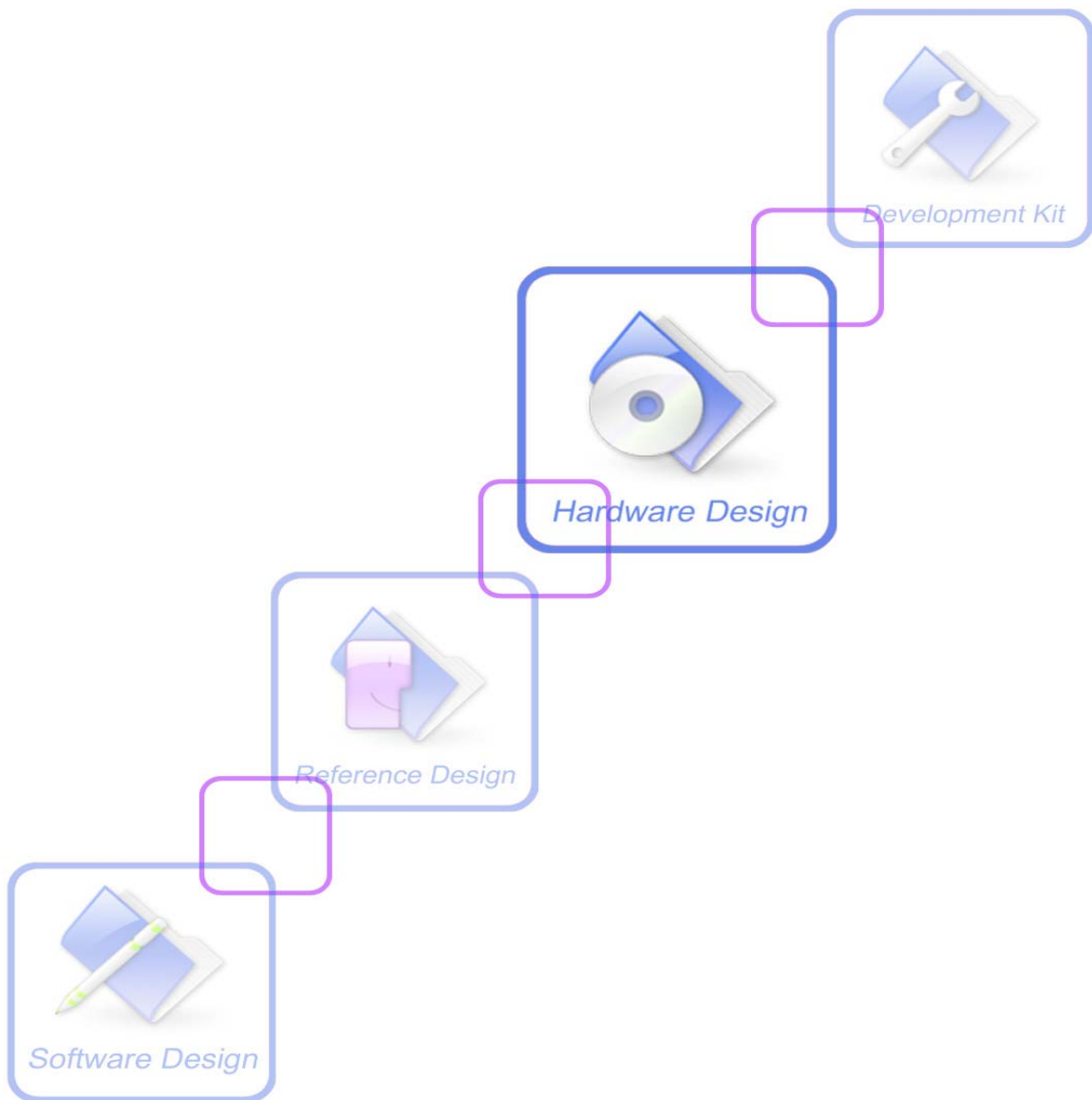




A company of SIM Tech

## SIM68 \_Hardware Design\_V1.01



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## Version History

Date	Version	Description of change	Author
2012-04-12	V1.00	Origin	ShengWu.Sun
2012-05-10	V1.01	Modify figure4	ShengWu.Sun

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# 1 Introduction

This document describes the hardware interface of the SIMCom module SIM68 which can be used as a GLONASS/GPS receiver. As a wide range of applications can be integrated in SIM68, all functional components of SIM68 are described in great detail.

## 2 SIM68 Overview

The SIM68 based on STA8088FG is a compact form factor GLONASS/GPS/Galileo module solution intended for a broad range of OEM products, where fast and easy system integration and minimal development risk is required. The user only need to provide DC power of 3.3V and GPS signal, the SIM68 will output navigation solution in standard NMEA-0183 protocol format.

The SIM68 receiver with 32 Tracking channels and 2 fast acquisition channels to achieve fast time to first fix and improved -148dBm cold start sensitivity. The superior cold start sensitivity allows it to acquire, track, and get position fix autonomously in difficult weak signal environment. The receiver's -162dBm tracking sensitivity allows continuous position coverage in nearly all application environments.

Measuring 15mm x 13mm, the SIM68 contains two LNA(one is embedded in STA8088FG chip, another is added in the module), SAW filter, 0.5ppm TCXO, RTC crystal, and LDO regulator.

The receiver is optimized for applications requiring high performance, low power, and low cost; suitable for a wide range of OEM configurations including mobile phone, PND, asset tracking, and vehicle navigation products.

The metal RF shielding provides protection and allows standard surface mount device pick-and-place process in fully-automated assembly process; enabling high-volume, very cost-efficient production. The SIM68 is available in tray form.

ST-AGPS™ Multimode Assisted GPS(extended ephemeris solution) is not yet supported.

### Key Feature

- Small footprint: 15 x 13 x 2.4mm, 34-pin LCC package
- 32 Tracking channels and 2 fast acquisition channels compatible with GPS, Galileo and Glonass systems
- Embedded RF Front-End with separate GPS/Galileo/QZSS and Glonass IF outputs
- Support SBAS
- High dynamics indoor sensitivity of -162dBm in tracking mode
- Fast TTFF 2s in Hot start and 35s in Cold Start
- Cold start sensitivity -148dBm
- Navigation sensitivity -160dBm
- Accuracy 1.5m CEP
- 330mW acquisition
- 214mW tracking
- Single 3.3V supply for operation
- Operating temperature -40 ~ +85°C
- 3 x UART or 2 x UART+USB
- 1 x I<sup>2</sup>C master/slave interface
- 2 x ADC
- 1 x Synchronous Serial Port (SSP, Motorola-SPI supported)
- 2 x CAN interface
- RoHS compliant

- Support jamming removing

## 2.1 SIM68 Functional Diagram

The following figure shows a functional diagram of the SIM68 and illustrates the mainly functional parts:

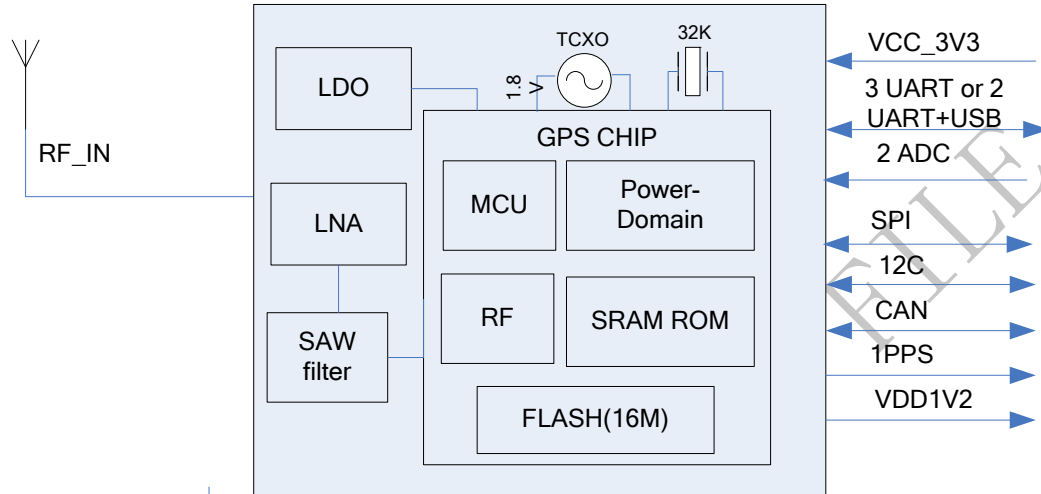


Figure 1:SIM68 functional diagram

## 2.2 GPS and GLONASS Performance

Table 1: GPS and GLONASS performance

Parameter	Description	Performance			
		Min	Typ	Max	Unit
Horizontal Position Accuracy <sup>(1)</sup>	Autonomous		<1.5		m
Velocity Accuracy <sup>(2)</sup>	Speed		<0.01		m/s
	Heading		<0.01		°
Time To First Fix <sup>(3)</sup>	Hot start		2		s
	Warm start		<34		s
	Cold start		<35		s
Sensitivity <sup>(4)</sup>	Autonomous acquisition		-148		dBm
	reacquisition		-150		dBm
	Tracking		-162		dBm
	Navigation		-160		dBm
Receiver	Channels		34		



	Update rate		1	10	Hz
	Altitude	-1500		< 100,000	km
	Velocity			<1854	km/h
	Tracking L1, CA Code				
	Protocol support NMEA,ST-NMEA				
Power consumption-A <sup>(5)</sup>	Acquisition		100		mA
	Continuous tracking		65		mA
	Sleep current		100		uA
Power consumption-B <sup>(6)</sup>	Acquisition		95		mA
	Continuous tracking		61		mA
	Sleep current		100		uA

(1) 50% 24hr static, -130dBm

(2) 50% at 30m/s

(3) GPS signal level: -130dBm

(4) Single Power supply 3V3 under GPS signal

(5) Single Power supply 3V3 under GPS+GLONASS signal

(6) Single Power supply 3V3 under only GPS signal and disable GLONASS function by \$PSTMSETPAR command; For details information, please refer to document [1]

### 3 Pin Description

#### 3.1 Pin out Diagram

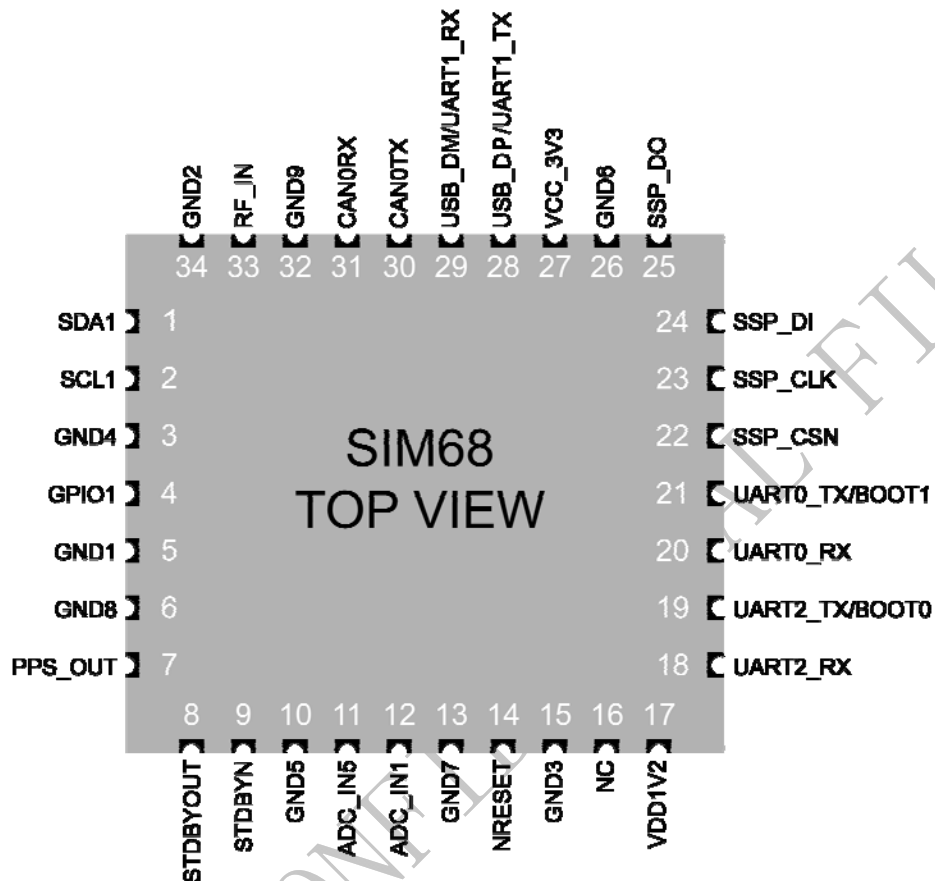


Figure 2:SIM68 pin out diagram (Top view)

#### 3.2 Pin Description

Table 2: pin description

Pin name	Pin number	I/O	Description	Comment
<b>Power supply</b>				
VCC_3V3	27	I	3V3 power supply for system.	
VDD1V2	17	O	1V2 voltage output	
GND	3,5,6,10,13,15,26,32,34		System ground	
<b>Power control</b>				
NRESET	14	I	Reset input, active low	has been pulled-up to VDD1V2 by a 100kohm

				resistor internally. 1V2 CMOS level input
STDBYN	9	I	Mode control input. When high, the module will be in active mode, if low, the module is forced in Sleep Mode	has been pulled-down internally. 3V3 level
<b>Host port interface</b>				
UART2_TX/BOOT0	19	O	UART serial data for NMEA output	For Boot Mode Configuration has been pulled-up by a 10kohm resistor internally. 3V3 Level.
UART2_RX	18	I	UART serial data for NMEA input	3V3 Level.
UART0_TX/BOOT1	21	O	UART Serial data for DEBUG output	For Boot Mode Configuration has been pulled-up by a 10kohm resistor internally. 3V3 Level.
UART0_RX	20	I	UART Serial data for DEBUG input	3V3 Level.
USB_DP/UART1_TX	28	O	UART serial data output or USB D+for NMEA	3V3 Level.
USB_DM/UART1_RX	29	I	UART serial data input or USB D-for NMEA	3V3 Level.
SDA1	1	I/O	I2C Serial data or CAN1 Transmit	3V3 Level.
SCL1	2	I/O	I2C Serial clock or CAN1 Receive	3V3 Level.
CAN0TX	30	O	CAN0 Transmit	3V3 Level.
CAN0RX	31	I	CAN0 Receive	3V3 Level.
SSP_CSN	22	I	SPI Chip Select or GPIO	has been pulled-up by a 10kohm resistor internally. 3V3Level.
SSP_CLK	23	I	SPI Clock or GPIO	3V3 Level.
SSP_DI	24	I	SPI Data Input or GPIO	3V3Level.
SSP_DO	25	O	SPI Data Output or GPIO	3V3Level.
<b>Others</b>				
PPS_OUT	7	O	One-pulse-per-second (1PPS)	3V3Level
ADC_IN5	11	I	ADC_input_5	Signal_level_0~1V4
ADC_IN1	12	I	ADC_input_1	Signal_level_0~1V4
STDBYOUT	8	O	Indicate the module's state, when it is running, it is high; when in sleep or off state, it is low	1V2 Level
GPIO1	4	I/O	General Purpose IO	1V8 Level
NC	16		No connection	Add 1uF capacitor
<b>RF interface</b>				
RF_IN	33	I	GPS RF input, connect to antenna.	

### 3.3 Recommended Operating Conditions

**Table 3: SIM68 operating conditions**

Parameter	Min	Typ	Max	Unit
Supply Voltage (VCC_3V3)	3	3.3	3.6	V
Acquisition Current (exclude active antenna current)		100		mA
Tracking Current (exclude active antenna current)		65		mA
In sleep mode		100		uA
Voltage output (VDD1V2)	1.1	1.2	1.3	V
Output Low Voltage(3V3,1V8,1V2 level)			0.3	V
Output HIGH Voltage(3V3,1V8,1V2 level)	VDD-0.3			V
Input LOW Voltage(3V3,1V8 level)			0.8	V
Input HIGH Voltage(3V3 level)	2			V
Input HIGH Voltage(1V8 level)		TBD		V
Input LOW Voltage(1V2 level)		TBD		V
Input HIGH Voltage(1V2 level)			1.3	V
RF Input Impedance (RFIN)		50		Ohm

### 3.4 Absolute maximum ratings

**Table 4:Absolute maximum ratings**

Parameter	Min	Typ	Max	Unit
SupplyVoltage (VCC_3V3)		TBD		V
Input Pin Voltage	-0.5		VDD+0.5	V
Input Power at RF_IN			+5	dBm
Storage Temperature	-45		+125	°C
Operative.Ambient Temperature	-40		+85	°C

## 4 Application Circuit

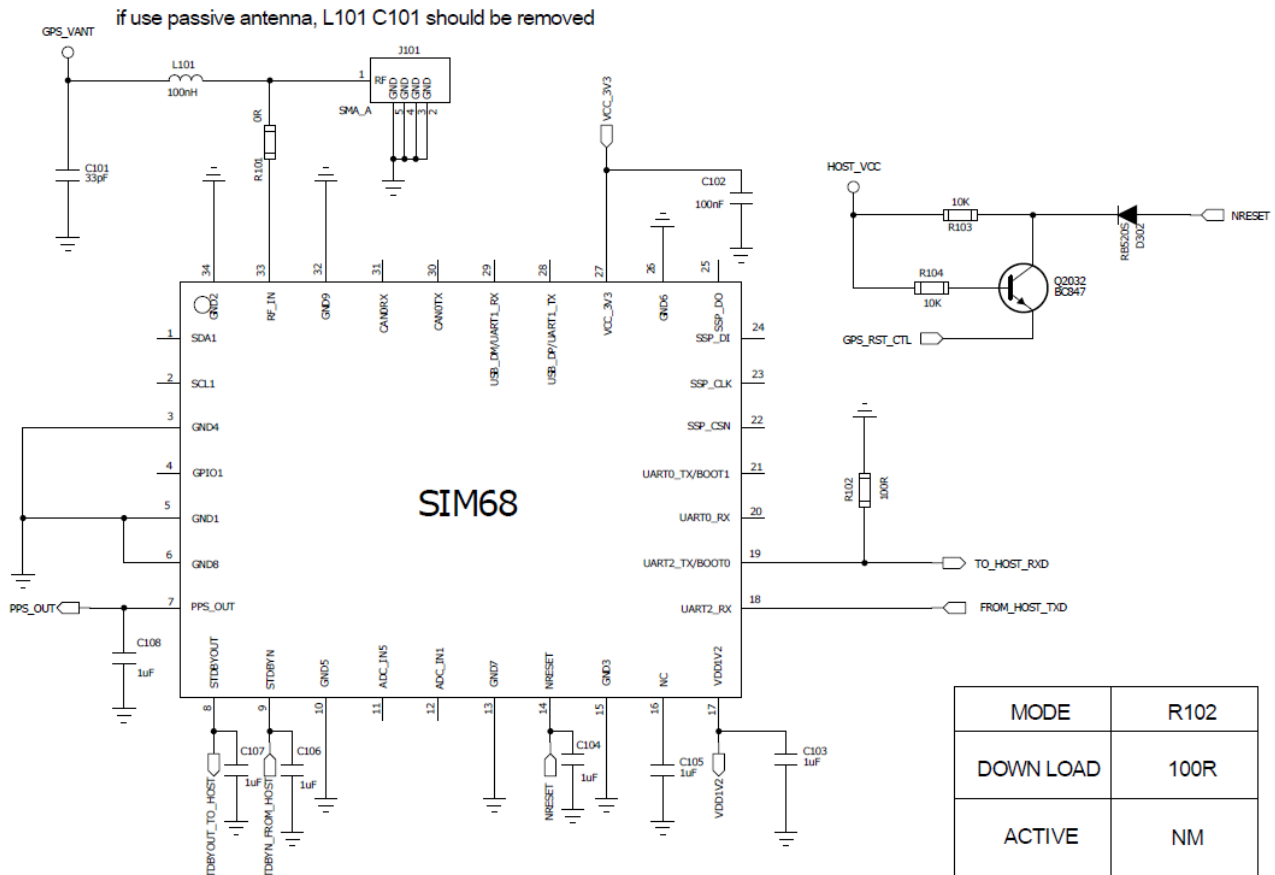


Figure 3: Application Circuit (for active antenna)

## 5 Application interface

### 5.1 Antenna Consideration

The antenna is the most critical item for successful GPS 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 the SIM68 with an active GPS/GLONASS antenna. In a typical application, Sim68 with an active antenna can get a tracking sensitivity about 3dB better than Sim68 with a passive antenna.

Active antenna is an antenna with built-in LNA. A coaxial cable connects the antenna to the module, and the supply voltage is fed to the antenna through the cable. Inside the antenna, the DC voltage is separated from the RF signal by an inner inductor and routed to the supply pin of the LNA.

It is suggested the active antenna should be chosen as following:

Antenna Chosen	
Frequency range	1574~1606MHz
Polarization	RHCP
Gain(without cable loss)	20dB<Gain<30dB
Noise Figure	<1.5
VSWR	<1.5

The active antenna type of GPSGLONASS03D-S3-00-A made of INPAQ Technology Co. LTD can be used well with Sim68.

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

When using a passive antenna, the patch antenna is recommended. It is flat, generally has a ceramic and metal body and is mounted on a metal base ground plate. Now linear antennas like chip antennas are becoming more popular, and the gain is reasonable, since a smaller ground plane can be used.

GPS/GLONASS 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.

## 5.2 Power Supply Requirement

The SIM68 Supply Voltage should be pure , and have 200mA power ability at best. At the first power on ,the figure4's sequence should be followed .The STDBYN,VCC\_3V3,NRESET must be controlled.

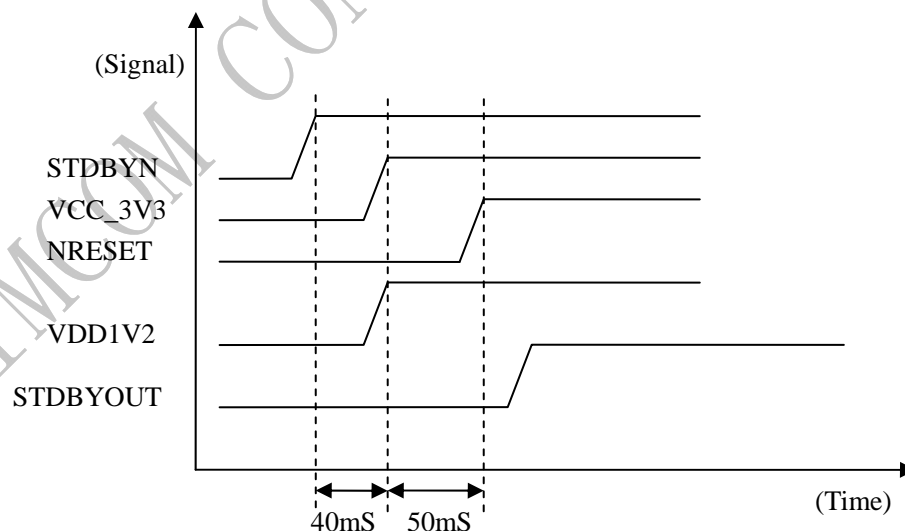


Figure 4: poweron sequence

### 5.3 Boot Mode Configuration (UART2\_TX and UART0\_TX)

User can select the boot mode between UART0/2 (programming flash memory) and internal SQI Flash during power up by configuring UART0\_TX/Boot1 and UART2\_TX/Boot0. Both of these pins have been pulled up internally. So if these pins are left unconnected, the SIM68 will boot from internal SQI Flash for operation mode. Otherwise, if firmware upgrade is needed, then UART2\_TX/Boot0 should be driven low at power-up; these boot mode signals are latched at rising edge at the release of a Reset state (NRESET signal low to high transition). Keep the boot configuration valid at least 50ms after Reset state is released; UART0\_TX /Boot1 can be left disconnected during boot mode for it's been pulled up internally.

**Table 5: Boot Mode Configuration**

Boot Mode	UART0_TX /Boot1	UART2_TX/Boot0
UART0/2	High	Low
SQI Flash (default)	High	High

### 5.4 1PPS Output

The 1PPS output signal provides pulse-per-second signal for timing purpose. Pulse length (high state) is by default 500 ms and it has 20 ns typ. jitter (Standard Deviation) typ. and it is synchronized at rising edge to full UTC second at 1  $\mu$ s accuracy. 1PPS pulse length, polarity and external delay are configurable by \$PSTMSETPAR command;

For details information, please refer to *document [1]*

### 5.5 STDBYN Input

STDBYN input is active low which is used to force the module from Navigation mode to the sleep mode. Note that the low level should be below 0.4 voltage, otherwise the module would run to sleep mode, but the current dissipation will increase to about 6 mA.

The MCU must control this pin to force the SIM68 going into sleep or navigation mode. If navigation mode is needed, pull this pin to high; otherwise pull it down to a low level.

Note that when the SIM68 module is powered on for the first time, the STDBYN pin should be pulled high before VCC\_3V3 is supplied.

### 5.6 ADC

There are two muxed 10-bit Analog-to-Digital Converter (ADC) inputs, ADC1 and ADC5. Conversion range is 0~1V4 at 500kps. The usage of ADC is limited for custom firmware.

## 5.7 Host port configuration

The default host port configuration is UART (ports 0 and 2). The UART2 is used for NMEA communication, the UART0 is used for DEBUG communication. The NMEA and DEBUG default baud rate is 115200bps. It can be modified from 300 to 921600bps at system runtime using the appropriate command. Take changing to 9600bps for example

```
$PSTMSETPAR,1102,0x5
$PSTMSAVEPAR
$PSTMSRR
```

When the baud rate has been changed, the module should be reset to enable the settings. And the settings will be stored in the internal memory so no command is needed to send when power up for the second time.

The UART1 and USB share the same physical port, User can change communication port to USB by setting following these commands

```
$PSTMSETPAR,1124,21
$PSTMSAVEPAR
$PSTMSETPAR,1130,0
$PSTMSAVEPAR
$PSTMSRR
```

Because the USB is VCOM only, When configured as USB communication, USB\_DP/UART1\_TX pin must be pulled up to 3V3 level by a 1K5ohm resistor.

User could come back the default software configuration by setting following command

```
$PSTMRESTOREPAR
$PSTMSRR
```

For details information, please refer to *document [1]*

*Notes: CAN, SPI, I2C are not supported on standard firmware.*

## 5.8 Layout Guidelines

Separate RF and digital circuits into different PCB regions

It is necessary to maintain 50-ohm impedance throughout the entire RF signal path. Try keeping the RF signal path as short as possible.

Do not route the RF signal line near noisy sources such as digital signals, oscillators, switching power supplies, or other RF transmitting circuit. Do not route the RF signal under or over any other components (including SIM68), or other signal traces. Do not route the RF signal path on an inner layer of a multi-layer PCB to minimize signal loss. Avoid vias with RF signal path whenever possible. Every via adds inductive impedance. Vias are acceptable for connecting the RF grounds between different layers.

Avoid sharp bends for RF signal path. Make two 45-deg bends or a circular bend instead of a single 90-degree bend if needed.

Each of the module's ground pins should have short trace tying immediately to the ground plane below through a via.

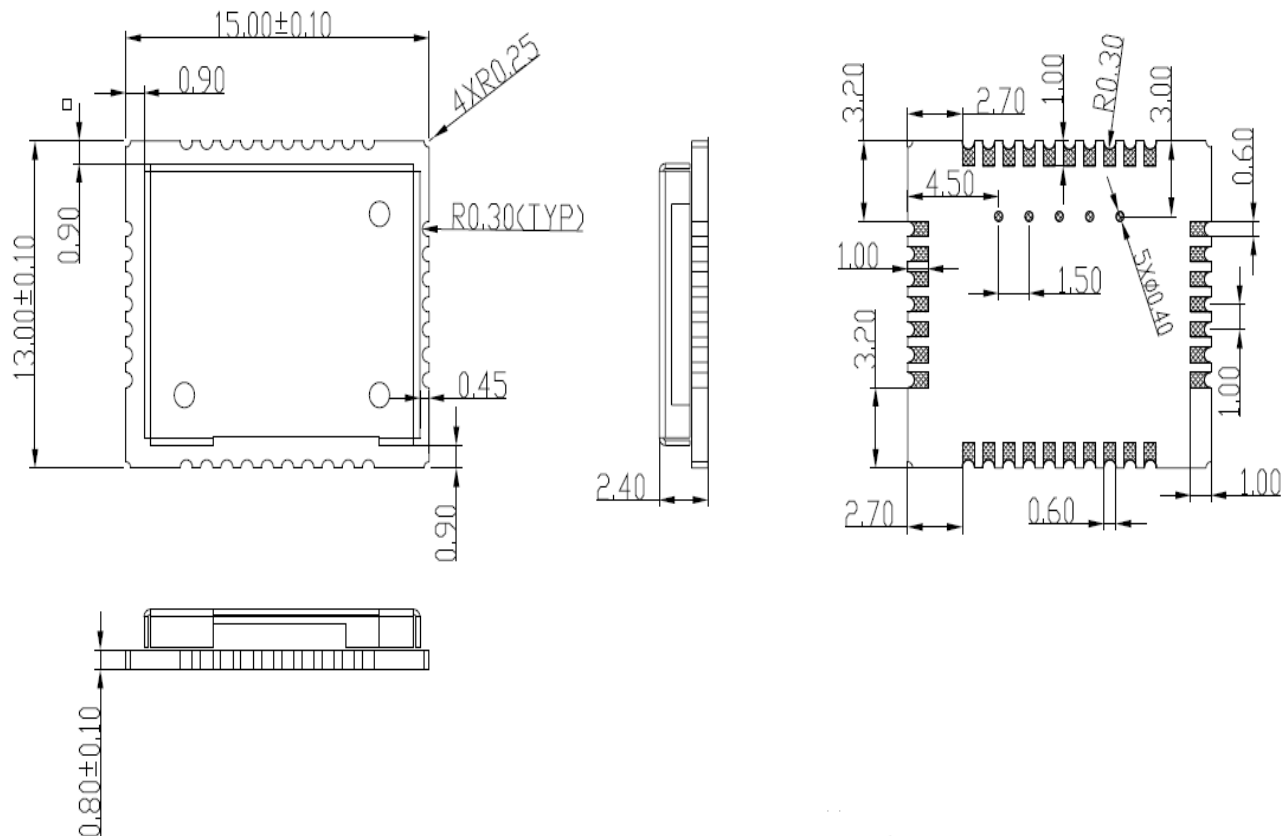
The bypass capacitors should be low ESR ceramic types and located directly adjacent to the pin they are for.



## 6 Package Information

## 6.1 Mechanical dimensions

Following figure shows the Mechanical dimensions of SIM68 (top view, side view and bottom view).



**Figure 5:SIM68 mechanical dimensions (Unit: mm)**

## 6.2 SIM68 Recommended Layout Pad

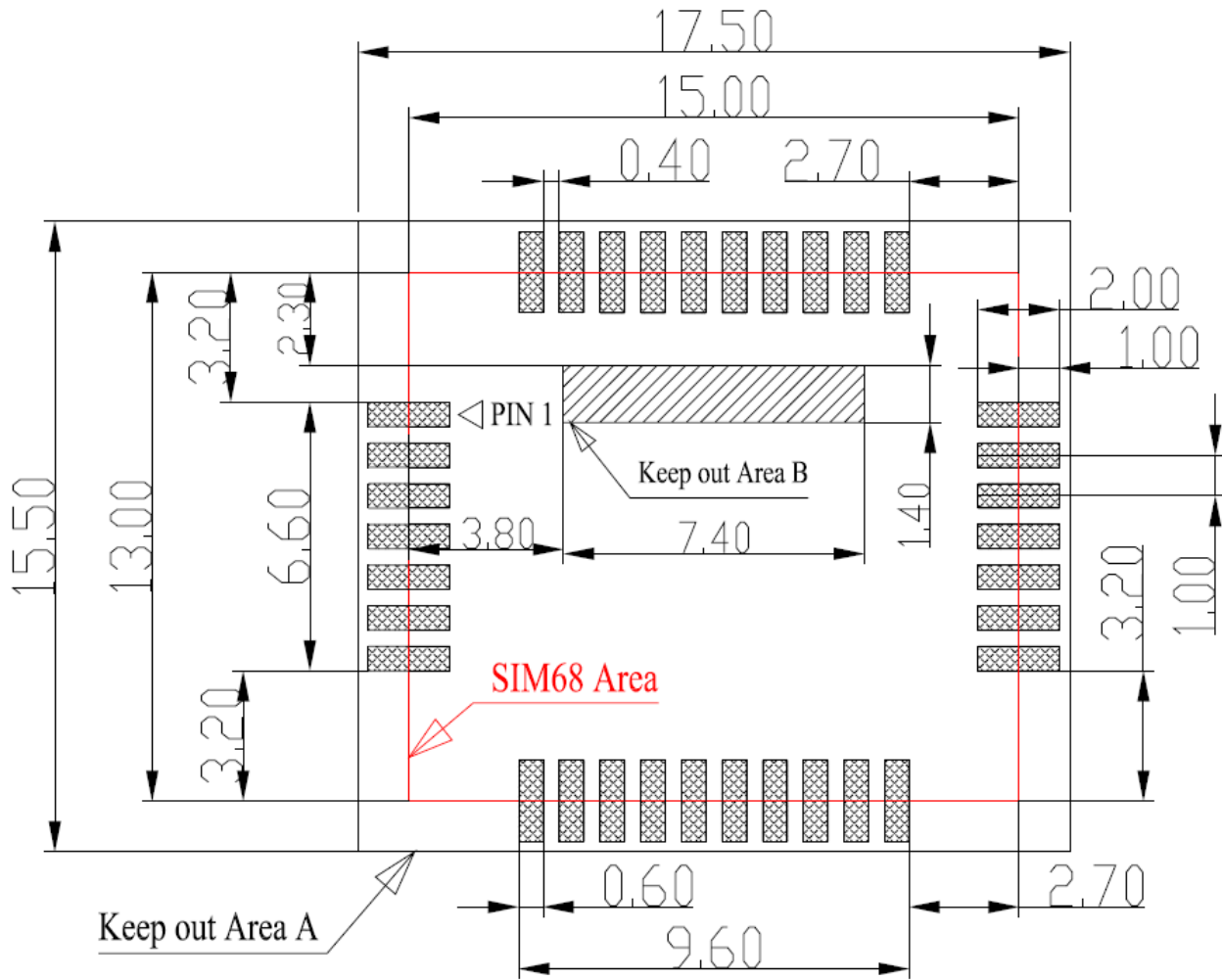


Figure 6: Recommended Layout Pad (Unit: mm)

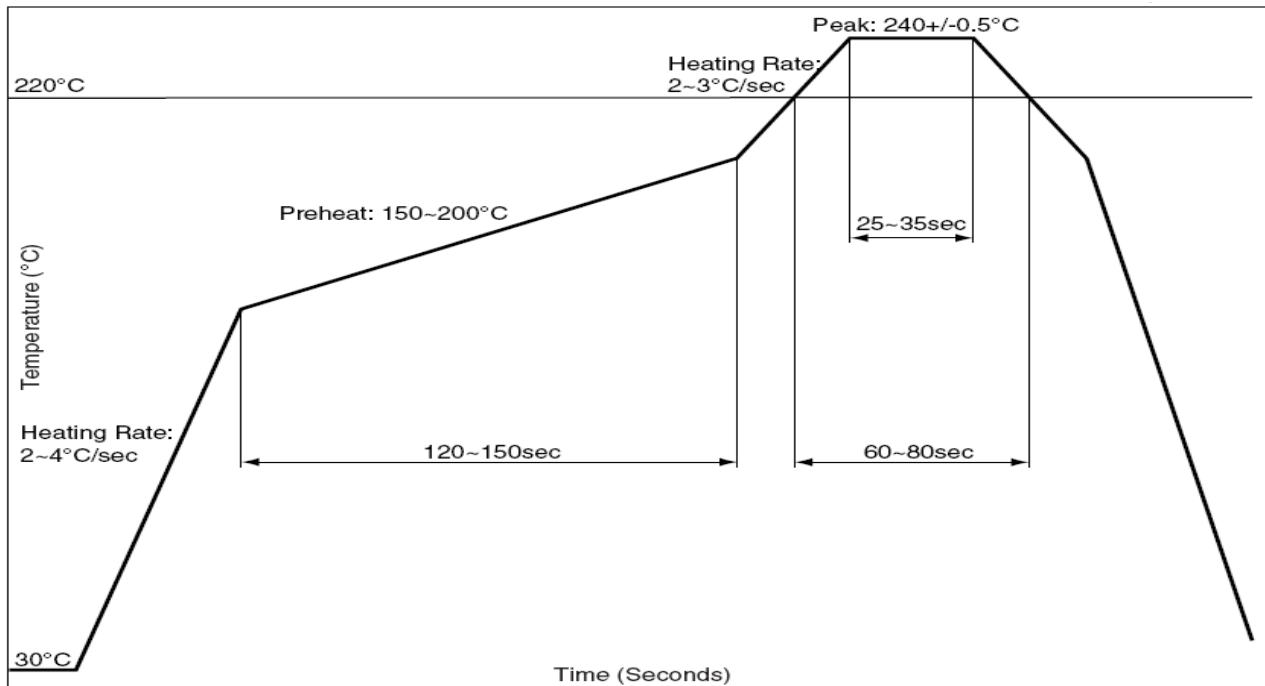
*Note :Do not place via in area B to avoid short circuit between the via on customer board and the test points on the bottom side of the module.*

## 7 Manufacturing

### 7.1 Assembly and Soldering

The SIM68 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 SIM68:



**Figure 7: The Ramp-Soak-Spike reflow profile of SIM68**

The reflow profile shown above should not be exceeded, since excessive temperatures or transport times during reflow can damage the module. Cooling temperature fall rate: max 3°C / sec

### 7.2 ESD handling precautions



SIM68 modules are Electrostatic Sensitive Devices (ESD). Observe precautions for handling!  
Failure to observe these precautions can result in severe damage to the receiver!



The 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.

## Appendix

### A. Related Documents

**Table 6: Related documents**

SN	Document name	Remark
[1]	GNSS_NMEA_Interface_37	GNSS_NMEA_Interface_37
[2]	STA8088F DATABRIEF ( V105)	STA8088FG Datasheet
[3]	CS-129435-MA	NMEA Reference Manual CS-129435-MA

### B. Terms and Abbreviations

**Table 7: Terms and abbreviations**

Abbreviation	Description
ESD	Electrostatic Sensitive Devices
GLONASS	Global Navigation Satellite System
GPS	Global Positioning System
I/O	Input/Output
SBAS	Satellite Based Augmentation Systems
QZSS	Quasi-Zenith Satellites System
NMEA	National Marine Electronics Association
TCXO	Temperature Compensate X'tal (crystal) Oscillator
LNA	Low Noise Amplifier
SAW	Surface Acoustic Wave
AGPS	Assisted Global Positioning System
SQI	Serial Quad Interface
bps	bits per second
CEP	Circular Error Probable

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