CHCNAV

Geodetic GNSS Receiver (P3DT)

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User Guide

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Shanghai Huace Navigation Technology LTD.

Make your work more efficient

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Preface

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Safety Warnings

The Global Positioning System (GPS) is operated by the U.S. Government, which is solely responsible for the accuracy and maintenance of the GPS network. Accuracy can also be affected by poor satellite geometry and obstructions, like buildings and heavy canopy.

1 Introduction

The P3DT GNSS Reference Receiver User Guide describes how to set up and use the CHC® P3DT™ GNSS reference receiver.

In this manual, “the receiver” refers to the P3DT GNSS reference receiver unless otherwise stated.

Even if you have used other Global Navigation Satellite Systems (GNSS) products before, CHC recommends that you spend some time reading this manual to learn about the special features of this product. If you are not familiar with GNSS, go to www.chcnav.com for an interactive look at CHC and GNSS.

1.1 About the Receiver

The P3DT GNSS reference receiver (“the receiver”) is a multiple-constellation and multiple-frequency GNSS receiver.

You can use the front panel of the receiver or an office computer to configure the receiver, download data or publish it on your company intranet or the Internet. The receiver makes it easy for you to set up a powerful, flexible, and reliable reference station for continuous operation.

The receiver can serve as common geodetic reference receiver. It can be main component in a Continuously Operating Reference Station (CORS), streaming data to CHC GNSS Infrastructure software. It can also work well as a campaign receiver prior to permanent deployment. The receiver makes an excellent portable RTK base station with its internal battery. It also has specialized capabilities that make it an excellent reference receiver for scientific applications.

1.2 Technical Support

If you have any problem and cannot find the information you need on CHC website (www.chcnav.com), please contact local CHC dealer from which you purchased the receiver(s).

If you need help from CHC technical support, feel free to contact us online via skype (chc_support) or send email to support@chcnav.com.

1.3 Disclaimer

Before using the receiver, please make sure that you have read and understood this User Guide, as well as the safety requirements. CHC holds no responsibility for the wrong operation by users and for the losses incurred by the wrong understanding about this User Guide. However, CHC reserves the rights to update and optimize the contents in this guide regularly. Please contact your local CHC dealer for new information.

1.4 User's Comments

Your feedback about this user guide will help us to improve it in future revision. Please email your comments to support@chcnav.com.

2 Overview

This chapter is a introduction about the P3DT GNSS reference receiver ("the receiver"). This receiver makes it easier for users to set up a powerful and reliable Continuously Operating Reference Station (CORS) or temporary data collection in the field.

The receiver is an ideal choice for the following applications:

- As part of a GNSS Infrastructure network integrated with CHC Precision Service (CPS) software.
- As part of a permanent reference station with or without related software.
- As a temporary base station in field to broadcast RTK corrections and collect observation data for post processing.

2.1 Receiver Framework

The receiver integrates multi-frequency GNSS technology into a specialized processing and communication framework. The receiver can either operate as a stand alone reference station or be integrated into a scalable network.

Using IP (Internet Protocol) as primary communications method, users can use public domain tools such as a web browser or FTP client, to configure the receiver and access logged data files.

NOTE - All references to the Internet refer to either a Wide Area Network (WAN) or a Local Area Network (LAN) connection.

The receiver adopts a secured system that requires password to log in for further receiver configuration and data access.

Use the network management features to create a base/rover configuration with a variety of operating modes. You can then enable those modes as necessary instead of switching the global state of the receiver from one mode to another. For example, you can configure a number of streaming services with different configurations (such as any combination of data stream, sample interval) on different TCP or UDP ports. To activate one or more modes, open the connection to the specific port. This allows multiple clients to access any given streaming service.

These kinds of features, shift the model of a GNSS receiver toward the concept of a "network appliance".

2.1.1 The Network Appliance Concept

Traditionally, a GNSS receiver has only one user. Thus that only one user can change the settings without affecting other users.

However, P3DT has more than one users. That means an operator can make it available as a network appliance for more than one users (or clients).

This network appliance concept brings multiple services to many other users via LAN(Local Area Network) or WAN(Wide Area Network) such as the Internet. Only a few small changes is needed after the receiver was set up.

lets you set up the receiver to provide one or more services that one or more users can access through a Local Area Network (LAN) or a Wide Area Network (WAN), such as the Internet. Once the receiver is set up, you need make only minimal changes, if any, to the receiver configuration.

When the receiver is operating as a network appliance, it provides services to all users attached to the receiver through the network.

Different streamed services may be configured on different ports, for example, with differing data rates or data combination. To obtain a service, the client has only to connect to a specific port. In this way, most users do not need to control the receiver. Changing global settings, such as masks, will affect all users of all services.

The receiver provides the following standard configuration and data logging services:

Use	To perform
HTTP	All manual and automated configuration operations to manage the logged data file space.
FTP	Remote manual and/or automated operations to manage the logged data file upload path.

2.2 Receiver Services

The receiver more than one data streaming and query services either through a RS-232 serial port or a TCP/IP port:

- Streaming service

Anyone with authorized access can obtain streamed information, such as GNSS measurements or RTCM corrections, without having to control or issue commands to the receiver. Users only need to connect with the port that is streaming the required information.

2.3 Receiver Features

- 220-channels
  - GPS: L1 C/A, L2E, L2C, L5
  - GLONASS: L1 C/A, L1 P, L2 C/A, L2 P
  - Galileo: L1 BOC, E5A, E5B, E5AltBOC
  - BDS: B1, B2
  - SBAS: L1 C/A, L5
  - QZSS: L1 C/A, L1 SAIF, L2C, L5
- Easy-to-use web page for quick configuration and status checking
- IP65 water proof and dust proof level, rugged design
- -40°C to +75°C (-40°F to +167°F) operating temperature
- 9 V to 36 V DC power input
- Multiple languages available for web interface
- NTRIP client/server/caster support
- Integrated Bluetooth wireless technology for cable-free data transmission

2.4 Insert Battery and SIM Card

This receiver can withstand harsh environment that typically occurs during CORS installation. However, it is a high-precision electronic instrument and should be treated with reasonable care.

⚠ **CAUTION** – Operating or storing the receiver outside the specified temperature range can damage it.

2.5 Electronic Interfaces

High-power signals from a nearby radio or radar transmitter can overwhelm the receiver circuits. This does not harm the instrument, but it can prevent the receiver electronics from functioning correctly.

Avoid locating the receiver or antenna within 400 meters of powerful radar, television, or other transmitters or GNSS antennas. Low-power transmitters, such as those in cell phones and two-way radios, normally do not interfere with receiver operations.

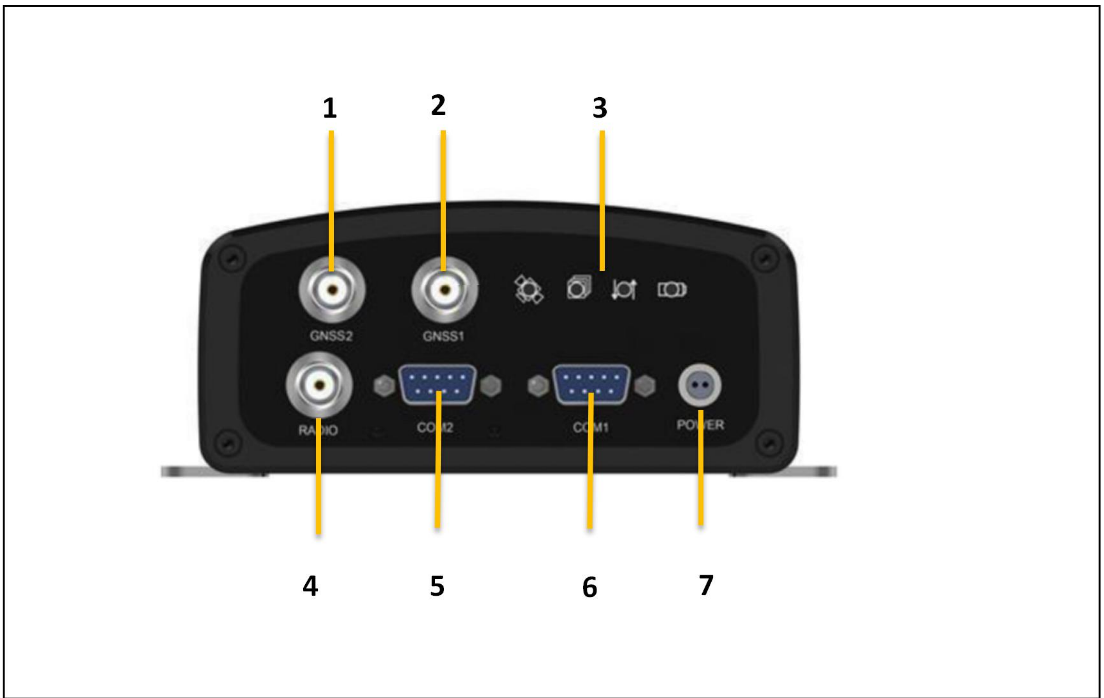
2.6 P3DT Accessories

The table below provides an overview of the different items composing the P3DT.

Name	Photo
CHC P3DT GNSS Receiver	
DB9 to DB9 Cable	
GPS Antenna Cable	
Power Cable	
Φ2.5-0.75m DC Semi-finished Line	
A220GR Geodetic GNSS Antenna	

Magnetic Mount	
Magnetic Mount UHF Antenna	
GPRS Antenna (SMA)	

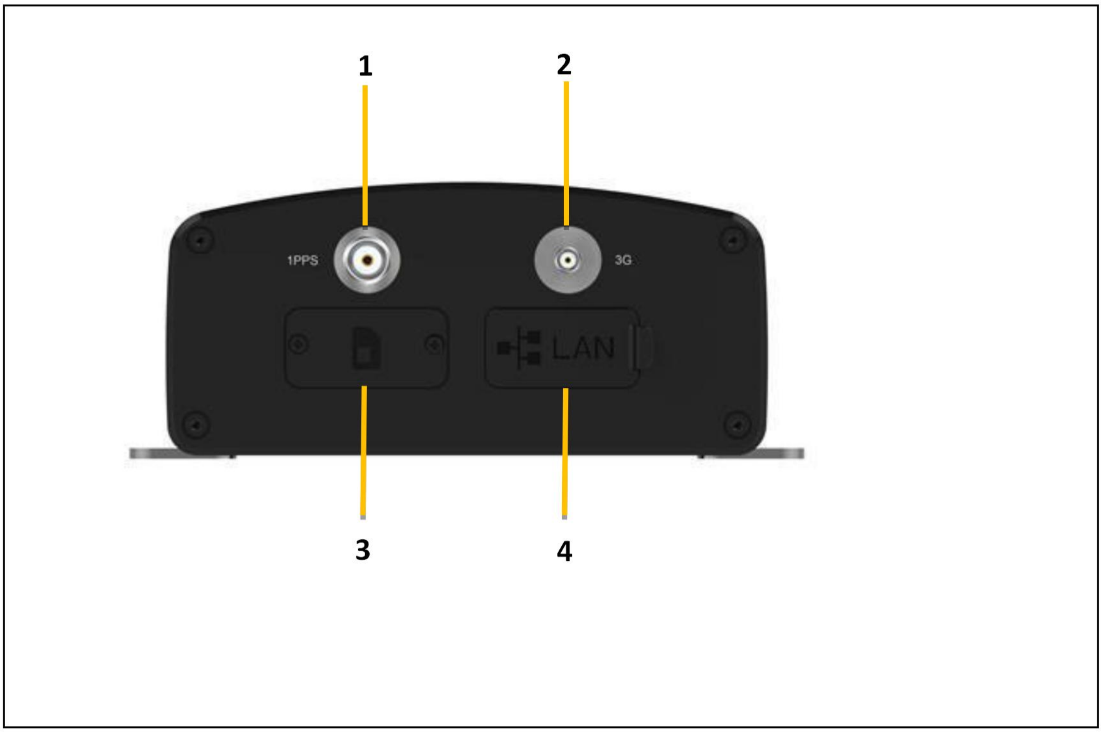
2.7 Front Connectors



	Feature	Description

1	TNC	Connect to the GNSS antenna
2	TNC	Connect to the GNSS antenna
3	LED	From left to right in picture above: ● Satellites LED. ● Record LED. ● Correction LED ● Power LED
4	TNC	Connect to the Radio antenna
5	DB9	RS-232 serial port, 9-pin male connector
6	DB9	RS-232 serial port, 9-pin male connector
7	Lemo (2-pin) port	Power Supply

2.8 Rear View



	Feature	Description
1	TNC	Connect with GNSS antenna
2	SMA	Connect to the 3G antenna
3	SIM card slot	Support to insert SIM card with middle size
4	RJ45 jack	• Supports links to 10BaseT/100BaseT auto-negotiate networks • HTTP, TCP/IP, UDP, FTP, NTRIP Caster, NTRIP Server, NTRIP Client • Simultaneously transmits multiple data stream

3 Setting Up the Receiver

This chapter describes best practices for setting up the equipment, and outline the precautions that you must take to protect the equipment. It also describes the typical installation diagram of reference station composed of P3DT GNSS receiver, GNSS antenna, external power and network cable.

3.1 System Installation

3.1.1 Supported Antenna

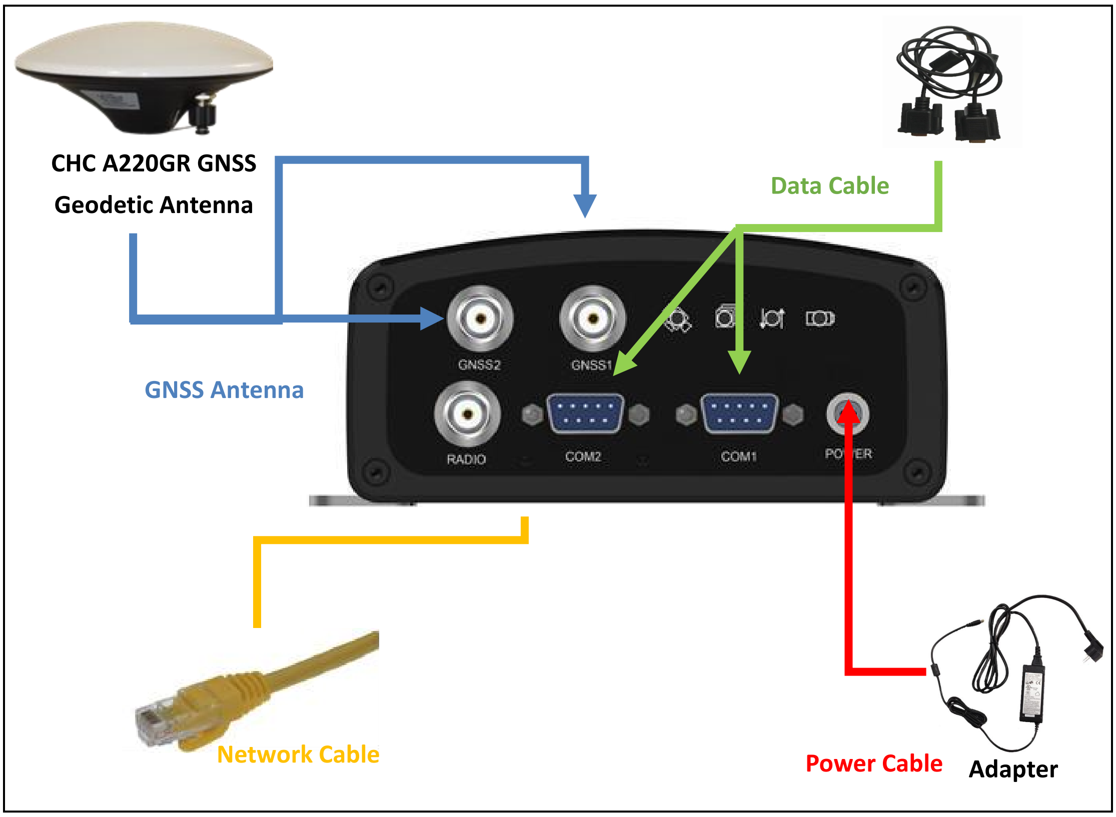
The receiver provides two TNC-type female connectors for connecting to antenna. The receiver is intended for use with two CHC Geodetic GNSS antennas.

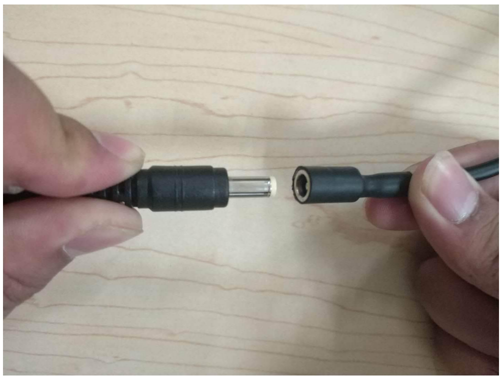
CHC A220GR GNSS Geodetic Antenna

Other GNSS antennas may however be used ensuring that the antenna receive the proper GNSS frequencies and operates at either 3.3V or 7.1V with a signal greater than 40 dB at the antenna port.

3.1.2 System Installation Diagram

The typical installation diagram of the CHC P3DT GNSS receiver connected with CHC A220GR GNSS Geodetic Antenna, external power supply and network cable.





1. Install the GNSS antenna at the appropriate location; connect the antenna to the TNC Plug Socket of P3DT via the GNSS Antenna Cable.

2. Power the P3DT by external power source (e.g. mains supply) with Adapter via Power Cable.

   A. Connect the 2-pin Lemo of CHC Power Cable to P3DT.
   B. Plug the male jack connector of Adapter into the female connector of CHC Power Cable.
   C. Connect two leg plugs or three leg plugs of Adapter to the mains supply.

3. Connect the network cable to the RJ45 jack of P3DT to link the P3DT with network.

NOTE: Also, the P3DT can be powered by external battery via CHC Data Cable. And the power supply voltage should be controlled between 9 to 36 V DC.

4 Configure P3DT Using CHC Software

The P3DT is a versatile GNSS Sensor which offers various setup and configuration software tools. Those software tools are described in the following pages. Please read this Getting Started Guide carefully before selecting the most appropriate ones for your application.

The configuration of the P3DT Sensor can be performed via the serial port link (RS232 or USB).

4.1 Configure P3DT Work Mode by Hcconfig

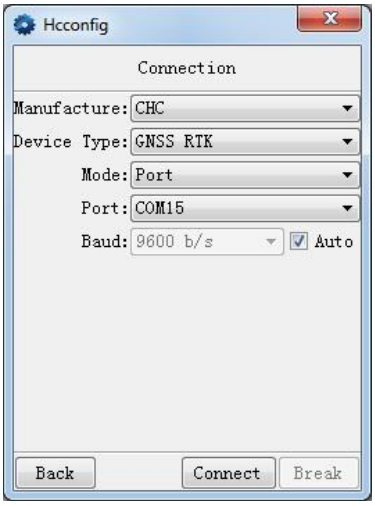
4.1.1 Two Ways to Connect P3DT

There are two ways to connect the P3DT with PC.

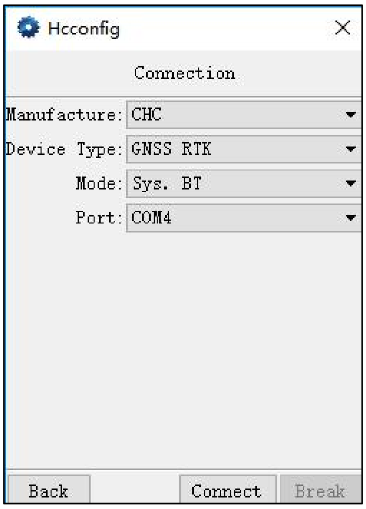
1.Via cable

Connect P3DT with computer via COM1 by DB9 to DB9 Cable.

Open Hcconfig, Manufacture select **CHC**, Device Type select **GNSS RTK**, choose the right port and baud (default baud 9600), click **connect**.



2.Via Bluetooth
Search the Bluetooth signal and connect the signal named as GNSS###### (SN of the receiver), the PIN is 1234.



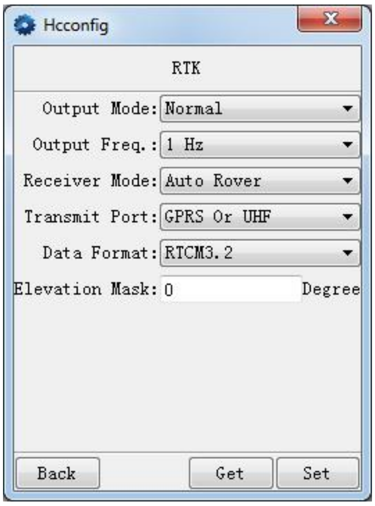
Then, the config steps are the same with these two kinds of connections.

4.1.2 RTK Set

Choose 

in software interface, Output Mode select **Normal**, Output Freq. select 1Hz (can be set by needed), Receiver Mode select **Auto Rover**, Transmit Port select **GPRS Or UHF**, Data Format is **the same as base station**, click **set** firstly and click **get** to check whether the setting is saved.

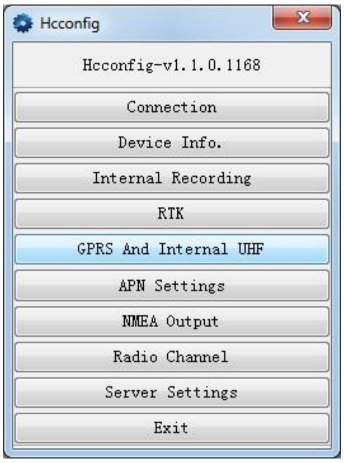
NOTE: After clicking **set**, receiver will restart, please click **get** when P3DT track satellites normally.

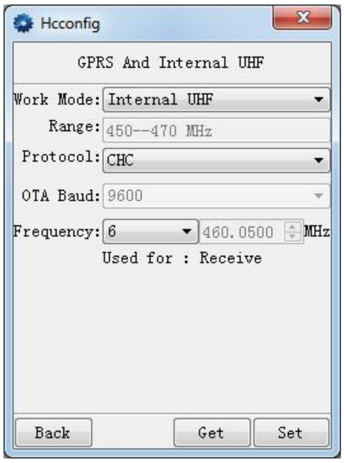


4.1.3 Radio Mode

Click into 

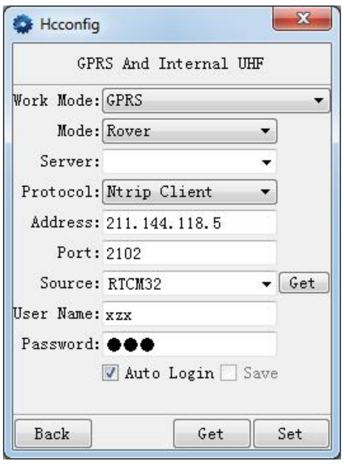
, work mode select **Internal UHF**, Protocol and Frequency select according to base station, click **set** firstly and click **get** to check whether the setting is saved.





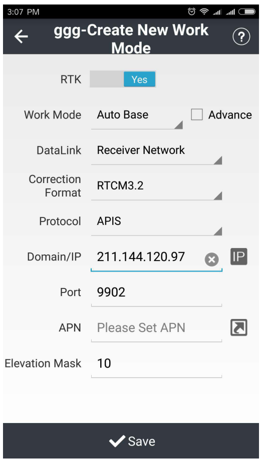
4.1.4 CORS Mode

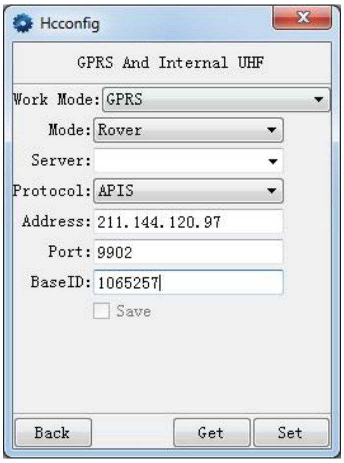
Insert SIM card (middle-sized), Work Mode select **GPRS**, Mode select **Rover**, Protocol select **Ntrip Client**, input Address, Port, Source (click **get** firstly), User Name and Password (Server is left blank), click **Auto Login**, click **set** firstly and click **get** to check whether the setting is saved. After setting successfully, correction LED will be on.



4.1.5 APIS Mode

Insert SIM card, Work Mode select GPRS, Mode select **Rover**, Server is **left blank**, Protocol select APIS, input Address, Port and Base ID (CHC receivers recommend to be base station), click **set** firstly and click **get** to check whether the setting is saved. After setting successfully, correction LED will be on.





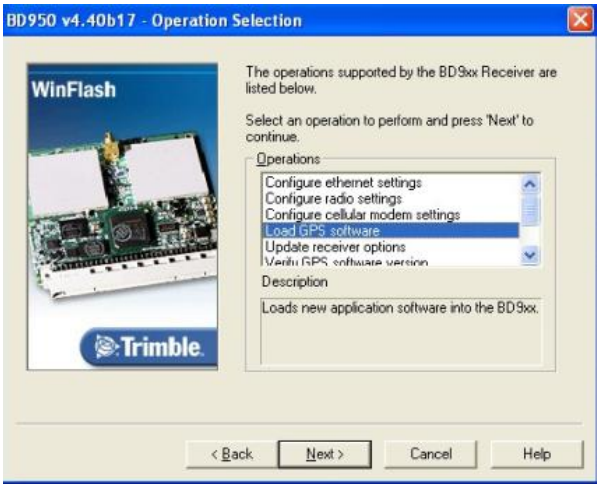
4.2 Configure P3DT using Winflash

- Install WinFlash on your PC
- Connect the P3DT to your PC using the GPS to PC Data cable by COM2 or Bluetooth

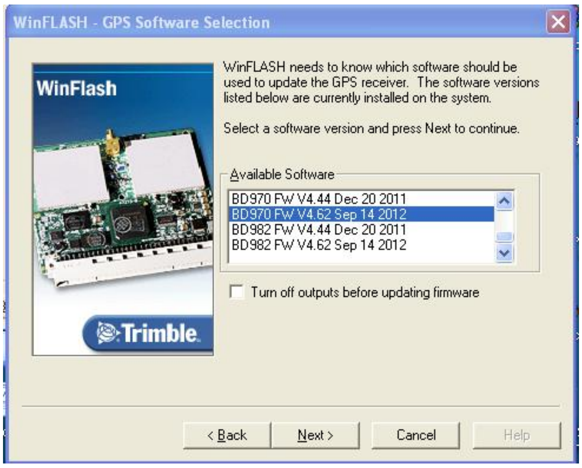
4.2.1 Receiver Firmware Upgrade

Start the WinFlash utility. The *Device Configuration* screen appears.

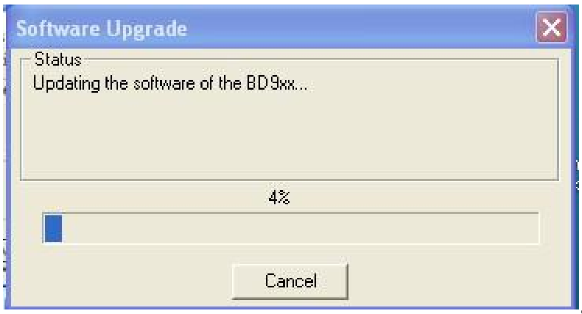
From the *PC serial port* field, select the serial (COM2) port on the computer that the receiver is connected to Click **Next.**



Select *Load GPS software* and then click **Next**. From the *Available Software* list, select the latest version and then click **Next**.

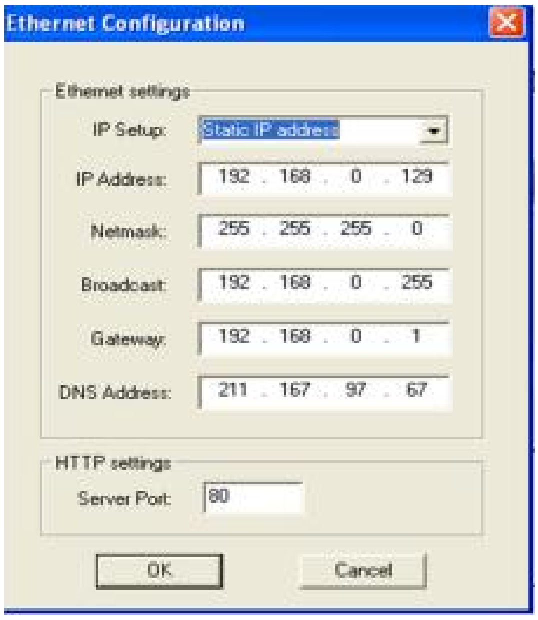


If all is correct, click **Finish**, then Click **OK**. The *Software Upgrade* window appears again and states that the operation was completed successfully.



4.2.2 IP Configuration

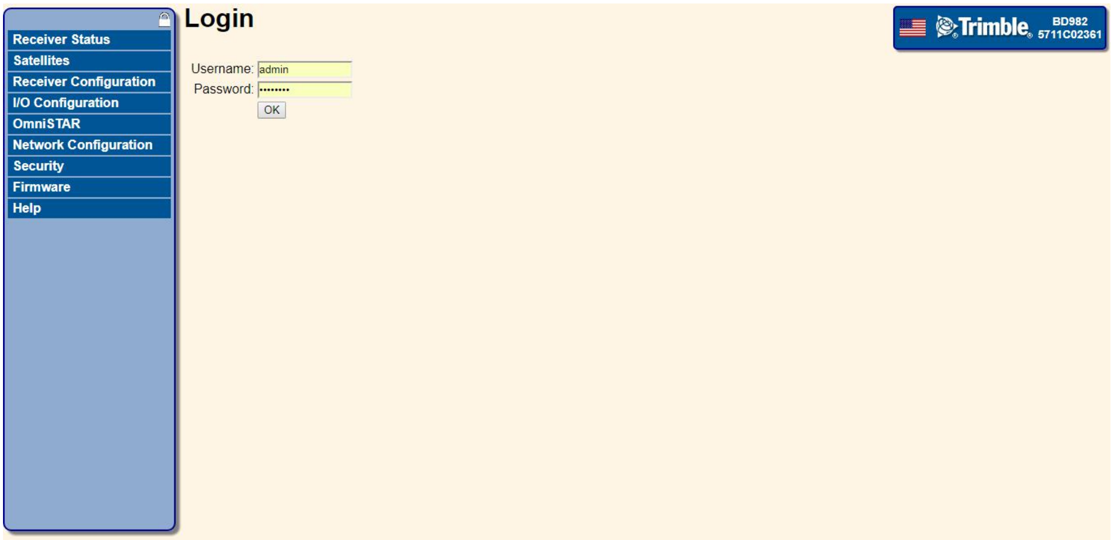
Start WinFlash and follow the instruction below to set the static IP of P3DT sensor to log on internet.



4.3 Configure through Web Browser

When connecting the P3DT to your PC using the LAN cable for the first time, follow the steps, if you already configuration P3DT static IP, please directly using this static IP to configuration P3DT.

- Set your PC IP address to "Obtain an IP address automatically
- Connect PC with P3DT with a LAN cable
- Type http://169.254.1.0 in your default Internet browser
- Enter default User name = admin and Password = password
- Press OK to login.
- The P3DT GNSS Sensor configuration screen will appear



The following menus are available on the left side on the screen:

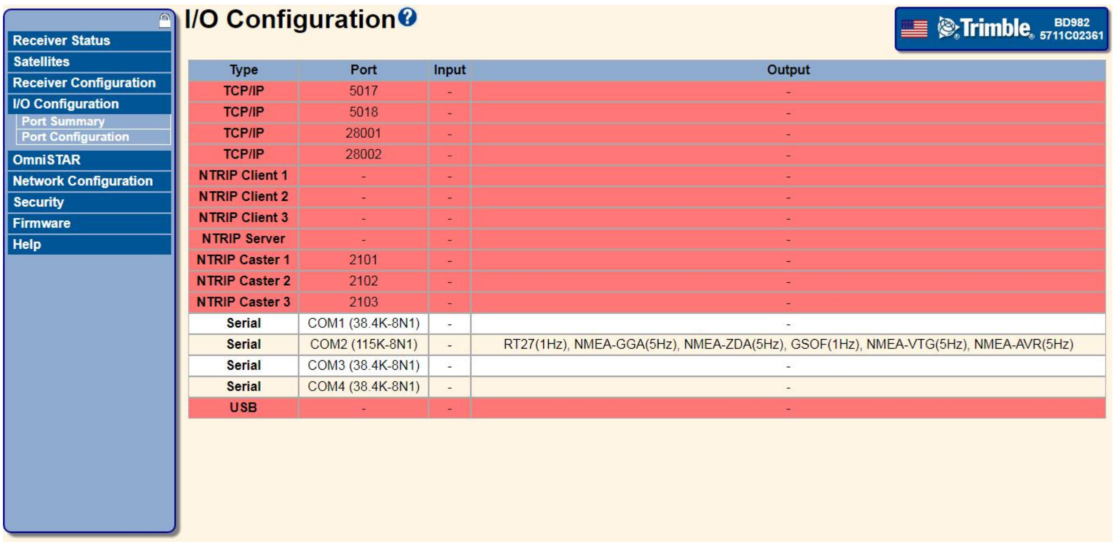
✓ Receiver Status

- ✓ Satellites
- ✓ Receiver Configuration
- ✓ I/O Configuration
- ✓ Network Configuration
- ✓ Security
- ✓ Firmware and Help

- ➔ Change the User Interface Language
- ➔ Check the receiver Status: differential status, receiver options
- ➔ Satellites configuration (Enable / Disable)
- ➔ Important **Setting**: set up NTRIP Client and Data output message
- ➔ IP configuration to set the P3DT Static IP address

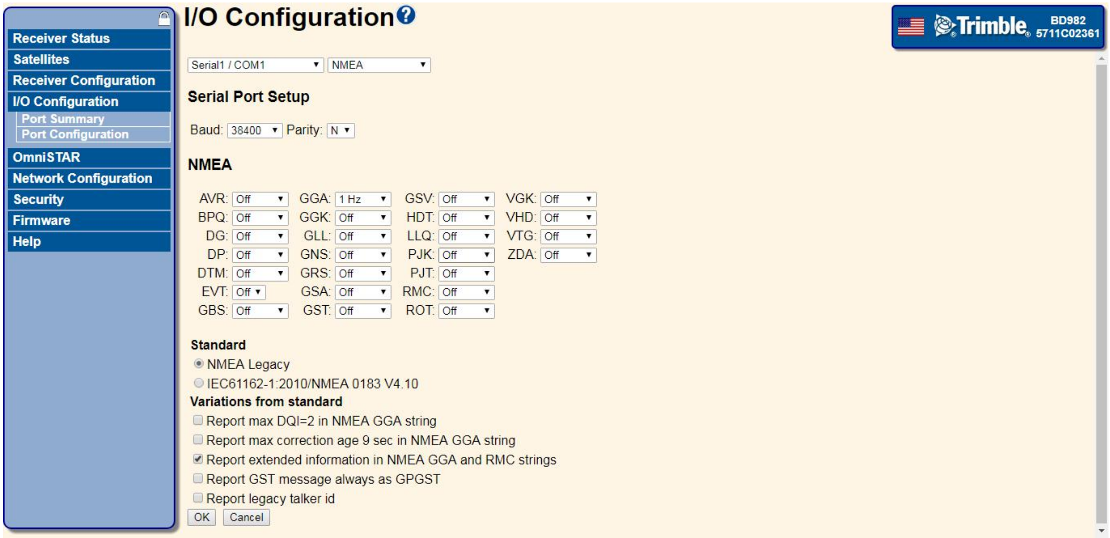
4.3.1 I/O Configuration

After configuring the P3DT via COM2, user can connect P3DT with PC via network cable.



Type	Port	Input	Output
TCP/IP	5017	-	-
TCP/IP	5018	-	-
TCP/IP	28001	-	-
TCP/IP	28002	-	-
NTRIP Client 1	-	-	-
NTRIP Client 2	-	-	-
NTRIP Client 3	-	-	-
NTRIP Server	-	-	-
NTRIP Caster 1	2101	-	-
NTRIP Caster 2	2102	-	-
NTRIP Caster 3	2103	-	-
Serial	COM1 (38.4K-8N1)	-	-
Serial	COM2 (115K-8N1)	-	RT27(1Hz), NMEA-GGA(5Hz), NMEA-ZDA(5Hz), GSOF(1Hz), NMEA-VTG(5Hz), NMEA-AVR(5Hz)
Serial	COM3 (38.4K-8N1)	-	-
Serial	COM4 (38.4K-8N1)	-	-
USB	-	-	-

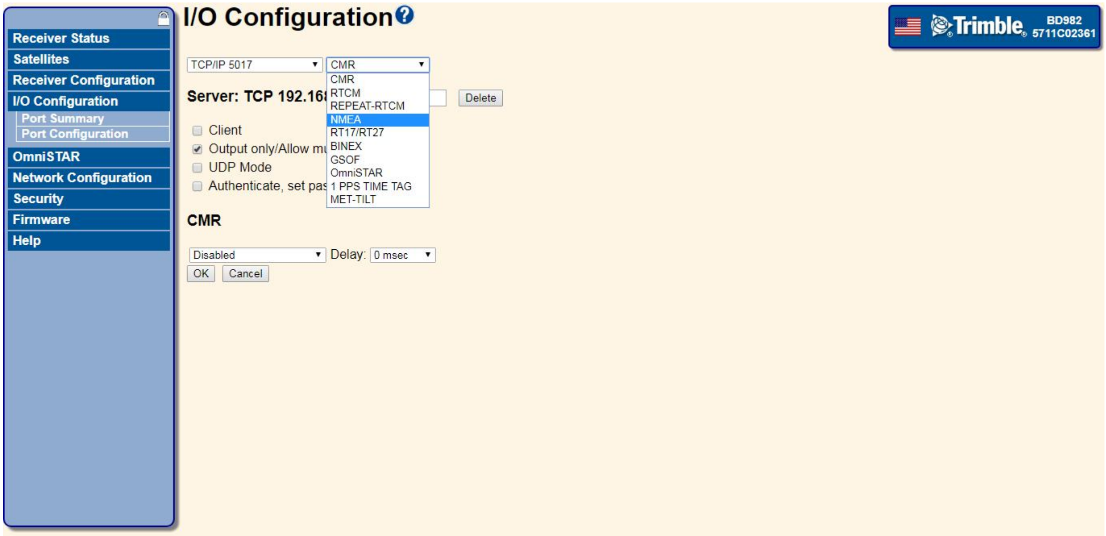
I/O Configuration Interface



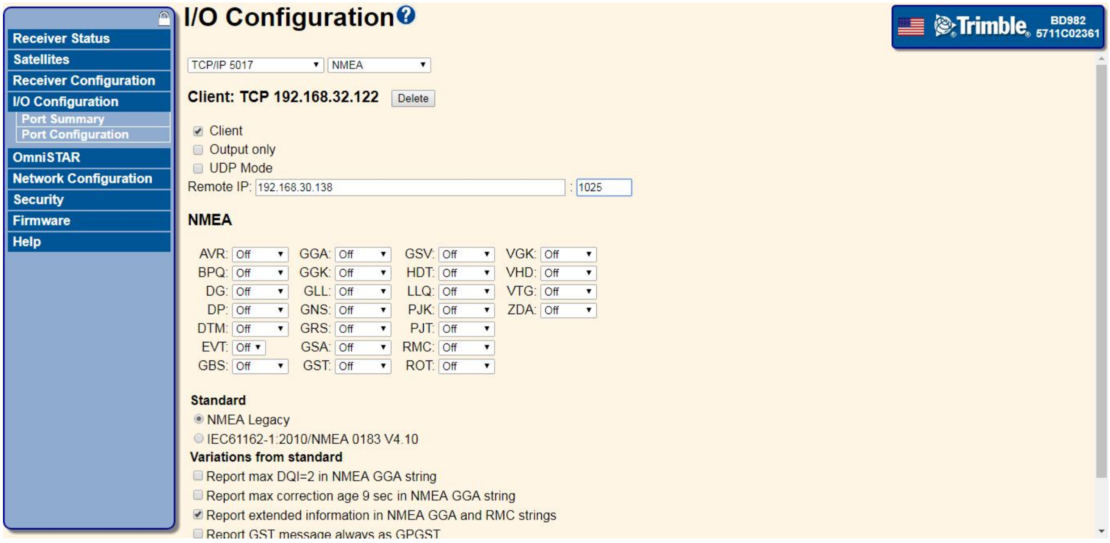
Serial Port Configuration Interface

4.3.2 Ethernet Port Configuration

After configuring the P3DT via COM2, in I/O configuration interface, choose **TCP/IP**, set up P3DT via following interface.



Data Output Option



Data Output Configuration

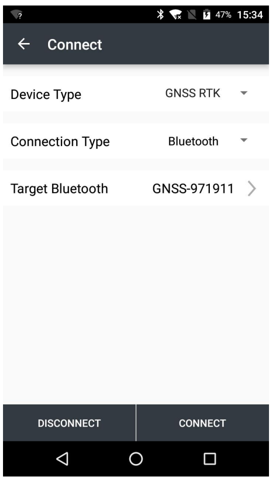
4.4 Connect P3DT using GNSSTool

Turn on the receiver → Launch GNSSTool → press config on the bottom of the screen → choose **Connect**.

In the **Connect** screen, set **Device Type** as **GNSS RTK**, **Connection Type** as **Bluetooth**.

Tap **Target Bluetooth** at the third row, press **Bluetooth icon** at right top of the screen and connect to the receiver's Bluetooth whose name is the GNSS-XXXXXXX (the SN of the current receiver, PIN is 1234).

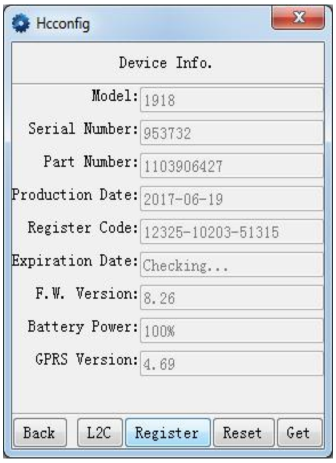
One step back, choose paired Bluetooth device with the receiver's SN. Press **Connect** on the lower right of the screen.



4.5 Receiver Registration

If the receiver is expired, it will do not output data normally. Please contact CHC Support, ask for registration code and register it via HCconfig.

Connect P3DT with PC via DB9 to DB9 cable, open HCconfig and click **Device Info.,** click **Register**, input registration code, when registration is finished, click **Get** to refresh the **Expiration Date**.



5 Specifications

This chapter describes the specifications of the P3DT GNSS reference receiver.

Specifications are subject to change without notice.

5.1 GNSS Characteristics

Feature	Specification
Tracking	• 220 channels – GPS: L1 C/A, L2C, L2E, L5 – GLONASS: L1 C/A, L1P, L2C/A, L2P – SBAS: L1 C/A, L5

	– Galileo: L1 BOC, E5A, E5B, E5AltBOC – BDS: B1, B2 – QZSS: L1 C/A, L1 SAIF, L2C, L5 • Pseudo-range measurement with high-precision multi-correlator • Very low noise carrier phase measurements with <1 mm precision in a 1 Hz bandwidth
Real Time Kinematic (RTK)	Horizontal: 8 mm + 1 ppm RMS Vertical: 15 mm + 1 ppm RMS
Initialization time	Typically < 1 minute
Initialization reliability	Typically > 99.9%

5.2 Communications

Feature	Specification
RJ45 Jack	Ethernet
COM1 (DB9 male)	3-wire RS232, see C.I. CHC N72 receiver DB9 maleconnector definition for details
COM2 (DB9 male)	3-wire RS232, see C.I. CHC N72 receiver DB9 male connector definition for details
LEMO PORT (2-pin)	Power Supply
Protocols	Correction formats: CMR, CMR+, SCMR, RTCM2.3, 3.0 Observables: RT17, RT27, RTCM3.X Position/Status I/O: NMEA-0183 V2.30 (GPGGA & GPGSV)

5.3 Physical

Feature	Specification
Size	175.5 x 140 x 63.8 mm (6.9 x 5.5 x 2.5 in)
Weight	1.2 kg (42 oz)
Operating temperature Storage temperature	-40 °C to +75 °C (-40 °F to +167 °F) -55 °C to +85 °C (-67 °F to +185 °F)
Humidity	100% condensation
Waterproof and dust proof	Tested to IP65; dustproof
Shock	Designed to survive a 2 m (6.56 ft) drop onto concrete

5.4 Electrical

Feature	Specification
Power consumption	4.5 W
	Power input on Lemo ports is 9 V DC to 36 V DC external power input

5.5 General

Feature	Specification
Receiver type	GNSS receiver
Antenna type	CHC A220GR GNSS Geodetic antenna Other models supported.

A Firmware Upgrading

The receiver is supplied with the latest version of the receiver firmware already installed. If a later version of the firmware becomes available, use the serial port to upgrade the firmware on your receiver. For the latest firmware resource, please consult your local CHC dealer.

AI The Winflash Utility

The WinFlash utility communicates with CHC products to perform various functions including:

- load or verify GPS software of the mainboard
- update or verify the receiver options

For more information, online help is also available when using the WinFlash utility.

AII Upgrading the receiver firmware through com port

1. Use the 2-pin lemo cable to power the receiver and to connect the receiver with the computer's COM1 port.

2. Run the firmware update application. Restart the receiver and then the screen will prompt you whether to upgrade the firmware.
3. Click 

button, and then go to **Connect Setup**.
4. Select the COM port that used to connect the receiver with your computer for Port and click **OK** button.
5. Go to **Connect→Link** (or click 

button).
6. Click 

button and then the prompt about restarting the receiver will be shown in the message box.
7. Turn off the receiver, wait for about 5 seconds, and then turn on the receiver, the update application program will update the receiver automatically.
8. When the update is complete, the prompt box will display. Click Ok and then exit the update application program.
9. Once the firmware update is done, turn off the receiver for about 5 seconds, and you will have the correct version of firmware.

NOTE: After the receiver firmware upgrading, the IP information may be changed. Please confirm the IP setting of the receiver before using it.

B Trouble Shooting

Use this appendix to identify and solve common problems that may occur during the use of the receiver.

Please read this section before you contact CHC Technical Support.

BI Receiver Issues

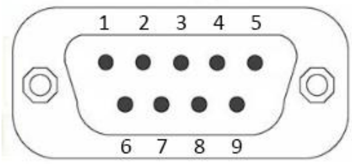
This section describes some possible receiver issues, possible causes, and how to solve them.

Issue	Possible Reason	Solution

The receiver does not turn on.	Power is too low.	Check the charge on the external battery and, if applicable, check the fuse.
	External power is not properly connected.	Check that the Lemo connector is seated correctly and that the cable is secured to the receiver. Check for broken or bent pins in the connector.
	Faulty power cable.	Check that you are using the correct cable for the connection between Lemo port and power supply. Check that the correct external power supply is connected to a particular Lemo port. Check pinouts with a multimeter to ensure internal wiring is intact.
The receiver is not responding.	Receiver needs a soft reset.	Turn off the receiver and then turn it back on again.
The receiver is not receiving satellite signals	The GNSS antenna cable is loose.	Make sure that the GNSS antenna cable is tightly seated in the antenna connector on the GNSS antenna.
	The cable is damaged.	Check the cable for any signs of damage. A damaged cable can inhibit signal detection from the antenna at the receiver.
	The GNSS antenna is not in clear line of sight to the sky.	Make sure that the GNSS antenna is located with a clear view of the sky. Restart the receiver as a last resort (turn off and then turn it on again).

C Communication Ports Definition

CI CHC P3DT Receiver DB9 Male Connector Definition



PIN	Signal Name	Description
1,4,6, 7,8,9	Not Used	
2	TXD	RS232-TX (transmit data through this pin)
3	RXD	RS232-RX (receive data through this pin)
4	Not Used	
5	GND	External Power Ground

D Glossary

base station Also called reference station. A base station in construction, is a receiver placed at a known point on a jobsite that tracks the same satellites as an RTK rover, and provides a real-time differential correction message stream through radio to the rover, to obtain centimeter level positions on a continuous real-time basis. A base station can also be a part of a virtual reference station network, or a location at which GPS observations are collected over a period of time, for subsequent postprocessing to obtain the most accurate position for the location.

carrier	A radio wave having at least one characteristic (such as frequency, amplitude, or phase) that can be varied from a known reference value by modulation.
carrier frequency	The frequency of the unmodulated fundamental output of a radio transmitter. The GPS L1 carrier frequency is 1575.42 MHz.
carrier phase	The time taken for the L1 or L2 carrier signal generated by the satellite to reach the GPS receiver. Measuring the number of carrier waves between the satellite and receiver is a very accurate method of calculating the distance between them.
CMR **CMR+**	Compact Measurement Record. A real-time message format developed by Trimble for broadcasting corrections to other Trimble mainboard receivers. CMR is a more efficient alternative to RTCM.
DGPS	See real-time differential GPS.
differential correction	Differential correction is the process of correcting GPS data collected on a rover with data collected simultaneously at a base station. Because the base station is on a known location, any errors in data collected at the base station can be measured, and the necessary corrections applied to the rover data. Differential correction can be done in real-time, or after the data has been collected by postprocessing.
Differential GPS	See real-time differential GPS.
DOP	Dilution of Precision. A measure of the quality of GPS positions, based on the geometry of the satellites used to compute the positions. When satellites are widely spaced relative to each other, the DOP value is lower, and position accuracy is greater. When satellites are close together in the sky, the DOP is higher and GPS positions may contain a greater level of error. PDOP (Position DOP) indicates the three-dimensional geometry of the satellites. Other DOP values include HDOP (Horizontal DOP) and VDOP (Vertical DOP), which indicate the accuracy of horizontal measurements (latitude and longitude) and vertical measurements respectively. PDOP is related to HDOP and VDOP as follows: $PDOP^2 = HDOP^2 + VDOP^2$
dual-frequency GPS	A type of receiver that uses both L1 and L2 signals from GPS satellites. A dual-frequency receiver can compute more precise position fixes over longer distances and under more adverse conditions because it compensates for ionospheric delays.
EGNOS	European Geostationary Navigation Overlay Service. A satellite-based augmentation system (SBAS) that provides a free-to-air differential correction service for GPS.

	EGNOS is the European equivalent of WAAS, which is available in the United States.
elevation mask	The angle below which the receiver will not track satellites. Normally set to 10 degrees to avoid interference problems caused by buildings and trees, and multipath errors.
ephemeris / ephemerides	A list of predicted (accurate) positions or locations of satellites as a function of time. A set of numerical parameters that can be used to determine a satellite's position. Available as broadcast ephemeris or as postprocessed precise ephemeris.
epoch	The measurement interval of a GPS receiver. The epoch varies according to the measurement type: for real-time measurement it is set at one second; for postprocessed measurement it can be set to a rate of between one second and one minute. For example, if data is measured every 15 seconds, loading data using 30-second epochs means loading every alternate measurement.
firmware	The program inside the receiver that controls receiver operations and hardware.
GLONASS	Global Orbiting Navigation Satellite System. GLONASS is a Soviet space-based navigation system comparable to the American GPS system. The operational system consists of 21 operational and 3 non-operational satellites in 3 orbit planes.
GNSS	Global Navigation Satellite System.
GSOF	General Serial Output Format. A Trimble proprietary message format.
HDOP	Horizontal Dilution of Precision. HDOP is a DOP value that indicates the accuracy of horizontal measurements. Other DOP values include VDOP (vertical DOP) and PDOP (Position DOP). Using a maximum HDOP is ideal for situations where vertical precision is not particularly important, and your position yield would be decreased by the vertical component of the PDOP (for example, if you are collecting data under canopy).
L1	The primary L-band carrier used by GPS satellites to transmit satellite data.
L2	The secondary L-band carrier used by GPS satellites to transmit satellite data.
L5	The third L-band carrier used by GPS satellites to transmit satellite data. L5 will provide a higher power level than the other carriers. As a result, acquiring and tracking weak signals will be easier.
MSAS	MTSAT Satellite-Based Augmentation System. A satellite-based augmentation system (SBAS) that provides a free-to-air differential correction service for GPS. MSAS is the Japanese equivalent of

	WAAS, which is available in the United States.
multi-frequency GPS	A type of receiver that uses multiple carrier phase measurements (L1, L2, and L5) from different satellite frequencies.
multipath	Interference, similar to ghosts on a television screen that occurs when GPS signals arrive at an antenna having traversed different paths. The signal traversing the longer path yields a larger pseudorange estimate and increases the error. Multiple paths can arise from reflections off the ground or off structures near the antenna.
NMEA	National Marine Electronics Association. NMEA 0183 defines the standard for interfacing marine electronic navigational devices. This standard defines a number of 'strings' referred to as NMEA strings that contain navigational details such as positions. Most CHC GPS receivers can output positions as NMEA strings.
PDOP	Position Dilution of Precision. PDOP is a DOP value that indicates the accuracy of three-dimensional measurements. Other DOP values include VDOP (vertical DOP) and HDOP (Horizontal Dilution of Precision). Using a maximum PDOP value is ideal for situations where both vertical and horizontal precision are important.
postprocessing	Postprocessing is the processing of satellite data after it has been collected, in order to eliminate error. This involves using computer software to compare data from the rover with data collected at the base station.
real-time differential GPS	Also known as *real-time differential correction* or *DGPS*. Real-time differential GPS is the process of correcting GPS data as you collect it. Corrections are calculated at a base station and then sent to the receiver through a radio link. As the rover receives the position it applies the corrections to give you a very accurate position in the field. Most real-time differential correction methods apply corrections to code phase positions. RTK uses carrier phase measurements. While DGPS is a generic term, its common interpretation is that it entails the use of single-frequency code phase data sent from a GPS base station to a rover GPS receiver to provide sub-meter position accuracy. The rover receiver can be at a long range (greater than 100 km (62 miles)) from the base station.
reference station	See base station
rover	A rover is any mobile GPS receiver that is used to collect or update data in the field, typically at an unknown location.
RTCM	Radio Technical Commission for Maritime Services. A commission

established to define a differential data link for the real-time differential correction of roving GPS receivers. There are three versions of RTCM correction messages. All CHC GPS receivers use Version 2 protocol for single-frequency DGPS type corrections. Carrier phase corrections are available on Version 2, or on the newer Version 3 RTCM protocol, which is available on certain CHC dual-frequency receivers. The Version 3 RTCM protocol is more compact but is not as widely supported as Version 2.

RTK Real-time kinematic. A real-time differential GPS method that uses carrier phase measurements for greater accuracy.

SBAS Satellite-Based Augmentation System. SBAS is based on differential GPS, but applies to wide area (WAAS/EGNOS and MSAS) networks of reference stations. Corrections and additional information are broadcast via geostationary satellites.

signal-to-noise ratio SNR. The signal strength of a satellite is a measure of the information content of the signal, relative to the signal's noise. The typical SNR of a satellite at 30° elevation is between 47 and 50 dBHz. The quality of a GPS position is degraded if the SNR of one or more satellites in the constellation falls below 39.

skyplot The satellite skyplot confirms reception of a differentially corrected GPS signal and displays the number of satellites tracked by the GPS receiver, as well as their relative positions.

SNR See signal-to-noise ratio

UTC Universal Time Coordinated. A time standard based on local solar mean time at the Greenwich meridian.

VRS Virtual Reference Station. A VRS system consists of GNSS hardware, software, and communication links. It uses data from a network of reference stations to provide corrections to each rover that are more accurate than corrections from a single base station.

To start using VRS corrections, the rover sends its position to the VRS server. The VRS server uses the reference station data to model systematic errors (such as ionospheric noise) at the rover position. It then sends RTCM or CMR correction messages back to the rover.

WAAS Wide Area Augmentation System. WAAS was established by the Federal Aviation Administration (FAA) for flight and approach navigation for civil aviation. WAAS improves the accuracy and availability of the basic GPS signals over its coverage area, which includes the continental United States and outlying parts of Canada and Mexico.

The WAAS system provides correction data for visible satellites. Corrections are computed from ground station observations and then uploaded to two geostationary satellites. This data is then broadcast on the L1 frequency, and is tracked using a channel on the GPS receiver, exactly like a GPS satellite.

Use WAAS when other correction sources are unavailable, to obtain greater accuracy than autonomous positions. For more information on WAAS, refer to the FAA website at http://gps.faa.gov.

The EGNOS service is the European equivalent and MSAS is the Japanese equivalent of WAAS.

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help.

Caution: Any changes or modifications to this device not explicitly approved by manufacturer could void your authority to operate this equipment.

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment.
This equipment should be installed and operated with minimum distance 20cm between the radiator & your body.

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