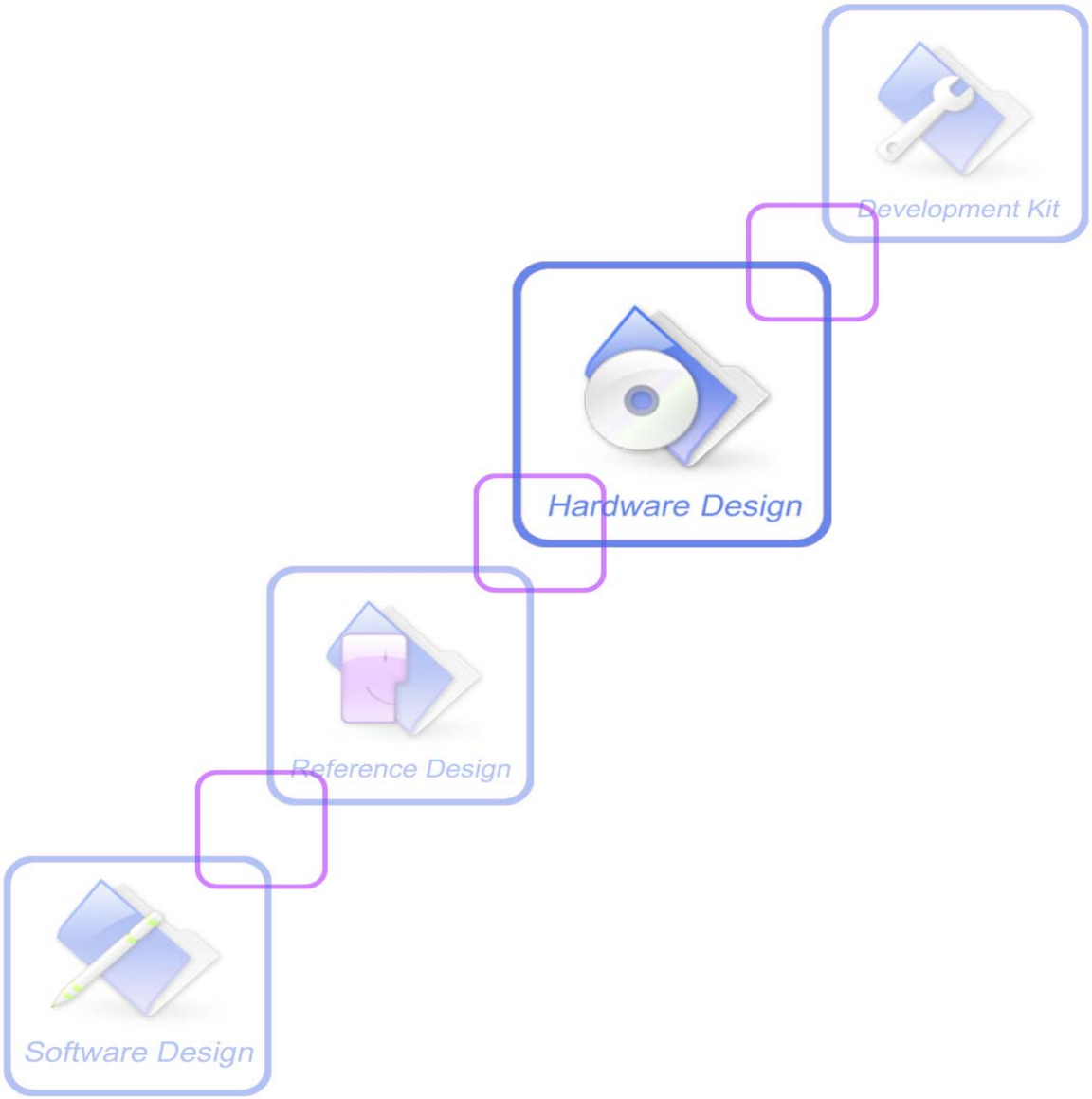
SIMCom

A company of SIM Tech

SIM68R_Hardware Design_V1.04



Document Title	SIM68R Hardware Design
Version	1.04
Date	2013-03-28
Status	Release
Document Control ID	SIM68R_Hardware Design_V1.04

General Notes

SIMCom offers this information as a service to its customers, to support application and engineering efforts that use the products designed by SIMCom. The information provided is based upon requirements specifically provided to SIMCom by the customers. SIMCom has not undertaken any independent search for additional relevant information, including any information that may be in the customer's possession. Furthermore, system validation of this product designed by SIMCom within a larger electronic system remains the responsibility of the customer or the customer's system integrator. All specifications supplied herein are subject to change.

Copyright

Contents

Contents **3**

Version History **7**

1 Introduction **8**

2 SIM68R Overview **8**

2.1 SIM68R Functional Diagram 9

2.2 GNSS Performance 9

2.3 General features 11

3 Package Information **12**

3.1 Pin out Diagram 12

3.2 Pin Description 12

3.3 Package Dimensions 14

3.4 SIM68R Recommended PCB Decal 15

4 Application Interface **16**

4.1 Power Management 16

4.1.1 Power Input 16

4.1.2 Starting SIM68R 16

4.1.3 Verification of SIM68R Start 16

4.1.4 Power Saving Modes 16

4.1.5 Operating Mode 17

4.1.5.1 Full on Mode 17

4.1.5.2 Sleep Mode 17

4.1.6 VCC_RF 17

4.2 UART Interface 17

4.3 I^2C interface 18

4.4 Timemark Output 18

4.5 DET_N 18

4.6 A-GPS 18

4.6.1 EPO 18

4.6.2 EASY MODE 19

4.6.3 SBAS and RTCM 19

4.7 GNSS Antenna 19

4.7.1 Antenna Interface 20

4.7.2 GNSS Antenna Choice Consideration 20

4.7.2.1 Passive Antenna 20

4.7.2.2 Active Antennas 22

4.7.2.3 Active antenna bias power 23

4.7.3 Active antenna supervisor 23

4.7.3.1 Short circuit Detection 24

4.7.3.2 Open circuit Detection 24

5 Electrical, Reliability and Radio Characteristics **26**

5.1 Absolute Maximum Ratings 26

5.2 Recommended Operating Conditions 26

5.3 Electro-Static Discharge 27
5.4 Certification 27

6 Manufacturing 28
6.1 Top and Bottom View of SIM68R 28
6.2 Assembly and Soldering 28
6.3 Moisture sensitivity 29
6.4 ESD handling precautions 30
6.5 Shipment 30

7 Reference Design 31

Appendix 32
A. Related Documents 32
B. Terms and Abbreviations 32

Table Index

TABLE 1: GNSS PERFORMANCE 9
TABLE 2: GENERAL FEATURES 11
TABLE 3: PIN DESCRIPTION 12
TABLE 4: POWER SUPPLY AND CLOCK STATE ACCORDING TO OPERATION MODE 17
TABLE 5: HOST PORT MULTIPLEXED FUNCTION PINS 18
TABLE 6: ANTENNA SPECIFICATIONS 19
TABLE 7: ABSOLUTE MAXIMUM RATINGS 26
TABLE 8: SIM68R OPERATING CONDITIONS 26
TABLE 9: SIM68R STANDARD IO FEATURES 26
TABLE 10: THE ESD ENDURE STATUE MEASURED TABLE (TEMPERATURE: 25℃, HUMIDITY:45%) 27
TABLE 11: ILLUSTRATION OF MODULE INFORMATION 28
TABLE 12: MOISTURE CLASSIFICATION LEVEL AND FLOOR LIFE 29
TABLE 13: RELATED DOCUMENTS 32
TABLE 14: TERMS AND ABBREVIATIONS 32

Figure Index

FIGURE 1: SIM68R FUNCTIONAL DIAGRAM 9
FIGURE 2: SIM68R PIN OUT DIAGRAM (TOP VIEW) 12
FIGURE 3: SIM68R MECHANICAL DIMENSIONS (UNIT: MM) 14
FIGURE 4: RECOMMENDED PCB DECAL (TOP VIEW) (UNIT: MM) 15
FIGURE 5: SIM68R PASSIVE ANTENNA DESIGN 21
FIGURE 6: SIM68R PASSIVE ANTENNA DESIGN (WITH EXTERNAL LNA AND SAW) 21
FIGURE 7: SIM68R PASSIVE ANTENNA DESIGN FOR BEST PERFORMANCE 22
FIGURE 8: SIM68R ACTIVE ANTENNA DESIGN 22
FIGURE 9: INTERNAL SUPPLY ANTENNA BIAS VOLTAGE 23
FIGURE 10: EXTERNAL SUPPLY ANTENNA BIAS VOLTAGE 23
FIGURE 11: OPEN CIRCUIR DETECTION-A 24
FIGURE 12: OPEN CIRCUIR DETECTION-B 25
FIGURE 13: TOP AND BOTTOM VIEW OF SIM68R 28
FIGURE 14: THE RAMP-SOAK-SPIKE REFLOW PROFILE OF SIM68R 29
FIGURE 15: EXAMPLE APPLICATION SCHEMATIC WITH UART 31

Version History

Date	Version	Description of change	Author
2012-10-17	V1.00	Origin	Shengwu.Sun Xiaohan.Jin
2013-01-22	V1.02	Add some features and Modify pictures	Shengwu.Sun
2013-03-05	V1.03	Add some features and Modify pictures	Shengwu.Sun
2013-03-28	V1.04	Modify tables	Xiaohan.Jin

1 Introduction

This document describes the hardware interface of the SIMCom module SIM68R， which can be used as GNSS or A-GPS（Assisted Global Positioning System） receiver. As wide range of applications, this document will describe them in great detail.

2 SIM68R Overview

With built-in LNA, SIM68R doesn't need external LNA. SIM68R can track as low as -167dBm signal even without network assistance. The SIM68R has excellent low power consumption characteristic (acquisition 34mA, tracking 30mA). SIM68R supports various location and navigation applications, including autonomous GPS, GLONASS, GALILEO, QZSS, SBAS ranging (WAAS, EGNOS, GAGAN, MSAS), DGPS (RTCM), and A-GPS.

Key Features

The user only need to provide DC power and GPS signal, the SIM68 will output navigation solution in NMEA protocol format. The module requires 2.8V~4.3V power supply. The host port is configurable to UART. Host data and I/O signal levels are 2.85V CMOS compatible.

- GPS/GLONASS/Galileo receiver, supports multi-GNSS include QZSS, SBAS ranging, supports WAAS/EGNOS/MSAS/GAGAN
- 33tracking/99 acquisition-channel GNSS receiver
- Small footprint: 17 x 22.4x 2.7mm, 28-pin LCC package
- 12 multi-tone active interference cancellers (ISSCC2011 award)
- Indoor and outdoor multi-path detection and compensation
- Supports FCC E911 compliance and A-GPS
- Max fixed update rate up to 10 HZ
- Advanced firmware features
  1. Alwayslocate advanced location awareness technology
  2. EPO/HotStill orbit prediction
  3. EASY self-generated orbit prediction
  4. supports logger function
  5. supports active interference cancellation (AIC)
- Pulse-per-second (PPS) GNSS time reference
  1. Adjustable duty cycle
  2. typical accuracy: ±10ns
- Interface
  UART×2
- Operating temperature -40 ~ +85ºC
- Accuracy <2.5m CEP
- RoHS compliant

2.1 SIM68R Functional Diagram

The following figure shows a functional diagram of the SIM68R and illustrates the main functional parts:

- The GNSS chip
- SAW filter
- The antenna interface
- The communication interface
- The control signals

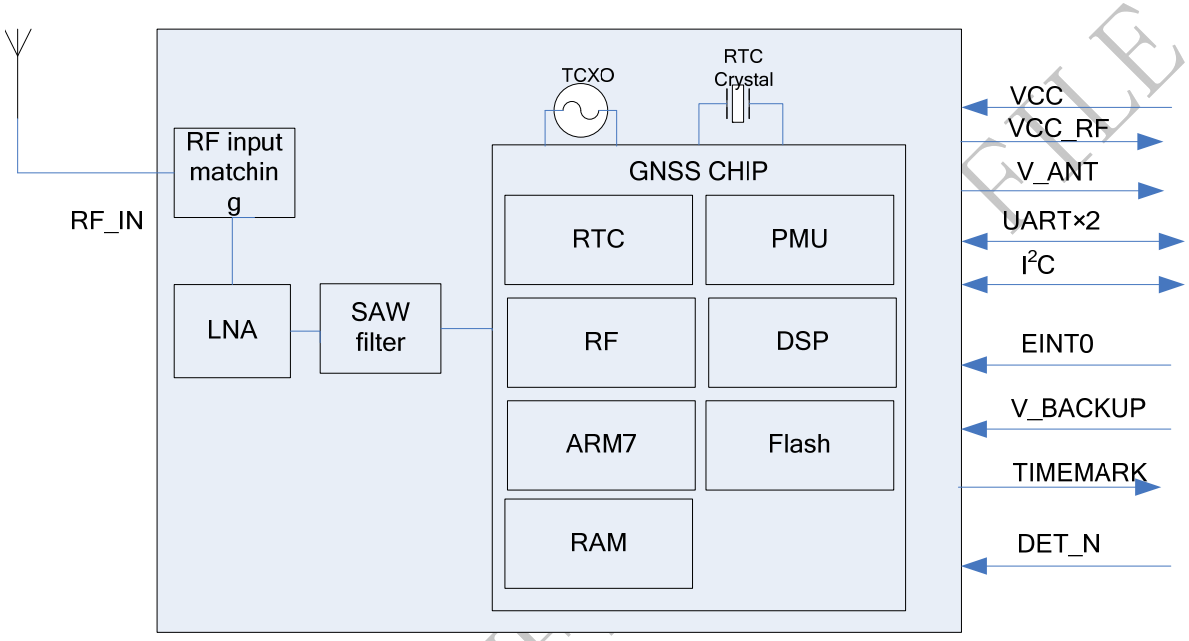


Figure 1: SIM68R functional diagram

2.2 GNSS Performance

Table 1: GNSS performance

Parameter	Description	Performance			
		Min	Type	Max	Unit
Horizontal Position Accuracy(1)	Autonomous		<2.5		m
Velocity Accuracy(2)	Without Aid		0.1		m/s
	DGPS		0.05		m/s
Acceleration Accuracy	Without Aid		0.1		m/s²
	DGPS		0.05		m/s²
Timing Accuracy			10		nS
Dynamic Performance	Maximum Altitude			18000	m
	Maximum Velocity			515	m/s
	Maximum Acceleration			4	G

Time To First Fix(3)	Hot start		<1		s
	Warm start		26		s
	Cold start		28		s
A-GPS TTFF(EPO in flash mode)	Hot start		0.7		s
	Warm start		1.5		s
	Cold start		12.5		s
Sensitivity(7)	Autonomous acquisition(cold start)		-148		dBm
	Re-acquisition		-160		dBm
	Tracking		-167		dBm
Sensitivity(8)	Autonomous acquisition(cold start)		-148		dBm
	Re-acquisition		-159		dBm
	Tracking		-167		dBm
Sensitivity(9)	Autonomous acquisition(cold start)		-147		dBm
	Re-acquisition		-154		dBm
	Tracking		-160		dBm
Receiver	Channels		132		
	Update rate		1	10	Hz
	Tracking L1, CA Code				
	Protocol support NMEA,PMTK				
Power consumption(4)	Acquisition		34		mA
	Continuous tracking		30		mA
	Sleep current		<440		uA
	Backup current		14		uA
Power consumption(5)	Acquisition		29		mA
	Continuous tracking		30		mA
	Sleep current		<440		uA
	Backup current		14		uA
Power consumption(6)	Acquisition		36		mA
	Continuous tracking		31		mA
	Sleep current		<440		uA
	Backup current		14		uA

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

(2) 50% at 30m/s

(3) –130 dBm, GPS&GLONASS mode

(4) Single Power supply 3.3V under GPS+GLONASS signal

(5) Single Power supply 3.3V under GPS signal

(6) Single Power supply 3.3V under GLONASS signal

(7) Single Power supply 3.3V under GPS signal

(8) Single Power supply 3.3V under GPS+GLONASS signal

(9) Single Power supply 3.3V under GLONASS signal

2.3 General features

Table 2: General features

Parameters		Value
Supply voltage VCC		+2.8V~4.3V
Supply voltage ripple VCC		54 mV(RMS) max @ f = 0~3MHz 15 mV(RMS) max @ f > 3 MHz
Power consumption(acquisition)		37mA type. @ VCC=3.3 V
Power consumption(sleep)		440uA type. @ VCC=3.3 V
Storage temperature		-40ºC~+85ºC
Operating temperature		-40ºC~+85ºC (note 1)
I/O signal levels	VIL	-0.3V~0.8V
	VIH	2.0V~3.6V
	VOL	-0.3V~0.4V
	VOH	2.4V~3.1V
I/O output sink/source capability		+/- 3mA max
I/O input leakage		+/- 10 uA max
Host port		UART,UART1
Other port		I^2C
Serial port protocol (UART)		NMEA; 8 bits, no parity, 1 stop bit; 115200 baud (configurable)
TM output (1PPS)		1 pulse per second, synchronized at rising edge, pulse length 300ms

Note 1: Operation in the temperature range –40°C~ –30°C is allowed but Time-to-First-Fix performance and tracking sensitivity may be degraded.

3 Package Information

3.1 Pin out Diagram

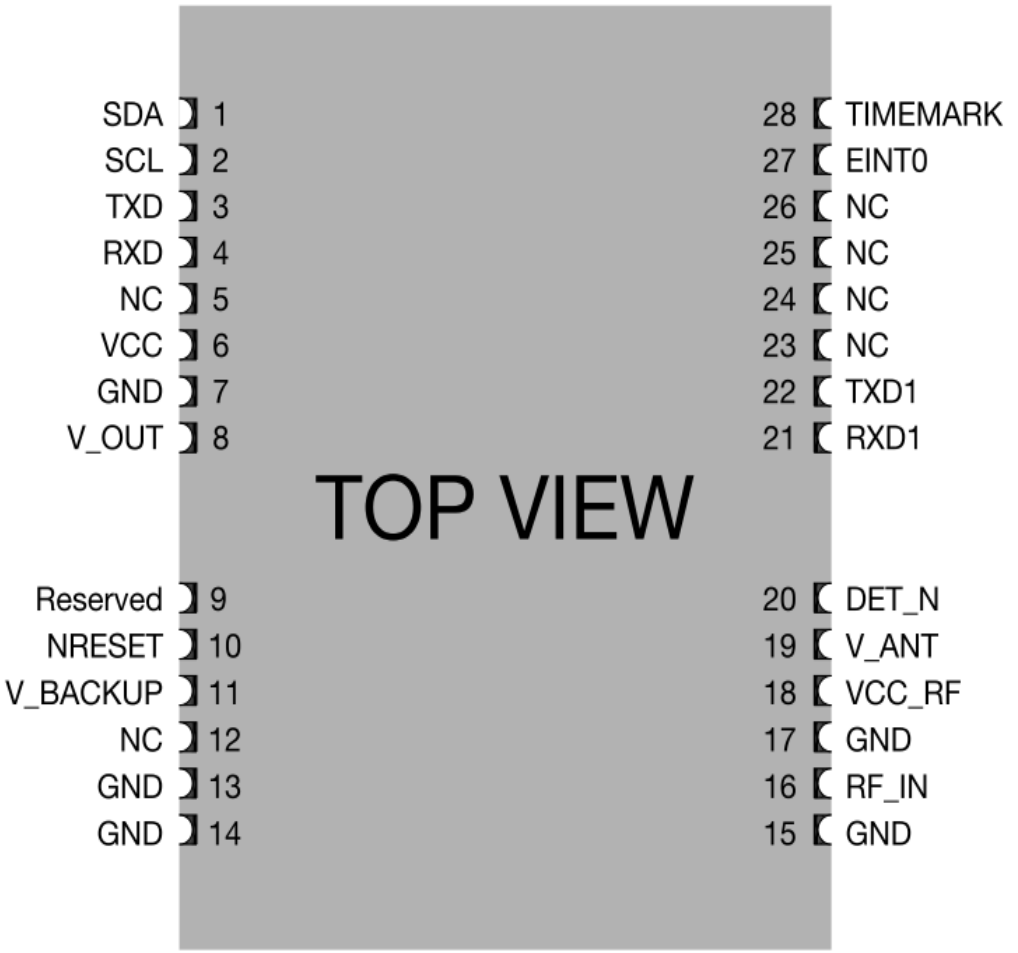


Figure 2: SIM68R pin out diagram (Top view)

3.2 Pin Description

Table 3: Pin description

Pin name	Pin number	I/O	Description	Comment
Power supply				
VCC	6	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.

V_OUT	8	O	Output voltage. It Has been connected to VCC inside the Module	If unused, keep open.
VCC_RF	18	O	2.8V output power supply for active antenna	If unused, keep open.
V_ANT	19	I	Antenna Bias voltage	If unused， connect to GND
V_BACKUP	11	I	The backup battery input power supply for RTC	If unused, keep open.
GND	7,13,14,15,17		Ground	GND
Host port interface				
SDA	1	I/O	I^2C data	If unused, keep open.
SCL	2	I/O	I^2C C Clock	
TXD	3	O	Serial output	If unused, keep open
RXD	4	I	Serial input	If unused, keep open
TXD1	22	O	Serial output as RTCM	
RXD1	21	I	Serial input as RTCM	
GPIOs				
EINT0	27	I	This interrupt source could act as wake up event during power saving mode. Provide an interrupt on either high or low logic level or edge-sensitive interrupt	Not supported yet, keep open.
TIMEMARK	28	O	Time Mark outputs timing pulse related to receiver time	If unused, keep open.
NRESET	10	I	Reset input, active low	If unused, keep open.
DET_N	20	I	Active Antenna Detect	If unused, keep open.
RF interface				
RF_IN	16	I	Radio antenna connection	Impendence must be controlled to 50Ω.
Other interface				
NC	5,12,23,24,25,26		Not Connected	
Reserved	9		Not Connected	

3.3 Package Dimensions

Following figure shows the Mechanical dimensions of SIM68R (top view, side view and bottom view).

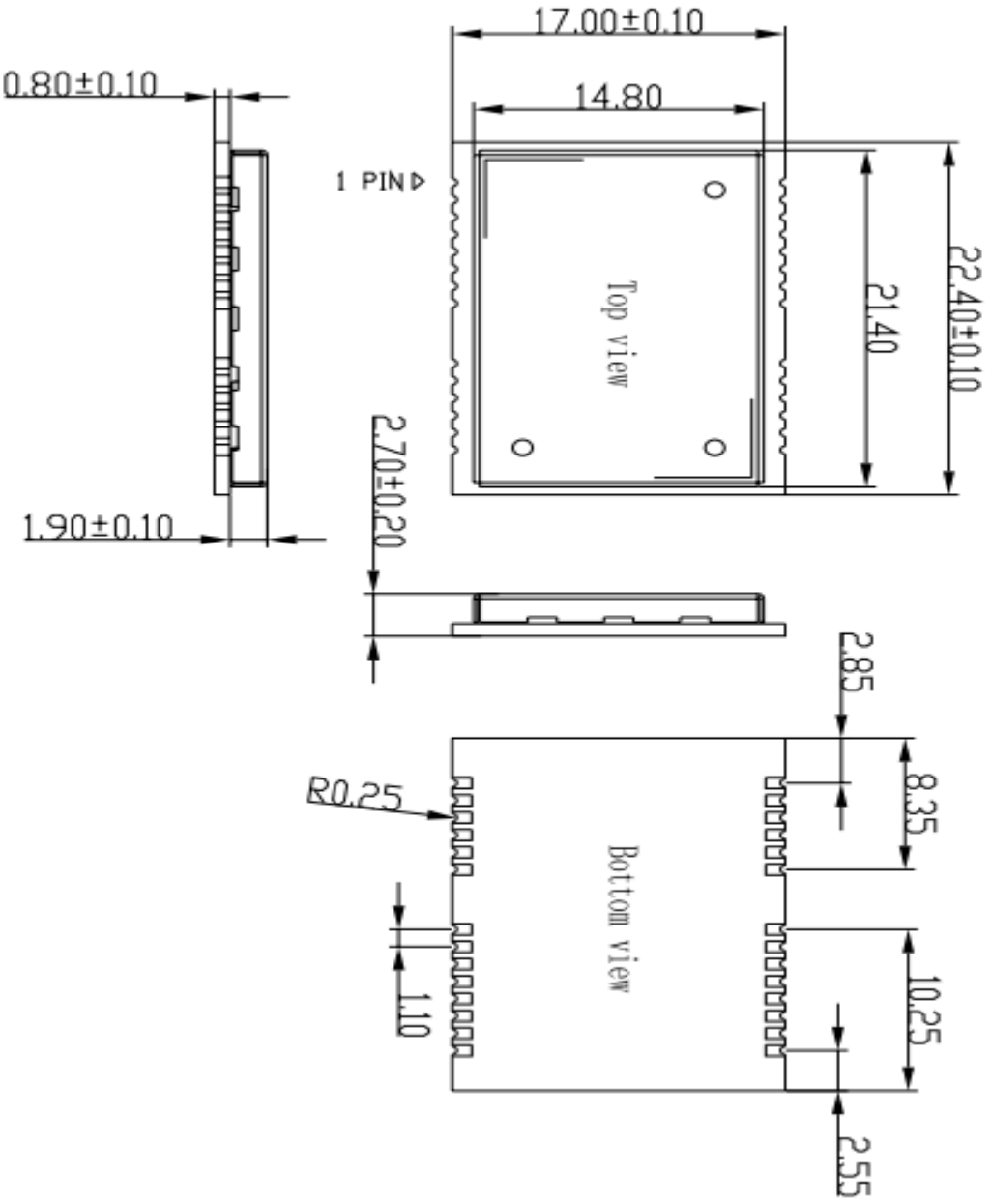


Figure 3: SIM68R mechanical dimensions (Unit: mm)

3.4 SIM68R Recommended PCB Decal

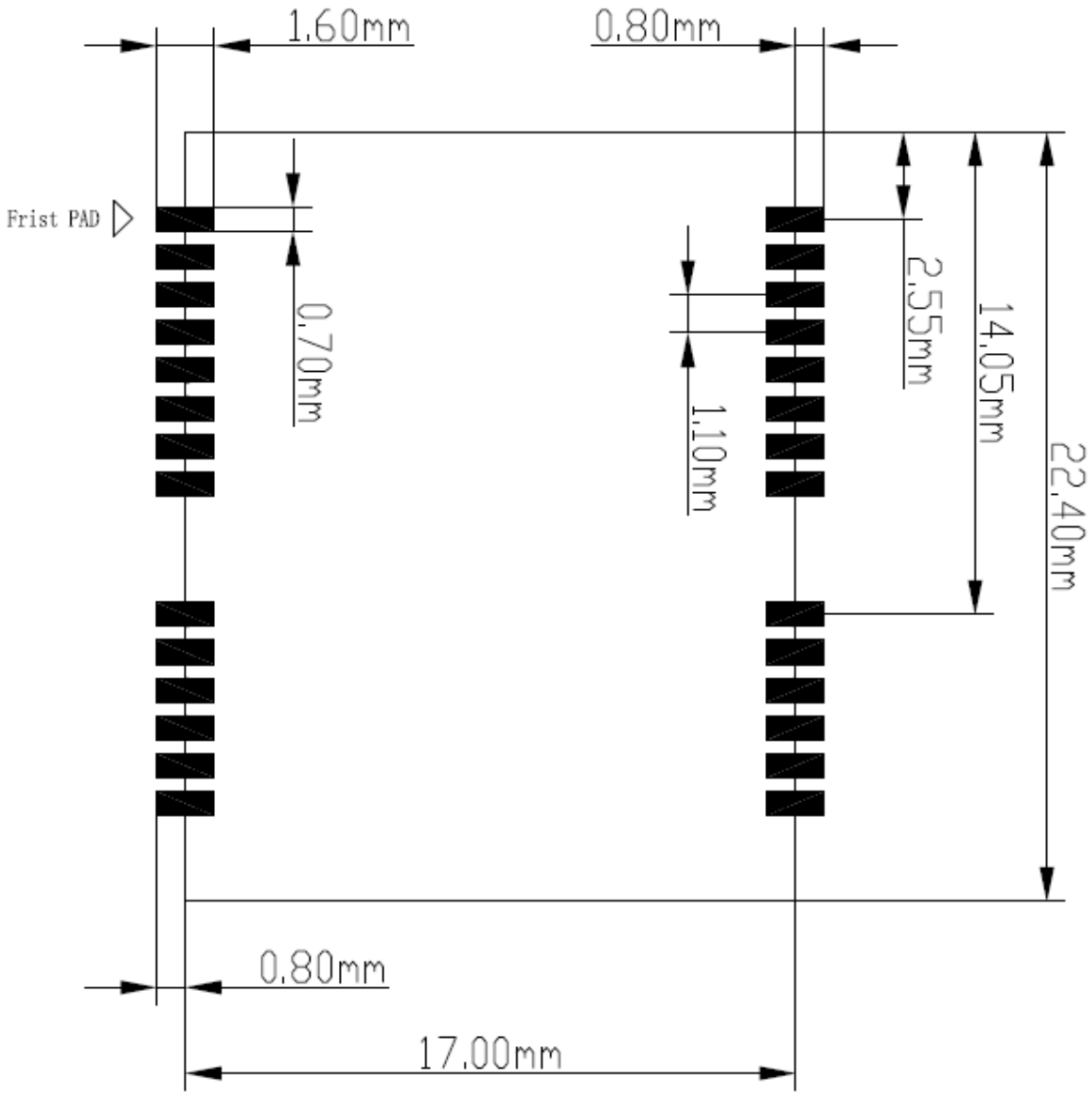


Figure 4: Recommended PCB decal (top view) (Unit: mm)

4 Application Interface

4.1 Power Management

4.1.1 Power Input

The power supply range is from 2.8V to 4.3V, and it should be able to provide sufficient current up to 100mA.

4.1.2 Starting SIM68R

- When power is first applied, SIM68R goes into operation mode.

4.1.3 Verification of SIM68R Start

System activity indication depends upon the chosen serial interface:

- When it is activated, SIM68R will output messages at the selected UART speed, and message types.

Note: the baud rate information can be found on the label.

4.1.4 Power Saving Modes

SIM68R supports operating modes for reduced average power consumption like sleep mode, backup mode, periodic mode, and AlwayLocate™ mode.

- Sleep mode**:** In this mode the receiver stays at full on power state. When this mode that can be wake up by the host sends the command through the communication interface or external interrupt.
- Backup mode**:** In this mode the SIM68R must be supplied by the backup and it can help to count down the time for backup mode. Software on host side to send the command through the communication interface into the backup mode.
- Periodic mode**:** In this mode the SIM68R enters tracking and backup mode according to the interval configured by users in the commands.
- AlwayLocate™ mode: AlwayLocate™ is an intelligent controller of SIM68R periodic mode. Depending on the environment and motion conditions, SIM68R can adaptive adjust the on/off time to achieve balance of positioning accuracy and power consumption.

Note: the modes mentioned above are operated by PMTK commands, users can refer to document [3] for more information.

SIM68R provides very low leakage battery back up memory, which contains all the necessary GNSS information for quick start up and a small amount of user configuration variables. It needs a 3V power supply for V_BACKUP pin, and the stable operation region ranges from very light load to about 3mA.

4.1.5 Operating Mode

Table 4: Power supply and clock state according to operation mode

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

4.1.5.1 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 numbers of satellites in track. This mode is also referenced as Full on, Full Power or Navigation mode.

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.

4.1.5.2 Sleep Mode

Sleep mode means a low quiescent (440uA type.) power state, non-volatile RTC, and backup RAM block is powered on. Other internal blocks like digital baseband and RF are internally powered off. The power supply input VCC shall be kept active all the time, even during sleep mode.
Entering into sleep mode is sent PMTK command through the communication interface by host side.

Waking up from sleep mode is sent any byte through the communication interface by host side.

4.1.6 VCC_RF

VCC_RF is a 2.8V output for external active antenna, if the external active antenna works at 2.8V voltage supply domain, the user can use the VCC_RF directly. If the antenna's power supply is not 2.8V, it should be open. For passive antenna, VCC_RF should be open.

4.2 UART Interface

SIM68R includes two UART (UART and UART1) interface for serial communication. The UART is as NMEA output and PMTK command input. The receiver (RXD) and transmitter (TXD) side of every port contains a 16-byte FIFO and has 256 bytes URAM. The baud rates are selectable and ranging from 4.8 to 921.6kbps through CoreBuilder tool. UART can provide the developers signal or message outputs. UART1 is as RTCM input.

For details about CoreBuilder information, please refer to document [2]

Table 5: Host port multiplexed function pins

Pin name	Pin number	UART function
TXD	3	data transmit
RXD	4	data receive

4.3 I²C interface

The SCL and SDA are the I²C bus pins, which can be connected to a external I²C interface EEPROM up to 1 Mbits for reading and writing data into EEPROM. This can be used to store configurations permanently.

NOTE: The EEPROM can't be supported currently.

4.4 Timemark Output

The Timemark pin outputs pulse-per-second (1PPS) pulse signal for precise timing purposes. It will come out after successfully positioning .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.

4.5 DET_N

DET_N is an input pin and is used to report whether an external circuit has detected an external antenna or not .Low level means the antenna has been detected. High level means no external antenna has been detected.

NOTE: The High level for DET_N should be 2.85V CMOS level.

4.6 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. SIM68R module supports EPO file, EASY mode and SBAS/RTCM

4.6.1 EPO

The SIM68R 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 and improve the acquisition sensitivity.

The user should update the EPO files from the EPO server daily through the internet. Then the EPO data should send to the SIM68R by the HOST side. SIM68R has the short cold TTFF and warm TTFF, when the A-GPS is used.

Note: For more information about EPO, please contact SIMCom sales. users can refer to document [4] for more information

4.6.2 EASY MODE

EASY is the abbreviation of Embedded Assist System, it works as embedded firmware 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 sleep 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 PMTK command.

4.6.3 SBAS and RTCM

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.

SIM68R module supports SBAS and 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 sales for supporting

4.7 GNSS Antenna

The SIM68R is designed for use with passive and active antennas.

Table 6: Antenna Specifications

Parameter	**Specification**	Passive and active antenna
Active Antenna Recommendations	Frequency range	1574～1606MHz
	Polarization	RHCP
	Gain	20dB<Gain<30dB
	Noise Figure	<1.5 dB

4.7.1 Antenna Interface

The SIM68R receives L1 band signals from GNSS and GALILEO satellites at a nominal frequency of 1574～1606 MHz. The RF signal is connected to the RF_IN pin. And the trace from RF_IN to antenna should be 50Ω controlled.

To suit the physical design of individual applications the RF interface pad can lead to three 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.

4.7.2 GNSS Antenna Choice Consideration

To obtain excellent GNSS receiving performance, a good antenna will always be required. The antenna is the most critical item for successful GNSS receiving 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.

4.7.2.1 Passive Antenna

Passive antenna contains 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.

The most common antenna type for GNSS applications is the patch antenna. Patch antennas are flat, generally hav e a ceramic and metal body and are mounted on a metal base plate.

Figure 5 shows a minimal setup for a PVT GNSS receiver with SIM68R module.

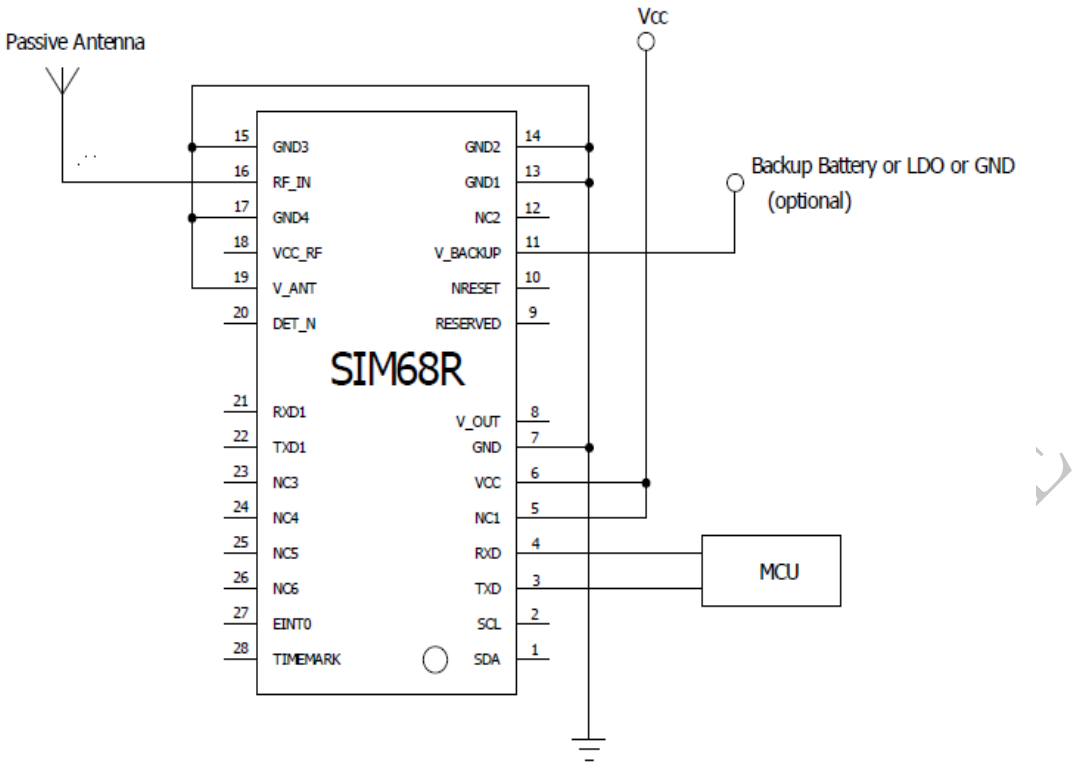


Figure 5: SIM68R passive antenna design

For best performance with passive antenna designs user can use an external LNA to increase the sensitivity up 3~4 dB. Please see Figure 6 and Figure 7.

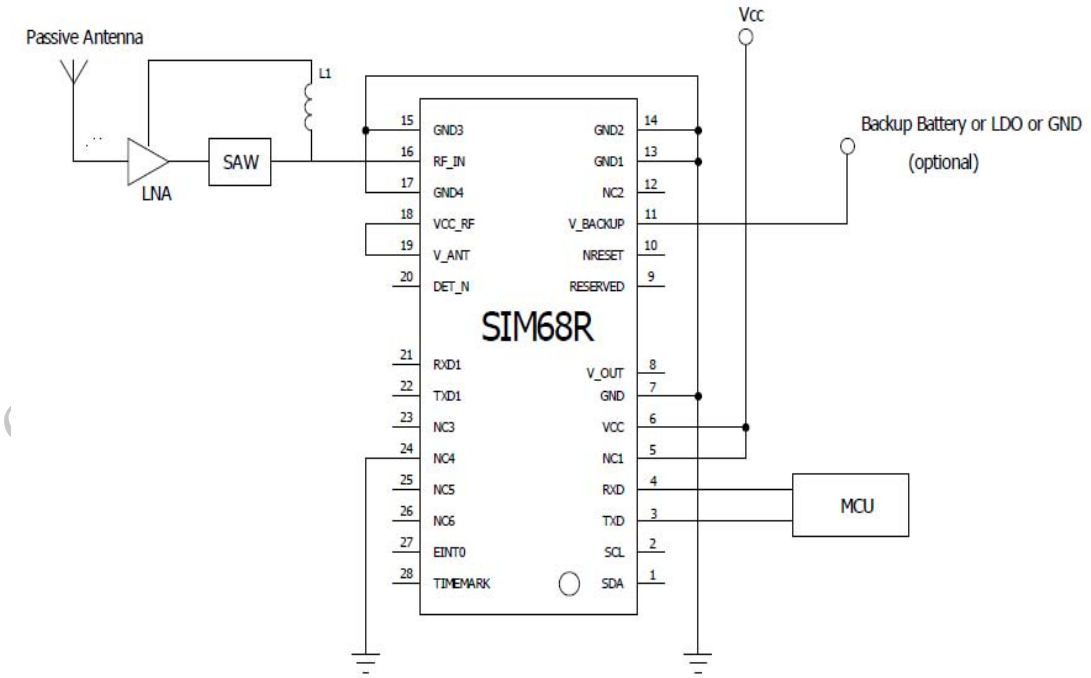


Figure 6: SIM68R passive antenna design (with external LNA and SAW)

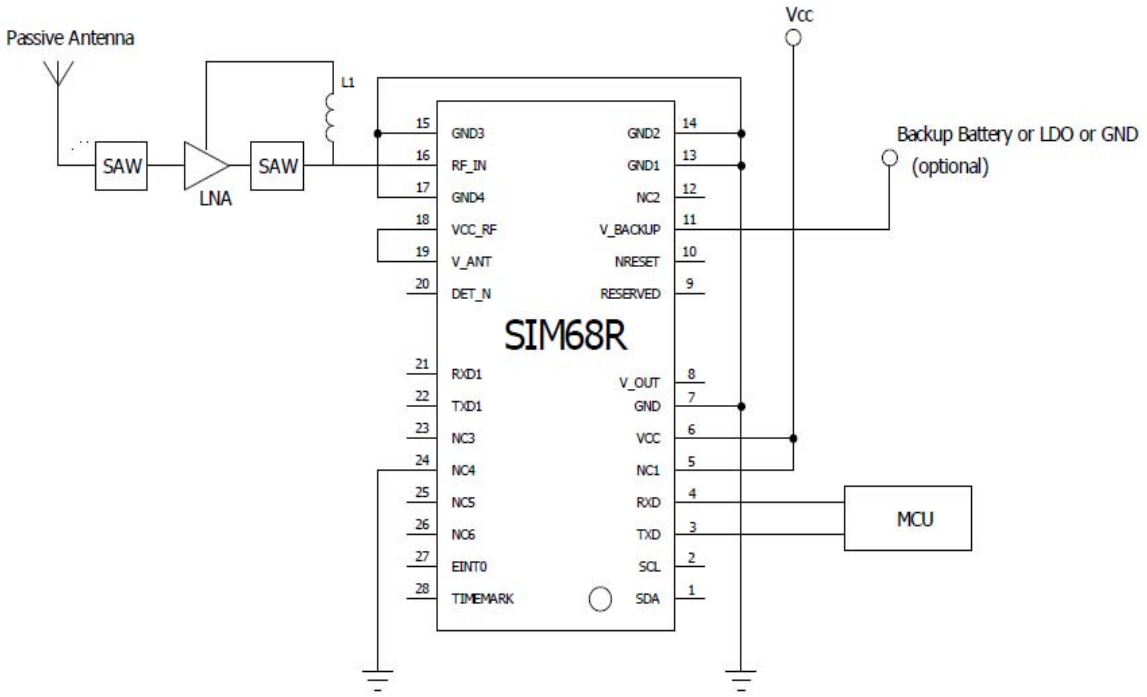


Figure 7: SIM68R passive antenna design for best performance

4.7.2.2 Active Antennas

Active antennas have an integrated Low-Noise Amplifier (LNA). They can be directly connected to **RF_IN**. If an active antenna is connected to **RF_IN**, the LNA of the antenna needs to be supplied with the correct voltage through pin **V_ANT**. Usually, the supply voltage is fed to the antenna through the coaxial RF cable shown as Figure 8. The output voltage of PIN 18 is 2.8V. If the supply voltage of active antenna is 2.8V, **VCC_RF** can supply the voltage through the pin **V_ANT**.

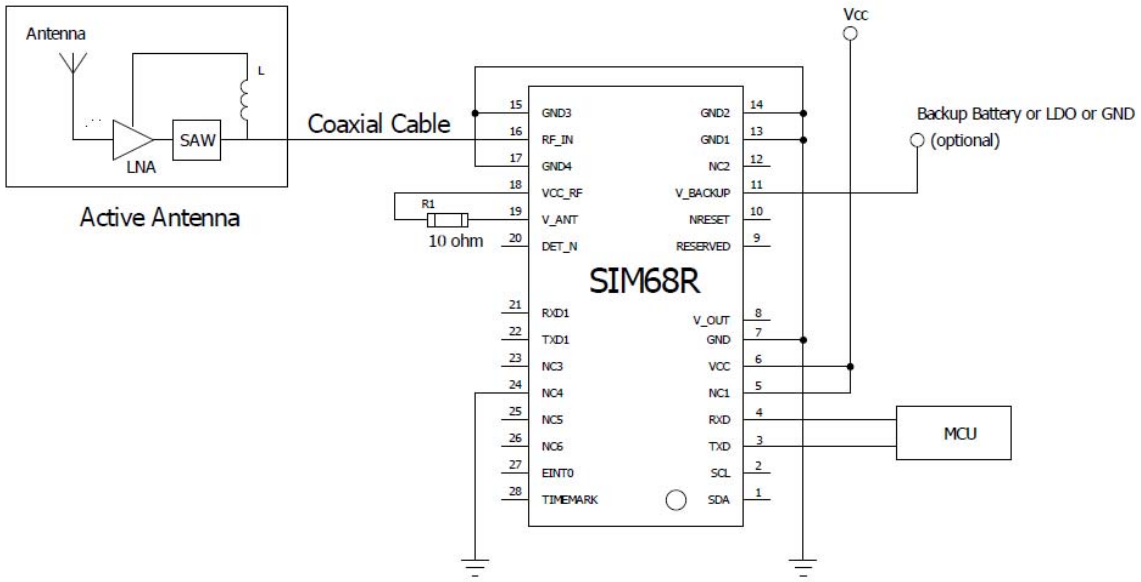


Figure 8: SIM68R Active antenna design

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.

4.7.2.3 Active antenna bias power

There are two ways to supply the bias voltage to pin V_ANT. For internal supply, the VCC_RF output must be connected to V_ANT to supply the antenna with a filtered supply voltage. However, the voltage specification of the antenna has to match the actual supply voltage of the SIM68R Receiver. For External supply, the supply should be virtually free of noise.

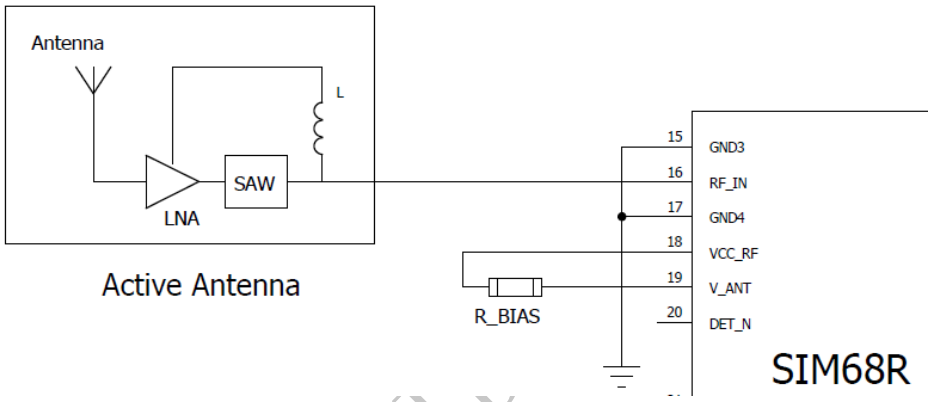


Figure 9: Internal supply Antenna bias voltage

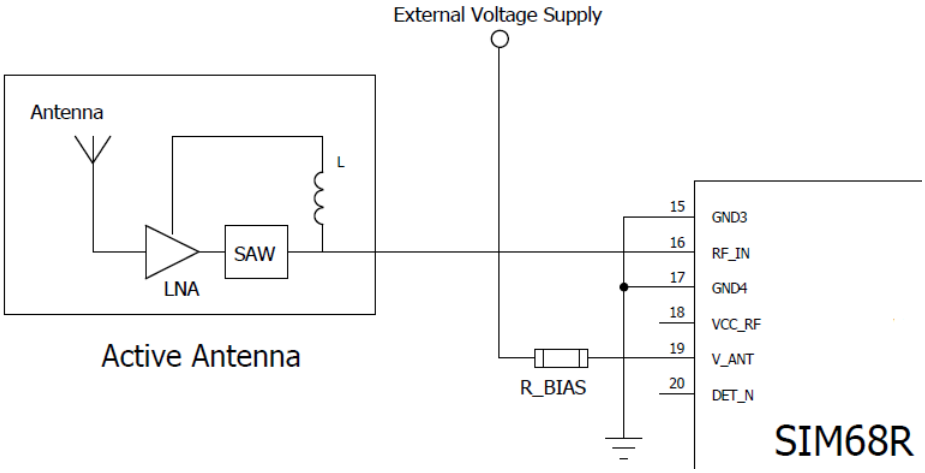


Figure 10: External supply Antenna bias voltage

4.7.3 Active antenna supervisor

SIM68R Technology provides the means to implement an active antenna supervisor with a minimal number of parts. The antenna supervisor is highly configurable to suit various different applications.

Note: The standard firmware does not support active antenna supervisor. If user wants this function, the firmware must be customized. Please contact SIMCom for more details.

4.7.3.1 Short circuit Detection

If a short circuit in the active antenna pulls V_ANT to ground, then the module will detect it, and the module will report $GPTXT,01,01,02,ANTSTATUS=SHORT*6D sentence through the serial port. The customer should check short circuit.

NOTE: The antenna supply voltage is not derived from VCC_RF.

4.7.3.2 Open circuit Detection

Firmware supports an active antenna supervisor circuit, which is connected to the pin DET_N. An example of an open circuit detection circuit is shown in Figure 11and Figure 12. High (2.85V level) on DET_N means that an external antenna is not connected, and the module will report $GPTXT,01,01,02,ANTSTATUS=OPEN*2B sentence through the serial port. Low on DET_N means that an external antenna is connected, and the module will report $GPTXT,01,01,02,ANTSTATUS=OK*3B sentence through the serial port.

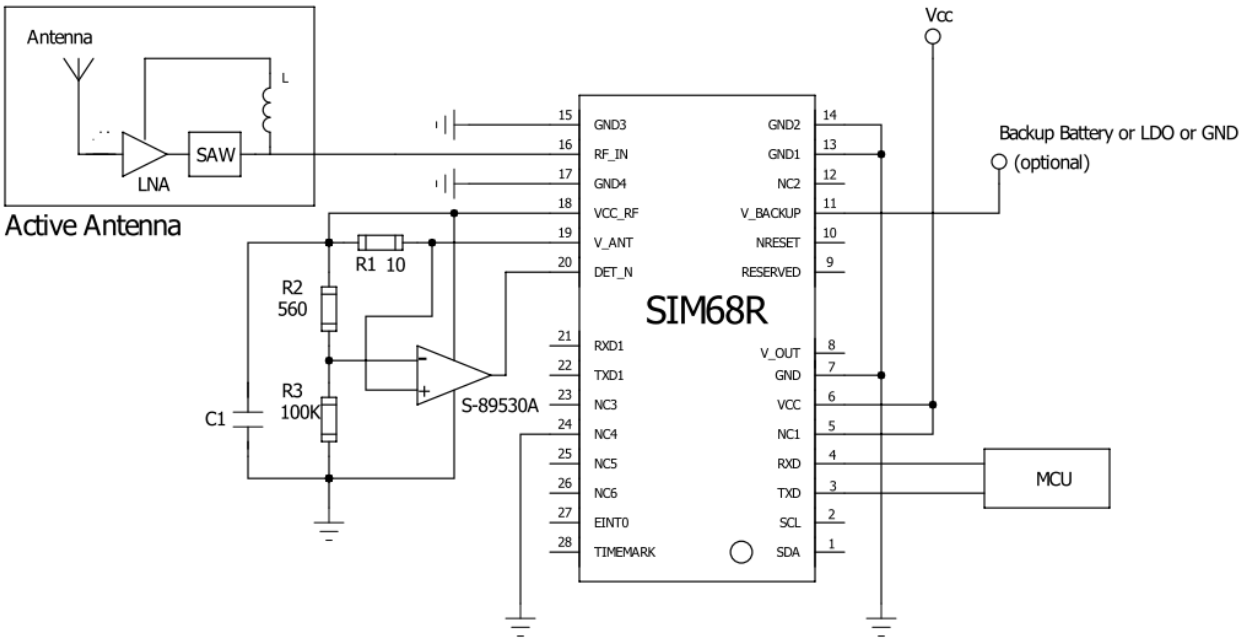


Figure 11: Open circuir detection-A

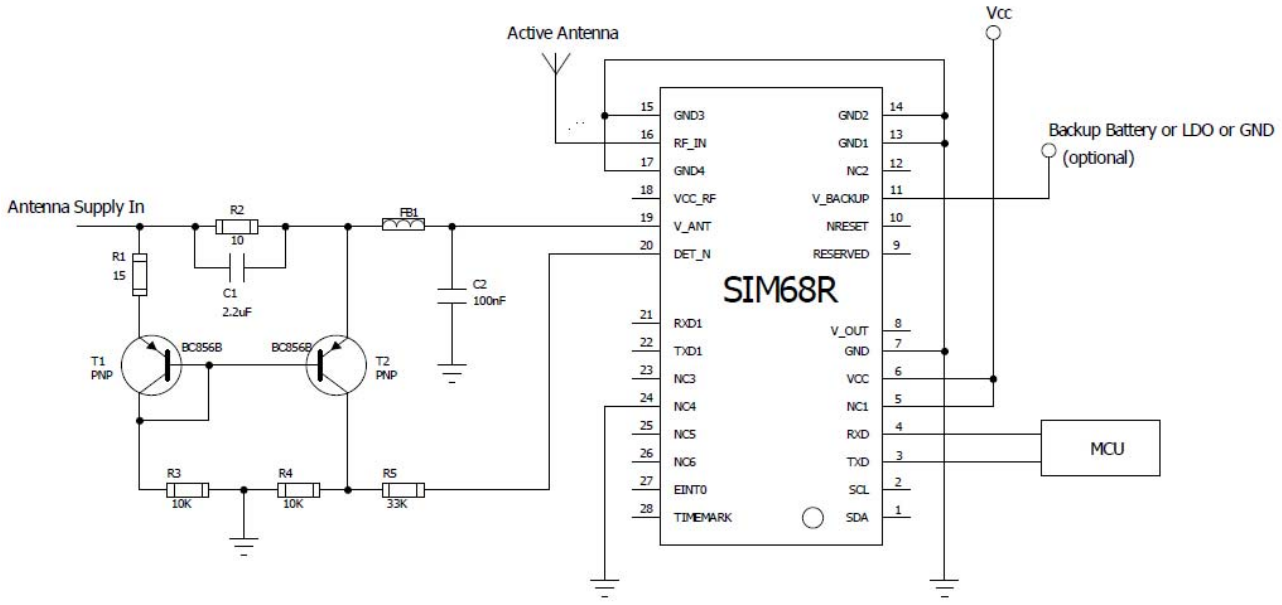


Figure 12: Open circuir detection-B

If the antenna supply voltage is not derived from VCC_RF, do not exceed the maximum voltage rating of DET_N.(5V)

5 Electrical, Reliability and Radio Characteristics

5.1 Absolute Maximum Ratings

The absolute maximum ratings stated in Table 7 are stress ratings under non-operating conditions. Stresses beyond any of these limits will cause permanent damage to SIM68R.

Table 7: Absolute maximum ratings

Parameter	Min	Max	Unit
VCC	-	4.3	V
V_ANT	-5.5V	+5.5	V
Input Power at RF_IN	-	-12	dbm
V_BACKUP	-	4.6	V
I/O pin voltage	-	3.6	V
Storage temperature	-45	+125	℃
Operating Temperature	-40	+85	℃

5.2 Recommended Operating Conditions

Table 8: SIM68R operating conditions

Parameter	Symbol	Min	Typ	Max	Unit
Operating temperature range		-40	+25	+85	℃
Main supply voltage	VCC	2.8	3	4.3	V
Active antenna supply voltage output	VCC_RF	2.7	2.8	2.9	V
	Imax			20	mA
Backup battery voltage	V_BACKUP	2.3		3.6	V

Table 9: SIM68R standard IO features

Parameter	Symbol	Min	Typ	Max	Unit
Low level output voltage Test conditions IOL = 2mA and 4.0mA	V_{ol}	-0.3		0.40	V
High level output voltage Test conditions IOL = 2mA and 4.0mA	V_{oh}	2.4		3.1	V
Low level input voltage	V_{il}	-0.3		0.8	V
High level input voltage	V_{ih}	2.0		3.6	V
Input Pull-up resistance	R_{PU}	40		190	K Ω
Input Pull-dowm resistance	R_{PD}	40		190	K Ω
Input capacitance	C_{in}		5		pF

Load capacitance	C_{load}			8	pF
Tri-state leakage current	I_{OZ}	-10		10	uA

5.3 Electro-Static Discharge

The GNSS 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 SIM68R module.

The measured values of SIM68R are shown as the following table:

Table 10: The ESD endure statue measured table (Temperature: 25℃, Humidity:45%)

Part	Contact discharge	Air discharge
VCC	±5KV	±10KV
V_BACKUP	±5KV	±6KV
GND	±5KV	±10KV
RXD, TXD	±4KV	±8KV
RF_IN	±5KV	±10KV
NRESET	±4KV	±8KV

5.4 Certification

SIM68R meets the requirements of Directive 2002/95/EC of the European Parliament and of the Council on the Restriction of Hazardous Substance (RoHS).and has acquired CE certification.

6 Manufacturing

6.1 Top and Bottom View of SIM68R

Figure 13: Top and bottom view of SIM68R

Table 11: Illustration of module information

Item	Description
A	LOGO
B	Module name
C	Module part number Hardware number and software number included; ex.S2-10595 is hardware number Z0Z04 is software number
D	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;
E	Module bar code
F	PIN 1 Mark

6.2 Assembly and Soldering

The SIM68R 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 SIM68R:

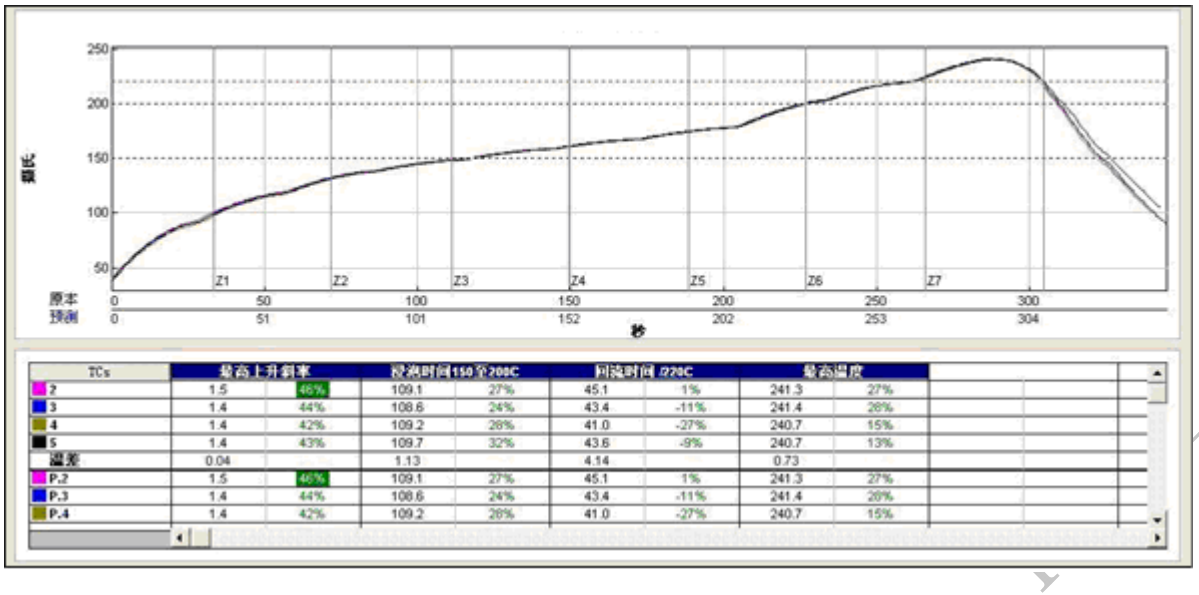


Figure 14: The Ramp-Soak-Spike reflow profile of SIM68R

SIM68R is Moisture Sensitive Devices (MSD), appropriate MSD handling instruction and precautions are summarized in Chapter 6.3.

SIM68R modules are also Electrostatic Sensitive Devices (ESD), handling SIM68R modules without proper ESD protection may destroy or damage them permanently.

Avoid ultrasonic exposure due to internal crystal and SAW components.

6.3 Moisture sensitivity

SIM68R 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 10 lists floor life for different MSL levels in the IPC/JDEC specification:

Table 12: 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, SIM68R 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.

Notes: 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.

6.4 ESD handling precautions

SIM68R modules are Electrostatic Sensitive Devices (ESD). Observe precautions for handling! Failure to observe these precautions can result in severe damage to the GNSS receiver!

GNSS 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).

6.5 Shipment

SIM68R is designed and packaged to be processed in an automatic assembly line, and it is now packaged in SIM68R tray.

7 Reference Design

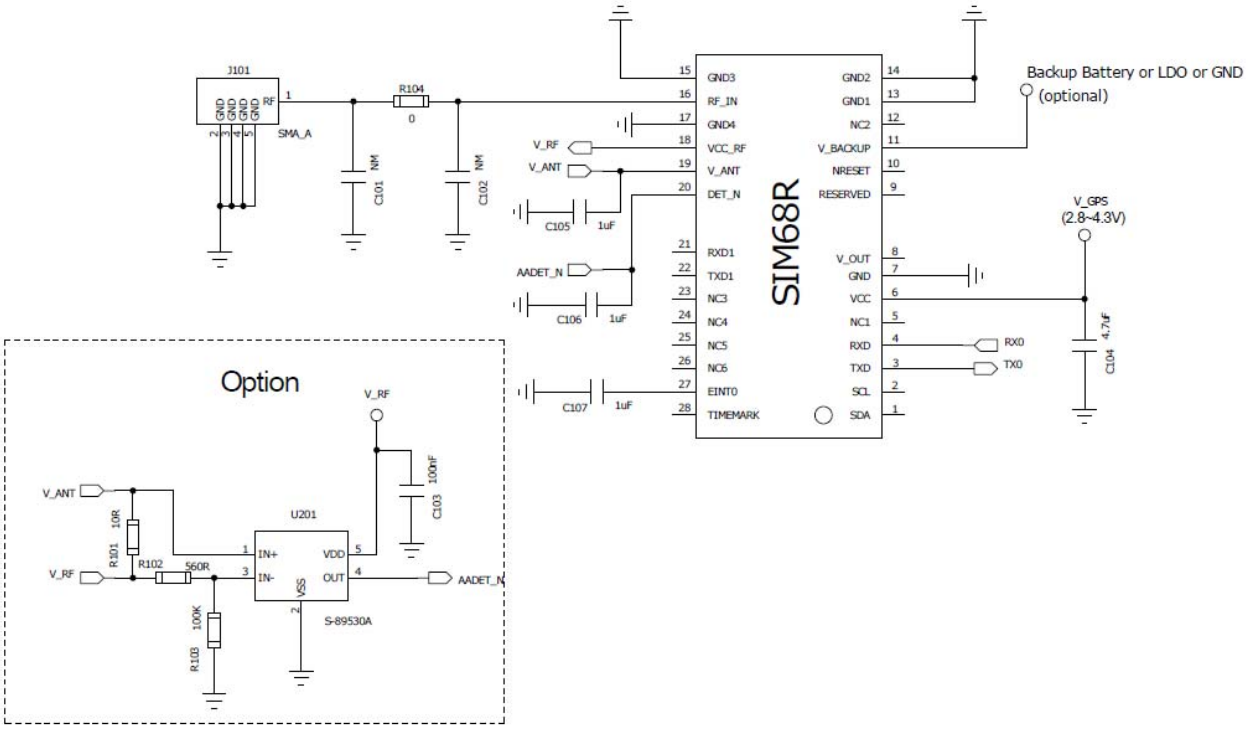


Figure 15: Example application schematic with UART

Notes:

1) The pin VCC_RF provides a 2.8V output level for external active antenna.

For active antenna, if antenna's power domain is 2.8V, the pin VCC_RF could supply the voltage .Do not connect VCC_RF pin to RF_IN pin directly, use V_ANT pin to supply power. Connect VCC_RF pin to V_ANT pin with 10ohm. If the antenna's power is not 2.8v, keep the pin VCC_RF open.

For passive antenna, the pin VCC_RF should be kept open, the pin V_ANT should be connected to GND.

Appendix

A. Related Documents

Table 13: Related documents

SN	Document name	Remark
[1]	MT3333_data_sheet_external_V1.01	MT3333 datasheet
[2]	CoreBuilder_User_Manual_0_4	CoreBuilder User Manual
[3]	SIM28 / 68R / 68V NMEA Messages SpecificationV1.00	
[4]	EPO-II_Format_Protocol_Customer	EPO-II_Format and Protocol

B. Terms and Abbreviations

Table 14: Terms and abbreviations

Abbreviation	Description
A-GPS	Assisted Global Positioning System
CMOS	Complementary Metal Oxide Semiconductor
CEP	Circular Error Probable
DGPS	Difference Global Positioning System
EEPROM	Electrically Erasable Programmable Read Only Memory
EPO	Extended Prediction Orbit
ESD	Electrostatic Sensitive Devices
EASY	Embedded Assist System
EGNOS	European Geostationary Navigation Overlay Service
GPS	Global Positioning System
GAGAN	The GPS Aided Geo Augmented Navigation
GLONASS	Global Navigation Satellite 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
MSL	moisture sensitive level
MSAS	Multi-Functional Satellite Augmentation System

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

Contact us:

Shanghai SIMCom Wireless Solutions Ltd.
Add: SIM Technology Building,No.633,Jinzhong Road,Changning District,Shanghai P.R. China 200335
Tel: +86 21 3235 3300
Fax: +86 21 3235 3301
URL: www.sim.com/wm