

## User Manual

Version V2.0-20190314



# User Manual For BX Series GNSS Receiver

©2019 Tersus GNSS Inc. All rights reserved.



### **Sales & Technical Support:**

[sales@tersus-gnss.com](mailto:sales@tersus-gnss.com) & [support@tersus-gnss.com](mailto:support@tersus-gnss.com)

More details, please visit [www.tersus-gnss.com](http://www.tersus-gnss.com)

## Revision History

Rev	Description	Date	Owner
1.0	Issued for Review	2018/06/29	CB
2.0	In section 1.2, add OEM board of BX316 and BX316R, add BX316D enclosure;  In section 1.2.7, remove external SD card for BX316 and BX316R enclosure;  In chapter 2, update pictures, links, tables and commands;  In section 4, list technical specifications for all BX series products;  In section 5.1, update rules for the file name;  In section 5.6, change RS05B radio to RS460 radio, update commands for outputting base position.	2019/03/14	LC

# Table of Content

Revision History.....	I
Table of Content.....	II
List of Figures.....	VI
List of Tables.....	IX
Notices.....	1
1. Introduction.....	4
1.1 Overview of BX Series GNSS Receivers.....	4
1.1.1 BX GNSS OEM Boards.....	4
1.1.2 BX GNSS Enclosures.....	4
1.2 Related Documents and Information.....	5
1.2.1 OEM BX306 Board.....	5
1.2.2 OEM BX306Z Board.....	7
1.2.3 OEM BX316 Board.....	9
1.2.4 OEM BX316R Board.....	11
1.2.5 OEM BX316D Board.....	12
1.2.6 BX306 Enclosure.....	14
1.2.7 BX316 Enclosure.....	15
1.2.8 BX316R Enclosure.....	17
1.2.9 BX316D Enclosure.....	19
1.3 BX Receivers System Overview.....	21
1.3.1 BX Series OEM Boards.....	22
1.3.2 BX Enclosures.....	22

---

1.3.3	Antenna.....	23
1.3.4	Power Supply.....	23
1.3.5	Communication Equipment.....	23
1.3.6	Internal eMMC Card/External SD Card.....	23
1.3.7	Enable Heading.....	24
2.	Installation.....	25
2.1	Shipping Box.....	25
2.2	UART to USB converter.....	26
2.3	Selecting a GNSS antenna.....	28
2.4	Power Supply Requirement.....	29
2.5	OEM Boards Installation Overview.....	30
2.6	Tersus GNSS Center Software.....	31
2.6.1	Auto Base Station List Function.....	34
2.7	Transmitting and Receiving Corrections.....	36
2.8	Heading Output.....	37
3.	Firmware Update and Auth Code.....	39
3.1	Firmware Update Overview.....	39
3.2	Firmware Update Using Tersus GNSS Center.....	40
3.3	Auth Code.....	45
4.	Technical Specifications.....	46
4.1	BX306 Board.....	46
4.1.1	BX306 Specifications.....	46
4.1.2	Connectors on BX306 board.....	49

---

4.1.3	Reference Schematic of the Interface Board.....	50
4.2	BX306Z Board.....	52
4.2.1	BX306Z Specifications.....	52
4.2.2	Connectors on BX306Z board.....	55
4.3	BX316 Board.....	59
4.3.1	BX316 Specifications.....	59
4.3.2	40pin external cable.....	62
4.4	BX316R Board.....	64
4.4.1	BX316R Specifications.....	64
4.4.2	40pin external cable.....	65
4.5	BX316D Board.....	65
4.5.1	BX316D Specifications.....	65
4.5.2	Connectors on BX316D board.....	68
4.6	BX306 Enclosure.....	70
4.6.1	BX306 Enclosure Specifications.....	70
4.6.2	20pin external cable.....	71
4.7	BX316 Enclosure.....	73
4.7.1	BX316 Enclosure Specifications.....	73
4.7.2	40pin external cable.....	75
4.8	BX316R Enclosure.....	76
4.8.1	BX316R Enclosure Specifications.....	76
4.8.2	40pin external cable.....	78
4.9	BX316D Enclosure.....	78

---

4.9.1	BX316D Enclosure Specifications.....	78
4.9.2	20pin external cable.....	80
5.	Typical Application.....	81
5.1	Data Collection on Internal eMMC.....	81
5.2	Download Files from Internal eMMC.....	84
5.3	Connect BX306 to an External Bluetooth.....	87
5.3.1	Communicate with NTRIP Client App.....	88
5.4	Save Data to an External Data Logger.....	91
5.5	Communicate with STRSVR Tool.....	92
5.6	Create RTK using BX306 and a Radio.....	95
5.6.1	Radio to Transmit RTK Corrections.....	96
5.6.2	Radio to Receive RTK Corrections.....	97
5.7	Connect BX306 to Pixhawk.....	97
5.8	Uninstall the Cable from BX306 Enclosure.....	101
6.	Terminology.....	102

## List of Figures

Figure 1.1 Overview of BX306 Board.....	5
Figure 1.2 The other side of BX306 Board.....	6
Figure 1.3 Overview of BX306Z Board.....	7
Figure 1.4 The other side of BX306Z Board.....	8
Figure 1.5 Overview of BX316 Board.....	9
Figure 1.6 The other side of BX316 Board.....	10
Figure 1.7 Overview of BX316R Board.....	11
Figure 1.8 The other side of BX316R Board.....	12
Figure 1.9 Overview of BX316D Board.....	12
Figure 1.10 The other side of BX316D Board.....	13
Figure 1.11 Overview of BX306 Enclosure.....	14
Figure 1.12 BX306 Enclosure Panel.....	15
Figure 1.13 Overview of BX316 Enclosure.....	15
Figure 1.14 BX316 Enclosure Panel.....	16
Figure 1.15 Overview of BX316R Enclosure.....	18
Figure 1.16 Overview of BX316D Enclosure.....	19
Figure 1.17 BX316D Enclosure Panel.....	20
Figure 1.18 System Overview of BX Boards.....	21
Figure 2.1 Carrying case.....	25
Figure 2.2 Major Parts in the BX306 GNSS Kit Package.....	26
Figure 2.3 Major Parts in the BX306 GNSS UAV Kit Package.....	26
Figure 2.4 UART to USB converter.....	27
Figure 2.5 Device Manager.....	27
Figure 2.6 AX3702 GNSS antenna.....	28
Figure 2.7 AX3703 mini GNSS antenna.....	28

---

Figure 2.8 AX3705 Helix Antenna.....	28
Figure 2.9 Config Page of Tersus GNSS Center.....	32
Figure 2.10 BX306 Enclosure Connected to a Laptop.....	33
Figure 2.11 Main Windows of Tersus GNSS Center.....	33
Figure 2.12 Auto Base Station List interface.....	35
Figure 2.13 Fixed position for base station.....	35
Figure 2.14 Base/Rover Configure.....	36
Figure 3.1 Main interface of Tersus GNSS Center.....	40
Figure 3.2 Stop button on Tersus GNSS Center.....	41
Figure 3.3 Find UpdateFirmware in Tools bar.....	41
Figure 3.4 Select file to update.....	42
Figure 3.5 Update in progress.....	42
Figure 3.6 Firmware update successful.....	43
Figure 3.7 Advance setting for firmware update.....	44
Figure 3.8 Advance Update Setting.....	44
Figure 4.1 Connector J3 on BX306 board.....	49
Figure 4.2 3.3V Reference Schematic.....	51
Figure 4.3 5V Reference Schematic.....	51
Figure 4.4 Reference Schematic for a Serial Port.....	51
Figure 4.5 Reference Schematic for USB.....	52
Figure 4.6 Connectors J20 and J21 of BX306Z.....	55
Figure 4.7 Outline of the 40pin external cable.....	62
Figure 4.8 Connector J3 of BX316D.....	68
Figure 4.9 Outline of the 20pin external cable.....	72
Figure 5.1 Cable is assembled.....	101
Figure 5.2 Uninstall the Cable.....	101
Figure 5.3 Cable between Pixhawk and BX306.....	97



---

Figure 5.4 Outline of BX306 connected to Pixhawk.....	97
Figure 5.5 Pixhawk Get Position from BX306.....	98
Figure 5.6 RTK corrections from the base BX306 are received.....	100
Figure 5.7 GPS status changes to rtk Fixed.....	100
Figure 5.8 Transfer Cable.....	95
Figure 5.9 Outline of BX306 Connected to RS460 Radio.....	96
Figure 5.10 Data logger DL207.....	91
Figure 5.11 Outline of BX306 Connected to DL207.....	91
Figure 5.12 BT120 and the Cable.....	87
Figure 5.13 Outline of BX306 Connected to BT120.....	87
Figure 5.14 Click Settings in NTRIP Client app.....	88
Figure 5.15 Setting page of the NTRIP Client app.....	89
Figure 5.16 Input Bluetooth name in the receiver settings.....	89
Figure 5.17 Reported location of the receiver.....	90
Figure 5.18 Configure serial port COM2.....	93
Figure 5.19 NTRIP Client configuration.....	93
Figure 5.20 Draft position of the receiver.....	94
Figure 5.21 Input and Output data in progress.....	94
Figure 5.22 Download Files from eMMC Card with a Serial Port.....	84
Figure 5.23 Download Files from eMMC Card with an USB Port.....	84
Figure 5.24 5pin to USB Type A male cable.....	85
Figure 5.25 File download using Tersus Download.....	85
Figure 5.26 Select serial port for Download Port.....	86
Figure 5.27 Select download speed.....	86
Figure 5.28 File downloading in progress.....	86

## List of Tables

Table 0.1 Document / Software used in this User Manual.....	3
Table 1.1 Features of BX306 Board.....	5
Table 1.2 LED Definition of BX306 board.....	6
Table 1.3 Features of BX306Z Board.....	7
Table 1.4 LED Definition of BX306Z Board.....	8
Table 1.5 Features of BX316 Board.....	9
Table 1.6 LED Definition of BX316 Board.....	10
Table 1.7 Features of BX316R Board.....	11
Table 1.8 Features of BX316D Board.....	12
Table 1.9 LED Definition of BX316D Board.....	13
Table 1.10 Features of BX306 Enclosure.....	14
Table 1.11 LED Definition of BX306 Enclosure.....	15
Table 1.12 Features of BX316 Enclosure.....	16
Table 1.13 LEDs on BX316 Enclosure Panel.....	17
Table 1.14 Features of BX316R Enclosure.....	18
Table 1.15 Features of BX316D Enclosure.....	19
Table 1.16 LED Definition of BX316D Enclosure.....	20
Table 2.1 Input Power Requirements.....	30
Table 2.2 Definition of the lights on Tersus GNSS Center.....	32
Table 4.1 BX306 Board Specifications.....	46
Table 4.2 Interface Signals Definition.....	49
Table 4.3 BX306Z Board Specifications.....	52
Table 4.4 2X12 Header Signals Definition.....	56
Table 4.5 2x3 Header Signals Definition.....	58

---

Table 4.6 BX316 Board Performance.....	59
Table 4.7 Pin Definition of the 40pin external cable.....	63
Table 4.8 BX306D Board Specifications.....	65
Table 4.9 Interface Signals Definition.....	68
Table 4.10 BX306 Enclosure Specifications.....	70
Table 4.11 Pin Definition of the 20pin external cable.....	72
Table 4.12 BX316 Enclosure Specifications.....	73
Table 4.14 BX316R Enclosure Specifications.....	76
Table 4.14 BX316D Enclosure Specifications.....	78

## Notices

### FCC Notices

The BX306 enclosure has been tested and found to comply with the radiated and conducted emission limits for a Class A digital device. The Class A limits are designed to provide reasonable protection against harmful interference in a residential installation.

The BX316 enclosure has been tested and found to comply with the radiated and conducted emission limits for a Class A digital device. The Class A limits are designed to provide reasonable protection against harmful interference in a residential installation.

### CE Marking

Tersus GNSS Inc. declares that BX306 enclosure and BX316 enclosure are in compliance with the essential requirements (radio performance, electromagnetic compatibility and electrical safety) and other relevant provisions of Directive 1999/5/EC, EMC Directive 2004/108/EC, and the RoHS Recast Directive 2011/65/EU. Therefore the equipment is labeled with the following CE-marking.



The Declaration of Conformity may be obtained from Tersus GNSS Inc.

The following notices apply to all Tersus BX series receivers.



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 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.

Tersus is providing BX series GNSS receivers with OEM version as well as with enclosure in a metal case. When a board is mentioned, it's OEM version of the receiver, specifically. When enclosure is mentioned, it's receiver version in a metal case, specifically.

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.

Table 0.1 Document / Software used in this User Manual

Name	Description	Link
Log & Command document	Document providing all the loggings output from BX series receivers and all the commands to the receivers	<a href="https://www.tersus-gnss.com/document">https://www.tersus-gnss.com/document</a> under GNSS OEM Board / User Manual
Tersus Tool Suite	Tersus Tools including TersusDownload, TersusGeoPix, TersusGNSSCenter, TersusUpdate, TersusRinexConverter	<a href="https://www.tersus-gnss.com/software">https://www.tersus-gnss.com/software</a>
RTKLIB	A free & popularly used Post processing tool	<a href="http://www.rtklib.com/">http://www.rtklib.com/</a>
Mission Planner	A popular Ground Station software	<a href="http://firmware.ardupilot.org/Tools/MissionPlanner/">http://firmware.ardupilot.org/Tools/MissionPlanner/</a>

## Support

If there is any problem and the information needed cannot be found in the product documentation, request technical support using the Tersus website at [www.tersus-gnss.com](http://www.tersus-gnss.com), or mail to [support@tersus-gnss.com](mailto:support@tersus-gnss.com)

# 1. Introduction

## 1.1 Overview of BX Series GNSS Receivers

BX series GNSS receivers are cost-efficient GNSS RTK board for cm-level positioning, which can be used for real-time RTK positioning as well as raw data collection for post-processing application. BX receivers support existed and planned GPS, BeiDou and GLONASS signals. Both OEM boards and the enclosures are designed for the flexibility of integration and configuration.

BX series receivers are delivered with OEM boards as well as in enclosures.

For further information about BX receivers, refer to

<https://www.tersus-gnss.com/> for more details.

### 1.1.1 BX GNSS OEM Boards

OEM BX306 board – refer to section 1.2.1 for details;

OEM BX306Z board – refer to section 1.2.2 for details;

OEM BX316 board – refer to section 1.2.3 for details;

OEM BX316R board – refer to section 1.2.4 for details;

OEM BX316D board – refer to section 1.2.5 for details;

### 1.1.2 BX GNSS Enclosures

BX306 enclosure – refer to section 1.2.6 for details;

BX316 enclosure – refer to section 1.2.7 for details;

BX316R enclosure – refer to section 1.2.8 for details;

BX316D enclosure – refer to section 1.2.9 for details.

## 1.2 Related Documents and Information

### 1.2.1 OEM BX306 Board

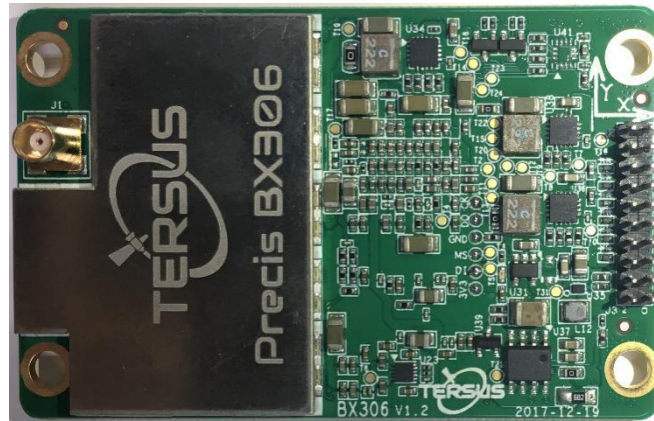


Figure 1.1 Overview of BX306 Board

Table 1.1 Features of BX306 Board

Supports three constellations, six frequencies: GPS L1/L2, GLONASS L1/L2, BEIDOU B1/B2	Supports NMEA-0183 and Tersus Binary format
Log & Command compatible with Novatel Protocol	Pin to Pin compatible with Novatel OEM615
Correction: RTCM 2.x/3.x/CMR/CMR+	Up to 20Hz RTK solution and raw data output <sup>1</sup>
Up to 4GB internal eMMC for data collection.	Compact design

Note 1: 20Hz solution is related to firmware release, contact Tersus technical support before this solution is used.

The technical specification of BX306 board is provided in chapter 4. Two LEDs are installed on the BX306 board, whose definition is given in Table 1.2:



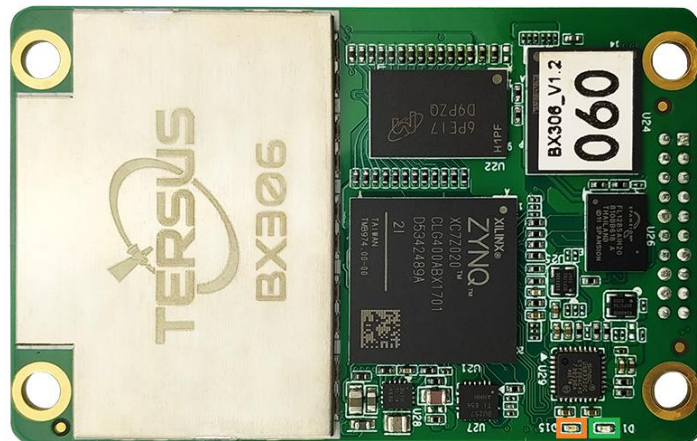


Figure 1.2 The other side of BX306 Board

Table 1.2 LED Definition of BX306 board

LED	Colour	Description
LED1 (left)	ORANGE	Blink 1Hz: if log is output at 1Hz or less. Blink the same rate as the log if log output rate >1Hz.
LED2 (right)	GREEN	ON: RTK fixed. Blink: RTK float solution. OFF: Other position types.



After power on, both LED1 and LED2 are ON for 3 – 5 seconds, then both are OFF for 2 seconds. Afterwards, LED1 will blink at 1Hz. The BX306 board is NOT booting up successfully if the LEDs are not acting as the above.

## 1.2.2 OEM BX306Z Board

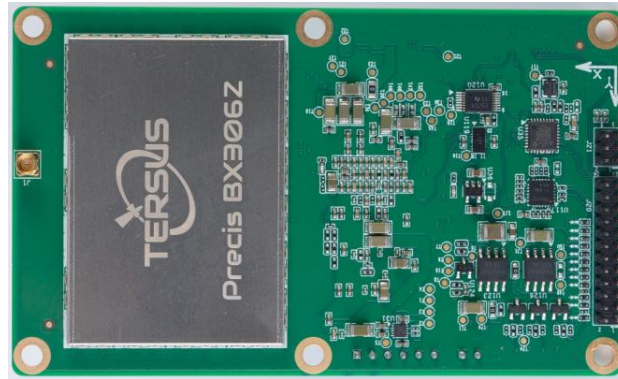


Figure 1.3 Overview of BX306Z Board

Table 1.3 Features of BX306Z Board

Supports three constellations, six frequencies: GPS L1/L2, GLONASS L1/L2, BEIDOU B1/B2	Supports NMEA-0183 and Tersus Binary format
Log & Command compatible with Novatel Protocol	Pin to Pin compatible with Trimble BD970
Correction: RTCM 2.x/3.x/CMR/CMR+	Up to 20Hz RTK solution and raw data output <sup>1</sup>
Up to 4GB internal eMMC for data collection.	

Note 1: 20Hz solution is related to firmware release, contact Tersus technical support before this solution is used.

The technical specification of BX306Z board is provided in chapter 4. Three LEDs are on the BX306Z board, the definition is given in Table 1.4.



Figure 1.4 The other side of BX306Z Board

Table 1.4 LED Definition of BX306Z Board

LED	Colour	Description
LED1 (left)	ORANGE	ON: RTK corrections are received. OFF: RTK corrections are not received.
LED2 (middle)	ORANGE	ON: after power on.
LED3 (right)	GREEN	Blink: RTK float. ON: RTK fixed. OFF: other position types



After power on, all the three LEDs are ON for 3 – 5 seconds, then all are OFF. After 2 seconds, LED2 will be ON.

The BX306Z board is NOT booting up successfully if the LEDs are not acting as the above.

### 1.2.3 OEM BX316 Board

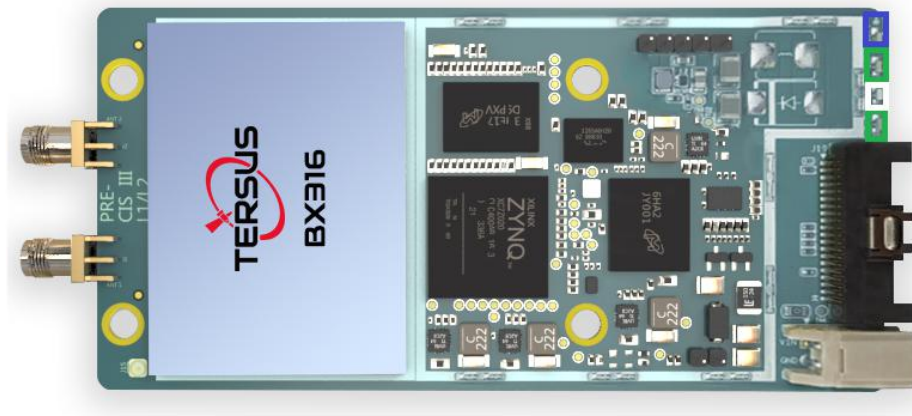


Figure 1.5 Overview of BX316 Board

Table 1.5 Features of BX316 Board


Supports three constellations, six frequencies GPS L1/L2, GLONASS L1/L2, BEIDOU B1/B2	Supports NMEA-0183 and Tersus Binary format
Log & Command compatible with Novatel Protocol	Up to 4GB internal eMMC for data collection.
Correction: RTCM 2.x/3.x/CMR/CMR+	Up to 20Hz RTK solution and raw data output <sup>1</sup>
Support heading	Compact design

Note 1: 20Hz solution is related to firmware release, contact Tersus technical support before this solution is used.

The technical specification of BX316 board is provided in chapter 4. Four LEDs are on the BX316 board, the definition is given in the table below.

Table 1.6 LED Definition of BX316 Board

LED	Colour	Description
PWR & Log (bottom 1)	GREEN	ON: if there is no data collection to eMMC card. Blink: data saved to eMMC card.
GPS (bottom 2)	WHITE	Default: 1Hz blink If data output at higher rate, the blink rate will increase accordingly.
Base (top 2)	GREEN	OFF: no RTK corrections are received. ON: RTK corrections can be received.
RTK (top 1)	BLUE	OFF: RTK not fixed. ON: RTK fixed.

	<p>After power on, All the four LEDs are ON for 3 – 5 seconds, then all are OFF for 2 seconds, PWR&amp;Log LED will be ON or blink. GPS LED will blink.</p> <p>The BX316 enclosure is NOT booting up successfully if the LEDs are not acting as the above.</p>
---	--

The other side of BX316 board is shown as below.

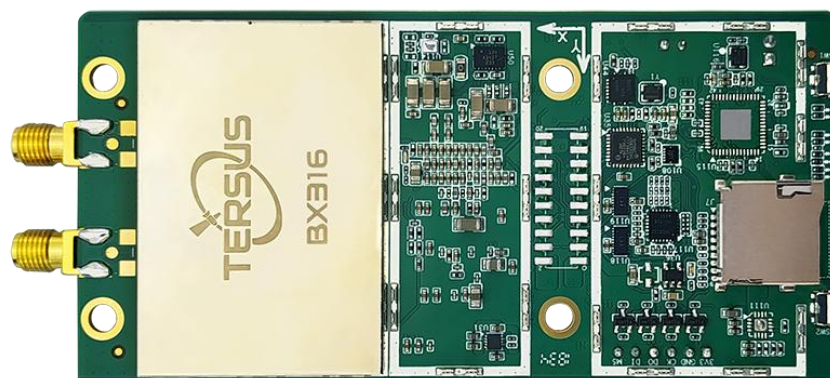


Figure 1.6 The other side of BX316 Board

## 1.2.4 OEM BX316R Board

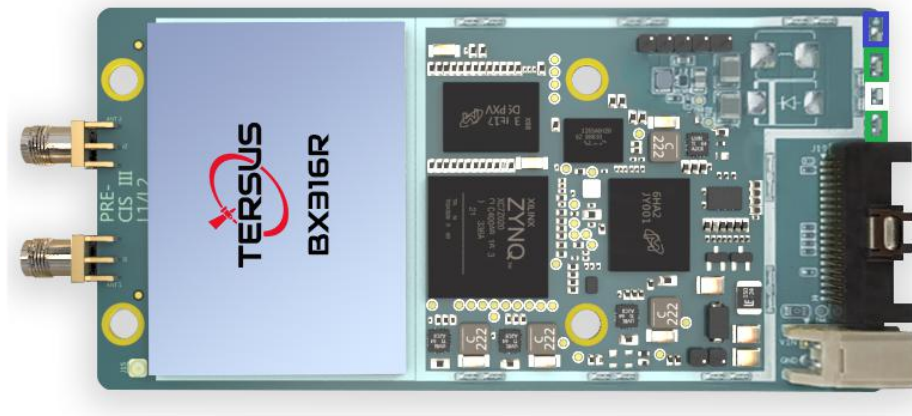


Figure 1.7 Overview of BX316R Board

Table 1.7 Features of BX316R Board

Supports three constellations, six frequencies GPS L1/L2, GLONASS L1/L2, BEIDOU B1/B2	Supports NMEA-0183 and Tersus Binary format
Log & Command compatible with Novatel Protocol	Up to 4GB internal eMMC for data collection.
Correction: RTCM 2.x/3.x/CMR/CMR+	Up to 20Hz RTK solution and raw data output <sup>1</sup>
Compact design	

Note 1: 20Hz solution is related to firmware release, contact Tersus technical support before this solution is used.

The technical specification of BX316R board is provided in chapter 4. Four LEDs are on the BX316R board, the definition is given in Table 1.6 in the section above.

The other side of BX316R board is shown below.

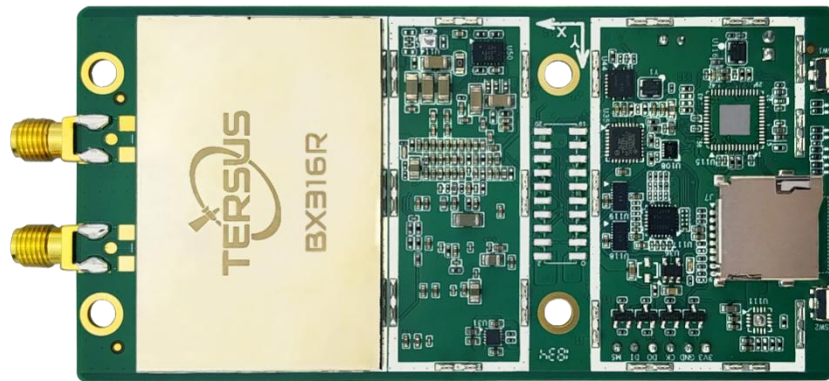


Figure 1.8 The other side of BX316R Board

### 1.2.5 OEM BX316D Board

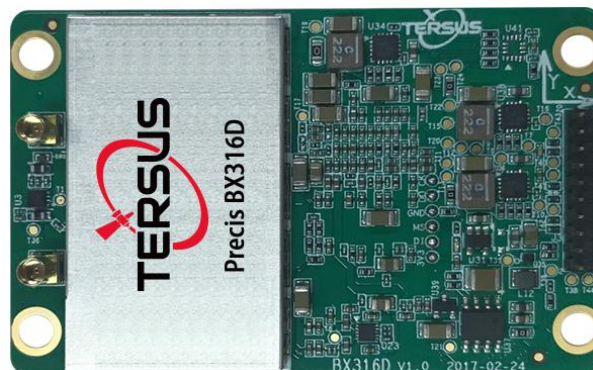


Figure 1.9 Overview of BX316D Board

Table 1.8 Features of BX316D Board

Supports three constellations, six frequencies GPS L1/L2, GLONASS L1/L2, BEIDOU B1/B2	Supports NMEA-0183 and Tersus Binary format
Log & Command compatible with Novatel Protocol	Pin to Pin compatible with Novatel 617D
Correction: RTCM 2.x/3.x/CMR/CMR+	Up to 20Hz RTK solution and raw data output <sup>1</sup>
Supporting heading	Compact design
Up to 4GB internal eMMC for data collection.	

Note 1: 20Hz solution is related to firmware release, contact Tersus technical support before this solution is used.

The technical specification of BX316D board is provided in chapter 4. Two LEDs are installed on the BX316D board, whose definition is given in Table 1.9:

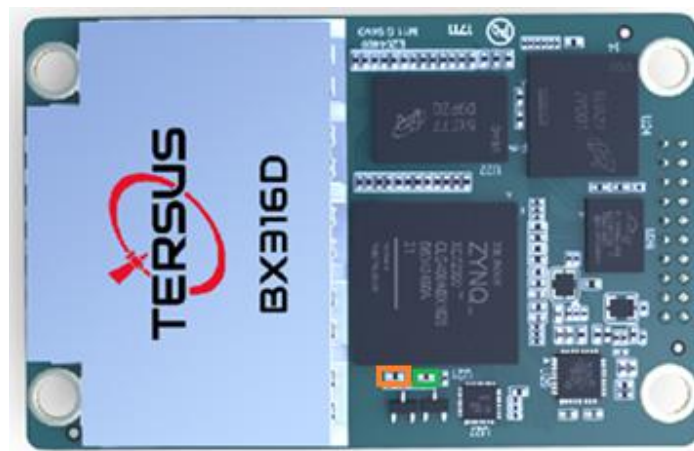



Figure 1.10 The other side of BX316D Board

Table 1.9 LED Definition of BX316D Board

LED	Colour	Description
LED1 (left)	ORANGE	Blink 1Hz: if log is output at 1Hz or less. Blink the same rate as the log if log output rate >1Hz.
LED2 (right)	GREEN	ON: RTK fixed. OFF: RTK not fixed.

	<p>After power on, both LED1 and LED2 are ON for 3 – 5 seconds, then both are OFF for 2 seconds. Afterwards, LED1 will blink at 1Hz.</p> <p>The BX316D board is NOT booting up successfully if the LEDs are not acting as the above.</p>
---	--



## 1.2.6 BX306 Enclosure



Figure 1.11 Overview of BX306 Enclosure

Table 1.10 Features of BX306 Enclosure

Feature	BX306 Enclosure
OEM board	BX306 board
Serial ports	2 LVTTTL serial port <sup>1</sup>
Antenna interface	Single SMA
USB	USB2.0
Input power	+5~+12VDC
Power interface	USB type A
GPS+BEIDOU+GLONASS positioning	Yes
PPS	Yes
Event	Yes

Note 1: The specific 20-pin cable has a COM3 connector, but its function is related to the firmware version, please check with Tersus technical support.

The technical specification of BX306 enclosure is provided in chapter 4. Two LEDs are given on the BX306 enclosure panel, the definition is in Table 1.11.



Figure 1.12 BX306 Enclosure Panel

Table 1.11 LED Definition of BX306 Enclosure

LED	Colour	Description
LED1	RED	ON: RTK fixed. OFF: RTK not fixed.
LED2	RED	ON: after power on.



After power on, both LED1 and LED2 are ON for 3 – 5 seconds, then LED1 will be OFF, while LED2 keeps ON.

The BX306 enclosure is NOT booting up successfully if the LEDs are not acting as the above.

## 1.2.7 BX316 Enclosure



Figure 1.13 Overview of BX316 Enclosure

Table 1.12 Features of BX316 Enclosure

Feature	BX316 Enclosure
OEM board	BX316 board
Serial ports	2 LVTTL serial port <sup>1</sup>
Antenna interface	Double SMA
Input power	+5~+12VDC
Power interface	USB type A
USB	USB2.0
GPS+GLONASS+BEIDOU in position and heading	Depends on the antenna mode, refer to command ANTENNAMODE in the Log & Command document for detail.
External SD card	No
Heading	Yes
PPS	Yes
Event	Yes

Note 1: The specific 40-pin cable has a COM3 and Ethernet connectors, however their function is related to the firmware version, please check with Tersus technical support.


Refer to section 2.8 for detail about how to output heading. The technical specification of BX316 enclosure is provided in chapter 4. Four LEDs are provided on the BX316 enclosure panel, refer to Table 1.13 for definition.



Figure 1.14 BX316 Enclosure Panel

Table 1.13 LEDs on BX316 Enclosure Panel

LED	Colour	Description
PWR & Log	GREEN	ON: if there is no data collection to eMMC card. Blink: data saved to eMMC card.
GPS	WHITE	Default: 1Hz blink If data output at higher rate, the blink rate will increase accordingly.
Base	GREEN	OFF: no RTK corrections are received. ON: RTK corrections can be received.
RTK	BLUE	OFF: RTK not fixed. ON: RTK fixed.

	<p>After power on, All the four LEDs are ON for 3 – 5 seconds, then all are OFF for 2 seconds, PWR&amp;Log LED will be ON or blink. GPS LED will blink.</p> <p>The BX316 enclosure is NOT booting up successfully if the LEDs are not acting as the above.</p>
---	--

### 1.2.8 BX316R Enclosure

BX316R enclosure is designed specifically for post processing applications, such as mobile mapping or monitoring system. It has the same hardware as that of BX316, however it cannot support RTK positioning or heading.


	<p>BX316R can support RTK positioning and heading after an auth code is input. Contact Tersus sales for more details.</p>
---	---



Figure 1.15 Overview of BX316R Enclosure

Table 1.14 Features of BX316R Enclosure

Feature	BX316R Enclosure
OEM board	BX316R board
Serial ports	2 LVTTTL serial port <sup>1</sup>
Antenna interface	Two SMA connectors <sup>2</sup>
Input power	+5~+12VDC
Power interface	USB type A
USB	USB2.0
GPS+GLONASS+BEIDOU in position	Yes
External SD card	No
Heading	No
PPS	Yes
Event	Yes

Note 1: The specific 40-pin cable has a COM3 connector, but its function is related to the firmware version.

Note 2: Only P-ANT interface can work.

The technical specification of BX316R enclosure is provided in chapter 4. BX316R enclosure has the same LEDs on panel as BX316 enclosure, and has the same the booting up mode as BX316 enclosure. Refer to section 1.2.7 for the LEDs definition of BX316R.

## 1.2.9 BX316D Enclosure



Figure 1.16 Overview of BX316D Enclosure

Table 1.15 Features of BX316D Enclosure

Feature	BX316D Enclosure
OEM board	BX316D board
Serial ports	2 LVTTTL serial port <sup>1</sup>
Antenna interface	Double SMA
Input power	+5~+28VDC
Power interface	USB type A
USB	USB2.0
GPS+GLONASS+BEIDOU in position and heading	Depends on the antenna mode, refer to command ANTENNAMODE in the Log & Command document for detail.
External SD card	No
Heading	Yes
PPS	Yes
Event	Yes

Note 1: The specific 20-pin cable has a COM3 connector, however its function is related to the firmware version, please check with Tersus technical support.

The technical specification of BX316D enclosure is provided in chapter 4. Two LEDs are given on the BX306 enclosure panel, the definition is in the table below.



Figure 1.17 BX316D Enclosure Panel

Table 1.16 LED Definition of BX316D Enclosure

LED	Colour	Description
PV	RED	ON: RTK fixed. Blink: RTK floating OFF: RTK in other position types
PWR	RED	ON: after power on.



After power on, both PV and PWR are ON for 3 – 5 seconds, then PV will be OFF, while PWR keeps ON.

The BX316D enclosure is NOT booting up successfully if the LEDs are not acting as the above.

### 1.3 BX Receivers System Overview

To make OEM BX series boards work, the following parts are necessary:

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

The BX series receivers are illustrated in Figure 1.18

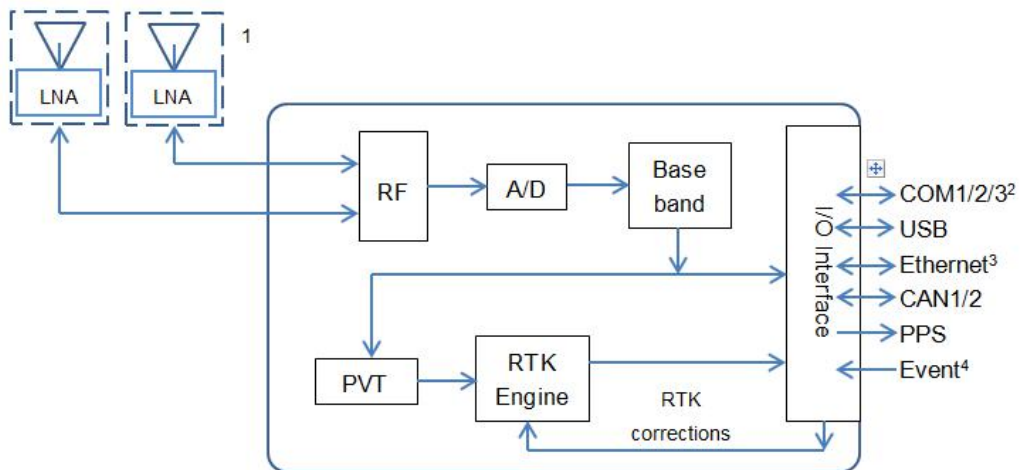


Figure 1.18 System Overview of BX Boards

Note 1: Only BX316 and BX316D can support the secondary antenna.

2: COM3 is related to firmware version, please contact Tersus technical support before it is used.

3: Currently Ethernet port is not supported.

4: Currently only one event input is supported.



### 1.3.1 BX Series OEM Boards

BX series OEM boards consist 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 1.18.

### 1.3.2 BX Enclosures

An enclosure is necessary to protect the OEM BX series boards from environmental extremes and high levels RF interference, and it brings convenience for the customers to use the receivers.

### 1.3.3 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 about antennas.

### 1.3.4 Power Supply

A power supply capable of delivering the minimum receiver operating voltage and power is required. Refer to section 2.4 for details.

### 1.3.5 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.

### 1.3.6 Internal eMMC Card/External SD Card



All the BX receivers support up to 4GB internal eMMC card by FW0020 or later firmware.

!	The external SD card must meet: Size ≤ 16GB File system: FAT32 The SD card should be installed into the external data logger before it is used, refer to section 5.4 for details.
---	--

The data can be saved on the internal eMMC or external SD card manually or automatically, which is determined by the command LOGFILE.

### 1.3.7 Enable Heading

!	Only OEM BX316D board/enclosure and BX316 board/enclosure can support heading output.
---	---

The default configuration of BX316D and BX316 is in single antenna mode, in which heading output is not supported. Heading output is supported only when they are in dual antenna mode. Command ANTENNAMODE must be input to select the antenna mode, refer to chapter 2.8 Heading Output for details.

!	When in single antenna mode, the connector for the secondary antenna connector can be left floating.
---	--

## 2. Installation

This chapter describes how to set up a BX receiver to make it work. In order to perform RTK positioning, BX receiver needs the GNSS satellites signals input from the antenna and RTK corrections input from a serial port.

!	The installation takes BX306 enclosure as the example, BX series OEM boards 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 Shipping Box

Generally, the BX series receiver kits are shipped in a plastic carrying box which is shown below. However, the BX series OEM boards are not shipped in this box. The following receivers / accessories can be packed in the standard carrying case.



Figure 2.1 Carrying case



Figure 2.2 Major Parts in the BX306 GNSS Kit Package



Figure 2.3 Major Parts in the BX306 GNSS UAV Kit Package

## 2.2 UART to USB converter

The BX enclosure receivers communicate with other devices via a serial port, which could be connected to a UART to USB converter, refer to Figure 2.4.



Figure 2.4 UART to USB converter

The driver for UART to USB converter can be downloaded from Tersus website: <https://tersus-gnss.com/software/gnss-kits> or contact Tersus Technical support by email [support@tersus-gnss.com](mailto:support@tersus-gnss.com) for software support.

After the driver is installed on your computer successfully, it can be found in device manager, refer to Figure 2.5. BX306 is connected to the UART to USB converter and any serial software tool can communicate with the BX306.

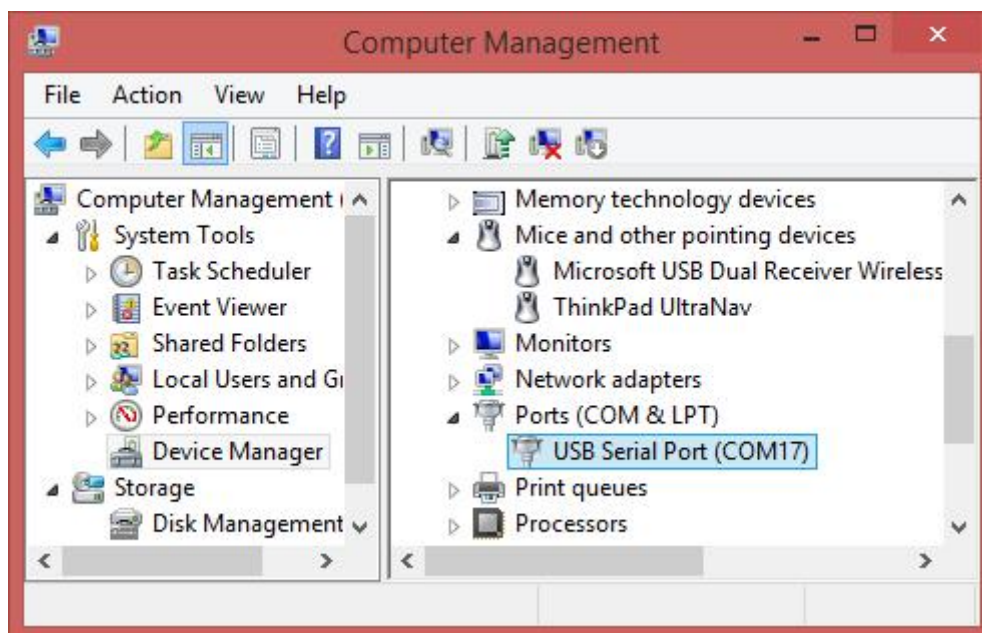


Figure 2.5 Device Manager

Tersus GNSS Center, a graphic serial software which is integrated into Tersus Tool Suite, is recommended to communicate with the receiver. It can be freely

downloaded from <https://tersus-gnss.com/software> . Figure 2.11 shows the main windows of Tersus GNSS Center, refer to section 2.6 for more details.

## 2.3 Selecting a GNSS antenna

The antennas provided by Tersus can be found on Tersus website <https://tersus-gnss.com/product/accessories>. It is highly recommended the antennas from Tersus are used to work with BX series receivers.



Figure 2.6 AX3702 GNSS antenna



Figure 2.7 AX3703 mini GNSS antenna



Figure 2.8 AX3705 Helix Antenna

Generally, AX3702 is widely used in survey application and is recommended for all other applications. AX3703 is recommended for UAV application. AX3705 is a part of solution for UAV PPK.



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.

## 2.4 Power Supply Requirement




Power to the BX series OEM boards 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.



If the voltage supplied is below the minimum specification, the receiver suspends operation. If the voltage supplied is above the maximum specification, the receiver may be permanently damaged, voiding the warranty.




	The LEDs on the OEM boards/enclosures can tell whether the receiver is booting up successfully or not, refer to the detailed information from section 1.2.1 to 1.2.9.
---	---

The input power requirement for the BX series receivers are given in Table 2.1

Table 2.1 Input Power Requirements

BX series receivers	Input Power Requirement
OEM BX306 board	+3.3 VDC +5%/-3% with less than 100 mV ripple
OEM BX306Z board	+3.3 VDC +5%/-3% with less than 100 mV ripple
OEM BX316 board	+5~+12VDC
OEM BX316R board	+5~+12VDC
OEM BX316D board	+3.3 VDC +5%/-3% with less than 100 mV ripple
BX306 enclosure	+5~+12VDC
BX316 enclosure	+5~+12VDC
BX316R enclosure	+5~+12VDC
BX316D enclosure	+5~+28VDC

	None of the BX receivers are supporting reversed polarity protection.
---	---

## 2.5 OEM Boards Installation Overview

When the appropriate equipment is selected, complete the following steps to set up and begin using the BX series receivers.

- a) Install the BX 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 RF cable.
- d) Apply power to the receiver, as described in section 2.4.
- e) Connect the receiver to a computer or other data communications equipment.



When OEM BXs series boards are handled, follow the guides below to avoid damage from ESD.

- Always wear a properly grounded anti-static wrist strap when handling BX series boards.
- 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

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

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

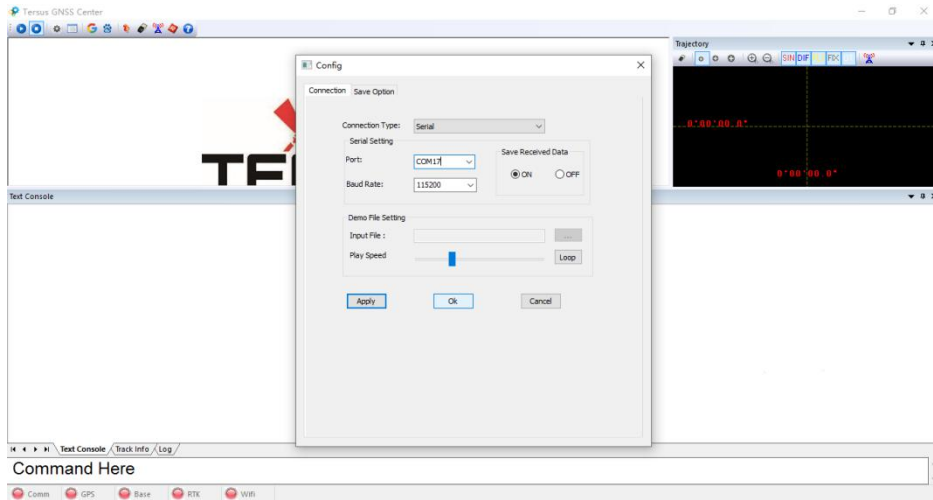


Figure 2.9 Config Page of Tersus GNSS Center

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

Table 2.2 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.



Figure 2.10 BX306 Enclosure Connected to a Laptop

Figure 2.10 shows a BX306 enclosure is connected to a laptop with a 20-pin external cable and a UART to USB converter.

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.

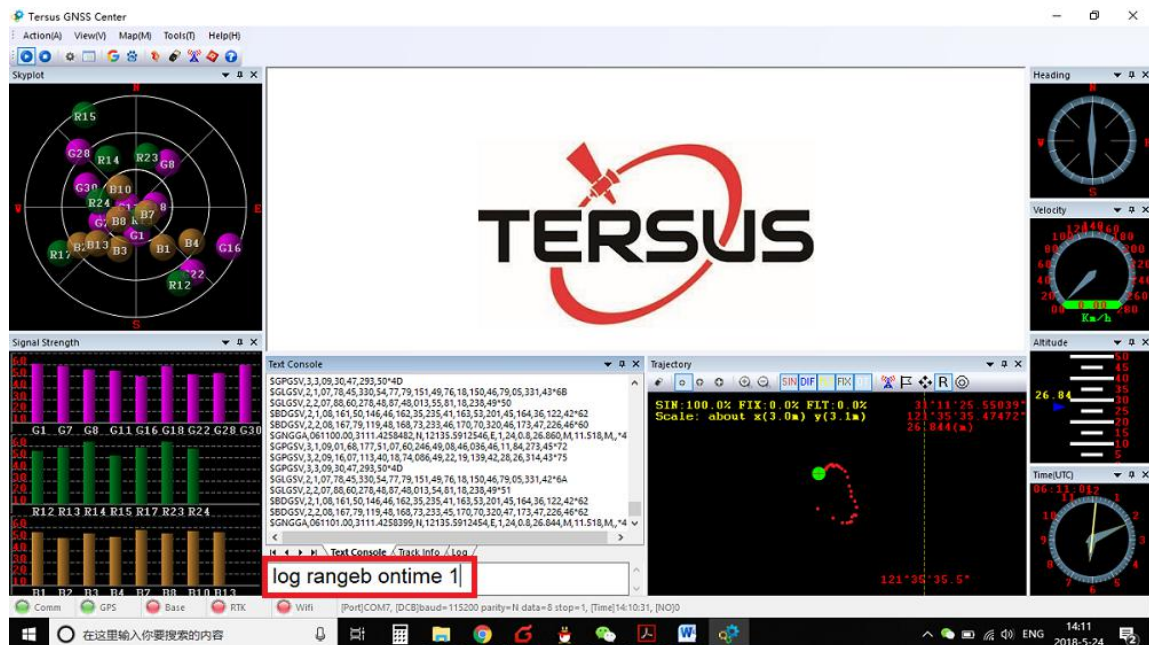


Figure 2.11 Main Windows of Tersus GNSS Center

!	<p>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:</p> <pre>LOG GPGBA 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.)</pre>
---	---

### 2.6.1 Auto Base Station List Function

If a base is setup with command POSAVE, according to its original definition, after a power cycle, the fixed position may be different even if the receiver is installed at the same point. More details about command POSAVE refer to the Log & Command document. For the users who need the base to keep the same fixed position after a power cycle, auto base station list function is introduced.

The procedure is introduced as below:

- 1) Create communication between the BX receiver and Tersus GNSS Center software, refer to section 2.6.
- 2) Under the Menu, click [Tool] -> [Auto Base Station List], the following interface is displayed.

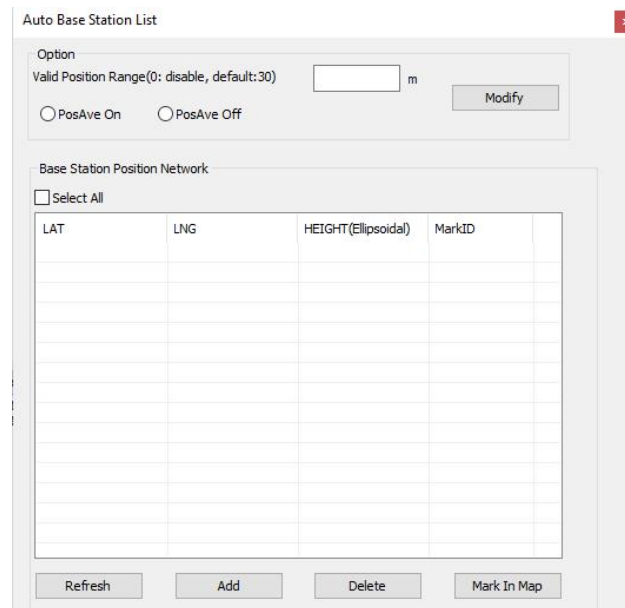


Figure 2.12 Auto Base Station List interface

- 3) Fill the valid position range, check PosAve On, and click [Modify]. It is recommended that valid position range is >20m.
- 4) After the specific time (in the example, 0.01 hour is 36 seconds), the base is fixed with the 36 seconds averaging position.
- 5) Click [Refresh], the fixed position is displayed as below.

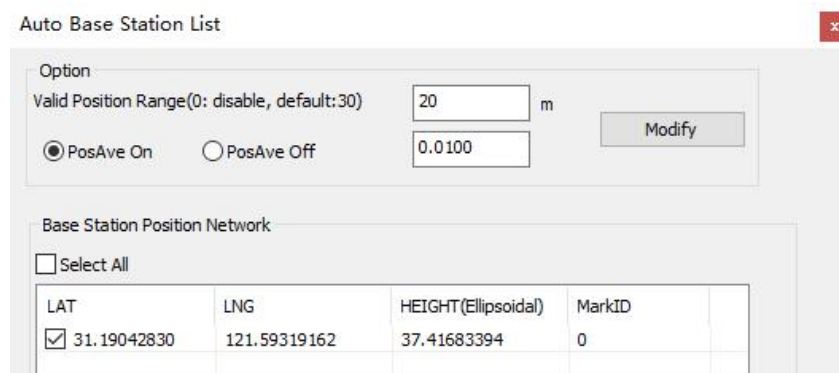


Figure 2.13 Fixed position for base station

- 6) After a power cycle, if the base is moved less than 20m away from the last position, it would fix with the same position. In the above example, latitude keeps 31.19042830, longitude keeps 121.59319162 and ellipsoid height keeps 37.4168.

## 2.7 Transmitting and Receiving Corrections

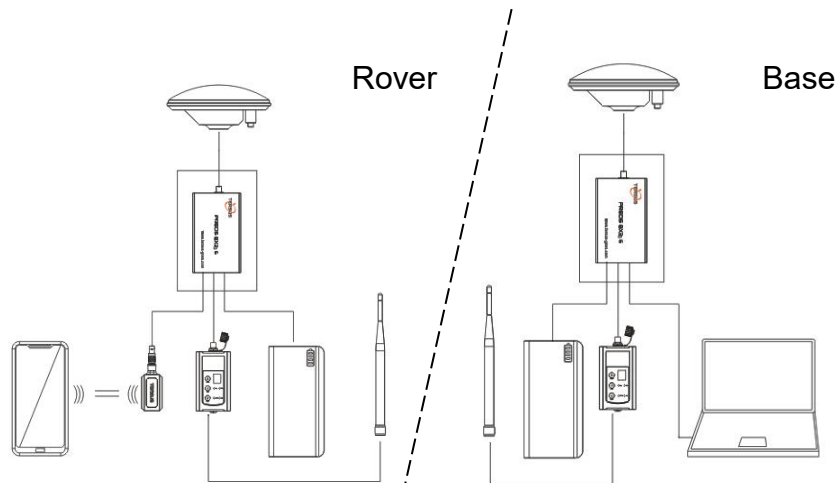


Figure 2.14 Base/Rover Configure

Example of RTK configuration (base mode):

```
COM COM2 115200 //set the baud rate, optional
INTERFACEMODE COM2 AUTO AUTO ON //set the interfacemode, optional
FIX POSITION LAT LON HGT //fix the position of the base, for
example: FIX POSITION 31.000302123 114.289244543 26.130
refer to Log & Command Reference document for details.
```

```
LOG COM2 RTCM1074 ONTIME 1 //output GPS RTK raw measurements
LOG COM2 RTCM1084 ONTIME 1 // output GLONASS raw measurements
LOG COM2 RTCM1124 ONTIME 1 // output BeiDou RTK raw measurements
LOG COM2 RTCM1005 ONTIME 10 // output the base's position
LOG COM2 RTCM1230 ONTIME 5 //output GLONASS bias information
SAVECONFIG //save the configuration above
```

Example of RTK configuration (rover mode):

```
COM COM2 115200 //set the baud rate, optional
```

```
INTERFACEMODE COM2 AUTO AUTO ON //set the interfacemode, optional
LOG GPGGA ONTIME 1 //output GPGGA to check position type
SAVECONFIG //save the configuration above
```

!	<p>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:</p> <ul style="list-style-type: none"><li>● If the base's position is known, input it directly with command FIX.</li><li>● 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 &amp; 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.</li><li>● If you require a cm level accuracy of base and rover, then:<ol style="list-style-type: none"><li>a. Configure the base receiver as a rover, receive RTK corrections from a CORS nearby, this receiver can get cm-level accuracy position.</li><li>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.</li></ol></li></ul>
---	---

## 2.8 Heading Output

!	Only BX316D board / enclosure and BX316 board / enclosure can support heading output.
---	---



The default configuration of BX316D and BX316 is in single antenna mode; heading output is supported only when they are in dual antenna mode. To output heading, follow the steps below:

- 1) Connect two GNSS antennas to the primary and secondary connectors, respectively.
- 2) Input one of the two commands below to select dual antenna mode.

```
ANTENNAMODE DUALGPSBDS // Primary antenna tracks GPS L1/L2, BeiDou B1/B2;
                        Secondary antenna tracks GPS L1, BeiDou B2
```

```
ANTENNAMODE DUALGPSGLO // Primary antenna tracks GPS L1/L2, GLO L1/L2;
                        Secondary antenna tracks GPS L1, GLO L2
```

- 3) LOG HEADING ONTIME 1 // heading output
- 4) SAVECONFIG // save the configuration above.
- 5) Power cycle the receiver.



The command ANTENNAMODE is not effective before a power cycle is completed.



In single antenna mode, the raw measurements in RANGE log are from the primary antenna only.

In dual antenna mode, the raw measurements from both the primary antenna and the secondary antenna are included in RANGE log.



It is recommended that the distance between two antennas is >1m. It is strongly recommended the distance is 0.5m at least.

## 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](mailto: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 COM1 0 0.0 UNKNOWN -1 0.000 00000000 0 20161214
< 1
<      BX306 G2SB2G2 008001181300000026 0020 20161123 3.0 Mar 16
2018 00:39:52
```

0020 is the firmware version. Refer to 'VERSION' in Tersus GNSS 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 GNSS receiver;
- 2) Run Tersus GNSS Center software and communicate with the receiver, refer to section 2.6 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;



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;

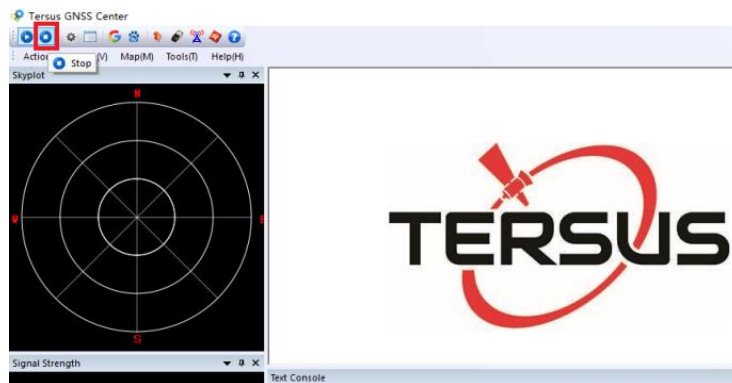


Figure 3.2 Stop button on TERSUS GNSS Center

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

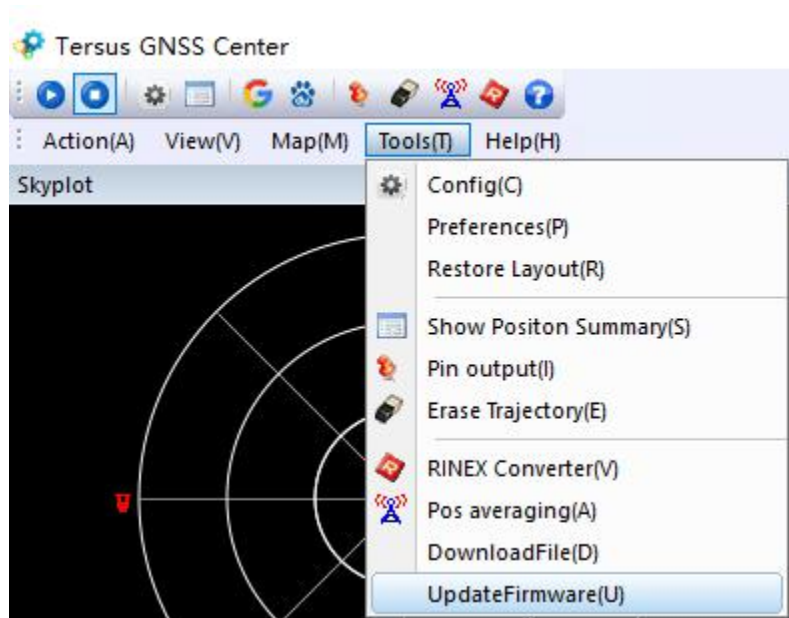


Figure 3.3 Find UpdateFirmware in Tools bar

- 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];

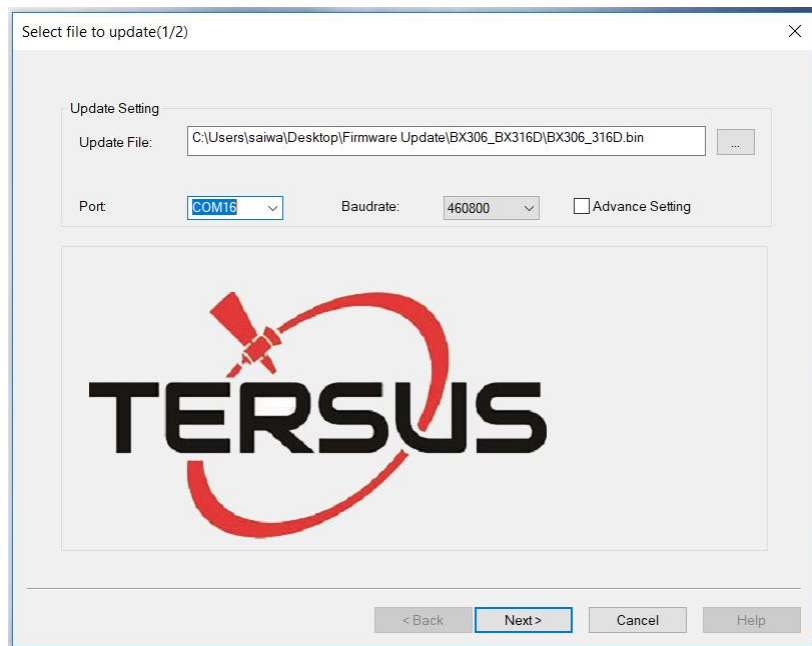


Figure 3.4 Select file to update

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

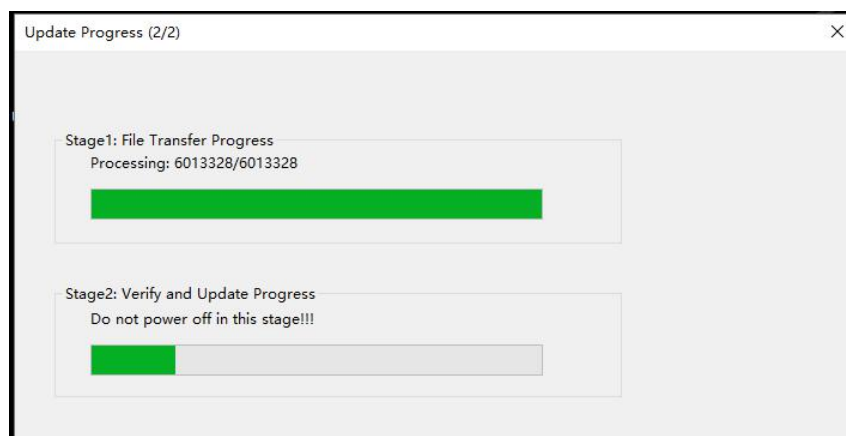


Figure 3.5 Update in progress



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

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

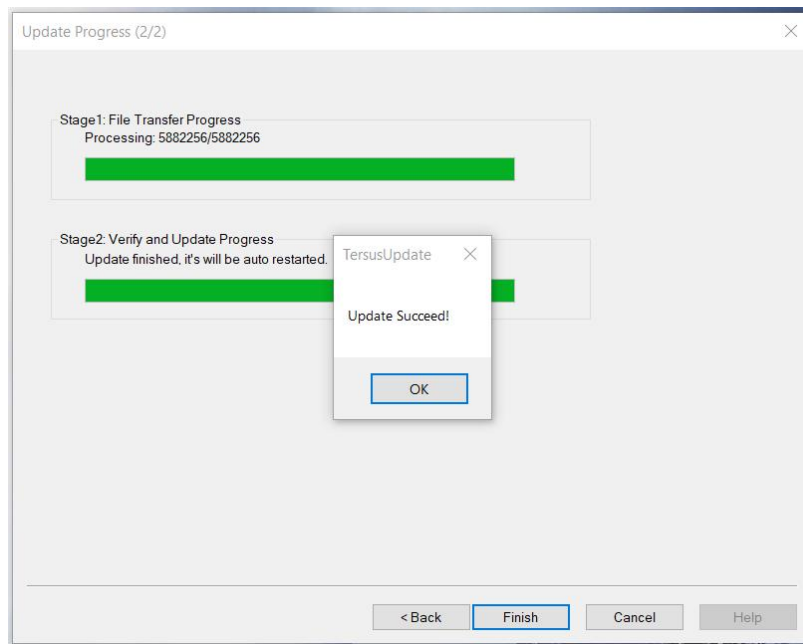


Figure 3.6 Firmware update successful

- 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.

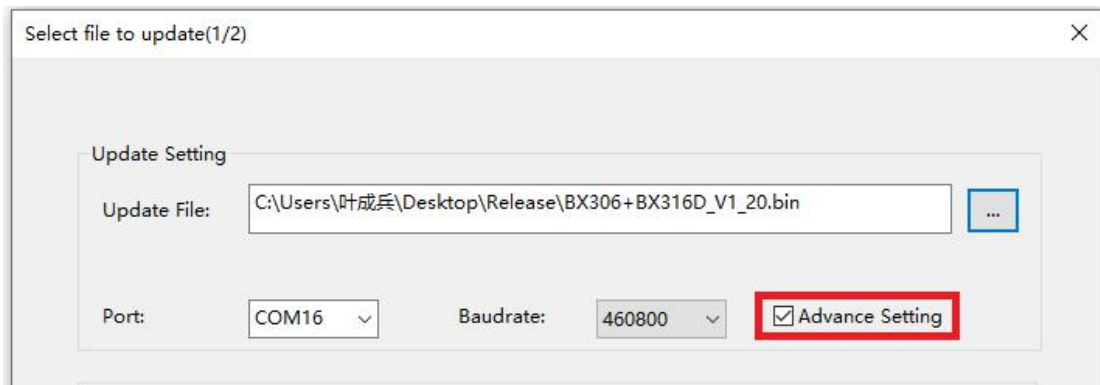


Figure 3.7 Advance setting for firmware update

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.

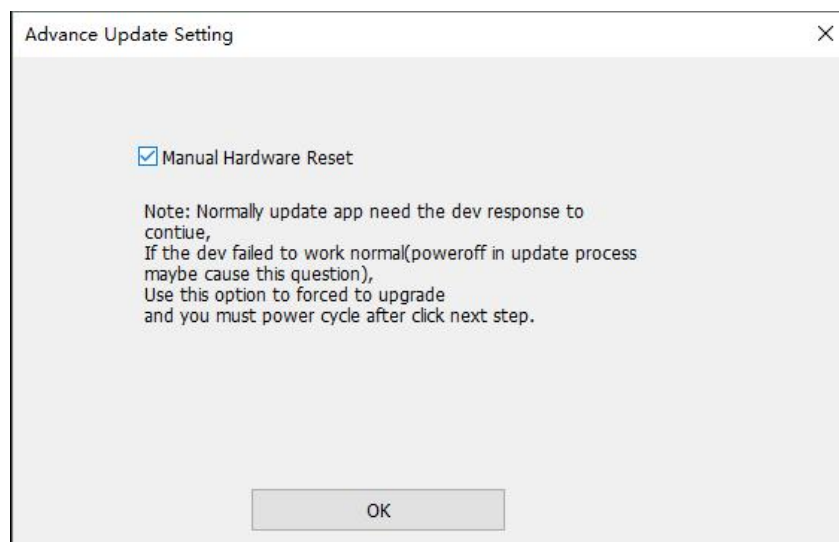


Figure 3.8 Advance Update Setting

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



**This option is for sophisticated 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.



## 4. Technical Specifications

### 4.1 BX306 Board

#### 4.1.1 BX306 Specifications

Table 4.1 BX306 Board Specifications

GNSS Performance			
Position Accuracy	Single positioning	1.5m RMS (Horizontal)	
		3.0m RMS (Vertical)	
	RTK Positioning	10mm+1ppm (Horizontal)	
		15mm+1ppm (Vertical)	
Time to First Fix	Cold Start: <50s Warm Start: <30s		
Reacquisition	0.5 s L1 (typical) 1.0 s L2 (typical)		
Data Rate	Measurements	20Hz	
	Position	5Hz	
Time Accuracy	20ns RMS		
Velocity Accuracy	0.03m/s RMS		
Measurement Precision	GPS	L1 PSR	6 cm
		L1 ADR	1.0mm
		L2 PSR	8 cm
		L2 ADR	1.2mm
	BEIDOU	L1 PSR	6 cm
		L1 ADR	1.0mm

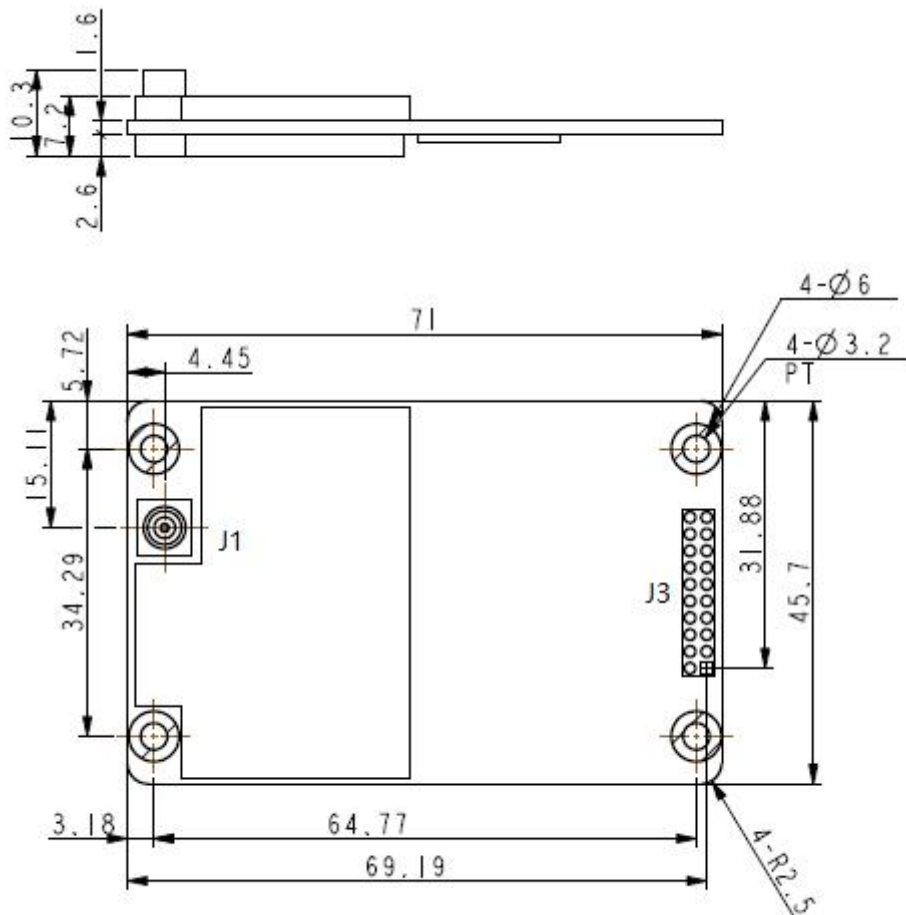
		L2 PSR	8 cm
		L2 ADR	1.0mm
	GLONASS	L1 PSR	8 cm
		L1 ADR	1.0mm
		L2 PSR	8 cm
		L2 ADR	1.0mm

### Physical Description

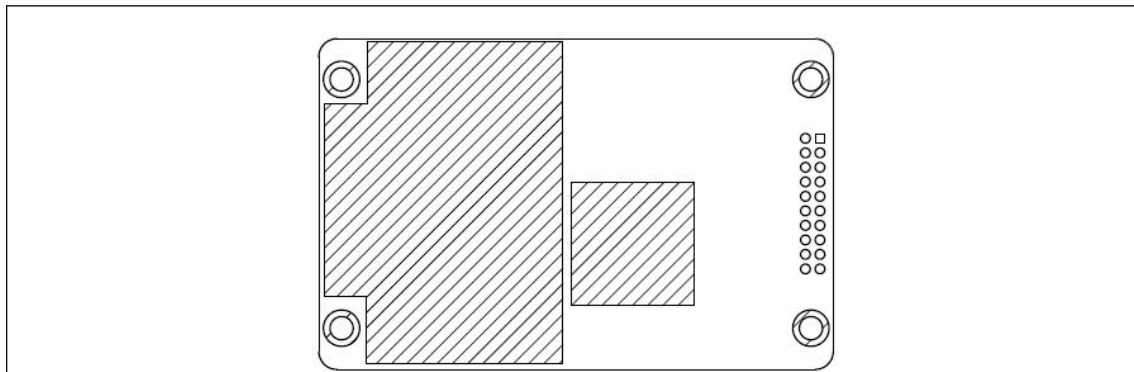
Size 71 \* 46 \* 10.3 mm<sup>3</sup>

Weight 27g

### Mechanical Drawing



### HEAT SINK POSITION<sup>1</sup>



### ENVIRONMENTAL

Operating Temperature	-40C to +85C
Storage Temperature	-55C to +95C
Humidity	MIL-STD-810G, Method 507.5 Procedure II (95%)
Random Vibration	MIL-STD 810G Method 514.6, Category 24 (7.7 g RMS)
Sinusoidal Vibration	IEC 60068-2-6 (5 g)
Bump	ISO 9022-31-06 (25 g)
Shock	Operating: MIL-STD-810G, Method 516.6, Procedure I (40 g) Non-operating: MIL-STD-810G, Method 516.6, Procedure V (75 g)

### Power Requirement

Input Voltage	+3.3 +5%/-3% VDC
Allowable Voltage Ripple	100 mV p-p maximum
Power Consumption	2.8W (typical)

Note 1: when BX306 board is assembled in a metal case, a head sink must be installed between the hatch area and the metal case, or the thermal performance of the board will be decreased.

### 4.1.2 Connectors on BX306 board

There are two connectors on the BX306 board, J1 and J3, refer to the mechanical drawing in the above table.

J1: MCX jack receptacle, straight (Johnson P/N 133-3711-202 or SAMTEC P/N MCX- J-P-HST-SMI or equivalent)

J3: 2x10 header, 2 mm pitch (SAMTEC P/N TMM-110-03-G-D)

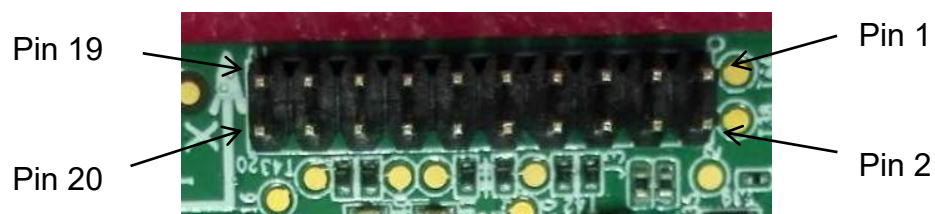


Figure 4.1 Connector J3 on BX306 board

Table 4.2 Interface Signals Definition

Pin	Signal	TYPE	Description	Comments
1	LNA_PWR	PWR	Antenna power input	Power to antenna, 3.3~12VDC.
2	3V3	PWR	Power to the board	3.3 V +5%/-3%
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	N.C		Not Connected	
9	EVENT1	IO	Event1 input	Has a 10K pull-up resistor on board.
10	GND	GND	Ground	
11	TXD1	O	COM1 transmit data	LVTTL level, the max band rate is 921600 bps.
12	RXD1	I	COM1 receive data	
13	GND	GND	Ground	
14	TXD2	O	COM2 transmit data	LVTTL level, the max band rate is 921600 bps.
15	RXD2	I	COM2 receive data	
16	GND	GND	Ground	
17	PV	O	Position valid indicator	High: when RTK solution is got. Low: other position types.
18	GND	GND	Ground	
19	PPS	O	Pulse per second output,	This pin has an internal 50 ohm line driver. Route as a 50 $\Omega$ single-ended trace
20	N.C		Not Connected	

#### 4.1.3 Reference Schematic of the Interface Board

If an interface board is designed to work with BX306 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.

### VDD 3.3V

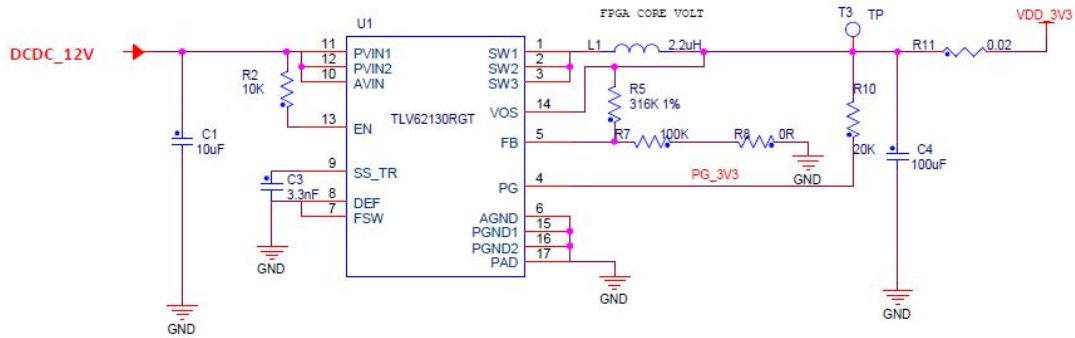


Figure 4.2 3.3V Reference Schematic

### VDD\_5V

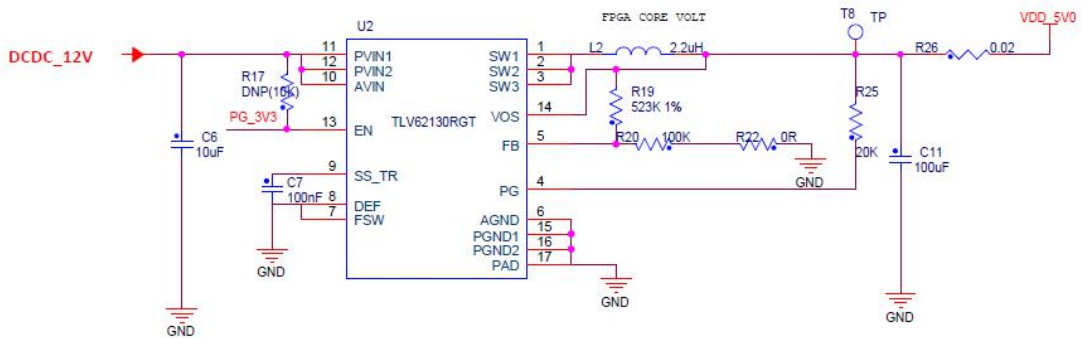


Figure 4.3 5V Reference Schematic

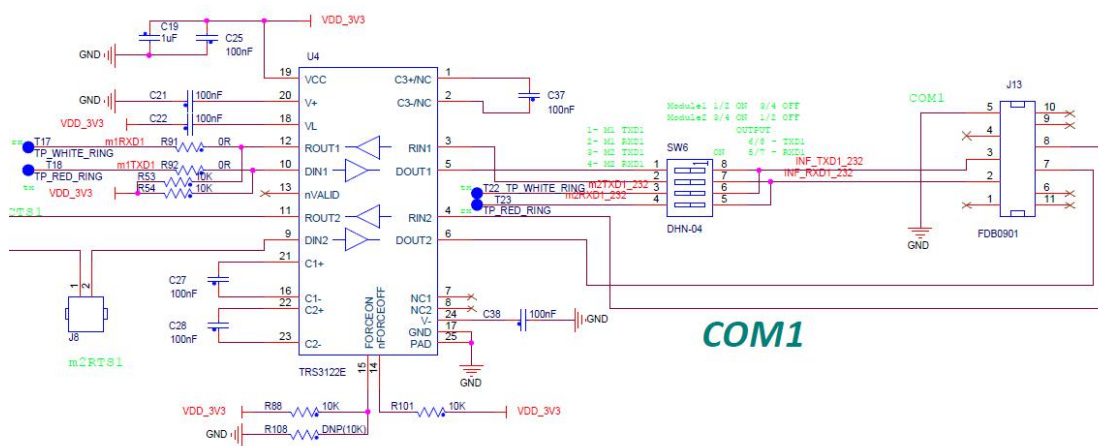


Figure 4.4 Reference Schematic for a Serial Port

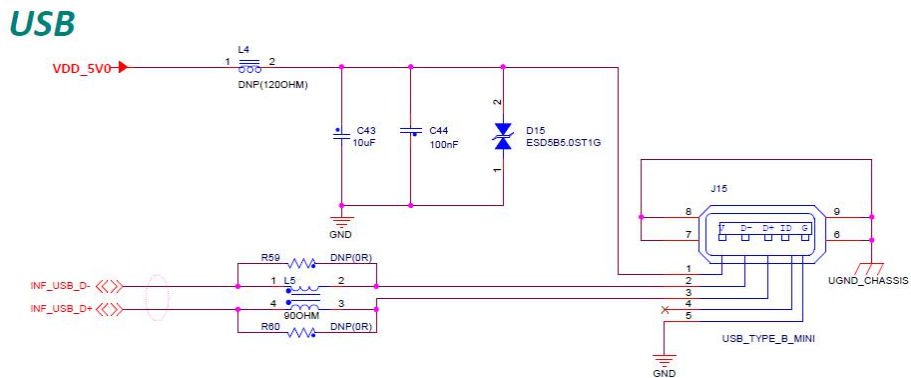


Figure 4.5 Reference Schematic for USB

## 4.2 BX306Z Board

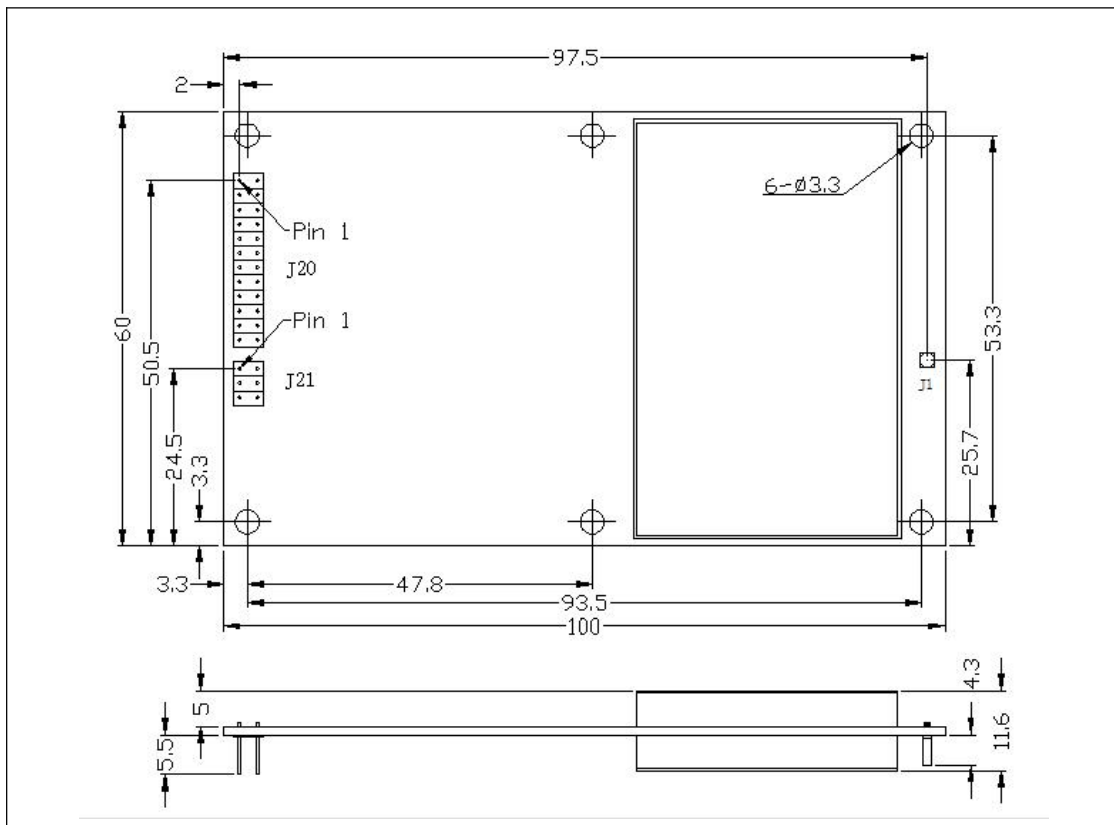
### 4.2.1 BX306Z Specifications

Table 4.3 BX306Z Board Specifications

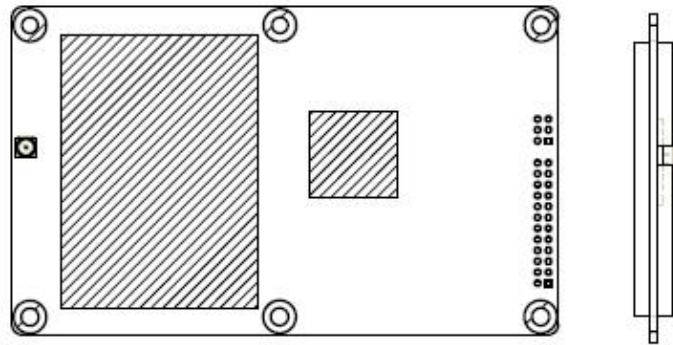
GNSS Performance		
Position Accuracy	Single positioning	1.5m RMS (Horizontal)
		3.0m RMS (Vertical)
	RTK Positioning	10mm+1ppm (Horizontal)
		15mm+1ppm (Vertical)
Time to First Fix	Cold Start: <50s	
	Warm Start: <30s	
Reacquisition	0.5 s L1 (typical)	
	1.0 s L2 (typical)	
Data Rate	Measurements	20Hz
	Position	5Hz

Time Accuracy	20ns RMS		
Velocity Accuracy	0.03m/s RMS		
Measurement Precision	GPS	L1 PSR	6 cm
		L1 ADR	1.0mm
		L2 PSR	8 cm
		L2 ADR	1.2mm
	BEIDOU	L1 PSR	6 cm
		L1 ADR	1.0mm
		L2 PSR	8 cm
		L2 ADR	1.0mm
	GLONASS	L1 PSR	8 cm
		L1 ADR	1.0mm
		L2 PSR	8 cm
		L2 ADR	1.0mm
<b>Physical Description</b>			
Size	100 * 60 * 11.6 mm <sup>3</sup>		
Weight	46g		
<b>Mechanical Drawing</b>			





#### HEAT SINK POSITION<sup>1</sup>



#### ENVIRONMENTAL

Operating Temperature	-40C to +85C
Storage Temperature	-55C to +95C
Humidity	MIL-STD-810G, Method 507.5 Procedure II (95%)
Random Vibration	MIL-STD 810G Method 514.6, Category 24 (7.7 g RMS)
Sinusoidal Vibration	IEC 60068-2-6 (5 g)

Bump	ISO 9022-31-06 (25 g)
Shock	Operating: MIL-STD-810G, Method 516.6, Procedure I (40 g) Non-operating: MIL-STD-810G, Method 516.6, Procedure V (75 g)
<b>Power Requirement</b>	
Input Voltage	+3.3 +5%/-3% VDC
Allowable Voltage Ripple	100 mV p-p maximum
Power Consumption	2.9W (typical)

Note 1: when BX306Z board is assembled in a case, a heat sink must be installed between the hatch area and the metal case, or the thermal performance of the board will be decreased.

#### 4.2.2 Connectors on BX306Z board

There are three connectors on the BX306Z board, J1, J20 and J21, refer to the mechanical drawing in the above table.

1. J20: 2x12 header, 2 mm pitch (SAMTEC P/N TMM-112-03-G-D)
2. J21: 2x3 header, 2 mm pitch (SAMTEC P/N TMM-103-03-G-D)
3. J1: MMCX jack receptacle, straight



Figure 4.6 Connectors J20 and J21 of BX306Z

Table 4.4 2X12 Header Signals Definition

Pin	Signal	TYPE	Description	Comments
1	GND	GND	Ground	
2	RTK LED	O	RTK LED. Flashes when an RTK correction is present.	To drive an LED, a series resistor with a 300Ohms is required.
3	POWER_OFF	I	Powers the unit on and off.	Drive high with a 3.3V to turn off, leave floating or ground to keep the unit on.
4	PPS	O	Pulse per second output	This is 3.3V TTL level, 4mA max drive capability.
5	VCC	PWR	Power to the board	3.3V +5%/-3%
6	VCC	PWR	Power to the board	3.3V +5%/-3%
7	Event2 <sup>1</sup> / CAN1_RX / COM3_RX <sup>1</sup>	I	Event2 – Event input CAN1_RX – CAN Receive line COM3_RX – COM3 Receive line	Event2 must be 3.3V TTL level.  Connect COM3_RX to a transceiver if RS-232 level is required.
8	Event1	I	Event input	must be 3.3 V TTL level
9	Power LED	O	POWER Indicator, High when unit is on.	When used to drive an LED, a series resistor with a typical value of 300Ohm is required.
10	Satellite LED	O	Satellite LED. Rapid flash: <5 satellites. Slow flash: >5 satellites.	To drive an LED, a series resistor with 300Ohm is required.
11	COM2_CTS	I	COM2 Clear to Send – TTL Level	Connect COM2_CTS to a transceiver if RS-232 level is required.
12	RESET_IN	I	RESET_IN – ground to reset	Drive low to reset the unit.

13	COM2_RTS	O	COM2 Request to Send – TTL Level	Connect COM2_RTS to a transceiver if RS-232 level is required.
14	COM2_RX	I	COM2 Receive line	Connect COM2_RX to a transceiver if RS-232 level is required.
15	No Connect		Reserved	
16	COM2_TX	O	COM2 transmit line	Connect COM2_TX to a transceiver if RS-232 level is required.
17	No Connect		Reserved	
18	COM1_RX	I	COM1 Receive line	RS-232 Level
19	CAN1_TX / COM3_TX <sup>1</sup>	O	CAN1_TX – CAN Transmit line COM3_Transmit Data – TTL Level	Connect CAN1_TX to TX line of a CAN driver. Connect COM3_TX to a transceiver if RS-232 level is required
20	COM1_TX	O	COM1 Transmit Data	RS-232 Level
21	USB-	I/O	USB D(-) Bi-directional USB interface data (-)	Device Mode only.
22	USB+	I/O	USB D(+) Bi-directional USB interface data (+)	Device Mode only.
23	GND	GND	Ground	
24	GND	GND	Ground	

Table 4.5 2x3 Header Signals Definition

Pin	Signal	TYPE	Description	Comments
1	ETH_RD <sup>-1</sup>	Differential pair.	Ethernet Receive line minus.	Connect to Magnetics RD-.
2	ETH_RD <sup>+1</sup>	Differential pair.	Ethernet Receive line plus.	Connect to Magnetics RD+.
3	CENT_RD <sup>1</sup>		RD Magnetic center tap.	Connect to Magnetics RD Centre Tap.
4	ETH_TD <sup>+1</sup>	Differential pair.	Ethernet Transmit line plus.	Connect to Magnetics TD+.
5	ETH_TD <sup>-1</sup>	Differential pair.	Ethernet Transmit line minus.	Connect to Magnetics TD-.
6	CENT_TD <sup>1</sup>		TD Magnetic center tap.	Connect to Magnetics TD Center Tap.

Note 1: all the ports are related to firmware release, contact Tersus technical support before using them.

Refer to section 4.1.3 if interface board is designed.

## 4.3 BX316 Board

### 4.3.1 BX316 Specifications

Table 4.6 BX316 Board Performance

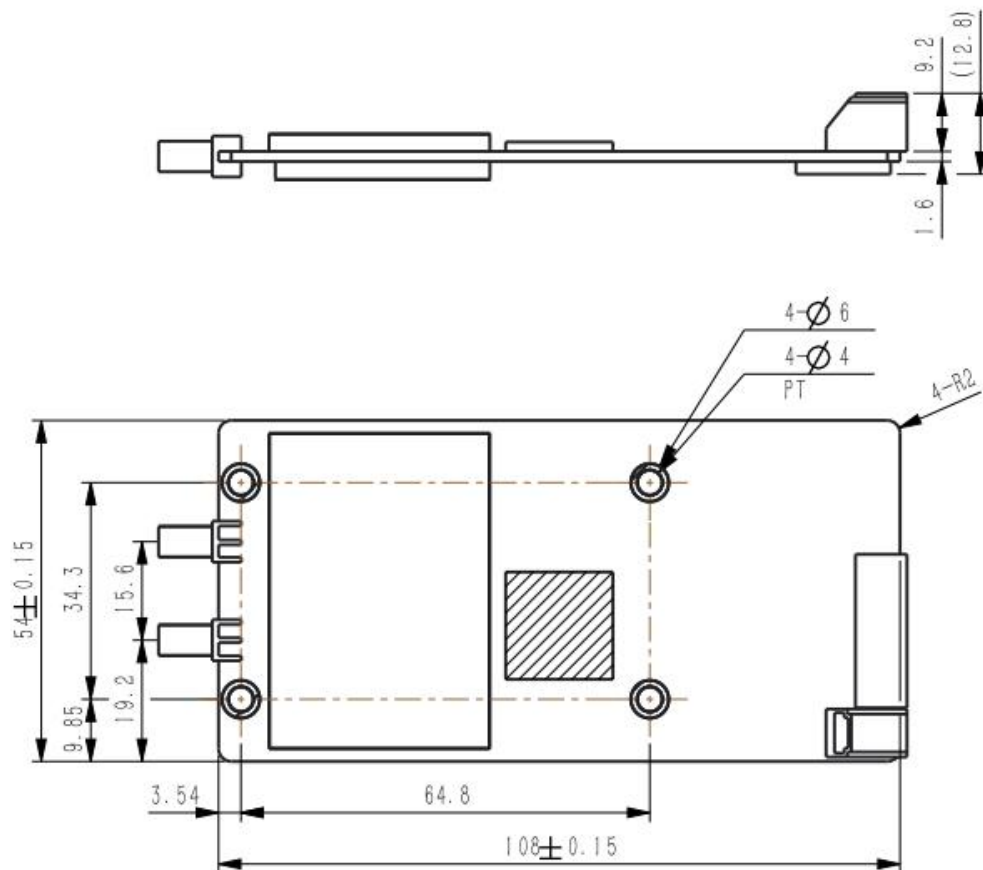
GNSS Performance			
Position Accuracy	Single positioning	1.5m RMS (Horizontal)	
		3.0m RMS (Vertical)	
	RTK Positioning	10mm+1ppm (Horizontal)	
		15mm+1ppm (Vertical)	
Heading accuracy	0.15 degree (1m baseline)		
Time to First Fix	Cold Start: <50s		
	Warm Start: <30s		
Reacquisition	0.5 s L1 (typical)		
	1.0 s L2 (typical)		
Data Rate	Measurements	20Hz	
	Position	5Hz	
Time Accuracy	20ns RMS		
Velocity Accuracy	0.03m/s RMS		
Measurement Precision	GPS	L1 PSR	6 cm
		L1 ADR	1.0mm
		L2 PSR	8 cm
		L2 ADR	1.2mm
	BEIDOU	L1 PSR	6 cm
		L1 ADR	1.0mm
		L2 PSR	8 cm
		L2 ADR	1.0mm

	GLONASS	L1 PSR	8 cm
		L1 ADR	1.0mm
		L2 PSR	8 cm
		L2 ADR	1.0mm

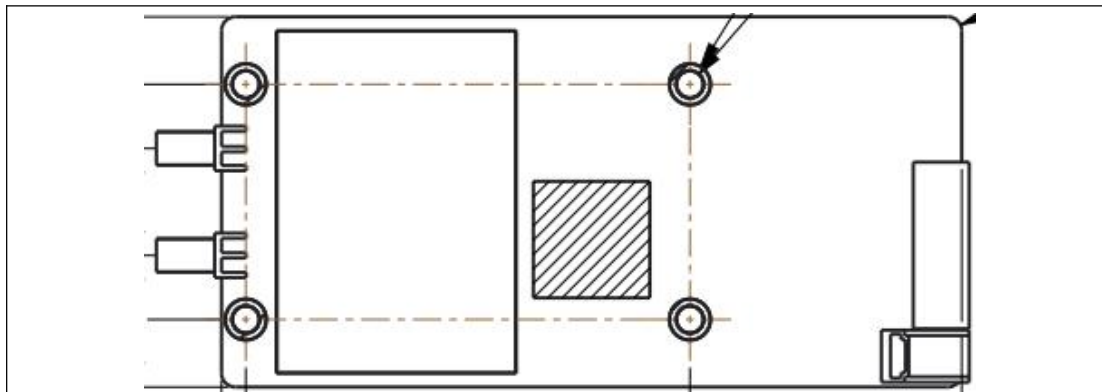
### Physical Description

Size	108 * 54 * 12 mm <sup>3</sup>
Weight	50g

### Mechanical Drawing



### HEAT SINK POSITION<sup>1</sup>



### ENVIRONMENTAL

Operating Temperature	-40C to +85C
Storage Temperature	-55C to +95C
Humidity	MIL-STD-810G, Method 507.5 Procedure II (95%)
Random Vibration	MIL-STD 810G Method 514.6, Category 24 (7.7 g RMS)
Sinusoidal Vibration	IEC 60068-2-6 (5 g)
Bump	ISO 9022-31-06 (25 g)
Shock	Operating: MIL-STD-810G, Method 516.6, Procedure I (40 g) Non-operating: MIL-STD-810G, Method 516.6, Procedure V (75 g)

### Power Requirement

Voltage	+5 – 12 VDC
Power Consumption	3.5W (typical)

Note 1: when BX316 board is assembled in a metal case, a head sink must be installed between the hatch area and the metal case, or the thermal performance of the board will be decreased.



### 4.3.2 40pin external cable

A 40pin external cable is provided with the BX316/BX316R board and enclosure.

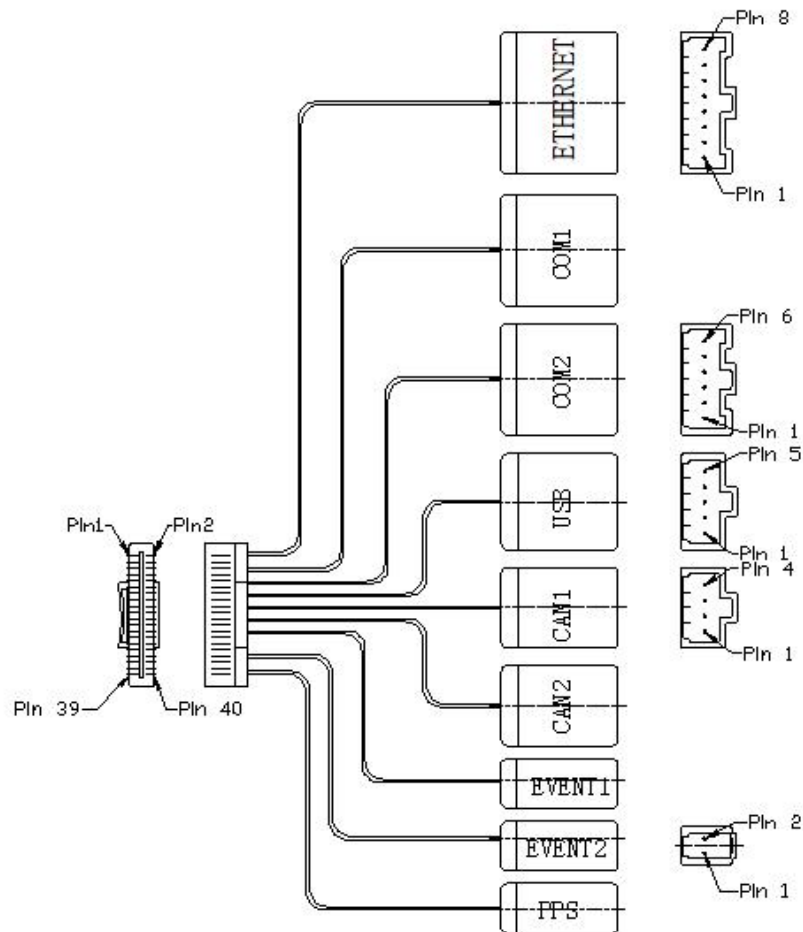


Figure 4.7 Outline of the 40pin external cable

The 40pin connector of the cable is Mouser's DF50S-40DS-1L or equivalent, the connectors at the other side of the cable are 3pcs Mouser's 7980DF1EA-6EP-2.5C and 2pcs 7980DF1EA-2EP-2.5C:

Table 4.7 Pin Definition of the 40pin external cable

Pin No.	Signal Name	Ethernet	COM1	COM2	USB	CAN1	CAN2	Event1	Event2	PPS
1	N.C									
2	TD1+	1								
3	EVENT2								1	
4	TD1-	2								
5	GND								2	
6	LED0	6								
7	RD1+	4								
8	LED1	7								
9	RD1-	5								
10	GND	8								
11	GND	3								
12	GND							2		
13	N.C									
14	EVENT1							1		
15	GND									2
16	PPS									1
17	GND			6						
18	COM1_RXD		3							
19	SDA			5						
20	COM1_TXD		2							
21	SCL			4						
22	GND		6							

23	COM2_RXD			3						
24	3.3V		1							
25	COM2_TXD			2						
26	3.3V					1				
27	3.3V			1						
28	CANH1_TXD					2				
29	N.C									
30	CANH1_RXD					3				
31	OTG_5V				1					
32	GND					4				
33	USB_DM				2					
34	3.3V						1			
35	USB_DP				3					
36	CANH2_TXD						2			
37	USB_ID				4					
38	CANH2_RXD						3			
39	GND				5					
40	GND						4			

## 4.4 BX316R Board

### 4.4.1 BX316R Specifications

The specifications of BX316R board is the same with that of BX316 board, refer to Table 4.6 BX316 Board Performance for details. The difference between BX316 and BX316R is the firmware, and BX316R supports PPK while BX316 supports RTK.

#### 4.4.2 40pin external cable

The details of 40pin external cable refer to 4.3.2 40pin external cable.

### 4.5 BX316D Board

#### 4.5.1 BX316D Specifications

Table 4.8 BX306D Board Specifications

GNSS Performance			
Position Accuracy	Single positioning	1.5m RMS (Horizontal)	
		3.0m RMS (Vertical)	
	RTK Positioning	10mm+1ppm (Horizontal)	
		15mm+1ppm (Vertical)	
Heading Accuracy	0.15 degree (Baseline is 1m)		
Time to First Fix	Cold Start: <50s Warm Start: <30s		
Reacquisition	0.5 s L1 (typical) 1.0 s L2 (typical)		
Data Rate	Measurements	20Hz	
	Position	5Hz	
Time Accuracy	20ns RMS		
Velocity Accuracy	0.03m/s RMS		
Measurement Precision	GPS	L1 PSR	6 cm
		L1 ADR	1.0mm
		L2 PSR	8 cm

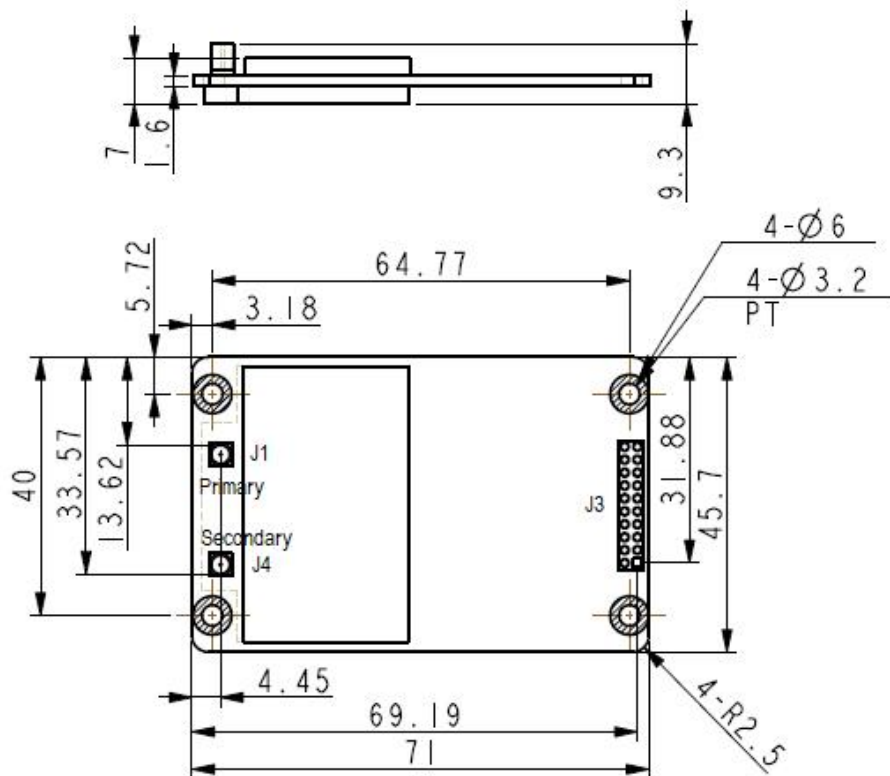
	BEIDOU	L2 ADR	1.2mm
		L1 PSR	6 cm
		L1 ADR	1.0mm
		L2 PSR	8 cm
		L2 ADR	1.0mm
	GLONASS	L1 PSR	8 cm
		L1 ADR	1.0mm
		L2 PSR	8 cm
		L2 ADR	1.0mm

### Physical Description

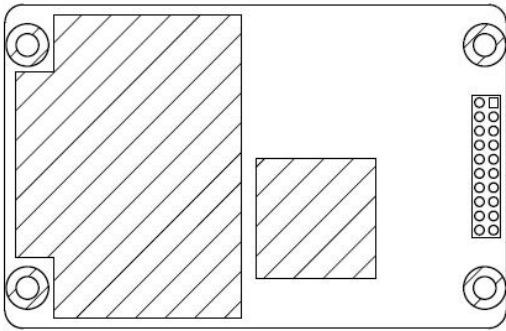
Size 71 \* 46 \* 9.3 mm<sup>3</sup>

Weight 27g

### Mechanical Drawing



### HEAT SINK POSITION<sup>1</sup>

	
ENVIRONMENTAL	
Operating Temperature	-40C to +85C
Storage Temperature	-55C to +95C
Humidity	MIL-STD-810G, Method 507.5 Procedure II (95%)
Random Vibration	MIL-STD 810G Method 514.6, Category 24 (7.7 g RMS)
Sinusoidal Vibration	IEC 60068-2-6 (5 g)
Bump	ISO 9022-31-06 (25 g)
Shock	Operating: MIL-STD-810G, Method 516.6, Procedure I (40 g) Non-operating: MIL-STD-810G, Method 516.6, Procedure V (75 g)
Power Requirement	
Input Voltage	+3.3 +5%/-3% VDC
Allowable Voltage Ripple	100 mV p-p maximum
Power Consumption	2.9W (typical)

Note 1: when BX316D board is assembled in a case, a head sink must be installed between the hatch area and the metal case, or the thermal performance of the board will be decreased.

## 4.5.2 Connectors on BX316D board

There are three connectors on the BX316D board, J1, J3 and J4, refer to the mechanical drawing in the above table.

1. J1/J4: MMCX jack receptacle, straight
2. J3: 2x10 header, 2 mm pitch (SAMTEC P/N TMM-110-03-G-D)



Figure 4.8 Connector J3 of BX316D

Table 4.9 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	3.3V +5%/-3%
3	USB_D-	IO	USB data (-)	One-half of a differential pair (pins 3 and 4). Match lengths and route as a 90 $\Omega$ 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	N.C		Not Connected	
9	EVENT1	IO	Event1 input	Has a 10K pull-up resistor on board.
10	GND	GND	Ground	
11	TXD1	O	COM1 transmit data	LVTTTL level, the max band rate is 921600 bps.
12	RXD1	I	COM1 receive data	
13	GND	GND	Ground	
14	TXD2	O	COM2 transmit data	LVTTTL level, the max band rate is 921600 bps.
15	RXD2	I	COM2 receive data	
16	GND	GND	Ground	
17	PV	O	Position valid indicator	High: when RTK solution is got. Low: other position types.
18	GND	GND	Ground	
19	PPS	O	Pulse per second output,	This pin has an internal 50 ohm line driver. Route as a 50 $\Omega$ single-ended trace
20	N.C		Not Connected	

Refer to section 4.1.3 if interface board is designed.

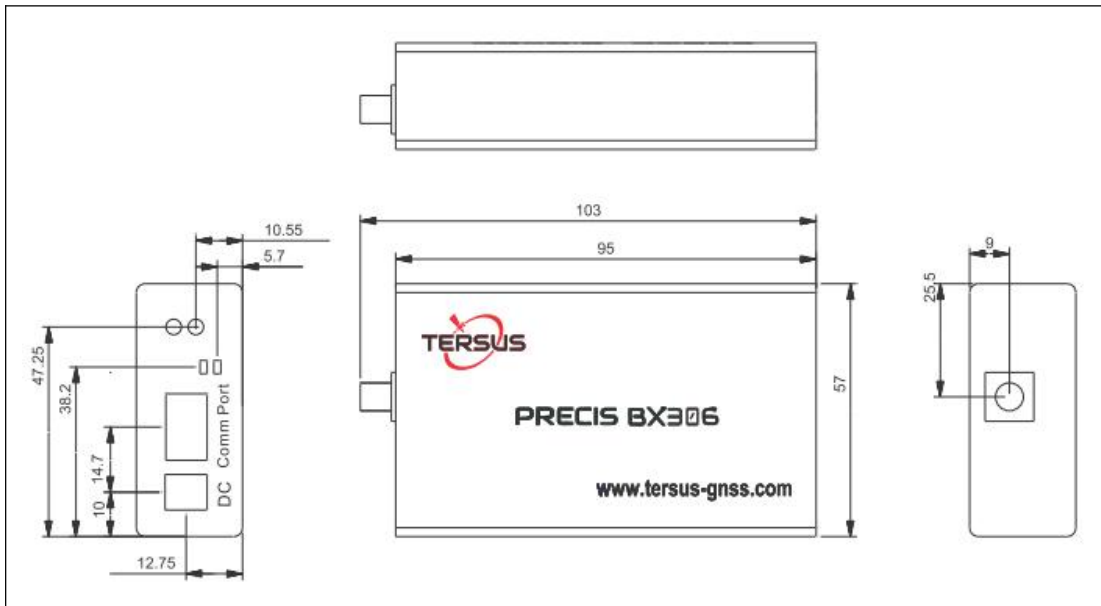


## 4.6 BX306 Enclosure

### 4.6.1 BX306 Enclosure Specifications

Table 4.10 BX306 Enclosure Specifications

GNSS Performance		
Position Accuracy	Single positioning	1.5m RMS (Horizontal)
		3.0m RMS (Vertical)
	RTK Positioning	10mm+1ppm (Horizontal)
		15mm+1ppm (Vertical)
Time to First Fix	Cold Start: <50s Warm Start: <30s	
Reacquisition	0.5 s L1 (typical) 1.0 s L2 (typical)	
Data Rate	Measurements	20Hz
	Position	5Hz
Time Accuracy	20ns RMS	
Velocity Accuracy	0.03m/s RMS	
Measurement Precision	Refer to BX306 board in chapter 4.	
Physical Description		
Size	102.5 * 57 * 24.5 mm <sup>3</sup>	
Weight	150g	
Mechanical Drawing		

	
<b>ENVIRONMENTAL</b>	
Operating Temperature	-40C to +85C
Storage Temperature	-55C to +95C
Humidity	MIL-STD-810G, Method 507.5 Procedure II (95%)
Random Vibration	MIL-STD 810G Method 514.6, Category 24 (7.7 g RMS)
Sinusoidal Vibration	IEC 60068-2-6 (5 g)
Bump	ISO 9022-31-06 (25 g)
Shock	Operating: MIL-STD-810G, Method 516.6, Procedure I (40 g) Non-operating: MIL-STD-810G, Method 516.6, Procedure V (75 g)
<b>Power Requirement</b>	
Voltage	+5 – 12 VDC
Power Consumption	3.2W (typical)

#### 4.6.2 20pin external cable

A 20pin external cable is provided with the BX306 and BX316D enclosure.

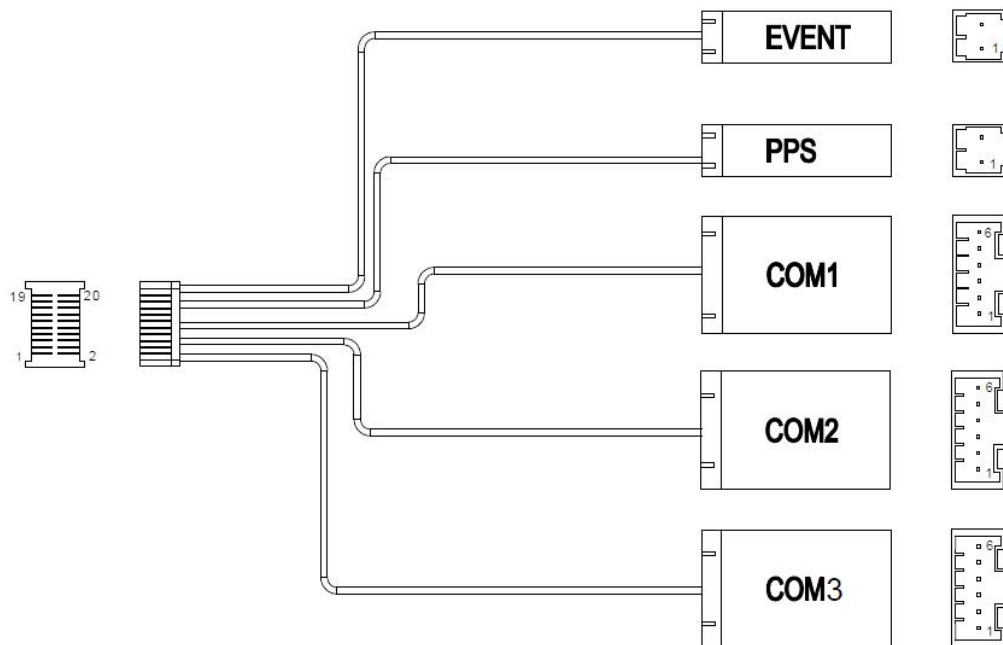


Figure 4.9 Outline of the 20pin external cable

The 20pin connector of the cable is Mouser's DF50S-20DS-1L or equivalent, the connectors at the other side of the cable are 3pcs Mouser's 7980DF1EA-6EP-2.5C and 2pcs 7980DF1EA-2EP-2.5C:

Table 4.11 Pin Definition of the 20pin external cable

No.	Signal Definition	COM1	COM2	COM3	EVENT	PPS
1	GND	Pin 6				
2	N.C					
3	COM1_TX	Pin 2				
4	COM2_RX		Pin 3			
5	COM1_RX	Pin 3				
6	COM2_TX		Pin 2			
7	3.3V	Pin 1				
8	3.3V					

9	PPS					Pin 1
10	COM2_SCL		Pin 4			
11	EVENT1				Pin 1	
12	COM2_SDA		Pin 5			
13	GND			Pin 6		
14	GND		Pin 6			
15	COM3_TX			Pin 2		
16	GND					Pin 2
17	COM3_RX			Pin 3		
18	GND				Pin 2	
19	3.3V		Pin 1	Pin 1		
20	N.C					

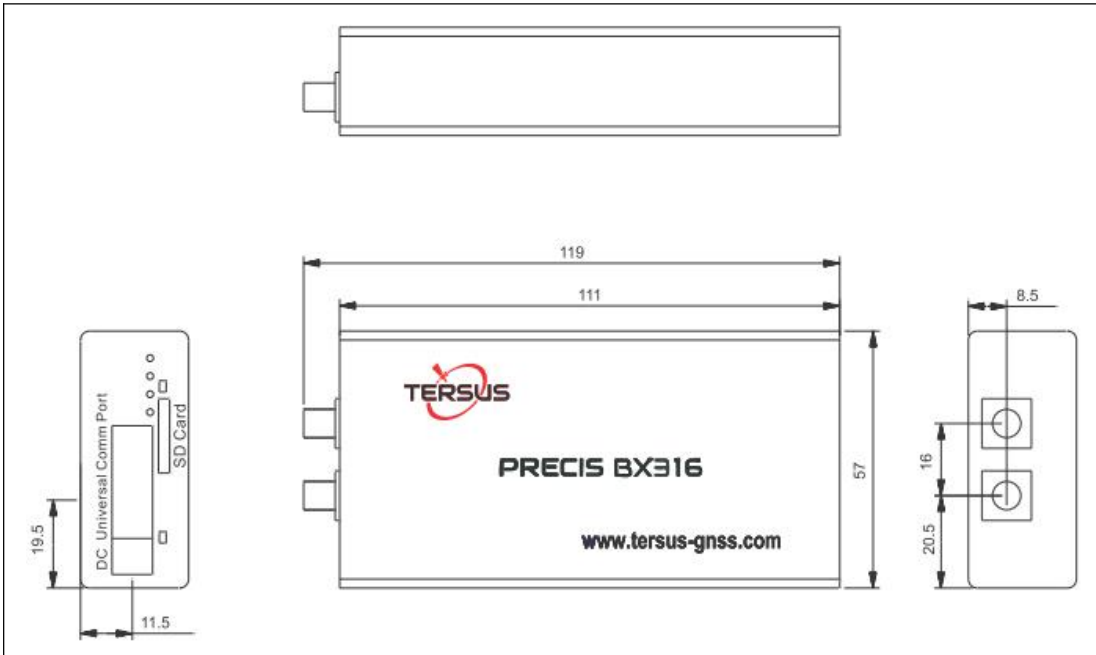
## 4.7 BX316 Enclosure

### 4.7.1 BX316 Enclosure Specifications

Table 4.12 BX316 Enclosure Specifications

GNSS Performance		
Position Accuracy	Single positioning	1.5m RMS (Horizontal)
		3.0m RMS (Vertical)
	RTK Positioning	10mm+1ppm (Horizontal)
		15mm+1ppm (Vertical)
Heading accuracy	0.15 degree (1m baseline)	
Time to First Fix	Cold Start: <50s Warm Start: <30s	

Reacquisition	0.5 s L1 (typical) 1.0 s L2 (typical)		
Data Rate	Measurements	20Hz	
	Position	5Hz	
Time Accuracy	20ns RMS		
Velocity Accuracy	0.03m/s RMS		
Measurement Precision	GPS	L1 PSR	6 cm
		L1 ADR	1.0mm
		L2 PSR	8 cm
		L2 ADR	1.2mm
	BEIDOU	L1 PSR	6 cm
		L1 ADR	1.0mm
		L2 PSR	8 cm
		L2 ADR	1.0mm
	GLONASS	L1 PSR	8 cm
		L1 ADR	1.0mm
		L2 PSR	8 cm
		L2 ADR	1.0mm
<b>Physical Description</b>			
Size	111 * 57 * 24.5 mm <sup>3</sup>		
Weight	150g		
<b>Mechanical Drawing</b>			

	
<b>ENVIRONMENTAL</b>	
Operating Temperature	-40C to +85C
Storage Temperature	-55C to +95C
Humidity	MIL-STD-810G, Method 507.5 Procedure II (95%)
Random Vibration	MIL-STD 810G Method 514.6, Category 24 (7.7 g RMS)
Sinusoidal Vibration	IEC 60068-2-6 (5 g)
Bump	ISO 9022-31-06 (25 g)
Shock	Operating: MIL-STD-810G, Method 516.6, Procedure I (40 g) Non-operating: MIL-STD-810G, Method 516.6, Procedure V (75 g)
<b>Power Requirement</b>	
Voltage	+5 – 12 VDC
Power Consumption	3.2W (typical)

#### 4.7.2 40pin external cable

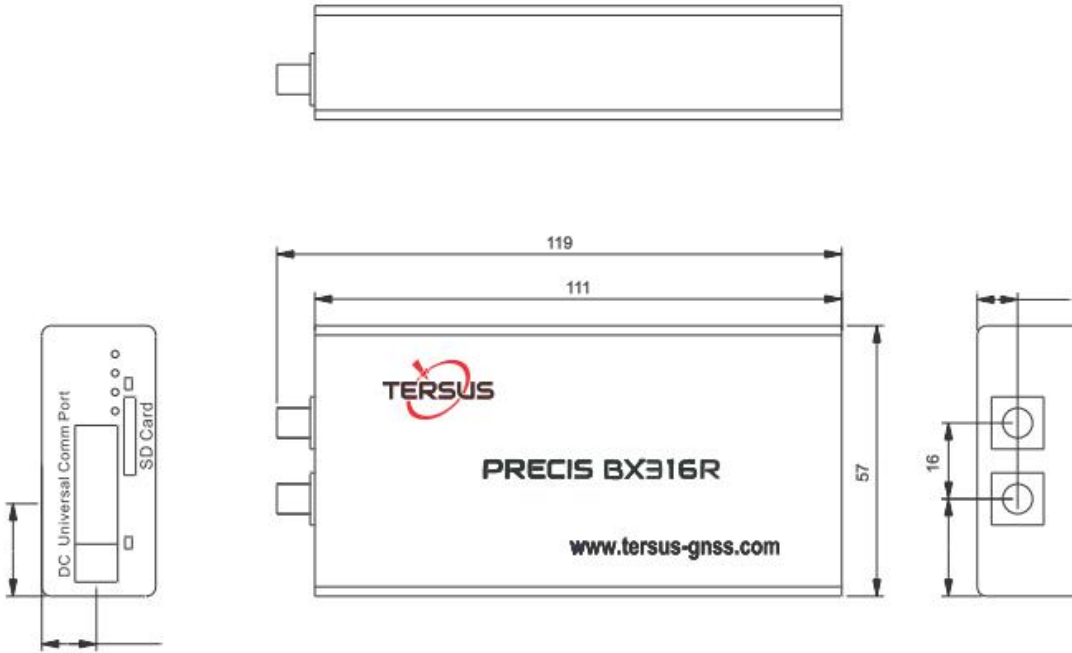
The details of 40pin external cable refer to 4.3.2 40pin external cable.

## 4.8 BX316R Enclosure

### 4.8.1 BX316R Enclosure Specifications

Table 4.13 BX316R Enclosure Specifications

GNSS Performance			
Position Accuracy	Single positioning	1.5m RMS (Horizontal)	
		3.0m RMC (Vertical)	
Time to First Fix	Cold Start: <50s Warm Start: <30s		
Reacquisition	0.5 s L1 (typical) 1.0 s L2 (typical)		
Data Rate	Measurements	20Hz	
	Position	5Hz	
Time Accuracy	20ns RMS		
Velocity Accuracy	0.03m/s RMS		
Measurement Precision	GPS	L1 PSR	6 cm
		L1 ADR	1.0mm
		L2 PSR	8 cm
		L2 ADR	1.2mm
	BEIDOU	L1 PSR	6 cm
		L1 ADR	1.0mm
		L2 PSR	8 cm
		L2 ADR	1.0mm
	GLONASS	L1 PSR	8 cm
		L1 ADR	1.0mm
		L2 PSR	8 cm

		L2 ADR	1.0mm
<b>Physical Description</b>			
Size	111 * 57 * 24.5 mm <sup>3</sup>		
Weight	150g		
<b>Mechanical Drawing</b>			
			
<b>ENVIRONMENTAL</b>			
Operating Temperature	-40C to +85C		
Storage Temperature	-55C to +95C		
Humidity	MIL-STD-810G, Method 507.5 Procedure II (95%)		
Random Vibration	MIL-STD 810G Method 514.6, Category 24 (7.7 g RMS)		
Sinusoidal Vibration	IEC 60068-2-6 (5 g)		
Bump	ISO 9022-31-06 (25 g)		
Shock	Operating: MIL-STD-810G, Method 516.6, Procedure I (40 g) Non-operating: MIL-STD-810G, Method 516.6, Procedure V (75 g)		
<b>Power Requirement</b>			



Voltage	+5 – 12 VDC
Power Consumption	3.5W (typical)

## 4.8.2 40pin external cable

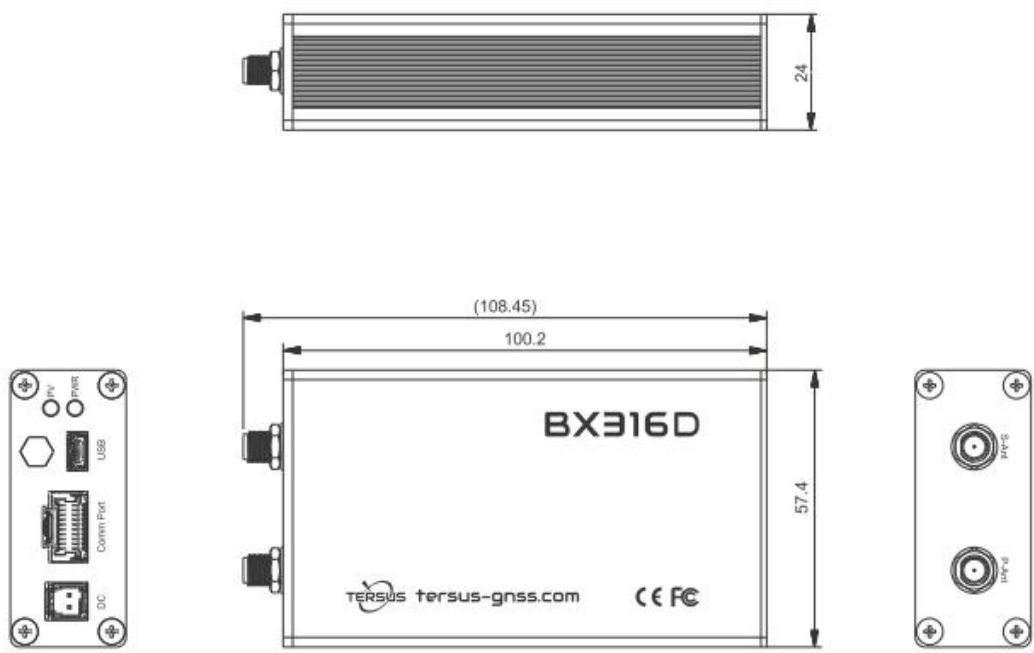
The details of 40pin external cable refer to 4.3.2 40pin external cable.

## 4.9 BX316D Enclosure

### 4.9.1 BX316D Enclosure Specifications

Table 4.14 BX316D Enclosure Specifications

GNSS Performance			
Position Accuracy	Single positioning	1.5m RMS (Horizontal)	
		3.0m RMC (Vertical)	
	RTK Positioning	10mm+1ppm (Horizontal)	
		15mm+1ppm (Vertical)	
Heading accuracy	0.15 degree (1m baseline)		
Time to First Fix	Cold Start: <50s Warm Start: <30s		
Reacquisition	0.5 s L1 (typical) 1.0 s L2 (typical)		
Data Rate	Measurements	20Hz	
	Position	5Hz	
Time Accuracy	20ns RMS		
Velocity Accuracy	0.03m/s RMS		
Measurement Precision	GPS	L1 PSR	6 cm

	BEIDOU	L1 ADR	1.0mm
		L2 PSR	8 cm
		L2 ADR	1.2mm
		L1 PSR	6 cm
		L1 ADR	1.0mm
		L2 PSR	8 cm
	GLONASS	L2 ADR	1.0mm
		L1 PSR	8 cm
		L1 ADR	1.0mm
		L2 PSR	8 cm
		L2 ADR	1.0mm
		L1 PSR	8 cm
<b>Physical Description</b>			
Size	100 * 57 * 24 mm <sup>3</sup>		
Weight	150g		
<b>Mechanical Drawing</b>			
 <p>The mechanical drawing illustrates the BX316D receiver from three perspectives:                 <ul style="list-style-type: none"> <li><b>Top View:</b> Shows a rectangular device with a length of 100.2 mm and a height of 57.4 mm. The model number 'BX316D' and the website 'tersus-gnss.com' are printed on the top surface.</li> <li><b>Side View:</b> Shows the device's thickness of 24 mm.</li> <li><b>Rear View:</b> Displays the connector panel with labels for 'POWER', 'USB', 'Comm Port', and 'DC'. It also shows two circular ports labeled 'PVTX' and 'INFC'.</li> </ul> </p>			

ENVIRONMENTAL	
Operating Temperature	-40C to +85C
Storage Temperature	-55C to +95C
Humidity	MIL-STD-810G, Method 507.5 Procedure II (95%)
Random Vibration	MIL-STD 810G Method 514.6, Category 24 (7.7 g RMS)
Sinusoidal Vibration	IEC 60068-2-6 (5 g)
Bump	ISO 9022-31-06 (25 g)
Shock	Operating: MIL-STD-810G, Method 516.6, Procedure I (40 g) Non-operating: MIL-STD-810G, Method 516.6, Procedure V (75 g)
Power Requirement	
Voltage	+5 – 28 VDC
Power Consumption	2.8W (typical)

#### 4.9.2 20pin external cable

The details of 40pin external cable refer to 4.6.2 20pin external cable.

## 5. Typical Application

### 5.1 Data Collection on Internal eMMC

All the BX boards/enclosures are embedded with up to 4GB internal eMMC card, which brings convenience for data collection.



Before data collection, please ensure enough space is available on the internal eMMC card, refer to section 0 to delete files on the internal eMMC card if needed.



The size of the logging:

LOG FILE RANGE B ONTIME 1 (about 110KByte/min if 20 satellites are tracked, about 165KByte/min if 30 satellites are tracked)

If the collection frequency is increased, the data size will be increased proportionately.



Rules for the file name & update time in the external SD card:

1) File name: there are two situations of file naming. A) Satellite signals are detected when creating file, the file is named as OEM board serial number last 5 digits\_YYYYMMDDHHMMSS.dat; B) Satellite signals have not been detected when creating file, the file is named as 8-digits.dat in which the 8-digit number represents the count every 100 seconds after the first boot. For example, the

receiver has worked 500 hours 40min since boot up,  $(500*3600 + 40*60)/100 = 18024$ , the file name is 00018024.dat. When the satellite signals are detected, the time is stored in the 8-digit.dat.attr file.

2) Update time: if the receiver hasn't gotten the GNSS time, the update time of the files will be 19800000 0:0 (YYYYMMDD HH:MM). If the receiver has gotten the GNSS time, the update time will be the UTC time.

Two modes can be selected for data collection: manually (default) and automatically.

If you want to save the loggings manually after the board is power on, please follow the steps below to configure the BX306 enclosure.

Steps of saving data on eMMC manually, take recording static data as example:

1) STORETYPE EMMC // the data will be saved on the internal eMMC card

2) Input all the loggings below:

```
LOG FILE RANGE B ONTIME 1 //save raw measurements
LOG FILE GPSEPHEMB ONTIME 30 //save GPS ephemeris
LOG FILE GLOEPHEMERISB ONTIME 30 //save GLONASS ephemeris
LOG FILE BDSEPHemerisB ONTIME 30 //save BeiDou ephemeris
LOG FILE BESTPOS B ONTIME 30 //save the best position solution
```

3) SAVECONFIG //save the configuration above

- 4) LOGFILE OPEN //open the file to start data collection
- 5) LOGFILE CLOSE //close the file to stop data collection

If you want to save the loggings automatically after the board is power on, please follow the steps below.

Steps of saving data on eMMC automatically, take the example of recording static data:

- 1) STORETYPE EMMC // the data will be saved on the internal eMMC card
- 2) LOGFILE AUTO //configure auto data collection
- 3) Input all the loggings below:
  - LOG FILE RANGE B ONTIME 1 //save raw measurements
  - LOG FILE GPSEPHEMB ONTIME 30 //save GPS ephemeris
  - LOG FILE GLOEPHEMERISB ONTIME 30 //save GLONASS ephemeris
  - LOG FILE BDSEPHemerisB ONTIME 30 //save BeiDou ephemeris
  - LOG FILE BESTPOS B ONTIME 30 //save the best position solution
- 4) SAVECONFIG //save the configuration above
- 5) Power cycle the board and data collection start.
- 6) LOGFILE CLOSE //close the file after data collection is finished

The last step is recommended although it is not mandatory. If power is off during the file collection, the data collected in the last second may not be saved.



The data collection will not be executed without a power cycle.

## 5.2 Download Files from Internal eMMC

The files saved on the internal eMMC card can be copied to the computer via a serial port.

If files are downloaded from a BX316 or a BX316R enclosure, the USB port is recommended. A specific USB cable (5pin to USB Type A male cable) is used to connect the USB port to the computer, refer to Figure 5.3 and Figure 4.7.

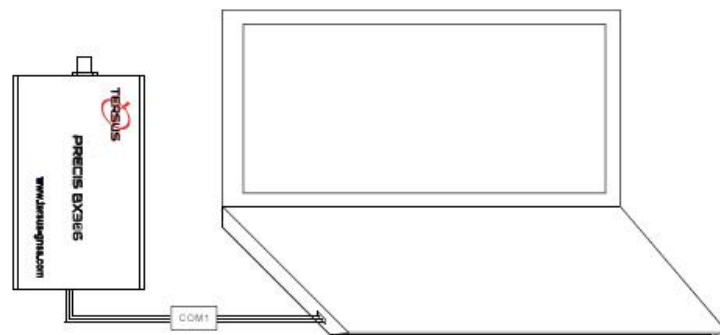


Figure 5.1 Download Files from eMMC Card with a Serial Port

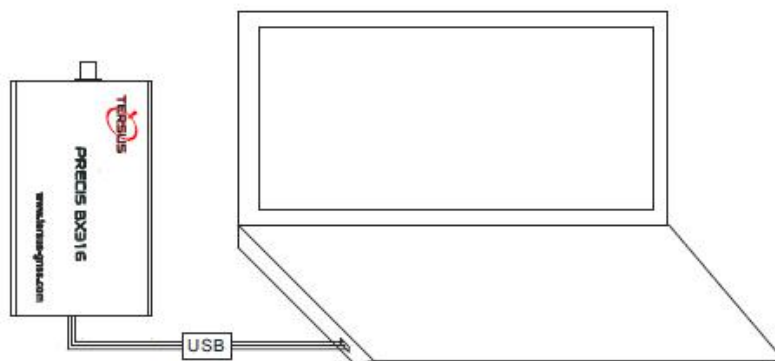


Figure 5.2 Download Files from eMMC Card with an USB Port



Figure 5.3 5pin to USB Type A male cable

After the UART to USB converter or the 5pin to USB Type A male cable is connected to the computer, it will be mapped to a serial port, refer to section 2.2 UART to USB converter.

Detailed steps to download files from eMMC card are as follows:

- 1) Refer to Figure 5.1 and Figure 5.2 to create connection between a BX306/BX316 receiver and a computer;
- 2) Run TersusDownload software on the computer;

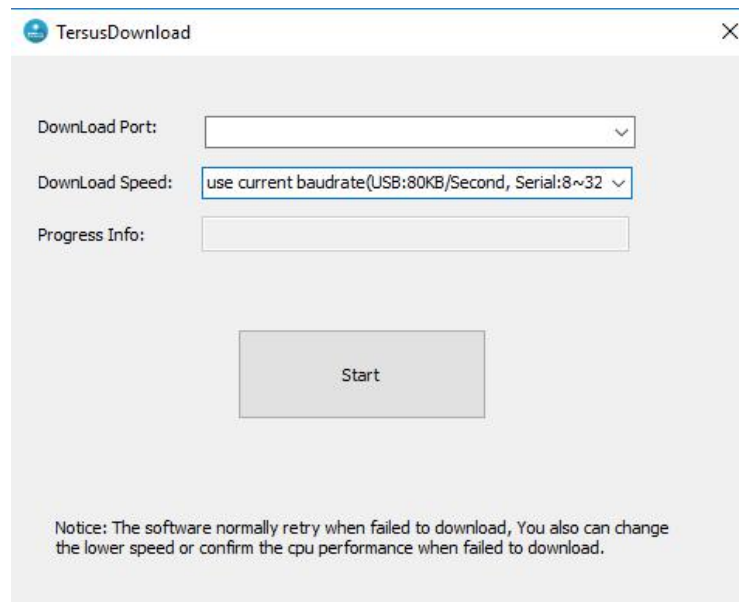


Figure 5.4 File download using Tersus Download

- 3) Select the serial port to communicate with the receiver;



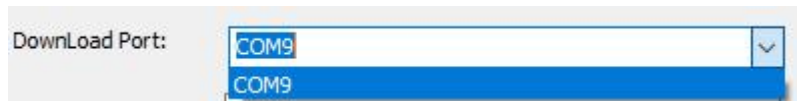


Figure 5.5 Select serial port for Download Port

- 4) Select the download speed (using USB port for example). Select baud rate if a serial port is used to download the files;

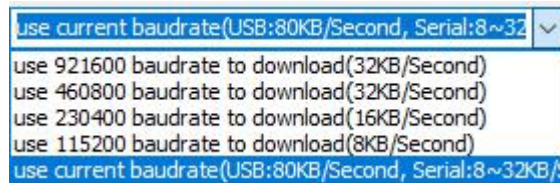


Figure 5.6 Select download speed

- 5) After completing the above two steps, click [Start] and it pops out below window. Select the DownloadPath to store the incoming files and check the files to be downloaded, click [Download] to start downloading.

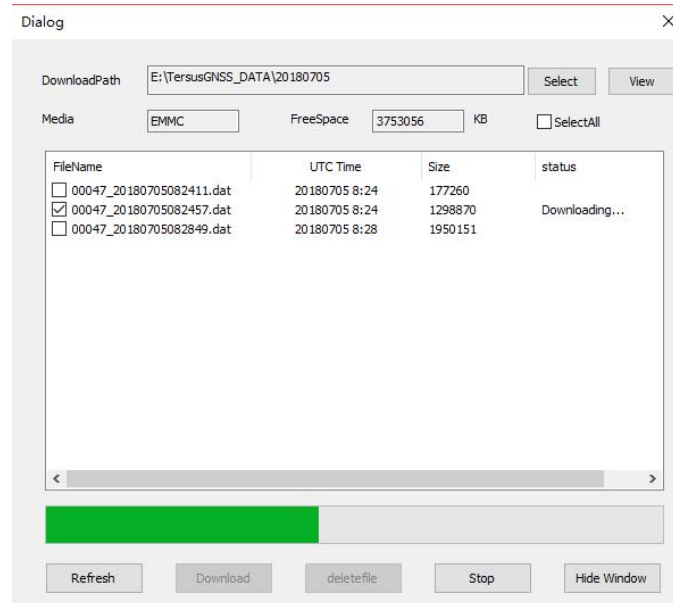


Figure 5.7 File downloading in progress

! The downloading rate is about 2MB/min, the downloading time can be estimated based on it.

### 5.3 Connect BX306 to an External Bluetooth

Tersus provides an external Bluetooth BT120, as well as the cable for the BX306 receiver. For more details about the Bluetooth module, please go to Tersus website <https://www.tersus-gnss.com/product/bluetooth-bt120> .

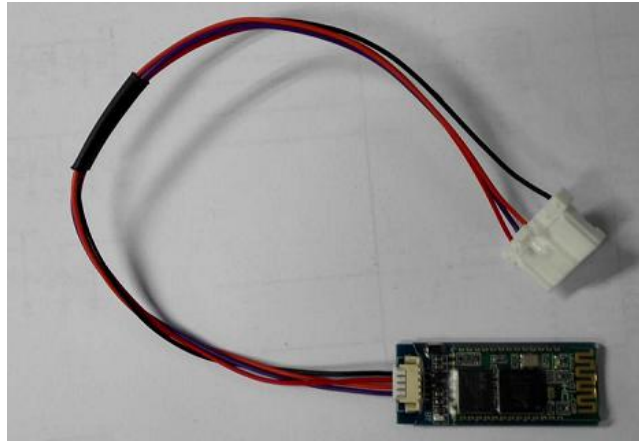


Figure 5.8 BT120 and the cable



Figure 5.9 Outline of BX306 Connected to BT120

The function of Bluetooth module is to communicate the BX306 enclosure with other Bluetooth device.



BT120 can only be paired with an Android phone or tablet; it cannot be paired with an iPhone or iPad.

### 5.3.1 Communicate with NTRIP Client App

The steps of BX306 communicating with NTRIP Client App are as follows:

- 1) Connect a BT120 to COM1 of the BX306 enclosure.
- 2) Connect COM2 of the BX306 to a laptop.
- 3) Connect an antenna to the BX306, and power on it.
- 4) Pair your smartphone with the BT120. The default ID of BT120 is HB-02, the pair password is 1234, after paired, HB-02 will be listed in the paired devices.
- 5) Run NTRIP Client App in the smartphone, click the Settings button to go to the Settings page:



Figure 5.10 Click Settings in NTRIP Client app

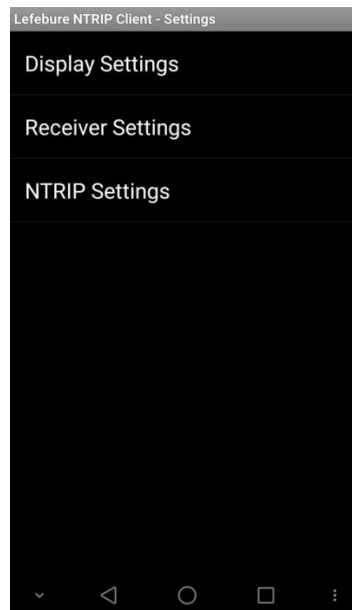


Figure 5.11 Setting page of the NTRIP Client app

- 6) In the 'Receiver Settings', input the Bluetooth name which has been paired in step 3), all other options keep the default.

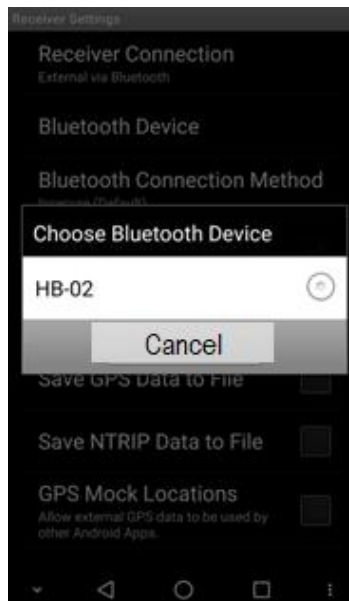


Figure 5.12 Input Bluetooth name in the receiver settings

- 7) In the 'NTRIP Settings', all the upper six fields (Network Protocol, Caster IP, Caster Port, Username, Password and Data Stream) are mandatory, input them with the information obtained from the NTRIP service provider. If

needed by the caster, input the draft location of the receiver in the three fields below.

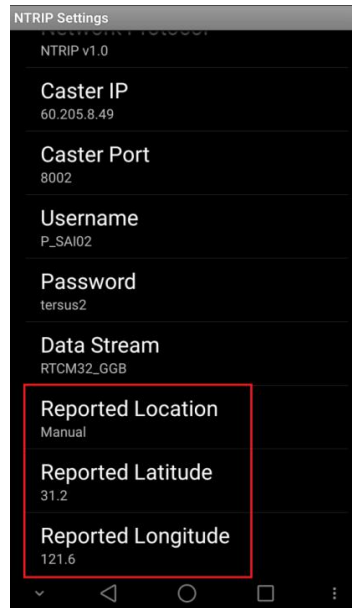
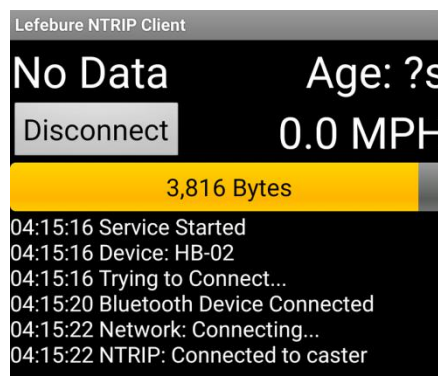


Figure 5.13 Reported location of the receiver

- 8) Go back to the first page of NTRIP and click [CONNECT] button, if everything is OK, it comes to the following page, which shows RTK corrections are being received and forwarded to the receiver via the Bluetooth.



- 9) Check the position type of the BX306.

## 5.4 Save Data to an External Data Logger

Tersus is providing an external data logger DL207, refer to Figure 5.14. DL207 supports up to 32GB SD card with FAT32 format. Refer to <https://www.tersus-gnss.com/product/external-data-logger-dl207> for more details.



Figure 5.14 Data logger DL207



Figure 5.15 Outline of BX306 Connected to DL207

The steps of saving data to external data logger are as follows:

- 1) Install a SD card to the DL207.
- 2) Connect an antenna to the BX306.

- 3) Connect COM2 of the BX306 to a laptop.
- 4) Power on the BX306.
- 5) Run Tersus GNSS Center to communicate with the COM2 of BX306.
- 6) Input all the data needed to save on the DL207, for example:  
LOG COM1 RANGEB ONTIME 1 //Save raw measurements  
LOG COM1 GPGGA ONTIEM 1 //Save GPGGA info  
LOG COM1 GPSEPHEMB ONTIME 30 //Save the GPS ephemeris  
LOG COM1 GLOEPHEMERISB ONTIME 30 //Save GLONASS ephemeris  
LOG COM1 BDSEPHemerISB ONTIME 30 //Save BeiDou ephemeris  
.....  
SAVECONFIG //Save the configuration above
- 7) Power off the BX306, connect the DL207 to the COM1 port of the BX306.
- 8) Power on the BX306, the data will be saved on the SD card.
- 9) Power off the BX306 after the data collection is finished.
- 10) Uninstall the SD card from the DL207, copy the files on the SD card to your laptop with a SD card reader.

## 5.5 Communicate with STRSVR Tool

The steps of BX306 communicating with STRSVR tool are as follows:

- 1) Power on the BX306 enclosure, connect COM1 and COM2 to the computer.  
COM1 is to communicate with Tersus GNSS Center, COM2 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 COM2 and configure it.

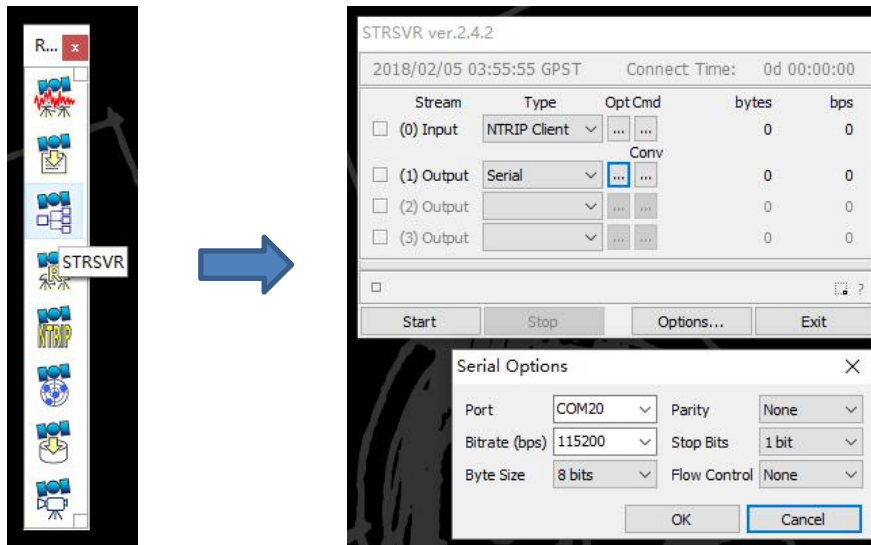


Figure 5.16 Configure serial port COM2

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

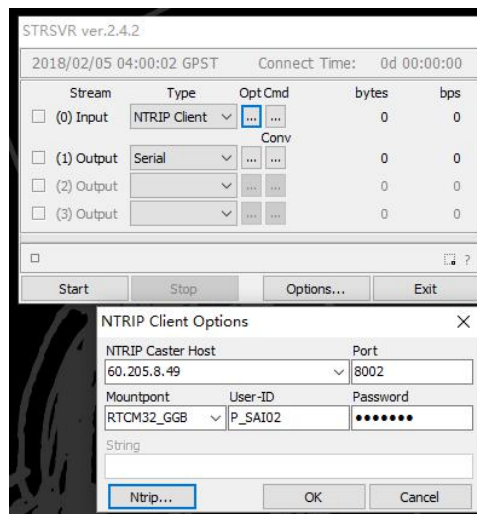


Figure 5.17 NTRIP Client configuration

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



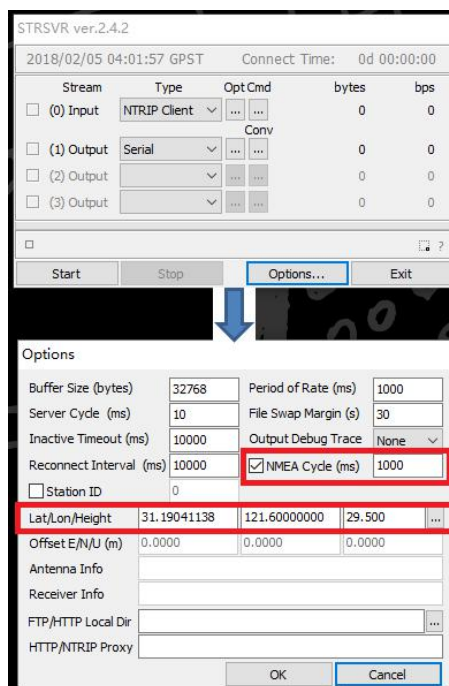


Figure 5.18 Draft position of the receiver

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.

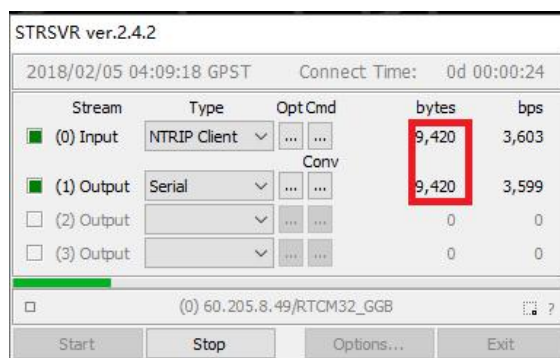


Figure 5.19 Input and Output data in progress

## 5.6 Create RTK using BX306 and a Radio

An external radio can be used to transmit RTK corrections, receive RTK corrections or transmit position results. BX306 receiver is able to connect to any radio which has a LVTTTL serial interface. Tersus is providing a transfer cable between LVTTTL and RS-232 level, refer to Figure 5.20, contact [support@tersus-gnss.com](mailto:support@tersus-gnss.com) for more details.



Figure 5.20 Transfer Cable



Two radios must have the same channel and the same protocol before they can communicate with each other.



It is highly recommended that the radio at the base side and the one at the rover side are from one supplier. Compatibility and reliability problems may occur if two radios are from different suppliers, although they are compatible.

Figure 5.21 shows a BX306 receiver connected to Tersus RS460 radio, refer to more about this radio in <https://www.tersus-gnss.com/product/2w-radio-rs460> .



Figure 5.21 Outline of BX306 Connected to RS460 Radio

### 5.6.1 Radio to Transmit RTK Corrections

The steps of radio transmitting RTK corrections are as follows:

- 1) Connect an antenna to the BX306.
- 2) Connect the COM1 of the BX306 to a laptop.
- 3) Connect the COM2 of the BX306 to the radio.
- 4) Power on the BX306 enclosure.
- 5) Connect to an antenna to RS460 radio and power it on.
- 6) Run Tersus GNSS Center to communicate with the BX306 enclosure.
- 7) Input the following commands / loggings to the BX306 enclosure in Tersus GNSS Center:

```

FIX POSITION LATITUDE LONGITUDE HEIGHT //Fix the base's position
LOG COM2 RTCM1074 ONTIME 1 //output GPS raw measurements
LOG COM2 RTCM1084 ONTIME 1 //output GLONASS raw
measurements
LOG COM2 RTCM1124 ONTIME 1 //output BEIDOU raw measurements
LOG COM2 RTCM1005 ONTIME 10 //output the base's position
LOG COM2 RTCM1230 ONTIME 5 //output GLONASS bias information
SAVECONFIG //save the configuration above
  
```

## 5.6.2 Radio to Receive RTK Corrections

Follow step 1) to 6) in section 5.6.1, and then

- 7) Ensure COM2 has the same baud rate as the radio's serial port.
- 8) Check the position type of the BX306 in Tersus GNSS Center.

## 5.7 Connect BX306 to Pixhawk

A specific Pixhawk cable is used to connect the BX306 receiver to Pixhawk's GPS port.



Figure 5.22 Cable between Pixhawk and BX306

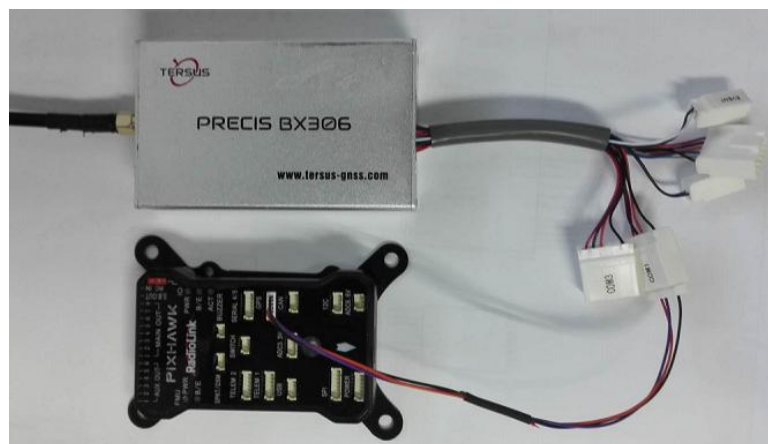


Figure 5.23 Outline of BX306 connected to Pixhawk

Steps of configuring Pixhawk

- 1) Refer to Figure 5.23 to create hardware connection with Pixhawk;
- 2) Power on the BX306 receiver;
- 3) Configure BX306 receiver by inputting below commands in the text console of Tersus GNSS Center software:

```

COM COM1 115200 //Configure baud rate, must be the same as the GPS port.
NMEATALKER GP //All NMEA will have GP talker
LOG COM1 GPGGA ONTIME 0.2 //Output GPGGA at 5Hz
LOG COM1 GPVTG ONTIME 0.2 //Output GPVTG at 5Hz
LOG COM1 GPRMC ONTIME 0.2 //Output GPRMC at 5Hz
SAVECONFIG //Save the configuration above
    
```

Run Mission Planner software and create communication with the Pixhawk. The GPS data from the BX306 is recognized by Mission Planner if the GPS status becomes '3D Fix' (refer to Figure 5.24).



Figure 5.24 Pixhawk Get Position from BX306

To get the cm-level position, RTK corrections must be transmitted to the BX306 enclosure, which is connected to the Pixhawk. Two methods are used

to transmit RTK corrections:

- 1) The BX306 on the UAV is connected to a radio, which is used to receive the RTK corrections from a base on ground, refer to section 5.6.
- 2) If a data link between the UAV and the on-ground laptop has been created, then a base BX306 can be installed on ground and COM1 of the BX306 is connected to the laptop.

Main Steps to create RTK base for Pixhawk

- 1) The configuration commands for the BX306 receiver as a base:

FIX POSITION LATITUDE LONGITUDE HEIGHT //Fix the position of the base,  
for example: FIX POSITION 31.000302123 114.289244543 26.130  
refer to *Log & Command Reference document* for details.

```
LOG COM1 RTCM1005 ONTIME 1 //Output the base's position
LOG COM1 RTCM1077 ONTIME 1 //Output GPS L1/L2 raw data
LOG COM1 RTCM1087 ONTIME 1 //Output GLONASS L1/L2 raw data
LOG COM1 RTCM1127 ONTIME 1 //Output BEIDOU B1/B2 raw data
LOG COM1 RTCM1033 ONTIME 10 //Receiver and Antenna Descriptors
LOG COM1 RTCM1230 ONTIME 5 //GLONASS L1&L2 Code-Phase Biases
```

- 2) Communicate Mission Planner with the Pixhawk, open the Initial Setup -> Optional Hardware -> RTK GPS Inject screen
- 3) Select the serial port and baud rate, click [Connect], the following figure shows the RTK corrections from the base BX306 are received.

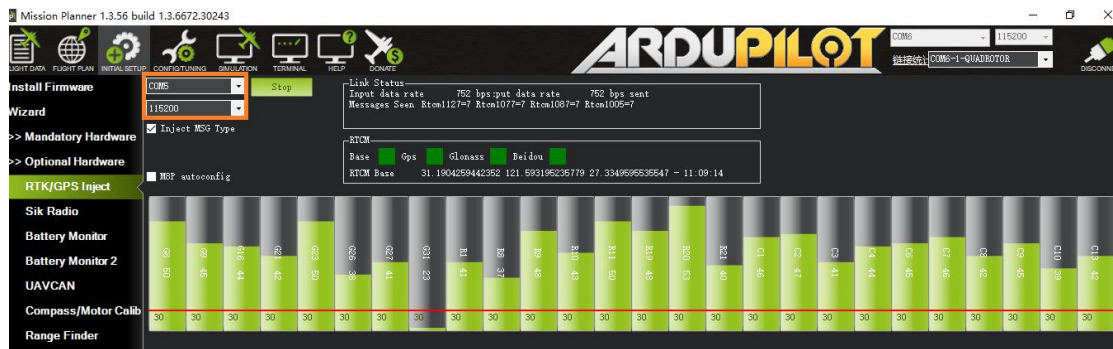


Figure 5.25 RTK corrections from the base BX306 are received

- 4) After the rover BX306 is outputting RTK solution to the Pixhawk, the GPS status will change from '3D fix' to 'rtk Fixed'.



Figure 5.26 GPS status changes to rtk Fixed

## 5.8 Uninstall the Cable from BX306 Enclosure

The 20pin/40pin external cable is self-locking, the connection is reliable after the cable is installed. The following figure gives how to uninstall the cable from the receiver with the 20pin external cable as an example.

After installed, the cable is like this:



Figure 5.27 Cable is assembled

Insert the gap with a flathead screwdriver, then pull out the cable.



Figure 5.28 Uninstall the Cable



## 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
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
TTF	Time to First Fix

TTL	Transistor-Transistor Logic level
UART	Universal Asynchronous Receiver/Transmitter
USB	Universal Serial BUS
WGS84	World Geodetic System 1984

**Proprietary Notice**

All Information in this document is subject to change without notice and does not reflect the commitment on Tersus GNSS Inc. No part of this manual may be reproduced or transmitted by all means without authorization of Tersus GNSS Inc. The software described in this document must be used in terms of the agreement. Any modification without permission from Tersus GNSS Inc. is not allowed.