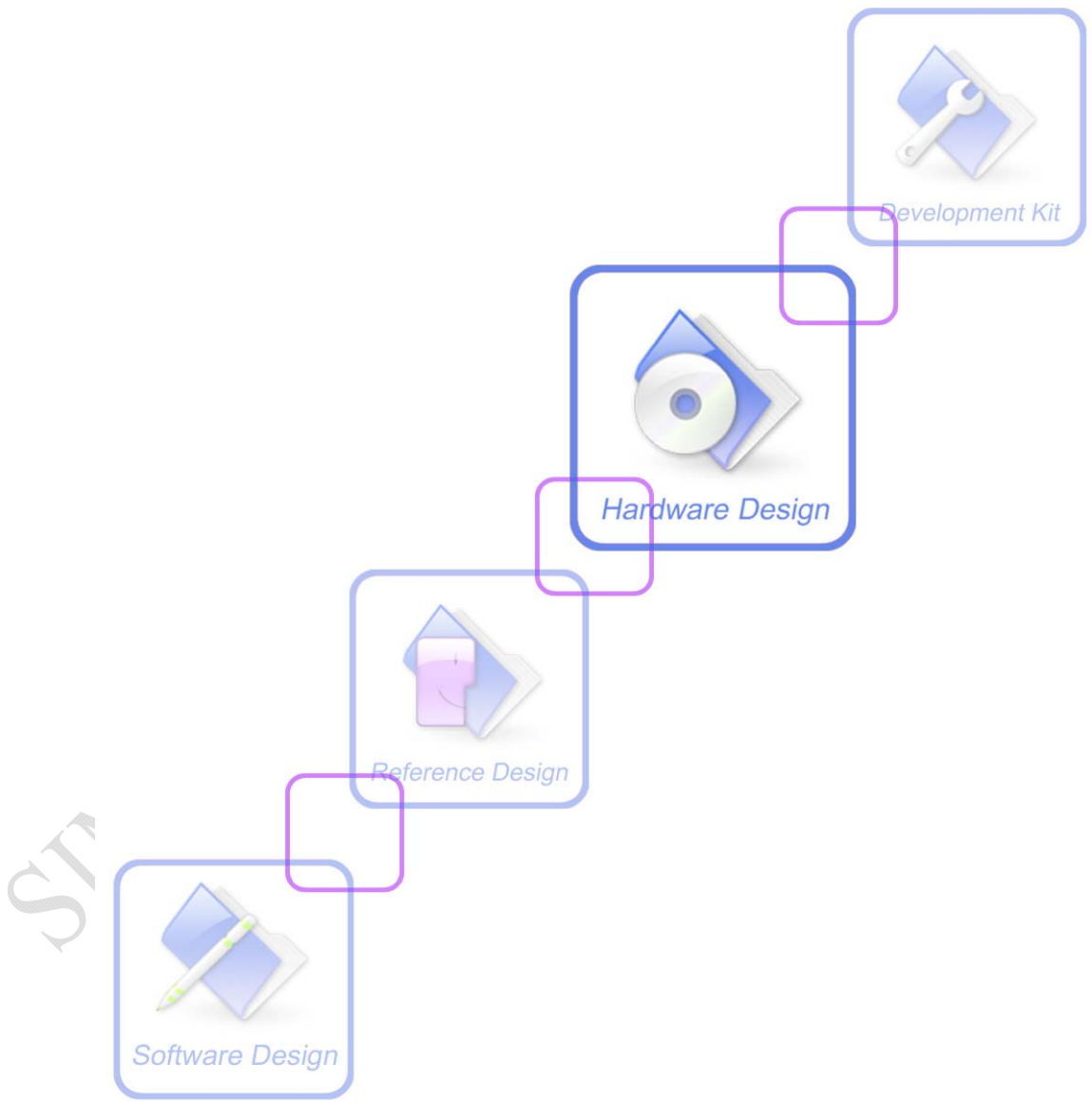
Hardware Design

SIM340C_HD_V1.04



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Version history

Date	Version	Description of change	Author
2007-01-23	1.01	origin	liyongsheng
2007-08-30	1.02	Modify the current of VDD_EXT to 10mA. Modify the range of autobauding as 4800-115200bps. Add the function of over-voltage automatic shutdown. Add the chapter 2.2, the chapter 2.3, the chapter 3.18, the Add the figure 1, 2, 4, 6, 7, 21, 34 and the table 8, 24. Modify the figure 9: Timing of turning off system (pulldown time of the PWRKEY from 1s-2s to 2s-3s), figure 5, figure 10.	song
2007-10-26	1.03	Modify the figure 9: Timing of turning off system (pulldown time of the PWRKEY from 2s-3s to 0.5s-1s) Add notes about Restricted operation	anyong
2008-03-12	1.04	Modify the duration of DTR low level that wakes up the module from sleep mode. Modify the behaviours of RI. Modify RF connector type MM9329-2700B to MM9329-2700RA1 Add notes that LCD display interface function is option. Add notes that keypad interface function is option. Add notes that GPIO function is option.	Lvning

1 Introduction

This document describes the hardware interface of the SIMCom SIM340C module that connects to the specific application and the air interface. As SIM340C can be integrated with a wide range of applications, all functional components of SIM340C are described in great detail.

This document can help you quickly understand SIM340C interface specifications, electrical and mechanical details. With the help of this document and other SIM340C application notes, user guide, you can use SIM340C module to design and set-up mobile applications quickly.

1.1 Related documents

Table 1: Related documents

SN	Document name	Remark
[1]	SIM300C_ATC	SIM300C_ATC
[2]	ITU-T Draft new recommendation V.25ter:	Serial asynchronous automatic dialing and control
[3]	GSM 07.07:	Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)
[4]	GSM 07.05:	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)
[5]	GSM 07.10:	Support GSM 07.10 multiplexing protocol
[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_SerialPort***	***AN_SerialPort***

1.2 Terms and abbreviations

Table 2: Terms and abbreviations

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

LED	Light Emitting Diode
Abbreviation	**Description**
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 Switched Broadcast Control Channel
PCB	Printed Circuit Board
PCS	Personal Communication System, also referred to as GSM 1900
PDU	Protocol Data Unit
PPP	Point-to-point protocol
RF	Radio Frequency
RMS	Root Mean Square (value)
RTC	Real Time Clock
Rx	Receive Direction
SIM	Subscriber Identification Module
SMS	Short Message Service
TDMA	Time Division Multiple Access
TE	Terminal Equipment, also referred to as DTE
TX	Transmit Direction
UART	Universal Asynchronous Receiver & Transmitter
URC	Unsolicited Result Code
USSD	Unstructured Supplementary Service Data
VSWR	Voltage Standing Wave Ratio
Vmax	Maximum Voltage Value
Vnorm	Normal Voltage Value
Vmin	Minimum Voltage Value
VIHmax	Maximum Input High Level Voltage Value
VIHmin	Minimum Input High Level Voltage Value
VILmax	Maximum Input Low Level Voltage Value
VILmin	Minimum Input Low Level Voltage Value
VImax	Absolute Maximum Input Voltage Value
VImin	Absolute Minimum Input Voltage Value
VOHmax	Maximum Output High Level Voltage Value
VOHmin	Minimum Output High Level Voltage Value
VOLmax	Maximum Output Low Level Voltage Value
VOLmin	Minimum Output Low Level Voltage Value

Phonebook abbreviations	
Abbreviation	**Description**
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
M2M	Machine to Machine
NC	Not connect

2 SIM340C overview

Designed for global market, SIM340C is a Quad-band GSM/GPRS engine that works on frequencies of GSM 850 MHz, EGSM 900 MHz, DCS 1800 MHz and PCS 1900 MHz.SIM340C features GPRS multi-slot class 10/ class8（optional） capability and support the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4.

With a tiny configuration of 50mm x 33mm x 6.2mm, SIM340C can meet almost all the space requirement in your industrial application, such as M2M, and mobile data communication system etc. With the charge circuit integrated inside the SIM340C, it is very suitable for the battery power application.

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

- The keypad and LCD display interface will give you the flexibility to develop customized applications.

- Serial port and Debug port can help you easily develop your applications.

- Two audio channels include two microphones inputs and two speakers' outputs. This can be easily configured by AT command.

- Charge interface

The SIM340C provides RF antenna interface with alternatives: antenna connector and antenna pad. The antenna connector is MURATA MM9329-2700. And customer's antenna can be soldered to the antenna pad.

The SIM340C is designed with power saving technique; so that the current consumption is as low as 2.5mA in SLEEP mode.

The SIM340C is integrated with the TCP/IP protocol, extended TCP/IP AT commands are developed for customers to use the TCP/IP protocol easily, which is very useful for those data transfer applications.

2.1 SIM340C key features

Table 3: SIM340C key features

Feature	Implementation
Power supply	Single supply voltage 3.4V – 4.5V
Power saving	Typical power consumption in SLEEP mode to 2.5mA (BS-PA-MFRMS =5)
Frequency Bands	● SIM340C Quad-band: GSM 850, EGSM 900, DCS 1800, PCS 1900. The SIM340C can search the 4 frequency bands automatically. The frequency bands also can be set by AT command. ● Compliant to GSM Phase 2/2+
GSM class	Small MS
Transmitting power	● Class 4 (2W) at EGSM900 ● Class 1 (1W) at DCS1800 and PCS 1900
GPRS connectivity	● GPRS multi-slot class 10 (default) ● GPRS multi-slot class 8 （option） ● GPRS mobile station class B
Temperature range	● Normal operation: -30°C to +80°C ● Restricted operation: -40°C to -30°C and +80 °C to +85°C(1) ● Storage temperature -45°C to +90°C
DATA *GPRS:* *CSD:*	● GPRS data downlink transfer: max. 85.6 kbps ● GPRS data uplink transfer: max. 42.8 kbps ● Coding scheme: CS-1, CS-2, CS-3 and CS-4 ● SIM340C supports the protocols PAP (Password Authentication Protocol) usually used for PPP connections. ● The SIM340C integrates the TCP/IP protocol. ● Support Packet Switched Broadcast Control Channel (PBCCH) ● CSD transmission rates: 2.4, 4.8, 9.6, 14.4 kbps, non-transparent ● Unstructured Supplementary Services Data (USSD) support
SMS	● MT, MO, CB, Text and PDU mode ● SMS storage: SIM card
FAX	Group 3 Class 1
SIM interface	Support SIM card: 1.8V, 3V
External antenna	Connected via 50 Ohm antenna connector or 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)

	● Echo suppression
Serial port and Debug port	● Serial port: seven lines on serial interface ● Serial port can be used for CSD FAX, GPRS service and send AT command to control module. ● Serial port can use multiplexing function ● Autobauding supports baud rate from 4800 bps to 115200bps. ● Debug port: two lines on serial interface /TXD and /RXD ● Debug port only used for debugging
Phonebook management	Support phonebook types: SM, FD, LD, RC, ON, MC.
SIM Application Toolkit	Support SAT class 3, GSM 11.14 Release 99
Real time clock	Implemented
Timer function	Programmable via AT command
Physical characteristics	Size: 50±0.15 x 33±0.15 x7.7±0.3mm (including application connector) 50±0.15 x 33±0.15 x 6.2±0.3mm (excluding application connector) Weight: 13.8g
Firmware upgrade	Firmware upgrade by serial port

(1) The SIM340C does works, but deviations from the GSM specification may occur, For example, both the frequency error and the phase error will be large.

Table 4: 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 SIM340C functional diagram

The following figure shows a functional diagram of the SIM340C and illustrates the mainly functional part:

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

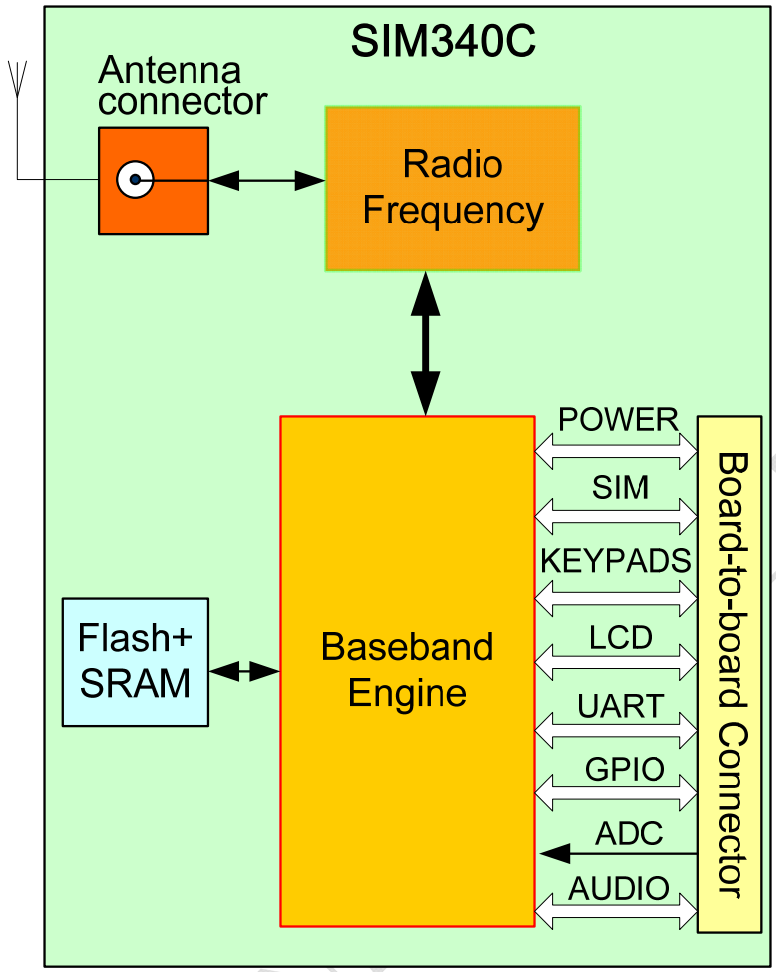


Figure 1: SIM340C functional diagram

2.3 SIM340C evaluation board

In order to help you on the application of SIM340C application, SIMCom can supply an Evaluation Board (EVB) that interfaces the SIM340C directly with appropriate power supply, SIM card holder, RS232 serial port, handset port, earphone port, antenna and all GPIO of the SIM340C.

Figure 2: Top view of SIM340C EVB

For details please refer to the *SIM340C-EVB_UGD* document.

3 Application interface

SIM 300C is equipped with a 60-pin 1.27mm pitch Board to Board connector that connects to the cellular application platform. Sub-interfaces included in this Board to Board connector are described in detail in following chapters:

- Power supply *(please refer to Chapter 3.3)*
- Serial interfaces *(please refer to Chapter 3.9)*
- Two analog audio interfaces *(please refer to Chapter 3.10)*
- SIM card interface *(please refer to Chapter 3.12)*

Electrical and mechanical characteristics of the Board to Board connector are specified in *Chapter 6.* There we also include order information for mating connectors.

3.1 SIM340C pin description

Table 5: Board-to-board connector pin description

Power Supply			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
VBAT		5 VBAT pins of the Board to Board connector are dedicated to connect the supply voltage. The power supply of SIM340C has to be a single voltage source of VBAT= 3.4V...4.5V. It must be able to provide sufficient current in a transmitting burst which typically rises to 2A. may be about 0.1ms up to 3A in some times , these 5 pins are voltage input	Vmax= 4.5V Vmin=3.4V Vnorm=4.0V
VRTC	I/O	Current input for RTC when the battery is not supplied for the system. Current output for backup battery when the main battery is present and the backup battery is in low voltage state.	Vmax=2.0V Vmin=1.2V Vnorm=1.8V $I_{out(max)}$= 20uA I_{in}=5 uA
VDD_EXT	O	Supply 2.93V voltage for external circuit. By measuring this pin, user can judge whether the system is power on or off. When the voltage is low, the system is power off. Otherwise, the system is power on.	Vmax=3.0V Vmin=2.75V Vnorm=2.93V Imax=10mA
VCHG	I	Voltage input for the charge circuit; making the system detect the charger.	Vmax=5.25V Vmin=1.1 * VBAT Vnorm=5.1V
GND		Digital ground	
Power on or power off			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
PWRKEY	I	Voltage input for PWRKEY. PWRKEY should be pulled low to power on or power off the system. The user should keep pressing the key for a moment when power on or power off the system because the system need margin time in order to assert the software.	VILmax=0.2*VBAT VIHmin=0.6*VBAT VImax=VBAT

Audio interfaces			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
MIC1P MIC1N	I	Positive and negative voice-band input	Audio DC Characteristics refer to chapter 3.10.4
MIC2P MIC2N	I	Auxiliary positive and negative voice-band input	
SPK1P SPK1N	O	Positive and negative voice-band output	
SPK2P SPK2N	O	Auxiliary positive and negative voice-band output	
BUZZER	O	Buzzer output	
AGND		Analog ground	
General purpose input/output			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
KBC0~KBC4	O	Keypad interface	VILmin=0V VILmax=0.3 *VDD_EXT VIHmin=0.7*VDD_EXT VIHmax= VDD_EXT+0.3 VOLmin=GND VOLmax=0.2V VOHmin= VDD_EXT-0.2 VOHmax= VDD_EXT
KBR0~KBR4	I		
DISP_DATA	I/O	LCD display interface	
DISP_CLK	O		
DISP_CS	O		
DISP_D/C	O		
DISP_RST	O		
NETLIGHT	O	Network status indication	
STATUS	O	Indicate work status	
GPIO0	I/O	Normal input/output port	
GPIO1	I/O		
Serial port			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
DTR	I	Data terminal ready	VILmin=0V VILmax=0.3*VDD_EXT VIHmin=0.7*VDD_EXT VIHmax= VDD_EXT+0.3 VOLmin=GND VOLmax=0.2V VOHmin= VDD_EXT-0.2 VOHmax= VDD_EXT
RXD	I	Receive data	
TXD	O	Transmit data	
RTS	I	Request to send	
CTS	O	Clear to send	
RI	O	Ring indicator	
DCD	O	Data carrier detection	
Debug port			
DBG_TXD	O	Serial interface for debugging only	
DBG_RXD	I		
SIM interface			

PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
SIM_VDD	O	Voltage supply for SIM card	The voltage can be select by software automatically either 1.8V or 3V
SIM_DATA	I/O	SIM data output	VILmin=0V VILmax=0.3*SIM_VDD VIHmin=0.7*SIM_VDD VIHmax= SIM_VDD+0.3 VOLmin=GND VOLmax=0.2V VOHmin= SIM_VDD-0.2 VOHmax= SIM_VDD
SIM_CLK	O	SIM clock	
SIM_PRESENCE	I	SIM card detection	
SIM_RST	O	SIM reset	
AUXADC			
PIN NAME	I/O	DESCRIPTION	DC CHARACTERISTICS
ADC0	I	General purpose analog to digital converter.	Input voltage range: 0V to 2.4V

3.2 Operating modes

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

Table 6: Overview of operating modes

Mode	Function	
Normal operation	GSM/GPRS SLEEP	Module will automatically go into SLEEP mode if DTR is set to high level and there is no on air and no hardware interrupt (such as GPIO interrupt or data on serial port). In this case, the current consumption of module will reduce to the minimal level. During SLEEP mode, the module can still receive paging message and SMS from the system normally.
	GSM IDLE	Software is active. Module has registered to the GSM network, and the module is ready to send and receive.
	GSM TALK	Connection is going on between two subscribers. 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 in transfer (PPP or TCP or UDP). In this case, power consumption is related with network settings (e.g.

		power control level), uplink / downlink data rates and GPRS configuration (e.g. used multi-slot settings).
POWER DOWN	Normal shutdown by sending the “AT+CPOWD=1” command or using the PWRKEY. The power management ASIC disconnects the power supply from the base band part of the module, and only the power supply for the RTC is remained. Software is not active. The serial port is not accessible. Operating voltage (connected to VBAT) remains applied.	
Minimum functionality mode (without remove power supply)	Use the “AT+CFUN” command can set the module to a minimum functionality mode without remove the power supply. In this case, the RF part of the module will not work or the SIM card is not accessible, or both RF part and SIM card be closed all, and the serial port is still accessible. The power consumption in this case is very low.	
Alarm mode	RTC alert function launches this restricted operation while the module is in POWER DOWN mode. SIM340C will not be registered to GSM network and only parts of AT commands can be available.	
GHOST Mode (Charge-only mode)	GHOST mode means off and charging mode. In this mode, the module can not be registered to GSM network and only limited AT commands can be accessible, the following way will launch GHOST mode: ● From POWER DOWN mode: Connect charger to the module’s VCHG pin and VBAT pin while SIM340C is power down. ● From Normal mode: Connect charger to the module’s VCHG pin and VBAT pin, then power down the module by “AT+CPOWD＝1”	
Charge mode during normal operation	Start charging while the module is in normal mode including: SLEEP, IDLE, TALK, GPRS STANDBY and GPRS DATA)	

3.3 Power supply

The power supply of SIM340C is from a single voltage source of VBAT= 3.4V...4.5V. In some case, the ripple in a transmitting burst may cause voltage drops when current consumption rises to typical peaks of 2A. So the power supply must be able to provide sufficient current up to 2A.

For the VBAT input, a local bypass capacitor is recommended. A capacitor (about 100μF, low ESR) is recommended. Multi-layer ceramic chip (MLCC) capacitors can provide the best combination of low ESR and small size but may not be cost effective. A lower cost choice may be a 100μF tantalum capacitor (low ESR) with a small (0.1μF to 1μF) ceramic in parallel, which is illustrated as following figure. The capacitors should put as close as possible to the SIM340C VBAT pins. The following figure is the recommended circuit.

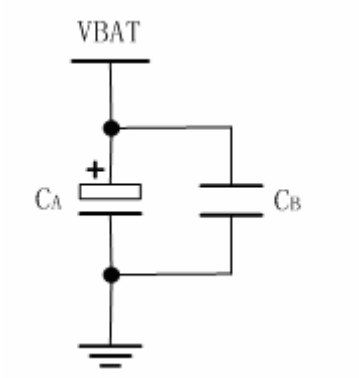


Figure 3: Reference circuit of the VBAT input

The circuit design of the power supply depends strongly from the power source (DC input) where this power is drained. The following figure is the reference design of DC input source power supply. The designed VBAT output for the power supply is 4V, thus a linear regulator can be used. If there's a big difference between the input source and the desired output (VBAT), a switching converter power supply will be preferable because of its better efficiency especially with the 2A peak current in burst mode of the module.

The single 3.6V Li-Ion cell battery type can be connected to the power supply of the SIM340C VBAT directly. But the Ni_Cd or Ni_MH battery types must be used carefully, since their maximum voltage can rise over the absolute maximum voltage for the module and damage it.

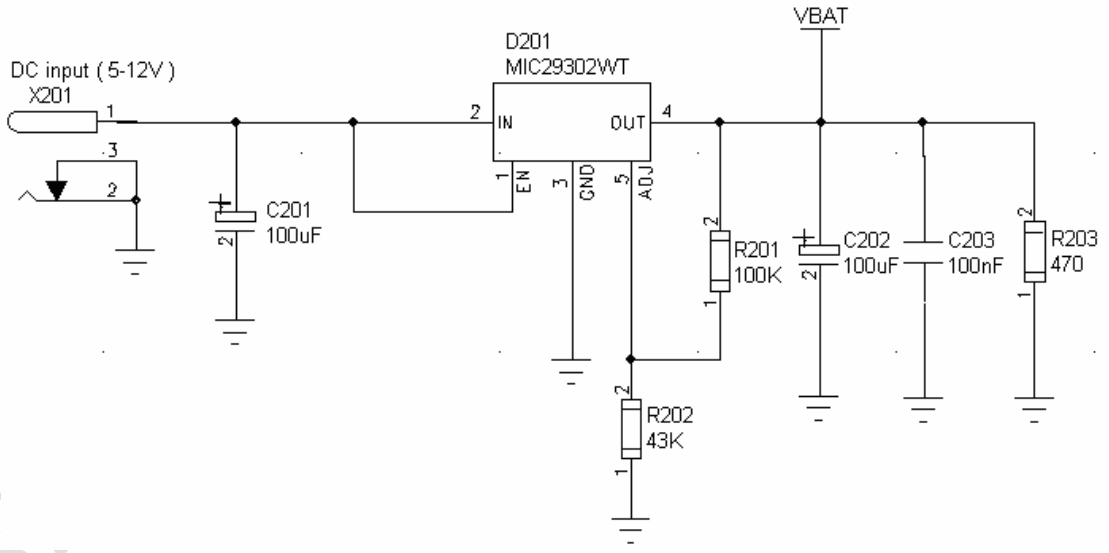


Figure 3: Reference circuit of the source power supply input

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

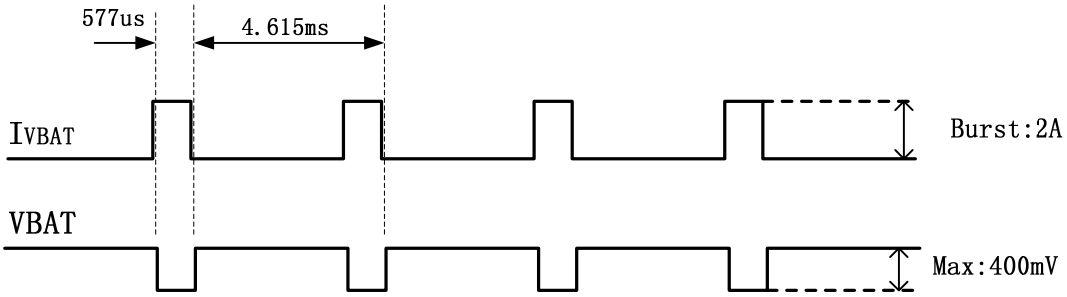


Figure 4: VBAT voltage drop during transmit burst

3.3.1 Power supply pins on the board-to-board connector

Five VBAT pins of the board-to-board connector are dedicated to connect the supply voltage; Five GND pins are recommended for grounding. VRTC pin can be used to back up the RTC.

3.3.2 Minimizing power losses

Please pay special attention to the supply power when you are designing your applications. Please make sure that the input voltage will never drop below 3.4V even in a transmitting burst during which the current consumption may rise up to 2A. If the power voltage drops below 3.4V, the module may be switched off. The PCB traces from the VBAT pins of connector to the power source must be wide enough to ensure no voltage drops occur in the transmitting burst mode.

3.3.3 Monitoring power supply

To monitor the supply voltage, you can use the "AT+CBC" command which include three parameters: charging status, percent of battery capacity and voltage value (in mV). It returns charge state, the percent of battery capacity and actual value measured at VBAT and GND.

The voltage is continuously measured at intervals depending on the operating mode. The displayed voltage (in mV) is averaged over the last measuring period before the AT+CBC command is executed.

3.4 Power up and power down scenarios

3.4.1 Turn on SIM340C

SIM340C can be turned on by various ways, which are described in following chapters:

- Via PWRKEY pin: starts normal operating mode *(please refer to chapter 3.4.1.1)*;

- Via RTC interrupt: starts ALARM modes *(please refer to chapter 3.4.1.2)*

Note: The AT command must be set after the SIM340C is power on and Unsolicited Result Code "RDY" is received from the serial port. However, if the SIM340C was set autobauding, the serial port will received nothing, the AT command can be set after 2-3s from the SIM340C is power on. You can use AT+IPR=x;&W to set a fix baud rate and save the configuration to non-volatile flash memory. After the configuration was saved as fix baud rate, the Code "RDY" should be received from the serial port all the time that the SIM340C was power on. Please refer to the chapter AT+IPR in document [1].

3.4.1.1 Turn on SIM340C using the PWRKEY pin (Power on)

You can turn on the SIM340C by driving the PWRKEY to a low level voltage for some time and then released. The simple circuit illustrates as the following figures.

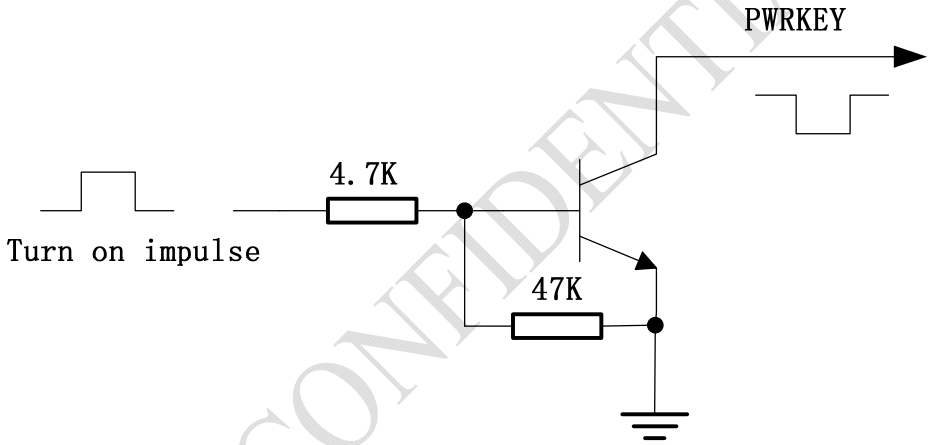


Figure 5: Turn on SIM340C using driving circuit

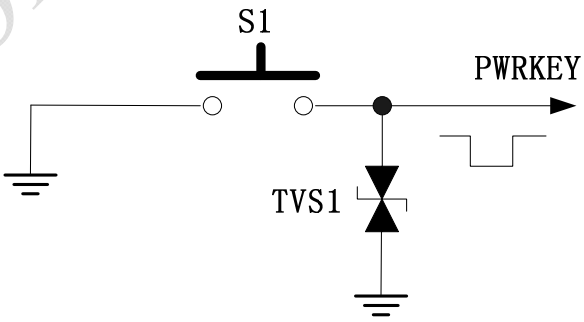


Figure 6: Turn on SIM340C using button

The power on scenario illustrates as following figure.

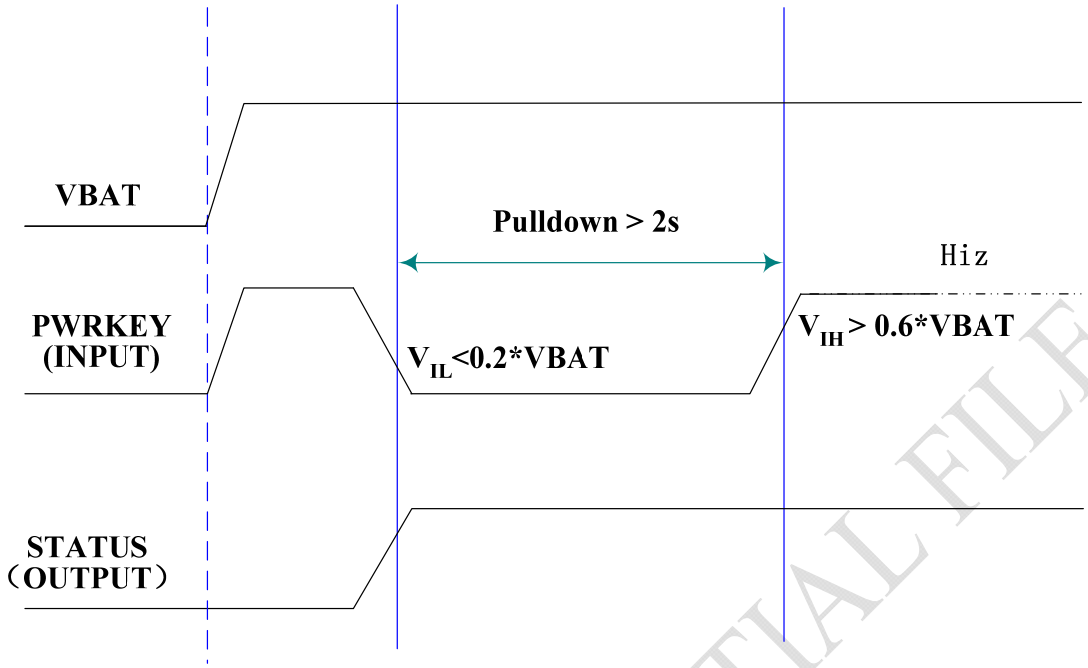


Figure8: Timing of turn on system

When power on procedure complete, SIM340C will send out following result code to indicate the module is ready to operate, and STATUS pin will drive to 2.8V and keep this level when in work mode. If the SIM340C is configured to a fix baud rate, it will send out an Unsolicited Result Code (URC):

RDY

This result code does not appear when autobauding is active.

3.4.1.2 Turn on SIM340C using the RTC (Alarm mode)

Alarm mode is a power-on approach by using the RTC. The alert function of RTC makes the SIM340C wake up while it is power off. In alarm mode, SIM340C will not register to GSM network and the software protocol stack is closed. Thus the parts of AT commands related with SIM card and Protocol stack will not be accessible, and the others can be used as well as in normal mode.

Use the AT+CALARM command to set the alarm time. The RTC remains the alarm time if SIM340C is power down by “AT+CPOWD=1” or by PWRKEY pin. Once the alarm time expires and executed, SIM340C will go into the Alarm mode. In this case, if the SIM340C is configured to a fixed baud rate, it will send out an Unsolicited Result Code (URC):

RDY

ALARM MODE

This result code does not appear when autobauding is active.

During alarm mode, using AT+CFUN command to query the status of software protocol stack; it will return 0 which indicates that the protocol stack is closed. Then after 90s, SIM340C will power down automatically. However, during alarm mode, if the software protocol is started by AT+CFUN=1 command, the process of automatic power down will not be available. In ALARM mode, driving the PWRKEY to a low level voltage for a period will cause SIM340C to be powered down (Please refer to the power down scenario).

The table follow briefly summarizes the AT commands that are used usually during alarm mode, for details of the instructions refer to *document [1]*:

Table 7: AT commands used in Alarm mode

AT command	Use
AT+CALARM	Set alarm time
AT+CCLK	Set data and time of RTC
AT+CPOWD	Power down
AT+CFUN	Start or close the protocol stack

3.4.1.3 Turn on the SIM340C using the VCHG signal

As described in chapter 3.5, charger can be connected to the SIM340C's VCHG pin regardless of the module's operating mode.

If the charger is connected to the module's VCHG pin while the SIM340C is in POWER DOWN mode, it will go into the GHOST mode (Off and charging). In this mode, the module will not register to network, and only a few AT commands can work in this mode. For detailed information please refers to *chapter 3.5.4*.
When the SIM340C is powered on using the VCHG signal and configured to a fixed baud rate, it will send out a result code as following:

RDY
GHOST MODE
+CFUN: 0
This result code does not appear when autobauding is active.

In GHOST mode, by driving the PWRKEY to a low level voltage for period time (Please refer to the power on scenario in 3.4.1.1), the SIM340C will power up and go into charge mode (charging in normal mode), all operation and AT commands can be available. In this case, if the SIM340C is configured to a fixed baud rate, it will send out result code as following:

From GHOST MODE to NORMAL MODE
This result code does not appear when autobauding is active.

3.4.2 Turn off SIM340C

Following procedure can be used to turn off the SIM340C:

- Normal power down procedure: Turn off SIM340C using the PWRKEY pin
- Normal power down procedure: Turn off SIM340C using AT command
- Over-voltage or under-voltage automatic shutdown: Take effect if over-voltage or under-voltage is detected
- Over-temperature or under-temperature automatic shutdown: Take effect if over-temperature or under-temperature is detected

3.4.2.1 Turn off SIM340C using the PWRKEY pin (Power down)

You can turn off the SIM340C by driving the PWRKEY to a low level voltage for some time. Please refer to the turn on circuit. The power down scenario illustrates as following figure.

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

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

NORMAL POWER DOWN

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

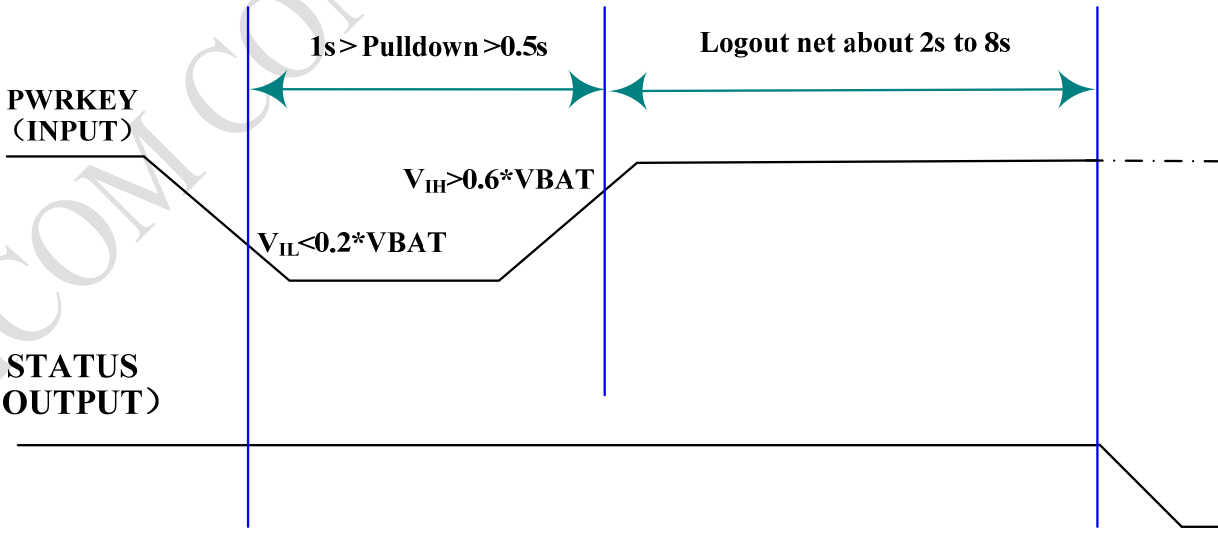


Figure 7: Timing of turn off system

3.4.2.2 Turn off SIM340C using AT command

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

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

NORMAL POWER DOWN

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

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

3.4.2.3 Over-voltage or under-voltage automatic shutdown

The module will constantly monitor the voltage applied on the VBAT, if the voltage ≤ 3.5V, the following URC will be presented:

UNDER-VOLTAGE WARNNING

If the voltage ≥ 4.5V, the following URC will be presented:

OVER-VOLTAGE WARNNING

The uncritical voltage range is 3.4V to 4.6V. If the voltage ≥ 4.6V or ≤ 3.4V, the module will be automatic shutdown soon.

If the voltage ≤ 3.4V, the following URC will be presented:

UNDER-VOLTAGE POWER DOWN

If the voltage ≥ 4.6V, the following URC will be presented:

OVER-VOLTAGE POWER DOWN

After this moment, no further more AT commands can be executed. The module logs off from network and enters POWER DOWN mode, and only the RTC is still active. POWER DOWN can also be indicated by VDD_EXT pin, which is a low level voltage in this mode.

3.4.2.4 Over-temperature or under-temperature automatic shutdown

The module will constantly monitor the temperature of the module, if the temperature ≥ 85℃, the following URC will be presented:

+CMTE:1

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

+CMTE:-1

The uncritical temperature range is -45℃ to 90℃. If the temperature ≥ 90℃ or ≤ -45℃, the module will be automatic shutdown soon.

If the temperature ≥ 90℃, the following URC will be presented:

+CMTE:2

If the temperature ≤ -45℃, the following URC will be presented:

+CMTE:-2

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

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

For details please refer to *document [1]*

3.4.3 Restart SIM340C by the PWRKEY pin

You can restart SIM340C by driving the PWRKEY to a low level voltage for some time, the same as turn on SIM340C using the PWRKEY pin. Before restarting the SIM340C, you need delay at least 0.5s from detecting the STATUS low level on. The restarting scenario illustrates as the following figure.

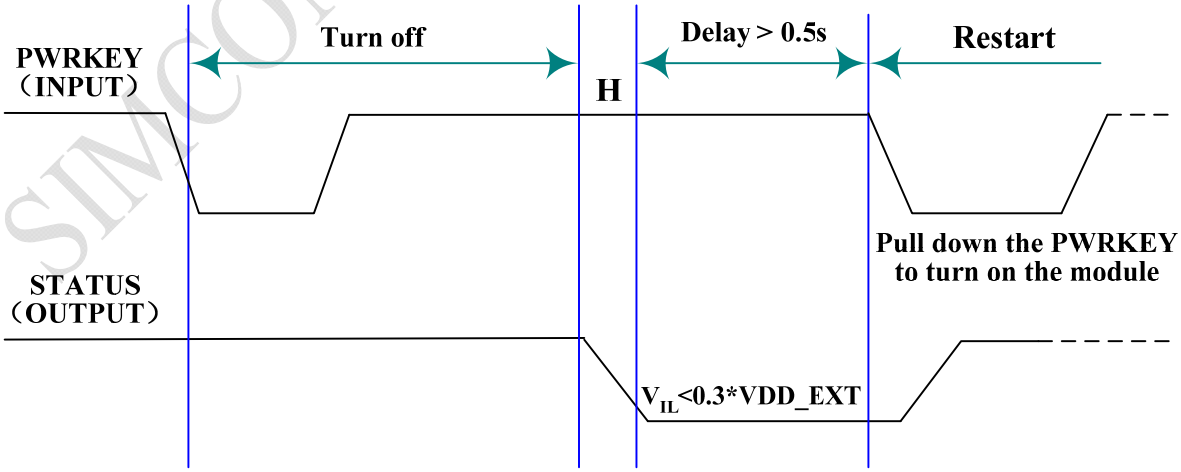


Figure10: Timing of restart system

3.5 Charging interface

The SIM340C has integrated a charging circuit inside the module for Li-Ion batteries charging control, which make it very convenient for applications to manage their battery charging.
A common connection is shown in the following figure:

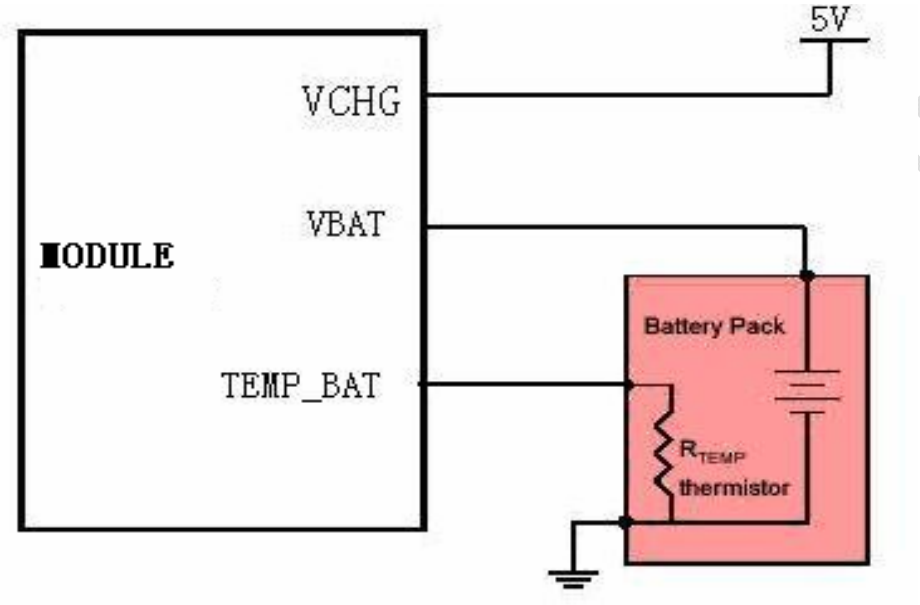


Figure11: Battery charger and pack

The TEMP_BAT function should be supported by the software in the module. It's a customization function. The R_{TEMP} is a NTC thermistor. We recommend using NCP15XH103F03RC from MURATA. The impedance of the NTC thermistor is 10Kohm in 25℃. Please refer to the fore figure for the reference circuit.

3.5.1 Battery pack characteristics

The SIM340C has optimized the charging algorithm for the Li-Ion battery that meets the characteristics listed below. To use the SIM340C's charging algorithm properly, it is recommended that the battery pack you integrated into your application is compliant with these specifications. The battery pack compliant with these specifications is also important for the AT command "AT+CBC" to monitor the voltage of battery, or the "AT+CBC" may return incorrect battery capacity values.

- The maximum charging voltage of the Li-Ion battery pack is 4.2V and the capacity is recommended to 580mAh. Battery packs with a The capacity of battery packs down to 580mAh or more than 580mAh are allowed, too.
- The battery pack should have a protection circuit to avoid overcharging, over discharging and

over-current. This circuit should be insensitive to pulsed current.

- The build-in circuit of the SIM340C's power management chipset monitors the supply voltage constantly. Once the Under-voltage is detected, the SIM340C will power down automatically. Under-voltage thresholds are specific to the battery pack.
- The internal resistance of the battery and the protection circuit should be as low as possible. It is recommended that the battery internal resistanc should not to exceed 70mΩ and the internal resistance include battery and protection circuit of battery pack should not exceed 130mΩ.
- The battery pack must be protected from reverse pole connection.
- The Li-Lon/Polymer battery charge protect parameter is required as following table

Table 8: recommended battery protect circuit parameter

Item	Min.	Typ.	Max.	Unit
Over-charge protect threshold.	4.25	4.3	4.35	V
Released Voltage from Over-charge	4.1		4.2	V
Over-discharge protect threshold	2.2		2.35	V
Released Voltage from Over-discharge	2.35	2.4	2.45	V

3.5.2 Recommended battery pack

Following is the spec of recommended battery pack:

Table 9: Spec of recommended battery pack

Product name & type	SCUD Li-Ion, 3.7V, 800mAh
To obtain more information, Please contact :	SCUD (FU JIAN) Electronic CO..LTD
Normal voltage	3.7V
Capacity	Minimum 800mAh
Charge Voltage	4.200~4.23V
Max Charge Current	1.2C
Max Discharge Current	2C
Charge Method	CC / CV (Constant Current / Constant Voltage)
Internal resistance	≤130mΩ
Over-charge protect threshold.(V)	4.28 ± 0.025

Released Voltage from Over-charge(V)	4.08 ± 0.05
Over-discharge protect threshold(V)	2.3± 0.1
Released Voltage from Over-discharge(V)	2.3± 0.1

3.5.3 Implemented charging technique

The SIM340C includes the function for battery charging. There are two pins in the connector related with the battery charging function: VCHG and VBAT pins. The VCHG pin is driven by an external voltage, system can use this pin to detect a charger supply and provide most charging current through the SIM340C module to battery when charging is in fast charge state. The VBAT gives out charging current from the SIM340C module to external battery.

So it is very simple to implement charging technique, you need only connect the charger to the VCHG pin and connect the battery to the VBAT pin.
The SIM340C detect charger supply and the battery is present, battery charging will happen. If there is no charger supply or no battery present the charging will not be enabled.

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

- DDLO charge and UVLO charge;
- Fast charge;
- Trickle charge;

DDLO charge and UVLO charge:
DDLO (deep discharge lock out) is the state of battery when its voltage under 2.4V. And UVLO (under voltage lock out) means the battery voltage less than 3.2V and more than 2.4V. The battery is not suitable for fast charge when its condition is DDLO or UVLO. The SIM340C provides a small constant current to the battery when the battery is between DDLO and UVLO. In DDLO charge, the SIM340C gives out 5mA current to the battery. And in UVLO charge, The SIM340C provide about 30mA current to the battery.

DDLO charge terminated when the battery voltage reaches 2.4V. UVLO charge terminated when the battery voltage is up to 3.2V. Both DDLO and UVLO charge are controlled by the SIM340C hardware only.

Fast charge:
If there is a charger supply and battery present and the battery is not in DDLO and UVLO, the SIM340C will enter fast charge state. Fast charge controlled by the software. Fast charge delivers a strong and constant current (about 450mA) through VBAT pin to the battery until battery voltage reach 4.2V.

Trickle charge:
After fast charging, the battery voltage is approach the whole battery capacity voltage, trick charge

begins .in this state, the SIM340C charge the battery under constant voltage.

3.5.4 Operating modes during charging

The battery can be charged during various operating mode. That means when the module is in Normal mode (SLEEP, IDLE, TALK, GPRS IDLE or GPRS DATA mode), charging can be in progress while the SIM340C remains operational (In this case the voltage supply should be sufficient). Here we name Charging in Normal mode as Charge mode.

If the charger is connected to the module's VCHG pin and the battery is connected to the VBAT pin while the SIM340C is in POWER DOWN mode, the SIM340C will go into the GHOST mode (Off and charging). The following table gives the difference between Charge mode and GHOST mode:

Table10: operating modes

	How to activate mode	Features
Charge Mode	Connect charger to module's VCHG pin and connect battery to VBAT pin of module while the SIM340C is in Normal operating mode, including: IDLE, TALK mode; SLEEP mode etc;	● GSM remains operational and registered GSM network while charging is in progress; ● The serial interface is available in IDLE, TALK mode, the AT command set can be used fully in this case; In SLEEP mode, the serial interface is not available, once the serial port is connected and there is data in transfer. Then the SIM340C will exit the SLEEP mode.
GHOST Mode	Connect charger to module's VCHG pin while the SIM340C is in POWER DOWN mode.	● Battery can be charged when GSM engine is not registered to GSM network; ● Only a few AT commands are available as listed below.

Note: VBAT can not provide much more than 5mA current while SIM340C module is during the DDLO charge state. In other words it is strongly recommended that VBAT should not be the main power supply in the application subsystem while SIM340C module is during the DDLO charge state.

Table 9: AT Command usually used in GHOST mode

AT command	Function
AT+CALARM	Set alarm time
AT+CCLK	Set data and time of RTC
AT+CPOWD	Power down

AT+CBC	Indicated charge state and voltage
AT+CFUN	Start or close the protocol Set AT command **"AT+CFUN =1**", module can be transferred from **GHOST** mode to **Charging in normal** mode, In **GHOST** mode , the default value is 0

3.5.5 Charger requirements

Following is the requirements of charger for the SIM340C.

- Simple transformer power plug
- Output voltage: 5.0V-5.25V
- Charging current limitation: 650mA
- A 10V peak voltage is allowed for maximum 1ms when charging current is switched off.
- A 1.6A peak current is allowed for maximum 1ms when charging current is switched on.

3.6 Power saving

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

3.6.1 Minimum functionality mode

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

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

If SIM340C has been set to minimum functionality by "AT+CFUN=0", then the RF function and SIM card function will be closed, in this case, the serial port is still accessible, but all AT commands correlative with RF function or SIM card function will not be accessible.

If SIM340C has been set by "AT+CFUN=4", the RF function will be closed, the serial port is still active in this case, all AT commands correlative with RF function will not be accessible.

After SIM340C has been set by "AT+CFUN=0" or "AT+CFUN=4", it can return to full functionality by "AT+CFUN=1".

For detailed information about "AT+CFUN", please refer to *document [1]*.

3.6.2 Sleep mode (slow clocking mode)

We can control SIM340C module to enter or exit the SLEEP mode in customer applications through DTR signal. Please note that the DTR pin is float inside SIM340C, so this pin must be in HIGH level to make the module enter SLEEP mode.

When DTR is in high level and there is no on air and hardware interrupt (such as GPIO interrupt or data on serial port), SIM340C will enter SLEEP mode automatically. In this mode, SIM340C can still receive paging or SMS from network but the serial port is not accessible.

Note: For SIM340C, it requests to set AT command "AT+CSCLK=1" to enable the sleep mode; the default value is 0, that can't make the module enter sleep mode,.For more details please refer to our AT command list.

3.6.3 Wake up SIM340C from SLEEP mode

When SIM340C is in SLEEP mode, the following method can wake up the module.

- Enable DTR pin to wake up SIM340C.
  If DTR Pin is pulled down to a low level, this signal will wake up SIM340C from power saving mode. The serial port will be active after DTR change to low level for about 40ms.
- Receiving a voice or data call from network to wake up SIM340C.
- Receiving a SMS from network to wake up SIM340C.
- RTC alarm expired to wake up SIM340C.

Note: DTR pin should be held low level during communicating between the module and DTE.

3.7 Summary of state transitions (except SLEEP mode)

Table 10: Summary of state transitions

Further mode Current mode	POWER DOWN	Normal mode	Alarm mode	Ghost mode (Charge-only mode)	Charging in normal
POWER DOWN		Use PWRKEY	Switch on from POWER DOWN mode by RTC	Connect charger to VCHG and connect battery to VBAT	No direct transition, but via "Ghost mode" or "Normal mode"
Normal mode	AT+CPOWD or use PWRKEY pin		Set alarm by "AT+CALARM", and then switch	Connect charger to VCHG and connect battery to	Connect charger to VCHG pin of module and connect

			off the module. When the timer expire, the module turn on and enter Alarm mode	VBAT, then switch off module by AT+CPOWD or using PWRKEY	battery to VBAT pin of module
Alarm mode	Use PWRKEY pin or wait module switch off automatically	Use AT+CFUN		No transition	Use AT+CFUN let module enter Normal mode, then connect the charger to VCHG pin of module
Ghost mode (Charge-only mode)	Disconnect charger	No direct transition, but via "Charging in normal" mode	Set alarm by "AT+CALARM" , when the timer expire, module will enter Alarm mode		Turn on the module using PWRKEY OR SET AT Command "AT+CFUN=1"
Charging in normal	AT+CPOWD → "Ghost mode" , then disconnect charger	Disconnect the charger	No direct transition	Switch off module by AT+CPOWD or using PWRKEY	

3.8 RTC backup

The RTC (Real Time Clock) power supply of module can be provided by an external capacitor or a battery (rechargeable or non-chargeable) through the VRTC on the board to board connector. There is a 10K resistance has been integrated in SIM340C module used for limiting current. You need only a coin-cell battery or a super-cap to VRTC to backup power supply for RTC.

Note: The VRTC couldn't be designed to a NC pin in your circuit. You should connect the VRTC pin to a battery or a capacitor.

The following figures show various sample circuits for RTC backup.

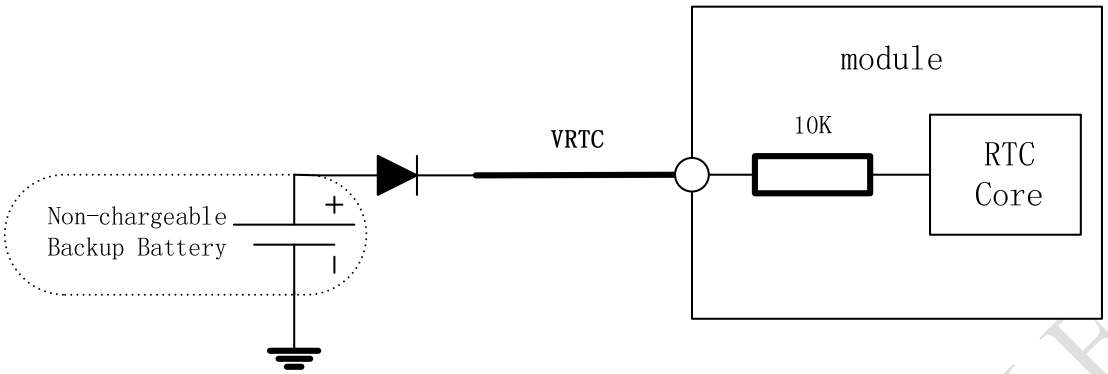


Figure12: RTC supply from non-chargeable battery

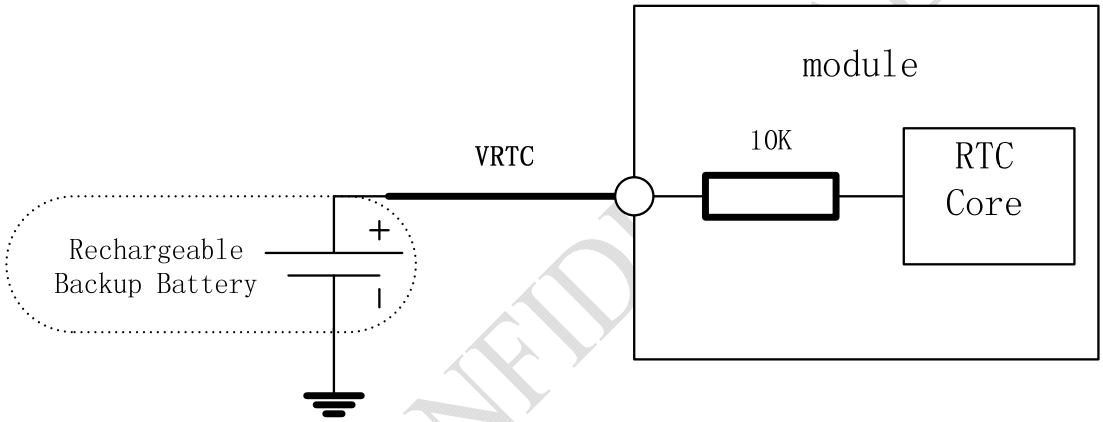


Figure13: RTC supply from rechargeable battery

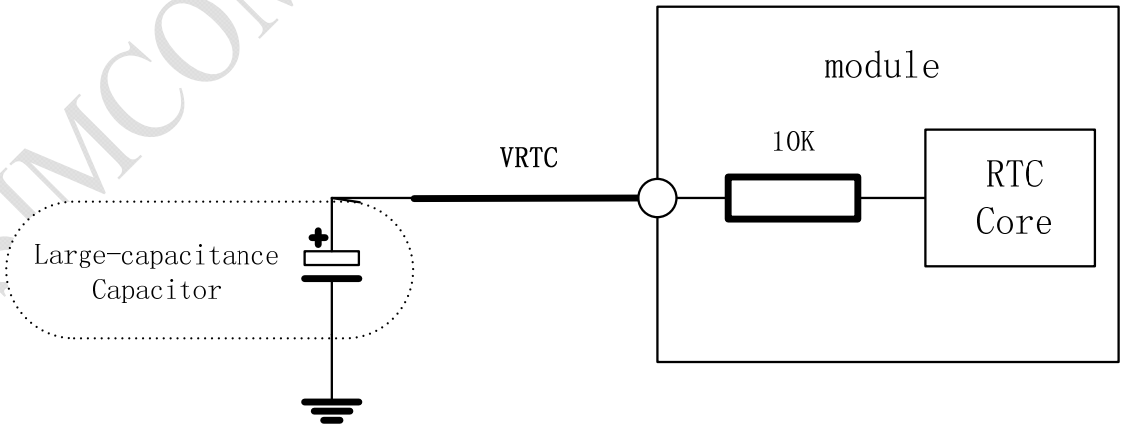


Figure14: RTC supply from capacitor

- **Li-battery backup**

Rechargeable Lithium coin cells such as the TC614 from Maxell, or the TS621 from Seiko, are also small in size, but have higher capacity than the double layer capacitors resulting in longer backup times.

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

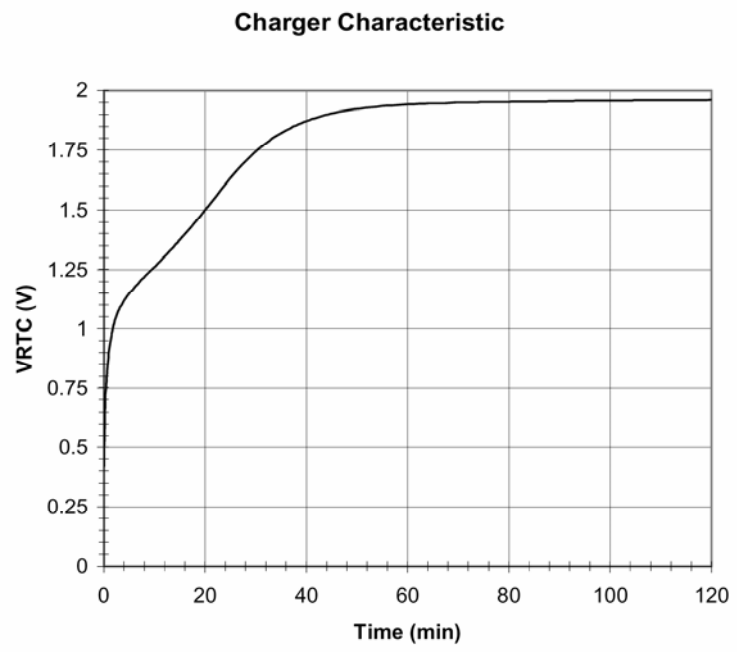


Figure 8: Panasonic EECEMOE204A Charge Characteristic

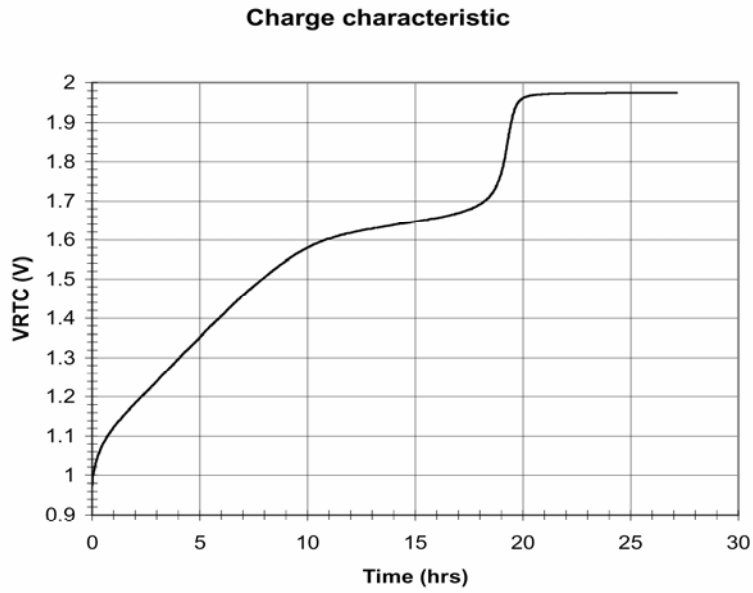


Figure 9: Maxell TC614 Charge Characteristic

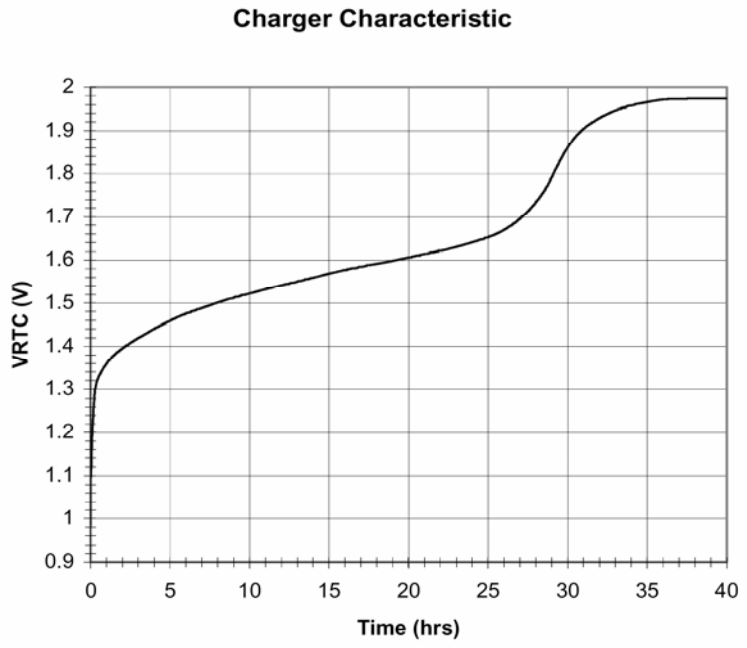


Figure 10: Seiko TS621 Charge Characteristic

Note:

Gold-capacitance backup

Some suitable coin cells are the electric double layer capacitors available from Seiko (XC621), or from Panasonic (EECEM0E204A). They have a small physical size (6.8 mm diameter) and a nominal capacity of 0.2F to 0.3F, giving hours of backup time.

3.9 Serial interfaces

Table 13: Pin definition of the serial interfaces

	Name	Pin	Function
Serial port	DCD	37	Data carrier detection
	DTR	39	Data terminal ready
	RXD	41	Receive data
	TXD	43	Transmit data
	RTS	45	Request to send
	CTS	47	Clear to send
	RI	49	Ring indicator
Debug port	DBG_RXD	48	Receive data
	DBG_TXD	50	Transmit data

SIM340C provides two unbalanced asynchronous serial ports. One is the serial port and another is the debug port. The GSM module is designed as a DCE (Data Communication Equipment), following the traditional DCE-DTE (Data Terminal Equipment) connection. The module and the client (DTE) are connected through the following signal (as following figure shows). Autobauding supports baud rate from 4800 bps to 115200bps.

Serial port

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

Debug port

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

The logic levels are described in following table

Table 11: Logic levels of the serial port and debug port

Parameter	Min	Max	Unit
V_{IL}	0	0.3*VDD_EXT	V
V_{IH}	0.7 *VDD_EXT	VDD_EXT +0.3	V
V_{OL}	GND	0.2	V
V_{OH}	VDD_EXT -0.2	VDD_EXT	V

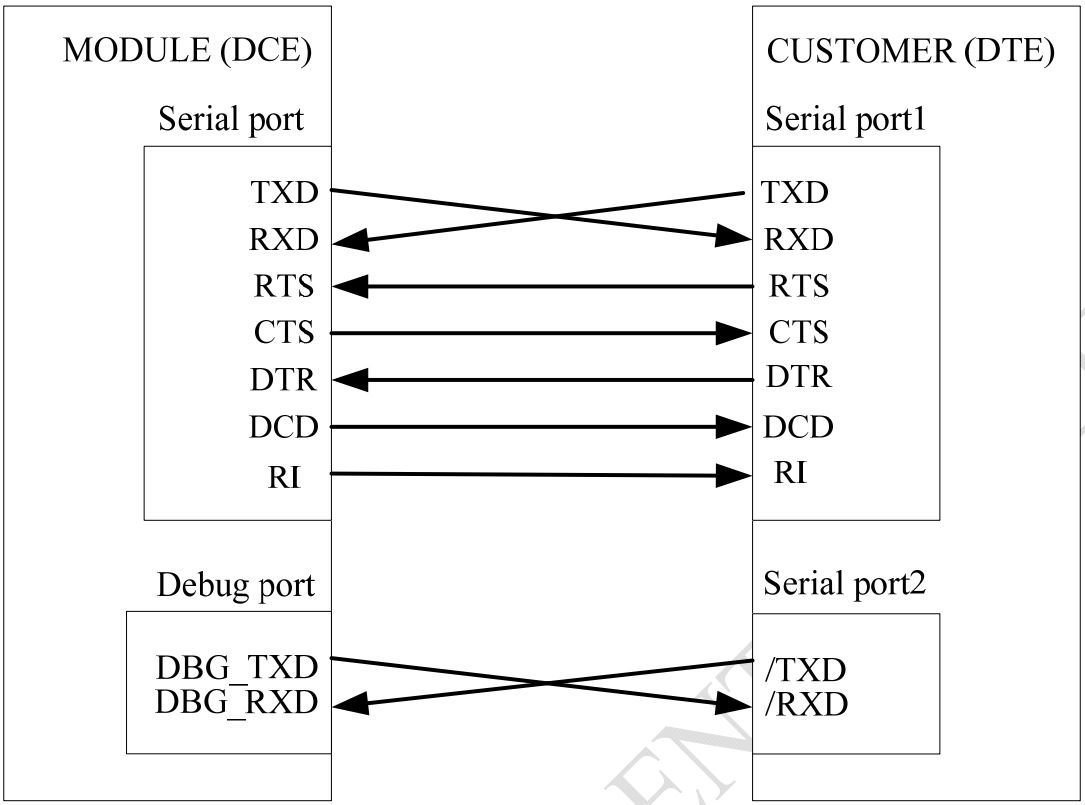


Figure 11: Connection of the serial interface

Note: The RTS PIN must be connected to the GND in the customer circuit when only the TXD and RXD are used in the Serial Port communication

3.9.1 Function of serial port supporting

Serial port

- Seven lines on serial interface
- Contains data lines TXD and RXD, State lines RTS and CTS, Control lines DTR, DCD and RI.
- Serial port can be used for CSD FAX, GPRS service and send AT command of controlling module. Also Serial port can be used for multiplexing function.
- Serial port supports the baud rates as following:
  300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Default as 115200bps.
- Autobauding supports baud rates as following:
  4800, 9600, 19200, 38400, 57600 and 115200bps.

Autobauding allows the GSM engine to automatically detect the baud rate configured in the host application. The serial port of the GSM engine supports autobauding for the following baud rates: 4800, 9600, 19200, 38400, 57600, 115200bps. Factory setting is autobauding enabled. This gives you the flexibility to put the GSM engine into operation no matter what baud rate your host application is configured to. To take advantage of autobauding mode specific attention should be

paid to the following requirements:

Synchronization between DTE and DCE

When DCE powers on with the autobauding enabled, it is recommended to wait 2 to 3 seconds before sending the first AT character. After receiving the “OK” response, DTE and DCE are correctly synchronized.

Restrictions on autobauding operation

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

Note: You can use AT+IPR=x;&W to set a fixed baud rate and save the configuration to non-volatile flash memory. After the configuration is saved as fixed baud rate, the Unsolicited Result Codes like "RDY" should be received from the serial port all the time that the SIM340C was power on.

Debug port

- Two lines on serial interface
- Only contains data lines DBG_TXD and DBG_RXD
- Debug port only used for debugging. It cannot be used for CSD call, FAX call. And the Debug port can not use multiplexing function; it doesn’t support autobauding function.
- Debug port supports the baud rates as following:
  9600, 19200, 38400, 57600, 115200bps

3.9.2 Software upgrade and software debug

The TXD、RXD、DBG_TXD、DBG_RXD and GND must be connected to the IO connector when user need to upgrade software and debug software, the TXD、 RXD should be used for software upgrade, the DBG_TXD、DBG_RXD for software debugging. The PWRKEY pin is recommended to connect to the IO connector. The user also can add a switch between the PWRKEY and the GND. The PWRKEY should be connected to the GND when SIM340C is upgrading software. Please refer to the following figure.

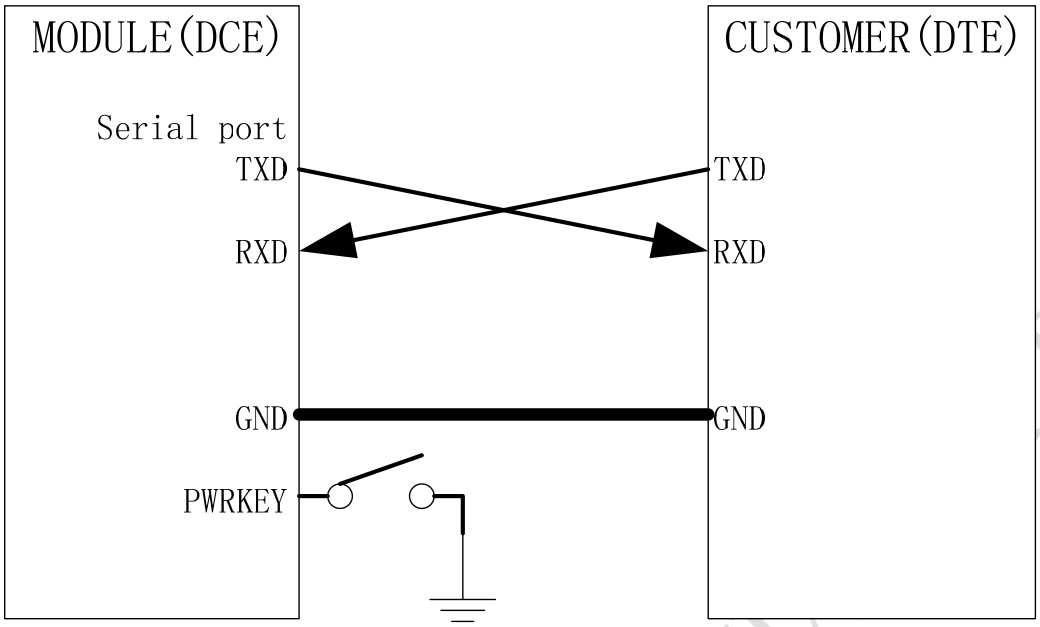


Figure 12: Connection of software upgrade

Note: The RTS PIN must be connected to the GND in the customer circuit when only TXD and RXD are used in the Serial Port communication.

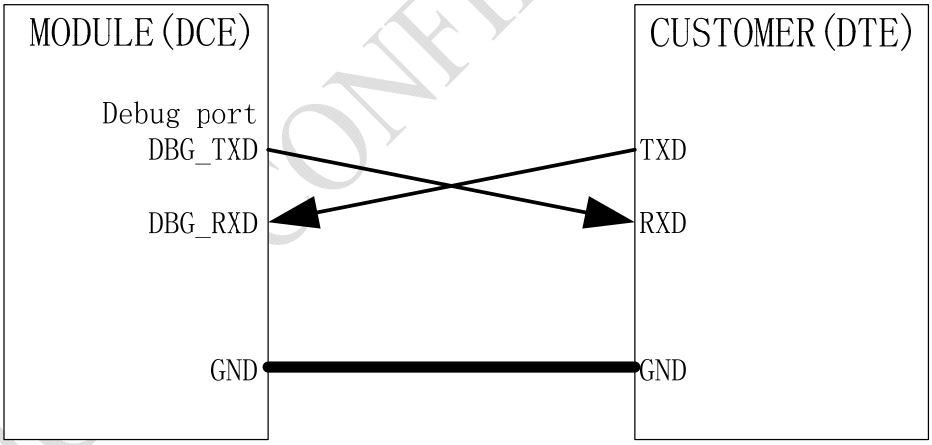


Figure 20: Connection of software debug

The serial port and the debug port doesn't support the RS_232 level, it only supports the CMOS level. Please refer to the table 14 for details about the voltage level. You should add the level converter IC between the DCE and DTE, if you connect it to the computer. Please refer to the following figure.

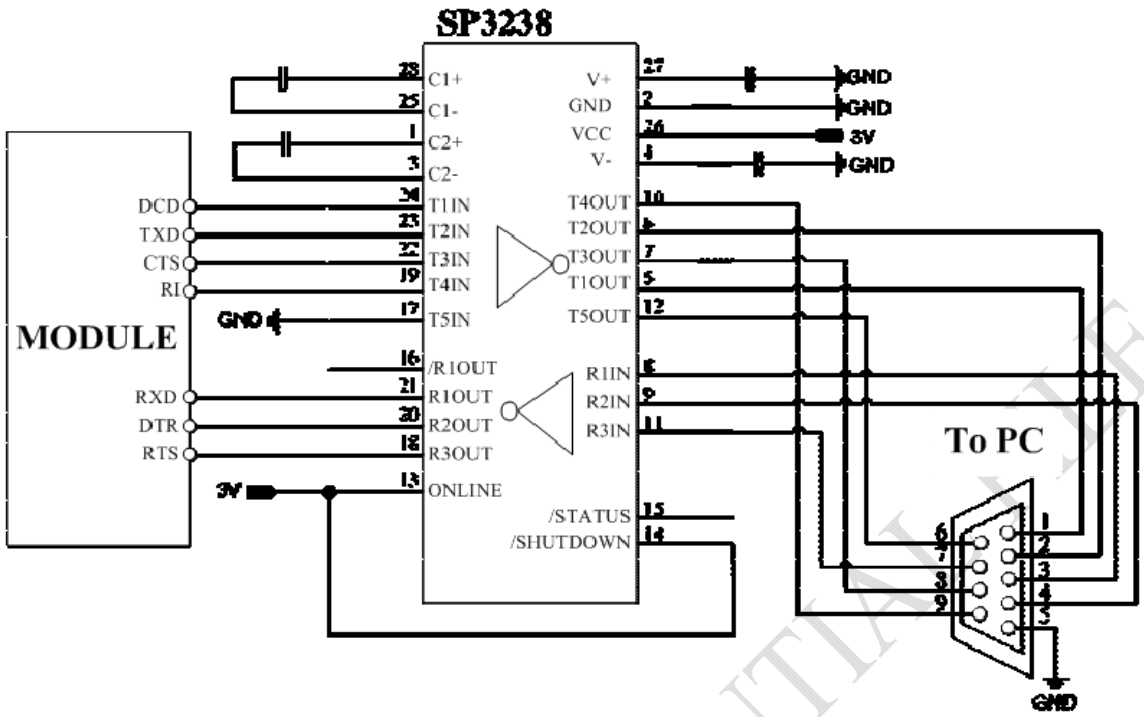


Figure 13: RS232 level converter circuit

Note：For detail information about serial port application, please refer to document [10]

3.10 Audio interfaces

Table 12: PIN definition of the Audio interface

	Name	Pin	Function
(AIN1/AOUT1)	MIC1P	54	Microphone1 input +
	MIC1N	56	Microphone1 input -
	SPK1P	53	Audio1 output+
	SPK1N	55	Audio1 output-
(AIN2/AOUT2)	MIC2P	58	Microphone2 input +
	MIC2N	60	Microphone2 input -
	SPK2P	57	Audio2 output+
	SPK2N	59	Audio2 output-

The module provides two analogy input channels, AIN1 and AIN2, which may be used for both microphone and line inputs. The electret microphone is recommended when the interface used for microphone. One of the two channels is typically used with a microphone built into a handset. The other channel is typically used with an external microphone or external line input. The module analogy input configuration is determined by control register settings and established using analogy multiplexes.

For each channels, you can use AT+CMIC to adjust the input gain level of microphone, use AT+SIDET to set the side-tone level. In addition, you can also use AT+CLVL to adjust the output gain level of both receiver and speaker at the same time, use AT+CHFA to activate one of the two audio channels and deactivate the other one.. For more details, please refer to *document [1]*.

Note: Use AT command AT+CHFA to select_audio channel:
0— AIN1/AOUT1 (normal audio channel), the default value is 0.
1— AIN2/AOUT2(aux_audio channel) .

It is suggested that you adopt one of the following two matching circuits in order to improve audio performance. The difference audio signals have to be layout according to difference signal layout rules. As show in following figures ***(Note: all components package are 0603.)*** If you want to adopt an amplifier circuit for audio, we recommend National company's LM4890. Of course you can select it according to your requirement.

3.10.1 Speaker interface configuration

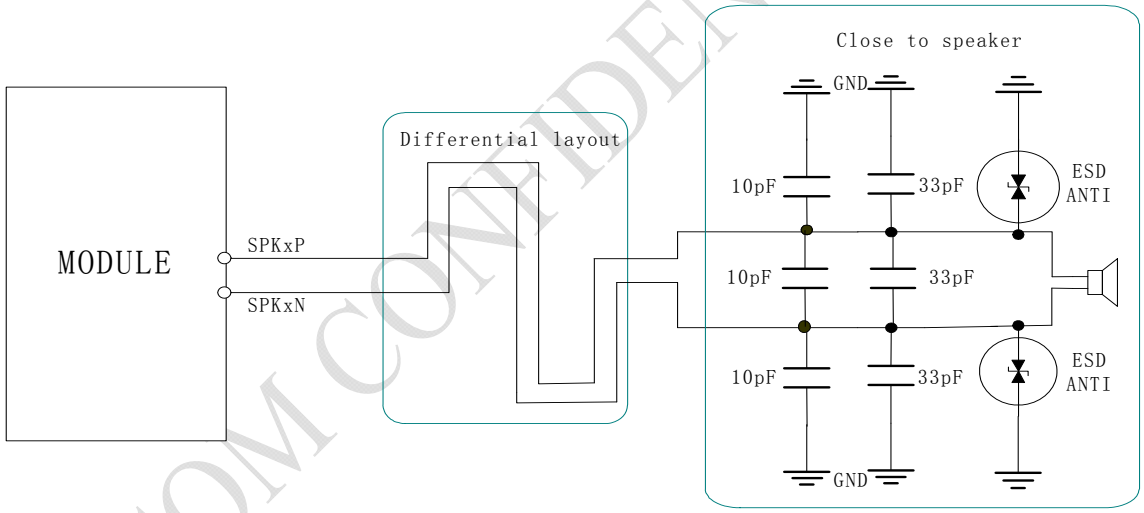


Figure 22: Speaker interface configuration

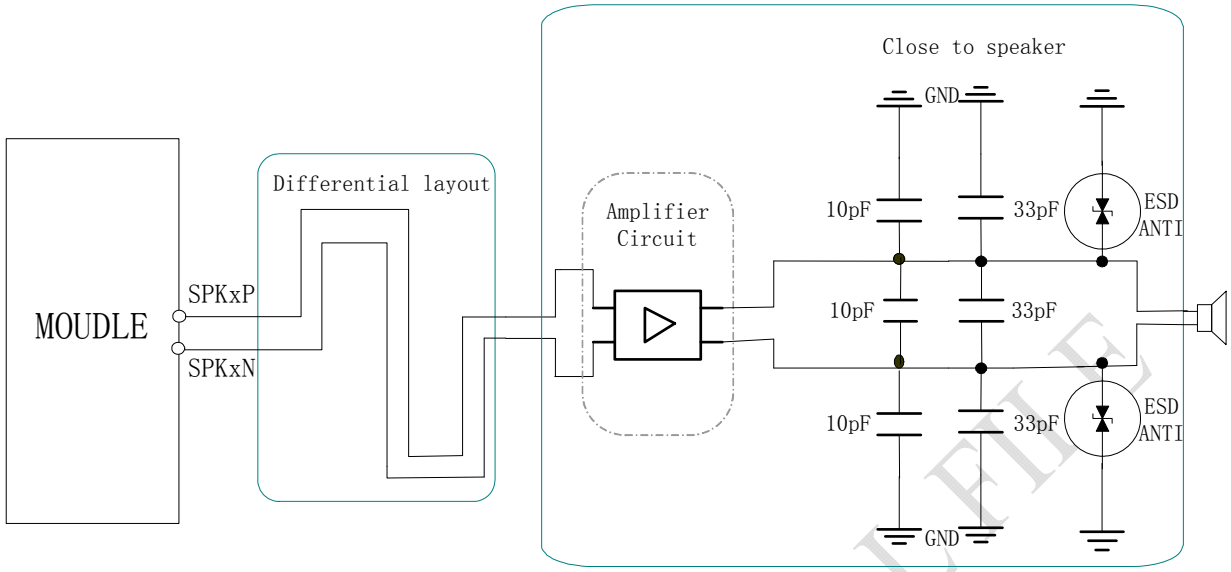


Figure 23: Speaker interface with amplifier configuration

3.10.2 Microphone interfaces configuration

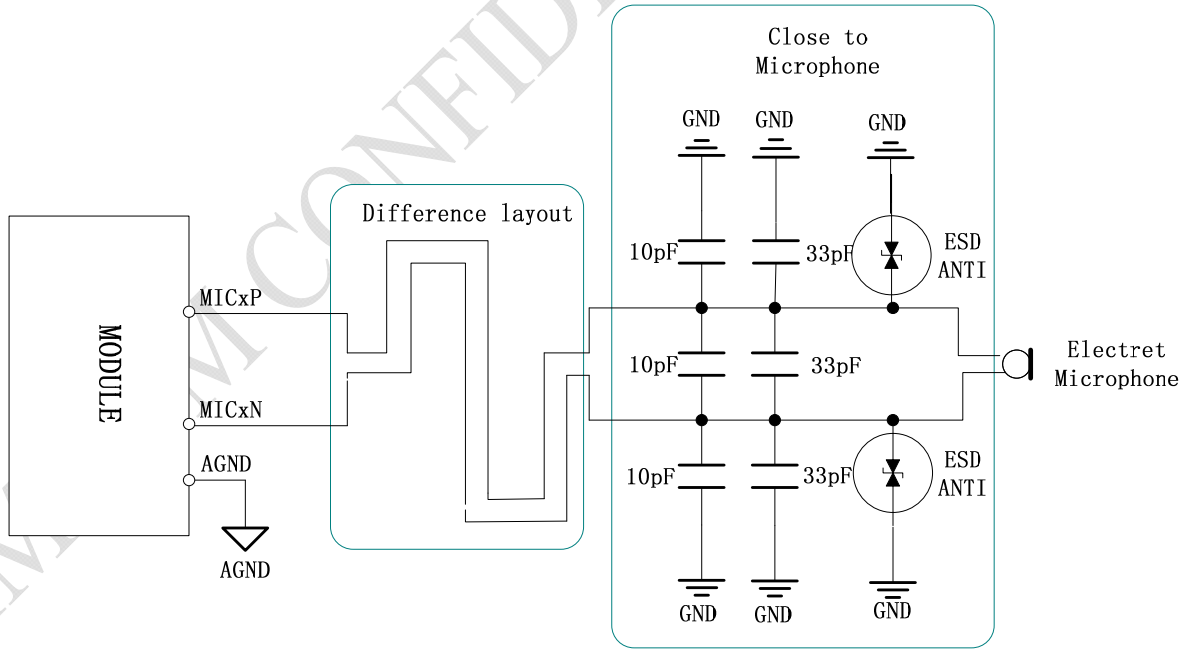


Figure 24: Microphone interface configuration

3.10.3 Earphone interface configuration

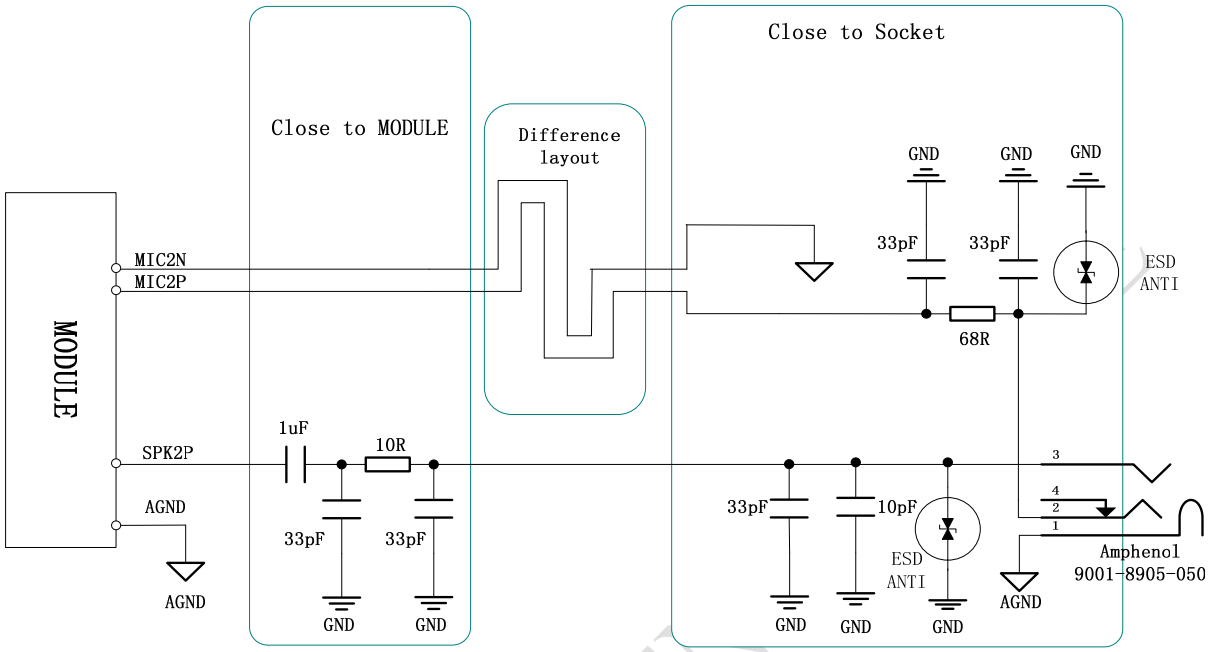


Figure 25: Earphone interface configuration

3.10.4 Referenced electronic characteristic

Table 13: MIC input characteristics

Parameter	Min	Typ	Max	Unit
Working Voltage	1.2	1.5	2.0	V
Working Current	200		500	uA
External Microphone Load Resistance	1.2	2.2		k Ohms

Table 14: Audio output characteristics

Parameter			Min	Typ	Max	Unit
Normal Output(SPK1)	Single Ended	load Resistance	27	32		Ohm
		Nominal Output Level(PGA=0dB)		0.5477 -12.04		Vpp dBm
	Differential	load Resistance	27	32		ohm
		Nominal Output Level(PGA=0dB)		1.0954 -6.02		Vpp dBm
Auxiliary Output(SPK2)	Single Ended	load Resistance	27	32		Ohm
		Nominal Output Level(PGA=0dB)		0.5477 -12.04		Vpp dBm
	Differential	load Resistance	27	32		ohm
		Nominal Output Level(PGA=0dB)		1.0954 -6.02		Vpp dBm

3.11 Buzzer

The BUZZER on the Board to Board connector can be used to drive a buzzer to indicate incoming call. The output volume of buzzer can be set by "AT+CRSL". The reference circuit for buzzer shown as following figure:

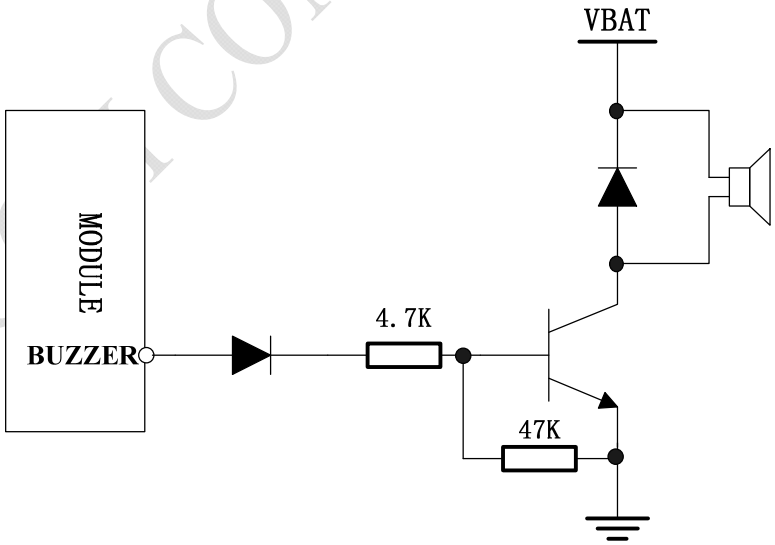


Figure 26: Reference circuit of BUZZER

Table 15: Buzzer output characteristics

Parameter	Min	Typ	Max	Unit

Working Voltage	2.4	2.8	3.3	V
Working Current		2		mA
Load Resistance	1			k Ohms

3.12 SIM card interface

3.12.1 SIM card application

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

The SIM interface supports the functionality of the GSM Phase 1 specification and also supports the functionality of the new GSM Phase 2+ specification for FAST 64 kbps SIM (intended for use with a SIM application Tool-kit).

Both 1.8V and 3.0V SIM Cards are supported.

The SIM interface is powered from an internal regulator in the module having normal voltage 3V. All pins reset as outputs driving low. Logic levels are as described in table

Table 16:PIN definition of the SIM interface

Name	Pin	Description
SIM_VDD	25	SIM Card Power output automatic output on SIM mode, one is 3.0V±10%, and another is 1.8V±10%. Current is about 10mA.
SIM_DATA	29	SIM Card data I/O
SIM_CLK	31	SIM Card Clock
SIM_RST	27	SIM Card Reset
SIM_PRESENCE	33	SIM Card Presence

Following is the reference circuit about SIM interface. We recommend an Electro-Static discharge device ST (www.st.com) ESDA6V1W5 or ON SEMI (www.onsemi.com) SMF05C for “ESD ANTI”. Note that the SIM peripheral circuit should be closed to the SIM card socket.

The SIM_PRESENCE pin is used for detecting the SIM card removal. You can use the AT command “AT+CSDT” to configure this function. For detail of this AT command, please refer to *document [1]*:

You can select the 8 pins SIM card holder. The reference circuit about 8 pins SIM card holder illustrates as the following figure.

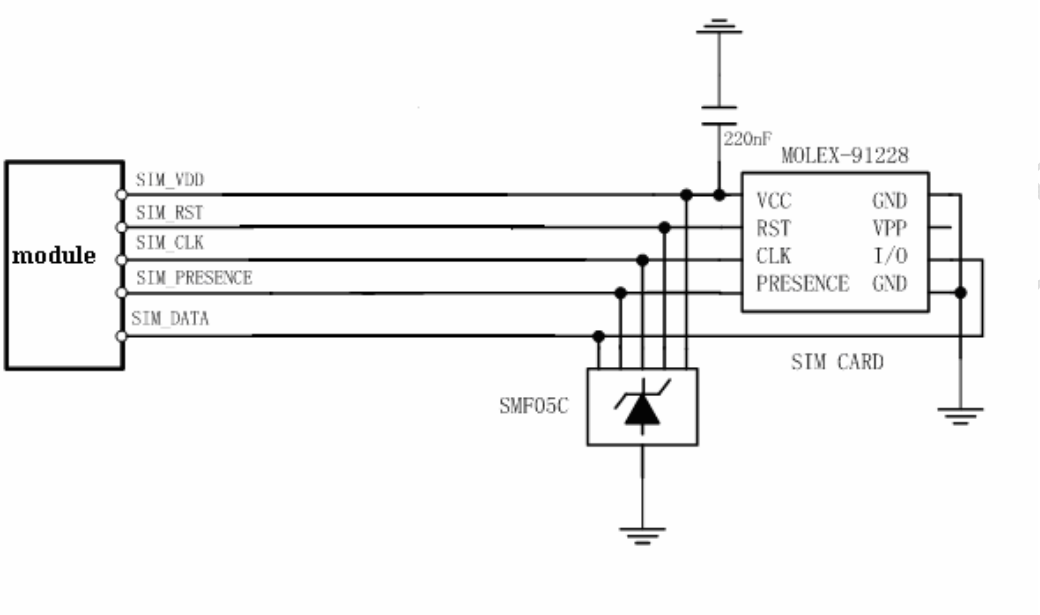


Figure 27: Reference circuit of the 8 pins SIM card holder

If you don't use the SIM card detection function, you can let the SIM_PRESENCE pin connect to the GND. The reference circuit about 6 pins SIM card holder illustrate as the following figure.

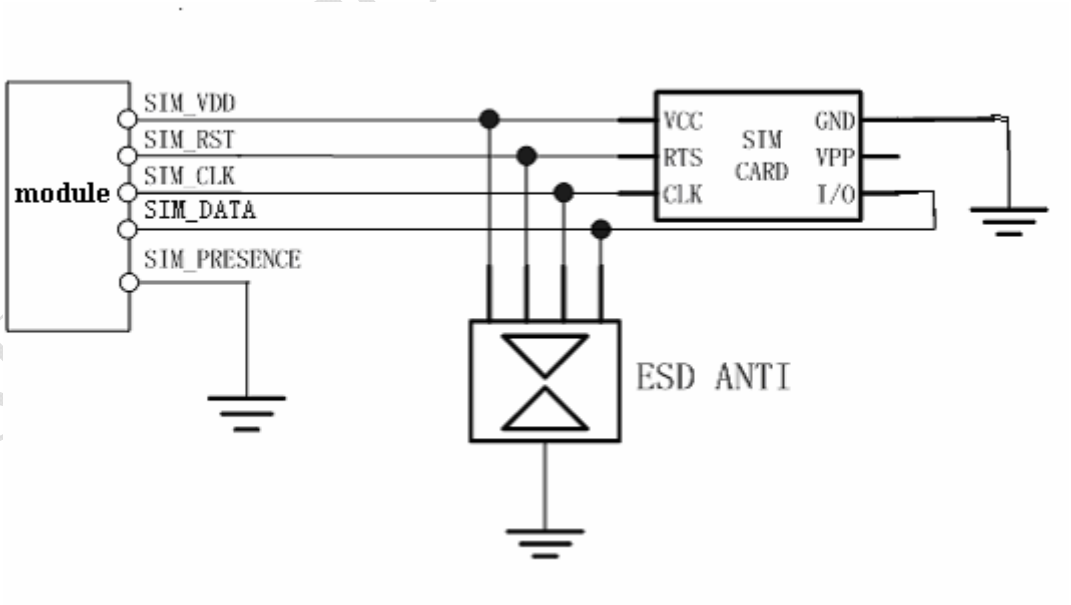


Figure 28: Reference circuit of the 6 pins SIM card holder

3.12.2 Design considerations for SIM card holder

For 6 pins SIM card holder, we recommend to use Amphenol C707 10M006 512 2 .You can visit http://www.amphenol.com for more information about the holder.

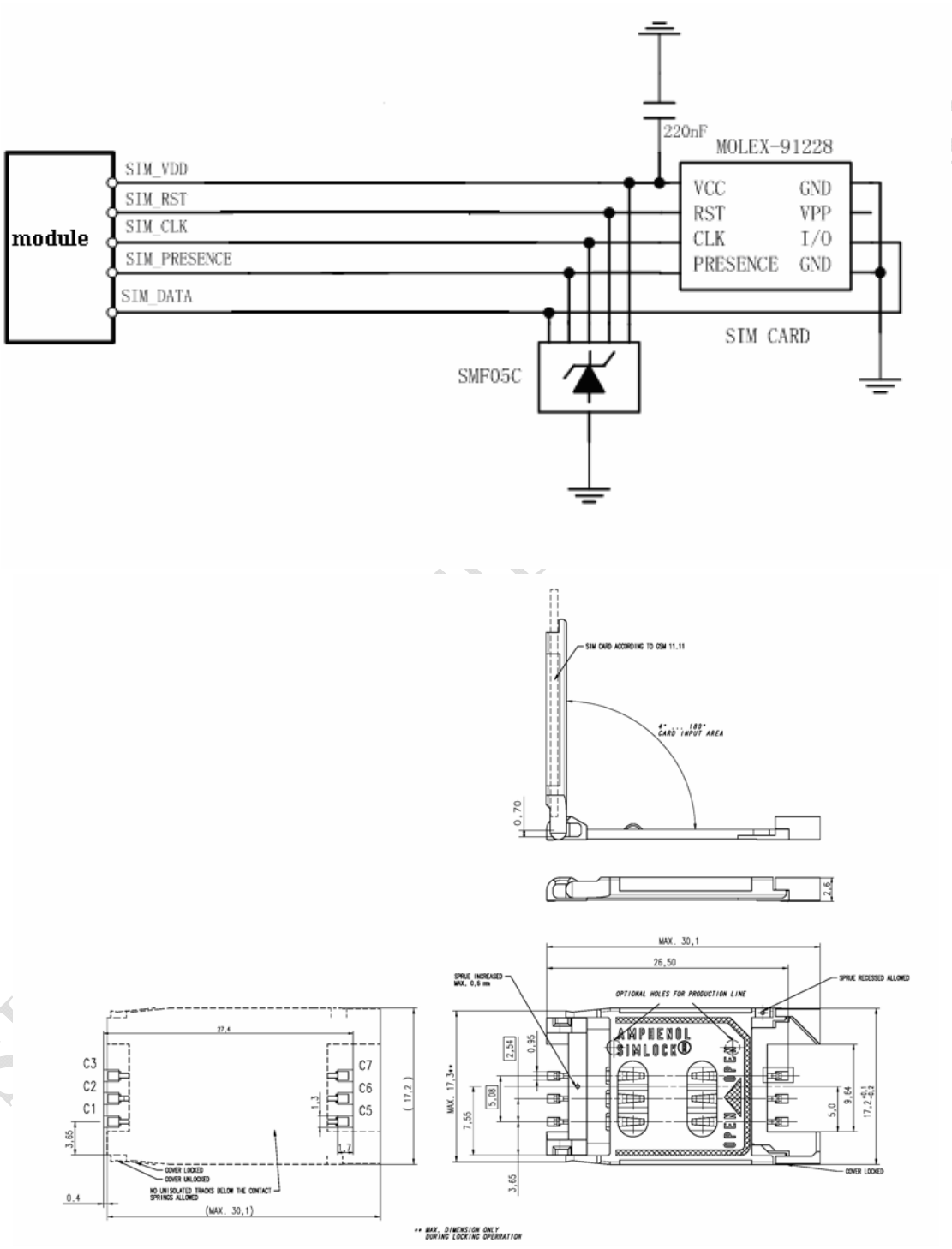


Figure 14: Amphenol C707 10M006 512 2 SIM card holder

Table 20: Pin description (Amphenol SIM card holder)

Pin	Signal	Description
C1	SIM_VDD	SIM Card Power supply, it can identify automatically the SIM Card power mode, one is 3.0V±10%, and another is 1.8V±10%. Current is about 10mA.
C2	SIM_RST	SIM Card Reset.
C3	SIM_CLK	SIM Card Clock.
C5	GND	Connect to GND.
C6	VPP	Not connect.
C7	SIM_DATA	SIM Card data I/O.

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

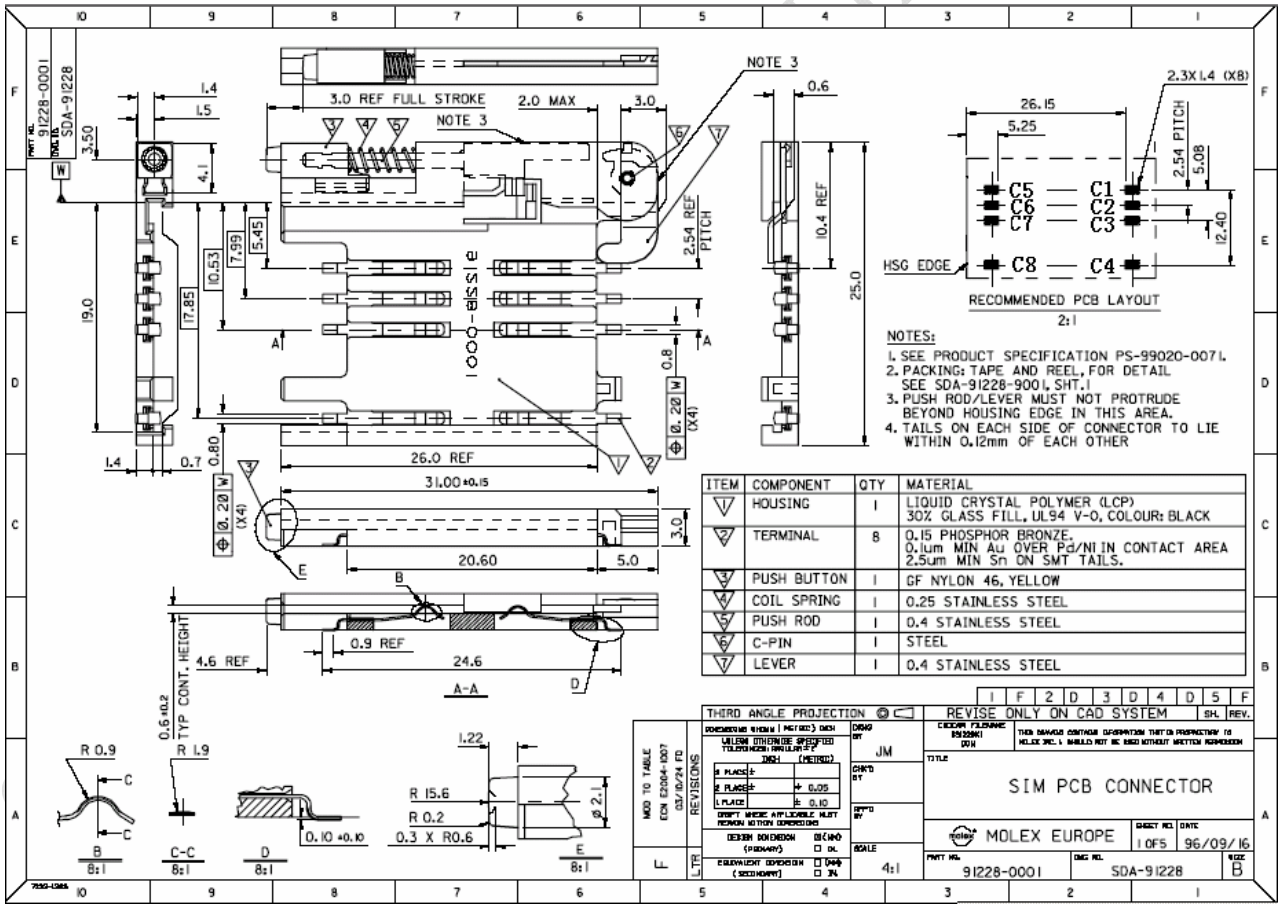


Figure 30: Molex 91228 SIM card holder

Table 21: Pin description (Molex SIM card holder)

Pin	Signal	Description
C1	SIM_VDD	SIM Card Power supply, it can identify automatically the SIM Card power mode, one is 3.0V±10%, and another is 1.8V±10%. Current is about 10mA.
C2	SIM_RST	SIM Card Reset.
C3	SIM_CLK	SIM Card Clock.
C4	GND	Connect to GND.
C5	GND	Connect to GND.
C6	VPP	Not connect.
C7	SIM_DATA	SIM Card data I/O.
C8	SIM_PRESENCE	Detect SIM Card Presence

Notes: Implement SIM Card Presence function must select 8 pin SIM Card Holder, and use AT command enable SIM Card Presence detect.

3.13 LCD display interface

SIM340C provides a serial LCD display interface that supports serial communication with LCD device. These are composite pins that can be used as GPIO ports or LCD display interface according to your application. When used as LCD interface, the following table is the pin definition. LCD interface timing should be united with the LCD device.

Table 17: PIN definition of the LCD interface

Name	Pin	Function
DISP_CS	38	Display data output
DISP_CLK	40	Display clock for LCD
DISP_DATA	42	Display enable
DISP_D/C	44	Display data or command select
DISP_RST	46	LCD reset

Note: This function is not supported in the default firmware.There must be some special firmware if you want. Please contact SIMCom for more details.

3.14 ADC

SIM340C provides one auxiliary ADC (General purpose analog to digital converter.) as voltage input pin, which can be used to detect the values of some external items such as voltage, temperature etc. We can use AT command “AT+CADC” to read the voltage value added on ADC0. For detail of this AT command, please refer to *document [1]*.

Table 18: Pin definition of ADC

Name	Pin (On Board to Board connector)	Input voltage(V)
ADC0	12	0 – 2.4

Table 19: ADC specification

	Min	Typ	Max	Unit
Voltage range	0		2.4	V
ADC Resolution	16		16	bits
ADC accuracy*		0.59		mV
Sampling rate		5		Sec

3.15 Behaviors of the RI

Table 20: Behaviours of the RI

State	RI respond
Standby	HIGH
Voice calling	Change LOW, then: （1）Change to HIGH when establish calling. （2）Use AT command ATH, the RI pin changes to HIGH. （3）Sender hangs up, change to HIGH. （4）Change to HIGH when SMS received.
Data calling	Change LOW, then： （1）Change to HIGH when establish calling. （2）Use AT command ATH, the RI changes to HIGH.
SMS	When receive SMS, The RI will change to LOW and hold low level about 120 ms, then change to HIGH.
URC	Some URCs triggers 120ms low level on RI. For more details, ***please refer to document [10]***

If the module is used as caller, the RI on the board-to-board connector will maintain high.

However, when it is used as receiver, following is timing of RI.

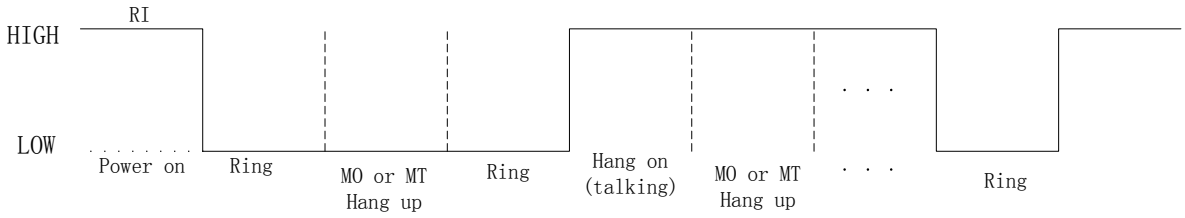


Figure 31: SIM340C Services as Receiver

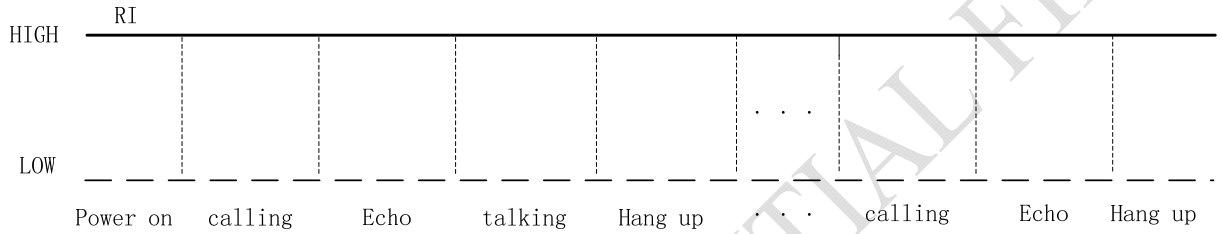


Figure 32: SIM340C Services as caller

3.16 Network status indication

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

Table 21: Working state of the NETLIGHT

State	SIM340C function
Off	SIM340C is not running
64ms On/ 800ms +50%Off	SIM340C does not find the network
64ms On/ 3000ms +50%Off	SIM340C find the network
64ms On/ 300ms +50% Off	GPRS communication

We provide a reference circuit for you, shown as following figure:

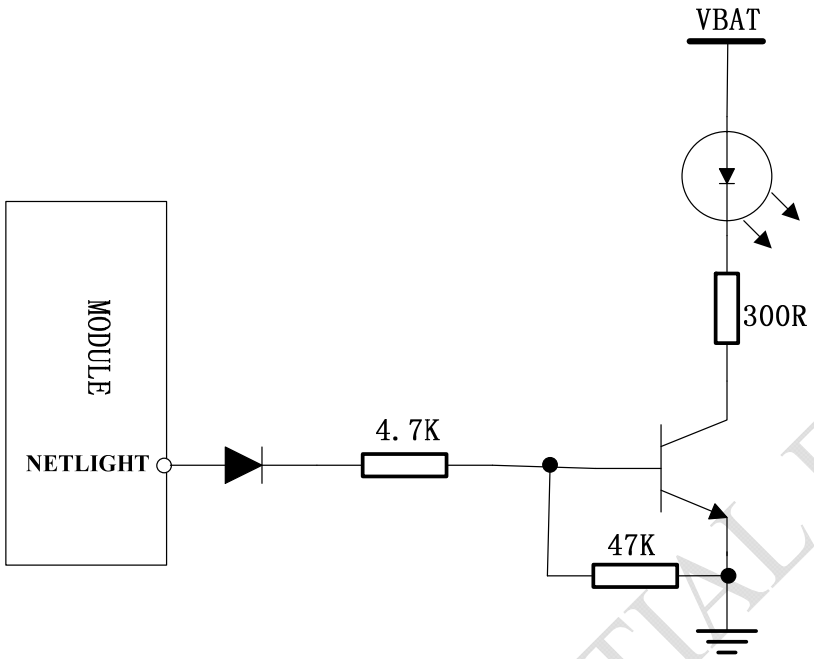


Figure 33: Reference circuit of the NETLIGHT

3.17 General purpose input & output (GPIO)

SIM340C provides a limited number of General Purpose Input/Output signal pins.

Table 22: Pin definition of the GPIO

Name	Pin	Function
STATUS	19	The Status indication of the module，General Purpose Output Port
GPIO0	21	General Purpose Input/Output Port
GPIO1	35	General Purpose Input/Output Port

Note: This function is not supported in the default firmware. There must be special firmware if you require. Please contact SIMCom for more details

3.18 Keypad interface

The keypad interface consists of 5 keypad column outputs and 5 keypad row inputs. The basic configuration is 5 keypad columns and 5 keypad rows, giving 25 keys, plus the 5 additional keys (i.e. where a keypad row is pulled low regardless of which column is enabled).

Table 28: Pin definition of the keypad interface

KBC1	20	
KBC2	22	
[illegible]	[illegible]	Keypad matrix column

KBC3	24	
KBC4	26	
KBR0	28	Keypad matrix row
KBR1	30	
KBR2	32	
KBR3	34	
KBR4	36	

The keypad interface allows a direct external matrix connection. A typical recommended circuit about the keypad is as shown in the following figure. The GND column is added for the additional 5 keys.

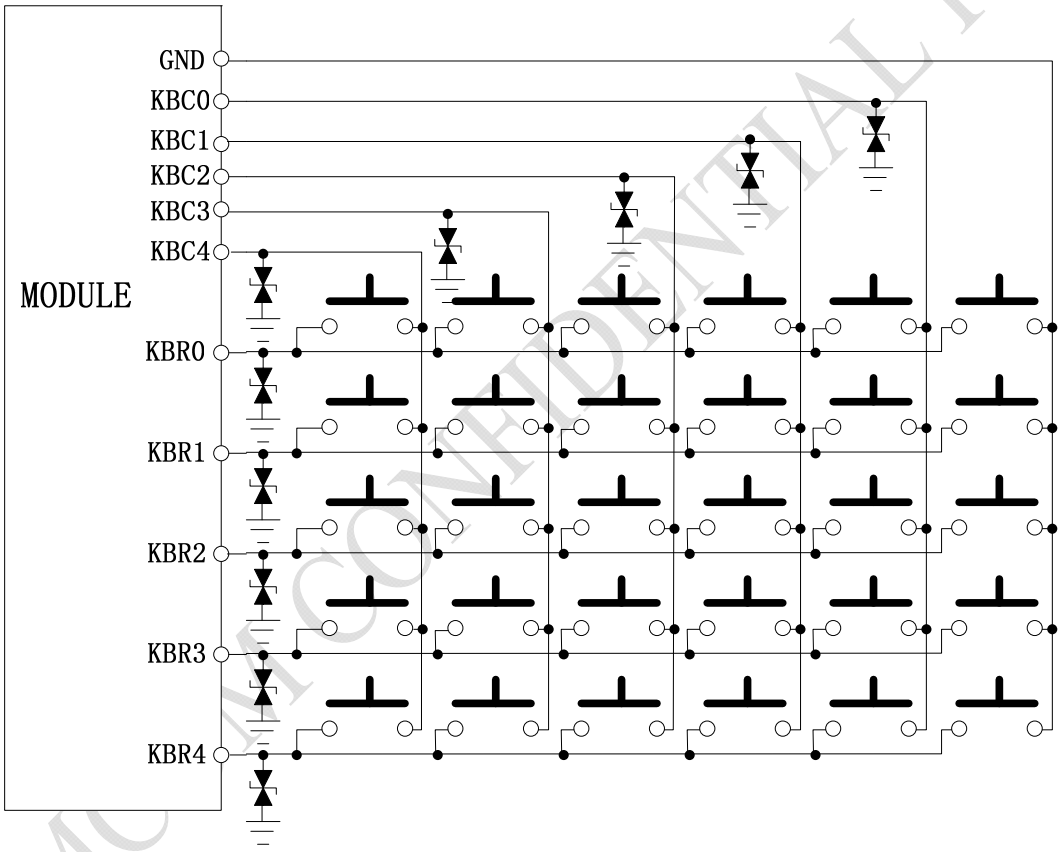


Figure 15: Reference circuit of the keypad interface

Note: This function is not supported in the default firmware. There must be special firmware if you want. Please contact SIMCom for more details.

4 Antenna interface

The RF interface has an impedance of 50Ω. To suit the physical design of individual applications SIM340C offers alternatives:

- Recommended approach: antenna connector on the component side of the PCB
- Antenna pad and grounding plane placed on the bottom side.

To minimize the loss on the RF cable, it need be very careful to choose RF cable. We recommend the insertion loss should be meet following requirement:

- GSM850/EGSM900<1dB
- DCS1800/PCS1900<1.5dB

4.1 Antenna installation

4.1.1 Antenna connector

SIM340C uses MURATA's MM9329-2700RA1 RF connector on the module side, we recommend user use MURATA's MXTK92XXXXX as matching connector on the application side. Please refer to appendix for detail info about MURATA's MXTK92XXXXX.

4.1.2 Antenna pad

The antenna can be soldered to the pad, or attached via contact springs. To help you to ground the antenna, SIM340C comes with a grounding plane located close to the antenna pad.
SIM340C material properties:
SIM340C PCB Material: FR4
Antenna pad: Gold plated pad
Antenna pad soldering temperature: we recommend 350℃.

Note: The soldering time for antenna pad and GND pad are different, less than 3s for antenna pad and less than 10s for GND pad.

4.2 Module RF output power

Table 23: SIM340C conducted RF output power

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

4.3 Module RF receive sensitivity

Table 30: SIM340C conducted RF receive sensitivity

Frequency	Receive sensitivity
GSM850	< -106dBm
EGSM900	< -106dBm
DCS1800	< -106dBm
PCS1900	< -106dBm

4.4 Module operating frequencies

Table 31: SIM340C operating frequencies

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

5 Electrical, reliability and radio characteristics

5.1 Absolute maximum ratings

Absolute maximum rating for power supply and voltage on digital and analog pins of SIM340C are listed in following table:

Table 32: Absolute maximum ratings

Parameter	Min	Max	Unit
Peak current of power supply	0	3.0	A
RMS current of power supply (during one TDMA- frame)	0	0.7	A
Voltage at digit pins	-0.3	3.3	V
Voltage at analog pins	-0.3	3.0	V
Voltage at digit/analog pins in POWER DOWN mode	-0.25	0.25	V

5.2 Operating temperatures

The operating temperature is listed in following table:

Table 33: SIM340C operating temperature

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

* SIM340C does work, but deviations from the GSM specification may occur, For example, the frequency error or the phase error will be large.

5.3 Power supply ratings

Table 34: SIM340C power supply ratings

Parameter	Description	Conditions	Min	Typ	Max	Unit
VBAT	Supply voltage	Voltage must stay within the min/max values, including voltage drop, ripple, and spikes.	3.4	4.0	4.5	V
	Voltage drop during transmit burst	Normal condition, power control level for Pout max			400	mV
	Voltage ripple	Normal condition, power control level for Pout max @ f<200kHz @ f>200kHz			 50 2	 mV
I_{VBAT}	Average supply current	POWER DOWN mode SLEEP mode (BS-PA-MFRMS=5)		35 2.5		uA mA
		IDLE mode GSM850/EGSM 900 DCS1800/ PCS1900		 23 23		 mA
		TALK mode GSM850/EGSM 900 DCS1800/ PCS1900		 260 200		 mA
		DATA mode, GPRS (3 Rx,2Tx) GSM850/EGSM 900 DCS1800/ PCS1900		 470 340		 mA
		DATA mode, GPRS (4 Rx,1Tx) GSM850/EGSM 900 DCS1800/ PCS1900		 275 220		 mA
	Peak supply current (during transmission slot every 4.6ms)	Power control level for Pout max		2		A

5.4 Current consumption

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

Table 24: SIM340C current consumption

Voice Call	
GSM 850/EGSM 900	@power level #5 <350mA,Typical 260mA @power level #10,Typical 130mA @power level #19,Typical 86mA
DCS 1800/ PCS 1900	@power level #0 <300mA,Typical 200mA @power level #10,Typical 87mA @power level #15,Typical 80mA
GPRS Data	
DATA mode, GPRS (1 Rx,1 Tx) CLASS 8	
GSM 850/EGSM 900	@power level #5 <350mA,Typical 260mA @power level #10,Typical 125mA @power level #19,Typical 84mA
DCS 1800/ PCS 1900	@power level #0 <300mA,Typical 200mA @power level #10,Typical 83mA @power level #15,Typical 76mA
DATA mode, GPRS (3 Rx, 2 Tx) CLASS 10	
GSM 850/EGSM 900	@power level #5 <550mA,Typical 470mA @power level #10,Typical 225mA @power level #19,Typical 142mA
DCS1800/ PCS1900	@power level #0 <450mA,Typical 340mA @power level #10,Typical 140mA @power level #15,Typical 127mA
DATA mode, GPRS (4 Rx,1 Tx) CLASS 8	
GSM 850/EGSM 900	@power level #5 <350mA,Typical 270mA @power level #10,Typical 160mA @power level #19,Typical 120mA
DCS 1800/ PCS 1900	@power level #0 <300mA,Typical 220mA @power level #10,Typical 120mA @power level #15,Typical 113mA

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

5.5 Electro-static discharge

The GSM engine is not protected against Electrostatic Discharge (ESD) in general. Therefore, it is subject to ESD handing precautions that typically apply to ESD sensitive components. Proper ESD handing and packaging procedures must be applied throughout the processing, handing and operation of any application using a SIM340C module.

Despite of this, we have equipped some clamp diodes to protect most lines of SIM340C from over voltage. And the measured values are shown as the following table:

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

Part	Contact discharge	Air discharge
VBAT,GND	±4KV	±8KV
KBR0-4,KBC0-4, NETLIGHT	±1KV	±2KV
Antenna port	±4KV	±8KV
Other port	±4KV	±8KV

6 Mechanics

This chapter describes the mechanical dimensions of SIM340C.

6.1 Mechanical dimensions of SIM340C

Following shows the Mechanical dimensions of SIM340C (top view and side view).

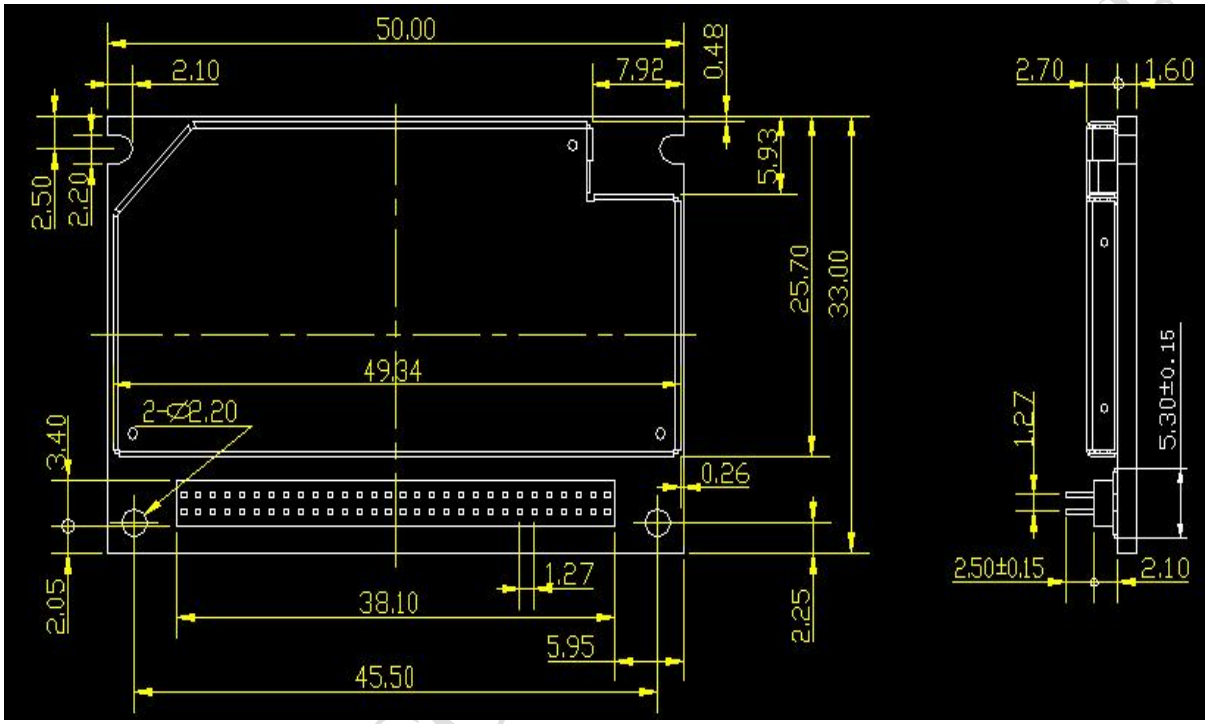


Figure 16: Mechanical dimensions of SIM340C（Unit: mm）

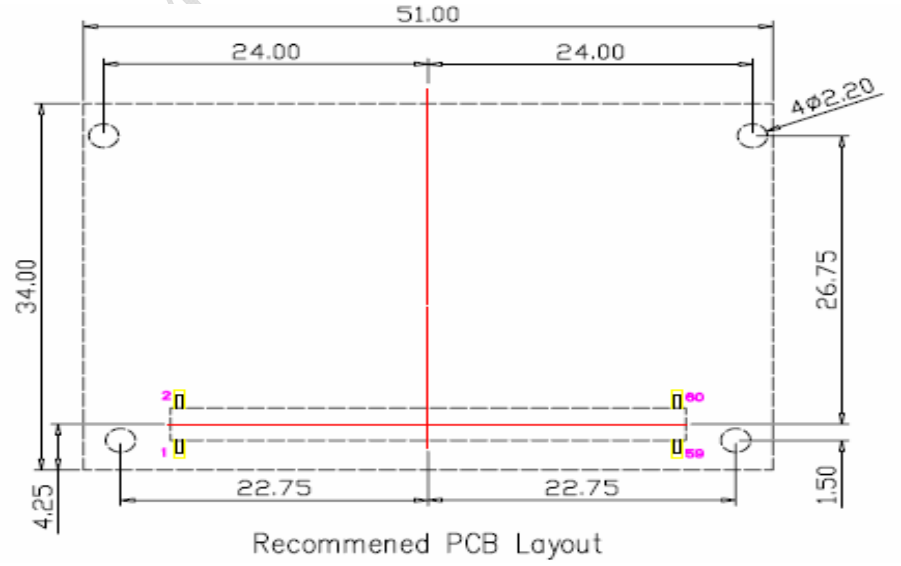


Figure 17:Recommened PCB Layout（Unit: mm）

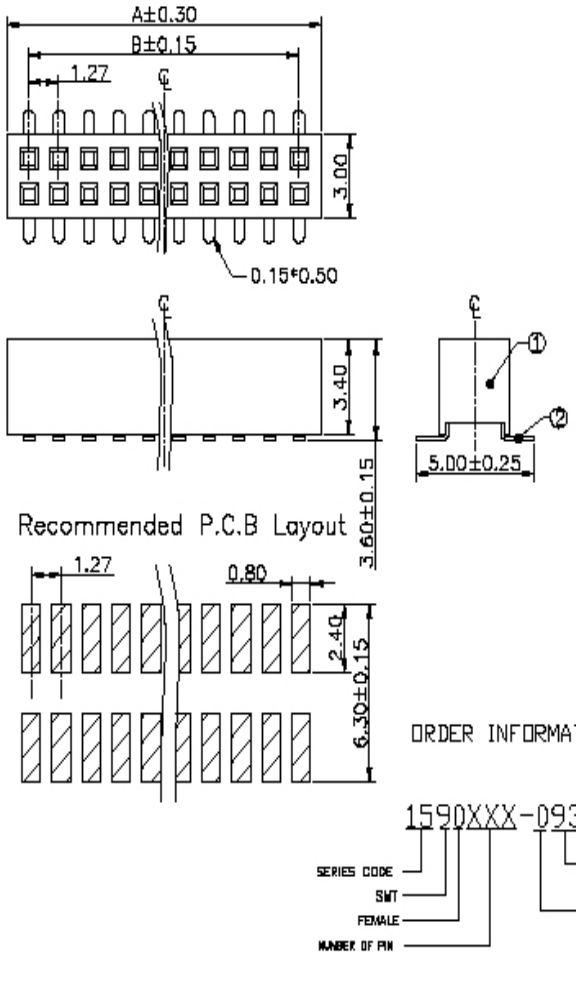
6.2 Mounting SIM340C onto the application platform

Use the connector ASTRON1491060-09T-R and four mounting pads to fix the SIM340C onto customer platform.

6.3 Board to Board connector

We recommend ASTRON Company's1491060-09T-R and 1590060-09T-R as the board-to-board connector. This high density SMT connector is designed for parallel PCB-to-PCB applications.

6.3.1 Mechanical dimensions of the ASTRON 1590060-09T-R



PIN \ DIM	DIM A	DIM B	PIN \ DIM	DIM A	DIM B
2*01	1.70	0.00	2*26	33.45	31.75
2*02	2.97	1.27	2*27	34.72	33.02
2*03	4.24	2.54	2*28	35.99	34.29
2*04	5.51	3.81	2*29	37.26	35.56
2*05	6.78	5.08	2*30	38.53	36.83
2*06	8.05	6.35	2*31	39.80	38.10
2*07	9.32	7.62	2*32	41.07	39.37
2*08	10.59	8.89	2*33	42.34	40.64
2*09	11.86	10.16	2*34	43.61	41.91
2*10	13.13	11.43	2*35	44.88	43.18
2*11	14.40	12.70	2*36	46.15	44.45
2*12	15.67	13.97	2*37	47.42	45.72
2*13	16.94	15.24	2*38	48.69	46.99
2*14	18.21	16.51	2*39	49.96	48.26
2*15	19.48	17.78	2*40	51.23	49.53
2*16	20.75	19.05	2*41	52.50	50.80
2*17	22.02	20.32	2*42	53.77	52.07
2*18	23.29	21.59	2*43	55.04	53.34
2*19	24.56	22.86	2*44	56.31	54.61
2*20	25.83	24.13	2*45	57.58	55.88
2*21	27.10	25.40	2*46	58.85	57.15
2*22	28.37	26.67	2*47	60.12	58.42
2*23	29.64	27.94	2*48	61.39	59.69
2*24	30.91	29.21	2*49	62.66	60.96
2*25	32.18	30.48	2*50	63.93	62.23

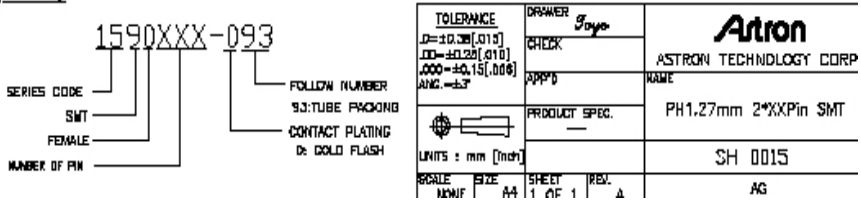


Figure 37: ASTRON1590060-09T-R Board to Board connector

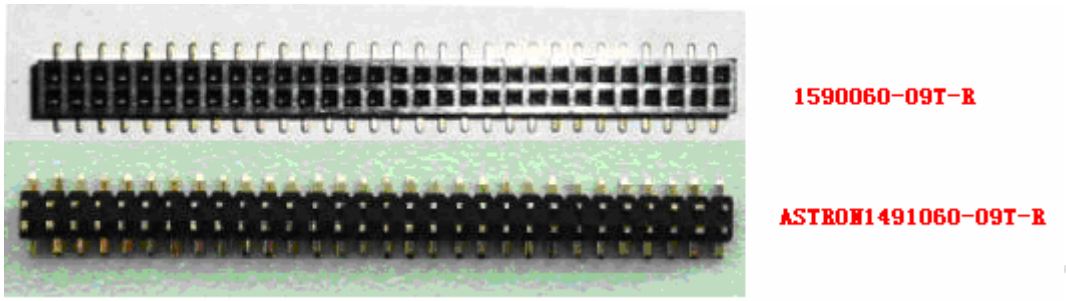


Figure 38: ASTRON Board to Board connector physical photo

NOTE:
The connector ASTRON ASTRON1491060-09T-R is used in pin side (SIM340C module) and 1590060-09T-R is used in socket side (user side).

6.4 RF adapter cabling

The RF connector in module side is Murata Company Microwave Coaxial Connectors MM9329-2700RA1, it makes a pair with Murata Company RF connector MXTK. It is have high performance with wide frequency range, surface mountable and reflow solderable. Following is parameter. Certainly you can visit http://www.murata.com/ for more information.

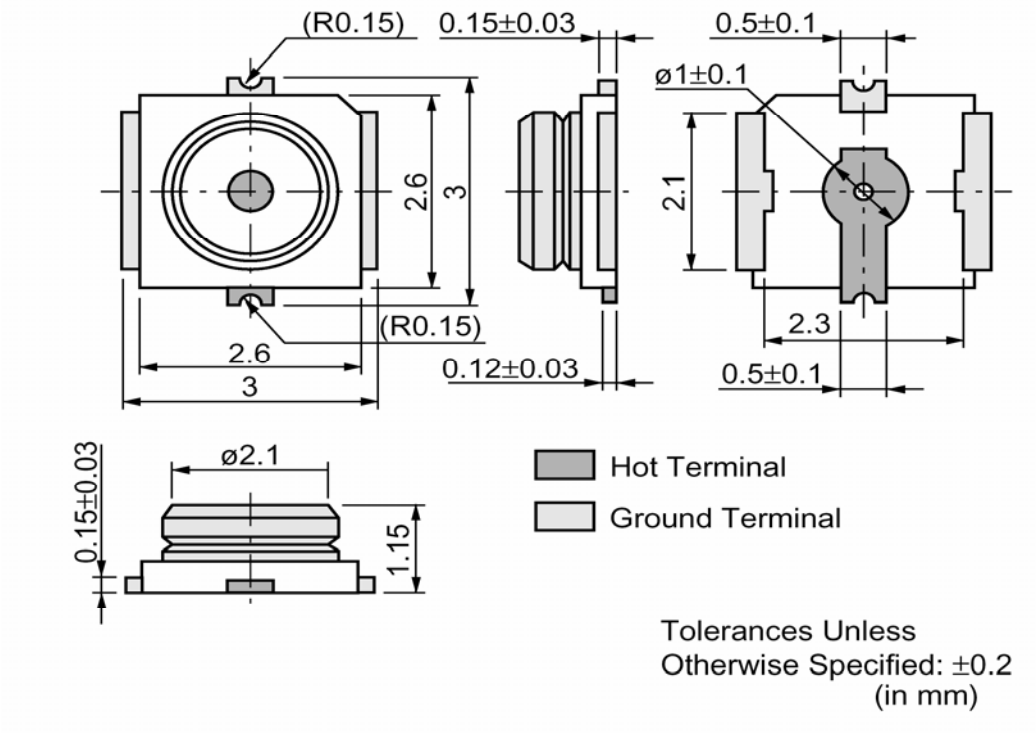


Figure 39: MM9329-2700B

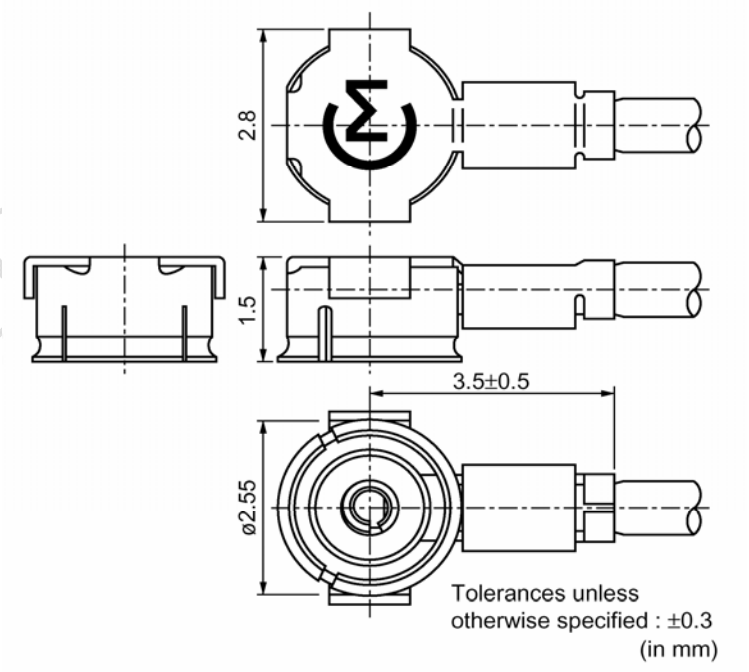


Figure 40: RF connector MXTK

For more information about the connector, please visit http://www.murata.com/

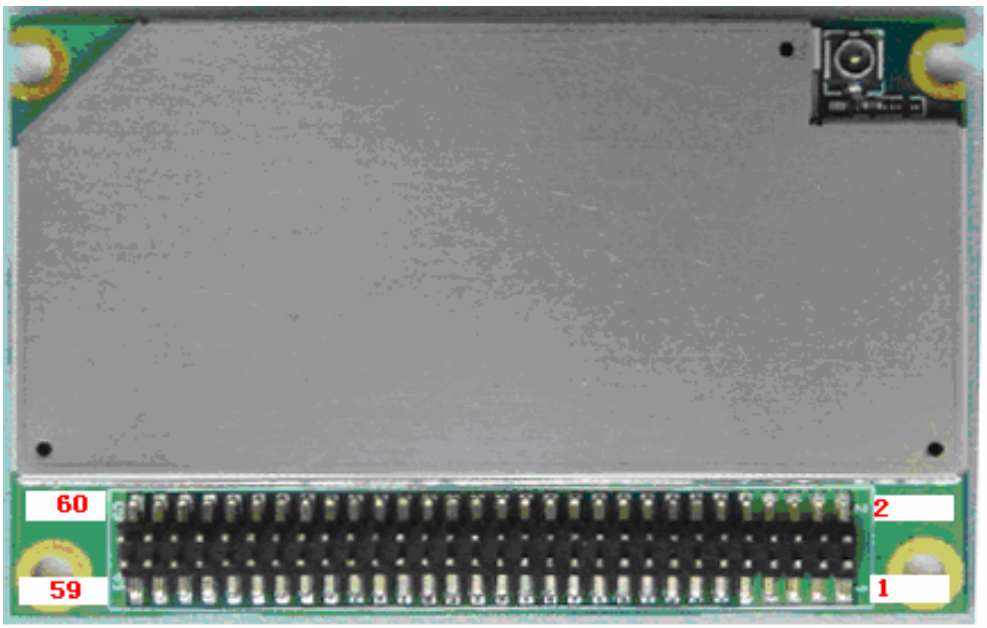


Figure 41: Bottom view of SIM340C

6.5 PIN assignment of SIM340C Board to Board connector

Table 26: Connection diagrams

PIN NO.	PIN NAME	I/O	PIN NO.	PIN NAME	I/O
1	VBAT	I/O	**2**	GND	
3	VBAT	I/O	**4**	GND	
5	VBAT	I/O	**6**	GND	
7	VBAT	I/O	**8**	GND	
9	VBAT	I/O	**10**	GND	
11	VCHG	I	**12**	ADC0	I
13	TEMP_BAT	I	**14**	VRTC	I/O
15	VDD_EXT	O	**16**	NETLIGHT	O
17	PWRKEY	I	**18**	KBC0	O
19	STATUS	O	**20**	KBC1	O
21	GPIO0	I/O	**22**	KBC2	O
23	BUZZER	O	**24**	KBC3	O
25	SIM_VDD	O	**26**	KBC4	O
27	SIM_RST	O	**28**	KBR0	I
29	SIM_DATA	I/O	**30**	KBR1	I

31	SIM_CLK	O	**32**	KBR2	I
33	SIM_PRESENCE	I	**34**	KBR3	I
35	GPIO1	I/O	**36**	KBR4	I
37	DCD	O	**38**	DISP_CS	O
39	DTR	I	**40**	DISP_CLK	O
41	RXD	I	**42**	DISP_DATA	I/O
43	TXD	O	**44**	DISP_D/C	O
45	RTS	I	**46**	DISP_RST	O
47	CTS	O	**48**	DBG_RXD	I
49	RI	O	**50**	DBG_TXD	O
51	AGND		**52**	AGND	
53	SPK1P	O	**54**	MIC1P	I
55	SPK1N	O	**56**	MIC1N	I
57	SPK2P	O	**58**	MIC2P	I
59	SPK2N	O	**60**	MIC2N	I

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