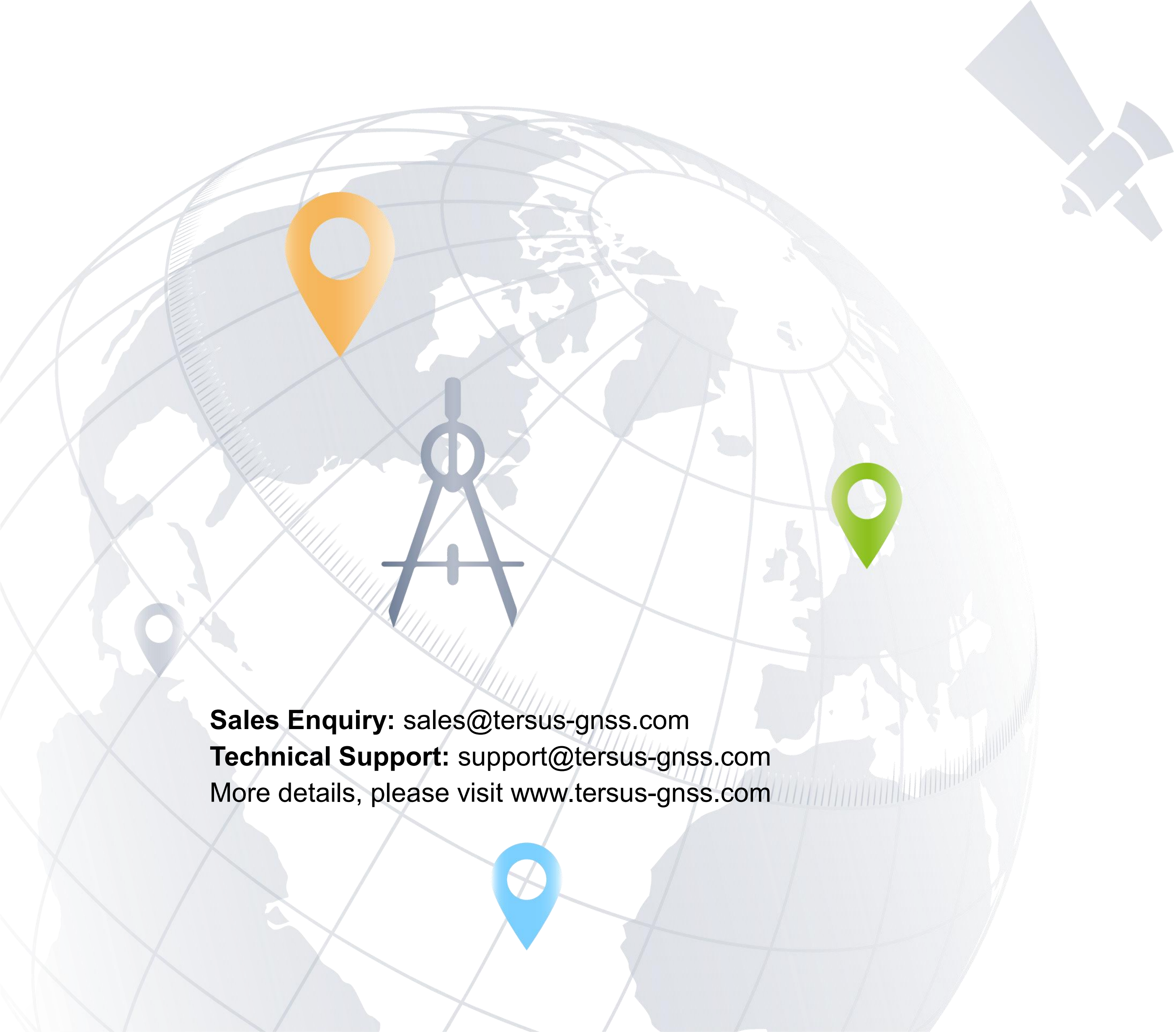
User Manual

Version V1.6-20241120

# BX50M-TAP GNSS RTK&PPP Board User Manual





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**Technical Support:** support@tersus-gnss.com
More details, please visit www.tersus-gnss.com

# Revision History

| Rev | Description | Date |
|---|---|---|
| 1.0 | Initial release | 20240326 |
| 1.1 | Update TAP | 20240513 |
| 1.2 | Update Section3.1 | 20240607 |
| 1.3 | Update Section3.2 | 20240701 |
| 1.4 | Update 28-pin header signals definition | 20240806 |
| 1.5 | Update section1.3.2 and section4 | 20240905 |
| 1.6 | Add section 3.2.2 LED description and section 3.2.3 reference schematic of the board.<br>Update section 4.2 & 4.3 & 4.4 & 4.5 PPP & RTK related operation description. | 20241120 |

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# Notices

The following notices apply to Tersus BX50M-TAP board.

| | |
|---|---|
| ⚠ | Changes or modifications to this equipment not expressly approved by Tersus could void the user's authority to operate this equipment or even has risk to damage the GNSS RTK Boards. |

## Conventions

The following conventions are used in this manual:

| | |
|---|---|
| ! | Information that supplements or clarifies text. |

| | |
|---|---|
| ⚠ | A caution that actions, operation or configuration may lead to incorrect or improper use of the hardware. |

| | |
|---|---|
| ⚠ | A warning that actions, operation or configuration may result in regulatory noncompliance, safety issues or equipment damage. |

In this manual, all the commands are in capital letters, which is just for easy identification, the commands are not case-sensitive.

# 1. Introduction

## 1.1 Overview of BX50M-TAP GNSS Board

The BX50M-TAP adopts Tersus Antares chip, and provides real-time monitoring of interference signals and automatic filtering. It tracks all current GNSS constellations including GPS, GLONASS, Galileo, BeiDou, QZSS, SBAS,IRNSS, and L-Band to improve continuity and reliability of RTK solutions that provide centimeter positioning.

The BX50M-TAP includes TAP, the satellite-based precise point positioning service developed by Tersus GNSS. With TAP, the GNSS rover board will not need to work with the local RTK base station or CORS, but directly receives corrections broadcast by the satellite, such as ephemeris error, satellite clock error, etc.

The BX50M-TAP board supports multiple constellations and multiple frequencies to improve the continuity and reliability of the RTK solution even in harsh environments. In-built 8GB memory makes data collection easy. It features compatibility with other GNSS boards in the market via flexible interfaces, smart hardware design, and commonly used log/command formats.

For further information about BX50M-TAP GNSS board, refer to https://www.tersus-gnss.com/ for more details.

## 1.2 Board Features

The BX50M-TAP board has the following features:

- Multiple constellations & frequencies

- GPS L1 C/A, L1C, L2C, L2P, L5C

- GLONASS L1OF, L2OF, L3OC

- BeiDou B1I, B2I, B3I, B1C, B2a, B2b

- Galileo E1, E5a, E5b, E5AltBOC, E6

- QZSS L1 C/A, L1C, L2C, L5C

- SBAS L1 C/A, L5

- IRNSS L5

- L-Band

- 1792 channels
- TAP
- Centimeter-level position accuracy
- Flexible interfaces such as TTL, USB, CAN, Ethernet
- PPS output and event mark input
- Supports up to 20Hz RTK solution updates and raw data output
- In-built 8GB memory makes data collection easy
- Pin-to-pin compatible with Novatel OEM6.
- Log/command compatible with NovAtel protocol

## 1.3 Related Information

Table 1.1 Document / Software used in this User Manual

| Name | Description | Link |
| --- | --- | --- |
| Log & Command document | Document providing all the loggings output from BX50M-TAP boards and all the commands to the boards | BX50C GNSS OEM Board \| Tersus GNSS (tersus-gnss.com) |
| Tersus Tool Suite | Tersus Tools including TersusDownload, TersusGeoPix, TersusGNSSCenter, TersusUpdate, TersusRinexConverter | https://www.tersus-gnss.com/software |
| RTKLIB | A free & popularly used Post processing tool | http://www.rtklib.com/ |

### Support

If there is any problem and the information needed cannot be found in the product documentation, request technical support by sending email to support@tersus-gnss.com or logging a ticket in our tracking system https://tersus.supportsystem.com/ .

## 1.4 BX50M-TAP System Overview

To make BX50M-TAP board work, the following parts are necessary:

- ✧ Interface board and cables
- ✧ Power supply
- ✧ Data communications equipment
- ✧ GNSS antenna with Low Noise Amplifier (LNA)

The BX50M-TAP board is illustrated in the figure below.

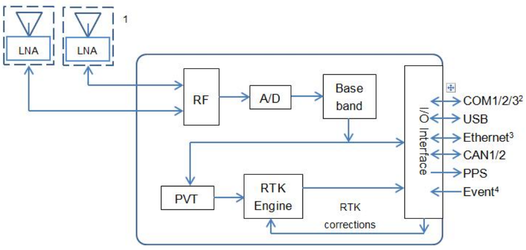



Figure 1.1 System Overview of BX Boards

Note 1. BX50M-TAP only support single antenna.

### 1.4.1 BX50M-TAP Board

The BX50M-TAP board is shown below.

Figure 1.2 The BX50M-TAP Board

BX50M-TAP board consists of a Radio Frequency (RF) section and a digital section.

**Radio Frequency (RF) Section**

The board obtains filtered, amplified GNSS signals from the antenna. The RF section down converts the incoming RF signals to Intermediate Frequency (IF) signals which are processed by the digital section. The RF section also supplies power to the active antenna LNA through the coaxial cable. The RF section has been designed to reject common sources of interference.

**Digital Section**

The core of the digital section is the base band, which is realized with a FPGA chip. The digital section digitizes and processes the base band signals to obtain a PVT (Position, Velocity and Time) solution. If RTK corrections from the base are received, the board will output cm-level position. The digital section also processes the system I/O, shown in Figure 1.1.

### 1.4.2 Antenna

The antenna converts electromagnetic signals transmitted by GNSS satellites into electrical signals that can be used by the board.

An active GNSS antenna is required for optimal board performance. Tersus is providing active GNSS antennas with precise phase centers and robust enclosures (refer to GNSS Antennas | Tersus GNSS (tersus-gnss.com) for more information about antennas.

Tersus antennas and coaxial cables meet board RF input gain requirements. Tersus coaxial cables are designed to introduce no more than 10dB loss and Tersus antennas are required with built-in LNAs that provide 33~40dB of gain to the satellite signal received.

### 1.4.3 Power Supply

A power supply capable of delivering the minimum board operating voltage and power is required. The board operates at +3.3 VDC ±5%, if the voltage supplied is below the specification, the board suspends operation.

| | |
|---|---|
| ⚠ | The BX50M-TAP board supports reversed polarity protection. |

### 1.4.4 Communication Equipment

A computer, a tablet or other data communications device are necessary to communicate with the board, and to receive and store the data that the board outputs.

### 1.4.5 Internal eMMC

BX50M-TAP board supports up to 8GB internal eMMC. According to the default configuration of the board 1Hz output calculation, 24h hookup can store 5 days of logs. After the storage is full, it will automatically clear the earliest logs according to date.

# 2. Installation

| | |
|---|---|
| ! | The BX50M-TAP board can be integrated to the customer's system in various packages, and all actions can refer to the installation guide in this chapter. |

## 2.1 Unpacking

Inspect the shipping cartons visually for any signs of damage or mishandling before unpacking the board. Immediately report any damage to the shipping carrier. Please check each item according to your order and the item list to confirm that all the accessories are correct for the purchased order.

## 2.2 Environmental Conditions

Install the board in a location situated in a dry environment with ESD protection. Avoid exposure to extreme environment conditions including:

- Water or excessive moisture
- Excessive heat greater than 85 °C (185 °F)
- Excessive cold less than –40 °C (–40 °F)
- Corrosive fluids and gases

Avoiding these conditions improves the board's performance and long-term reliability.

## 2.3 Selecting a GNSS Antenna

The BX50M-TAP tracks multiple GNSS frequencies, ensure that the antenna you choose supports the frequencies you need to track.

The antennas provided by Tersus can be found on Tersus website GNSS Antennas | Tersus GNSS (tersus-gnss.com). It is highly recommended that the antennas from Tersus are used to work with BX50M-TAP.

If a non-Tersus GNSS antenna is chosen, a typical antenna LNA gain between 32dB and 40dB is recommended in a rover station application.

The power to the antenna LNA is provided through the board's RF port center conductor. BX50M-TAP provides +5.0 VDC ±5% at a maximum of 100mA.

| | |
|---|---|
| ! | For passive antennas, a spacer needs to be installed between the board and the antenna to prevent the antenna power supply from shorting out. |
| ⚠ | Contact Tersus support if problem occurs when an antenna from other vendors is used. |

When installing the antenna:

- Choose an antenna location with a good view of the sky so that there is no obstruction from horizon to horizon.
- Mount the antenna on a secure, stable structure capable of safe operation in the specific environment.
- Avoid areas with high vibration, excessive heat, electrical interference, and strong magnetic fields.
- Avoid mounting the antenna close to stays, electrical cables, metal masts, and other antennas.
- Avoid mounting the antenna near transmitting antennas, radar arrays, or satellite communication equipment.

## 2.4 Board Installation

When the appropriate equipment is selected, complete the following steps to set up and begin using the BX50M-TAP.

a) Install the BX50M-TAP board in an enclosure or on a mother board.

b) Mount the GNSS antenna to a secure, stable structure.

c) Connect the GNSS antenna to the board with a GNSS antenna cable.

d) Apply power to the board, as described in section 1.4.3.

e) Connect the board to a computer or other data communications equipment.

When BX50M-TAP board is handled, follow the guides below to avoid damage from ESD.

- Always wear a properly grounded anti-static wrist strap when handling BX50M-TAP board.
- Always hold the board by the corners or the RF shield: avoid direct contact with any of the components.
- Never let the board come in contact with clothing. The ground strap cannot dissipate static charges from fabrics.
- Failure to follow accepted ESD handling practices could cause damage to the board permanently.
- The warranty may be void if equipment is damaged by ESD.

## 2.5 Tersus GNSS Center Software

BX50M-TAP GNSS RTK board has serial ports, hence lots of serial tools can be used to communicate with the board. Tersus GNSS Center is a windows-platform-based serial tool, which is recommended to communicate with the BX50M-TAP board. Tersus GNSS Center can be downloaded from Tersus website https://tersus-gnss.com/software .

Connect BX50M-TAP to a laptop/PC with an external cable. Run Tersus GNSS

Center, the following config page is shown, input the port and band rate (default is 115200).

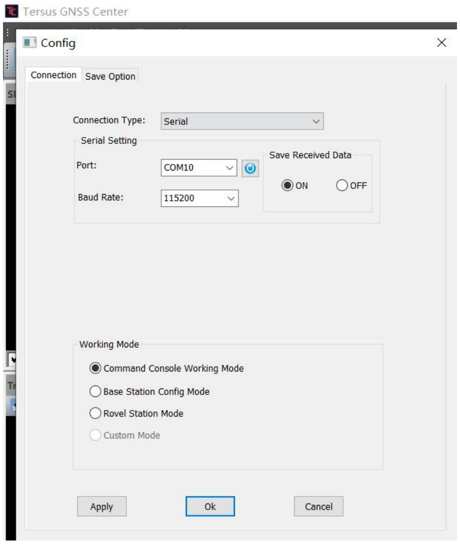



Figure 2.1 Config Page of Tersus GNSS Center

The following table gives definition for the lights at the bottom of Tersus GNSS Center interface.

Table 2.1 Definition of the lights on Tersus GNSS Center

| Lights | Description |
|---|---|
| Comm | GREEN: the communication with the board is established.<br>RED: the communication with the board is not established. |
| TAP | GRAY: NOT support TAP.<br>GREEN: support TAP. |

Commands can be input in the text console window, an [OK] response is output after a command is input, or the command is not input successfully.

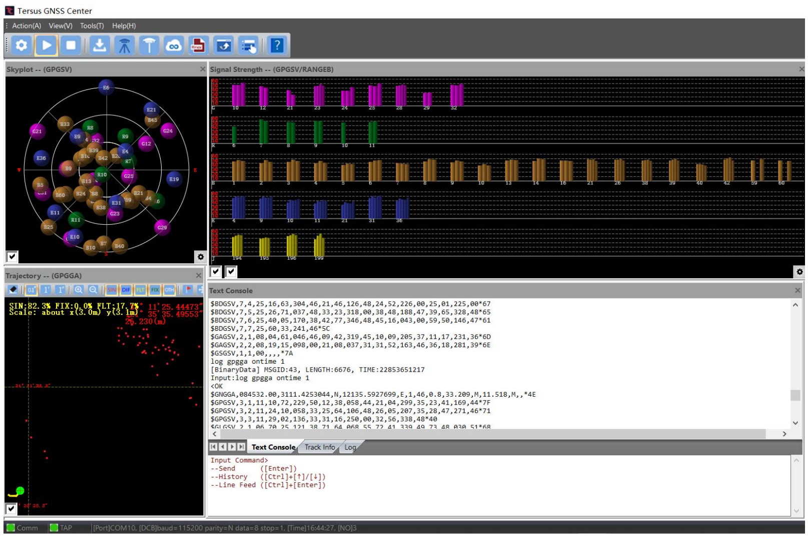



Figure 2.2 Main Windows of Tersus GNSS Center

| | |
|---|---|
| ! | To active the skyplot, signal strength, trajectory and other windows, the antenna signals must be received and the following three loggings must be input to the board:<br><br>LOG GPGGA ONTIME 1 // output position and time<br>LOG GPGSV ONTIME 1 // output SVs in view, elevation and SNR (Signal Noise Ratio)<br>LOG RNAGEB ONTIME 1 // output PSR (Pseudorange) and ADR (Accumulated Doppler Range.) |

refer to *Log & Command Reference document* for details.

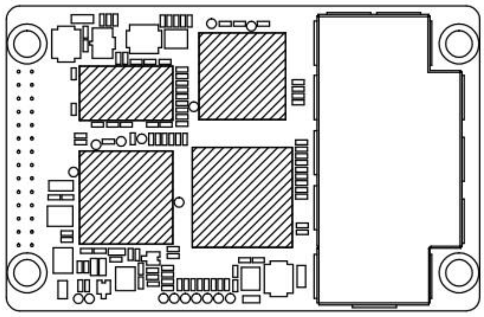
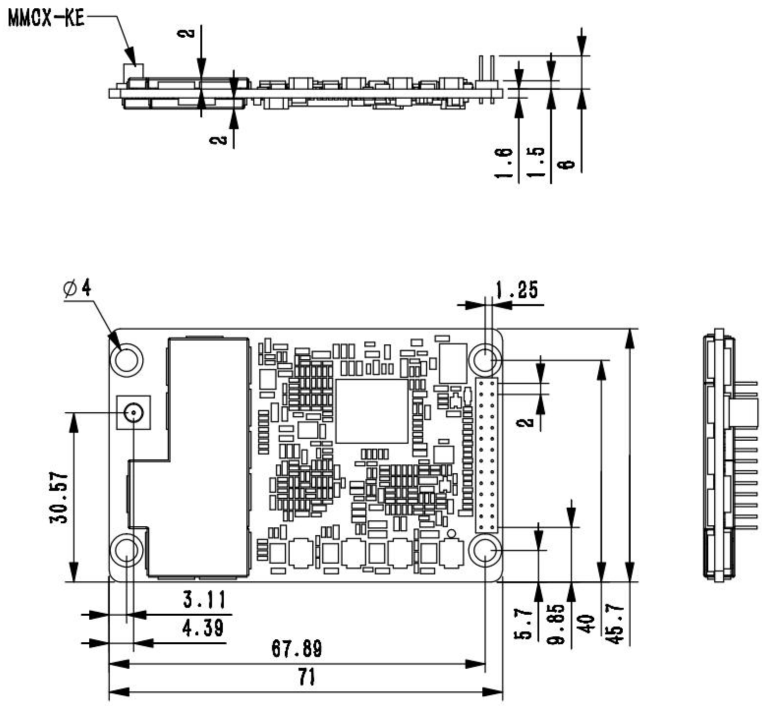
# 3. Technical Specifications

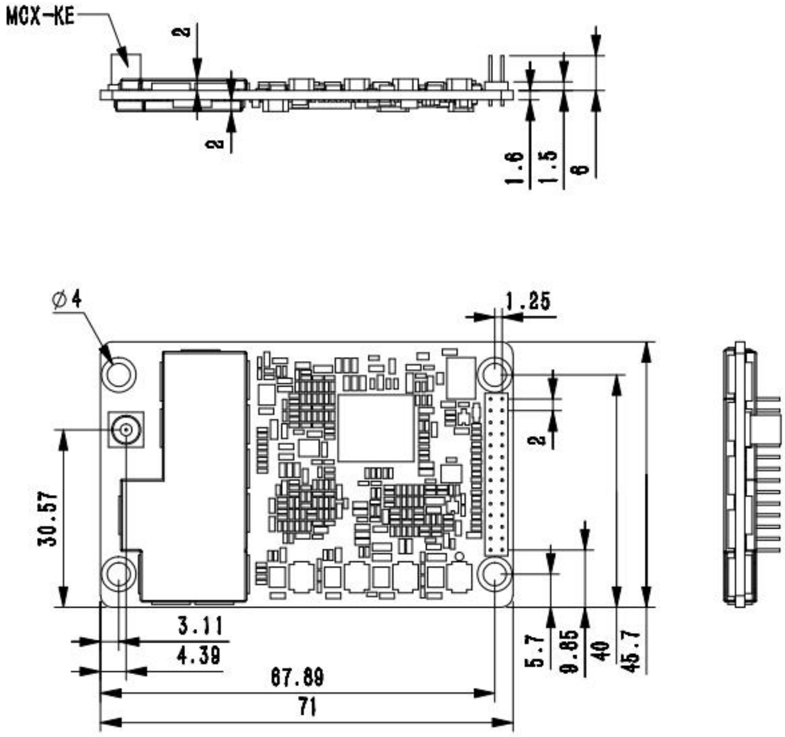
## 3.1 BX50M-TAP Specifications

Table 3.1 BX50M-TAP Board Specifications

| Performance | | |
|---|---|---|
| Signal Tracking | GPS L1 C/A, L1C, L2C, L2P, L5C<br>GLONASS L1OF, L2OF, L3OC<br>BeiDou B1I, B2I, B3I, B1C, B2a, B2b<br>Galileo E1, E5a, E5b, E5AltBOC, E6<br>QZSS L1 C/A, L1C, L2C, L5C<br>SBAS L1 C/A, L5<br>IRNSS L5<br>L-Band | |
| GNSS Channels | 1792 | |
| Position Accuracy(RMS) | Single point positioning | 1.5m (Horizontal) |
| | | 3.0m (Vertical) |
| | RTK positioning | 8mm+1ppm (Horizontal) |
| | | 15mm+1ppm (Vertical) |
| | DGPS positioning | 0.25m (Horizontal) |
| | | 0.5m (Vertical) |
| | High-Precision Static | 2.5mm+0.1ppm (Horizontal) |
| | | 3.5mm+0.4ppm (Vertical) |
| TAP | Positioning Accuracy(RMS) | 15mm(Horizontal) |
| | | 30mm(Vertical) |
| | Convergence Time | 3 minutes |
| | Coverage | Global |

| | | |
|---|---|---|
| | Signal stability | 99.99% |
| Observation Accuracy (zenith direction): | C/A Code<br>P Code<br>Carrier Phase | 10cm<br>10cm<br>1mm |
| Time to First Fix | Cold Start<br>Warm Start | <35s<br><10s |
| Reacquisition | <1s | |
| Time Accuracy(RMS) | 20ns | |
| Velocity Accuracy(RMS) | 0.03m/s | |
| Initialization (typical) | 4s | |
| Initialization Reliability | >99.99% | |
| Correction | RTCM 2.3/3.0/3.1/3.2/CMR/CMR+ | |
| Data output | NMEA-0183 and Tersus Binary Format | |
| Data Rate | 20Hz | |
| Storage | In-built 8GB memory | |
| **Communication** | | |
| Serial ports | LV TTL x3 | |
| COM baud rate | Up to 921600bps | |
| USB ports | USB 2.0 device x1 | |
| PPS ports | LVTTL x1 | |
| Event mark | LVTTL x1 | |
| **Electrical** | | |
| Input Voltage | +3.3 VDC ±5% | |
| Power Consumption | 1.9W (typical) | |
| **Physical** | | |
| Size | 71 * 46 * 11 $mm^3$ | |
| Weight | 24g | |

| | |
|---|---|
| IO connectors | 28pin header |
| Antenna Connector | MCX female x1(default), MMCX female x1(optional) |
| **Environmental** | |
| Operating Temperature | -40°C ~ +85°C(Heat sink required at 85°C) |
| Storage Temperature | -55°C ~ +95°C |
| **Heat Sink Position** | |
|  Note: For optimum heat transfer, Tersus recommends the use of thermal interface materials between the processor and the heat sink. | |
| **Mechanical Drawing** | |
| **MMCX** | |
|  | |

| MCX |
|---|
|  |

## 3.2 System Integration

### 3.2.1 Connectors on BX50M-TAP Board

Figure 3.1 The 28-pin header

Table 3.2 28-pin header signals definition

| Pin | Signal | Type | Description |
|---|---|---|---|
| 1 | SPI_MOSI | SPI DATA | Reserved |
| 2 | SPI_CS | SPI CS | Reserved |
| 3 | SPI_CLK | SPI CLK | Reserved |
| 4 | TPO_MID | TPO_MID | Reserved |
| 5 | RSV | Reserved | |
| 6 | VCC | Power input | +3.3V DC ±5% |
| 7 | USB_OTG_DN | USB Data- | |
| 8 | RXD3 | COM3 Input Receive Data | LV TTL |
| 9 | RESETIN_N | Reset Input | LV TTL, Active low, duration > 5ms |
| 10 | USB_OTG_DP | USB Data+ | |
| 11 | EVENT | Input | LV TTL |
| 12 | CAN_RX2 | CAN Receive Line | |
| 13 | TXD3 | COM3 Output Transmit Data | LV TTL |
| 14 | GND | Digital and Power Ground | |
| 15 | TXD1 | COM1 Output Transmit Data | LV TTL |
| 16 | RXD1 | COM1 Input Receive Data | LV TTL |
| 17 | GND | Digital and Power Ground | |
| 18 | TXD2 | COM2 Output Transmit Data | LV TTL |
| 19 | RXD2 | COM2 Input Receive Data | LV TTL |
| 20 | GND | Digital and Power Ground | |
| 21 | PV | Position Validity Indicator | Satellite LED, Active high |
| 22 | GND | Digital and Power Ground | |
| 23 | PPS | Clock output | LV TTL |
| 24 | CAN_TX2 | CAN Transmit Line | |
| 25 | TPO+ | TPO+ | Reserved |
| 26 | TP1+ | TP1+ | Reserved |
| 27 | TPO- | TPO- | Reserved |
| 28 | TP1- | TP1- | Reserved |

### 3.2.2 LED description

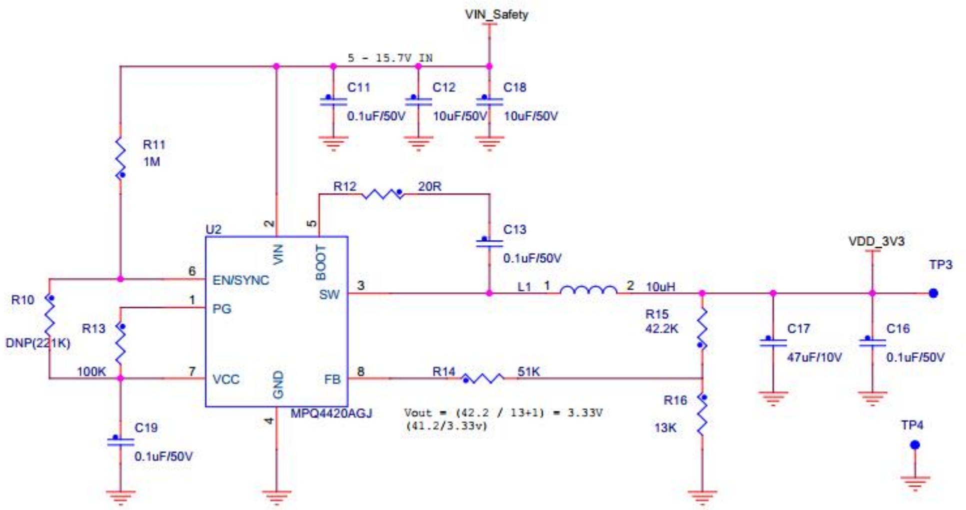
There are three LEDs on the BX50M-TAP receiver. The descriptions for these LEDs are as below.

Table 3.3 LED description

| Color | Description |
|---|---|
| Red | Power LED. Steady red indicates the unit is powered on. |
| Orange | FPGA LED. Flashes orange. |
| Green | Satellite LED. Green flashes indicate that the satellite is being searched for, while a steady green light shows that the satellites are being tracked. |

### 3.2.3 Reference schematic of the board

If an interface board is designed to work with the BX50M-TAP board, the reference schematics for the power are provided below. Please contact Tersus technical support if you need more information about the interface board.




The BX50M-TAP board operates at +3.3 VDC ±5%, and the resistance values of resistors R15 and R16 can be adjusted based on the actual voltage level.

# 4.Typical Application

## 4.1Firmware Upgrade

If a new firmware update is released, it will be available on the Tersus web site https://www.tersus-gnss.com/software , or you can get the updates from Tersus technical support by email support@tersus-gnss.com .

The firmware version of a Tersus receiver can be updated in field. Connect the COM2 port of the receiver with Tersus GNSS Center, and input 'LOG VERSION' in the text console, the following info will be output:

```
log version
>VERSION COM2 0 0.0 UNKNOWN 0 247.000 00000000 0 1
<     1
<     GPSCARD BX50L 045001241000000256 0451001030000 1.0.1909_release  Jul 16 2024 16:36:15
Input:log version
<OK
```

1909 is the firmware version. Refer to 'VERSION' in BX50M Log & Command Reference document for more details.

Please follow the steps below to upgrade the firmware.

1) Power on the BX50M-TAP GNSS board;
2) Run Tersus GNSS Center software and communicate with the receiver, refer to section 2.5 for details. Make sure the board has finished initialization, which can be confirmed by input 'LOG VERSION' in the console window and the board will output feedback;

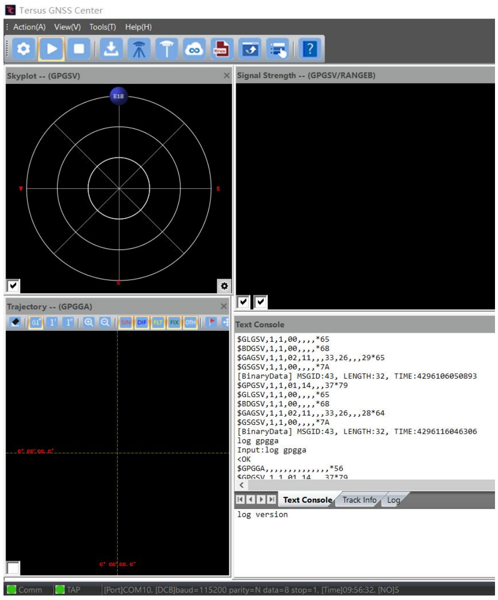



Figure 4.1 Main interface of Tersus GNSS Center

3) Click [Stop] button as shown below to terminate the communication between the computer and the receiver;

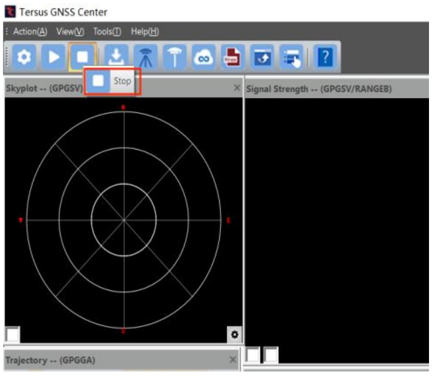



Figure 4.2 Stop button on Tersus GNSS Center

4) Select [Tools] -> [UpdateFirmware];

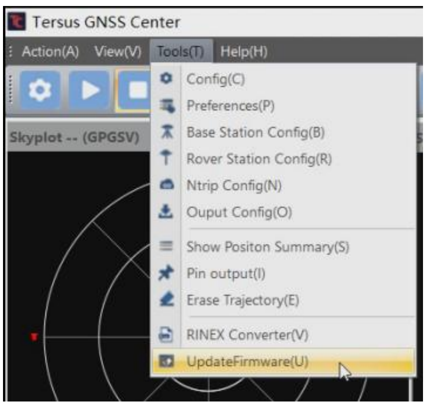



Figure 4.3 Find UpdateFirmware in Tools bar

5) Select the upgrade file. When a file is selected, the file is shown in the Update File bar. Select port and baud rate, click [Next];

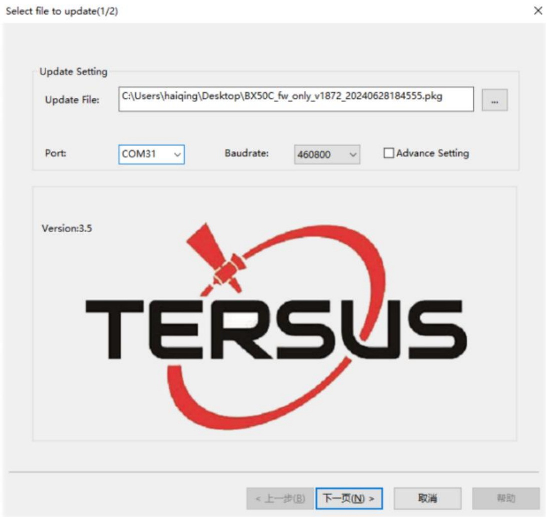



Figure 4.4 Select file to update

6) The following figure shows the firmware is upgrading, two progresses are included in the firmware update;

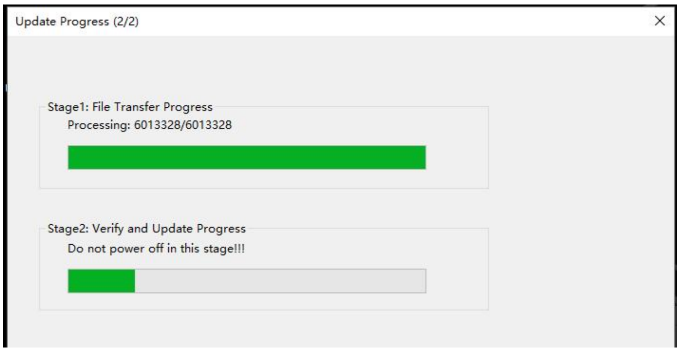



Figure 4.5 Update in progress

| | |
|---|---|
| ⚠ | Do not power off the receiver during the verification and update process. |

7) After the firmware is upgraded successfully, The following is shown;

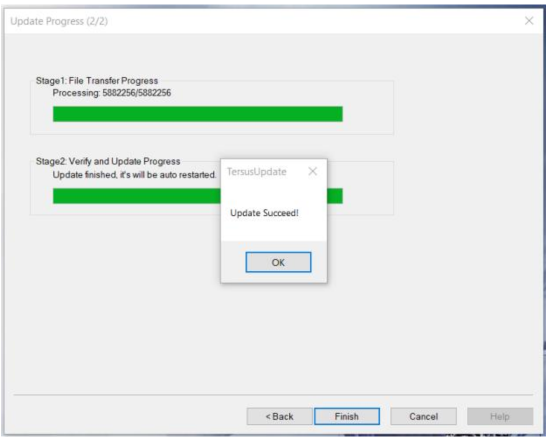



Figure 4.6 Firmware update successful

8) Click [OK] and [Finish] buttons to close the firmware upgrade windows, the receiver will reset automatically.
9) After the board is booted, the firmware version can be confirmed by repeating step 2.

**Note:**

**There is Advance Setting option in the firmware update page, if a receiver**

- **cannot boot up successfully, or**
- **cannot work well after boot up, or**
- **cannot finish FW update successfully according to the above steps,**

**[Advance Setting] option can be selected to start FW update again.**

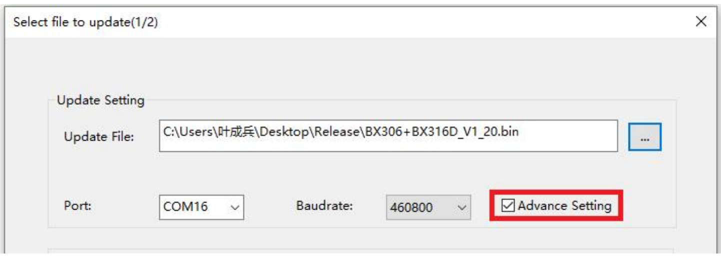



Figure 4.7 Advance setting for firmware update

If the [Advance Setting] is selected, the following page will be displayed, select [Manual Hardware Reset] and click [OK]. Click [Next] in the previous interface, power off the receiver, wait for five seconds and power on the receiver again.

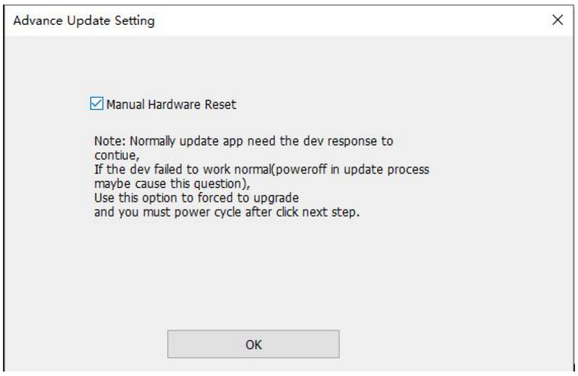



Figure 4.8 Advance Update Setting

After firmware update is finished, power off the receiver, wait for five seconds and power on the receiver again.

| ⚠ | **This option is for experienced users. If the customer is not sure whether it should be selected, contact Tersus technical support before select this option.** |
|---|---|

## 4.2 Auth Code

An auth code is used to determine the features and valid time for a board. If the auth code is expired, the board will not work. And a license requirement is output from all the ports. Before contacting Tersus technical support for a new auth code, input:

LOG AUTHLIST    //query the board registration and PPP service expiration

In the text console window of Tersus GNSS Center when the receiver is connected with computer, and send all the output information to Tersus technical support.

Where in the AUTHLIST output message:

<s/n:037001203200000134 represents the SN of the board.

<tap-serial:3410134 represents the SN of the PPP.

<status:valid level:4 expiredday:2099/12/31 group:0 groupnum:0

Displays the board registration expiration time.

<l-band:subscripted mode:PPP-AR expiredday:2023/08/21

Displays the PPP service registration expiration time.

If the board registration auth code application is approved, you will get a txt file, in which command AUTHCODE and the auth code will be given, copy all of them (Ctrl + A & Ctrl + C) and paste them to the text console window of Tersus GNSS Center when the receiver is connected with computer.

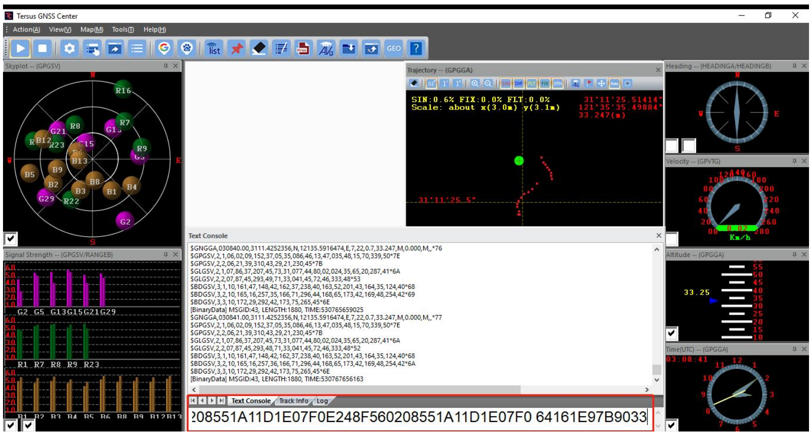



Figure 4.9 Register via Tersus GNSS Center

If the PPP service registration code application is approved, Tersus technical support will assist in remote activation. The process is as follows.

1. Place the board outside in an open area. When registering for PPP, the board needs to enable the PPP service first to ensure that the L-Band satellites are tracked. The BX50M-TAP board enables the PPP service by default, if the PPP service is disabled, enter the command [PPPSOURCE TapSat ENABLE] to enable the PPP service.

2. Enter the command [LOG LBANDTRACKSTAT ONTIME 1] to view the Bit

Error Rate (BER). An example return is shown below.

<IRTAP 1546240000 1200 C685 0010 0 -215.6 54.24 5.03 0 0 1555 0.000122

<OCTAP 1545875000 1200 2873 0010 0 -62.8 45.17 180.00 0 6 1775 0.000854

The last field in the return represents the BER. The BER parameters for the L-Band satellites that can currently be tracked all have return values. The satellite with the lowest BER should be selected for approval. In this sample, 0.000122 is the current BER value.

The BER grading is as follows:

- A BER of 0.000XXX indicates an open sky, which represents the optimal state for activation.
- A BER of 0.00XXXX suggests that there is some blockage. In this state, the probability of activation failure increases, so multiple attempts are recommended.
- A BER of 0.0XXXXX means that the blockage is more severe, leading to a higher chance of activation failure. It is not advisable to attempt activation of the planetary base in this case.
- A BER of 0.1XXXXX is generally not fixable and is not recommended for satellite-based activation, as success is highly unlikely.
- A BER value up to 0.30000 indicates that the L-Band satellite has not been tracked and cannot be activated.

Please ensure that the BER parameter falls within the range of 0.000X to 0.00X. If the BER exceeds this range, please adjust the device's environment accordingly.

3. Please reach out to Tersus technical support and provide them with the PPP serial number, city, and the validity period for activation to enable remote

activation.

Note: TAP activation occurs in real-time. Ensure that the device is turned on and that the BER parameter is within the range of 0.000X to 0.00X during the activation process.

## 4.3 PPP Configuration

To query whether the PPP service is enabled, enter the command [PPPSOURCE], the BX50M-TAP board enables the PPP service by default, the default output is [PPPSOURCE TapSat ENABLE]. If the PPP service is disabled, enter the command [PPPSOURCE TapSat ENABLE] to enable the PPP service, and enter the command [SAVECONFIG] to save the current configuration.

The PPP registration code is within the validity to use the PPP service normally, please refer to the section 4.2 for details.

Ensure the board is not accessing RTK differential data, as RTK is prioritized over PPP. To check the current time, position and fix related data of the board, enter the command [log gpgga ontime 1]. The differential base station ID field in the output message represents the different results of the board, where ID=5000 represents that PPP has not yet converged, ID=5001 represents that PPP is converging, and ID=5002 represents that it has been PPP-AR fixed.

If the PPP is not fixed for a long time ,enter the command [log lbandtrackstat] to query the L-Band signal tracking status of the board and analyze the Bit Error Rate（BER）in the output messages.

Under an open sky, the Bit Error Rate (BER) typically measures around

0.000xxx. In conditions of obstruction, it usually increases to about 0.00xxxx, and under serious obstruction, it can rise to approximately 0.0xxxxx. The BER can reach up to 0.1xxxxx, which is generally considered unfixed. The maximum BER is 0.300000, indicating that the L-Band satellite is not being tracked.

## 4.4 PPP&RTK Switching

The BX50M-TAP board enables the PPP service by default, the PPP and RTK can be used at the same time. Priority of the output: RTK FIX>PPP FIX>RTK Float>PPP Float. PPP and RTK services, as well as the application of the coordinate frame, can be configured using the command [MAXRTKPPPAGE].

The default value of MAXRTKPPPAGE is 0, which means that the PPP fixed solution is not converted to the RTK coordinate frame. In this case, the output is determined based on priority. When the value of MAXRTKPPPAGE is between 1 and 255, it indicates that if the RTK differential age exceeds this value and a PPP fixed solution is available, the PPP fixed solution will be converted to the RTK coordinate frame, and the coordinates of the PPP fixed solution will be outputted.

When configuring the [MAXRTKPPPAGE], it’s important to ensure that its value is less than that of [RTKTIMEOUT]. The [RTKTIMEOUT] sets the maximum age of RTK data that can be used. The board will switch to a float solution when the RTK differential age exceeds this value. This setting of the [RTKTIMEOUT] should be configured between 5 and 300 seconds, with a default of 60 seconds.

## 4.5RTK Configuration

Enter the command [PPPSOURCE TapSat DISABLE] to disable the PPP service, and enter the command [SAVECONFIG] to save the current configuration. When the PPP service is disabled, only RTK is used for positioning. Enter the command [log gpgga ontime 1]. The differential base station ID field ID ≤ 4095 in the output message represents the RTK positioning result.

Example of RTK configuration (base mode):

UNLOGALL //remove all logs

UNDULATION USER 0.0 //Set user specified undulation value for ellipsoid height

FIX POSITION B L H //B: latitude (degree), L: longitude (degree), H: ellipsoid height (m)

For example: FIX POSITION xx.xxxxxx xx.xxxxxxx xx.xx

or POSAVE ON 0.02 //Turn on position average for 0.02 hour (72s)

LOG COM2 RTCM1006 ONTIME 10 //output the base coordinate

LOG COM2 RTCM1074 ONTIME 1 //output GPS observations

LOG COM2 RTCM1084 ONTIME 1 //output GLONASS observations

LOG COM2 RTCM1094 ONTIME 1 //output Galileo observations

LOG COM2 RTCM1114 ONTIME 1 //output QZSS observations

LOG COM2 RTCM1124 ONTIME 1 //output BeiDou observations

LOG COM2 RTCM1230 ONTIME 10 //output GLONASS bias information

LOG COM2 RTCM1033 ONTIME 10 //output antenna, board information

SAVECONFIG //save the configuration above

Example of RTK configuration (rover mode):

UNLOGALL //remove all logs

FIX NONE //cancel the fixed coordinate of a base station

LOG GPGGA ONTIME 1 //output GPGGA to check position type
SAVECONFIG //save the configuration above

| | |
|---|---|
| ! | The antenna of the base must be static and its position must be input, several ways can be used to input the position of the base:<br><br>● If the base's position is known, input it directly with command FIX.<br>● If the base's position is unknown, and the accuracy of the base can be meter-level, then it is recommended to use command POSAVE to setup the base, refer to the Log & Command document for more about this command. Please note the base's position will be different after a power cycle even if the antenna is installed at the same point if POSAVE command is input.<br>● If you require a cm level accuracy of base and rover, then:<br>a. Configure the base board as a rover, receive RTK corrections from a CORS nearby, this board can get cm-level accuracy position.<br>b. Collect raw measurements for half an hour, process it with post processing software or send the data to an online processing web, e.g. OPUS, to get an accurate position. |

## 4.6 Data Collection on Internal eMMC

The BX50M-TAP board is embedded with up to 8GB internal eMMC chip, which brings convenience for data collection.

| | |
|---|---|
| ⚠ | Before data collection, please make sure enough space is available on the internal eMMC chip. |
| ! | The size of the logging:Collect raw measurements at 1Hz(about 110KByte/min if 20 satellites are tracked, about 165KByte/min if 30 satellites are tracked)If the collection frequency increases, the data size would increase proportionately. |

The detailed steps for static data collection are as follows:

```
UNLOGALL                                        //remove all logs
LOG FILE RANGECMPB ONTIME 15.00 NOHOLD
//save the compressed version of the RANGE log
LOG FILE GPSEPHEMB ONCHANGED NOHOLD
//save the decoded GPS ephemeris.
LOG FILE BDSEPHEMERISB ONCHANGED NOHOLD
//save the decoded BDS ephemeris.
LOG FILE GLOEPHEMERISB ONCHANGED NOHOLD
//save the decoded GLONASS ephemeris.
LOG FILE GALINAVEPHEMERISB ONCHANGED NOHOLD
//save the decoded Galileo INAV ephemeris
LOG FILE QZSSEPHEMERISB ONCHANGED NOHOLD
//save the decoded QZSS ephemeris
SAVECONFIG                                      //save configuration
```

## 4.7Download Files from Internal eMMC

The files saved on the internal eMMC chip can be copied to the computer via a USB port. Detailed steps to download files from eMMC chip are as follows:

1) Create a connection between a BX50M-TAP board and a computer via the cables below. Connect the COMM2 port of a BX50M-TAP board to the USB port of a computer using COMM2-7pin to USB & DB9 cable and DB9 Male to USB Type A Male converter cable.

Figure 4.10 COMM2-7pin to USB & DB9 Cable

Figure 4.11 DB9 Male to USB Type A Male converter cable

2) Power on the BX50M-TAP board.
3) A GNSS_U disk will display on the computer.
4) Open the GNSS_U disk and there are two folders：inner and user.
5) Copy the inner and user folders to see the related information from eMMC.


Figure 4.12 Folders in the GNSS_U disk

| | |
|---|---|
| ! | It is recommended to ensure the computer has available CPU and memory when downloading files. |

## 4.8 Communicate with STRSVR Tool

The steps of BX50M-TAP communicating with STRSVR tool are as follows:

1) Power on the BX50M-TAP board, connect COM1 and COM2 to the computer. COM2 is to communicate with Tersus GNSS Center, COM1 is to receive RTK corrections from a NTRIP caster.
2) Run RTKLIB -> STRSVR, select serial for output type. And click the option button for serial port COM1 and configure it.

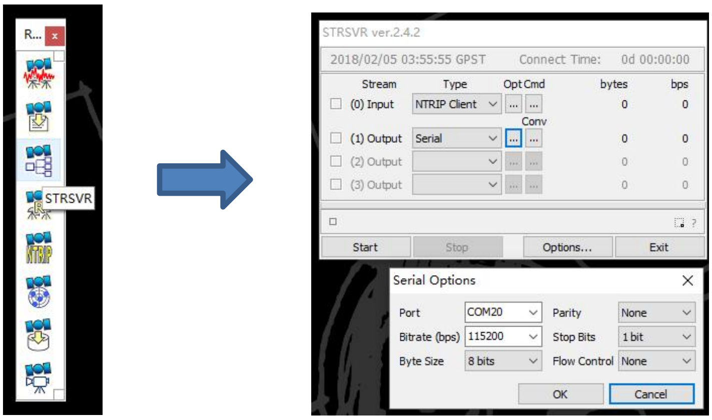



Figure 4.13 Configure serial port COM1

3) Select NTRIP client for input type, click the Opt button for NTRIP, and fill all the five fields for NTRIP client configuration.

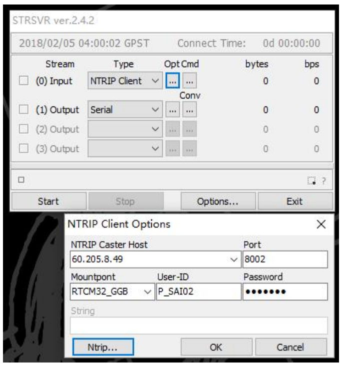



Figure 4.14 NTRIP client configuration

4) If needed, draft position of the board is input, refer to the following figure.

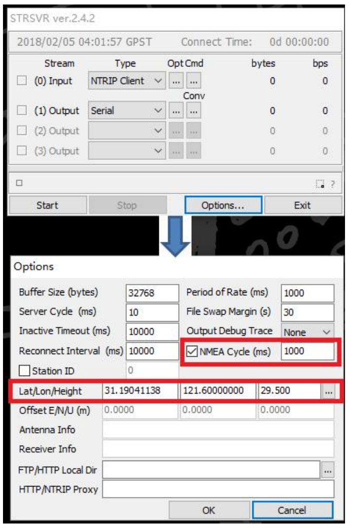



Figure 4.15 Draft position of the board

5) Go back to the main page, and click [Start]. If everything is [OK] the following page will be shown. The input and output data will increase with time. And the position type of the board can be checked in Tersus GNSS Center software.

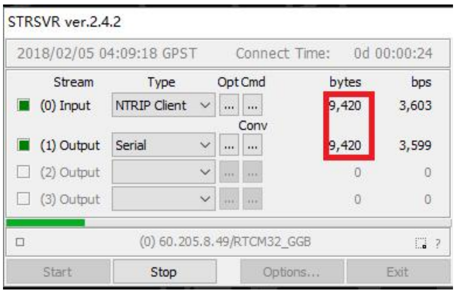



Figure 4.16 Input and Output data in progress

# 5. Terminology

| | |
|---|---|
| ASCII | American Standard Code for Information Interchange |
| CMR | Compact Measurement Record |
| DC | Direct Current |
| ESD | Electro-Static Discharge |
| ECEF | Earth Center Earth Fixed |
| EGNOS | European Geostationary Navigation Overlay Service |
| GAGAN | GPS Aided Geo Augmented Navigation |
| GLONASS | GLObal NAvigation Satellite System |
| GNSS | Global Navigation Satellite System |
| GPS | Global Positioning System |
| IF | Intermediate Frequency |
| IMU | Inertial Measurement Unit |
| IO | Input / Output |
| LED | Light Emitting Diode |
| LNA | Low Noise Amplifier |
| MPU | Micro Processing Unit |
| NMEA | National Marine Electronics Association |
| PC | Personal Computer |
| PPS | Pulse Per Second |
| QZSS | Quasi-Zenith Satellite System |
| RF | Radio Frequency |
| RINEX | board Independent Exchange format |
| RMS | Root Mean Squares |
| RTK | Real-Time Kinematic |

| | |
|---|---|
| RTCM | Radio Technical Commission for Maritime Services |
| SBAS | Satellite-Based Augmentation System |
| SNR | Signal-to-Noise Ratio |
| SMA | Sub-Miniature-A interface |
| TTFF | Time to First Fix |
| TTL | Transistor-Transistor Logic level |
| UART | Universal Asynchronous board/Transmitter |
| USB | Universal Serial BUS |
| UTC | Universal Time Coordinated |
| VRS | Virtual Reference Station |
| WAAS | Wide Area Augmentation System |
| WGS84 | World Geodetic System 1984 |