SIM68D
Hardware Design

GNSS Module

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1 Introduction

This document describes the hardware interface of the SIMCom module SIM68D, SIM68D is a GNSS All-in-one solution, which can be used as a Stand-alone or A-GPS（Assisted Global Positioning System）,GLONASS and QZSS receiver. All functional components of SIM68D are described in great detail，and SIM68D supports L1+L5.

SIM68D is a GNSS All-in-one module with stand-alone GPS (A-GPS supported) /GLONASS/BEIDOU receiver, with built-in LNA, SIM68D can relax antenna requirement and don't need external LNA. SIM68D supports various location and navigation applications, including autonomous GPS, GLONASS, BEIDOU, SBAS ranging (WAAS, EGNOS, GAGAN and MSAS), QZSS, DGPS (RTCM), and A-GPS.

Key Features

The module provides complete signal processing from antenna input to host port in NMEA messages. The module requires 2.8V to 4.3V power supply, which gives customers plenty of choices for the application circuit. The host port is configurable to UART. Host data and I/O signal levels are 2.8V CMOS compatible.

- GPS/GLONASS/BEIDOU receiver, supports multi-GNSS include QZSS, DGPS (RTCM),SBAS ranging, supports WAAS/EGNOS/MSAS/GAGAN
- 33tracking/99 acquisition-channel GNSS receiver
- Small footprint: 16 x 12.2 x 2.4mm, 24-pin LCC package
- 12 multi-tone active interference cancellers and jamming elimination[1]
- Indoor and outdoor multi-path detection and compensation
- Max fixed update rate up to 10 HZ[2]
- Advanced software features
    1. Alwayslocate advanced location awareness technology
    2. EPO/HotStill orbit prediction
    3. EASY self-generated orbit prediction
- Pulse-per-second (PPS) GPS time reference
    1. Adjustable duty cycle
    2. typical accuracy: +/- 20ns
- Interface
    1. UART[3]
    2. SPI
    3. I2C[4]
- Operating temperature: -40 ~ +85ºC
- Accuracy 1m CEP[5]
- RoHS compliant

NOTE

1. AIC is default open and can be controlled by PAIR command, see *document [2]* for details；
2. Default is 1 HZ；
3. UART0 for output NMAEA and download，UART1 for system LOG，UART2 for RTCM function.
4. When using the I2C function, contact FAE to evaluate the software and hardware, and a separate software version is required;
5. Static receive 24hours OPEN SKY.

1.1 SIM68D Functional Diagram

The following figure shows a functional diagram of the SIM68D and illustrates the mainly functional parts:

- The main chip
- SAW filter
- Low noise amplifier
- The antenna interface
- The communication interface
- The control signals

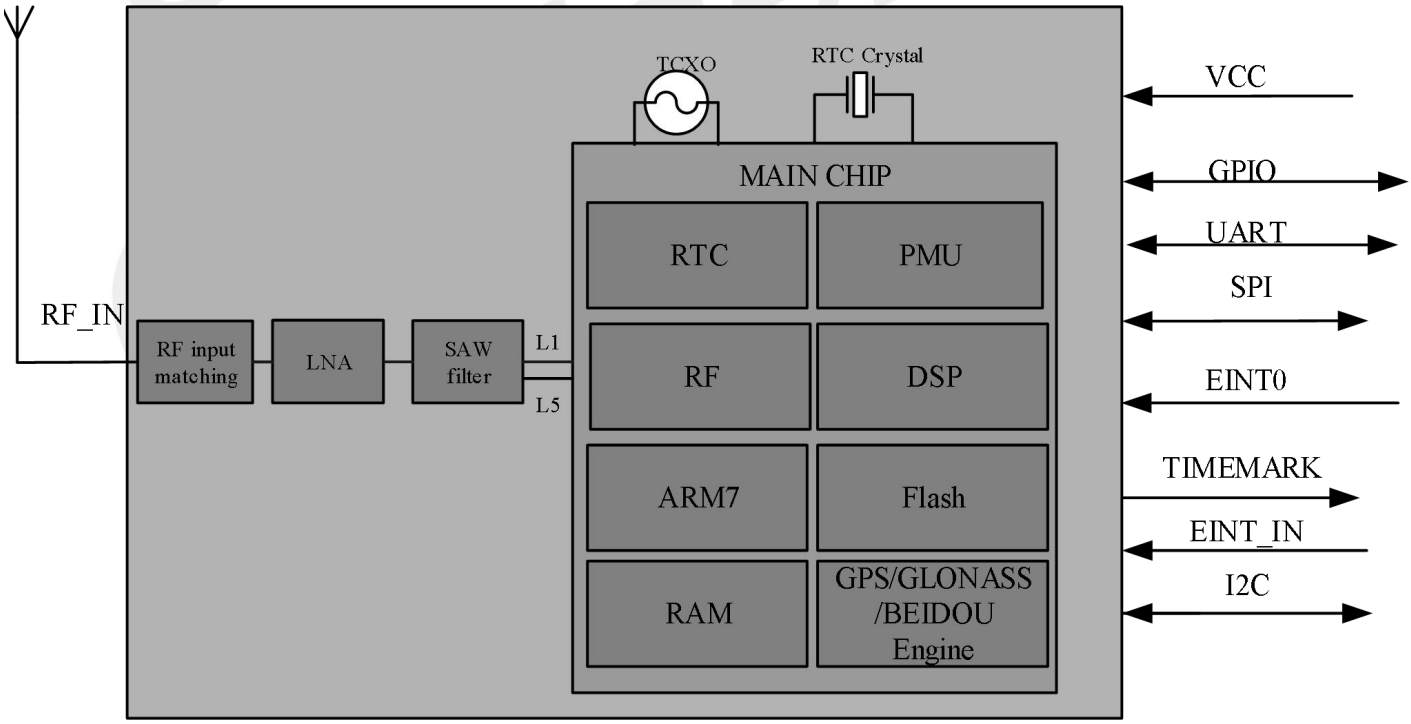

Figure 1: SIM68D functional diagram

1.1.1 GNSS Performance

Table 1: GNSS Performance

Parameter	Description	Performance			
		Min	Type	Max	Unit
Horizontal Position Accuracy[1]	Automatic position		1		m
Velocity Accuracy[2]	Without Aid		0.1		m/s
	DGPS		0.05		m/s
Timing Accuracy			10		nS
Dynamic Performance	Maximum Altitude			18000	m
	Maximum Velocity			500	m/s
	Maximum Acceleration			4	G
TTFF with GPS（L1+L5） and GALILEO[3]	Hot start		0.6		S
	Warm start		24.9		S
	Cold start		30.2		S
A-GPS TTFF(EPO in flash mode)	Hot start		0.5		S
	Warm start		2.9		S
	Cold start		12.6		S
Sensitivity with GPS（L1+L5） only mode	Autonomous acquisition(cold start)		-148		dBm
	Re-acquisition		-158		dBm
	Tracking		-166		dBm
Sensitivity with GPS（L1+L5） and GLONASS and BEIDOU mode	Autonomous acquisition(cold start)		-148		dBm
	Re-acquisition		-158		dBm
	Tracking		-166		dBm
Receiver	Channels		L1:75 L5:60		
	Update rate		1	10	Hz
	Tracking L1, CA Code				
	Protocol support NMEA,PAIR				
Power consumption With GPS（L1+L5） and GLONASS and BEIDOU mode[4]	Acquisition		30		mA
	Continuous tracking		32		mA
	Sleep current		340		uA
	RTC current		50		uA

NOTE

1. 50% 24hr static, -130dBm；
2. 50% at 30m/s；
3. GPS signal level: -130dBm; GLONASS signal level: -130dBm; GALILEO signal level: -130dBm; BEIDOU signal level: -130dBm；
4. Power supply 3.3V；

1.1.2 General features

Table 2: General features

Parameters		Value
Supply voltage VCC		+2.8V~4.3V typical:3.3V
Supply voltage ripple VCC		30 mV(RMS) max @ f = 0~3MHz 15 mV(RMS) max @ f > 3 MHz
Power consumption(acquisition)		30mA.@ VCC=3.3 V
Power consumption(sleep)		340uA.@ VCC=3.3 V
Power consumption(software RTC)		50uA.@ VCC=3.3V
Storage temperature		-45ºC~+95ºC
Operating temperature		-40ºC~+85ºC[1]
DVDDIO=2.8V I/O signal levels(V)	V_{IL}	-0.3V ~ 0.7V
	V_{IH}	1.75V ~ 3.08V
	V_{OL}	-0.3V ~ 0.35V
	V_{OH}	2.1V ~ 3.1V
DVDDIO=1.8V I/O signal levels(V)	V_{IL}	-0.3V ~ 0.7V
	V_{IH}	1.17V ~ 2.1V
	V_{OL}	-0.3V ~ 0.45V
	V_{OH}	1.35V ~ 1.98V
I/O output sink/source capability		+/- 6mA max
I/O input leakage		+/- 16 uA max
Host port		UART0
Other port		I2C,SPI,UART1,UART2
Serial port protocol (UART)		NMEA; 8 bits, no parity, 1 stop bit; 115200 baud (configurable)
TM output (1PPS)		3D-FIXED 1 pulse per second, synchronized at rising edge, The rising edge of the pulse is aligned with UTC

	seconds, with an accuracy of about 20nS pulse length 100ms

2 Package Information

2.1 Pin out Diagram

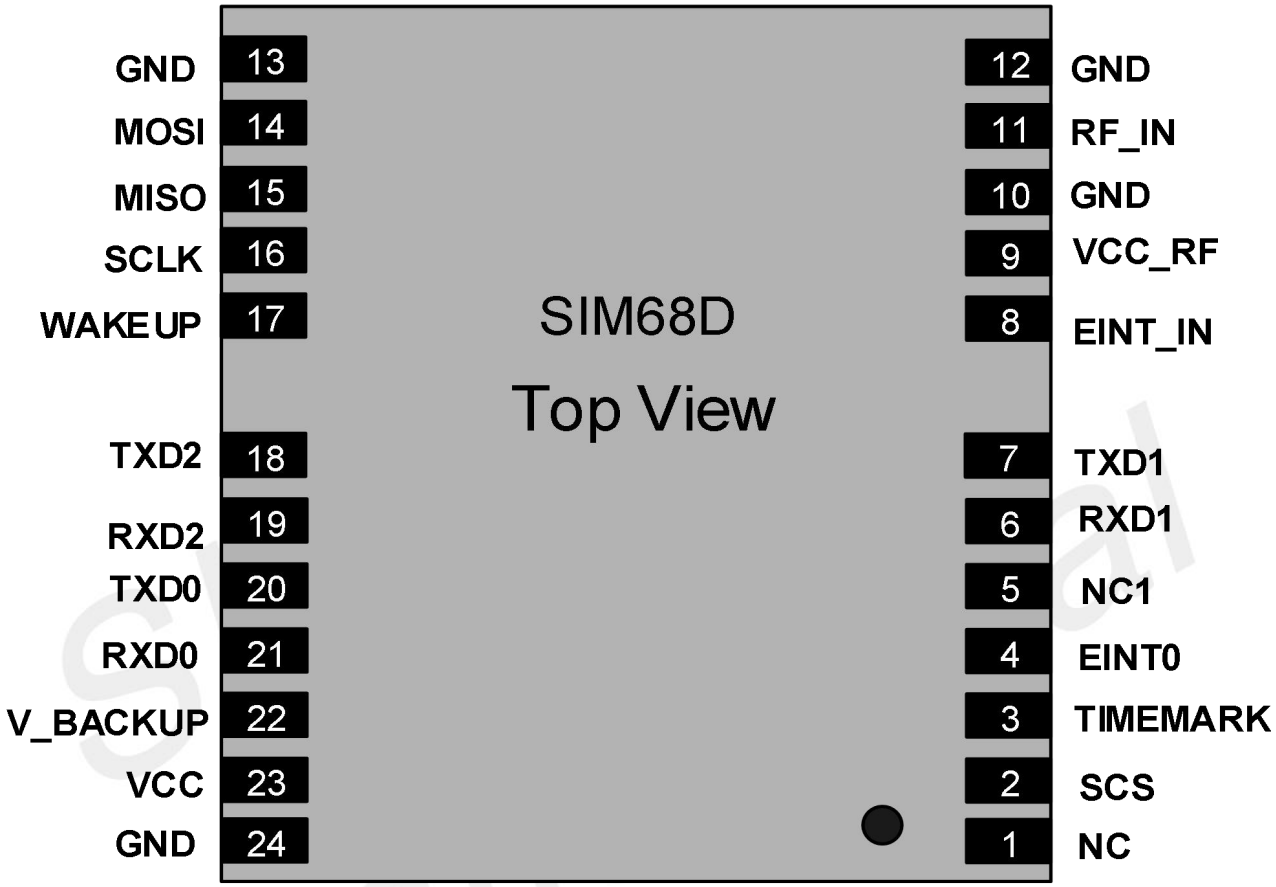

Figure 2: SIM68D pin diagram (Top view)

2.1.1 Pin Description

Table 3: Pin description

Pin name	Pin number	I/O	Description	Comment
Power supply				
VCC	23	I	Main power input, which will be used to power the baseband and RF section internally.	Provide clean and stable power source to this pin. Add a 4.7uF capacitor to this pin for decoupling.
VCC_RF	9	O	2.8V output power supply for active antenna	If unused, keep open.
V_BACKUP	22	I	The backup battery input power supply for RTC	If unused, keep open.
GND	10,12,13,24		Ground	GND
Host port interface				
MISO	15	I	SPI MISO	1.8V power domain, If unused, keep open.
MOSI	14	O	SPI MOSI	
SCLK	16	O	SPI clock	
SCS	2	O	SPI slave select	
TXD2	18	O	RTCM function and NMEA	2.8V power domain, If unused, keep open.
RXD2	19	I		
TXD0	20	O	NMEA serial output/ input	
RXD0	21	I		
TXD1	7	O	System LOG serial output/ input	
RXD1	6	I		
GPIOs				
EINT0[1]	4	I	RTC interrupt , exit RTC mode	1.8V power domain, ENT0 pull high 10ms that module will exit RTC mode. Must be connected
TIMEMARK	3	O	Timemark outputs timing pulse related to receiver time	2.8V power domain, If unused, keep open.
EINT_IN[2]	8	I	Wakeup SIM68D, low active EDGE trigger, default PULL HIGHT	1.8V power domain, pull up to 1.8V,; Must be connected
WAKEUP[3]	17	O	Wakeup HOST& Notify data ready HIGHT active, level trigger	1.8V power domain,
RF interface				
RF_IN	11	I	Radio antenna connection	Impendence must be controlled to 50Ω.

Other interface			
NC	1,5	Not connected	Keep floating

NOTE

1. 4pin EINT0 must be connected, otherwise it may cause failure to exit RTC mode.
2. 8pin EINT_IN must be connected, otherwise it may cause failure to exit sleep mode, please refer to section 3.4 for details.
3. 17pin WAKEUP wake up host and notify data ready, choose according to their own project situation.

2.1.2 Package Dimensions

Following figure shows the Mechanical dimensions of SIM68D (top view, side view and bottom view).

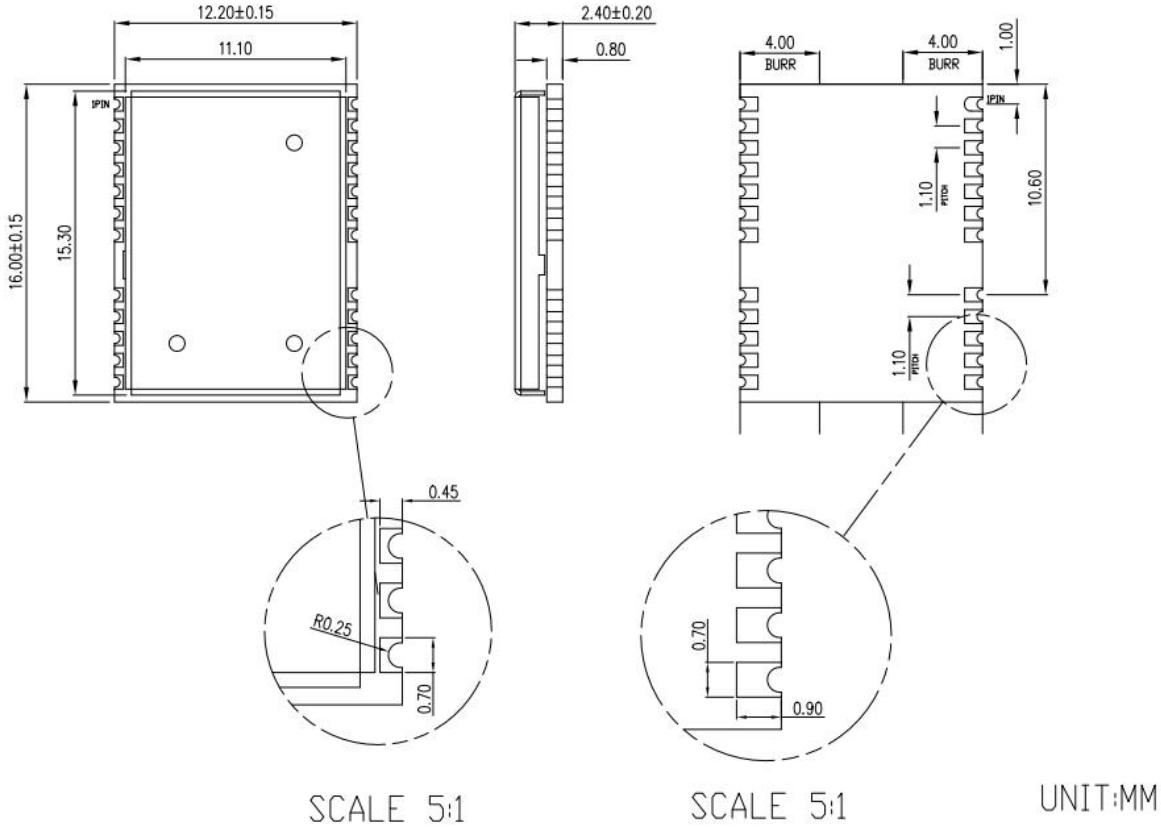

Figure 3: SIM68D mechanical dimensions (Unit: mm)

3 Application Interface

3.1 Power Management

3.1.1 Power Input

- VCC supply requirements

  The power supply range of SIM68AD is from 2.8V to 4.3V, typical 3.3V. The power supply should be able to provide sufficient current up to 100mA. SIM68D positioning modules require a stable power supply, consider the following points:

1. Wide power lines or even power planes are preferred.
2. VCC supply needs to add a 4.7uF and 100nF multi-layer ceramic chip (MLCC) capacitors with low ESR in high frequency band, which can be used for EMC performance .
3. The ripple of the VCC supply cannot be higher than 15mV.
4. VCC supply needs a ESD and surge protection.

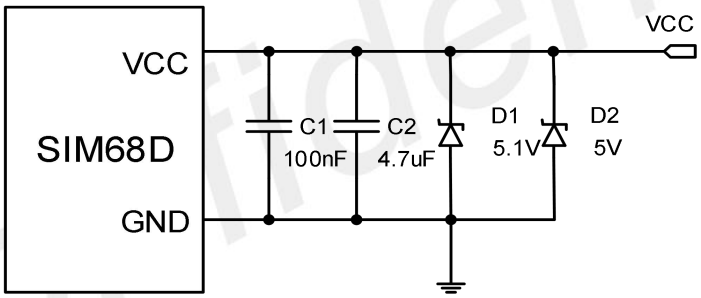

Figure 4: Power supply reference circuit

NOTE

1. C1 and C2 are multi-layer ceramic chip (MLCC) capacitors with low ESR in high frequency band, which can be used for EMC performance.
2. D2 is used for ESD protection and D1 is used for surge protection.

- Backup supply requirements

Using valid time and SIM68D orbit data at startup will improve GPS/GNSS performance. Enable hot start. In order to take advantage of these functions, connect a power source (such as a battery, etc.) to V_BCKUP to continue supplying power to the backup domain in the event of a power failure in the VCC after sending a command to enter the RTC mode.

Table 4: Recommended D1 and D2 list

No.	Manufacturer	Part number	VRWM	Package	Ref. Designator
1	JCET	ESDBW5V0A1	5V	DFN1006-2L	D2
2	WAYON	WS05DPF-B	5V	DFN1006-2L	
3	LRC	LEDZ5.1BT1G	5.1V	SOD-523	D1
4	Prisemi	PZ5D4V2H	5.1V	SOD-523	

3.1.2 Starting SIM68D

When power is first applied, SIM68D goes into operation mode.

3.1.3 Verification of SIM68D Start

System activity indication depends upon the chosen serial interface:

When it is activated, SIM68D will output messages at the selected UART speed, and message types. The default baud rate is 115200bps.

NOTE

The baud rate information can be found on the label. The last two digits of the SN number represent the baud rate, for example, 11 represents 115200.

3.1.4 SIM68D Power off

When the VCC power supply of the module is disconnected, the voltage should be guaranteed to drop rapidly within 50ms.

In order to ensure that the power-on sequence is abnormal when the module is powered on and restarted

next time, it should be ensured that the VCC of the module is powered down below 100mV and maintained for at least 1s, and then power-on and restart.

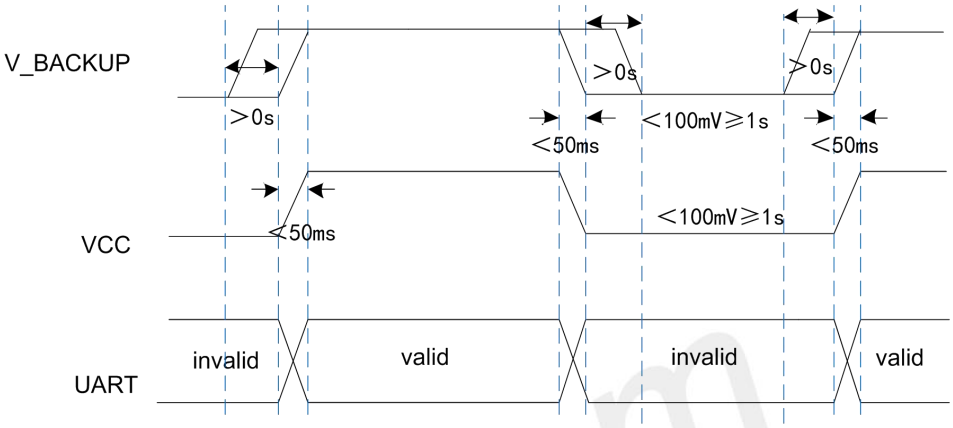

Figure 5: power on/off and restart sequence

3.1.5 Power Saving Modes

SIM68D supports power saving modes for reducing average power consumption like sleep mode, RTC mode, periodic mode.

- Sleep mode**:** In this mode the receiver stays at full on power state. This mode can be woken up by the host by sending external interrupt.
- RTC mode**:** Software on host side to send the command through the communication interface to into the soft RTC mode，wake UP by ENIT0.

NOTE

The modes mentioned above are operated by PAIR commands, users can refer to "SIM68 Series_NMEA Message_User Guide" for more information.

3.1.6 Operating Mode

Table 5: Power supply and clock state according to operation mode

Mode	VCC	V_BACKUP	Internal LDO	Main clock	RTC clock
Full on	on	on/off	on	on	on
Sleep mode	on	on/off	on	off	on
RTC mode	on/off	off/on	off	off	on

NOTE

Before SIM68D sends PAIR650 command to enter RTC mode, connect V_BACKUP, after entering RTC mode, customers can choose whether to disconnect VCC according to your needs.

Full on Mode

The module will enter full on mode after first power up with factory configuration settings. Power consumption will vary depending on the amount of satellite acquisitions and number of satellites in track. This mode is also referenced as full on, full power or navigation mode.

First positioning (different CN value, different positioning time), can download complete ephemeris data 15 minutes after positioning.

Navigation is available and any configuration settings are valid as long as the VCC power supply is active. When the power supply is off, settings are reset to factory configuration and receiver performs a cold start on next power up.

Sleep Mode

Sleep mode means a low quiescent (340uA type.) power state, non-volatile RTC, and backup RAM block is powered on. Other internal blocks like digital baseband and RF are internally sleeping. The PMU is changed to low power mode, The power supply input VCC shall be kept active all the time, even during sleep mode.

Entering into sleep mode is controlled by UART interface, enter $PAIR003*39\r\n to enter sleep mode.Pull down “ENIT_IN” pin 10ms, in the process of pulling down EINT_IN 10ms, SIM68D will return $PAIR012*39, and send $PAIR002*38\r\n to exit sleep mode within 100ms after returning $PAIR012*39.

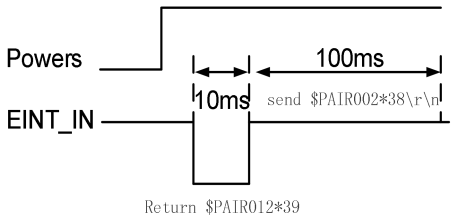

Figure 6: Exit sleep mode

NOTE

You must pull down “ENIT_IN” 10ms at least.

RTC Mode

RTC mode provides a lower current consumption than sleep mode. It is suitable for applications that remain idle for a long period. Triggering RTC mode is software configurable. The RTC timer or EINT0 can be used to exit RTC mode

Enter RTC mode

Entering into RTC mode is controlled by UART interface, send $PAIR650,0*25\r\n to enter RTC mode.

NOTE

For command PAIR650, please refer to SIM68 Series_NMEA Message_User Guide.

Exit RTC Mode

SIM68D module ENT0 pin can be used to exit RTC mode, when ENT0 pull high 10ms that module will exit RTC mode.

Case1：Using host control power source
Step1: enable external power source witch have to meeting power on sequence.
Step2: Pull up EINT0 10ms.
Step3: SIM68D module will auto exit RTC mode.

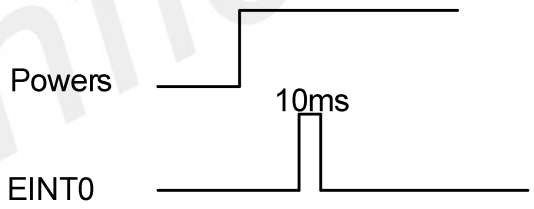

Figure 7: Exit RTC Mode

3.2 VCC_RF

VCC_RF is a 2.8V output for external antenna, for the detail usage of VCC_RF, customer can refer to document [3] for more information.

3.3 EINT0 Signal

SIM68D module EINT0 pin can be used to exit RTC mode, when EINT0 pull high 10ms that module will exit RTC mode.

Case1：Using host control power source
Step1: enable external power source witch have to meeting power on sequence.
Step2: Pull up EINT0 10ms.
Step3: SIM68D module will auto exit RTC mode.

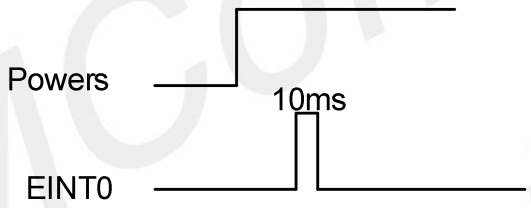

Figure 8: Exit RTC Mode

3.4 EINT_IN Signal

When the module is successfully positioned, it will enter a short-term sleep mode to reduce power consumption. UART_RX wakes up when outputting NMEA every and sleeps at other times. If the host sends a command after the module is positioned, there is a greater chance that it cannot be executed, 8pin EINT_IN is used to wake up this sleep mode.

3.5 UART Interface

UART can provide the developers signal or message outputs.SIM68D includes three UART interfaces.
UART0 interface for serial communication, and this UART support NMEA output and PAIR command input.
UART1 interface is System LOG.
UART2 interface is the RTCM format data input used for RTCM function.

Table 6: Host port multiplexed function pins

Pin name	Pin number	I/O	Description	Comment
TXD2/SDA	18	O	RTCM function and NMEA	2.8V power domain, If unused, keep open.
RXD2/SCL	19	I		

TXD0	20	O	Serial data output of NMEA	2.8V power domain
RXD0	21	I	Serial data input for firmware update	
TXD1	7	O	System LOG output/ input	2.8V power domain, If unused, keep open.
RXD1	6	I		

NOTE

The default baud rate is 9600 or 115200, if other baud rate required please contact SIMCom.

The following figure shows the connection between module and client (DTE).

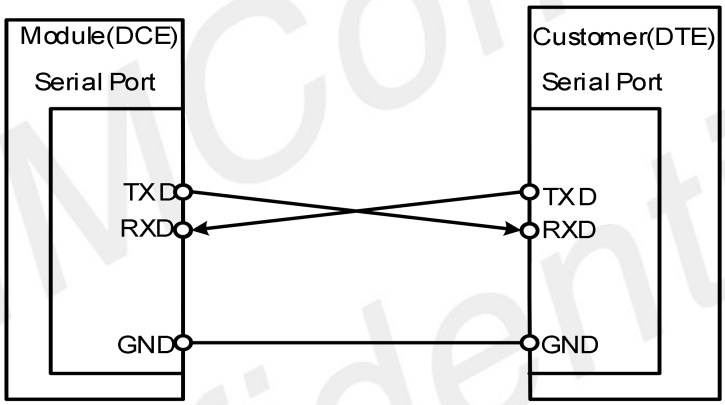

Figure 9: Connection of the serial interfaces

3.6 SPI Interface*

The SPI interface is for connection of external serial flash to save configuration and A-GPS data. The SCS chip select signal is available to select external slaves. External SPI serial flash up to 128Mbits is supported.

Table 7 : SPI function pins

Pin name	Pin number	SPI function
MISO	15	Master input
MOSI	14	Master output
SCLK	16	Clock output
SCS	2	Chip select

NOTE

1. “*” means under development.

3.7 I2C Interface*

The SCL and SDA can be connected to an external I2C interface EEPROM up to 1 Mbits for reading and writing data into EEPROM. This can be used to store configurations permanently.

NOTE

1. “*” means under development.
2. The EEPROM and flash can’t be supported synchronously
3. The Function under development, if Function required please contact SIMCom.
4. 2.2K needs to be pulled up outside the module

3.8 Timemark Output

The Timemark pin outputs pulse-per-second (PPS) pulse signal for precise timing purposes after the position has been fixed. The Timemark 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, support for time service application, which is achieved by the PPS vs NMEA feature.

The following figure is the typical application of the TIMEMARK function.

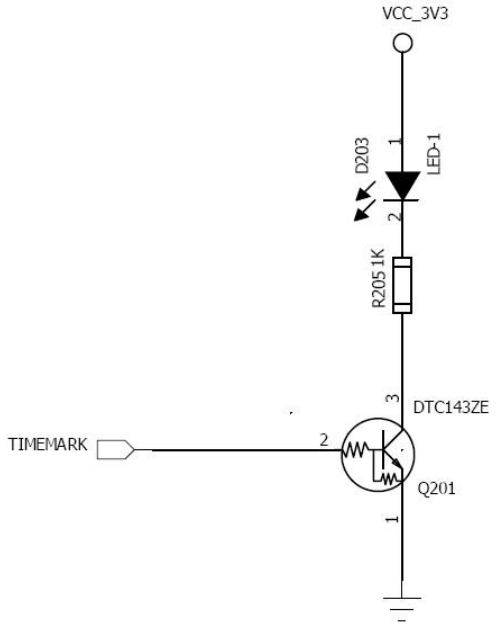

Figure 10: TIMEMARK application circuit

3.9 A-GPS

A-GPS is the meaning of Assisted GPS, which is a system that can under certain conditions improve the startup performance, or time-to-first-fix (TTFF) of a GPS satellite-based positioning system. SIM68D module supports EPO file, EASY mode, SBAS and RTCM.

3.9.1 EPO

The SIM68D supports the EPO (Extended Prediction Orbit) data service. The EPO data service is supporting 7/14/30-day orbit predictions to customers. It needs occasional download from EPO server. Supply of aiding information like ephemeris, almanac, rough last position and time and satellite status and an optional time synchronization signal will reduce time to first fix significantly.

The user should update the EPO files from the EPO server in the period of validity of EPO file through the internet. Then the EPO data should send to the SIM68D by the HOST side. SIM68D has the shorter cold TTFF and warm TTFF, when the A-GPS is used.

NOTE

For more information about EPO, please contact SIMCom.

3.9.2 EASY Mode

EASY is the abbreviation of Embedded Assist System, it works as embedded software which accelerates TTFF by predicting satellite navigation messages from received ephemeris.

No additional computing interval for EASY task. EASY is efficiently scheduled and computed in free time of every second after GPS navigation solution.

Easy function is conceptually designed to automatically engage for predicting after first receiving the broadcast ephemeris. After a while （generally tens of seconds）, 3-day extensions will be completely generated then all EASY functions will be maintained at a standby condition. EASY assistance is going to be engaged when the GPS requests in new TTFF condition or re-generates again with another new received ephemeris. Meanwhile, TTFF will be benefited by EASY assistance.

NOTE

EASY function is default open and can be closed by PAIR command.

3.9.3 SBAS and RTCM

3.7.3.1 SBAS

SBAS is the abbreviation of Satellite Based Augmentation System. The SBAS concept is based on the transmission of differential corrections and integrity messages for navigation satellites that are within sight of a network of reference stations deployed across an entire continent. SBAS messages are broadcast via geostationary satellites able to cover vast areas.

Several countries have implemented their own satellite-based augmentation system. Europe has the European Geostationary Navigation Overlay Service (EGNOS) which covers Western Europe and beyond. The USA has its Wide Area Augmentation System (WAAS). Japan is covered by its Multi-functional Satellite Augmentation System (MSAS). India has launched its own SBAS program named GPS and GEO Augmented Navigation (GAGAN) to cover the Indian subcontinent.

3.7.3.2 RTC Mode

SIM68D module supports soft RTCM, but only one mode can be applied at one time, and SBAS is the default feature, customers who want to apply RTCM in the design can contact SIMCom for supporting.

3.10 Antenna

The antenna is the most critical item for successful GPS/GLONASS/BEIDOU reception in a weak signal environment. Proper choice and placement of the antenna will ensure that satellites at all elevations can be seen, and therefore, accurate fix measurements are obtained.

It is recommended to use an active GPS/GLONASS/BEIDOU antenna. In a typical application, SIM68D with an active antenna can get a tracking sensitivity about 3dB better than SIM68D with a passive antenna.

3.10.1 Antenna Interface

The SIM68D receives L1 and L5 band signals from GPS/GLONASS/BEIDOU satellites, The RF signal is connected to the RF_IN pin. And the trace from RF_IN to antenna should be controlled to 50Ω impendence.

To suit the physical design of individual applications the RF interface pad can lead to two alternatives:

- Recommended approach: solderable RF coaxial cable assembly antenna connector, such as HRS' U.FL-R-SMT (10) connector or I-PEX's 20279-001E-01 RF connector.
- SMA connector.

3.10.2 Antenna Choice Consideration

To obtain excellent GNSS reception performance, a good antenna will always be required. Proper choice and placement of the antenna will ensure that satellites at all elevations can be seen, and therefore, accurate fix measurements are obtained.

- The total noise figure should be well below 3 dB.
- If a patch antenna is the preferred antenna, choose a patch of at least 15x15x4 mm for standalone.
- GPS/QZSS, or choose a patch of at least 25x25x4 mm for GPS + GLONASS. For smaller antennas, an LNA with a noise figure <2 dB is recommended.
- Make sure the antenna is not located close to noisy parts of the circuitry (e.g. micro-controller or High Power or display).
- To optimize performance in environments with out-of-band jamming sources, use an additional SAW filter.
- The micro strip must be 50 Ω and be routed in a section of the PCB where minimal interference from noise sources can be expected.
- In case of a multi-layer PCB, use the thickness of the dielectric between the signal and the first GND layer (typically the 2nd layer) for the micro strip calculation.
- If the distance between the micro strip and the adjacent GND area (on the same layer) does not

exceed 5 times the track width of the micro strip.

- Use an external LNA if your design does not include an active antenna when optimal performance is important.

The following table shows GNSS Operating frequencies

Table 8: GNSS Operating frequencies

Type	Frequecy
GPS L1	1575.42±1.023MHz
GLONASS G1	1601.7±6.75MHz
Galileo E1	1575.42±1.023MHz
BeiDou B1I	1561.098±2.046MHz
GPS L5	1176.45±10.23MHz
BeiDou B2a	1176.45±10.23MHz
Galileo E5a	1176.45±10.23MHz

The suggested active antenna should be chosen as following:

Table 9: Antenna Specifications

	Specification	Passive and active antenna
Active Antenna Recommendations	Frequency range L1	1560～1609MHz
	Frequency range L5	1166～1187MHz
	Polarization	RHCP
	Gain	>20dB (max 50 dB)
	Noise Figure	<1.5 dB

3.10.2.1 Passive Antenna

Passive antenna contains only the radiating element, e.g. the ceramic patch, the helix structure, and chip antennas. Sometimes it also contains a passive matching network to match the electrical connection to 50 Ohms impedance.

The most common antenna type for GPS/GLONASS/BEIDOU application is the patch antenna. Patch antennas are flat, generally have a ceramic and metal body and are mounted on a metal base plate.

Figure 6 shows a minimal setup for a GPS/GLONASS/BEIDOU receiver with SIM68D module.

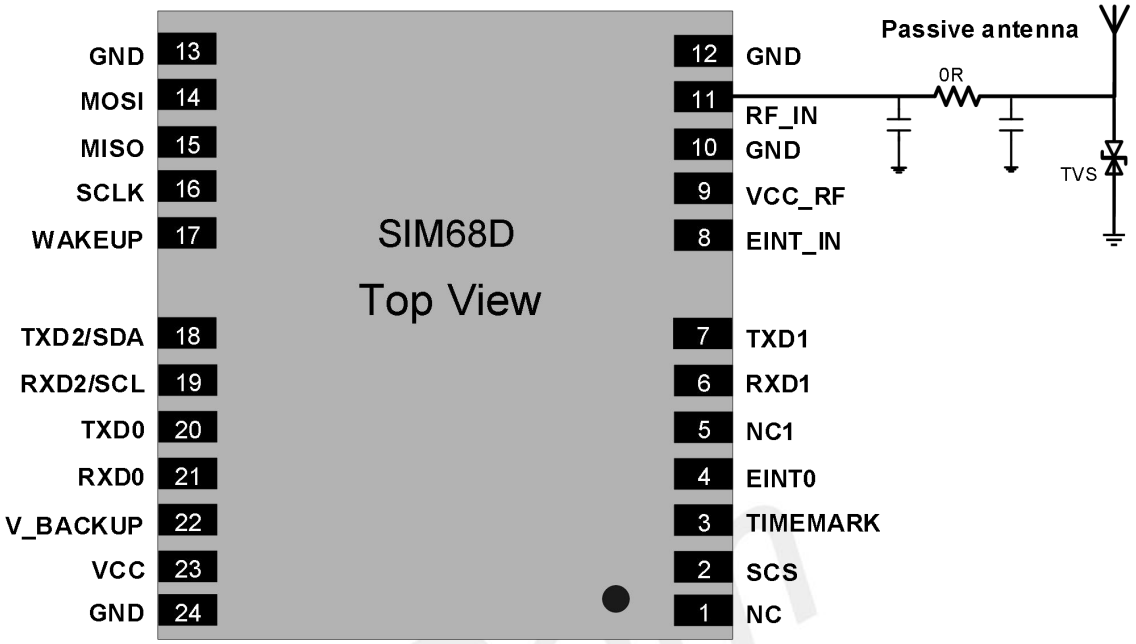

Figure 11: SIM68D passive antenna design

For better performance with passive antenna designs user can use an external LNA to increase the sensitivity up 3~4 dB. Please see Figure 8.

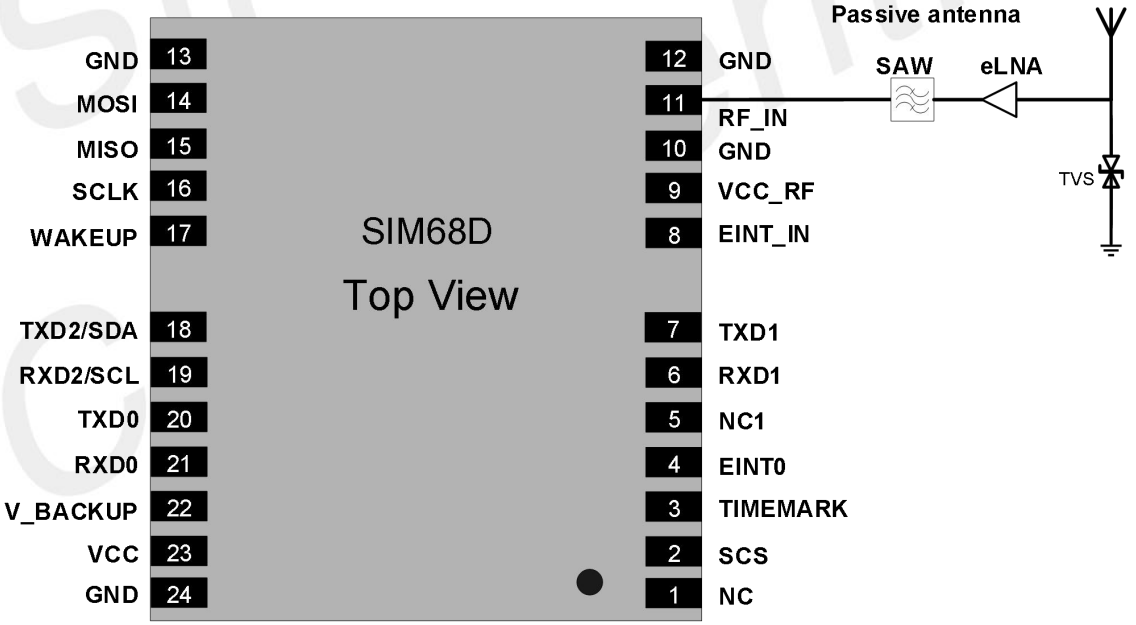

Figure 12: SIM68D passive antenna design (with external LNA and SAW)

For best performance, user can add an external saw based on Figure9 design to avoid interference, please see Figure 10.

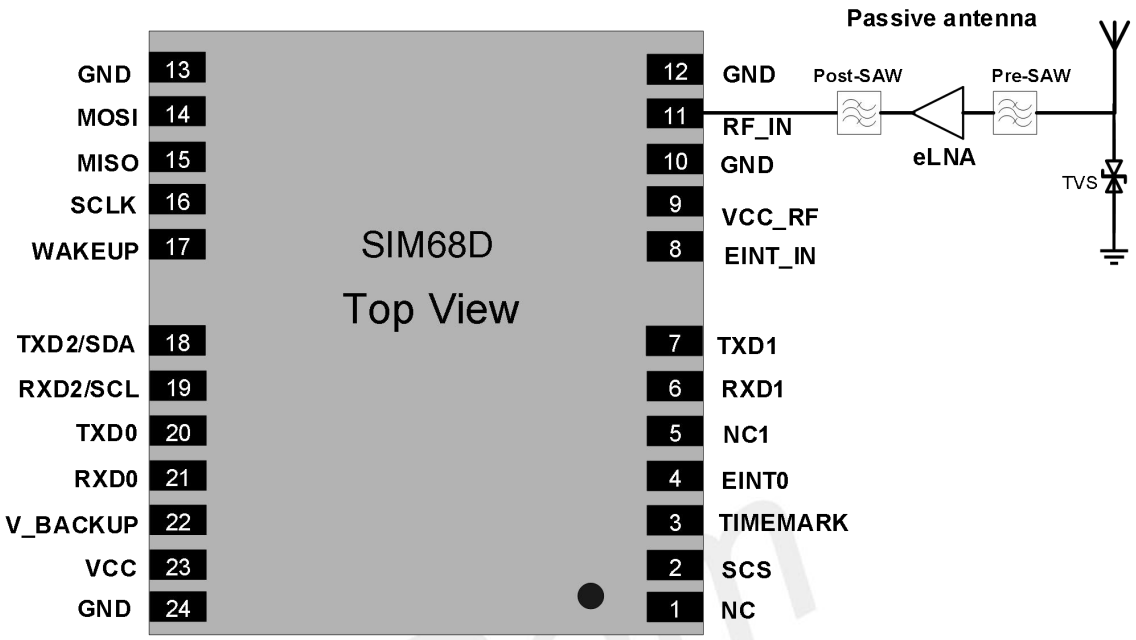

Figure 13: SIM68D passive antenna design

3.10.2.2 Active Antenna

Active antenna has an integrated Low-Noise Amplifier (LNA). Active antenna needs a power supply that will contribute to GNSS system power consumption.

Usually, the supply voltage is fed to the antenna through the coaxial RF cable shown as Figure 9. The output voltage of PIN 9 is 2.8V. If the supply voltage of active antenna is 2.8V, PIN 9 VCC_RF can be connected to RF_IN as figure 9 shows. If the active antenna is not 2.8V, other power should be connected to RF_IN.

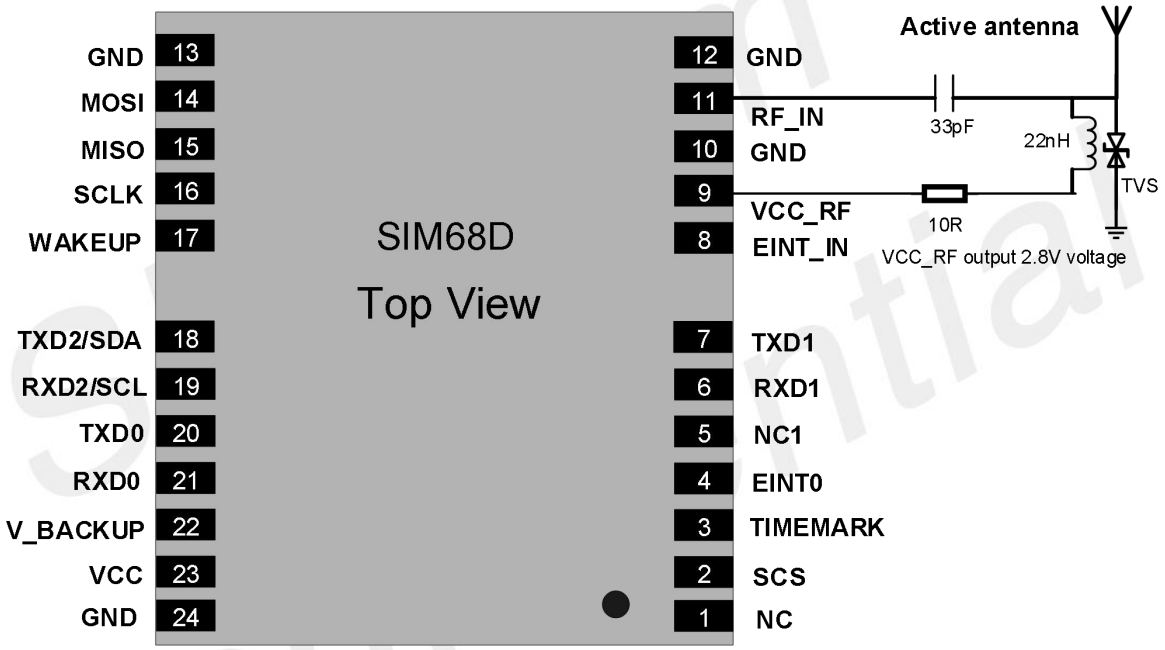

Figure 14: SIM68D active antenna design

If the customer's design is for automotive applications, then an active antenna can be used and located on top of the car in order to guarantee the best signal quality.

GNSS antenna choice should base on the designing product and other conditions. For detailed Antenna designing consideration, please refer to related antenna vendor's design recommendation. The antenna vendor will offer further technical support and tune their antenna characteristic to achieve successful GNSS reception performance depending on the customer's design.

4 Electrical Characteristics

4.1 Absolute Maximum Ratings

The absolute maximum ratings stated in Table 8 are stress ratings under non-operating conditions. Stresses beyond any of these limits will cause permanent damage to SIM68D.

Table 10: Absolute maximum ratings

Parameter	Min	Max	Unit
VCC	-	5.5	V
RF_IN	-	3.6	V
V_BACKUP	-	4.6	V
I/O pin voltage	-	3.1	V
Storage temperature	-45	+95	℃
Operating Temperature	-40	+85	℃

NOTE

The absolute maximum rating of RF_IN please reference to the active antenna datasheet

4.2 Recommended Operating Conditions

Table 11: SIM68D operating conditions

Parameter	Symbol	Min	Typ	Max	Unit
Operating temperature range		-40	+25	+85	℃
Main supply voltage	VCC	2.8	3.3	4.3	V
VCC_RF Active antenna supply voltage output	VCC_RF	2.7	2.8	2.9	V
	Imax			100	mA
Backup battery voltage	V_BACKUP	2.8	3.3	4.3	V

Table 12: SIM68D standard IO features

Parameter	Symbol	Min	Typ	Max	Unit
Low level output voltage Test conditions IOL = 2mA and 4.0mA@2.8V	V_{ol}	-0.3		0.35	V
High level output voltage Test conditions IOL = 2mA and 4.0mA@2.8V	V_{oh}	2.1		3.1	V
Low level input voltage@2.8V	V_{il}	-0.3		0.7	V
High level input voltage@2.8V	V_{ih}	1.75		3.1	V
Low level output voltage Test conditions IOL = 2mA and 4.0mA@1.8V	V_{ol}	-0.3		0.45	V
High level output voltage Test conditions IOL = 2mA and 4.0mA@1.8V	V_{oh}	1.35		1.98	V
Low level input voltage@1.8V	V_{il}	-0.3		0.63	V
High level input voltage@1.8V	V_{ih}	1.17		1.98	V
Input Pull-up resistance	RPU	40	75	190	KΩ
Input Pull-dowm resistance	RPD	40	75	190	KΩ
Input capacitance	Cin		5		pF
Load capacitance	Cload			8	pF
Tri-state leakage current	IOZ	-10		10	uA

4.3 Electro-Static Discharge

The GPS engine is not protected against Electrostatic Discharge (ESD) in general. Therefore, it is subject to ESD handing precautions that typically apply to ESD sensitive components. Proper ESD handing and packaging procedures must be applied throughout the processing, handing and operation of any application using a SIM68D module.

Table 13: The ESD characteristics (Temperature: 25℃, Humidity: 45 %)

Pin	Contact discharge	Air discharge
VCC	± 4 kV	± 8 kV
GND	± 4 kV	± 8 kV
VCC_RF	± 4 kV	± 8 kV
RF_IN	± 4 kV	± 8 kV

NOTE

Test conditions:
1. The external of the module has surge protection diodes and ESD protection diodes.
2. The data in Table 13 were tested using SIMCom EVB.

5 Manufacturing

5.1 Top and bottom View of SIM68D

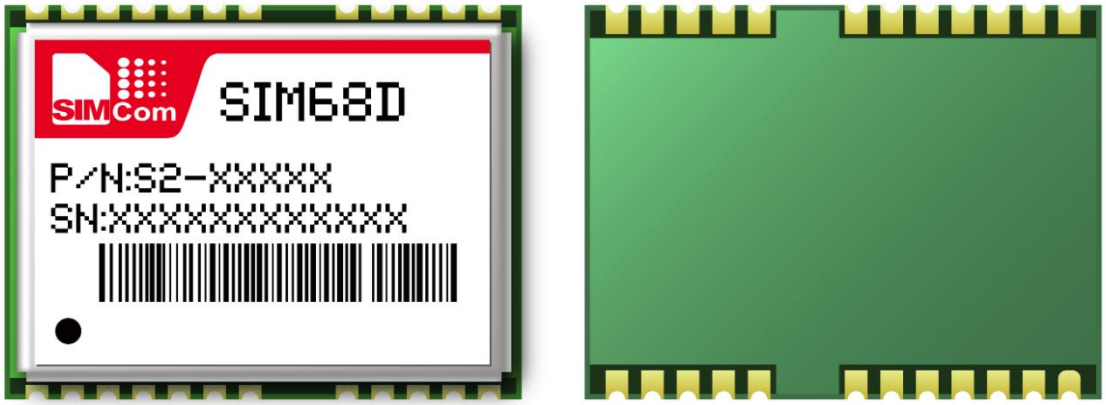

Figure 15: Top and bottom view of SIM68D

NOTE

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

5.2 Label information

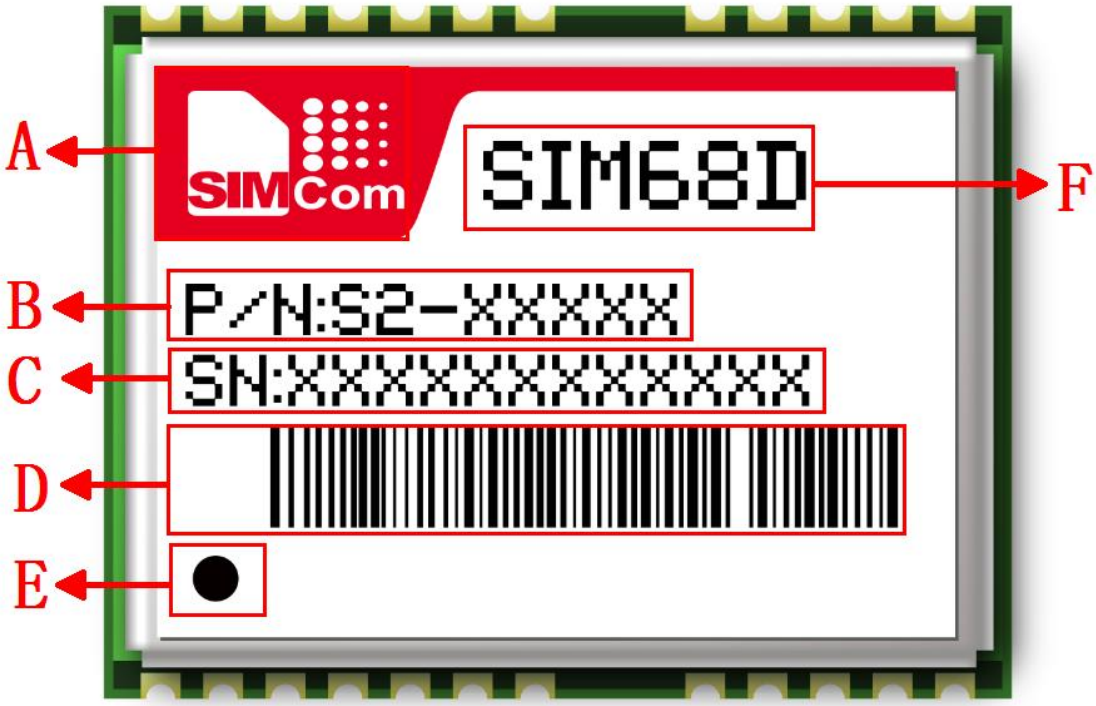

Figure 16: Label of SIM68D

Table 14: illustration of module information

Item	Description
A	Logo of SIMCom
B	Module part number Hardware number included; ex.S2-10990 is hardware number
C	Module serial number The first number stands for factory code; The second number stands for year code; The third to eighth numbers is the SN number in hexadecimal numeric; The last two numbers stands for MNEA sentence baud rate, “11” stands for 115200, “96” stands for 9600;
D	Module bar code Stands for the first 6 numbers of SN number
E	PIN 1 Mark
F	Module name

5.3 SIM68D Recommended PCB Decal

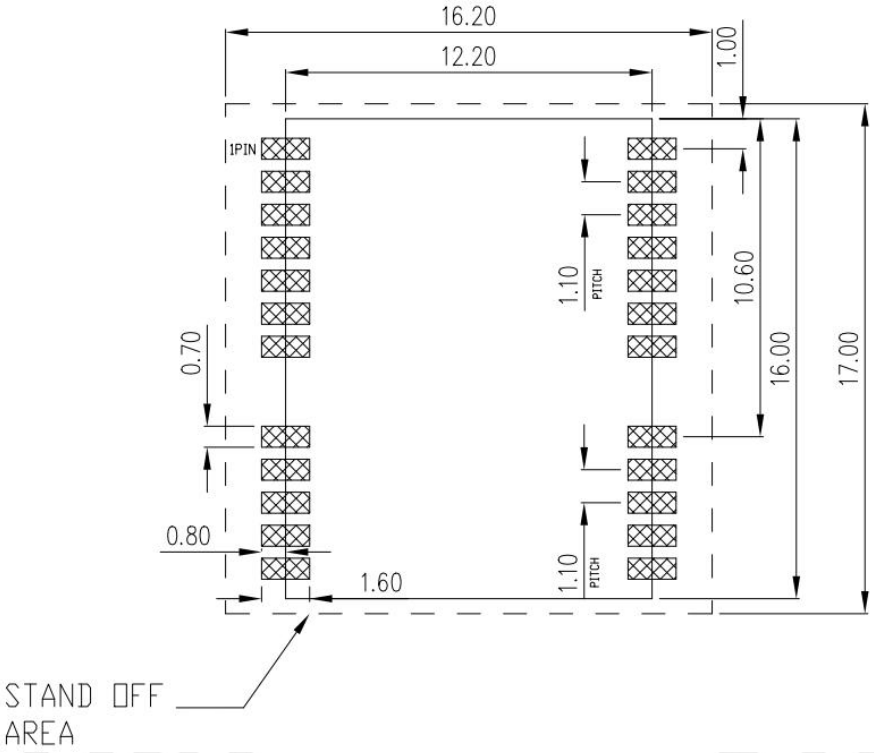

Figure 17: Recommended PCB decal (top view) (Unit: mm)

5.4 Recommended SMT Stencil

The following figure shows the SMT stencil of SIM68D.

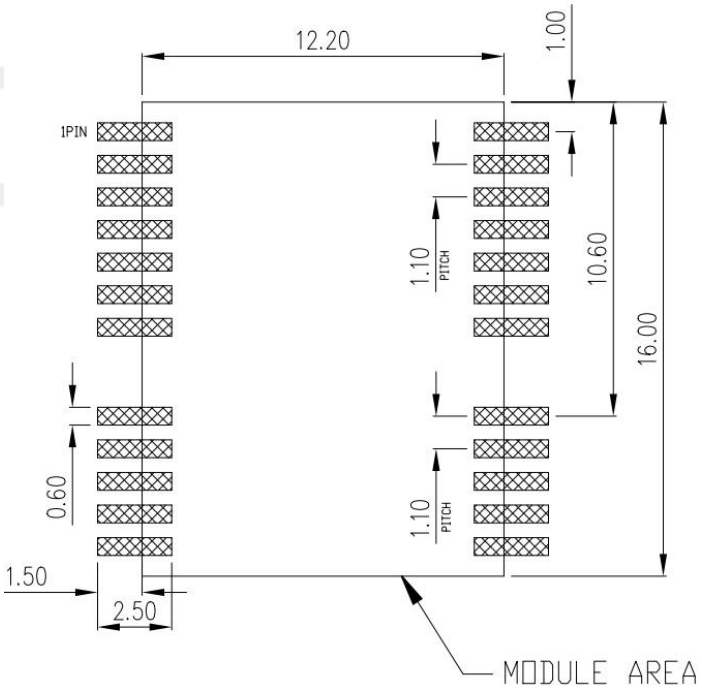

Figure 18: Recommended SMT stencil

5.5 Assembly and Soldering

The SIM68D module is intended for SMT assembly and soldering in a Pb-free reflow process on the top side of the PCB. Suggested solder paste stencil height is 150um minimum to ensure sufficient solder volume. If required paste mask pad openings can be increased to ensure proper soldering and solder wetting over pads.

The following figure is the Ramp-Soak-Spike Reflow Profile of SIM68D:

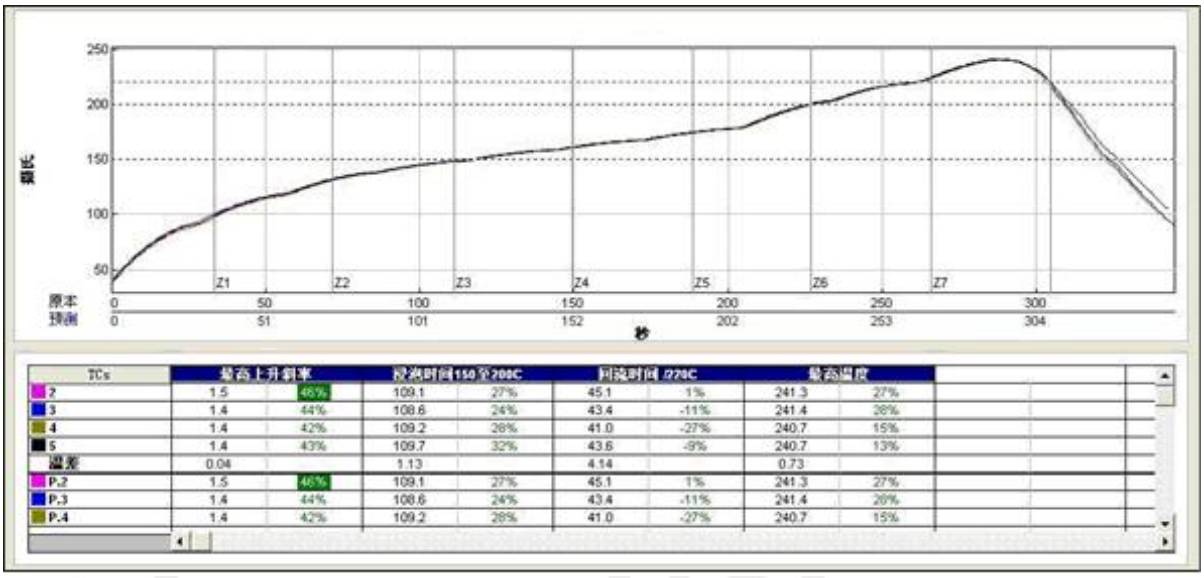

Figure 19: The Ramp-Soak-Spike reflow profile of SIM68D

SIM68D is Moisture Sensitive Devices (MSD), appropriate MSD handling instruction and precautions are summarized in Chapter 6.3.

SIM68D modules are also Electrostatic Sensitive Devices (ESD), handling SIM68D modules without proper ESD protection may destroy or damage them permanently.

Avoid ultrasonic exposure due to internal crystal and SAW components.

5.6 Moisture sensitivity

SIM68D module is moisture sensitive at MSL level 3, dry packed according to IPC/JEDEC specification J-STD-020C. The calculated shelf life for dry packed SMD packages is a minimum of 12 months from the bag seal date, when stored in a non condensing atmospheric environment of <40°C/90% RH.

Table 13 lists floor life for different MSL levels in the IPC/JDEC specification:

Table 15: Moisture Classification Level and Floor Life

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

Factory floor life is 1 week for MSL 3, SIM68D must be processed and soldered within the time. If this time is exceeded, or the humidity indicator card in the sealed package indicates that they have been exposed to moisture, the devices need to be pre-baked before the reflow solder process.

Both encapsulate and substrate materials absorb moisture. IPC/JEDEC specification J-STD-020 must be observed to prevent cracking and delamination associated with the "popcorn" effect during reflow soldering. The popcorn effect can be described as miniature explosions of evaporating moisture. Baking before processing is required in the following cases:

- Humidity indicator card: At least one circular indicator is no longer blue
- Floor life or environmental requirements after opening the seal have been exceeded, e.g. exposure to excessive seasonal humidity.

Refer to Section 4 of IPC/JEDEC J-STD-033 for recommended baking procedures.

NOTE

Oxidation Risk: Baking SMD packages may cause oxidation and/or inter metallic growth of the terminations, which if excessive can result in solder ability problems during board assembly. The temperature and time for baking SMD packages are therefore limited by solder ability considerations. The cumulative bake time at a temperature greater than 90°C and up to 125°C shall not exceed 96 hours.

5.7 ESD handling precautions

SIM68D modules are Electrostatic Sensitive Devices (ESD). Observe precautions for handling!

Failure to observe these precautions can result in severe damage to the GPS receiver!

GPS receivers are Electrostatic Sensitive Devices (ESD) and require special precautions when handling. Particular care must be exercised when handling patch antennas, due to the risk of electrostatic charges. In addition to standard ESD safety practices, the following measures should be taken into account whenever handling the receiver:

Unless there is a galvanic coupling between the local GND (i.e. the work Table) and the PCB GND, then the first point of contact when handling the PCB shall always be between the local GND and PCB GND.
Before mounting an antenna patch, connect ground of the device

When handling the RF pin, do not come into contact with any charged capacitors and be careful when contacting materials that can develop charges (e.g. patch antenna ~10pF, coax cable ~50-80pF/m, soldering iron,)
To prevent electrostatic discharge through the RF input, do not touch the mounted patch antenna.

When soldering RF connectors and patch antennas to the receiver's RF pin, the user must make sure to use an ESD safe soldering iron (tip).

5.8 Shipment

SIM68D is designed and packaged to be processed in an automatic assembly line, and it is now packaged in SIM68D tray.

6 Reference Design

Following figure is the typical application of SIM68D with active antenna which supplied by VCC_RF. If customer applies other kind of active antenna, keep PIN 9 floating and connect other voltage to the R8.

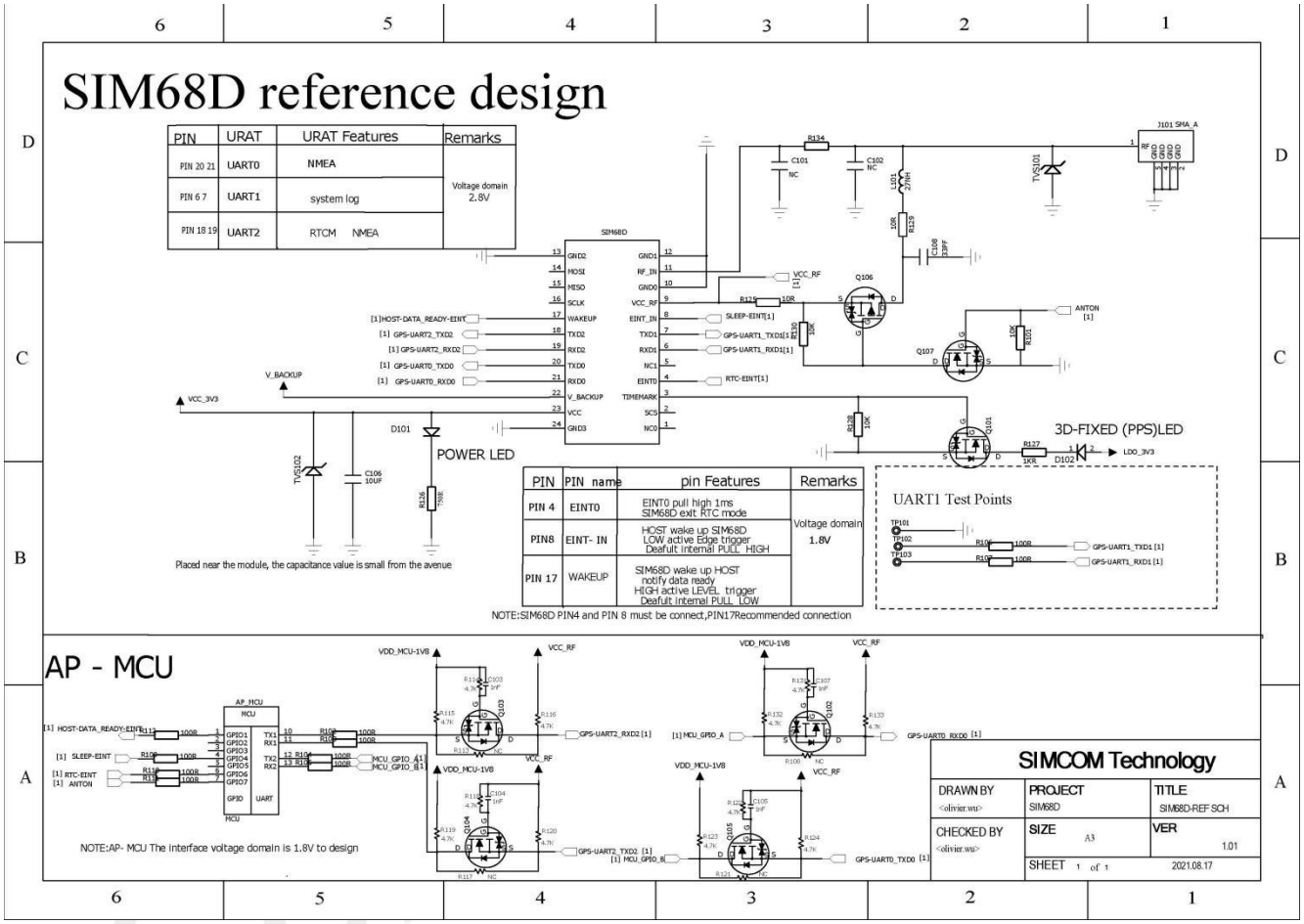

Figure 20: Refer schematic

NOTE

1、 I/Os of SIM6D are 2.8V and 1.8V CMOS voltage level; attentions should be paid if the voltage level of the host controller not compatible.

7 Appendix

7.1 Related Documents

Table 16: Related documents

SN	Document name	Remark
[1]	SIM68D and SIM68I_EVB kit_User Guide	
[2]	SIM68 Series_NMEA Message_User Guide	
[3]	SIM68D REFERENCE DESIGN	

7.2 Terms and Abbreviations

Table 17: Terms and abbreviations

Abbreviation	Description
A-GPS	Assisted- Global Positioning System
CMOS	Complementary Metal Oxide Semiconductor
DGPS	Difference Global Positioning System
EASY	Embedded Assist System
EEPROM	Electrically Erasable Programmable Read Only Memory
EGNOS	Euro Geostationary Navigation Overlay Service
EPO	Extended Prediction Orbit
ESD	Electrostatic Sensitive Devices
FSM	Finite State Machine
GAGAN	The GPS Aided Geo Augmented Navigation
GPS	Global Positioning System
GNSS	Global Navigation Satellite System
I/O	Input/Output
IC	Integrated Circuit
Inorm	Normal Current
Imax	Maximum Load Current
kbps	Kilo bits per second
LNA	Low Noise Amplifier
MSAS	Multi-Functional Satellite Augmentation
MSL	moisture sensitive level
NMEA	National Marine Electronics Association
QZSS	Quasi-Zenith Satellites System

RTCM	Radio Technical Commission for Maritime Services
SBAS	Satellite Based Augmentation Systems
WAAS	Wide Area Augmentation System

7.3 Safety Caution

Table 18: 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.
	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 (U)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 (U)SIM card be properly inserted in the cellular terminal or mobile.