SIM7080G&Y7080E Compatible Design

LPWA Module

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1 Introduction

This document is targeted for customers to understand the differences between SIM7080G and Y7080E. Users can use SIM7080G or Y7080E module to design and develop applications quickly.

1.1 Product Outline

The physical dimension of SIM7080G and Y7080E is 17.6mm×15.7mm×2.4 mm.
The following table shows the differences frequency bands and interface of SIM7080G and Y7080E.

Table 1: SIM7080G and Y7080E Frequency Bands and air interface

Network Type	Band	SIM7080G		Y7080E
	Category	M1	NB1/NB2	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	✓	✓

NOTE

Galileo of SIM7080G is default closed in software. But users can open it via AT command "AT+CGNSMOD". For more information about these AT commands, please refer to Document [3].

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2 Package Information

2.1 Pin Assignment Overview

The following table shows the pin assignment of SIM7080G and Y7080E.

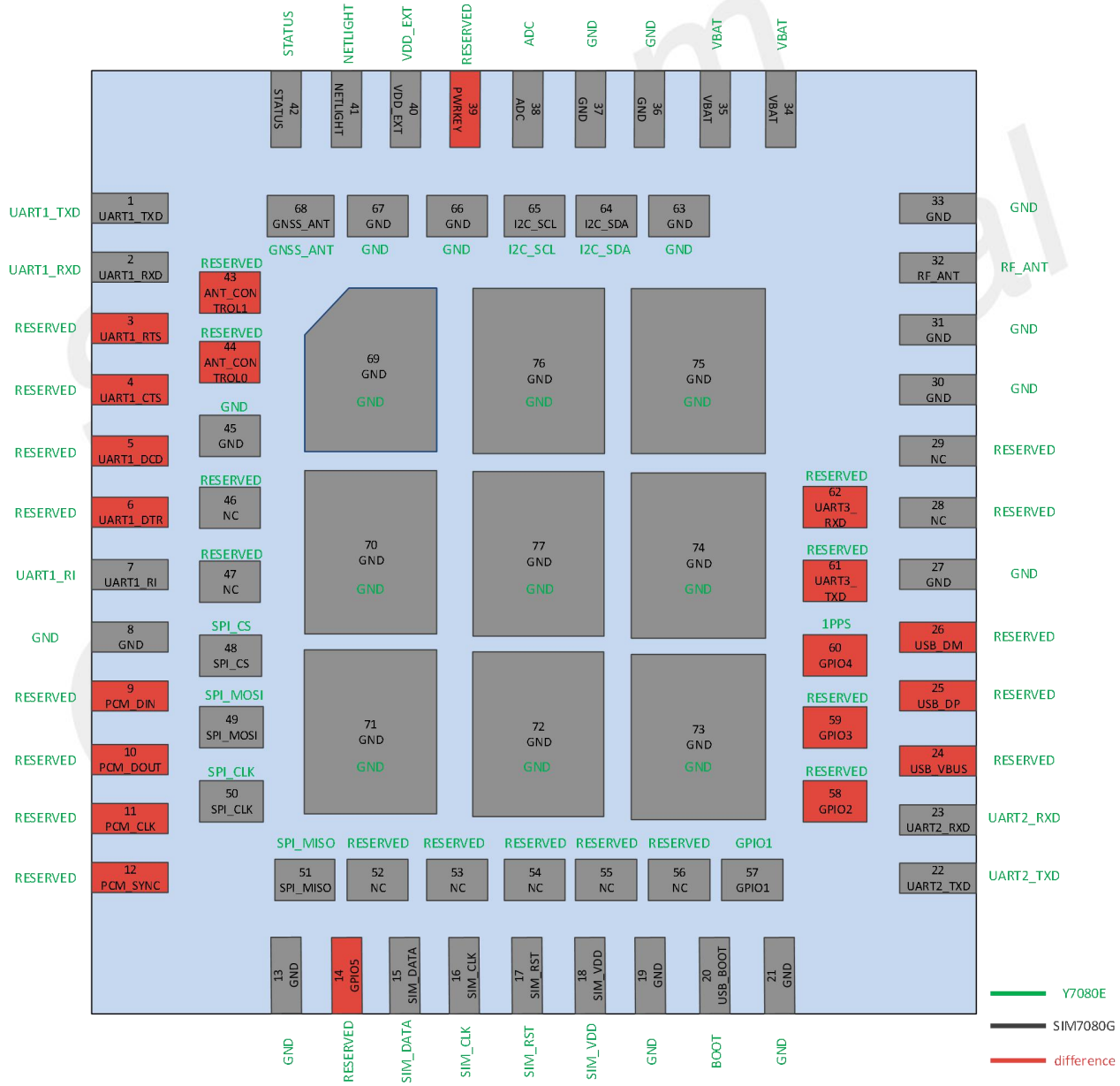

Figure 1: Pin assignment overview

2.2 Differences Overview

Table 2: The Differences overview

Functions	SIM7080G	Y7080E
Cellular technology	CAT-M,NB-IOT,GNSS	NB-IOT,GNSS
Audio	Support	Not support
USB	Support	Not support
PWRKEY	Support	Not support
SPI	Support	Support
I2C	Support	Support
RFGRFC	Support	Not support
Download interface	USB	UART1
Debug interface	UART2	UART2
IO Power Domain	1.8V	3.0V

2.3 Differences of Electronic Characteristic

Table 3: The Differences overview

Pin#	SIM7080G		Y7080E	
	PIN name	Voltage range	PIN name	Voltage range
34,35	VBAT	2.7V~4.8V	VBAT	3.0V~4.2V
1~7	UART1	1.8V	UART1	3.0V
15~18	SIM card	1.8V	SIM card	1.8V/3.0V
22,23	UART2	1.8V	UART2	3.0V
25,26	USB	\	Not support	\
38	ADC	0~1.875V	ADC	0~1V
39	PWRKEY	1.5V	Not support	\
40	VDD_EXT	1.8V	VDD_EXT	3.0V
41	NETLIGHT	1.8V	NETLIGHT	3.0V
42	STATUS	1.8V	STATUS	3.0V
61,62	UART3	1.8V	Not support	\

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3 Recommended Footprint

3.1 Top and Bottom View

The following figures show top and bottom view of SIM7080G and Y7080E.
There are some differences for footprint.

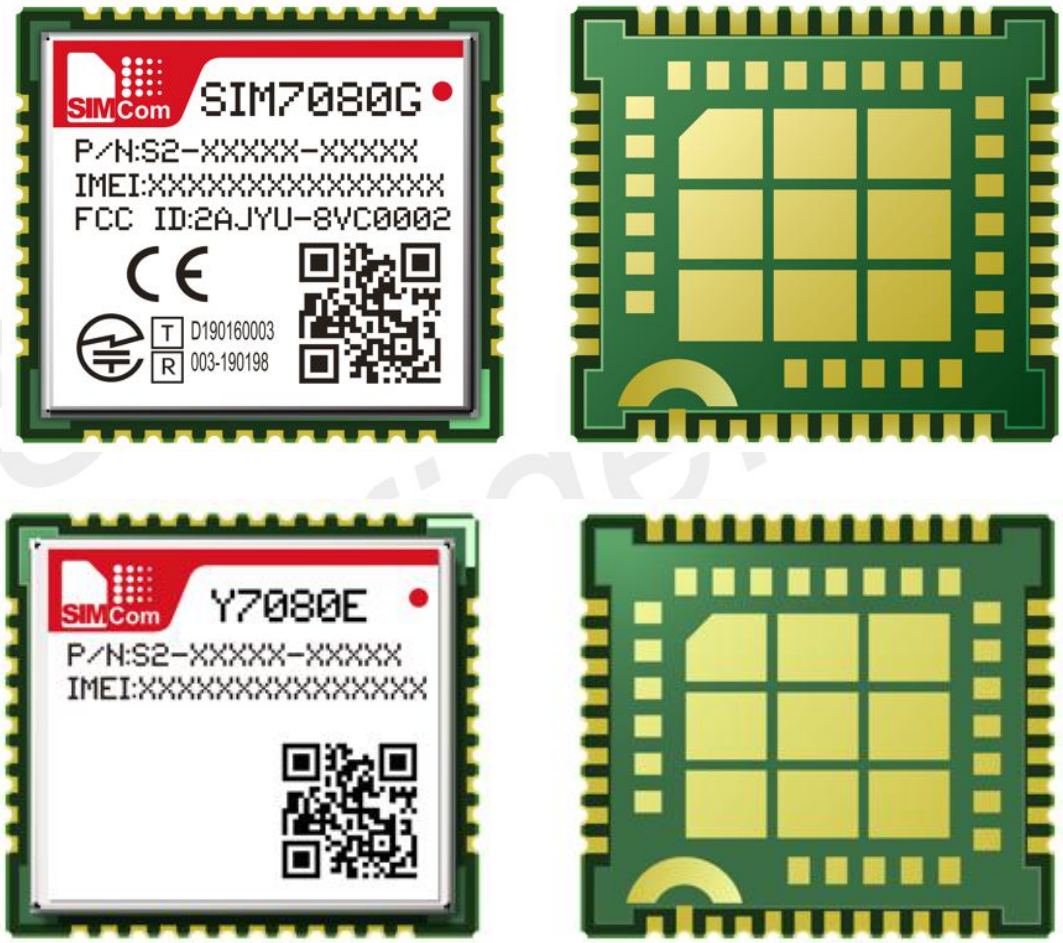

Figure 2: SIM7080G and Y7080E top and bottom view

NOTE

Figure 2 is the effect diagrams of the module, for reference only. Please refer to the actual product for appearance.

3.2 Recommended Footprint

SIM7080G and Y7080E can use the same recommended footprint design.

The recommended footprint design for SIM7080G and Y7080E is shown as below.

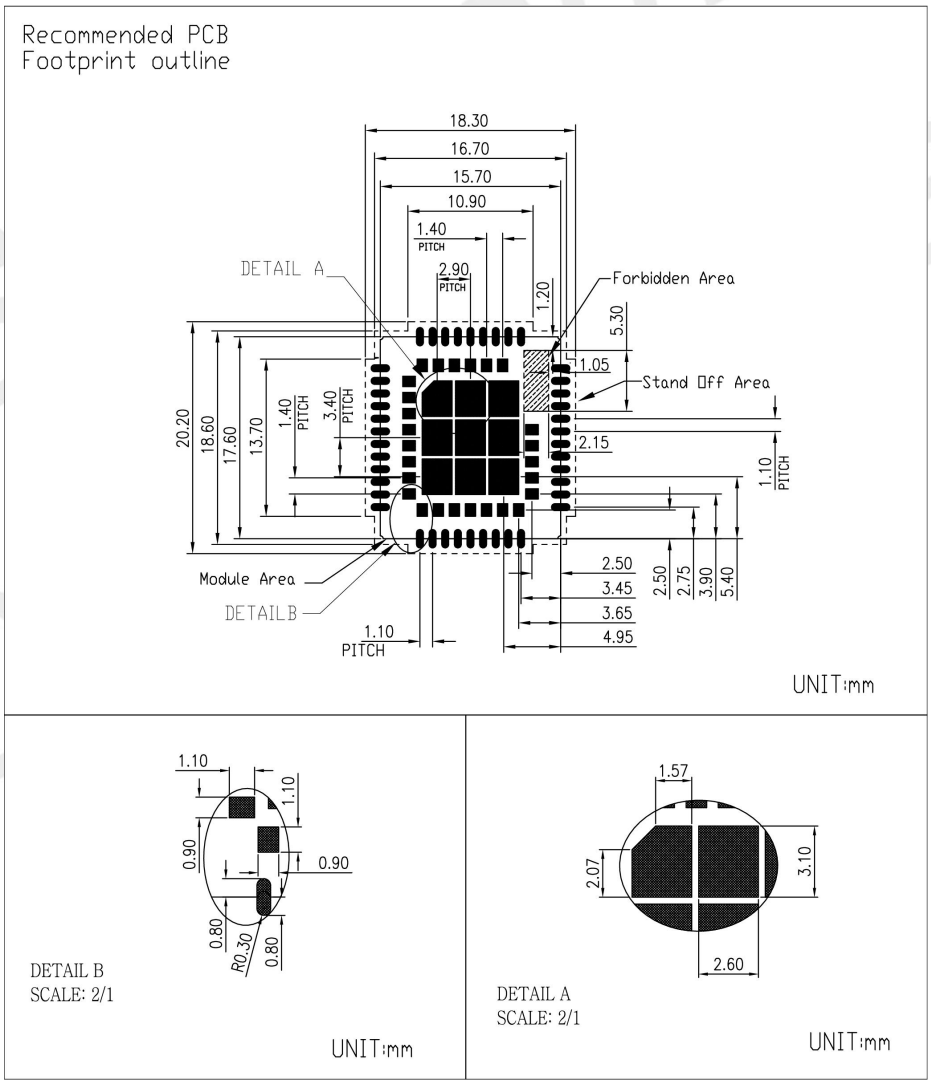

Figure 3: Recommended Footprint Design for SIM7080G and Y7080E (Unit: mm)

3.3 Recommended Stencil Design

It is strongly recommended that SIM7080G and Y7080E use their own the recommended stencil design.

The recommended stencil design for SIM7080G is shown as below.

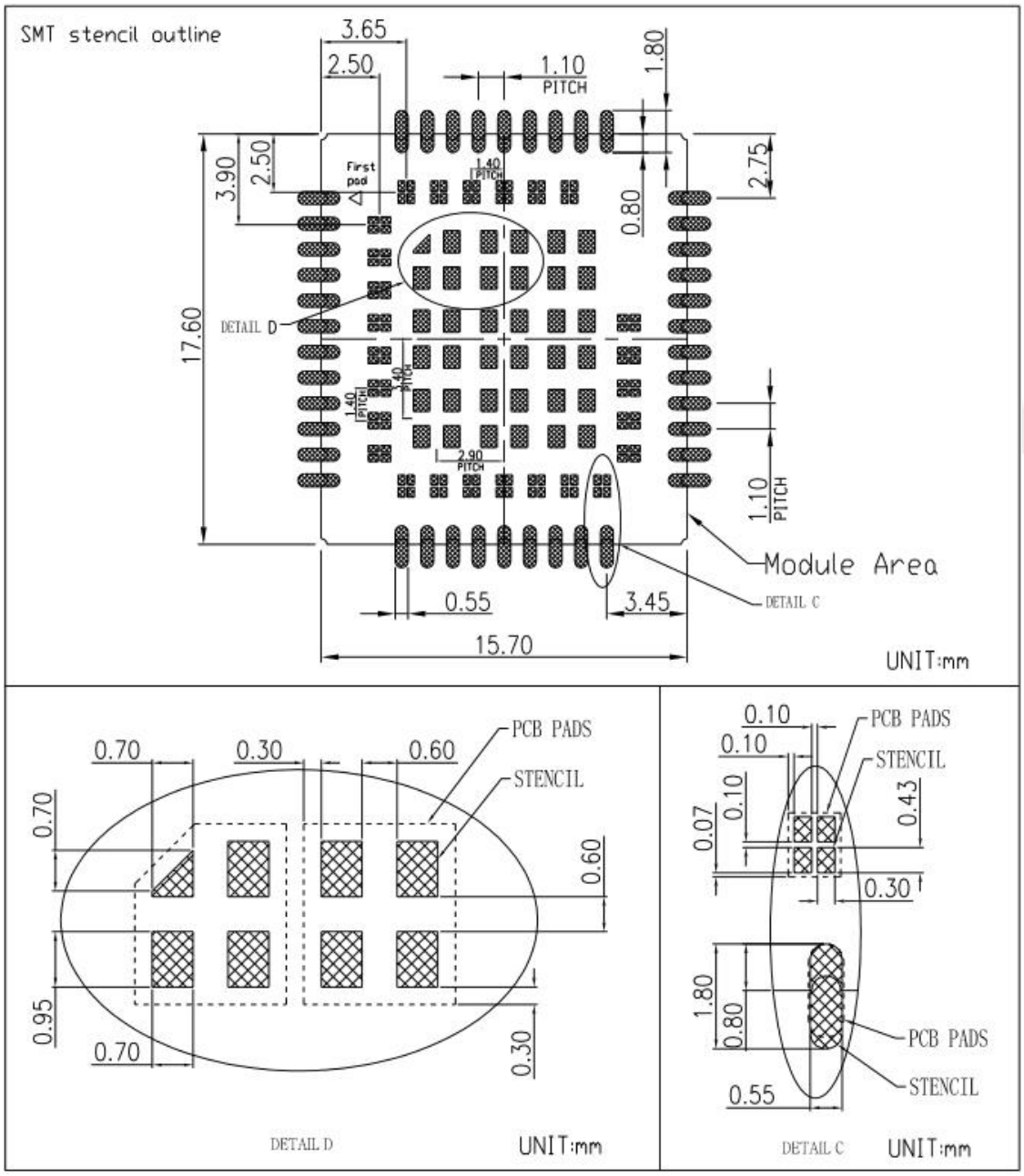

Figure 4: Recommended Stencil Design for SIM7080G and Y7080E (Unit: mm)

4 Hardware Reference Design

The chapter introduces compatible design between SIM7080G and Y7080E on main functionalities.

4.1 Power Supply

The power supply pins of SIM7080G and Y7080E include two VBAT pins (pin 34 and pin 35). VBAT pins directly supply the power to RF circuit and baseband circuit. Both VBAT pins of the module must be used together. The following figure is the reference design of the module VBAT power supply.

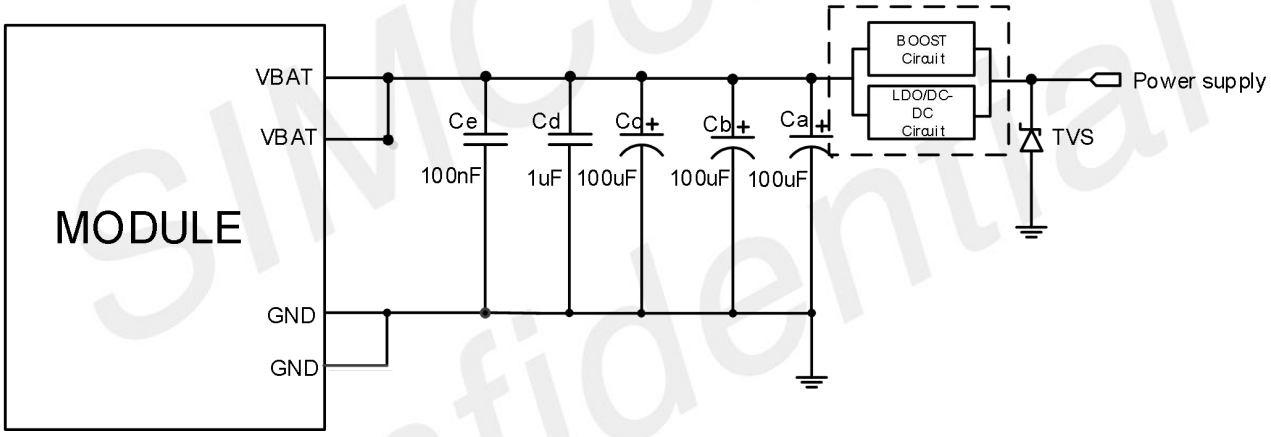

Figure 5: Power supply reference circuit

According to power supply type (battery or DC power), the reference design for power switching circuit in the above dashed box will be different. The details are illustrated in the table below.

Table 4: Power Supply Type and Power Switching Circuit Relationship

Power Supply Type	SIM7080G (VBAT=2.7~4.8V)	Y7080E (VBAT=3.0~4.2V)
Li-SOC12 Battery (2.0~3.6V)	Boost Circuit	Boost Circuit
Li-MnO2 Battery (1.8V~3.0V)	Boost Circuit	Boost Circuit
DC Power Supply	LDO/DC-DC Circuit	LDO/DC-DC Circuit

The VBAT has different input power range for SIM7080G and Y7080E. Please refer to the following table.

Table 5: The differences for VBAT power range

Module	VBAT power supply			VBAT power peak current
	Min	Typical	Max	MAX
SIM7080G	2.7	3.8	4.8	500mA
Y7080E	3.0	3.3	4.2	500mA

Power design for a module is important to its performance. The power supply of SIM7080G and Y7080E should be able to provide sufficient current up to 500mA.

NOTE

For details information, please refer to each HD guide.

4.2 Power on/off circuit

The 39 pin of SIM7080G is PWRKEY, but it is RESERVED for Y7080E. SIM7080G can be turned on by driving the 39 pin to a low level. But the Y7080E is automatically turned on after power on.

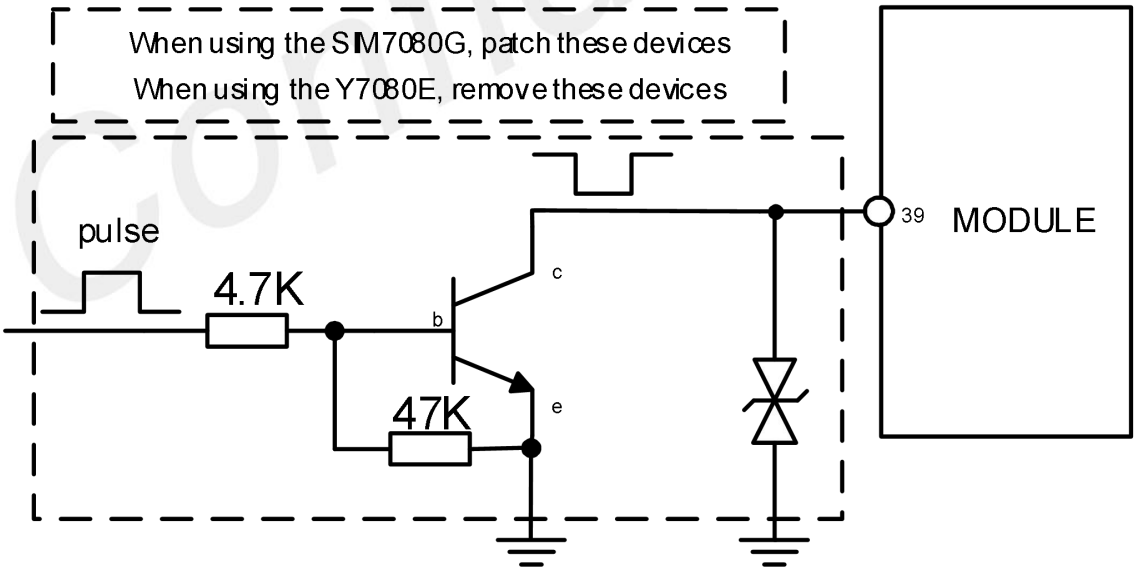

Figure 6: Power on/off reference circuit

The electrical parameters of 39 pin of SIM7080G are show as below.

Table 6: The SIM7080G power on timing and electronic characteristic

Symbol	Parameter	Min.	Typ.	Max.	Unit
T_{on}	The time of active low level impulse of PWRKEY pin to power on module	1	-	12.6	s
$T_{on(Vdd)}$	The time from power-on issue to VDD_EXT pin output high level.		64		ms
$T_{on(status)}$	The time from power-on issue to STATUS pin output high level(indicating power up ready)	1.8	-	-	s
$T_{on(uart)}$	The time from power-on issue to UART port ready	1.8	-	-	s
$T_{on(usb)}$	The time from power-on issue to USB port ready	1.8	-	-	s
V_{IH}	Input high level voltage on PWRKEY pin	1.0	1.5	1.8	V
V_{IL}	Input low level voltage on PWRKEY pin	-0.3	0	0.4	V

Table 7: The SIM7080G power on timing and electronic characteristic

Symbol	Parameter	Min.	Typ.	Max.	Unit
T_{off}	The active low level time pulse on PWRKEY pin to power off module	1.2	-	-	s
$T_{off(Vdd)}$	The time from power-off issue to VDD_EXT pin output low level	1.8	-	-	s
$T_{off(status)}$	The time from power-off issue to STATUS pin output low level(indicating power off)*	1.8	-	-	s
$T_{off(uart)}$	The time from power-off issue to UART port off	1.8	-	-	s
$T_{off(usb)}$	The time from power-off issue to USB port off	1.8	-	-	s
T_{off-on}	The buffer time from power-off issue to power-on issue	2	-	-	s

NOTE

For details information of the electrical parameters, please refer to each HD guide.

4.3 UART Interface

The module is as the DCE (Data Communication Equipment) and the client PC is as the DTE (Data Terminal Equipment). AT commands are executed through UART interface.

SIM7080G can provide 3 channels serial ports: one channel full-function serial port UART1, one channel DEBUG serial port UART2, one channel 2-wire serial port UART3. UART1 can be used for AT command communication; UART2 will output boot log during the system boot-up; UART3 will be configured GPIO after booting.

Y7080E can provide 2 channels serial ports: one channel 2-wire serial port UART1, one channel DEBUG serial port UART2. UART1 can be used for AT command communication, firmware upgrade and calibration; UART2 can view the underlying log information for software debugging.

When the serial port of the module and serial port of MCU have the same voltage level, the serial port and GPIO of module can connect to the MCU directly. The reference design circuit is shown as following figure.

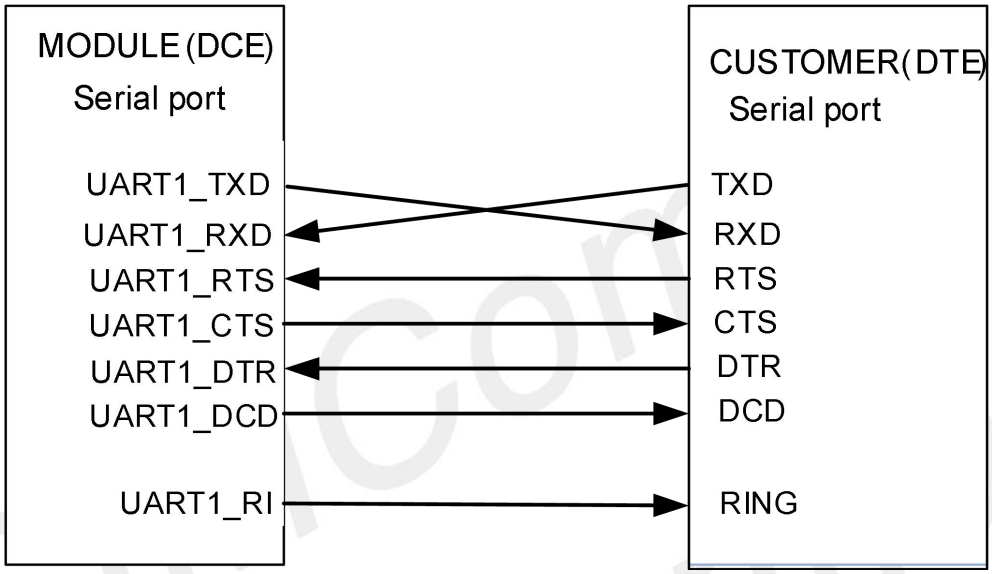

Figure 7: UART full modem circuit

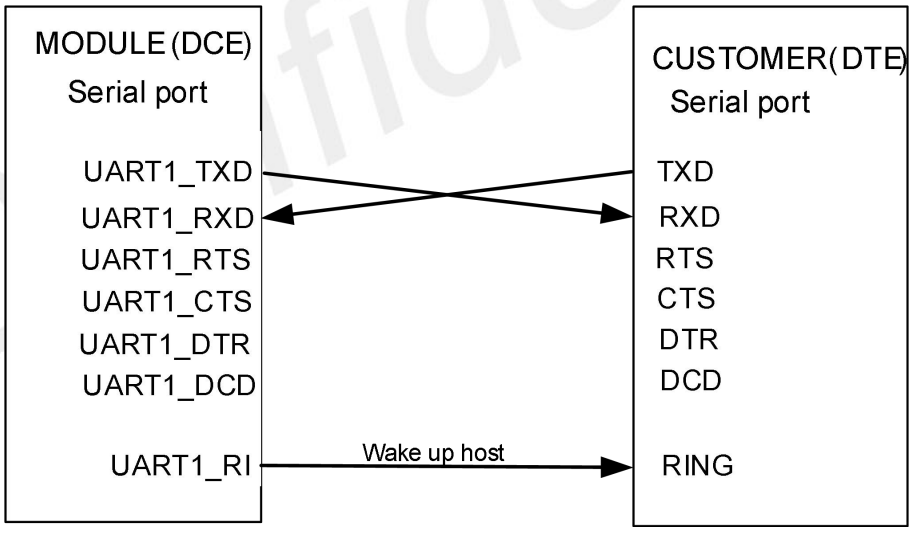

Figure 8: UART null modem circuit

When the serial port of MCU does not match the serial port of module, it is recommended to use voltage level translator to match the voltage level. The reference design circuit is shown as following figure.

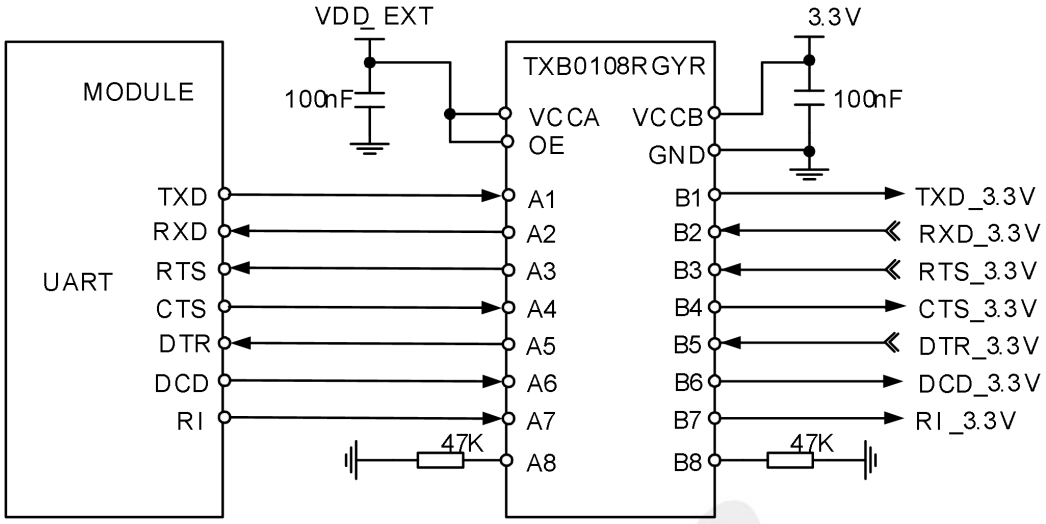

Figure 9: Reference circuit of level translator

NOTE

When it uses the level shifter IC, the pull up resistance on TXD_3.3V, RTS_3.3V, DCD_3.3V and RI_3.3V should not be less than 47KΩ.

4.4 USIM Interface

SIM7080G only supports 1.8V SIM Card, but Y7080E can support 1.8V and 3.0V SIM card.

The pin assignment of SIM7080G USIM interface and Y7080E USIM interface are compatible with each other. A compatible design for 6-pin USIM interface is shown in the figure below:

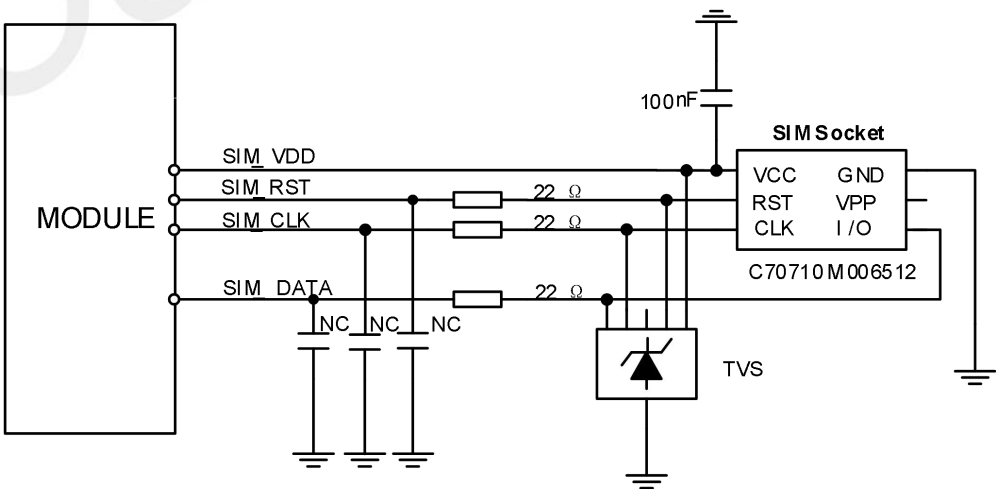

Figure 10: SIM interface reference circuit

SIM card signal could be interference by some high frequency signal, it is strongly recommended to follow these guidelines while designing:

- Add some TVS which parasitic capacitance should not exceed 50pF
- SIM card holder should be far away from GSM antenna
- SIM traces should keep away from RF lines, VBAT and high-speed signal lines, the traces should be as short as possible
- Keep SIM card holder's GND connect to main ground directly
- Shielding the SIM_CLK to prevent the interference to other signals

4.5 USB Interface

SIM7080G provide a USB interface, but the Y7080E don't provide a USB interface. If use the Y7080E module, please disconnect the wire of USB. The reference design circuit is shown as following figure.

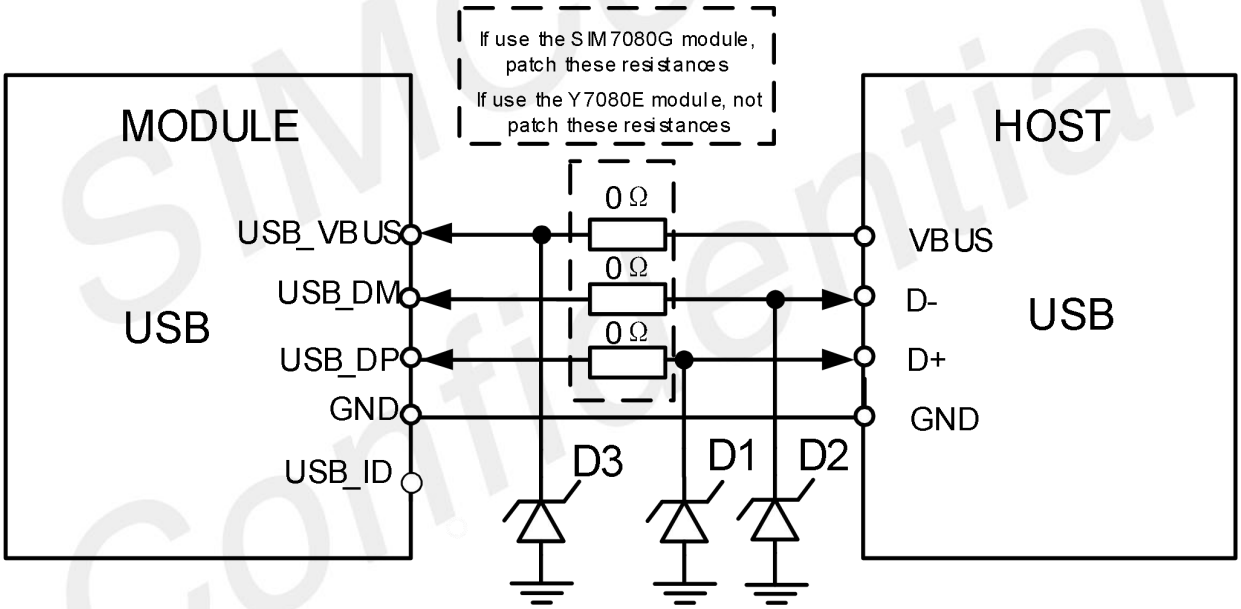

Figure 11: USB interface reference circuit

NOTE

If use the SIM7080G module, patch these three 0R resistances, if use the Y7080E module, please not patch these three resistances, make sure the Y7080E pin 24,25,26 keep float.

4.6 Network Status Indication

The pin assignment of SIM7080G network status indication and Y7080E network status indication are compatible with each other. The NETLIGHT pin is used to control Network Status LED, its reference circuit is shown in the following figure.

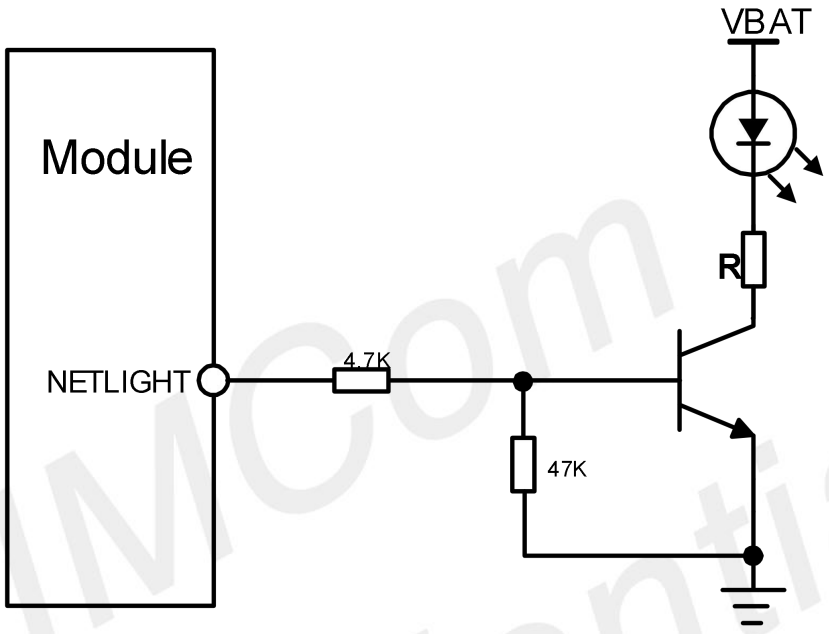

Figure 12: NETLIGHT reference circuit

The pin status of SIM7080G and Y7080E is shown as following table.

Table 8: SIM7080G and Y7080E 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

4.7 Audio Interface

SIM7080G provides a PCM interface for external codec, which can be used in master mode with short sync and 16 bits linear format, but Y7080E not support PCM and it is RESERVED instead of PCM.

The function of SIM7080G is shown as follows.

Table 9: The function overview

Symbol	SIM7080G
	PIN name
9	PCM_DIN
10	PCM_DOUT
11	PCM_CLK
12	PCM_SYNC

The following figure shows the external codec reference design.

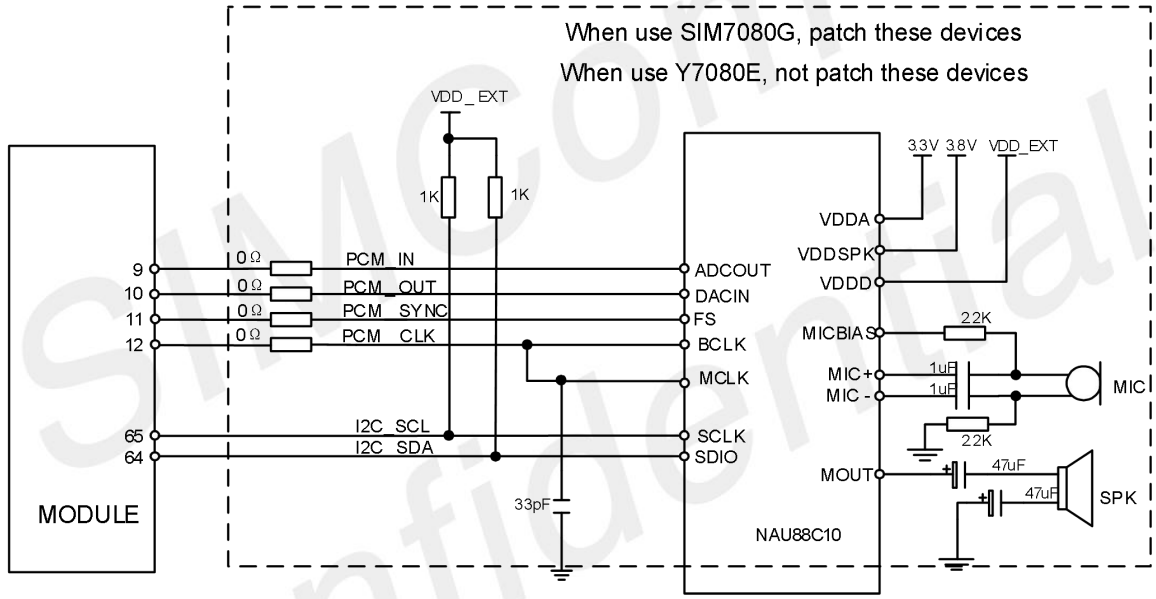

Figure 13: Audio codec reference circuit

4.8 I2C Interface

The pin 64 and pin 65 of SIM7080G and Y7080E is I2C.
SIM7080G and Y7080E provide an I2C interface with clock rate up to 400 kbps. The SIM7080G operation voltage is 1.8V but the Y7080E operation voltage is 3.0V.

The following figure shows the I2C bus reference design.

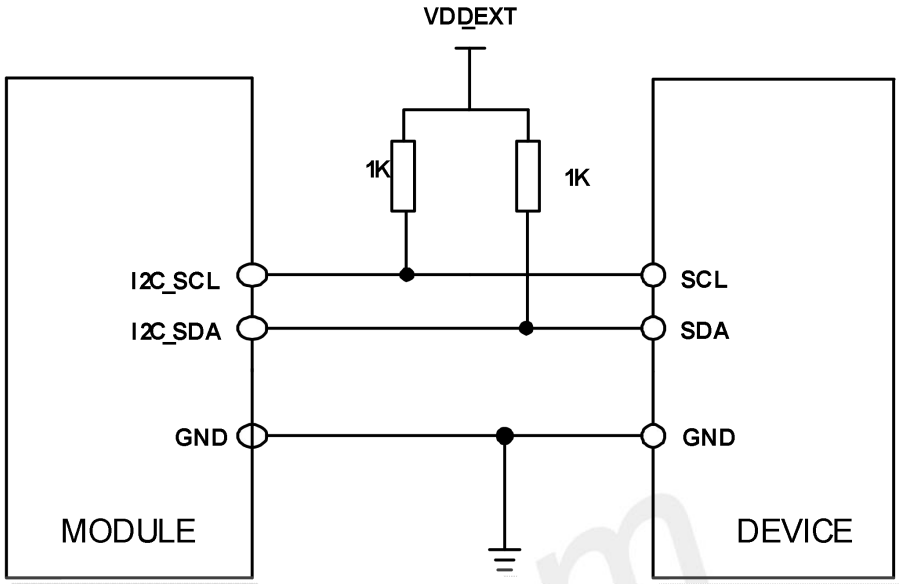

Figure 14: I2C reference circuit

4.9 ADC Interface

The pin assignment of SIM7080G ADC and Y7080E ADC are compatible with each other.
They have different sampling scope. If the input voltage of ADC PIN exceeds its range, it is necessary to implement the resistance partial pressure on the hardware. The ADC electronic characteristics is shown as follows.

Table 10: The Differences overview

interface	SIM7080G		Y7080E	
	PIN name	Voltage range	PIN name	Voltage range
38	ADC	0~1.875V	ADC	0~1V

4.10 RFGRFC Interface

SIM7080G provides the GRFC function, but Y7080E does not

SIM7080G provides a set of antenna GRFC dedicated signals lines. It can be used to control the antenna tuner to improve antenna performance.

The reference circuit is shown in the following figure:

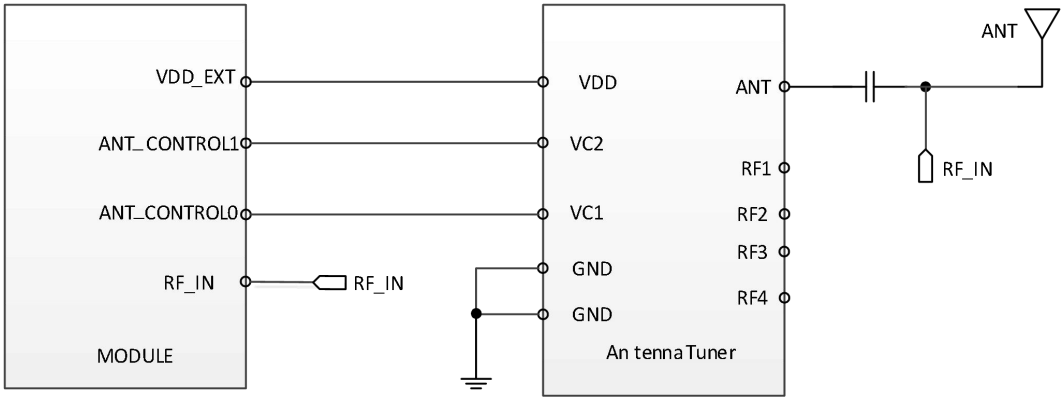

Figure 15: RFGRFC interface reference circuit

4.11 RF Interface

SIM7080G or Y7080E provide a cellular antenna interface.

Users should connect antennas to SIM7080G'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 11: 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.

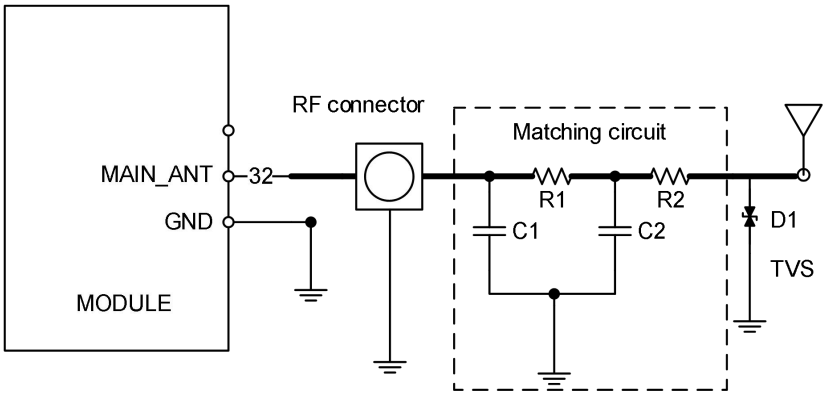

Figure 16: Antenna matching circuit (MAIN_ANT)

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 SIM7080G and antenna must be controlled in 50Ω.

Two TVS are recommended in the table below.

Table 12: Recommended TVS

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

4.12 GNSS

The SIM7080G and Y7080E contain GNSS.

SIM7080G 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.

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4.12.1 GNSS Technical specification

- Tracking sensitivity: TBD（GPS）/ TBD（GLONASS）/TBD (BD)
- Cold-start sensitivity: TBD
- Accuracy (Open Sky): 0.74 m (CEP50)
- TTFF (Open Sky) : Hot start < 1 s, Cold start< 30 s
- Receiver Type: 16-channel, C/A Code
- GNSS L1 Frequency: 1575.42±1.023MHz
- GLONASS: 1597.5~1605.8 MHz
- BD: 1559.05~1563.14 MHz
- Galileo L1: 1575.42±1.023MHz
- Update rate: Default 1 Hz
- GNSS data format: NMEA-0183
- GNSS Current consumption : 16 mA (GSM/LTE Sleep, in total on VBAT pins)
- 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.

4.12.2 GNSS Application Guide

Users can adopt an active antenna or a passive antenna to SIM7080G. If using a passive antenna, an external LNA is a must to get better performance. The following figures are the reference circuits.

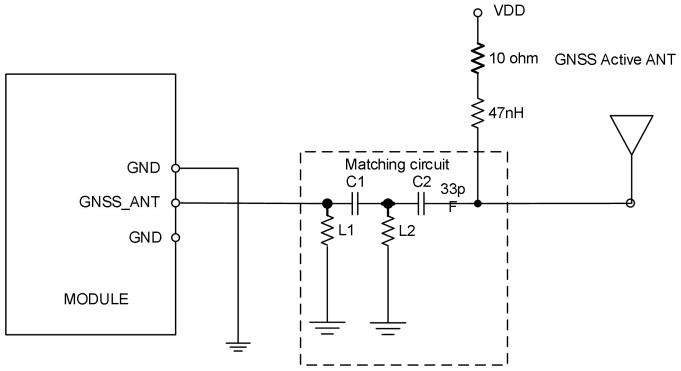

Figure 17: Active antenna circuit

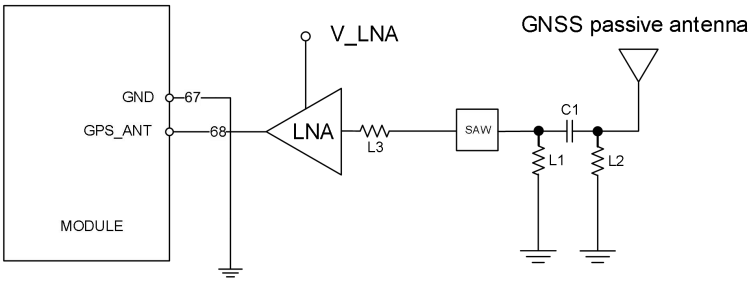

Figure 18: Passive antenna circuit (Default)

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 SIM7080G in proper operating mode by AT command. Please refer to related documents for details. SIM7080G can also get position location information through AT directly.

NOTE

1. GNSS is opened by default.
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.

5 Appendix

5.1 Design check list

Table 13: 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

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Table 14: 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.

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5.2 Related Documents

Table 15: Related Documents

NO.	Title	Description
[1]	Y7080E Hardware Design	Y7080E HD document
[2]	SIM7080G Hardware Design	SIM7080G HD document
[3]	SIM7080G AT Command Manual	AT Command Manual
[4]	Y7080E AT Command Manual	AT Command Manual

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5.3 Terms and Abbreviations

Table 16: 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

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

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5.4 Safety Caution

Table 17: 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.

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