Y7080E
Hardware Design

LPWA Module

SIMCom Wireless Solutions Limited
SIMCom Headquarters Building, Building 3, No. 289 Linhong Road, Changning District, Shanghai P.R. China
Tel: 86-21-31575100
support@simcom.com
www.simcom.com

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SIMCom Wireless Solutions Limited
SIMCom Headquarters Building, Building 3, No. 289 Linhong Road, Changning District, Shanghai P.R. China
Tel: +86 21 31575100
Email: simcom@simcom.com

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1. Introduction

This document describes the electronic specifications, RF specifications, interfaces, mechanical characteristics and testing results of SIMCom Y7080E module. With the help of this document and other related software application notes/user guides, users can understand and use Y7080E to design and develop applications quickly.

1.1. Product Outline

The Y7080E modules support LTE CAT-NB1/NB2 and GNSS.
The physical dimension of Y7080E is 17.6mm×15.7mm×2.4 mm. And the physical dimension is compatible with the packaging of SIM7080G and SIM7020G.

Table 1: Y7080E Frequency Bands and air interface

Network Type	Band	Y7080E
	Category	NB1/NB2
LTE-FDD* HD-FDD	LTE-FDD B1	
	LTE-FDD B2	
	LTE-FDD B3	✓
	LTE-FDD B4	
	LTE-FDD B5	✓
	LTE-FDD B8	✓
	LTE-FDD B12	
	LTE-FDD B13	
	LTE-FDD B14	
	LTE-FDD B18	
	LTE-FDD B19	
	LTE-FDD B20	✓
	LTE-FDD B25	
	LTE-FDD B26	
	LTE-FDD B27	
	LTE-FDD B28	✓
	LTE-FDD B66	
	LTE-FDD B71	

	LTE-FDD B85	
GNSS	GPS	✓
	GLONASS	✓
	BeiDou	✓
	Galileo	✓

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
- I2C Interface
- SPI Interface
- GPIOs
- Antenna Interface

1.3. Hardware Block Diagram

The block diagram of the Y7080E module is shown in the figure below.

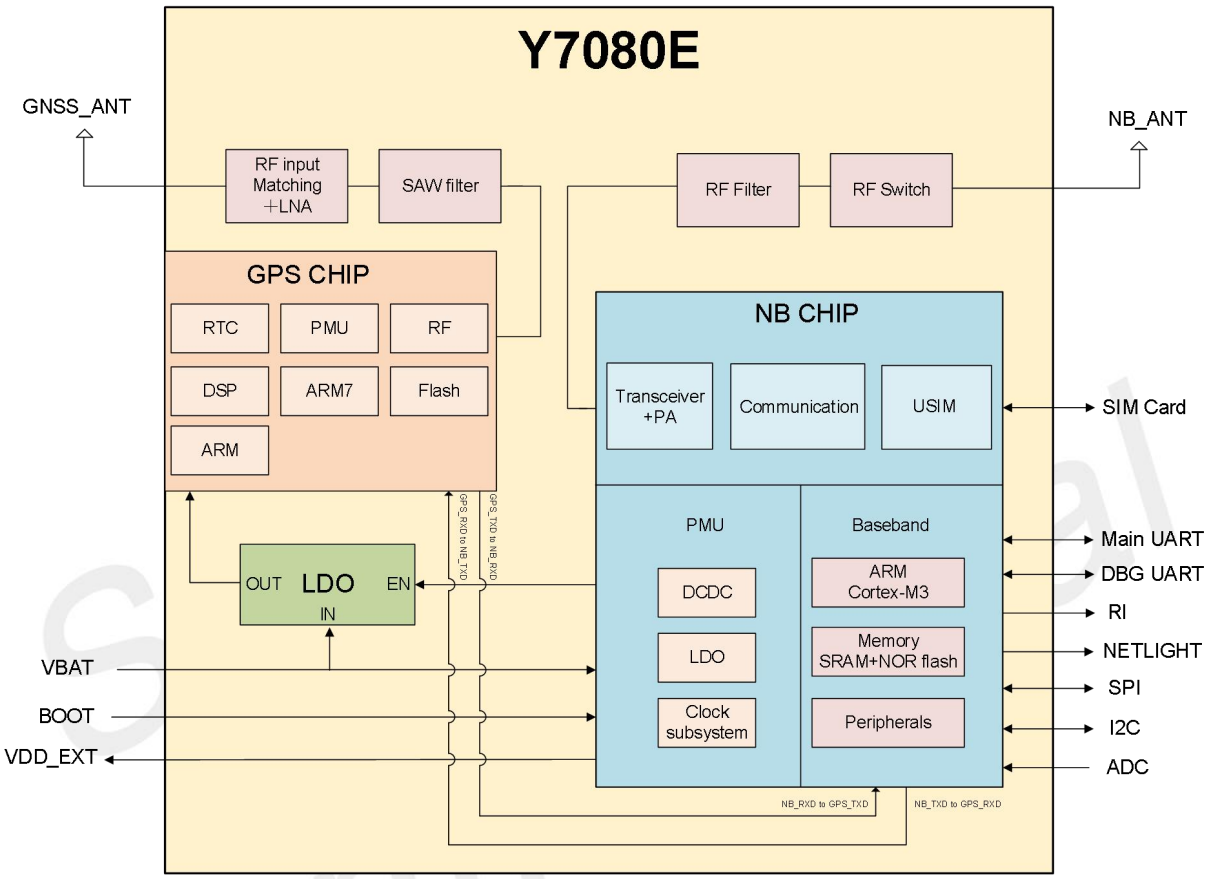

Figure 1: Y7080E block diagram

1.4. Functional Overview

Table 2: General features

Feature	Implementation
Power supply	Power supply voltage：3.0V～4.2V. Default :3.3V
Power saving	Current in PSM mode: 1.7uA @3.6V
Radio frequency bands	Please refer to the table 1
Transmitting power	LTE power class: 3
Data Transmission Throughput	LTE CAT NB2: 127 Kbps (DL) ,158.5Kbps (UL)
Antenna	LTE main antenna.

	GNSS antenna.
GNSS	GNSS engine (GPS, GLONASS, BD and Galileo). Protocol: NMEA.
SIM interface	Support identity card: 1.8V/3.0V.
SPI interface	Support for serial data bus SPI, SPI supports master and slave mode.
UART interface	One channel 2-wire UART1 by default can be used for AT command, data transmission and firmware upgrade. Baud rate: 4800bps to 921600bps. Default rate is 9600bps. Support auto baud rate, but only limited to 4800, 9600, 19200, 38400, 57600 and 115200 bps. Two channel 2-wire UART2 used as software debug and transmit log information.
Firmware upgrade	Firmware upgrade over UART or FOTA
Physical characteristics	Size: 17.6×15.7×2.4mm Weight: 1.2g±0.1g
Temperature range	operation temperature: -40℃ ~ +85℃ Storage temperature -45°C to + 90°C

2. Package Information

2.1 Pin Assignment Overview

The module has 77 pins and provides all the hardware interfaces of the module.

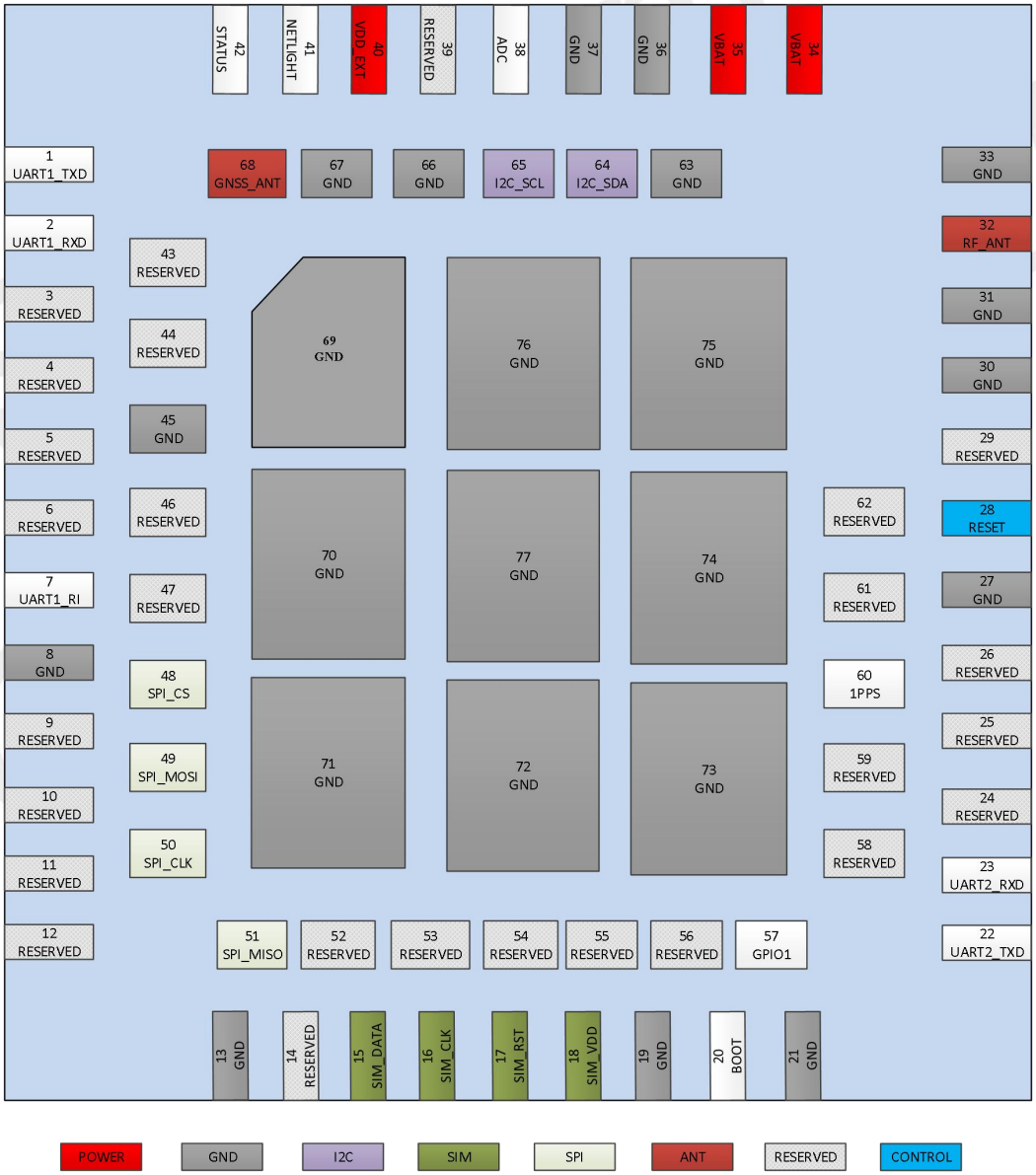

Figure 2: Pin assignment overview

Table 3: Pin definition

Pin No.	Pin Name	Pin No.	Pin Name	Pin No.	Pin Name
1	UART1_TXD	2	UART1_RXD	3	RESERVED
4	RESERVED	5	RESERVED	6	RESERVED
7	UART1_RI	8	GND	9	RESERVED
10	RESERVED	11	RESERVED	12	RESERVED
13	GND	14	RESERVED	15	SIM_DATA
16	SIM_CLK	17	SIM_RST	18	SIM_VDD
19	GND	20	BOOT	21	GND
22	UART2_TXD	23	UART2_RXD	24	RESERVED
25	RESERVED	26	RESERVED	27	GND
28	RESET	29	RESERVED	30	GND
31	GND	32	RF_ANT	33	GND
34	VBAT	35	VBAT	36	GND
37	GND	38	ADC	39	RESERVED
40	VDD_EXT	41	NETLIGHT	42	STATUS
43	RESERVED	44	RESERVED	45	GND
46	RESERVED	47	RESERVED	48	SPI_CS
49	SPI_MOSI	50	SPI_CLK	51	SPI_MISO
52	RESERVED	53	RESERVED	54	RESERVED
55	RESERVED	56	RESERVED	57	GPIO1
58	RESERVED	59	RESERVED	60	1PPS
61	RESERVED	62	RESERVED	63	GND
64	I2C_SDA	65	I2C_SCL	66	GND
67	GND	68	GNSS_ANT	69	GND
70	GND	71	GND	72	GND
73	GND	74	GND	75	GND
76	GND	77	GND		

NOTE

Before the normal power up, BOOT cannot be pulled up.

2.2 Pin Description

Table 4: IO parameters definition

Pin type	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 number	Default status	Description	Comment
Power supply				
VBAT	34,35	PI	Power supply, voltage range: 3.0V～4.2V.	
VDD_EXT	40	PO	Power output 3.0V for other external circuits with Max 50mA current output.	This power supple only use for external GPIO pulling up or level shift circuit. If unused, keep it open.
GND	8, 13, 19, 21, 27, 30, 31, 33, 36, 37, 45, 63, 66, 67, 69, 70, 71, 72, 73, 74, 75, 76, 77		Ground	

RESET				
RESET	28	DI,PD	The reset function of module, active high.	
SIM interface				
SIM_DATA	15	I/O,PU	SIM Card data I/O, which has been pulled up via a 10KR resistor to SIM_VDD internally. Do not pull it up or down externally.	All lines of SIM interface should be protected against ESD.
SIM_RST	17	DO	SIM reset	
SIM_CLK	16	DO	SIM clock	
SIM_VDD	18	PO	Power output for SIM card, its output Voltage depends on SIM card type automatically. Its output current is up to 30mA.	
UART interface				
UART1_TXD	1	DOH	Transmit Data	Main UART port: Used for AT command, data transmission and firmware upgrade. Support fixed baud rate and auto baud rate. Baud rate: 300bps to 3686400bps. Default rate is 0bps (auto baud rate). Support auto baud rate, but only limited to 9600, 19200, 38400, 57600 and 115200 bps.
UART1_RXD	2	DI,PU	Receive Data	
UART1_RI	7	DOH	Ring Indicator	
UART2_TXD	22	DOH	Transmit Data	Software debug and transmit log information
UART2_RXD	23	DI,PU	Receive Data	
I2C interface				
I2C_SDA	64	I/O	I2C data input/output	If unused, keep open, or else pull them up via 1KΩ resistors to the VDD_EXT.
I2C_SCL	65	DO	I2C clock output	
SPI interface				
SPI_CS	48	DO	Chip Select	If unused, please keep them open.
SPI_MOSI	49	DO	Main Controller DATA output.	

SPI_CLK	50	DO	Bus clock output	
SPI_MISO	51	DI	Main Controller DATA input	
GPIO				
NETLIGHT	41	DO	LED control output as network status indication.	If unused, keep them open.
STATUS	42	DO	Operating status output. High level: Power on and firmware ready Low level: Power off	
GPIO1	57	IO	GPIO	
1PPS	60	O	1PPS output	
RF interface				
GNSS_ANT	68	AI	GNSS antenna soldering pad	
RF_ANT	32	AIO	MAIN antenna soldering pad	
Other interface				
BOOT	20	DI,PD	If it needs to enter into forced download mode, it must be pulling up this pin to VDD_EXT before power on. If it needs to boot up normally, please keep this pin open.	Reserve a test points for it. Keep it open. DO NOT PULL UP DURING NORMAL POWER UP!
ADC	38	AI	Analog-digital converter input. voltage range: 0V～1.0V.	If unused, keep them open.
NC	3,4,5,6,9,10,11,12,14,24,25,26,29,39,43,44,46,47,52,53,54,55,56,58,59,61,62		No connection.	Keep it open

NOTE

Please reserve a test point for BOOT and VDD_EXT, ensure protected against ESD.

2.3 Mechanical Information

The following figure shows the package outline drawing of Y7080E.

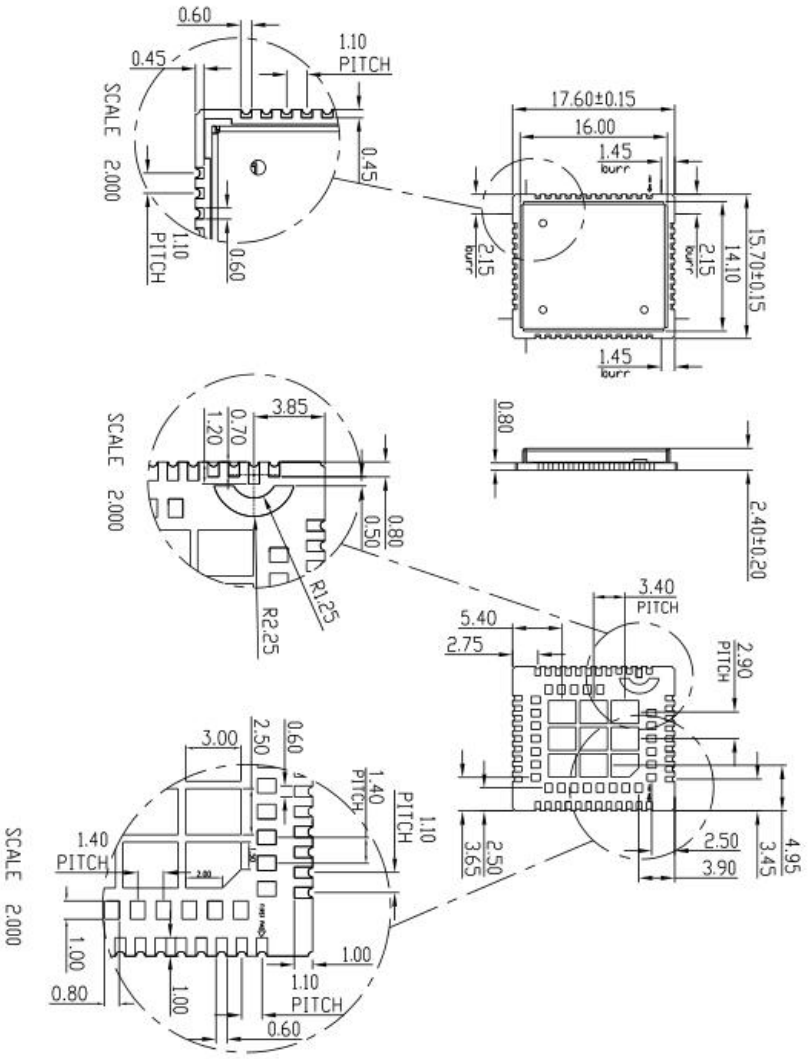

Figure 3: Dimensions (Unit: mm)

2.4 Footprint Recommendation

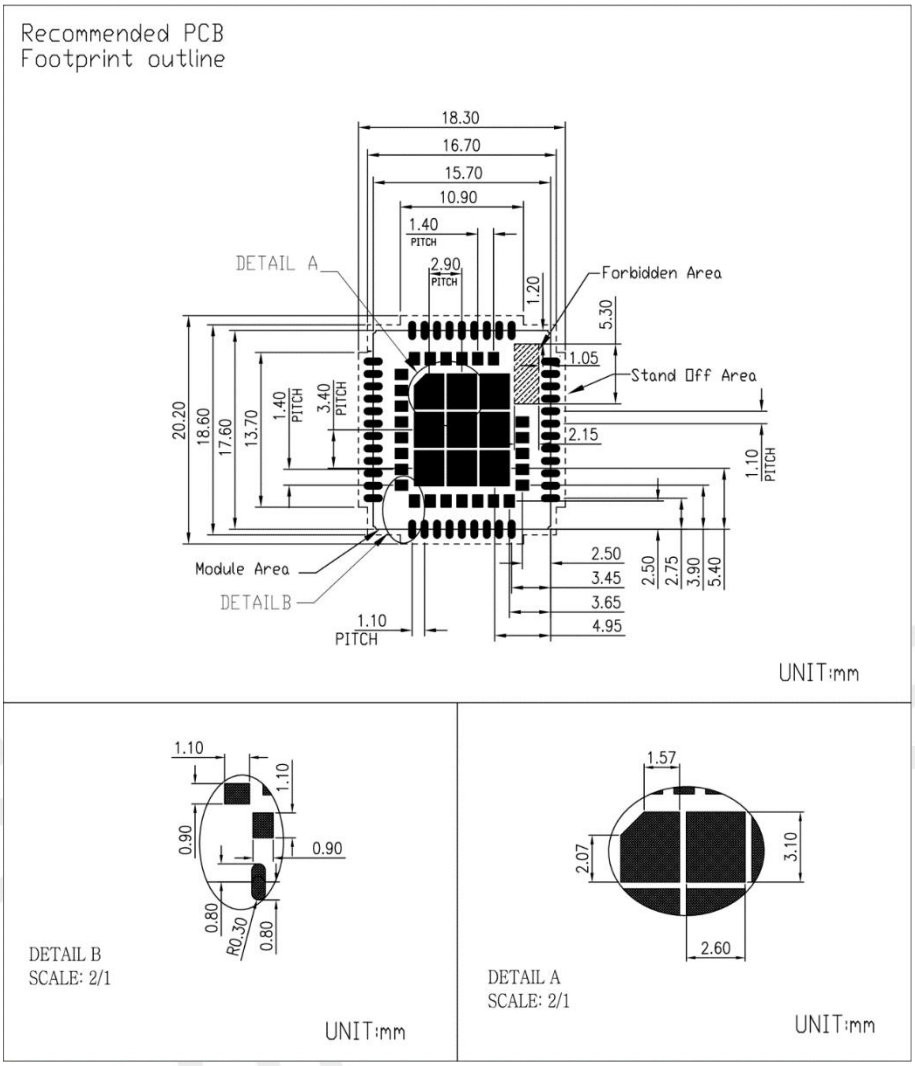

Figure 4: Footprint recommendation (Unit: mm)

3. Interface Application

3.1 Power Supply

Pin 34 and pin 35 are VBAT power input.

On VBAT pads, when module works in the NB-IoT and GNSS cooperative working mode, the ripple current is up to 0.5A typically. For steady voltage, the power supply capability must be up to 0.5A.

Table 6: VBAT pins electronic characteristic

Symbol	Description	Min	Typ	Max	Unit
VBAT	Module power voltage	3.0	3.3	4.2	V
$I_{VBAT(peak)}$	Module power peak current in NB-IoT and GNSS cooperative working mode.	-	0.5	-	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				
$I_{VBAT(PSM)}$	Module power current in PSM mode.	-	1.7	-	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 to ensure that the drop of VBAT is not less than 3.0V even when the module's current consumption reaches the instantaneous maximum. If the voltage drop is less than 3.0V, the module may work abnormally due to the low voltage.

The following figure shows the recommended circuit.

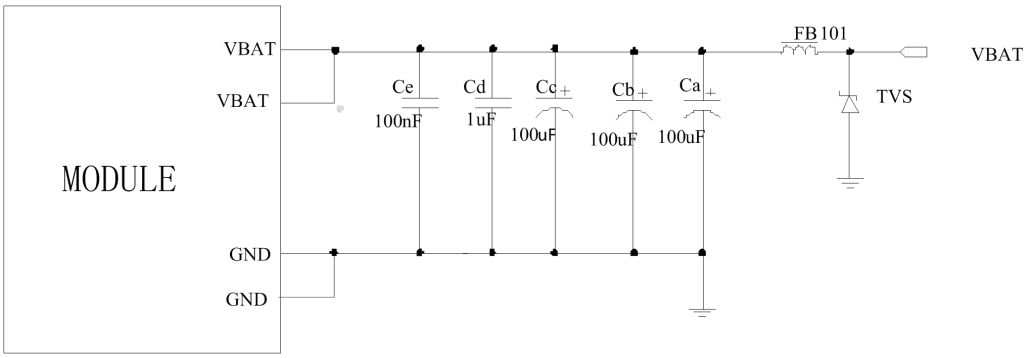

Figure 5: Power supply application circuit

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 mm to minimize PCB trace impedance.

Table 7: 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.
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 Y7080E, it is also necessary to consider the low static power consumption of IC in PSM mode.

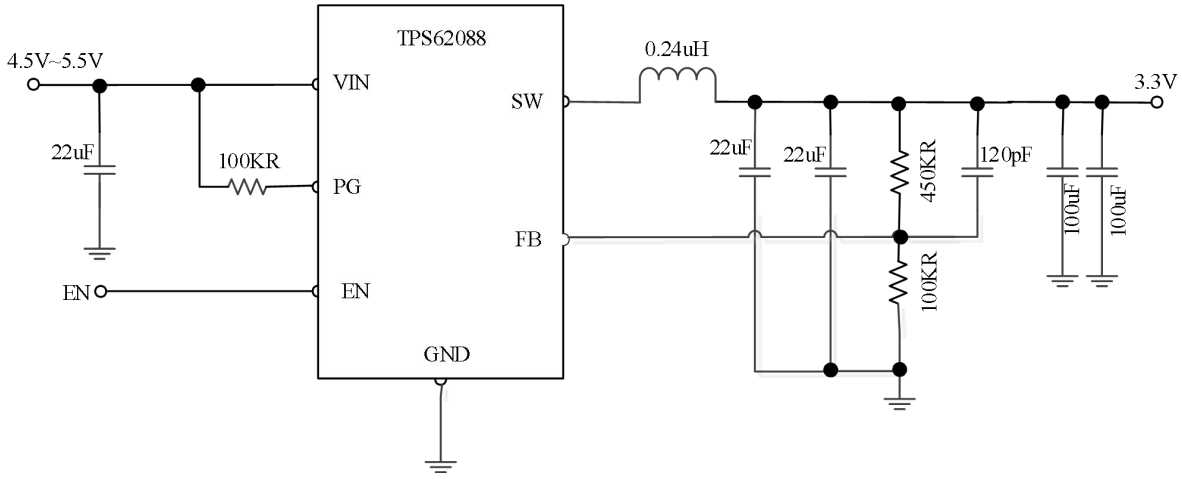

Figure 6: power supply reference circuit

3.1.3. Voltage Monitor*

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

AT command “AT+CBATCHK=1” can be used to enable the overvoltage warning function and the under-voltage warning function. The default value of the overvoltage warning function in the software is 4.4V, and the default value of the under-voltage warning function is 3.0V. If the power supply for VBAT pins is up 4.4V or under 3.0V, module will be warning.

NOTE

The under-voltage warning function is under development.

3.2 Power on/Power off Function

3.2.1. Power on

The module will automatically boot when it is powered on. After ensuring that the BOOT pin is not pulled up by the outside, the module will automatically boot after supplying a voltage of 3.0V to 4.2V to the VBAT pin.

The customer's circuit design must have the function that the master can control the power off of the module.

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

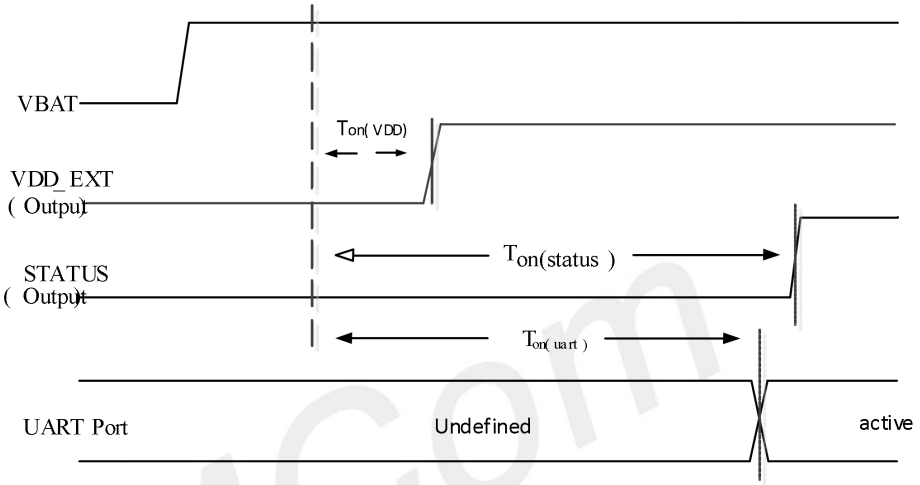

Figure 7: Power on timing sequence

Table 8: Power on timing and electronic characteristic

Symbol	Parameter	Min.	Typ.	Max.	Unit
Ton(Vdd)	The time from power-on issue to VDD_EXT pin output high level.		8		ms
Ton(status)	The time from power-on issue to STATUS pin output high level(indicating power up ready)	120	-	-	ms
Ton(uart)	The time from power-on issue to UART port ready	120	-	-	ms

3.2.2. Power off

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.

NOTE

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.
2. 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.

3.2.3. Reset and Wakeup

The Y7080E can be reset and wakeup by pulling the RESET pin to high level. The effective duration of RESET pin restart can be set by "AT+RESETCTL".

The RESET pin of the module has been pulled down through resistor inside the module, and the high level effective. The recommended reference circuit for transistor control is shown in the figure below.

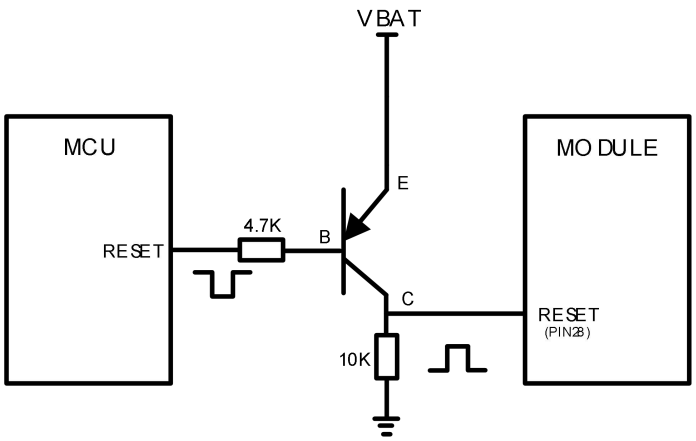

Figure 8: The transistor control RESET reference circuit

The recommended reference circuit for button control is shown in the figure below.

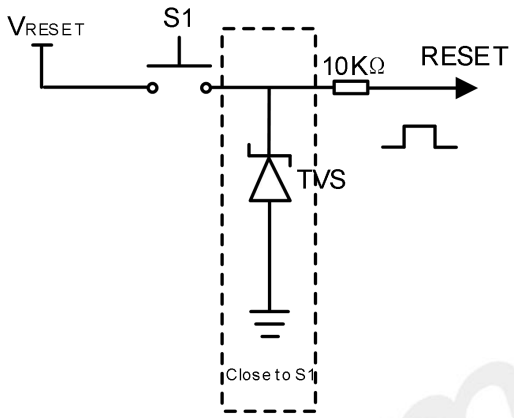

Figure 9: The button control reference circuit

Table 9: RESET pin electrical characteristic

Symbol	Description	Min.	Typ.	Max.	Unit
T_{reset} (Mode 0)	Hold time of Wakeup high level	-	-	15	ms
	Hold time of Reset high level	20	-	-	
T_{reset} (Mode 1)	Hold time of Wakeup high level	-	-	5	s
	Hold time of Reset high level	6	-	-	
V_{Reset}	Input high level voltage on RESET pin	1.1	1.2	4.2	V

NOTE

1. For ESD protection, it is suggested to add a TVS diode near the RESET pin.

3.3 UART Interface

Y7080E can provide 2 channels serial ports:

One channel 2-wire serial port UART1, it can be used for AT command communication and data transmission between the module and the peripheral MCU. UART1 can be used for firmware upgrade, it is strongly recommended to reserve test points for firmware upgrade.

One channel 2-wire serial port UART2, it can be used for software debug and transmit log information.

The UART1 port is used as the AT communication port, it supports auto baud rates and fixed baud rates. The fixe baud rates include: 0, 4800, 9600, 19200, 38400, 57600, 115200, 230400, 460800 and 921600 bps. The rate 0bps marks auto baud rate. And it supports auto baud rate, but the rate only supported on 4800, 9600, 19200, 38400, 57600 and 115200.

3.3.1. UART Design Guide

The following figures show the reference design.

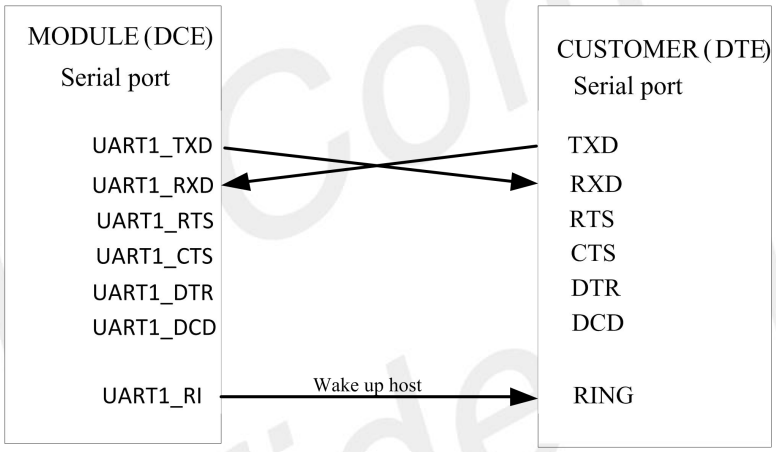

Figure 10: UART null modem

Table 10: UART electronic characteristic

Symbol	Description	Min	Typ.	Max	Unit
V_{IH}	UART input high level voltage	VDDIO-0.3	VDDIO	VDDIO+0.3	V
V_{IL}	UART input low level voltage	-0.3	0	0.3	V
V_{OH}	UART output high level voltage	VDDIO-0.3	VDDIO	VDDIO+0.3	V
V_{OL}	UART output low level voltage	-0.3	0	0.3	V

NOTE

When VBAT is higher than 3V, VDDIO voltage is 3V; when VBAT is lower than 3V, VDDIO voltage will be same as the VBAT.

The Y7080E UART is 3.0V voltage interface. If user's UART application circuit is 1.8V voltage interface, the level shifter circuits should be used for voltage matching. The following figure shows the voltage matching reference design.

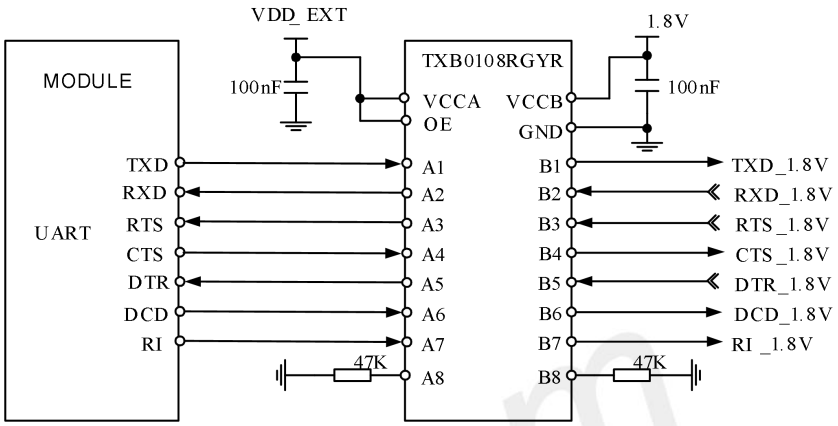

Figure 11: Reference circuit of level shift

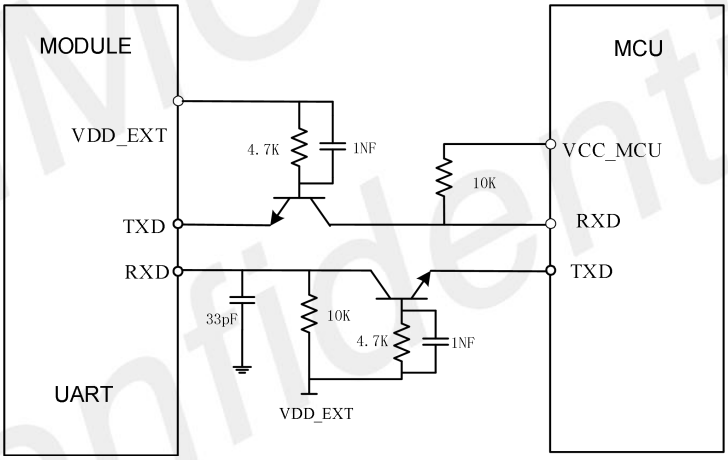

Figure 12: Reference circuit with Transistor

NOTE

1. When it uses the level shifter IC, the pull up resistance on TXD_1.8V, RTS_1.8V, DCD_1.8V and RI_1.8V 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.

3.3.2. RI Behavior

The RI pin description:
The RI pin can be used to interrupt output signal to inform the host controller such as application CPU. Before that, users must use AT command "AT+CFGRI=1" to enable this function.
Normally RI will keep high level until certain conditions such as receiving SMS, or a URC report coming, then it will output a low level pulse 120ms, in the end, it will become high level.

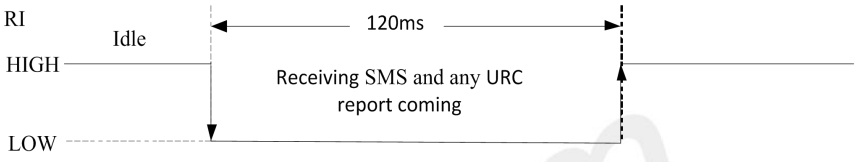

Figure 13: RI behaviour（SMS and URC report）

NOTE

For more details of AT commands about UART, please refer to document [1].

3.4 SIM Interface

Y7080E supports 1.8V and 3.0V SIM cards.

Table 11: SIM electronic characteristic in 1.8V mode (SIM_VDD=1.8V)

Symbol	Parameter	Min.	Typ.	Max.	Unit
SIM_VDD	LDO power output voltage	1.62	1.8	1.98	V
VIH	High-level input voltage	1.62	1.8	1.98	V
VIL	Low-level input voltage	-0.3	0	0.3	V
VOH	High-level output voltage	1.62	1.8	1.98	V
VOL	Low-level output voltage	-0.3	0	0.3	V

Table 12: SIM electronic characteristic in 3.0V mode (SIM_VDD=3.0V)

Symbol	Parameter	Min.	Typ.	Max.	Unit
SIM_VDD	LDO power output voltage	VDDIO-0.3	VDDIO	VDDIO+0.3	V
VIH	High-level input voltage	VDDIO-0.3	3	VDDIO+0.3	V
VIL	Low-level input voltage	-0.3	0	0.3	V
VOH	High-level output voltage	VDDIO-0.3	3	VDDIO+0.3	V
VOL	Low-level output voltage	-0.3	0	0.3	V

NOTE

The module does not support the SIM card hot swap function.

3.4.1 SIM Application Guide

It is recommended to use an ESD protection component such as ESDA6V1W5 produced by ST (www.st.com) or SMF15C produced by ON SEMI (www.onsemi.com). Note that the SIM peripheral circuit should be close to the SIM card socket. The following figure shows the 6-pin SIM card holder reference circuit.

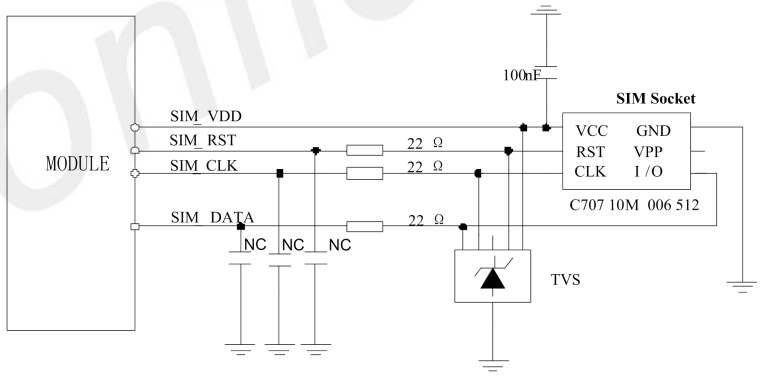

Figure 14: SIM interface reference circuit

SIM_DATA has been pulled up with a 10KΩ 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.

3.5 I2C Interface

Y7080E provides an I2C interface with clock rate up to 400kbps. Its operation voltage is 3.0V.

The following figure shows the I2C bus reference design.

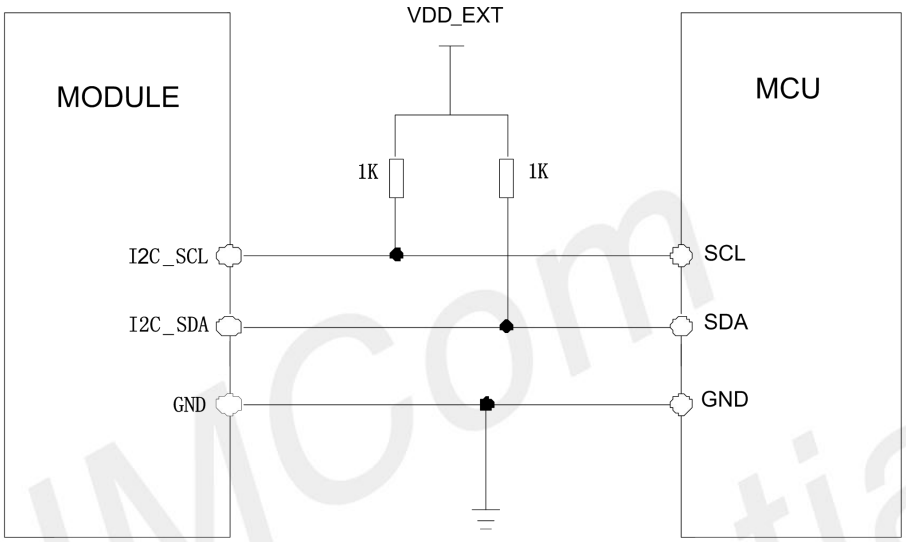

Figure 15: I2C reference circuit

NOTE

The I2C signal has no pull-up resistors in module. So the pulling up resistors 1KΩ to VDD_EXT is necessary in application circuit.

3.6 SPI Interface

Y7080E supports a set of 4- wire (MISO, MOSI, CS and CLK) SPI interfaces and supports both SPI master mode and SPI slave mode. The maximum clock frequency is up to 20MHz when operating in SPI master and slave mode. This feature is only used in DAM (Downloadable Application Module) application when secondary development.

The following figure shows the SPI bus reference design.

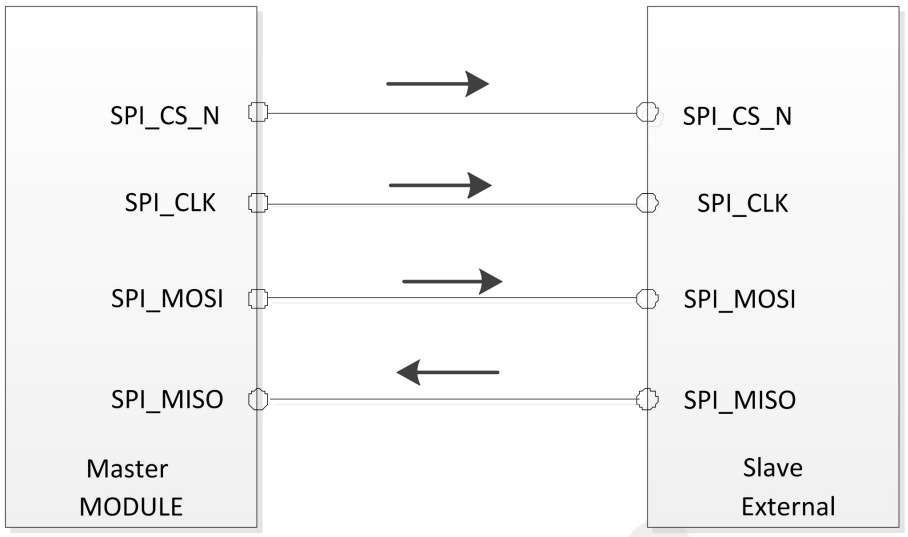

Figure 16: SPI master mode circuit

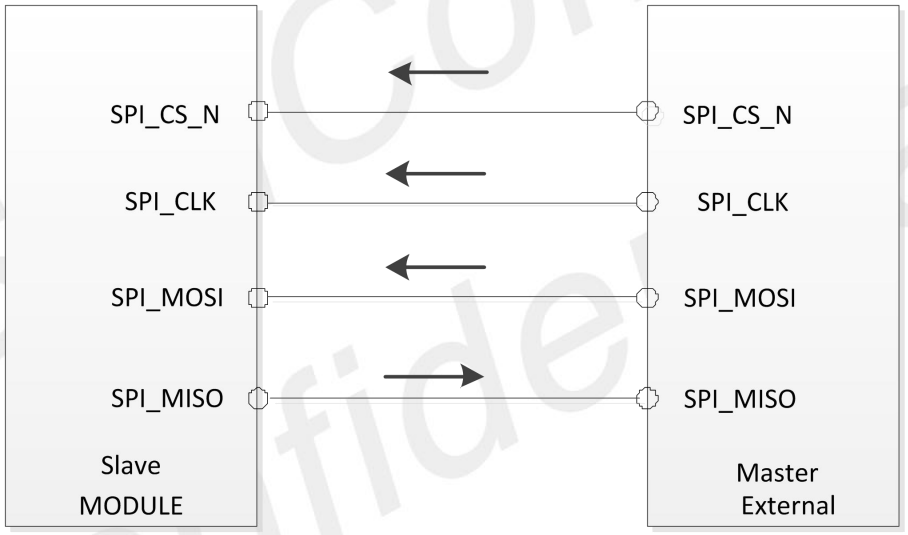

Figure 17: SPI slave mode circuit

3.7 Network status

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

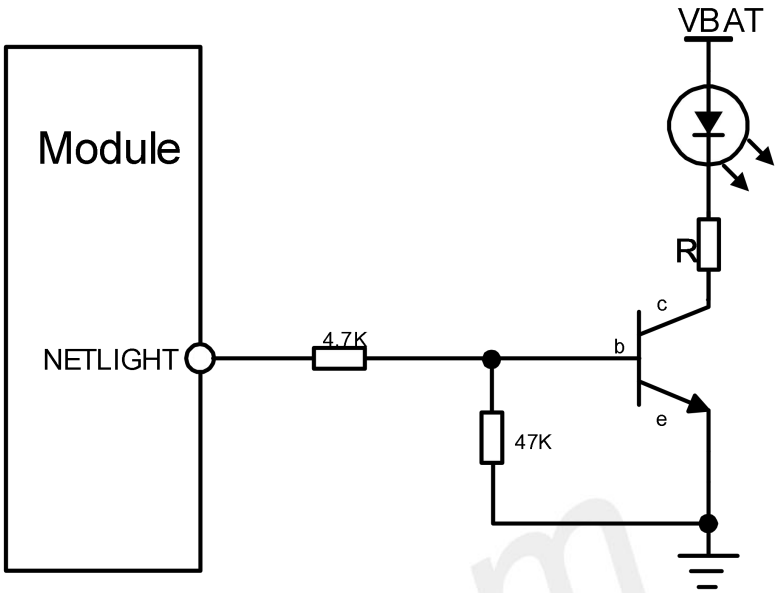

Figure 18: NETLIGHT reference circuit

NOTE

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

Table 13: NETLIGHT pin status

NETLIGHT pin status	Module status
64ms ON, 800ms OFF	No registered network
64ms ON, 3000ms OFF	Registered network (PS domain registration success)
64ms 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 1PPS

The 1PPS pin outputs pulse-per-second (PPS) pulse signal for precise timing purposes after the position has been fixed. The 1PPS signal can be provided through designated output pin for many external applications. This pulse is not only limited to be active every second but also allowed to set the required duration, frequency, and active high/low by programming user-defined settings.

PPS GPS time reference with adjustable duty cycle and +/- 10ns accuracy supports time service application, which is achieved by the PPS vs NMEA feature.

The following figure is the typical application of the 1PPS function.

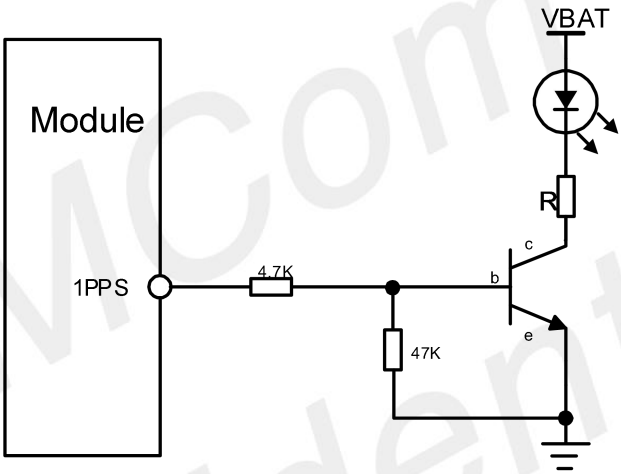

Figure 17: 1PPS reference circuit

3.9 ADC Interface

Y7080E has a dedicated ADC pin. It is available for digitizing analog signals such as battery voltage and so on. Its input voltage range is from 0V to 1v. That is the maximum measurement range of ADC cannot exceed 1V. 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 are shown in the following table.

Table 14: ADC electronic characteristics

Characteristics	Min.	Typ.	Max.	Unit
Input Range	0		1	V
ADC resolution		10		bit

NOTE

"AT+CADC" can be used to read the voltage of the ADC pin, for more details, please refer to document [1].

3.10 LDO output

Y7080E has a LDO power output named VDD_EXT. The output voltage is 3.0V. This voltage can only be pulled up for the external GPIO or power supply for the level conversion circuit.

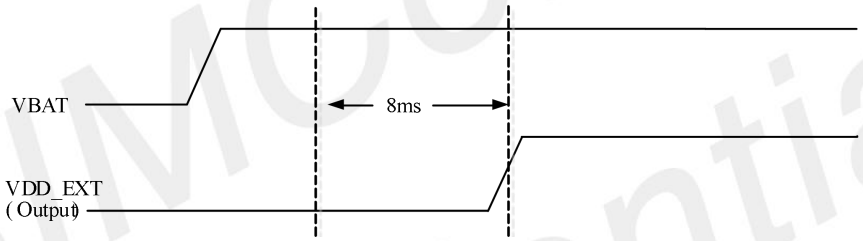

Figure 20: Power on sequence of the VDD_EXT

Table 15: Electronic characteristic

Symbol	Description	Min.	Typ.	Max.	Unit
V_{VDD_EXT}	Output voltage	2.7	3.0	3.3	V
I_O	Output current	-	-	50	mA

NOTE

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

3.11 Force Download Interface

The module can enter the forced download mode with pulling up the BOOT pin. The reference circuit refers to the following figure.

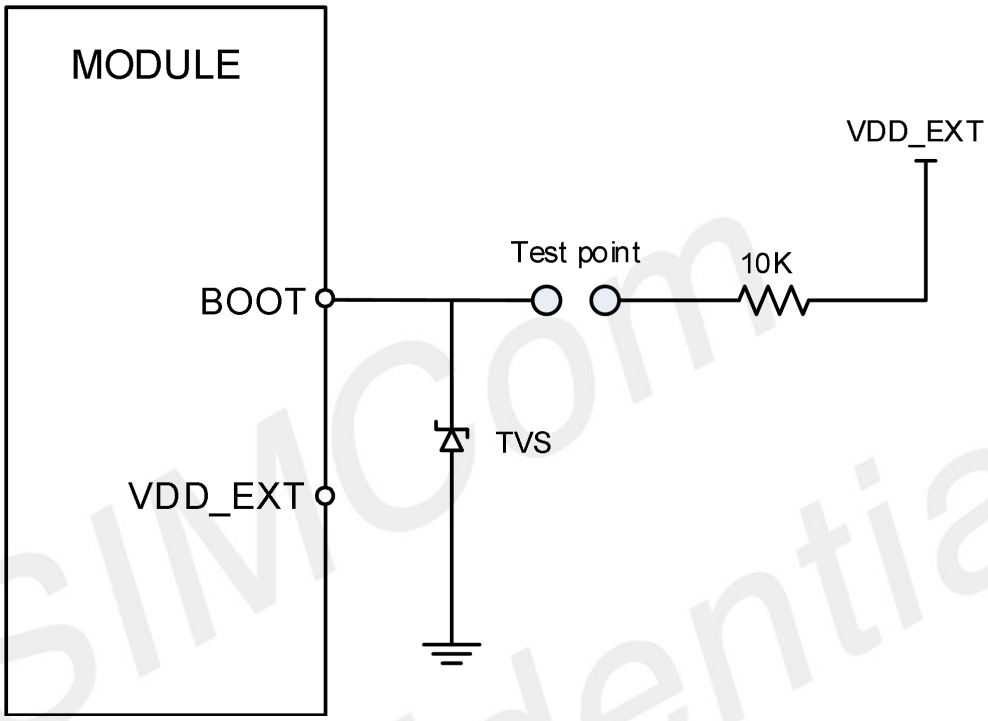

Figure 21: Reference circuit of BOOT interface

4. RF Specifications

4.1 LTE RF Specifications

Table 16: Conducted transmission power

CAT-NB2

Frequency band	Maximum Power	Minimum Power
LTE-FDD B3	23dBm +/-2.7dB	<-40dBm
LTE-FDD B5	23dBm +/-2.7dB	<-40dBm
LTE-FDD B8	23dBm +/-2.7dB	<-40dBm
LTE-FDD B20	23dBm +/-2.7dB	<-40dBm
LTE-FDD B28	23dBm +/-2.7dB	<-40dBm

NOTE

The maximum power above is the test result of single-tone. For the power test result of multi-tone, please refer to chapter 6.2.3 F.3.

Table 17: UE CAT NB2 maximum power fall back

CAT-NB2

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 3Tones allocation	0-5 and 6-11		
MPR	≤ 1 dB	≤ 1 dB	
Tone positions for 3 Tones allocation	0-11		
MPR	≤ 2 dB		

Table 18: GNSS Operating frequencies

Frequency	Receiving	Transmission
BAND Information	Refers to Table 1	
GPS L1 BAND	1574.4 ～1576.44 MHz	
GLONASS	1598 ～1606 MHz	
BD	1559 ～1563 MHz	
Galileo	1575.42±1.023MHz	

Table 19: Frequency band information

Band number	Uplink operating frequency band	Downstream operating frequency band	Duplex mode
3	1710 – 1785 MHz	1805 – 1880 MHz	HD-FDD
5	824 – 849 MHz	869 – 894 MHz	HD-FDD
8	880 – 915 MHz	925 – 960 MHz	HD-FDD
20	832~862MHz	791~821MHz	HD-FDD
28	703~748MHz	758~803MHz	HD-FDD

Table 20: CAT-NB2 reference sensitivity

Working frequency	Receiving sensitivity (dBm) / 95% transmission (required by 3GPP)	Receiving sensitivity (dBm) / 95% transmission
3	-108.2	-116
5	-108.2	-118
8	-108.2	-117
20	-108.2	-118
28	-108.2	-118

4.2 LTE Antenna Design Guide

Users should connect antennas to Y7080E's 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.

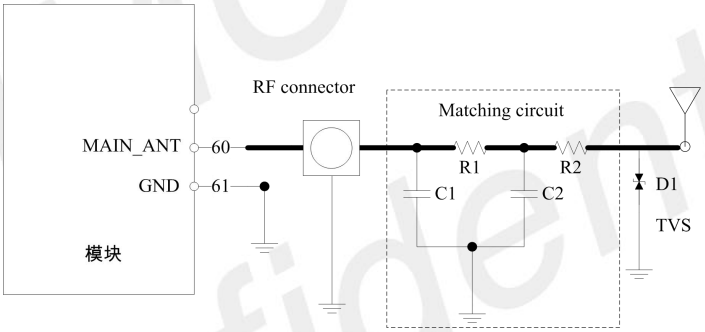

Figure 22: Antenna matching circuit (MAIN_ANT)

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 Y7080E and antenna must be controlled in 50 Ω.
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 GNSS

Y7080E merges GNSS (GPS/GLONASS/BD) satellite and network information to provide a high-availability solution that offers industry-leading accuracy and performance. This solution performs well, even in very challenging environmental conditions where conventional GNSS receivers fail, and provides a platform to enable wireless operators to address both location-based services and emergency mandates.

4.3.1. GNSS Technical specification

- Tracking sensitivity: -159 dBm (GPS+GLONASS)/-159 dBm (GPS+BD)
- Cold-start sensitivity: -147.5 dBm
  Accuracy (Open Sky): 0.4 m(GPS+BD)
- TTFF (Open Sky) : Hot start < 1 s, Cold start< 31 s
- Receiver Type: 16-channel, C/A Code
- GPS L1 Frequency: 1575.42±1.023MHz
- GLONASS L1: 1598.0625 ~1605.375MHz
- BDS B1: 1559.052~1591.788MHz
- Galileo L1:1575.42±1.023MHz
- Update rate: Default 1 Hz
- GNSS data format: NMEA-0183
- GNSS Current consumption :54mA (AT+CFUN=0,without USB)
- GNSS antenna: Passive/Active antenna

NOTE

If the antenna is active type, the power should be given by main board because there is no power supply on the GNSS antenna pad. If the antenna is passive, it is suggested that the external LNA should be used.

4.3.2. GNSS Application Guide

Users can adopt an active antenna or a passive antenna to Y7080E. If using a passive antenna, an external LNA is a must to get better performance. The following figures are the reference circuits.

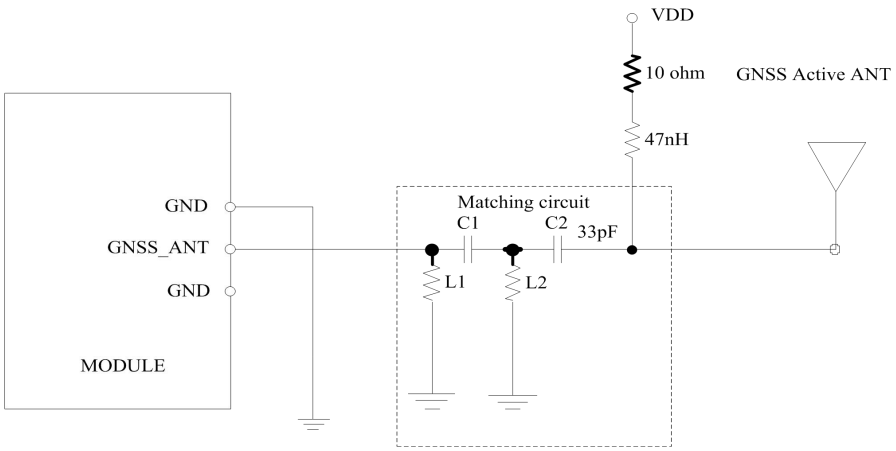

Figure 23: Active antenna circuit

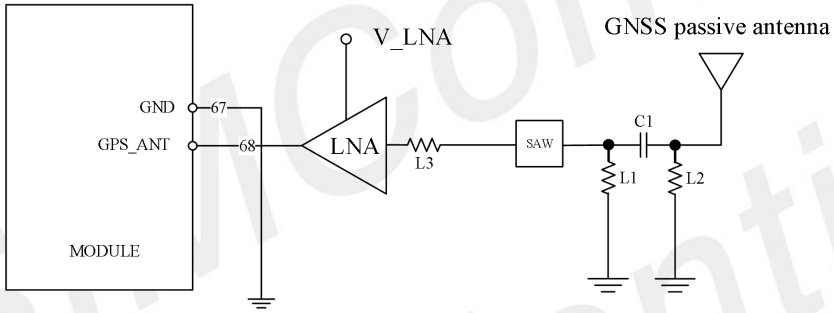

Figure 24: Passive antenna circuit (Default)

In above figures, the components C1, L1 and L2 are used for antenna matching. Usually, the values of the components can only be achieved after antenna tuning and usually provided by antenna vendor. C2 is used for DC blocking. L3 is the matching component of the external LNA, and the value of L3 is determined by the LNA characteristic and PCB layout. Both VDD of active antenna and V_LNA need external power supplies which should be considered according to active antenna and LNA characteristic. LDO/DCDC is recommended to get lower current consuming by shutting down active antennas and LNA when GNSS is not working.

GNSS can be tested by NMEA port. NMEA sentences can be obtained through UART or USB automatically. NMEA sentences include GSV, GGA, RMC, GSA, and VTG. Before using GNSS, user should configure Y7080E in proper operating mode by AT command. Please refer to related documents for details. Y7080E can also get position location information through AT directly.

NOTE

1. GNSS is closed by default and can be started by "AT+CGNSPWR=1". The AT command has two parameters, the first is on/off, and the second is GNSS mode. Default mode is standalone mode. AGPS mode needs more support from the mobile telecommunication network. Please refer to document [21] for more details.
2. If the passive antenna is used, put the LNA close to the antenna.
3. Make sure there are no noise signals around GNSS antenna.

4.4 RF traces note

4.4.1. 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.
-

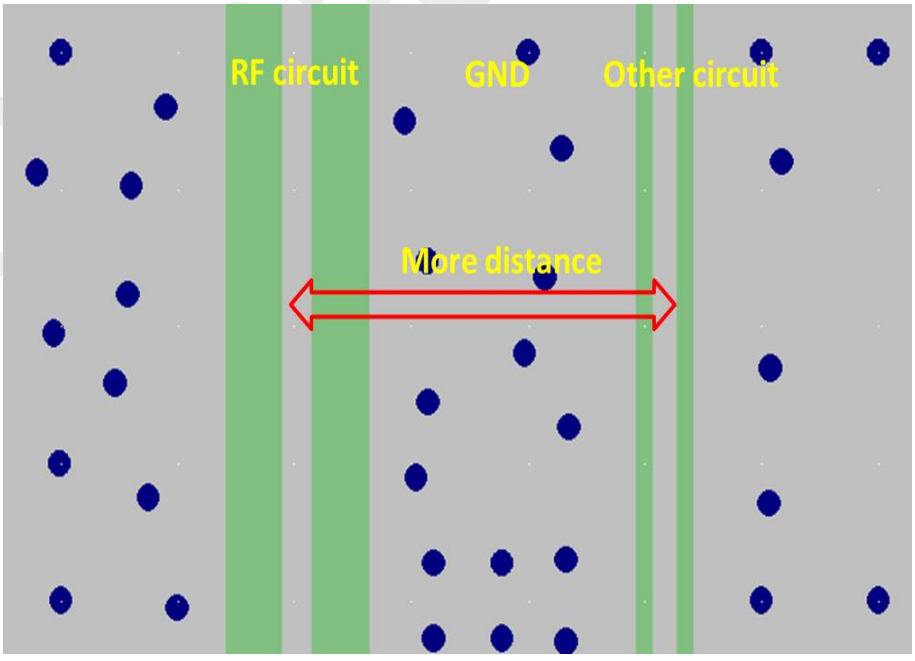

Figure 25: RF trace should be far away from other high speed signal lines

- 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.

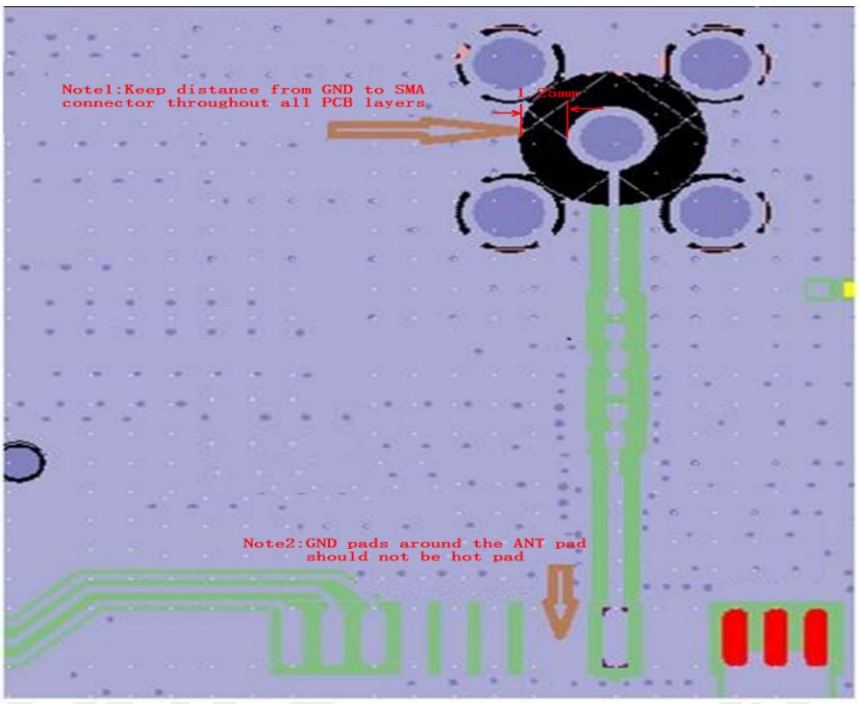

Figure 26: The distance between GND to the inner conductor of SMA

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

4.4.2. 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].

4.4.3. LTE antenna recommendation:

Table 23: list of recommended antenna models

Model	Supplier
MF25D	Huizhou Speed Wireless Technology Co., Limited

Table 24: list of recommended antenna parameters

Antenna parameters	Specifications
Reflection loss	Less than -10dB
Efficiency	Greater than 35%
Gain	Greater than -4.5dBi

5. Electrical Specifications

5.1. Absolute Maximum Ratings

Absolute maximum rating for digital and analog pins of Y7080E are listed in the following table:

Table 25: Absolute maximum ratings

Parameter	Min	Type	Max	Unit
Voltage on VBAT	-0.3		4.4	V
Voltage at digital pins (GPIO,I2C,UART,SPI)	-0.3	3.0	3.3	V
ADC	-0.3		4.2	V

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 26: Recommended operating ratings

Parameter	Min	Type	Max	Unit
Voltage at VBAT	3.0	3.3	4.2	V

Make sure that the voltage on the VBAT pins will never drop below 3.0V, even during a transmit burst. Otherwise, module will be power down.

Table 27: 3.0V Digital I/O characteristics

Parameter	Description	Min	Type	Max	Unit
V_{IH}	High-level input voltage	VDDIO-0.3	VDDIO	VDDIO+0.3	V
V_{IL}	Low-level input voltage	-0.3	0	-0.3	V
V_{OH}	High-level output voltage	VDDIO-0.3	VDDIO	VDDIO+0.3	V
V_{OL}	Low-level output voltage	-0.3	0	-0.3	V

NOTE

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

The operating temperature of Y7080E is listed in the following table.

Table 28: Operating temperature

Parameter	Min	Type	Max	Unit
operation temperature	-40	25	85	℃
Storage temperature	-45	25	+90	℃

NOTE

Module is able to make and receive data calls, SMS and make LTE traffic in -40℃ ~ +85℃. 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 Y7080E product.

Table 29: Operating Mode Definition

Mode		Function
Normal operation	**Idle**	Software is active. Module is registered to the network, and the Module is ready to communicate.
	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” 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.
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. And all of the functions will be unavailable except the RTC function. PWRKEY and timer expires can wake up the module.
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. Minimum functionality mode and Flight mode

There are three functionality modes, which could be set by AT command "AT+CFUN=<fun>". The command provides the choice of the functionality levels <fun>=0, 1, 5.

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

If Y7080E has been set to minimum functionality mode, the RF function and SIM card function will be closed. In this case, the serial port is still accessible, but RF function and SIM card will be unavailable.
When Y7080E is in minimum functionality mode, it can return to full functionality by the AT command "AT+CFUN=1".

5.3.3. Power Saving Mode (PSM)

Y7080E 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:

- When the timer expires, the module will be automatically woken up.
-

5.3.4. Extended Mode DRX (e-DRX)

In idle 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.

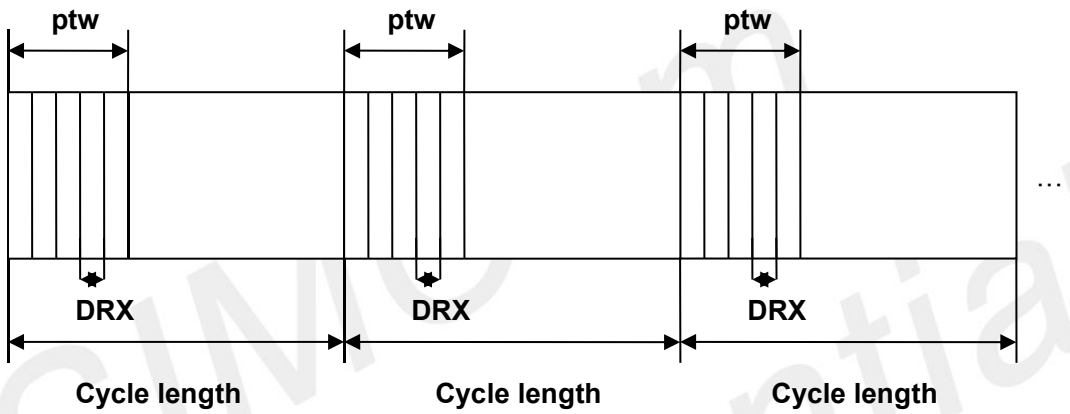

Figure 27: e-DRX diagrammatic sketch

When module and the network negotiate stratum signaling in idle 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 30: Current consumption on VBAT Pins (VBAT=3.3V)

Idle mode		
LTE supply current (GNSS off)		Idle mode Typical: 0.75mA
Power Saving Mode		
PSM supply current		PSM mode Typical: 1.7uA
e-DRX		
e-DRX mode supply current （Tested in sleep mode）		@PTW=40.96s，eDRX=81.92s，DRX=2.56s, Typical：0.3mA @PTW=25.6s，eDRX=163.84s，DRX=2.56s, Typical：0.13mA
Data Transmission		
LTE Cat-NB1/NB2 Data Transmission (15KHz single tone)MHz)	**LTE-FDD B3**	@21dbm Typical: 150mA @10dbm Typical: 57mA @0dbm Typical: 42mA
	LTE-FDD B5	@21dbm Typical: 135mA @10dbm Typical: 53mA @0dbm Typical: 40mA
	LTE-FDD B8	@21dbm Typical: 135mA @10dbm Typical: 54mA @0dbm Typical: 42mA
	LTE-FDD B20	@21dbm Typical: 132mA @10dbm Typical: 53mA @0dbm Typical: 41mA
	LTE-FDD B28	@21dbm Typical: 155mA @10dbm Typical: 54mA @0dbm Typical: 40mA

5.5. ESD Notes

Y7080E is sensitive to ESD in the process of storage, transporting, and assembling. When Y7080E 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 Y7080E ESD measurement performance without any external ESD component.

Table 31: The ESD performance measurement table (Temperature: 25℃, Humidity: 45%.)

Part	Contact discharge	Air discharge
VBAT,GND	±5KV	±10KV
Antenna port	±4KV	±8KV
Other PADs	±2KV	±4KV

NOTE

Test conditions:
1. The external of the module has surge protection diodes and ESD protection diodes.
2. The data in Table 31 was tested using SIMCom EVB.

6. SMT Production Guide

6.1. Top and Bottom View of Y7080E

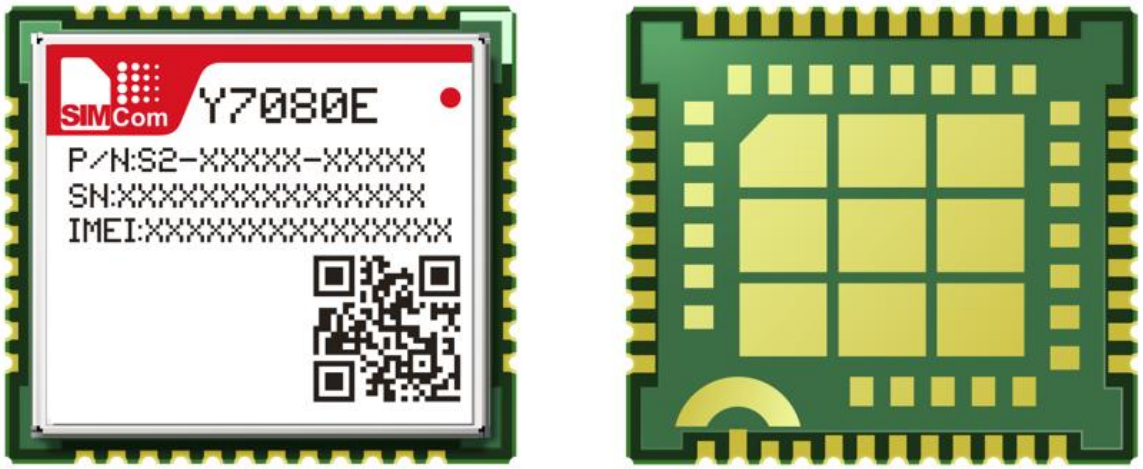

Figure 28: Top and bottom view of Y7080E

6.2. Label Information

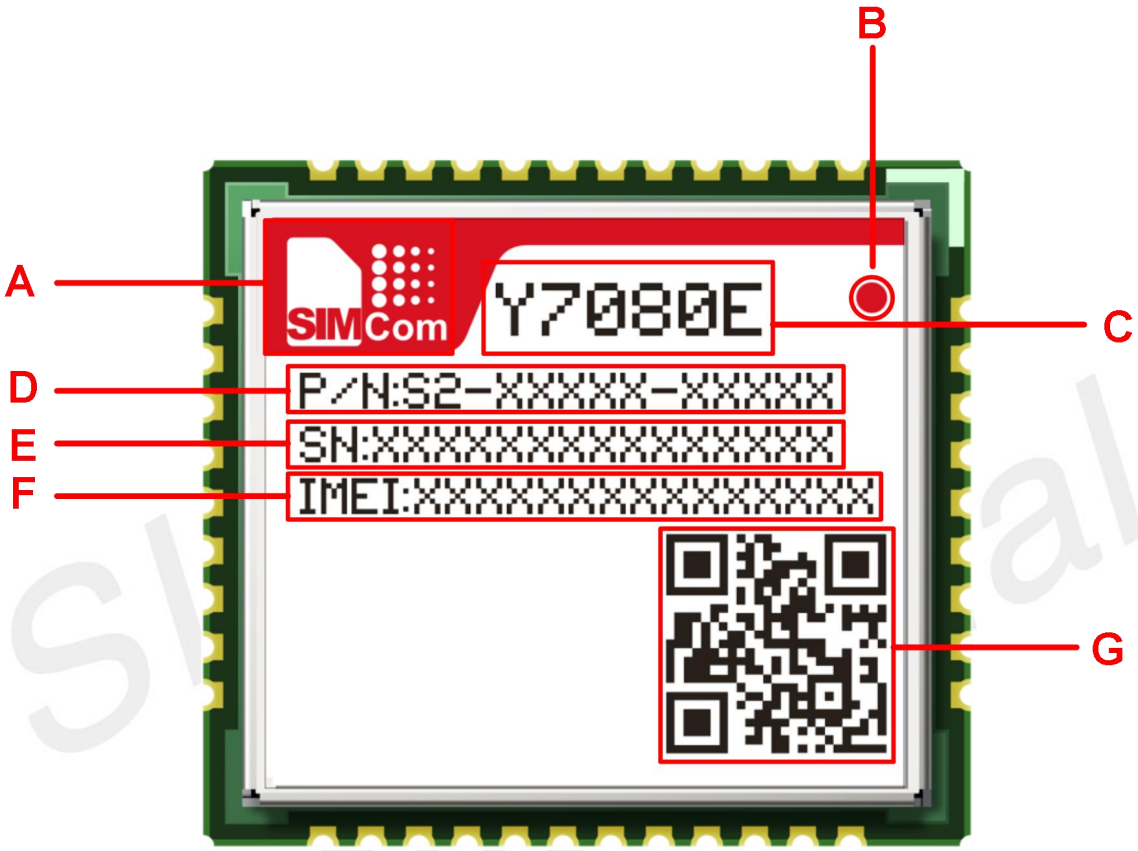

Figure 29: Label information

Table 32: The description of label information

Part	Contact discharge
A	LOGO
B	No.1 Pin
C	Project name
D	Product code
E	Serial Number
F	International mobile equipment identity

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.

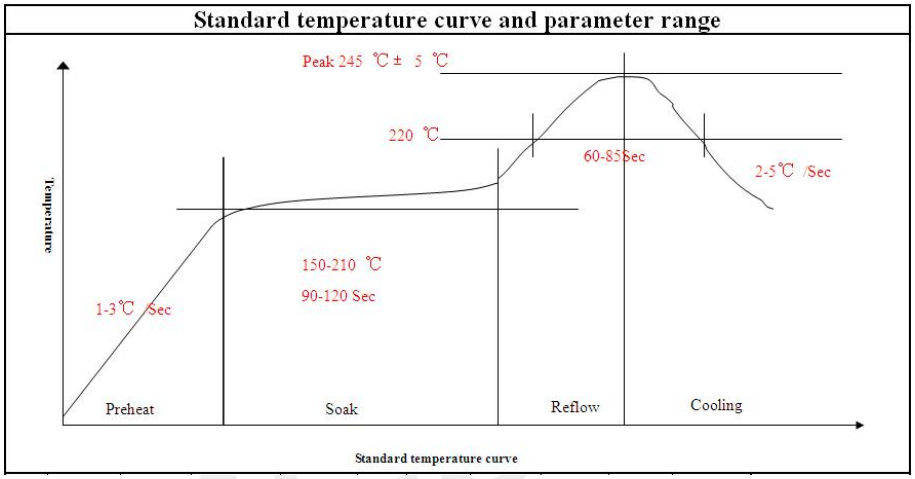

Figure 30: The ramp-soak-spike reflow profile of Y7080E

NOTE

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

6.4. Moisture Sensitivity Level (MSL)

Y7080E 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 33: 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 date of production is within six months has no use for baking. If the date of production is more than six months, the module must be baking.
- If the packaging had been opened or damaged, the module must be baking.

Table 34: Baking conditions

conditions	parameters
Baking temperature	120℃
Baking time	8 hours

NOTE

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

6.6. Stencil Foil Design Recommendation

The recommended thickness of stencil foil is 0.15mm.

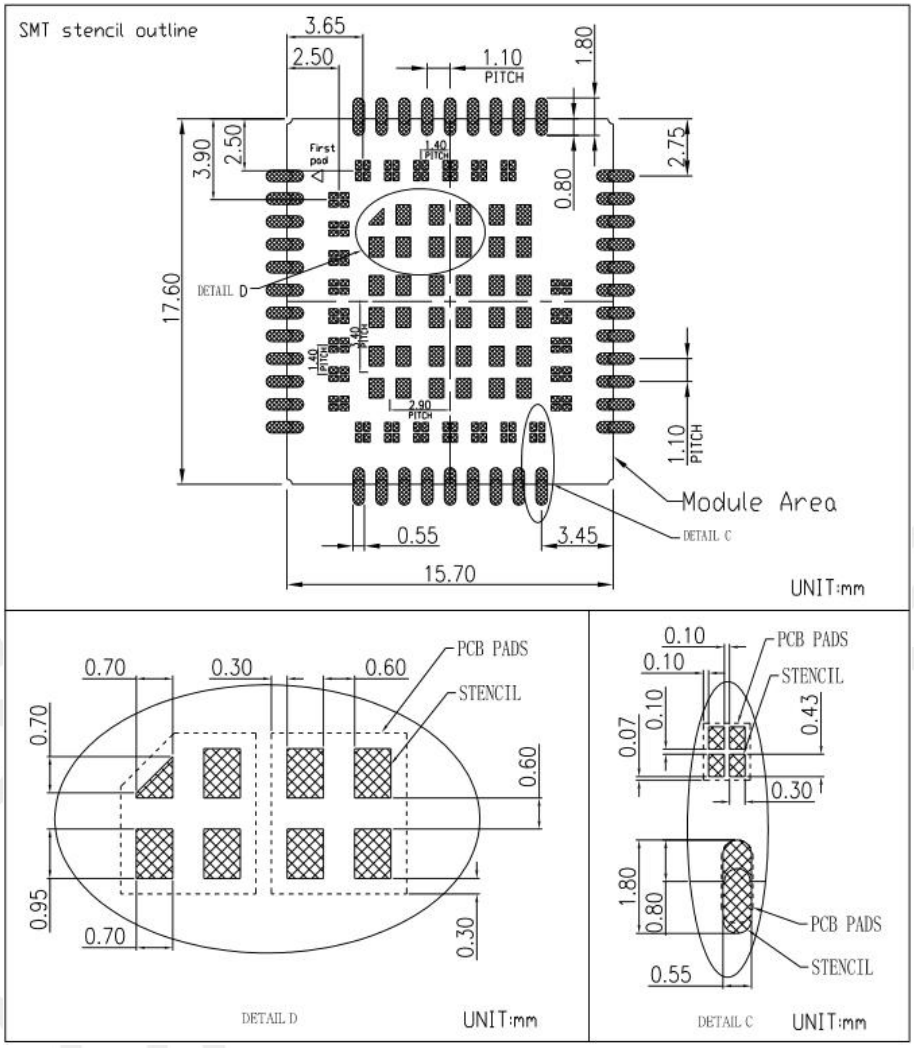

Figure 31: Stencil recommendation (Unit: mm)

7. Packaging

Y7080E module support tray packaging.

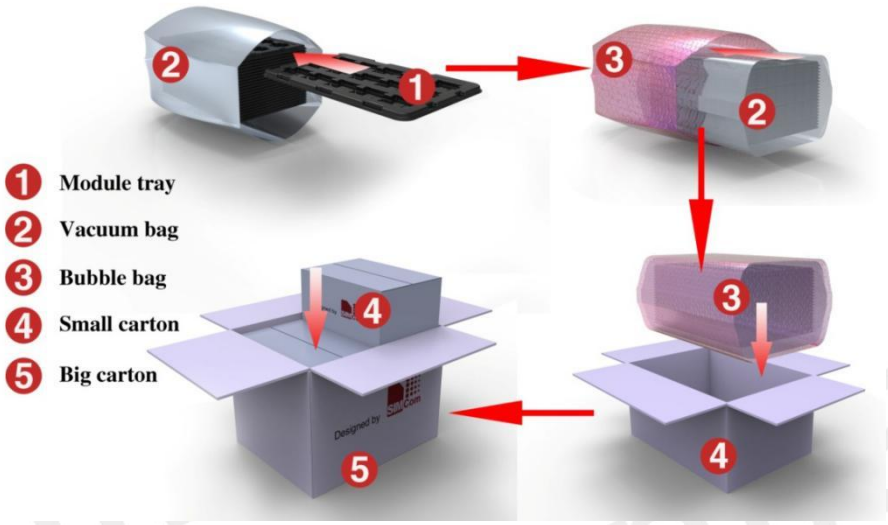

Figure 32: Packaging diagram

Module tray drawing：

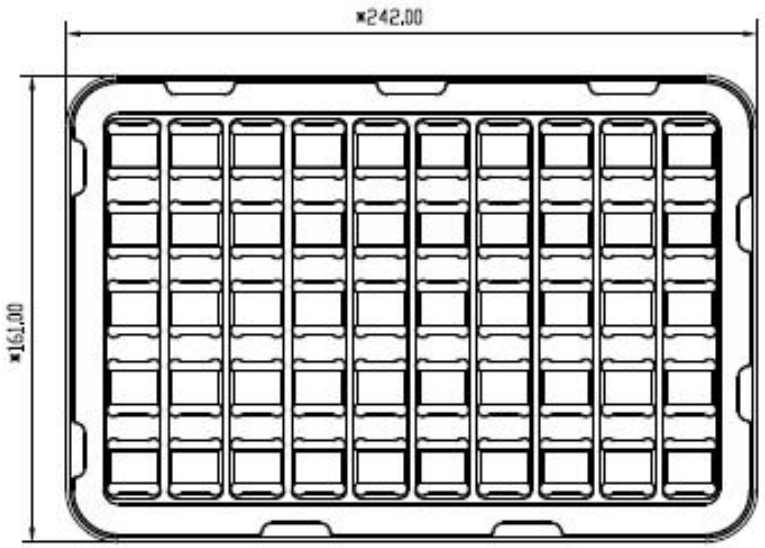

Figure 33: Tray drawing

Table 35: Tray size

Length（±3mm）	Width（±3mm）	Module number
242.0	161.0	50

Small carton drawing：

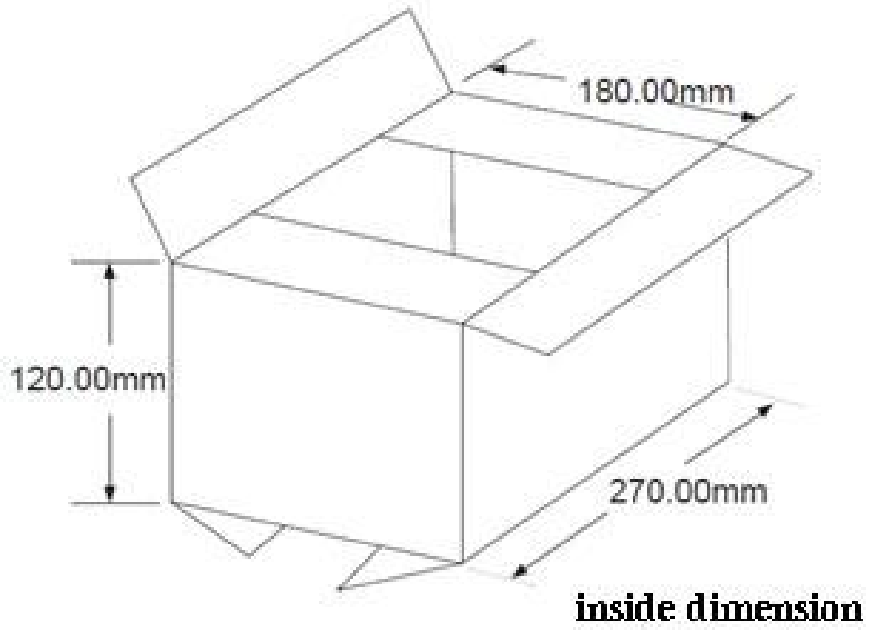

Figure 34: Small carton drawing

Table 36: Small Carton size

Length（±10mm）	Width（±10mm）	Height（±10mm）	Module number
270	180	120	50*20=1000

Big carton drawing：

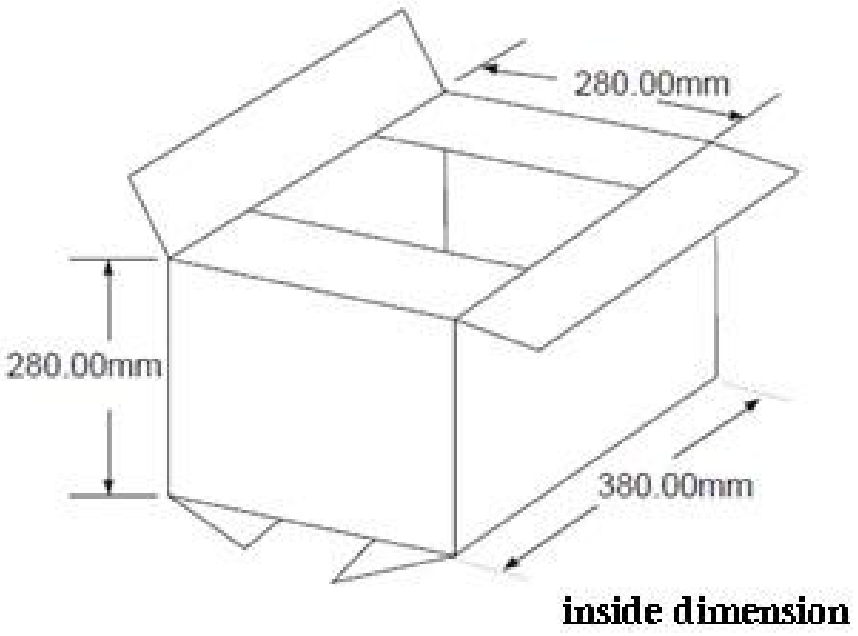

Figure 35: Big carton drawing

Table 37: Big Carton size

Length（±10mm）	Width（±10mm）	Height（±10mm）	Module number
380	280	280	1000*4=4000

8. Appendix

8.1 Reference Design

Refer to < Y7080E Reference Design V1.01> for the details.

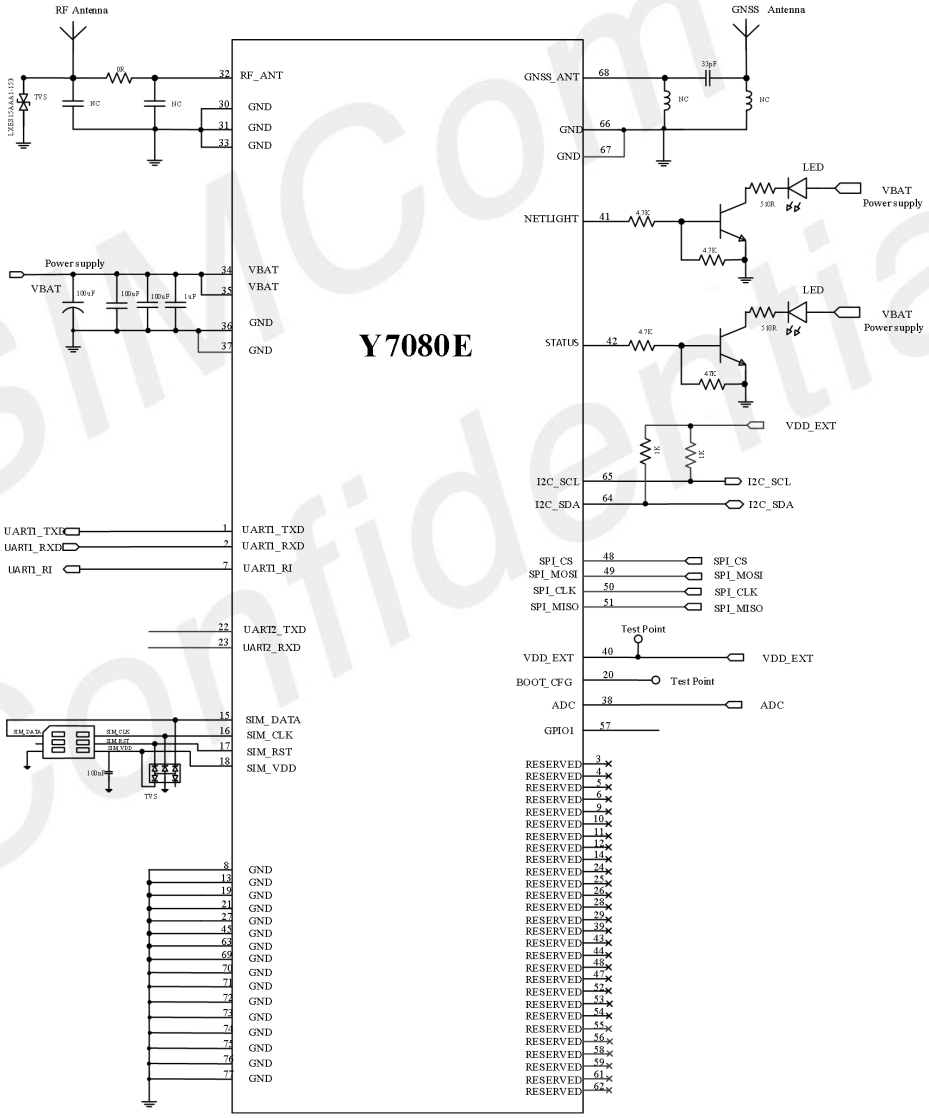

Figure 36: Reference design

8.2 Design check list

Table 38: Schematic Check List

NO.	Items
1	Insure the supply voltage for VBAT is within the range of 2.7V~4.8V.
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 200mV. And the voltage never dropped below 2.7V.
4	Insure the input signal for PWRKEY pin meet its electrical level match. It recommended use BJT to shift its level.
5	Insure the net connections 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 USB port had used TVS to protect signal. And the junction capacity of TVS for DP/DM must be less than 3pf.
7	Insure SIM card signal had used TVS to protect. And the junction capacity of TVS must be less than 50pf.
8	The power supply of the active antenna should be controlled and closed.
9	Insure I2C signal had used resistors 1Kohm pull up to VDD_EXT if used.
10	The electrical level of all GPIOs is 1.8V. Insure the signal for GPIO pins meet its electrical level match.
11	The input range of ADC is 0V~1.875V. Insure the input signal never exceed its range.
12	User must pull up DTR when module enters into sleep mode. Insure DTR can be controlled by host.
13	Suggesting to reserve test ports for VDD_EXT and BOOT_CFG. BOOT_CFG should keep open before boot up.
14	LTE main ANT should Keep TVS to prevent ESD destroyed. And the TVS should be Low junction capacitance.
15	LTE main ANT should have a PI type matching to debug antenna

Table 39: 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 PCM trance is protected by GND, and keep it far from interference source, such as power supply trace, USB trace, RF trace and so on.
5	Insure USB trance is protected by GND, and keep it far from interference source, such as power supply trace, RF trace and so on. Insure DM/DP trace is differential routing, and differential impedance is 90 ohm.
6	Insure ADC trance is protected by GND.
7	Insure SIM card signal trance is protected by GND. Especially SIM_CLK must be protected alone. And avoid signal trace branched Routing.
8	Insure TVS avoid bypass. The trace must go through TVS pad first, and then arrived module pad.
9	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.
10	The RF line reference GND should be complete. And avoid high speed lines crossing below it.
11	the GND side of the RF output pin should be not hot welding disk
12	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 Coding Schemes and Maximum Net Data Rates over Air Interface

Table 40: Coding Schemes and Maximum Net Data Rates over Air Interface

LTE-FDD device category (Downlink)	Max data rate (peak)	Modulation type
Category M1	300 kbps	QPSK/16QAM
Category NB2	20 kbps	BPSK/QPSK
LTE-FDD device category (Uplink)	**Max data rate (peak)**	**Modulation type**
Category M1	300 kbps	QPSK/16QAM
Category NB2	10.3 kbps	BPSK/QPSK

8.4 Related Documents

Table 41: Related Documents

NO.	Title	Description
[1]	Y7080E AT Command Manual V1.xx	AT Command Manual
[2]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[3]	3GPP TS 34.124	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[4]	3GPP TS 34.121	Electromagnetic Compatibility (EMC) for mobile terminals and ancillary equipment.
[5]	3GPP TS 34.123-1	Technical Specification Group Radio Access Network; Terminal conformance specification; Radio transmission and reception (FDD)
[6]	3GPP TS 34.123-3	User Equipment (UE) conformance specification; Part 3: Abstract Test Suites.
[7]	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
[8]	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
[9]	IEC/EN60950-1(2001)	Safety of information technology equipment (2000)
[10]	3GPP TS 51.010-1	Digital cellular telecommunications system (Release 5); Mobile Station (MS) conformance specification
[11]	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)
[12]	Module secondary-SMT-UGD V1.xx	Module secondary SMT Guidelines
[13]	Y7080E UART Application Note_V1.xx	This document describes how to use UART interface of SIMCom modules.

[14]	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
[15]	ANTENNA DESIGN GUIDELINES FOR MULTI-ANTENNA SYSTEM V1 01	Design notice for multi-antenna.

8.5 Terms and Abbreviations

Table 42: 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
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

8.6 Safety Caution

Table 43: 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.