# SIM28
# Hardware Design

**GNSS Module**

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# Version History

| Date | Version | Description of change | Author |
|------|---------|----------------------|--------|
| 2011-06-25 | V1.00 | Origin | Jing.zhou jianmei.zhou |
| 2011-09-19 | V1.01 | Delete internal LNA | Honggang ma |
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| 2013-04-17 | V1.05 | Update the operating temperature to -40 ~ +85ºC | Honggang ma |
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# 1 Introduction

This document describes the hardware interface of the SIMCom module SIM28 which can be used as a stand alone or A-GPS（Assisted Global Positioning System） receiver. As a wide range of applications can be integrated in SIM28, all functional components of SIM28 are described in great detail.

SIM28 is a stand-alone or A-GPS receiver. With built-in LNA, SIM28 can relax antenna requirement and don't need for external LNA. SIM28 can track as low as -165dBm signal even without network assistance. SIM28 has excellent low power consumption characteristic (acquisition 16mA, tracking 15mA). SIM28 supports various location and navigation applications, including autonomous GPS, QZSS, SBAS ranging (WAAS, EGNOS, GAGAN, MSAS), RTCM and A-GPS.

Key Features

- GPS receiver, supports multi-GNSS include QZSS, SBAS ranging, supports WAAS/EGNOS/MSAS/GAGAN
- 22tracking/66 acquisition-channel GNSS receiver, up to 210 PRN channels
- 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 NMEA update rate up to 10 HZ[2]
- Advanced software features
    1. EASY self-generated orbit prediction
    2. EPO/HotStill orbit prediction
    3. AlwaysLocate advanced location awareness technology
- Pulse-per-second (PPS) GPS time reference
    1. Adjustable duty cycle
    2. typical accuracy: ±10ns
- Interface
    1. UART
    2. SPI/I2C(3)
- Operating temperature: -40 ~ +85ºC
- Accuracy 2.5m CEP
- RoHS compliant

(1) AIC can be controlled by PMTK command, see document [2] for details.
(2) Default is 1 HZ. And EASY function can be activated only at 1 HZ update rate.
(3) SPI and I2C can not't be applied synchronously.

## 1.1 SIM28 Functional Diagram

The following figure shows a functional diagram of the SIM28 and illustrates the mainly functional parts:

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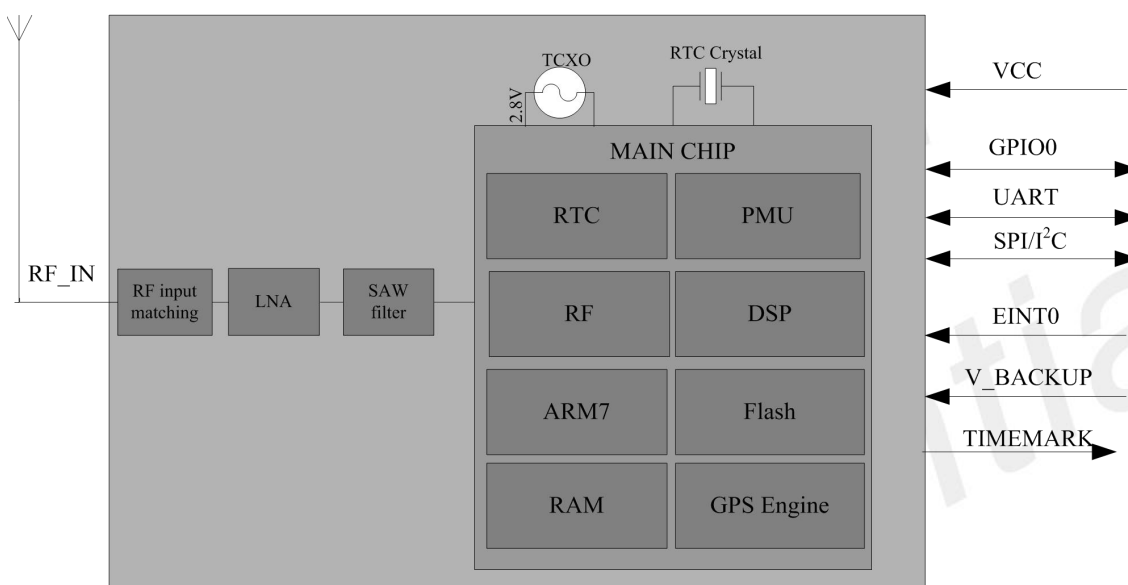


Figure 1: SIM28 functional diagram

## 1.2 GPS Performance

**Table 1: GPS performance**

| Parameter | Description | Performance | | | |
| --- | --- | --- | --- | --- | --- |
| | | Min | Type | Max | Unit |
| Horizontal Position Accuracy[1] | Autonomous | | 2.5m CEP | | m |
| Velocity | Without Aid | | 0.1 | | m/s |

| Accuracy[2] | DGPS | 0.05 | | m/s |
|---|---|---|---|---|
| Acceleration Accuracy | Without Aid | 0.1 | | m/s$^2$ |
| | DGPS | 0.05 | | m/s$^2$ |
| Timing Accuracy | | 10 | | nS |
| Dynamic Performance | Maximum Altitude | | 18000 | m |
| | Maximum Velocity | | 515 | m/s |
| | Maximum Acceleration | | 4 | G |
| TTFF[3] | Hot start | <1 | | s |
| | Warm start | 30 | | s |
| | Cold start | 32 | | s |
| TTFF with EASY[5] | Hot start | 0.3 | | s |
| | Warm start | 1.4 | | s |
| | Cold start | 13.8 | | s |
| A-GPS TTFF(EPO in flash mode) | Hot start | 0.7 | | s |
| | Warm start | 1.5 | | s |
| | Cold start | 12.5 | | s |
| Sensitivity | Autonomous acquisition(cold start) | -147 | | dBm |
| | Re-acquisition | -160 | | dBm |
| | Tracking | -165 | | dBm |
| Receiver | Channels | 66 | | |
| | Update rate | 1 | 10 | Hz |
| | Tracking L1, CA Code | | | |
| | Protocol support NMEA,PMTK | | | |
| Power consumption[4] | Continuous tracking | 19 | | mA |
| | Sleep current | 200 | | uA |

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

(2) 50% at 30m/s

(3) GPS signal level: -130dBm

(4) Single Power supply 3.3V

(5) EASY can not work at the simulation environment, this test implemented at a good test condition.

## 1.3 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<br>15 mV(RMS) max @ f > 3 MHz |
| Power consumption(acquisition) | | 24mA type. @ VCC=3.3 V |
| Power consumption(sleep) | | 200uA 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 |
| Other port | | I$^2$C/SPI |
| Host port | | UART |
| Serial port protocol (UART) | | NMEA; 8 bits, no parity, 1 stop bit; 115200 baud (configurable) |
| TIMEMARK output (1PPS) | | 1 pulse per second, synchronized at rising edge, pulse length 300ms |

# 2 Package Information

## 2.1 Pin out Diagram
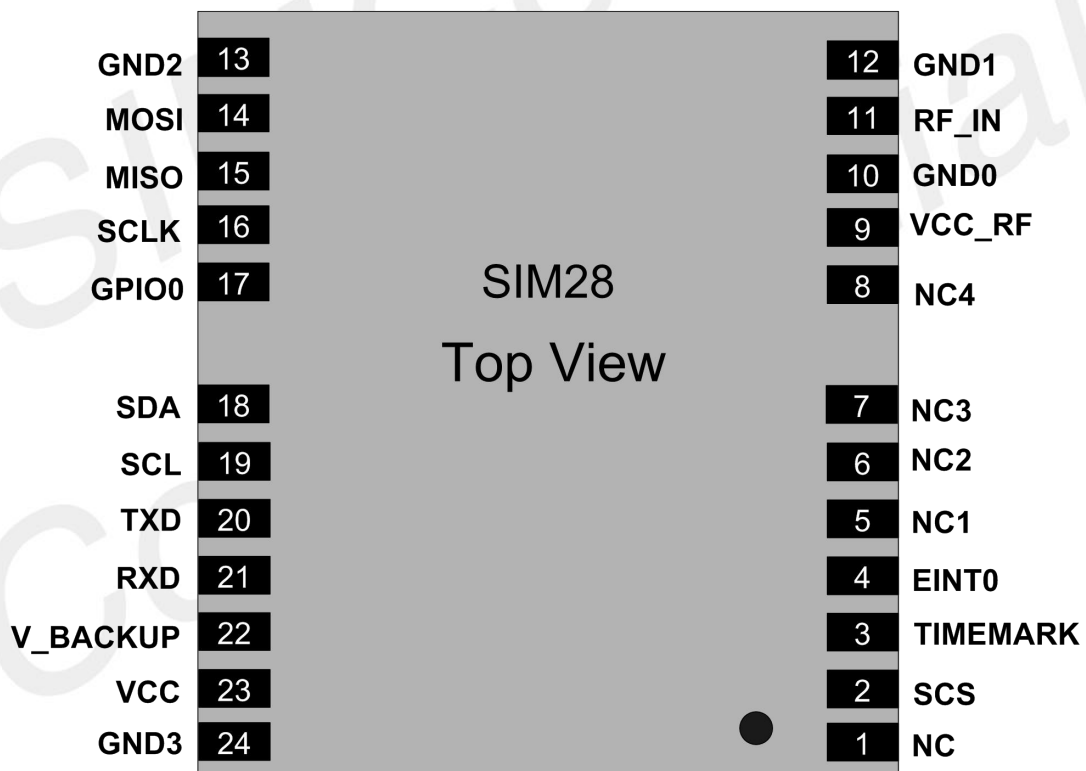


Figure 2: SIM28 pin out diagram (Top view)

## 2.2 Pin Description

**Table 3: Pin description**

| Pin Name | Pin No. | 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 | Power supply for active antenna or external LNA | | IF unused, keep open |
| V_BACKUP | 22 | I/O | 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 | If unused, keep open. |
| MOSI | 14 | | O | SPI MOSI | |
| SCLK | 16 | | O | SPI clock | |
| SCS | 2 | | O | SPI slave select | |
| SDA | 18 | | I/O | $I^2C$ data | If unused, keep open. |
| SCL | 19 | | I/O | $I^2C$ C Clock | |
| TXD | 20 | | O | Serial output | |
| RXD | 21 | | I | Serial input | |
| **GPIOs** | | | | | |
| EINT0 | 4 | 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 | | If unused, keep open. |
| TIMEMARK | 3 | O | Time Mark outputs timing pulse related to receiver time | | If unused, keep open. |
| GPIO0 | 17 | I/O | GPIO can provide the developers signal or message outputs. GPIO supports a simple control interface. | | If unused, keep open. |
| **RF interface** | | | | | |
| RF_IN | 11 | I | Radio antenna connection | | Impendence must be controlled to 50Ω. |
| **Other interface** | | | | | |

| NC | 1,5,6,7, 8 | Not Connected | |
|---|---|---|---|

## 2.3 Package Dimensions

Following figure shows the Mechanical dimensions of SIM28 (top view, side view and bottom view).
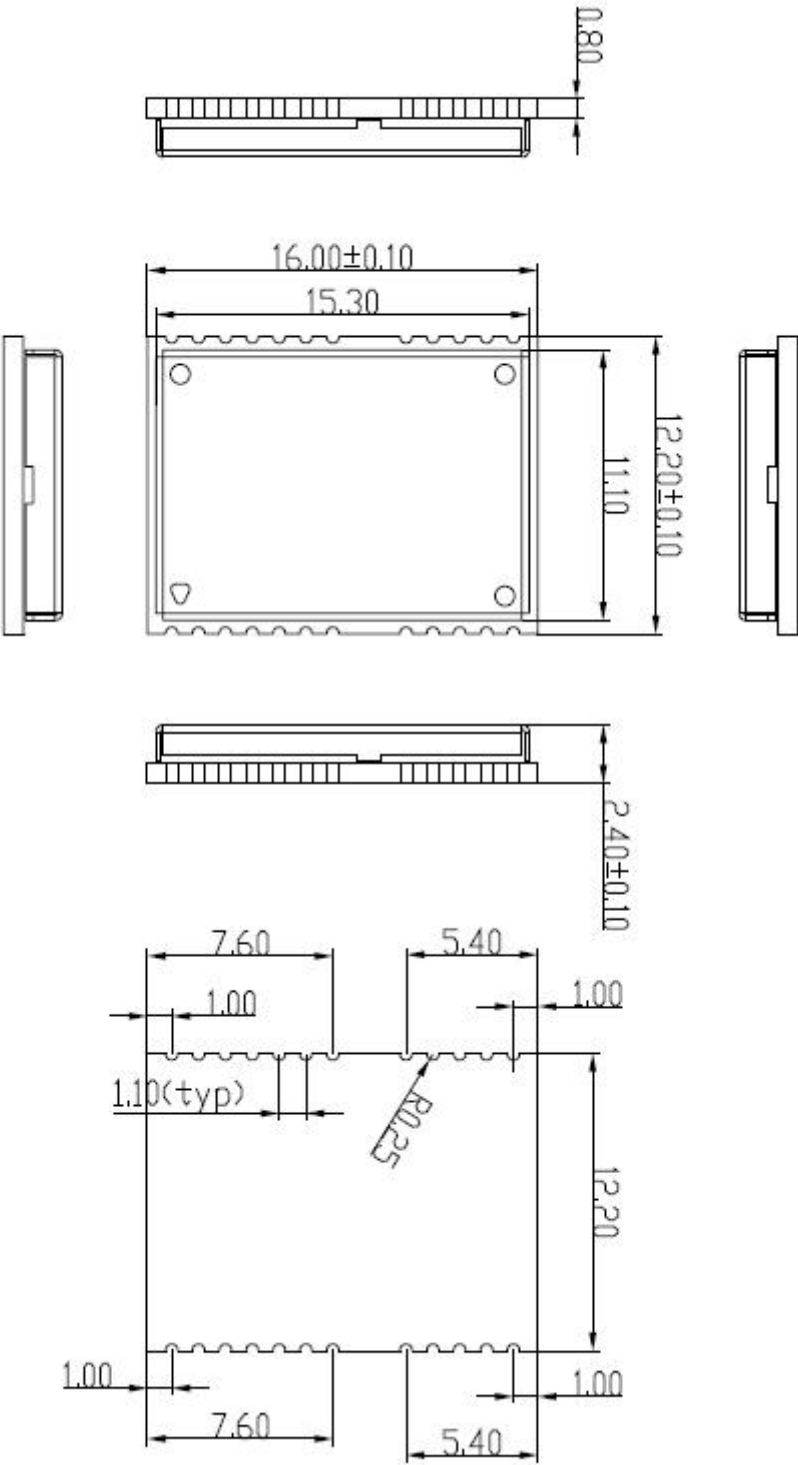
Figure 3: SIM28 mechanical dimensions (Unit: mm)

## 3.1. SIM28 Recommended PCB Decal
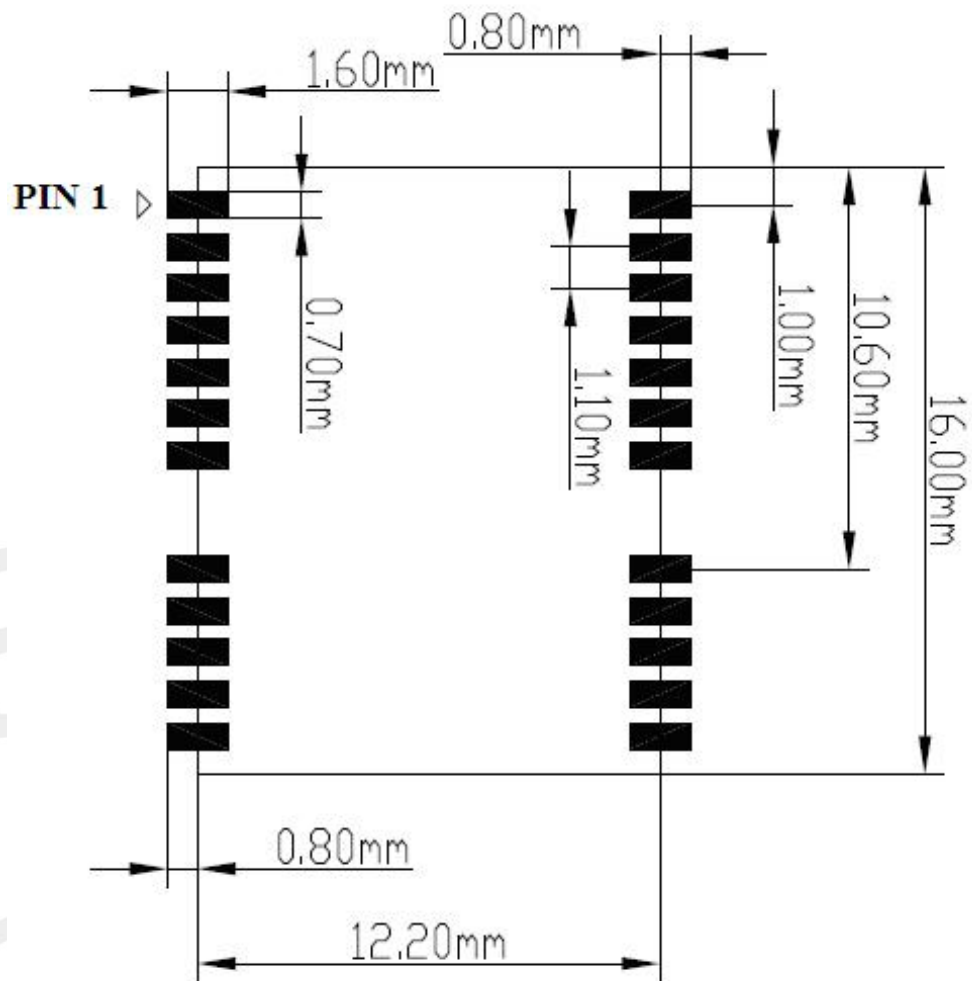


Figure 4: Recommended PCB decal (top view) (Unit: mm)

# 3 Application Interface

## 3.1 Power Management

### 3.1.1 Power Intput

The power supply range of SIM28 is from 2.8V to 4.3V. The power supply should be able to provide sufficient current up to 100mA.

The power supply range of V_BACKUP is from 2V to 4.3V, typical 3.0V, suggest customer keep the V_BACKUP supply active all the time, the module will perform a quick start every time it is power-on.

### 3.1.2 Starting SIM28

For initial power up, the RTC must start oscillating to sequence the Finite State Machine. RTC startup time may vary. When power is first applied, SIM28 goes into operation mode.

### 3.1.3 Verification of SIM28 Start

System activity indication depends upon the chosen serial interface, When it is activated, SIM28 will output messages at the selected UART speed, and message types. The default baud rate is 115200bps.

### 3.1.4 Power Saving Modes

SIM28 provides very low leakage battery back up memory, which contains all the necessary GPS 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.

SIM28 supports operating modes for reduced average power consumption like standby mode, backup mode, periodic mode, and AlwaysLocate™ mode.

- Sleep mode: In this mode the receiver stays at full on power state. This mode can be waken up by the host sending the command through the communication interface or external interrupt.
- AlwayLocate™ mode: AlwayLocate™ is an intelligent controller of SIM28 periodic mode. Depending on the environment and motion conditions, SIM28 can adapt to adjust the on/off time to achieve balance of positioning accuracy and power consumption.

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**NOTE**

all the operation to the SIM28 module are applied by PMTK commands, customer can refer to document [2] for more information..

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### 3.1.5    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 | off | on | off | off | on |

#### 3.1.5.1    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 number 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.

#### 3.1.5.2    Sleep Mode

Sleep mode means a low quiescent (200uA 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. Waking up from and entering

into sleep mode is controlled by UART interface, any byte typing-in will drag SIM28 out of sleep 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 application example.

## 3.3 UART Interface

SIM28 includes one configurable UART interface for serial communication. This UART can be as NEMA output and PMTK command input. The bit rates are selectable and ranging from 4.8 to 921.6kbps. UART can provide the developers signal or message outputs.

| NOTE |
| --- |
| The baud rate is 115200, if other baud rate required please contact SIMCom FAE. |

**Table 5: Host port multiplexed function pins**

| Pin name | Pin number | UART function | Pin name |
| --- | --- | --- | --- |
| TXD | 20 | data transmit | TXD |
| RXD | 21 | data receive | RXD |

## 3.4 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 6: SPI function pins**

| Pin name | Pin number | SPI function | Pin name |
| --- | --- | --- | --- |
| MISO | 15 | Master input | MISO |

| MOSI | 14 | Master output | MOSI |
|------|----|--------------|------|
| SCLK | 16 | Clock output | SCLK |
| SCS | 2 | Chip select | SCS |

## 3.5 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**
>
> The EEPROM and flash can notn't be supported at the same time.

## 3.6 TIMEMAKE Output

The Timemark pin outputs pulse-per-second (1PPS) pulse signal for precise timing purpose. 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.

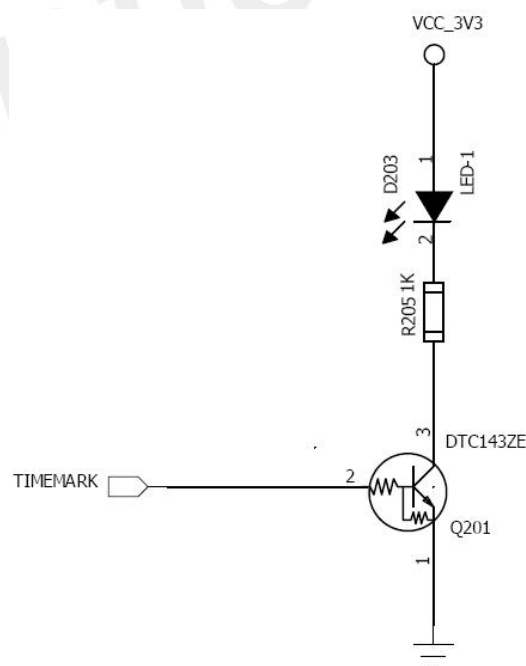The following figure is the typical application of the TIMEMARK function



Figure 5: TIMEMARK application circuit

# 3.7 A-GPS

A-GPS is the meaning of Assisted GPS, which is a system that can improve the startup performance under certain conditions, or time-to-first-fix (TTFF) of a GPS satellite-based positioning system. SIM28 module supports EPO file, EASY mode.

## 3.7.1 EPO

The SIM28 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 be sent send to the SIM28 by the HOST side. SIM28 has the shorter cold TTFF and warm TTFF when the A-GPS is used.

**NOTE**

For more information about EPO please reefer to document [4].

## 3.7.2 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 by default and can be closed by PMTK command.

## 3.8 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.

## 3.9 GPS Antenna

The antenna is a critical item for successful GPS reception in a weak signal environment. Proper choice 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 antenna. In a typical application, SIM28 with an active antenna can get a tracking sensitivity about 3dB better than SIM28 with a passive antenna.

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

**Table 7: Antenna Specifications**

| Parameter | Specification | Passive and active antenna |
|---|---|---|
| Active Antenna Recommendations | Frequency range | 1575±3MHz |
| | Polarization | RHCP |
| | Gain | >20dB (max 40 dB) |
| | Noise Figure | <1.5 dB |

### 3.9.1  Antenna Interface

The SIM28 receives L1 band signals from GPS satellites at a nominal frequency of 1575.42 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 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.

## 3.9.2   Antenna Choice and RF Design Consideration

To obtain excellent GPS reception performance, a good antenna will always be required. The RF circuits should also be designed properly based on the type of antenna.

### 3.9.2.1   Full on Mode

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 applications is the patch antenna. Patch antennas are flat, generally have a ceramic and metal body and are mounted on a metal base plate.

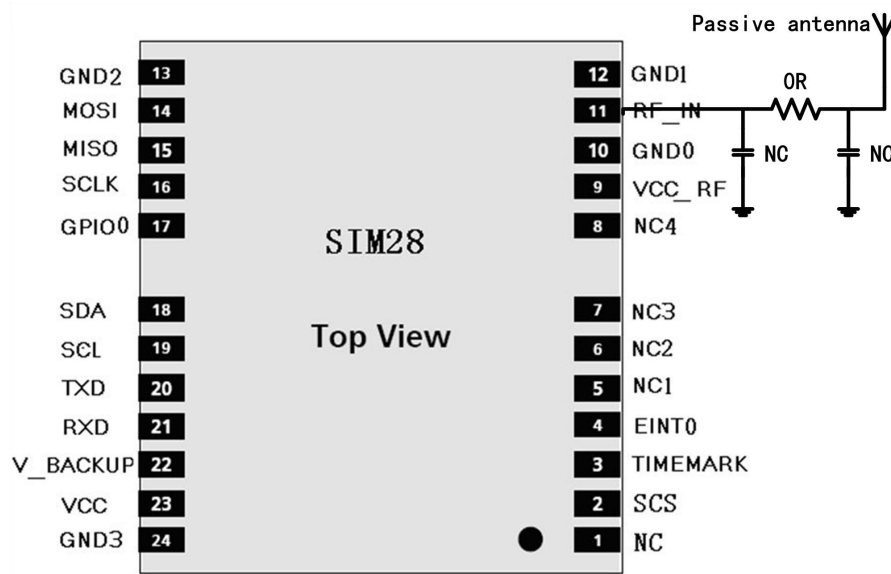Figure 5 shows a minimal setup for a GPS receiver with SIM28 module.

Figure 6: SIM28 passive antenna design

For best performance with passive antenna designs user can use an external LNA to increase the sensitivity. Please see Figure 6 and Figure 7, Figure 8
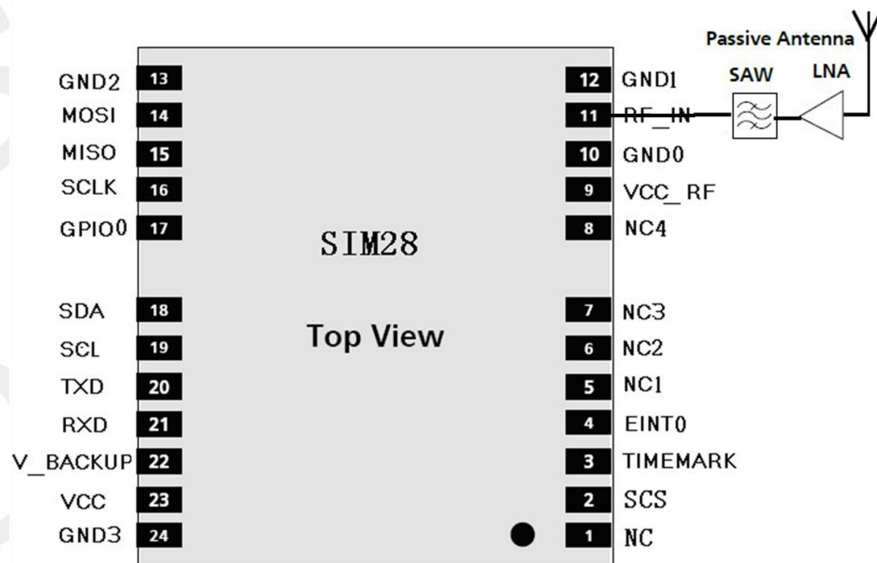


Figure 7: SIM28 passive antenna design (with external LNA and SAW)
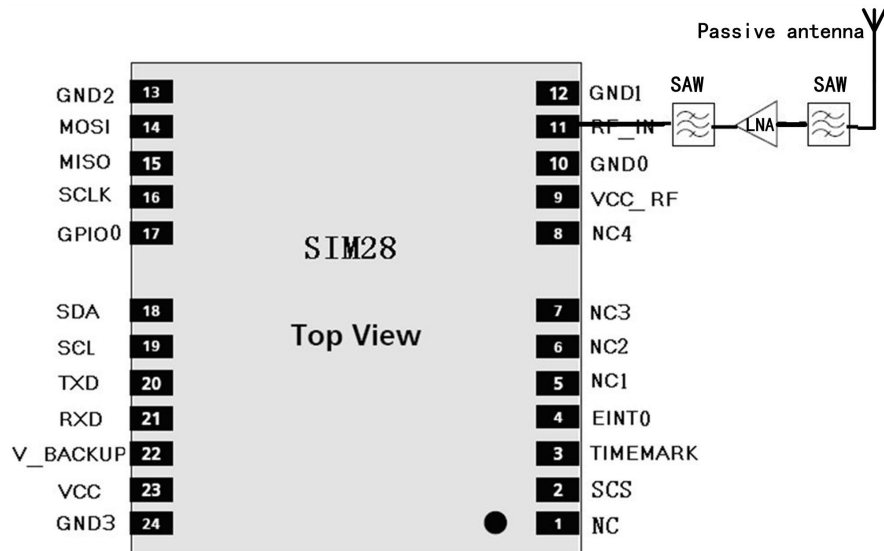
Figure 8: SIM28 passive antenna design for best performance and increased immunity

### 3.9.2.2 Active Antennas

Active antennas have an integrated Low-Noise Amplifier (LNA). Active antennas need a power supply that will contribute to GPS 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 used as **V_ANT**. If the active antenna is less than 2.8V, other power should be connected to **RF_IN**.
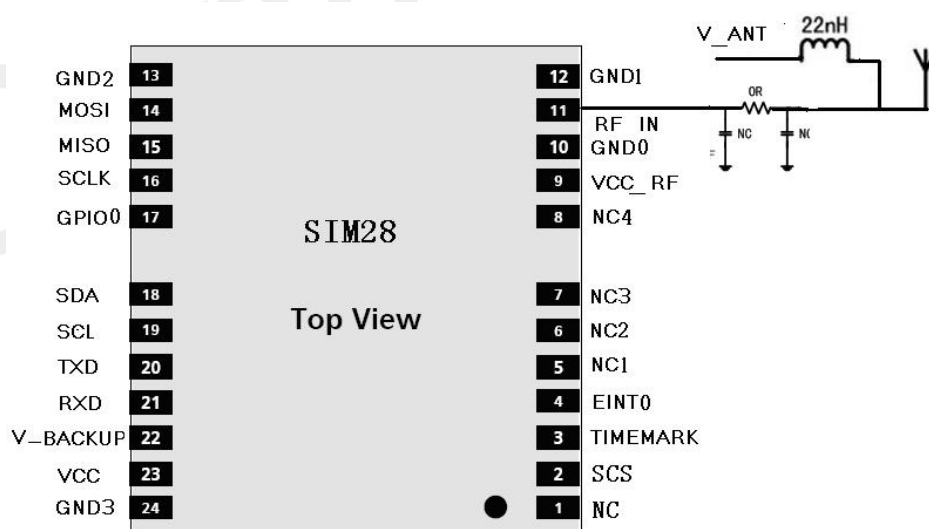


Figure 9: SIM28 Active antenna design

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.

GPS 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 GPS reception performance depending on the customer's design.

# 4 Electrical, Reliability and Radio 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 SIM28.

**Table 8: Absolute maximum ratings**

| Parameter | Min | Max | Unit |
|---|---|---|---|
| VCC | - | 4.3 | 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 | ℃ |

## 4.2 Recommended Operating Conditions

**Table 9: SIM28 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 |
| Active antenna supply voltage output | VCC_RF | 2.7 | 2.8 | 2.9 | V |
| | Imax | | | 10 | mA |
| Backup battery | V_BACKUP | 2.3 | | 4.3 | V |

| | | | | | |
|---|---|---|---|---|---|
| voltage | | | | | |

**Table 10:** **SIM28 standard IO features**

| Parameter | Symbol | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Low level output voltage | | | | | |
| Test conditions IOL = 2mA and 4.0mA | Vol | -0.3 | | 0.40 | V |
| High level output voltage | | | | | |
| Test conditions IOL = 2mA and 4.0mA | Voh | 2.4 | | 3.1 | V |
| Low level input voltage | Vil | -0.3 | | 0.8 | V |
| High level input voltage | Vih | 2.0 | | 3.6 | V |
| Input Pull-up resistance | RPU | 40 | | 190 | KΩ |
| Input Pull-dowm resistance | RPD | 40 | | 190 | KΩ |
| Input capacitance | Cin | | 5 | | pF |

## 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 SIM28 Lmodule. The ESD test results are shown in the following table.

**Table 11:** **The ESD characteristics (Temperature: 25℃, Humidity: 45 %)**

| Pin | Contact discharge（KV） | Air discharge（KV） |
|---|---|---|
| VCC | ±5 | ±10 |
| GND | ±5 | ±10 |
| VCC_RF | ±5 | ±10 |
| RF_IN | ±5 | ±10 |

# 5 Manufacturing

## 5.1 Label information



Figure 10: Label of SIM28

**Table 12: illustration of module information**

| Item | Description |
|------|-------------|
| A | Logo of SIMCom |
| B | Module name |
| C | Module part number<br>Hardware number and software number included;<br>ex.S2-10488 is hardware number<br>    Z0X02 is software number |
| D | Module serial number<br>The first number stands for factory code;<br>The second number stands for year code;<br>The third to eighth numbers is the SN number in hexadecimal numeric;<br>The last two numbers stands for MNEA sentence baud rate, "11" stands for 115200, "96" stands for 9600; "38" stands for 38400; |
| E | Module bar code<br>Stands for the first 6 numbers of SN number |

| F | PIN 1 Mark |
| --- | --- |

## 5.2 Assembly and Soldering

The SIM28 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.

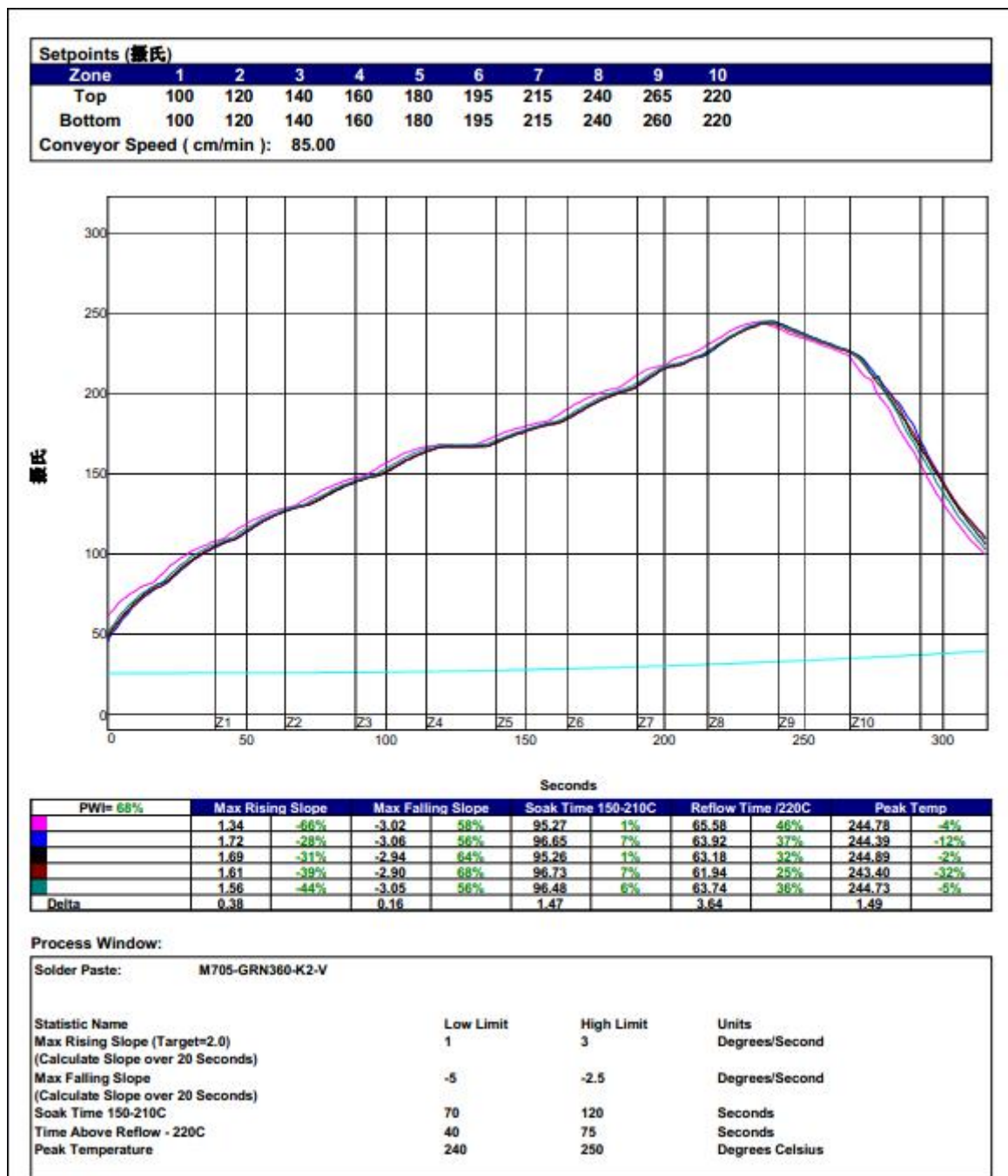The following figure is the Ramp-Soak-Spike Reflow Profile of SIM28:

Figure 11: The Ramp-Soak-Spike reflow profile of SIM28

SIM28 is Moisture Sensitive Devices (MSD), appropriate MSD handling instruction and precautions are summarized in Chapter 6.2.

SIM28 modules are also Electrostatic Sensitive Devices (ESD), handling SIM28 modules without proper ESD protection may destroy or damage them permanently.

Avoid ultrasonic exposure due to internal crystal and SAW components.

## 5.3 Moisture sensitivity

SIM28 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 13: 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, SIM28 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.

## 5.4 ESD handling precautions

SIM28 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).

## 5.5 Shipment

SIM28 is designed and packaged to be processed in an automatic assembly line, and it is now packaged in SIM28 tray.
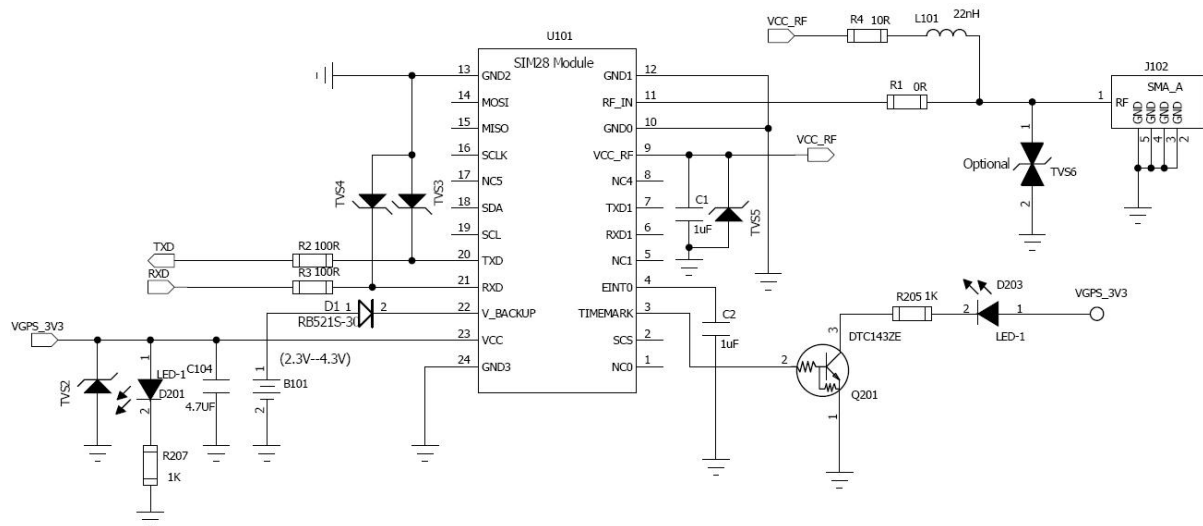
# 6 Reference Design



Figure 12: Application schematics

**NOTE**

I/Os of SIM28V are 2.8V CMOS voltage level, attentions should be paid if the voltage level of the host controller not compatible; B101 is an un-rechargeable battery, if rechargeable backup battery used in the design, customer should design a charge circuit; To get the best performance on ESD testing, please take appropriate measures as the reference design shows.

# 7 Appendix

## 7.1 Related Documents

**Table 14: Related documents**

| SN | Document name | Remark |
|----|---------------|--------|
| [1] | SIM28_EVB kit_User Guide_V1 02 | |
| [2] | SIM28/68R/68V NMEA Messages SpecificationV1.01 | |
| [3] | SIM28 REFERENCE DESIGN PACKAGE | |
| [4] | SIM28 /68R /68V EPO-II_ProtocolV1.00 | |

## 7.2 Terms and Abbreviations

**Table 15: Terms and abbreviations**

| Abbreviation | Description |
|--------------|-------------|
| A-GPS | |
| CMOS | Complementary Metal Oxide Semiconductor |
| EEPROM | Electrically Erasable Programmable Read Only Memory |
| EPO | Extended Prediction Orbit |
| ESD | Electrostatic Sensitive Devices |
| FSM | Finite State Machine |
| GPS | Global Positioning System |
| I/O | Input/Output |
| IC | Integrated Circuit |
| Inorm | Normal Current |
| Imax | Maximum Load Current |
| kbps | Kilo bits per second |
| KA | Keep alive |
| MSL | moisture sensitive level |
| NEMA | National Marine Electronics Association |
| SGEE | server-generated extended ephemeris |