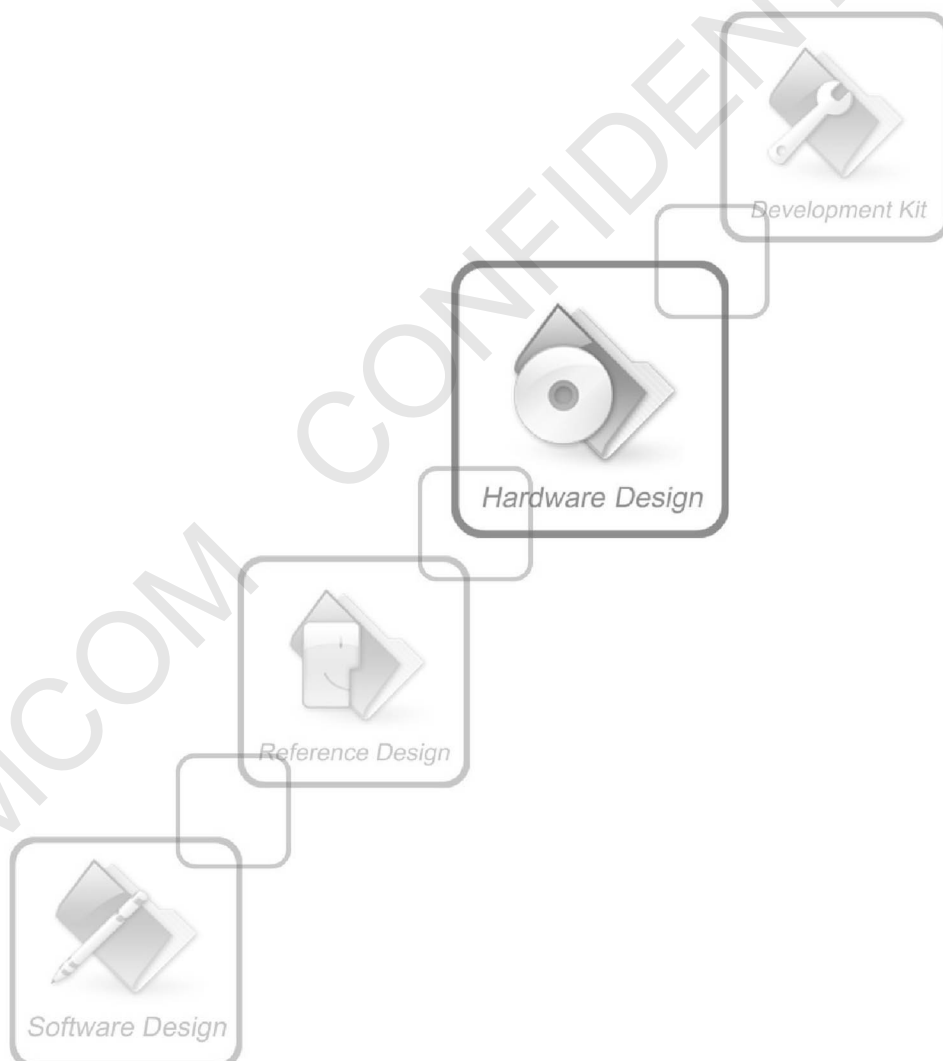


SIM5300E Hardware Design



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SIMCOM CONFIDENTIAL FILE

1 INTRODUCTION

This document describes SIM5300E hardware interface in great detail. Also, it is suitable for SIM5300EA. Both SIM5300E and SIM5300EA have the same function except audio, which is particular for SIM5300EA.

This document can help users to understand SIM5300E interface specifications, electrical and mechanical details. With the help of this document and other SIM5300E application notes, users can use SIM5300E to design various applications quickly.

Table 1: The difference of SIM5300E and SIM5300EA

Module	SIM5300E	SIM5300EA
Audio	Not supported	Supported

2 SIM5300E OVERVIEW

Designed for global market, SIM5300E is a dual-Band GSM/GPRS/EDGE and dual-band UMTS/HSPA module that works on frequency bands EGSM 900MHz, DCS 1800MHz and WCDMA2100/900MHz. SIM5300E features GPRS multi-slot class 12 and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4.

With a tiny configuration of 24*24*2.4mm, SIM5300E can meet almost all space requirements in user applications, such as M2M, PDA and other mobile devices.

SIM5300E has 68 pins, which provides all hardware interfaces between module and customers' boards, which includes:

- Power Supply
- UART Interface which can support full modem.
- Audio channel which includes a microphone input and a receiver output (only for SIM5300EA).
- GPIOs
- SPI Interface
- I2C Interface

- USB Interface
- ADC
- USIM Interface
- RTC
- PWM
- Debug Port

SIM5300E is designed with power saving technique where the current consumption is as low as 0.88mA in sleep mode (BS-PA-MFRMS=9).

SIM5300E integrates TCP/IP protocol and extended TCP/IP AT commands which are very useful for data transfer applications. For details about TCP/IP applications, please refer to *document [2]*.

2.1 SIM5300E KEY FEATURES

Table 2: SIM5300E key features

Feature	Implementation
Power supply	3.4V ~ 4.4V
Power saving	Typical power consumption in sleep mode is 0.88mA (BS-PA-MFRMS=9)
Frequency bands	<ul style="list-style-type: none"> • Support bands: EGSM 900, DCS 1800 and WCDMA B1, WCDMA B8. SIM5300E 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	<p>GSM/GPRS:</p> <ul style="list-style-type: none"> • Class 4 (2W): EGSM900 • Class 1 (1W): DCS1800 <p>UMTS:</p> <ul style="list-style-type: none"> • Class 3 (0.25W): WCDMA
CSD	<ul style="list-style-type: none"> • Support CSD transmission

Temperature range	<ul style="list-style-type: none"> Operating temperature: -40°C ~ +85°C Storage temperature -45°C ~ +90°C
Data Transmission Throughput	<ul style="list-style-type: none"> GPRS multi-slot class 12 GPRS data transfer: Max. 85.6 kbps (DL/UL) EDGE data transfer: Only support EDGE downlink Max. 236.8 kbps(DL) UMTS R99 speed: 384 kbps (DL/UL) HSDPA category8 (7.2 Mbps) - single receive HSUPA category6 (5.76 Mbps) Integrate the TCP/IP protocol Support Packet Broadcast Control Channel (PBCCH)
SMS	<ul style="list-style-type: none"> MT, MO, CB, Text and PDU mode SMS storage: USIM card
USIM interface	<ul style="list-style-type: none"> Support USIM card: 1.8V, 3V
USB	<ul style="list-style-type: none"> USB 2.0 specification, 90 Ohms differential
External antenna	<ul style="list-style-type: none"> Antenna pad,50 Ohms
Audio features for SIM5300EA	<p>Speech codec modes:</p> <ul style="list-style-type: none"> Half Rate (ETS 06.20) Full Rate (ETS 06.10) Enhanced Full Rate (ETS 06.50 / 06.60 / 06.80) Adaptive multi rate (AMR) Echo Cancellation Noise Suppression
Serial port and debug port	<p>Serial port:</p> <ul style="list-style-type: none"> Full modem interface with status and control lines, unbalanced, asynchronous. Baud rate: 300bps to 460800bps(default:115200bps) Autobauding supports baud rate from 1200 bps 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. <p>Debug port:</p> <ul style="list-style-type: none"> Null modem interface DBG_TXD and DBG_RXD. Can be used for debugging.

Phonebook management	Support phonebook types: SM, FD, LD, RC, ON, MC
USIM application toolkit	GSM 11.14 Release 99
Real time clock	Support RTC
Physical characteristics	Size: 24*24*2.4mm Weight:3 g
Firmware upgrade	Firmware upgradeable by USB interface (recommended) and serial Port

2.2 OPERATING MODES

The table below summarizes the various operating modes of SIM5300E.

Table 3: Operating mode Definition

Mode	Function	
Sleep mode	GSM/WCDMA SLEEP	Module will automatically enter SLEEP mode if DTR is set to high level and there is no air or hardware interruption (such as GPIO interrupt or data on serial port). In this case, the current consumption of module will be reduced to the minimal level. In SLEEP mode, the module can still receive paging message, voice call and SMS.
	GSM IDLE	Software is active. Module has registered to the GSM network, and the module is ready to communicate.
GSM	GSM TALK	Connection between two subscribers is in progress. In this case, the power consumption depends on network settings (DTX off/on, FR/EFR/HR, hopping sequences, etc.) and antenna.
GPRS	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).
EDGE	EDGE STANDBY	Module is ready for data transfer in EDGE mode, but no data is currently sent or received. In this case, power consumption depends on network settings and EDGE configuration
	EDGE DATA	There is EDGE 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 EDGE configuration.
WCDMA	WCDMA IDLE	Module has registered to the WCDMA network, and the module is ready to communicate.
	WCDMA TALK	Module is active in WCDMA mode. The power consumption depends on network settings.
Power down	Module can be powered down by the AT command “AT+CPOWD=1” or by using PWRKEY pin. The power management unit shuts down the power supply of module, only the power supply of RTC is remained. The serial interface is not accessible.	
Minimum functionality mode	The 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 will be closed. The serial port is still accessible. The power consumption in this mode is very low.	

2.3 SIM5300E FUNCTIONAL DIAGRAM

The following figure shows a functional diagram of SIM5300E:

- The GSM PA
- Processor/PMU
- The oscillator
- The antenna interface
- The other interfaces

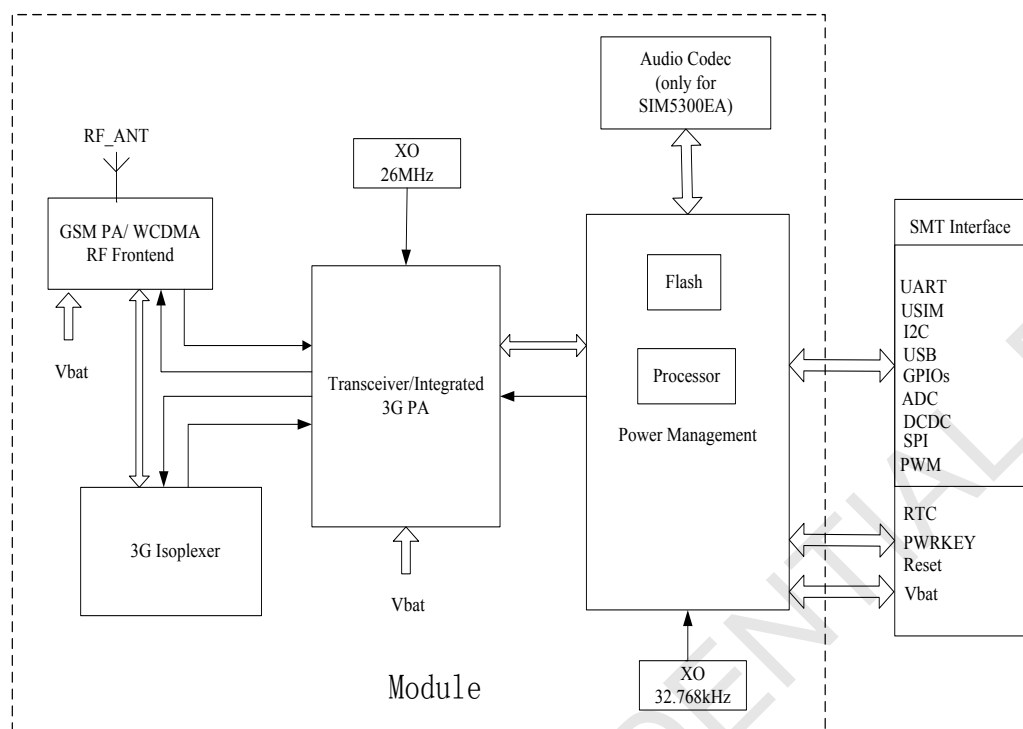


Figure 1: SIM5300E functional diagram

3 PACKAGE INFORMATION

3.1 PINOUT DIAGRAM

All functions of the SIM5300E will be provided through 68 pins that will be connected to the customers' platform. The following Figures are high-level views of the pin assignment of SIM5300E and SIM5300EA.

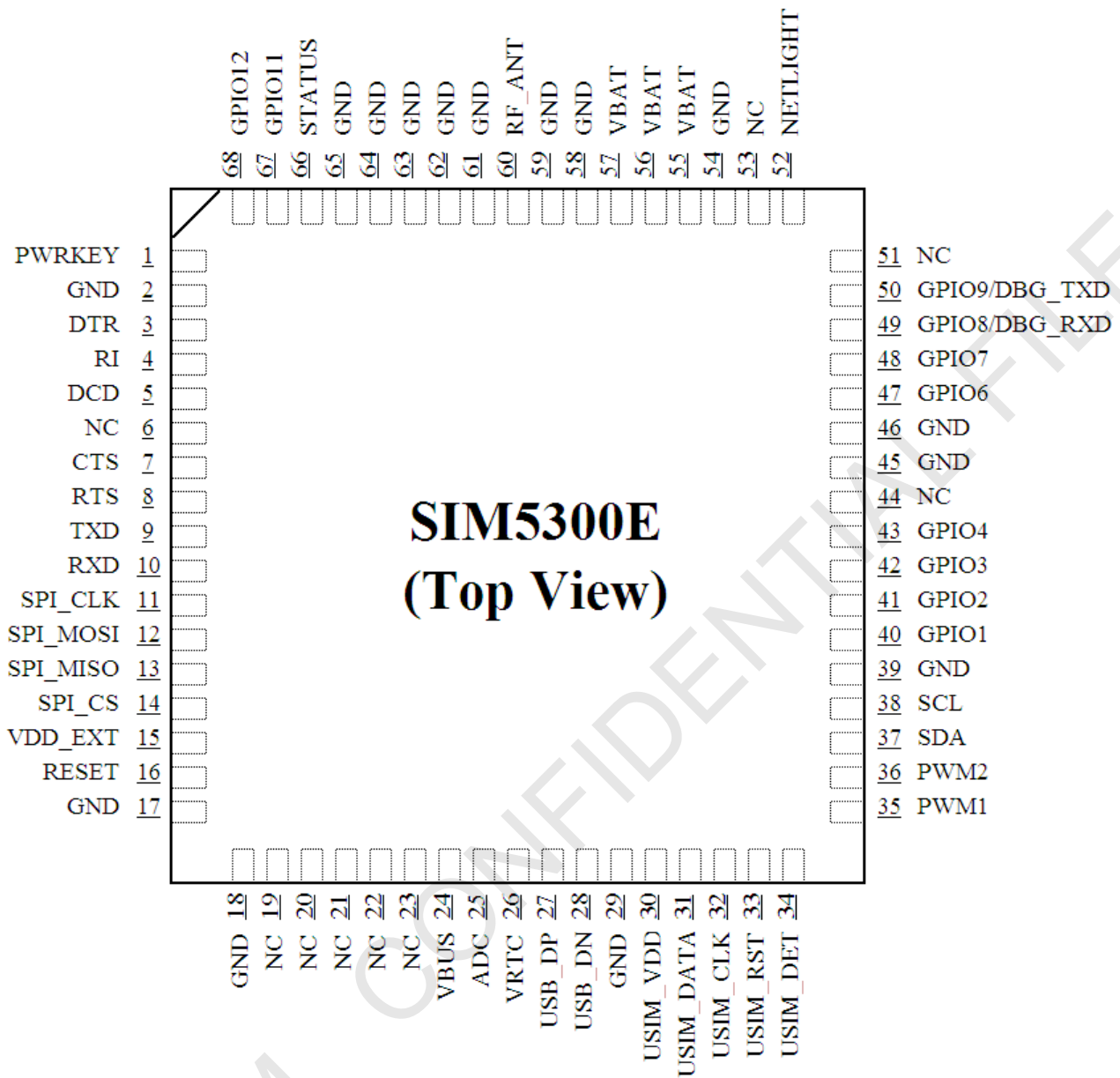


Figure 2: SIM5300E pin out diagram (Top view)

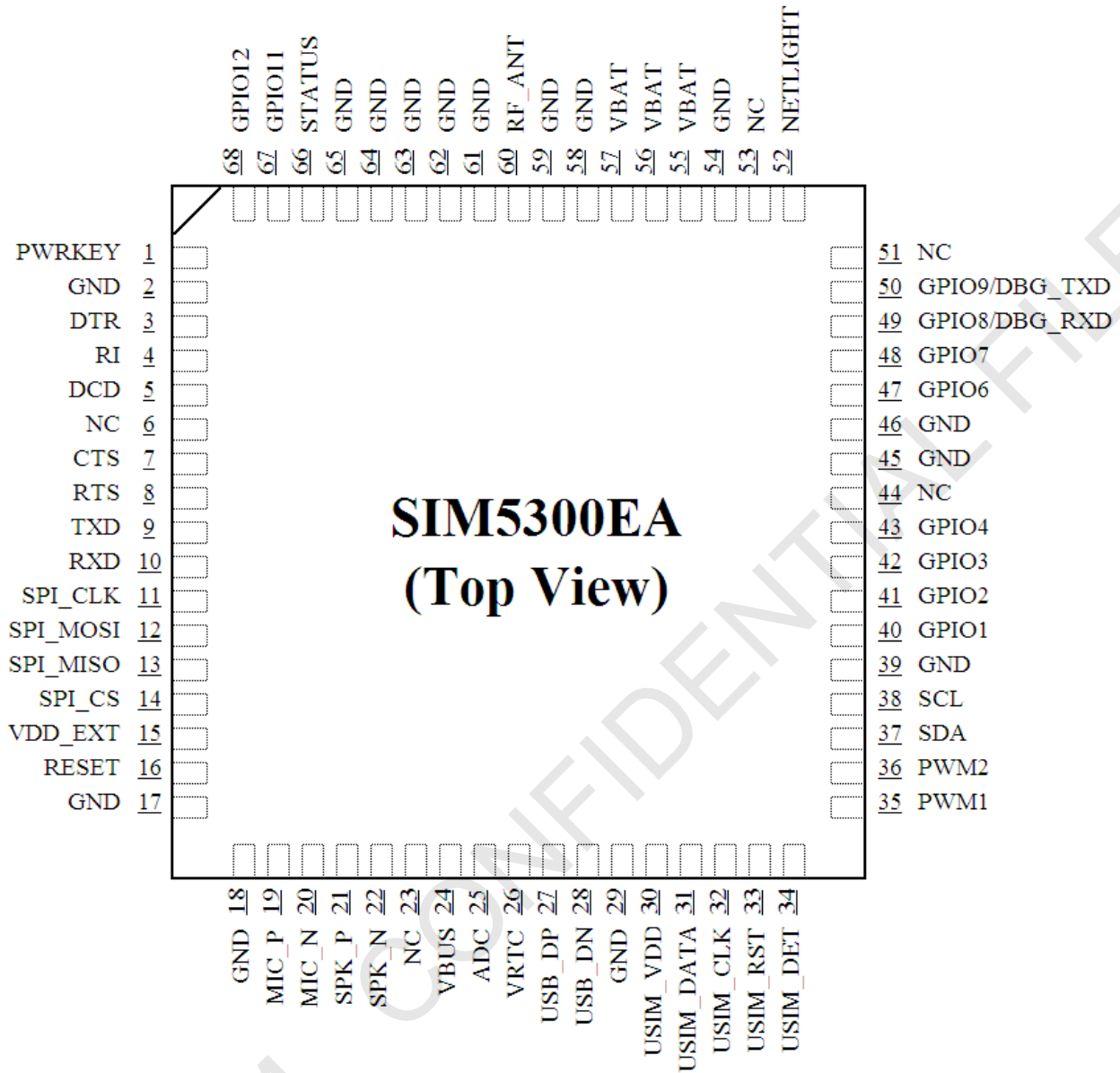


Figure 3: SIM5300EA pin out diagram (Top view)

3.2 PIN DESCRIPTION

Table 4: IO Parameters Definition

Pin Type	Description
PI	Power input
PO	Power output

IO	Bidirectional input / output
DI	Digital input
DO	Digital output
AI	Analog input
AO	Analog output

Table 5: Pin description

Pin name	Pin number	IO	Description	Comment
Power supply				
VBAT	55,56,57	PI	Power supply	
VRTC	26	PI/ PO	Power supply for RTC	It is recommended to connect with a battery or a capacitor (e.g. 4.7uF).
VDD_EXT	15	PO	1.8V output power supply	At all times, VDD_EXT must not be influenced by any external voltage above 2V. If it is unused, keep floating.
GND	2,17,18,29,39 ,45,46,54,58, 59,61,62,63,6 4,65		Ground	
Power on/down				
PWRKEY	1	DI	PWRKEY should be pulled low at least 100ms to power on or 1s to power down the module.	Pulled up internally.

Audio interfaces only for SIM5300EA (these pins of SIM5300E should be NC)

MIC_P	19	AI	Differential audio input	If these pins are unused, keep floating.
MIC_N	20			
SPK_P	21	AO	Differential audio output	
SPK_N	22			

Status

STATUS	66	DO	Power on status indication	If these pins are unused, keep floating.
NETLIGHT	52	DO	Network status indication	

SPI interface

SPI_CLK	11	DO	SPI interface	If these pins are unused, keep floating.
SPI_MOSI	12	DO		
SPI_MISO	13	DI		
SPI_CS	14	DO		

I2C interface

SDA	37	IO	I2C serial bus data	If these pins are unused, keep floating.
SCL	38	DO	I2C serial bus clock	

GPIOs

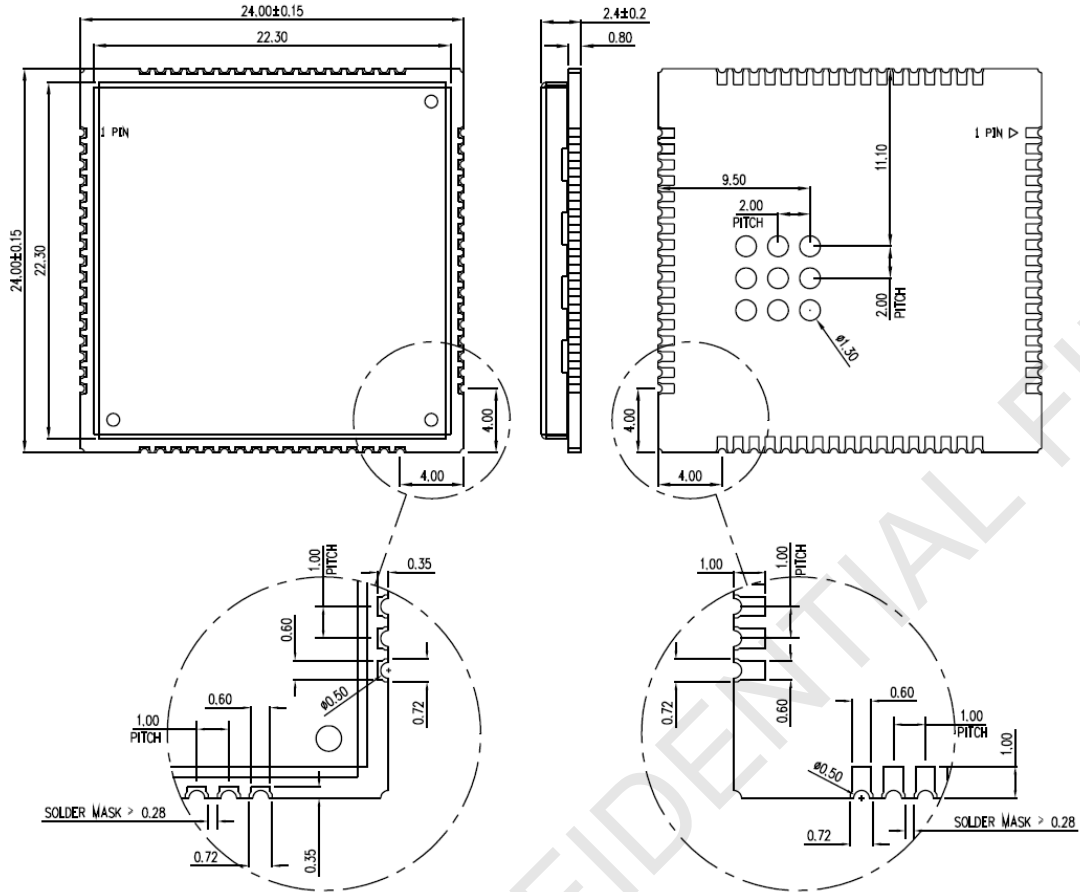
GPIO1	40	IO	GPIO1	If these pins are unused, keep floating.
GPIO2	41		GPIO2	
GPIO3	42		GPIO3	
GPIO4	43		GPIO4	
GPIO6	47		GPIO6	
GPIO7	48		GPIO7	

GPIO11	67		GPIO11	
GPIO12	68		GPIO12	
Serial port				
RXD	10	DI	Receive data	TXD must be prevented from accessing excessive voltage above 2V. If these pins are unused, keep floating.
TXD	9	DO	Transmit data	
RTS	8	DI	Request to send	
CTS	7	DO	Clear to send	
DCD	5	DO	Data carrier detect	
RI	4	DO	Ring indicator	
DTR	3	DI	Data terminal ready	
Debug port				
GPIO8/DBG_RXD	49	DI	Default DBG_RXD	If these pins are unused, keep floating.
GPIO9/DBG_TXD	50	DO	Default DBG_TXD	
USB interface				
VBUS	24	PI	VBUS (5V)	If these pins are unused, keep floating.
USB_DP	27	IO	USB 2.0 specification, 90 Ohms differential	
USB_DN	28	IO		
USIM interface				
USIM_VDD	30	PO	Voltage supply for USIM card. Support 1.8V or 3V USIM card	All signals of USIM interface should be protected against ESD with a TVS diode array.
USIM_DATA	31	IO	USIM data input/output	
USIM_CLK	32	DO	USIM clock	

USIM_RST	33	DO	USIM reset	
USIM_DET	34	DI	USIM card detection	If it is unused, keep floating.
ADC				
ADC	25	AI	Input voltage range: 0V ~ 1.1V	If it is unused, keep floating.
External reset				
RESET	16	DI	Reset input(Active low)	Recommend to connect a 100pF capacitor.
Pulse width modulation(PWM)				
PWM1	35	DO	PWM	If these pins are unused, keep floating.
PWM2	36	DO	PWM	
RF interface				
RF_ANT	60	IO	Radio antenna connection	Impedence must be controlled to 50Ω.
Not connect				
NC	6,23,44,51,53	-		These pins should be kept floating.

Note: Pins like VDD_EXT and TXD must be prevented from excessive voltage above 2V. NC-pins should be left disconnected

3.3 PACKAGE DIMENSIONS



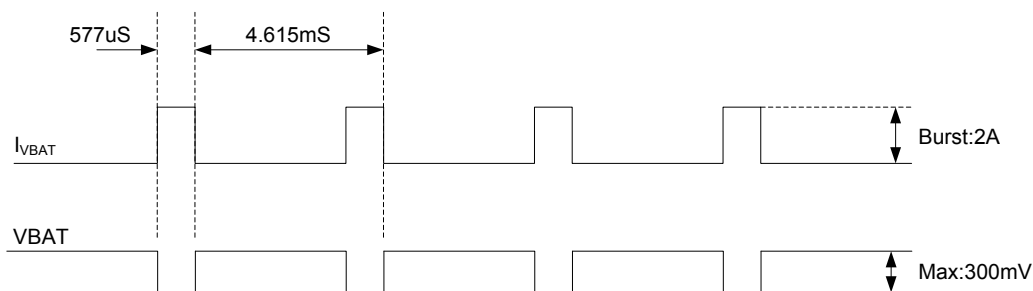


Figure 6: Reference circuit of the DC-DC power supply

Using large tantalum capacitors (above 100uF) is the best way to reduce the voltage drops. For better RF performance and system stability, some multi-layer ceramic chip (MLCC) capacitors (0.1/1uF) need to be used for EMC, which have low ESR in high frequencies. Adding 33pF capacitors can effectively eliminate high frequency interference. Note that capacitors should be put close to VBAT pins. Also, users should minimize the PCB trace impedance from the power supply to VBAT pins by widening trace to 80 mils or more. It is suggested to use a zener diode, and its reverse zener voltage is 5.1V and dissipation power is more than 500mW. The following figure is the recommended circuit.

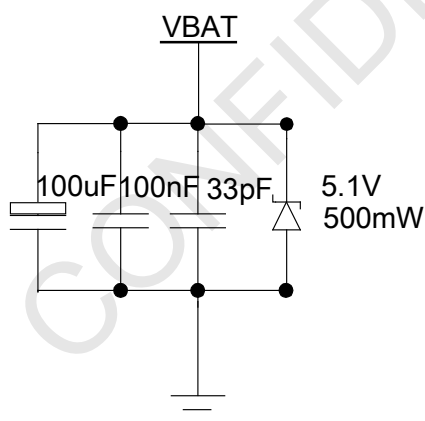


Figure 7: VBAT input application circuit

Table 6: Recommended zener diode models

No.	Manufacturer	Part Number	Power	Package
1	On semi	MMSZ5231BT1G	500mW	SOD123
2	Prisemi	PZ3D4V2H	500mW	SOD323
3	Vishay	MMSZ4689-V	500mW	SOD123
4	Crownpo	CDZ55C5V1SM	500mW	0805

It is recommended that DC-DC or LDO should be used for the power supply of the module, make sure that the peak current of power components can rise up to more than 2A. The following figure is the reference design of +5V input power supply. The designed output of the power supply is 3.8V and a linear regulator can be used here.

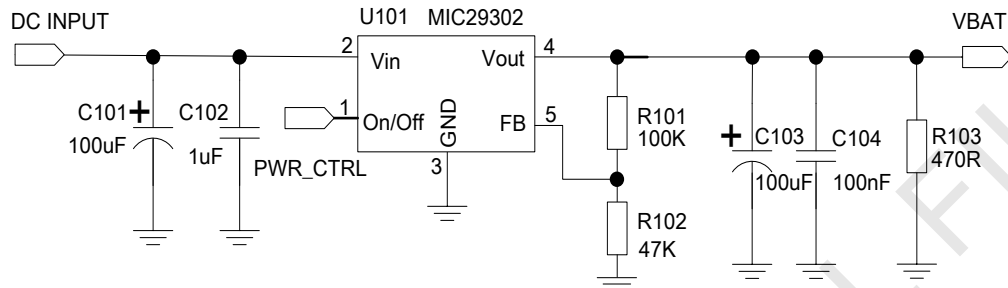


Figure 8: Reference circuit of the LDO power supply

If there is a high drop-out between the input and the desired output (VBAT), a DC-DC power supply will be preferable for higher efficiency. The following figure is the reference circuit. Note that DC-DC may influence RF performance because of ripple current intrinsically.

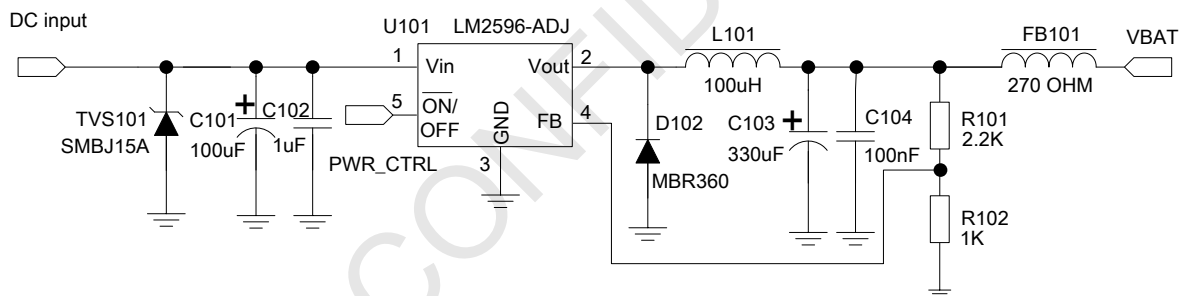


Figure 9: Reference circuit of the DC-DC power supply

To monitor the power supply voltage, users can use the AT command "AT+CBC". This command has two parameters: the battery status and the voltage value (mV). It will return the capacity percentage and actual value of battery (at the VBAT pin).

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

4.2 POWER ON/DOWN SCENARIOS

4.2.1 Power on SIM5300E

User can power on SIM5300E by pulling down the PWRKEY pin for at least 100ms and then release. This pin is already pulled up to 1.8V internally, so external pull up is not necessary. Reference circuit is shown as below.

T_{on}	The time of active low level impulse of PWRKEY pin to power on module	50	100	-	ms
$T_{on(status)}$	The time from power-on issue to STATUS pin output high level(indicating power up ready)	3	-	5	s
$T_{on(uart)}$	The time from power-on issue to UART port ready	3	-	5	s
$T_{on(usb)}$	The time from power-on issue to USB port ready	9	-	15	s
V_{IH}	Input high level voltage on PWRKEY pin	1.26	1.8	2.0	V
V_{IL}	Input low level voltage on PWRKEY pin	0		0.54	V

When power on procedure is completed, SIM5300E 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” will be received from the serial port every time when SIM5300E is powered on. For details, please refer to the chapter “AT+IPR” in document [1].

4.2.2 Power down SIM5300E

SIM5300E will be powered down in the following situations:

- Normal power down procedure: power down SIM5300E by the PWRKEY pin.
- Normal power down procedure: power down SIM5300E by AT command “AT+CPOWD=1”.
- Abnormal power down: over-voltage or under-voltage automatically power down.
- Abnormal power down: over-temperature or under-temperature automatically power down.

POWER DOWN SIM5300E BY THE PWRKEY PIN

User can power down SIM5300E by pulling down the PWRKEY pin for at least 1 second and then release. Please refer to the power on circuit. The power down scenario is illustrated in following figure.

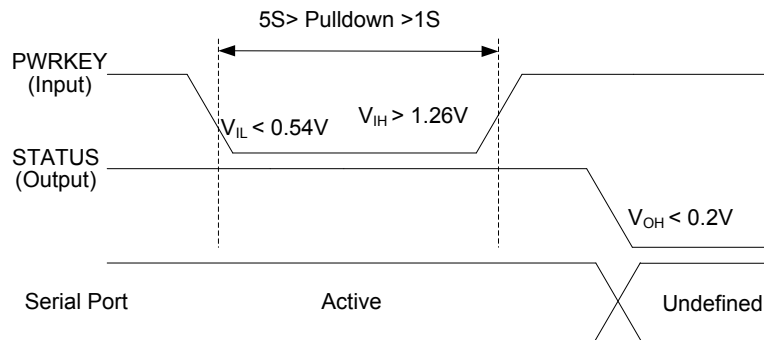


Figure 13: Timing of power down SIM5300E by PWRKEY

This procedure makes the module to log off from the network and allows the software to enter 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 cannot 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.

POWER DOWN SIM5300E BY AT COMMAND

SIM5300E can be powered down by AT command "AT+CPOWD=1". This procedure makes the module to log off from the network and allows the software to enter 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 cannot 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 details about the AT command "AT+CPOWD", please refer to *document [1]*.

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 WARNING

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

OVER-VOLTAGE WARNING

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

UNDER-VOLTAGE POWER DOWN

If the voltage $\geq 4.4V$, the following URC will be reported, and the module will be automatically powered down.

OVER-VOLTAGE POWER DOWN

At this moment, AT commands cannot 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.

OVER-TEMPERATURE OR UNDER-TEMPERATURE POWER DOWN

The module will constantly monitor the temperature of the module,

If the temperature $> +80^{\circ}C$, the following URC will be reported:

+CMTE: 1

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

+CMTE:-1

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

+CMTE: 2

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

+CMTE:-2

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

The AT command "AT+CMTE?" could be used to read the temperature when the module is running.

For details please refer to *document [1]*.

4.2.3 Restart SIM5300Eby PWRKEY Pin

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

- Power down the module.
- Wait for at least 15S after STATUS pin changing to low level.
- Power on the module.

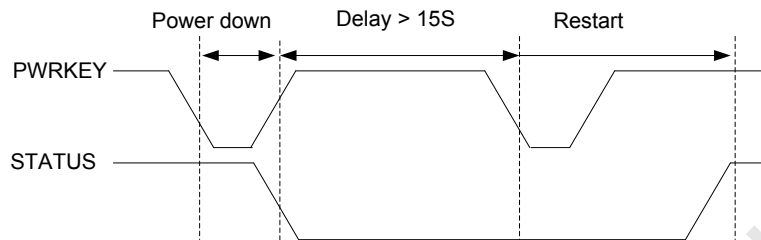


Figure 14: Timing of restart SIM5300E

4.3 EXTERNAL RESET

The external RESET pin is used to reset the module. This function is used as an emergency reset only when AT command “AT+CPOWD=1” and the PWRKEY pin are of no avail. The reset timing is illustrated in the following figure.

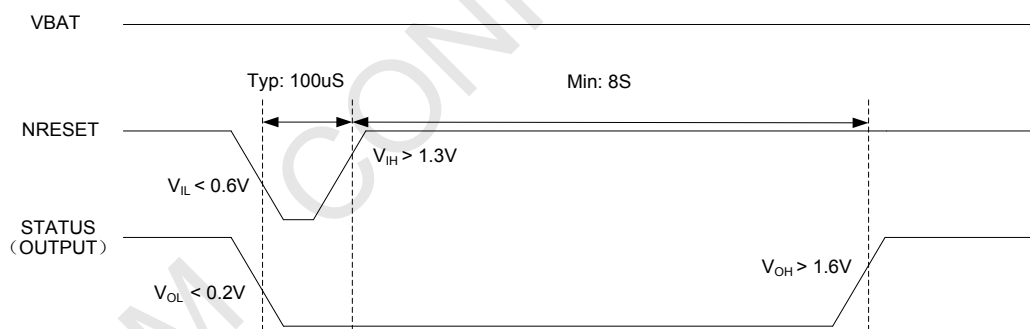


Figure 15: Reset timing

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

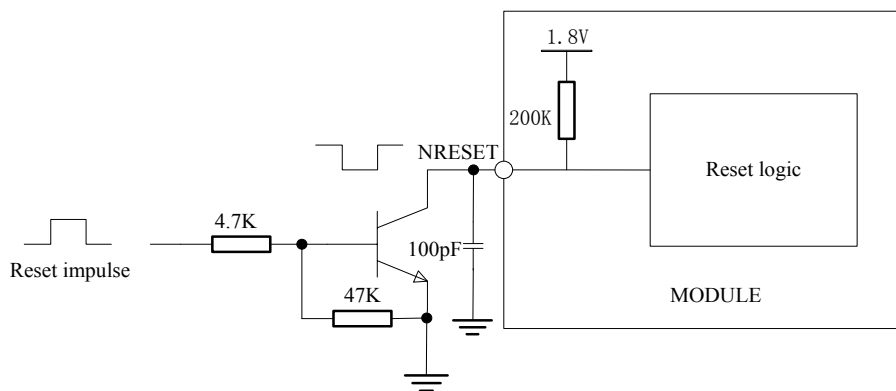


Figure 16: Reset reference design circuit

Note: It is recommended to cut off the VBAT power supply directly instead of using external reset pin when SIM5300E cannot respond to the AT command “AT+CPOWD=1” and PWRKEY pin.

4.4 POWER SAVING MODE

The module has two kinds of sleep modes, which are selected by AT command: the Sleep Mode 1 is enabled by hardware pin DTR and “AT+CSCLK=1”, the Sleep Mode 2 is enabled by serial port and “AT+CSCLK=2” regardless of DTR. In sleep mode, the current of module is very small. The AT command “AT+CFUN=<fun>” can be used to set SIM5300E into minimum functionality. When SIM5300E is in sleep mode and minimum functionality, the current of module is the lowest.

4.4.1 Minimum Functionality Mode

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

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

Minimum functionality mode minimizes the current consumption to the lowest level. If SIM5300E is set to minimum functionality mode by “AT+CFUN=0”, the RF function and USIM card function will be disabled. In this case, the serial port is still accessible, but all AT commands correlative with RF function and USIM card function will not be accessible.

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

Table 8: The Current Consumption of Minimum Functionality Mode

<fun>		Current consumption(mA) (sleep mode)
0		0.65
1	BS-PA-MFRMS=2	1.9
	BS-PA-MFRMS=5	1.5
	BS-PA-MFRMS=9	1.4
4		0.7

4.4.2 Sleep Mode 1 (AT+CSCLK=1)

After setting command “AT+CSCLK=1”, user can control SIM5300E module to enter or exit the sleep mode 1 (AT+CSCLK=1) by DTR signal. When DTR is in high level and the module does not receive interruptions on air and hardware (such as a GPIO interruption or data in serial port), SIM5300E will enter sleep mode 1 automatically. In this mode, SIM5300E can still receive paging or SMS from network, but the serial port is not accessible.

Note: SIM5300E requires to set AT command “AT+CSCLK=1” and ensure DTR at high level to enable the sleep mode 1; the default value is 0, which cannot make the module to enter sleep mode. For more details, please refer to document [1].

4.4.3 Wake Up SIM5300E from Sleep Mode 1 (AT+CSCLK=1)

When SIM5300E is in sleep mode 1 (AT+CSCLK=1), the following methods can wake up the module:

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

4.4.4 Sleep Mode 2 (AT+CSCLK=2)

In this mode, SIM5300E will continuously monitor the serial port data signal. When there is no data transfer over 5 seconds on the RXD signal and there are no on air and hardware interruptions (such as a GPIO interruption), SIM5300E will enter sleep mode 2 automatically. In this mode, SIM5300E can still receive paging or SMS from network but the serial port is not accessible.

Note: SIM5300E requires to set AT command “AT+CSCLK=2” to enable the sleep mode 2; the default value is 0, which cannot make the module to enter sleep mode. For more details, please refer to document [1].

4.4.5 Wake Up SIM5300E from Sleep Mode 2 (AT+CSCLK=2)

When SIM5300E is in sleep mode 2 (AT+CSCLK=2), the following methods can wake up the module:

- Send data to SIM5300E through main serial port.

- Receive a voice or data call from network.
- Receive a SMS from network.

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

4.5 RTC BACKUP

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

● External capacitor backup

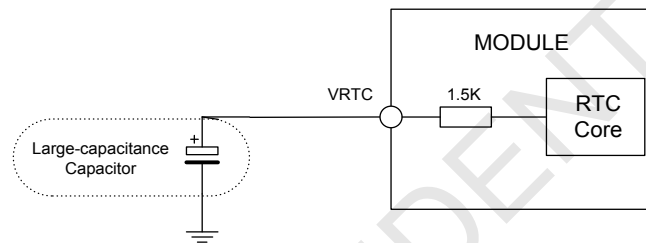


Figure 17: RTC supply from capacitor

● Non-chargeable battery backup

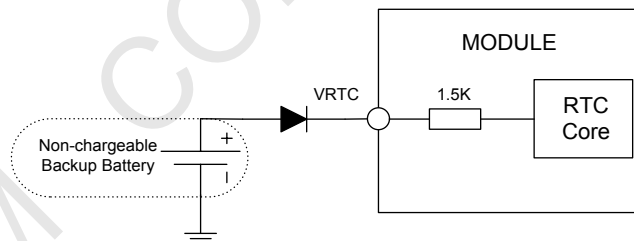


Figure 18: RTC supply from non-chargeable battery

● Rechargeable battery backup

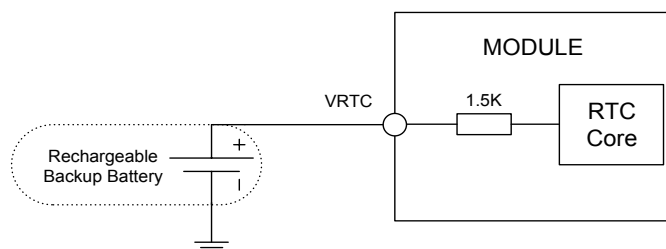


Figure 19: RTC supply from rechargeable battery

4.6 SERIAL INTERFACES

SIM5300E provides two unbalanced asynchronous serial ports. One is the serial port and the other is the debug port. The module is designed as a DCE (Data Communication Equipment). The following figure shows the connection between module and client (DTE).

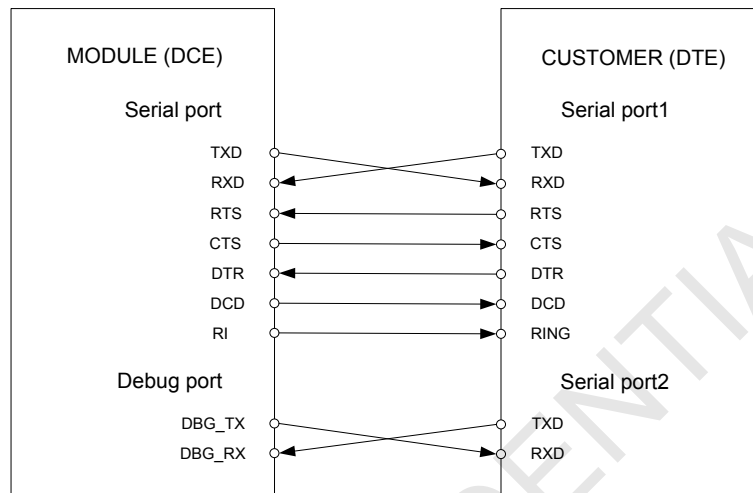


Figure 20: Connection of the serial interfaces

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

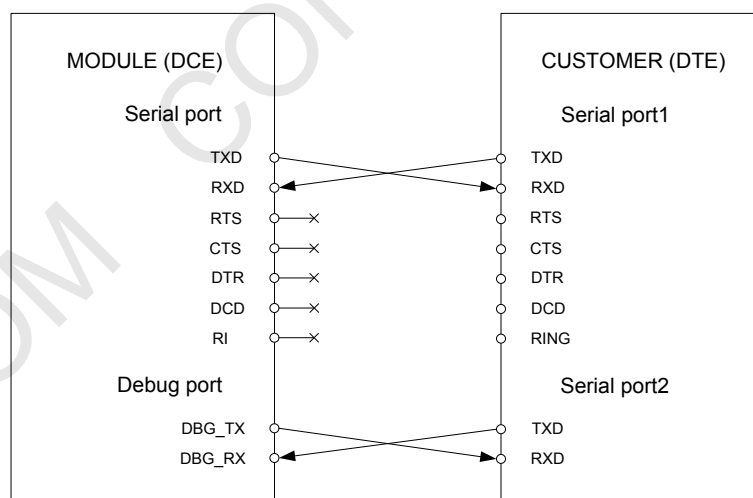


Figure 21: Connection of RXD and TXD only

The SIM5300E UART and Debug port are 1.8V voltage interface. If user's UART/Debug application circuit is 3.3V voltage interface, the level shift circuits should be used for voltage matching. The following figure shows the voltage matching reference design.

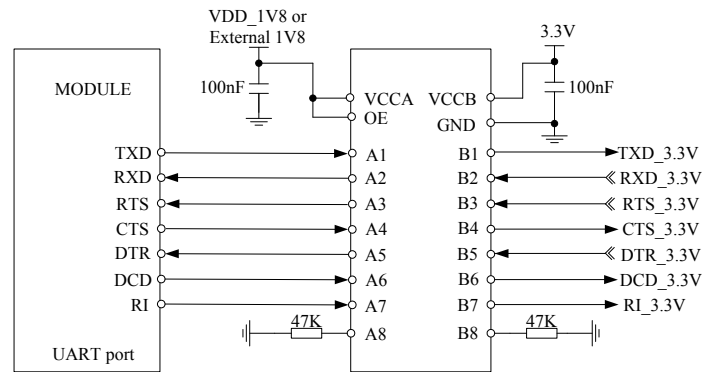


Figure 22: Reference circuit of level shift

To comply with RS-232-C protocol, the RS-232-C level shift chip should be used to connect SIM5300E to the RS-232-C interface, for example SP3238ECA, etc.

4.6.1 Function of Serial Port and Debug Port

Serial port:

- Full modem device.
- Contains data lines TXD and RXD, hardware flow control lines RTS and CTS, status lines DTR, DCD and RI.
- Serial port can be used for CSD FAX, GPRS service and AT communication. It can also be used for multiplexing function. For details about multiplexing function, please refer to document [3].
- Serial port supports the following baud rates:
300, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400 and 460800bps
- Autobauding only supports the following baud rates:
From 1200 bps to 115200bps
- The default setting is autobauding.

Autobauding allows SIM5300E 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" until DTE receives "OK" response, which means DTE and DCE are correctly synchronized. For more information, please refer to the AT command "AT+IPR".

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 SIM5300E is powered on.

4.6.2 Software Debug

Refer to the following figure for debugging software.

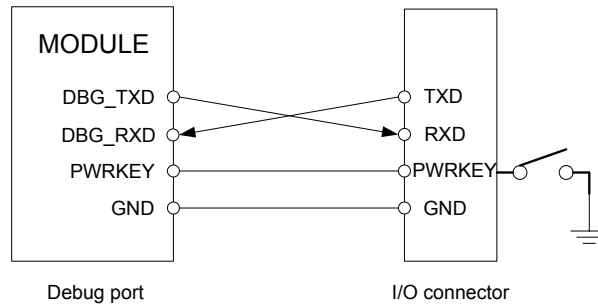


Figure 23: Connection for software upgrading and debugging

The serial port and the debug port support the CMOS level. If user connects the module to the computer, the level shifter should be added between the DCE and DTE (like Figure 21).

4.7 AUDIO INTERFACES

SIM5300EA provides one analog input, which could be used for electric microphone. The module also provides one analog output. The output can directly drive 32Ω receiver.

AT command “AT+CMIC” is used to adjust the input gain level of microphone. AT command “AT+SIDET” is used to set the side-tone level. In addition, AT command “AT+CLVL” is used to adjust the output gain level. For more details, please refer to *document [1]*

In order to improve audio performance, the following reference circuits are recommended. The audio signals have to be layout according to differential signal layout rules as shown in following figures. If user needs to use an amplifier circuit for audio, National Semiconductor Company’s LM4890 is recommended.

Note: Only SIM5300EA support Audio Function.

4.7.1 Speaker Interface Configuration

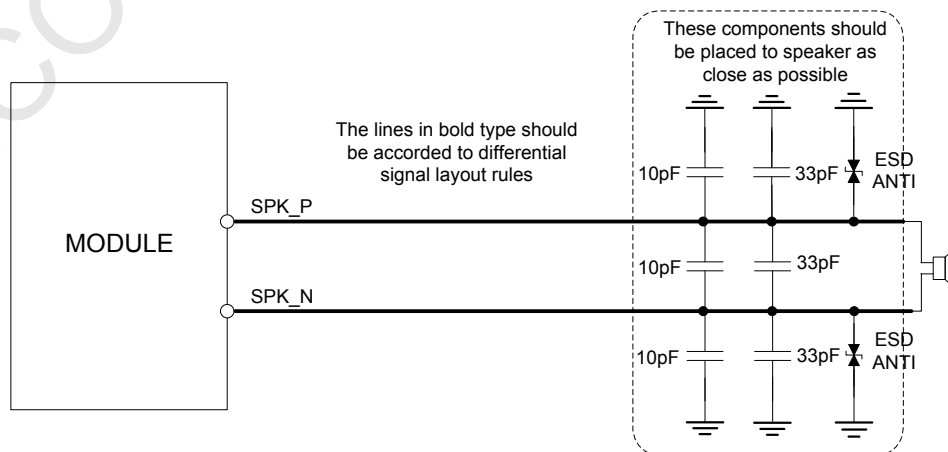


Figure 24: Speaker reference circuit

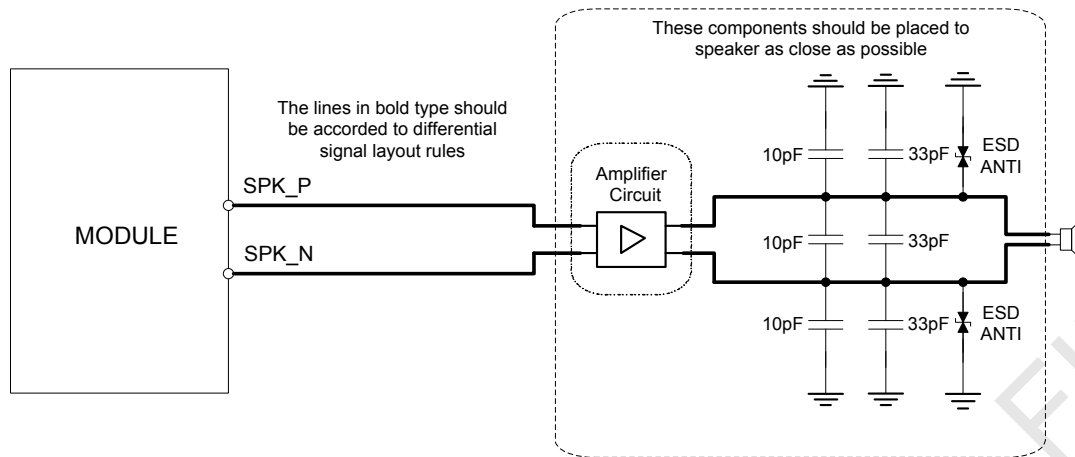


Figure 25: Speaker with amplifier reference circuit

4.7.2 Microphone Interfaces Configuration

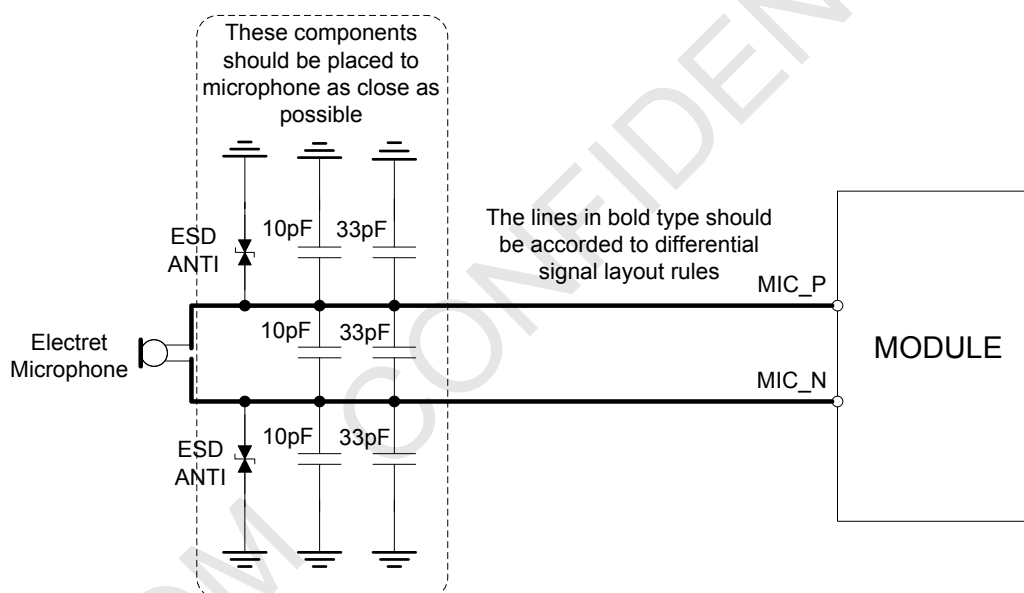


Figure 26: Microphone reference circuit

4.7.3 Earphone Interface Configuration

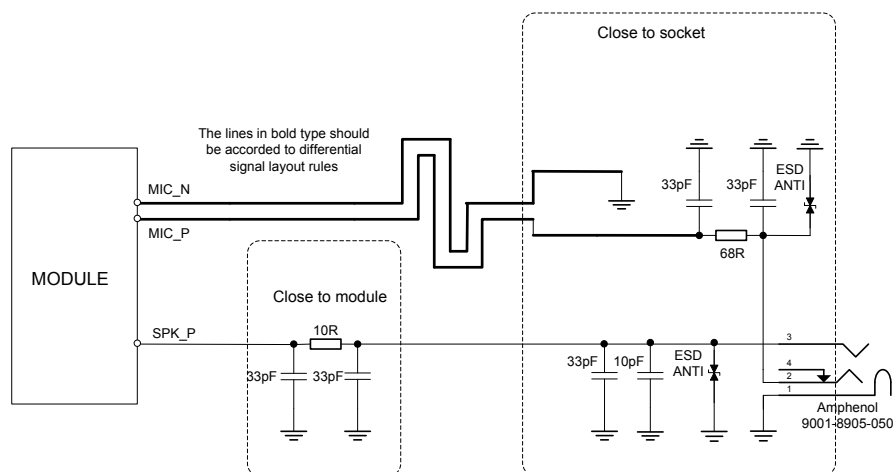


Figure 27: Earphone reference circuit

4.7.4 Audio Electronic Characteristics

Table 9: Microphone Input Characteristics

Parameter	Min	Typ	Max	Unit
Mic biasing Voltage	2.5	2.54	2.8	V
Working Current			3	mA
External Microphone Load Resistance		2.2		k Ω
Total Harmonic Distortion		-79	-65	dB
Equivalent output noise	Gain set to 35.25dB	110		μ V

Table 10: Audio Output Characteristics

Parameter	Conditions	Min	Typ	Max	Unit
Normal Output	RL=32 Ω Receiver			90	mW

4.8 USIM CARD INTERFACE

4.8.1 USIM Card Application

SIM5300E supports both 1.8V and 3.0V USIM cards. The USIM interface is powered from an internal regulator in the module.

Table 11: USIM Electronic characteristic in 1.8V mode (USIM_VDD=1.8V)

Symbol	Parameter	Min.	Typ.	Max.	Unit
USIM_VDD	LDO power output voltage	1.7	1.8	1.9	V
V _{IL}	High-level input voltage	0		0.2*USIM_VDD	V
V _{IH}	Low-level input voltage	0.7*USIM_VDD		USIM_VDD+0.2	V
V _{OL}	High-level output voltage	0		0.2*USIM_VDD	V
V _{OH}	Low-level output voltage	0.7*USIM_VDD		USIM_VDD+0.1	V

Table 12: USM Electronic characteristic 3.0V mode (USIM_VDD=2.9V)

Symbol	Parameter	Min.	Typ.	Max.	Unit
USIM_VDD	LDO power output voltage	2.7	2.9	3.1	V
V _{IL}	High-level input voltage	0		0.2*USIM_VDD	V
V _{IH}	Low-level input voltage	0.7*USIM_VDD		USIM_VDD+0.2	V
V _{OL}	High-level output voltage	0		0.2*USIM_VDD	V
V _{OH}	Low-level output voltage	0.7*USIM_VDD		USIM_VDD+0.1	V

It is recommended to use an ESD protection component such as ST (www.st.com) ESDA6V1W5 or ON SEMI (www.onsemi.com) SMF05C. The pull up resistor (4.7KΩ) on the USIM_DATA line is already added in the module internally. Note that the USIM peripheral circuit should be closed to the USIM card socket. The reference circuit of the 8-pin USIM card holder is illustrated in the following figure.

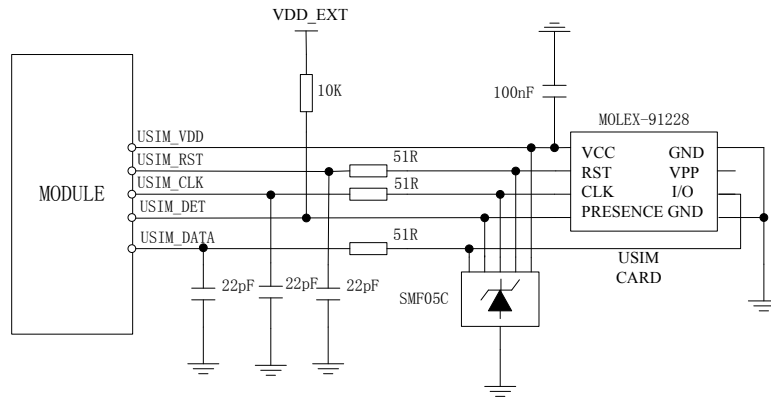


Figure 28: Reference circuit of the 8-pin USIM card holder

The USIM_DET pin is used for detection of the USIM card hot plug in. User can select the 8-pin USIM card holder to implement USIM card detection function. AT command “AT+CSDT” is used to enable or disable USIM card detection function. For details of this AT command, please refer to *document [1]*.

If the USIM card detection function is not used, user can keep the USIM_DET pin open. The reference circuit of 6-pin USIM card holder is illustrated in the following figure.

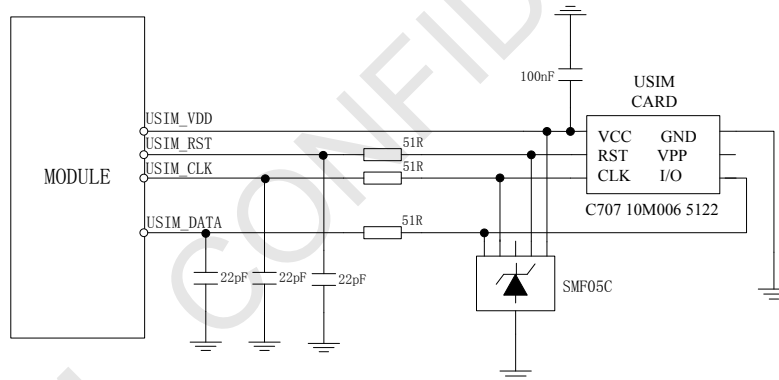


Figure 29: Reference circuit of the 6-pin USIM card holder

4.8.2 Design Considerations for USIM Card Holder

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

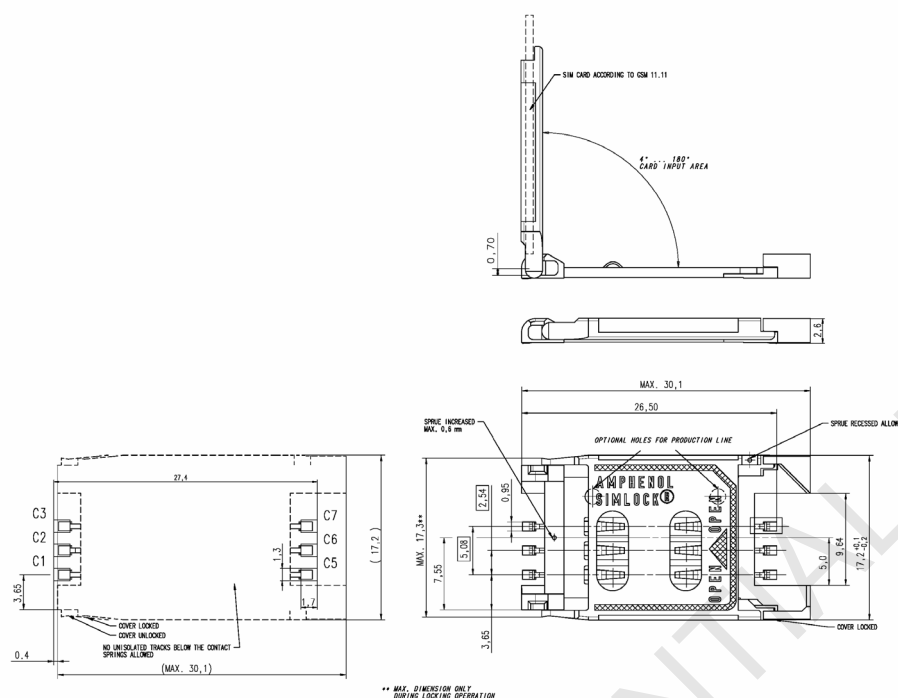


Figure 30: Amphenol C707 10M006 5122 USIM card holder

Table 13: Pin description (Amphenol USIM card holder)

Pin name	Signal	Description
C1	USIM_VDD	USIM card power supply
C2	USIM_RST	USIM card reset
C3	USIM_CLK	USIM card clock
C5	GND	Connect to GND
C6	VPP	Not connect
C7	USIM_DATA	USIM card data I/O

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

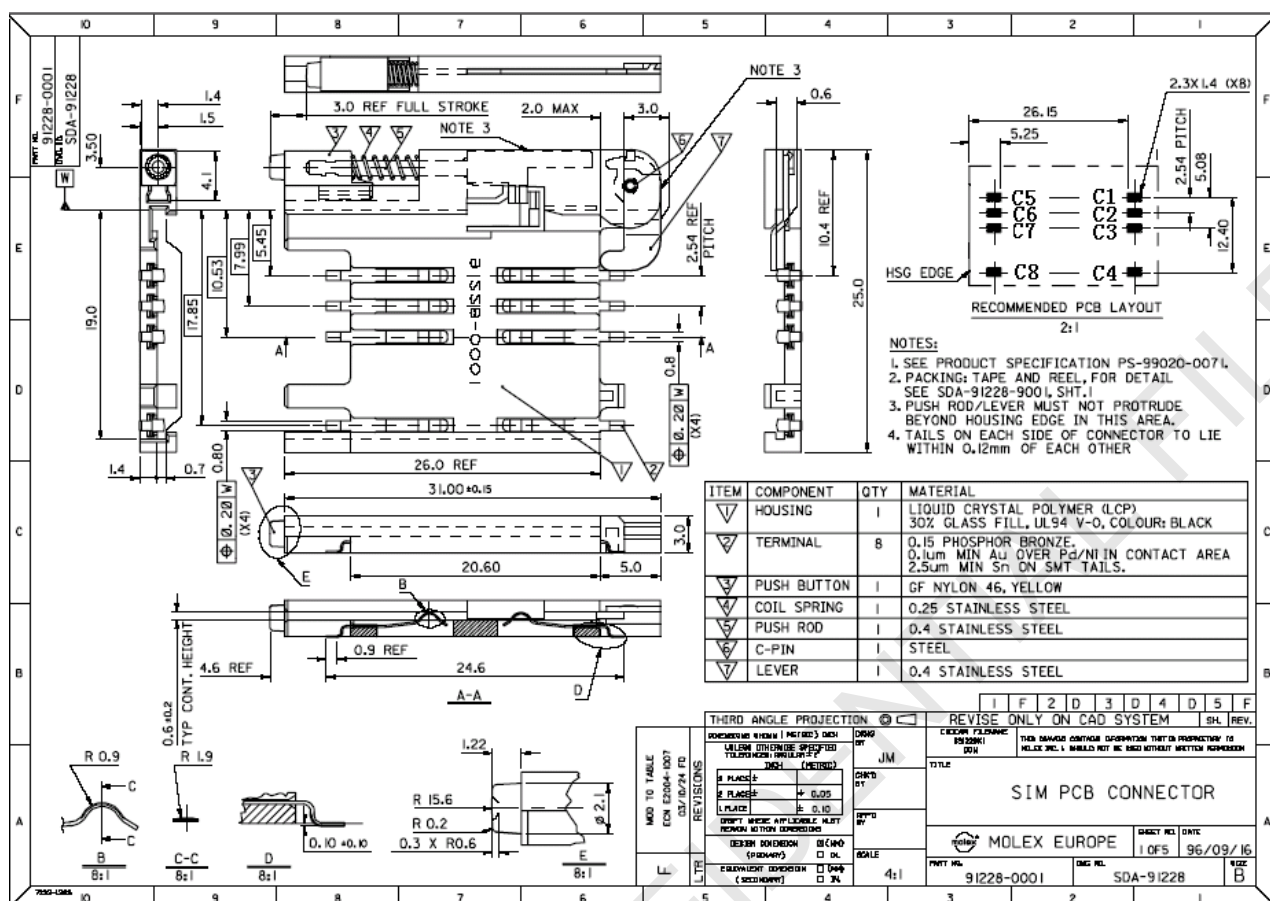


Figure 31: Molex 91228 USIM card holder

Table 14: Pin description (Molex USIM card holder)

Pin name	Signal	Description
C1	USIM_VDD	USIM card power supply
C2	USIM_RST	USIM card reset
C3	USIM_CLK	USIM card clock
C4	GND	Connect to GND
C5	GND	Connect to GND
C6	VPP	Not connect
C7	USIM_DATA	USIM card data I/O
C8	USIM_PRESENCE	Detect USIM card presence

4.9 USB INTERFACE

SIM5300E module contains a USB interface, which is used for AT port or updata software. This interface is compliant with the USB2.0 specification. It supports full-speed (FS, 12Mbps) and high-speed (HS, 480Mbps) transfers. USB charging and USB-OTG is not supported. The characteristic impedance value should be as close as possible to 90 Ohms differential. Capacitive loading, trace lengths should be minimized.

Table 15: Electronic characteristic

Pin Name	Pin No.	Min	Typ.	Max	Unit
USB_VBUS	24	4.5	5.0	5.25	V
USB_DP	27	USB 2.0 specification, 90 Ohms differential.			
USB_DN	28				

4.9.1 Application Guide

Currently SIM5300E supports the USB suspend and resume mechanism which can help to save power. If no transaction is on USB bus, SIM5300E will enter suspend mode. When some events such as voice call or receiving SMS happen, SIM5300E will resume normal mode automatically.

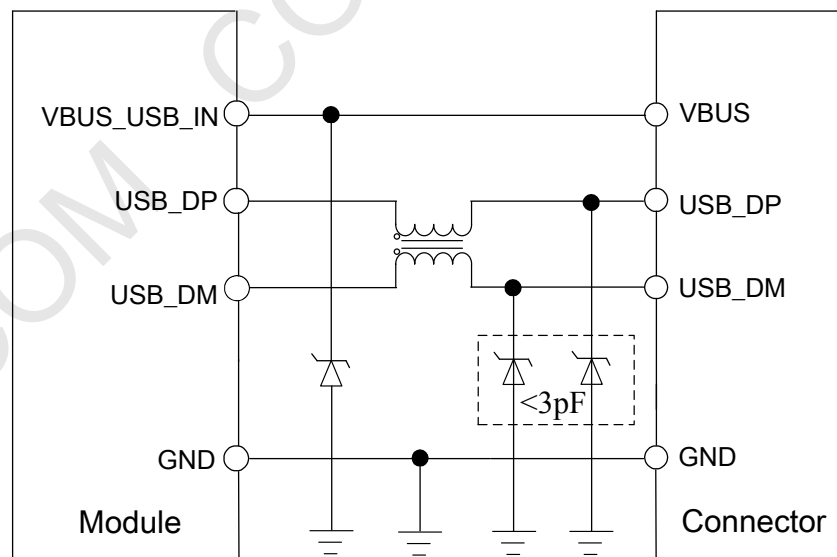


Figure 32: USB interface

Because of high bit rate on USB bus, pay attention to the influence of ESD component's junction capacitance on USB data lines. Typically, the capacitance should be less than 3pF.

It is recommended to use an ESD protection component such as ON SEMI (www.onsemi.com) ESD9M5.0ST5G (load C 2.5pF) or ESD9L5.0ST5G (load c 0.5pF).

Note: The SIM5300E has two kinds of interface (UART and USB) to connect to host CPU. USB interface is mapped to six virtual ports: “SimTech HS-USB AT Port 0020”, “SimTech HS-USB Diagnostics 0020”, “SimTech HS-USB Diagnostics 0020”, “SimTech HS-USB OCT 0020”, “SimTech HS-USB Port 0020”, “SimTech HS-USB Port 0020”.

4.10 SPI INTERFACE

SIM5300E provides SPI interface in the embedded AT application. For details about embedded AT application, please refer to *document [1]*.

Note: This function is not supported in the standard software. If user wants this function, please contact SIMCom for more details.

4.11 ADC

SIM5300E provides an 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 16: ADC specification

Parameter	Min	Typ.	Max	Unit
Voltage range	0	-	1.1	V
Input resistance	1			MΩ
Resolution	-	10	-	bits
Input capacitance		1		pF

4.12 RI BEHAVIORS

Table 17: RI Behaviors

State	RI response
Standby	High

Voice call	<p>The pin is changed to low. When any of the following events occur, the pin will be changed to high:</p> <ul style="list-style-type: none"> (1) Establish the call (2) Hang up the call
Data call	<p>The pin is changed to low. When any of the following events occur, the pin will be changed to high:</p> <ul style="list-style-type: none"> (1) Establish the call (2) Hang up the call
SMS	<p>The pin is changed to low, and kept low for 120ms when a SMS is received. Then it is changed to high.</p>
URC	<p>The pin is changed to low, and kept low for 120ms when some URCs are reported. Then it is changed to high. For more details, please refer to <i>document [3]</i>.</p>

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

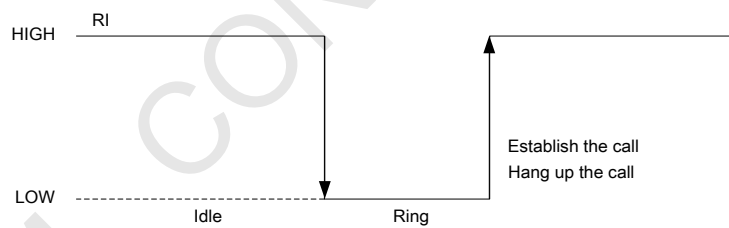


Figure 33: RI behavior of voice calling as a receiver

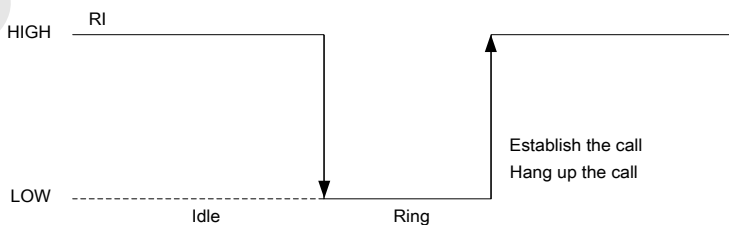


Figure 34: RI behavior of data calling as a receiver

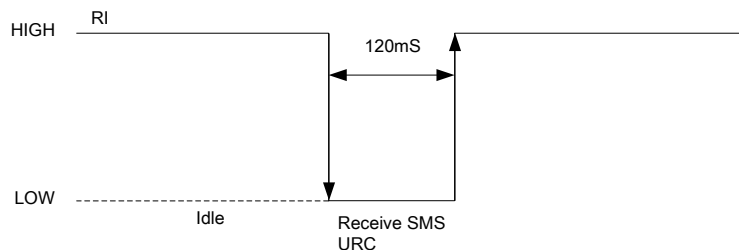


Figure 35: RI behavior of URC or receive SMS

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



Figure 36: RI behavior as a caller

4.13 NETWORK STATUS INDICATION

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

Table 18: Status of the NETLIGHT pin

Status	SIM5300E behavior
Off	SIM5300E is not running
64ms On/ 800ms Off	SIM5300E not registered the network
64ms On/ 3000ms Off	SIM5300E registered to the network
64ms On/ 300ms Off	Communication is established

A reference circuit is recommended in the following figure:

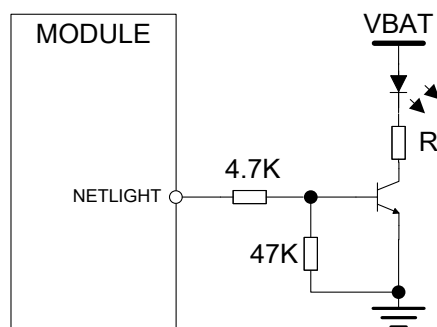


Figure 37: Reference circuit of NETLIGHT

4.14 PWM

SIM5300E provides two PWMs which can't be used at the same time. Each PWM output frequency varies from 400Hz to 100KHz. The AT command "AT + SPWM" is used to set the output period and duty cycle of the PWM. For details, please refer to *document [1]*.

4.15 I2C BUS

The SIM5300E provides an I2C interface. The pull up resistors on SDA and SCL line are already added in the module internally.

Note: This function is not supported in the standard software. If user wants this function, please contact SIMCom for more details.

4.16 ANTENNA INTERFACE

SIM5300E provides a RF antenna interface. The customer's antenna should be located in the customer's main board and connected to module's antenna pad through micro strip line or other type of RF trace whose impedance must be controlled in 50Ω . To facilitate the antenna tuning and certification test, a RF connector and an antenna matching circuit should be added. The following figure is the recommended circuit.

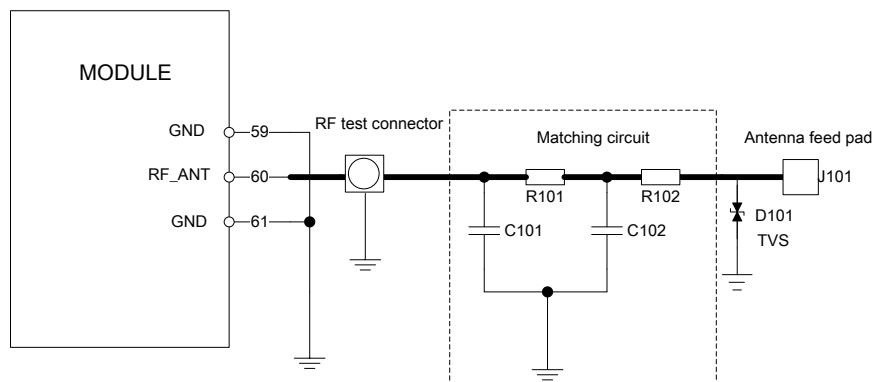


Figure 38: Antenna matching circuit

In this figure, the components R101, R102, C101 and C102 is used for antenna matching, the components' value can only be got after the antenna tuning. Usually, matching components' value is provided by antenna vendor, and the default value of R101 and R102 are $0\ \Omega$. Reserve the place of C101 and C102, they are used for tuning. The component D101 is a bidirectional TVS component, which is used for ESD protection. The recommended part numbers of the TVS are listed in the following table:

Table 19: TVS part number list

Package	Type	Supplier
0201	LXES03AAA1-154	Murata
0402	LXES15AAA1-153	Murata

The RF test connector in figure 37 shown above is used for conducted RF performance test, and should be placed as close as possible to the module's RF_ANT pin. The traces in bold type should be $50\ \Omega$ impedance controlled line in PCB layout.

5 ELECTRICAL, RELIABILITY AND RADIO CHARACTERISTICS

5.1 ABSOLUTE MAXIMUM RATINGS

The absolute maximum ratings stated in following table are stress ratings under non-operating conditions. Stresses beyond any of these limits will cause permanent damage to SIM5300E.

Table 20: Absolute maximum ratings

Symbol	Parameter	Min	Typ.	Max	Unit
VBAT	Power supply voltage	-	-	5.5	V
VBUS	VBUS		5.0	5.5	V
V_I^*	Input voltage	-0.3	-	2.3	V

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

5.2 RECOMMENDED OPERATING CONDITIONS

Table 21: Recommended operating conditions

Symbol	Parameter	Min	Typ	Max	Unit
VBAT	Power supply voltage	3.4	3.8	4.4	V
VBUS		4.5	5.0	5.25	V
T_{OPER}	Operating temperature	-40	+25	+85	°C
T_{STG}	Storage temperature	-45		+90	°C

5.3 DIGITAL INTERFACE CHARACTERISTICS

Table 22: Digital interface characteristics

Symbol	Parameter	Min	Typ	Max	Unit
I_{IH}	High-level input current	-0.7	-	0.7	uA
I_{IL}	Low-level input current	-0.7	-	0.7	uA
V_{IH}	High-level input voltage	1.26	-	2	V
V_{IL}	Low-level input voltage	-0.2	-	0.36	V
V_{OH}	High-level output voltage	1.6	-	-	V

V_{OL}	Low-level output voltage	-	-	0.2	V
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5.4 VDD_EXT CHARACTERISTICS

Table 23: VDD_EXT characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V_O	Output voltage	1.773	1.8	1.827	V
I_O	Output current	-	50		mA

5.5 VRTC CHARACTERISTICS

Table 24: VRTC characteristics

Symbol	Parameter	Min	Typ	Max	Unit
V_{RTC-IN}	VRTC input voltage		1.8		V
I_{RTC-IN}	VRTC input current	-	TBD	-	uA
$V_{RTC-OUT}$	VRTC output voltage	-	1.8	-	V
$I_{RTC-OUT}$	VRTC output current	-	TBD	-	uA

5.6 CURRENT CONSUMPTION (VBAT = 3.8V)

Table 25: Current consumption*

OFF state	
OFF state supply current	Power down 140uA
Idle Current consumption (GSM idle mode)	
Idle supply current (GSM)	11.4mA

Sleep mode	
GSM/GPRS supply current	Sleep mode @ BS-PA-MFRMS=2 1.9mA
	Sleep mode @ BS-PA-MFRMS=5 1.5mA
	Sleep mode @ BS-PA-MFRMS=9 1.4mA
Voice Call	
GSM 900	@power level #5 <300mA, Typical 232mA
DCS1800	@power level #0 <250mA, Typical 161mA
DATA mode, GPRS (1 Rx, 4 Tx) CLASS 12	
GSM 900	@power level #5 <660mA, Typical 503mA
DCS1800	@power level #0 <530mA, Typical 325mA
DATA mode, GPRS (3Rx, 2 Tx) CLASS 12	
GSM 900	@power level #5 <500mA, Typical 412mA
DCS1800	@power level #0 <400mA, Typical 273mA
DATA mode, GPRS (4Rx, 1 Tx) CLASS 12	
GSM 900	@power level #5 <300mA, Typical 236mA
DCS1800	@power level #0 <250mA, Typical 165mA
DATA mode, EGPRS (1Rx, 4 Tx)	
GSM 900	@power level #8<500mA, Typical 425mA
DCS 1800	@power level #2<500mA, Typical 313mA
DATA mode, EGPRS (3 Rx, 2 Tx)	
GSM 900	@power level #8<330mA, Typical 243mA
DCS 1800	@power level #2<330mA, Typical 189mA
DATA mode, EGPRS (4Rx, 1 Tx)	

GSM 900	@power level #8<240mA,Typical 147mA
DCS 1800	@power level #2<240mA,Typical 121mA
WCDMA Sleep/Idle Mode	
WCDMA supply current	Sleep mode @DRX=8 1.8 mA
	Idlemode 11.9mA
WCDMA Talk	
WCDMA 2100	@Power MAX Typical 612mA
	@Power 21dBm Typical 537mA
	@Power 10dBm Typical 187mA
WCDMA 900	@Power MAX Typical 540mA
	@Power 21dBm Typical 446mA
	@Power 10dBm Typical 165mA

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

5.7 ELECTRO-STATIC DISCHARGE

SIM5300E is an ESD sensitive component, so more attention should be paid to the procedure of handling and packaging. The ESD test results are shown in the following table.

Table 26: The ESD characteristics (Temperature: 25℃, Humidity: 45 %)

Pin	Contact discharge	Air discharge
VBAT	±5KV	±10KV
GND	±6KV	±12KV
Antenna port	±5KV	±10KV
RXD, TXD	±4KV	±8KV
SPK_P/ SPK_N	±4KV	±8KV

MIC_P/ MIC_N		
USB-DM/USB-DP	$\pm 4KV$	$\pm 8KV$
PWRKEY	$\pm 4KV$	$\pm 8KV$

5.8 RF SPECIFICATION

5.8.1 Conducted Transmission Power

The following table shows the module conducted output power, and it follows the 3GPP TS 05.05 & 3GPP TS 34.121 technical specification requirement.

Table 27: SIM5300E Conducted RF Output Power

Frequency	Max	Min
E-GSM900	33dBm $\pm 2dB$	5dBm $\pm 5dB$
DCS1800	30dBm $\pm 2dB$	0dBm $\pm 5dB$
WCDMA 2100	24dBm $+1/-3dB$	-56dBm $\pm 5dB$
WCDMA 900	24dBm $+1/-3dB$	-56dBm $\pm 5dB$

For the module's output power, please note:

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

At DCS1800 band, the module is a class 1 device, so the module's output power should not exceed 30dBm on the maximum power level. At the same time, the output power tolerance should not exceed $\pm 2dB$ under normal condition and $\pm 2.5dB$ under extreme condition.

At WCDMA band, the module is a class 3 device, so the module's output power should not exceed 24dBm on the maximum power level, and the output power tolerance should not exceed $\pm 1/-3dB$.

5.8.2 Module RF Receive Sensitivity

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

Table 28: SIM5300E conducted RF receive sensitivity

Frequency	Received sensitivity(Typ.)	Received sensitivity(Max)
EGSM900	<-109dBm	-108dBm
DCS1800	<-110dBm	-108dBm
WCDMA B1	<-110dBm	-108dBm
WCDMA B8	<-108dBm	-106dBm

5.8.3 Module Operating Frequency Bands

The following table shows the module's operating frequency range, which follows the 3GPP technical specification requirement.

Table 29: SIM5300E operating frequencies

Operating Band	DL Frequencies	UL Frequencies
	Receive(MHz)	Transmit(MHz)
EGSM900	925 ~ 960	880 ~ 915
DCS1800	1805 ~ 1880	1710 ~ 1785
WCDMA B1	2110~2170	1920~1980
WCDMA B8	925~960	880~915

5.8.4 Module Operating Frequency Bands

SIM5300E can support high rate data by GSM/WCDMA wireless network. In the different network environment, data transmission rate shifts depending on modulation and encoding.

Table 30: SIM5300E GPRS data throughput

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

Table 31: SIM5300E EDGE data throughput

Coding scheme	1 timeslot	2 timeslot	4 timeslot
MCS1	8.8 kbps	17.6 kbps	35.2 kbps
MCS2	11.2 kbps	22.4 kbps	44.8 kbps
MCS3	14.8 kbps	29.6 kbps	59.2 kbps
MCS4	17.6 kbps	35.2 kbps	70.4 kbps
MCS5	22.4 kbps	44.8 kbps	89.6 kbps
MCS6	29.6 kbps	59.2kbps	118.4 kbps
MCS7	44.8 kbps	89.6 kbps	179.2 kbps
MCS8	54.4 kbps	108.8 kbps	217.6 kbps
MCS9	59.2 kbps	118.4 kbps	236.8 kbps

Table 32: SIM5300E data throughput

Transmission Mode	Category	Theoretical max peak rate	Modulation
HSDPA	Category8	7.2 Mbps	16QAM,QPSK
HSUPA	Category6	5.76 Mbps	QPSK

6 MANUFACTURING

6.1 TYPICAL SOLDER REFLOW PROFILE

Top and Bottom View of SIM5300E:



Figure 39: Top and bottom view of SIM5300E

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

For customer's convenience, SIMCom provides a typical example of a commonly used soldering profile. In final board assembly, the typical solder reflow profile will be determined by the largest component on the board, as well as the type of solder/flux used and PCB stack-up. Therefore the soldering profile shown below is only a generic recommendation and should be adjusted to the specific application and manufacturing constraints.

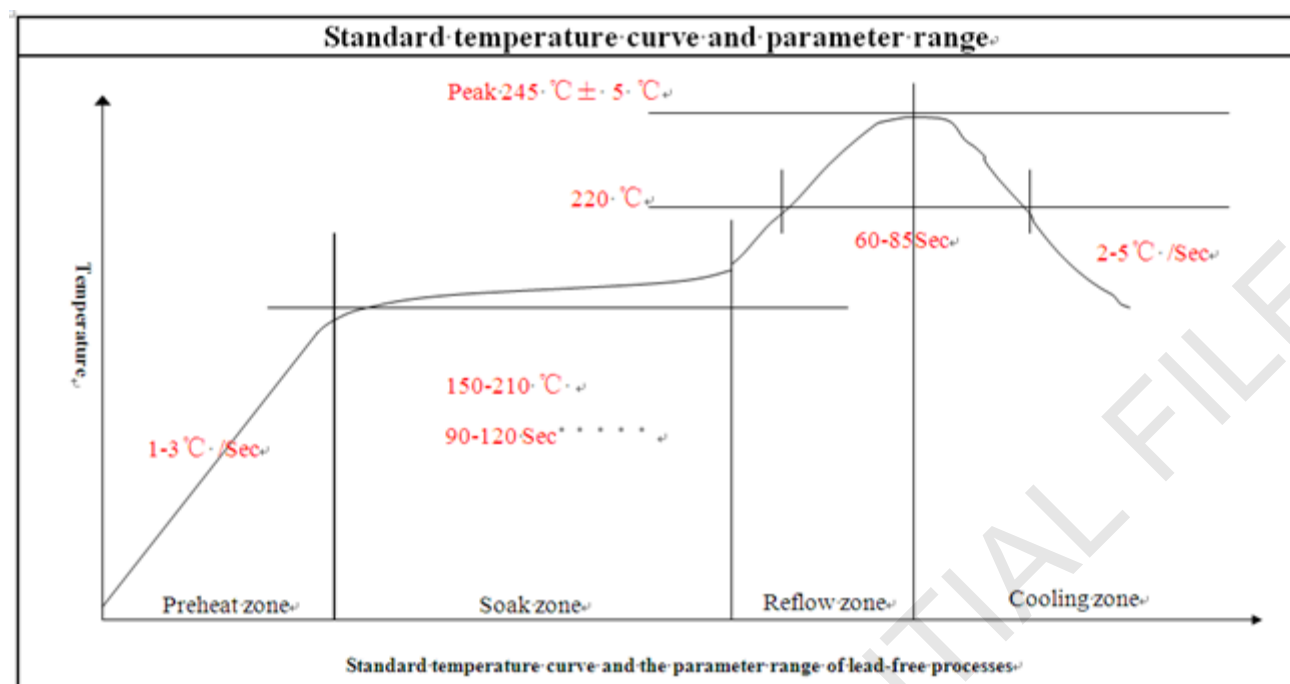


Figure 40: The ramp-soak-spike reflow profile of 5300E

6.2 THE MOISTURE SENSITIVITY LEVEL

The moisture sensitivity level of SIM5300E is 3. The module should be mounted within 168 hours after unpacking in the environmental conditions of temperature <30°C and relative humidity <60% (RH). It is necessary to bake the module if the above conditions are not met.

Table 33: Moisture classification level and floor life

Level	Floor Life (out of bag) at factory ambient ≤30°C /60% RH or as stated
1	Unlimited at ≤30°C /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:

1. If the vacuum package is not open for 6 months or longer than the packing date, baking is also recommended before re-flow soldering.
2. Product handling, storage and processing must follow IPC / JEDEC J-STD-033.

6.3 BAKING REQUIREMENTS

Because of its sensitivity to moisture absorption, SIM5300E should be baked sufficiently before re-flow soldering. Otherwise SIM5300E will be at the risk of permanent damage during re-flow soldering. SIM5300E should be baked 192 hours at temperature $40^{\circ}\text{C} \pm 5^{\circ}\text{C}$ / -0°C and $<5\%$ RH for low-temperature device containers, or 72 hours at temperature $80^{\circ}\text{C} \pm 5^{\circ}\text{C}$ for high-temperature device containers. When baking SIM5300E modules, note that the plastic tray is not heat resistant. Otherwise the tray may be damaged by high-temperature during baking.

Table 34: Baking requirements

Baking temperature	Moisture	Time
$40^{\circ}\text{C} \pm 5^{\circ}\text{C}$	$<5\%$	192 hours
$120^{\circ}\text{C} \pm 5^{\circ}\text{C}$	$<5\%$	4 hours

7 PACKAGING

SIM5300E module support tray packaging.

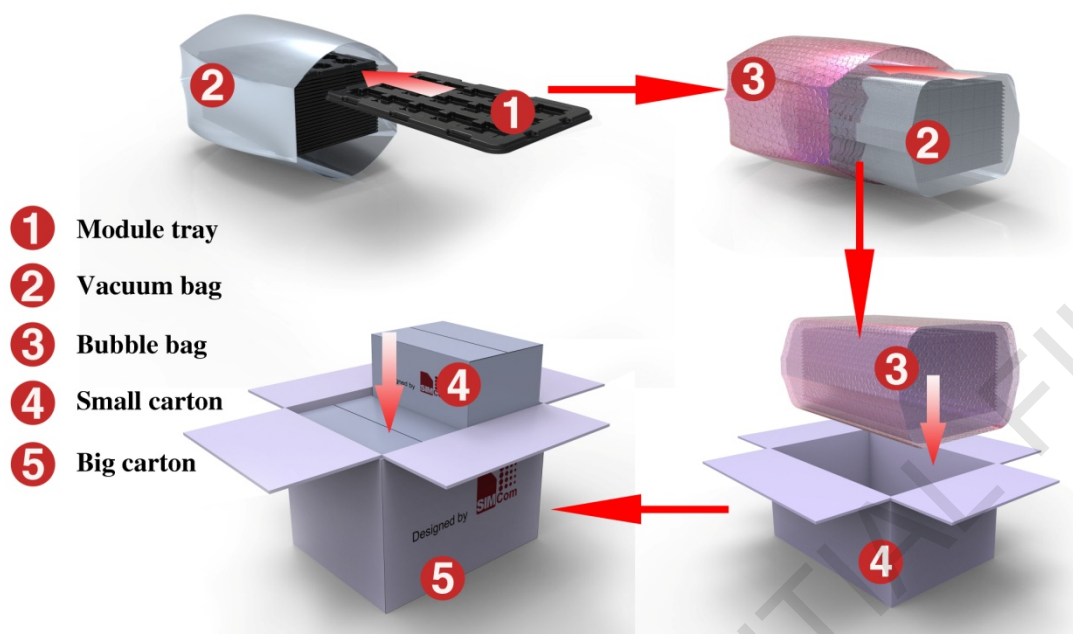


Figure 41: Packaging introduce

Module tray drawing:

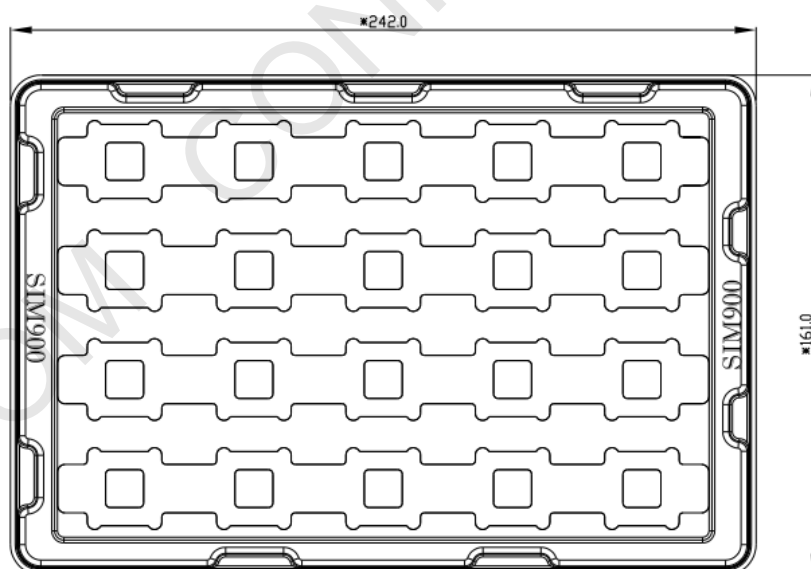


Figure 42: Tray drawing

Table 35: Tray size

Length (±3mm)	Width (±3mm)	Number
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242.0	161.0	20
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Small carton drawing:

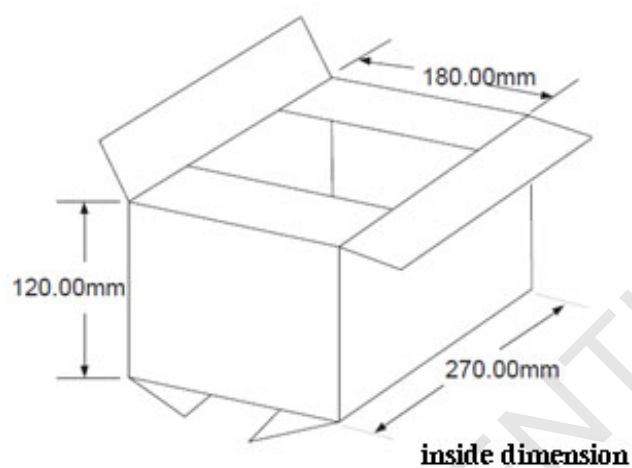


Figure 43: Small carton drawing

Table 36: Small carton size

Length (±10mm)	Width (±10mm)	Height (±10mm)	Number
270	180	120	20*20=400

Big carton drawing:

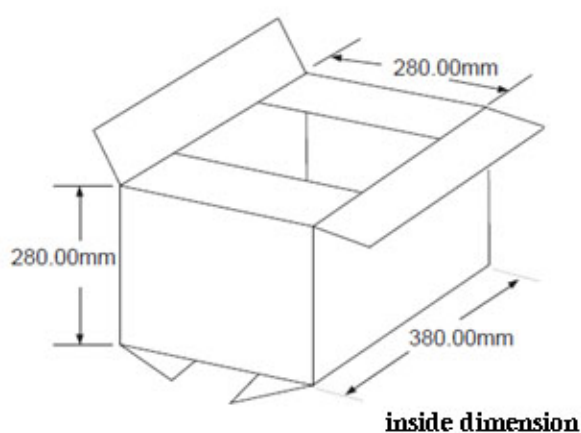


Figure 44: Big carton drawing

Table 37: Big carton size

Length (±10mm)	Width (±10mm)	Height (±10mm)	Number
380	280	280	400*4=1600

8 APPENDIX

A. RELATED DOCUMENTS

Table 38: Related documents

SN	Document name	Remark
[1]	SIM5300E_AT_Command_Manual	SIM5300E_AT_Command_Manual
[2]	SIM5300E_TCPIP_ApplicationNote	TCP/IP Applications User Manual
[3]	SIM5300E_Network_ApplicationNote	Network Application Note

B. TERMS AND ABBREVIATIONS

Table 39: 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
USIM	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	USIM fix dialing phonebook
LD	USIM last dialing phonebook (list of numbers most recently dialed)
MC	Mobile Equipment list of unanswered MT calls (missed calls)
ON	USIM (or ME) own numbers (MSISDNs) list
RC	Mobile Equipment list of received calls
SM	USIM phonebook
NC	Not connect

C. SAFETY CAUTION

Table 40: Safety Requirements

Marks	Requirements
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	<p>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 the mobile and not operate normally for RF energy interference.</p>
	<p>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 as it interferes with communication systems. Forgetting to think much of these instructions may lead to local legal action as it interferes with flight safety.</p>
	<p>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 anywhere near where blasting operations are in progress. Operation of any electrical equipment in potentially explosive atmospheres can constitute a safety hazard.</p>
	<p>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. To avoid damage to any device, keep your cellular terminal or mobile away from other electric equipments.</p>
	<p>Road safety comes first! Do not use a hand-held cellular terminal or mobile when driving a vehicle, unless it is securely mounted in a holder for hands free operation. Before making a call with a hand-held terminal or mobile, park the vehicle.</p>
	<p>GSM cellular terminals or mobiles operate over radio frequency signals and cellular networks and cannot be guaranteed to connect in all conditions. For example, one could have a mobile fee or an invalid USIM card. While you are in this condition and need emergent help, please remember to use emergency calls. In order to make or receive calls, the cellular terminal or mobile must be switched on and in a service area with adequate cellular signal strength.</p> <p>Some networks do not allow emergency calls if certain network services or phone features are in use (e.g. lock functions, fixed dialing etc.). You may have to deactivate those features before you can make an emergency call.</p> <p>Also, some networks require that a valid USIM card be properly inserted in the cellular terminal or mobile.</p>

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