conducted RF output power**

| GSM 900 and EGSM 850 |                            |                               |         |
|----------------------|----------------------------|-------------------------------|---------|
| 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 30: SIM908 DCS 1800 and PCS 1900 conducted RF output power**

| DCS 1800 and PCS 1900 |                            |                               |         |
|-----------------------|----------------------------|-------------------------------|---------|
| 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 | $\pm 4$ | $\pm 5$ |
| 12    | 6 | $\pm 4$ | $\pm 5$ |
| 13    | 4 | $\pm 4$ | $\pm 5$ |
| 14    | 2 | $\pm 5$ | $\pm 6$ |
| 15-28 | 0 | $\pm 5$ | $\pm 6$ |

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

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

### 6.10.2 Module RF Receive Sensitivity

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

**Table 31: SIM908 conducted RF receive sensitivity**

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

### 6.10.3 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 32: SIM908 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 |

## 7 Manufacturing

### 7.1 Top View of SIM908



Figure 41: Top view of SIM908 module

### 7.2 Typical Solder Reflow Profile

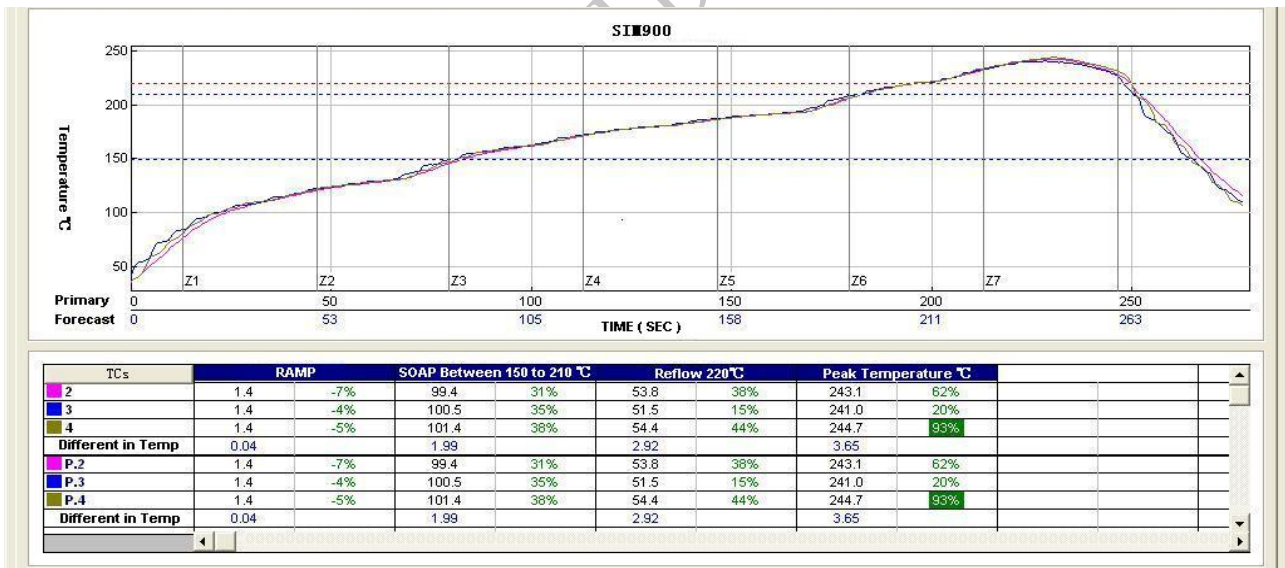


Figure 42: Typical solder reflow profile

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

### 7.3 Moisture Sensitivity Level (MSL)

SIM908 is qualified to MSL3 in accordance with IPC/JEDEC J-STD-033.

## Appendix

### A. Related Documents

**Table 33: Related documents**

| SN   | Document name                                     | Remark   |
|------|---|--|
| [1]  | SIM908_AT Command Manual                          | SIM908 AT Command Manual   |
| [2]  | AN_SIM900_TCPIP                                   | TCP/IP Applications User Manual  |
| [3]  | SIM900_Multiplexer User Manual_Application Note   | SIM908 Multiplexer User Manual Application Note  |
| [4]  | AN_SIM900 Series_Update Tool_UGD                  | SIM908 Series Update Tool User Guide   |
| [5]  | AN_SIM900_AUDIO                                   | Applications Note About SIM908 Audio   |
| [6]  | AN_SIM900_Audio LINE-IN input                     | Applications Note About SIM908 LINE-IN Input   |
| [7]  | SIM900_Embedded AT Application Note               | SIM908 Embedded AT Application Note  |
| [8]  | AN_Serial Port                                    | Application Note About Serial Port   |
| [9]  | AN_SIM900-TE PCB Layout & Schematic for Reference | Application Note About SIM908-TE PCB Layout & Schematic  |
| [10] | Module secondary-SMT-UGD                          | Module secondary SMT User Guide  |
| [11] | ITU-T Draft new recommendation V.25ter:           | Serial asynchronous automatic dialing and control  |
| [12] | GSM 07.07:  | Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)   |
| [13] | GSM 07.10:  | Support GSM 07.10 multiplexing protocol  |
| [14] | 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) |
| [15] | 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                             |
| [16] | GSM 11.11:  | Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface   |
| [17] | GSM 03.38:  | Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information   |
| [18] | GSM 11.10   | Digital cellular telecommunications system (Phase 2); Mobile Station (MS) conformance specification; Part 1: Conformance specification   |

## B. Terms and Abbreviations







**Table 34: 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                                      |
| 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                           |
| <b>Phonebook abbreviations</b> |   |
| 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 35: 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.   |
|  | <p>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.</p> <p>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.</p> <p>Also, some networks require that a valid SIM card be properly inserted in the cellular terminal or mobile.</p> |

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