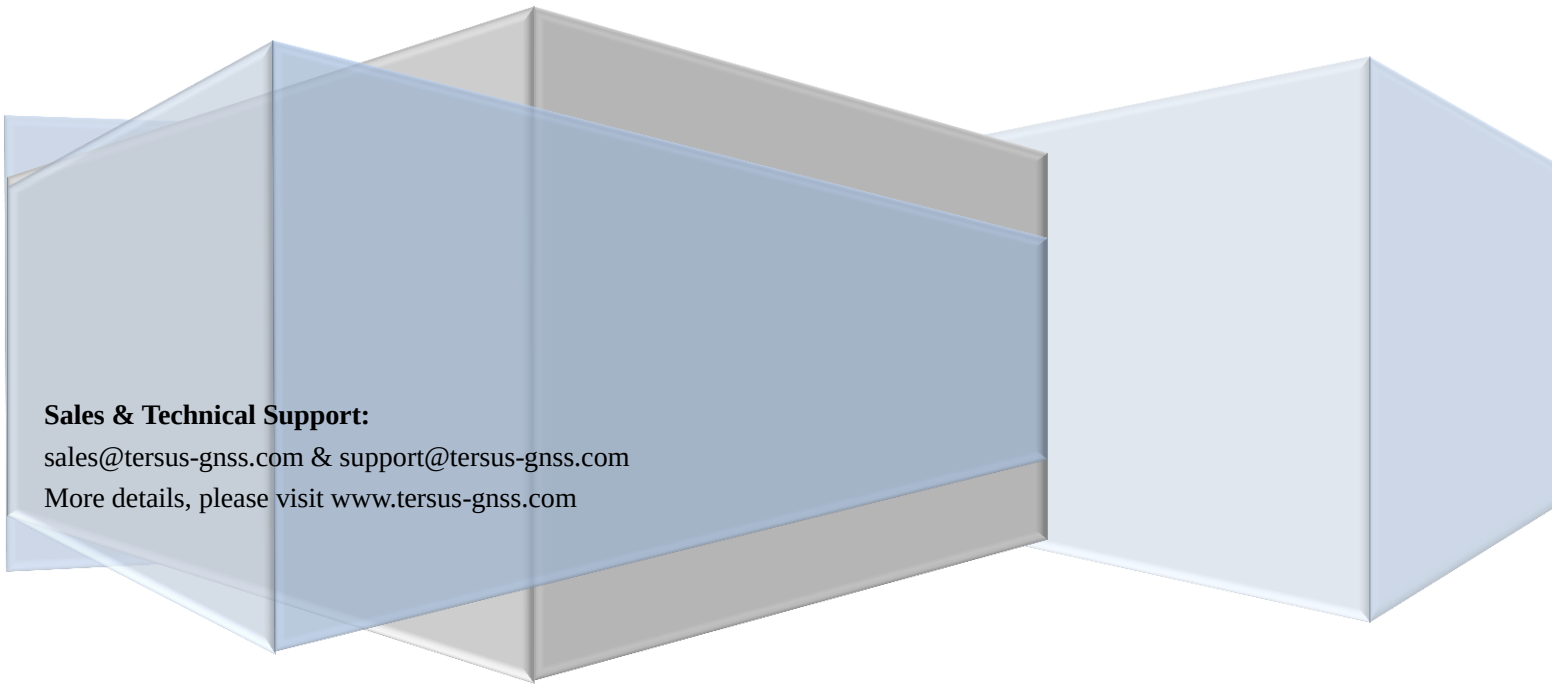
User Manual BX306



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Revision History

Date	Major change	Version
2017-04-12	Initialization	1.0

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1. Introduction

1.1 Overview of BX306 Board

The Precis-BX306 board provides millimeter level carrier phase observation as well as centimeter level RTK positioning accuracy. It also supports chip level multi path mitigation, RTK positioning, especially suitable for high accuracy navigation and positioning used in moving objects like cars, unmanned aerial vehicles (UAV) etc. it also applies for the control of agriculture machinery, engineering machinery and port machinery, as well as displacement measurement and GIS etc.

Figure 1 Outlook of Precis-BX306 Board

1.1.1 Features of BX306 Board

- Support GPS L1/L2, GLONASS L1/L2, and Beidou B1/B2;
- Support single satellite system positioning and multi-system positioning;
- Support sub-meter RTD positioning and centimeter level RTK positioning;
- Support raw measurements output.
- Support 2 COMs and 1 PPS (Pulse Per Second accuracy timing);
- Support Event mark input;
- Update rate up to 20Hz;
- Powered by +3.3V for board and +5V~12VDC power supply for receiver;
- Onboard 6DOF IMU, support integrated navigation system (INS).

1.1.2 System Overview

Precis-BX306 board block diagram is presented as follows

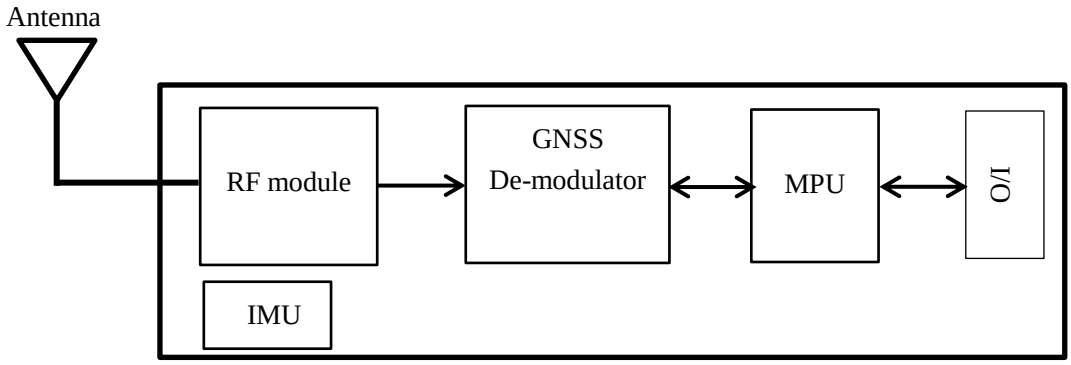


Figure 2 BX306 system block diagram

RF module: Receives GNSS signals from antenna, sends to baseband module as IF signal after filtering and low noise amplifying.
Baseband: Demodulates GNSS IF signals into navigation message.
MPU: A microprocessor for PVT calculation, differential position processing, and data transfer to and from peripherals.
IMU: an on-board 6 axis IMU can provide motion tracking information under obstacles environment where GNSS signal is lost.
I/O interface: Includes COMs, event mark and power supply etc. interface.

1.1.3 Connectors and Indicator Locations

There are two connectors on BX306 board, J1 is a MCX connector, which is for the RF signal input and J2 is a 2mm straight 2x10 header, which is for power, data input/output and signaling.
Top view of

Figure 3 gives the locations of these two connectors.

The Two LED indicators show the power/positioning status of Precis-BX306 board. The location and functions of the two indicators are given in

Figure 3 and Table 1, respectively.

Top View

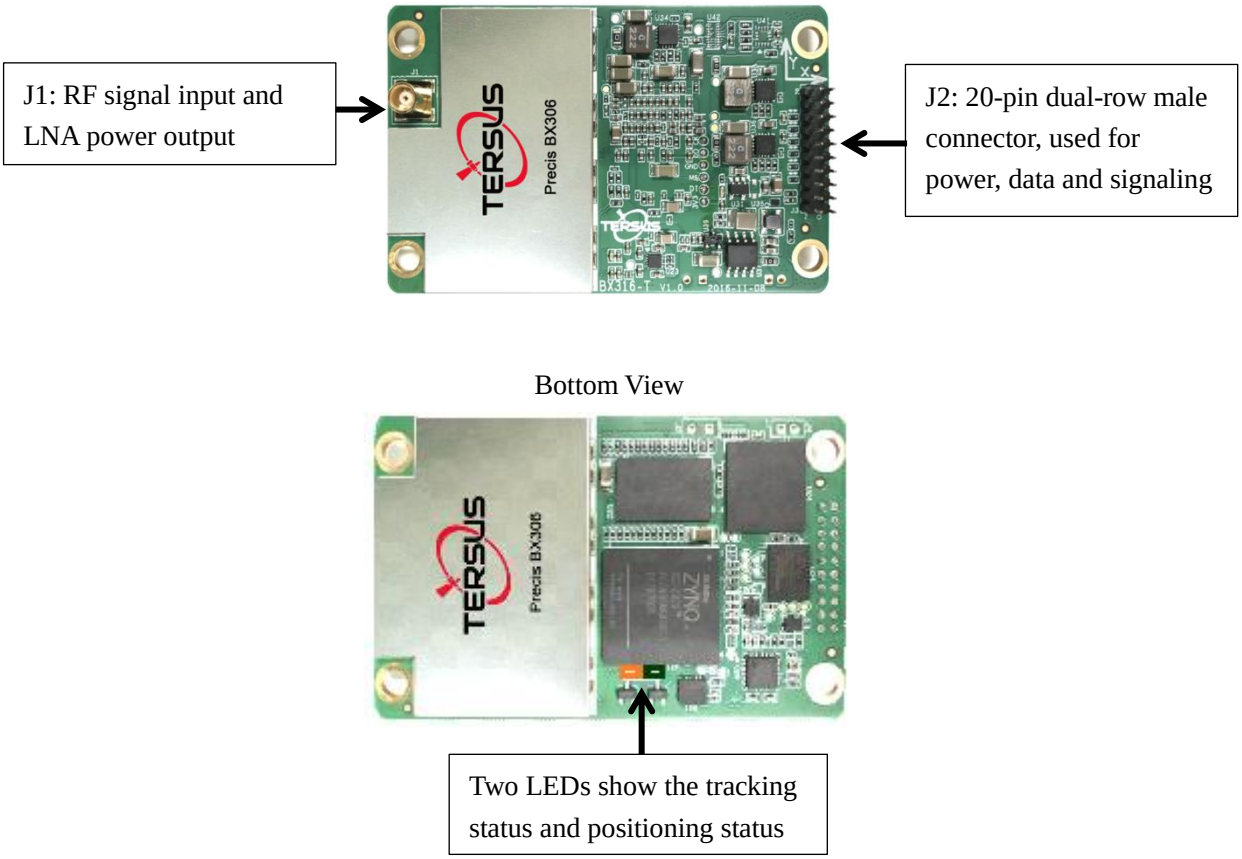


Figure 3 Connectors and LED Indicators

Table 1 The definition of the LEDs on board

	LED1 (ORANGE)	LED2 (GREEN)
Satellites not tracked	OFF	OFF
Satellites tracked	BLINK	OFF
RTK float solution	ON	BLINK
RTK fix solution	ON	ON

1.2 Overview of BX306 Receiver V1.1

Tersus BX306 receiver V1.1 uses the BX306 board to deliver centimeter level positioning in a compact enclosure. The BX306 provides accurate positioning with serial interfaces. Figure 4 gives an outlook of the BX306 receiver V1.1. The following sections provide more about the ports on the receiver.

Figure 4 BX306 receiver V1.1

1.2.1 Ports Description and LEDs

Figure 5 and Figure 5 indicate an USB type-A port, four red LEDs, COM1/COM2 and a micro-USB port provided on the right side of the BX306 receiver and two SMA connectors provided at the left side of it. Table 2 gives a brief introduction about the ports.

Figure 5 Ports at the right side of BX306 receiver V1.1

Figure 6 Ports at the left side of BX306 receiver V1.1

Table 2 Description of the ports on BX306 receiver.

Interfaces	Descriptions
COM1	5pin PicoBlade receptacle connector with LVTTL voltage level
COM2	5pin PicoBlade receptacle connector with LVTTL voltage level
LED	Indicate operating status, see 1.2.3 for detail.
USB Type A	Reserved
Micro USB	5V DC power supply
GNSS SMA	For GNSS RF input
PPA SMA	For PPS output

1.2.2 Micor_USB Power Supply Port

The Micro_USB port is the power input for BX306 receiver. At the Micro_USB port, only VBUS and GND Pin are connected. VBUS Pin is for the whole Receiver Box power supply. And the supply voltage range is 5V DC +5% ~ -3%. The internal circuit of the port is given in Figure 7.

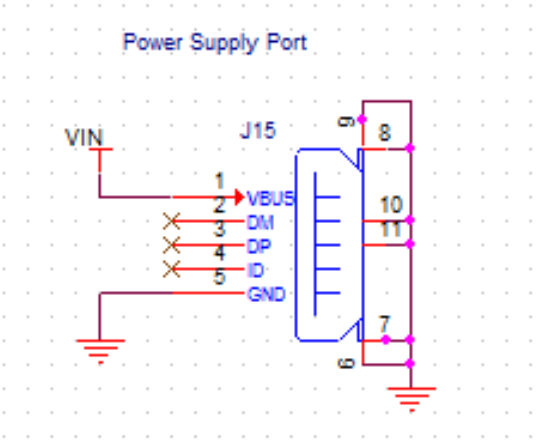


Figure 7 Schematic of Internal Micro_USB Connector

A general USB cable assembly, shown in , is used to connect the micro_USB port to the USB port in any devices. Figure 9 shows a BX306 receiver is powered via the USB port.

Figure 8 The two connectors of the USB cable

Figure 9 BX306 receiver powered via an USB port

1.2.3 LED Indicator of BX306 Receiver V1.1

The four red LED indicators show the operating status of Precis-BX306 receiver. The functions of these indicators are defined in Table 3.

Table 3 Definition of LED indicators

LED1	LED2	LED3	LED4
Reserved	Reserved	Positioning status, it will blink if the receiver has RTK float solution, and is ON if the receiver has RTK fix solution. Otherwise, it will be OFF.	Power indicator, after power on, it's always ON.

1.2.4 GNSS SMA Port

The GNSS SMA connector receives GNSS RF signal and outputs 5V voltage for the LNA in the active GNSS Antenna. The current is limited to 100mA. For details of the RF signal and Antenna Bias voltage and current, please refer to Table 13.

1.2.5 PPS SMA Port

PPS signal from the PPS SMA connector is 3.3V LVTTL. The following table is the details of the signal description. About the electronics details, please refer to Table 10.

Table 4 PPS signal Description

Signal	Input/Output	Factory Default	Comment
PPS	Output	Active Low	High voltage is 3.3V and IO type is LVTTL.A time synchronization output. This is a pulse where the leading edge is synchronized to receiver-calculated GNSS Time. The polarity, period and pulse width can be configured using command PPSCONTROL, see Tersus GNSS Log & Command Reference document for more detail about this command

1.2.6 USB Type-A Port

The USB type-A port is reserved now.

1.3 Overview of BX306 Receiver V3.1

Tersus BX306 receiver V3.1 uses the BX306 board to deliver centimeter level positioning in a compact enclosure. The BX306 V3.1 provides accurate positioning with serial interfaces. Figure 10 gives an outlook of the BX306 V3.1 receiver. The following sections provide more about the ports on it.

Figure 10 BX306 receiver V3.1

1.3.1 Ports Description and LEDs

Figure 11 and Figure 12 indicate the SMA connector at the right side of the receiver, and the power/communication ports at the left side of it.

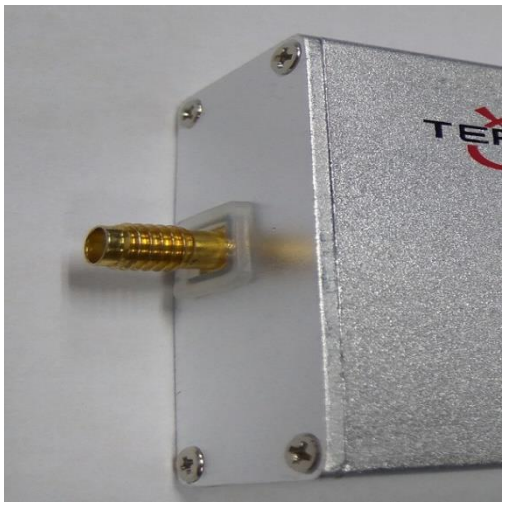


Figure 11 SMA connector

Figure 12 Power and communication ports

The SMA is the connector for the RF signal input from the antenna and +5VDC power output to the LNA in the active antenna. The DC port is the power port to this receiver, the input range is 5~12VDC. The Comm port includes three serial ports, a PPS and an EVENT mark signals, see Table 10 for more detail about DC power requirements and Table 17 for the signal definition of the Comm port. Two LEDs show the status of the receiver, Table 5 gives the definition of the two LEDs.

Table 5 LED definition

	LED1	LED2
POWER	ON	OFF
RTK float solution	ON	BLINK
RTK fix solution	ON	ON

1.3.2 Accessories and Connection

Several accessories can be connected with the BX306 receiver. The following sections give more about how the data logger, Pixhawk, radio and BlueTooth modules are connected with the BX306 receiver. Please contact with Tersus support for more about the modules above. Several kinds of cables are provided as the accessories to the modules above.

1.3.3 UART_To_USB Converter Module

This module's function is to convert UART LVTTL signal to USB signal. One end of the module is connected to BX306 COM1 via the Comm cable, and the USB connector should be inserted to the USB port on a PC or a laptop. Figure 13 shows how the converter module is connected between the BX306 receiver and the laptop.

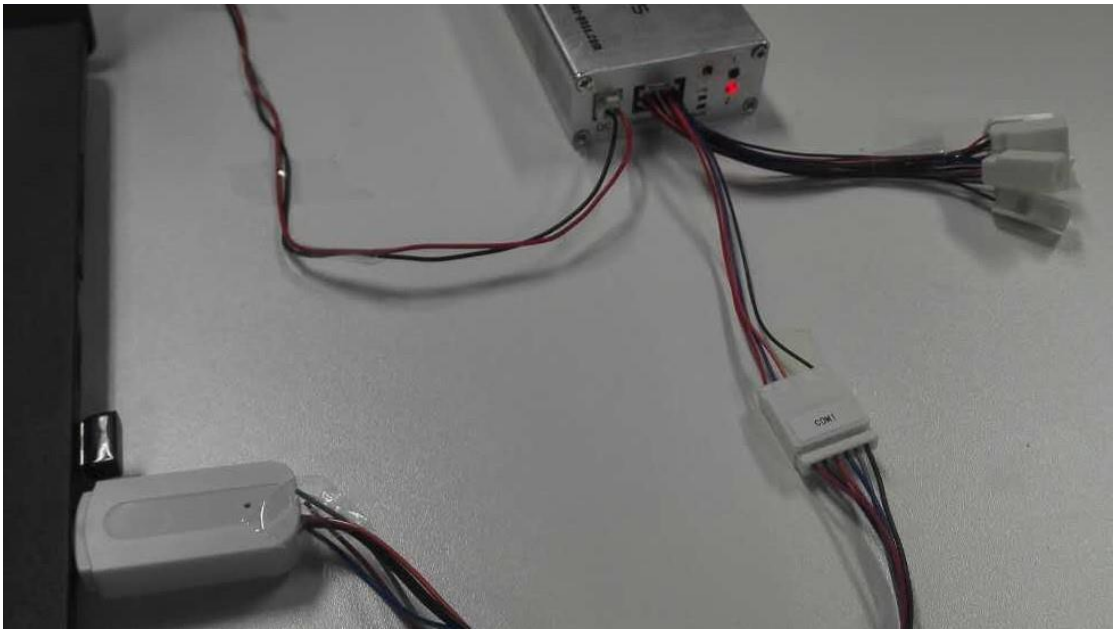


Figure 13 Connection between Precis-BX306 and UART_to_USB Converter

1.3.4 Data Logger Module and Cable

Data logger module is supporting log data to SD card from serial port at 115200 baud rate. Figure 14 shows the data logger is connected to the COM1 of the BX306 receiver. For more about the data logger, please go to here.

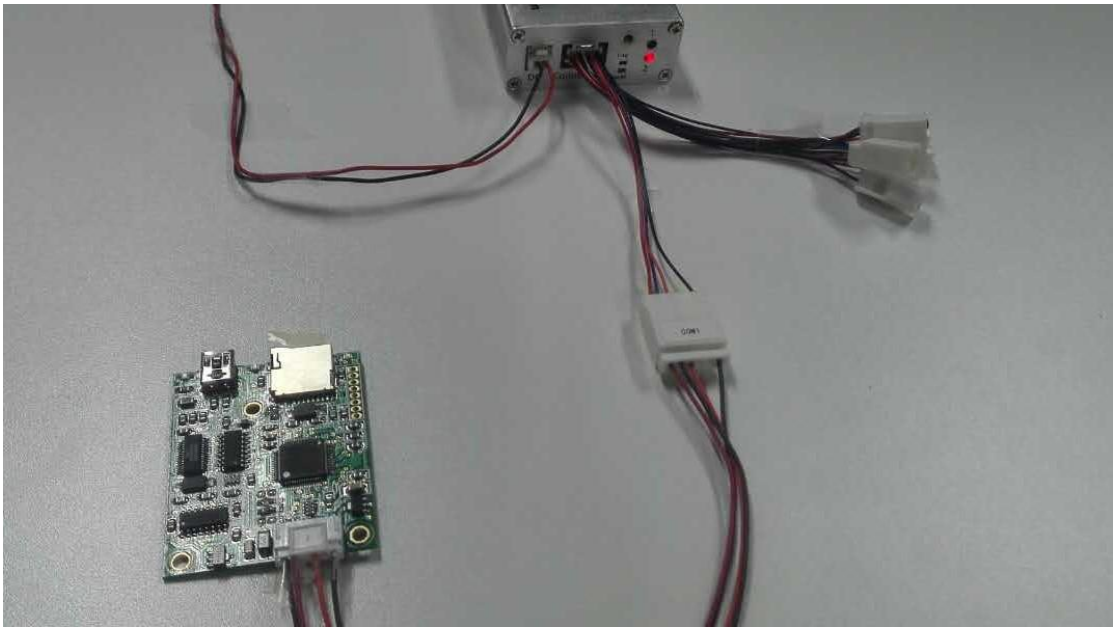


Figure 14 Connection between Precis-BX306 and Data Logger

1.3.5 Pixhawk and Cable

Pixhawk cable is used to connect the BX306 receiver with Pixhawk of UAV through COM1.

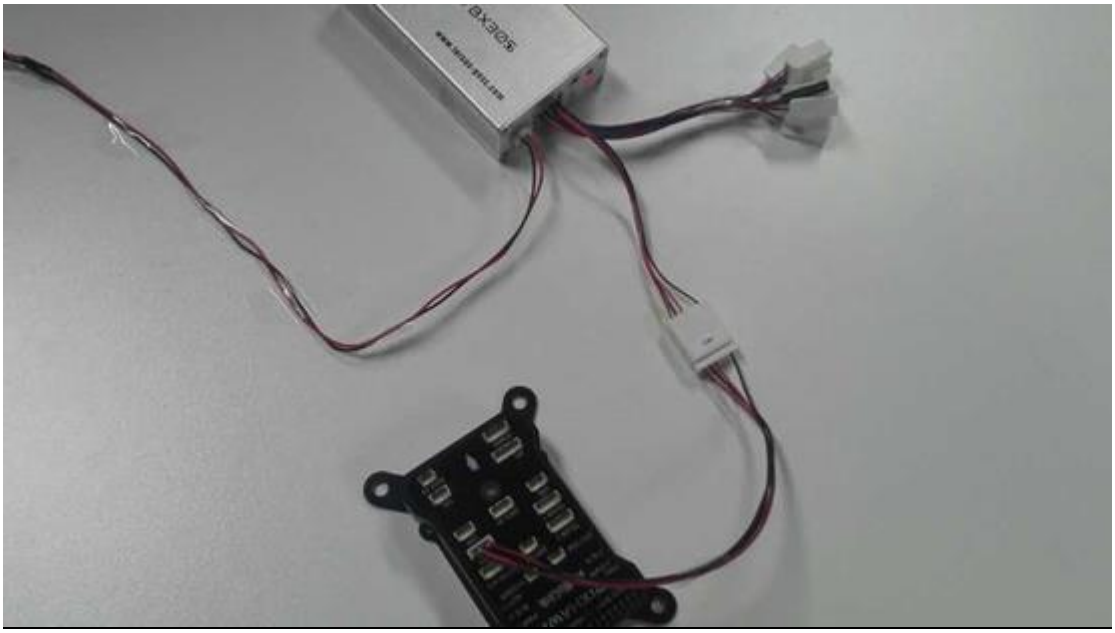


Figure 15 Connection between Pixhawk and Precis-BX306

1.3.6 Radio Module and Cable

The function of radio module is to transmit RTCM/CMR/CMR+ stream data from a base to a rover. Radio cable is used to connect the board with radio through COM2.

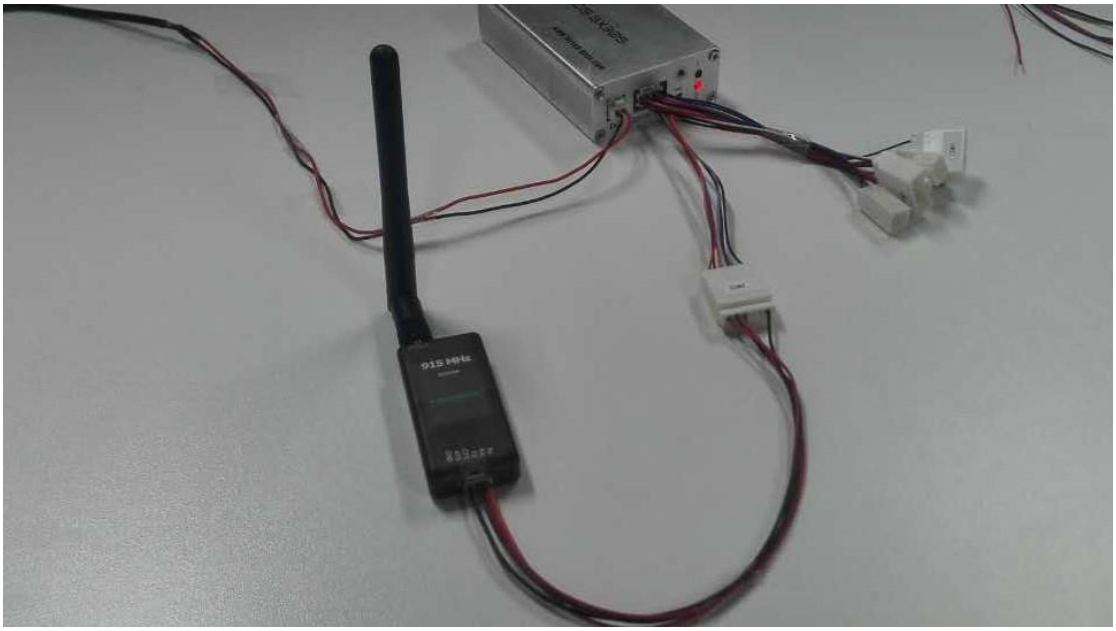


Figure 16 Connection between Pixhawk and Precis-BX306

1.3.7 Bluetooth Module and Cable

The function of Bluetooth module is to communicate the board with Bluetooth instrument. For more details about the Bluetooth module, please go to here. Bluetooth cable is used to connect the board with Bluetooth module with COM2.

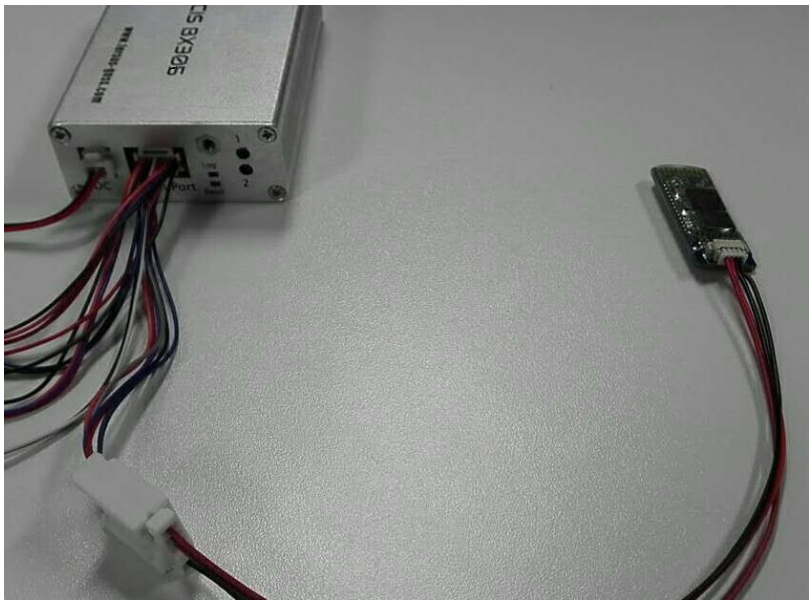


Figure 17 Connection between Bluetooth module and Precis-BX306

2. Setting Up the Receiver

This chapter describes how to set up the Precis-BX306 receiver to make it work. In order to perform RTK positioning, Precis-BX306 need the GNSS signals input from the SMA connector and differential data stream input from COM2 port. COM1 port is used for configuration commands input and solution output. Precis-BX306 can be accessed with a serial terminal tool, but it's recommended to communicate it with graphical tool Tersus GNSS Center, the link is here.

2.1 Connect to Computer

The first step to set up your receiver is configuring it with Tersus GNSS Center, which is running on Windows. Before running the tools, you need physically connect your Precis-BX306 board to your computer. Tersus USB adapter is connected to the COM1 terminal of the Comm port cable and an USB port of your computer (see Figure 19Figure 18). The power for the board is supplied via the DC port of the board. The USB driver is required to let your computer recognize the USB adapter device and it can be downloaded from our website. There is a LED indicator on the connector to shows whether data is received and transmitted.

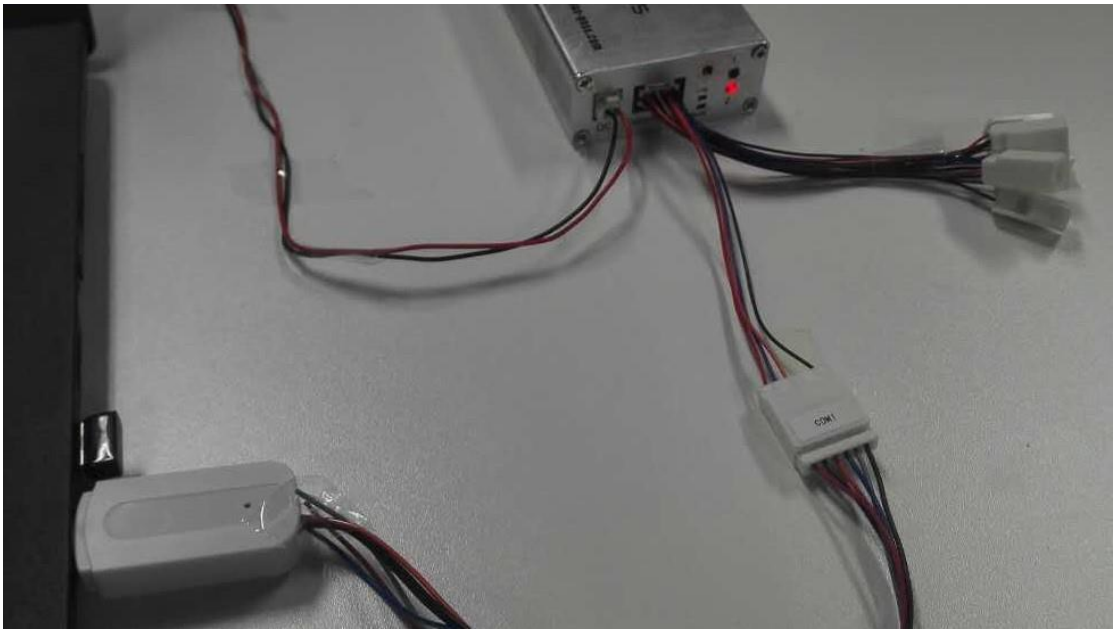


Figure 18 Demonstration of wired connection to computer

After the Tersus USB adapter is installed on your computer successfully, you can find it in device manager (see Figure 19). (Device manager can be found in right click “This Computer” icon on desktop and choose ‘Manage’, then select Device manager on the right panel). Precix-BX306 is shown as “USB Serial Port” and you can read solution of Precis-BX306 board by connecting this serial port with any serial tools. The default serial connection parameter of Precis-BX306 COM1 and COM2 are listed in Table 6. Then you can use serial tool to receive/transmit data from/to the board. We recommend you connect the board with the Tersus GNSS Center software, which can be freely downloaded from our website, Figure 20 shows the main window of Tersus GNSS

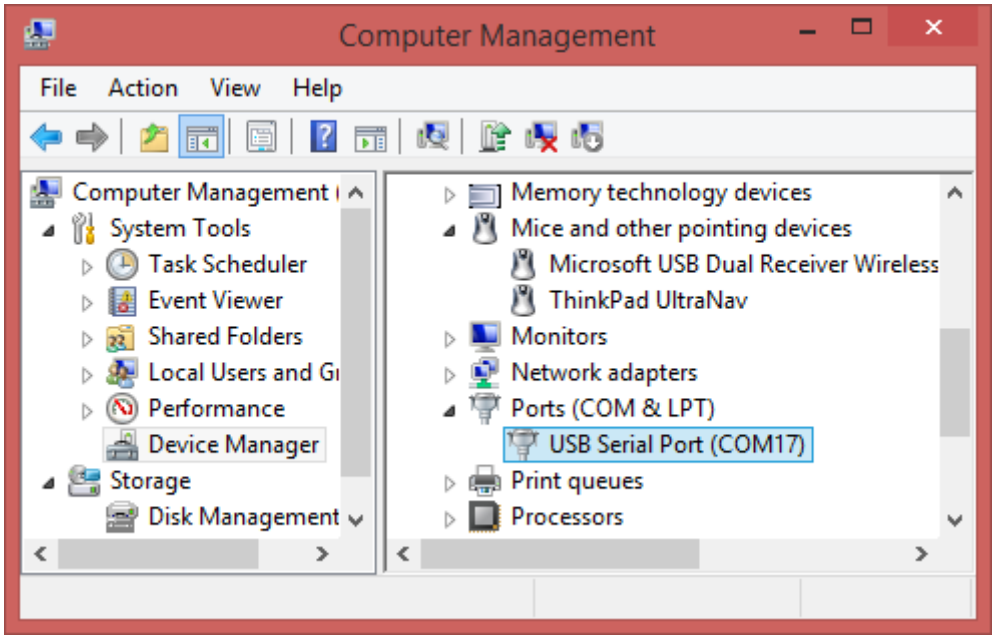


Figure 19 Demonstration of Precis board in Window device manager

Table 6 Default Serial port parameter of Precis-BX306 COM1 and COM2

Serial port parameter	Default value
Baud rate	115200
Byte Size	8 bits
Parity	None
Stop Bits	1bit
Flow Control	None

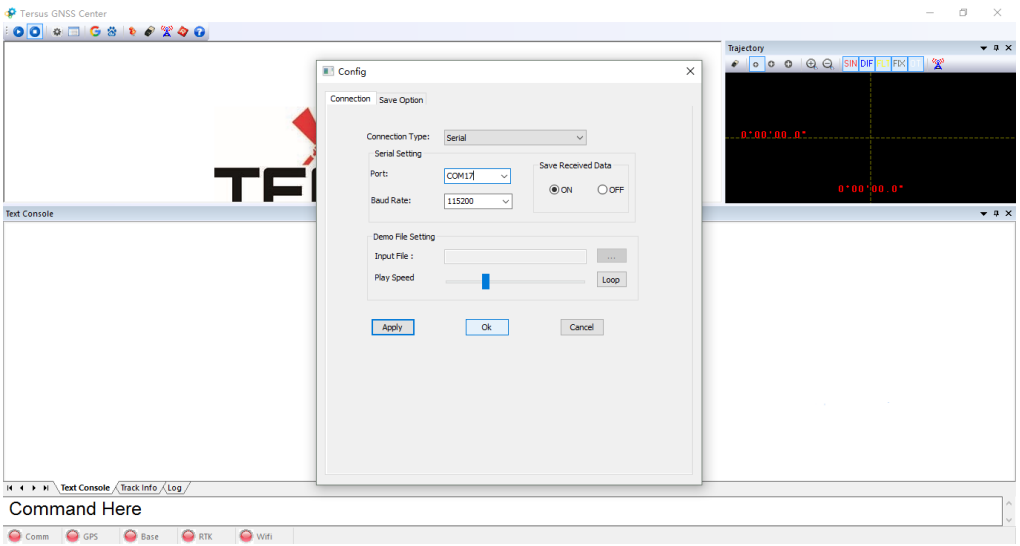


Figure 20 Tersus GNSS Center connect to BX306

2.2 Connect to Antenna

Precis-BX306 provides a SMA female connector for connecting to GNSS antenna. Both active and passive GNSS antennas are acceptable. For active antenna, Precis-BX306 board can provide 5V, up to 100mA current to the LNA in the antenna. Two recommended Antenna types are shown in Figure 21. For more about the antennas, visit our accessories website at https://www.tersus-gnss.com/collections/gnss-accessories.

Figure 21 Recommended GNSS Antennas for Precis-BX306

2.3 Connect to Base Station

RTK technique requires a real-time stream from (virtual) reference station to perform relative position. Considering the signal transmission medium, Precis-BX306 board allows to connect to base station in three manners: wired connection, UHF connection and Wi-Fi connection. A demonstration of the ways to access the data stream from the base station is shown in Figure 22.

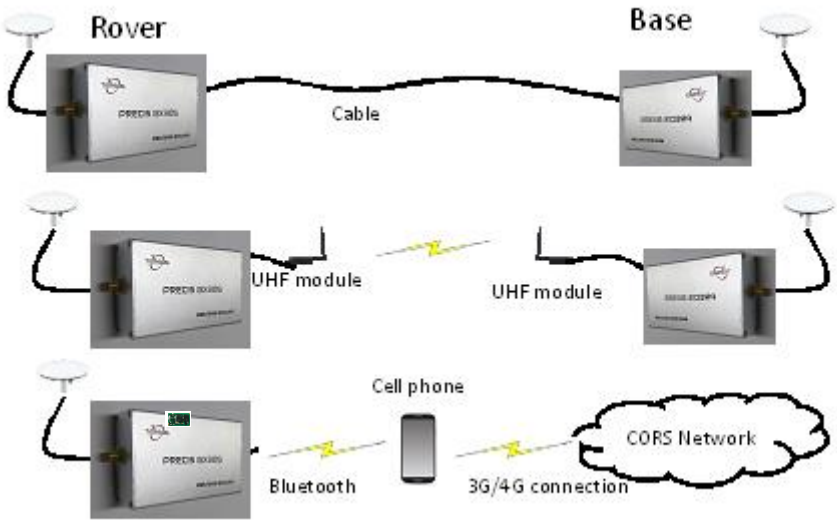


Figure 22 Three ways to connect to the base data stream: wired connection, UHF connection

Wired connection method is the simplest way, but it is limited to a few meters. In this case, a cable connects directly the COM2 port of both base and rover. No additional communication device requires. It is often used in altitude determination or other ultra-short baseline applications. The details of the other two connection methods will be discussed in following sections.

2.4 Connect to Base Station with UHF Radio Module

GNSS RTK is a precise relative positioning technique, which achieves centimeter positioning accuracy. RTK positioning requires two set of Tersus RTK boards at minimum, which are used as the base station and the rover station, respectively. Normally, the base station is set up on a fixed known point and it transmits differential corrections to the rover station consistently. The rover station, after receiving differential corrections from the base station, calculates very precise RTK solution. Figure 23 is an overview of Tersus GNSS RTK system, which demonstrates how it works. We recommend using COM2 to transmit/receive the differential data (in RTCM format) and using COM1 for configuration and logging RTK solution.

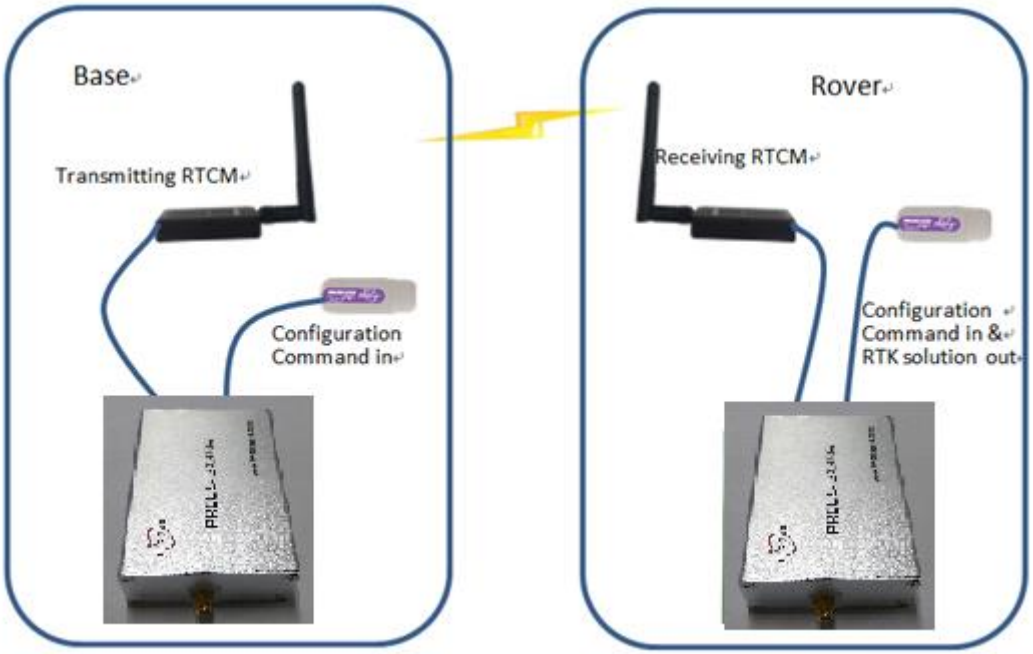


Figure 23 Overview of Tersus GNSS RTK Systems

（1） Hardware & Software Requirement

- Hardware required
  - Precis-BX306 RTK board ×2
  - Tersus USB connector ×2
  - GNSS antenna ×2
  - GNSS Antenna cable ×2
  - UHF module ×2
  - UHF module cable ×2
  - 5V~12VDC Power supplier ×2

Precis-BX306 bundle kit includes all hardware listed above except power supplier.

- Software required
  - Tersus USB adapter driver
  - Tersus GNSS Center

You can download above software freely through our website.
www.tersus-gnss.com/pages/document-software

（2） Configuration of Precis-BX306 RTK Boards

Before starting field work, the first step is to configure the board into the right mode. What you need to do is to connect the board to your PC and key in commands with the Tersus GNSS Center

software. The detailed steps are given as follows:

- Connect the board to you PC with Tersus USB adapter (see section 2.1).
- Power on the BX306 receiver.
- Connect the board with Tersus GNSS Center. Launch Tersus GNSS Center. Choose serial as the connection type and choose the right serial port and baud rate (115200 by default). Click ‘OK’ to establish the serial connection. If the connection is successfully established, the Comm indicator on the status bar will turn to green.
-

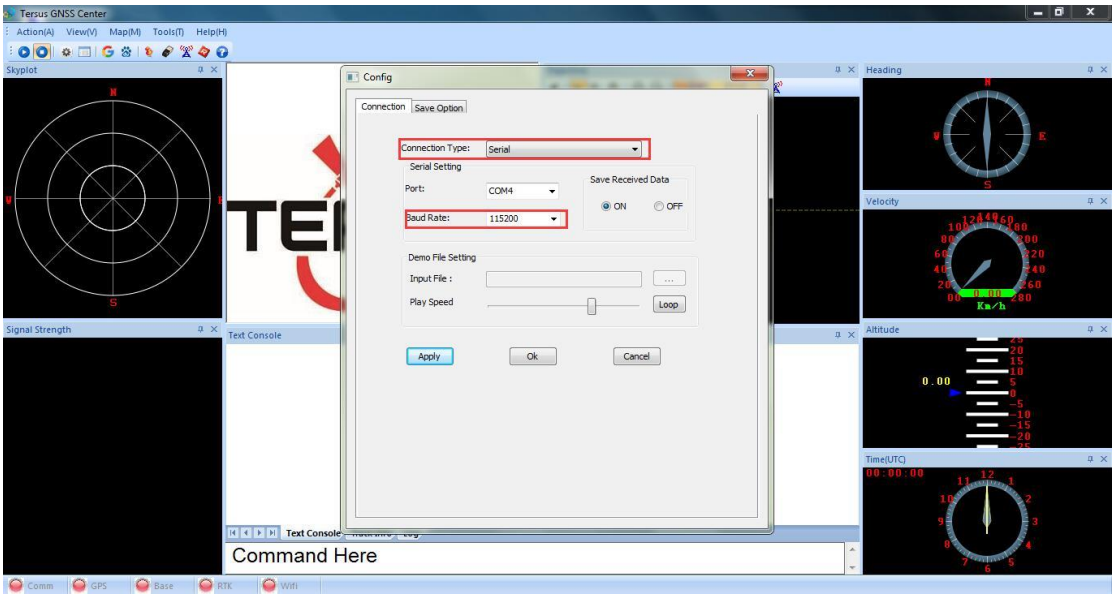


Figure 24 Establish Serial Connection with Tersus GNSS Center

- Enter commands in the text console window

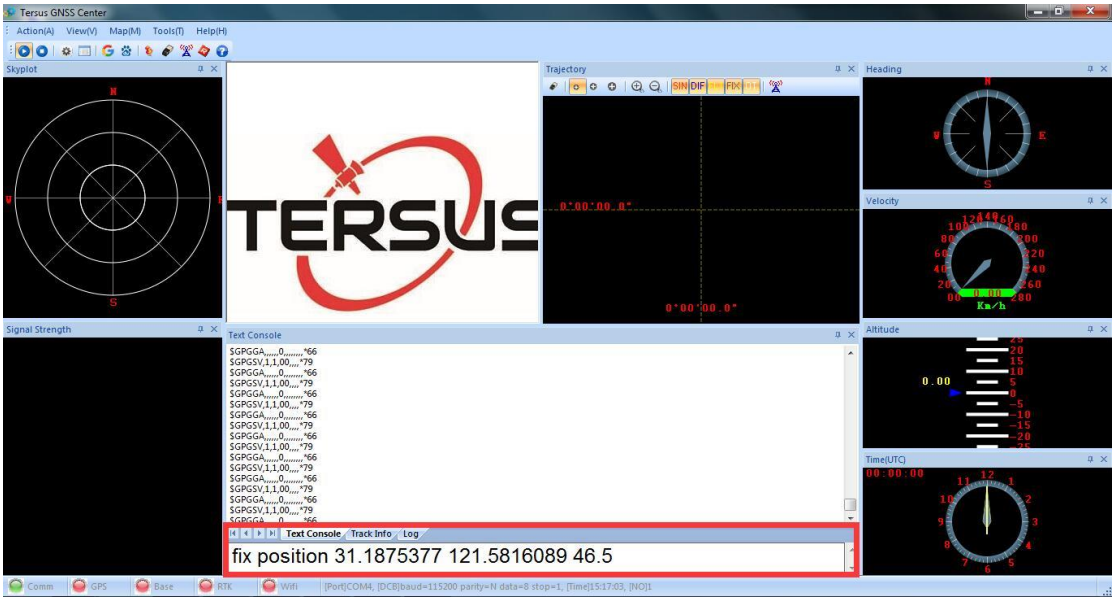


Figure 25 Text Console Window of Tersus GNSS Center

Commands for the Base Station Board:

fix position 31.1874808 121.58111234 41.4618
log com2 rtcm1074 ontime 1
log com2 rtcm1084 ontime 1
log com2 rtcm1124 ontime 1
log com2 rtcm1005 ontime 10
saveconfig

These commands fix the coordinate of the base station and configure RTCM message to be transmitted. The coordinates are expressed in degree/meter. After each command is sent, the board will automatically acknowledge a '>OK', which means the configuration takes effect. If no acknowledge is received, please refer to 'trouble shooting' section in the user guide or contact Tersus support support@tersus-gnss.com .

2.5 Connect to CORS with External Bluetooth Module and Mobile Phone

The CORS is an appealing way to do RTK due to its convenience and large coverage area. Precis-BX306 currently does not support build-in NTRIP client feature. An alternative way to connect CORS network is employing external Bluetooth module and a cellphone. Here is a detailed procedure about how to connect to CORS Network with Precis-BX306 receiver.

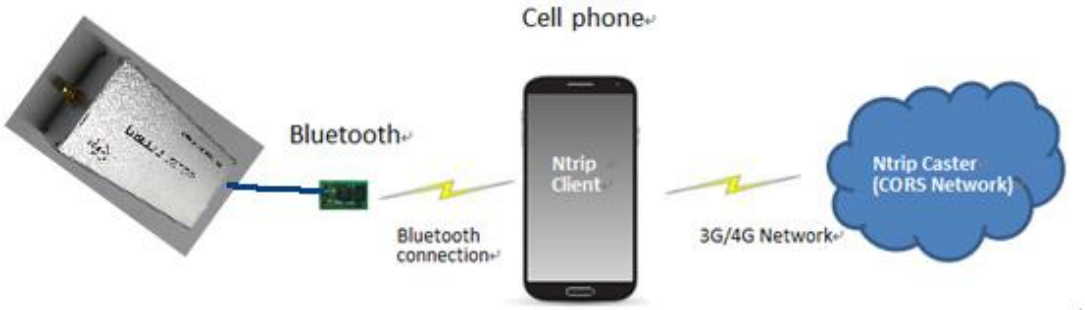


Figure 26 Demonstration of connecting Precis BX306 to CORS Network

（1） Hardware & Software Requirement

- Hardware required
  - Precis-BX306
  - GNSS antenna
  - GNSS antenna cable
  - External Bluetooth module
  - Bluetooth cable
  - Cell phone (android system)
  - 5V~12DC power supplier

- Software required
  - NTRIP client (free android apps)

（2） Connect to CORS Network

Please follow below steps.

- Connect GNSS antenna to Precis-BX306.
- Connect external Bluetooth module to COM2 of the board
- Connect to power supplier

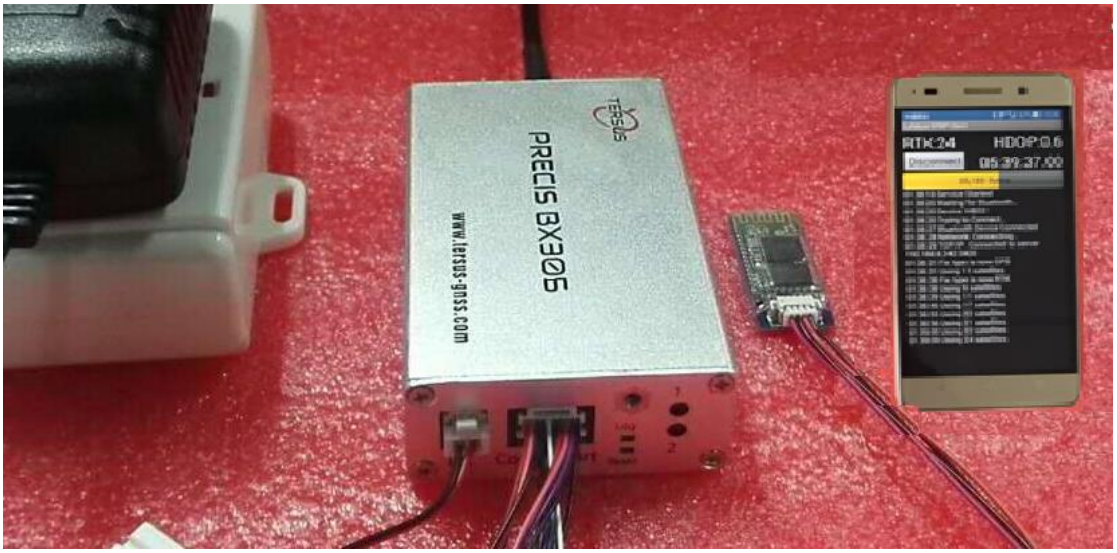


Figure 27 Demonstration of connecting Bluetooth module, mobile phone and Precis-BX306

- Turn on the Bluetooth of the mobile phone and scan and pair the mobile phone with the external Bluetooth device. By default, the external Bluetooth device name is 'HC-06' and the default PIN is '1234'. You can manually change the device name when you are trying to connect multiple Bluetooth devices.
- Install NTRIP Client APP from App store and launch this App.
- Configure Settings->Receiver Settings. Set Receiver Connection as 'External via Bluetooth'. Set Bluetooth Connection Method as Secure. Tick Auto-Enable Bluetooth.
- Configure Settings->NTRIP Settings. Launch NTRIP Client and configure the NTRIP Settings as below, then click Connect
    - Network Protocol：NTRIP V1.0
    - Caster IP & Port:
    - Username & Password:
    - Data Stream: RTCM32
    - Reported Location: Automatic

As the CORS network may require the approximate location of users, the NTRIP client allows to report the location automatically or manually. By automatic means that the client read NMEA GGA data from the board and sends it to NTRIP caster, so the board has to be output NMEA GGA sentences in this way. Failure to report user location may cause connection failure. Alternatively, you can manually report the latitude and longitude to the NTRIP caster.

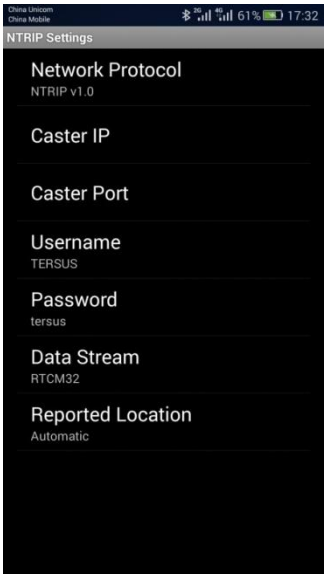


Figure 28 Example of NTRIP Settings

- After configuration, return to main panel and click connect to establish a NTRIP connection. If you receive message 'Connected to server ****', it means the connection are established successfully.

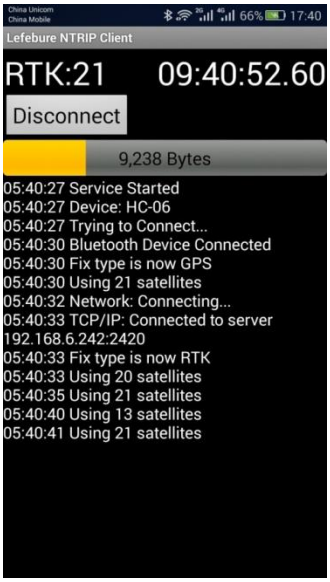


Figure 29 Demonstration of Connection Status

2.6 Integration with Autopilots

Precis-BX306 board can be integrated with autopilots. In this section, the connecting to Pixhawk flight control is used as an example. A cable is used to connect the COM1 port of

Precis-BX306 board and the GPS port of the Pixhawk (see Figure 30). The pin definition of the Pixhawk GPS port is listed in Table 7. With regarding to the power consumption, we recommend using external power sources. Please also pay attention to the baud rate setting of Pixhawk as the default baud rate of Precis-BX306 board is 115200. The Pixhawk can only recognize the NMEA sentence with GP NMEA talker. Incorrect NMEA talker configuration may cause connection failure. The GPS_type in Pixhawk parameters should be set to NMEA.

Figure 30 Demonstration of Integration with Pixhawk autopilot

Table 7 Pin definition of Pixhawk GPS port (from left to right)

Pin	Pin1	Pin2	Pin3	Pin4	Pin5	Pin6
Signal	VCC	TX	RX	CAN2 TX	CAN2 RX	GND
Voltage	+5V	+3.3V	+3.3V	+3.3V	+3.3V	GND

Then you need to mount the GNSS antenna and the board on your vehicle. Please beware of following instructions when you mount the GNSS antenna to your drone.

- Place the module on the outside of your vehicle (in an elevated position if appropriate) with a clear view of the sky
- Keep the module from DC power wiring and the batteries by at least 10cm

Next step is to setup the Pixhawk with Mission Planner. Open Mission Planner software and choose the right COM port on the top right corner. Choose 115200 as baud rate (default baud rate of Precis BX306 COM1 port). Then click ‘connect button’ on the right. Then the Precis-BX306 is recognized by mission planner if the GPS status becomes ‘3D Fix’ (see Figure 31).

Figure 31 Precis-BX306 board is recognized by Pixhawk and Mission Planner

2.7 Set Up Base Station

RTK positioning requires a rover station and a base station. Normally, the base station is set up on a known point and it is assumed that the base station does not move during RTK positioning procedure. There are 3 issues need to pay attention during the setup of the base station:

2.7.1 Obtain the Coordinate of the Base Station

RTK is a kind of relative positioning technique; it actually measures the coordinate difference between the rover station and the base station. If the base station coordinate has a small offset (up to a few meters), the rover position will offset the same amount. Therefore, if your positioning results need to be compatible with others (e.g. map, reference trajectory), then you need set your base station coordinate compatible with your target coordinate system. You can obtain your base station coordinate by relative positioning, precise point positioning (PPP) or standard point positioning (SPP):

- Relative Positioning. You can observe on your base station and another site with known coordinate. Then performing relative positioning with professional software to deliver precise known position to your base station. You can also uses CORS service for convenient.

- PPP. Many institutes also provide online PPP services for free. What you need prepare is GNSS data in RINEX format. After uploading your file to their online platform, you can acquire precise base station.

- SPP. If you only need obtain a good self-repeatability, you can input a single point positioning (SPP) result as base station for first time and record it. You need input this coordinates as known when you set up your base station on the same site next time.

2.7.2 Antenna Installation

For normal RTK positioning case, the base station does not change, so the antennas need to be installed on a stable platform, such as tripod or pier. A key issue of antenna installation is measuring the antenna offset. As the known point is normally a monument or a mark on the ground, while what GNSS measured is to the antenna phase center. Therefore the offset between the ground mark and the antenna phase center need to be measured during antenna installation. This offset is normally expressed as north, east and height and normally the first two components are negligible. Therefore, the antenna height (shown as Δh in Figure 32) need to be measured during antenna installation. The measure method is antenna dependent, so we recommend you refer to GNSS antenna installation guide.

Figure 32 Demonstration of antenna height measurement

2.7.3 Observation Environment

GNSS signals can be severely contaminated by multipath effect, so it is necessary to avoid some unnecessary inference from environments. Tersus recommends following conditions when you choose your base station site:

- Open sky. No blockage/very few blockage above 15 degree.

- Keep away from signal emission source, such as large radar antenna, radio transceiver, etc.
- Keep away from voltage transformer, and high voltage power line.
- Keep away from tall buildings and water, such as lake, pool.
- Select a stable site to avoid antenna shaking

2.8 Log Data to SD Card

Precis BX306 does not have onboard SD Card slot, but it support data logging with external data logger. This section will introduce how to log raw observations to SD Card.

2.8.1 Hardware and Software Required

- 1*Precis-BX306 RTK Board
- 1*Tersus USB adapter
- 1*External data logger
- 1*SD Card (formatted into FAT32 file system, max size is 32G)
- GNSS antenna
- GNSS antenna cable
- Cable for data logger
- +5~12VDC power supplier
- Tersus GNSS Center (software)

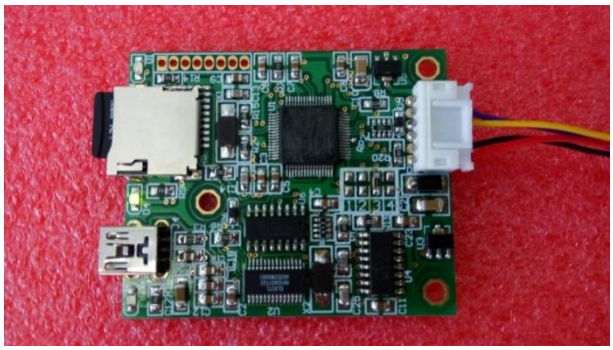


Figure 33 External data logger

2.8.2 Configuring raw Observation Output

- Connect COM1 of the board to your PC with Tersus USB adapter, and then establish a serial connection to board with Tersus GNSS Center.

- Enter the following commands in the text console window to log the raw observation and broadcast ephemeris data.

  unlogall
  log rangecmpb ontime 1
  log gpsephemb ontime 60
  log bd2ephemb ontime 60
  log gloephemerisb ontime 60
  saveconfig

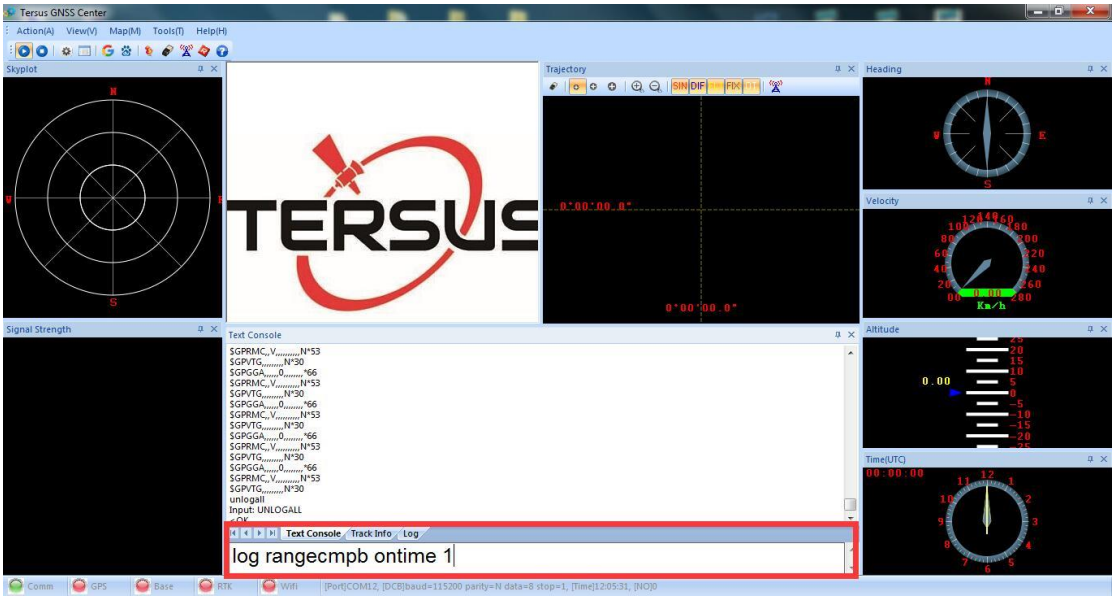


Figure 34 Enter commands for logging raw observation and broadcasting ephemeris data

2.8.3 Connect to Data Logger

Disconnect with Tersus USB adapter and connect the external data logger to COM1 of Precis-BX306. Connect the GNSS antenna to the board and power up the board. The board can supply power to the data logger and the data logger can automatically log the received data. By default, the data logger accept data stream from serial port at 115200 baud rate.

There are two indicators on the data logger. The green indicator shows whether the SD card is well

connected to the board and the red indicator blinking shows whether the SD card is working as expected. A solid red indicator shows the SD is not correctly mounted. In this case, please check whether the SD card is inserted into the slot properly or whether the SD card is formatted in to FAT32 file system.

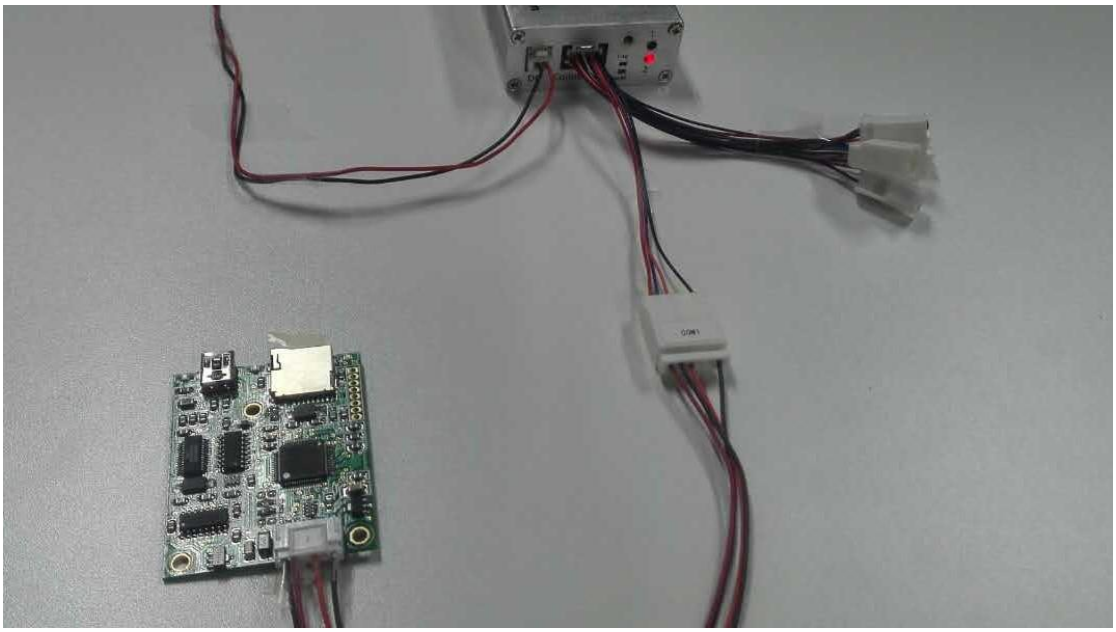


Figure 35 Connection of Precis-BX306, external data logger

2.8.4 Export Logged Data and Format Conversion

The data logger can log the required data without any manipulation. After finished data collection, you simply disconnect the data logger from the board to finalize data logging. The logged binary observation data can be converted in to RINEX 3.2 format with Tersus RINEX Converter or Tersus GNSS Center. You can connect the data logger from the mini USB port to your PC, then the data logger works as a USB storage mode. You can access the logged file as just like a USB disk. The data will be automatically saved in the file named as 'mydata.txt'.

If you try to log data multiple times, the logged data will automatically append the end of the file. Therefore, we recommend you move or manually rename the file after you finish data logging.

2.9 Event Mark Input

BX306 provides an event mark input, whose polarity and enable/disable can be controlled by command MARKCONTROL, see Tersus GNSS Log & Command Reference document for more

detail about this command.

This input signal is useful when the receiver is integrated with a camera, which is popular application in UAV/mapping. Please see Table 10 for the detailed requirement of event mark. Generally, hot shoe port on a camera is used to connect to the event mark.

The event mark signal has a 10K pull-up resistor to 3.3V on the board, so no pull-up is needed in the interface board.

Use the following circuit to create adequate protection for the EVENTx in most situations.

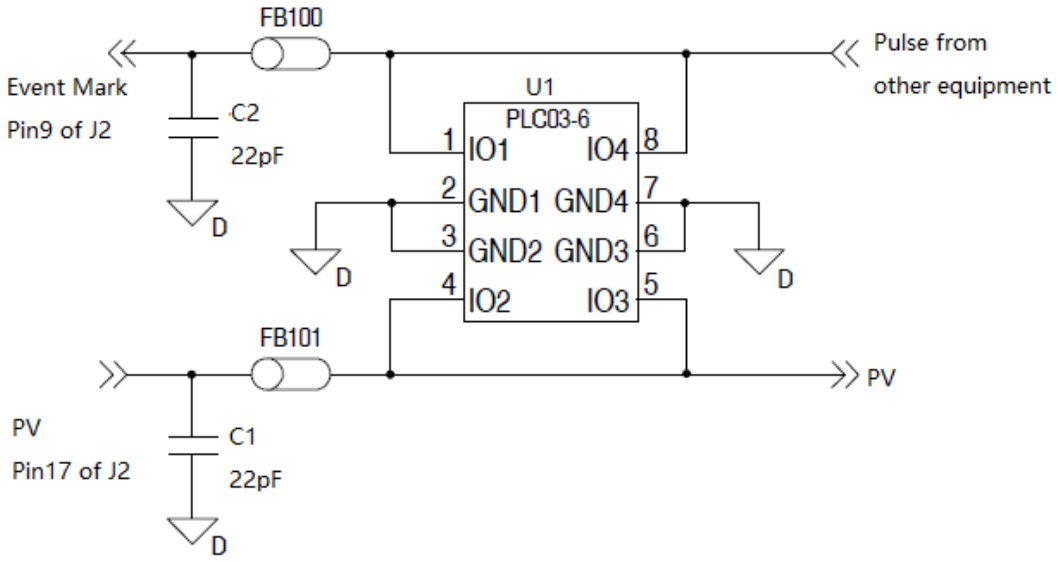


Figure 36 Protection for EVENT mark input

2.10 Installation and Operation Guideline

At last, introduces the guideline of Precis-BX306 installation and operation to avoid misuse or damage of device.

2.10.1 ESD Protection

To prevent any electronic devices in Precis-BX306 board suffering harmful effects from ESD, it's required to read following cautions before you open the anti-static packing box:

- Please handle the board on an anti-static table, from where connect an anti-static wrist strap to you. If anti-static table is not available, please connect your anti-static wrist strap to the metal case.

- Please touch the fringe area only when you take the board on and off, touch the electronic components directly should be avoided. Please check if any components obviously dropped off or damaged at the first time you receive the board, otherwise please contact your local dealer.

- Please keep the anti-static packing box well in case you need transfer Precis-BX306 with it later.

2.10.2 Avoid Signal Inference

Strong electromagnetic inference may interrupt GNSS signal tracking or degrade GNSS positioning performance. Keep your antenna away from following noise source during operation:

- High-voltage power line
- Power generators
- Power switch
- Voltage transformer
- High power wireless signal generator

3. FW Update

3.1 Firmware Updates

If a new firmware update is released, it will be available on the Tersus web site. Or you can get the updates from Tersus support.

The FW version of a Tersus receiver can be updated in field. Connect the COM port of the board with Tersus GNSS Center, and input ‘log version’, the following info will be output:

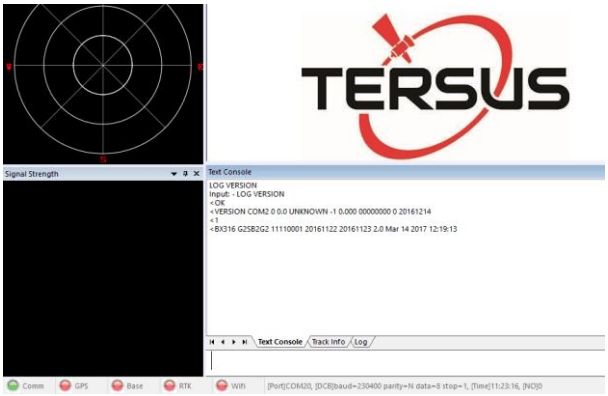
VERSION COM2 0 0.0 UNKNOWN -1 0.000 00000000 0 20161214
< 1
< BX306 G2SB2G2 **hc_sdln0020** 20161122 20161123 2.0 Mar 12 2017 20:28:37

hc_adln0020 is the FW version. See ‘version’ in Tersus GNSS Log & Command Reference document for more detail about this log.

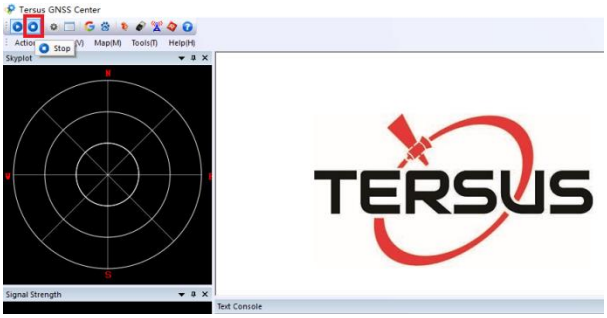
3.2 Upgrading FW Using the Tersus GNSS Center

Please follow the following steps to upgrade the FW.

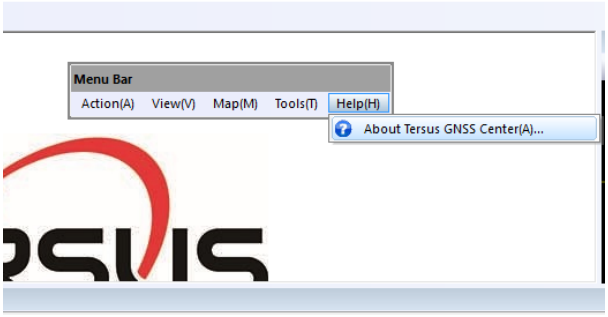
- Power on the receiver.
- Run Tersus GNSS Center software and communicate with the receiver, see section 2.1 for detail. Make sure the receiver has finished initialization, which can be confirmed by input ‘log version’ in the console window and the receiver will output feedback.



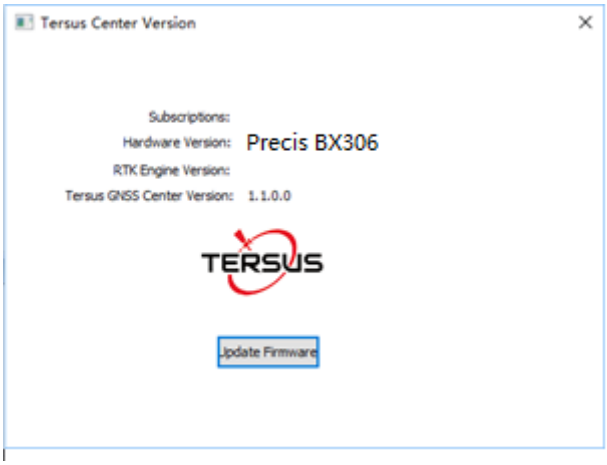
- Press Stop button to terminal the communication between the computer and the receiver.



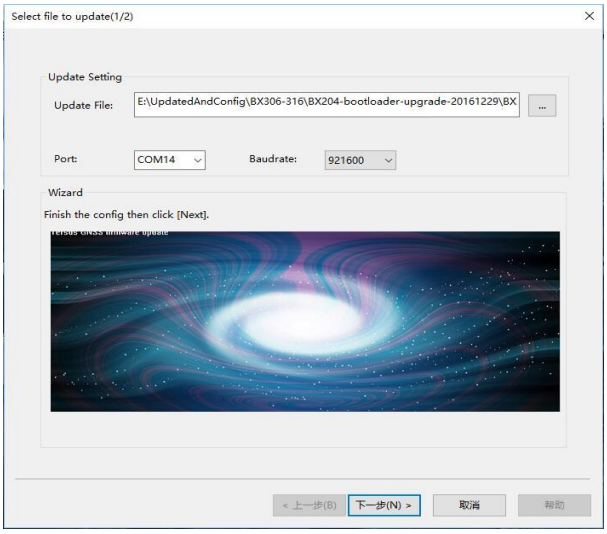
- Select Help|About Tersus GNSS Center…



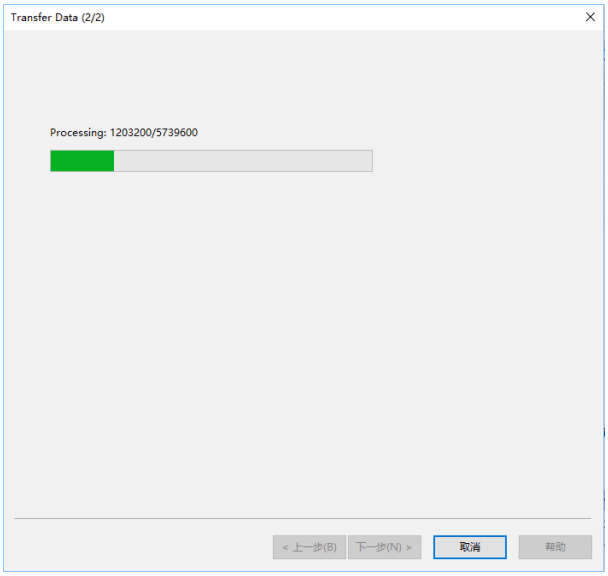
- Select UPDATE FIRMWARE button in the following



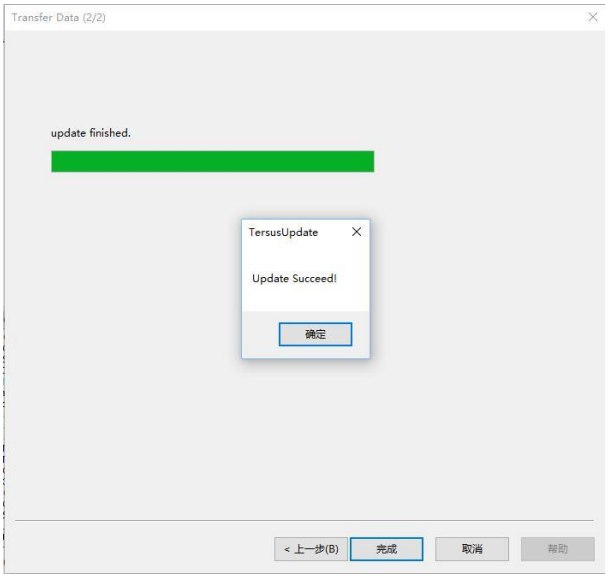
- Select the upgrade file, when a file is selected, the file will be shown in the Update File bar. PORT is the PC's serial port for the USB adapter. 921600 is recommended for the Baudrate. Press Next



- The following figure shows the FW is upgrading



- After the FW is upgraded successfully, The following show



- Press finish button to close the FW upgrade window. You can confirm the FW version by connecting to the receiver and input ‘log version’ and check the FW version.

4. Specifications

The detailed performance and physical specification of Precis-BX306 is introduced in this chapter.

4.1 Performance Specification

The BX306 board, the BX306 receiver V1.1 and the BX306 receiver V3.1 have the same performance; all are listed in Table 8Table 8.

Table 8 Performance specification of Precis-BX306

Feature	Specification
Channel Number	192
Supported Signals	GPS L1/L2/+GLONASS L1/L2+Beidou B1/B2
Standard Positioning Accuracy	
Horizontal (RMS)	1.5m
Vertical (RMS)	3.0m
RTK Positioning Accuracy	
Horizontal	10mm+1ppm
Vertical	15mm+1ppm
Observations Accuracy	
C/A Code (zenith direction)	10cm
P Code (zenith direction)	10cm
Carrier Phase (zenith direction)	1mm
Time to First Fix (TTFF)	
Cold start	<50s
Warm start	<10s
Initialization	<10s (typically)
Initialization reliability	>99.9%
Timing Accuracy (RMS)	20ns
Velocity Accuracy (RMS)	0.05m/s
Differential Data Format	RTCM2.x/RTCM 3.2/CMR/CMR+
Max. Update Rate	20Hz

4.2 Electronic Characteristics

4.2.1 Absolute Maximum Ratings

Table 9 Description of Absolute Maximum Ratings for BX306 board

Parameter	Symbol	Condition	Min	Max	Unit
Power Supply Voltage	Vin			3.6	V
Input pin applied DC Voltage	RXD_UART			3.6	V
	Vin			3.6	V
DC current through any digital input pin	Ipin			10	mA
Input power at RF_IN	Prfin	Source impedance = 50 Ω, continuous wave		13	dBm
Antenna bias voltage	V_ANT			6	V
Antenna bias current	I_ANT			100	mA
Storage temperature	Tstg		-40	85	℃

Note: Stressing the device beyond the "Absolute Maximum Ratings" may cause permanent damage. These are stress ratings only. The product is not protected against overvoltage or reversed voltages. 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.

4.2.2 Operation Ratings

Table 10 Description of Operation Ratings for BX306 board

Parameter	Symbol	Condition	Min	Typ	Max	Unit
Power Supply Voltage	VCC			3.3		V
Power Consumption	P				3.9	W
Digital IO Pin Low level input voltage	RXD_UART		0	0	0.66	V
Digital IO Pin High level input voltage	TXD_UART		2.3	3.3		V
Digital EVENT input voltage	V_{IL}				0.8	V
	V_{IH}		2.0			V
Digital PPS output voltage	V_{OL}				0.55	V
	V_{OH}		2.3			V
Output Power voltage	Vout		3.135	3.3	3.465	V
Output Power current	Iout				200	mA
Antenna bias current	I_ANT				100	mA
RF Input Level	Prf		-122		-85	dBm
Operation temperature	Topt		-40			85

Note: All specifications are at an ambient temperature of 25℃. Extreme operating temperatures can significantly impact specification values. Applications operating near the temperature limits should be tested to ensure the specification.

4.3 Physical Specification

4.3.1 Physical Specification for BX306 board

Table 11 Physical Specification of Precis-BX306 board

Feature	Specification
Power	3.3V DC +5% ~ -5%
Ripple	100mV p-p (Max)
Power Consumption	2.9W (Typical)
Active Antenna Input Impedance	50Ω

Max. Antenna Bias Current Draw	100mA
GNSS input sensitivity	-85 dBm ~ -122 dBm
Size	71×41×11mm
Weight	27g
Temperature	-40℃～+85℃
Humidity	95% non-condensing
Vibration	TBD
Shock	TBD

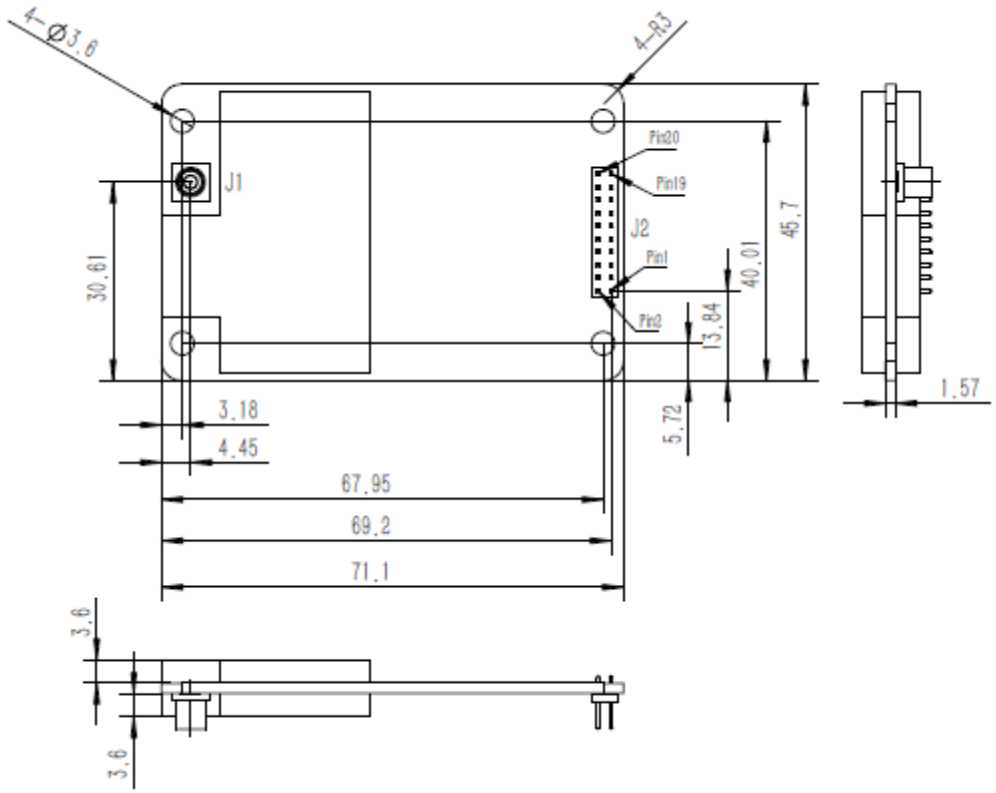


Figure 37 BX306 board dimension

Note:

1. Dimensions are in milli-meters
2. J1: MCX jack receptacle, straight (Johnson P/N 133-3711-202 or SAMTEC P/ N MCX-J-P-HST-SMI or equivalent)
   J2: 2x10 header, 2 mm pitch (SAMTEC P/ N TMM-110-03-G-D)

Table 12 Interface signals definition

Pin	Signal	TYPE	Description	Comments
1	LNA_PWR	PWR	Antenna power input	Power to antenna, should be input 5VDC.
2	3V3	PWR	Power to the board	3.3 V ±5%
3	USB_D-	IO	USB data (-)	One-half of a differential pair (pins 3 and 4). Match lengths and route as a 90 Ω differential pair if USB is required
4	USB_D+	IO	USB data (+)	
5	/RESETIN	I	Reset input t	Active low reset
6	USERVARF	IO	Variable frequency output	
7	EVENT2	IO	Event 2 Input	
8	NC			
9	EVENT1	IO	Event1 input	Has a 10K pull-up resistor on board.
10	GND	PWR	Signal and power ground	
11	TXD1	O	COM1 transmit data	LVTTL level, the max band rate is 921600 bps.
12	RXD1	I	COM1 receive data	
13	GND	PWR	Signal and power ground	
14	TXD2	O	COM2 transmit data	LVTTL level, the max band rate is 921600 bps.
15	RXD2	I	COM2 receive data	
16	GND	PWR	Signal and power ground	
17	PV	O	Position valid indicator	Active high output
18	GND	PWR	Signal and power ground	

19	PPS	O	Pulse per second output,	This pin has an internal 50 ohm line driver. Route as a 50 Ω single-ended trace
20	NC			

4.3.2 Physical Specification for BX306 V1.1

Table 13 Physical Specification of Precis-BX306 receiver V1.1

Feature	Specification
Power	5V DC +5% ~ -3%
Ripple	100mV p-p (Max)
Power Consumption	3.0W (Typical)
Active Antenna Input Impedance	50Ω
Max. Antenna Bias Current Draw	100mA
GNSS input sensitivity	-122 dBm ~ -85 dBm
Size	132*66*28mm
Weight	229g
Temperature	-40℃～+85℃
Humidity	95% non-condensing
Vibration	TBD
Shock	TBD
Antenna Connector	SMA Receptacle×2
Serial Port	5pin receptacle PicoBlade connector (LVTTL level)

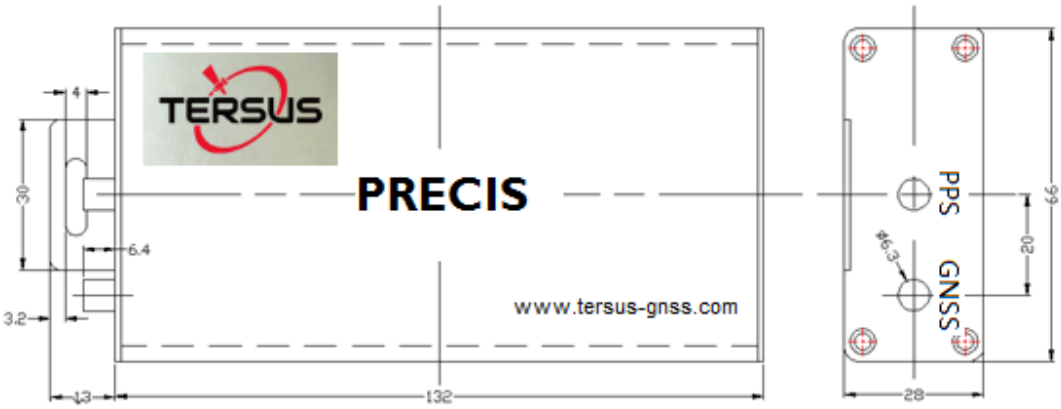


Figure 38 BX306 receiver V1.1

The signal definition of the two serial ports:

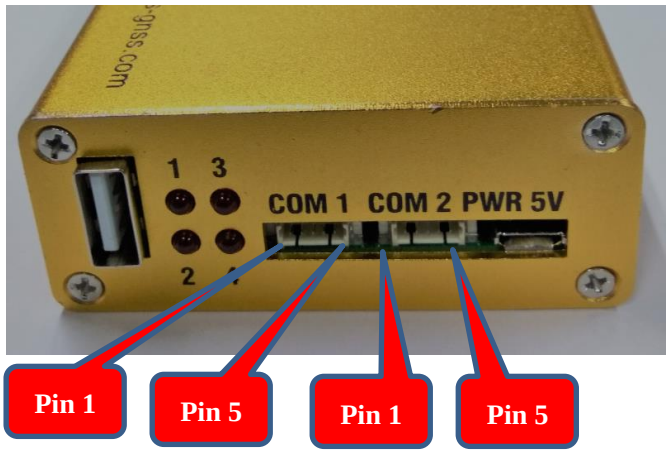


Figure39 Serial port pin definition

Table 14 COM1 pin definition

Serial port	Pin Number	Signal Definition
COM1	Pin 1	5V
	Pin 2	3.3V
	Pin 3	TXD
	Pin 4	RXD
	Pin 5	GND

Table 15 COM2 pin definition

Serial port	Pin Number	Signal Definition
COM2	Pin 1	5V
	Pin 2	3.3V
	Pin 3	RXD
	Pin 4	TXD
	Pin 5	GND

Note：When LVTTL serial ports are used, pin1 will NOT be connected.

4.3.3 Physical Specification for BX306 V3.1

Table 16 Physical Specification of Precis-BX306 receiver V3.1

Feature	Specification
Power	5V ~ 12VDC
Ripple	100mV p-p (Max)
Power Consumption	3.0W (Typical)
Active Antenna Input Impedance	50Ω
Max. Antenna Bias Current Draw	100mA
GNSS input sensitivity	-122 dBm ~ -85 dBm
Size	92*57*24 mm
Weight	136g
Temperature	-40℃～+85℃
Humidity	95% non-condensing
Vibration	TBD
Shock	TBD
Antenna Connector	SMA Receptacle×1
Serial Port	6pin receptacle connector (LVTTL level)

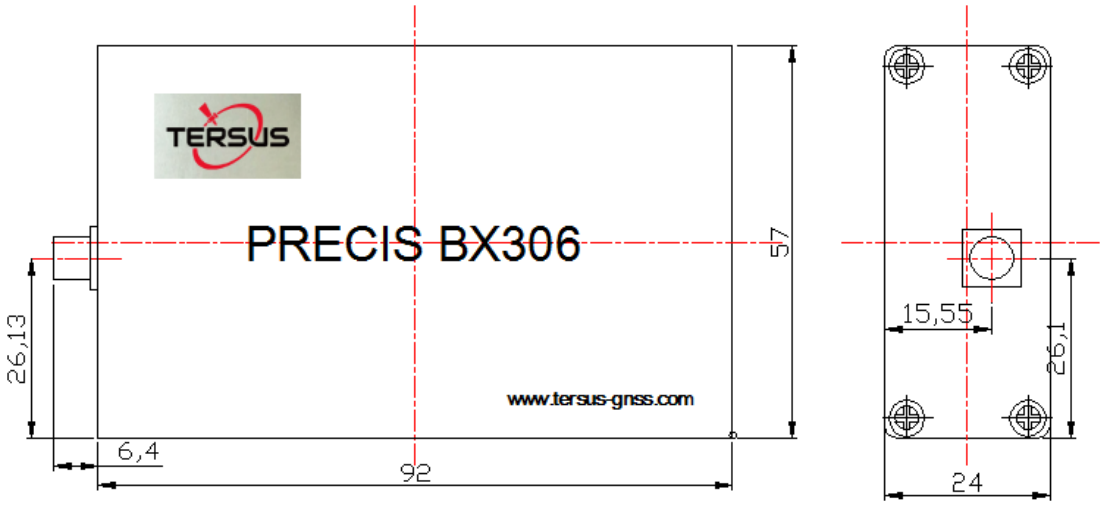


Figure 40 Size of the BX306 receiverV3.1

Cable for the communication port of the BX306 receiver V3.1

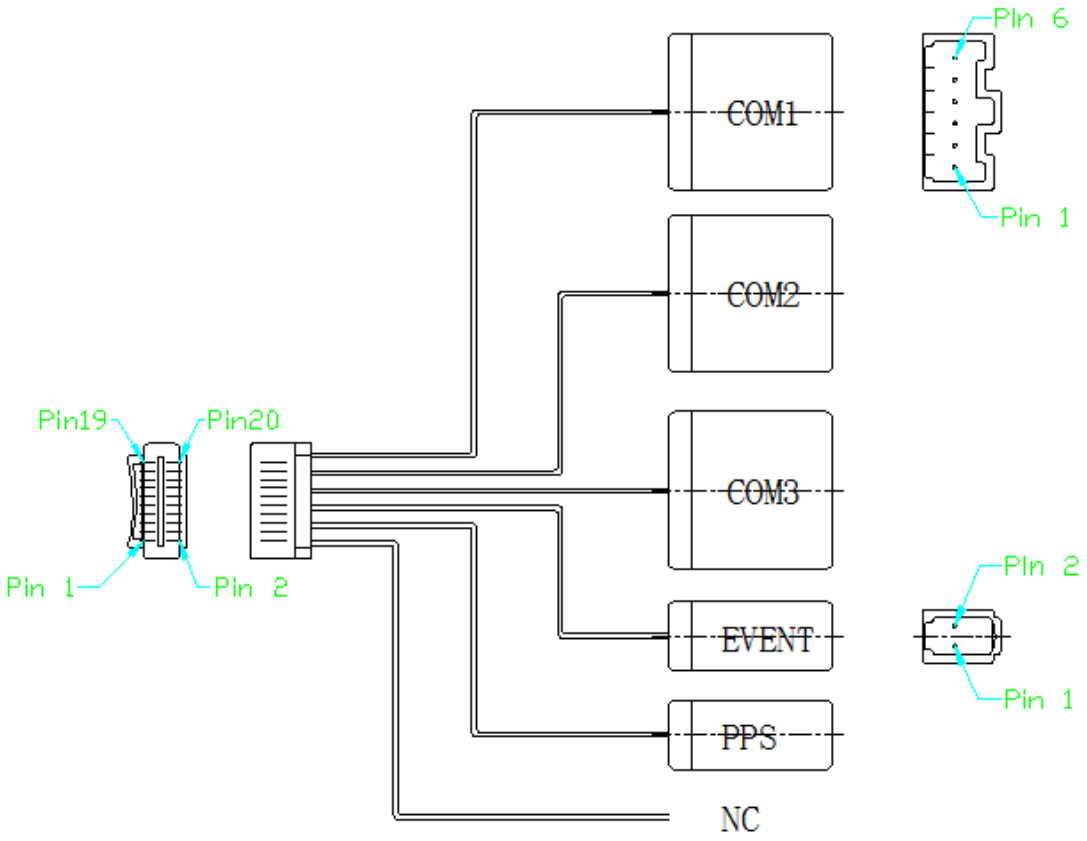


Figure 41 Comm cable for the BX306V3.1

The 20pin connector of the cable is Mouser's DF50S-20DS-1L or equivalent, the connectors at the other end of the cable are 3pcs Mouser's 798-DF1EA-6EP-2.5C and 2pcs Mouser's 798-DF1EA-2EP-2.5C.

Table 17 Comm port pin definition

No.	Signal definition	COM1	COM2	COM3	EVENT	PPS
1	GND	Pin 6				
2	NC					
3	TXD1	Pin 2				
4	RXD2		Pin 3			
5	RXD1	Pin 3				
6	TXD2		Pin 2			
7	3.3V	Pin 1				
8	3.3V		Pin 1			
9	PPS					Pin 1
10	SCL		Pin 4			
11	EVENT1				Pin 1	
12	SDA		Pin 5			
13	GND			Pin 6		
14	GND		Pin 6			
15	TXD3			Pin 2		
16	GND					Pin 2
17	RXD3			Pin 3		
18	GND				Pin 2	
19	3.3V			Pin 1		
20	NC					

5. RTK Configure Example

Example of RTK configuration (base mode):

```
FIX POSITION 31.000302123 114.289244543 26.130
ECUTOFF BD2 15.0
ECUTOFF GPS 15.0
ECUTOFF GLONASS 15.0
INTERFACEMODE COM2 AUTOMATIC AUTOMATIC ON
LOG COM2 RTCM1074 ONTIME 1
LOG COM2 RTCM1084 ONTIME 1
LOG COM2 RTCM1124 ONTIME 1
LOG COM2 RTCM1005 ONTIME 10
SAVECONFIG
```

Example of RTK configuration (rover mode):

```
FIX NONE
INTERFACEMODE COM1 AUTOMATIC AUTOMATIC ON
LOG GPGGA ONTIME 1
SAVECONF
```

6. Trouble Shooting

6.1. Why the Precis-BX306 board does not output RTCM data after I key in the RTCM output related commands?

It can be caused by following reasons:

(1) Fix the coordinate is the prerequisite of RTCM output. Therefore, use Fix position command (see Tersus GNSS Command & Log Reference document) to fix the coordinate first.

(2) Check the interfacemode. If the target serial port is not in right mode, it may not output RTCM properly. Use the interfacemode command (see Tersus GNSS Log & Command Reference document) to set the serial mode.

6.2. Why mission planner cannot recognize my Precis-BX306 board?

It can be caused by following reasons:

(1) Check power supply. Precis-BX306 board power consumption is about 3W. Although Pixhawk can supply power, its power output is far less than 3W, so BX306 must be powered on by external power source. A voltage transformer is recommended to convert 12V power output from battery to 5V and then connect to Precis-BX306 board.

(2) Please check the baud rate settings in Mission planner. It cannot be recognized if incorrect baud rate is used. By default, the baud rate of Precis-BX306 COM1 port is 115200 bps.

(3) Please check the NMEA output. Mission planner requires GPS sensors output NMEA GGA sentence, RMC sentence and VTG sentence at 5Hz. Missing VTG sentence or low update rate may cause failure to recognition.

(4) Check the NMEA talker. Pixhawk can only recognize the NMEA sentence with GP NMEA talker. Incorrect NMEA talker may cause failure.

6.3. Why my configuration lost after the board is power off?

You need execute ‘saveconfig’ command to save your configuration to the non-volatile memory before power off; otherwise, your configuration will lost as long as it is powered off.

6.4. Why I can receive NMEA data from the board, but I cannot configure it?

It depends on the serial tool you are using. The board can only recognize the command end up with ‘\r\n’ (carriage and line feed) and these two characteristics need to be added automatically by the serial tools, which is often referred as ‘new line mode’. In order to avoid this case, we recommend you configure the board with

Tersus GNSS Center, which can be downloaded from our website.

7. Terminology

ASCII	American Standard Code for Information Interchange
CMR	Compact Measurement Record
DC	Direct Current
ESD	Electro Static Discharge
ECEF	Earth Center Earth Fixed
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
RF	Radio Frequency
RINEX	Receiver Independent Exchange format
RMS	Root Mean Squares
RTK	Real-Time Kinematic
RTCM	Radio Technical Commission for Maritime Services
SMA	Sub-Miniature-A interface
TTFF	Time to First Fix
TTL	Transistor-Transistor Logic level
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial BUS
WGS84	Word Geodetic System 1984