3.2. Pin Description

Table 4: Pin description

Pin name	Pin number	I/O	Description	Comment
Power supply				
VBAT	1,42	I	Power supply	
VRTC	56	I/O	Power supply for RTC	It is recommended to connect with a battery or a capacitor (e.g. 4.7uF).
VEXT	18	O	2.8V power output	If these pins are unused, keep open.
GND	2,6,8,35,37,38,39,41,43,44,45,58,67,71,72,73,76,77,78,79,80,81,82,83,84,85,86,87,88		Ground	GND for VBAT recommend to use 2,43,44,45pin
Power on/down				
PWRKEY	48	I	PWRKEY should be pulled low at least 1 second and then released to power on/down the module.	Internally pulled up to VBAT.
Audio interfaces				
MIC1P	52	I	Differential audio input	If these pins are unused, keep open.
MIC1N	12			
SPK1P	53	O	Differential audio output	
SPK1N	13			
MIC2P	9	I	Differential audio input	
MIC2N	10			
SPK2P	51	O	Differential audio output	
SPK2N	11			
PCM interface				
PCMCLK	29	O	PCM interface for audio	If these pins are unused, keep open.
PCMOUT	30	O		
PCMSYNC	65	O		
PCMIN	66	I		
Keypads interface				
COL4	24	I	Support up to 50 buttons (5*5*2)	If these pins are unused, keep open.（Pin number 20 external cannot be pulled down）
COL3	21	I		
COL2	22	I		
COL1	25	I		
COL0	20	I		
ROW4	63	O		
ROW3	23	O		

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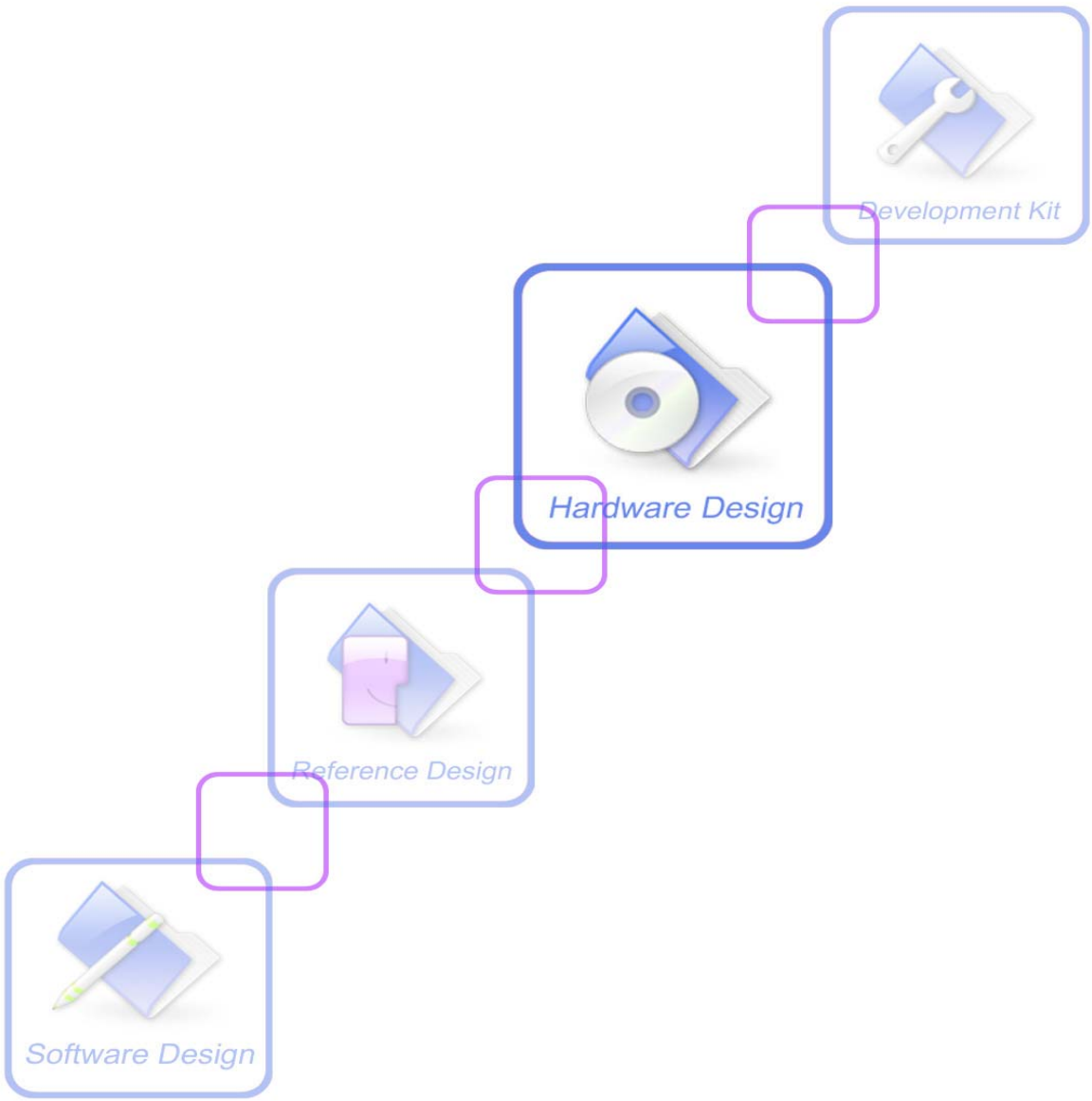

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Version History

Date	Version	Description of change	Author
2013-08-20	1.00	Origin	Jialin.song; Ya.li

1. Introduction

This document describes SIM800L hardware interface in great detail.
This document can help user to quickly understand SIM800L interface specifications, electrical and mechanical details. With the help of this document and other SIM800L application notes, user guide, users can use SIM800L to design various applications quickly.

2. SIM800L Overview

SIM800L is a quad-band GSM/GPRS module, that works on frequencies GSM850MHz, EGSM900MHz, DCS1800MHz and PCS1900MHz. SIM800L features GPRS multi-slot class 12/ class 10 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4.

With a tiny configuration of 15.8*17.8*2.4mm, SIM800L can meet almost all the space requirements in user applications, such as smart phone, PDA and other mobile devices.

SIM800L has 88pin pads of LGA packaging, and provides all hardware interfaces between the module and customers' boards.

- Support 5*5*2 keypads
- One full modem serial port, user can configure two serial ports
- One USB, the USB interfaces can debug, download software
- Audio channel which includes two microphone input; a receiver output and a speaker output
- Programmable general purpose input and output.
- A SIM card interface
- Support FM
- Support one PWM

SIM800L is designed with power saving technique so that the current consumption is as low as 0.7mA in sleep mode.

2.1. SIM800L Key Features

Table 1: SIM800L key features

Feature	Implementation
Power supply	3.4V ~4.4V
Power saving	typical power consumption in sleep mode is 0.7mA (AT+CFUN=0)
Frequency bands	● Quad-band: GSM 850, EGSM 900, DCS 1800, PCS 1900. SIM800L can search the 4 frequency bands automatically. The frequency bands can also be set by AT command "AT+CBAND". For details, please refer to document [1]. ● Compliant to GSM Phase 2/2+
Transmitting power	● Class 4 (2W) at GSM 850 and EGSM 900 ● Class 1 (1W) at DCS 1800 and PCS 1900
GPRS connectivity	● GPRS multi-slot class 12（default） ● GPRS multi-slot class 1~12 (option)
Temperature range	● Normal operation: -40°C ~ +85°C

	● Storage temperature -45°C ~ +90°C
Data GPRS	● GPRS data downlink transfer: max. 85.6 kbps ● GPRS data uplink transfer: max. 85.6 kbps ● Coding scheme: CS-1, CS-2, CS-3 and CS-4 ● PAP protocol for PPP connect ● Integrate the TCP/IP protocol. ● Support Packet Broadcast Control Channel (PBCCH) ● CSD transmission rates：2.4，4.8，9.6，14.4 kbps
CSD	● Support CSD transmission
USSD	● Unstructured Supplementary Services Data (USSD) support
SMS	● MT, MO, CB, Text and PDU mode ● SMS storage: SIM card
SIM interface	Support SIM card: 1.8V, 3V
External antenna	Antenna pad
Audio features	Speech codec modes: ● Half Rate (ETS 06.20) ● Full Rate (ETS 06.10) ● Enhanced Full Rate (ETS 06.50 / 06.60 / 06.80) ● Adaptive multi rate (AMR) ● Echo Cancellation ● Noise Suppression
Serial port and 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. ● upgrading firmware **Debug port:** ● USB_DM and USB_DP ● 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
Timing functions	Use AT command set
Physical characteristics	Size:15.8*17.8*2.4mm Weight:1.35g
Firmware upgrade	Main serial port or USB port.

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 Mode

The table below summarizes the various operating modes of SIM800L.

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 is registered to the GSM network, and the module is ready to communicate.
	GSM TALK	Connection between two subscribers is in progress. In this case, the power consumption depends on network settings such as DTX off/on, FR/EFR/HR, hopping sequences, antenna.
	GPRS STANDBY	Module is ready for GPRS data transfer, but no data is currently sent or received. In this case, power consumption depends on network settings and GPRS configuration.
	GPRS DATA	There is GPRS data transfer (PPP or TCP or UDP) in progress. In this case, power consumption is related with network settings (e.g. power control level); uplink/downlink data rates and GPRS configuration (e.g. used multi-slot settings).
Power down	Normal power down by sending AT command “AT+CPOWD=1” or using the PWRKEY. The power management unit shuts down the power supply for the baseband part of the module, 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. Functional Diagram

The following figure shows a functional diagram of SIM800L:

- GSM baseband
- GSM RF
- Antenna interface
- Other interface

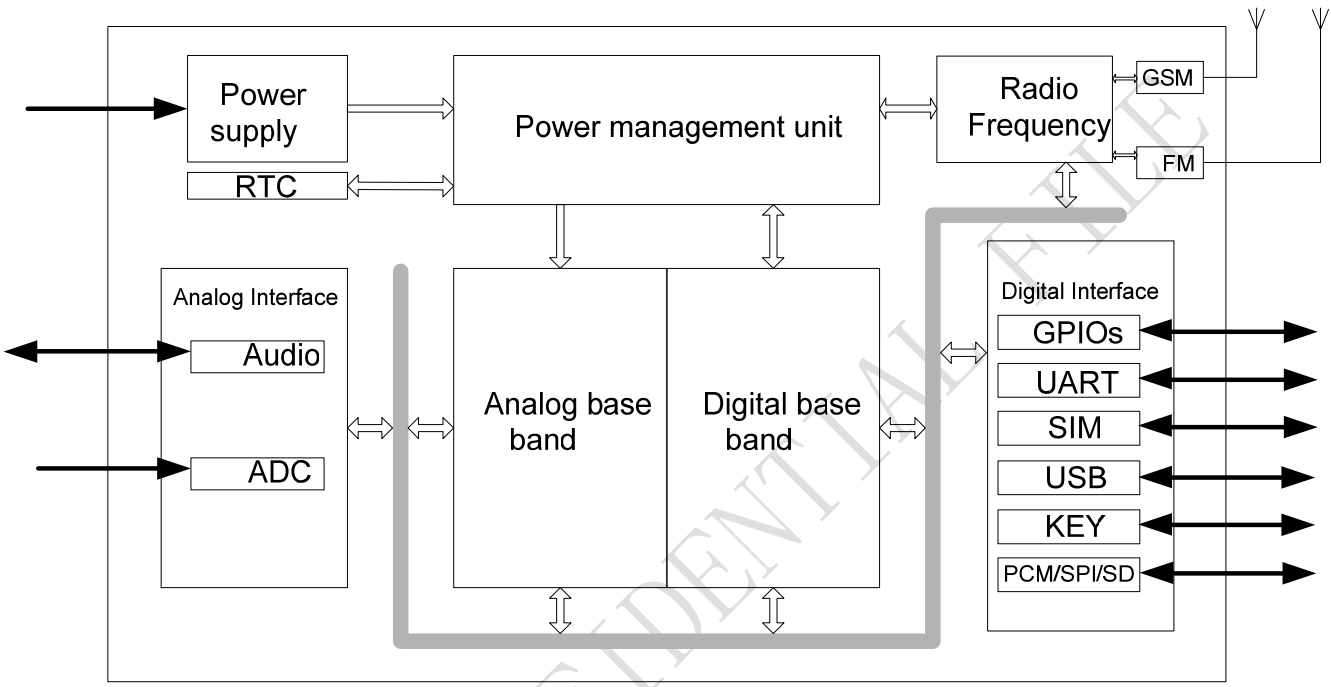


Figure 1: SIM800L functional diagram

3. Package Information

3.1. Pin out Diagram

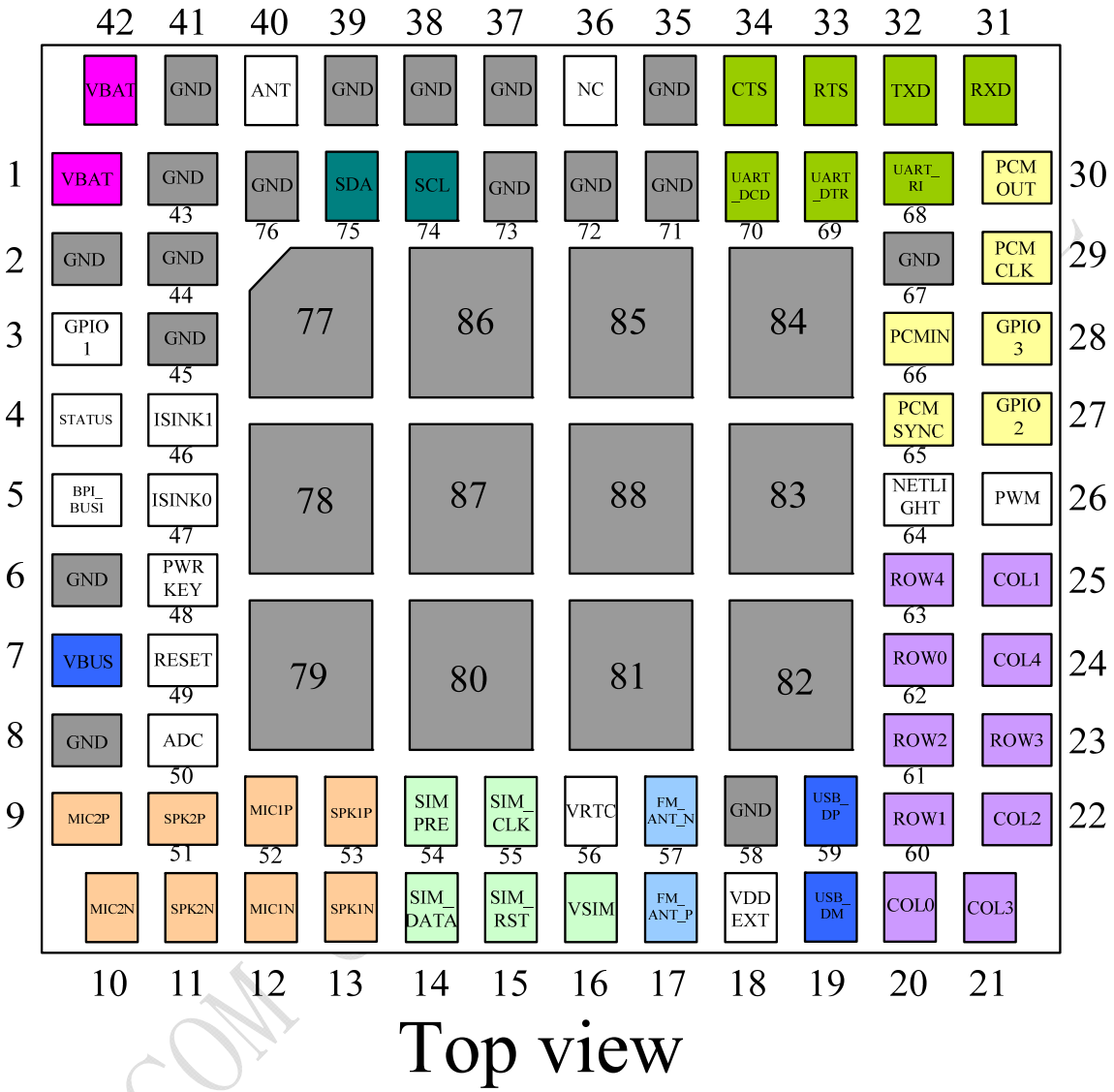


Figure 2: SIM800L pin out diagram (Top view)

ROW2	61	O		
ROW1	60	O		
ROW0	62	O		
GPIO				
GPIO1	3	I/O	Programmable general purpose input and output	
GPIO2	27	I/O		
GPIO3	28	I/O		
NETLIGHT	64	O	Network status	
STATUS	4	O	Power on status	
Serial port				
UART_DTR	69	I	Data terminal ready	If these pins are unused, keep open.
UART_RI	68	O	Ring indicator	
UART_DCD	70	O	Data carrier detect	
CTS	34	O	Request to send	
RTS	33	I	Clear to send	
TXD	32	O	Transmit data	
RXD	31	I	Receive data	
Debug interface				
VBUS	7	I	Debug and download	If these pins are unused, keep open.
USB_DP	59	I/O		
USB_DM	19	I/O		
ADC				
ADC	50	I	10bit general analog to digital converter	If these pins are unused, keep open.
PWM				
PWM	26	O	Pulse-width modulation	If these pins are unused, keep open.
I^2C				
SDA	75	I/O	I^2C serial bus data	Need external pulled up
SCL	74	O	I^2C serial bus clock	
SIM card interface				
VSIM	16	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	14	I/O	SIM data input/output	
SIM_CLK	55	O	SIM clock	
SIM_RST	15	O	SIM reset	
SIMPRE	54	I	SIM card detection	Reservation function
Antenna interface				
ANT	40	I/O	Connect GSM antenna	
FM_ANT_P	17	I	Differential antenna for FM	
FM_ANT_N	57	I		
Synchronizing signal of RF				

BPI_BUS1	5	O	Synchronizing signal of RF	
Other				
RESET	49	I	Reset input(Active low)	
ISINK1	46	I	Drive keypad backlight	
ISINK0	47	I	Drive LCD backlight	
NC				
NC	36			

3.3. Package Dimensions

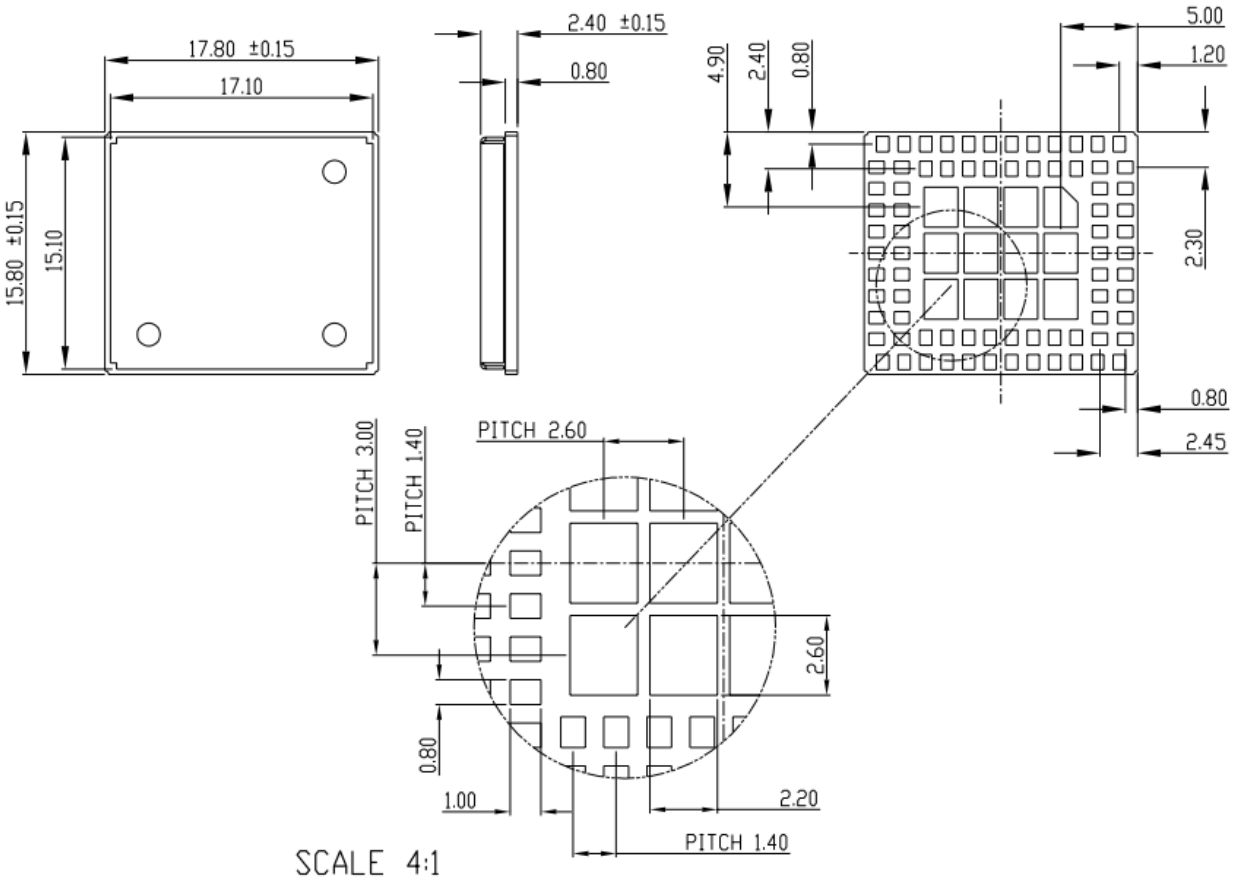


Figure 3: Dimensions of SIM800L (Unit: mm)

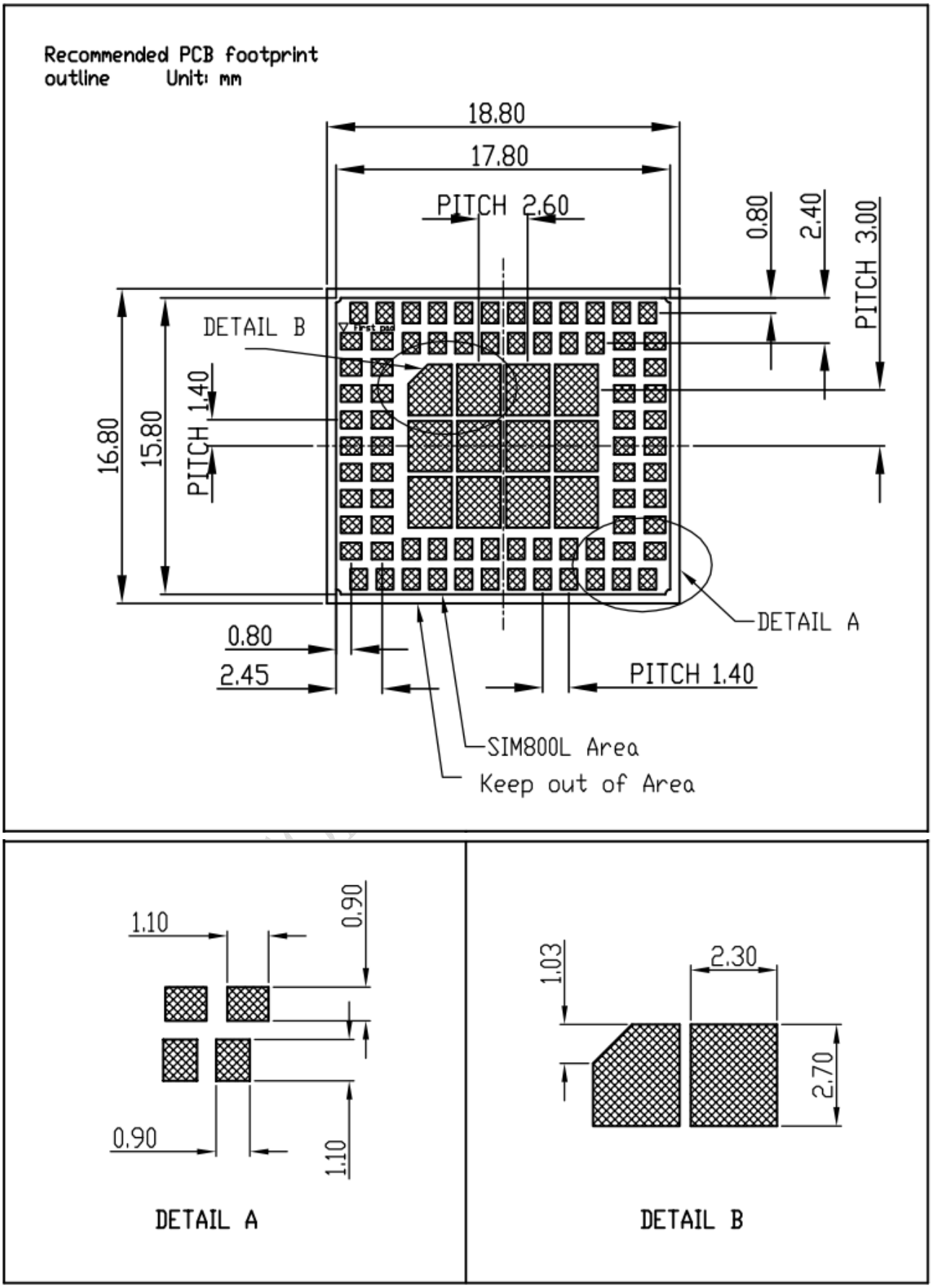


Figure 4: Recommended PCB footprint outline (Unit: mm)

4. Application Interface

4.1. Power Supply

The power supply range of SIM800L is from 3.4V to 4.4V.Recommended voltage is 4.0V.The transmitting burst will cause voltage drop and the power supply must be able to provide sufficient current up to 2A. For the VBAT input, a bypass capacitor (low ESR) such as a 100 μF is strongly recommended.

Increase the 33PF and 10PF capacitors can effectively eliminate the high frequency interference. A 5.1V/500mW Zener diode is strongly recommended, the diode can prevent chip from damaging by the voltage surge. These capacitors and Zener diode should be placed as close as possible to SIM800L VBAT pins.

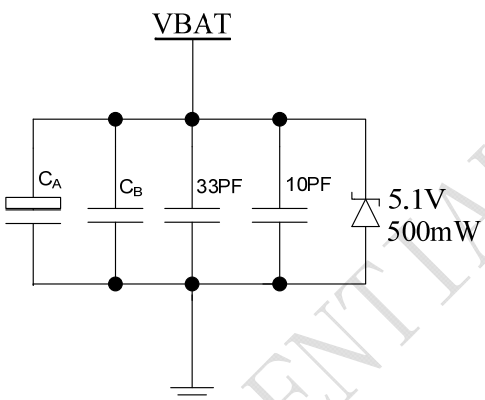


Figure 5: Reference circuit of the VBAT input

Table 5: Recommended Zener diode

	Vendor	Part number	Power(watts)	Packages
1	On semi	MMSZ5231BT1G	500mW	SOD123
2	Prisemi	PZ3D4V2H	500mW	SOD323
3	Prisemi	PZ5D4V2H	500mW	SOD523
4	Vishay	MMSZ4689-V	500mW	SOD123
5	Crownpo	CDZ55C5V1SM	500mW	0805

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.

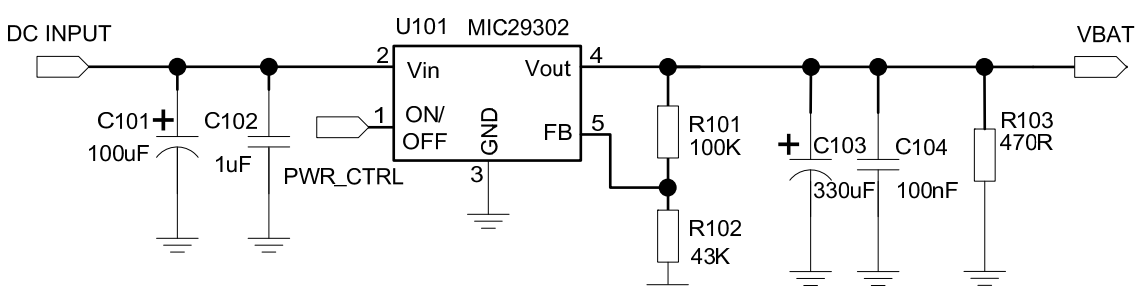


Figure 6: Reference circuit of the LDO power supply

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.

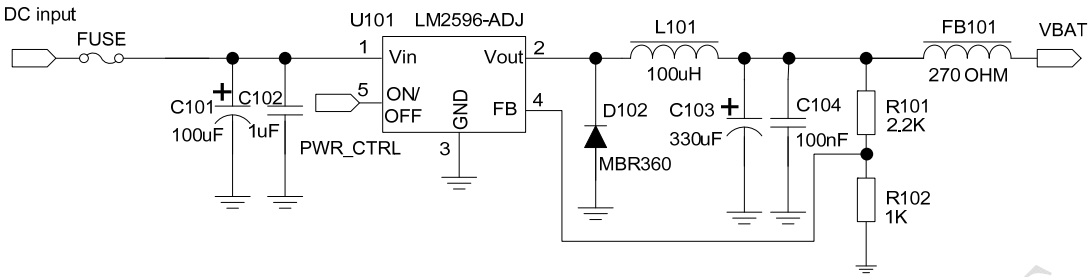


Figure 7: Reference circuit of the DC-DC power supply

The single 3.7V Li-ion cell battery can be connected to SIM800L 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.

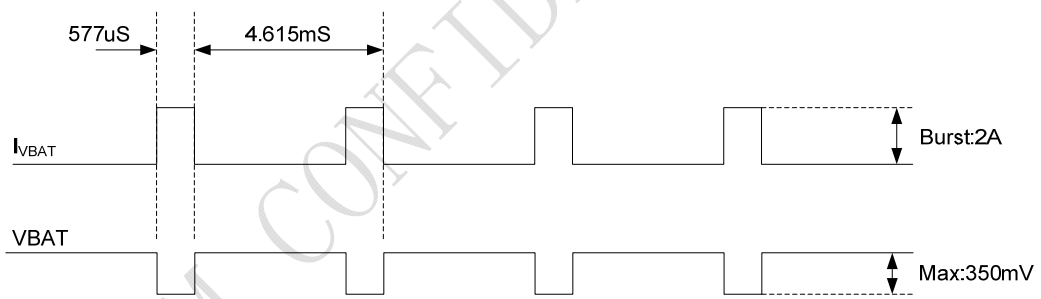


Figure 8: VBAT voltage drop during transmit burst

4.1.1. Power supply pin

Pin 1 and Pin 42 are VBAT input, Pins 2,43,44,45 are GND of power supply, VRTC pin is power supply of the RTC cicuit in the module.VDD_EXT output 2.8V when module is in normal operation mode.

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

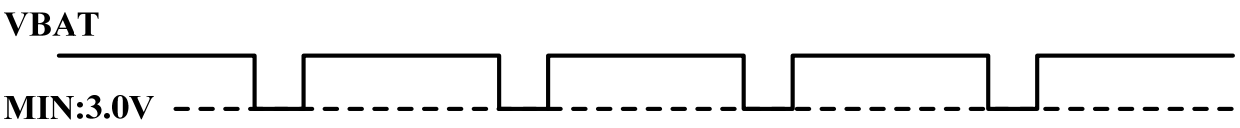


Figure 9: The minimal VBAT voltage requirement at VBAT drop

4.1.2. Monitoring Power Supply

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

4.2. Power on/down Scenarios

4.2.1. Power on SIM800L

User can power on SIM800L by pulling down the PWRKEY pin for at least 1 second and release. This pin is already pulled up to VBAT in the module internal, so external pull up is not necessary. Reference circuit is shown as below.

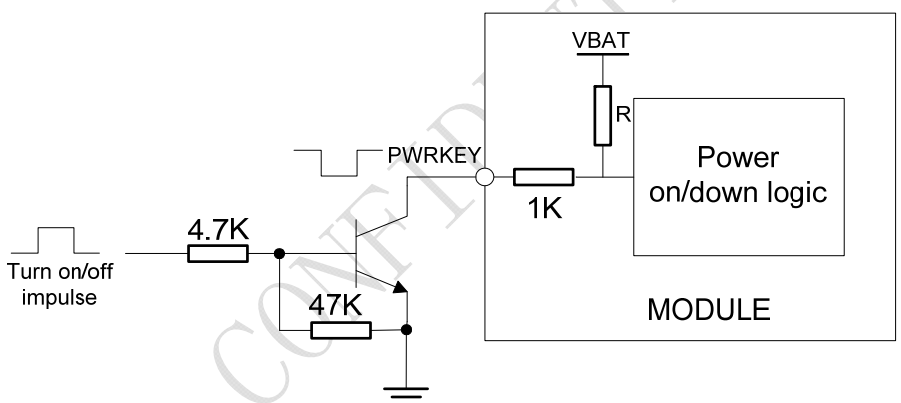


Figure 10: Powered on/down module using transistor

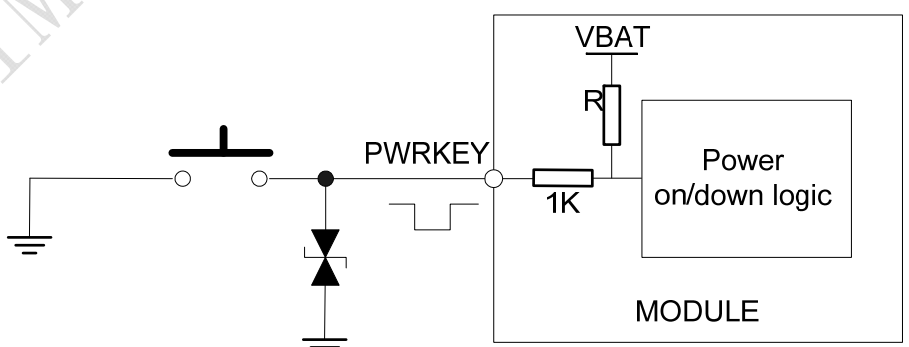


Figure 11: Powered on/down module using button

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

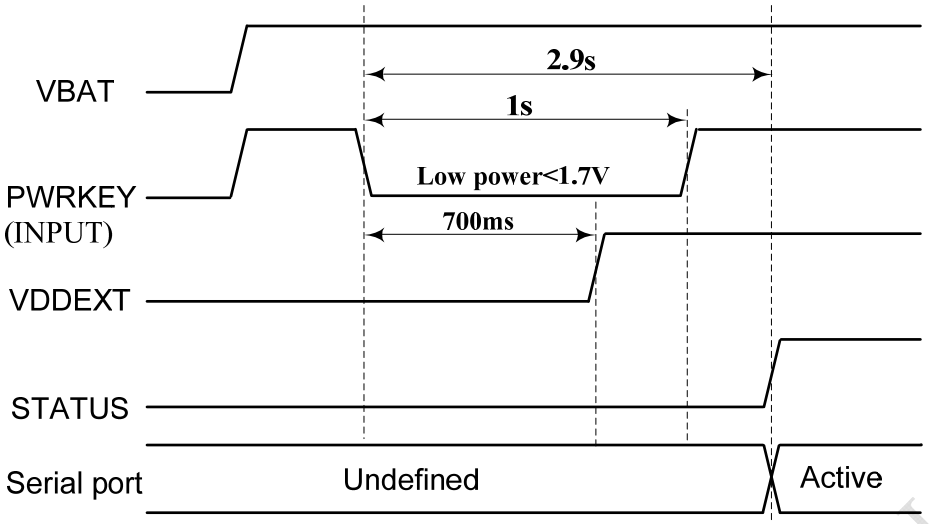


Figure 12: Timing of power on module

When power on procedure is completed, SIM800L 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 SIM800L is powered on. For details, please refer to the chapter "AT+IPR" in document [1].

4.2.2. Power down SIM800L

SIM800L will be powered down in the following situations：

- Normal power down procedure: power down SIM800L by the PWRKEY pin.
- Normal power down procedure: power down SIM800L 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 SIM800L by the PWRKEY Pin

User can power down SIM800L by pulling down the PWRKEY pin for at least 1 second and release. Please refer to the power on circuit. The power down timing is illustrated in the following figure.

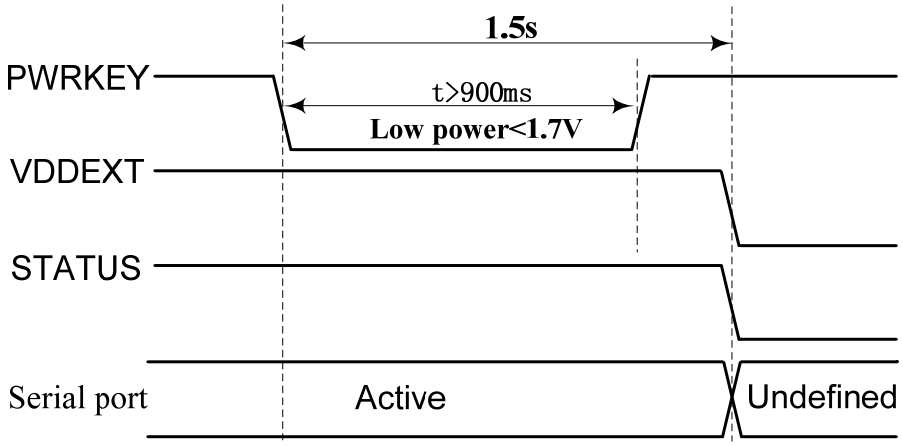


Figure 13: Timing of power down SIM800L by PWRKEY

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 SIM800L by AT Command

SIM800L 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 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 ≤ 3.5V, the following URC will be reported:

UNDER-VOLTAGE WARNNING

If the voltage ≥ 4.3V, the following URC will be reported:

OVER-VOLTAGE WARNNING

If the voltage < 3.4V, the following URC will be reported, and the module will be automatically powered down.

UNDER-VOLTAGE POWER DOWN

If the voltage > 4.4V, 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℃, 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.

Note：The default temperature detect is disable, 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. Reset Function

SIM800L also has a RESET pin (pin 49) used to reset the module. This function is used as an emergency reset only when AT command "AT+CPOWD=1" and the POWER_ON pin has no effect. User can pull the RESET pin to ground, then the module will reset.

This pin is already isolated in the module, so the external isolation is not necessary. Following figure is internal circuit of the RESET pin.

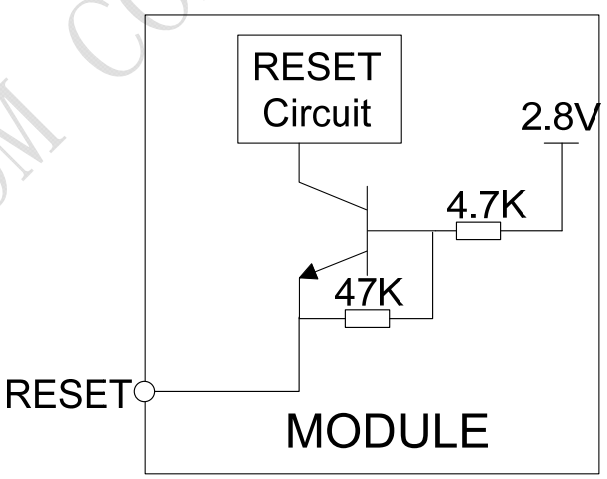


Figure 14: Reset circuit

The typical value of RESET pin at High level is 2.8V, so for the 3V or 3.3V, customer could use MCU's GPIO to driver this pin directly, cascading some resistors could enhance the ESD performance but the value should not be too big; otherwise the level of RESET could be lower than threshold value; RESET hardware parameters can refer to the table below:

Table 6: Electronic characteristic of the RESET pin

Pin name	Symbol	Min	Typ	Max	Unit
RESET	V_{IH}	2.7	2.8	2.9	V
	V_{IL}	-	-	0.6	V
	Low power time	105		-	ms

The reset scenarios are illustrated in the following figures.

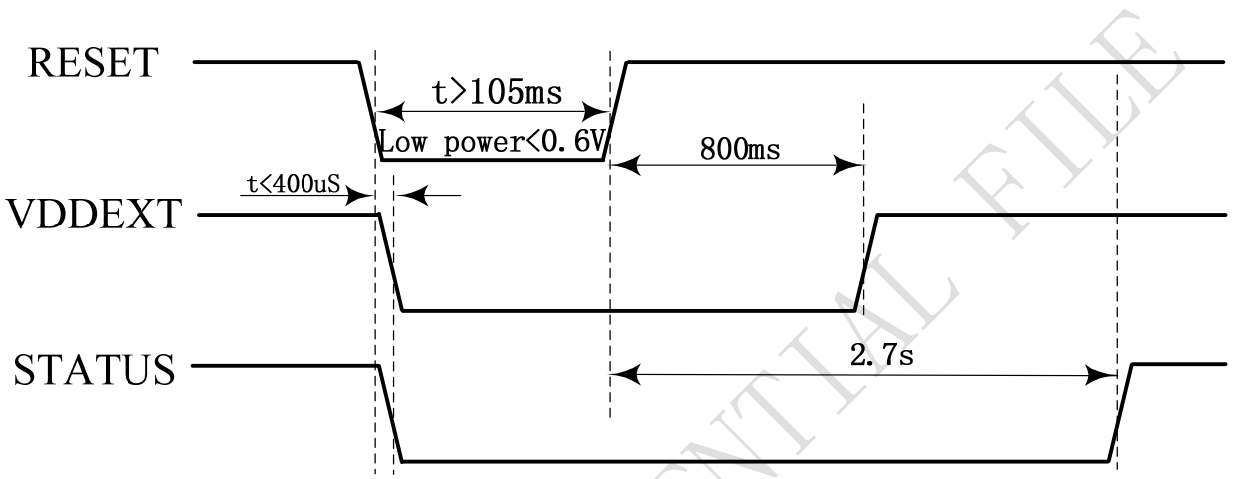


Figure 15: Reset timing sequence

4.3. Power Saving Mode

SIM800L has two power saving modes: Minimum functionality mode and sleep mode. AT command "AT+CSCLK=1"can be used to set SIM800L into sleep mode. AT command "AT+CFUN=<fun>" can be used to set SIM800L into minimum functionality. When SIM800L is in sleep mode and minimum functionality mode, the current of module is lowest.

4.3.1. Minimum Functionality Mode

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

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

Table 7: The current consumption of Minimum Functionality Mode (BS-PA-MFRMS=9)

<fun>	Current consumption(mA) (sleep mode)
0	0.796
1	1.02
4	0.892

Minimum functionality mode minimizes the current consumption to the lowest level. If SIM800L 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 to RF function and SIM card function will not be accessible.

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

4.3.2. Sleep Mode (AT+CSCLK=1)

User can control SIM800L module to enter or exit the sleep mode (AT+CSCLK=1) by DTR signal. When DTR is in high level and without interrupt (on air and hardware such as GPIO interrupt or data in serial port), SIM800L will enter sleep mode automatically. In this mode, SIM800L can still receive paging or SMS from network but the serial port is not accessible.

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

4.3.3. Wake Up SIM800L from Sleep Mode (AT+CSCLK=1)

When SIM800L is in sleep mode (AT+CSCLK=1), the following methods can wake up the module:

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

4.4. RTC Backup

Current input for RTC when the VBAT is not supplied for the system. Current output for backup battery when the VBAT power supply is 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**

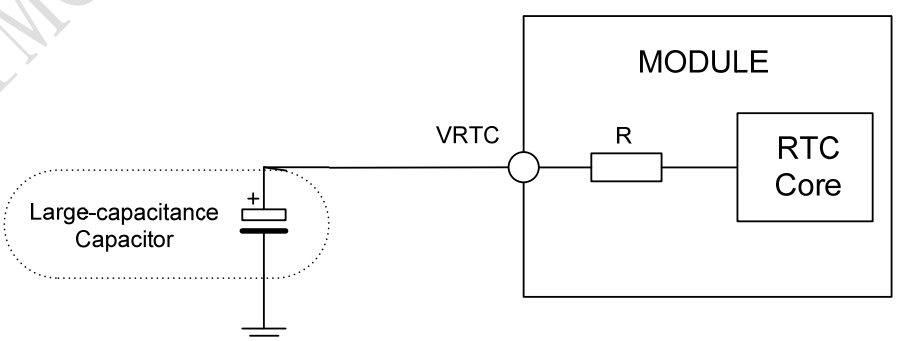


Figure 16: RTC supply from capacitor

- **Non-chargeable battery backup**

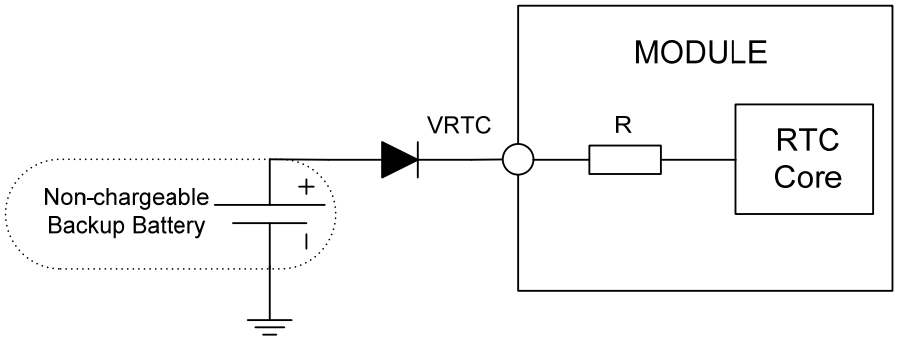


Figure 17: RTC supply from non-chargeable battery

- **Rechargeable battery backup**

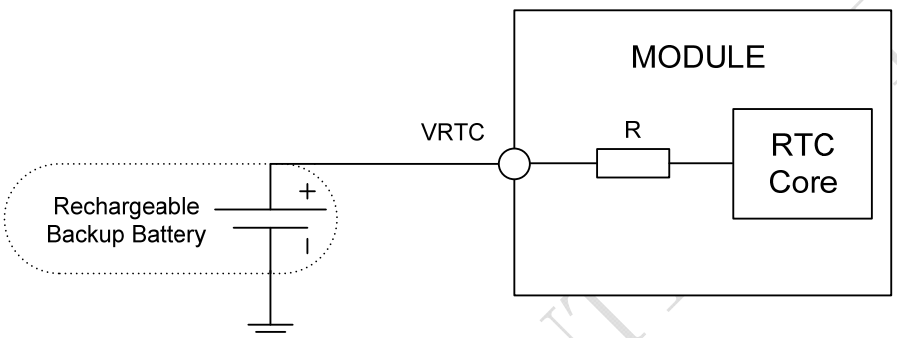


Figure 18: RTC supply from rechargeable battery

4.5. Serial Port and USB Interface

SIM800L provides one unbalanced asynchronous serial ports. The module is designed as a DCE (Data Communication Equipment). The following figure shows the connection between module and client (DTE).

Table 8: Serial port and USB pin definition

	Pin name	Pin number	Function
Serial port	UART_DTR	69	Data terminal ready
	UART_RI	68	Ring indicator
	UART_DCD	70	Data carrier detect
	CTS	34	Request to send
	RTS	33	Clear to send
	TXD	32	Transmit data
	RXD	31	Receive data
Debug port	VBUS	7	USB power supply
	USB_DP	59	
	USB_DM	19	

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

document [1]

Table 9: Serial port characteristics

Symbol	Min	Max	Unit
V_{IL}	0	0.3	V
V_{IH}	2.5	2.8	V
V_{OL}	0	0.1	V
V_{OH}	2.7	2.8	V

4.5.1 Function of Serial 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 *table 11*.
- 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 SIM800L to automatically detect the baud rate of the host device. Pay more attention to the following requirements:

- **Synchronization between DTE and DCE:**
  When DCE powers on with autobauding enabled, it is recommended to send "AT" or "at" or "aT" or "At" to synchronize the baud rate, until DTE receives the "OK" response, which means DTE and DCE are correctly synchronized. For more information please refer to AT command "AT+IPR".

- **Restrictions of autobauding operation:**
  The DTE serial port must be set at 8 data bits, no parity and 1 stop bit.
  The URC such as "RDY", "+CFUN: 1" and "+CPIN: READY" will not be reported.

Note: 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 SIM800L is powered on.

4.5.2 Serial Interfaces

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

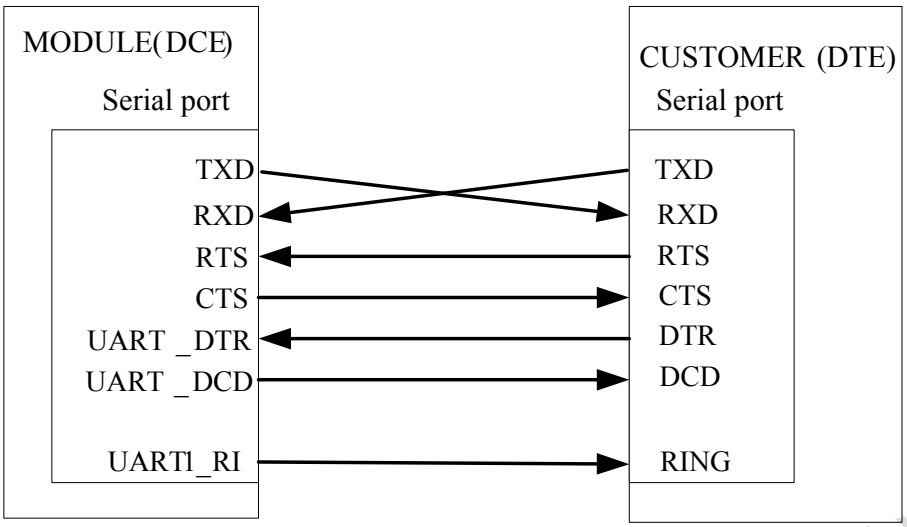


Figure 19: Connection of the serial interfaces

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

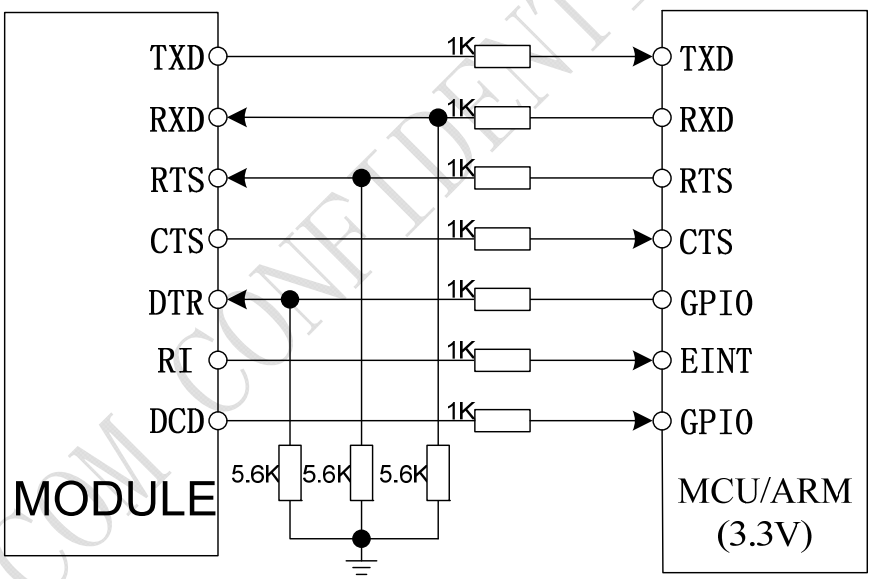


Figure 20: Resistor matching circuit

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

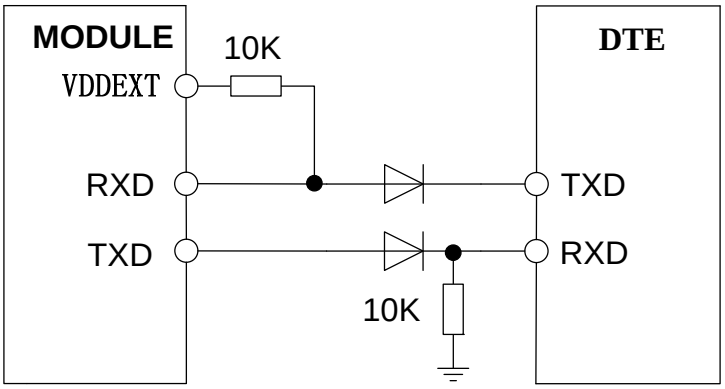


Figure 21 : Diode isolation circuit

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

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

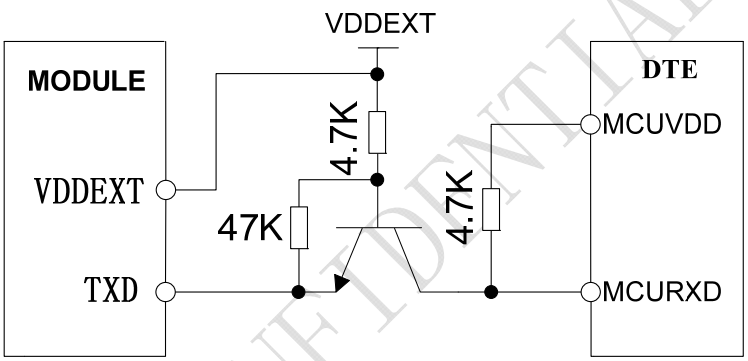


Figure 22: TX level matching circuit

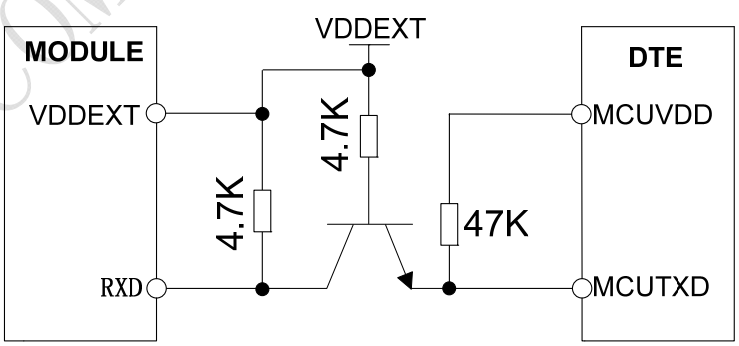


Figure 23: RX level matching circuit

Note: When Fig 22 and Fig 23are used for electrical level isolation, if customers use serial port to upgrade SW, please note VDDEXT has no voltage output during the upgrading process, LDO output could be used as VDDEXT in the figure, upgrading through USB port is recommended.

4.5.3 Debug Interface

SIM800L could achieve software debug function through USB interface. When powering on the module, connect VBUS,USB_DP,USB_DM, and GND to PC, then install the driver following the prompts, a UART port could be recognized by PC, customer could achieve the software Debug with this UART port.
SIMcom recommendeds the following connected diagram:

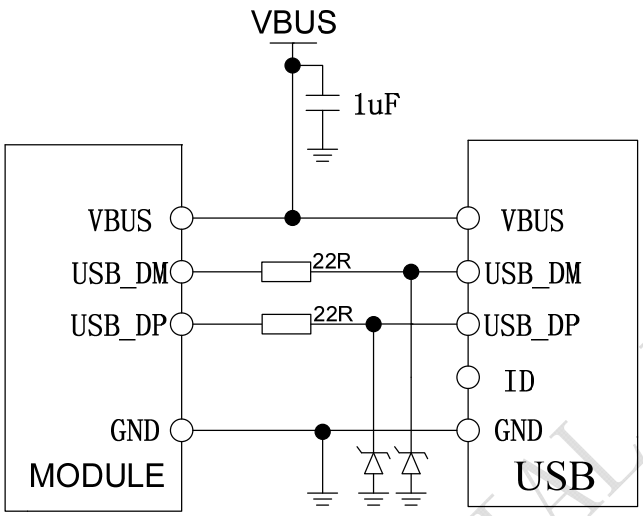


Figure 24: USB reference circuit

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

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

Table 10: VBUS operation voltage

Pin	Min	Typ	Max	Unit
VBUS	4.3	5	7	V

4.5.4 Software Upgrade and Debug

Customer could upgrade module's firmware through USB or UART interface.

If upgrading through USB port, it is necessary to power on SIM800L first, then connect VBUS, USB_DP, USB_DM, and GND to PC. There is no need to operate PWRKEY pin in the whole procedure, when SIM800L detects VBUS and could communicate normally with USB_DP and USB_DM, it will enter USB download mode automatically.

Note: When only USB_DP and USB_DM are connected, no VBUS, customer need to pull down COL0(pin20) before power on the module, then press the PWRKEY button, the module will enter download mode;

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

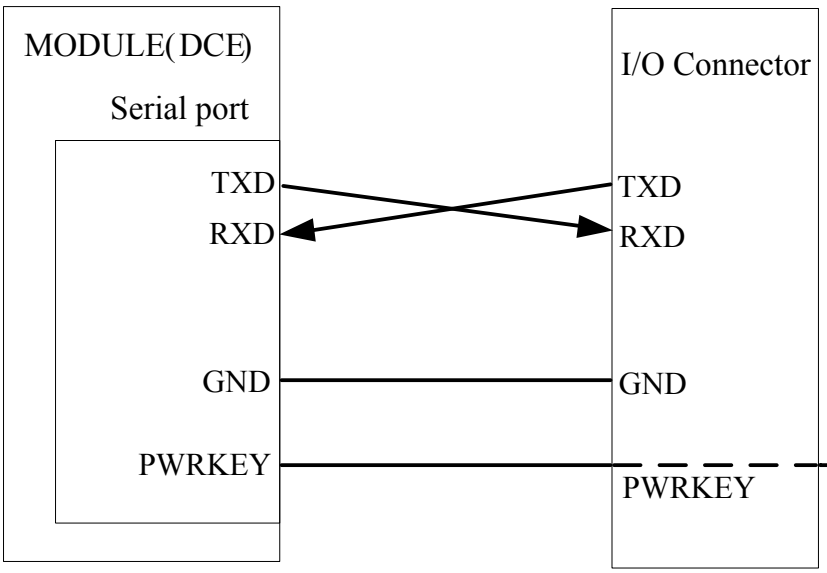


Figure 25: Connection for software upgrading and debugging

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.

4.5.5 Multiplexing function of serial port

If full modem is not necessary, it could be multiplexed into two serial ports without flow control, the details could be found in the following table:

Table 11: Multiplexing function of serial port

Pin name	Pin number	Mode 0(default)	Mode 1
UART_DTR	69	UART_DTR	GPIO22
UART_RI	68	UART_RI	GPIO23
UART_DCD	70	UART_DCD	GPIO24
CTS	34	CTS	URXD2(IN)
RTS	33	RTS	UTXD2(OUT)
TXD	32	TXD	UTXD1(OUT)
RXD	31	RXD	URXD1(IN)

Note: Multiplexing function need different software supply.

4.6. RI Behaviors

Table 12: RI behaviors

State	RI response
Standby	High
Voice call	The pin is changed to low. When any of the following events occur, the pin will be changed to high: （1）Establish the call （2）Hang up the call
Data call	The pin is changed to low. When any of the following events occur, the pin will be changed to high: （1）Establish the call （2）Hang up the call
SMS	The pin is changed to low, and kept low for 120ms when a SMS is received. Then it is changed to high.
URC	The pin is changed to low, and kept low for 120ms when some URCs are reported. Then it is changed to high. For more details, please refer to *document [10]*.

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

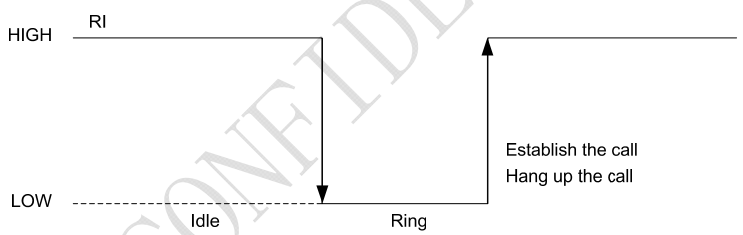


Figure 26: RI behaviour of voice calling as a receiver

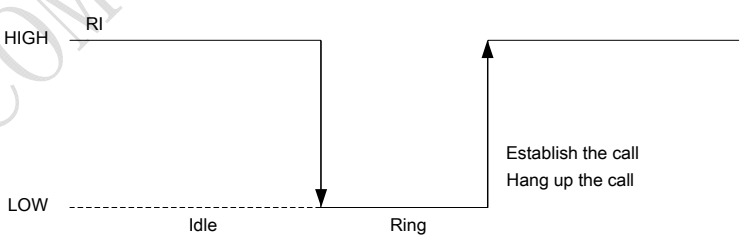


Figure 27: RI behaviour of data calling as a receiver

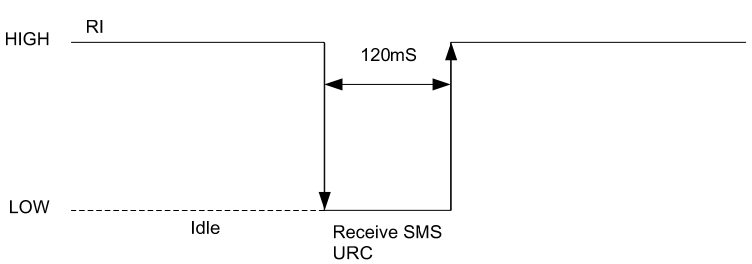


Figure 28: RI behaviour of URC or receive SMS

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

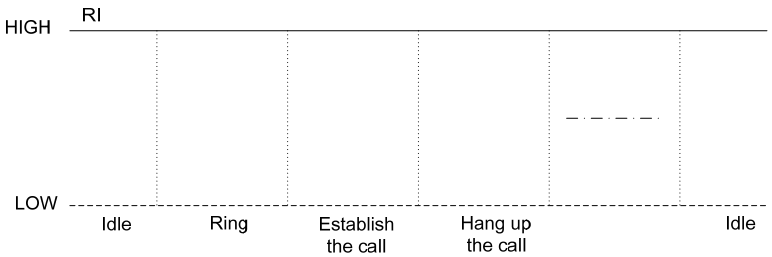


Figure 29: RI behaviour as a caller

4.7. Audio Interfaces

SIM800L provides two analog inputs (MIC1P/1N; MIC2P/2N), which could be used for electret microphone. The module also provides two analog outputs (SPK1P/1N; SPK2P/2N).

Table 13: Audio interface definition

	Pin Name	Pin number	Function
Main	MIC1P	52	Main Audio input positive
	MIC1N	12	Main Audio input negative
	SPK1P	53	Main Audio output positive
	SPK1N	13	Main Audio output negative
Secondary	MIC2P	9	Secondary Audio input positive
	MIC2N	10	Secondary Audio input negative
	SPK2P	51	Secondary Audio output positive
	SPK2N	11	Secondary Audio output negative

SPK1P/1N output can directly drive 32Ω receiver, SIM800L internal has class-AB audio amplifier, the following table is class-AB performance:

Table 14: Performance of audio amplifier

Conditions	Class-AB AMP
4.2V 8Ohm THD+N=1%	0.87W
3.4V 8Ohm THD+N=1%	0.53W
4.2V 8Ohm THD+N=10%	1.08W
3.4V 8Ohm THD+N=10%	0.65W

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

AT command “AT+CMIC” is used to adjust the input gain level of microphone. AT command “AT+SIDET”

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

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

4.7.1. Speaker Interfaces Configuration

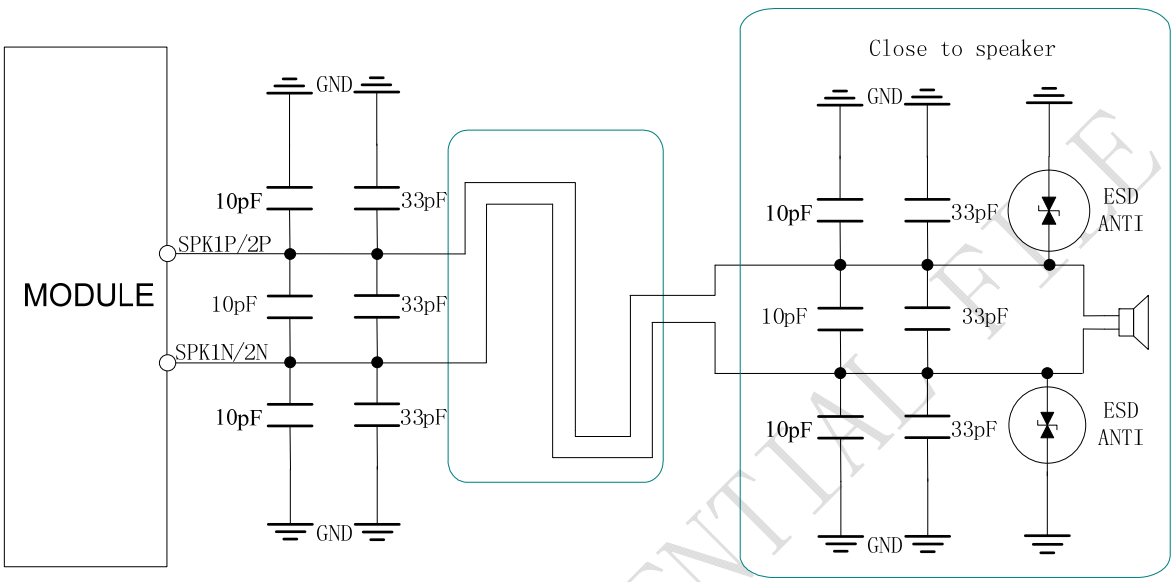


Figure 30: Speaker reference circuit

4.7.2. Microphone Interfaces Configuration

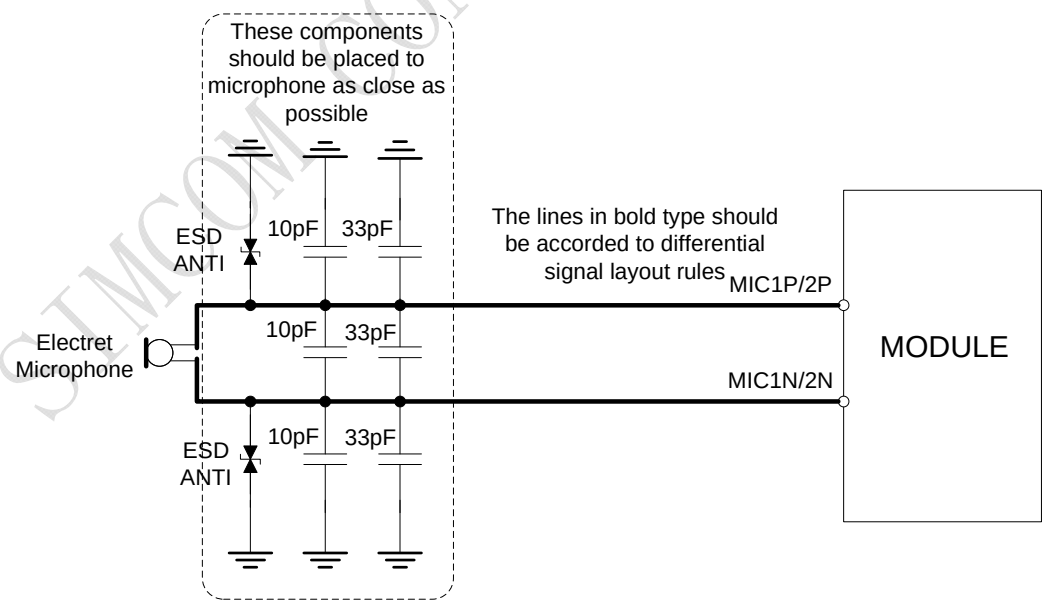


Figure 31: Speaker with amplifier reference circuit

4.7.3. Audio Electronic Characteristic

Table 15: Microphone input characteristics

Parameter		Min	Typ	Max	Unit
Microphone biasing voltage			1.9	2.2	V
Working current				2	mA
Input impedance(differential)		13	20	27	KΩ
Idle channel noise				-67	dBm0
SINAD	Input level:-40dBm0	29			dB
	Input level:0dBm0		69		dB

Table 16: Audio output characteristics

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

4.7.4. TDD

GSM signal could interfere audio by coupling or conducting. Coupling noise could be filtered by adding 33pF and 10pF capacitor over audio lines. 33pF capacitor could eliminate noise from GSM850/EGSM900MHz, while 10pF capacitor could eliminate noise from DCS1800/PCS1900Mhz frequency. Coupling noise should have something to do with PCB layout. Under some scenarios, TDD noise from GSM850/EGSM900MHz frequency affects heavily, but some different story is from DCS1800/PCS1900Mhz frequency, so customer should develop this filter solution according to field test result.

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

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

TDD noise has something to do with GND signal surely. If GND signal issued is not good, lots of high-frequency noises will interfere microphone and speaker over bypass capacitor. So care of good GND during PCB layout need to be taken.

4.8. SIM Card Interface

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.

4.8.1. SIM Card Application

Table 17: SIM pin definition

Pin name	Pin number	Function
VSIM	16	Voltage supply for SIM card. Support 1.8V or 3V SIM card
SIM_DATA	14	SIM data input/output
SIM_CLK	55	SIM clock
SIM_RST	15	SIM reset
SIM_PRE	54	SIM card detection

It is recommended to use an ESD protection component such as ST (www.st.com) ESDA6V1W5 or ON SEMI (www.onsemi.com) SMF05C. 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.

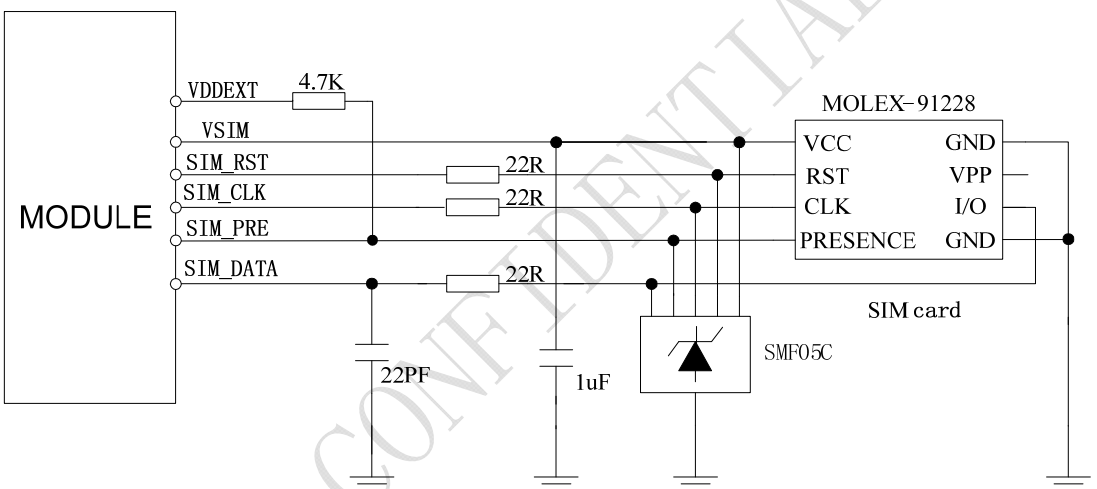


Figure 32: Reference circuit of the 8-pin SIM card holder

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.

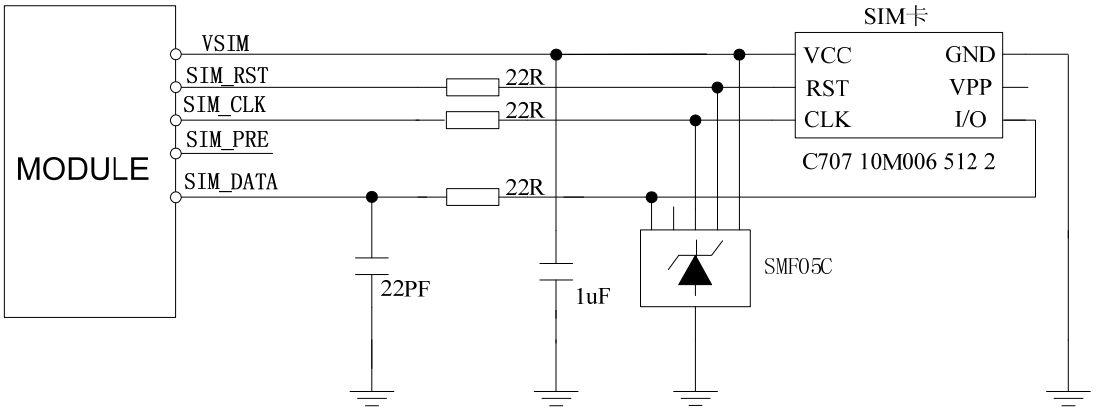


Figure 33: Reference circuit of the 6-pin SIM card holder

4.8.2. SIM Card Design Guide

SIM card circuit is susceptible to interference, causing the SIM card failures or some other situations, it is strongly recommended to follow these guidelines while designing:

- Make sure that SIM card holder should far away from GSM antenna while in PCB layout.
- SIM traces should keep away from RF lines, VBAT and high-speed signal lines.
- The traces should be as short as possible.
- Keep SIM holder's GND connect to main ground directly.
- Shielding the SIM card signal by ground well.
- Recommended to place a 1uF capacitor on VSIM line and keep close to the holder.
- Add some TVS and the parasitic capacitance should not exceed 50pF, and 22Ohm resistor in serials the SIM signal could enhance ESD protection.

4.8.3. Design Considerations for SIM Card Holder

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.

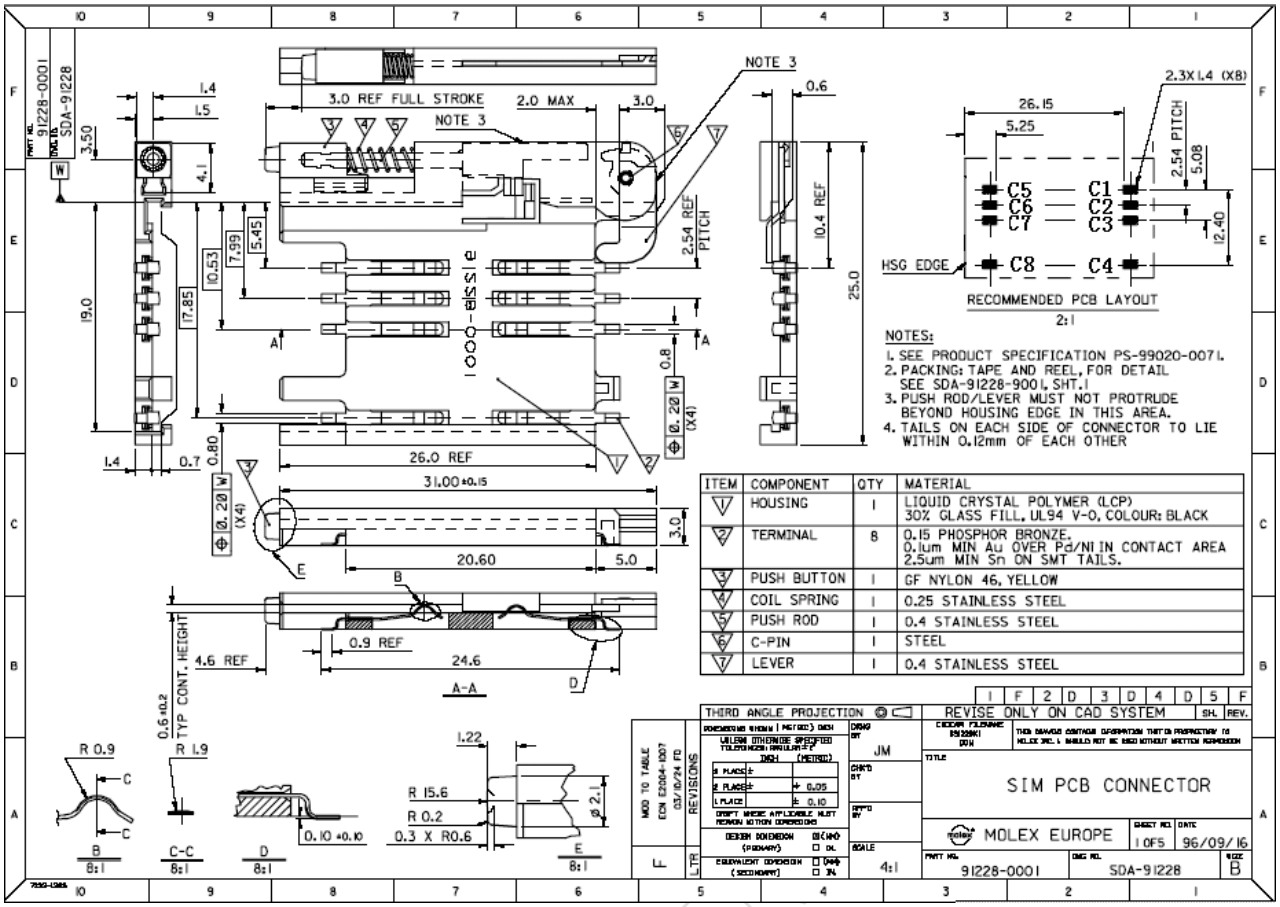


Figure 34: Molex 91228 SIM card holder

Table 18: Pin description (Molex SIM card holder)

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

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.

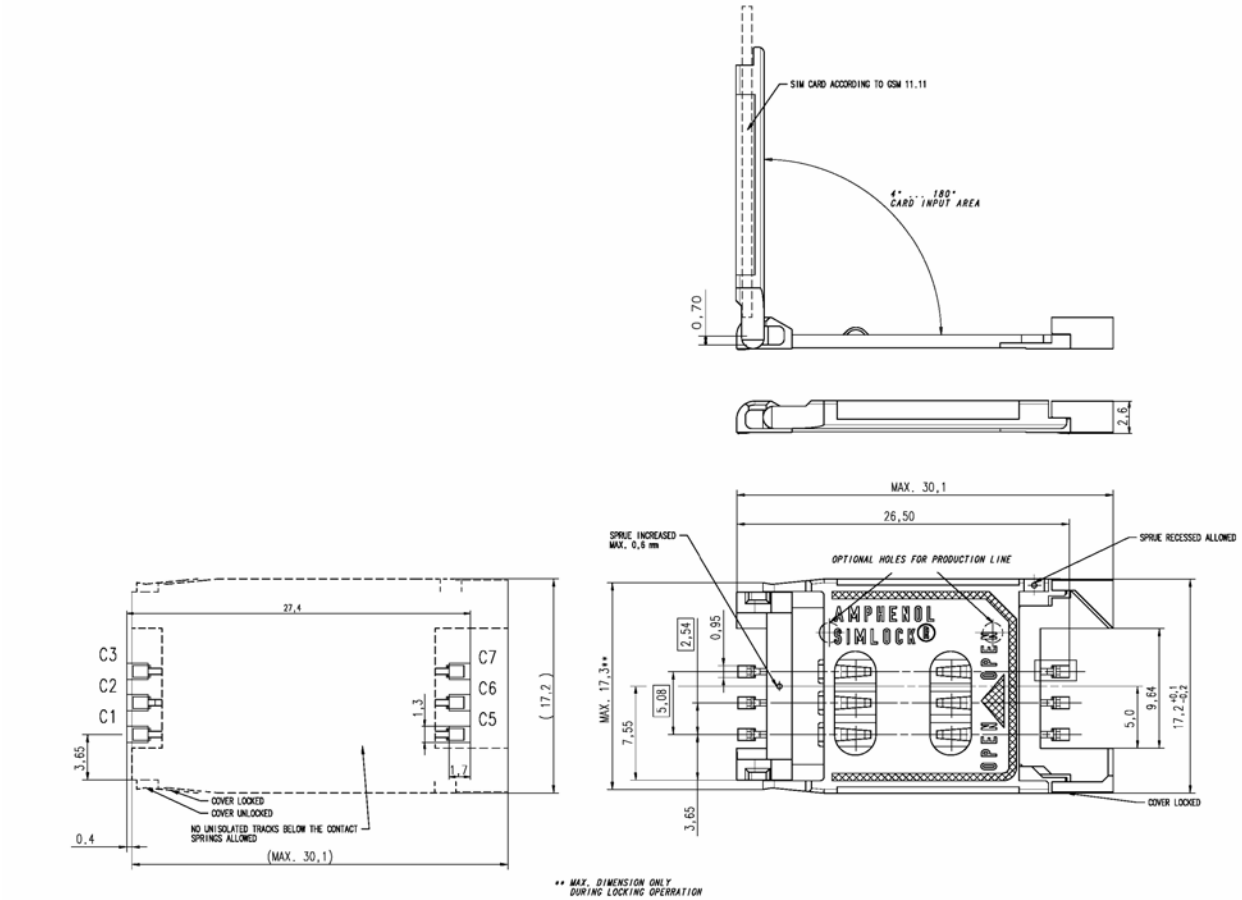


Figure 35: Amphenol C707 10M006 5122 SIM card holder

Table 19: Pin description (Amphenol SIM card holder)

Pin name	Signal	Description
C1	VSIM	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

4.9. PCM Interface

SIM800L provides a hardware PCM interface:

Table 20: PCM Pin definition

Pin name	Pin number	Description
PCMCLK	29	PCM clock
PCMOUT	30	PCM data output
PCMSYNC	65	PCM synchrony
PCMIN	66	PCM data input

SIM800L PCM interface only supply master mode, data length is 16 bits (linear)，PCM clock rate is 256KHz.

Table 21: PCM specification

Parameter	Specification
Line Interface Format	Linear(Fixed)
Data length	16bits(Fixed)
PCM Clock/Sync Source	Master Mode(Fixed)
PCM Clock Rate	256Khz(Fixed)
PCM Sync Format	Short sync/Long sync both support
Zero Padding/Sign extension	Zero Padding(Fixed)
Data Ordering	MSB/LSB both support

Note: User can use AT command control PCM interface. For detail ,please refer to document[1].

4.9.1. PCM Multiplexing Function

With GPIO17 and GPIO19, PCM interface can be configured as SPI or SD interface, the following table shows the detailed multiplexing function.

Table 22: PCM multiplexing function

Pin name	Pin number	Mode 0(default)	Mode 1	Mode 2	Mode 3
PCMCLK	29	PCMCLK	DISP_RSTB	MC3CM0	GPIO18
PCMOUT	30	PCMOUT	DISP_DI	MC3DA3	GPIO19
PCMSYNC	65	PCMSYNC	DISP_CEB	MC3CK	GPIO20
PCMIN	66	PCMIN	DISP_DA	MC3DA2	GPIO21
GPIO2	27	GPIO2	DISP_A0DA	MC3DA0	-
GPIO3	28	GPIO3	DISP_CLK	MC3DA1	-

Note: Multiplexing function need different software supply.

4.9.2. PCM Interface

Refer to the following figure for PCM design:

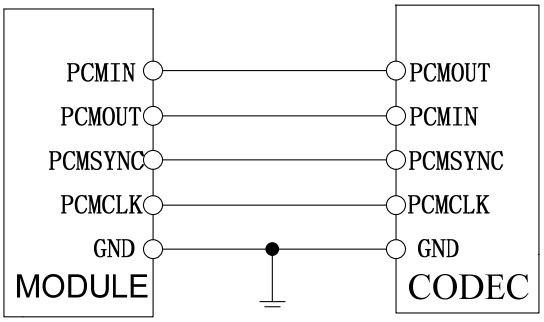


Figure 36: PCM reference circuit

4.9.3. LCD Display/SPI Interface

SIM800L provides a serial interface. It could be used as SPI interface in the embedded AT application.

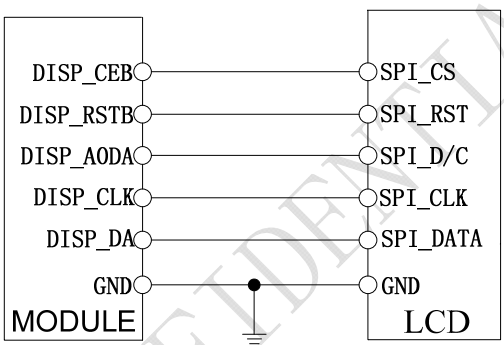


Figure 37: LCD reference circuit

4.9.4. SD Card Interface

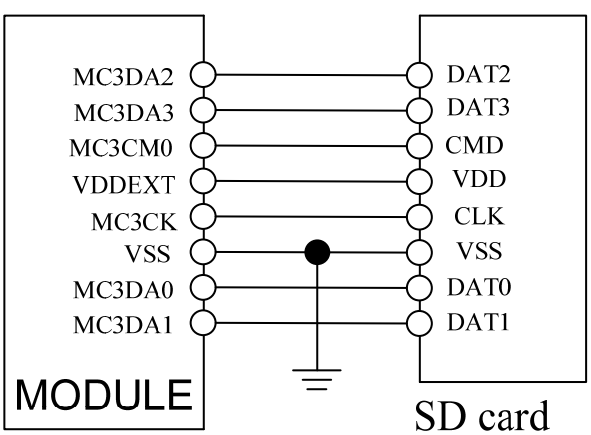


Figure 38: SD reference circuit

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

4.10. Keypad Interface

The keypad interface consists of 5 keypad column outputs and 5 keypad row inputs, with total 5*5*2, which is 50 keys. Module keys have two connections: connections 1, which can support 25 keys; connections 2, which can support 50 keys.

Connections 1:

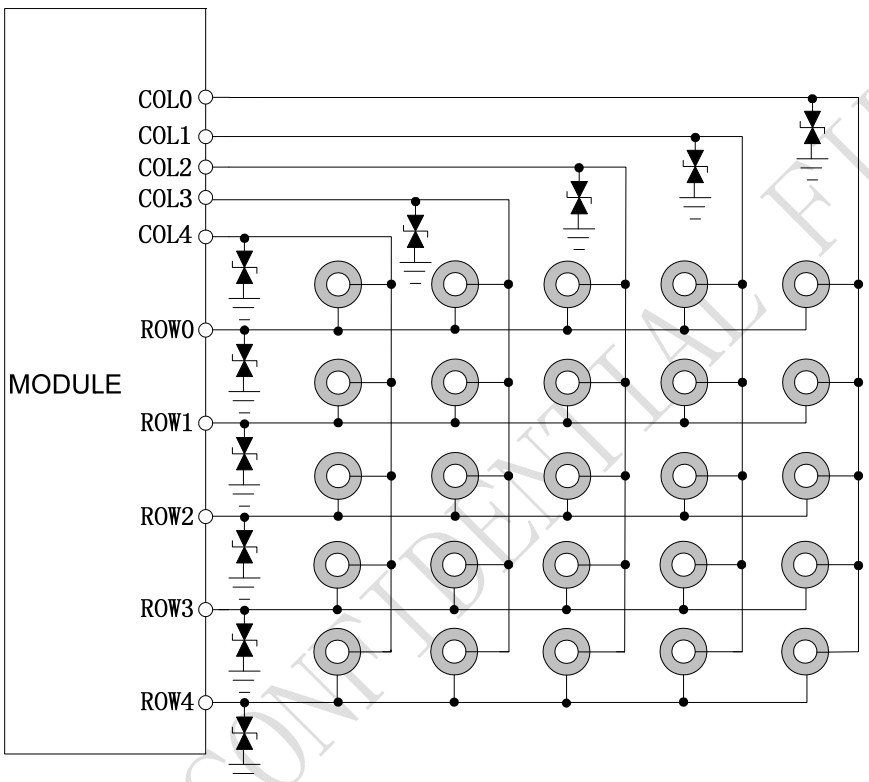


Figure 39: 25 keys reference circuit

Note：According to the traditional 5 * 5 to design buttons, when there is spare COL or ROW, user can execute AT command to define as GPIO for details please see the relevant manuals.

Connections 2:

Module supports a new key connection, can support 50 keys, which meets full keyboard demand, the connection diagram is as following:

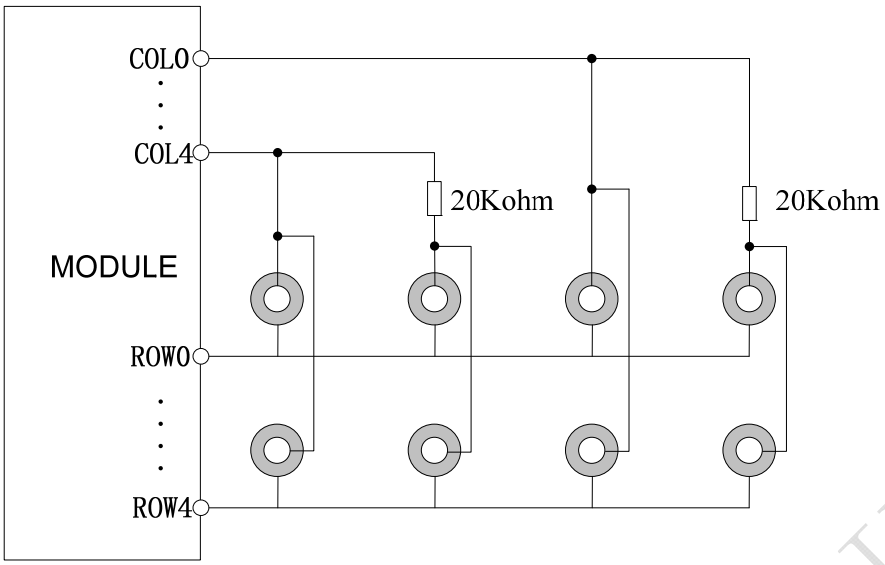


Figure 40: 50 keys reference circuit

Note：Do not change the 20KOhm resistor in the diagram.

Customer could cascade a less than 1K resistor to enhance the ESD performance, the connection diagram is as following:

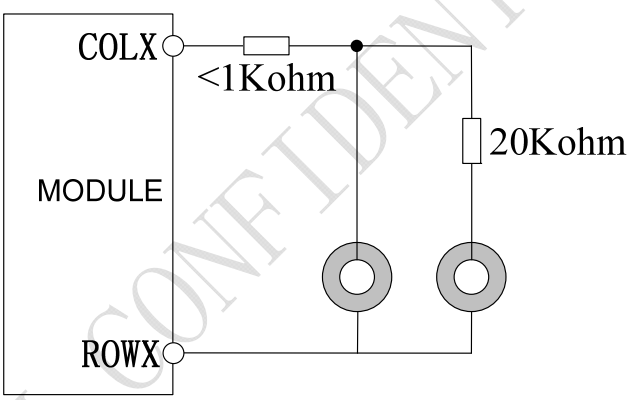


Figure 41: Keypad reference circuit

Whether using a 5*5 keys or 5*5*2 keys, the module can also detecte the two buttons pressed. But when using a 5*5*2 button, the same row, column two buttons at the same time can not be detected when pressed, as shown below:

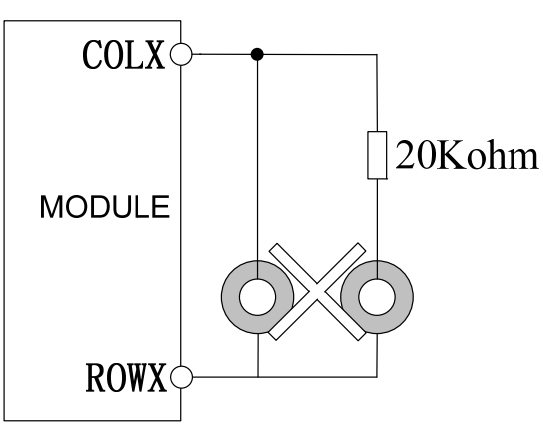


Figure 42: Keypad detected

Table 23: Pin definition of the keypad interface

Pin name	Pin number	Function	Default state
COL0	20	Keypad matrix column	Pull up
COL1	25		Pull down
COL2	22		Pull down
COL3	21		Pull down
COL4	24		Pull down
ROW0	62	Keypad matrix row	Pull down
ROW1	60		Pull down
ROW2	61		Pull down
ROW3	23		Pull down
ROW4	63		Pull down

4.10.1. Keypad Multiplexing Function

Table 24: Keypad multiplexing function

Pin name	Pin number	Mode 0(default)	Mode 1
COL0	20	COL0	GPIO6
COL1	25	COL1	GPIO7
COL2	22	COL2	GPIO8
COL3	21	COL3	GPIO9
COL4	24	COL4	GPIO10
ROW0	62	ROW0	GPIO11
ROW1	60	ROW1	GPIO12
ROW2	61	ROW2	GPIO13
ROW3	23	ROW3	GPIO14
ROW4	63	ROW4	GPIO15

Note: Multiplexing function need different software supply.

4.11. I2C Bus

The SIM800L provides an I^2C interface which is only used in the embedded AT application.

Table 25: Pin definition of the I^2C

Pin name	Pin number	Description
SCL	74	I^2C serial bus clock
SDA	75	I^2C serial bus data

Notes:

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.If user design I^2C please pull up to VDD_EXT.

4.11.1. I2C Multiplexing Function

Table 26: I2C multiplexing function

Pin name	Pin number	Mode 0(default)	Mode 1
SCL	74	SCL	GPIO25
SDA	75	SDA	GPIO26

Note: Multiplexing function need different software supply.

4.12. General Purpose Input/Output (GPIO)

SIM800L provides 3 GPIO pins. The output voltage level of the GPIO can be set by AT command "AT+ SGPIO". The input voltage level of the GPIO can also be read by AT command "AT+ SGPIO". For more details, please refer to *document [1]*.

Table 27: Pin definition of the GPIO

Pin name	Pin number	Reret state
GPIO1	3	-
GPIO2	27	Pull down
GPIO3	28	Pull down

4.13. ADC

Table 28: Pin definition of the ADC

Pin name	Pin number	Description
ADC	50	Analog voltage input

SIM800L 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 29: ADC specification

Parameter	Min	Typ	Max	Unit
Voltage range	0	-	2.8	V
ADC Resolution	-	10	-	bits
Sampling rate	-	-	1.0833	MHz
ADC precision		10	20	mV

4.14. PWM

Table 30: Pin definition of the PWM

Pin name	Pin number	Description

PWM	26	PWM signal

SIM800L provides a PWM which can be used to drive a vibrator, and a backlight LED for display or keyboard. PWM output frequency varies from 0 to 2KHz. Two 7-bit unsigned binary parameters are used for the output period and for the duty cycle. AT command "AT + SPWM" is used to set the output period and duty cycle of the PWM. For details, please refer to *document [1]*.

A typical recommended circuit of the PWM driver buzzer is shown in the following figure.

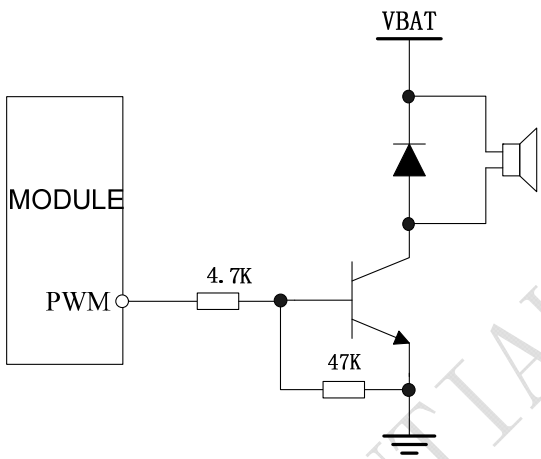


Figure 43: Reference circuit of PWM driver buzzer

Table 31: Buzzer output characteristics

Parameter	Min	Typ	Max	Unit
Working voltage	2.5	2.8	2.9	V
Working current			16	mA

Note: PWM pin must be kept at low power level when module is in the power on procedure.

4.14.1. PWM Multiplexing Function

Table 32: PWM multiplexing function

Pin name	Pin number	Mode 0(default)	Mode 1
PWM	26	PWM	GPIO16

Note: Multiplexing function need different software supply.

4.15. Network Status Indication

Table 33: Pin definition of the NETLIGHT

Pin name	Pin number	Description
NETLIGHT	64	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 34: Status of the NETLIGHT pin

Status	SIM800L behavior
Off	SIM800L is not running
64ms On/ 800ms Off	SIM800L not registered the network
64ms On/ 3000ms Off	SIM800L registered to the network
64ms On/ 300ms Off	GPRS communication is established

Reference circuit is recommended in the following figure:

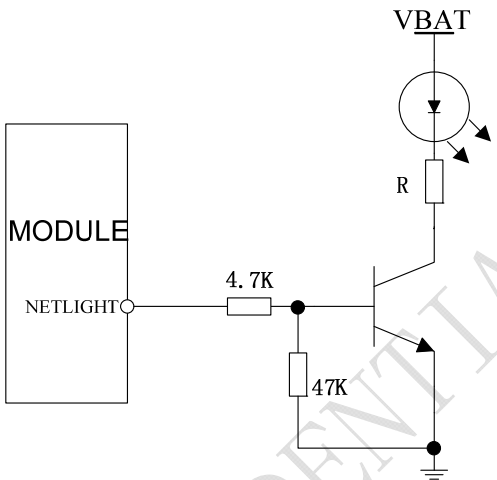


Figure 44: Reference circuit of NETLIGHT

4.15.1. NETLIGHT Multiplexing Function

Table 35: NETLIGHT multiplexing function

Pin name	Pin number	Mode 0(default)	Mode 1
NETLIGHT	64	NETLIGHT	GPIO17

Note: Multiplexing function need different software supply.

4.16. Operating Status Indication

The pin4 is for operating status indication of the module. The pin output is high when module is powered on, and output is low when module is powered off.

Table 36: Pin definition of the STATUS

Pin name	Pin number	Description
STATUS	4	operating Status Indication

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

4.16.1. STATUS Multiplexing Function

Table 37: STATUS multiplexing function

Pin name	Pin number	Mode 0(default)	Mode 1
STATUS	4	STATUS	GPIO4

Note: Multiplexing function need different software supply.

4.17. LED Interface

SIM800L provides two LED driver pin. The two pin are open-drain output.

Table 38: Pin definition of the LED

Pin name	Pin number	Description
ISINK0	47	Sink current for LCM module
ISINK1	46	Sink current for keypad LED

Reference circuit is recommended in the following figure:

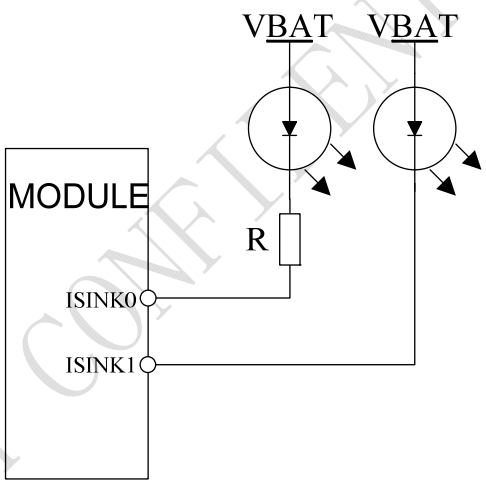


Figure 45: LED driver reference circuit

Table 39: LED specification

Pin name	Min	Typ	Max	Unit
ISINK0	-		24	mA
ISINK1	60	-	100	mA

Note: Isink0 provide 6-current-level steps of up to 24mA.

4.18. RF Synchronization Signal

The synchronization signal serves to indicate growing power consumption during the transmit burst. The signal is generated by the BPI_BUS1 pin.

Table 40: Definition of the BPI_BUS1 pin

Pin name	Pin number	Description
BPI_BUS1	5	Transmit synchronization signal

The timing of the synchronization signal is shown below. High level of the BPI_BUS1 pin indicates increased power consumption during transmission.

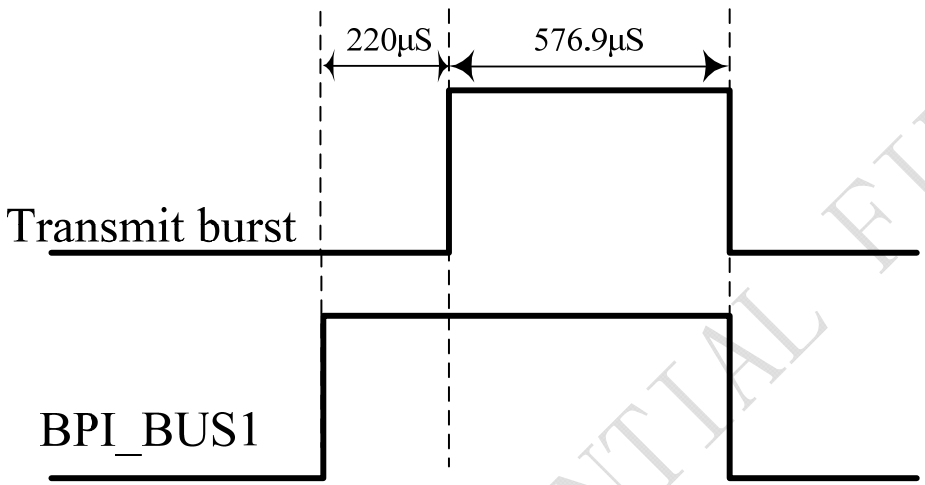


Figure 46: BPI_BUS1 signal during transmit burst

4.19. Antenna Interface

There are three antenna ports for SIM800L, GSM antenna port named RF_ANT, antenna port named BT_ANT and FM antenna port named FM_ANT_P/ FM_ANT_N, The RF interface of the three antenna ports has an impedance of 50Ω.

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

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

4.19.1. GSM Antenna Interface

There is a GSM antenna pad named RF_ANT for SIM800L, the connection of the antenna must be decoupled from DC voltage. This is necessary because the antenna connector is DC coupled to ground via an inductor for ESD protection.

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

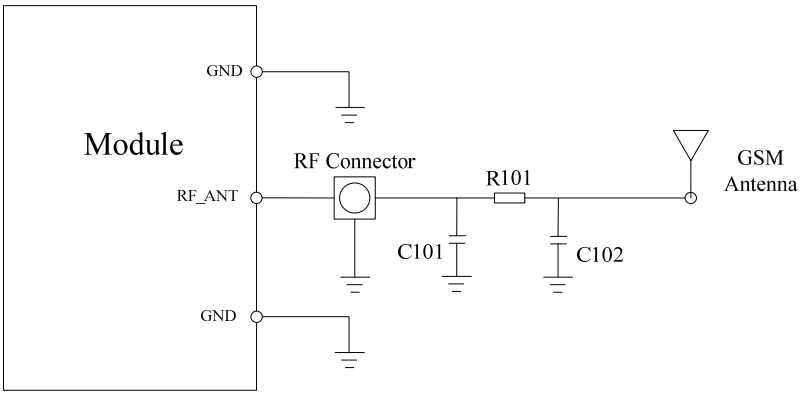


Figure 47: GSM antenna matching circuit

R101，C101，C102 are the matching circuit, the value should be defined by the antenna design. Normally R101 is 0Ω, C101 and C102 are not mounted. The RF connector is used for conduction test. If the space between RF pin and antenna is not enough, the matching circuit should be designed as in the following figure:

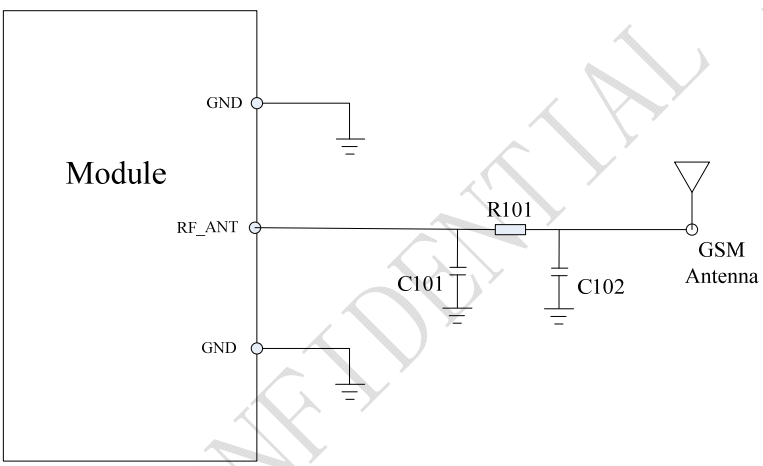


Figure 48: GSM simple antenna matching circuit

Normally R101 is 0Ω, C101 and C102 are not mounted.

4.19.2. FM Antenna Interface

The module provides 2 FM antenna pad named FM_ANT_P and FM_ANT_N, these are difference signal. The FM antenna interface circuit is recommended as following:

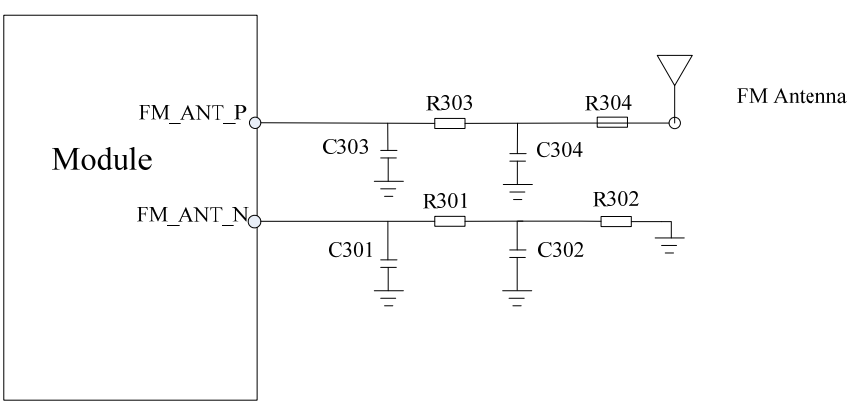


Figure 49: FM antenna matching circuit

Normally, R301\R302\R303\R304 are 0Ω, C301\C302\C303\C304 are not mounted.

The earphone is often used for FM antenna, as an example, the pin GND of the 3.5mm earphone is connected to the FM interface. The circuit is recommended as following:

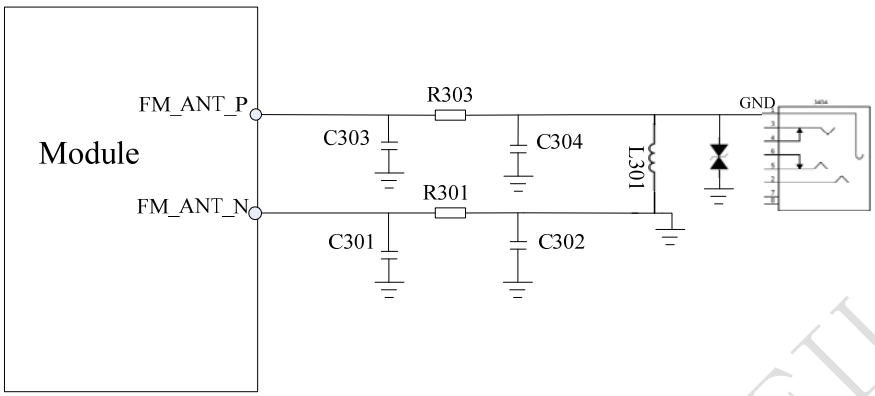


Figure 50: GND pin of the earphone use to be the FM antenna interface

Normally, R301\R303 are 0Ω, C301\C302\C303\C304\L301 are not mounted.

5. PCB Layout

Usually, most electronic products with good performance are based on good PCB layout. A bad PCB layout will lead to lots of issues, like TDD noise, SIM card not be detected, etc. the final solution for these problems is to redo PCB layout. Making good PCB layout at beginning will save develop schedule and cost as well.

This section will give some guidelines on PCB layout, in order to eliminate interfere or noise by greatest degree, and save product development period.

5.1 Pin Assignment

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

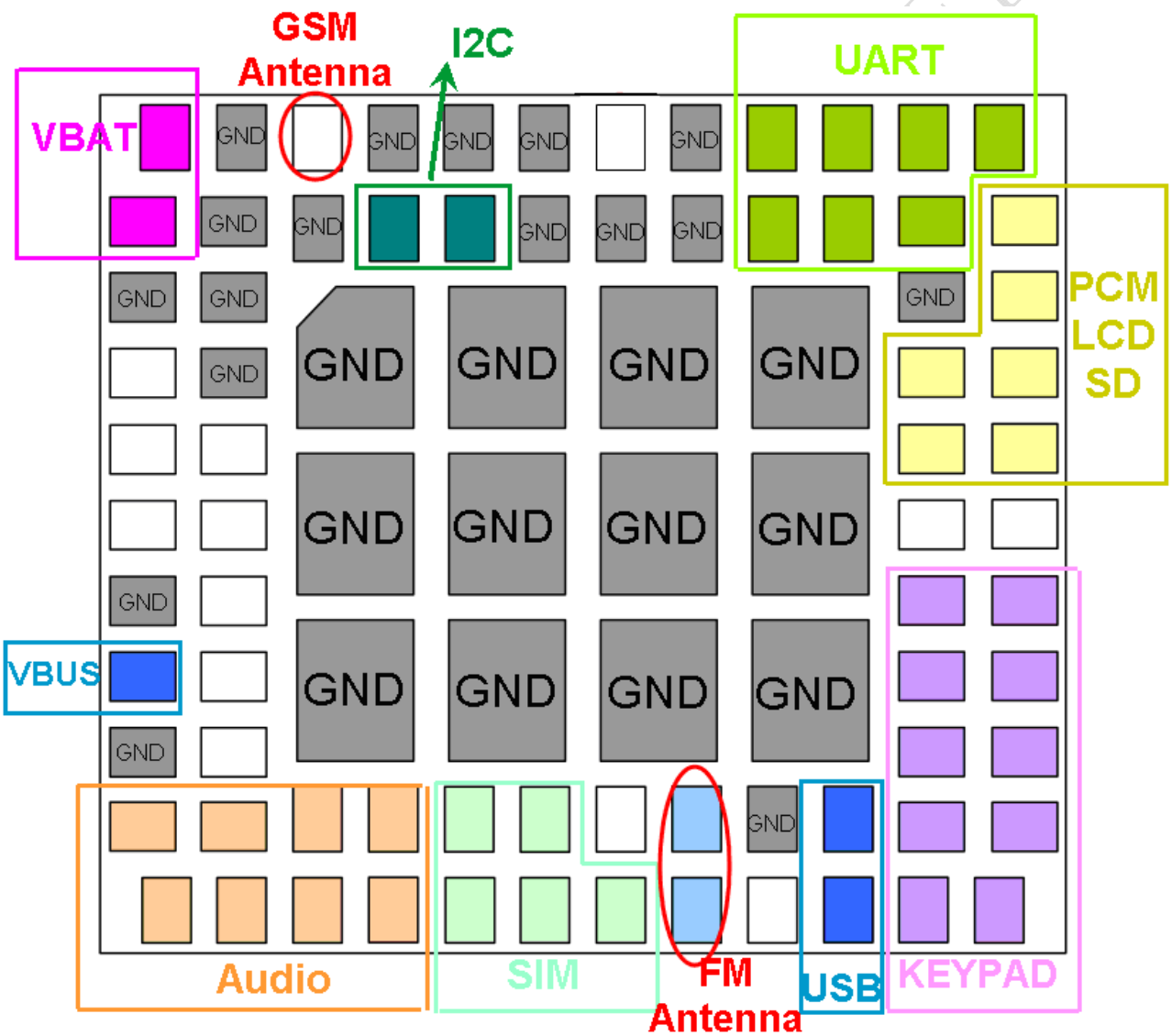


Figure 51: Pin assignment

5.2 Principle of PCB layout

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

5.2.1 Antenna Interface

The basis principle is that, the length of trace between pin output and connector should be as short as possible, in order to avoid coupling issue. Do not trace RF signal over across the board. Even the RF cable must be put over the board, it should be far away from SIM card, power ICs.

There are FM antenna interface and GSM antenna interface. If product equips these antennas as well, do pay attention to the distance between each single antenna.

5.2.2. Power Supply

Not only VBAT but also return GND are very important in layout. The positive line of VBAT should be as short and wide as possible. The correct flow from source to VBAT pin should go though Zener diode then huge capacitor. Pin 2, Pin 43, Pin 44 and Pin45 are GND signals, and shortest layout to GND of power source should be designed.

There are 12 GND pads in middle of module, these pads could enhance the GND performances. On the upper layer of these pads, do not trace any signal if possible.

5.2.3 SIM Card Interface

SIM card holder will take large space on board, and there is no anti-EMI component inside.Thus SIM card interface maybe interfered, please pay more attention on this interface during layout. Ensure SIM card holder is far way from antenna or RF cable inside. And it is better to put SIM card holder near the module, as nearer as possible. It is better to add ESD component to protect clock, data, reset and VSIM signals which should be far away from power and high-speed-frequency signal.

5.2.4 Audio Interface

In order to avoid TDD noise, or current noise, or some other noise, the signal trace of audio should far away from antenna and power. And do not let audio trace and VBAT trace parallel.

5.2.5 Others

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

5.3 Recommended PCB Layout

Based on above principles, recommended layout is shown in the following illustration.

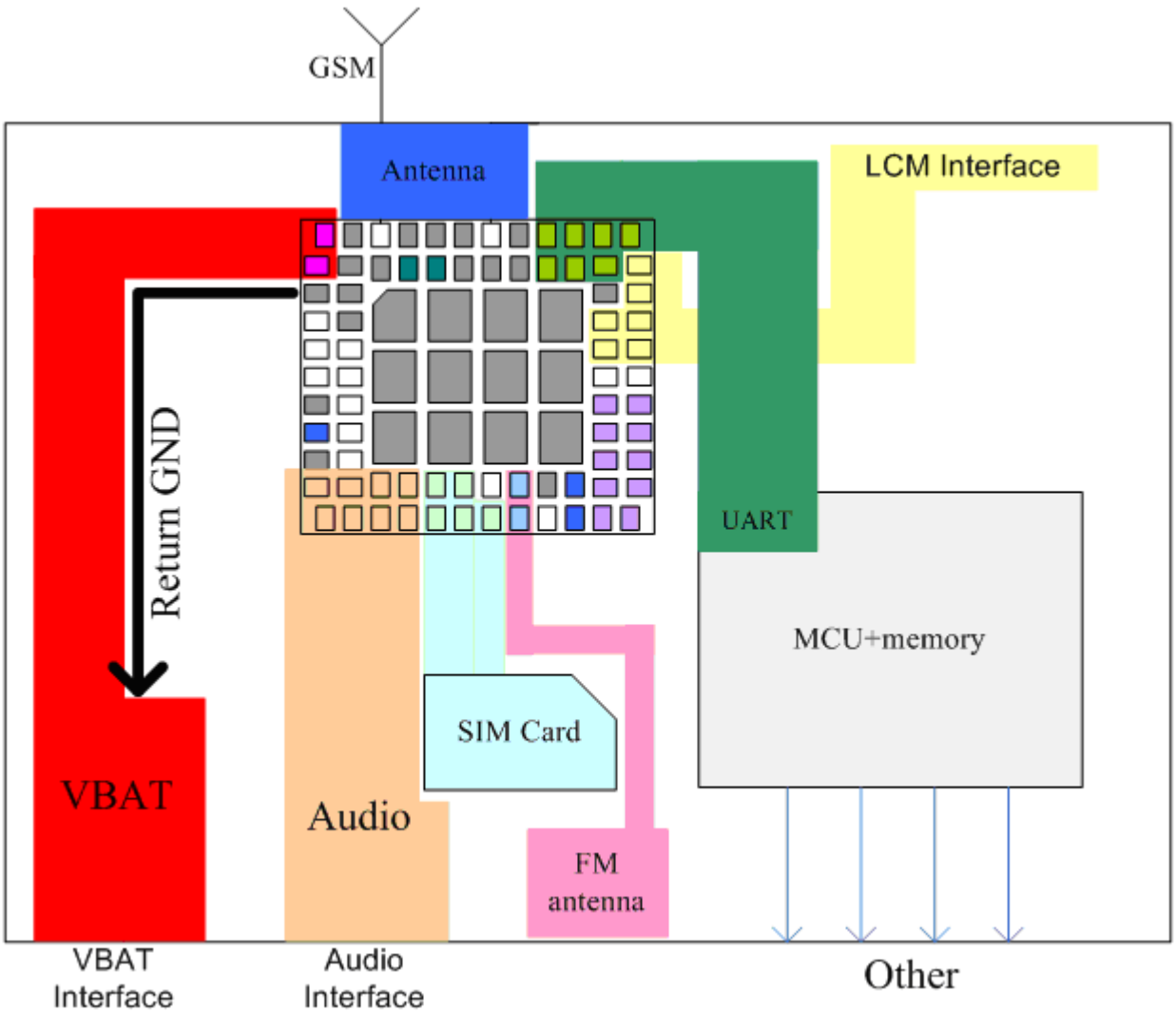


Figure 52: Recommended PCB layout

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 SIM800L.

Table 41: Absolute maximum ratings

Symbol	Min	Typ	Max	Unit
VBAT	-	-	4.5	V
Current	0	-	2.0	A
VBUS	-	-	30	V
I_I*	-	-	8	mA
I_O*	-	-	8	mA

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

6.2 Recommended Operating Conditions

Table 42: Recommended operating conditions

Symbol	Parameter	Min	Typ	Max	Unit
VBAT	Power supply voltage	3.4	4.0	4.4	V
T_{OPER}	Operating temperature	-40	+25	+85	℃
T_{STG}	Storage temperature	-45		+90	℃

6.3 Digital Interface Characteristics

Table 43: Digital interface characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V_{IH}	High-level input current	2.1	-	3.1	V
V_{IL}	Low-level input current	-0.3	-	0.7	V
V_{OH}	High-level output voltage	2.4	-	-	V
V_{OL}	Low-level output voltage	-	-	0.4	V

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

6.4 SIM Card Interface Characteristics

Table 44: SIM card interface characteristics

Symbol	Parameter	Min	Typ	Max	Unit
I_{IH}	High-level input current	-1	-	1	uA
I_{IL}	Low-level input current	-1	-	1	uA
V_{IH}	High-level input voltage	1.4	-	-	V
		2.4	-	-	V
V_{IL}	Low-level input voltage	-	-	0.27	V
				0.4	V
V_{OH}	High-level output voltage	1.62	-	-	V
		2.7	-	-	V
V_{OL}	Low-level output voltage	-	-	0.36	V
		-	-	0.4	V

6.5 SIM_VDD Characteristics

Table 45: SIM_VDD characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V_O	Output voltage	-	3	-	V
		-	1.80	-	
I_O	Output voltage	-	-	10	mA

6.6 VDD_EXT Characteristics

Table 46: VDD_EXT characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V_O	Output voltage	2.70	2.80	2.90	V
I_O	Output current	-	-	50	mA

6.7 VRTC Characteristics

Table 47: VRTC characteristics

Symbol	Description	Min	Typ	Max	Unit
V_{RTC-IN}	VRTC input voltage		2.8		V
I_{RTC-IN}	VRTC input current	-	3	-	uA
$V_{RTC-OUT}$	VRTC output voltage	-	2.8	-	V
$I_{RTC-OUT}$	VRTC output current	-		2	mA

6.8 Current Consumption (VBAT=3.8V)

Table 48: Current consumption

Symbol	Parameter	Conditions	Min	Typ	Max	Unit
VBAT	Voltage		3.4	4.0	4.4	V
	Power drop	PCL=5			350	mV
	Voltage ripple	PCL=5 @ f<200kHz @ f>200kHz			 50 2	 mV mV
I_{VBAT}	Average currnet	Power down mode		50	60	uA
		Sleep mode (at+cfun=1): (BS-PA-MFRMS=9) (BS-PA-MFRMS=5) (BS-PA-MFRMS=2)		 1.02 1.11 1.88		 mA mA mA
		Idle mode (at+cfun=1): GSM850 EGSM900 DCS1800 PCS1900		 18.7 18.7 18.7 18.7		 mA
		Voice call (PCL=5): GSM850 EGSM900 DCS1800 PCS1900		 199.48 216.12 146.48 131.77		 mA mA
		Data mode GPRS (1Rx,4Tx): GSM850 EGSM900 DCS1800 PCS1900		 453.57 344.74 216.20 274.04		 mA mA
		Data mode GPRS (3Rx,2Tx): GSM850 EGSM900 DCS1800 PCS1900		 386.09 345.02 216.79 239.12		 mA mA
		Data mode GPRS (4Rx,1Tx): GSM850 EGSM900 DCS1800 PCS1900		 212.69 227.95 158.19 148.49		 mA mA
I_{MAX}	Peak current	During Tx burst		2.0		A

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

6.9 Electro-Static Discharge

SIM800L is an ESD sensitive component, so attention should be paid to the procedure of handling and packaging. The ESD test results are shown in the following table.

Table 49: The ESD characteristics (Temperature: 25℃, Humidity: 45 %)

Pin name	Contact discharge	Air discharge
VBAT	±6KV	±12KV
GND	±6KV	±12KV
RXD, TXD	±2KV	±8KV
Antenna port	±5KV	±10KV
SPK_P/SPK_N/MIC_P/MIC_N	±2KV	±5KV
PWRKEY	±2KV	±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 50: GSM850 and EGSM900 conducted RF output power

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

Table 51: DCS1800 and PCS1900 conducted RF output power

DCS1800,PCS1900			
PCL	Nominal output power (dBm)	Tolerance (dB) for conditions	
		Normal	Extreme
0	30	±2	±2.5
1	28	±3	±4
2	26	±3	±4
3	24	±3	±4
4	22	±3	±4
5	20	±3	±4
6	18	±3	±4
7	16	±3	±4
8	14	±3	±4
9	12	±4	±5
10	10	±4	±5
11	8	±4	±5
12	6	±4	±5
13	4	±4	±5
14	2	±5	±6
15	0	±5	±6

6.11 Module RF Receive Sensitivity

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

Table 52: Conducted RF receive sensitivity

Frequency	Receive sensitivity（Typical）	Receive sensitivity(Max)
GSM850,EGSM900	< -108dBm	< -106dBm
DCS1800,PCS1900	< -108dBm	< -106dBm

6.12 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 53: Operating frequencies

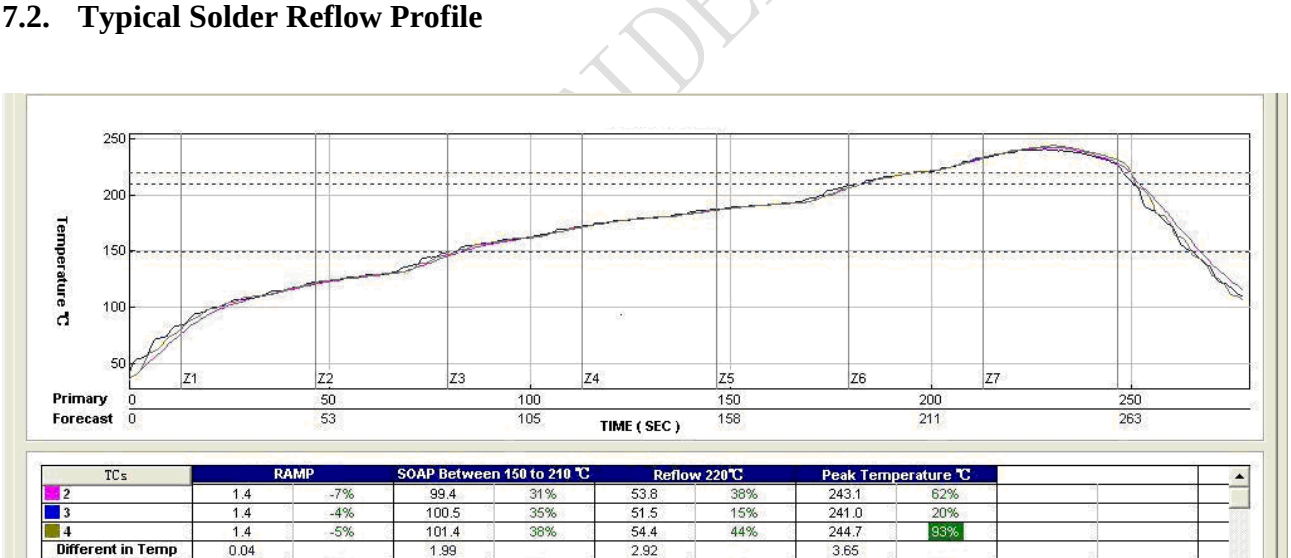
Frequency	Receive	Transmit
GSM850	869 ～ 894MHz	824 ～ 849MHz
EGSM900	925 ～ 960MHz	880 ～ 915MHz
DCS1800	1805 ～ 1880MHz	1710 ～ 1785MHz
PCS1900	1930 ～ 1990MHz	1850 ～ 1910MHz

7. Manufacturing

7.1. Top and Bottom View of SIM800L

Figure 53: Top and bottom view of SIM800L

7.2. Typical Solder Reflow Profile



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

Figure 54: Typical solder reflow profile

7.3. The Moisture Sensitivity Level

The moisture sensitivity level of SIM800L module is 3. The modules should be mounted within 168 hours after unpacking in the environmental conditions of temperature <30℃ and relative humidity of <60% (RH). It is

necessary to bake the module if the above conditions are not met:

Table 54: Moisture sensitivity level and floor life

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

NOTES:

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

7.4. Baking Requirements

SIM800L modules are vacuum packaged, and guaranteed for 6 months storage without opening or leakage under the following conditions: the environment temperature is lower than 40℃, and the air humidity is less than 90%.

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

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

Table 55: Baking requirements

Baking temperature	Moisture	Time
40℃±5℃	<5%	192 hours
120℃±5℃	<5%	6 hours

NOTES：

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

8. Appendix

I. Related Documents

Table 56: Related documents

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

II. Multiplexing Function

Table 57: Multiplexing function

Pin name	Pin number	Mode 0(default)	Mode 1	Mode 2	Mode 3
STATUS	4	STATUS	GPIO4		
SIMPRE	54	SIMPRE	GPIO5	EINT7	
COL0	20	COL0	GPIO6	-	-
COL1	25	COL1	GPIO7	-	-
COL2	22	COL2	GPIO8	-	-
COL3	21	COL3	GPIO9	-	-
COL4	24	COL4	GPIO10	EINT1	-
ROW0	62	ROW0	GPIO11	-	-
ROW1	60	ROW1	GPIO12	-	-
ROW2	61	ROW2	GPIO13	-	-
ROW3	23	ROW3	GPIO14	-	-
ROW4	63	ROW4	GPIO15	EINT3	-
PWM	26	PWM	GPIO16	EINT0	-
NETLIGHT	64	NETLIGHT	GPIO17	-	-
PCMCLK	29	PCMCLK	DISP_RSTB	MC3CM0	GPIO18
PCMOUT	30	PCMOUT	DISP_DI	MC3DA3	GPIO19
PCMSYNC	65	PCMSYNC	DISP_CEB	MC3CK	GPIO20
PCMIN	66	PCMIN	DISP_DA	MC3DA2	GPIO21
GPIO2	27	GPIO2	DISP_A0DA	MC3DA0	-
GPIO3	28	GPIO3	DISP_CLK	MC3DA1	-
UART_DTR	69	UART_DTR	GPIO22	EINT8	-
UART_RI	68	UART_RI	GPIO23	-	-
UART_DCD	70	UART_DCD	GPIO24	-	-
CTS	34	CTS	URXD2(IN)	-	-
RTS	33	RTS	UTXD2(OUT)	-	-
TXD	32	TXD	UTXD1(OUT)	-	-
RXD	31	RXD	URXD1(IN)	EINT4	-
SCL	74	SCL	GPIO25	-	-
SDA	75	SDA	GPIO26	-	-

Note: Multiplexing function need different software supply.

III. Terms and Abbreviations

Table 58: 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

IV. Safety Caution

Table 59: 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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