R7072 Hardware Design

LPWA Module

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Date	Version	Description of change	Author
2021-05-26	1.01	Original	Xin.Zhou Chenglang.Hu
2022-05-25	1.02	Update NB2 data transmission Update temperature data Update cat-NB2 receive sensitivity Update some reference pictures	Xin.Zhou Chenglang.Hu

Contents

Table Index

Figure Index

1 Introduction

This document describes the electronic specifications, RF specifications, interfaces, mechanical characteristics and testing results of the SIMCom R7072 module. With the help of this document and other software application notes/user guides, users can understand and use R7072 module to design and develop applications quickly.

1.1 Product Outline

The R7072 Series modules support NB, GSM, GPRS. The physical dimension of R7072 is 24mm∗24mm∗2.5 mm. And the physical dimension is compatible with the packaging of SIM7000, SIM800F and SIM900. It is designed for applications that need low latency, Low throughput data communication in a variety of radio propagation conditions. Due to the unique combination of performance, security and flexibility, this module is ideally suited for M2M applications, such as metering, asset tracking, remote monitoring and E-health etc.

Table 1: R7072 frequency bands and air interface

Network Type	Band	R7072
GSM/GPRS	EGSM900	✓
	DCS1800	✓
NB	B3/B5/B8/B20/B28	✓

1.2 Hardware Interface Overview

The interfaces are described in detail in the next chapters include:

- Power Supply
- UART Interface
- SIM Interface
- ADC
- LDO Power Output
- MIC Right Channel Input
- Audio Receiver Output
- I2C Interface
- SPI Interface
- GPIOs
- NETLIGHT Interface
- Antenna Interface

1.3 Hardware Block Diagram

The block diagram of the R7072 module is shown in the figure below.

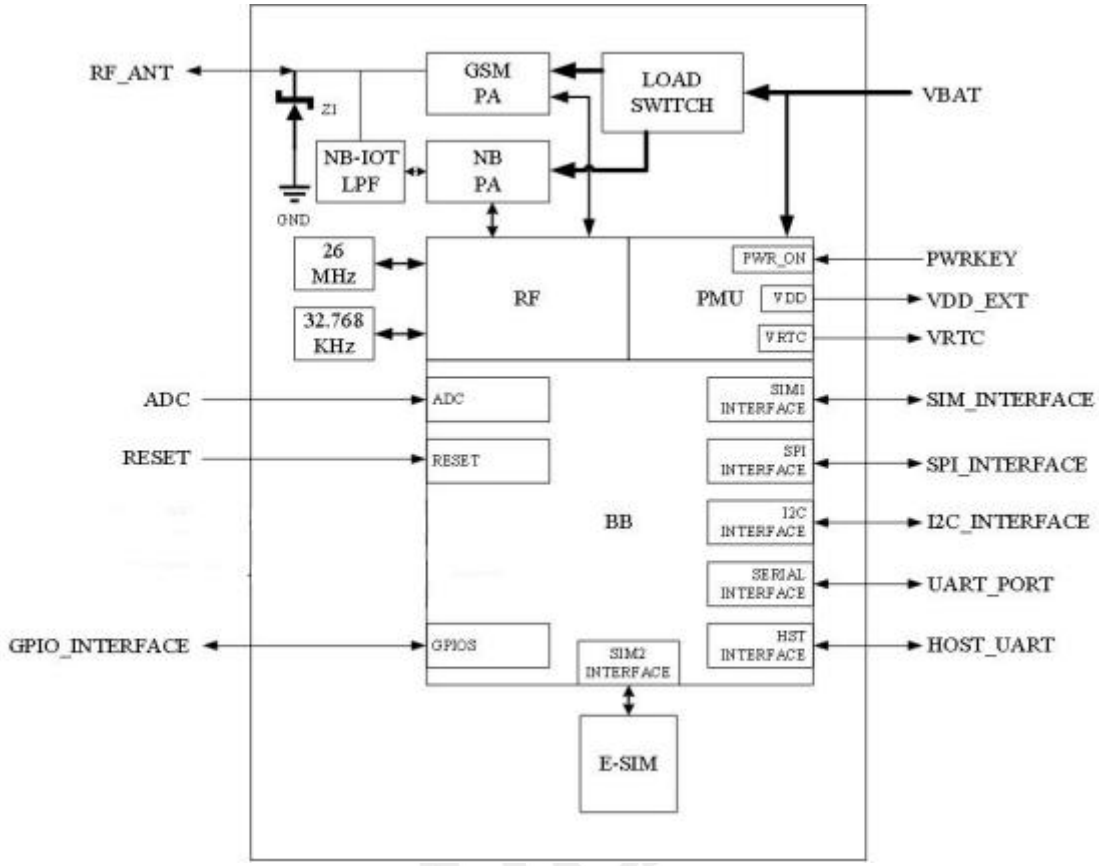

Figure 1: R7072 module block diagram

1.4 Functional Overview

Table 2 describes the features of the R7072 modules.

Table 2: General features

Feature	Implementation
Power supply	Power supply voltage 3.4V～4.2V. Default :3.8V
Power saving	Current in PSM mode: 4.5uA
Radio frequency bands	Please refer to the table 1
Transmitting power	GSM/GPRS power class: -- EGSM900: 4 (2W) -- DCS1800: 1 (1W) LTE power level: 3 (0.25W)
Data Transmission Throughput	GPRS: 85.6Kbps(UL) 85.6Kbps(DL) NB-IOT：NB1/NB2 ： 127Kbps (DL) NB1/NB2 ： 158.5Kbps (UL)
Antenna	Main antenna.
SIM interface	Support 1.8V or 3V card
analog audio feature	Support MIC and REC interface.
SPI interface	Support for serial data bus SPI, only used during DAM application secondary development.
UART interface	One channel full-function UART1 by default can be used for AT communication. Support 2400, 4800, 9600, 14400, 19200, 28800, 38400, 57600bps, default rate is 9600 bps, you can use AT command to set rate. R7072 not support auto rate. Support RTS/CTS hardware handshake. Two channel 2-wire UART2 and UART3 only used as UART in DAM application when secondary development.
Firmware upgrade	Firmware upgrade over DEBUGE UART interface
Physical characteristics	Size: 24*24*2.5mm Weight: 2.7±0.2g
Temperature range	Normal operation temperature: -20℃~ +70℃ Extended operation temperature：-40℃~ +85℃ Storage temperature -40°C to +90°C

2 Package Information

2.1 Pin Assignment Overview

All functions of the R7072 module will be provided through 68 pads that will be connected to the customers' platform. The Figure 2 is the pin assignment of the R7072.

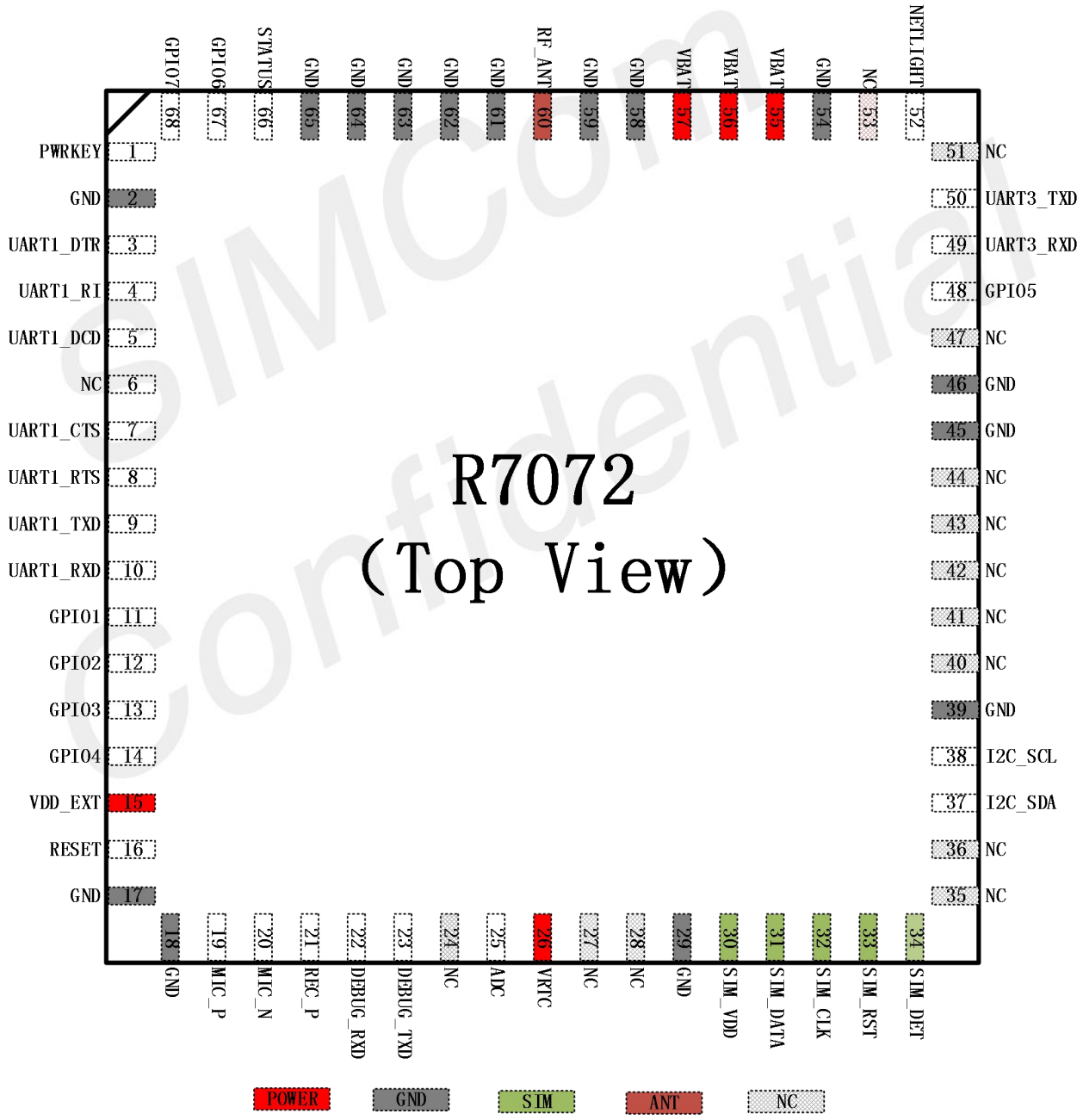

Figure 2: Pin assignment overview

Table 3 lists the R7072 module pin numbers and pin definitions.

Table 3: Pin definition

Pin No.	Pin name.	Pin No.	Pin name.
1	PWRKEY	2	GND
3	UART1_DTR	4	UART1_RI
5	UART1_DCD	6	NC
7	UART1_CTS	8	UART1_RTS
9	UART1_TXD	10	UART1_RXD
11	GPIO1	12	GPIO2
13	GPIO3	14	GPIO4
15	VDD_EXT	16	RESET
17	GND	18	GND
19	MIC_P	20	MIC_N
21	REC_P	22	DEBUG_RXD
23	DEBUG_TXD	24	NC
25	ADC	26	VRTC
27	NC	28	NC
29	GND	30	SIM_VDD
31	SIM_DATA	32	SIM_CLK
33	SIM_RST	34	SIM_DET
35	NC	36	NC
37	I2C_SDA	38	I2C_SCL
39	GND	40	NC
41	NC	42	NC
43	NC	44	NC
45	GND	46	GND
47	NC	48	GPIO5
49	UART3_RXD	50	UART3_TXD
51	NC	52	NETLIGHT
53	NC	54	GND
55	VBAT	56	VBAT
57	VBAT	58	GND
59	GND	60	RF_ANT
61	GND	62	GND
63	GND	64	GND
65	GND	66	STATUS
67	GPIO6	68	GPIO7

2.2 Pin Description

This section describes the R7072 module pin function definitions

Table 4: IO parameters definition

Pintype	Description
PI	Power input
PO	Power output
AI	Analog input
AIO	Analog input/output
I/O	Bidirectional input /output
DI	Digital input
DO	Digital output
DOH	Digital output with high level
DOL	Digital output with low level
PU	Pull up
PD	Pull down

Table 5: Pin description

Pin name	Pin No.	Default status	Description	Comment
Power supply				
VBAT	55,56 57	PI	Power supply,voltage range: 3.4～4.2V.default 3.8V	
VDD_EXT	15	PO	LDO power output 1.7V for other external circuits with Max 200mA current output.	This power supple only use for external GPIO pulling up or level shift circuit. If unused, keep it open.
GND	2,17 18,29 39,45 46,54 58,59 61,62 63,64 65		Ground	
VRTC	26	PO	RTC power output	
System Control				
PWRKEY	1	DI,PU	System power on control input, active low.	The level is 1.05V when this PIN is floating;
RESET	16	DI,PU	System reset control input, active low.	The level is 1.05V when this PIN is floating;
SIM Interface				
SIM_VDD	30	PO	Power output for SIM card, its output	Its output current is up

			Voltage depends on SIM card type automatically.	to 80mA.
SIM_DATA	31	I/O,PU	SIM Card data I/O.	It has been pulled up via a 10KR resistor to SIM_VDD internally. Do not pull it up or down externally.
SIM_CLK	32	DO	SIM clock	
SIM_RST	33	DO	SIM Reset	
SIM_DET	34	DI	SIM Card hot swap function	It has been pulled up via a 10KR resistor to 1.8V internally. Do not pull it up or down externally.
UART Interface				
UART1_DTR	3	DI,PH	DTE get ready	If unused, keep them open.
UART1_RI	4	DOH	Ring Indicator	
UART1_DCD	5	DOH	Carrier detects	
UART1_CTS	7	DOL	Clear to Send	
UART1_RTS	8	DI,PL	Request to send	
UART1_TXD	9	DOH	Transmit Data	
UART1_RXD	10	DI,PL	Receive Data	
UART3_RXD	49	DI,PL	The default function is UART. It can be used as AT communication port. It can also be configured as GPIO	If unused, keep them open.
UART3_TXD	50	DOH		
DEBUG_RXD	22	DI,PL	It can be used to update software ,and capture log of the module.Cannot be used as AT communication port.	If unused, keep them open.
DEBUG_TXD	23	DOH		
I2C Interface				
I2C_SDA	37	I/O	I2C data input/output	If unused, keep open, or else do not pull them up via resistors to VDD_EXT, they have been pulled up in the module.
I2C_SCL	38	DO	I2C clock output	
SPI Interface				
SPI_MOSI	12	DO	Main Controller DATA output. Multiplexed by GPIO2	If unused, please keep them open.
SPI_MISO	13	DO	Main Controller DATA input. Multiplexed by GPIO3	
SPI_CLK	11	DI	Bus clock output, Multiplexed by GPIO1	
SPI_CS	14	DO	Chip Select, Multiplexed by GPIO4	
Audio Interface				
MICR_P	19	AI	MIC right channel positive input	If unused, please keep them open.
MICR_N	20	AI	MIC right channel negative input	

REC_P	21	AO	Audio receiver positive output	
REC_N	22	AO	Audio receiver negative output	Multiplexed by DEBUG_RXD. Module support DEBUG_RXD function default.
GPIO				
NETLIGHT	52	DO	LED control output as network status indication.	If unused, keep them open.
STATUS	66	DO	Operating status output. High level: Power on and firmware ready Low level: Power off	
GPIO1	11	IO	General purpose input/output, Configurable as SPI_CLK	
GPIO2	12	IO	General purpose input/output, Configurable as SPI_MOSI	
GPIO3	13	IO	General purpose input/output, Configurable as SPI_MISO	
GPIO4	14	IO	General purpose input/output, Configurable as SPI_CS	
GPIO5	48	IO	General purpose input/output	
GPIO6	67	IO	General purpose input/output	
GPIO7	68	IO	General purpose input/output	
RF Interface				
RF_ANT	60	AIO	MAIN antenna soldering pad	
Other Interface				
ADC	25	AI	Analog-digital converter input. voltage range:0V～1.7V.	If unused, keep them open.
NC	6,24,27,28，35,36 40,41 42,43 44,47 51		No connection.	Keep it open

NOTE

SIMCom suggests that the test points of DEBUG_RXD, DEBUG_TXD should be added in the design to facilitate the software debugging when the module fails.

2.3 Mechanical Information

Figure 3 depicts the mechanical dimensions of the R7072 module and describes the length, width, height and tolerance of the R7072 modules.

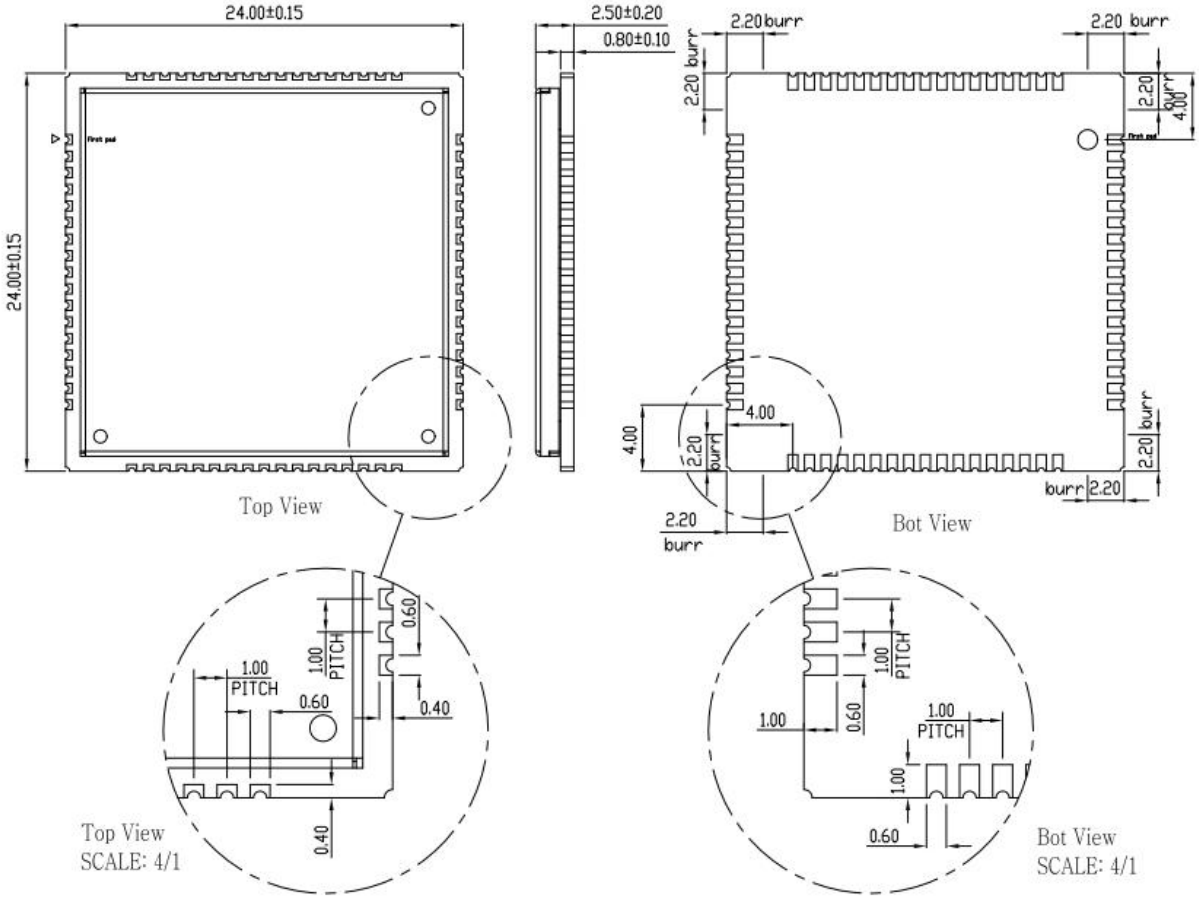

Figure 3: Dimensions (Unit: mm)

2.4 Footprint Recommendation

Figure 4 depicts the Foot printer commended of The R7072 modules.

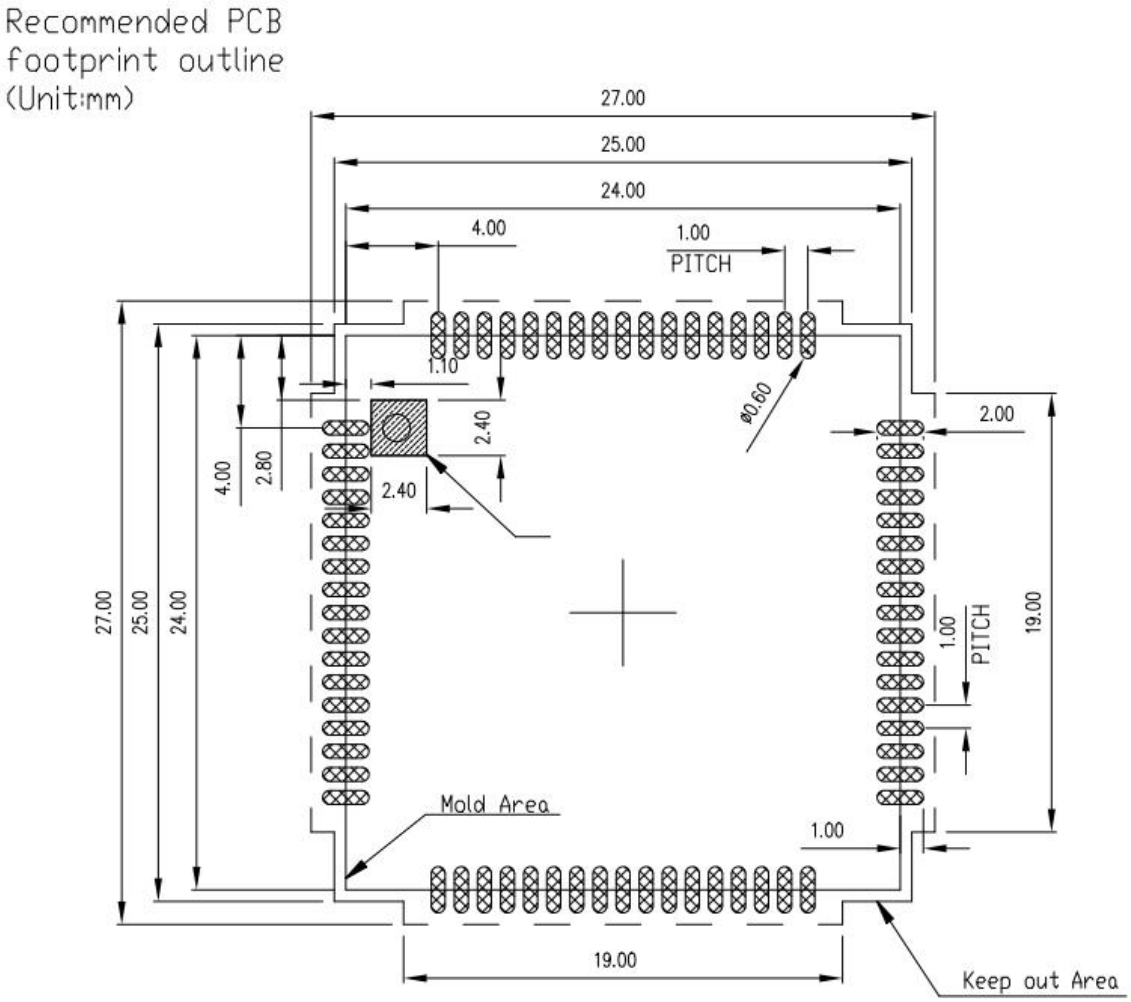

Figure 4: Footprint recommendation (Unit: mm)

3 Interface Application

3.1 Power Supply

Pin 55, pin 56 and pin 57 are VBAT power input.

On VBAT pads, when module works on NB-IoT mode, the ripple current is up to 420mA typically. For steady voltage, the power supply capability must be up to 420mA.

On VBAT pads, when module works on EDGE or GPRS mode, the ripple current is up to 1.6A typically. For steady voltage, the power supply capability must be up to 1.6A. In order to avoid the voltage dropped down more than 300mV, the load capacitor on VBAT pads must be up to 300uF.

The figure 5 shows the VBAT voltage ripple wave at the maximum power transmit phase in EDGE/GPRS emission mode.

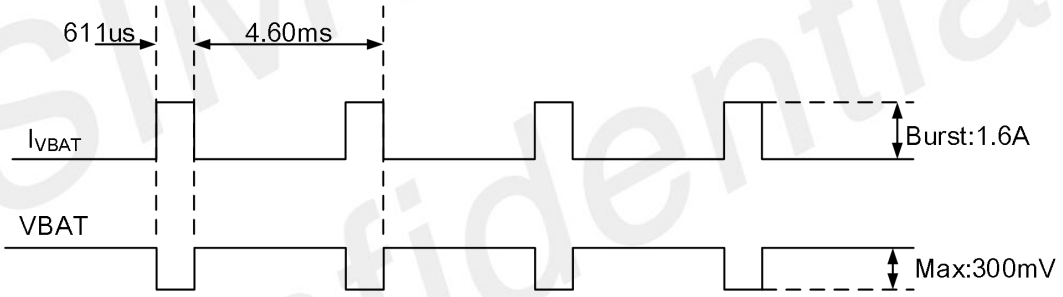

Figure 5: Voltage drop in EDGE or GPRS mode

Table 6 describes the electrical characteristics of the VBAT pin and the current consumption of the module in different modes.

Table 6: VBAT pins electronic characteristic

Symbol	Description		Min	Typ	Max	Unit
VBAT	Module power voltage	R7072	3.4	3.8	4.2	V
$I_{VBAT(peak)}$	Module power peak current in GPRS emission mode.			1.6		A
$I_{VBAT(peak)}$	Module power peak current in NB-IoT emission mode.		-	0.42	-	A
$I_{VBAT(average)}$	Module power average current in normal mode		Please refer to the chapter 5.4			
$I_{VBAT(sleep)}$	Power supply current in sleep mode					
$I_{VBAT(power-off)}$	Module power current in power off mode.		-	-	7	uA
$I_{VBAT(PSM)}$	Module power current in PSM mode.		-	-	4.5	uA

3.1.1 Power Supply Design Guide

In the user's design, special attention must be paid to the design of the power supply section to ensure that the VBAT drop cannot be lower than the minimum voltage shown in Table 7 even when the module current consumption reaches the instantaneous maximum. If the VBAT voltage drops below the minimum input voltage, the module may shut down due to low voltage

Table 7: Minimum input voltage

Module	Minimum input voltage(V)
R7072	3.4

The figure 6 shows the recommended circuit.

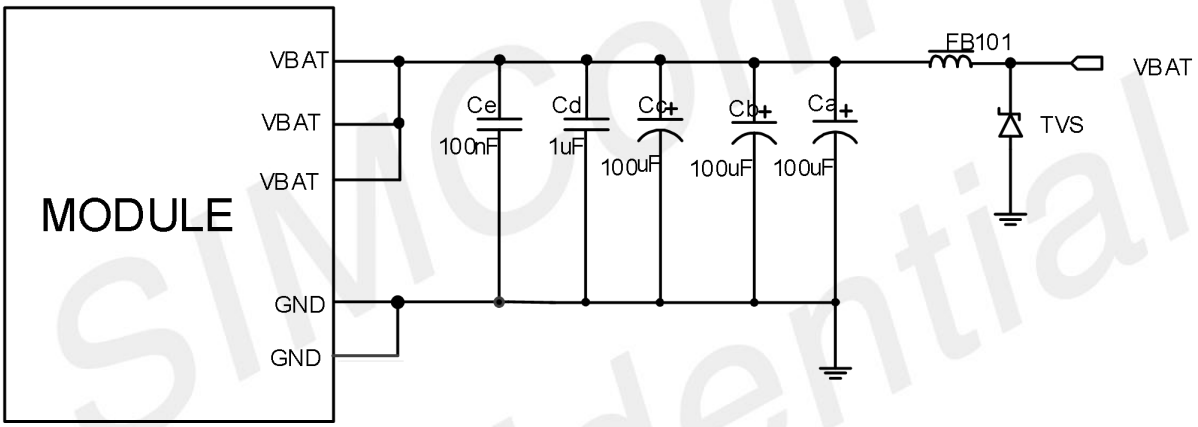

Figure 6: Power supply application circuit

In addition, for ESD protection, it is suggested to add a TVS diode near the VBAT PINs. These capacitors should be put as close as possible to VBAT pads. Also, users should keep VBAT trace on circuit board wider than 1.6 mm to minimize PCB trace impedance.

Table 8: Recommended TVS diode list

No.	Manufacturer	Part Number	Package
1	Prisemi	PESDHC2FD4V5B	DFN1006
2	Prisemi	PESDHC3D3V3U	SOD323
3	WILLsemi	ESD5651N-2/TR	DFN1006

NOTE

1. The customer's circuit design must have the function that the master can control the power off of the module. The module can be shut down or restarted normally. Only when the module is abnormal and cannot be shut down or restarted normally can the power be turned off.
2. When the module is working normally, do not cut off the power supply of the module VBAT directly to avoid damage to the internal flash of the module. It is strongly recommended to turn off the module through AT command before disconnecting the module VBAT power.

3.1.2 Recommended Power Supply Circuit

If the supply voltage exceeds the supply range of VBAT, the buck circuit should be used to meet the demand of power supply. When choosing buck chip, besides considering the maximum current output capability of IC to meet the demand of R7072 module, it is also necessary to consider the low static power consumption of IC in PSM mode.

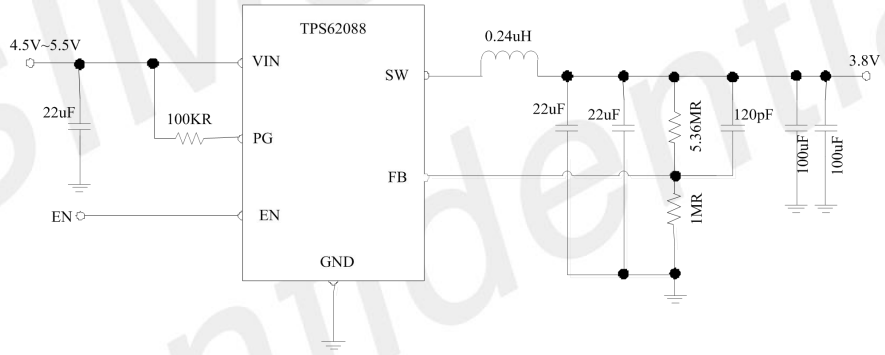

Figure 7: Power supply reference circuit

3.1.3 Voltage Monitor

To monitor the VBAT voltage, the AT command "AT+CBC" can be used.

NOTE

For more information about the "AT+CBC" commands, please refer to Document [1].

3.2 Power on/Power off/Reset Function

3.2.1 Power on

The PWTRKEY pin has a default voltage of 1.05V. R7072 module can be powered on by pulling the PWRKEY pin to ground. It is strongly recommended to put an ESD protection diode close to the PWRKEY pin, as it would strongly enhance the ESD performance of PWRKEY pin. Please refer to the following figure for the recommended reference circuit.

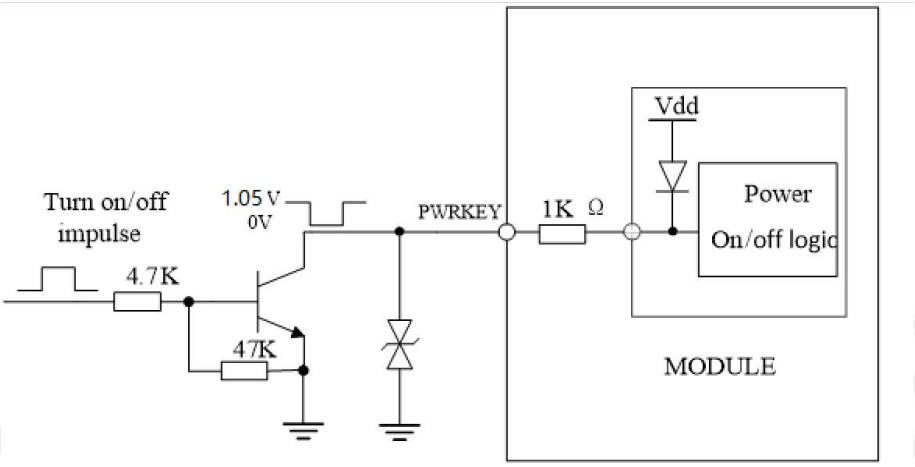

Figure 8: Reference power on circuit

The power-on scenarios are illustrated in the following figure.

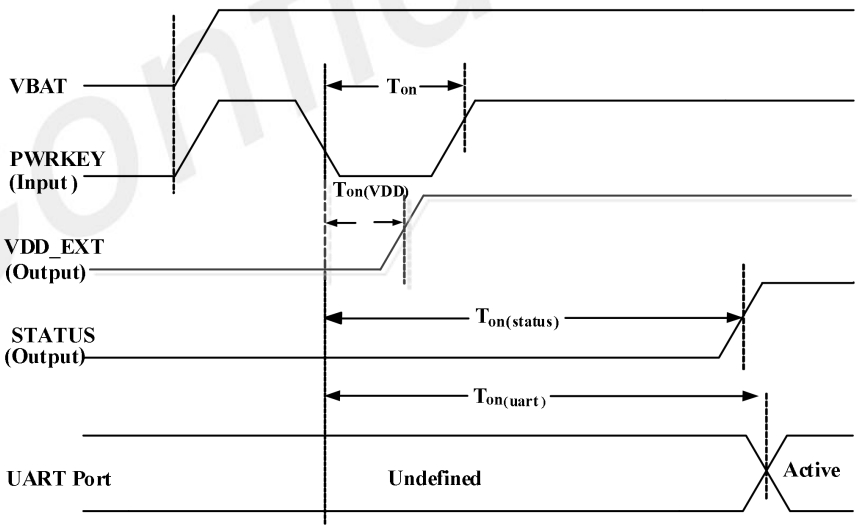

Figure 9: Power on timing sequence

Table 9: Power on timing and electronic characteristic

Symbol	Parameter	Min.	Typ.	Max.	Unit
T_{on}	The time of active low level impulse of PWRKEY pin to power on module	500	-	-	ms
$T_{on(Vdd)}$	The time from power-on issue to VDD_EXT pin output high level.	-	510	-	ms
$T_{on(status)}$	The time from power-on issue to STATUS pin output high level(indicating power up ready)	2.5	-	-	s
$T_{on(uart)}$	The time from power-on issue to UART port ready	2.5	-	-	s
VIH	Input high level voltage on PWRKEY pin	0.68	1.05	1.41	V
VIL	Input low level voltage on PWRKEY pin	-0.3	0	0.3	V

NOTE

1. It is recommended to ensure that the VBAT voltage rises and stabilizes before pulling down the PWRKEY pin to start up.
2. Before turning on the module, be sure to pay attention to the maximum conditions (such as voltage and temperature range) allowed by the module, otherwise exceeding the absolute maximum value of the module may cause permanent damage to the module.

3.2.2 Power off

The following methods can be used to power off the module.

- Power off R7072 Series by AT command “AT+CPOF”.

NOTE

For details about “AT+CPOF”, please refer to Document [1].
It is not recommended to turn off the module by disconnecting VBAT power. Otherwise, there is a risk of damage to the module file system.

These procedures will make modules disconnect from the network and allow the software to enter a safe state, and save data before module be powered off completely.

The power off scenario by AT command is illustrated in the figure 10.

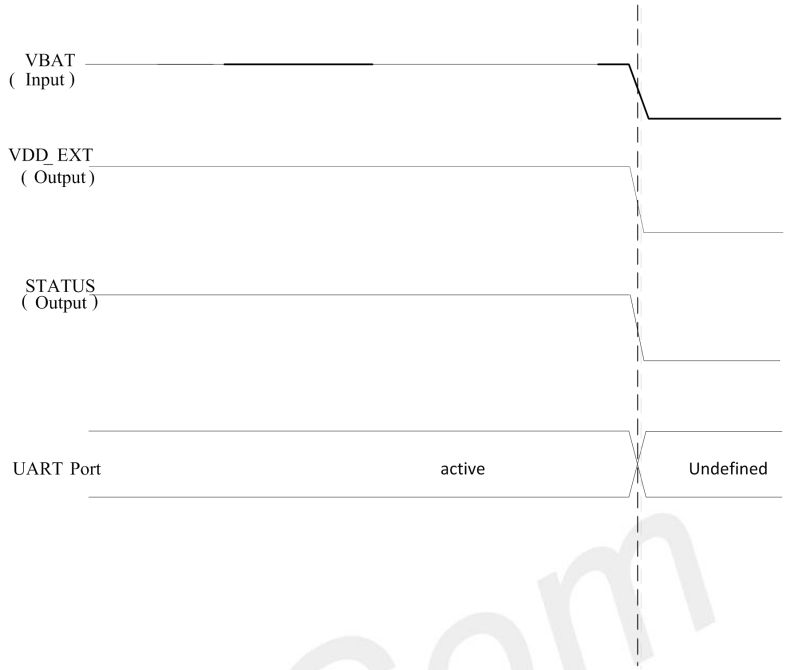

Figure 10: Power off timing sequence

NOTE

The STATUS pin can be used to detect whether module is powered on or not. When module has been powered on and firmware goes ready, STATUS will be high level, or else STATUS will still low level.

3.3 UART Interface

R7072 module provides 3 channels serial ports:

One channel full-function serial port UART1, it can be used for AT command communication between the module and the peripheral MCU.

One channel 2-wire serial port UART3, the default function after booting is UART,it can be used for AT command communication. It can be configured as a GPIO function.

One channel serial port DEBUG_UART, the boot log will be output from hear during the system boot-up. You can update software through DEBUG_UART,but it cannot be used for AT command communication.

The UART1 and UART3 support 2400, 4800, 9600, 4400, 19200, 28800, 38400, 57600bps, default rate is 9600 bps, it does not support auto baud rate, but you can use "AT +IPR" to set and read the rate.

3.3.1 UART Design Guide

The following figures show the reference design.

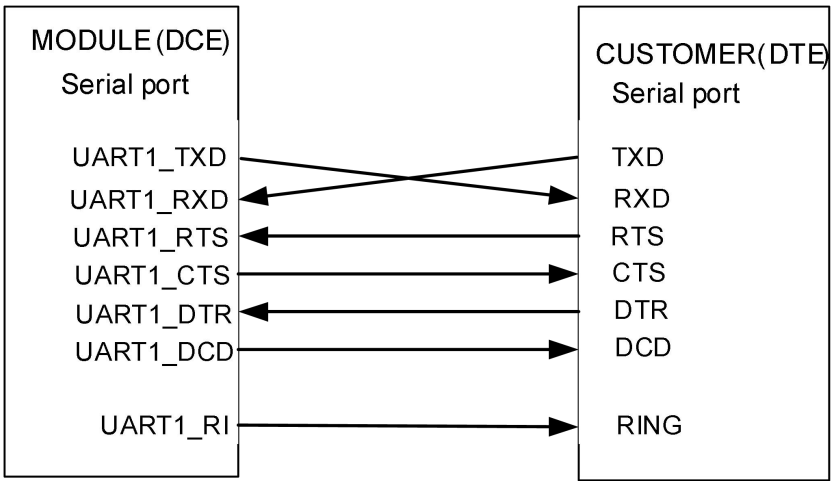

Figure 11: UART full modem

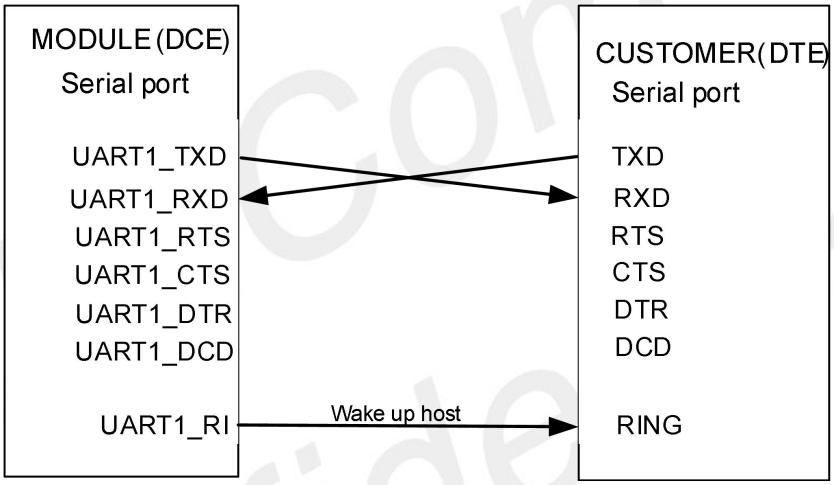

Figure 12: UART null modem

Table 10: UART electronic characteristic

Symbol	Description	Min.	Typ.	Max.	Unit
VIH	UART input high level voltage	1.17	1.8	2.1	V
VIL	UART input low level voltage	-0.3	0	0.63	V
VOH	UART output high level voltage	1.35	1.8	1.8	V
VOL	UART output low level voltage	0	0	0.45	V

The R7072 module UART is 1.8V voltage interface. If user's UART application circuit is 3.3V voltage interface, the level shifter circuits should be used for voltage matching. The following figure shows the voltage matching reference design.

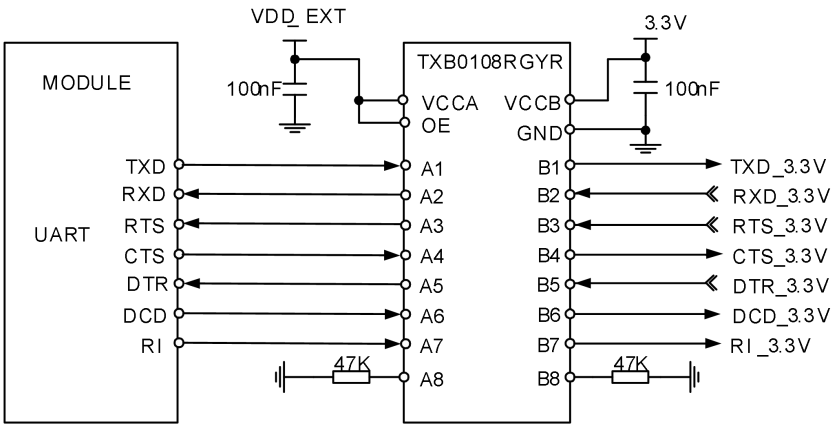

Figure 13: Reference circuit with level shifter IC

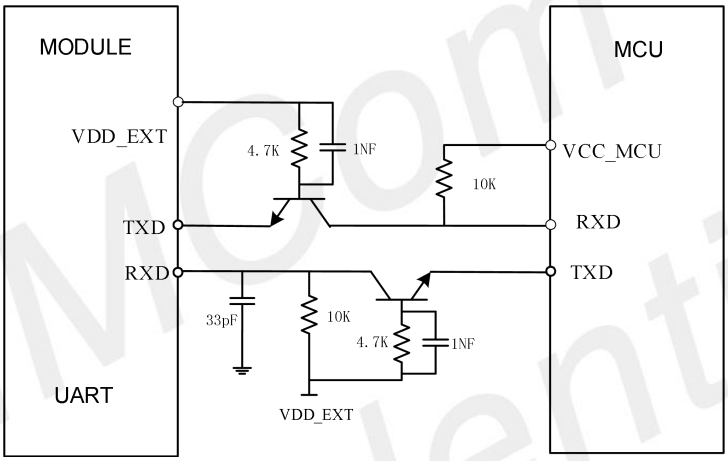

Figure 14: Reference circuit with Transistor

NOTE

1. When it uses the level shifter IC, the pull up resistance on TXD_3.3V, RTS_3.3V, DCD_3.3V and RI_3.3V should not be less than 47KΩ.
2. When it uses the transistor, the selection of the transistor must be a high-speed transistor, and the model MMBT3904 is recommended.

3.4 SIM Interface

R7072 module supports the 1.8V and 3V SIM Card.

Table 11: SIM electronic characteristic

Symbol	Parameter	Min.	Typ.	Max.	Unit
SIM_VDD	SIM card power	1.75 or 2.95	1.8 or 3	1.93 or 3.15	V
V_{IH}	High-level input voltage	0.65*SIM_VDD	-	SIM_VDD +0.3	V

VIL	Low-level input voltage	-0.3	0	0.35*SIM_VDD	V
VOH	High-level output voltage	SIM_VDD -0.45	-	SIM_VDD	V
VOL	Low-level output voltage	0	0	0.45	V

3.4.1 SIM Application Guide

Note that the SIM peripheral circuit should be close to the SIM card socket. If you want the module supports SIM card hot swap function, you should connect the module SIM_DET pin to the SIM card's hot swap pin. If you don't need hot swap function, keep the SIM_DET pin open. The following figure shows the reference circuit with the hot swap function.

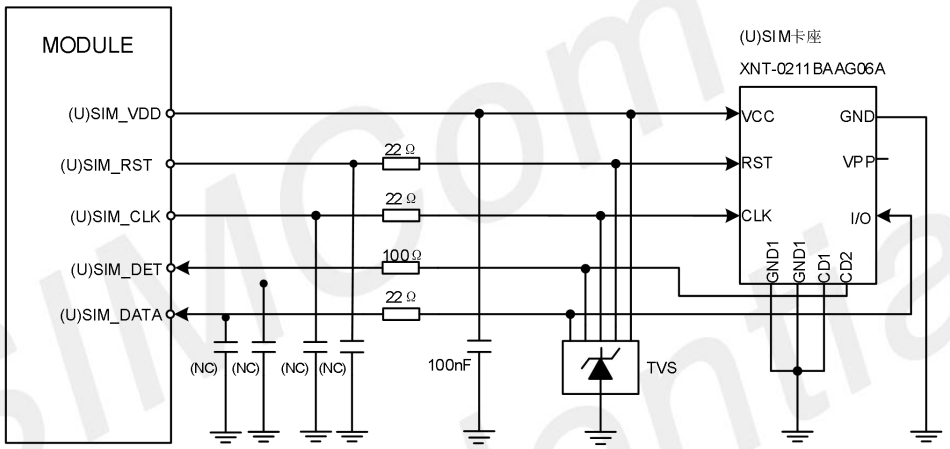

Figure 15: SIM interface reference circuit

When the (U)SIM card is inserted, the (U)SIM_DET will change from high to low level. The falling edge will indicate insertion of the (U)SIM card. When the (U)SIM card is removed, the (U)SIM_DET will change from low to high level. This rising edge will indicate unplug the (U)SIM card.

SIM_DATA has been pulled up with a 10KR resistor to SIM_VDD in module, so it no need pulled up resistor anymore. SIM_VDD needs a 100nF capacitor close to SIM socket.

SIM_CLK is very important signal, the rise time and fall time of SIM_CLK should be less than 40ns. So the junction capacity of the TVS need to less 50pF.

In order to enhance the reliability and availability of the (U)SIM card in applications. Please follow the guidelines below when designing.

- It is recommended to place a 100nF capacitor on the SIM_VDD signal line close to the SIM card holder.
- Place TVS near the SIM card holder. The junction capacity of the TVS should not exceed 50pF. The 22Ω resistor in series between the SIM card holder and the module can enhance the ESD protection performance.
- Keep SIM card signals away from RF and VBAT traces.
- SIM card signal line traces to avoid branch.
- To avoid cross-talk between SIM_DATA and SIM_CLK, keep them away from each other and shield them with surrounded ground. USIM_RST should also be ground shielded.

NOTE

1. The module support 1.8V or 3V SIM card.
2. The SIM card hot swap function is under the development.

3.5 I2C Interface

R7072 module provides one I2C interface with clock rate up to 400 kbps. Its operation voltage is 1.8V.

The following figure shows the I2C bus reference design.

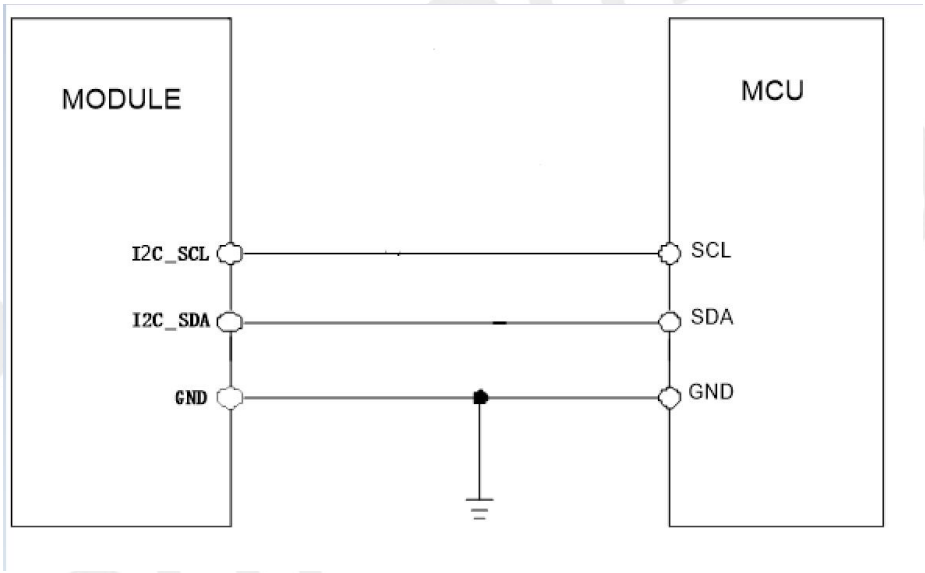

Figure 16: I2C reference circuit

NOTE

The I2C signal has been pulled up in module. so it no need pulled up resistor anymore.

Table 12: I2C electronic characteristic

Symbol	Parameter	Min.	Typ.	Max.	Unit
VIH	High-level input voltage	1.17	1.8	2.1	V
VIL	Low-level input voltage	-0.3	0	0.63	V
VOH	High-level output voltage	1.35	1.8	1.8	V
VOL	Low-level output voltage	0	0	0.45	V

3.6 SPI Interface

R7072 module supports a set of 4-wire (MISO, MOSI, CS and CLK) SPI interface. The default function of the SPI interface is GPIO. The SPI function is only available in software secondary development.

The SPI only supports the master mode. The maximum clock frequency is up to 26MHz when operating in SPI master mode.

The SPI function of R7072 series is multiplexed by GPIO1, GPIO2, GPIO3 and GPIO4.
Table 12 describes the multiplex function of the SPI.

Table 13: Multiplex function of the SPI

Pin No.	Pin Name	multiplex function
11	GPIO1	SPI_CLK
12	GPIO2	SPI_MOSI
13	GPIO3	SPI_MISO
14	GPIO4	SPI_CS

The following figure shows the SPI bus reference design.

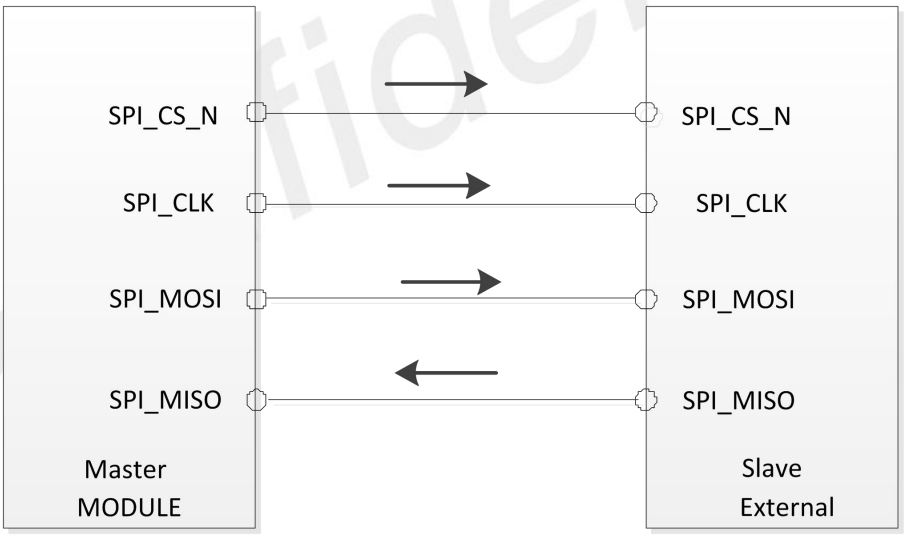

Figure 17: SPI master mode circuit

3.7 Network status

The NETLIGHT pin is used to control Network Status LED, its reference circuit is shown in the following figure.

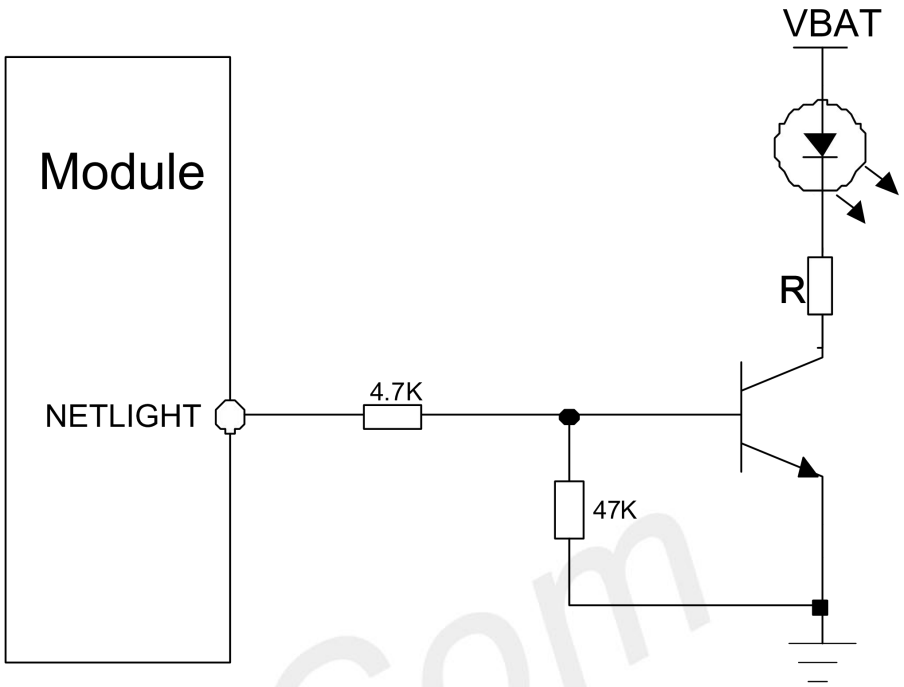

Figure 18: NETLIGHT reference circuit

NOTE

The value of the resistor named "R" depends on the LED characteristic.

Table 14: NETLIGHT pin status

NETLIGHT pin status	Module status
100ms ON, 800ms OFF	No registered network
100ms ON, 3000ms OFF	Registered network (PS domain registration success)
100ms ON, 300ms OFF	Data transmit (PPP dial-up state and use of data services such as internal TCP/FTP/HTTP)
OFF	Power off or PSM mode

NOTE

NETLIGHT output low level as "OFF" and high level as "ON".

3.8 ADC interface

R7072 module provides a 10-bit high sample rate (ADC) interfaces.Its input voltage range is from 0V to 1.7V. The maximum measurement range of ADC cannot exceed 1.7V. If the input voltage of ADC PIN exceeds its range, it is necessary to implement the resistance partial pressure on the hardware.

The electronic specifications of the ADC are shown in the following table.

Table 15: ADC electronic characteristics

Characteristics	Min.	Typ.	Max.	Unit
Input Range	0		1.7	V
Internal pull-up resistor		400		KΩ
Input serial resistance	1	–	–	MΩ
Resolution		10		bits

3.9 LDO output

R7072 module has a LDO power output named VDD_EXT. The output voltage is 1.8V. This voltage can only be used for pull up for the external GPIO or power supply for the level conversion circuit.

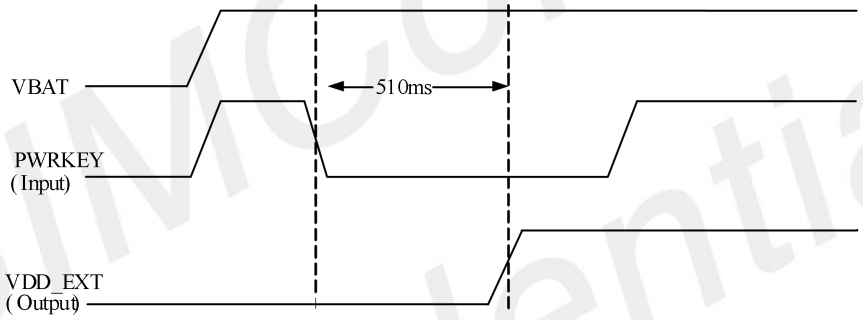

Figure 19: Power on sequence of the VDD_EXT

Table 16: Electronic characteristic

Symbol	Description	Min.	Typ.	Max.	Unit
VVDD_EXT	Output voltage	1.68	1.7	1.89	V
IO	Output current	-	-	200	mA

NOTE

The VDD_EXT is used to the IO power in the module. The Output voltage is not supported to adjust.

4 RF Specifications

4.1 RF Specifications

Table 17: Conducted transmission power

Frequency	Power	Min.
Band3(NB-IoT)	23dBm±2.7dB	≤ -40 dBm
Band5(NB-IoT)	23dBm±2.7dB	≤ -40 dBm
Band8(NB-IoT)	23dBm±2.7dB	≤ -40 dBm
Band20(NB-IoT)	23dBm±2.7dB	≤ -40 dBm
Band28(NB-IoT)	23dBm±2.7dB	≤ -40 dBm
GSM900	33dBm ±2dB	5dBm ± 5dB
GSM1800	30dBm ±2dB	0dBm ± 5dB

NOTE

The max power is tested result single-tone in CAT-NB. Multi-tone test results please refer to part 6.2.3F.3 for CAT-NB.

Table 18: Maximum Power Reduction (MPR) for UE category NB Power Class 3

Modulation	QPSK		
Tone positions for 3 Tones allocation	0-2	3-5 and 6-8	9-11
MPR	≤ 0.5 dB	0 dB	≤ 0.5 dB
Tone positions for 6 Tones allocation	0-5 and 6-11		
MPR	≤ 1 dB	≤ 1 dB	
Tone positions for 12 Tones allocation	0-11		
MPR	≤ 2 dB		

Table 19: Operating frequencies

Frequency	Transmit	Receive
Band3(NB-IoT)	1710~1785MHz	1805~1880MHz
Band5(NB-IoT)	824~849MHz	869~894MHz
Band8(NB-IoT)	880~915MHz	925~960MHz
Band20(NB-IoT)	832~862MHz	791~821MHz
Band28(NB-IoT)	703~748MHz	758~803MHz
GSM900	880 ~ 915MHz	925 ~ 960MHz
GSM1800	1710 ~ 1785MHz	1805 ~ 1880MHz

Table 20: Conducted receive sensitivity

Frequency	3GPP Request	Typical
Band3(NB-IoT)	<-107.5dBm	-116dBm
Band5(NB-IoT)	<-107.5dBm	-117dBm
Band8(NB-IoT)	<-107.5dBm	-117dBm
Band20(NB-IoT)	<-107.5dBm	-116dBm
Band28(NB-IoT)	<-107.5dBm	-116dBm
GSM900	<-107 dBm	-112dBm
GSM1800	<-107 dBm	-111dBm

4.2 Antenna Design Guide

Users should connect antennas to R7072 module antenna pads through micro-strip line or other types of RF trace and the trace impedance must be controlled in 50Ω. SIMCom recommends that the total insertion loss between the antenna pads and antennas should meet the following requirements:

Table 21: Trace loss

Frequency	Loss
700MHz-960MHz	<0.5dB
1710MHz-2170MHz	<0.9dB
2300MHz-2650MHz	<1.2dB

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.

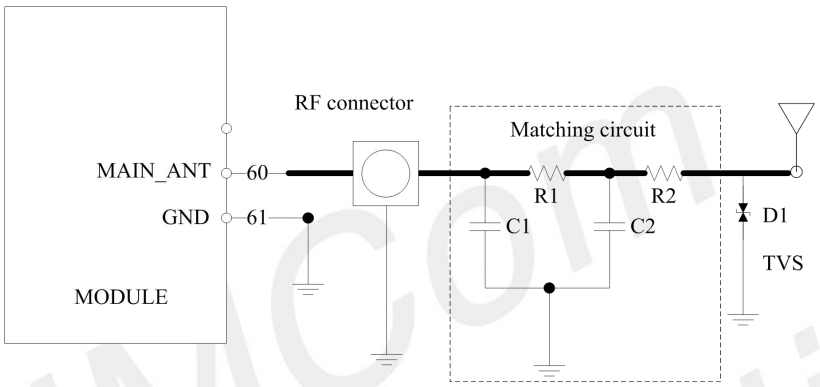

Figure 20: Antenna matching circuit (MAIN_ANT)

In above figure, the components R1, C1, C2 and R2 are used for antenna matching, the values of components can only be achieved after the antenna tuning and usually provided by antenna vendor. By default, the R1, R2 are 0Ω resistors, and the C1, C2 are reserved for tuning. The component D1 is a TVS for ESD protection, and it is optional for users according to application environment.
The RF test connector is used for the conducted RF performance test, and should be placed as close as to the module's MAIN_ANT pin. The traces impedance between R7072 Series and antenna must be controlled in 50Ω.
Two TVS are recommended in the table below.

Table 22: Recommended TVS

Package	Part Number	Vender
0201	LXES03AAA1-154	Murata
0402	LXES15AAA1-153	Murata

4.3 RF traces note

4.3.1 RF traces layout

- Keep the RF trace from module ant pin to antenna as short as possible
- RF trace should be 50 Ω either on the top layer or in the inner layer
- RF trace should be avoided right angle and sharp angle.
- Put enough GND vias around RF traces.
- RF trace should be far away from other high speed signal lines.

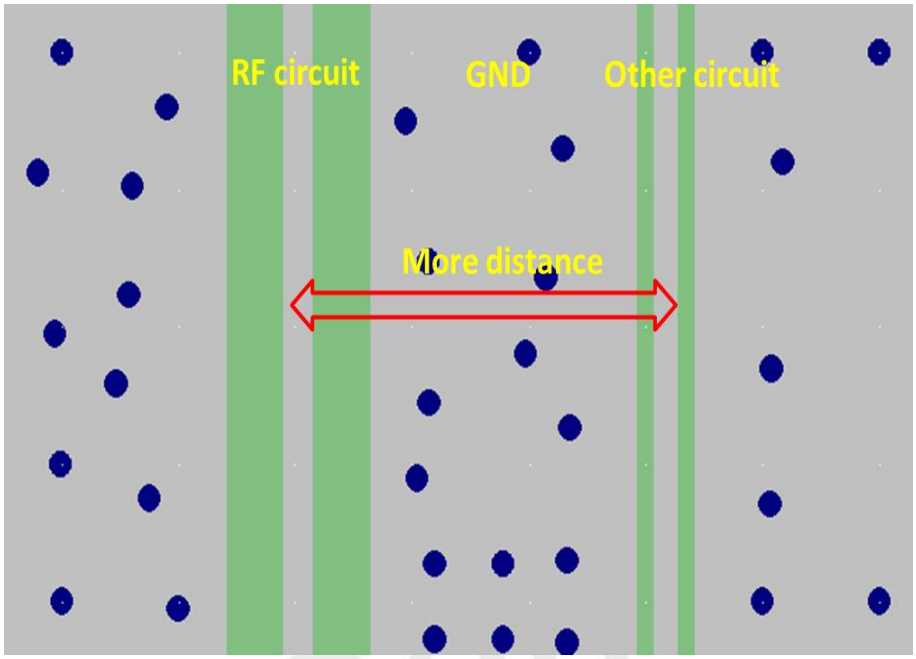

Figure 21: RF trace should be far away from other high speed signal lines

- Avoiding the paroling rout of other system antennas nearly.
- There should be some distance from The GND to the inner conductor of the SMA connector. It is better to keep out all the layers from inner to the outer conductor.

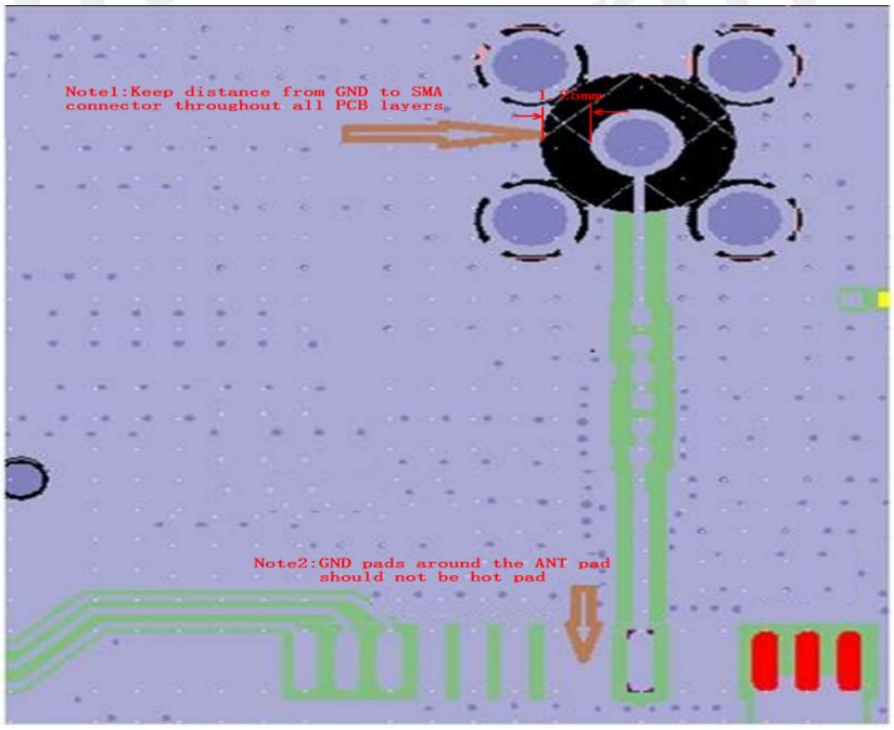

Figure 22: The distance between GND to the inner conductor of SMA

- GND pads around the ANT pad should not be hot pad to keep the GND complete.

4.3.2 LTE ANT and other system ANT decoupling

- Make sure the efficiency of LTE main ANT more than 40%
- Keep the decoupling of LTE main ANT to WLAN ANT more than 15dB
- Keep the decoupling of LTE main ANT to GNSS ANT more than 30dB

NOTE

The decoupling value can be provided by ANT adventure. More details can refer to the document [22].

5 Electrical Specifications

5.1 Absolute maximum ratings

Absolute maximum rating for digital and analog pins of R7072 module are listed in the following table:

Table 23: Absolute maximum ratings

Parameter	Min.	Typ.	Max.	Unit
Voltage on VBAT	-0.3	-	4.35	V
Voltage at digital pins (RESET,GPIO,I2C,UART,PCM)	-0.3	-	3.65	V
Voltage at PWRKEY	-0.3	-	1.41	V
ADC	-0.3	-	1.8	V

NOTE

The absolute parameter is tested when VBAT has the power but the PWRKEY has no pulled down. If it is over the range, the module will be damage. If the power supply on VBAT pin had been shut down, and the other pin should not have the voltage. Otherwise, it may lead to abnormally boot up or damage the module.

5.2 Operating conditions

Table 24: Recommended operating ratings

Parameter		Min.	Typ.	Max.	Unit
Voltage at VBAT	R7072	3.4	3.8	4.2	V

The operating temperature of R7072 module is listed in the following table.

Table 25: 1.8V Digital I/O characteristics*

Parameter	Description	Min.	Typ.	Max.	Unit
VIH	High-level input voltage	1.6	1.8	2.0	V
VIL	Low-level input voltage	-0.3	0	0.54	V
VOH	High-level output voltage	1.26	-	1.8	V

VOL	Low-level output voltage	0	-	0.45	V
IOH	High-level output current(no pull down resistor)	-	2	-	mA
IOL	Low-level output current(no pull up resistor)	-	-2	-	mA
IIH	Input high leakage current (no pull down resistor)	-	-	1	uA
IIL	Input low leakage current(no pull up resistor)	-1	-	-	uA

NOTE

These parameters are for digital interface pins, such as GPIOs (including NETLIGHT and STATUS), I2C, UART.

Table 26: Operating temperature

Parameter	Min.	Typ.	Max.	Unit
Normal operation temperature	-20	25	70	℃
Extended operation temperature	-40	25	85	℃
Storage temperature	-40	25	+90	℃

NOTE

Module is able to make and receive voice calls, data calls, SMS and make GPRS traffic in -20℃ ~ +70℃. The performance will be reduced slightly from the 3GPP specifications if the temperature is outside the normal operating temperature range and still within the extreme operating temperature range.

5.3 Operating Mode

5.3.1 Operating Mode Definition

The table below summarizes the various operating modes of R7072 Series product.

Table 27: Operating mode Definition

Mode		Function
Normal operation	Sleep	In this case, the current consumption of module will be reduced to the minimal level and the module can still receive paging message and SMS.
	Idle	Software is active. Module is registered to the network, and the module is ready to communicate.
	Voice Call	Connection between two subscribers is in progress. In this case, the power consumption depends on network settings.
	Standby	Module is ready for data transmission, but no data is currently sent or received. In this case, power consumption depends on network settings.
	Data transmission	There is data transmission in progress. In this case, power consumption is related to network settings (e.g. power control level); uplink/downlink data rates, etc.
Minimum functionality mode		AT command "AT+CFUN=0" and "AT+CSCLK=1"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 and the SIM card will not be accessible, but the serial port and USB port are still accessible. The power consumption in this mode is lower than normal mode.
Flight mode		AT command "AT+CFUN=4"can be used to set the module to flight mode without removing the power supply. In this mode, the RF part of the module will not work, but the serial port and USB port are still accessible. The power consumption in this mode is lower than normal mode.
Power Saving Mode (PSM)		Setting AT command" AT+CPSMS=1" can be enable the PSM mode. In this mode, The mode is similar to power-off. But the module remains registered on the network and there is no need to re-attach or re-establish the network connections.
Extended Mode DRX (e-DRX)		In idle or sleep mode, module and the network may negotiate over non-access stratum signaling the use of extended mode DRX for reducing power consumption.

5.3.2 Sleep mode

Module can enter into sleep mode for reducing its power consumption in idle module. In sleep mode, the current consumption of module will be reduced to very small level, and module can still receive paging message and SMS.

Several hardware and software conditions must be satisfied together in order to let R7072 enter sleep mode:

- Software condition: If module wants to enter into sleep mode, AT comment "AT+CSCLK=1" must be set

to close some clock in the module. If the value “AT+CSCLK” is “0”, module will never enter into sleep mode.

- UART condition: If module wants to enter into sleep mode,don’t communicate with R7072 through UART interface.

If it meets all the conditions at the same time, module will enter into sleep mode. If the host need to communicate with module, it can seed AT command through UART1 interface to wake up module.

5.3.3 Minimum functionality mode and Flight mode

Minimum functionality mode ceases a majority function of the module, thus minimizing the power consumption. This mode is set by the AT command which provides a choice of the functionality levels.

- AT+CFUN=0: Minimum functionality
- AT+CFUN=1: Full functionality (Default)
- AT+CFUN=4: Flight mode

If R7072 has been set to minimum functionality mode, the RF function and SIM card function will be closed. In this case, the serial port and USB are still accessible, but RF function and SIM card will be unavailable.

If R7072 has been set to flight mode, the RF function will be closed. In this case, the serial port and USB are still accessible, but RF function will be unavailable.

When R7072 is in minimum functionality or flight mode, it can return to full functionality by the AT command “AT+CFUN=1”.

5.3.4 Power Saving Mode (PSM)

R7072 module can enter into PSM for reducing its power consumption. The mode is similar to power-off, but the module remains registered on the network and there is no need to re-attach or re-establish the network connections. So in PSM all the functions will be unavailable except the RTC function, module cannot immediately respond users’ requests.

When the module wants to use the PSM, it can be enabled via “AT+CPSMS=1” command. The command takes effect after module reboot. If the network supports PSM and accepts that the module uses PSM, the network confirms usage of PSM by allocating an Active Time value to the module. Module will be into PSM according to the command from network.

Either of the following methods will wake up the module from PSM:

- Seed AT command through UART1 interface to wake up module
- When the timer expires, the module will be automatically woken up.

5.3.5 Extended Mode DRX (e-DRX)

In idle or sleep mode, module and the network may negotiate over non-access stratum signaling the use of extended mode DRX for reducing power consumption.
E-DRX diagrammatic sketch refer to the following figure.

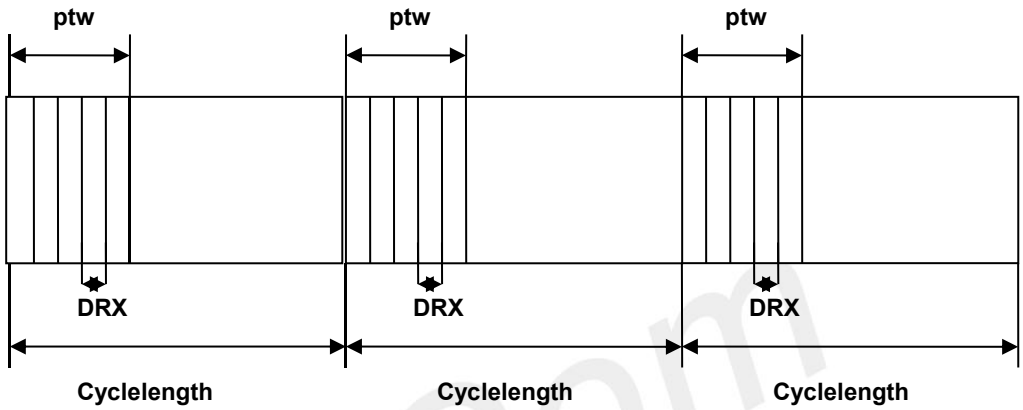

Figure 23: e-DRX diagrammatic sketch

When module and the network negotiate stratum signaling in idle mode or sleep mode, extended mode DRX can decrease the times of paging time window (PTW) and increase the cycle length. For this reason it had reduced the times of DRX, and had reduced the frequency of DRX between module and the network. So that can reduce power consumption for module.

If e-DRX is supported by the network, then it can be enabled by "AT+CEDRXS" command.

NOTE

For details about "AT+CEDRXS", please refer to Document [1]

5.4 Current Consumption

The current consumption is listed in the table below.

Table 28: Current consumption on VBAT Pins (VBAT=3.8V)

关机电流		
正常关机电流	7uA	
空闲		
待机耗流 (AT+CSCLK=0；AT+CFUN=1）	GSM	典型值：11mA
	NB-IOT	典型值：9.5mA

休眠		
GSM耗流 (AT+CSCLK=1；AT+CFUN=0）	GSM	典型值：0.73mA
NB-IOT耗流 (AT+CSCLK=1；AT+CFUN=0）	NB-IOT	典型值：0.78mA
PSM模式		
PSM模式耗流	进入PSM模式，典型值：4.5uA	
e-DRX		
e-DRX模式耗流 （休眠模式下测试）	@PTW=40.96s；eDRX=81.92s；DRX=2.56s 典型值：0.98mA	
	@PTW=25.6s；eDRX=163.84s；DRX=2.56s 典型值：0.81mA	
GPRS 数据传输		
GSM900 CH62(4收,1发)	@功率等级 #5典型值：198mA	
DCS1800 CH698(4收,1发)	@功率等级 #0典型值：130mA	
GSM900 CH62 (1收, 4发)	@功率等级 #5典型值：366mA	
DCS1800 CH698 (1收,4发)	@功率等级 #0典型值：238mA	
LTE Cat-NB 数据传输(15KHz single tone)		
LTE-FDD B3	@21dbm Typical: 142mA @10dbm Typical:58mA @0dbm Typical: 30mA	
LTE-FDD B5	@21dbm Typical: 87mA @10dbm Typical: 49mA @0dbm Typical: 28mA	
LTE-FDD B8	@21dbm Typical: 96mA @10dbm Typical: 50mA @0dbm Typical: 28mA	
LTE-FDD B20	@21dbm Typical: 87mA @10dbm Typical: 49mA @0dbm Typical: 28mA	
LTE-FDD B28	@21dbm Typical: 109mA @10dbm Typical: 52mA @0dbm Typical: 29mA	

5.5 ESD Notes

R7072 is sensitive to ESD in the process of storage, transporting, and assembling. WhenR7072 is mounted on the users' mother board, the ESD components should be placed beside the connectors which human body may touch, such as SIM card holder, audio jacks, switches, keys, etc. The following table shows R7072 ESD measurement performance without any external ESD component.

Table 29: The ESD performance measurement table (Temperature: 25℃, Humidity: 45%.)

Part	Contact discharge	Air discharge
GND	+/- 5KV	+/- 10KV
VBAT	+/- 4KV	+/- 8KV

Antenna port	+/- 4KV	+/- 8KV
PWRKEY	+/- 3KV	+/- 6KV
RESET	+/- 2KV	+/- 5KV
(U)SIM	+/- 2KV	+/- 5KV
Other PADs	+/- 3KV	+/- 6KV

NOTE

Test conditions:
1. The external of the module has surge protection diodes and ESD protection diodes.
2. The data in Table 29 was tested using SIMCom EVB.

6 SMT Production Guide

6.1 Top and Bottom View of R7072

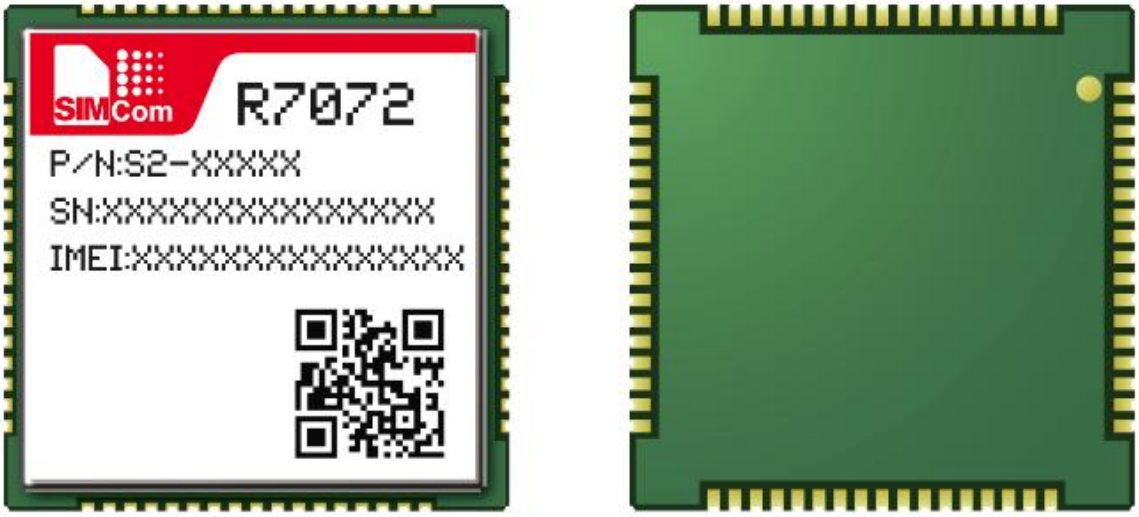

Figure 24: Top and bottom view of R7072

NOTE

The above is the design effect diagram of the module for reference. The actual appearance is subject to the actual product.

6.2 Label Information

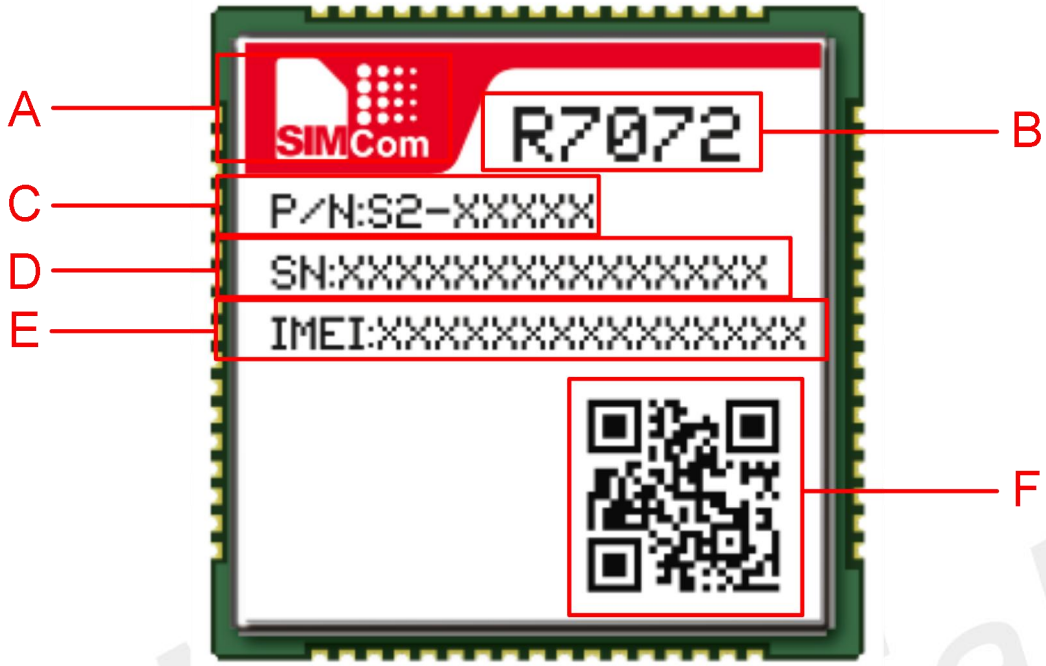

Figure 25: Label information

Table 30: The description of label information

No.	Description
A	LOGO,No.1 Pin
B	Project name
C	Product code
D	Serial number
E	International mobile equipment identity
F	QR code

6.3 Typical SMT Reflow Profile

SIMCom provides a typical soldering profile. Therefore the soldering profile shown below is only a generic recommendation and should be adjusted to the specific application and manufacturing constraints.

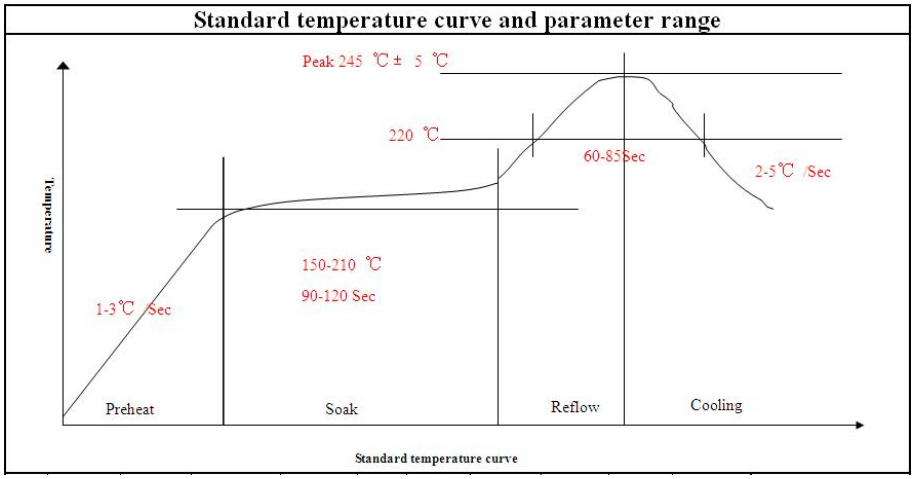

Figure 26: The ramp-soak-spike reflow profile of R7072 Series

NOTE

For more details about secondary SMT, please refer to the document [19].

6.4 Moisture Sensitivity Level (MSL)

R7072 is qualified to Moisture Sensitivity Level (MSL) 3 in accordance with JEDEC J-STD-033.

The following table shows the features of Moisture Sensitivity Level (MSL). After seal off, storage conditions must meet the following table. If the storage time was expired, module must be baking before SMT.

Table 31: Moisture Sensitivity Level and Floor Life

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

6.5 Baking

In order to get better yield, the module need to bake before SMT.

- If the packaging is in perfect condition, the module which dateofproduction is within six months has no use for baking. If the dateofproduction is more thansix months, the module must be baking.
- If the packaging had been opened or damaged, the module must be baking.

Table 32: Baking conditions

conditions	parameters
Baking temperature	120℃
Baking time	8 hours

NOTE

IPC / JEDEC J-STD-033standard must be followed for production and storage.

6.6 Stencil Foil Design Recommendation

The recommended thickness of stencil foil is 0.15mm.

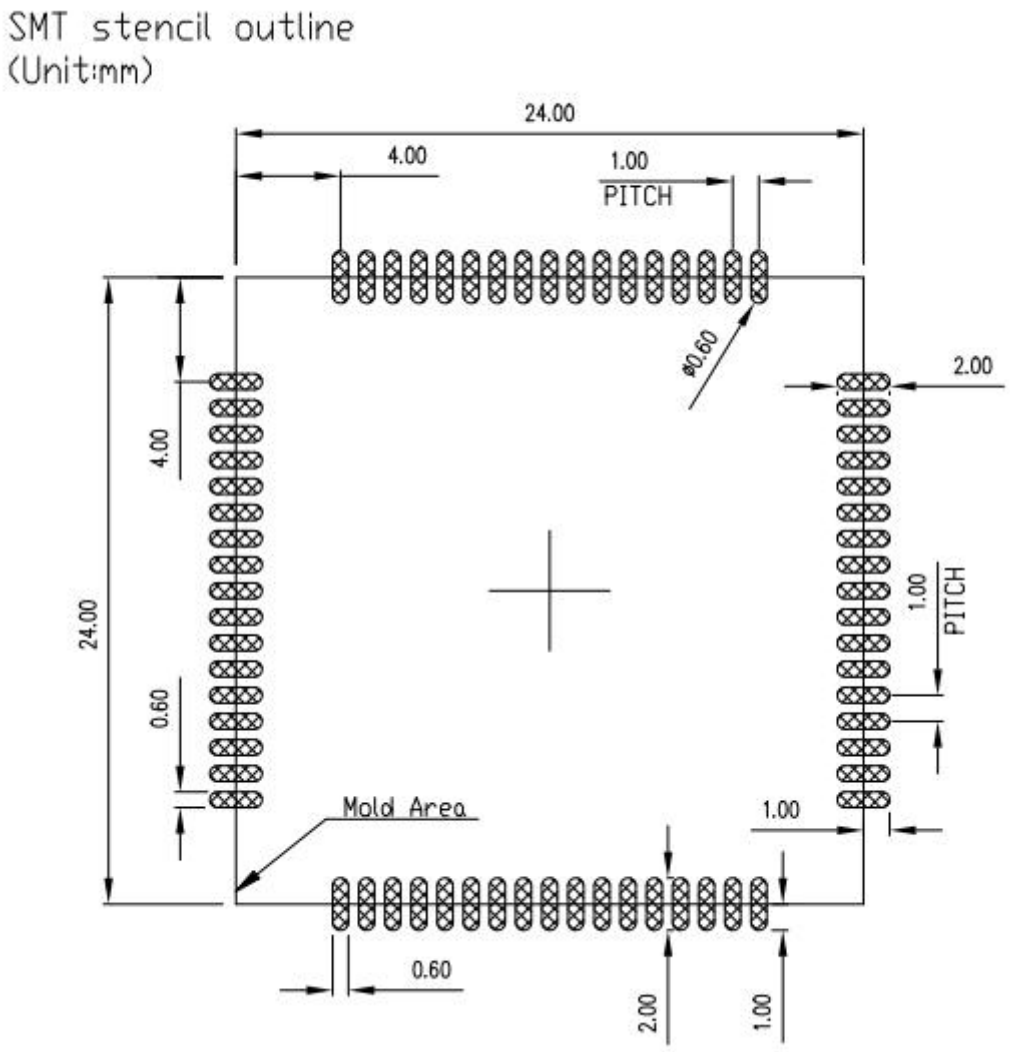

Figure 27: stencil recommendation (Unit: mm)

7 Packaging

7.1 Tray packaging

R7072 module support tray packaging.

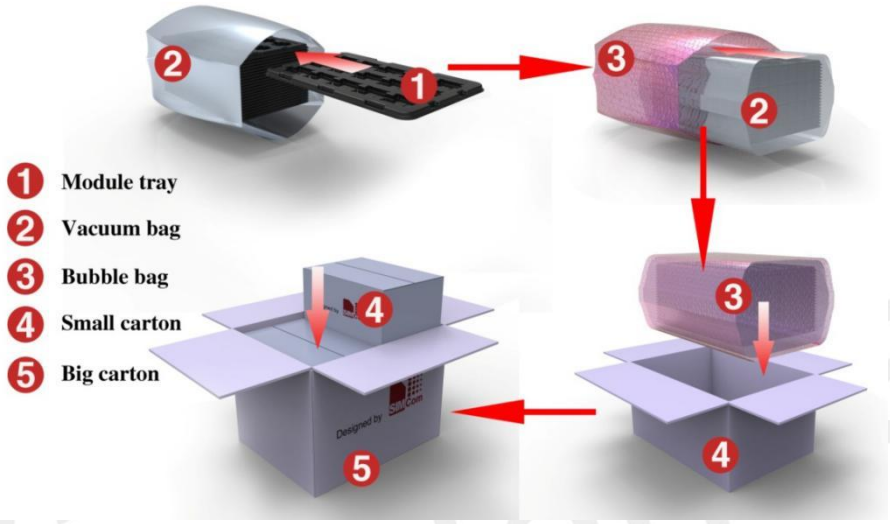

Figure 28: packaging diagram

Module tray drawing：

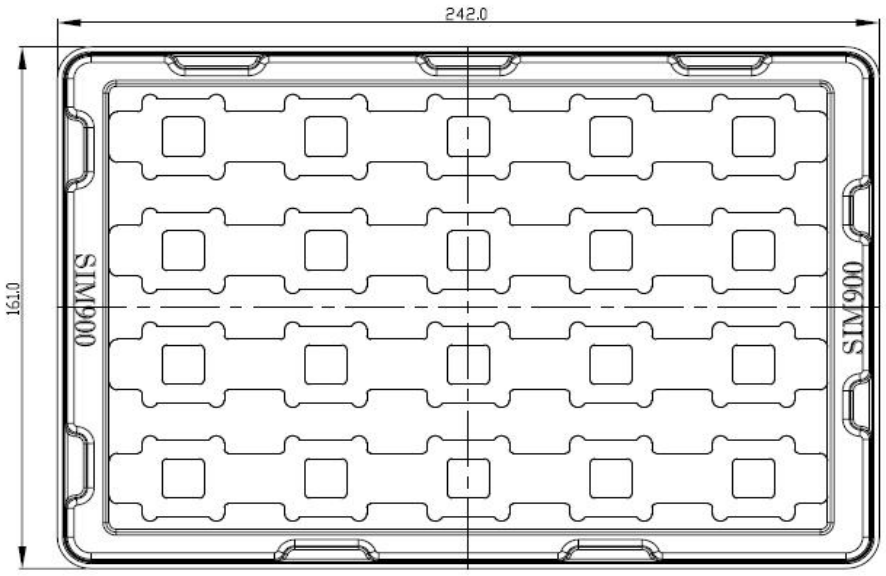

Figure 29: Tray drawing

Table 33: Tray size

Length（±3mm）	Width（±3mm）	Module number
242.0	161.0	20

Small carton drawing：

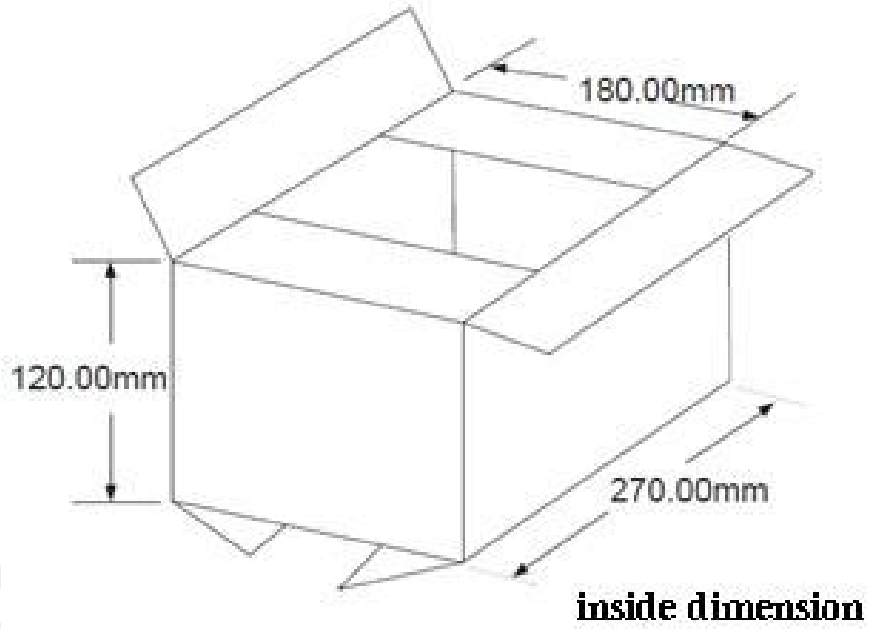

Figure 30: Small carton drawing

Table 34: Small Carton size

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

Big carton drawing：

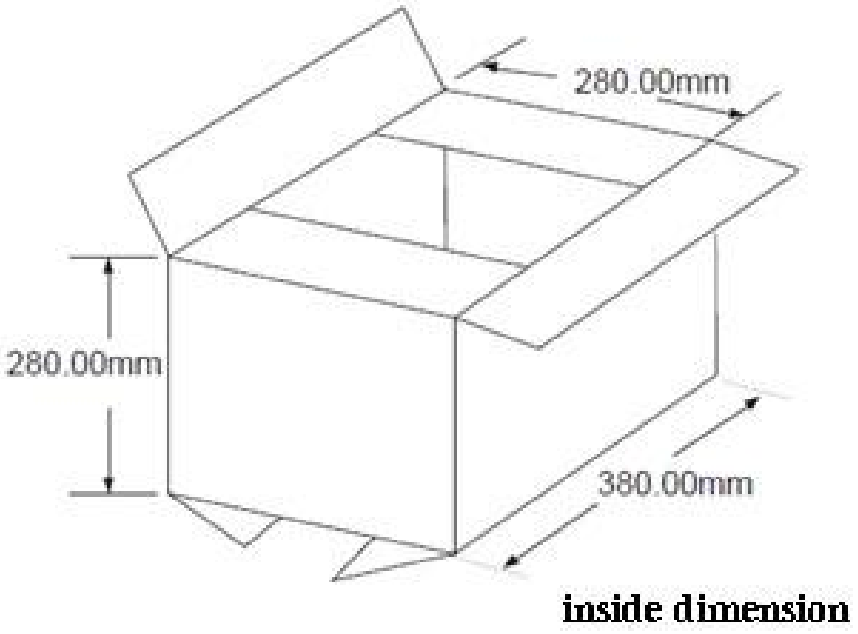

Figure 31: Big carton drawing

Table 35: Big Carton size

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

8 Appendix

8.1 Reference Design

Refer to <R7072 Series Reference Design V1.01> for the details.

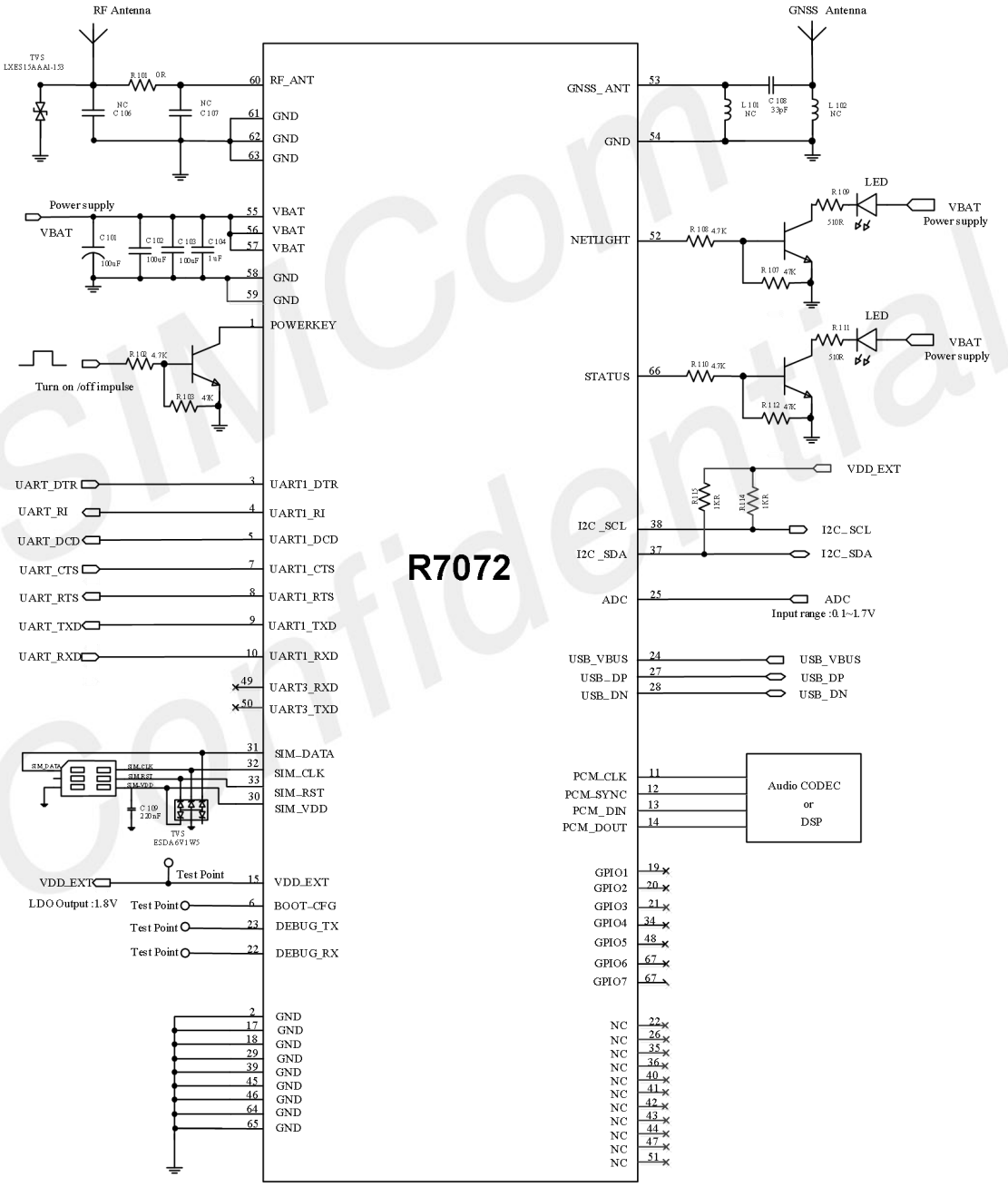

Figure 32: Reference design

8.2 Design check list

Table 36: Schematic Check List

NO.	Items
1	Insure the supply voltage for VBAT is withintherange
2	Insure the maximum supply current for VBAT is above its consumption when it is maximum power emission.
3	Insure the capacitor for VBAT is meet its request, in order to avoid the voltage drop exceed 300mV.
4	Insure the input signal for PWRKEY pin meet its electrical level match. It recommended use BJT to shift its level.
5	Insure the netconnections of UART be correctness according to signal direction. Insure the signal for UART pins meet its electrical level match. It recommended use BJT or level shift IC to shift its level.
6	Insure SIM card signal had used TVS to protect. And the junction capacity of TVS must be less than 50pf.
7	The power supply of the active antenna should be controlled and closed.
8	The I2C signal has been pulled up in module. so it no need pulled up resistor anymore.
9	The electrical level of all GPIOs is 1.8V. Insure the signal for GPIO pins meet its electrical level match.
10	The input range of ADC is 0V~1.8V. Insure the input signal never exceed its range.
11	ANT should Keep TVS to prevent ESD destroyed. And the TVS should be Low junction capacitance.
12	ANT should have a PI type matching to debug antenna

Table 37: PCB Layout Check List

NO.	Items
1	Insure the capacitor placement for VBAT be near module pin.
2	Insure VBAT trace width be greater than 2mm. If NB only, insure VBAT trace width be greater than 1mm. And the VIA number must be enough for getting through the current.
3	Insure the return path GND of the power supply is good. Insure the connectivity between module GND and mother board GND is good.
4	Insure ADC trance is protected by GND.
5	Insure SIM card signal trance is protected by GND. Especially SIM_CLK must be protected alone. And avoid signal trace branched Routing.
6	Insure TVS avoid bypass. The trace must go through TVS pad first, and then arrived module pad.
7	There should be enough ground around the RF line. RF lines Routing prohibit right angles and sharp angles, trying to trace circular or obtuse angle line.
8	The RF line reference GND should be complete. And avoid high speed lines crossing below it.
9	the GND side of the RF output pin should be non hot welding disk
10	The routing which is RF output PIN to antenna should be isolated from other high-speed lines. And the routing should be 50Ωimpedance control.

8.3 Related Documents

Table 38: Related Documents

NO.	Title	Description
[1]	R7072 Series AT Command Manual_V1.xx	AT Command Manual
[2]	GSM 07.07	Digital cellular telecommunications (Phase 2+); AT command set for GSM Mobile Equipment (ME)
[3]	GSM 07.10	Support GSM 07.10 multiplexing protocol
[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 11.14	Digital cellular telecommunications system (Phase 2+); Specification of the SIM Application Toolkit for the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[6]	GSM 11.11	Digital cellular telecommunications system (Phase 2+); Specification of the Subscriber Identity Module – Mobile Equipment (SIM – ME) interface
[7]	GSM 03.38	Digital cellular telecommunications system (Phase 2+); Alphabets and language-specific information
[8]	GSM 11.10	Digital cellular telecommunications system (Phase 2)； Mobile Station (MS) conformance specification； Part 1: Conformance specification
[9]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[10]	3GPP TS 34.124	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[11]	3GPP TS 34.121	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[12]	3GPP TS 34.123-1	Technical Specification Group Radio Access Network; Terminal conformance specification; Radio transmission and reception (FDD)
[13]	3GPP TS 34.123-3	User Equipment (UE) conformance specification; Part 3: Abstract Test Suites.
[14]	EN 301 908-02 V2.2.1	Electromagnetic compatibility and Radio spectrum Matters (ERM); Base Stations (BS) and User Equipment (UE) for IMT-2000. Third Generation cellular networks; Part 2: Harmonized EN for IMT-2000, CDMA Direct Spread (UTRA FDD) (UE) covering essential requirements of article 3.2 of the R&TTE Directive
[15]	EN 301 489-24 V1.2.1	Electromagnetic compatibility and Radio Spectrum Matters (ERM); Electromagnetic Compatibility (EMC) standard for radio equipment and services; Part 24: Specific conditions for IMT-2000 CDMA Direct Spread (UTRA) for Mobile and portable (UE) radio and ancillary equipment
[16]	IEC/EN60950-1(2001)	Safety of information technology equipment (2000)
[17]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[18]	2002/95/EC	Directive of the European Parliament and of the Council of 27 January 2003 on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

[19]	Module secondary-SMT-UGD-V1.xx	Module secondary SMT Guidelines
[20]	R7072 Series UART Application Note_V1.xx	This document describes how to use UART interface of SIMCom modules.
[21]	ETSI EN 301 908-13 (ETSI TS 136521-1 R13.4.0)	IMT cellular networks; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive; Part 13
[22]	ANTENNA DESIGN GUIDELINES FOR MULTI-ANTENNA SYSTEM V1 01	Design notice for multi-antenna.

8.4 Terms and Abbreviations

Table 39: Terms and Abbreviations

Abbreviation	Description
ADC	Analog-to-Digital Converter
ARP	Antenna Reference Point
BER	Bit Error Rate
BD	BeiDou
BTS	Base Transceiver Station
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
DAM	Downloadable Application Module
DPO	Dynamic Power Optimization
DRX	Discontinuous Reception
e-DRX	Extended Discontinuous Reception
EFR	Enhanced Full Rate
EGSM	Enhanced GSM
EMC	Electromagnetic Compatibility
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
EVDO	Evolution Data Only
FCC	Federal Communications Commission (U.S.)
FD	SIM fix dialing phonebook
FDMA	Frequency Division Multiple Access
FR	Full Rate
GMSK	Gaussian Minimum Shift Keying
GNSS	Global Navigation Satellite System
GPRS	General Packet Radio Service
GPS	Global Positioning System
GSM	Global Standard for Mobile Communications
HR	Half Rate
HSPA	High Speed Packet Access

I2C	Inter-Integrated Circuit
IMEI	International Mobile Equipment Identity
LTE	Long Term Evolution
MO	Mobile Originated
MS	Mobile Station (GSM engine), also referred to as TE
MT	Mobile Terminated
NMEA	National Marine Electronics Association
PAP	Password Authentication Protocol
PBCCH	Packet Switched Broadcast Control Channel
PCB	Printed Circuit Board
PCS	Personal Communication System, also referred to as GSM 1900
RF	Radio Frequency
RMS	Root Mean Square (value)
RTC	Real Time Clock
SIM	Subscriber Identification Module
SMS	Short Message Service
SMPS	Switched-mode power supply
TDMA	Time Division Multiple Access
TE	Terminal Equipment, also referred to as DTE
TX	Transmit Direction
UART	Universal Asynchronous Receiver & Transmitter
VSWR	Voltage Standing Wave Ratio
SM	SIM phonebook
NC	Not connect
EDGE	Enhanced data rates for GSM evolution
HSDPA	High Speed Downlink Packet Access
HSUPA	High Speed Uplink Packet Access
ZIF	Zero intermediate frequency
WCDMA	Wideband Code Division Multiple Access
VCTCXO	Voltage control temperature-compensated crystal oscillator
SIM	Universal subscriber identity module
UMTS	Universal mobile telecommunications system
UART	Universal asynchronous receiver transmitter
PSM	Power saving mode
LD	SIM last dialing phonebook (list of numbers most recently dialed)
MC	Mobile Equipment list of unanswered MT calls (missed calls)
ON	SIM (or ME) own numbers (MSISDNs) list
RC	Mobile Equipment list of received calls
SM	SIM phonebook
NC	Not connect

8.5 Safety Caution

Table 40: Safety Caution

Marks	Requirements
	When in a hospital or other health care facility, observe the restrictions about the use of mobiles. Switch the cellular terminal or mobile off, medical equipment may be sensitive and not operate normally due to RF energy interference.
	Switch off the cellular terminal or mobile before boarding an aircraft. Make sure it is switched off. The operation of wireless appliances in an aircraft is forbidden to prevent interference with communication systems. Forgetting to think much of these instructions may impact the flight safety, or offend local legal action, or both.
	Do not operate the cellular terminal or mobile in the presence of flammable gases or fumes. Switch off the cellular terminal when you are near petrol stations, fuel depots, chemical plants or where blasting operations are in progress. Operation of any electrical equipment in potentially explosive atmospheres can constitute a safety hazard.
	Your cellular terminal or mobile receives and transmits radio frequency energy while switched on. RF interference can occur if it is used close to TV sets, radios, computers or other electric equipment.
	Road safety comes first! Do not use a hand-held cellular terminal or mobile when driving a vehicle, unless it is securely mounted in a holder for hands free operation. Before making a call with a hand-held terminal or mobile, park the vehicle.
	GSM cellular terminals or mobiles operate over radio frequency signals and cellular networks and cannot be guaranteed to connect in all conditions, especially with a mobile fee or an invalid SIM 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. Some networks do not allow for emergency call if certain network services or phone features are in use (e.g. lock functions, fixed dialing etc.). You may have to deactivate those features before you can make an emergency call. Also, some networks require that a valid SIM card be properly inserted in the cellular terminal or mobile.