



GTS-4E Hardware User Manual

Version: V1.1.0

Date: 2013-12-04



Confidential Material

This document contains information highly confidential to Fibocom Wireless Inc. (Fibocom). Fibocom offers this information as a service to its customers, to support application and engineering efforts that use the products designed by Fibocom. The information provided is based upon requirements specifically provided to Fibocom by the customers. All specifications supplied herein are subject to change. Disclosure of this information to other parties is prohibited without the written consent of Fibocom.

Copyright

Copy, Reproduce, Distribute and/or Edit of this document or part of it as well as utilization of its contents and communication thereof to others without express authorization are prohibited. Offenders will be held liable for payment of damages. All rights created by patent grant or registration of a utility model or design patent are reserved. Copyright ©2013 Fibocom Wireless Inc. All rights reserved.

Trademarks Notice



The FIBOCOM Logo is registered by Fibocom Wireless Inc. All other product or service names or logos are the property of their respective owners. Copyright ©2013 Fibocom Wireless Inc. All rights reserved.

Revision History

| Version | Date | Remarks |
|---------|------------|--|
| V1.0.0 | 2011-01-04 | Initial Version |
| V1.0.1 | 2011-08-06 | Add hardware design, change some descriptions |
| V1.0.2 | 2012-01-06 | Add GTS-4E-6x2, add recommended circuit |
| V1.0.3 | 2012-03-27 | Update the mechanical specifications |
| V1.0.4 | 2012-06-25 | Delete ATP and APM |
| V1.0.5 | 2013-05-03 | 1. Delete GTS-4E-00 and GTS-4E-10, add GTS-4E-70 2. Add product features 3. Delete PCB layout 4. Update block diagram |
| V1.0.6 | 2013-05-20 | Add Horizontal Accuracy |
| V1.0.7 | 2013-06-13 | Modify the voltage of interface |
| V1.0.8 | 2013-07-05 | Add GTS-4E-50, Update the name of the document |
| V1.0.9 | 2013-10-08 | Add NMEA and Pin definition Delete baud rate description of GTS-4E-70 |

| | | |
|--------|------------|--|
| V1.1.0 | 2013-12-04 | Update descriptions about \$PSRF in section 2.6 Update description about active antenna in section 5.1.2 Update description about baud rate configuration in section 3.2 |
|--------|------------|--|

Applicability Table

| No. | Type | SPI | UART | Note |
|-----|-----------|---------------|---------------|--|
| 1 | GTS-4E-50 | Supported | Not supported | It doesn't support ON_OFF、RESET and IPPS function. |
| 2 | GTS-4E-60 | Not supported | Supported | |
| 3 | GTS-4E-70 | Supported | Not supported | |

Contents

| | | |
|-------|--|----|
| 1 | Preface..... | 6 |
| 2 | Overview | 7 |
| 2.1 | Description..... | 7 |
| 2.2 | GPS Performance | 7 |
| 2.3 | Block Diagram..... | 8 |
| 2.4 | SPI Interface | 8 |
| 2.5 | UART Interface | 9 |
| 2.6 | Protocols | 10 |
| 2.7 | Power..... | 10 |
| 2.7.1 | Power Signal | 10 |
| 2.7.2 | Working Mode | 11 |
| 2.8 | Control Signal..... | 11 |
| 2.8.1 | ON_OFF | 11 |
| 2.8.2 | RESET | 11 |
| 2.8.3 | 1PPS | 12 |
| 3 | Hardware Description..... | 13 |
| 3.1 | Pin Definition..... | 13 |
| 3.2 | Baud Rate..... | 15 |
| 3.3 | Recommended PCB Layout and Stencil Design..... | 15 |
| 3.4 | Mechanical Specifications | 17 |
| 4 | Electrical Features | 18 |
| 4.1 | Absolute Maximum Ratings | 18 |
| 4.2 | Pin Level | 18 |
| 5 | Antenna | 19 |
| 5.1 | Active Antenna | 19 |
| 5.1.1 | Supplied by External Power | 19 |
| 5.1.2 | Supplied by Internal Power | 20 |
| 5.2 | Passive Antenna | 20 |
| 5.3 | ESD Precautions for Antennas | 21 |

1 Preface

This document mainly introduces technical details about GTS-4E serials GPS modules.

2 Overview

This chapter gives a general description of the GPS Module.

2.1 Description

The GTS-4E is a new generation of GPS receiving module. It has the following features:

- Capture the GPS signals quickly
- Ultra-high sensitivity
- Strong anti-jamming performance
- LCC mounting
- Lower power consumption

GTS - 4E serial module is widely be used in monitoring, positioning, mapping, navigation, security applications, and other fields.

2.2 GPS Performance

| Parameter | Specification | |
|------------------------------|------------------------------------|---------|
| Receiver Type | 48 Channels, Tracking L1, C/A code | |
| Time-To-First-Fix* | Cold Start (autonomous) | 35s |
| | Hot Start(autonomous) | 1s |
| Horizontal Accuracy | 2.5m | |
| Sensitivity* | Tracking | -161dBm |
| | Acquisition | -147dBm |
| Accuracy of Timepulse Signal | RMS | 100ms |
| Power Consumption* | Acquisition | 54mA |
| | Navigation | 33mA |
| | Sleep Mode | 550uA |
| | Deep Sleep Mode | 200uA |
| Max Navigation Update Rate | 1Hz | |
| Interface | UART | 9600bps |
| Weight | ≤1g | |
| Size (L x W x H) | 16.0mm x 12.2mm x 2.6mm | |
| Operational Limits | Altitude | 18000m |
| | Velocity | 500m/s |

Note: Parameters with "*" mark means typical value.

2.3 Block Diagram

The following figure shows the block diagram of GTS-4E:

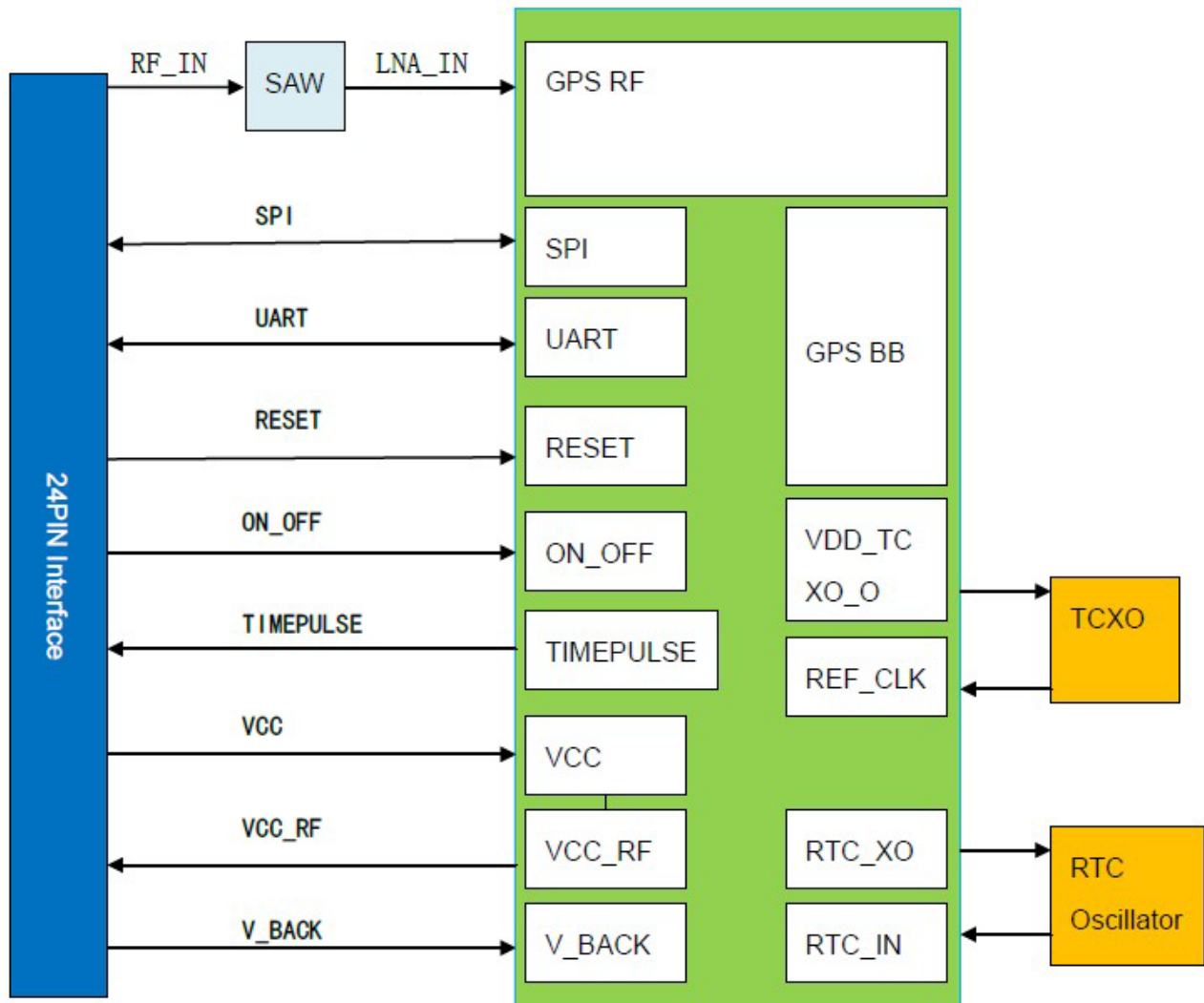


Figure 2-1 GTS-4E Block Diagram

2.4 SPI Interface

Pin description for SPI interface:

| Pin Name | Pin Description |
|----------|-------------------------------------|
| SPI_MISO | Module SPI interface output |
| SPI_MOSI | Module SPI interface input |
| SS_N | Module SPI interface chip selection |
| SPI_CLK | Module SPI interface clock |

SPI interface connection:

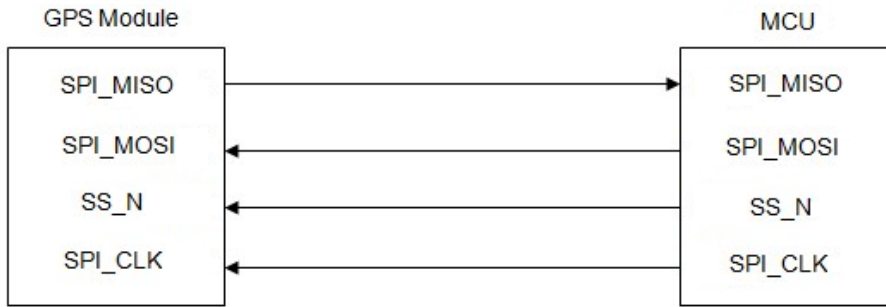


Figure 2-2 SPI Interface Connection

Slave mode: GPS module is slave, MCU is master.

Maximum clock frequency is 6.8MHz, recommended frequency range: 100 KHz-1.5MHz.

When powered on, SPI_CLK is high impedance.

Data is captured on the falling edge of the clock signal, triggered on the rising edge of the clock signal.

SPI host port timing diagram:

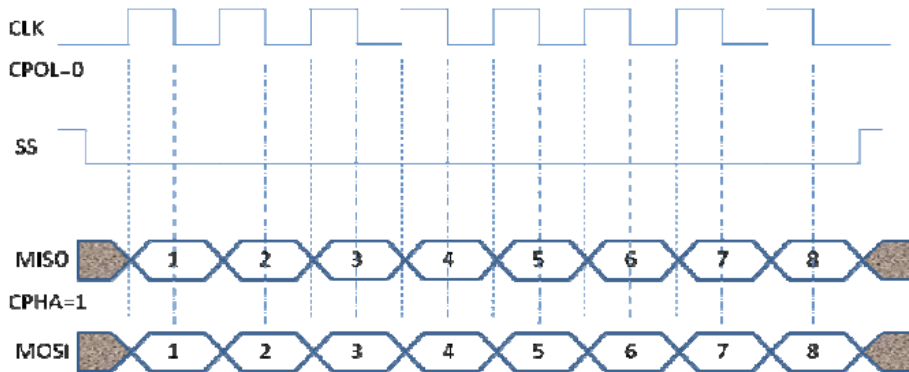


Figure 2-3 SPI host port timing diagram, SPI mode 1(single byte transfer)

2.5 UART Interface

Pin description for UART interface:

| Pin Name | Pin Description |
|----------|---------------------------|
| TXD | Module UART Transmit Data |
| RXD | Module UART Receive Data |

UART interface design:

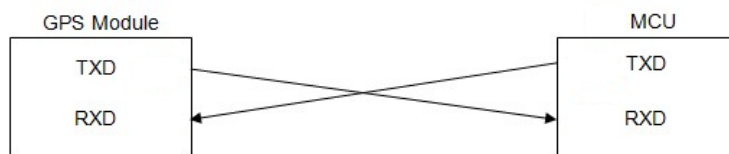


Figure 2-4 UART Interface Connection

2.6 Protocols

The GTS-4E module complies with the following protocol:

| Protocol | Type |
|----------|--|
| NMEA | NMEA 0183 ASCII, (version 3.01, January 1, 2002) |
| OSP | SiRF Binary Protocol |

The default protocol of GTS-4E is NMEA, and the default configuration of NMEA protocol is : \$GPGGA, \$GPGSA, \$GPRMC output data every second; \$GPGSV output data every 5 seconds;

- Control the message outputs of GGA, GSA and GSV by command \$PSRF103 command
- Switch to SiRF OSP protocol by command \$PSRF100, configure the baud rate by command \$PSRF100, the baud rate can be configured to: 4800, 9600, 19200, 38400, 115200, 230400, 460800, 921600, 1228800, unit: bps; the module restores to the default settings after you restart it.

2.7 Power

2.7.1 Power Signal

GTS-4E has three power pins: VCC, VCC_RF and V_BACK.

Pin description for power pin:

| Pin Name | Pin Description |
|----------|--|
| VCC | Main power supply input |
| VCC_RF | Active antenna power supply output, module connects to the VCC internally. |
| V_BACK | Standby battery power input, it is used for saving ephemeris. |

The range of working voltage:

| Pin Name | Minimum Value | Recommended Value | Maximum Value |
|----------|--|-------------------|---------------|
| VCC | 2.7 V | 3.3 V | 5.5 V |
| V_BACK | 2.7 V | 3.3 V | 5.5 V |
| VCC_RF | Module connects to the VCC internally. | | |

The main function of V_BACK is to supply the power for internal RAM and RTC, so the data in RAM can be saved

The module goes into hot start and warm start status when main power is re-powered on, if the main power is cut off when power is not supplied by V_BACK, after you re-power on the module, it changes to cold start status.

2.7.2 Working Mode

The module supports the following working modes:

| Working Mode | Status Description |
|-----------------|--|
| Capture Mode | VCC enabled, module captures satellite signals. |
| Navigation Mode | VCC enabled, module goes into navigation mode, TIMEPULSE output 1PPS waveform. |
| Sleep Mode | VCC disabled, V_BACK keeps enabled, saving ephemeris. It goes into hot start, repositioning quickly. |
| Deep Sleep Mode | VCC enabled, control ON_OFF timing by software, the module goes into deep sleep mode, and then VCC disabled, V_BACK keeps enabled. |
| Power off Mode | Disable VCC and V_BACK, goes into power off mode, clear ephemeris, you need to recapture the satellite signals after power on. |

2.8 Control Signal

2.8.1 ON_OFF

ON_OFF pin is used for controlling deep sleep of the module; this function is not supported so far.

2.8.2 RESET

RST is the reset pin of the module.

After the module is powered on, RST pin is high level, input a 200ms low pulse to Reset pin, the module will reset, as shown in the following figure:



Figure 2-5 Reset Timing

Pulse timing requirements:

| Parameter | Minimum Value | Typical Value | Maximum Value | Unit |
|-------------------|---------------|---------------|---------------|------|
| RESET pulse width | 200 | 300 | 1000 | ms |

After reset, packet data stops, after module restarts and positions, packet data restores.

2.8.3 1PPS

TIMEPULSE is the output pin for 1PPS signal.

The module goes into navigation mode; the following figure shows the waveform outputs by 1PPS.

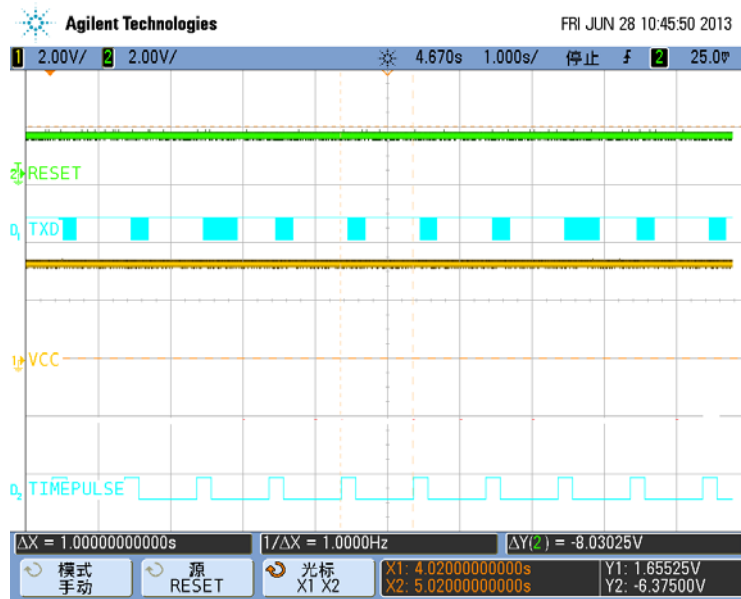


Figure 2-6 1PPS Waveform

3 Hardware Description

3.1 Pin Definition



Figure 3-1 Pin Definition

| No. | Module | Name | I/O | Description |
|-----|-----------|-----------|-----|---|
| 1 | ALL | RESERVE | | No Connect |
| 2 | GTS-4E-70 | SS_N | I | SPI Slave Select |
| | GTS-4E-50 | RESERVE | | No Connect |
| 3 | GTS-4E-70 | TIMEPULSE | O | 1PPS: one pulse per second after navigated. |
| | GTS-4E-60 | RESERVE | | No Connect |
| | GTS-4E-50 | RESERVE | | No Connect |
| 4 | GTS-4E-70 | ON_OFF | I | Power mode control pin, not supported so far, no connect. |
| | GTS-4E-60 | RESERVE | | No Connect |
| | GTS-4E-50 | RESERVE | | No Connect |
| 5 | ALL | RESERVE | | No Connect |

| | | | | |
|----|------------------------|-------------|---|--|
| 6 | ALL | RESERVE | | No Connect |
| 7 | ALL | RESERVE | | No Connect |
| 8 | ALL | RESERVE | | No Connect |
| 9 | ALL | VCC_RF | O | Output Voltage ,RF Section |
| 10 | ALL | GND | | Ground |
| 11 | ALL | RF_IN | I | GPS Signal Input |
| 12 | ALL | GND | | Ground |
| 13 | ALL | GND | | Ground |
| 14 | GTS-4E-70 GTS-4E-50 | SPI_MOSI | I | SPI MOSI |
| | GTS-4E-60 | RESERVE | | No Connect |
| 15 | GTS-4E-70 GTS-4E-50 | SPI_MISO | I | SPI MISO |
| | GTS-4E-60 | RESERVE | | No Connect |
| 16 | GTS-4E-70 GTS-4E-50 | SPI_CLK | I | SPI Clock |
| | GTS-4E-60 | RESERVE | | No Connect |
| 17 | GTS-4E-70 GTS-4E-60 | RST | I | RESET, pull-up internally ,low level activated |
| | GTS-4E-50 | RESERVE | | No Connect |
| 18 | GTS-4E-70 GTS-4E-50 | RESERVE | I | No Connect |
| | GTS-4E-60 | BAUD_RATE_0 | | Baud rate configuration |
| 19 | GTS-4E-70 GTS-4E-50 | RESERVE | I | No Connect |
| | GTS-4E-60 | BAUD_RATE_1 | | Baud rate configuration |
| 20 | GTS-4E-70 GTS-4E-50 | RESERVE | | No Connect |
| | GTS-4E-60 | TXD | O | Serial Port |
| 21 | GTS-4E-70 GTS-4E-50 | RESERVE | | No Connect |
| | GTS-4E-60 | RXD | I | UART data input |
| 22 | ALL | V_BACK | I | Backup Supply Voltage |
| 23 | ALL | VCC | I | Supply Voltage |
| 24 | ALL | GND | | Ground |

3.2 Baud Rate

The default baud rate of UART interface is 9600bps.

You can configure different baud rate by BAUD_RATE_0 and BAUD_RATE_1, the following table shows the control logic:

| BAUD_RATE_0 | BAUD_RATE_1 | Protocol | Baud Rate |
|-------------|-------------|----------|-----------|
| Pull high | Pull high | NMEA | 4800 |
| Pull high | Pull low | NMEA | 9600 |
| Pull low | Pull high | NMEA | 38400 |
| Pull low | Pull low | OSP | 115200 |

Note: The module has the corresponding pull-up and pull-down internally by default (pull-up by high level 1.8V, the resistor is 10KΩ). If you want to change, the external must be strong pull-up and pull-down; the recommended resistor is 1KΩ.

3.3 Recommended PCB Layout and Stencil Design

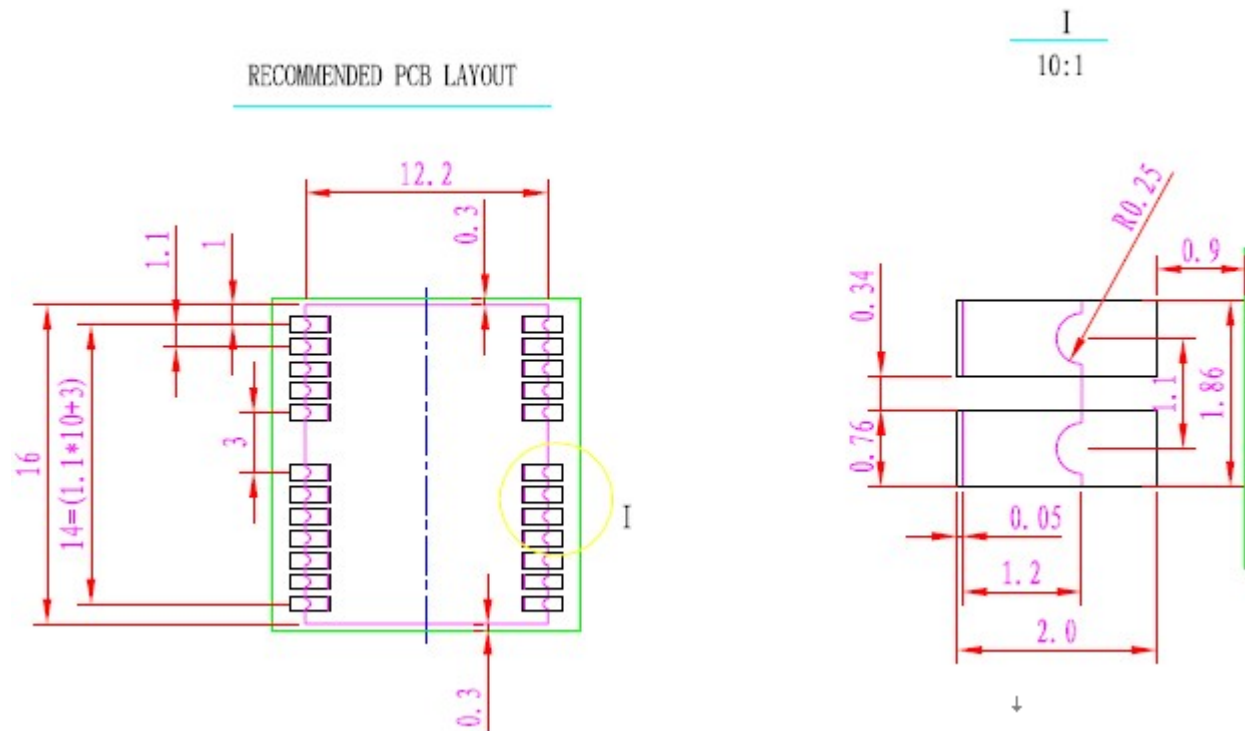


Figure 3-2 Recommended PCB Layout

Note: Do not place any component in the green area.

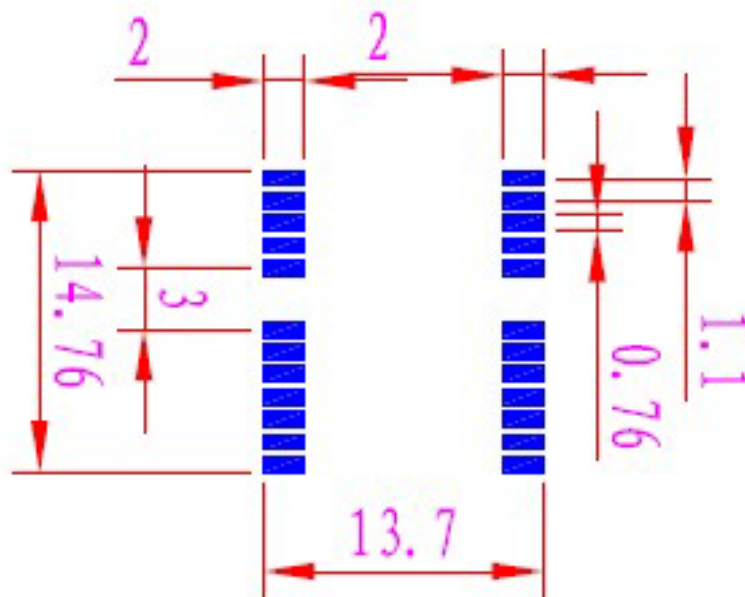


Figure 3-3 Recommended Stencil Design

Note:

- The thickness of the stencil: 0.18mm
- The stencil hole should be beyond 0.8mm of PCB pad. This design has been verified. Solder paste will be dragged back to the pad after soldering.

3.4 Mechanical Specifications

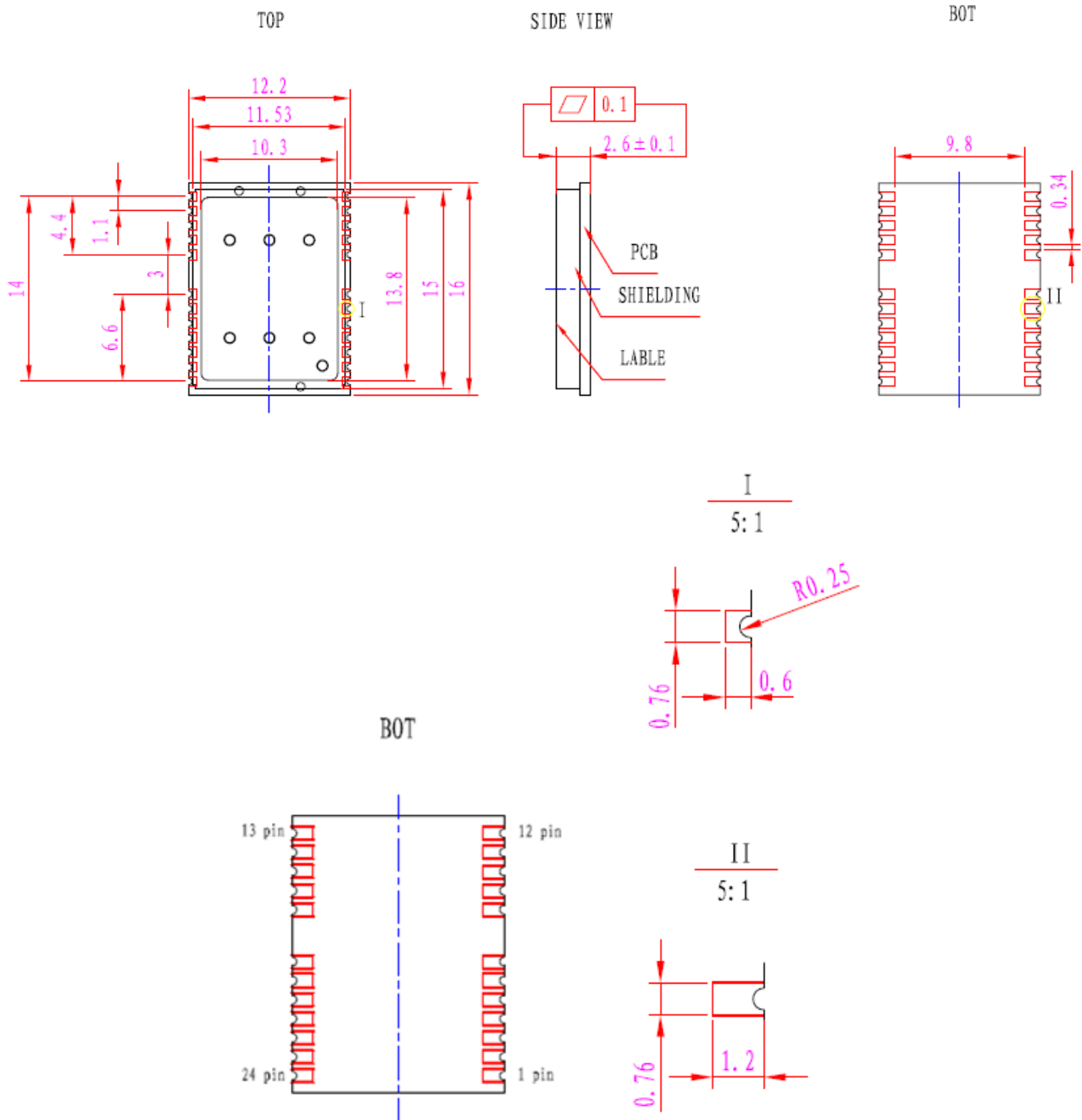


Figure 3-3 Mechanical Specifications

4 Electrical Features

4.1 Absolute Maximum Ratings

| Parameter | Minimum Value | Maximum Value | Units |
|---------------------------------|---------------|---------------|-------|
| Power Supply Voltage (VCC) | -0.1 | 5.5 | V |
| Backup Battery Voltage (V_BACK) | -0.1 | 5.5 | V |
| Operating Temperature | -40 | 85 | °C |
| Storage Temperature | -40 | 85 | °C |

4.2 Pin Level

| Pin Name | Parameter | Minimum Value | Maximum Value |
|-------------|-----------|---------------|---------------|
| TXD | High | 2.7V | VCC |
| | Low | -0.3V | 0.3V |
| RXD | High | 1.71V | 3.6V |
| | Low | -0.3V | 0.3V |
| SPI_MISO | High | 2.7V | VCC |
| | Low | -0.3V | 0.3V |
| SPI_MOSI | High | 1.71V | 3.6V |
| | Low | -0.3V | 0.3V |
| SS_N | High | 1.71V | 3.6V |
| | Low | -0.3V | 0.3V |
| SPI_CLK | High | 1.71V | 3.6V |
| | Low | -0.3V | 0.3V |
| ON_OFF | High | 1.71V | 1.89V |
| | Low | -0.3V | 0.3V |
| RST | High | 1.71V | 1.89V |
| | Low | -0.3V | 0.3V |
| BUAD_RATE_0 | High | 1.71V | 3.6V |
| | Low | -0.3V | 0.3V |
| BUAD_RATE_1 | High | 1.71V | 3.6V |
| | Low | -0.3V | 0.3V |

5 Antenna

GTS-4E modules are compatible with passive antennas and active antennas.

| Parameter | Specification |
|--------------------------------|---|
| Impedance | 50 ohm |
| Frequency Point | 1575.42MHz |
| Bandwidth | 2.046MHz |
| Antenna Type | Passive antenna or active antenna |
| Antenna Power Supply | Using VCC_RF or external voltage, VCC_RF connects to VCC inside the module. |
| Active Antenna Recommendations | Minimum Gain: 15dB |
| | Maximum Noise Figure: 1.5 dB |
| | Maximum Gain: 28dB |

5.1 Active Antenna

5.1.1 Supplied by External Power

RF_IN power is supplied by External Power; the following figure shows the reference design:

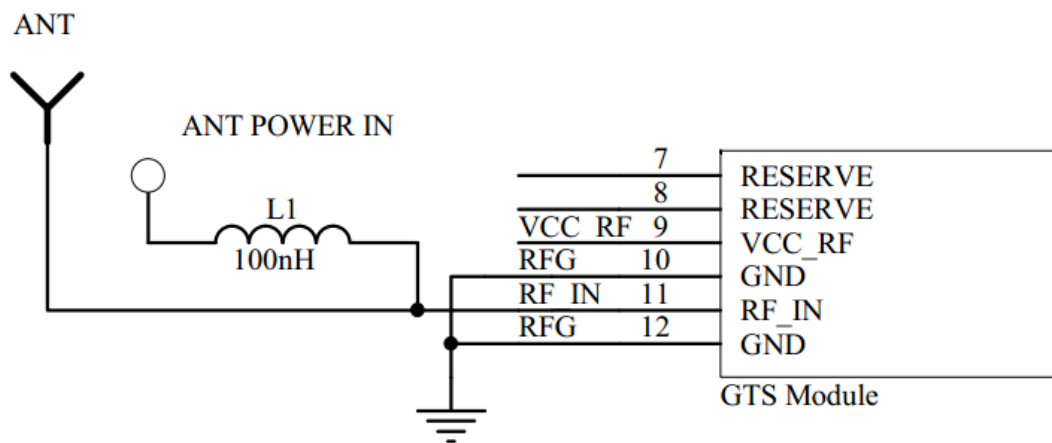


Figure 5-1 Supplied by External Power

5.1.2 Supplied by Internal Power

RF_IN power is supplied by VCC_RF of GPS module, VCC_RF is connected to VCC internally, and the following figure shows the reference design:

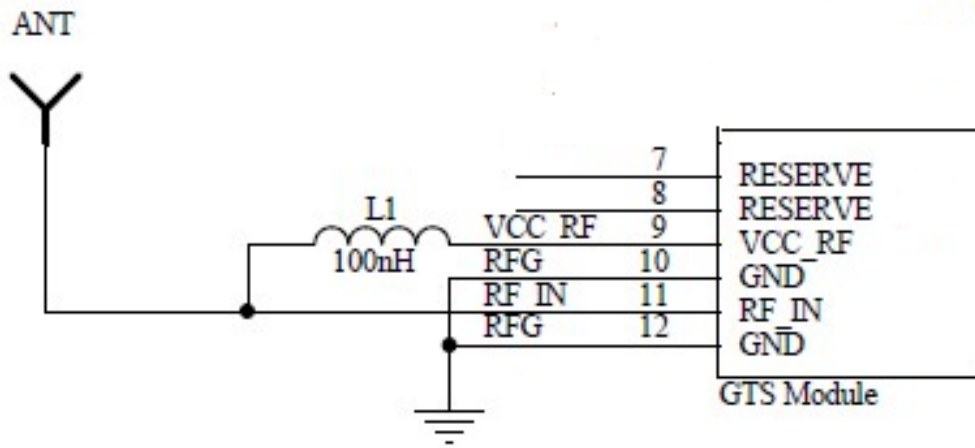


Figure 5-2 VCC_RF supplies the power

Note: If the power is supplied by internal power, the supply voltage of the active antenna must be matched with the VCC. For example, if the supply voltage of the active antenna is 5V, then VCC cannot be 3.3V.

5.2 Passive Antenna

The following figure shows the connection of passive antenna:

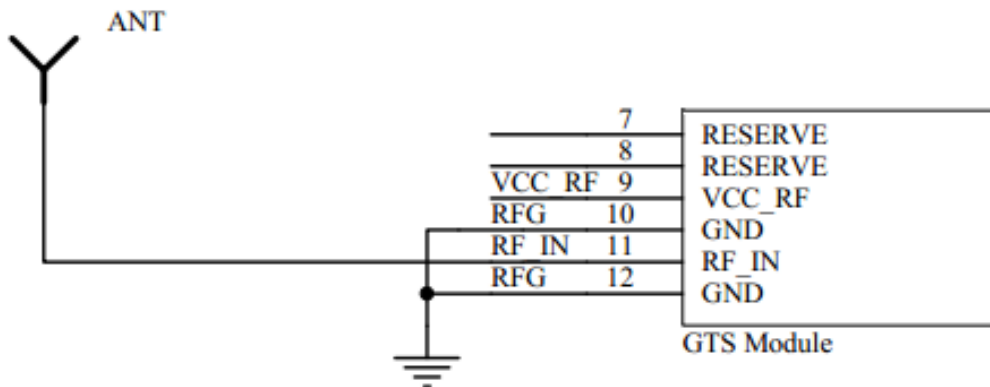


Figure 5-3 Passive Antenna Connection

5.3 ESD Precautions for Antennas

As for GPS receiver, antenna is a particularly sensitive area. To increase resistance to external transient voltage spikes, you can use ESD protection circuits. Like a low capacitance ESD protection diode can achieve ESD protection IEC-61000-2-4 Level 1 (The load capacitance must be less than 0.5pF, e.g. Infineon ESD0P2RF).

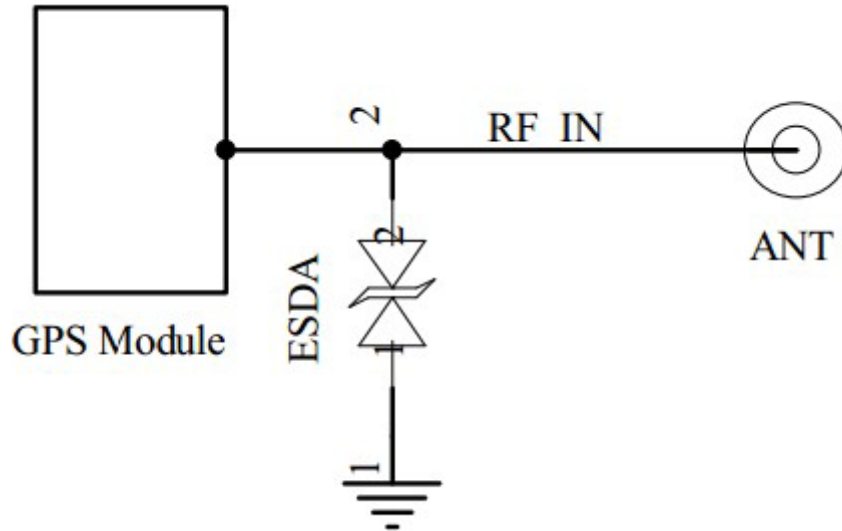


Figure 5-4 ESD Recommended Design