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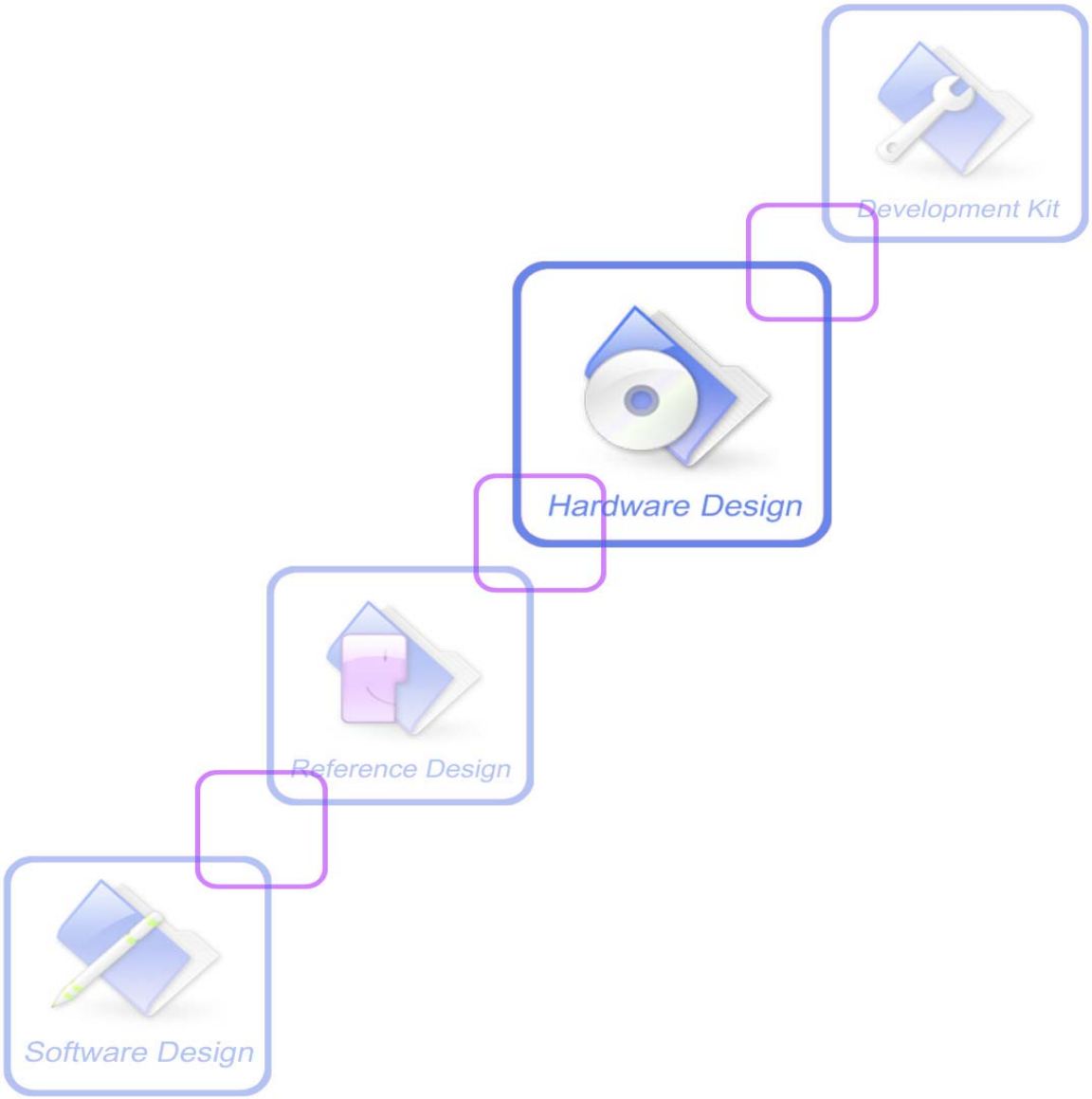
SIM900B_Hardware Design_V2.00



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Contents

Table Index

Figure Index

Version History

Date	Version	Description of change	Author
2010-04-08	1.01	Origin	Huangqiuju
2010-05-31	1.02	Modify voltage domain， current consumption and figure37	Huangqiuju
2010-06-23	1.03	§2.1, §3.3. §3.4 Modify the power supply range from 3.2V~4.8V to 3.1V~4.8V §3.7, Modify the VRTC pin connection when RTC backup is not needed.	Huangqiuju
2010-08-19	1.04	Modify the power supply range to 3.2v~4.8v. §3.3.2 Add Figure 6:The minimal VBAT voltage at VBAT drop. §3.4 Modify figure 7. §3.4 Add table 7. §3.5 Add 3.5.4 and 3.5.5 description. Delete chapter 3.6. Add figure 29,figure 30,figure 31,figure 32 Modified figure 39 and B2B connector’s manufacture	Huangqiuju
2011-02-09	2.00	Arrange the structure of document.	Huangqiuju

1 Introduction

This document describes SIM900B hardware interface in great detail.
This document can help user to quickly understand SIM900B interface specifications, electrical and mechanical details. With the help of this document and other SIM900B application notes, user guide, users can use SIM900B to design various applications quickly.

2 SIM900B Overview

Designed for global market, SIM900B is a quad-band GSM/GPRS module that works on frequencies GSM 850MHz, EGSM 900MHz, DCS 1800MHz and PCS 1900MHz. SIM900B features GPRS multi-slot class 10/ class 8 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4.

With a tiny configuration of 40mm*33mm *3mm, SIM900B can meet almost all the space requirements in user applications, such as M2M, smart phone, PDA, FWP, and other mobile devices.

The physical interface to the mobile application is a 60-pin board-to-board connector, which provides all hardware interfaces between the module and customers' boards except the RF antenna interface.

- Serial port and Debug port can help user easily develop the applications.
- Two audio channels include two microphone inputs and two speaker outputs.
- Programmable general purpose input and output.
- The keypad and SPI display interface will give user the flexibility to develop customized applications.

SIM900B 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 SIM900B Key Features

Table 1: SIM900B 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)
Frequency bands	● SIM900B Quad-band: GSM 850, EGSM 900, DCS 1800, PCS 1900. SIM900B can search the 4 frequency bands automatically. The frequency bands also can be set by AT command "AT+CBAND". For details, please refer to *document [1]*. ● Compliant to GSM Phase 2/2+
Transmitting power	● Class 4 (2W) at GSM 850 and EGSM 900 ● Class 1 (1W) at DCS 1800 and PCS 1900
GPRS connectivity	● GPRS multi-slot class 10（default） ● GPRS multi-slot class 8 (option)
Temperature range	● Normal operation: -30°C ~ +80°C

	● Restricted operation: -40°C ~ -30°C and +80 °C ~ +85°C* ● Storage temperature -45°C ~ +90°C
Data GPRS	● GPRS data downlink transfer: max. 85.6 kbps ● GPRS data uplink transfer: max. 42.8 kbps ● Coding scheme: CS-1, CS-2, CS-3 and CS-4 ● Integrate the TCP/IP protocol. ● Support Packet Broadcast Control Channel (PBCCH)
CSD	● Support CSD transmission
USSD	● Unstructured Supplementary Services Data (USSD) support
SMS	● MT, MO, CB, Text and PDU mode ● SMS storage: SIM card
FAX	Group 3 Class 1
SIM interface	Support SIM card: 1.8V, 3V
External antenna	Antenna pad
Audio features	Speech codec modes: ● Half Rate (ETS 06.20) ● Full Rate (ETS 06.10) ● Enhanced Full Rate (ETS 06.50 / 06.60 / 06.80) ● Adaptive multi rate (AMR) ● Echo Cancellation ● Noise Suppression
Serial port and debug port	**Serial port:** ● Full modem interface with status and control lines, unbalanced, asynchronous. ● 1200bps to 115200bps. ● Can be used for AT commands or data stream. ● Support RTS/CTS hardware handshake and software ON/OFF flow control. ● Multiplex ability according to GSM 07.10 Multiplexer Protocol. ● Autobauding supports baud rate from 1200 bps to 57600bps. **Debug port:** ● Null modem interface DBG_TXD and DBG_RXD. ● Can be used for debugging and upgrading firmware.
Phonebook management	Support phonebook types: SM, FD, LD, RC, ON, MC.
SIM application toolkit	GSM 11.14 Release 99
Real time clock	Support RTC
Physical characteristics	Size: 40mm * 33mm*3mm Weight: 7g
Firmware upgrade	Firmware upgradeable by debug port.

*SIM900B does work at this temperature, but some radio frequency characteristics may deviate from the GSM specification.

Table 2: Coding schemes and maximum net data rates over air interface

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

2.2 Operating Modes

The table below summarizes the various operating modes of SIM900B.

Table 3: Overview of operating modes

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

2.3 SIM900B Functional Diagram

The following figure shows a functional diagram of SIM900B:

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

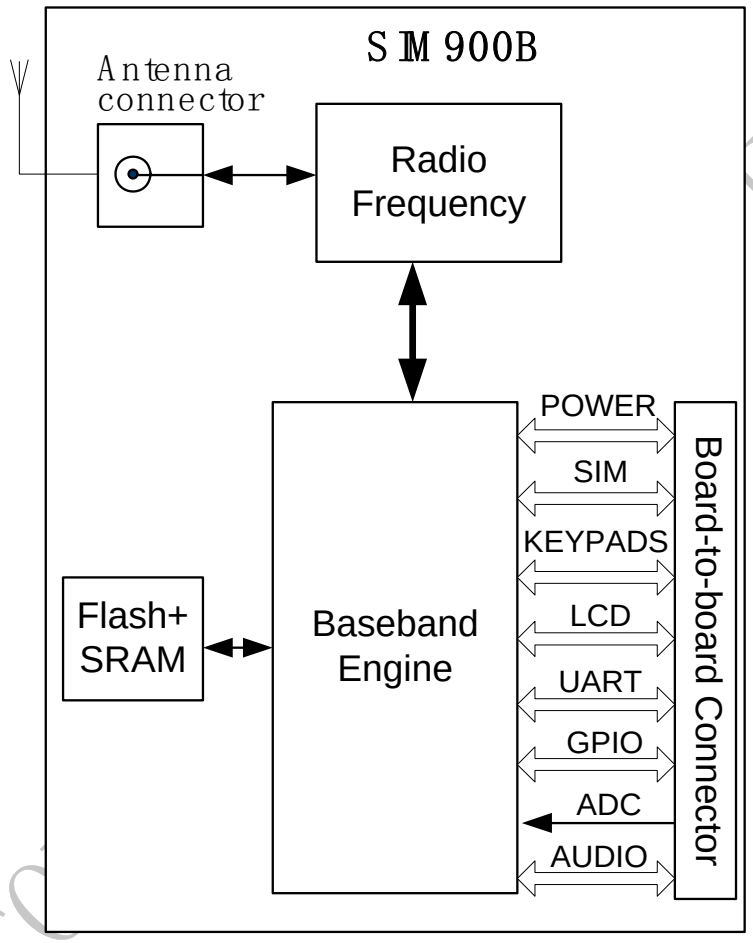


Figure 1: SIM900B functional diagram

3 Application Interface

3.1 Pin Description

Table 4: Pin description

Pin name	Pin number	I/O	Description	Comment
Power supply				
VBAT	1,2,3,4,5,6,7,8	I	Power supply	
VRTC	15	I/O	Power supply for RTC	It is recommended to connect with a battery or a capacitor (e.g. 4.7uF).
VDD_EXT	17	O	2.8V output power supply	If it is unused, keep open.
AGND	50，51		Analog ground	Separate ground connection for external audio circuits. If unused connect to GND directory.
GND	9,10,11,12,13, 14		Ground	
Power on/down				
PWRKEY	34	I	PWRKEY should be pulled low at least 1 second and then released to power on/down the module.	VILmax=0.9V VIHmin=2.6V VImax=3.3V VILmin= 0V It has been pulled up internally (3V).
Audio interfaces				
MIC1P	53	I	Differential audio input	If these pins are unused, keep open.
MIC1N	55			
SPK1P	54	O	Differential audio output	
SPK1N	56			
MIC2P	57	I	Differential audio input	
MIC2N	59			
SPK2P	58	O	Differential audio output	
SPK2N	60			
Status				
NETLIGHT	30	O	Network status	
LCD interface				
DISP _CLK	20	O	Display interface	If these pins are unused, keep open.
DISP_DATA	18	I/O		
DISP _D/C	24	O		

DISP _CS	22	O		
DISP_RST	26	O		
Keypad interface / GPIOs				
GPIO1/KBC4	35	I/O	Defaults are as GPIO, they can be multiplexed as keypad	If these pins are unused ,keep open
GPIO2/KBC3	33	I/O		
GPIO3/KBC2	31	I/O		
GPIO4/KBC1	29	I/O		
GPIO6/KBR3	45	I/O		
GPIO7/KBR4	43	I/O		
GPIO8/KBR2	41	I/O		
GPIO9/KBR1	39	I/O		
GPIO5/KBC0	27	I/O	GPIO	Just can be used as GPIO, if these pins are unused, keep open
GPIO10/KBR0	37			
Serial port				
RXD	40	I	Receive data	This pin should be pulled up to 3V externally.
TXD	42	O	Transmit data	If these pins are unused, keep open.
RTS	44	I	Request to send	
CTS	46	O	Clear to send	
RI	48	O	Ring indicator	
DCD	28	O	Data carry detect	
DTR	38	I	Data terminal Ready	
Debug interface				
DBG_TXD	49	O	Serial interface for debugging and firmware upgrade	If these pins are unused, keep open.
DBG_RXD	47	I		
SIM interface				
SIM_VDD	19	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. If SIM_PRESENCE is unused, just keep open
SIM_DATA	21	I/O	SIM data input/output	
SIM_CLK	23	O	SIM clock	
SIM_RST	25	O	SIM reset	
SIM_PRESENCE	16	I	SIM card detection	
ADC				
ADC0	52	I	General purpose analog to digital converter. Input voltage range: 0V ~ 2.8V	If it is unused ,keep open
Pulse Width Modulation				
BUZZER	36	O	PWM Output	If it is unused, keep open

3.2 Power Supply

The power supply range of SIM900B 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 µF is strongly recommended; this capacitor should be placed as close as possible to SIM900B 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.

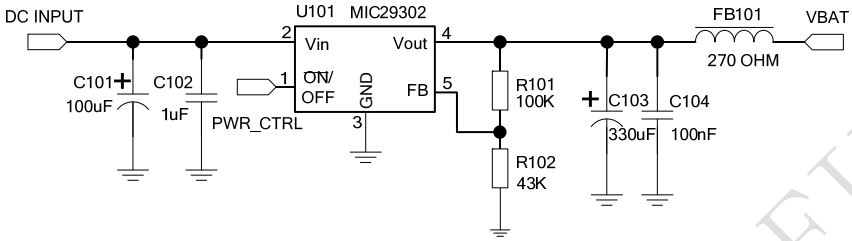


Figure 2: Reference circuit of the LDO power supply

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.

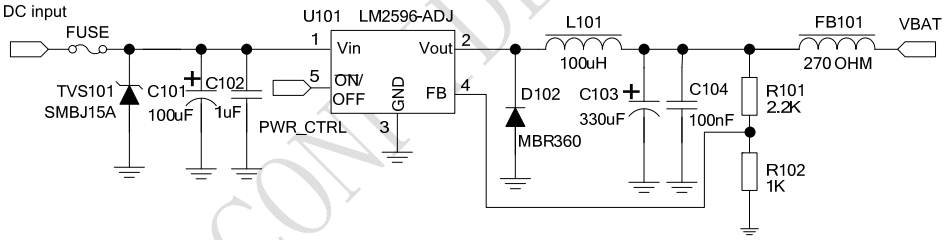


Figure 3: Reference circuit of the DC-DC power supply

The single 3.6V Li-ion cell battery can be connected to SIM900B VBAT pins directly. But the Ni-Cd or Ni-MH battery must be used carefully, since their maximum voltage can rise over the absolute maximum voltage of the module and damage it.

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

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

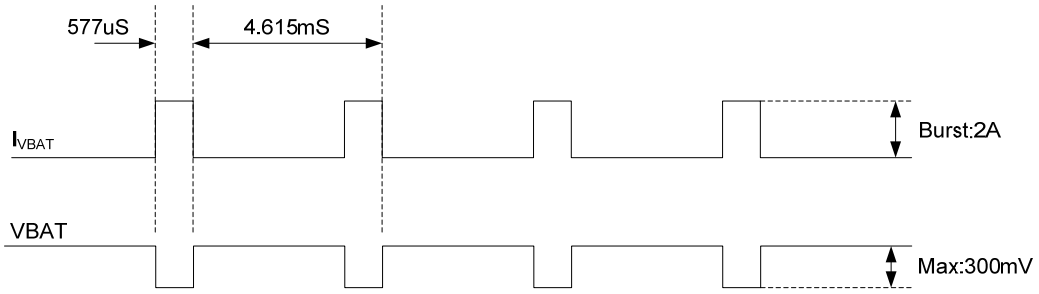


Figure 4: VBAT voltage drop during transmit burst

3.2.1 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.

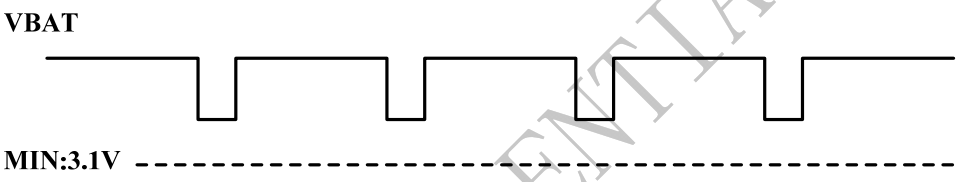


Figure 5: The minimal VBAT voltage requirement at VBAT drop

3.2.2 Monitoring Power Supply

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

3.3 Power on/down Scenarios

3.3.1 Power on SIM900B

3.3.1.1 Turn on SIM900B Using the PWRKEY Pin (Power on)

User can power on SIM900B 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.

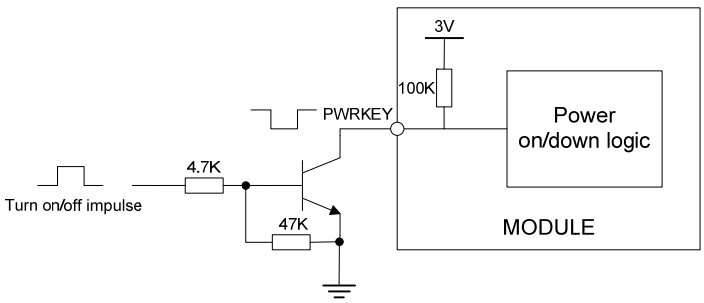


Figure 6: Powered on/down module using transistor

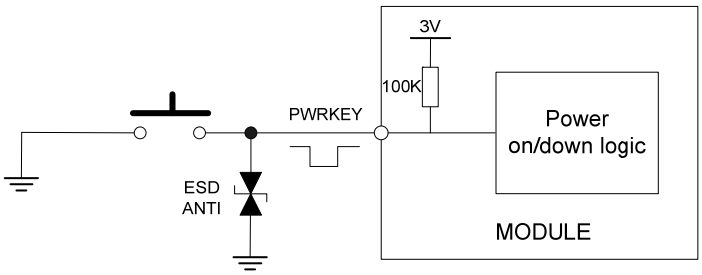


Figure 7: Powered on/down module using button

The power on scenarios is illustrated as following figure.

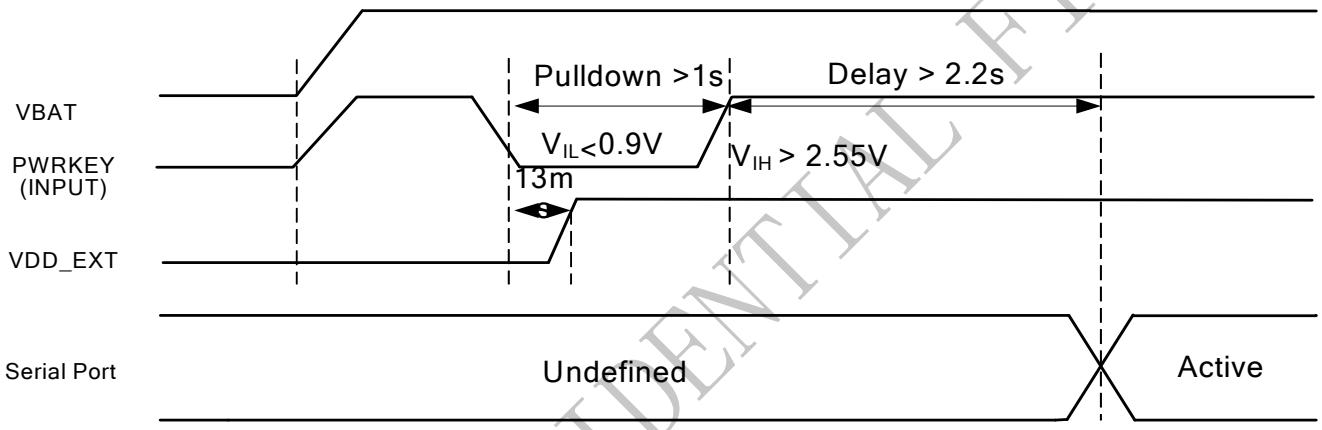


Figure 8: Timing of power on module

When power on procedure is completed, SIM900B 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 SIM900B is powered on. For details, please refer to the chapter "AT+IPR" in document [1].

3.3.2 Power down SIM900B

SIM900B will be powered down in the following situations:

- Normal power down procedure: power down SIM900B by the PWRKEY pin.
- Normal power down procedure: power down SIM900B 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.

3.3.2.1 Power down SIM900B by the PWRKEY Pin

User can power down SIM900B 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 the following figure.

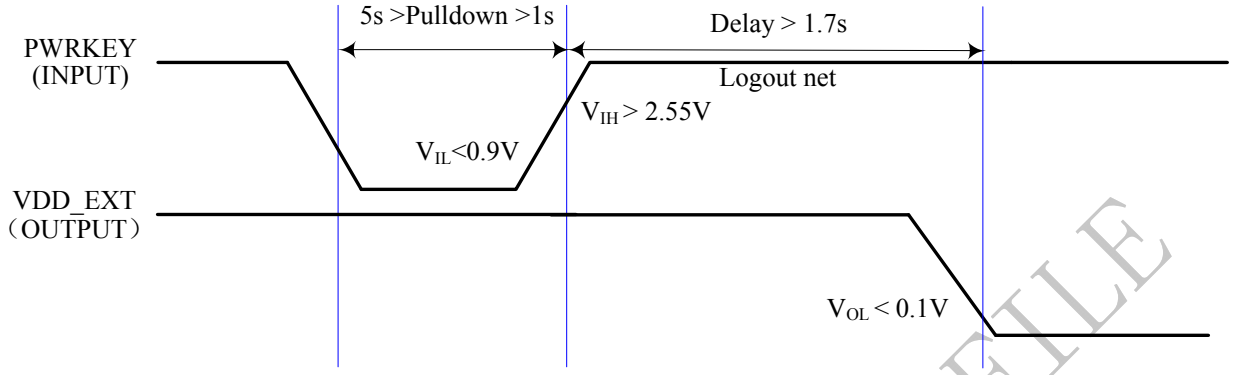


Figure 9: Timing of power down SIM900B by PWRKEY

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.

3.3.2.2 Power down of SIM900B by AT Command

SIM900B 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]*

3.3.2.3 Over-voltage or Under-voltage Power down

The module software monitors the VBAT voltage constantly.

If the voltage ≤ 3.3V, the following URC will be reported:

UNDER-VOLTAGE WARNNING

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

OVER-VOLTAGE WARNNING

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

UNDER-VOLTAGE POWER DOWN

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

OVER-VOLTAGE POWER DOWN

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

3.3.2.4 Over-temperature or Under-temperature Power down

The module will constantly monitor the temperature of the module,

If the temperature > +80℃, the following URC will be reported:

+CMTE: 1

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

+CMTE:-1

If the temperature > +85℃, the following URC will be reported, and the module will be automatically powered down.

+CMTE: 2

If the temperature < -40℃, 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]*.

3.3.3 Restart SIM900B 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.

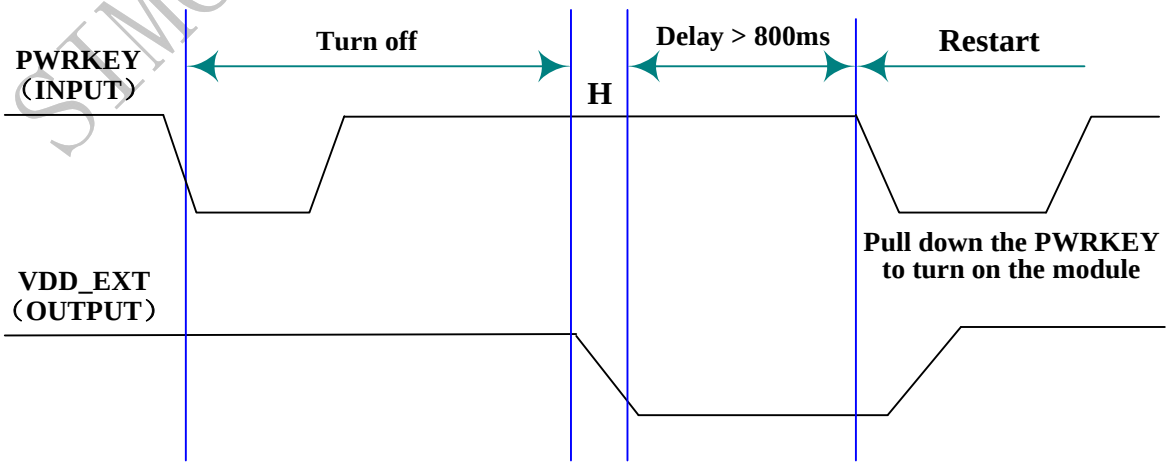


Figure 10: Timing of restart SIM900B

3.4 Power Saving Mode

SIM900B has 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 consumption of the module is very low. The AT command "AT+CFUN=<fun>" can be used to set SIM900B into minimum functionality. When SIM900B is in sleep mode and minimum functionality, the current of module is the lowest.

3.4.1 Minimum Functionality Mode

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

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

Minimum functionality mode minimizes the current consumption to the lowest level. If SIM900B is set to minimum functionality by "AT+CFUN=0", the RF function and SIM card function will be disabled. In this case, the serial port is still accessible, but all AT commands correlative with RF function and SIM card function will not be accessible.

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

Table 5:The Current consumption of Minimum Functionality Mode

<fun>	Current consumption(uA) (sleep mode)
0	651
1	1000
4	715

3.4.2 Sleep Mode 1 (AT+CSCLK=1)

User can control SIM900B 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), SIM900B will enter sleep mode 1 automatically. In this mode, SIM900B can still receive paging or SMS from network but the serial port is not accessible.

Note: For SIM900B, it is requested to set AT command "AT+CSCLK=1" and to ensure DTR at high level to enable the sleep mode 1; the default value is 0, which can not make the module to go into sleep mode. For more details please refer to document [1].

3.4.3 Wake Up SIM900B from Sleep Mode 1 (AT+CSCLK=1)

When SIM900B 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.

3.4.4 Sleep Mode 2 (AT+CSCLK=2)

In this mode, SIM900B 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), SIM900B will enter sleep mode 2 automatically. In this mode, SIM900B can still receive paging or SMS from network but the serial port is not accessible.

Note: For SIM900B, 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].

3.4.5 Wake Up SIM900B from Sleep Mode 2 (AT+CSCLK=2)

When SIM900B is in sleep mode 2 (AT+CSCLK=2), the following methods can wake up the module:

- Send data to SIM900B 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.

3.5 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 the 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**

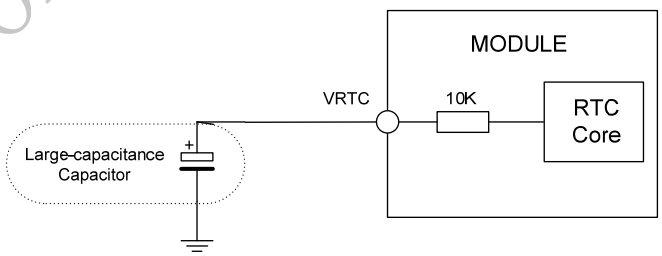


Figure 11: RTC supply from capacitor

- **Non-chargeable battery backup**

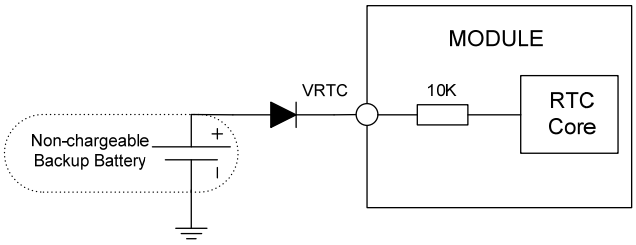


Figure 12: RTC supply from non-chargeable battery

- **Rechargeable battery backup**

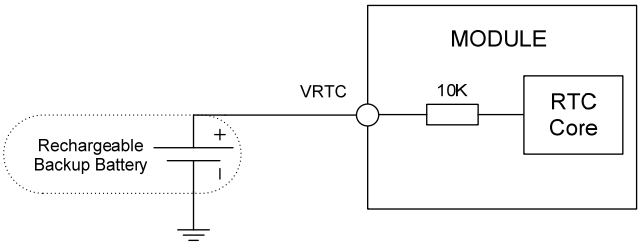


Figure 13: RTC supply from rechargeable battery

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

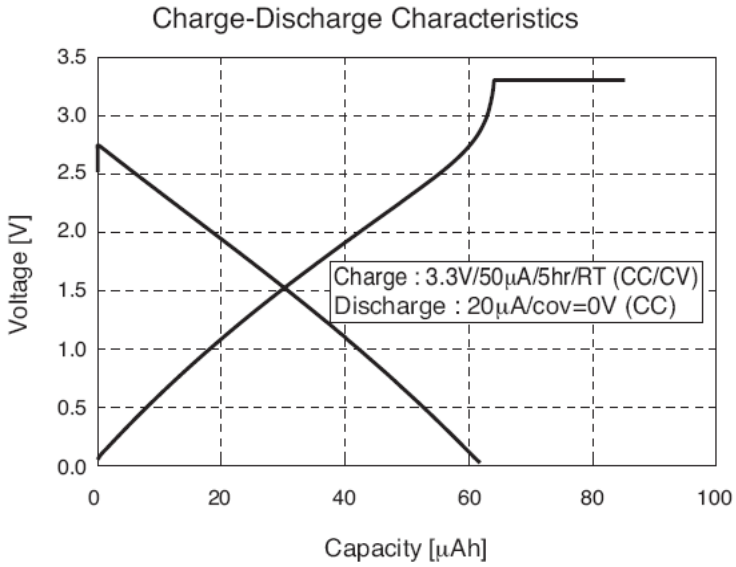


Figure 14: Seiko XH414H-IV01E Charge-Discharge Characteristic

3.6 Serial Interfaces

SIM900B 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).

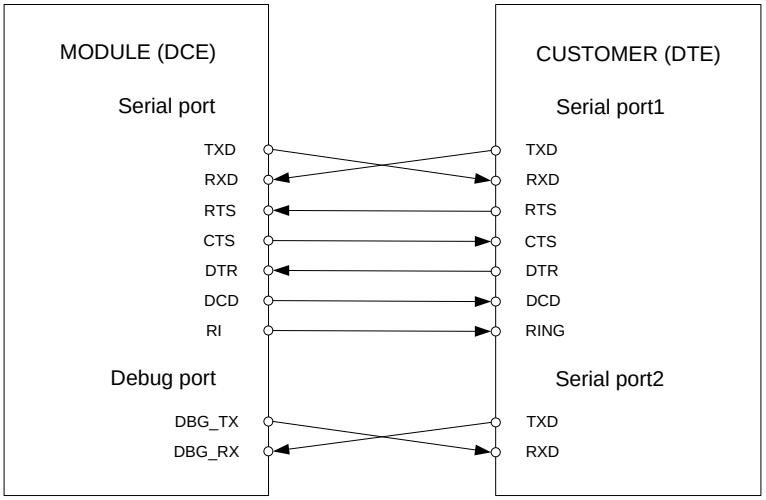


Figure 15: Connection of the serial interfaces

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

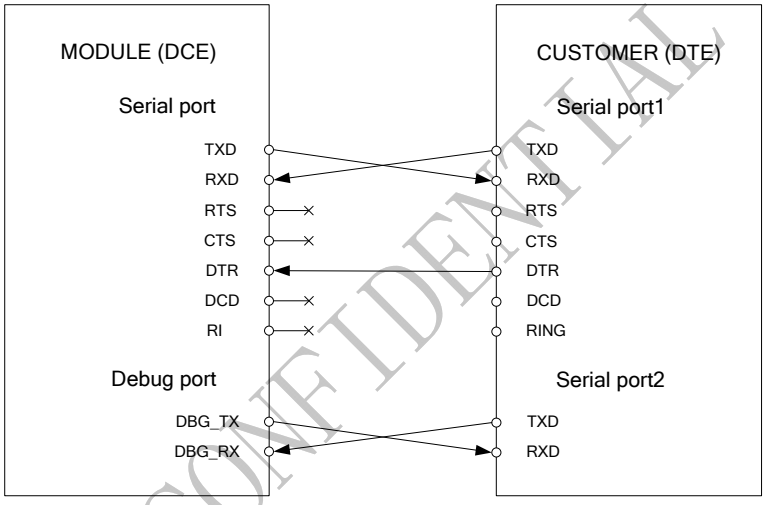


Figure 16: Connection of RXD and TXD only

Note: if sleep mode is need in this situation, the user nees to connect the DTR signal as well, or only sleep mode2 can be used. For details, please refer to document [7].

3.6.1 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 [7]*.
- 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 SIM900B 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 SIM900B is powered on.

Debug port:

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

3.6.2 Software Upgrade and Debug

Refer to the following figure for debugging and upgrading software.

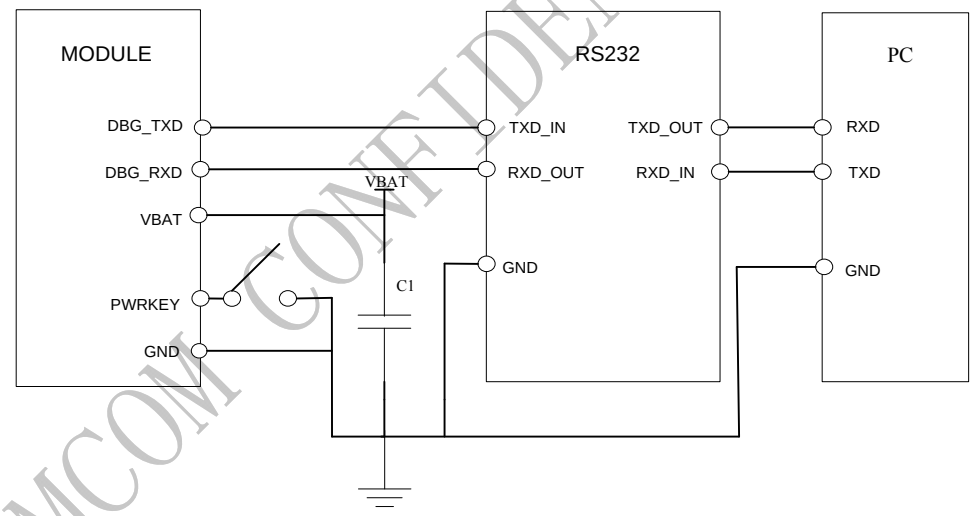


Figure 17: Connection for software upgrading and debugging

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]*.

3.7 Audio Interfaces

SIM900B 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.

3.7.1 Speaker Interface Configuration

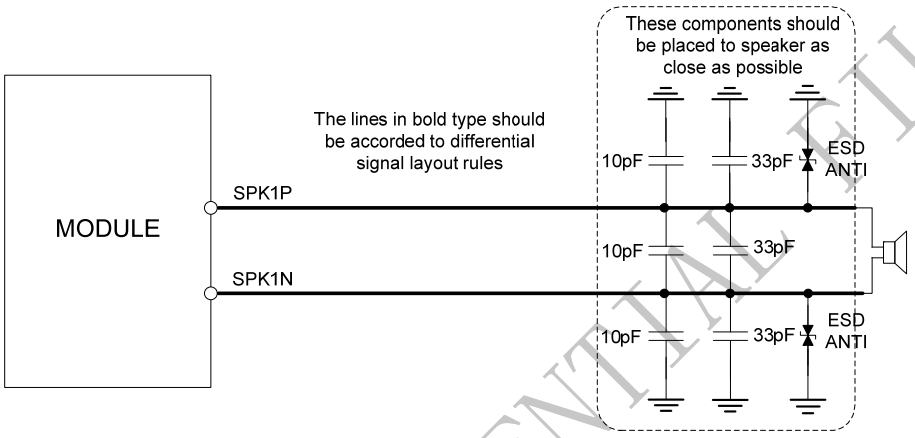


Figure 18: Speaker reference circuit

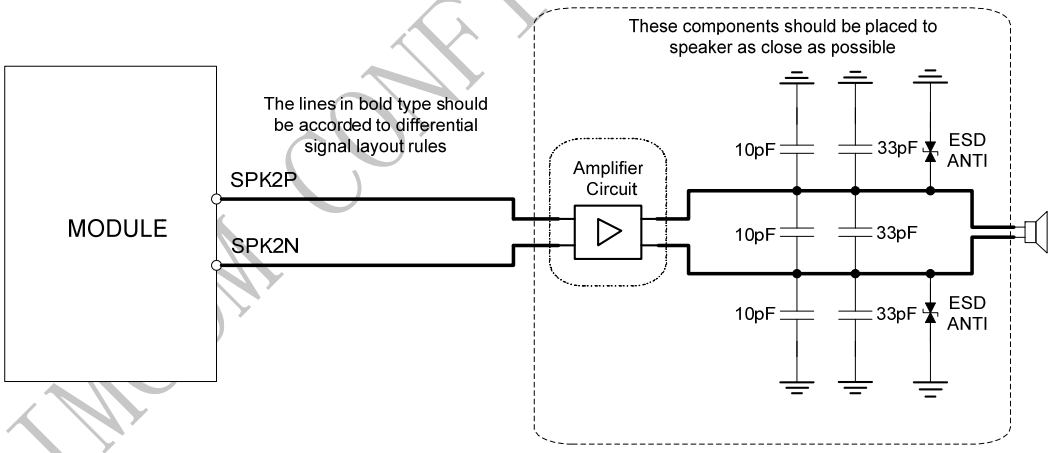


Figure 19: Speaker with amplifier reference circuit

3.7.2 Microphone Interfaces Configuration

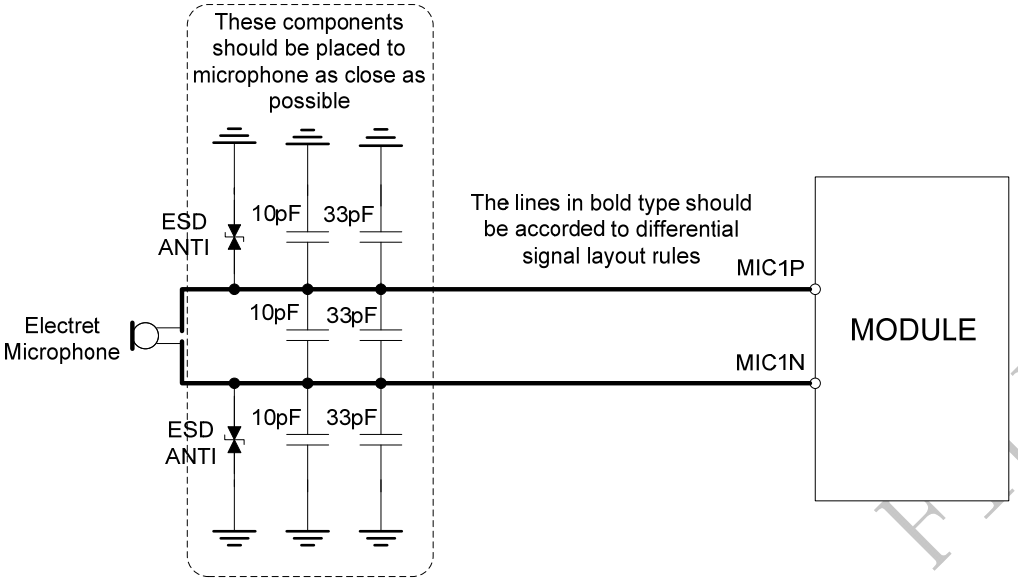


Figure 20: Microphone reference circuit

3.7.3 Earphone Interface Configuration

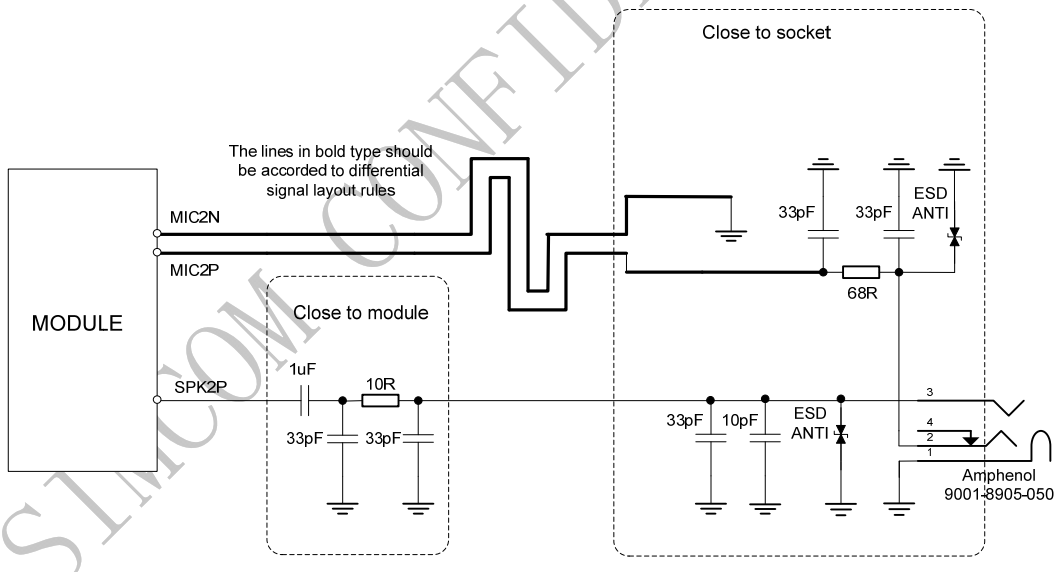


Figure 21: Earphone reference circuit

3.7.4 Audio Electronic Characteristics

Table 6: Microphone Input Characteristics

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

Table 7: Audio Output Characteristics

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

3.8 SIM Card Interface

3.8.1 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 cards are supported. The SIM interface is powered from an internal regulator in the module.

It is recommended to use an ESD protection component such as ST (www.st.com) ESDA6V1W5 or ON SEMI (www.onsemi.com) SMF05C.The pull-up resistor (15KΩ) 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.

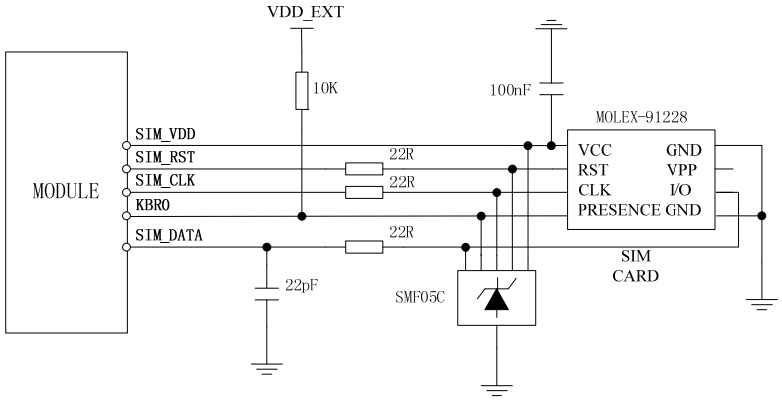


Figure 22: Reference circuit of the 8-pin SIM card holder

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.

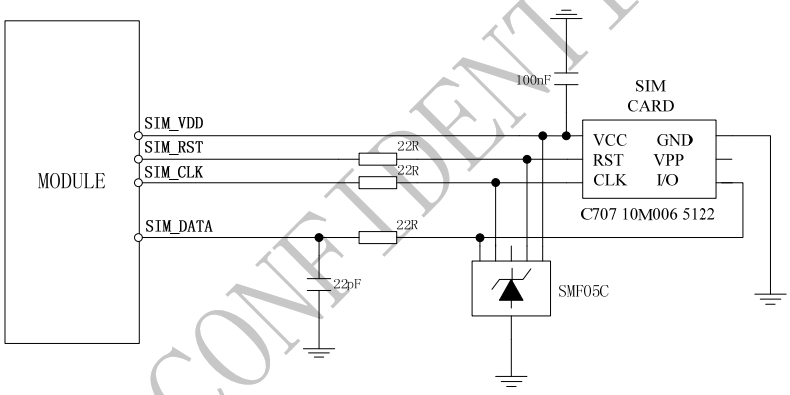


Figure 23: Reference circuit of the 6-pin SIM card holder

3.8.2 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.

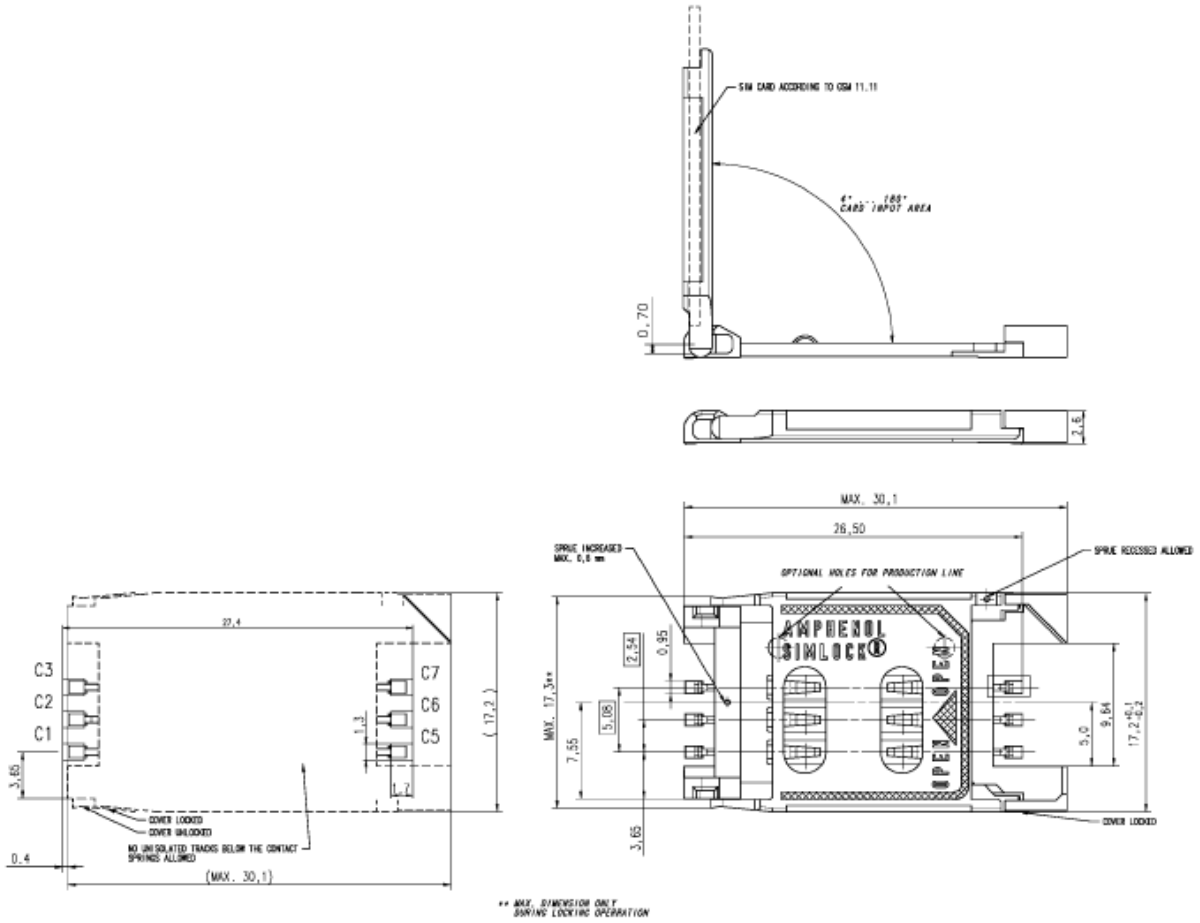


Figure 24: Amphenol C707 10M006 5122 SIM card holder

Table 8: Pin description (Amphenol SIM card holder)

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

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

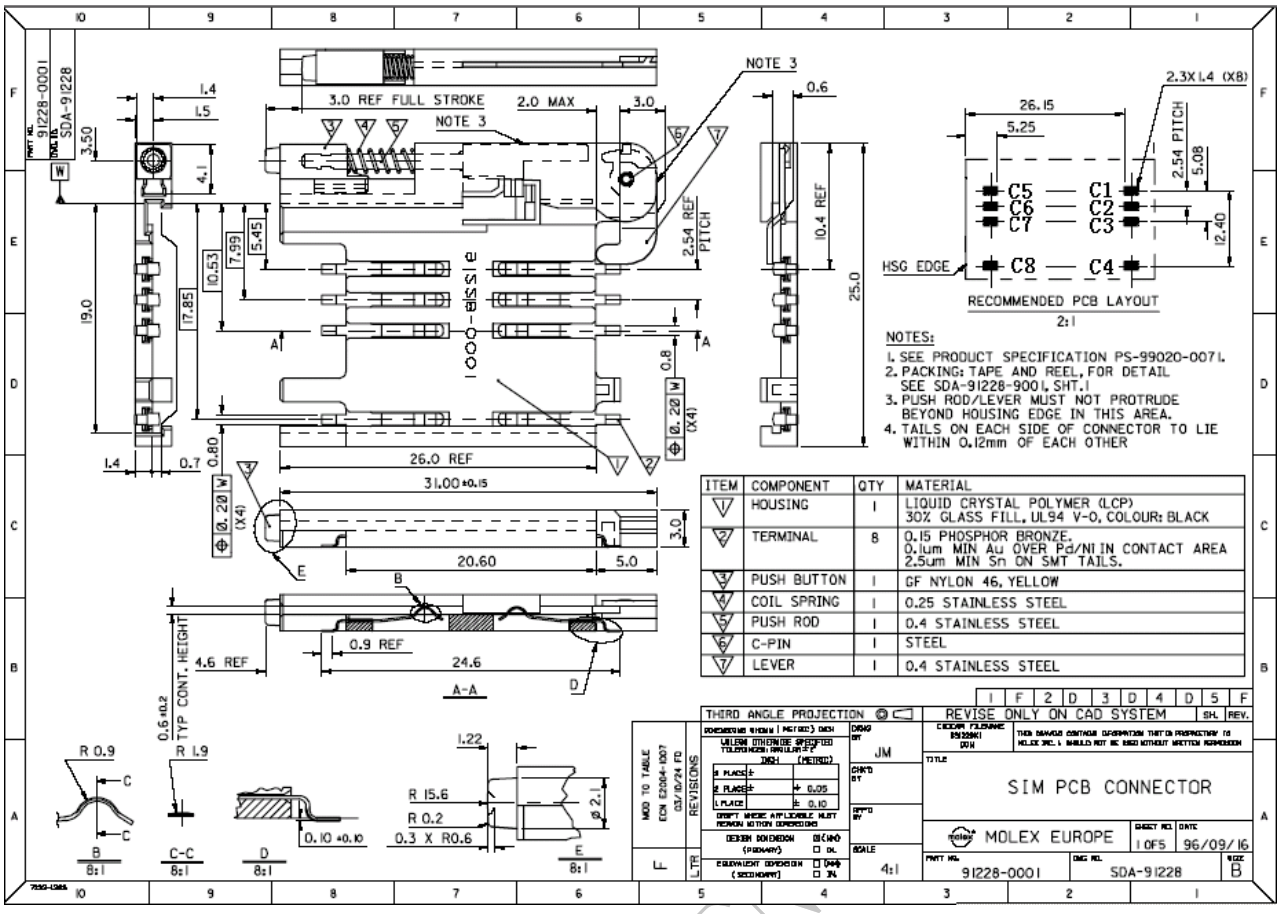


Figure 25: Molex 91228 SIM card holder

Table 9: Pin description (Molex SIM card holder)

Pin name	Signal	Description
C1	SIM_VDD	SIM card power supply
C2	SIM_RST	SIM card reset
C3	SIM_CLK	SIM card clock
C4	GND	Connect to GND
C5	GND	Connect to GND
C6	VPP	Not connect
C7	SIM_DATA	SIM card data I/O
C8	SIM_PRESENCE	Detect SIM card presence

3.9 LCD Display/SPI Interface

SIM900B 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 [6]*.

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.

3.10 ADC

SIM900B provides an auxiliary ADC, which can be used to measure the voltage. User can use AT command "AT+CADC" to read the voltage value. For details of this AT command, please refer to *document [1]*.

Table 10: ADC specification

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

3.11 RI Behaviors

Table 11: RI Behaviors

State	RI response
Standby	High
Voice call	The pin is changed to low. When any of the following events occurs, the pin will be changed to high: （1）Establish the call （2）Hang up the call
Data call	The pin is changed to low. When any of the following events occurs, the pin will be changed to high: （1）Establish the call （2）Hang up the call
SMS	The pin is changed to low, and kept low for 120ms when a SMS is received. Then it is changed to high.
URC	The pin is changed to low, and kept low for 120ms when some URCs are reported. Then it is changed to high. For more details, please refer to *document [7]*.

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

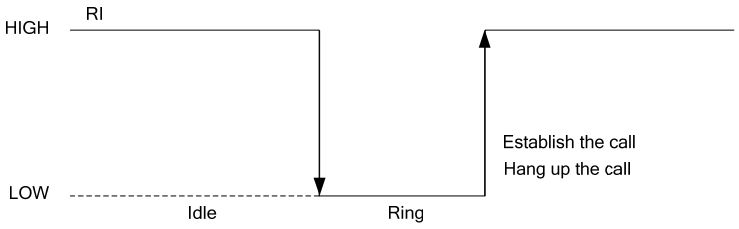


Figure 26: RI behaviour of voice calling as a receiver

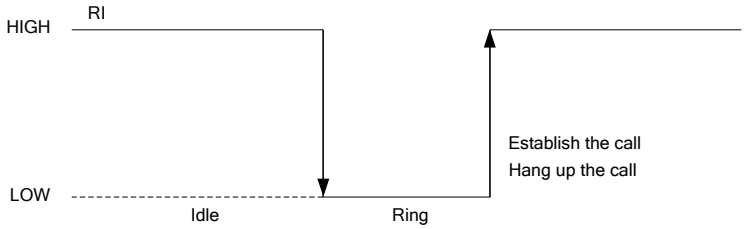


Figure 27: RI behaviour of data calling as a receiver

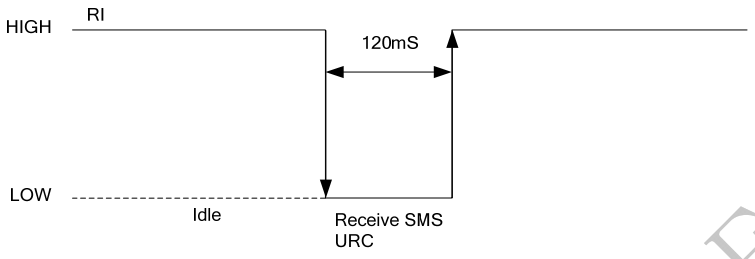


Figure 28: RI behaviour of URC or receive SMS

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

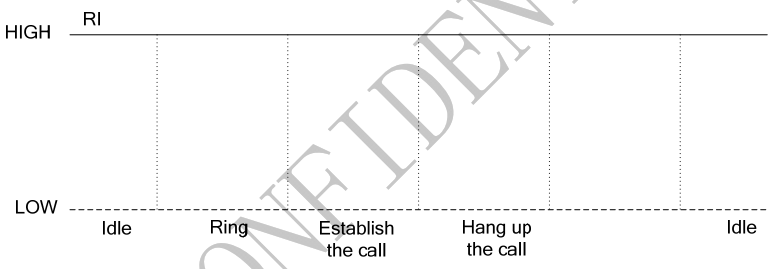


Figure 29: RI behaviour as a caller

3.12 Network Status Indication

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

Table 12: Status of the NETLIGHT pin

Status	SIM900B behavior
Off	SIM900B is not running
64ms On/ 800ms Off	SIM900B not registered the network
64ms On/ 3000ms Off	SIM900B registered to the network
64ms On/ 300ms Off	GPRS communication is established

A reference circuit is recommended in the following figure:

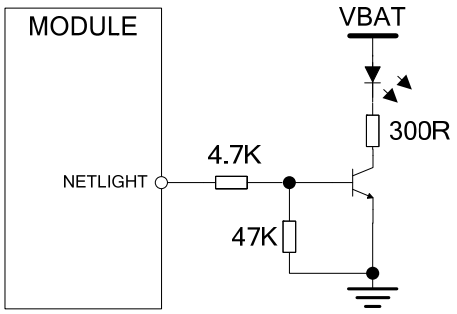


Figure 30: Reference circuit of NETLIGHT

3.13 General Purpose Input/Output (GPIO)

3.14 Keypad Interface

The keypad interface consists of 5 keypad column outputs and 4 keypad row inputs. The basic configuration is 5 keypad columns and 4 keypad rows, giving 20 keys.

Table 13: Pin definition of the keypad interface

Name	Pin	Function
GPIO5/KBC0	27	Keypad matrix column
GPIO4/KBC1	29	
GPIO3/KBC2	31	
GPIO2/KBC3	33	
GPIO1/KBC4	35	
GPIO9/KBR1	39	Keypad matrix row
GPIO8/KBR2	41	
GPIO7/KBR3	43	
GPIO6/KBR4	45	

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

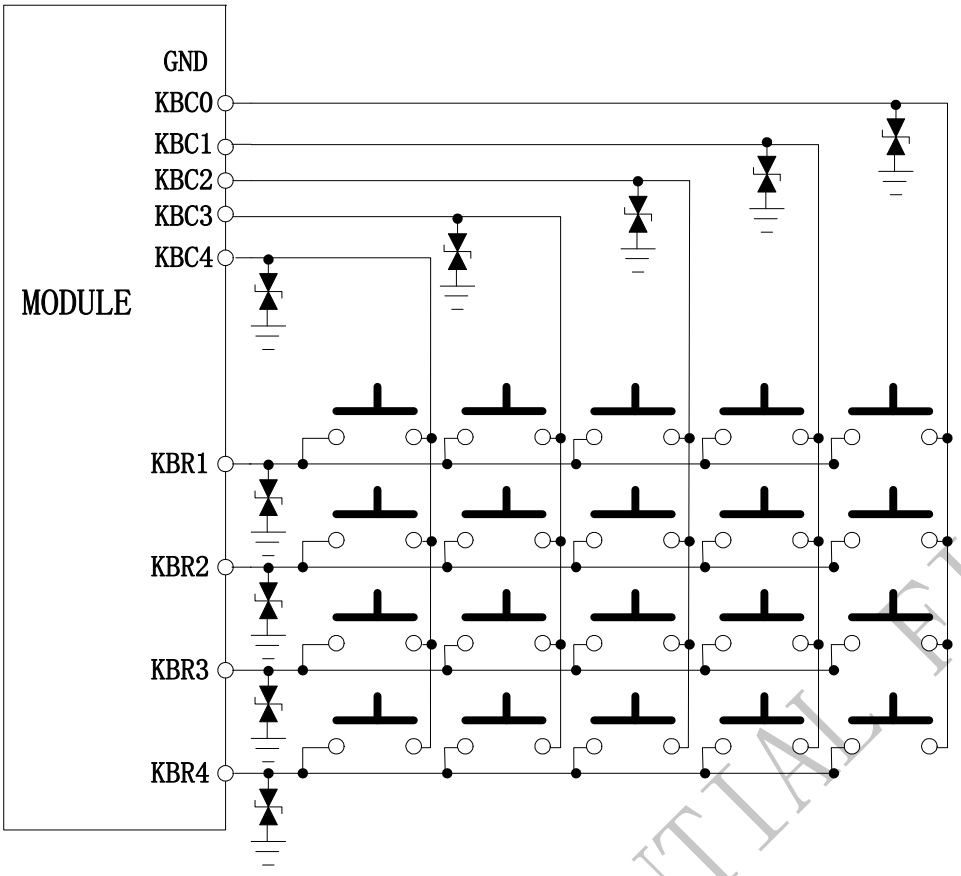


Figure 31: Reference circuit of the keypad interface

***Note:**

1. 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.

2. KBR0&KBC0 are used to power off the module, so user can't connect these two pins as a key.

3. keypad is the second function of these pins, the default function is GPIO.

3.15 Buzzer

Features of buzzer:

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

The 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.

For details, please refer to document[1]

4 Electrical, Reliability and Radio Characteristics

4.1 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 SIM900B.

Table 14: Absolute maximum ratings

Symbol	Parameter	Min	Typ	Max	Unit
VBAT	Power supply voltage	-	-	5.5	V
V_I*	Input voltage	-0.3	-	3.1	V
I_I*	Input current	-	-	10	mA
I_O*	Output current	-	-	10	mA

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

4.2 Recommended Operating Conditions

Table 15: Recommended operating conditions

Symbol	Parameter	Min	Typ	Max	Unit
VBAT	Power supply voltage	3.2	4.0	4.8	V
T_{OPER}	Operating temperature	-40	+25	+85	℃
T_{STG}	Storage temperature	-45		+90	℃

4.3 Digital Interface Characteristics

Table 16: Digital interface characteristics

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

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

4.4 SIM Card Interface Characteristics

Table 17: SIM card interface characteristics

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

4.5 SIM_VDD Characteristics

Table 18: SIM_VDD characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V_O	Output voltage	2.75	2.9	3.00	V
		1.65	1.80	1.95	
I_O	Output current	-	-	10	mA

4.6 VRTC Characteristics

Table 19: VRTC characteristics

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

4.7 Current Consumption (VBAT = 3.8V)

Table 20: Current consumption

Symbol	Parameter	Conditions		Value	Unit
I_{VRTC}	VRTC current	VBAT disconnects. Backup battery is 3 V		2	uA
I_{VBAT}	VBAT current	Power down mode		30	uA
		Sleep mode	BS-PA-MFRMS=9	1.0	mA

			BS-PA-MFRMS=5		1.2	
			BS-PA-MFRMS=2		1.5	
		Idle mode	GSM 850		22	mA
			EGSM 900			
			DCS 1800			
			PCS 1900			
		Voice call	GSM 850 EGSM 900	PCL=5	250	mA
				PCL=12	110	
				PCL=19	80	
			DCS 1800 PCS 1900	PCL=0	180	
				PCL=7	94	
				PCL=15	76	
		Data mode GPRS(1Rx,1Tx)	GSM 850 EGSM 900	PCL=5	235	mA
				PCL=12	102	
				PCL=19	74	
			DCS 1800 PCS 1900	PCL=0	170	mA
				PCL=7	90	
				PCL=15	70	
		Data mode GPRS(4Rx,1Tx)	GSM 850 EGSM 900	PCL=5	273	mA
				PCL=12	145	
				PCL=19	120	
			DCS 1800 PCS 1900	PCL=0	205	mA
				PCL=7	130	
				PCL=15	110	
		Data mode GPRS(3Rx,2Tx)	GSM 850 EGSM 900	PCL=5	440	mA
				PCL=12	185	
				PCL=19	125	
			DCS 1800 PCS 1900	PCL=0	320	mA
				PCL=7	155	
				PCL=15	120	
$I_{VBAT-peak}$	Peak current	During Tx burst			2	A

4.8 Electro-Static Discharge

SIM900B 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 21: The ESD characteristics (Temperature: 25℃, Humidity: 45 %)

Pin	Contact discharge	Air discharge
VBAT	±5KV	±10KV
GND	±5KV	±10KV

RXD, TXD	±2KV	±8KV
Antenna port	±5KV	±10KV
SPK1P/ SPK1N SPK2P/ SPK2N MIC1P/ MIC1N MIC2P/ MIC2N	±2KV	±5KV
PWRKEY	±2KV	±8KV

4.9 Radio Characteristics

4.9.1 Module RF Output Power

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

Table 22: SIM900B 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 23: SIM900B 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	±4	±5
12	6	±4	±5
13	4	±4	±5
14	2	±5	±6
15-28	0	±5	±6

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

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

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

4.9.2 Module RF Receive Sensitivity

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

Table 24: SIM900B conducted RF receive sensitivity

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

4.9.3 Module Operating Frequencies

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

Table 25: SIM900B operating frequencies

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

5 Manufacturing

This chapter describes the mechanical dimensions of SIM900B.

5.1 Mechanical Dimensions of SIM900B

Following figure shows the Mechanical dimensions of SIM900B (top view, side view and bottom view).

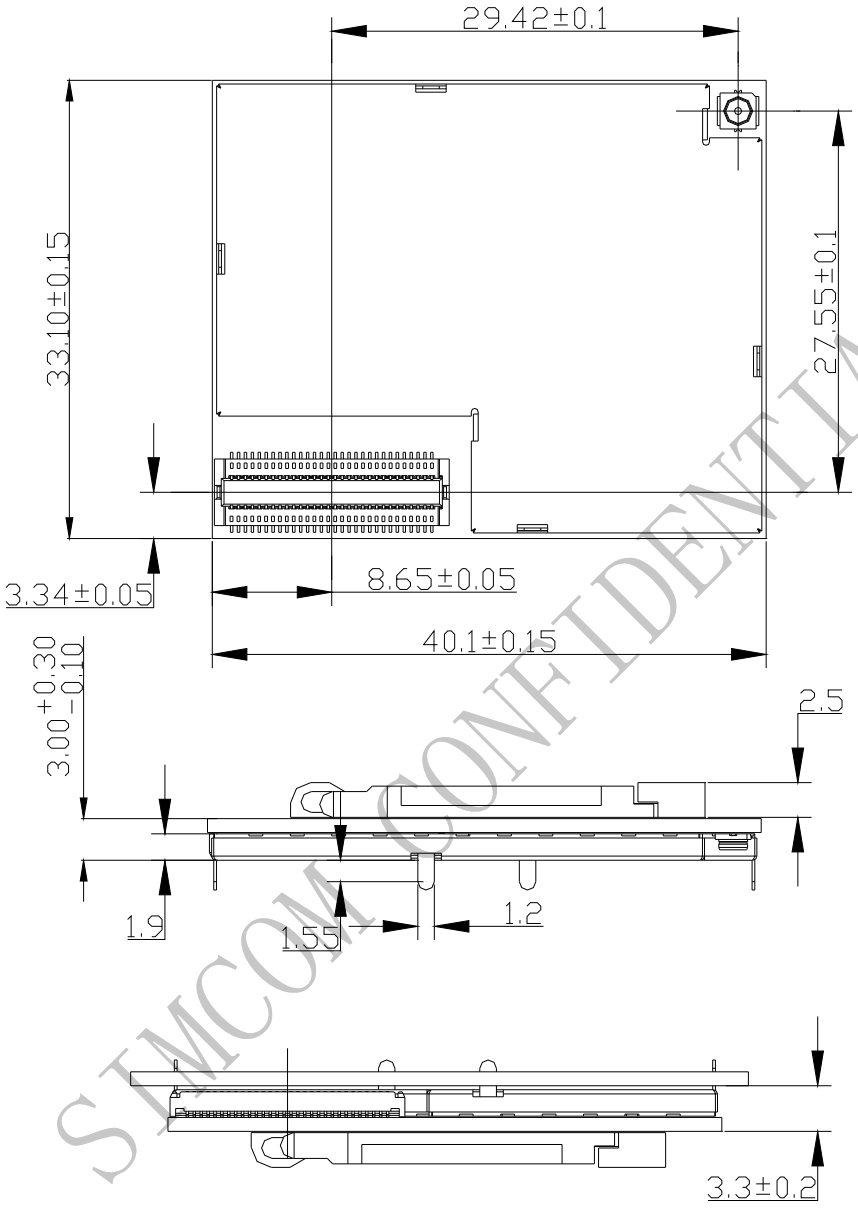


Figure 32: Top an Side Mechanical dimensions of module （Unit: mm）

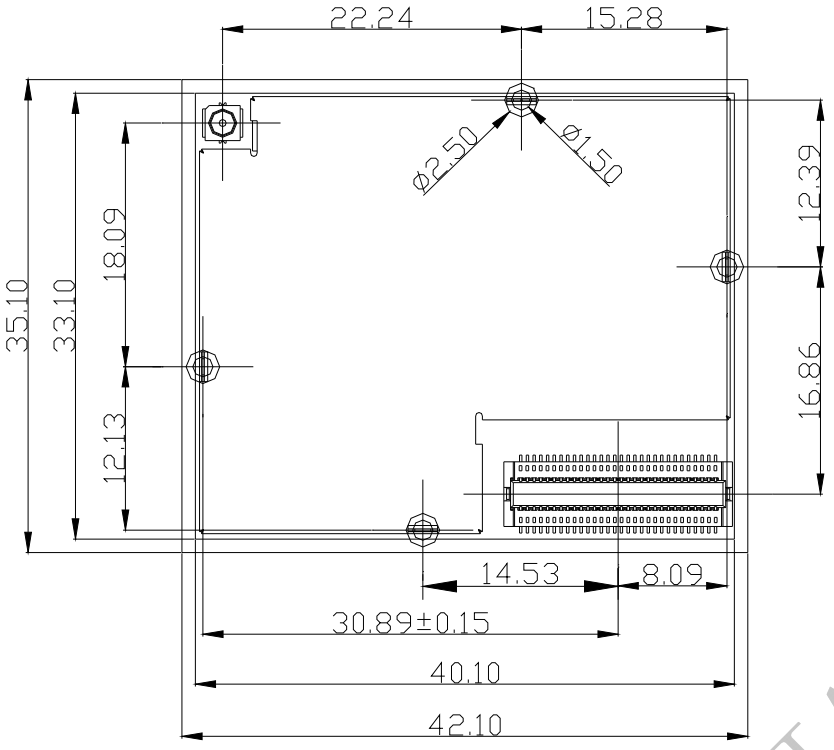


Figure 33: Recommended PCB footprint outline（Unit: mm）

5.2 Mounting SIM900B onto the application platform

Use the connector BB530-06001-20R to fix the SIM900B onto the customer platform.

5.3 Board-to-board connector

SIMCom recommends to use RUNFENG Company's BB530-06001-20R as the board-to-board connector. This high density SMT connector is designed for parallel PCB-to-PCB applications. It is ideal to use in VCRs, notebook PCs, cordless telephones, mobile phones, audio/visual and other telecommunications equipment where reduced size and weight are important. Following is the parameter of BB530-06001-20R. User can contact SIMCom for more information.

5.4 Mechanical dimensions of the RUNFENG BB530-06001-20R

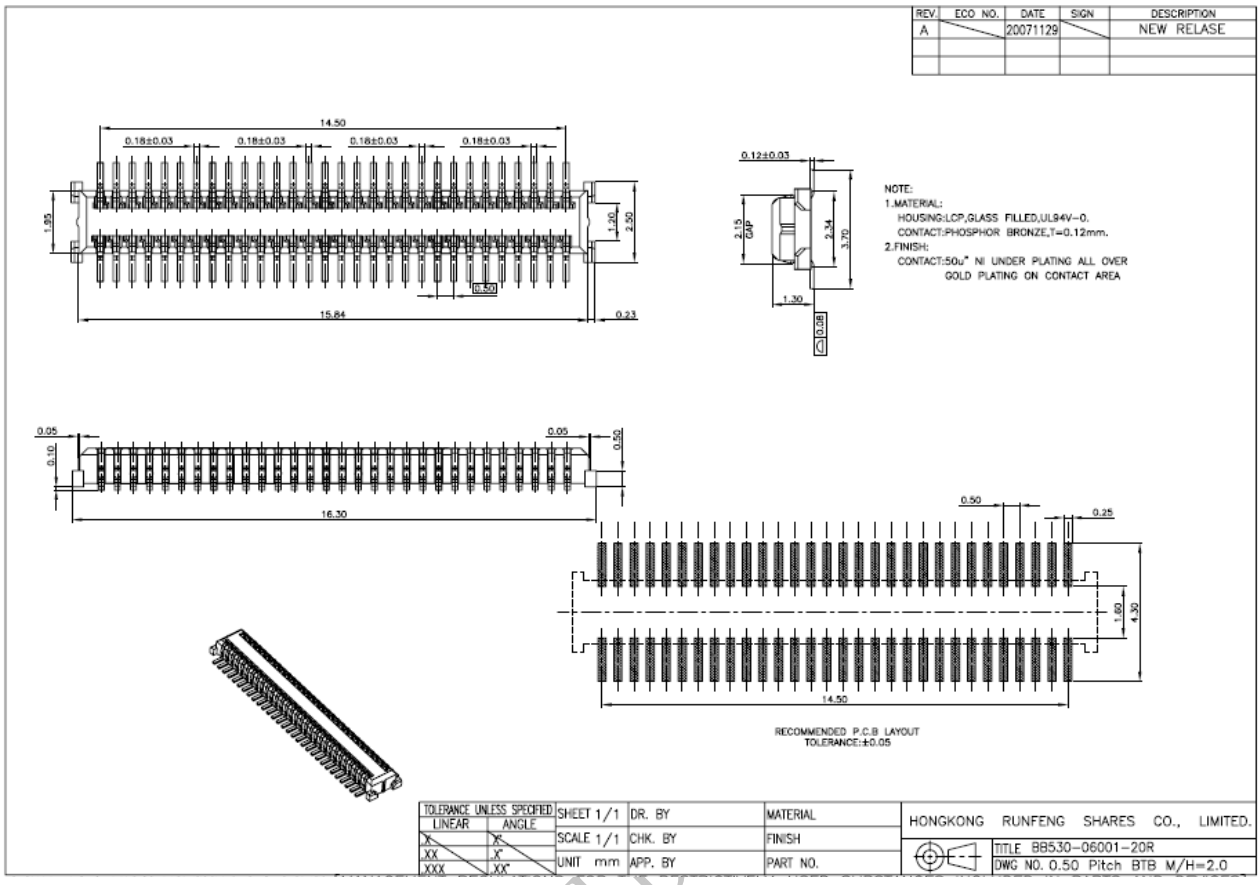


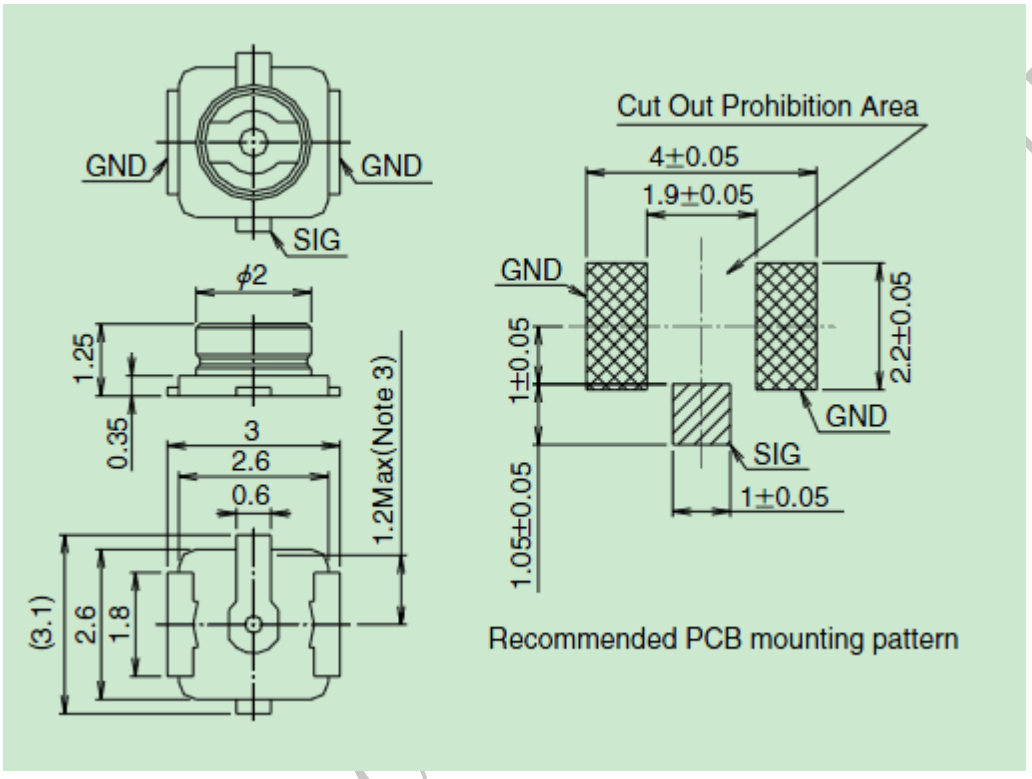
Figure 34: BB530-06001-20R board-to-board connector

Figure 35 : Board-to-board connector physical photo

5.5 RF connector

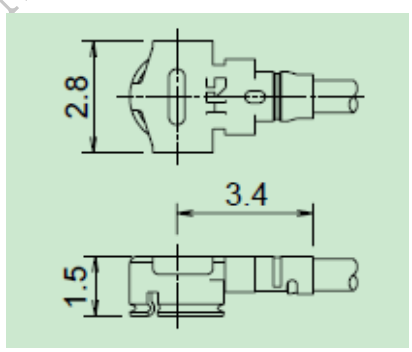
The RF connector in the module side is an ultra small surface mount coaxial connectors (Part Number: U.FL-R-SMT, vended by HRS). It has high performance with wide frequency range, surface mountable and reflows solderable. Following are parameters (Figure 36). Certainly user can visit http://www.hirose-connectors.com/ 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 (Figure 41) is the dimensions of U.FL series RF adapter cable. User can contact SIMCom for more information.



Unit:mm

Figure 36: U.FL-R-SMT



Unit:mm

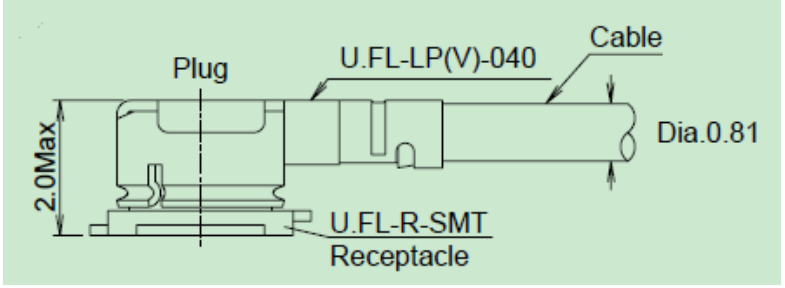


Figure 37: U.FL series RF adapter cable

5.6 Top View of the SIM900B

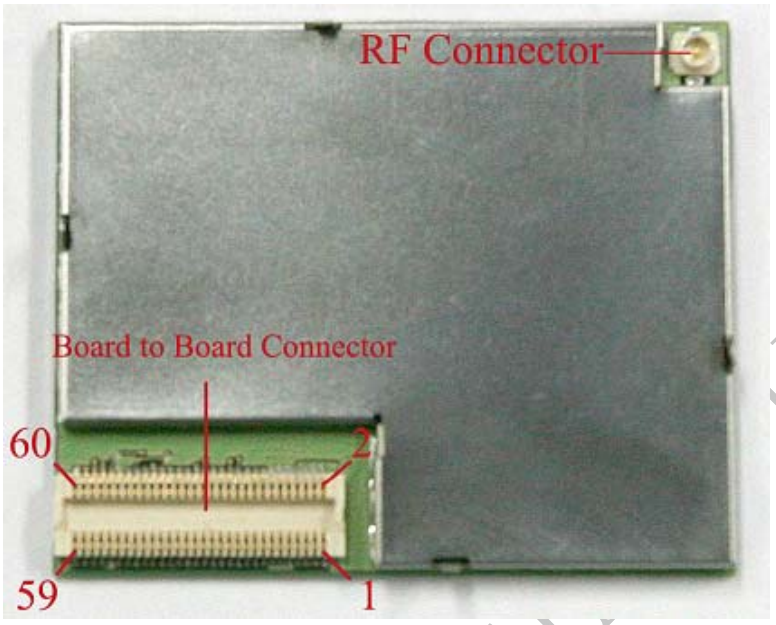


Figure 38: Top view of the SIM900B

5.7 PIN Assignment of SIM900B

Table 26: PIN assignment

PIN NO.	PIN NAME	I/O		PIN NO.	PIN NAME	I/O
1	VBAT	I		2	VBAT	I
3	VBAT	I		4	VBAT	I
5	VBAT	I		6	VBAT	I
7	VBAT	I		8	VBAT	I
9	GND			10	GND	
11	GND			12	GND	
13	GND			14	GND	
15	VRTC	I/O		16	SIM_PRESENCE	I
17	VDD_EXT	O		18	DISP_DATA	I/O
19	SIM_VDD	O		20	DISP_CLK	O
21	SIM_DATA	I/O		22	DISP_CS	O
23	SIM_CLK	O		24	DISP_D/C	O
25	SIM_RST	O		26	DISP_RST	O
27	GPIO5/KBC0	I/O		28	DCD	O
29	GPIO4/KBC1	I/O		30	NETLIGHT	O
31	GPIO3/KBC2	I/O		32	GPIO0	I/O
33	GPIO2/KBC3	I/O		34	PWRKEY	I
35	GPIO1/KBC4	I/O		36	BUZZER	O
37	GPIO10/KBR0	I/O		38	DTR	I
39	GPIO9/KBR1	I/O		40	RXD	I
41	GPIO8/KBR2	I/O		42	TXD	O
43	GPIO7/KBR3	I/O		44	RTS	I
45	GPIO6/KBR4	I/O		46	CTS	O
47	DBG_RXD	I		48	RI	O
49	DBG_TXD	O		50	AGND	
51	AGND			52	ADC0	I
53	MIC1P	I		54	SPK1P	O
55	MIC1N	I		56	SPK1N	O
57	MIC2P	I		58	SPK2P	O
59	MIC2N	I		60	SPK2N	O

Appendix

A. Related Documents

Table 27: Related documents

SN	Document name	Remark
[1]	SIM900_AT Command Manual	SIM900 AT Command Manual
[2]	AN_SIM900_TCPIP	TCP/IP Applications User Manual
[3]	SIM900_Multiplexer User Manual_Application Note	SIM900 Multiplexer User Manual Application Note
[4]	AN_SIM900 Series_Update Tool_UGD	SIM900 Series Update Tool User Guide
[5]	AN_SIM900_AUDIO	Applications Note About SIM900 Audio
[6]	SIM900_Embedded AT Application Note	SIM900 Embedded AT Application Note
[7]	AN_Serial Port	Application Note About Serial Port
[8]	AN_SIM900-TE PCB Layout & Schematic for Reference	Application Note About SIM900-TE PCB Layout & Schematic
[9]	Module secondary-SMT-UGD	Module secondary SMT User Guide
[10]	ITU-T Draft new recommendation V.25ter:	Serial asynchronous automatic dialing and control
[11]	GSM 07.07:	Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)
[12]	GSM 07.10:	Support GSM 07.10 multiplexing protocol
[13]	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)
[14]	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
[15]	GSM 11.11:	Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[16]	GSM 03.38:	Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information
[17]	GSM 11.10	Digital cellular telecommunications system (Phase 2)； Mobile Station (MS) conformance specification； Part 1: Conformance specification

B. Terms and Abbreviations

Table 28: 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
Phonebook abbreviations	
FD	SIM fix dialing phonebook
LD	SIM last dialing phonebook (list of numbers most recently dialed)
MC	Mobile Equipment list of unanswered MT calls (missed calls)
ON	SIM (or ME) own numbers (MSISDNs) list
RC	Mobile Equipment list of received calls
SM	SIM phonebook
NC	Not connect

C. Safety Caution

Table 29: Safety caution

Marks	Requirements
	When in a hospital or other health care facility, observe the restrictions about the use of mobiles. Switch the cellular terminal or mobile off, medical equipment may be sensitive to not operate normally for RF energy interference.
	Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it is switched off. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. Forget to think much of these instructions may lead to the flight safety or offend against local legal action, or both.
	Do not operate the cellular terminal or mobile in the presence of flammable gases or fumes. Switch off the cellular terminal when you are near petrol stations, fuel depots, chemical plants or where blasting operations are in progress. Operation of any electrical equipment in potentially explosive atmospheres can constitute a safety hazard.
	Your cellular terminal or mobile receives and transmits radio frequency energy while switched on. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment.
	Road safety comes first! Do not use a hand-held cellular terminal or mobile when driving a vehicle, unless it is securely mounted in a holder for hands free operation. Before making a call with a hand-held terminal or mobile, park the vehicle.
	GSM cellular terminals or mobiles operate over radio frequency signals and cellular networks and cannot be guaranteed to connect in all conditions, for example no mobile fee or a invalid SIM card. While you are in this condition and need emergent help, please remember using emergency calls. In order to make or receive calls, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength. Some networks do not allow for emergency call if certain network services or phone features are in use (e.g. lock functions, fixed dialing etc.). You may have to deactivate those features before you can make an emergency call. Also, some networks require that a valid SIM card be properly inserted in the cellular terminal or mobile.

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