User Manual

Version V2.0-20210913

User Manual
For BX40C GNSS Board

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Revision History

Rev	Description	Date	Owner
1.0	Initial release	2020/12/23	LC
2.0	Renew	2021/09/13	LYP

Table of Content

List of Figures

List of Tables

Notices

The following notices apply to Tersus BX40C 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 receivers.

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 to a receiver are in capital letters, which is just for easy identification, the commands are not case-sensitive.

1. Introduction

1.1 Overview of BX40C GNSS board

The Tersus BX40C is a compact GNSS RTK board with full constellation tracking for providing cm-level accuracy positioning. It can be integrated with autopilots and inertial navigation units.

The BX40C 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 BX40C GNSS board, refer to https://www.tersus-gnss.com/ for more details.

1.2 Receiver features

The BX40C Receiver has the following features:

- Supports multiple constellations & frequencies
  - GPS L1C/A, L2C, L2P, L5
  - GLONASS L1C/A, L2C/A
  - Beidou B1, B2, B3, support BDS-3
  - Galileo E1, E5a, E5b
  - QZSS L1C/A, L2C, L5
- Supports 576 channels
- Centimeter-level position accuracy
- Flexible interfaces such as RS232, TTL, USB, CAN, Ethernet
- Supports 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 Trimble BD970
- 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 BX40C receivers and all the commands to the receivers	https://www.tersus-gnss.com/product/bx40c under Documents
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 BX40C System Overview

To make BX40C board work, the following parts are necessary:

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

The BX40C receiver is illustrated in the figure below.

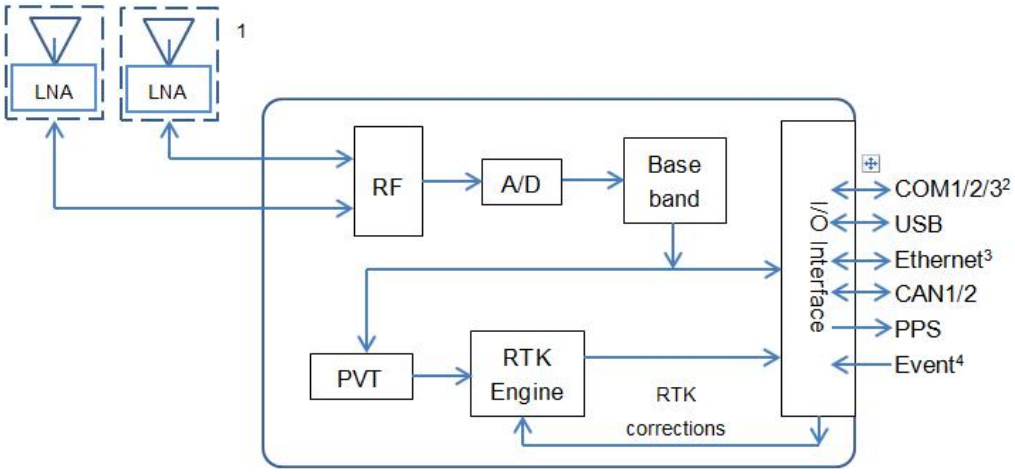


Figure 1.1 System Overview of BX Boards

Note 1. BX40C only support single antenna.

2. COM3_TX is multiplexed with CAN1_TX, COM3_RX is multiplexed with Event 2.

3. Hardware of Ethernet is ready, reserved for future upgrade.

4: Currently two event inputs are supported.

1.4.1 BX40C Board

BX40C board consists of a Radio Frequency (RF) section and a digital section.

Radio Frequency (RF) Section

The receiver 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 receiver 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 receiver.

An active GNSS antenna is required for optimal receiver performance. Tersus is providing active GNSS antennas with precise phase centers and robust

enclosures (refer to https://www.tersus-gnss.com/product/accessories for more information about antennas.

1.4.3 Power Supply

A power supply capable of delivering the minimum receiver operating voltage and power is required. The receiver operates at 3.45V.

1.4.4 Communication Equipment

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

1.4.5 Internal eMMC

BX40C receiver supports up to 8GB internal eMMC.

2. Installation

!	The BX40C 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 receiver. 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 receiver 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 75 °C (167 °F)
- Excessive cold less than –40 °C (–40 °F)
- Corrosive fluids and gases

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

2.3 Selecting a GNSS antenna

The BX40C receiver 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 https://tersus-gnss.com/product/accessories. It is highly recommended that the antennas from Tersus are used to work with BX40C receivers.

⚠	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 Power Supply Notices

⚠	Power to the BX40C board must be applied for >150ms before any of the external interfaces are powered on by the integrator's board. Hold the RESETIN pin low during power up and for >150ms after power is applied.

⚠	The receiver operates at 3.45V. If the voltage supplied is below the specification, the receiver suspends operation.

⚠	The LEDs on the board can tell whether the receiver is booting up successfully or not, refer to Table 4.4 LED descriptions.

⚠	The BX40C receiver supports reversed polarity protection.

2.5 Receiver Installation

When the appropriate equipment is selected, complete the following steps to set up and begin using the BX40C receiver.

a) Install the BX40C 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 receiver with a GNSS antenna cable.

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

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

⚠	When BX40C board is handled, follow the guides below to avoid damage from ESD. ● Always wear a properly grounded anti-static wrist strap when handling BX40C 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.

2.6 Tersus GNSS Center Software

BX40C receiver has serial ports, hence lots of serial tools can be used to communicate with the receiver. Tersus GNSS Center is a windows-platform-based serial tool, which is recommended to communicate with the BX40C receiver. Tersus GNSS Center can be downloaded from Tersus website https://tersus-gnss.com/software .

Connect BX40C 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).

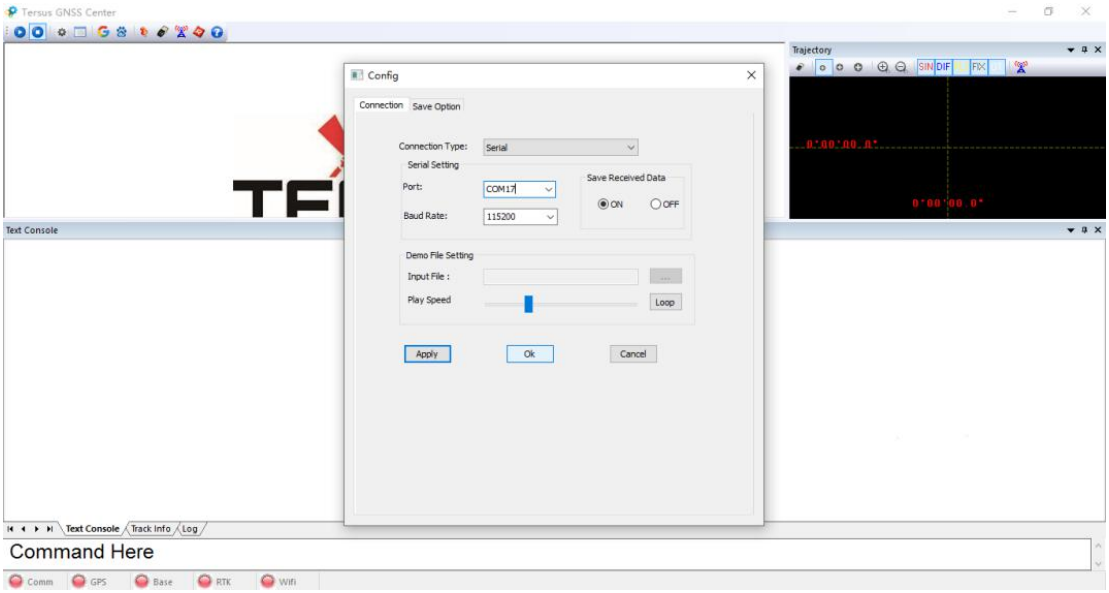


Figure 2.1 Config Page of Tersus GNSS Center

The following table gives definition for the five 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 receiver is established. RED: the communication with the receiver is not established.
GPS	GREEN: valid GPGGA is received. RED: No valid GPGGA is received.
Base	GREEN: valid corrections are received. RED: No valid corrections are received.
RTK	SOLID GREEN: RTK solution is got. BLINK GREEN: float solution is got. RED: other solutions are got.
Wifi	Reserved.

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.

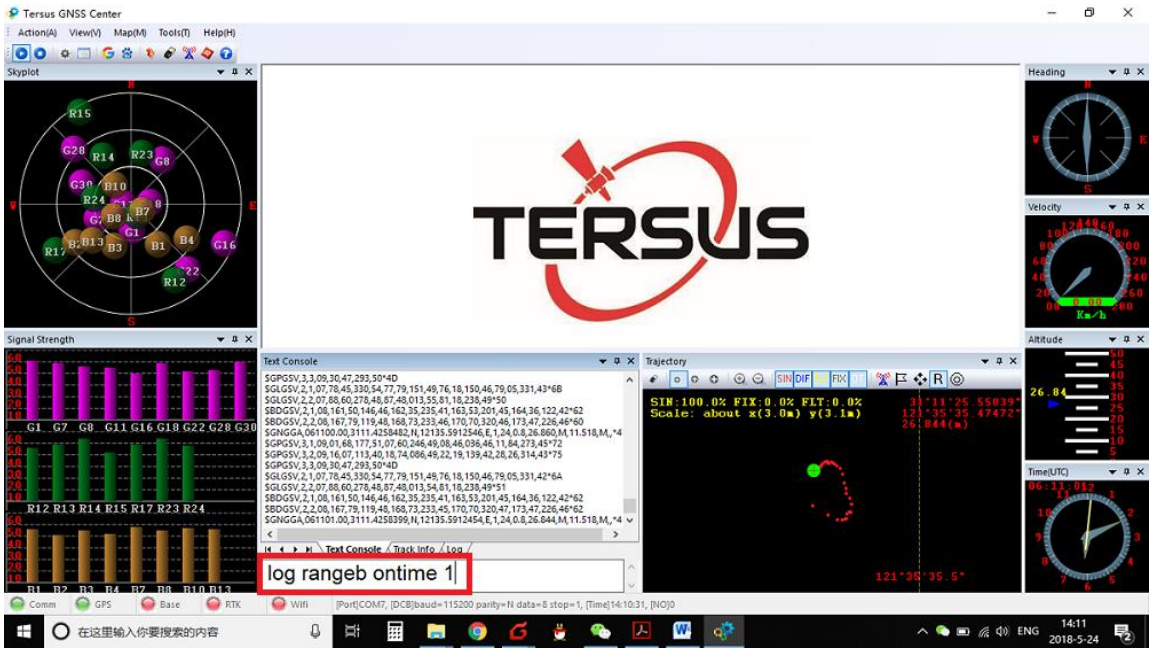


Figure 2.2 Main Windows of Tersus GNSS Center

!	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 receiver: LOG GPGGA ONTIME 1 // output position and time LOG GPGSV ONTIME 1 // output SVs in view, elevation and SNR (Signal Noise Ratio) LOG RNAGEB ONTIME 1 // output PSR (Pseudorange) and ADR (Accumulated Doppler Range.)

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

2.7 RTK Configuration

Example of RTK configuration (base mode):

UNLOGALL //remove all logs

UNDULATION USER 0.0 //Set user specified undulation value for ellipsoid height[2]

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, receiver 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: ● If the base's position is known, input it directly with command FIX.

	• 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. • If you require a cm level accuracy of base and rover, then: a. Configure the base receiver as a rover, receive RTK corrections from a CORS nearby, this receiver can get cm-level accuracy position. 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.

3. Firmware Update and Auth Code

3.1 Firmware Update Overview

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:

VERSION COM2 -1 0.0 FINE 2173 182239.000 00000000 0 1

< 1

< GPSCARD BX40C 037001203200000001 0371001020003 1.0.848_debug Oct 27 2020 11:13:37

848 is the firmware version. Refer to 'VERSION' in BX40C Log & Command Reference document for more details.

3.2 Firmware Update Using Tersus GNSS Center

Please follow the steps below to upgrade the firmware.

1) Power on the BX40C GNSS receiver;
2) Run Tersus GNSS Center software and communicate with the receiver, refer to section 2.6 for details. 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;

Figure 3.1 Main interface of Tersus GNSS Center

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

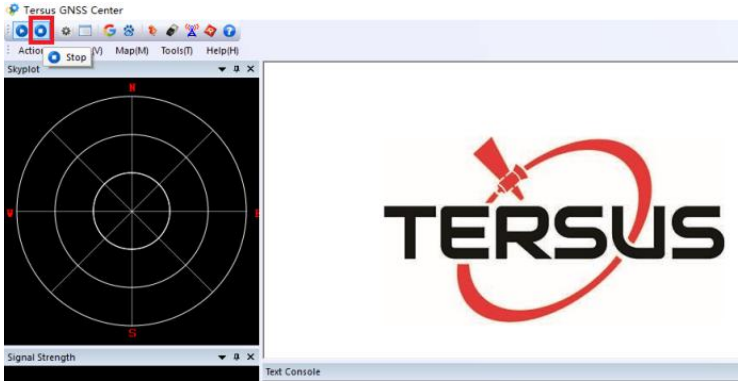


Figure 3.2 Stop button on Tersus GNSS Center

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

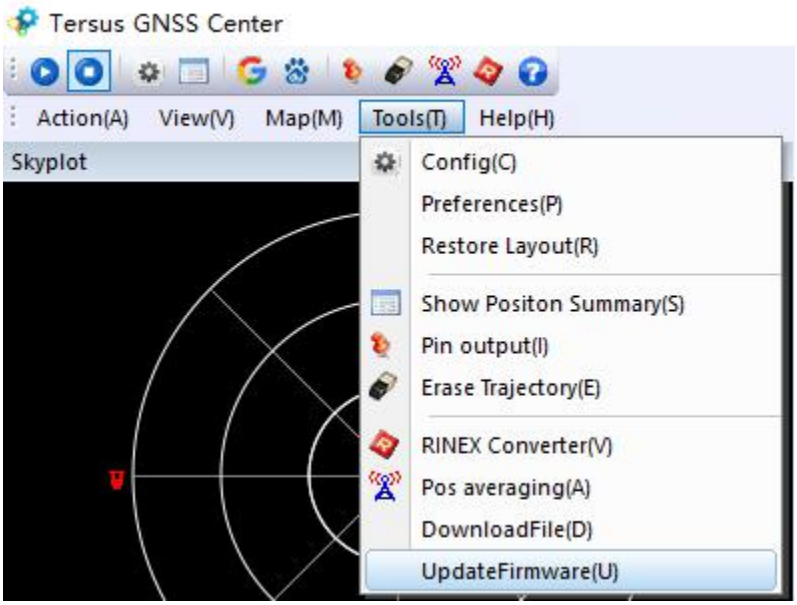


Figure 3.3 Find UpdateFirmware in Tools bar

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];

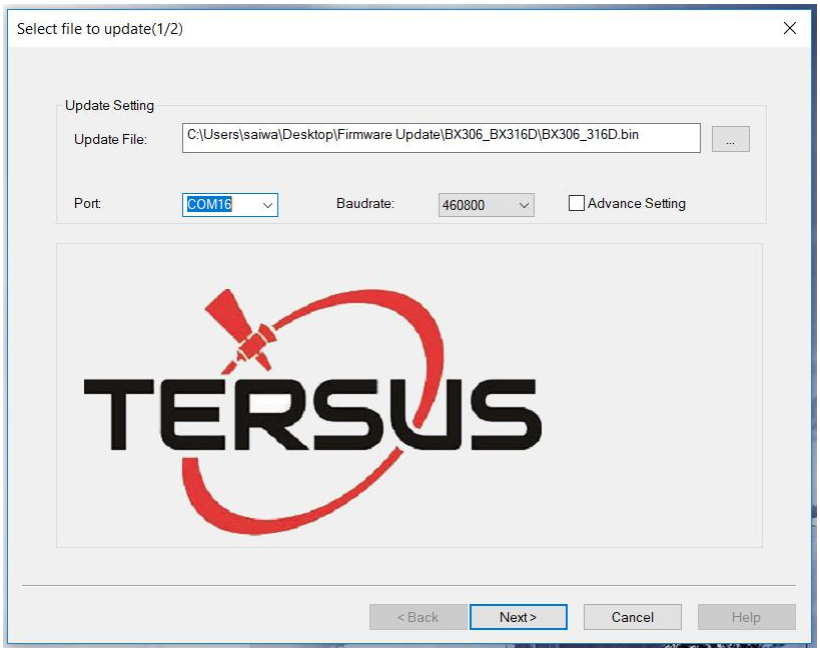


Figure 3.4 Select file to update

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

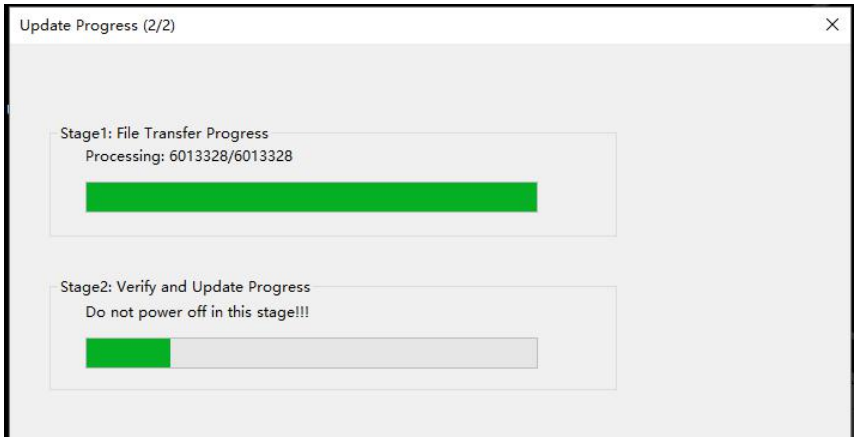


Figure 3.5 Update in progress

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

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

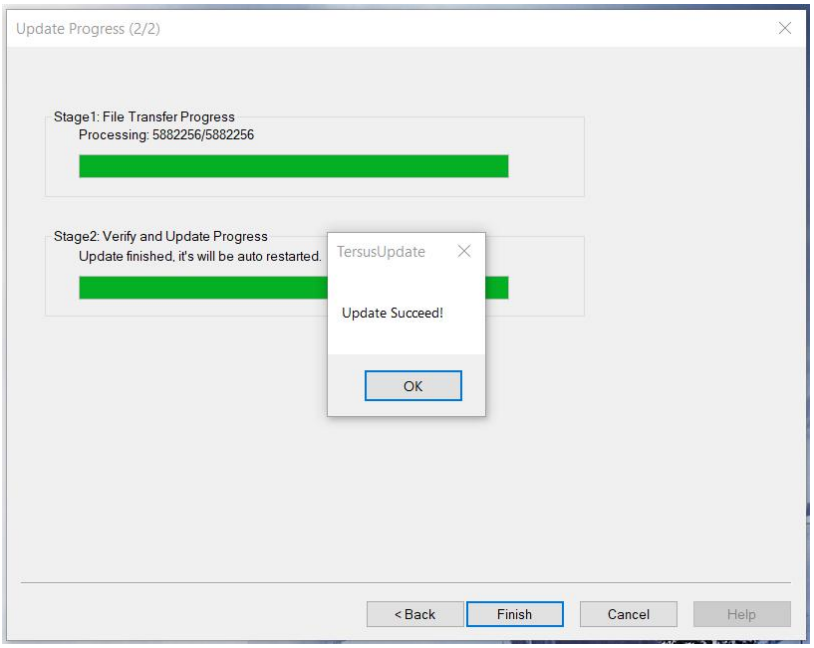


Figure 3.6 Firmware update successful

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.

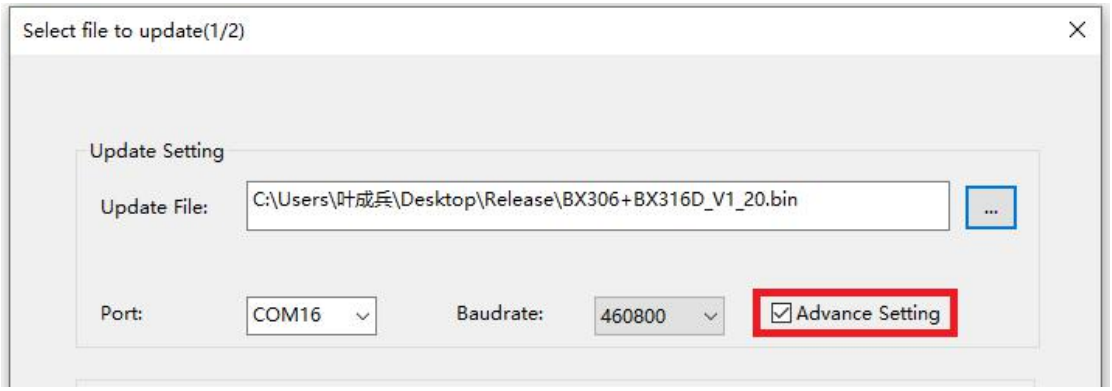


Figure 3.7 Advance setting for firmware update

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.

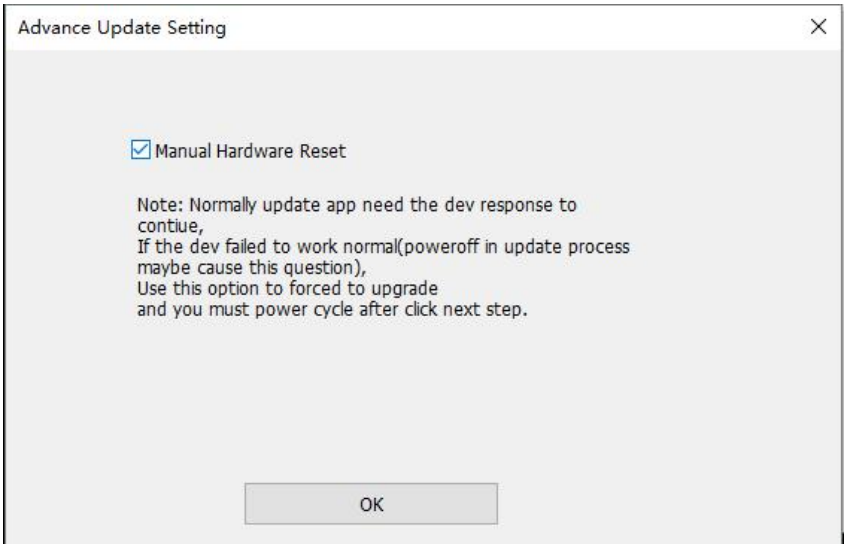


Figure 3.8 Advance Update Setting

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.**

3.3 Auth Code

An auth code is used to determine the features and valid time for a receiver. If the auth code is expired, the receiver 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 VERSION

LOG AUTHLIST

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. If the 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.

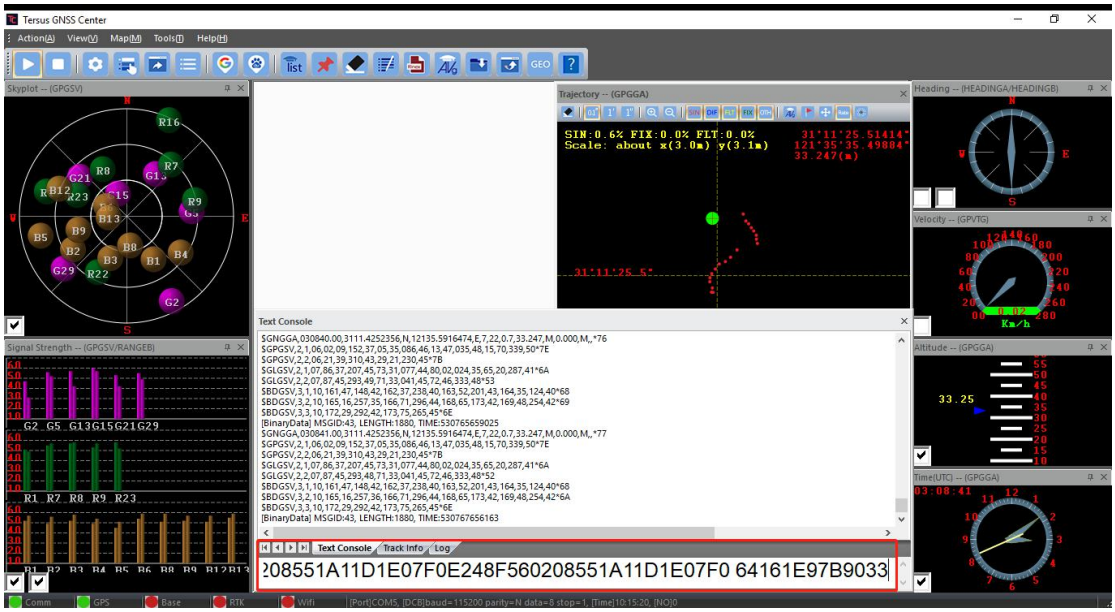


Figure 3.9 Register via Tersus GNSS Center

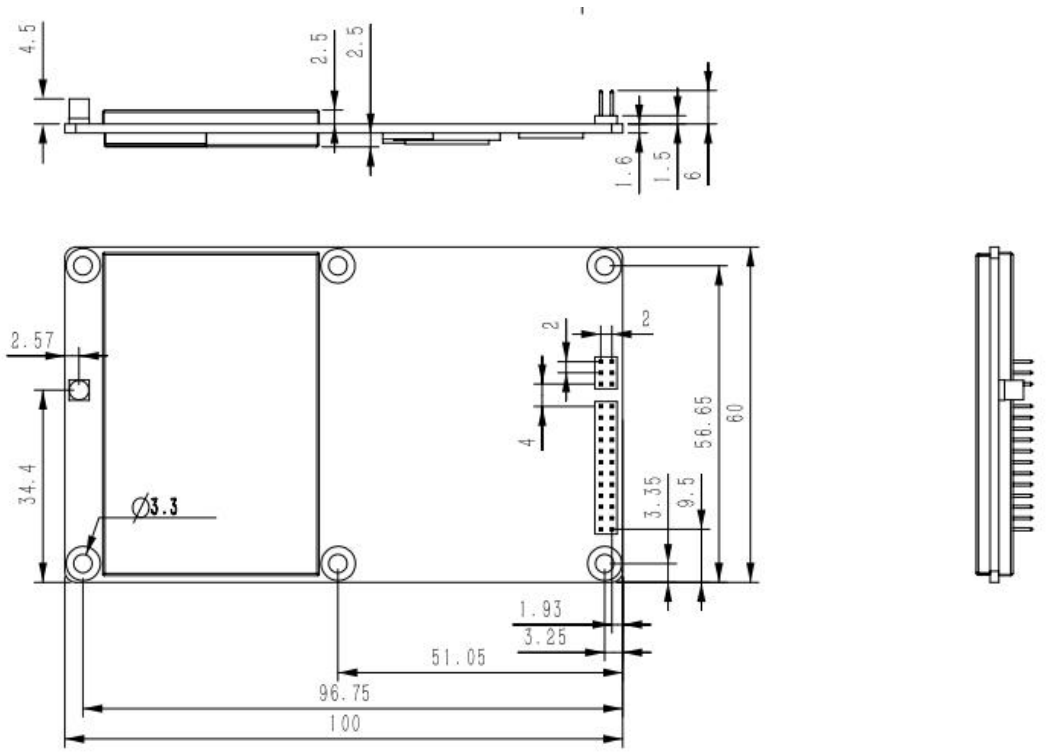
4. Technical Specifications

4.1 BX40C specifications

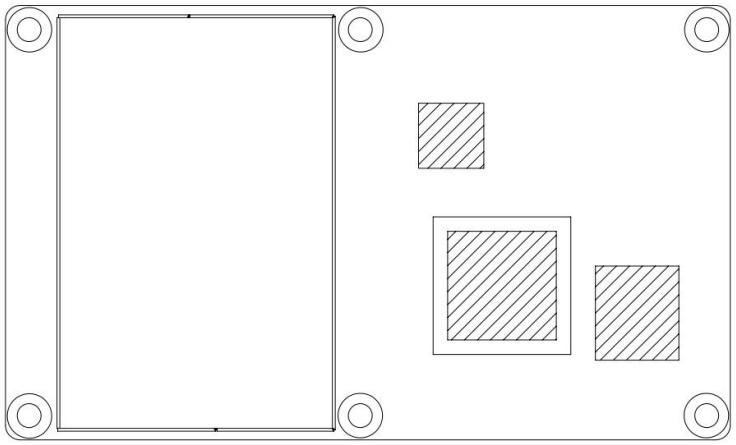
Table 4.1 BX40C Board Specifications

Performance		
Signal Tracking	GPS L1 C/A, L2C, L2P, L5 GLONASS L1 C/A, L2 C/A BeiDou B1, B2, B3, support BDS-3 Galileo E1, E5a, E5b QZSS L1 C/A, L2C, L5	
GNSS Channels	576	
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)
Observation Accuracy (zenith direction):	C/A Code: 10cm P Code: 10cm Carrier Phase: 1mm	
Time to First Fix	Cold Start: <50s Warm Start: <30s	
Reacquisition	<2s	
Time Accuracy(RMS)	20ns	
Velocity Accuracy(RMS)	0.03m/s	
Initialization (typical)	<10s	

Initialization Reliability	>99.9%	
Correction	RTCM 2.x/3.x/CMR/CMR+	
Data output	NMEA-0183 and Tersus Binary Format	
Data Rate	Measurements	20Hz
	Position	5Hz
Storage	In-built 8GB memory	
Communication		
Serial ports	RS-232 x1, TTL x2	
COM baud rate	Up to 921600bps	
USB ports	USB 2.0 device x1	
PPS ports	LVTTL x1	
Event mark	LVTTL x2	
CAN ports	ISO/DIS 11898 x1	
Ethernet	10BaseT/100BaseT*	
Electrical		
Input Voltage	+3.45 VDC	
Power Consumption	3.6W (typical)	
Physical		
Size	100 * 60 * 10.1 mm^3	
Weight	44g	
IO connectors	24pin header + 6pin header	
Antenna Connector	MMCX female x1	
Mechanical Drawing		



Heat Sink Position



Note: For optimum heat transfer, Tersus recommends the use of thermal interface materials between the processor and the heat sink.

Environmental	
Operating Temperature	-40°C ~ +75°C
Storage Temperature	-55°C ~ +85°C

4.2 System integration

4.2.1 Connectors on BX40C board

There are two connectors on the BX40C board: a 24-pin and a 6-pin header.

Table 4.2 24-pin header signals definition

Pin	Signal	Type	Description
1	GND	GND	Ground digital ground
2	RTK_LED	O	RTK LED, flashes when an RTK correction is present.
3	RSV/POWER_OFF	IO	Reserved, compatible with power off
4	PPS	O	Pulse per second output, 3.45V TTL level.
5	VCC	PWR	+3.45V DC power supply
6	VCC	PWR	+3.45V DC power supply
7	CAN1_RX/RX3/EVENT2	IO	CAN1_RX, CAN Receive line; COM3 RX, COM3 Receive line, TTL level; Event2, Event input, TTL level.
8	EVENT1	IO	Event1 input, 3.45V TTL level
9	PWRLED	O	Power indicator, high when unit is on, low when off.
10	SATLED	O	Satellite LED, rapid flash indicates <5 satellites, slow flash indicates >5 satellites.
11	COM2_CTS	IO	COM2 Clear to Send, TTL level
12	nRESETIN	I	Reset input, active low to reset.
13	COM2_RTS	IO	COM2 Request to Send, TTL level
14	COM2_RX	I	COM2 Receive Data, TTL level
15	COM1_CTS	IO	COM1 Clear to Send, RS-232 level
16	COM2_TX	O	COM2 Transmit Data, TTL level
17	COM1_RTS	IO	COM1 Request to Send, RS-232 level
18	COM1_RX	I	COM1 Receive Data, RS-232 level
19	COM3_TX/CAN1_TX	O	COM3 Transmit Data, TTL level; CAN1 Transmit line.
20	COM1_TX	O	COM1 Transmit Data, RS-232 level
21	USB D-	IO	USB Data- bi-directional
22	USB D+	IO	USB Data+ bi-directional
23	GND	GND	Ground digital ground
24	GND	GND	Ground digital ground

Table 4.3 6-pin header signal definition

Pin	Signal	Type	Description
1	ETH_RD-	I	Ethernet Receiver line minus. Differential pair.
2	ETH_RD+	I	Ethernet Receiver line plus. Differential pair.
3	CENT_RD	IO	RD Magnetic center tap
4	ETH_TD+	O	Ethernet Transmit line plus. Differential pair.
5	ETH_TD-	O	Ethernet Transmit line minus. Differential pair.
6	CENT_TD	IO	TD Magnetic center tap.

*Hardware of Ethernet is ready, reserved for future upgrade.

4.2.2 LED Descriptions

There are four LEDs on the front side of the BX40C receiver. The descriptions for these LEDs are as below.

Table 4.4 LED descriptions

RefDes	Short name	Color	Description
D5	P	Red	Power LED. Steady red indicates the unit is powered on.
D6	M	Green	RTK LED.RTK correction indicator. Steady green indicates that the unit is receiving corrections.
D4	F	Orange	FPGA LED. A rapid flash indicates that less than 5 satellites are tracked while a slow flash indicates that greater than 5 satellites are tracked.
D19	S	Green	Satellite LED. Steady green after powering on.

4.2.3 Reference Schematic of the Interface Board

If an interface board is designed to work with BX40C board, the following are the reference schematics for the power, serial port, USB port, and CAN port. Please contact Tersus technical support if you need more about the interface board.

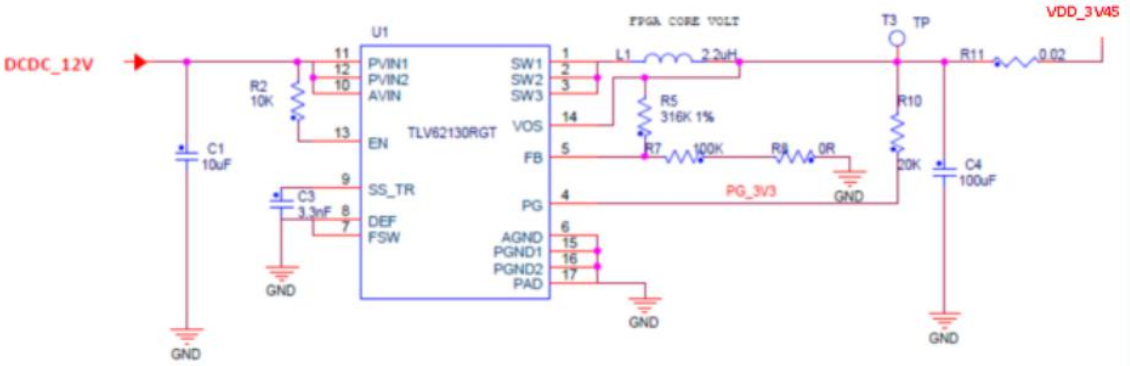


Figure 4.1 3.45V Reference Schematic

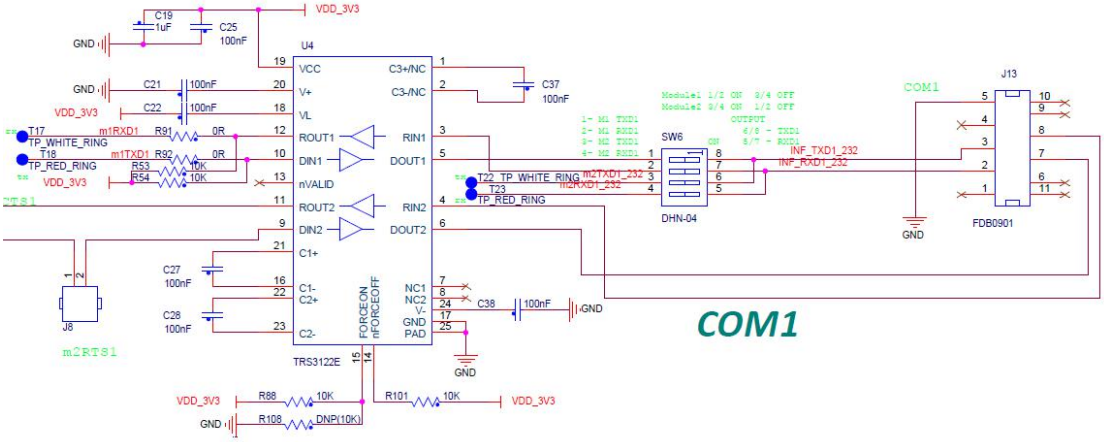


Figure 4.2 Reference Schematic for a Serial Port

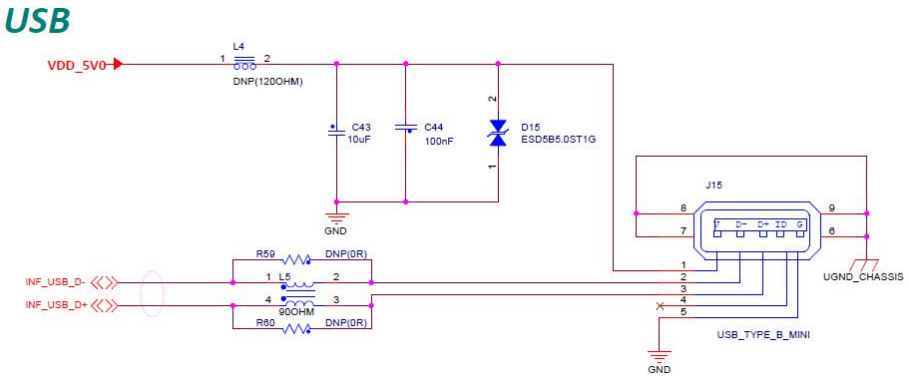


Figure 4.3 Reference Schematic for USB

5. Typical Application

5.1 Data Collection on Internal eMMC

The BX40C 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

5.2 Download 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 BX40C receiver and a computer via the cables below. Connect the COMM2 port of a BX40C receiver 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 5.1 COMM2-7pin to USB & DB9 Cable

Figure 5.2 DB9 Male to USB Type A Male converter cable

2) Power on the BX40C receiver
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 5.3 Folders in the GNSS_U disk

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

5.3 Communicate with STRSVR Tool

The steps of BX40C communicating with STRSVR tool are as follows:

1) Power on the BX40C receiver, 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.

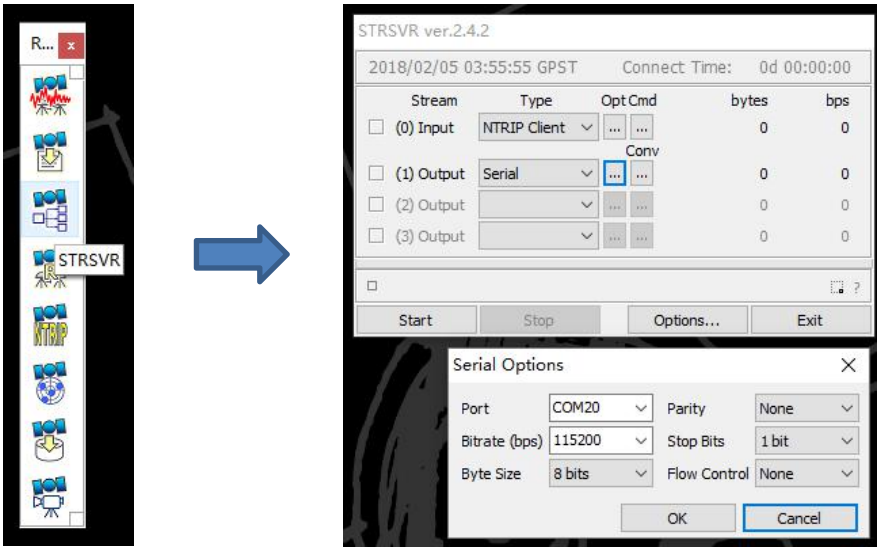


Figure 5.6 Configure serial port COM1

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

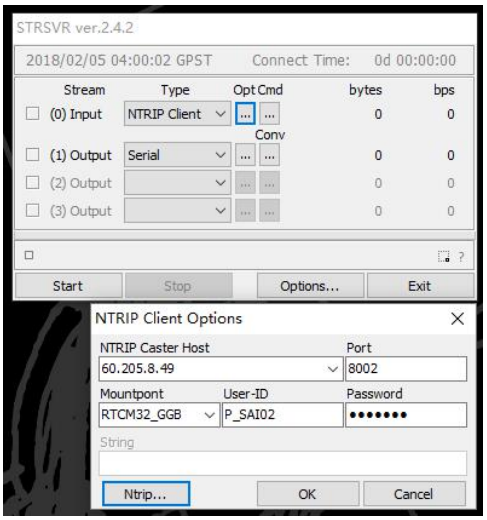


Figure 5.7 NTRIP Client configuration

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

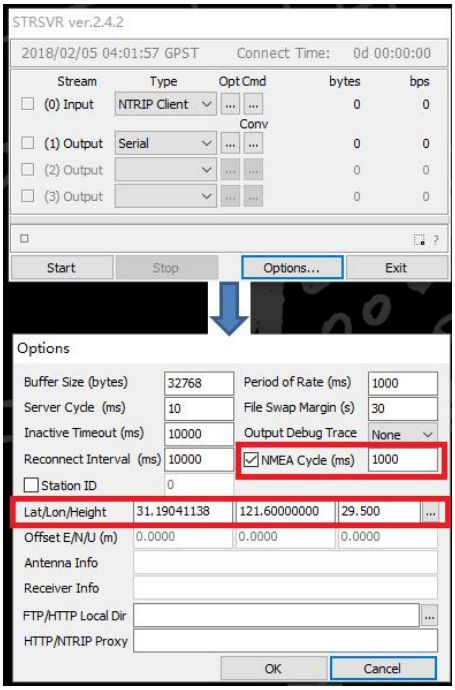


Figure 5.8 Draft position of the receiver

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 receiver can be checked in Tersus GNSS Center

software.

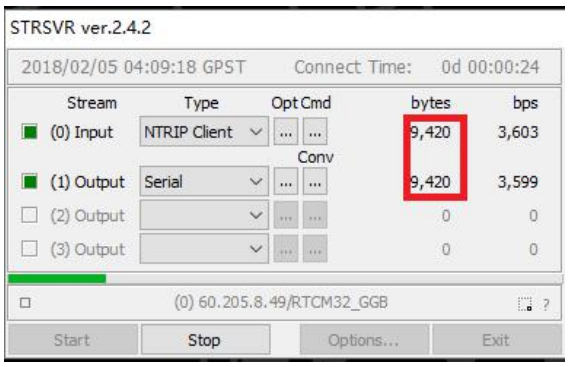


Figure 5.9 Input and Output data in progress

6. 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	Receiver 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 Receiver/Transmitter
USB	Universal Serial BUS
UTC	Universal Time Coordinated
VRS	Virtual Reference Station
WAAS	Wide Area Augmentation System
WGS84	World Geodetic System 1984