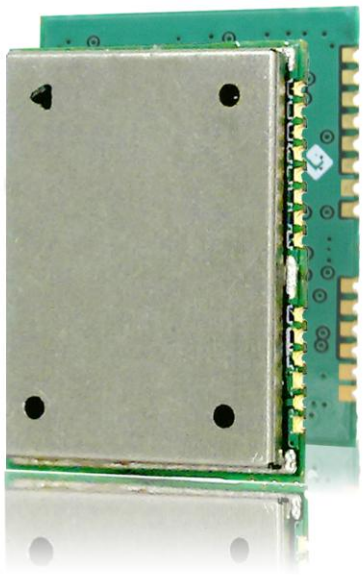
# L10-C

## Quectel GPS Engine



# Hardware Design

**L10-C_HD_V1.1**

| | |
|---|---|
| **Document Title** | L10-C Hardware Design |
| **Revision** | 1.1 |
| **Date** | 2011-06-27 |
| **Status** | Release |
| **Document Control ID** | L10-C_HD_V1.1 |

## General Notes

Quectel offers this information as a service to its customers, to support application and engineering efforts that use the products designed by Quectel. The information provided is based upon requirements specifically provided for customers of Quectel. Quectel has not undertaken any independent search for additional information, relevant to any information that may be in the customer's possession. Furthermore, system validation of this product designed by Quectel 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

# Table Index

# Figure Index

# 0. Revision history

| Revision | Date | Author | Description of change |
|---|---|---|---|
| 1.0 | 2011-06-02 | Layne YE | Initial |
| 1.1 | 2011-06-27 | Layne YE | 1) Deleted the note of module current consumption in different mode in chapter 5.4<br>2) Added the note of the module current consumption in standby mode when the active antenna use VCC_RF as power supply in Figure13 |

# 1. Introduction

This document defines and specifies L10-C GPS module. It describes L10-C hardware interface and its external application reference circuits, mechanical size and air interface.

This document can help you quickly understand module interface specifications, electrical and mechanical details. With the help of this document and other application notes, you can use L10-C module to design and set up your applications quickly.

## 1.1 Related documents

**Table 1: Related documents**

| SN | Document name | Remark |
|---|---|---|
| [1] | L10-C_HD_AN | L10-C Hardware Design Application Notes |
| [2] | L10_EVB_UGD* | L10 EVB User Guide |
| [3] | L10-C_GPS_Protocol | L10-C GPS Protocol Specification |

**** L10-C module uses the same EVB as L10 module. For the use of L10-C EVB, please refer to the L10_EVB_UGD document.***

## 1.2 Terms and abbreviations

**Table 2: Terms and abbreviations**

| Abbreviation | Description |
|---|---|
| BEE | Broadcast Ephemeris Extension |
| EMC | Electromagnetic Compatibility |
| ESD | Electrostatic Discharge |
| EPO | Extended Prediction Orbit |
| EGNOS, | European Geostationary Navigation Overlay Service |
| GPS | Global Positioning System |
| GNSS | Global Navigation Satellite System |
| GGA | GPS Fix Data |
| GLL | Geographic Position – Latitude/Longitude |
| GSA | GNSS DOP and Active Satellites |
| GSV | GNSS Satellites in View |
| HDOP | Horizontal Dilution of Precision |
| IC | Integrated Circuit |

| | |
|---|---|
| I/O | Input/Output |
| Kbps | Kilo Bits Per Second |
| LNA | Low Noise Amplifier |
| MSAS | Multi-Functional Satellite Augmentation System |
| NMEA | National Marine Electronics Association |
| OMA | Open Mobile Alliance |
| PDOP | Position Dilution of Precision |
| PMTK | MTK Private Protocol |
| RMC | Recommended Minimum Specific GNSS Data |
| RTCM | Radio Technical Commission for Maritime Services |
| SBAS | Satellite-based Augmentation System |
| SUPL | Secure User Plane Location |
| SAW | Surface Acoustic Wave |
| USB | Universal Serial Bus |
| UART | Universal Asynchronous Receiver & Transmitter |
| VDOP | Vertical Dilution of Precision |
| VTG | Course over Ground and Ground Speed, Horizontal Course and Horizontal Velocity |
| WAAS | Wide Area Augmentation System |
| ZDA | Time & Date |
| Inorm | Normal Current |
| Imax | Maximum Load Current |
| Vmax | Maximum Voltage Value |
| Vnorm | Normal Voltage Value |
| Vmin | Minimum Voltage Value |
| VIHmax | Maximum Input High Level Voltage Value |
| VIHmin | Minimum Input High Level Voltage Value |
| VILmax | Maximum Input Low Level Voltage Value |
| VILmin | Minimum Input Low Level Voltage Value |
| VImax | Absolute Maximum Input Voltage Value |
| VImin | Absolute Minimum Input Voltage Value |
| VOHmax | Maximum Output High Level Voltage Value |
| VOHmin | Minimum Output High Level Voltage Value |
| VOLmax | Maximum Output Low Level Voltage Value |
| VOLmin | Minimum Output Low Level Voltage Value |

# 2. Product concept

L10-C GPS module brings the high performance of the MTK positioning engine conforming to the industrial standard. The module supports 210 PRN channels. With 66 search channels and 22 simultaneous tracking channels, it acquires and tracks satellites in the shortest time even at very low signal level. This versatile, stand-alone receiver combines an extensive array of features with flexible connectivity options. The embedded FLASH memory provides capacity for storing user-specific configuration settings and allows for future updates. L10-C advanced jamming suppression mechanism and innovative RF architecture provide a high level of immunity for jamming, ensuring maximum GPS performance. The module supports location, navigation and industrial applications including autonomous GPS C/A, SBAS (including WAAS, EGNOS, and MSAS) and AGPS.

L10-C module is an SMD type module with the compact 22.4mm x 17.0mm x 3.0 mm form factor, which can be embedded in users' applications through 28-pin pads. It provides all hardware interfaces between the module and customer's board.

- The UART port can help to develop customer's application easily.
- The USB port is available for faster data transmission and more flexible.
- The antenna interface supports passive and active antenna.

The module is fully RoHS compliant to EU regulation.

## 2.1 Key features

**Table 3: Module key features**

| Feature | Implementation |
|---|---|
| Power supply | Single supply voltage: 3.0V – 4.3V typical : 3.3V |
| Power consumption (passive antenna) | ● Acquisition 43mA<br>● Tracking 35mA<br>● Standby 2mA |
| Receiver Type | ● GPS L1 1575.42MHz C/A Code<br>● 66 search channels, 22 simultaneous tracking channels |
| Sensitivity (passive antenna) | ● Cold Start (Autonomous) -145 dBm<br>● Reacquisition -157 dBm<br>● Tracking -162 dBm |
| Time-To-First-Fix | ● Cold Start (Autonomous) 35s average<br>● Warm Start (Autonomous) 35s average<br>● Hot Start (Autonomous) <1.2 s<br>● SUPL 5 ~10s |
| Position Accuracy | ● 1.25 m CEP |
| Max Update Rate | ● 5Hz |
| Accuracy of 1PPS Signal | ● Typical accuracy 61 ns |

| Feature | Implementation |
|---|---|
| | ● Time pulse adjustable from 1ms to 999ms, default 100ms |
| Velocity Accuracy | ● 0.1 m/s |
| Acceleration Accuracy | ● 0.1 m/s ² |
| Dynamic Performance | ● Maximum Altitude 18,000 m<br>● Maximum Velocity 515 m/s<br>● Acceleration 4 G |
| UART Port | UART Port:<br>● Two lines TXD1 and RXD1<br>● UART Port supports baud rate from 4800bps to 115200bps.<br>● UART Port is used for NMEA output or input , PMTK private messages input and firmware upgrade |
| USB Port | ● Support USB 2.0 full-speed compatible<br>● USB Port is used for NMEA outputting or inputting , PMTK private messages inputting and firmware upgrade |
| Temperature range | ● Normal operation: -40 ℃ ~ +85 ℃<br>● Storage temperature: -45 ℃ ~ +125 ℃ |
| Physical Characteristics | Size:<br>22.4±0.15 x 17±0.15 x 3.0±0.1mm<br>Weight: about 2.2g |
| Firmware Upgrade | Firmware upgrade over UART port or USB port |

## 2.2 Functional diagram

The following figure shows a block diagram of L10-C module.

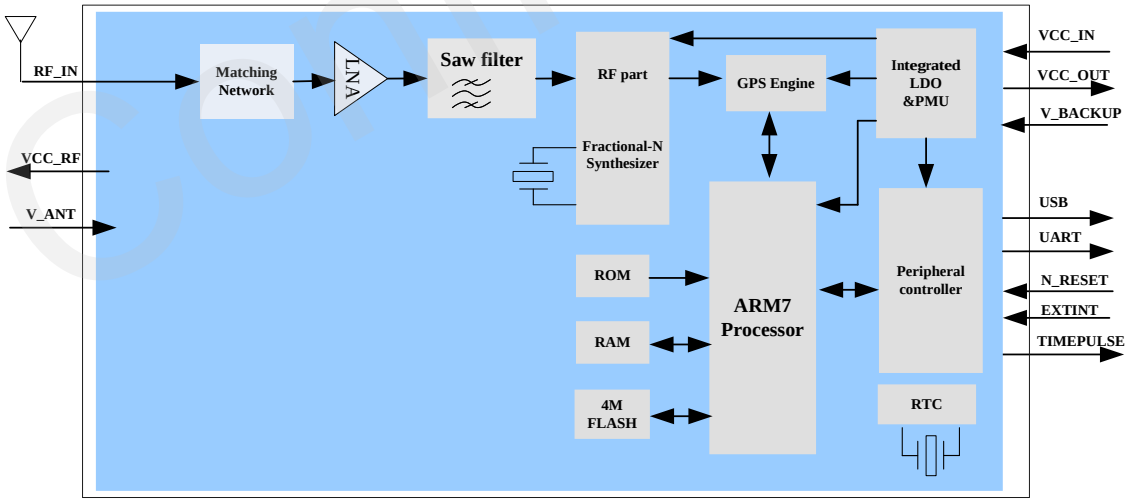



**Figure 1: Module functional diagram**

## 2.3 Evaluation board

In order to help customer to develop applications with L10-C, Quectel supplies an Evaluation Board (EVB) with appropriate power supply, RS-232 serial cable, USB cable, antenna and the module. For more details, please refer to the *document [2]*.

## 2.4 Assisted GPS

Supplying aided information, like ephemeris, almanac, rough last position, time, and satellite status, can improve the acquisition sensitivity. L10-C module supports OMA SUPL compliant, but for lack of some testing condition, it is still not be verified by Quectel.

## 2.5 Protocol

The module supports standard NMEA-0183 protocol and MTK private protocol (PMTK messages) that can be used to provide extended capabilities for many applications. The module is capable of supporting the following NMEA formats: ***GGA, GSA, GLL, GSV, RMC, ZDA, and VTG.***

**Table 4: The module supports protocol**

| Protocol | Type |
|---|---|
| NMEA | Input/output, ASCII, 0183, 3.01 |
| PMTK | Input/output, MTK private protocol |

***Note: Please refer to document [3] about NMEA standard protocol and MTK private protocol.***

# 3. Application interface

The module is equipped with 28-pin 1.1mm pitch SMT pads that connect to user's application platform. Sub-interfaces included in these pads are described in details in the following chapters:

- Power supply *(refer to Chapter 3.3)*
- UART interfaces *(refer to Chapter 3.7)*
- USB interfaces *(refer to Chapter 3.8)*

Electrical and mechanical characteristics of the SMT pad are specified in *Chapter 5&Chapter 6.*

## 3.1 Pin description

**Table 5: Pin description**

| **Power Supply** | | | | |
|---|---|---|---|---|
| PIN NAME | I/O | DESCRIPTION | DC CHARACTERISTICS | COMMENT |
| VCC | I | Supply voltage | Vmax= 4.3V<br>Vmin=3.0V<br>Vnorm=3.3V | Supply current for no less than 150mA. |
| V_BCKP | I | Backup voltage supply | Vmax=4.3V<br>Vmin=2.0V<br>Vnorm=3.3V<br>Iin=4uA | Power supply for RTC when VCC is not applied for the system. |
| VCC_OUT | O | Output voltage | Vmax= 4.3V<br>Vmin=3.0V<br>Vnorm=3.3V<br>Imax=20mA | If not used, keep this pin open. This pin is internally connected to VCC. |
| VCC_RF | O | Output voltage RF section | Vmax=4.3V<br>Vmin=3.0V<br>Vnorm=3.3V<br>Imax=50mA | If not used, keep this pin open. Usually supply for external active antenna. VCC_RF≈ VCC-0.1V |
| V_ANT | I | Antenna bias voltage | Vmax=5.5V<br>Vmin=2.8V | If not used, keep this pin open. Using VCC_RF or external voltage source. |

| **Reset** | | | | |
|---|---|---|---|---|
| PIN NAME | I/O | DESCRIPTION | DC CHARACTERISTICS | COMMENT |
| RESET_N | I | System reset, low level active. | VILmin=-0.3V<br>VILmax=0.5V<br>VIHmin=2.1V<br>VIHmax=2.8V | If not used, keep this pin open. Internally pulled up |
| **General purpose input/output** | | | | |
| PIN NAME | I/O | DESCRIPTION | DC CHARACTERISTICS | COMMENT |
| EXTINT0 | I | External interrupt input | VILmin=-0.3V<br>VILmax=0.8V<br>VIHmin=2.0V<br>VIHmax= 3.6V<br>VOLmin=-0.3V<br>VOLmax=0.4V<br>VOHmin=2.4V<br>VOHmax=2.9 V | If not used, keep this pin open. Internally pulled up. |
| TIMEPULSE | O | Time pulse | VOLmin=-0.3V<br>VOLmax=0.4V<br>VOHmin=2.4V<br>VOHmax=2.9V | 1 pulse per second (1PPS.) Synchronized at rising edge, 100ms pulse width. If not used, keep this pin open. |
| **UART port** | | | | |
| PIN NAME | I/O | DESCRIPTION | DC CHARACTERISTICS | COMMENT |
| RXD1 | I | Receive data | VILmin=-0.3V<br>VILmax=0.8V<br>VIHmin=2.0V<br>VIHmax= 3.6V<br>VOLmin=-0.3V<br>VOLmax=0.4V<br>VOHmin=2.4V<br>VOHmax=2.9V | Be used to output NMEA and input PMTK private messages |
| TXD1 | O | Transmit data | | |
| **USB Port** | | | | |
| PIN NAME | I/O | DESCRIPTION | DC CHARACTERISTICS | COMMENT |
| VDDUSB | I | Voltage supply for USB port | Vmax=3.6V<br>Vmin=3.0V<br>Vnorm=3.3V | If not used , connect to GND. |
| USB_DM | I/O | USB data negative | Compliant with USB2.0 specification | If not used, keep this pin open. Compatible with USB with 27 Ohms series resistance. |
| USB_DP | | USB data positive | | |

| RF interface | | | | |
|---|---|---|---|---|
| PIN NAME | I/O | DESCRIPTION | DC CHARACTERISTICS | COMMENT |
| RF_IN | I/O | GPS signal input | Impedance of 50Ω | *Refer to chapter 4* |

## 3.2 Operating modes

The table below briefly summarizes the various operating modes referred to in the following chapters.

**Table 6: Overview of operating modes**

| Mode | Function |
|---|---|
| Acquisition mode | The module starts to search satellite, determine visible satellites and coarse carrier frequency and code phase of satellite signals. When the acquisition is performed, it switches to tracking mode automatically. |
| Tracking mode | The module refines acquisition's message, as well as keeps tracking and demodulating the navigation data from the specific satellites. |
| Standby mode | EXTINT0 pin can be used to make the module enter into standby mode. In this case, the UART port and USB port are not accessible, and the current consumption of the module is also minimal. The module could be woken up by EXTINT0 pin. |

## 3.3 Power supply

The main power supply is fed through the VCC pin. It is important that the system power supply circuitry is able to support the peak power. So the power supply must be able to provide sufficient current up to 150mA.

The circuit design of the power supply strongly depends on the power source where this power is drained. An LDO (Low Dropout Regulator) device, such as Torex (http://www.torex.co.jp/English) XC6219B332MR is recommended. For more details of this power supply application, please refer to *document [1]*.

## 3.4 Turn on and turn off

### 3.4.1 Turn on

The module can be turned on by two ways which are described in the following chapters:

- Power on reset *(please refer to chapter 3.4.1.1)*;
- Via RESET_N pin: restarts module *(please refer to chapter 3.4.1.2)*

#### 3.4.1.1 Power on

A built-in reset controller automatically turns on the module when VCC is supplied.

#### 3.4.1.2 Restart module using the RESET_N pin

L10-C module can be restarted by driving the RESET_N to low level voltage for a certain time and then releasing it. An open drain driver circuit is suggested in application to control the RESET_N. A simple reference circuit is illustrated in Figure 2.

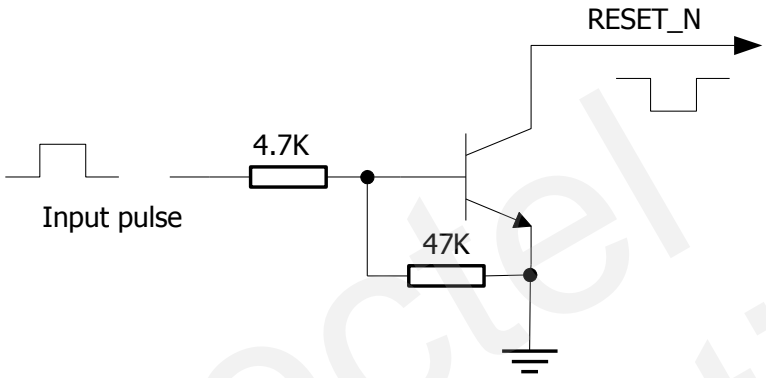



**Figure 2: Reference reset circuit using OC circuit**

The other way to control the RESET_N is using a button directly. A TVS component needs to be placed nearby the button for ESD protection. While pressing the key, ESD strike may be generate from finger. A reference circuit is illustrated in Figure 3.

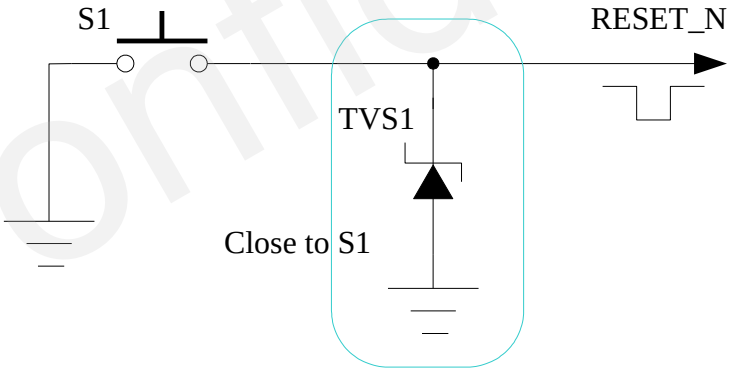



**Figure 3: Reference reset circuit using button**

The restart timing is illustrated in Figure 4.

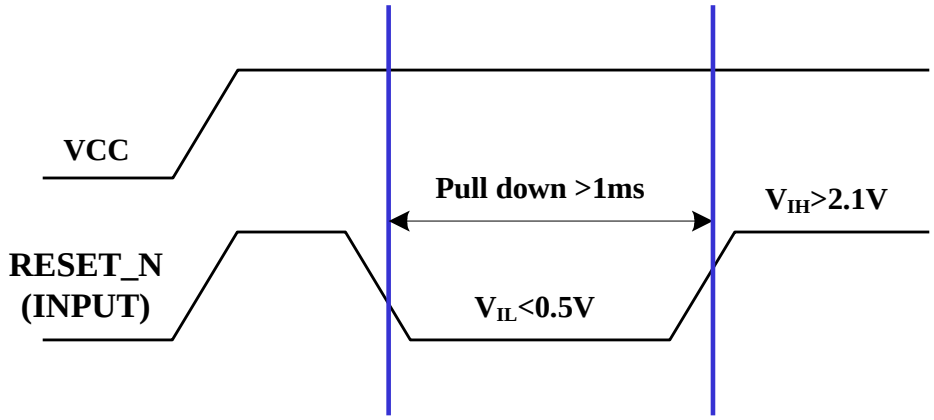



**Figure 4: Timing of restart system**

### 3.4.2 Turn off

Shutting down the module's power supply is the only way to turn off the system. For more details of this part application, please refer to *document [1]*.

## 3.5 Power saving

### 3.5.1 Enter standby mode

The EXTINT0 pin can be used to drive the module into standby mode. When the EXTINT0 pin is changed from high to low, the module will enter the standby mode. In this case, the UART port and the USB port are not accessible, and the current consumption of the module is also minimal.

***Note: When USB interface of the module is being used, the module could not enter standby mode.***

### 3.5.2 Exit from standby mode

When the EXTINT0 pin is changed from low to high, the module will exit from the standby mode.

## 3.6 RTC backup

The RTC (Real Time Clock) power supply of module can be directly provided by an external capacitor or battery (rechargeable or non-chargeable) through the V_BCKP pin. It can supply power for backed-up memory which contains all the necessary GPS information for quick start-up and a small amount of user configuration variables.

**Table 7: Pin definition of the V_BCKP pin**

| Name | Pin | Function |
|---|---|---|
| V_BCKP | 11 | Backup voltage supply |

***Note: The V_BCKP couldn't keep open. The V_BCKP pin should be connected to a battery or a capacitor for GPS module hot start and AGPS.***

Please refer to the following figure for RTC backup:

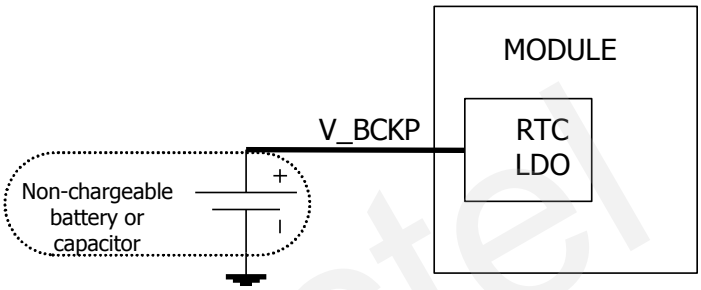



**Figure 5: RTC supply from non-chargeable battery or capacitor**

The V_BCKP pin does not implement charging for rechargeable battery. It is necessary to add a charging circuit for rechargeable battery, as shown in the following figure:

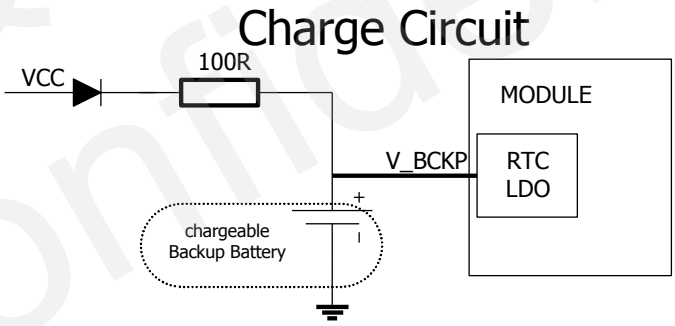



**Figure 6: Reference charging circuit for chargeable battery**

- **Coin-type Capacitor backup**

Coin-type Rechargeable Capacitor such as XH414H-IV01E from Seiko can be used.

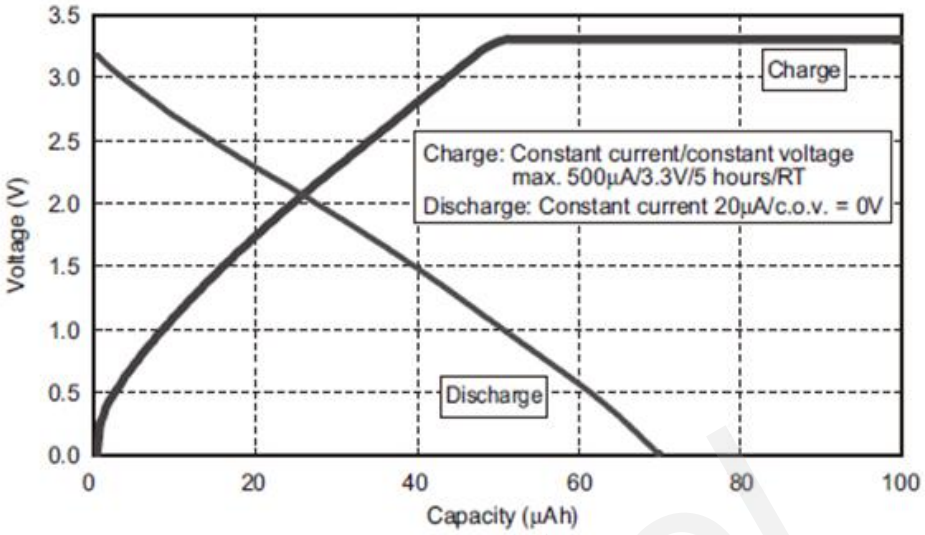



**Figure 7: Seiko XH414H-IV01E charge characteristic**

## 3.7 UART interface

UART port is used for the NMEA&PMTK input/output

**Table 8: Pin definition of the UART interfaces**

| Interface | Name | Pin | Function |
|---|---|---|---|
| UART Port | TXD1 | 3 | Transmit data |
| | RXD1 | 4 | Receive data |

UART port:

- TXD1: Send data to the RXD signal line of DTE
- RXD1: Receive data from the TXD signal line of DTE

The module is designed as a DCE (Data Communication Equipment), following the traditional DCE-DTE (Data Terminal Equipment) connection. The module and the client (DTE) are connected through the following signal (shown as Figure 8). It supports data baud-rate from 4800bps to 115200bps.

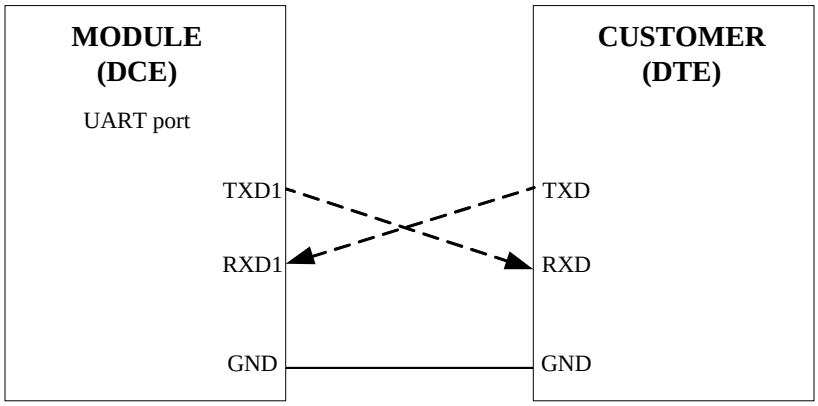



**Figure 8: Connection of UART port**

This UART port has the following features:

- UART port can be used for firmware upgrade, inputting or outputting NMEA or PMTK private messages.
  The default output NMEA type setting is **RMC, VTG, GGA, GSA, GSV, and GLL.**
- UART port supports the following data rates:
  4800, 9600, 14400, 19200, 28800, 38400, 57600, 115200
  **The default setting is 9600bps, 8 bits, no parity bit, 1 stop bit, no hardware flow control**.
- Hardware flow control and synchronous operation are not supported.

***Note: It is strongly recommended that the UART port is used to output NMEA message to serial port of host in design.***

**The default setting is 9600bps, 8 bits, no parity bit, 1 stop bit, no hardware flow control**

The UART port does not support the RS-232 level but only support the LVTTL level. If the module's UART port is connected to the UART port of computer, it is necessary to add a voltage level shift circuit between the module and the computer. Please refer to the following figure.

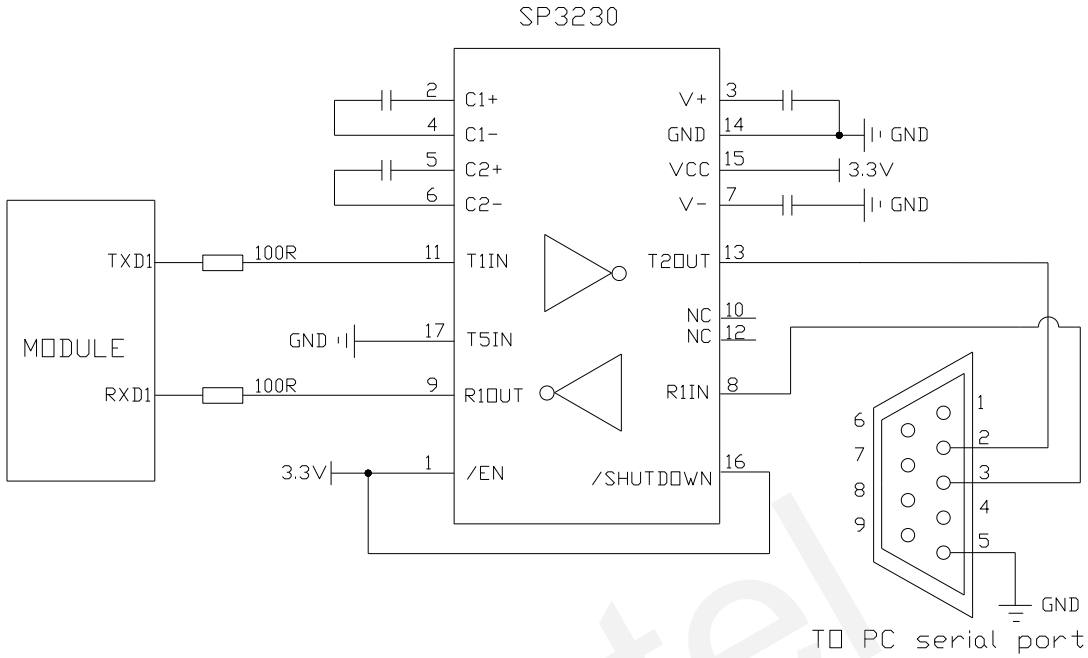



**Figure 9: RS-232 level shift circuit**

## 3.8 USB interface

The USB (Universal Serial Bus) port which is compatible with Full-Speed USB 2.0 makes the GPS receiver capable of significantly improving data transmission and receiving rate. This interface is automatically converted to COM port to HOST operating systems and its driver could operate on Windows 98, 2000, XP, and Vista operation system. Customer can update firmware through this port.

The USB port can be used for firmware update, inputting or outputting NMEA or PMTK private messages. It is the same function as serial port.

Plug-and-Play feature provides easier way for customer's data communication with most navigation software. Moreover, flexibility of applications for different USB classes is available.

**Table 9: Pin definition of USB interface**

| Interface | Name | Pin | Function |
|---|---|---|---|
| USB Port | VDDUSB | 24 | USB power supply |
| | USB_DM | 25 | USB data- |
| | USB_DP | 26 | USB data+ |

In order to comply with USB specifications, VDDUSB must be connected to an LDO as shown in Figure 10 when the USB port is used. For more details please refer to *document [1]*.

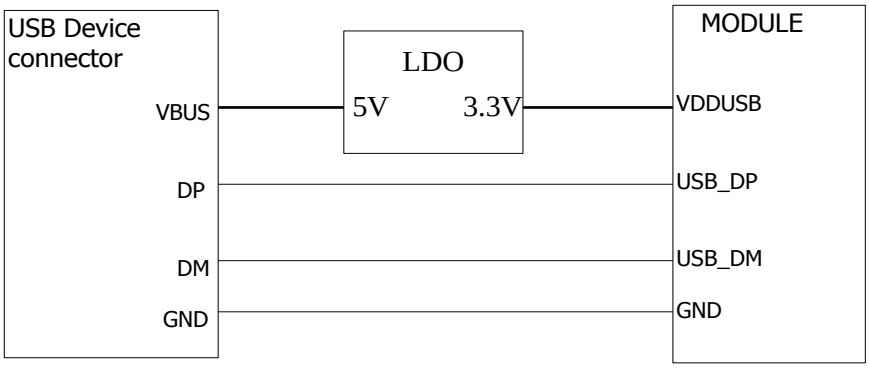



**Figure 10: USB interface circuit**

***Note: The USB interface is not recommended to output NMEA message to USB port of the host, such as ARM processor because the driver of USB may be not reliable. If don't use the USB port, please connect VDDUSB to GND.***

## 3.9 Software upgrade

The UART port and USB port can be used for firmware upgrade, and one of them should be selected.

## 3.10 EXTINT0

The EXTINT0 pin is an external interrupt input pin. It is an edge trigger interrupt and can be used to wake up the module from the standby mode. When the EXTINT0 pin is changed from high to low, the module will enter into the standby mode. When the EXTINT0 pin is changed from low to high, the module will exit from standby mode.

**Table 10: Pin definition of the EXTINT0**

| Name | Pin | Function |
|---|---|---|
| EXTINT0 | 27 | External interrupt input |

# 4. Antenna interface

L10-C module receives L1 band signal from GPS satellites at a nominal frequency of 1575.42MHz. The RF signal is connected to the RF_IN pin. Customer should use a controlled impedance transmission line of 50 Ohm to connect to RF_IN.

## 4.1 Antenna

L10-C module can be connected to passive or active antenna. The specification of passive antenna and active antenna is listed as Table 11

**Table 11: Antenna specification for L10-C module**

| Antenna type | Specification |
|---|---|
| Passive antenna | Center frequency: 1575.42 MHz<br>Band Width: >20 MHz<br>Gain: >0 dBi<br>Polarization: RHCP or Linear |
| Active antenna | Center frequency: 1575.42 MHz<br>Band Width: >5 MHz<br>Minimum gain: 15-20dBi(compensate signal loss in RF cable)<br>Maximum noise figure: 1.5dB<br>Maximum gain: 50dBi<br>Polarization: RHCP or Linear |

## 4.2 Antenna supply

### 4.2.1 Passive antenna

Passive antenna does not require a DC bias voltage and can be connected to RF_IN pin directly. V_ANT can be connected to GND. It is always beneficial to reserve a passive matching network between the antenna and the RF_IN port of the module. Figure 11 is the reference design.

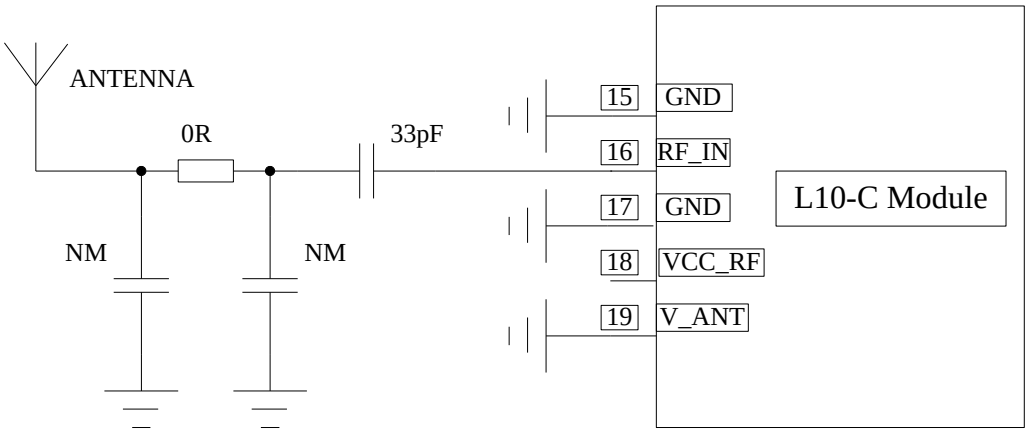



**Figure 11: Reference design for passive antenna**

### 4.2.2 Active antenna

Active antenna has an integrated low-noise amplifier which could be connected to RF_IN directly. If an active antenna is connected to RF_IN, the integrated low-noise amplifier 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. An active antenna consumes current at 5~20mA. The inductor inside the module can separate the RF signal from the V_ANT pin and route the bias supply to the active antenna. The block diagram of the supply part for active antenna is shown in Figure 12.

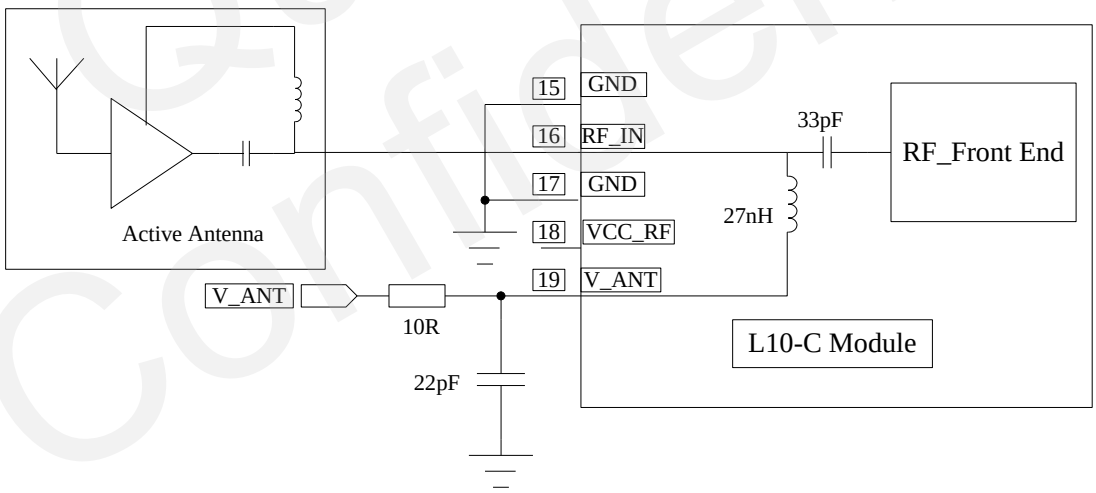



**Figure 12: Active antenna biasing**

If the VCC_RF voltage is suitable for powering the active antenna, pin VCC_RF could be directly connected to pin V_ANT. A reference circuit is shown in Figure 13.

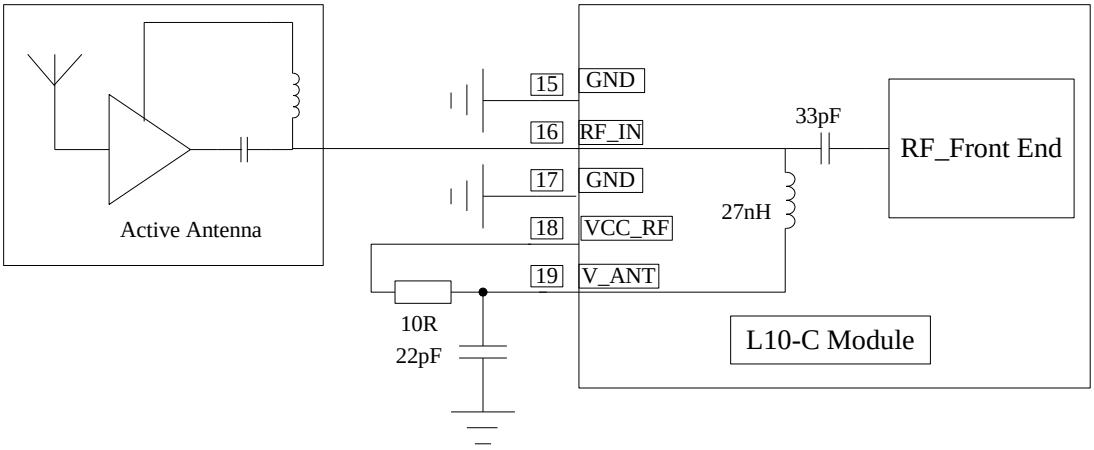



**Figure 13: Active antenna using VCC_RF as power supply**

***Note: When the active antenna uses VCC_RF as power supply and the module enter standby mode, the current consumption of the module is minimal, but the active antenna power supply can not be cut off, so the active antenna will consume current in standby mode.***

If the VCC_RF voltage does not meet the requirement for powering the active antenna, an external LDO could be used. The output of the external LDO can be connected to pin V_ANT. A reference circuit is shown in Figure 14.

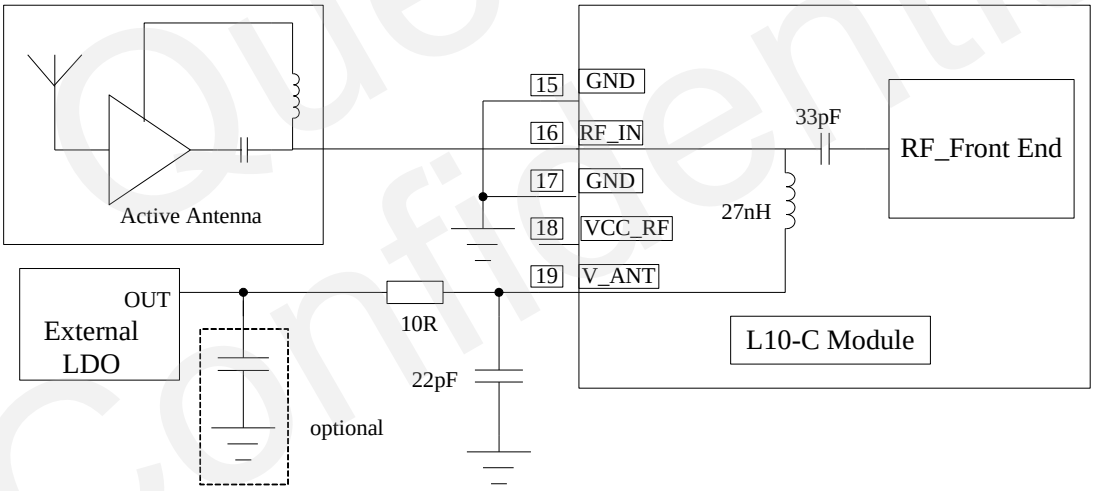



**Figure 14: Active antenna with external LDO**

# 5. Electrical, reliability and radio characteristics

## 5.1 PIN assignment of the module

**Table 12: L10-C pin assignment**

| PIN NO. | PIN NAME | I/O | | PIN NO. | PIN NAME | I/O |
|---|---|---|---|---|---|---|
| 1 | RESERVED | | | 15 | GND | |
| 2 | RESERVED | | | 16 | RF_IN | I |
| 3 | TXD1 | O | | 17 | GND | |
| 4 | RXD1 | I | | 18 | VCC_RF | O |
| 5 | RESERVED | | | 19 | V_ANT | I |
| 6 | VCC | I | | 20 | RESERVED | |
| 7 | GND | | | 21 | RESERVED | |
| 8 | VCC_OUT | O | | 22 | RESERVED | |
| 9 | RESERVED | | | 23 | RESERVED | |
| 10 | RESET_N | I | | 24 | VDDUSB | I |
| 11 | V_BCKP | I | | 25 | USB_DM | I/O |
| 12 | RESERVED | | | 26 | USB_DP | I/O |
| 13 | GND | | | 27 | EXTINT0 | I |
| 14 | GND | | | 28 | TIMEPULSE | O |

***Note: Please keep all reserved pins open.***

## 5.2 Absolute maximum ratings

Absolute maximum rating for power supply and voltage on digital pins of module are listed in Table 13.

**Table 13: Absolute maximum ratings**

| Parameter | Min | Max | Unit |
|---|---|---|---|
| Power supply voltage （VCC） | -0.3 | 4.3 | V |
| Backup battery voltage (V_BCKP) | -0.3 | 4.3 | V |
| USB supply voltage (VDDUSB) | -0.3 | 3.6 | V |
| Input voltage at digital pins | -0.5 | 3.6 | V |
| | -0.5 | 3.6 | V |
| VCC_RF output current (Ivccrf) | | 50 | mA |
| Input power at RF_IN (Prfin) | | 0 | dBm |
| Antenna bias voltage (V_ANT) | 0 | 6 | V |
| Storage temperature | -45 | 125 | ℃ |

***Note: Stressing the device beyond the "Absolute Maximum Ratings" may cause permanent damage. These are stress ratings only. The product is not protected against over voltage or reversed voltage. If necessary, voltage spikes exceeding the power supply voltage specification, given in table above, must be limited to values within the specified boundaries by using appropriate protection diodes.***

## 5.3 Operating conditions

**Table 14: The module power supply ratings**

| Parameter | Description | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| VCC | Supply voltage | Voltage must stay within the min/max values, including voltage drop, ripple, and spikes. | 3.0 | 3.3 | 4.3 | V |
| $I_{VCCP}$* | Peak supply current | VCC=3.3V | | | 150 | mA |
| V_BCKP | Backup voltage supply | | 2.0 | 3.3 | 4.3 | V |
| $I_{BCKP}$ | Backup battery current | V_BCKP=3.3V | | 4 | | uA |
| V_ANT | Antenna bias voltage | | 2.8 | | 5.5 | V |
| $V_{ANT\_DROP}$ | Antenna bias voltage drop | | | | 0.1 | V |

| Parameter | Description | Conditions | Min | Typ | Max | Unit |
|---|---|---|---|---|---|---|
| $I_{ANT}$ | V_ANT supply current | V_ANT=3.3V | | | 100 | mA |
| VDDUSB | USB supply voltage | | 3.0 | 3.3 | 3.6 | V |
| VCC_RF | Output voltage RF section | | | | VCC -0.1 | V |
| $I_{VCC\_RF}$ | VCC_RF output current | | | | 50 | mA |
| $T_{OPR}$ | Normal Operating temperature | | -40 | 25 | 85 | ℃ |

**** Use this figure to determine the maximum current capability of power supply.***
***Note: Operation beyond the "Operating Conditions" is not recommended and extended exposure beyond the "Operating Conditions" may affect device reliability.***

## 5.4 Current consumption

The values of current consumption are shown in Table 15.

**Table 15: The module current consumption (passive antenna)**

| Parameter | Condition | Min | Typ | Max | Unit |
|---|---|---|---|---|---|
| Icc Acquisition | Passive antenna@-130dBm | | 43 | | mA |
| Icc Tracking | For Cold Start, 10 minutes after First Fix. For Hot Start, 15 seconds after First Fix with passive antenna. | | 35 | | mA |
| Icc Standby | EXTINT0 pin is changed from high to low with passive antenna. | | 2 | | mA |

## 5.5 Electro-static discharge

Although the module is fully protected against ESD strike, ESD protection precautions should still be emphasized. Proper ESD handing and packaging procedures must be applied throughout the processing, handing and operation of any application.

The ESD bearing capability of the module is listed in Table 16.

**Table 16: The ESD endurance table (Temperature: 25℃, Humidity: 45 %)**

| Pin | Contact discharge | Air discharge |
|---|---|---|
| Antenna port | ±5KV | ±10KV |
| VCC,GND | ±4KV | ±8KV |
| Others | ±4KV | ±8KV |

## 5.6 Reliability test

**Table 17: Reliability test**

| Test term | Condition | Standard |
|---|---|---|
| Thermal shock | -30℃...+80℃, 144 cycles | GB/T 2423.22-2002 Test Na<br>IEC 68-2-14 Na |
| Damp heat, cyclic | +55℃; >90% Rh 6 cycles for 144 hours | IEC 68-2-30 Db Test |
| Vibration shock | 5~20Hz,0.96$m^2/s^3$;20~500Hz,0.96$m^2/s^3$-3dB/oct, 1hour/axis; no function | 2423.13-1997 Test Fdb<br>IEC 68-2-36 Fdb Test |
| Heat test | 85 °C, 2 hours, Operational | GB/T 2423.1-2001 Ab<br>IEC 68-2-1 Test |
| Cold test | -40 °C, 2 hours, Operational | GB/T 2423.1-2001 Ab<br>IEC 68-2-1 Test |
| Heat soak | 90 °C, 72 hours, Non-Operational | GB/T 2423.2-2001 Bb<br>IEC 68-2-2 Test B |
| Cold soak | -45 °C, 72 hours, Non-Operational | GB/T 2423.1-2001 A<br>IEC 68-2-1 Test |

# 6. Mechanics

This chapter describes the mechanical dimensions of the module.

## 6.1 Mechanical dimensions of the module

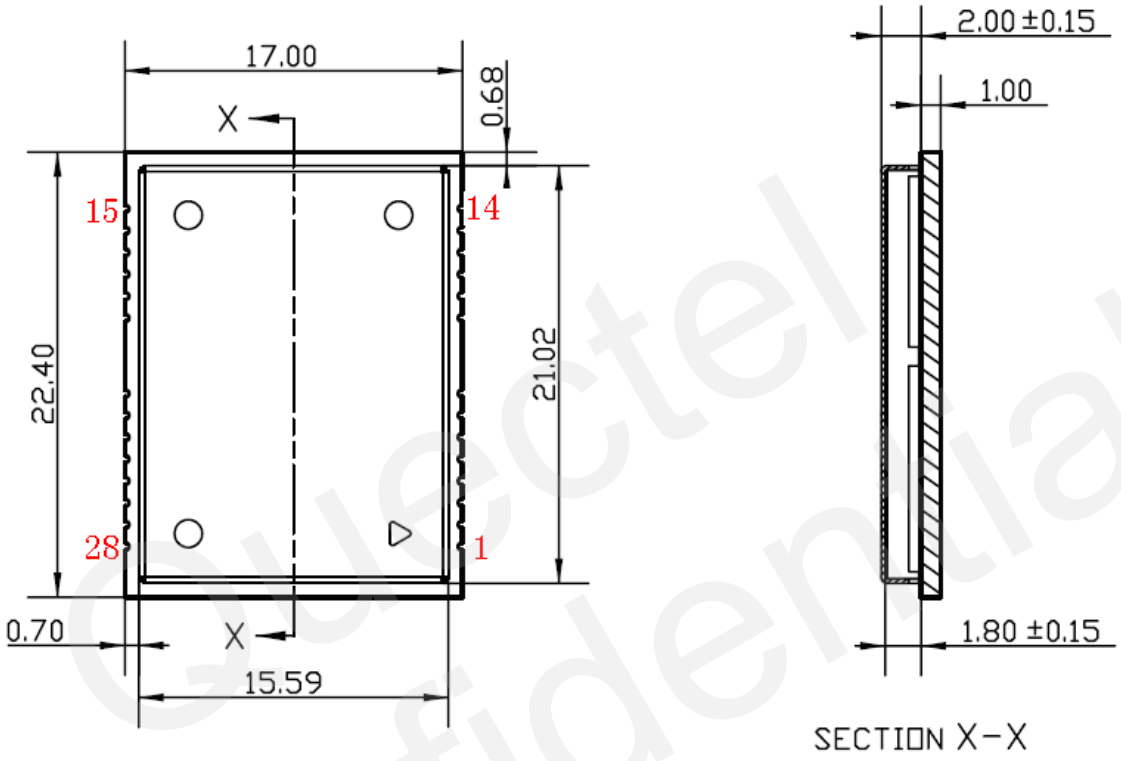



**Figure 15: L10-C Top view and Side dimensions（Unit:mm）**

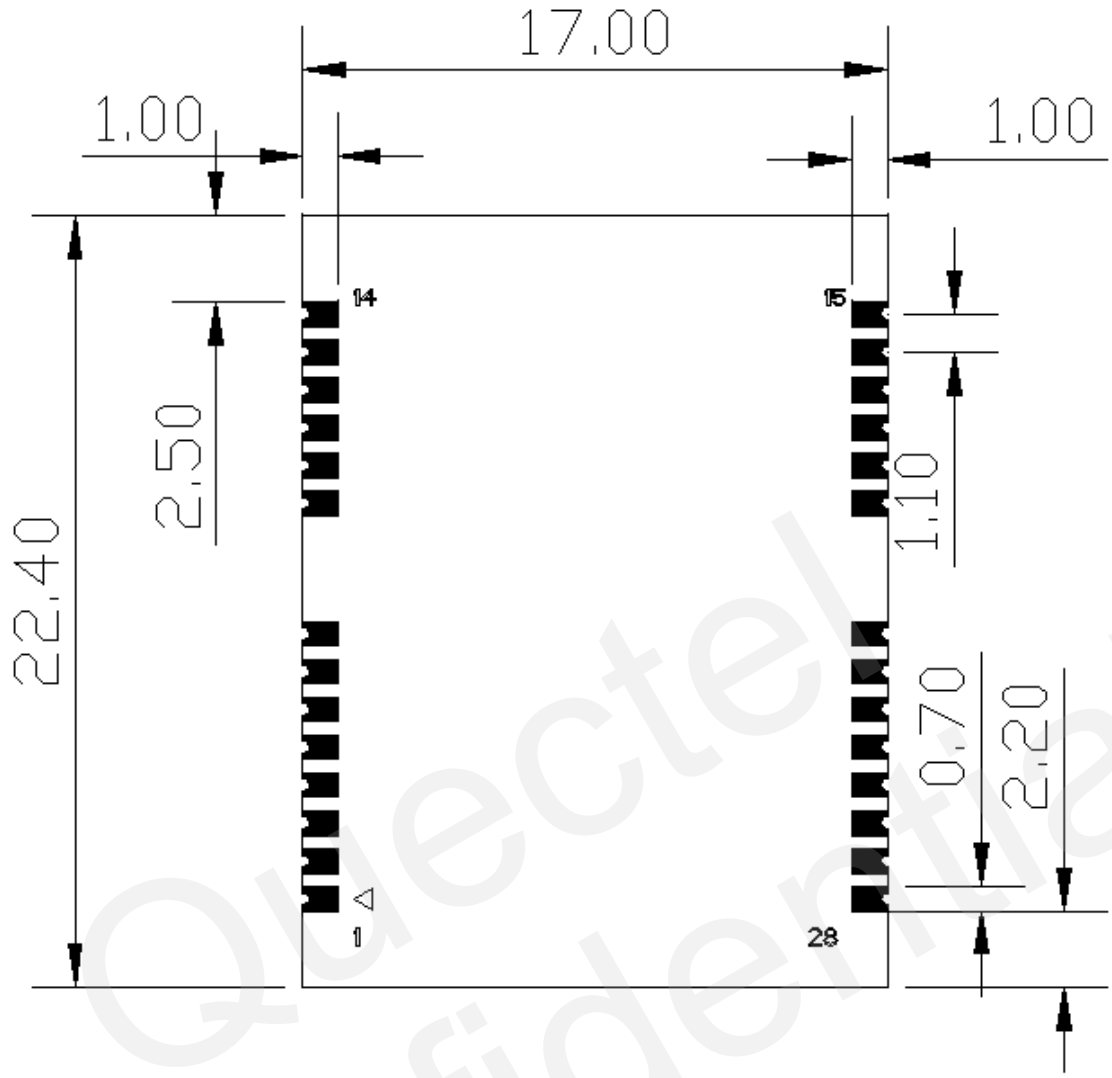



**Figure 16: L10-C Bottom dimensions（Unit:mm）**

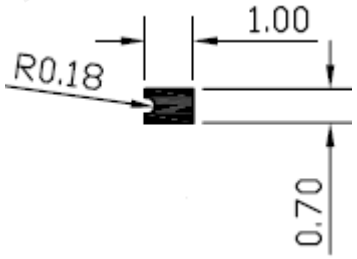



**Figure 17: PAD Bottom dimensions（Unit:mm）**

## 6.2 Footprint of recommendation

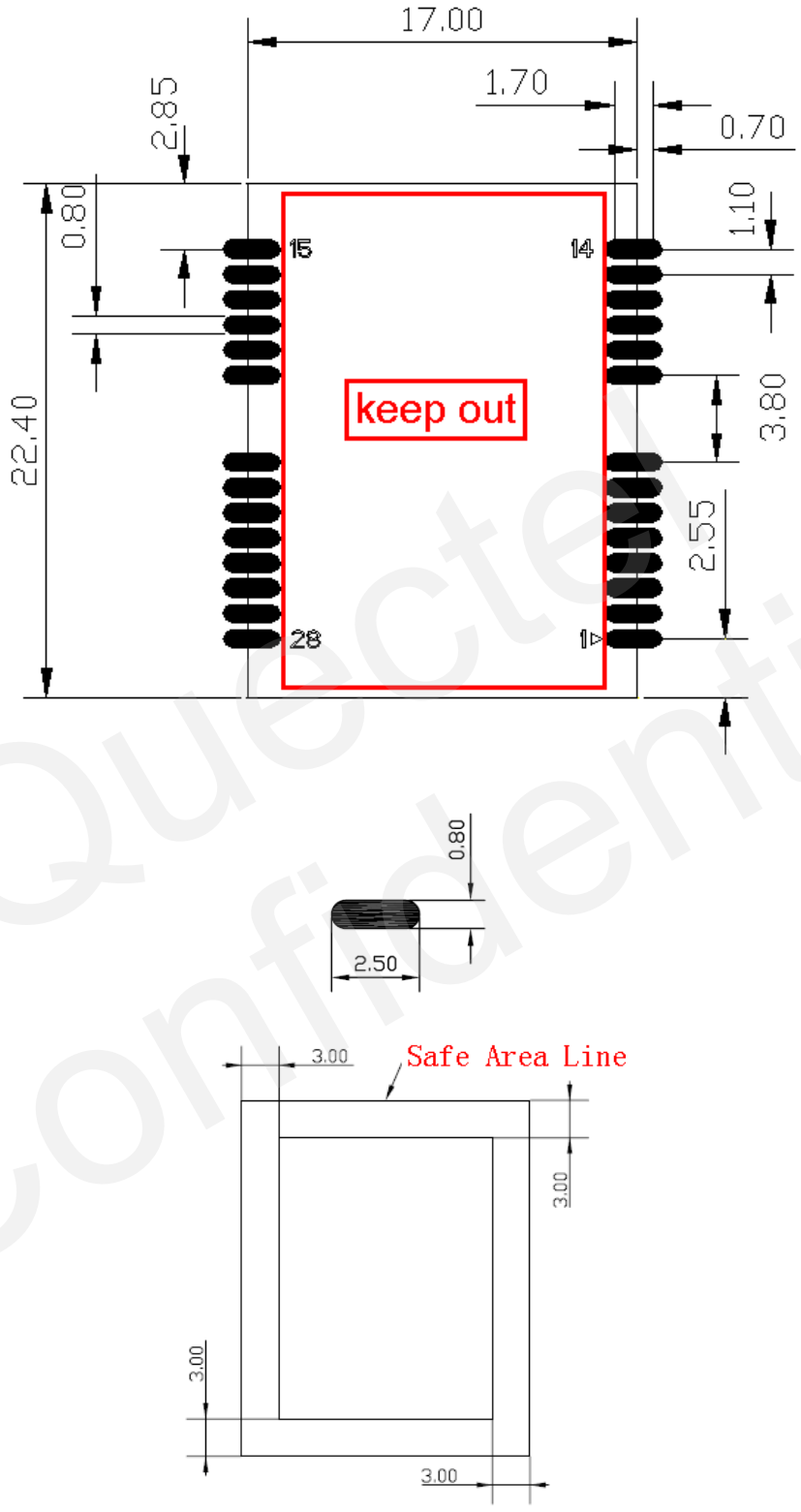



**Figure 18: Footprint of recommendation（Unit: mm）**

***Note1：Keep out on the host board below the module and the keep-out area should be covered by solder mask and top silk layer for isolation between the top layer of host board and the bottom layer of the module.***

***Note2：For easy maintenance of this module and accessing to these pads, please keep a distance no less than 3mm between the module and other components in host board.***

## 6.3 Top view of the module

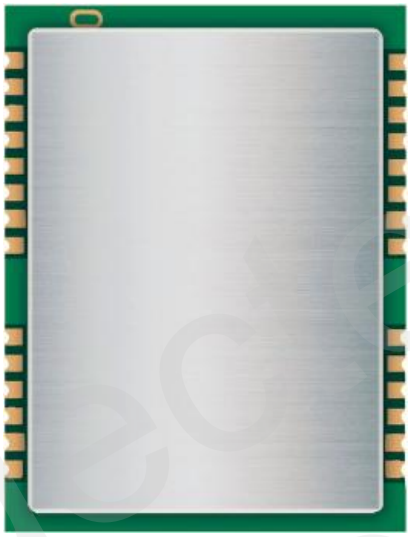


**Figure 19: Top view of the module**

## 6.4 Bottom view of the module

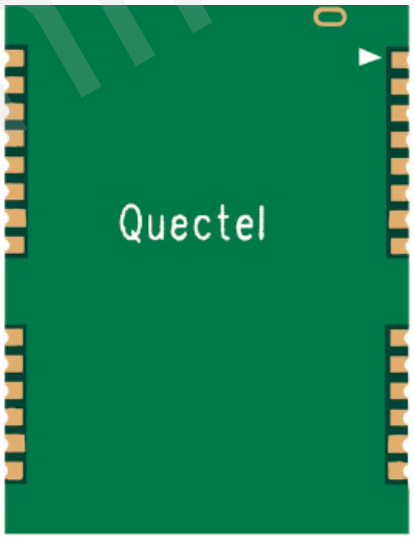



**Figure 20: Bottom view of the module**


**Shanghai Quectel Wireless Solutions Co., Ltd.**

**Room 501 Building 13, No.99, TianZhou Road, Shanghai, China 201103**

**Tel: +86 21 5108 6236**

**Mail: info@quectel.com**