Technoration India Pvt. Ltd.

TR-7680C

Hardware Design Manual

LTE Module

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Preface

This module is mainly used for voice or data communication, and the company does not bear the responsibility for property loss or personal injury caused by the user's abnormal operation.

Users are requested to develop corresponding products in accordance with the technical specifications and reference designs in the manual. At the same time, pay attention to the general safety issues that should be paid attention to when using mobile products.

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Version history

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1 Introduction

This document describes the hardware interface of the module, which can help users quickly understand the detailed information of the module's interface definition, electrical performance and structural dimensions. Combining this document and other application documents, users can quickly use the module to design mobile communication applications. Technoration Provide a set of evaluation boards to facilitateTR-7680CModule testing and use. The evaluation board tools includeEVBboard,USBWires, antennas and other peripherals.

1.1 Module overview

TR-7680CModule can support LTE-TDD with LTE-FDD. Users can flexibly choose different models of modules to meet diversified market needs begging.

For detailed frequency band description, please refer to the table below:

table 1:TR-7680C Module frequency band list

Network Type	Frequency band	TR-7680C
LTE-FDD	LTE-FDD B1	
	LTE-FDD B3	
	LTE-FDD B5	
	LTE-FDD B8	
LTE-TDD	LTE TDD B34	
	LTE TDD B38	
	LTE TDD B39	
	LTE TDD B40	
	LTE TDD B41	
Category		CAT1

The size of the module is only17.6*15.7*2.1mm, Can almost satisfy allM2MSpace requirements in applications, such as vehicle, metering, security, routing, wirelessPOS, Mobile computing devices,PDA, Tablet PC, etc.

TR-7680CTotally provided92Pins including outer ring42ALCCPins and inner ring50ALGAPins, this article will focus on all functional pins Open an introduction.

1.2 Interface overview

TR-7680CProvides the following hardware interfaces:

power input

All the wayUSB 2.0 interface

threeroadUARTInterface, a group of full-function serial ports, a group of ordinary serial ports, a group ofDEBUGSerial port

All the wayUSIMCard interface

Multiple programmable universal input and output interfaces (GPIO)

OneroadADCinterface

One power output

One analog audio interface

All the wayUSB_BOOTDownload boot interface

Network status indicator interface

Module operating status indicator interface

An antenna interface

1.3 Block diagram

The following figure lists the main functional architecture of the module:

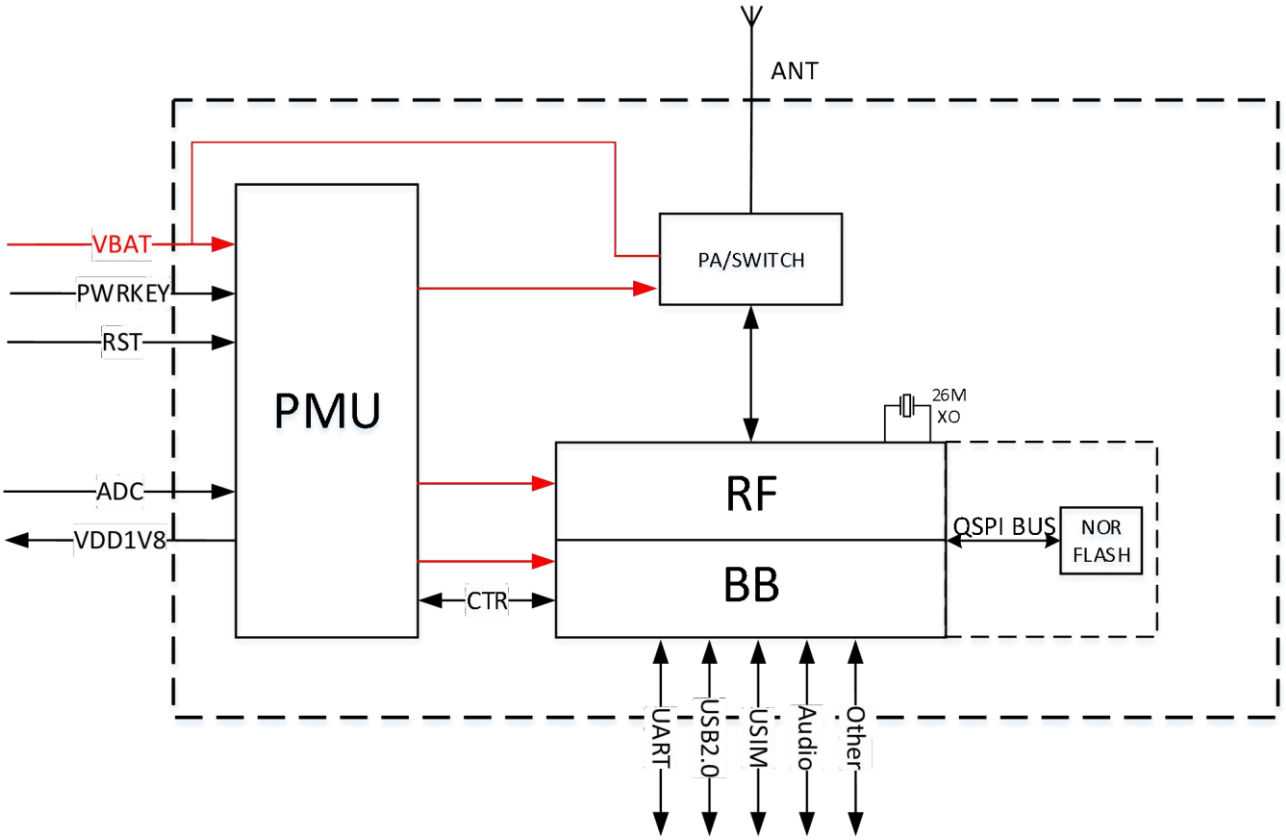

Figure 1：Module block diagram

1.4 Main features

table 2：The main features of the module

characteristic	Description
powered by	voltage range:3.4V ~4.2V,Recommended value 3.8V

Power saving	Current consumption in sleep mode:TBD
Frequency band	Please refer to the table 1
Transmit power	LTE Power rating 3 (23dBm±2.7dB) TDD/FDD-LTE category 1:
data transmission	10Mbps (Down),5 Mbps (Up)
Antenna interface	LTE Antenna interface
short message(SMS)	MT,MO,CB,Text with PDU mode short message(SMS) Storage device:USIMcard, CB Does not support saving in SIM stand byCS Domain and PS Domain SMS
USIMCard interface	Supported 1.8V/3V USIMcard
USIMApplication Toolkit	stand by SAT grade 3 stand by USAT
Address book management	SM/FD/ON/AP/SDN
audio port	Support one analog audio interface
Serial port	● Main serial portUART Baud rate support from 300bps To 3686400bps Can be sent through the serial port AT Command and data stand byRTS/CTS Hardware flow control ● Ordinary serial port UART3 Can be used for external devices ● Serial port DBG_UART Can supportDebug use
USB interface	meets theUSB 2.0 Specification, support slave mode, do not support master mode can be used AT Command sending, data transmission, software debugging and upgrading
software upgrade	passedUSB Upgrade software
Physical size	size:17.6*15.7*2.1mm weight:TBD
temperature range	Operating temperature:-30°C~ +80°C Extended working temperature:-40°C~ +85°C* storage temperature:-45°C~ +90°C

※ pay attention

Within the extended operating temperature range, the module can work normally, but full compliance is not guaranteed 3GPP Test Specification.

2 Package information

2.1 Pin layout

Shared modules92Pins.

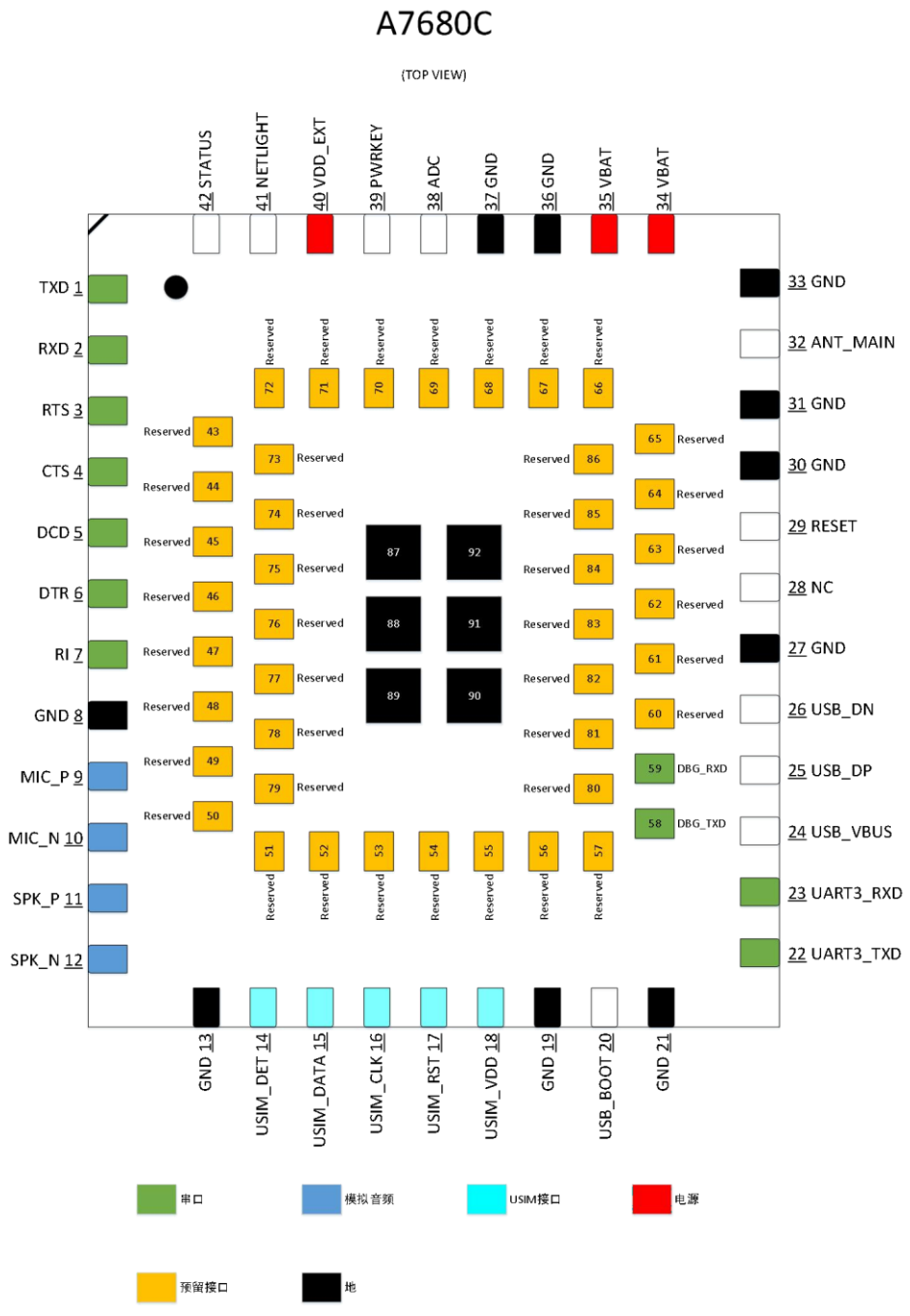

Figure 2：Module pin diagram (front view)

Pin number	Pin name	Pin number	Pin name
1	TXD	2	RXD
3	RTS	4	CTS
5	DCD	6	DTR
7	RI	8	GND
9	MIC_P	10	MIC_N
11	SPK_P	12	SPK_N
13	GND	14	USIM_DET
15	USIM_DATA	16	USIM_CLK
17	USIM_RST	18	USIM_VDD
19	GND	20	USB_BOOT●
twenty one	GND	twenty two	UART3_TXD
twenty three	UART3_RXD	twenty four	USB_VBUS
25	USB_DP	26	USB_DN
27	GND	28	NC
29	RESET	30	GND
31	GND	32	ANT_MAIN
33	GND	34	VBAT
35	VBAT	36	GND
37	GND	38	ADC
39	PWRKEY	40	VDD_EXT
41	NETLIGHT	42	STATUS
43	Reserved	44	Reserved
45	Reserved	46	Reserved
47	Reserved	48	Reserved
49	Reserved	50	Reserved
51	Reserved	52	Reserved
53	Reserved	54	Reserved
55	Reserved	56	Reserved
57	Reserved	58	DBG_TXD
59	DBG_RXD	60	Reserved
61	Reserved	62	Reserved
63	Reserved	64	Reserved
65	Reserved	66	Reserved
67	Reserved	68	Reserved
69	Reserved	70	Reserved
71	Reserved	72	Reserved
73	Reserved	74	Reserved
75	Reserved	76	Reserved

table 3：Pin definition list

77	Reserved	78	Reserved
79	Reserved	80	Reserved
81	Reserved	82	Reserved
83	Reserved	84	Reserved
85	Reserved	86	Reserved
87	GND	88	GND
89	GND	90	GND
91	GND	92	GND

※ pay attention

● It means that these signals cannot be pulled down before power on, otherwise it will affect the normal power on of the module.

2.2 Pin description

table 4: Abbreviation of pin parameter

abbreviation	description
Pin attributes	
PI	power input
PO	Power Output
AI	Analog input
AO	Analog output
I/O	Input or output
DI	Digital input
DO	Digital output
DOH	Default output high level
DOL	Default output low level
PU	pull up
PD	drop down
OD	Open drain

table 5:1.8V IOPin electrical characteristics

Pin voltage Domain attributes	abbreviation	description	Minimum	Typical value	Max
1.8V	DC input conditions (VCC=1.8V)				
	VIH	Input effective high level	VCC * 0.7	1.8V	VCC+0.2
	VIL	Input valid low level	-0.3V	0V	VCC *0.3

	Rpu	Module internal pull-up resistor	55K	79 K	121K
	Rpd	Module internal pull-down resistor	51K	87 K	169K
1.8V	DC input conditions (VCC = 1.8V Typical) IIL				
		Input leakage current	-	-	10uA
	DC output conditions (VCC = 1.8V Typical)				
	VOH	Output level range	VCC-0.2	-	-
	VOL	Output level range	-	-	0.2V
	Iol	Low-level output current Vpad=0.2V	-	-	13mA
	Ioh	High level output current Vpad=VCC-0.2V	-	-	11mA

table 6:3.3V IOPin electrical characteristics

Pin voltage Domain attributes	abbreviation	description	Minimum	Typical value	Max
3.3V	VIH	Input effective high level	2V	-	VCC+0.3
	VIL	Input valid low level	-0.3V	0V	0.8V
	Rpu	Module internal pull-up resistor	26K	47K	72K
	Rpd	Module internal pull-down resistor	27K	54K	267K
	IIL	Input leakage current	-	-	10uA
3.3V	VOH	Output level range	2.4V	-	-
	VOL	Output level range	-	-	0.4V
	Iol	Low-level output current Vpad=0.4V	-	-	7mA
	Ioh	High level output current Vpad=VCC-0.5V	-	-	7mA

table 7: Pin description

Pin name	Pin number	Pin attributes		description	Remarks
		Voltage domain	Types of		
powered by					
VBAT	34,35	-	PI	Module power supply input, input voltage range From 3.4V~4.2V,Supply current requirements ReachableTo 1A.	
VDD_1V8	40	-	PO	internal 1.8V Power output Maximum flow 50mA, Can't give high power Load power supply, can be level conversion circuit And so on to provide power.	If not used, just leave it open can.
GND	8,13,19, 21,27,30, 31,33,36,	-	-	Grounded	

	37,87,88, 89,90,91, 92				
System control					
PWRKEY	39	-	DI,PU	Switch machine control input, active low The power button defaults to high level VIH :0.7*VBAT VIL:0.3*VBAT	PMU internal 50K (Typical) Pull up to VBAT .
RESET	29	-	DI,PU	Hardware reset control input, low level has effect VIH:0.7*VBAT VIL:0.3*VBAT	PMU Internally passed 50K(Typical)on Pull to VBAT .
USIMinterface					
USIM_DATA	15	1.8/3.0V	I/O, PU	USIMBus data, inside the module 4.7KΩ resistor pulled up to USIM_VDD	
USIM_RST	17	1.8/3.0V	I/O, PU	USIMBus reset output	
USIM_CLK	16	1.8/3.0V	I/O, PU	USIMBus clock output	
USIM_VDD	18	1.8/3.0V	PO	USIMCard power output, output voltage Can be dynamically changed according to the type of external card Change, the maximum output current 50mA	
USIM_DET	14	1.8V	I/O	USIMCard hot plug detection, you can AT The instruction is set to high/low effective, refer to the text files[25]	
USBinterface					
USB_VBUS	twenty four	-	AI	USB In-position detection input, high level Effective, the highest recognition voltage 5.2V	
USB_DN	26	-	I/O	USB Bus differential negative	
USB_DP	25	-	I/O	USB Bus differential positive	
Main serial port					
RTS	3	1.8V	DI	RTSenter	If not used, just leave it open can.
CTS	4	1.8V	DO	CTSOutput	
RXD	2	1.8V	DI	Data reception	
TXD	1	1.8V	DO	Data sending	
RI	7	1.8V	DO	Ring indicator	
DCD	5	1.8V	DO	Carrier detect	
DTR	6	1.8V	DI	DTEReady	
Debug serial port					
DBG_TXD	58	1.8V	DO	Log Output	Default as the debug terminal mouth.
DBG_RXD	59	1.8V	DI	Log enter	
Analog audio interface					
MIC_P	9	1.8V	AI	Audio microphone input positive	If not used, just leave it open

MIC_N	10	1.8V	AI	Audio microphone input negative	can.
SPK_P	11	1.8V	AO	Audio output positive	
SPK_N	12	1.8V	AO	Audio output negative	
Antenna interface					
ANT_MAIN	32	-	AIO	Main antenna interface	
Other function pins					
ADC	38	-	AI	Universal analog to digital converter interface	If not used, just leave it open can.
STATUS	42	1.8V	DO	Module status indication (indicator lamp) High level: boot Low level: shutdown	
NETLIGHT	41	1.8V	DO	Network registration status indication (indicator) High level: The network is registered Low level: the network is not registered	
USB_BOOT	20	1.8V	DI	Code guide control input, pull down when power on arrived,TR-7680C Will enter USB Download mode	It is recommended to place test points, Convenient for debugging and upgrading. Before booting normally, no Can pull down USB_BOOT!

2.3 Mechanical Dimensions

The following picture describesTR-7680CThe package size.

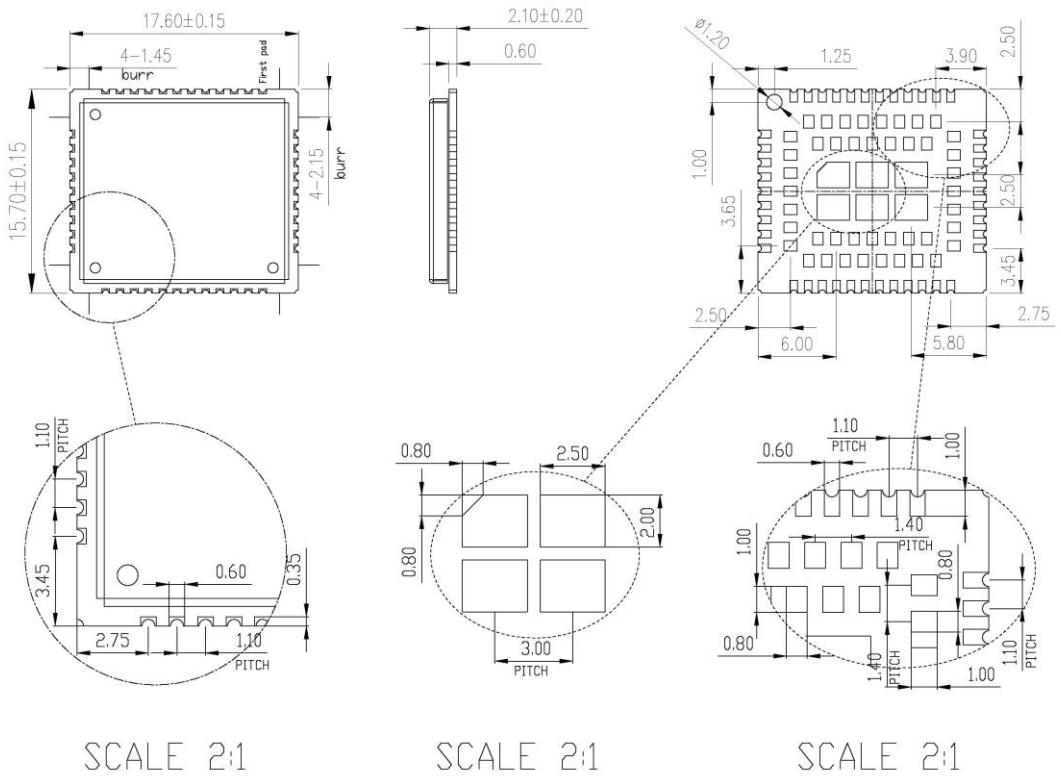

Figure 3：Three-dimensional size (unit: mm)

2.4 Recommend PCB Package size

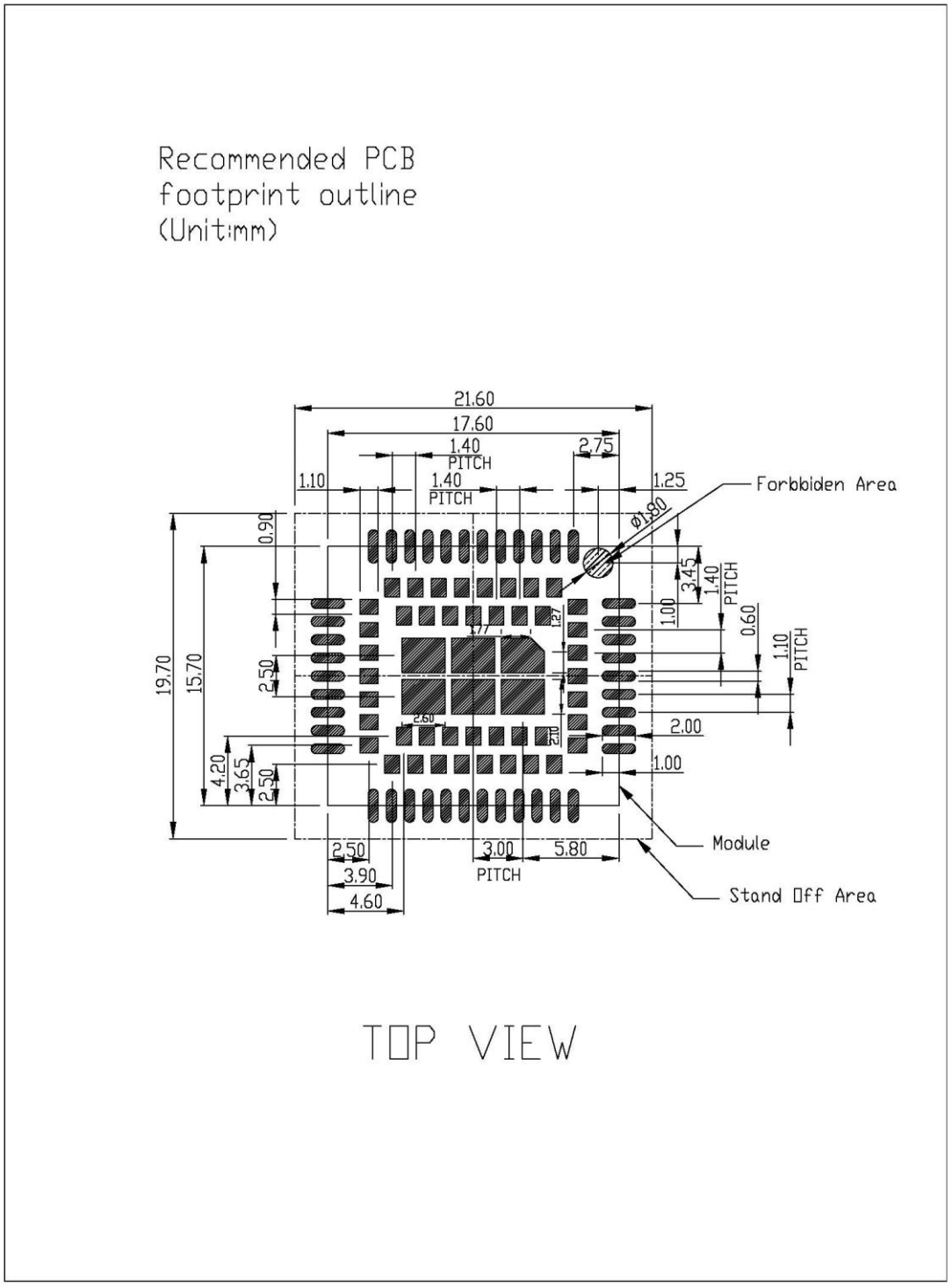

Figure 4:recommend PCB Package size (unit: mm)

2.5 Recommended stencil size

Recommended steel mesh thickness ≥0.15mm,Less than0.18mm.

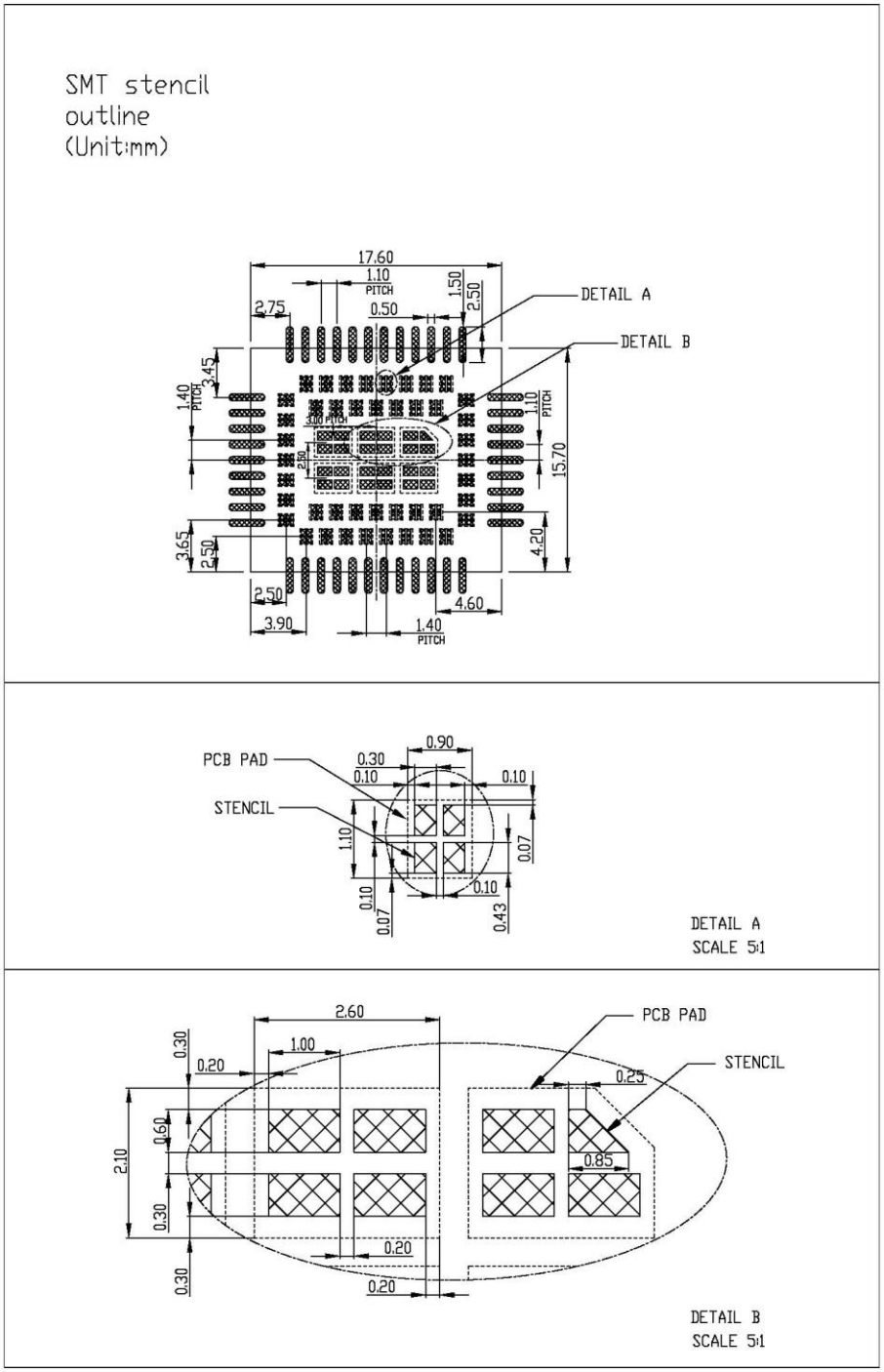

Figure 5：Recommended steel mesh size (unit: mm)

3 Application interface

3.1 Power input

TR-7680CUse a single power supply, share2Pins (34, 35Pin) asVBATpower input.TR-7680CPass this2Two pins supply power to the internal radio frequency and baseband circuits.

When the module isLTEWhen transmitting at maximum power in the mode, the peak current can reach the highest instantaneously1A, Resulting inVBATThere is a larger voltage fall. To ensure that the voltage drop is less than300mV, Must ensure that the external power supply capacity is not less than1A.

※ pay attention

Test Conditions:VBAT powered by 3.8V, Module belt TEBoard test.

table 8:VBATPin electrical parameters

symbol	Symbol description	The smallest	typical	maximum	unit
VBAT	Module power supply input voltage	3.4	3.8	4.2	V
IVBAT(peak)	Module peak current consumption	-	-	1	A
IVBAT(average)	Average current consumption of the module (normal mode)	Please refer to the table 30			
IVBAT(sleep)	Average current consumption of the module (sleep mode)				
IVBAT(power-off)	Average current consumption of the module (shutdown state)	-	-	20	uA

3.1.1 Power supply reference design

In the user's design, special attention must be paid to the design of the power supply part. If the voltage drops below3.4V, The RF performance of the module will be affected, and a low voltage will cause the module to shut down. It is recommended to choose the one with enabling pinLDOorDC-DCChip, enable pin byMCUcontrol.

※ pay attention

When the power supply can provide 1A When the continuous current is high, the total capacitance of the external power supply capacitor is recommended not to be less than 200uF; If not available 1A Continuous current, it is recommended that the total capacitance of the external capacitor is not less than 500uFTo ensure that at any time VBAT The voltage drop on the pin does not exceed 300mV.

It is recommended to approachVBATplace33pf/10pf/0.1/1μFA total of four ceramic capacitors to improve RF performance and system stability. At the same time, it is recommended PCBFrom the power supply to the moduleVBATTrace width at least2mm. The reference design recommendations are as follows:

in caseVBATThe input contains high frequency interference. It is recommended to add magnetic beads for filtering. The recommended model of magnetic beads isBLM21PG300SN1Dwith MPZ2012S221A.

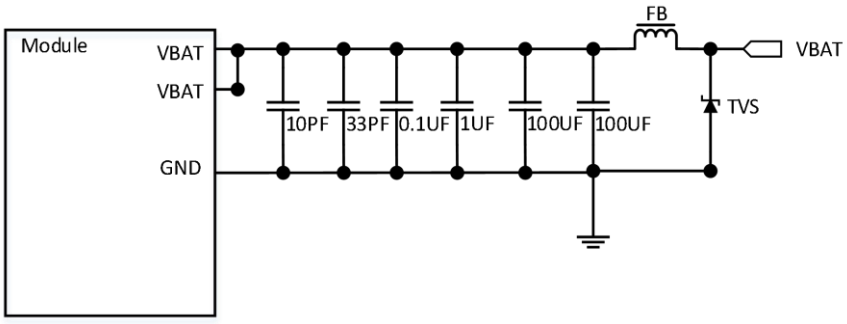

Figure 6:VBATInput reference circuit

In addition, in order to prevent surge and overvoltageTR-7680CDamage, it is recommended that the moduleVBATOne pin in parallelTVStube.

table 9:recommended TVS Tube list

Numbering	factory	Part No	Operating Voltage	Encapsulation
1	Changdian	ESDBW5V0A1	5V	DFN1006-2L
2	Changyuan Wei'an	WS05DPF-B	5V	DFN1006-2L
3	Weir	ESD5611N	5V	DFN1006-2L
4	Weir	ESD56151W05	5V	SOD-323

※ pay attention

Customers choose TVS At this time, we need to pay attention to the clamping voltage during surge protection,100V During surge input, the clamping voltage should not be higher than 10V.

3.1.2 Recommended external power circuit

DesignMCU It must have the function of powering off the module, but it is prohibited to use it when the module can be shut down or restarted normally. Only the module has abnormal conduction.

If the module cannot be shut down or restarted normally, the module can be powered off. It is recommended to choose the one with an enable pin LDO orDC-DC chip.When the input power is greater than

9V When, it is recommended to use DCDC chip：When the input is less than 9V When, it is recommended to use LDO powered by. If you use the moduleOPEN LINUX Second time

Development function, because there is no MCU, You can add a low-cost microcontroller to pull POWERKEY The function of the hardware watchdog that can power on and power off.

The recommended circuit of linear power supply is shown in the figure below, wherePWR_CTRLFor the control foot:

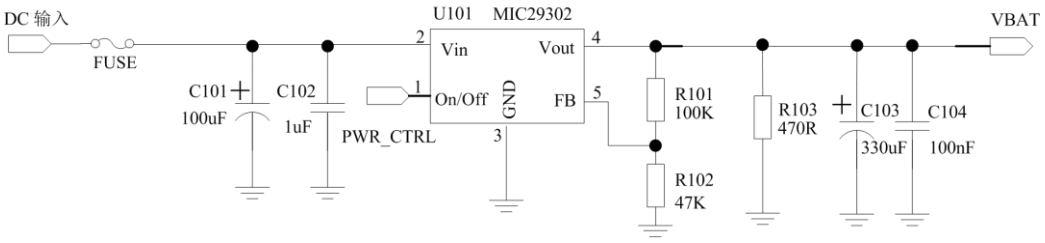

Figure 7：Recommended circuit for linear power supply

The recommended circuit of the switching power supply is shown in the figure below:

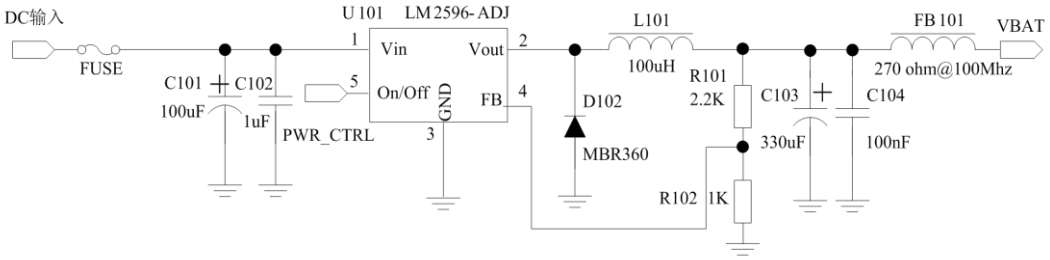

Figure 8：Recommended circuit for switching power supply

3.1.3 Power monitoring

ATcommand"AT+CBC"Can be used to monitorVBATvoltage.

ATcommand"AT+CVALARM"High/low voltage alarm voltage can be set, when the actual voltage exceeds the preset value range, it will passATWarning information is reported at the mouth.

use"AT+CPMVT"You can set the high/low voltage shutdown voltage, when the actual voltage exceeds the preset value range, the module will directly shut down automatically.

※ pay attention

During the debugging of the power supply voltage monitoring function, the over-voltage alarm and over-voltage shutdown functions are turned off by default. RelatedAT For detailed information about the command, please refer to the document [1] .

3.2 Power on/off/reset

3.2.1 Module boot

Pull downPWRKEYThe pin turns on the module. This pin has been pulled up inside the module toVBAT. It is recommended that customers increase the pins of the module when designingTVSThe tube can effectively enhance the antistatic ability of the module, the recommended circuit is as follows:

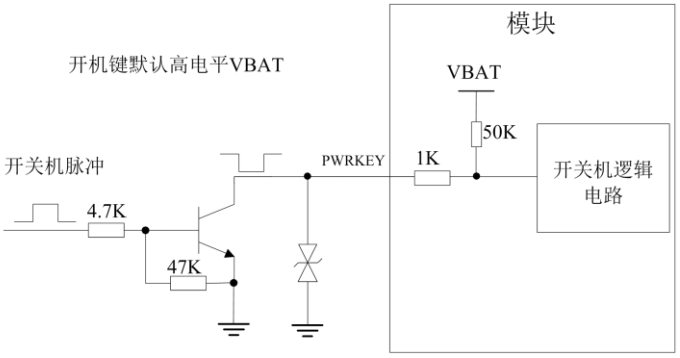

Figure 9：Switch machine reference circuit

※ pay attention

If the customer does not need to power on automatically, please do not PWRKEY with RESET onParallel over 100NF capacitance, Otherwise the module will automatically turn on if a low level is detected after power-on.

because PWRKEY with RESET All have the function of pulling down the power-on, prohibiting the power-on process within a short time PWRKEY with RESET, Otherwise it may cause abnormal startup.

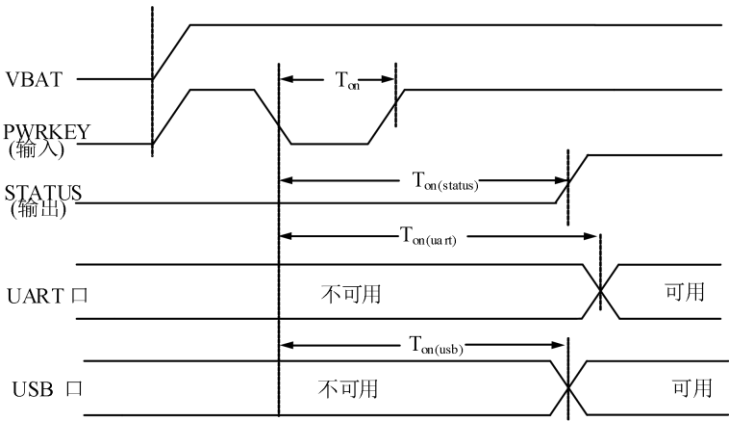

Figure 10:PWRKEYBoot sequence

table 10: Power-on timing parameters

symbol	description	Minimum	Typical value	Max	unit
Ton	Power-on low-level pulse width	-	50	-	ms
Ton(status)	Boot time (according to STATUS Pin judgment)		TBD	-	s
Ton(uart)	boot time (according toUART judgment)	-	TBD	-	s
Ton(usb)	Boot time (according toUSB judgment)	-	TBD	-	s
VIH	PWRKEY Pin input high level voltage	0.7*VBAT	-	VBAT	V
VIL	PWRKEY Pin input low-level voltage	0	0	0.3*VBAT	V

3.2.2 Module shutdown

TR-7680CThe module has the following shutdown methods:

use PWRKEY Pin shutdown

use"AT+CPOF"Command shutdown

High/low pressure overvoltage shutdown, use"AT+CPMVT"Set the voltage range (Debugging).

High and low temperature shutdown

It is strongly recommended that customers usePWRKEYorAT+CPOFShut down, then turn off theVBATPower off (especially when the module does not need to work at all), and it cannot be disconnectedVBATShut down, this may affectFLASHCause damage.

※ pay attention

When the temperature exceeds-30~+80In the range of ℃,A7680C Will pass AT The warning message is reported at the mouth. When the temperature exceeds-40~+85In the range of ℃, A7680CAutomatic shut-down. "AT+CPOF"with"AT+CPMVT"For a detailed description, please refer to the document [1].

The user can passPWRKEYPull down the signal to shut down, and the shutdown sequence diagram is shown in the figure below:

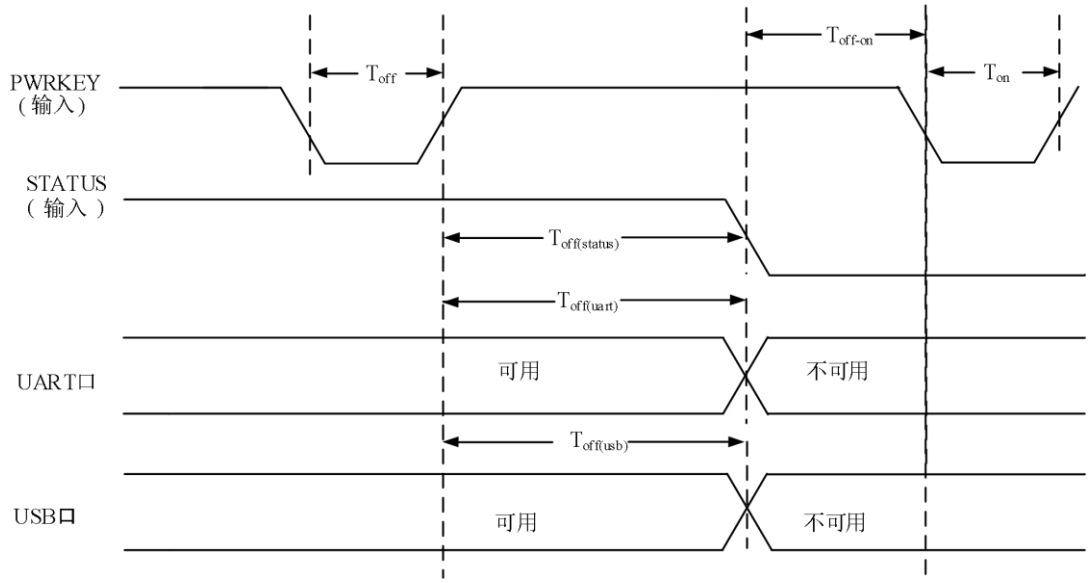

Figure 11:PWRKEYShutdown sequence

table 11: Shutdown timing parameters

symbol	description	Minimum	Typical value	Max	unit
Toff	Shutdown machine low-level pulse width	2.5	-	-	s
Toff(status)	Shutdown time (according to STATUS Pin judgment)		TBD	-	s
Toff(uart)	shutdown time (according toUART judgment)	-	TBD	-	s
Toff(usb)	Shutdown time (according toUSB judgment)	-	TBD	-	s
Toff-on	Shutdown-boot buffer time	2	-	-	s

※ pay attention

STATUS The pin can be used to determine whether the module is powered on. When the module is powered on and the initialization is complete,STATUS Output high level, otherwise maintain low level all the time.

3.2.3 Module reset

TR-7680CYou can pull down the moduleRESETPin to restart the module.RESETThe pin also has the function of pulling down the boot function (independent of the machine function), but Is recommendedPWRKEYSwitch on and offRESETUsed as a reset function.

Already inside the module50KΩPull-up resistor, so there is no need to add a pull-up resistor externally. The recommended circuit is as follows:

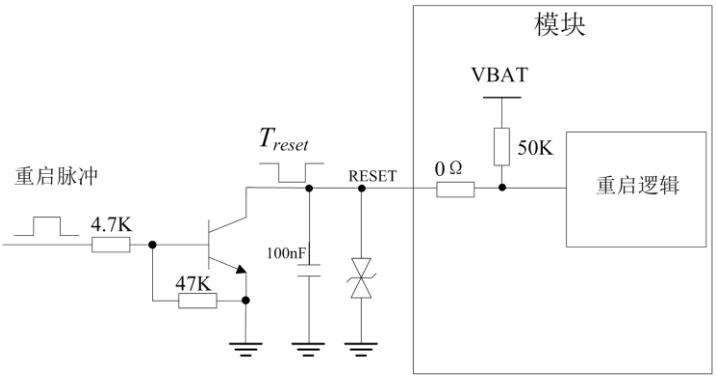

Figure 12：Recommended circuit for reset

table 12:RESET Pin electrical parameters

parameter	description	Minimum	Typical value	Max	unit
Treset	Restart low pulse width	2	2.5	-	S
VIH	RESET Pin input high level voltage	0.7*VBAT	-	VBAT	V
VIL	RESET Pin input low-level voltage	0	0	0.3*VBAT	V

※ pay attention

It is recommended to use only in emergency situations, such as when the module does not respond RESET Pin.RESET Recommended reset time 2.5s.

3.3 Serial port

TR-7680CProvide three serial ports, main communication serial portUART, One ordinary serial port, all the way printinglogSerial portDBG_UATR, The module isDCE (Data Communication Equipment)equipment.

When the user uses the full-function serial port, you can refer to the following connection method:

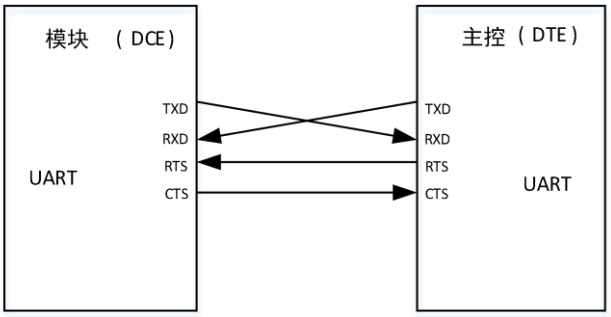

Figure 13：Serial connection diagram (full function mode)

use2When connecting to a serial port, you can refer to the following connection method:

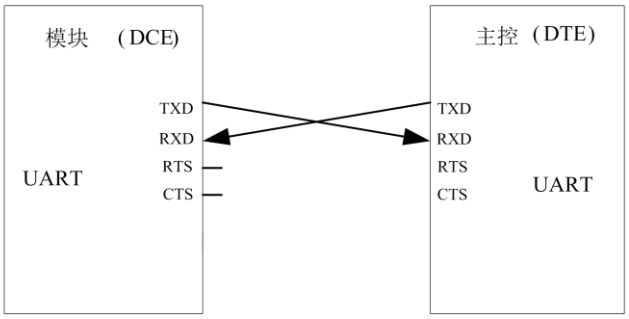

Figure 14：Serial connection diagram (NULL mode)

The following figure shows the use of a transistor for circuit conversion, the dotted line part of the circuit can refer to the solid lineTXDwithRXDThe circuit requires attention to the direction of the signal.

The recommended transistor model here isMMBT3904.

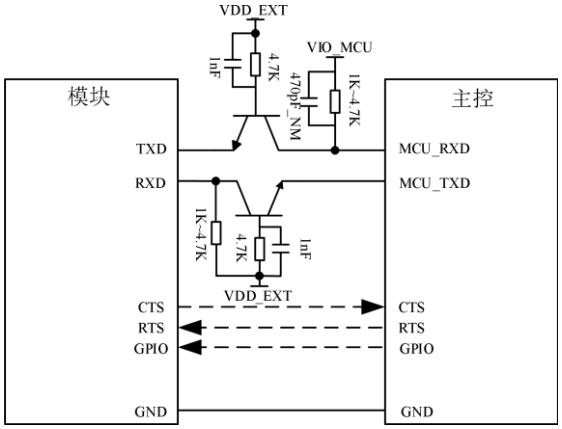

Figure 15: Triode level conversion circuit

※ pay attention

1.A7680C The main serial port supports the following baud rates:300, 600, 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800, 921600, 1842000, 3686400. The default baud rate is115200bps.

2.Due to the existence of the parasitic capacitance of the triode, it will affect the edge of the high-speed digital signal, and the signal speed is higher than 115200bps It is not recommended to use this circuit.

3.3.1 RI withDTRdescription

RIThe pin can be used as an interrupt to wake up the host.RINormally keep the high level output, when receiving a short message orURCWhen reporting,RI Output120ms(short message)/60ms(URC) Low level, then return to high level state;RIWill output low level. When receiving a phone call as the called party,RIOutput low level,RIAfter outputting low level, it will keep low level until the host uses "ATA"Command to accept the call, or the caller to stop the callRIOnly then will the output high level be restored.

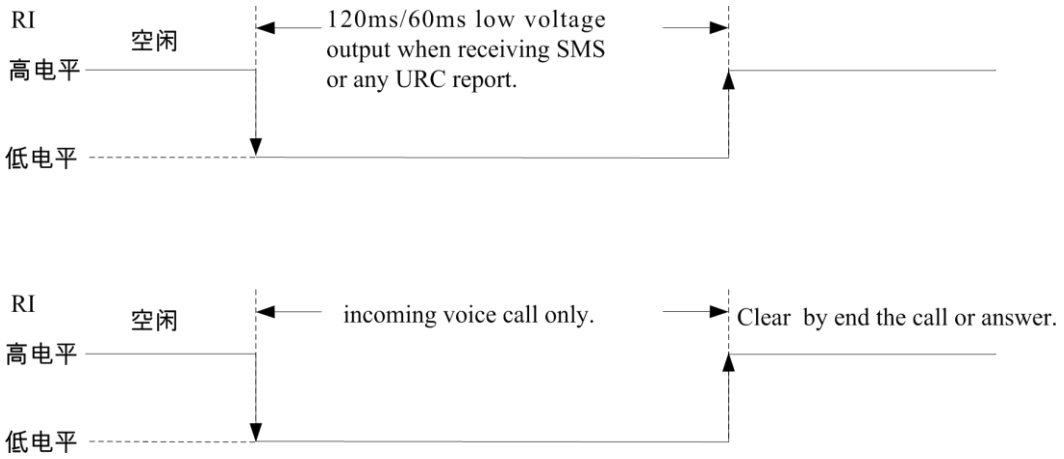

Figure 16:RI Level changes (messages,URC,Incoming call)

DTR can be used as TR-7680C The sleep wake-up pin of the module. whenTR-7680C After the module enters sleep mode, pull down DTR Can wake up TR-7680CModule.

When the user sets "AT+CSCLK=1"After, pull up DTR Pin, the module will automatically enter sleep mode. The serial port function cannot communicate normally at this time. whenTR-7680CAfter entering sleep mode, pull down DTRCan wake up TR-7680C Module.

In settings"AT+CSCLK=0"Mode, pull up DTRPin, there will be no impact, and the normal communication of the serial port function will not be affected.

3.4 USBinterface

TR-7680COwn the wayUSB2.0Interface, not supportedUSBCharging function, not supportedUSB HOSTmode.

USBIt is the main debugging port and software upgrade interface, it is recommended that customers reserve during designUSBTest point, if the main control chip is connected, design Need to be reserved0RThe resistance is used to switch the external test point, as shown in the figure below.

3.4.1 USBReference design

TR-7680Ccan be used asUSBSlave device, supportUSBSleep and wake-up mechanism, the recommended connection circuit diagram is as follows:

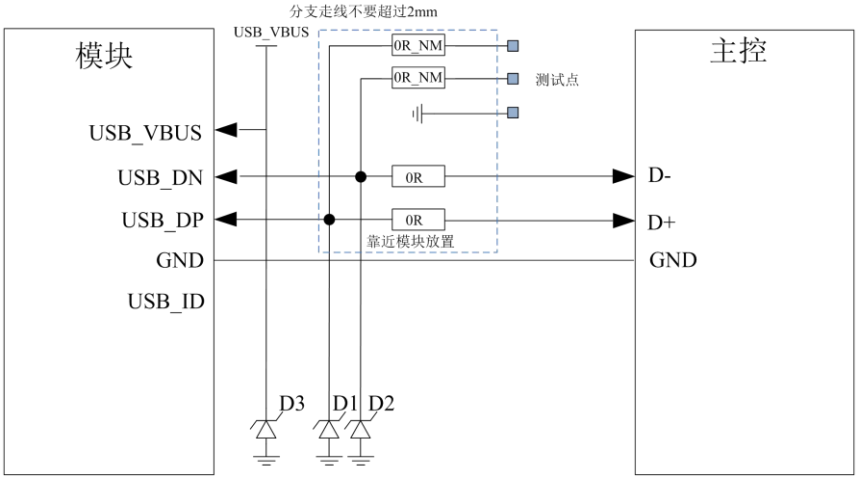

Figure 17:USB Connection Diagram

Customers should pay attention when usingD3The selection of the device, it is recommended to choose the anti-static and anti-surge two-in-one device, you can place oneTVSTube, push Recommended modelESD5681N07.

※ pay attention

1. USB The data line must be strictly 90Ω+/-10%Differential wiring, on the data line TVS Device D1 with D2 Must choose equivalent capacitance Value is less than 1pF of,TVS Device close to USB Connector or test point placement, recommended model ESD73011N withWS05DUCFM.
2. USB2.0 The rate of detection is determined by USB The agreement is automatically completed, and the customer does not need external pull-upsDP, Otherwise it may affect the equipment USB enumerate.

3.4.2 USB_BOOTinterface

The module provides a mandatory download boot interfaceUSB_BOOT.

table 13:USB_BOOT description

Pin number	Pin name	I/O	Function description	Voltage domain	Default state	Remarks
2	USB_BOOT	DI	Force download boot port	1.8V	B-PU	

If the module cannot be turned on due to abnormal upgrade, you can useUSB_BOOTMandatory upgrade.

Before turning on the module, putUSB_BOOTPull your feet down to the ground, and then addVBATPower, pressRESET, The module will enter the download mode. Need to release after entering download modeUSB_BOOT, Remove the drop-down.

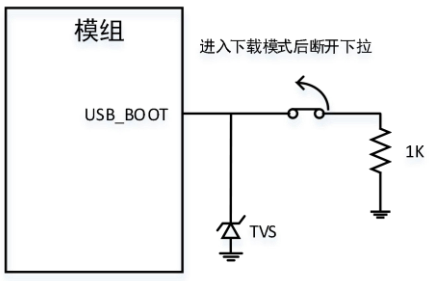

Figure 18:USB_BOOT Connection Diagram

Customers canWindowsThe download port can be viewed in the device manager port of the system.

Figure 19: Mandatory download port

※ pay attention

USB_BOOT It only has the function of compulsory downloading and booting before starting up (cannot be pulled down before normal use), and it has other functions after starting up.

3.5 USIMCard interface

TR-7680Cstand by1.8Vwith3.0V ofUSIMcard.USIMThe interface power of the card is provided by the voltage regulator inside the module, and the normal voltage value is 3Vor1.8V.

table 14:1.8V Mode USIMInterface electrical parameters (USIM_VDD=1.8V)

symbol	description	Minimum	Typical value	Max	unit
USIM_VDD	Output toUSIMPower supply voltage of the card	1.62	1.8	1.98	V
V_{IH}	Input high level voltage	0.7*USIM_VDD	-	USIM_VDD +0.4 V	
V_{IL}	Input low-level voltage	-0.4	0	0.25*USIM_VDD V	
V_{OH}	Output high level voltage	USIM_VDD -0.4	-	USIM_VDD V	
V_{OL}	Output low-level voltage	0	0	0.2 V	

table 15:3.0V Mode USIMInterface electrical parameters (USIM_VDD=3V)

symbol	description	Minimum	Typical value	Max	unit
USIM_VDD	Output toUSIMPower supply voltage of the card	2.7	3	3.3	V
V_{IH}	Input high level voltage	0.7*USIM_VDD	-	USIM_VDD +0.4 V	
V_{IL}	Input low-level voltage	-0.4	0	0.25*USIM_VDD V	
V_{OH}	Output high level voltage	USIM_VDD -0.45-		USIM_VDD V	
V_{OL}	Output low-level voltage	0 0		0.3 V	

3.5.1 USIMReference design

The picture below isUSIMRecommended interface circuit for the card. For protectionUSIMCard, recommendedST (www.st.com)company'sESDA6V15WDevice orON SEMI (www.onsemi.com)company'sSMF15CThe device is used for electrostatic protection.SIMThe peripheral circuit components of the card should be close toUSIMcard

Seat placement.8PinUSIMThe recommended circuit of the deck is shown in the figure below.

The reference circuit is shown in the figure below.

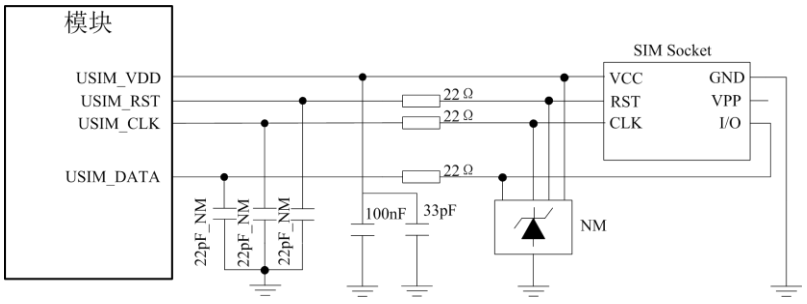

Figure 20:USIMInterface recommended circuit

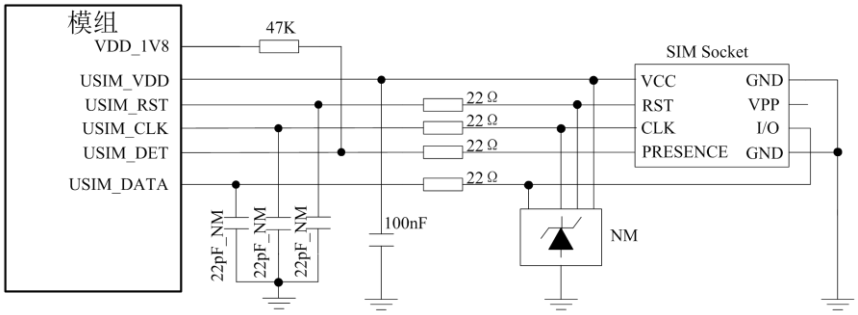

Figure twenty one:USIMInterface recommended circuit (8PIN)

※ pay attention

USIM_DATA passed 4.7KΩThe resistor is pulled up to USIM_VDD, The external circuit does not need to be pulled up. In addition, inUSIM_VDD Up 100nF It is recommended that decoupling capacitors must be retained. For more onUSIMCard-operated AT Command, please refer to the document [1].

SIMThe card circuit is more susceptible to interference, causing the card not to be read or dropped, so please follow the following principles when designing:

in PCB The layout stage must be USIMThe deck is far away from the main antenna.

USIMKeep the card wiring as far away as possible RF line,VBAT And high-speed signal lines, at the same timeUSIMThe card trace should not be too long.

USIMDeckGND To be with the moduleGNDMaintain good connectivity so that the twoGNDEquipotential. To prevent USIM_CLK For other signal interference, it is recommended toUSIM_CLK Do a separate package to protect the treatment. Suggest atUSIM_VDD Signal line closeUSIMPlace a deck 220nF capacitance.

ApproachingUSIMWhere to place the deck TVS, The TVS The parasitic capacitance should not be greater than 50pF Like ESD9L5.0ST5G.

inUSIMSeries connection between deck and module 22ΩResistance can be enhanced ESD Protection performance. In order to make the routing the most smooth, it is recommended to use a single channelTVS, Placed close to each pin of the card socket.

USIM_CLK The signal is very important and the customer should ensure USIM_CLK The rising and falling edge time of the signal is less than 40ns, Otherwise There may be abnormalities in card recognition.

※ pay attention

If the customer is designing an in-vehicle product, please choose the one with better reliability push-push Structural SIMDeck.

3.6 Analog audio interface

TR-7680CProvide a set of analog audio interfaces, integrated audio codec and audio front end, provide1Analog audioMICInput interface and1 Analog audioSPKThe output interface, the customer can make a voice call with an external handle.

ADC: 90dB SNR@20 ~20kHz

DAC: 95dB SNR@20 ~20kHz

(Class-AB): THD< -85dB@32-ohm

table 16: Analog audio output (AVDD_AUD=1.8V,T=25°C)

parameter	condition	DR(Typical value)	THD+N(Typical value) Maximum power
ADC	RL=10K	101dBA	-96dB(@vout -2dBv) 1.59Vp
Class-AB	Mono,32Ω Difference	100dBA	-90dB(0.00316%) (@20mW output) 37mW

3.6.1 Analog audio reference design

The recommended circuit for analog audio is shown in the figure below:

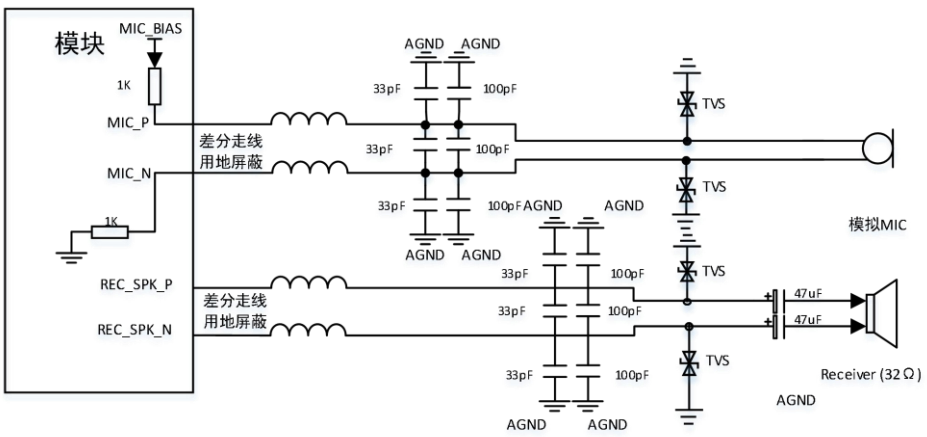

Figure twenty two：Recommended circuit for analog audio interface

3.7 Network status indication

NETLIGHTCan indicate the current network status, usually used to drive the network statusledLamp, its reference circuit is as follows:

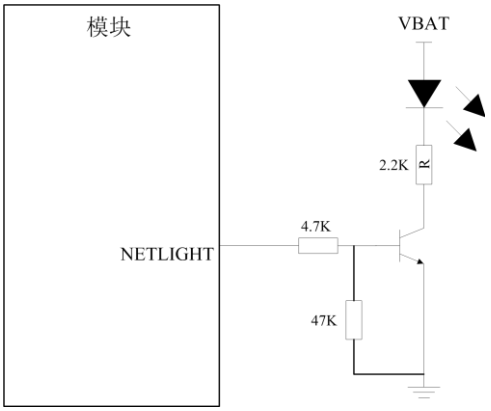

Figure twenty three:NETLIGHT Reference circuit

※ pay attention

Resistance in the picture aboveRThe resistance value depends on VBAT and led Depending on the specific parameters.

NETLIGHTThe signal is used to control the indicator of the network statusledLamp, the working status of this pin is as follows:

table 17:LTEUnder standardNETLIGHT Working status

Network light status	Module working status
Chang Liang	Looking for net
200ms bright/ 200ms Go out	The data connection has been established, or the network has been registered
Go out	Shut down, or conditions AT+CSCLK=1,andDTRBe pulled up.

3.8 Other interfaces

3.8.1 Analog-to-digital converter (ADC)

TR-7680Cprovided1roadADC, Its electrical characteristics are as follows:

table 18:ADC Electrical characteristics

characteristic	Minimum	Typical value	Max	unit
ADC Resolution	-	9	-	bits
Input voltage range	0	-	1.8	V
Input resistance	TBD	-	-	MΩ

※ pay attention

ADC During function debugging, use "AT+CADC"Can read ADCThe voltage value on the pin. For more information, please refer to the document [1].

3.8.2 LDO

TR-7680CProvide one power outputVDD_EXT.

VDD_EXTModular systemIOPower supply, only available50mAIt cannot be used as a high-current drive source.

table 19:VDD_EXT Electrical characteristics

symbol	description	Minimum	Typical value	Max	unit
V_{VDD_1V8}	The output voltage	-	1.8	-	V
I_O	Output current	-	-	50	mA

※ pay attention

The power supply is the system power supply. If damage will affect the system startup, it is recommended that the customer add TVS Protection, recommended model ESD56051N.

4 RF parameters

4.1 LTE RF parameters

table 20: Conducted emission power

frequency	power	Minimum
LTE-FDD B1	23dBm +/-2.7dB	<-40dBm
LTE-FDD B3	23dBm +/-2.7dB	<-40dBm
LTE-FDD B5	23dBm +/-2.7dB	<-40dBm
LTE-FDD B8	23dBm +/-2.7dB	<-40dBm
LTE-TDD B34	23dBm +/-2.7dB	<-40dBm
LTE-TDD B38	23dBm +/-2.7dB	<-40dBm
LTE-TDD B39	23dBm +/-2.7dB	<-40dBm
LTE-TDD B40	23dBm +/-2.7dB	<-40dBm
LTE-TDD B41	23dBm +/-2.7dB	<-40dBm

table twenty one:4G Frequency band information

E-UTRABand number	Uplink operating frequency band	Downstream operating frequency band	Duplex mode
1	1920 ~1980 MHz	2110 ~2170 MHz	FDD
3	1710 ~1785 MHz	1805 ~1880 MHz	FDD
5	869~894 MHz	824~849 MHz	FDD
8	880 ~915 MHz	925 ~960 MHz	FDD
34	2010~2025 MHz	2010~2025 MHz	TDD
38	2570 ~2620 MHz	2570 ~2620 MHz	TDD
39	1880 ~1920 MHz	1880 ~1920 MHz	TDD
40	2300 ~2400 MHz	2300 ~2400 MHz	TDD
41	2535 ~2655 MHz	2535 ~2655 MHz	TDD

table twenty two: Reference sensitivity (QPSK)

E-UTRA Band number	3GPPstandard						Measured value	Duplex
	1.4 MHz 3	Hz	5MHz	10MHz	15 MHz	20 MHz 1	MHz m	de
1	-	-	-100	-97	-95.2	-94	TBD	FDD
3	-101.7	-98.7	-97	-94	-92.2	-91	TBD	FDD
5	-103.2	-100.2	-98	-95	-	-	TBD	FDD

8	-102.2	-99.2	-97	-94	-	-	TBD	FDD
34	-	-	-100	-97	-95.2	-	TBD	TDD
38	-	-	-100	-97	-95.2	-94	TBD	TDD
39	-	-	-100	-97	-95.2	-94	TBD	TDD
40	-	-	-100	-97	-95.2	-94	TBD	TDD
41	-	-	-99	-96	-94.2	-93	TBD	TDD

4.2 LTE Antenna requirements

For better overall performance, it is recommended that the antenna design refer to the index requirements in the following table.

table twenty three:LTEAntenna requirements

Antenna index	Index requirements
Working frequency	Reference table twenty one
Directionality	Omni Directional
Gain	>-3dBi (Avg)
impedance	50 Ω
effectiveness	> 50%
Maximum input power	50W
VSWR	<2
Isolation	> 20dB
PCBWire insertion loss (<1GHz)	<0.5dB
PCBWire insertion loss (1GHz~2.2GHz)	<1dB
PCBWire insertion loss (2.3GHz~2.7GHz)	<1.5dB

4.3 Antenna reference design

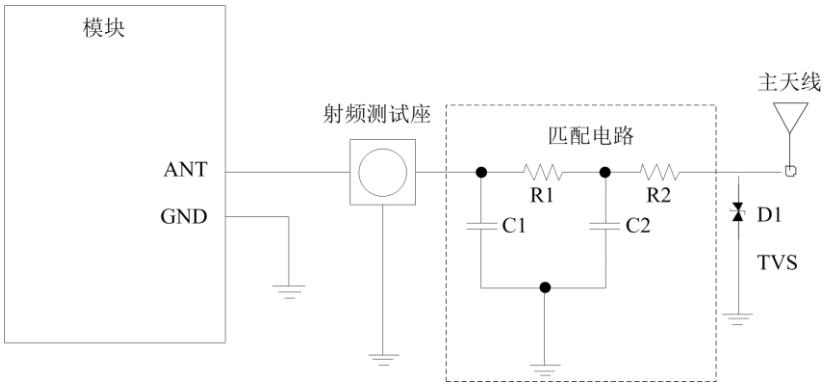

Figure twenty four：Passive antenna connection circuit

In the matching circuit in the figure aboveR1,C1,C2withR2The specific value of is usually provided by the antenna factory and determined by the antenna optimization. among them,R1withR2 Default post0Ω,C1withC2Not posted by default.D1Two-wayTVSDevice, it is recommended to choose to paste, the capacitance value requirement is less than0.2pFTo avoid module internals Pieces are damaged. recommendedTVSModels are as follows:

table twenty four:TVS Recommended model list

Encapsulation	model	supplier
0201	CE0201S05G01R	Shuoke
0402	PESD0402-03	PRISEMI

4.4 PCBLayout design

User at PCB When wiring, pay attention to the module ANT Port to antenna connector PCB The impedance design of the trace, the trace length is recommended to be controlled within 20mmWithin and away from interference signals such as power clocks. It is recommended to reserve an RF test socket to facilitate conduction testing. Reference model of the RF test socket ECT:818011998.

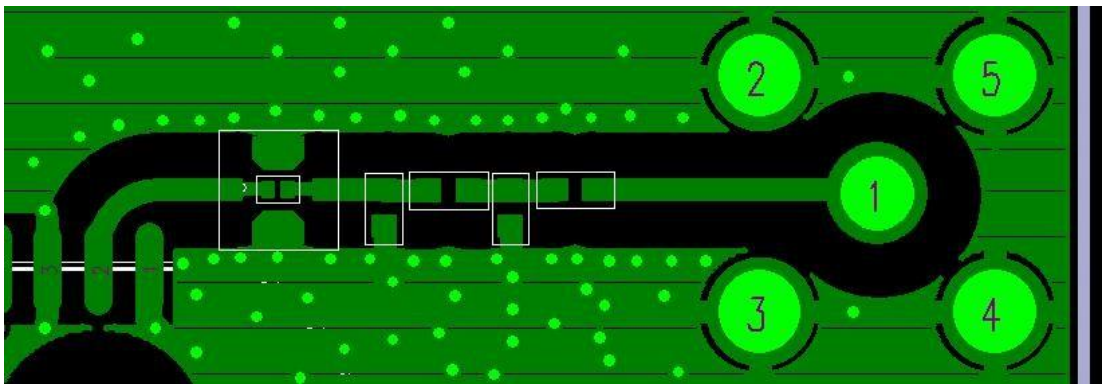

Figure 25:PCB Wiring reference

5 Electrical parameters

5.1 Limit parameters

The following table shows the state of the absolute maximum value under abnormal working conditions. Exceeding these limit values may cause permanent damage to the module.

table 25：Limit parameters

parameter	Minimum	Typical value	Max	unit
VBAT Pin limit voltage	-0.5	-	4.8	V
VBUS Pin limit voltage	-0.5	-	5.4	V
IOLimit voltage: GPIO,UART	-0.3	-	2.0	V
IOLimit voltage:	-0.3	-	2.0	V
USIM	-0.3	-	3.9	V
PWRKEY,RESET	-0.3	-	4.8	V

5.2 Normal working conditions

table 26：Recommended working voltage of the module

parameter	Minimum	Typical value	Max	unit
VBAT Pin working voltage	3.4	3.8	4.2	V
VBUS Pin working voltage	3.0	5.0	5.2	V

table 27:1.8V Digital interface characteristics

parameter	description	Minimum	Typical value	Max	unit
V_{IH}	Input high level voltage	VCC*0.7	1.8	VCC+0.2	V
V_{IL}	Input low-level voltage	-0.3	0	VCC*0.3	V
V_{OH}	Output high level voltage	VCC-0.2	-	-	V
V_{OL}	Output low-level voltage	0	-	0.2	V
I_{OH}	High-level output current (when the module is not equipped with a pull-down resistor)	-	-	13	mA
I_{OL}	Low-level output current (when the module is not equipped with a pull-up resistor)		-	13	mA
I_{IH}	High-level input current (when the module is not equipped with a pull-down resistor)	-	-	10	uA
I_{IL}	Low-level input current (when the module is not equipped with a pull-up resistor)-1		-	-	uA

※ pay attention

The above parameters apply to: GPIO, UART with USB_BOOT.

table 28: Module operating temperature

parameter	Minimum	Typical value	Max	unit
Normal working temperature	-30	+ 25	+ 80	°C
Extended operating temperature	-40	+ 25	+ 85	°C
storage temperature	-45	+ 25	+90	°C

※ pay attention

When working under extended operating temperature, the module's radio frequency specifications may not meet 3GPP specification.

5.3 Operating mode

5.3.1 Working mode definition

The following table briefly introduces the various working modes that will be mentioned in the following chapters.

table 29: Working mode definition

Mode function		definition
Normal working mode	LTE Dormant	In this state, the current consumption of the module will be reduced to a minimum, and the module can still receive paging messages and SMS.
	LTE idle	The software runs normally, the module has been registered on the network, and can send and receive data at any time.
	LTE call	Two users are connected. In this case, the power consumption of the module is related to the network and the configuration of the module.
	LTE Standby	The module is ready for data transmission at any time, but it is not currently sending or receiving data. In this case, power consumption depends on network conditions and configuration.
	LTE data transmission	The data is being transferred. In this case, the power consumption depends on the network conditions (for example: power control level), the data rate of the uplink and downlink data links, and the network configuration (for example: using a multi-slot configuration).
Minimal function mode		In the case of uninterrupted power, you can use "AT+CFUN=0" The command configures the module to the minimum function mode. under these circumstances,RF Partial sum USIMThe card part is not working, but the serial port and USB It can still be used, and the power consumption is lower than in
Flight mode		normal working mode. In the case of uninterrupted power, use"AT+CFUN=4" Command or pull down

	FLIGHTMODE Pin to configure the module into flight mode. under these circumstances, RF Part does not work, but the serial port andUSB It can still be used, and the power consumption is lower than in normal working mode.
Shutdown mode	by "AT+CPOF"Command or pull down PWRKEY Pin can be turned off TR-7680C. At this time, all power supplies inside the module are turned off, and the software stops running. Serial port and USB None are available.

5.3.2 Sleep mode

In sleep mode, the current consumption of the module will be reduced to a minimum, but the module can still receive paging messages andSMS. When the module meets the following software and hardware conditions,TR-7680CCan automatically enter sleep mode:

UARTcondition

USBcondition

Software setting conditions

For more information about sleep mode, please refer to the document [twenty four].

5.3.3 Function mode

You can pass the command "AT+CFUN=<fun>"Set the module to this mode. This command provides three options for setting different functions. can.

AT+CFUN=0: Minimum function mode;

AT+CFUN=1: Full function mode (default);

AT+CFUN=4: Airplane mode.

Set up"AT+CFUN=0"After the module enters the minimum function mode, the radio frequency function andUSIMThe function of the card. In this case, the serial port andUSBIt can still be used, but with radio frequency andUSIMCard-related functions and partsATThe command cannot be used.

Set up"AT+CFUN=4"After that, the module enters the flight mode and turns off the radio frequency function. In this case, the serial port of the module andUSBIt can still be used, but the RF-related functions and someATThe command cannot be used.

When the module enters the minimum function mode or enters the flight mode, it can be commanded"AT+CFUN=1"Return it to full function mode. related"AT+CFUN"For command details, please refer to the document [1].

5.4 Current consumption

table 30:VBATCurrent consumption (VBAT=3.8V)

LTESleep/idle	
LTE supply current (WithoutUSB connection)	Typical sleep mode:TBD Typical values of idle mode:TBD
LTE data transmission	
LTE-FDD B1	@5MHz 23.0dBm Typical value:TBD @10MHz 23.0dBm Typical value:TBD @20MHz 23.0dBm Typical value:TBD

LTE-FDD B3	@5MHz 23.0dBm Typical value:TBD @10MHz 23.0dBm Typical value:TBD @20MHz23.0dBm Typical value:TBD
LTE-FDD B5	@5MHz23.0dBm Typical value:TBD @10MHz 23.0dBm Typical value:TBD
LTE-FDD B8	@5MHz23.0dBm Typical value:TBD @10MHz 23.0dBm Typical value:TBD
LTE-TDD B34	@5MHz 23.0dBmTypical value:TBD @20MHz 23.0dBmTypical value: TBD
LTE-TDD B38	@5MHz 23.0dBmTypical value:TBD @20MHz 23.0dBmTypical value:TBD
LTE-TDD B39	@5MHz 23.0dBmTypical value:TBD @20MHz 23.0dBmTypical value:TBD
LTE-TDD B40	@5MHz 23.0dBmTypical value:TBD @20MHz 23.0dBmTypical value:TBD
LTE-TDD B41	@5MHz 23.0dBmTypical value:TBD @20MHz 23.0dBmTypical value:TBD

5.5 Static Protection

TR-7680CIt is an electrostatic sensitive device. Therefore, users must pay attention to electrostatic protection when producing, assembling and operating the module. The electrostatic performance parameters of the module

The numbers are as follows:

table 31:ESD Performance parameters (temperature:25°C, humidity:45%)

Pin	Contact discharge	Air discharge
VBAT, GND	TBD	TBD
Antenna port	TBD	TBD
USB interface	TBD	TBD
UART interface	TBD	TBD
Other pins	TBD	TBD

6 Patch production

6.1 Top and bottom views of the module

Figure 26: Top view and bottom view of the module

※ pay attention

The above is the module design renderings for reference, and the actual appearance is subject to the actual product.

6.2 Label Information

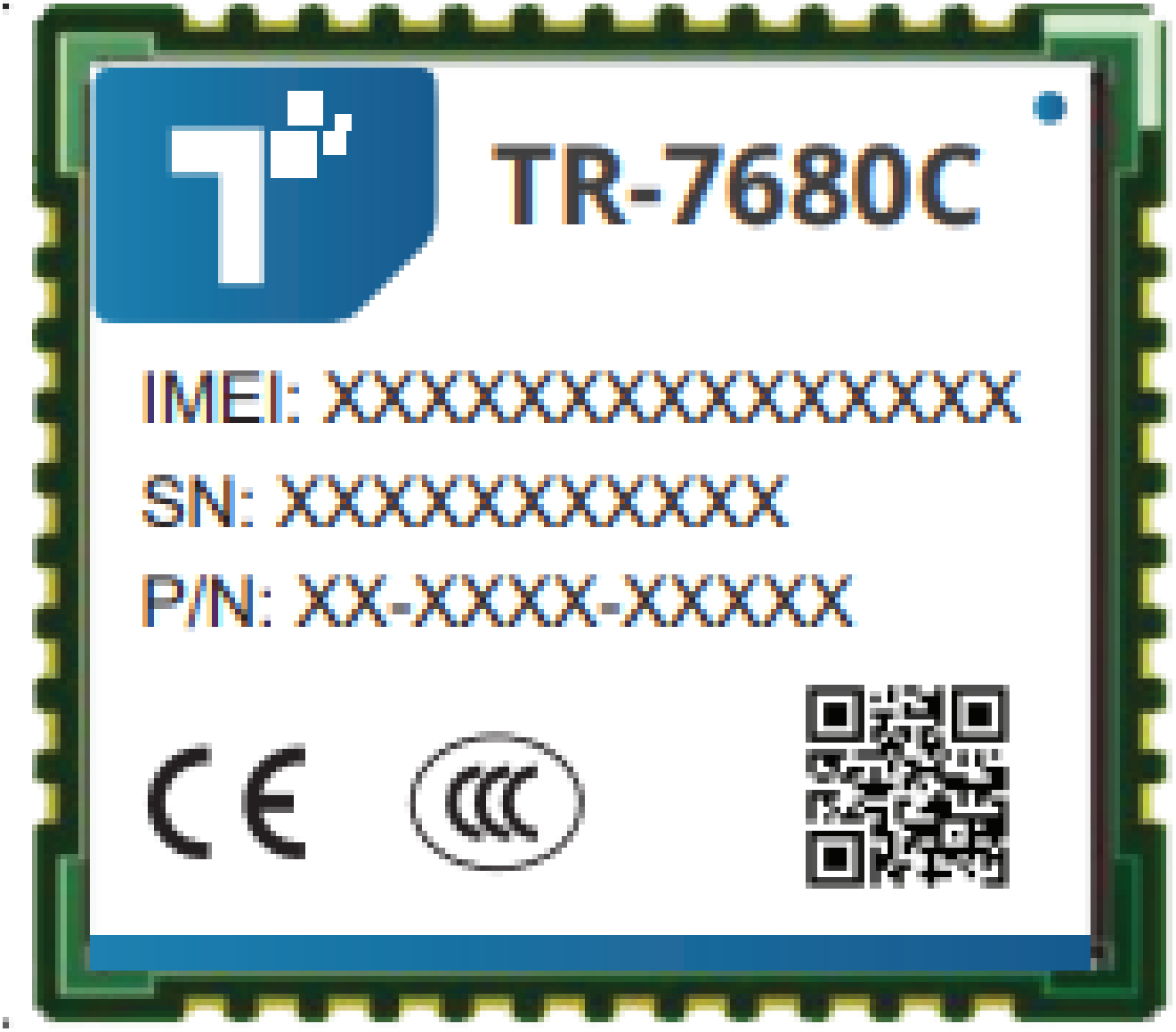

Figure 27:Label Information

table 32: Module information description

Item	description
A	Project name
B	Product Code
C	Module SN number
D	Module IMEI number
E	QR code

6.3 Typical welding furnace temperature curve

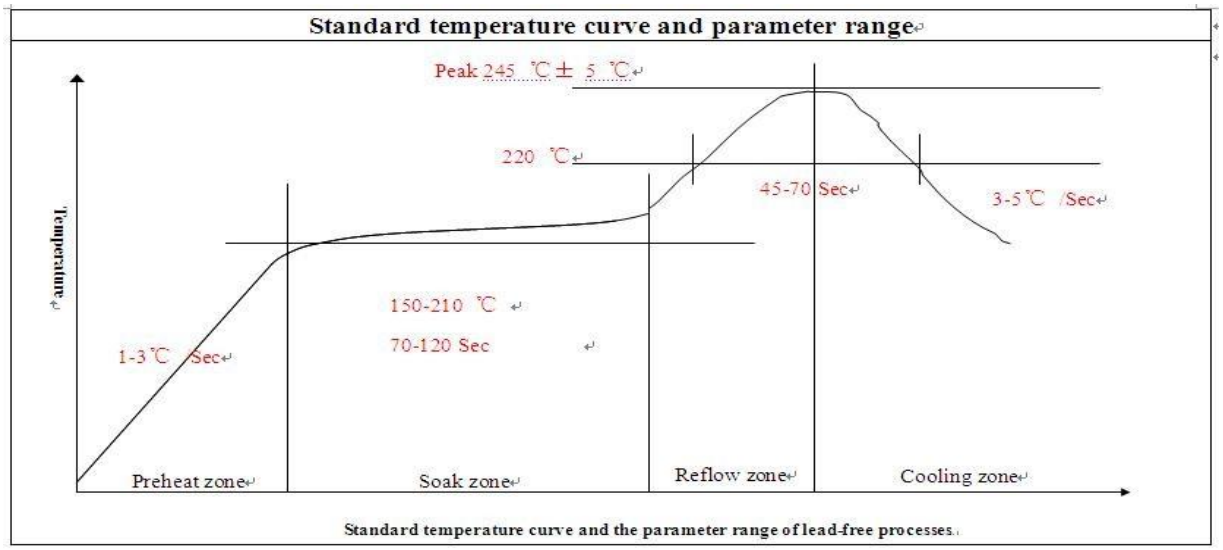

Figure 28：Recommended soldering furnace temperature curve (lead-free process)

※ pay attention

Please refer to the document for more introduction to the second patch [twenty one].

6.4 Humidity sensitive characteristics

TR-7680CThe humidity sensitivity of the module is3level. If any one of the following two conditions is met,TR-7680CThe module should be fully baked before reflow soldering, otherwise the module may cause permanent damage during the reflow soldering process.

After unpacking or vacuum packaging is damaged and leaks, the temperature <30Degree and relative humidity<60%Under the environmental conditions,TR-7680CModule required168hour InsideSMTPatch. If the above conditions are not met, bake is required.

If the vacuum package is not opened, but the shelf life has expired, baking is also required.

Baking conditions: when the humidity is less than5% ,temperature40+5/-0°C Conditions need to bake192 Hours; when the humidity is less than5% ,temperature85+5/-0°C Conditions need to bake72Hours (if using a tray, please pay attention to whether the tray is resistant to thermal deformation).

table 33：Module humidity sensitivity characteristics

grade	Floor life (factory environment≦+30°C/60%RH)
1	Guaranteed indefinitely in the environment≦+30°C/85% RH Under conditions
2	1 year
2a	4 week
3	168 hour

4	72 hour
5	48 hour
5a	twenty four hour
6	Use it after forced baking. After baking, the module must be patched within the time limit specified on the label.

※ pay attention

Product handling, storage, and processing must be followed IPC/JEDEC J-STD-033.

7 package

TR-7680CModule packaging is processed in an automatic assembly line, and modules support pallet packaging.

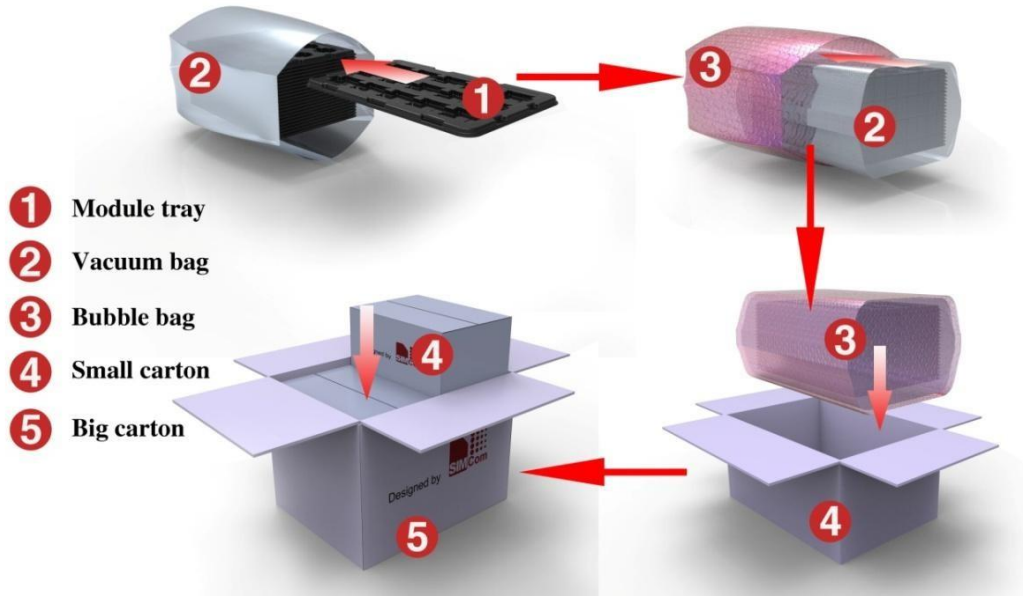

Figure 29：Schematic diagram of pallet packaging

Below isTR-7680CtrayDimensions:

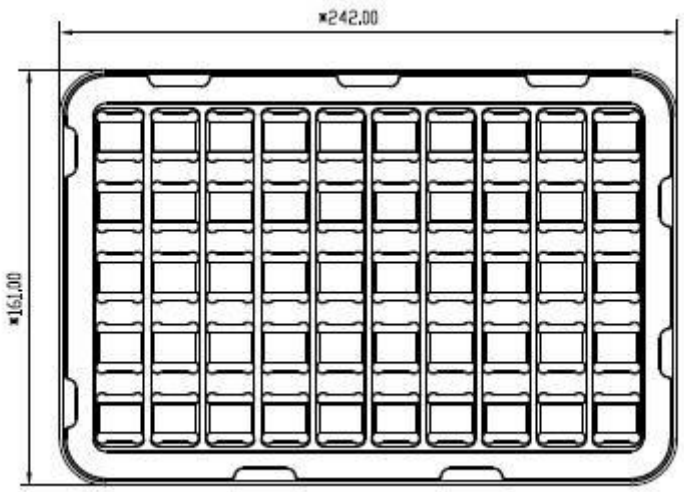

Figure 30：Tray size chart

table 34: Pallet size information

Pallet length (±3mm)	Pallet width (±3mm)	Number of standard packages

242.0	161.0	50

Below is a small cartoon box on a pallet (Small carton)Dimensions:

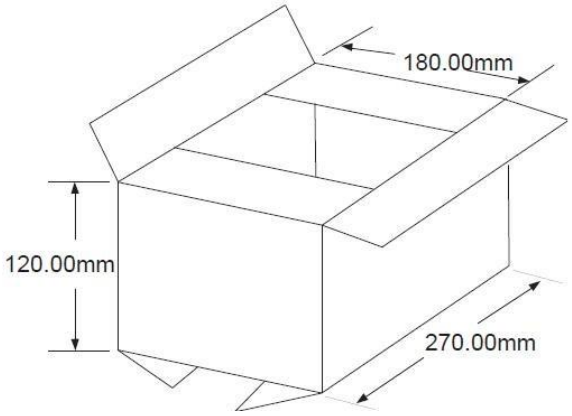

Figure 31：Dimensional drawing of small cartoon pallet box

table 35：The size information of the pallet cartoon box

Box length (±10mm)	Box width (±10mm)	Box height (±10mm)	Number of standard packages
270	180	120	50*20=1000

The following is the size drawing of the pallet large cartoon box:

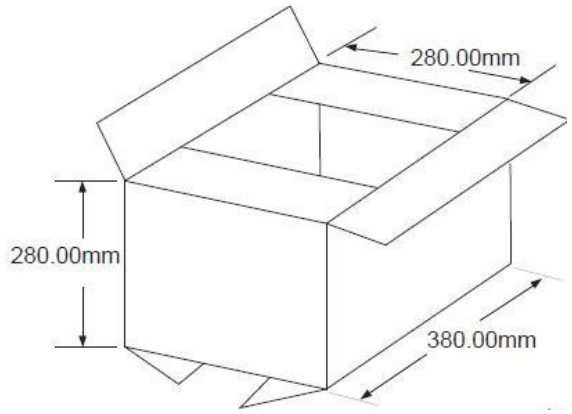

Figure 32：Dimensional drawing of pallet large cartoon box

table 36：Size information of pallet large cartoon box

Box length (±10mm)	Box width (±10mm)	Box height (±10mm)	Number of standard packages
380	280	280	1000*4=4000

8 appendix

8.1 Encoding method and maximum data rate

table 37: Coding method and maximum data rate

LTE-FDD device l category(Downlink)	x data rate(peak)	Modulation type
Category 1	10Mbps	QPSK/16QAM/64QAM
Category 2	50Mbps	QPSK/16QAM/64QAM
Category 3	100Mbps	QPSK/16QAM/64QAM
Category 4	150Mbps	QPSK/16QAM/64QAM
LTE-FDD device l category(Uplink)	**x data rate(peak)**	**Modulation type**
Category 1	5Mbps	QPSK/16QAM
Category 2	25Mbps	QPSK/16QAM
Category 3	50Mbps	QPSK/16QAM
Category 4	50Mbps	QPSK/16QAM

Serial numb r	file name	Annotation
[1]	TR-7680C Series_AT Command Manual _V1.00.04	AT Command Manual
[2]	ITU-T Draft new recommendationV.25ter	Serial asynchronous automatic dialing and control
[10]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[11]	3GPP TS 34.124	Electromagnetic CompatibilityEMC) for mobile terminals and ancillary equipment.
[12]	3GPP TS 34.121	Electromagnetic CompatibilityEMC) for mobile terminals and ancillary equipment.
[13]	3GPP TS 34.123-1	Technical Specification Group Radio Access Network; Terminal conformance specification; Radio transmission and reception (FDD)
[14]	3GPP TS 34.123-3	User Equipment (UE) conformance specification; Part 3: Abstract Test Suites.
[15]	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
[16]	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
[17]	IEC/EN60950-1(2001)	Safety of information technology equipment (2000)
[18]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[19]	GCF-CC V3.23.1	Global Certification Forum-Certification Criteria
[20]	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)
[twenty one]	Module secondary-SMT-UGD-V1.xx	Module secondary SMT Guidelines
[twenty two]	TR-7680CSeries_UART_Application Note_V1.xx	This document describes how to use UART interface of Technoration modules.
[twenty three]	Antenna design guidelines for	Antenna design guidelines for diversity receiver system

8.2 Reference documents

table 38: Reference documents

	diversity receiver system	
[twenty four]	TR-7680C Series_Sleep Mode_Application Note_V1.xx	Sleep Mode Application Note
[25]	TR-7680C Series_UIM HOT SWAP_Application Note_V1.00	This document introduces UIM card detection and UIM hot awsp

the term	Explanation
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
ESD	Electrostatic Discharge
ETS	European Telecommunication Standard
FR	Full Rate
GPRS	General Packet Radio Service
GSM	Global Standard for Mobile Communications
HR	Half Rate
IMEI	International Mobile Equipment Identity
Li-ion	Lithium-Ion
MO	Mobile Originated
MS	Mobile Station (GSM engine), also referred to as TE
MT	Mobile Terminated
PAP	Password Authentication Protocol
PBCCH	Packet Broadcast Control Channel
PCB	Printed Circuit Board
PCL	Power Control Level
PCS	Personal Communication System, also referred to as GSM 1900
PDU	Protocol Data Unit
PPP	Point-to-point protocol
RF	Radio Frequency
RMS	Root Mean Square (value)
RTC	Real Time Clock
RX	Receive Direction
SIM	Subscriber Identification Module
SMS	Short Message Service
TE	Terminal Equipment, also referred to as DTE
TX	Transmit Direction

8.3 Terminology and explanation

table 39: Terminology and explanation

UART	Universal Asynchronous Receiver & Transmitter
URC	Unsolicited Result Code
USSD	Unstructured Supplementary Service Data
Phone book abbreviation	
FD	SIM fix dialing phonebook
LD	SIM last dialing phonebook (list of numbers most recently dialed)
MC	Mobile Equipment list of unanswered MT calls (missed calls) SIM
ON	(or ME) own numbers (MSISDNs) list
RC	Mobile Equipment list of received calls
SM	SIM phonebook
NC	Not connect

8.4 safety warning

Pay attention to the following safety precautions when using or repairing any terminal or mobile phone that contains a module. The terminal equipment should inform the user of the following safety information. otherwiseTechnoration Will not bear any consequences arising from the user's failure to follow these warnings.

table 40:safety warning

Logo	Claim
	When in a hospital or next to medical equipment, observe the restrictions on the use of mobile phones. Please turn off the terminal or mobile phone if necessary, otherwise the medical equipment may cause misoperation due to radio frequency interference.
	Turn off the wireless terminal or mobile phone before boarding. In order to prevent interference with the communication system, the use of wireless communication equipment on the aircraft is prohibited. Ignoring the above matters will violate local laws and may lead to flight accidents.
	Do not use mobile terminals or cell phones in front of flammable gases. Turn off your mobile phone terminal when you are near explosive operations, chemical plants, fuel depots, or gas stations. It is very dangerous to operate a mobile terminal near any potentially explosive electrical equipment.
	The mobile phone terminal receives or emits radio frequency energy when it is turned on. When it is close to TV, radio, computer or other electrical equipment, it will cause interference.
	Road safety first! Do not use handheld terminals or mobile phones when driving vehicles, please use hands-free devices. Stop the car before using the handheld terminal or mobile phone.
	GSMMobile phone terminals operate under radio frequency signals and cellular networks, but there is no guarantee that they can be connected under all conditions. For example, no phone bill or invalidSIMcard. When you need emergency services in this situation, remember to use the emergency phone. In order to be able to make and receive calls, the mobile terminal must be turned on and be in a service area where the mobile signal is strong enough. Emergency calls are not allowed when certain network services or phone functions are in use, such as function lock and keyboard lock. Before using the emergency phone, disable these functions. Some networks need to be effectiveSIMCard support.