ComNav marine ltd

G9 GNSS Smart Antenna

SURVEY GRADE – BASE STATION OR ROVER

Installation & Operation Manual

Certified System ISO 9001

CE

PN 29010106 V 1.0

Welcome

Congratulations on your purchase of a ComNav G9 Smart Antenna! At ComNav, we are dedicated to reliability & quality in all our products, these products are a good example of that. We promise to do our best to ensure your satisfaction with your new G9 Smart Antenna.

Warranty Notice

Prior to the installation and/or operation of the equipment, ensure that you read, understand, and accept the conditions of the warranties as detailed in the **Warranty Information** section of this manual. Additionally, please make sure you have read and understood all the safety, warnings and caution details in this manual. ComNav holds no responsibility for incorrect operation by users and for losses incurred by inappropriate interpretations of this manual. Additionally, ComNav reserves the rights to update and upgrade the contents of this guide regularly, and on a regular basis, please consult your local ComNav dealer for new information or review available latest documentation downloads via the ComNav website. www.comnav.com

The warranty information section also outlines the Firmware Licensing Agreement and Limitations on Liability.

General Notice

This document, ComNav part number 29010106 Version 1 Revision 1, is the approved Installation and Operation Manual for use with G9 Smart Antenna. Where versions of this manual exist in other languages, the English version shall be considered authoritative.

Copyright

Warning

If your ComNav Model G9 is equipped with a 400 MHz radio, you may be required to obtain a valid radio license for your region or jurisdiction. Only set the radio to the frequency and power you are licensed to use at your location.

USA – Federal Communication Commission (FCC)

Radio Frequency radiation exposure information:

This equipment complies with FCC radiation exposure limits set forth for an uncontrolled environment. The equipment is expected to operate with the following requirements:

- When using GSM to receive correction data, this equipment should be installed and operated with a minimum distance of 30 cm between the radio and your body.

- When using 400 MHz SATEL UHF radio, this equipment should be installed and operated with a minimum distance of 30 cm from the G9 GNSS receiver.
- The transmitter must not be operating in conjunction with any other antenna or transmitter.
- If the operation of the equipment is not expressly approved by ComNav, ComNav, at its sole authority could void the user's rights to operate the equipment.

This device complies with Part 15 of the FCC Rules. Operation is subject to the following 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 has been tested in accordance 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, it may cause harmful interference to radio communications and equipment. However, there is no guarantee that interference will not occur in a specific installation.

If this equipment does cause harmful interference to radio reception, which can be determined by tuning the equipment off and on, the user is encouraged to attempt to eliminate the interference by one or more of the following methods:

- Increase the distance between the equipment and receiver
- Reorient or reposition the receiving antenna
- Connect the equipment power outlet on a circuit that is different or isolated from that to which the receiver is connected.
- Consult the dealer or an experienced radio technician for assistance

Any modifications not expressly authorized and approved by the party responsible for compliance could void the user's authority to operate the equipment.

Caution: Exposure to Radio Frequency Radiation.

This device must not be positioned in conjunction with any other antenna or transmitter.

Canada – Industry Canada (IC)

This equipment complies with RSS210 of Industry Canada. Operation is subject to the following two conditions: 1) This equipment may not cause interference, and 2) This equipment must accept any interference, including interference that may cause undesired operation of this equipment.

Caution: Exposure to Radio Frequency Radiation.

The installer of this radio equipment must ensure that the antenna is located or pointed such that it does not emit RF field in excess of Health Canada limits for the general population; Safety Code 6, obtainable from Health Canada's website.

Europe – Declaration of Conformity

This equipment is in compliance with part 15 of the FCC. Operation is subject to the following two conditions:

1) This equipment many not cause harmful interference, and
2) This equipment must accept any interference received, including interference that may cause undesired operation.

This product complies with essential requirements and other relevant provisions of the Directive 2014/53/EU. This declaration of conformity is another quality commitment from ComNav.

Technical Support

In order to provide you the best technical support if you cannot find the information in this manual, whether it be for installation, operation or queries, you are encouraged to contact your local authorized ComNav technical servicing dealer. To locate the ComNav authorized dealer near you, please contact:

ComNav
15 – 13511 Crestwood Place
Richmond, BC
Canada
V6V 2G1
Tel # 604 207 1600
Fax # 604 207 8008
service@comnav.com

Document History

Revision	Date	Description
1	15 March 2018	First Release

About this Manual

This manual provides essential information for the safe and reliable operation of the ComNav's G9 Smart Antenna. Read this manual in its entirety before using the G9 Smart Antenna for the first time. Keep the manual handy until you become thoroughly familiar with the operation of the Smart Antenna.

Your Comments

Your feedback about this user guide will help us to improve reviews of this version for development of future revisions. Please email all your comments to service@comnav.com

Manual Format

This manual has been formatted to be printed on both sides of the pages of the manual, and on standard Letter-sized paper (8.5" x 11").

If you have obtained this manual as a soft-copy, please note that it is in Adobe® Portable Document Format ("pdf"), and so may be viewed & printed with Adobe Reader®, or compatible pdf-format viewers.

When printing this manual with Reader, you should select "duplex printing" (or the equivalent term used by your printer's software driver), in order to print it double-sided on the paper. If your printer does not have built-in duplexing capability, you can still print this manual double-sided by following the instructions that came with your printer for doing "hand duplexing".

You should also select the Auto-Rotate and Centre option in the Print Dialog box, de-select the Choose Paper Source by PDF page size option; as well, you should set Page Scaling to None – Reader's default setting is Shrink to Printable Area, and is printer-dependant (usually set at ~97%), but that is not needed here.

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Introduction

The following Acronyms and their respective Definitions are summarized in the following table for your convenience and familiarity:

AVL	Automated Vehicle Locations
Base Station	Station providing real time corrections to nearby RTK rovers via UHF radio or the internet
BeiDou	Chinese satellite based navigation system
CDMA	Code Division Multiple Access – a cellular network protocol
DHCP	Dynamic Host Configuration Protocol
Datalink	Device to send RTK corrections to one or more rovers such as UHF radio or NTRIP (see NTRIP and NTRIP server)
DGPS / DGNSS	Differential GPS/GNSS refers to receiver using differential corrections
EGNOS	European Geo-Stationary Overlay System that provides free differential corrections service over satellite in parts of Europe
Elevation Mask	Minimum angle between a satellite and the horizon for the receiver to utilize that satellite in the specific application
Firmware	Embedded software into the receiver that manages the processing of the receiver and controls the GNSS engine
GALILEO	GNSS installed by the European Union and European Space Agency
GAGAN	GPS Aided GEO Augmented Navigation System (India)
GLONASS	Global Orbiting Navigation Satellite System implemented by Russia similar to GPS by USA
GNSS	Global Navigation Satellite System. Satellite constellations that provide autonomous 3D position (latitude, longitude, altitude) along with precise timing globally
GPS	Global Positioning System (GPS) implemented by USA
IMU	Inertial Measurement Unit
INS	Inertial Navigation System
NASA	National Aeronautics and Space Administration (USA)
NMEA	National Marine Electronics Association. NMEA 0183 or N2K are specifications for data protocols for communications between various marine electronics equipment, such as GNSS receivers
NTRIP	Networked Transport of RTCM via Internet Protocol (NTRIP) is a protocol for streaming GNSS data or RTK corrections over internet
NTRIP Server	NTRIP server sends data from NTRIP source (base station) to the NTRIP caster.
Mountpoint	Specified data streams in NTRIP. Multiple base stations may send data to an NTRIP caster
Multipath	When GNSS signals reach the antenna by two or more paths causing incorrect pseudorange measurements leading to less precise GNSS calculations
MMT	Multipath Mitigation Technology
PPS	Pulse Per Second or Precise Positioning Service
QZSS	Quasi Zenith Satellite System developed by Japan
PSR	Pseudorange

RTCM	Radio Technical Commission for Maritime Services (RTCM) is an industry standard to define RTK message formats
RTK	Real Time Kinematic is a real time differential corrections method to provide improved accuracy
SA	Selective Availability or Smart Antenna
SBAS	Satellite Based Augmentation System providing differential corrections over a wide area or region
UART	Universal Asynchronous Receiver Transmitter
UHF	Ultra High Frequency
WAAS	Wide Area Augmentation System is a SBAS that provides free differential corrections over satellite in North American regions

Overview

The G9 Smart Antenna is a state-of-the-art multi frequency survey grade GNSS RTK receiver. Precise positioning intelligent receiver is user configurable to operate as a precise Base Station or to operate as a Rover in a network. The unit comes in a compact industrial grade package designed for rugged lightweight universal applications.

The model G9 encompasses multiple wireless communication ports, including WiFi and Bluetooth, with an embedded UHF SATEL radio along with a 4G internal cellular modem for worldwide coverage to receive correction data. The device can be configured via web user interface to control functions, alongside managing data collections, or conduct easy firmware upgrades.

The G9 features fast start-up and signal re-acquisition times, heading & position updates up to 50 times per second, coupled with onboard high-speed memory storage up to 32 GB. The G9 is a complete Smart Antenna in a single rugged, marine-grade enclosure engineered for the most demanding environment applications.

The model G9 provides world class centimeter level accuracy RTK corrections on precise positioning. The units are tested to perform in multi-faceted open sky applications, with long base lines, and optimal for use in applications such as marine, land, survey, dredging, GIS, engineering, research, scientific, engineering, machine control, agricultural, USVs, and many other specialized situations demanding precise positioning.

It needs only one single power/data cable routing, which greatly simplifies installation or for mobile portable applications, the unit is embedded with a rechargeable 10,200 mAh Li-Ion battery capacity, designed for ease of use for GIS, survey and construction work.

Information in this manual will guide you in adjusting the G9 unit to operate in the best possible configuration which suits your needs.

Installation and Operation

Installation

Please refer to the Warranty Information section of this manual before proceeding with installation of the G9.

Tools Required

General-purpose tools such as a portable drill, pliers, wire cutters, screwdrivers, wire, mounting bolts and wrenches will be required. An accurate voltmeter or multi-meter would also be useful.

Hazard warning!

Extreme caution is advised when using tools powered by alternating current (AC) from main supply circuits, regardless of whether those circuits are rated for "indoor", "outdoor", "marine" or "industrial" use. Water, especially sea water, is an excellent conductor of electricity, and can complete a path to AC Ground through your body, causing injury or death, if a tool malfunctions or short-circuits.

ⓘ Battery powered tools are STRONGLY recommended ⓘ

If AC tools are used, they must be plugged into a circuit that is adequately protected against Ground Faults and other safety hazards, in accordance with local electrical codes.

Power Supply

Unit is powered by the vessel's or vehicle's power supply system and must have an adequate circuit breaker or fuse. Power supply must be in voltage range of 9 to 36 volts DC. It is recommended to connect the unit to power via an on/off switch.

Ensure adequate wire sizes are used to handle the expected maximum currents.

Important: Charge your Li-On battery upon receipt of Shipment

- According to the 2017 IATA Dangerous Goods Regulations and Supplemental IATA Lithium Battery Guidance, batteries must not be charged to less than 30% to meet international air freight requirements.

Environmental Considerations

- Ensure that the G9's Operating & Storage Temperature Ranges are not exceeded (see Specifications in Appendix 1).
- The G9 unit operates in an environment with up to 100% relative humidity. The G9 unit and cable are water resistant – but are ***not*** submersible.

Warnings and Cautions

An absence of specific alerts does not mean that there are no safety risks involved.

A Warning or Caution information is intended to minimize the risk of personal injury and/or damage to the equipment.

WARNING – Warning alerts you to a potential misused or wrong setting of the equipment.

CAUTION – Caution alerts you to possible risk of serious injury to a person and/or damage to equipment.

Regulations and Safety

The receivers contain a built-in wireless modem for signal communication through Bluetooth® wireless technology or through external communication datalink. Regulations regarding the use of the wireless modem vary greatly from country to country. In some countries, the unit can be used without obtaining an end-user license. However, in some countries, the administrative permissions are required. For license information, consult your local dealer. Bluetooth® operates in license-free bands.

Before operating a G9 GNSS receiver, determine if authorization or a license to operate the unit is required in your country. It is the responsibility of the end-user to obtain an operator's permit or license for the receiver for the location or country of use.

Use and Care

This receiver is designed to withstand the rough environment that typically occurs in the field. However, the receiver is high-precision electronic equipment and should be treated with reasonable care.

CAUTION – Operating or storing the receiver outside the specified temperature range will cause irreversible damage.

General GNSS Reception Considerations

GNSS reception considerations must be considered as follows:

- If possible, mount the G9 elevated above all obscuration. Ensure that there is an unobstructed clear view of the sky when the unit is mounted in order to avoid blocking of satellites signals.
- It is important to position the G9 as far away as possible from any metallic or magnetic surfaces which could reflect the GNSS satellites signals.
- Avoid positioning the G9 within a few meters of any RF signal transmitting antennas.

Getting Started with G9

About the Receiver

The G9 GNSS receiver incorporates a GNSS engine, GNSS antenna, internal radio (403 MHz – 473 MHz), 4G cellular modem, Bluetooth, Wi-Fi, and dual-battery in a ruggedized and miniature unit that is easy for you to set up for an all-in-one RTK Rover or mobile Base Station. Bluetooth and Wi-Fi technology provide cable-free communication between the receiver and controller.

The receiver can be used as the part of a RTK GNSS system coupled with COMNAV Data Collection software to download GNSS data recorded in the internal memory of a receiver for forwarding to a computer. To configure the receiver for performing a wide variety of functions, you can use the web interface by connecting the receiver with PC or smartphone via Wi-Fi.

Parts of the Receiver

The operating controls are all located on the front panel. Battery compartment and the SIM card slot are on the rear of the unit. Serial ports and connectors are located on the bottom of the unit.

Front Panel

The figure 1 shows a front view of the G9 GNSS receiver.

Figure 1 – G9 GNSS receiver front panel.

The figure 2 shows the front panel containing the two buttons: the Power button and Function button, and two indicators: Satellite LED and Correction LED.

Figure 2 – G9 GNSS receiver buttons and LED indicators.

The Table 1 summarizes the G9 GNSS receiver buttons and indicators function and operation.

Name	Description
Correction LED (Orange or Green)	• Indicates whether the G9 is transmitting/receiving differential data The Orange LED flashes once per second when the G9 is: ○ configured as a base station and is receiving differential data ○ configured as a rover station and is receiving differential data and the solution is FLOAT • The Green LED flashes once per second when the G9 is configured as a rover station and is receiving differential data and the solution is FIX
Satellite LED (Blue)	• Shows the number of satellites that the receiver has tracked • When the G9 is searching for satellites, the blue LED flashes once every 5 seconds. • When the G9 has tracked *N* satellites, the blue LED will flash *N* times every 5 seconds.
Function button (Yellow)	• When the G9 is recording static data: ○ If the recording rate is larger than 1 s, the LED will flash as the setting rate. ○ If the recording rate is less than 1 s, the LED will flash twice per every second. • If the memory of G9 is full, the Function LED indicator will be ON.

Power button (Green/Red/Orange)	• To power up/shut down the G9: Press and hold the power button for 3 seconds. When turned on the Power button will turn GREEN
	• The green light will flicker when the battery is low
	• If the G9 is turned off and is charging via the 2-pin port:
	  ○ If the power of the internal battery is less than 70%, the power LED (red) will flash once per 2 s.
	  ○ If the power of internal battery is between 70% and 99%, the power LED (red) will flash once per 4 s.
	  ○ If charging is finished, the power LED (red) will be solid.
	  ○ If charging is abnormal, the power LED (red) will flash 4 times every second.
	• To Reset the G9, hold the function button and press the power button five times consecutively

Table 1 - G9 GNSS receiver buttons and indicators function.

G9 GNSS Receiver Ports

The figure 3 shows the bottom view of the G9 GNSS receiver. The Table 2 shows the list of ports and connections to the receiver.

Figure 3 – G9 GNSS receiver bottom view.

Part name	Name	Description
	IO port	• This port is a 7-pin Lemo connector that supports RS-232 communications and external power input (9 VDC to 36 VDC). • Connect the GNSS to PC Data Cable (see Table 3) to receive RS232 communications between the G9 and computer. • The GNSS to PC Data cable can be used to transmit differential data to an external radio.
	USB port	• This port is a mini-USB connector that supports USB communications. • Users can use the USB Cable supplied with the system to download the logged data to a computer.
	Radio antenna connector	1. Connect a UHF radio whip antenna to use the UHF internal radio of the G9. This connector is not used if you are using an external radio. To use the external radio (see IO port)

	Power Connector	• Connect the power adapter (see Table 3) to this port to charge the G9. • The input power rating is 12 V DC
	SIM card	• Insert a nano SIM card

Table 2 – G9 GNSS receiver ports and connections.

Battery and Power:

Internal Battery

The G9 GNSS receiver has an internal rechargeable Lithium-ion battery, which can be charged by the supplied Adaptor.

Charging the Battery

The rechargeable Lithium-ion battery is supplied partially charged. Ensure charging of the battery completely before using it for the first time. To charge the battery, first connect power Adaptor via cable supplied to the specified correct AC power.

WARNING - Charge and use the rechargeable Lithium-ion battery only in strict accordance with the instructions. Charging or using the battery in unauthorized equipment can cause an explosion or fire, and can result in personal injury and/or equipment damage.

To prevent injury or damage:

- Do not charge or use the battery if it appears to be damaged or leaking.
- Charge the Lithium-ion battery only in a COMNAV product that is specified to charge it. Be sure to follow all instructions that are provided with the battery charger.
- Discontinue charging a battery if it gives off extreme heat or a burning odor.
- Use the battery only in COMNAV equipment that is specified to use it.
- Use the battery only for its intended use and according to the instructions in the supplied product documentation.

Battery Safety

WARNING - Do not damage the rechargeable Lithium-ion battery. A damaged battery can cause an explosion or fire, and can result in personal injury and/or property damage. Avoid contact with the rechargeable Lithium-ion battery if it appears to be leaking. Battery fluid is corrosive, and contact with it can result in personal injury and/or property damage.

To prevent injury or damage:

- Do not use or charge the battery if it appears to be damaged. Signs of damage include, but are not limited to, discoloration, warping, and leaking battery fluid.
- Do not expose the battery to fire, high temperature, or direct sunlight.

- Do not immerse the battery in water.
- Do not use or store the battery inside a vehicle under hot weather condition.
- Do not drop or puncture the battery.
- Do not open the battery or short-circuit its contacts.
- If the battery leaks, avoid contact with the battery fluid.
- If battery fluid gets into your eyes, immediately rinses your eyes with clean water and seek medical attention. Please do not rub your eyes!
- If battery fluid gets onto your skin or clothing, immediately use clean water to wash off the battery fluid.

External Power Supply

Two methods are available for providing the external power to the receiver, either by

1.) the G9 Smart Antenna to the 7-pin LEMO connector (PC Data Cable + Power Adaptor), or
2.) the G9 Smart Antenna to the 7-pin LEMO connector (PC Data Cable + short power cable) + external power cable (client or installer supplied) + vessel (or vehicle) battery (12 to 36 VDC).

In the office, indoor or laboratory applications:

The Power Adaptor connects with AC power of 100 - 240V, the output port of the Power Adaptor connects with the Power Port of the GNSS receiver to PC Data Cable.

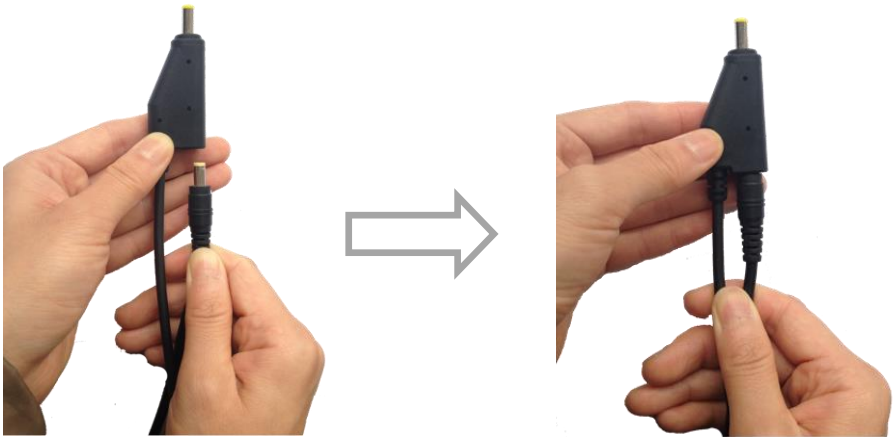


Figure 4 – Illustration of AC power connection to the GNSS to PC data cable.

In the marine application field:

The external power cable connects and terminates with a vessel battery, the output port of the external power cable connects with the Power Port of the GNSS receiver to PC Data Cable.

In the land application field:

The external power cable connects and terminates with a vehicle battery, the output of the external power cable connects with the Power Port of the GNSS receiver to PC Data Cable.

WARNING - Use caution when connecting external power cable's clip leads to a vessel or vehicle battery. Do not allow any metal object to connect (short) the battery's positive (+) terminal to either the negative (-) terminal or the metal part of the vehicle battery. This could result in high current, arcing, and high temperatures, exposing the user to possible injury.

If the unit is powered by the vessel's or vehicle's power supply system, the system must have an adequate in-line circuit breaker or fuse. The Power supply must be in the voltage range of 9 to 36 volts DC. If possible, it is also recommended that the unit be powered via an external on/off switch for possible isolation provisions if required by the system. Ensure adequate wire sizes are used to handle expected maximum currents for respective wire lengths.

Product Basic Supply Accessories

Tables 3 and 4 show the base and rover supply kits respectively.

Base Station Basic Supply Kit

Item	Picture
G9 GNSS Receiver (P/N: 31910004)	
UHF Whip Antenna (410-470 MHz) (P/N: 31910007)	
USB Cable (P/N: 31910008)	
GNSS to PC Data Cable (P/N: 31910009)	
Power Adaptor with Cord (P/N: 31910017 + 31910018)	

H.I. Tape (P/N: 31910014)	
Extension Pole (30 cm) (P/N: 31910016)	
Tribrach with optical plummet (P/N: 31910015)	
Auxiliary H.I. Tool (P/N: 31910019)	
Tribrach Adaptor (P/N: 31910013)	
RS232 to USB Converter (P/N: 31910012)	
External Power cable (P/N: 31910010)	
Transport Hard Case (P/N: 31910011)	

Table 3 – Base station supply kit.

Rover System Basic Supply Kit

Item	Picture
G9 GNSS Receiver (P/N: 31910004)	
UHF Whip Antenna (410-470 MHz) (P/N: 31910007)	
USB Cable (P/N: 31910008)	
GNSS to PC Data Cable (P/N: 31910009)	
Power Adaptor with Cord (P/N: 31910017 + 31910018)	
2M Range Pole w/bag (P/N: 31910039)	
Auxiliary H.I. Tool (P/N: 31910019)	

RS232 to USB Converter (P/N: 31910012)	
External Power cable (P/N: 31910010)	
Transport Hard Case (P/N: 31910011)	

Table 4 – Rover system basic supply kit.

Internal UHF Radio

Based on whether the G9 is configured to act as a base or as a rover, the UHF radio can be used to send or receive GNSS correction data. In order to use the UHF radio inside the G9, the UHF Whip antenna (shown in table 3 or 4) need to be connected to the radio antenna TNC connector (shown in table 2).

4G Cellular Modem

The 4G cellular modem and antenna are embedded inside the G9. Insert a nano SIM card to the SIM card slot (shown in Table 2) and configure the G9 to start sending/receiving cellular data. Obtain a SIM card from a cellular network service provider. See Section *Mobile Network Setting Submenu* for more details on how to setup the SIM card.

Installing the G9 Smart Antenna on a Tribrach

The G9 smart antenna mounting connects to the tribrach by securing the 5/8” female metal mount portion of the G9 to the standard 5/8” male portion of the tribrach adaptor as shown in Figure 5. Upon alignment, hand tighten (with up to 40 in-lbs of torque) to secure the G9 antenna onto the mount in a clock wise rotation.

Figure 5 – Installing the G9 onto a Tribrach.

Installing G9 on a Range Pole

Applications include: GIS, Survey, Agricultural and Engineering applications.

Utilizing a standard 5/8” mount on the bottom of the G9 smart antenna unit, one can secure the unit to a field standard 5/8” range pole as shown in Figure 6. The G9 should be carefully aligned on the range pole, to verify and confirm, cross-threading does not get implemented, while rotating the device in a clockwise direction. Upon alignment, hand tighten (with up to 40 in-lbs of torque) to secure the G9 unit. The Handheld G9H data collector unit is an optional accessory that connects to the G9 and can be used to configure different settings on the G9. Alternatively, the standrad way to connect to the G9 is through a web interface using a computer or a mobile device (See the Section *Configuring Through a Web Browser* for details).

Figure 6 – Shows the G9 and handheld data collector mounted on a range pole.

Powering the G9 On /Off

The G9 receiver has a power on / off keypad on the front panel.

- Power On receiver: Press the key for three seconds
- Power Off receiver: Press the key for three seconds to turn the device off

Connecting to an Office Computer for serial data output

The G9 receiver can be connected to an office computer for serial data transfer (e.g. NMEA 0183) via a GNSS to PC Data Cable as shown in Figure 7. Before you connect to the office computer, ensure that the receiver is powered on by internal battery or external power. Refer to External Power Supply section for details on power connections and termination. The following figure shows standard connection to the computer for serial data transfer:

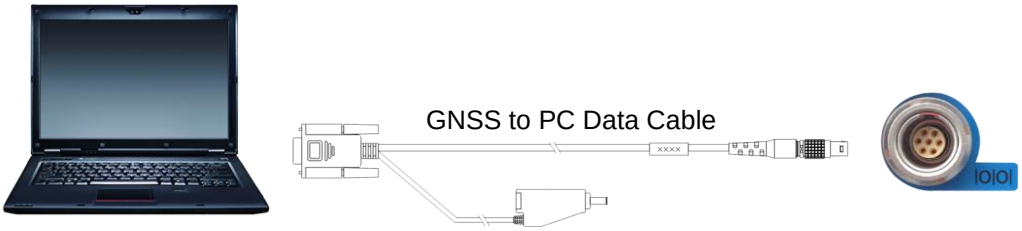


Figure 7 – GNSS to PC data cable connction.

When routing the cable, it is recommended to:

- ⇒ Keep the cable well away from rotating machinery;
- ⇒ Avoid running the cable in areas of excessive heat;
- ⇒ Keep the cable away from corrosive chemicals;
- ⇒ Do not run the cable through door or window jams;
- ⇒ Do not excessively bend, or crimp, the cable;
- ⇒ Avoid running the cables in close proximity to areas known to be of high electromagnetic emissions;
- ⇒ Secure the cable along the route using plastic tie wraps as necessary.

Cables & Extensions

Cable can be routed into a customized break-out box with internal terminal strips, or use soldered or crimped, with marine-grade and standards, utilizing wire-to-wire connection techniques. If the cable end is un-terminated or without a keyed/locking connector, the conductor will require field stripping and tinning for termination.

Communication port pinout

G9 Receiver IO Port (7-pin Lemo Port) Definition

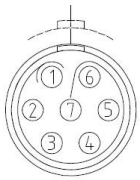


Figure 8 – G9 receiver IO port.

PIN	FUNCTION
1	Ground (-)
2	Ground (-)
3	RS232-TX (Output)

4	PPS
5	Not Used
6	VIN
7	RS232-RX (Input)

Table 5 - Cable Colour Code.

Signal Grounds

Whether or not to connect the G9's Signal Ground to the Signal Ground (or the Main or Power Ground, if there is no Signal Ground) of the other device or devices on your vessel or vehicle depends on how your vessel or vehicle, and any other equipment, is wired.

- ⇒ RS-422: per the NMEA 0183 Standard, the Listener will have optically (or galvanically) isolated RS-422 inputs; thus, it is usually not strictly necessary – and sometimes it is not even possible – to connect the Grounds.
- ⇒ RS-232: the G9's RS-232 Signal Ground ***MUST*** be connected to the other device's Signal Ground, when using the RS-232 ports.
- ⇒ On the other hand, it is sometimes better – from the perspective of signal integrity and/or electrical noise-reduction – to connect some or all of the Grounds in a system.

Consult your ComNav Dealer electronic technician for help, if you are unsure what will work best on your vessel or vehicle.

Serial Port Settings

Ports using ordinary asynchronous serial data formatting, as specified in the NMEA 0183 Standard; the formatting is fixed, and can not be changed:

- ⇒ 1 Start Bit, 8 Data bits, No Parity Bit & 1 Stop Bit (commonly described as "8-N-1").

The baud rates of the G9's serial ports must be the same as the device(s) to which they are connected. The baud rates can be selected and configured accordingly.

Downloading Logged Data

Data logging involves the collection of GNSS measurement data over a period at a static point or points, and subsequent post-processing of the information to accurately compute baseline information. Data logging using receivers requires access to suitable GNSS post-processing software such as the COMNAV Geomatics Office (CGO) Software.

The procedures of downloading logged data in the receiver are as follows:

(1) Switch on the G9 receiver and connect it with a computer via a USB Cable (see Table 2). After the successful connection, a removable disk named as the Serial Number (SN) of the receiver will appear on the computer.

(2) Double click the removable disk and you will see the folder named as “repo”. Double click this folder, you will see 9 folders. The “push_log” folder is used to save the log files, and the other 8 folders represent different logging session and are used for store static data.

(3) Double click the folder that you have configured to store the static data, you will see the folder(s) created by the G9 system automatically and named by the date which is decide by GPS time when you start to log data.

(4) Select the destination folder and double click it, and then two folders named as different data format (hcn and rinex) will be displayed.

(5) Select the data format that you has configured to save the static data, you will find the static raw data.

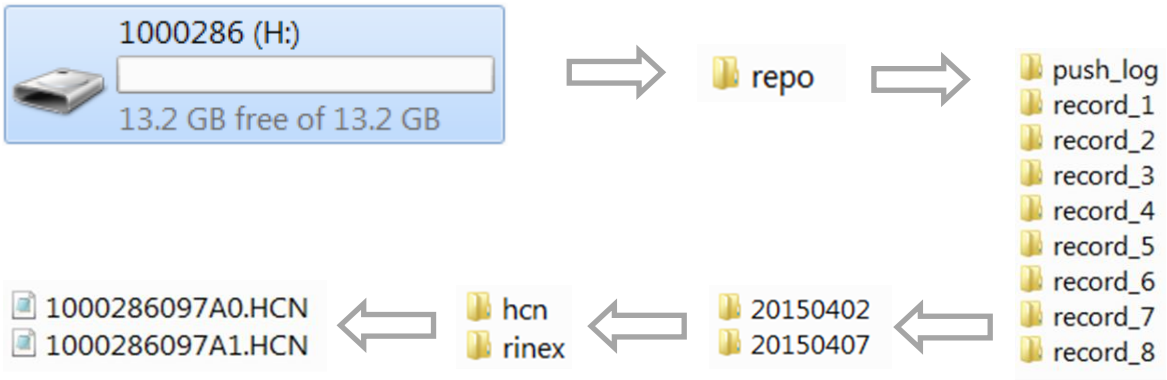


Figure 9 – Saved files directory.

Tip – For hcn files, the name of the file is represented as XXXXXXDDDNN, where XXXXXX is the SN of the receiver, DDD is day of year, and NN is the recording session.

WARNING – The static data will be saved in the first logging session, the “record_1” folder, by default. Old files will be deleted if the storage space is full. If you configure not to auto delete old files when the memory is low, the receiver will stop data logging.

Base Station Setup and Operation

Real-Time Kinematic (RTK) operation provides centimeter-level precision by eliminating errors that are present in the GNSS system. For all RTK operations, you require both a rover receiver and a source of corrections from a base station or network of base stations.

A base station consists of a receiver that is placed at a known point. The receiver tracks the same satellites that are being tracked by the rover receiver simultaneously. Errors in the GNSS system are monitored at the base station, and a series of position corrections are computed. The messages are sent through a radio link to the rover receiver, where they are used to correct the real time positions of the rover.

This chapter provides the information to help you identify good setup locations, outlines basic precautions that you need to take to protect the equipment, and describes the conventional process to set up the base station and the configuring procedure that required for transmitting correction data.

Base Station Setup Guidelines

For good performance, the following base station setup guidelines are recommended:

- Place the GNSS receiver in a location on the worksite where equal range in all directions provides full coverage of the site.
- Place the GNSS antenna in a location that has a clear line of sight to the sky in all directions. Do not place the antenna near vertical obstructions such as buildings, deep cuttings, site vehicles, towers, or tree canopy.
- The GNSS antenna must have a clear line of sight to the sky at all times during operation.
- Place the GNSS and radio antennas as high as practical. This minimizes multipath from the surrounding area, and enables the radio to broadcast to the maximum distance.
- Choose the most appropriate radio antenna for the size of the worksite. The higher the gain on the antenna, the longer the range.
- Make sure that the GNSS receiver does not lose power. To operate continuously for more than a few hours without loss of power at the base station, provide external power. When you use an external power supply, the integrated battery provides a backup power supply, enabling you to maintain continuous operation through a mains power failure.
- Do not locate a GNSS receiver, GNSS antenna, or radio antenna within 400 meters (about 1,300 feet) of transmitters, such as a power radar or cellular communications tower.
- Do not set up the base station close to the sources of electromagnetic interference, include alternators and generators, electric motors, equipment with DC-to-AC converters, etc.
- Do not operate the receiver outside the specified operating temperature range -40°C to +60°C (-40°F to +140°F).
- Take reasonable care to keep the GNSS receiver equipment dry, which could prolong their life and reduce the effects of corrosion on ports and connectors.

Base Station Modes of Operation

The Table 6 below summarizes the different mode that the G9 can operate in as a base station.

Requirement/mode	Cellular Network	Internal UHF	External UHF
Hardware	Insert SIM card to the G9	Connect a UHF whip Antenna to TNC antenna adapter of G9	Connect the *PC to data Cable* to external datalink and to G9 external UHF antenna

Table 6 – Base station mode operations.

For good performance, the following base station setup guidelines are recommended:
Components:

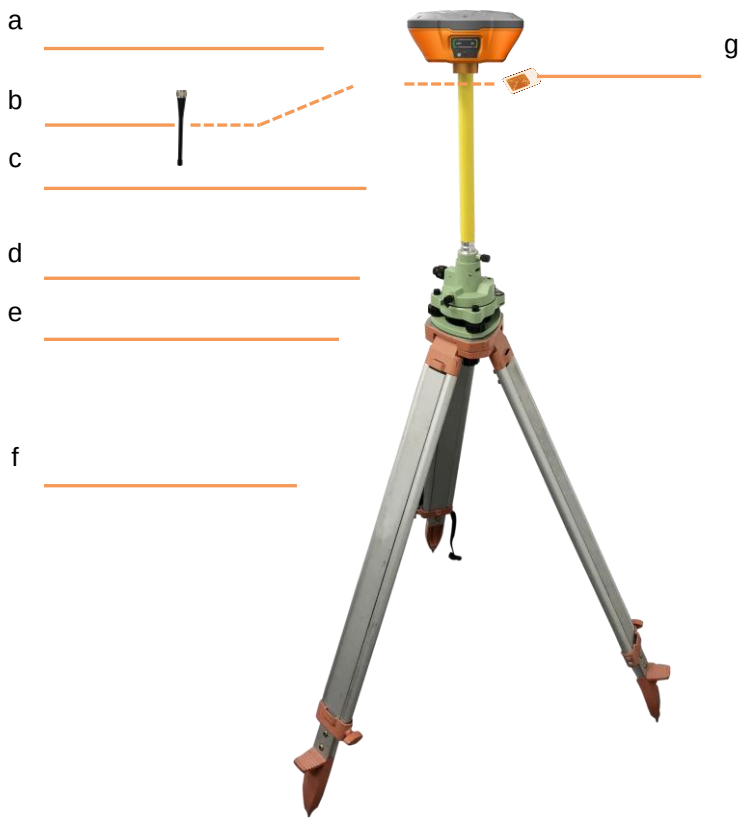


Figure 10 – Base station setup.

No	Name
a	G9 GNSS receiver

b	UHF whip antenna
c	Extension pole (30 cm)
d	Tribrach adaptor
e	Tribrach w/ Opti
f	Aluminum tripod
g	Nano SIM card (12.3mm × 8.8 mm)

Table 7 – Base station setup components.

Steps:

(1) Put tripod in the target position, center and level it roughly.
(2) Place and lock the tribrach in the tripod.
(3) **If work as a cellular base station**, the SIM card need to be inserted.
(4) Screw the receiver onto the tribrach.
(5) Center and level the receiver more precisely.
(6) **If work as a UHF base station**, the UHF whip antenna need to be connected to the receiver.
(7) Connect the receiver to external battery by using external power cable if necessary.
(8) Connect the receiver to external storage disk by using USB cable if necessary.
(9) Turn on the receiver by pressing the power button for 3 s.
(10) Measure the antenna height by using H.I. tape and auxiliary H.I. tool.
(11) Switch on the data controller and connect it to the receiver.
(12) Use software to configure the receiver as cellular base or UHF base mode.

External UHF

For good performance, the following base station setup guidelines are recommended:

Components:

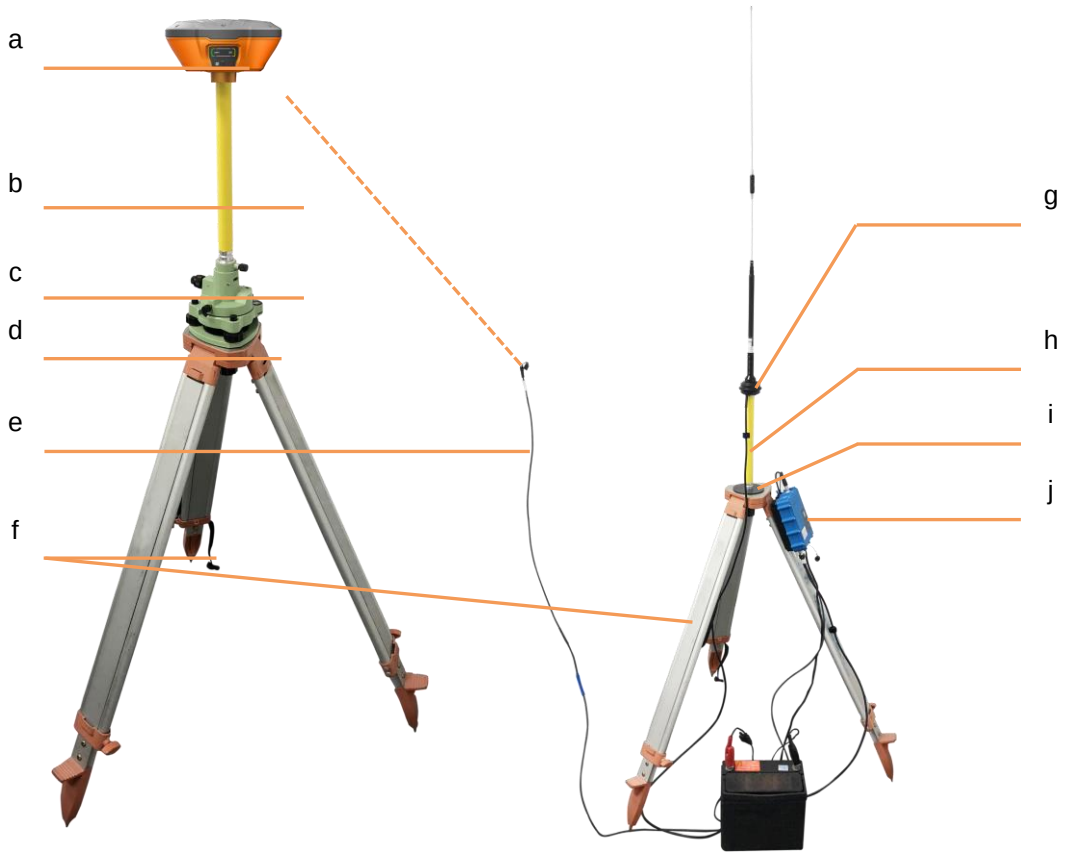


Figure 11 – Base station with external UHF antenna setup.

No	Name
a	G9 Geodetic GNSS receiver
b	Extension pole (30 cm)
c	Tribrach adaptor
d	Tribrach w/ Opti
e	GNSS to datalink cable (power cable)
f	Aluminum tripod
g	Datalink antenna mounting pole

h	3 m cable for datalink antenna
i	Pole mounting
j	External UHF datalink

Table 8 – Base station setup for external antenna.

Steps:

(1) Put tripod in the target position, center and level it roughly.
(2) Place and lock the tribrach in the tripod.
(3) Screw the receiver onto the tribrach.
(4) Center and level the receiver more precisely.
(5) Connect the receiver to external datalink by using GNSS to datalink cable.
(6) Hang the external datalink on the tripod leg.
(7) Connect the receiver to external battery by using external power cable if necessary.
(8) Connect the receiver to external storage disk by using USB cable if necessary.
(9) Turn on the receiver by pressing the power button for 3 s.
(10) Measure the antenna height by using H.I. tape and auxiliary H.I. tool.
(11) Turn on the external datalink and configure it as need.

If work with a data controller:

(12) Switch on the data controller and connect it to the receiver.
(13) Use software to configure the receiver as cellular base or UHF base mode.

CAUTION – The Datalink Antenna must be connected to the Datalink before the Datalink is powered on; otherwise, the Datalink can be damaged.

Rover Station Setup and Operation

Real-Time Kinematic (RTK) operation provides centimeter-level precision by eliminating errors that are present in the GNSS system. For all RTK operations, you require both a rover receiver and a source of corrections from a base station or network of base stations.

The second part of the RTK GNSS system is the rover receiver. The rover receiver is moved between the points that require measurement or stakeout. The rover receiver is connected to a base station or to a source of RTK corrections such as a CORS (Continuous Operational Reference System) or the COMNAV APIS service. The connection is provided by:

- an integrated radio
- an integrated cellular modem
- a cellular modem in the controller

This chapter provides the information to help you identify good setup locations, describes the conventional process to set up the rover station and the configuring procedure that required for receiving correction data.

Rover Station Setup Guidelines

For good rover operation, observe the following setup guidelines:

- Place the GNSS antenna in a location that has a clear line of sight to the sky in all directions. Do not place the antenna near vertical obstructions such as buildings, deep cuttings, site vehicles, towers, or tree canopy. GNSS rovers and the base station receive the same satellite signals from the same satellites. The system needs five common satellites to provide RTK positioning.

WARNING – Take care not to touch overhead power lines with the COMNAV G9 GNSS receiver or the range pole when moving the equipment into position. Touching overhead power lines may cause electrocution, leading to serious injury.

- GNSS satellites are constantly moving. Because you cannot measure at a specific location now does not mean that you will not be able to measure these later, when satellite coverage at the location improves.
- To get a fixed position solution with centimeter precision, initialize the RTK rover receiver. For initialization to take place, the receiver must track at least five satellites that the base station is also tracking. In a dual-satellite constellation operation, for example, GPS and GLONASS, the receiver must track at least six satellites.
- To continue to survey at centimeter precisions, the rover must continuously track at least four satellites that the base station is also tracking. The radio link between the base and rover receivers must also be maintained.
- Loss of the satellite signals will result in a loss of centimeter position precision.

Rover Modes of Operation

The Table 9 below summarizes the different mode that the G9 can operate in as a rover station.

Requirement/mode	Cellular Network	Internal UHF
Hardware	Insert SIM card to the G9	Connect a UHF whip Antenna to TNC antenna adapter of G9

Table 9 – Rover mode operations.

Rover Station Setup

The Table 10 below summarizes the components to set the G9 as a rover.

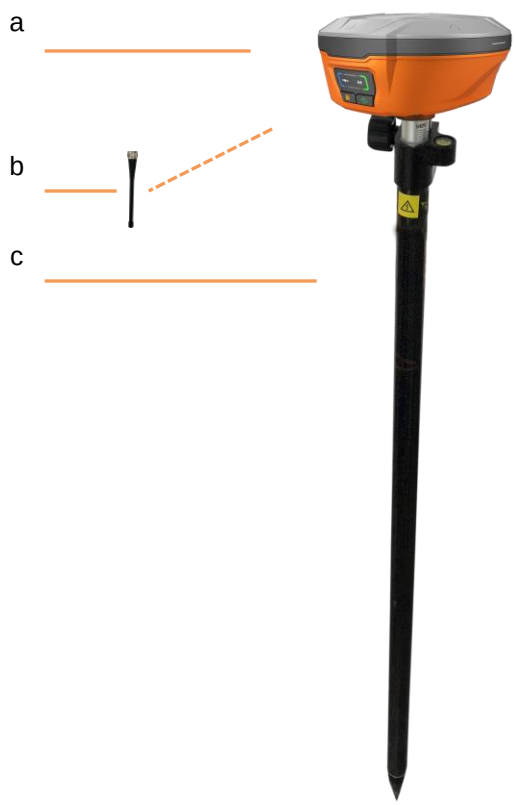


Figure 12 – Rover setup.

No	Name
a	G9 Geodetic GNSS receiver

b	UHF whip antenna
c	2M range pole w/ bag

Table 10 – Rover station setup components.

Steps:

(1) **If work as a cellular rover station**, the SIM card need to be inserted.
(2) Screw the receiver onto the pole.
(3) **If work as a UHF rover station**, the UHF whip antenna need to be connected to the receiver.
(4) Turn on the receiver by pressing the power button for 3 s.
(5) Switch on the data controller and connect it to the receiver.
(6) Use software to configure the receiver as cellular rover or UHF rover mode.
(7) Center and level the receiver more precisely.
(8) Use software to start survey.

Configuring Through a Web Browser

This chapter describes the operation for setting up the G9 receiver using the web interface. This includes configuring the receiver work mode, data output setup as well other settings.

Please make sure the receiver is powered on and running normally before modifying the settings.

Supported browsers:

- Google Chrome
- Microsoft Internet Explorer® version 10, or higher

1. Turn on the G9 GNSS receiver. By default the WiFi is turned on.
2. Search the wireless network named as GNSS-XXXXXXX (the SN of your receiver) on your computer, and then establish the connection.
3. After the successful connection between your computer and the receiver, enter the IP address of the receiver into the address bar of the web browser on your computer:

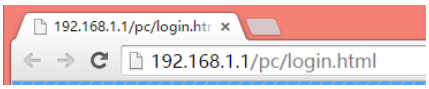


Figure 13 – Login using Web.

4. The web browser prompts you to enter a login account and password:

Figure 14 – Login details.

The default login account for the receiver is:

- Login Account: admin
- Password: password

Note – Tick **remember me** option, and then the browser will remember the Login Account and Password you entered for the next time you enter this login screen.

5. Once you are logged in, the web page appears as follows:

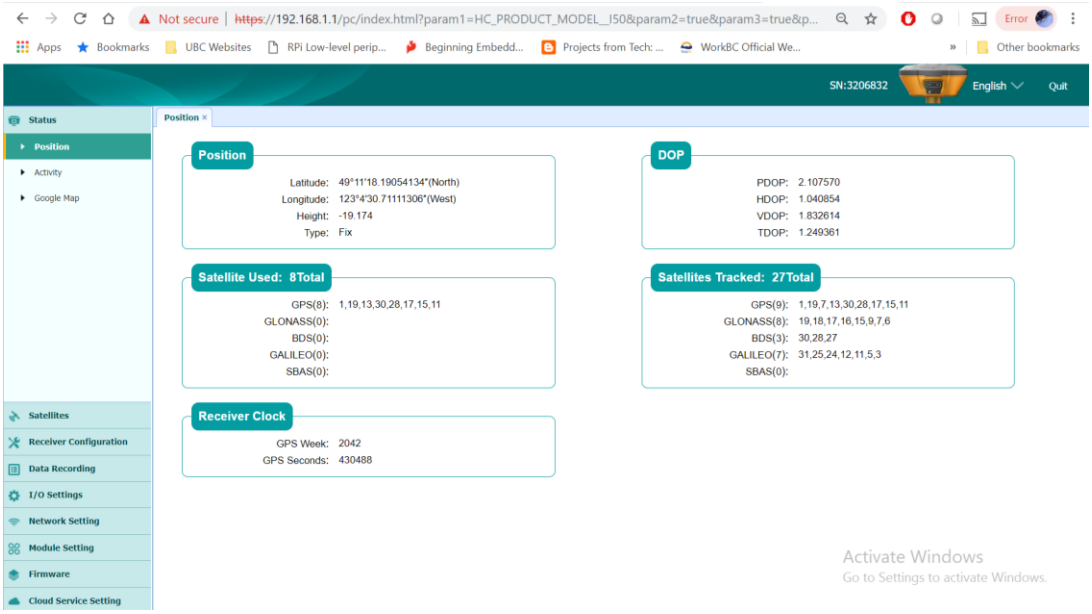


Figure 15 – G9 position solution details.

This web page shows the configuration menus on the left of the browser window, and the setting on the right. Each configuration menu contains the related submenus to configure the receiver and monitor receiver performance.

This chapter describes each configuration menu.

To view the web page in another language, select the corresponding language name from the dropdown list on the upper right corner of the web page.

Currently, three languages are available:

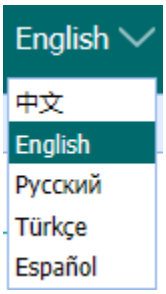


Figure 16 – Language settings.

Status Menu

This menu provides a quick link to review the receiver's position information, satellites tracked, runtime, current data log status, current outputs, available memory, and more.

Figure 17 – Status menu.

Position Submenu

This page shows the relevant position information about the receiver's position solution which including the position, DOP values, satellites used and tracked, and the receiver clock information.

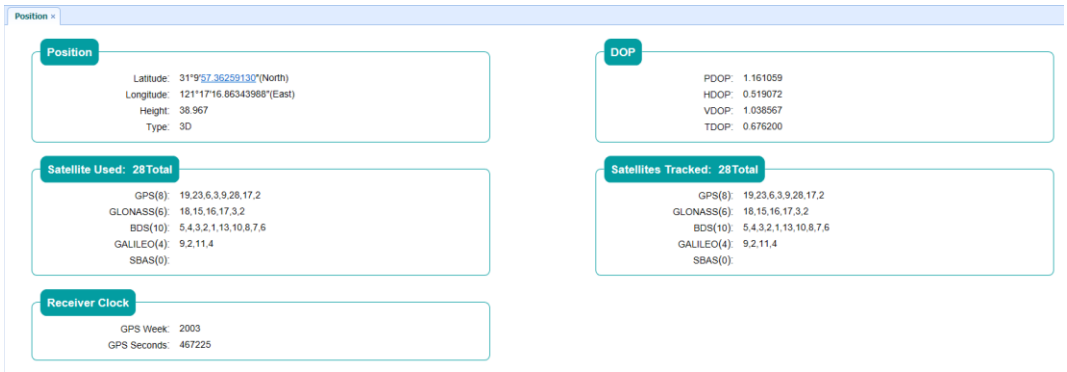


Figure 18 – Position submenu.

Activity Submenu

Lists several important items to help you understand how the receiver is being used and its current operating condition. Items include the identities of currently tracked satellites, internal and external storage usage rate, how long the receiver has been operational, state of the internal battery, power source state, files being logged, and data streams being output. With this information, it is easy to tell exactly what functions the receiver is performing:

Recording Number	File Name	Activated	Log Status
1	record1	Yes	Recording
2	record2	No	Not Recording
3	record3	No	Not Recording
4	record4	No	Not Recording
5	record5	No	Not Recording
6	record6	No	Not Recording
7	record7	No	Not Recording
8	record8	No	Not Recording

	Type	Description	Output
1	RTK Client	211.144.118.5:2102	---
2	TCP/UDP_Client1/NTRIP Server1	192.168.3.18:9900	---
3	TCP/UDP_Client2/NTRIP Server2	192.168.3.18:9901	---
4	TCP/UDP_Client3/NTRIP Server3	192.168.3.18:9902	---
5	TCP/UDP_Client4/NTRIP Server4	192.168.3.18:9903	---
6	TCP/UDP_Client5/NTRIP Server5	192.168.3.18:9904	---
7	TCP/UDP_Client6/NTRIP Server6	192.168.3.18:9905	---
8	TCP Server/NTRIP Caster1	9901	---
9	TCP Server/NTRIP Caster2	9902	---
10	TCP Server/NTRIP Caster3	9903	---
11	TCP Server/NTRIP Caster4	9904	---
12	Serial Port	9600	---
13	Bluetooth	GNSS-3200193	---
14	Radio	460.0500MHz	---

Figure 19 – Activity submenu.

Google Map Submenu

Tap this submenu to show the location of the receiver on Google map.

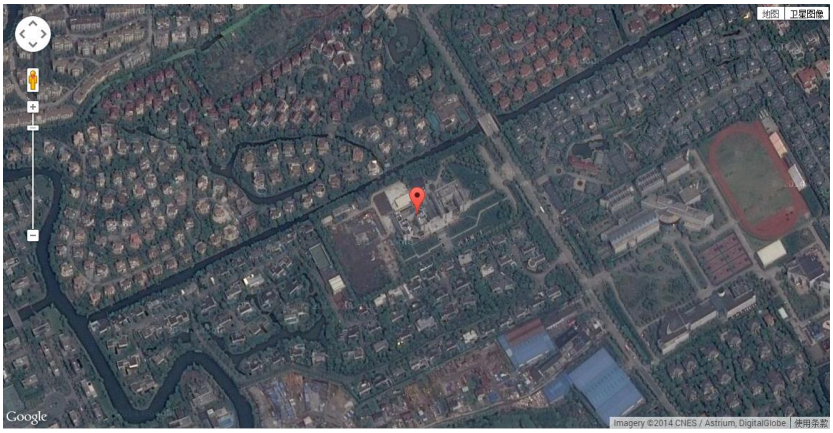


Figure 20 – Google map location.

Satellites Menu

Use the Satellites menu to view satellite tracking details and enable/disable GPS, SBAS, GLONASS, BDS and Galileo constellations. These menus include tabular and graphical displays to provide all required information on satellite tracking status.

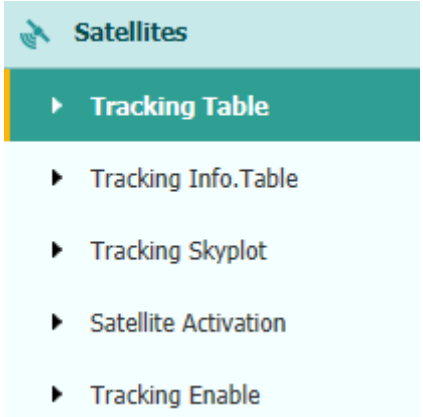


Figure 21 – Satellites menu.

Tracking Table Submenu

Provides the status of satellites tracked in general, such as the satellite ID, satellite type, attitude angle, azimuth angle, L1 SNR, L2 SNR, L5 SNR and enable/disable status of each one.

Tracking Table

6	GPS	53	304	42.000	32.000	33.000	Yes
3	GPS	26	42	31.000	0.000	0.000	Yes
9	GPS	21	128	39.000	29.000	30.000	Yes
28	GPS	35	179	45.000	34.000	0.000	Yes
17	GPS	70	31	46.000	34.000	0.000	Yes
2	GPS	20	272	36.000	26.000	0.000	Yes
18	GLONASS	40	340	21.000	0.000	0.000	Yes
15	GLONASS	10	212	33.000	0.000	0.000	Yes
16	GLONASS	24	273	22.000	0.000	0.000	Yes
17	GLONASS	41	53	37.000	40.000	0.000	Yes
3	GLONASS	50	148	45.000	46.000	0.000	Yes
2	GLONASS	46	56	31.000	0.000	0.000	Yes
5	BDS	15	255	33.000	38.000	0.000	Yes
4	BDS	35	122	39.000	42.000	0.000	Yes
3	BDS	52	200	40.000	45.000	0.000	Yes
2	BDS	36	236	37.000	43.000	0.000	Yes
1	BDS	48	146	39.000	45.000	0.000	Yes
13	BDS	50	313	38.000	39.000	0.000	Yes
10	BDS	38	225	43.000	43.000	0.000	Yes
8	BDS	58	356	40.000	43.000	0.000	Yes
7	BDS	25	193	42.000	44.000	0.000	Yes
6	BDS	23	169	40.000	44.000	0.000	Yes
9	GALILEO	37	153	41.000	52.000	34.000	Yes
12	GALILEO	15	82	32.000	40.000	38.000	Yes
2	GALILEO	27	287	39.000	46.000	27.000	Yes

Figure 22 – Satellite information.

Tracking Info. Table Submenu

The following figure is an example of satellite track diagram page. Users can determine the satellite types and the corresponding SNR of L-band carriers to be displayed in any combination.

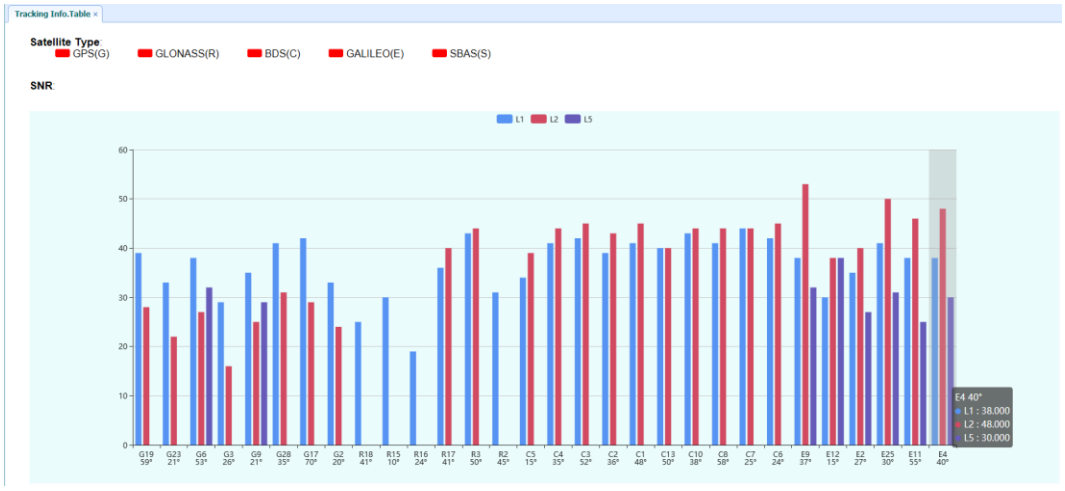


Figure 23 – Chart showing signal strength received from the different Satellites.

Tracking Skyplot Submenu

The following figure is an example of Skyplot page.

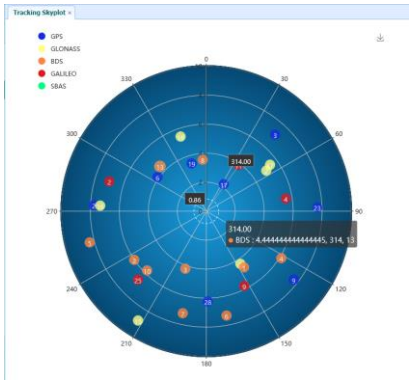


Figure 24 – Satellite Skyplot.

Satellite Activation Submenu

Use this menu to enable or disable satellites.

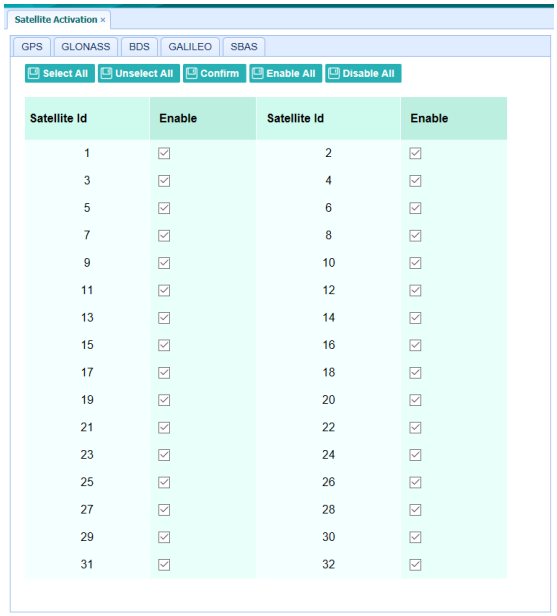
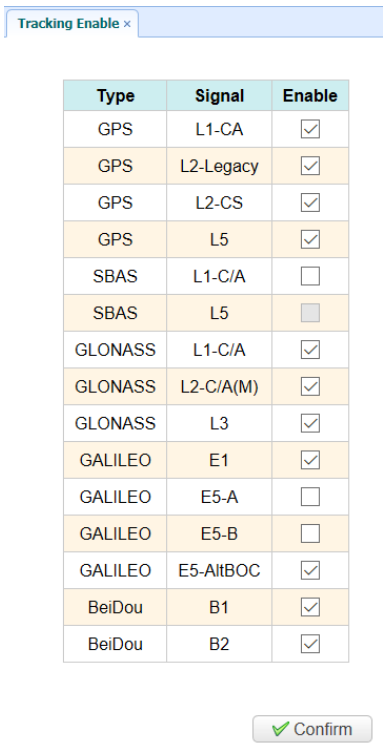


Figure 25 – Satellites to enable/disable.

Tracking Enable Submenu

Use this menu to enable or disable tracking signals.



Type	Signal	Enable
GPS	L1-CA	☑
GPS	L2-Legacy	☑
GPS	L2-CS	☑
GPS	L5	☑
SBAS	L1-C/A	☐
SBAS	L5	☐
GLONASS	L1-C/A	☑
GLONASS	L2-C/A(M)	☑
GLONASS	L3	☑
GALILEO	E1	☑
GALILEO	E5-A	☐
GALILEO	E5-B	☐
GALILEO	E5-AltBOC	☑
BeiDou	B1	☑
BeiDou	B2	☑

Figure 26 – Select satellites to enable and confirm settings.

Receiver Configuration Menu

Use this menu to configure settings such as the antenna type and height, elevation mask and PDOP setting, the reference station coordinates, receiver resetting and web interface language:

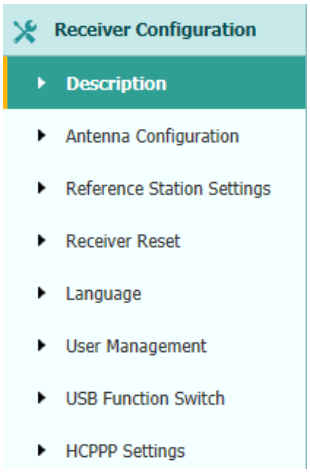


Figure 27 – Receiever configuration menu.

Description

This submenu shows the receiver information and reference station information, including antenna related information, elevation mask angle, reference station work mode and position, etc.

Figure 28 – Receiver information.

Antenna Configuration Submenu

Use this screen to configure all of the items relating to the GNSS antenna. You must enter the correct values for all antenna-related fields, as the choices you make significantly affect the accuracy for logged data and broadcast correction data:

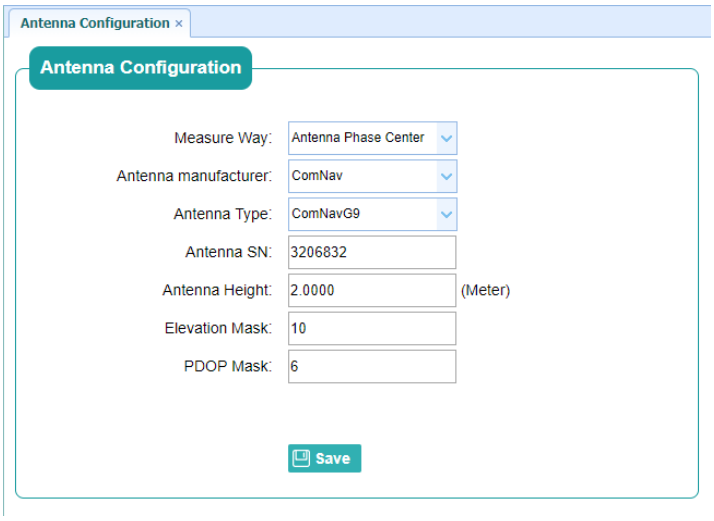


Figure 29 – Antenna configuration.

Reference Station Settings Submenu

Use this screen to configure settings such as the station coordinates and the broadcast station identifiers. You must enter accurate information in these fields, as this data significantly affects the accuracy of logged data files and broadcast correction data:

For **Reference Station Mode**:

There are three modes available:

a) **Auto Rover:** The receiver will serve as a rover after this mode is enabled, and then receive correction data through the working mode set last time.

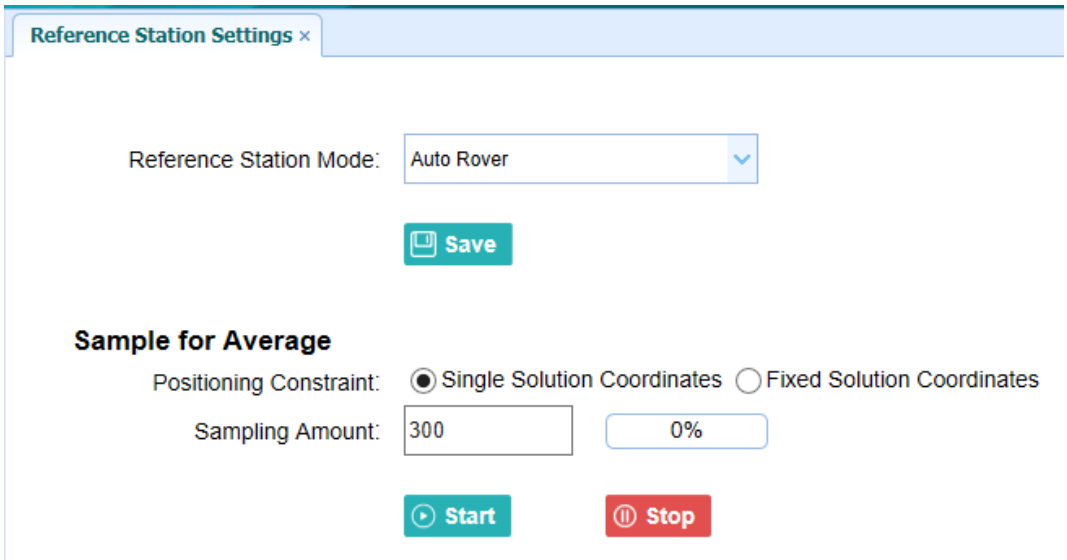


Figure 30 – Reference station mode selection: Auto Rover.

b) **Auto Base:** The receiver will serve as a base after this mode is enabled, and then broadcast correction data based on coordinate inputted by user, or obtained through autonomous positioning automatically.

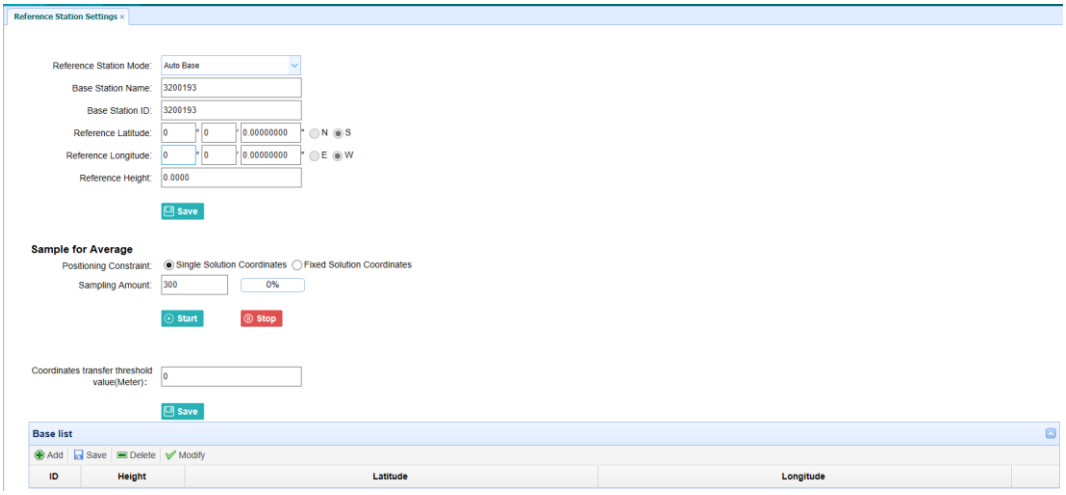


Figure 31 – Reference station mode selection: Auto Base.

c) **Manual Base:** The receiver will serve neither as a base or a rover after this mode is enabled. Users need to configure the receiver manually.

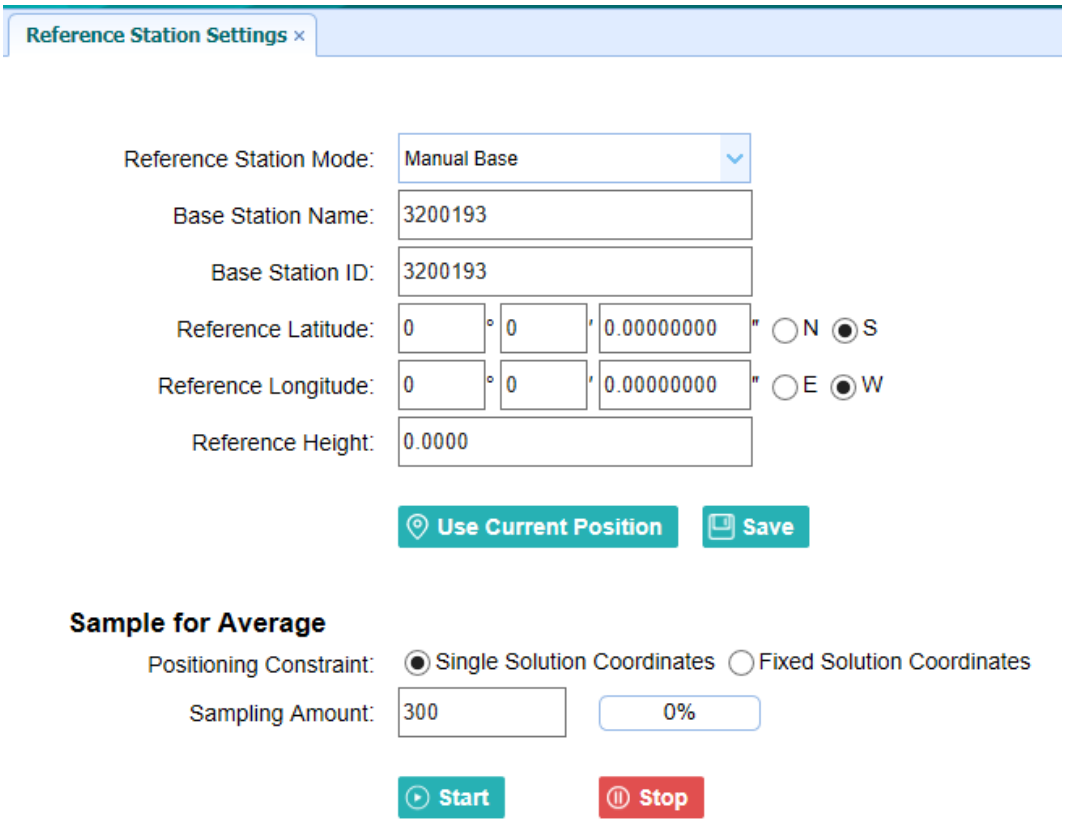


Figure 32 – Reference station mode selection: Manual Base.

For **Reference Latitude** and **Reference Longitude**:
There are mainly three methods to enter the reference coordinates and shown as follows:

a) **Acquire Current Position**: Click this button to acquire current position obtained through autonomous

positioning automatically.

b) **Manual Input**: Manually input the coordinate of a control point.
c) **From CORS**: After the receiver logging in CORS, the software can record the coordinate of current position based on fix solution.

For **Sample for Average**:

Users can determine the positioning limit and sampling amount. The positioning limit falls into two types:

a) **Single Solution Coordinates**: Collect the coordinates of receiver obtained through autonomous positioning.
b) **Fixed Solution Coordinates**: Only collect coordinates of receiver with a fixed solution.

After the configuration of positioning limit and sampling amount, click Start to carry out sampling and averaging → the progress bar will show the progress → the result will be served as the coordinate of current positon.

If users need to save the changes, please tap Save button.

Receiver Reset Submenu

Use this screen to completely or partially reset the receiver:

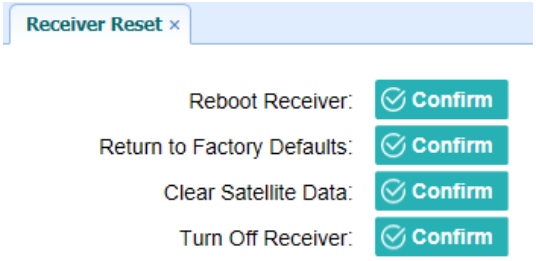


Figure 33 – Receiver reset submenu.

Languages Submenu

Use this screen to select the web interface language:

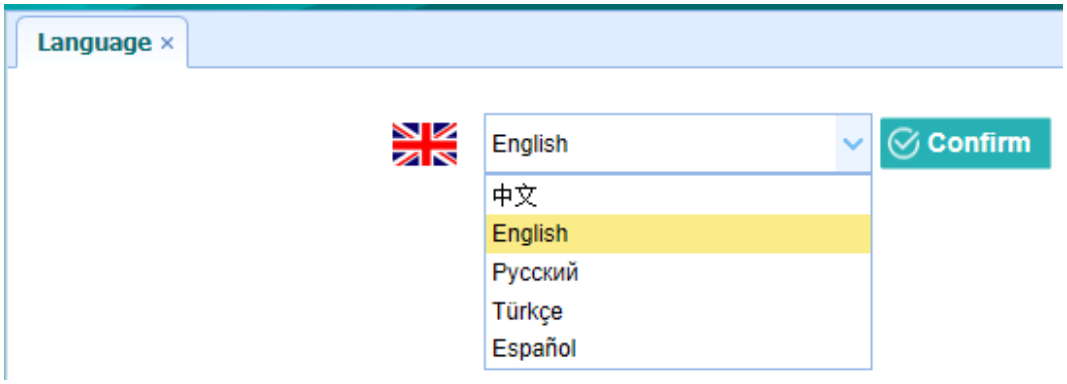


Figure 34 – Language submenu.

User Management Submenu

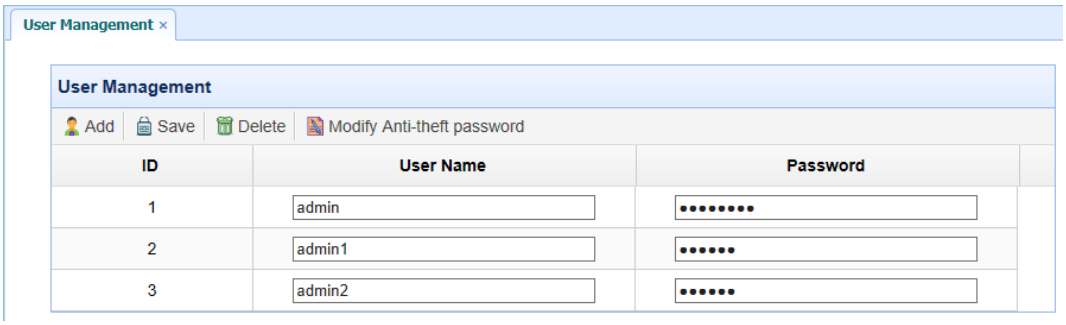


Figure 35 – User management submenu.

USB Function Switch Submenu

Use this menu to switch between USB personal area network and Multimedia storage.

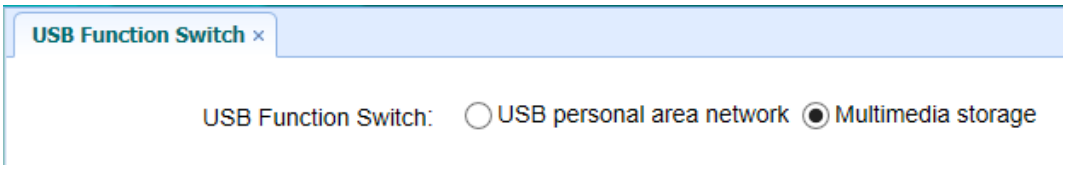


Figure 36 – USB funtion switch.

HCPPP Settings Submenu

Use this menu to select HCPPP Range.

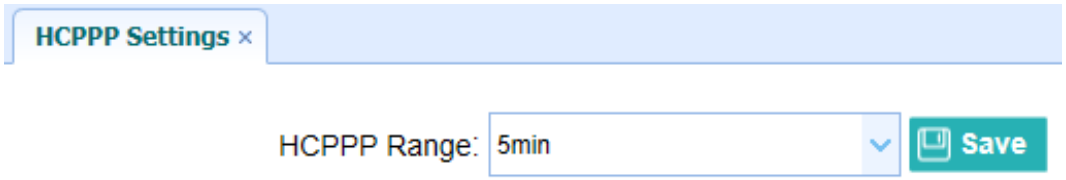


Figure 37 – PPP settings submenu.

Data Recording Menu

Use the Data Logging menu to set up the receiver to log static GNSS data and to view the logging settings. You can configure settings such as observable rate, recording rate, continuous logging limit, and whether to auto delete old files if memory is low. This menu also provides the controls for the FTP push feature:

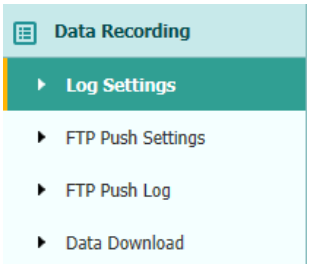


Figure 38 – Data recording menu.

Log Settings Submenu

Here shows the data logging status, including internal and external storage usage and data logging status of each session. Also, users can configure the data logging settings for each session, including recording name, store location, storage limit, store formats, start time, etc.

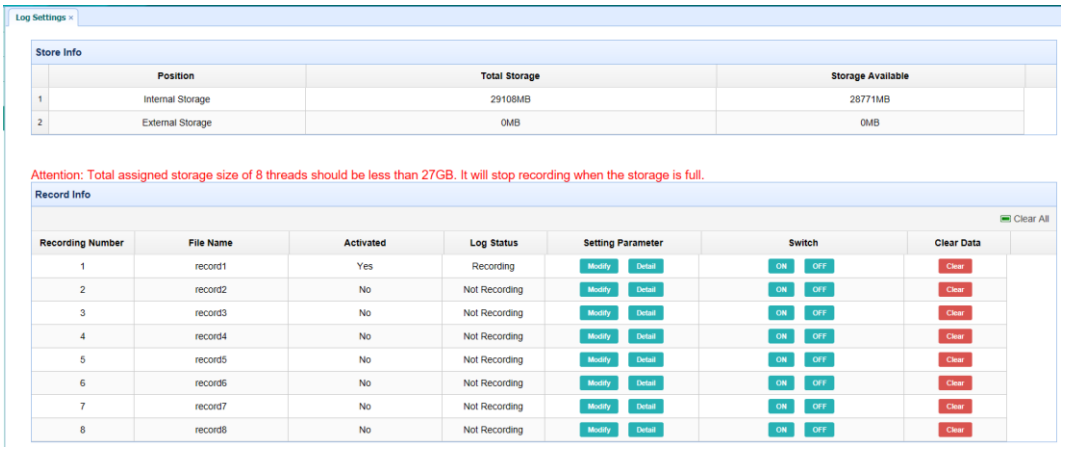


Figure 39 – Log settings menu.

To edit the settings of each session, click the **Modify** button to the right of the required session, and then the *Recording Edit* screen appears:

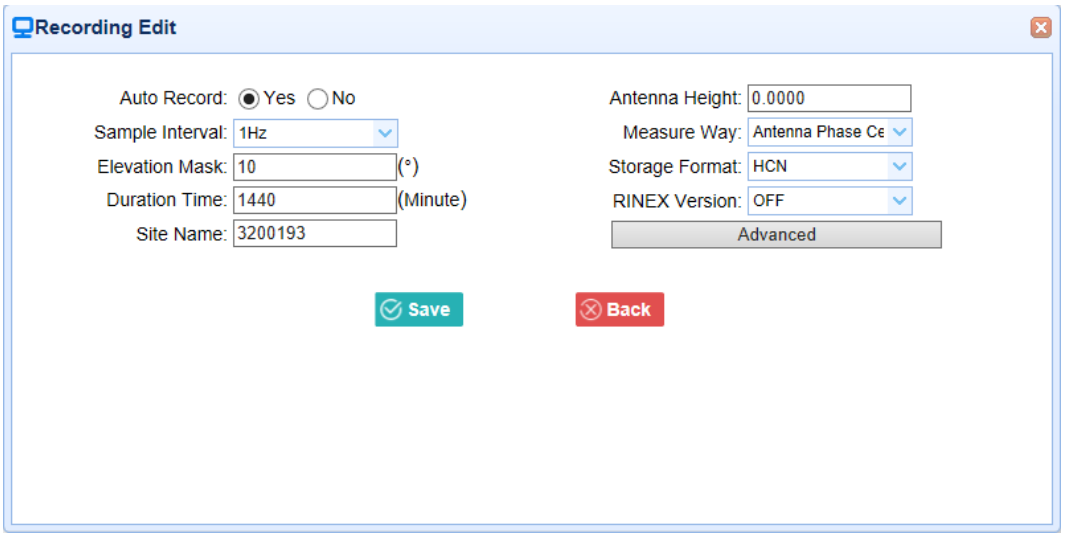


Figure 40 – Recording session options.

Click advanced to see more settings.

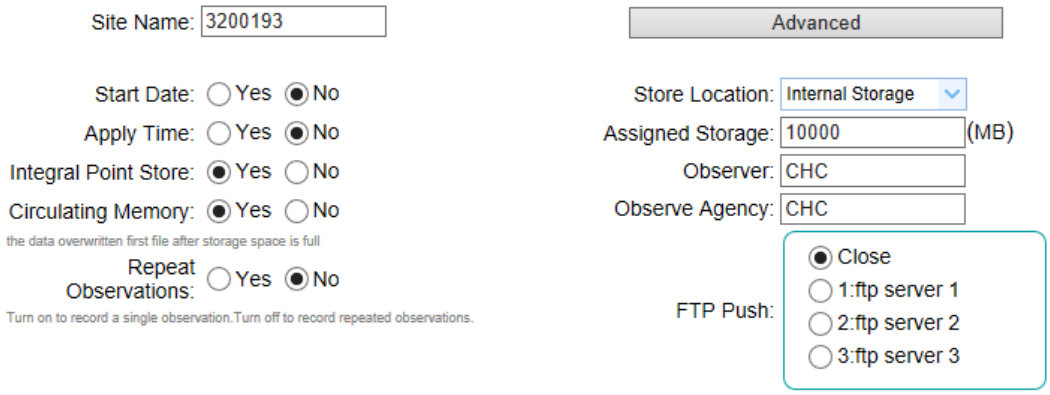


Figure 41 – Advanced recording settings.

In this screen, you can configure all the data logging parameters, and determine whether the recording files will be affected by the FTP Push. The parameters are mainly as follows:

- **File Name**: The name of this logging session.
- **Sample Interval**: Select the observable rate from the dropdown list.
- **Store Location**: Determine whether to store at internal storage or external storage.
- **Enable Start Time**: Set the start time of data logging in UTC. Select **Or not** option below to determine whether to start data logging from the start time defined, or immediately after this session is switched on.
- **Duration Time**: Set the duration of data logging.
- **Assigned Storage**: Set the storage space of this session.
- **Circulating Memory**: Select **Yes** or **No** option to determine whether to auto delete old files if the storage space is full.
- **Data Format**: Set the data format of the logged data.
- **FTP Push**: Decide whether to push the stored files to the FTP server of your choice.

Tap Save button to save the settings and back to the *Log Settings* screen. Also, users can click Back to abandon the changed settings and back to *Log Settings* screen.

Note – To modify data logging parameters, make sure the data logging session is switched off.

To switch on or off **ANY** data logging session, tap the **ON** or **OFF** button to the right of the required session.

To delete the recorded files of **ANY** data logging session, tap the **Clear** button to the right of the required session.

To delete the recorded files of **ALL** data logging sessions, tap the **Clear ALL Accounts** button.

FTP Push Settings Submenu

Use this screen to configure the receiver to push stored files to the FTP server of your choice. Only files that are configured to use FTP push are transmitted.

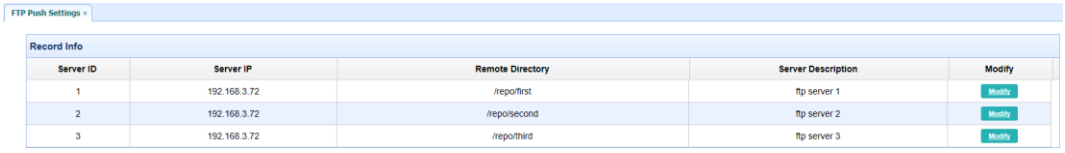


Figure 42 – FTP push submenu.

Tap **Modify** button to the right of the required FTP server and the *FTP Push Settings* screen appears:

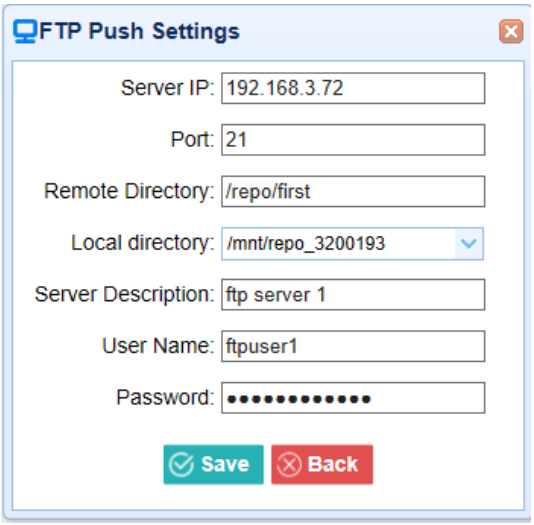


Figure 43 – FTP push settings.

FTP Push Log Submenu

Shows the related information about the recorded filed that be pushed. And users can tap **Clear Ftp Send Log** button in the upper right corner to clear the log of FTP Push operations.

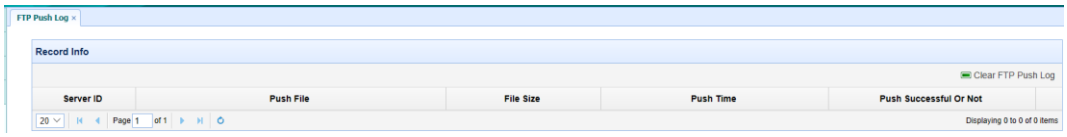


Figure 44 – Clear FTP push.

Data Download Submenu

In this submenu, users can download the data files that got recorded in the internal storage through the internal FTP site.

1. Click this submenu, and then the log on dialogue box will prompt you to enter a user name and password:

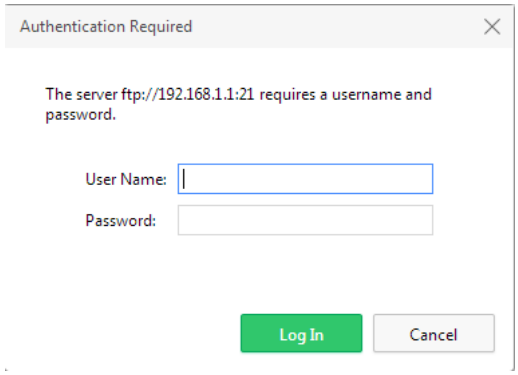


Figure 45 – Data storage access through FTP.

The default logon account for the internal FTP site is:

- User name: ftp
- Password: ftp

2. Click the directory named as “repo” to view and download the files currently stored on the receiver:

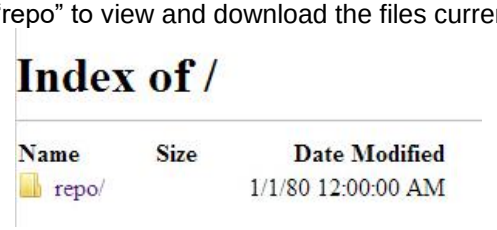


Figure 46 – Saved files in G9.

3. To find the file need to be downloaded, click the name of data logging session → the date of file that be recorded → the format of the file → the name of the target file.

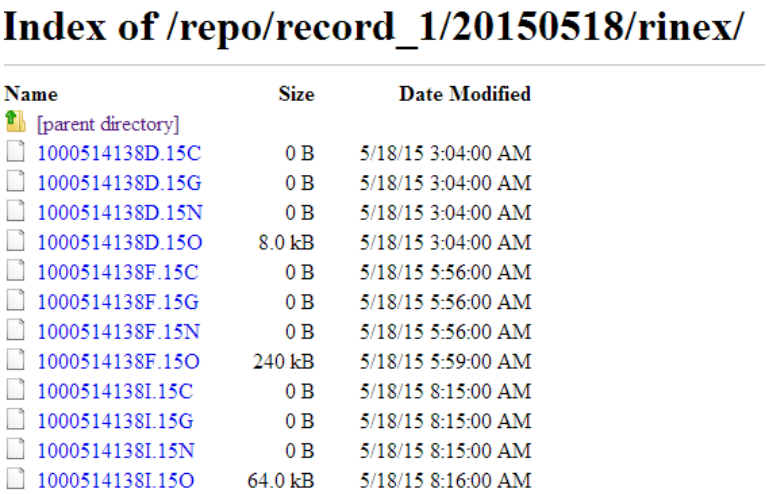


Figure 47 – Files recorded information.

4. To download a file, left-click the name of the target file → download the file according to the prompts.

IO Settings Menu

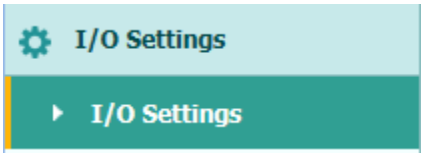
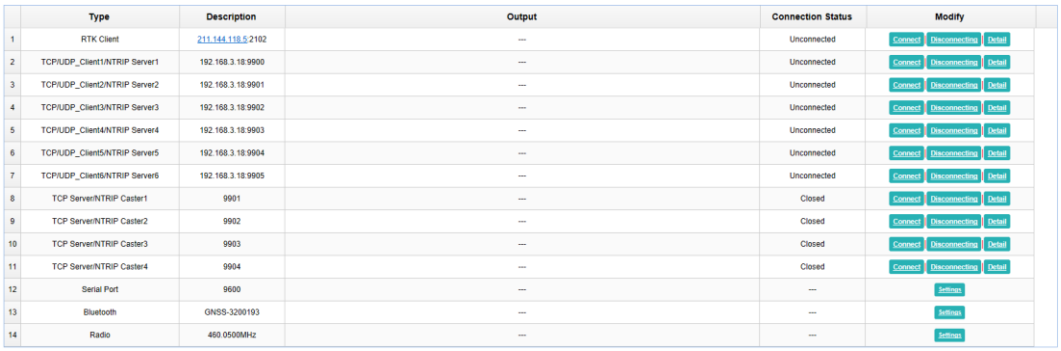


Figure 48 – IO settings for G9.

Use the IO Settings menu to set up all receiver outputs and inputs. The receiver can output CMR, RTCM, Raw data, Ephemeris data, GPGGA, GPGSV, on TCP/IP, UDP, serial port, or Bluetooth ports.

IO Settings Submenu

The following figure shows an example of the screen that appears when you select this submenu.



	Type	Description	Output	Connection Status	Modify
1	RTK Client	211.144.118.5:2102	---	Unconnected	Connect Disconnecting Detail
2	TCP/UDP_Client1/NTRIP Server1	192.168.3.18:9900	---	Unconnected	Connect Disconnecting Detail
3	TCP/UDP_Client2/NTRIP Server2	192.168.3.18:9901	---	Unconnected	Connect Disconnecting Detail
4	TCP/UDP_Client3/NTRIP Server3	192.168.3.18:9902	---	Unconnected	Connect Disconnecting Detail
5	TCP/UDP_Client4/NTRIP Server4	192.168.3.18:9903	---	Unconnected	Connect Disconnecting Detail
6	TCP/UDP_Client5/NTRIP Server5	192.168.3.18:9904	---	Unconnected	Connect Disconnecting Detail
7	TCP/UDP_Client6/NTRIP Server6	192.168.3.18:9905	---	Unconnected	Connect Disconnecting Detail
8	TCP Server/NTRIP Caster1	9901	---	Closed	Connect Disconnecting Detail
9	TCP Server/NTRIP Caster2	9902	---	Closed	Connect Disconnecting Detail
10	TCP Server/NTRIP Caster3	9903	---	Closed	Connect Disconnecting Detail
11	TCP Server/NTRIP Caster4	9904	---	Closed	Connect Disconnecting Detail
12	Serial Port	9600	---	---	Settings
13	Bluetooth	GNSS-3200193	---	---	Settings
14	Radio	460.0500MHz	---	---	Settings

Figure 49 – IO menu showing six different IO settings.

In this submenu, users can configure 6 types of input and output settings.

1. RTK Client
   After configuring the settings of RTK client, users can log on CORS or APIS. Tap the **Connect** button to the right → the *IO Settings* screen will appear → choose one of the connection protocols among the NTRIP, APIS_BASE and APIS_ROVER → configure the related parameters → click Confirm to log on CORS or APIS.
   - Connection Protocol: NTRIP

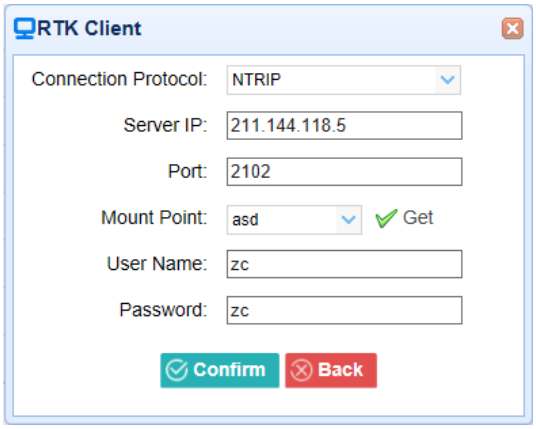


Figure 50 – RTK client setup.

- Connection Protocol: APIS_BASE

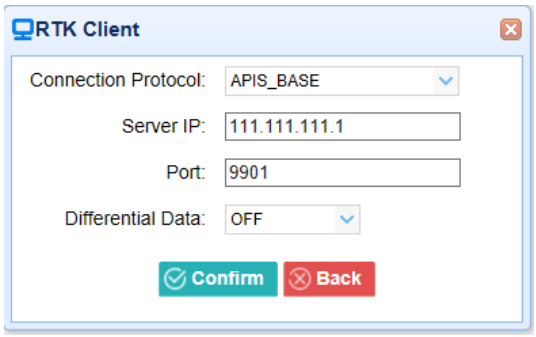


Figure 51 – RTK client - APIS_base mode.

- Connection Protocol: APIS_ROVER

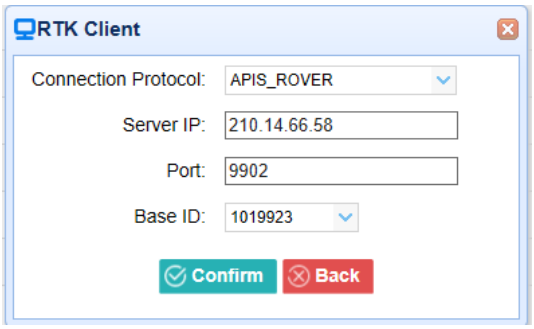


Figure 52 – RTK client - APIS rover mode.

- Connection Protocol: TCP

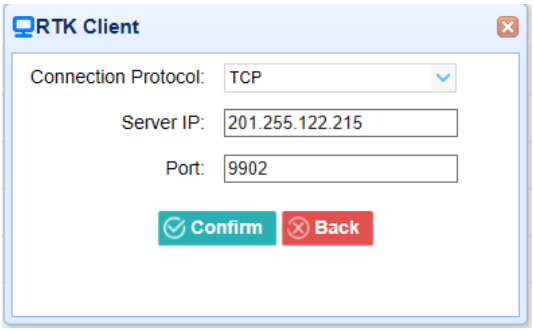


Figure 53 – RTK client TCP mode.

2. TCP/UDP/NTRIP
   Tap the **Connect** button to the right of required TCP/UDP Client → the *IO Settings* screen will appear → select the connection protocol between TCP and UDP → enter the IP and Port of the target server → configure messages that you want to output to the target server → click Confirm to save and complete the connection.
   - Connection Protocol: TCP

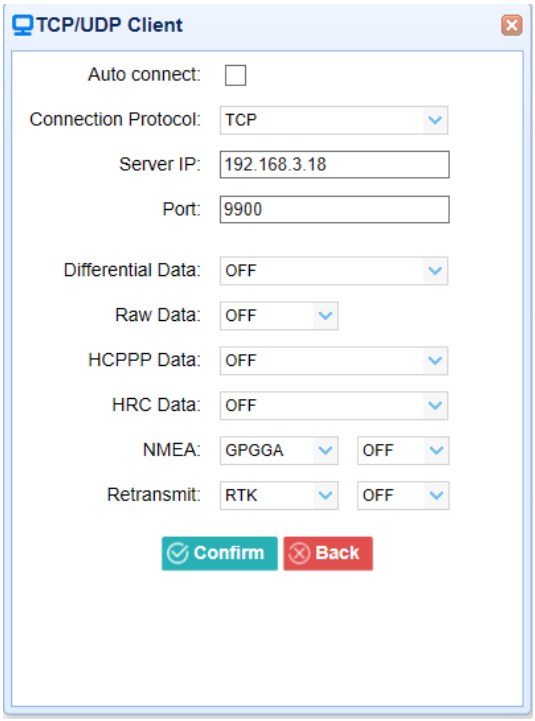


Figure 54 – TCP client setting.

- Connection Protocol: UDP

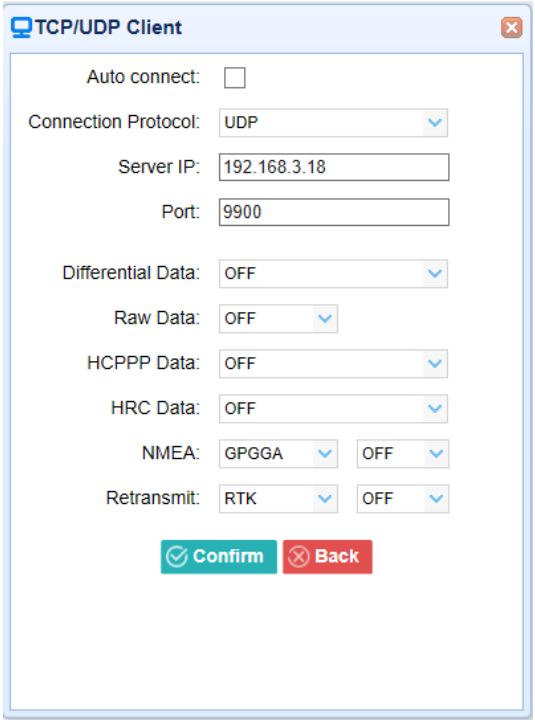


Figure 55 – UDP client setting.

- Connection Protocol: NTRIP1.0

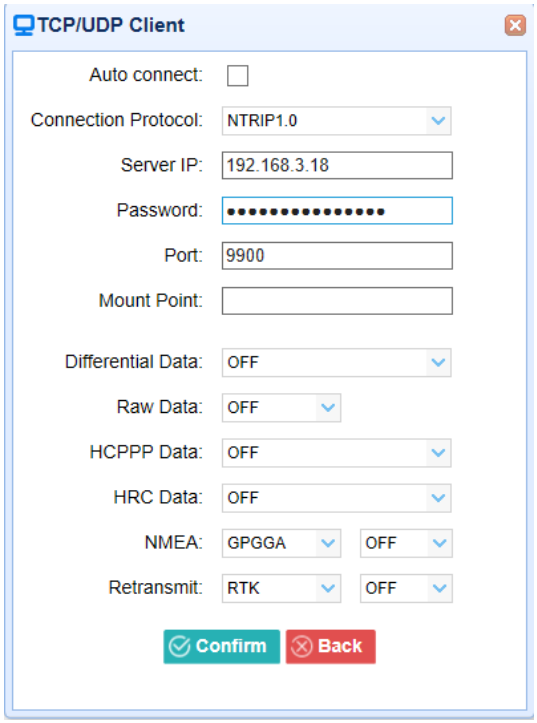


Figure 56 – Ntrip 1.0 server setting.

- Connection Protocol: NTRIP2.0

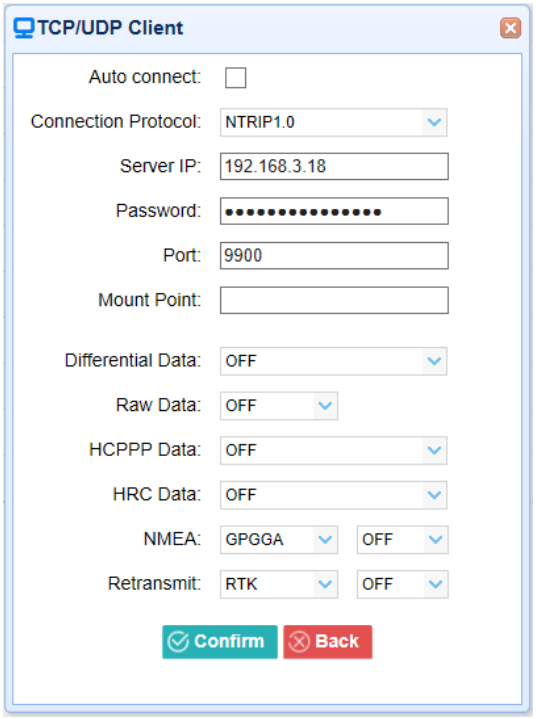


Figure 57 – Ntrip 2.0 server setting.

3. TCP Server/NTRIP Caster
   Tap the **Connect** button to the right of required TCP Server/NTRIP Caster → the **IO Settings** screen will appear → select one of the connection protocols between NTRIP and TCP → configure the other related parameters → click Confirm to save the settings and open the server.
   - Connection Protocol: TCP

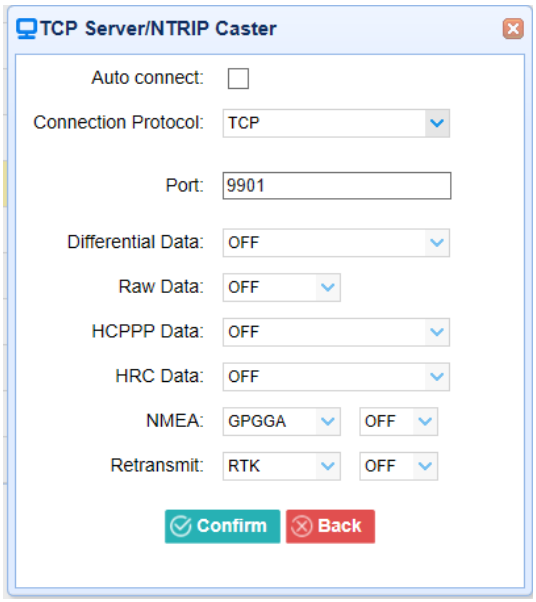


Figure 58 – TCP server settings.

   - Connection Protocol: NTRIP

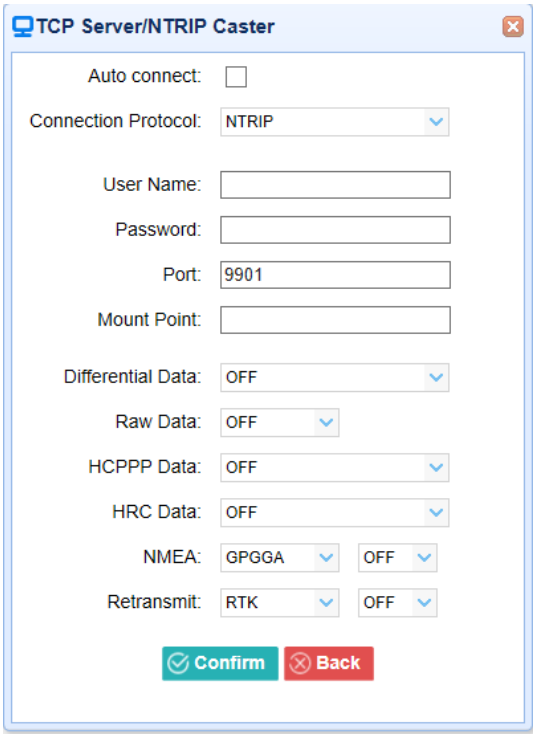


Figure 59 – Ntrip caster settings.

4. Serial Port
   Tap the **Settings** button to the right of Serial Port → the *Serial Port Setup* screen will appear → select Baud Rate used to transmit data → configure the messages that you want to output through the serial port → click Confirm to save the settings and start to transmit.

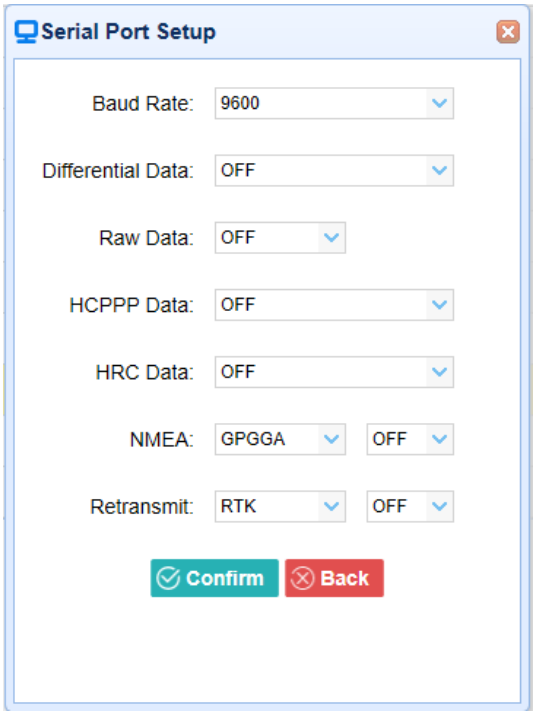


Figure 60 – Serial port setings.

5. Bluetooth
   Tap the **Settings** button to the right of Bluetooth → the *Bluetooth Set* screen will appear → configure the messages that you want to transmit through Bluetooth → click Confirm to save the settings and start to transmit.

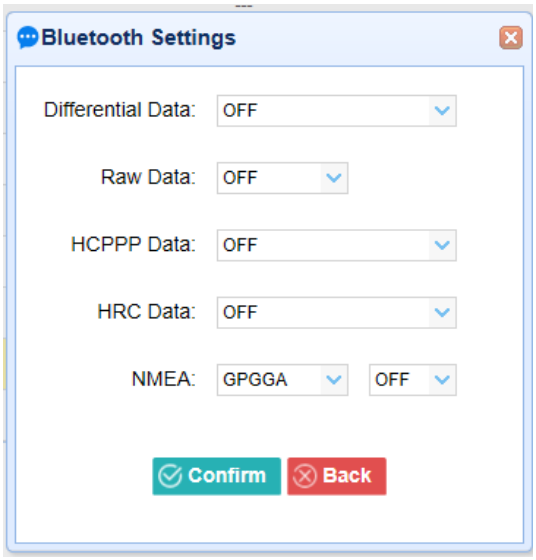
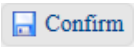


Figure 61 – Bluetooth settings.

6. Radio
   Tap the **Settings** button to the right of Radio → the *Radio Settings* screen will appear → select the format of differential data that you want to transmit through radio from the dropdown list → click 

   to save the settings and start to transmit.

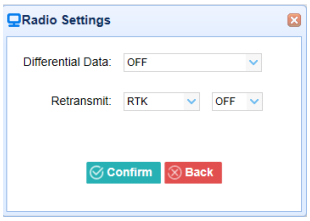


Figure 62 – UHF radio settings.

Network Setting Menu

Use this menu to view network information, configure the receiver's mobile network, set email alert for specific situation, configure HTTP or HTTPS port, and the user name and password of internal FTP site:

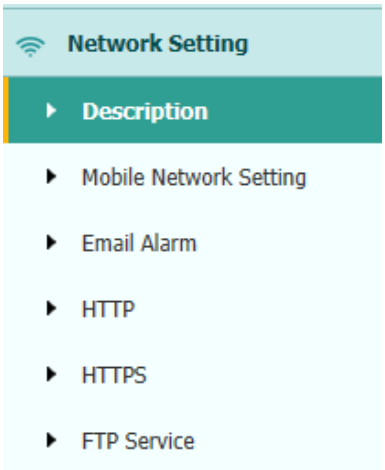


Figure 63 – Network settings submenu.

Description Submenu

Use this submenu to check the information of network setting. In the figure below, the SIM card is successfully connected to the network since the dialing status is connected, and the G9 registers an IP address.

Figure 64 – Network info showing successful SIM card connection to the internet.

Mobile Network Setting Submenu

Use this submenu to configure the GPRS model, network module and modify dialing status. Contact the SIM card service provider for the APN and dialing number fields.

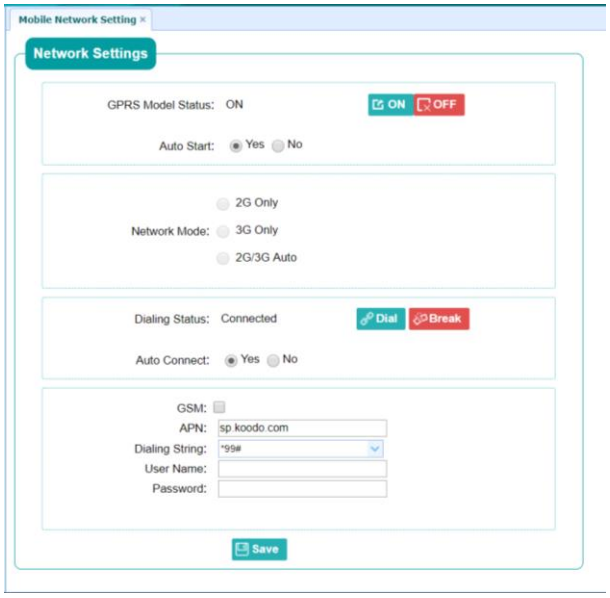


Figure 65 – Mobile network setting submenu.

Email Alarm Submenu

Use this submenu to choose which situation of receiver will be alerted and input the email address.

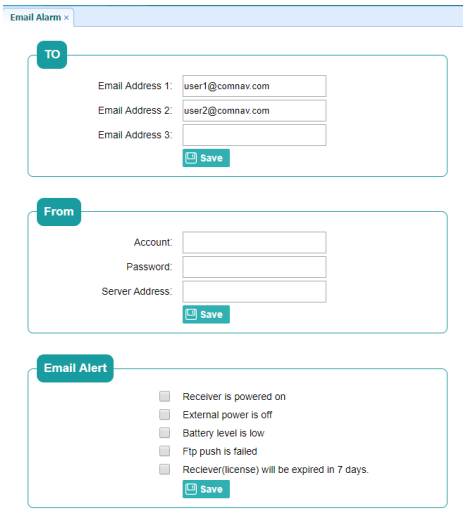


Figure 66 – Email alarm setting.

HTTP Submenu

Use this submenu to configure HTTP port.

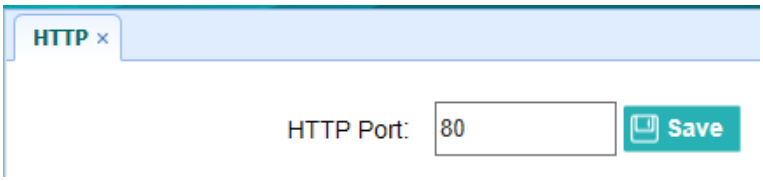


Figure 67 – HTTP submenu.

HTTPS Submenu

Use this submenu to configure HTTPS port.

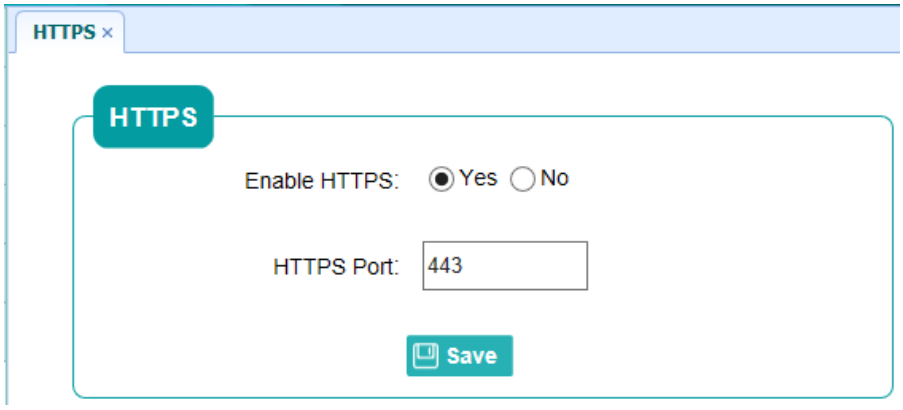


Figure 68 – HTTPS port enable.

FTP Service Submenu

Use this submenu to configure the user name and password of internal FTP site.

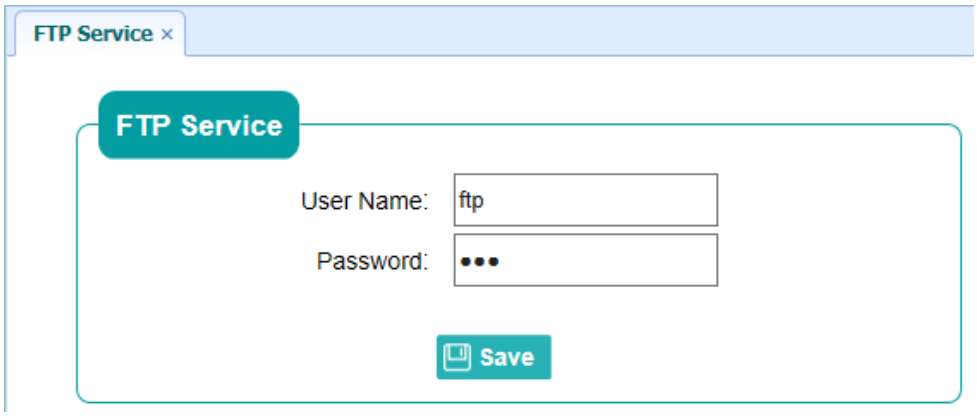


Figure 69 – FTP service user configuration.

Module Setting Menu

Use this menu to check module information, configure WiFi, bluetooth, radio related settings, and turn on/off static voice of buzzer:

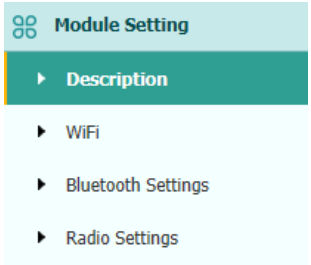


Figure 70 – Module setting menu.

Description Submenu

Use this submenu to check the information of WiFi module, bluetooth module and radio module.

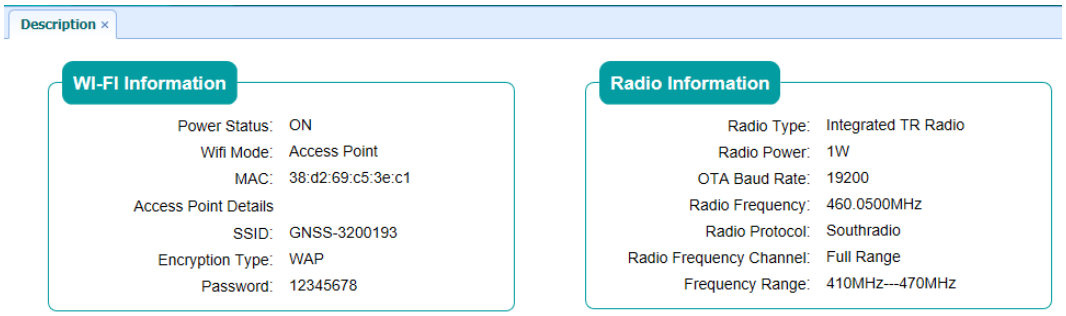


Figure 71 – WiFi and radio setting.

WiFi Submenu

Use this submenu to turn on/off WiFi function and modify password.

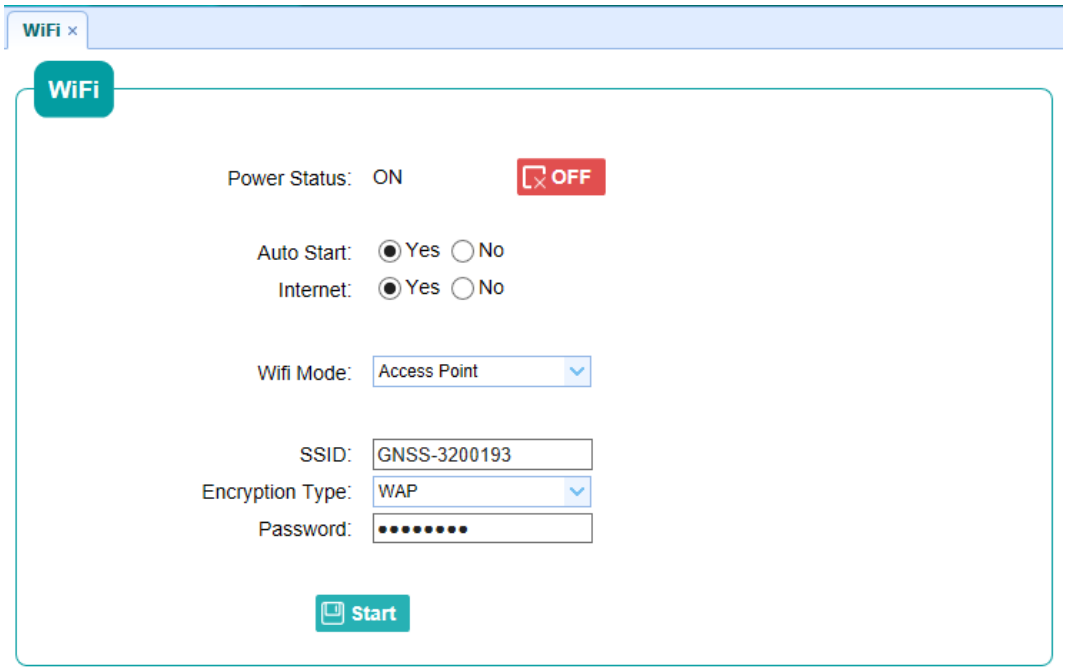


Figure 72 – WiFi configuration settings.

Bluetooth Settings Submenu

Use this submenu to turn on/off Bluetooth function and modify PIN number.

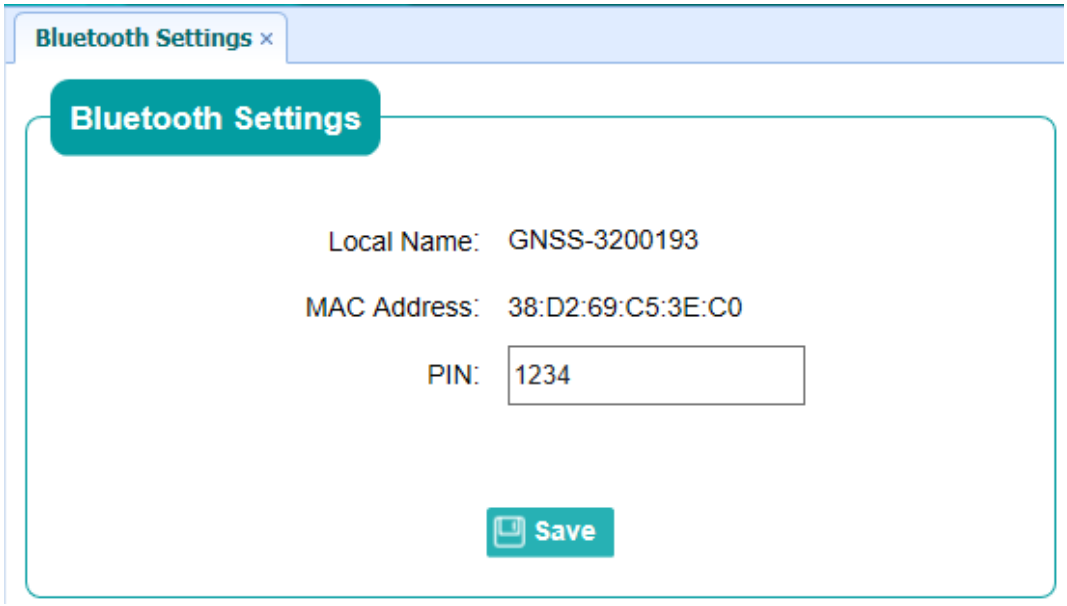


Figure 73 – Bluetooth settings menu.

Radio Settings Submenu

Use this submenu to turn on/off radio function and configure radio parameters.

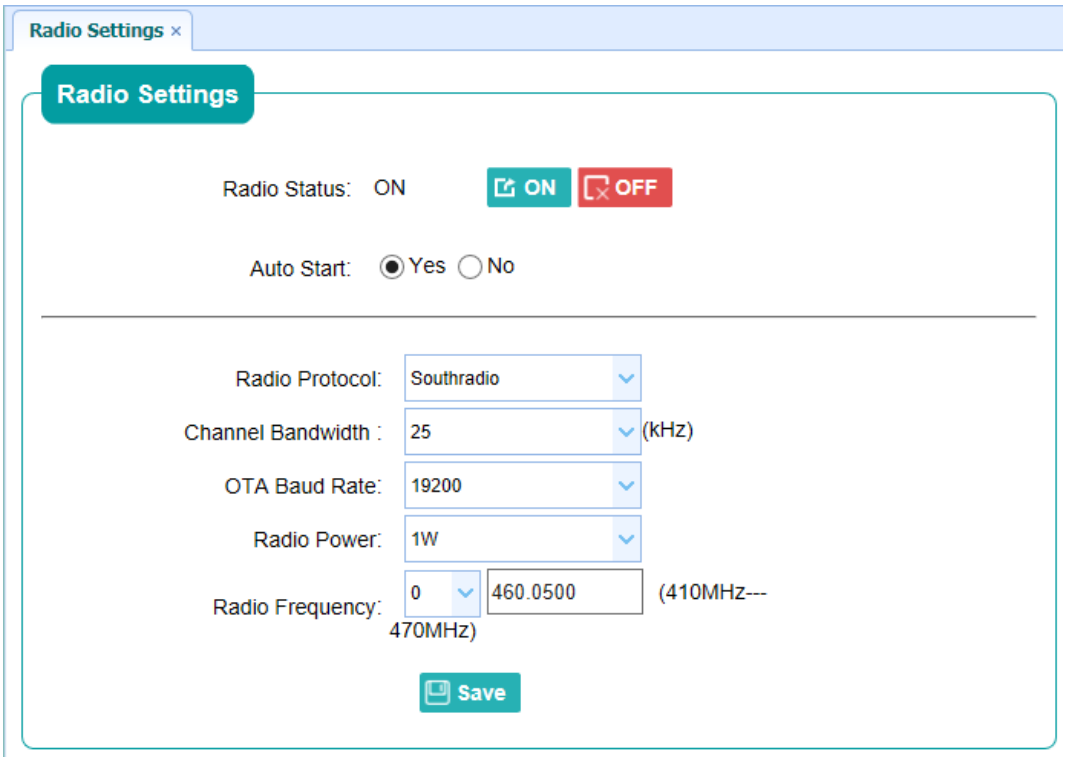


Figure 74 – UHF radio settings.

Firmware Menu

Use this menu to check the current firmware information, download the system log, update the receiver firmware, download or update the configuration file and register the receiver, and more:

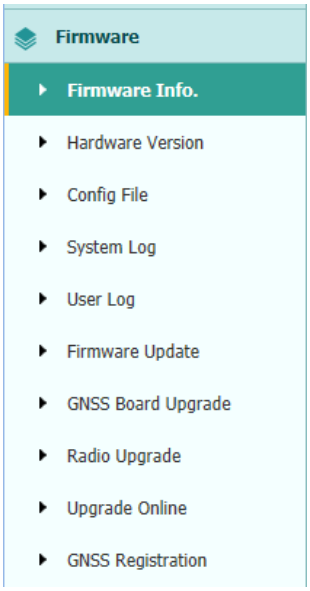


Figure 75 – Firmware menu.

Firmware Info Submenu

Use this submenu to check the current firmware information. The following figure shows an example of the firmware information.

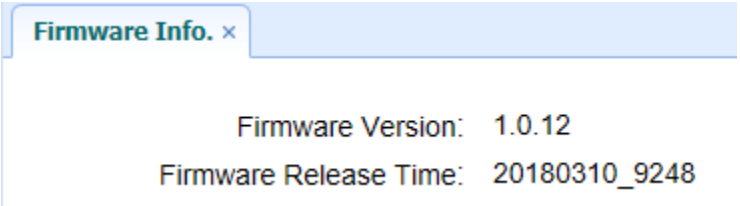


Figure 76 – Firmware info submenu showing firmware version and release date.

Config File Submenu

Use this submenu to update Configuration File.

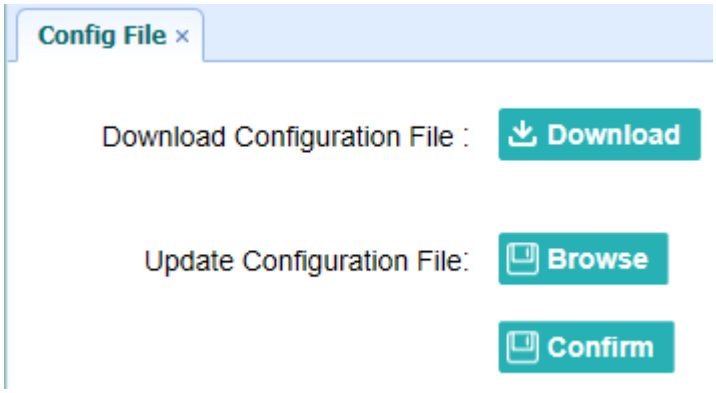


Figure 77 – Configuration file update menu.

System Log Download Submenu

Use this submenu to download the system log of the receiver.

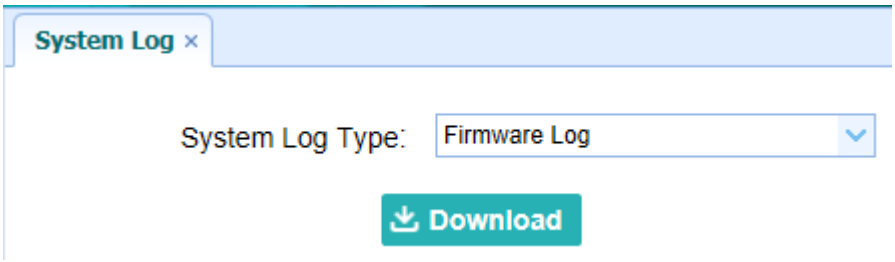


Figure 78 – G9 system log download.

User Log Submenu

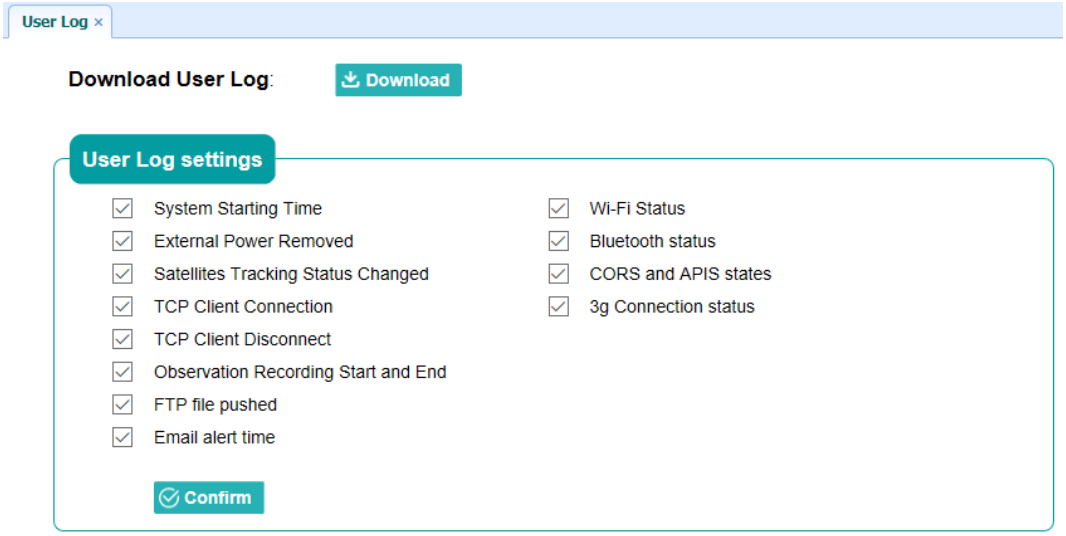


Figure 79 – User log submenu.

Firmware Update Submenu

Use this submenu to load new firmware to the receiver across the network. Tap the **Browse** button to locate the upgrade file → tap **Confirm** button to confirm the selected upgrading file and start upgrading.

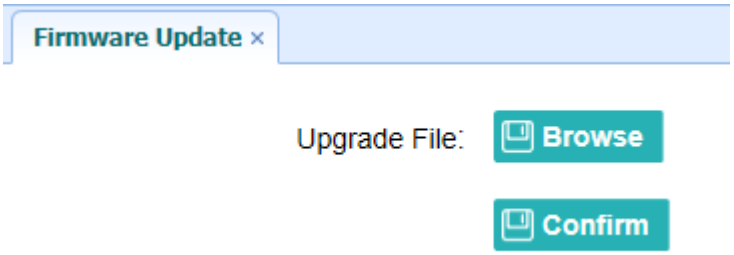


Figure 80 – Firmware upgrade menu.

Notes

- It maye take about 3 or 4 minutes to complete the firmware upgrade. Do not touch the power button or unplug the power until the upgrade process is finished, or damage will be caused to the receiver.

- The receiver will restart after the firmware upgrade is done, so users need to reconnect the receiver with your computer via Wi-Fi, and then log-in the receiver through a web browser to continue the configuration.

GNSS Board Upgrade Submenu

Use this submenu to upgrade GNSS Board.

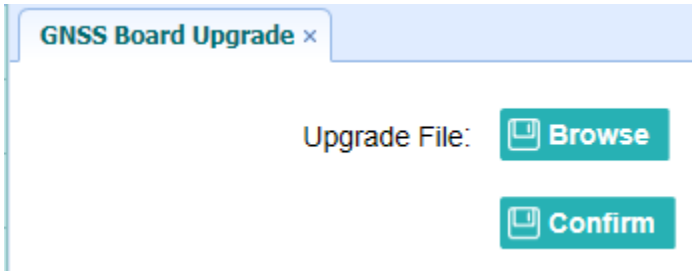


Figure 81 – GNSS board upgrade.

Radio Upgrade Submenu

Use this submenu to browse upgrade file and upgrade radio.

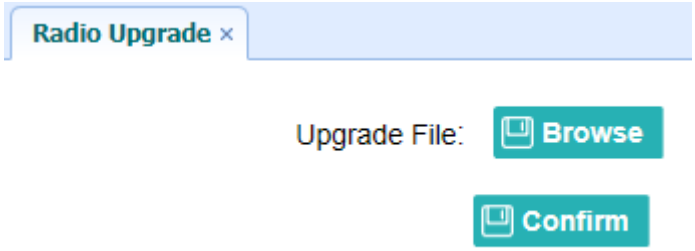


Figure 82 – Radio upgrade.

GNSS Registration Submenu

Use this submenu to register the receiver. Paste or enter the registration code to the *Registration Code* field → tap **Registration** button to complete the registration.

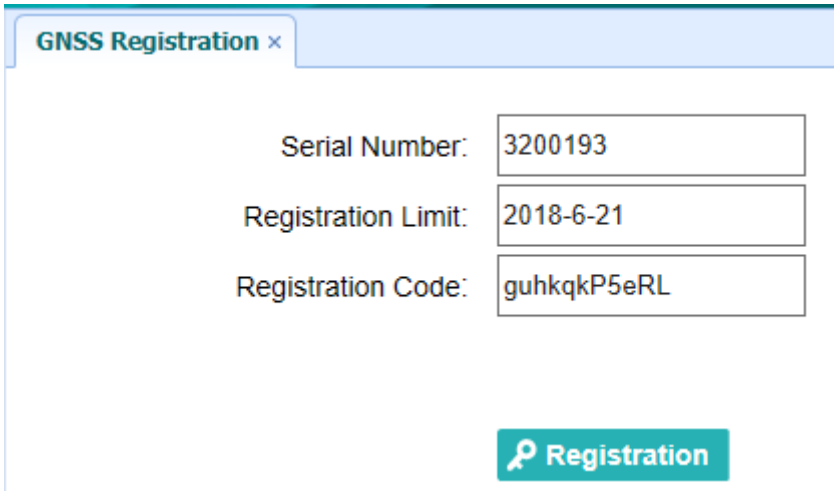


Figure 83 – GNSS registration.

Cloud Service Setting Menu

Cloud Service Setting Submenu

Use this submenu to turn on or turn off Cloud Service, Auto Start, Remote Control and configure other settings.

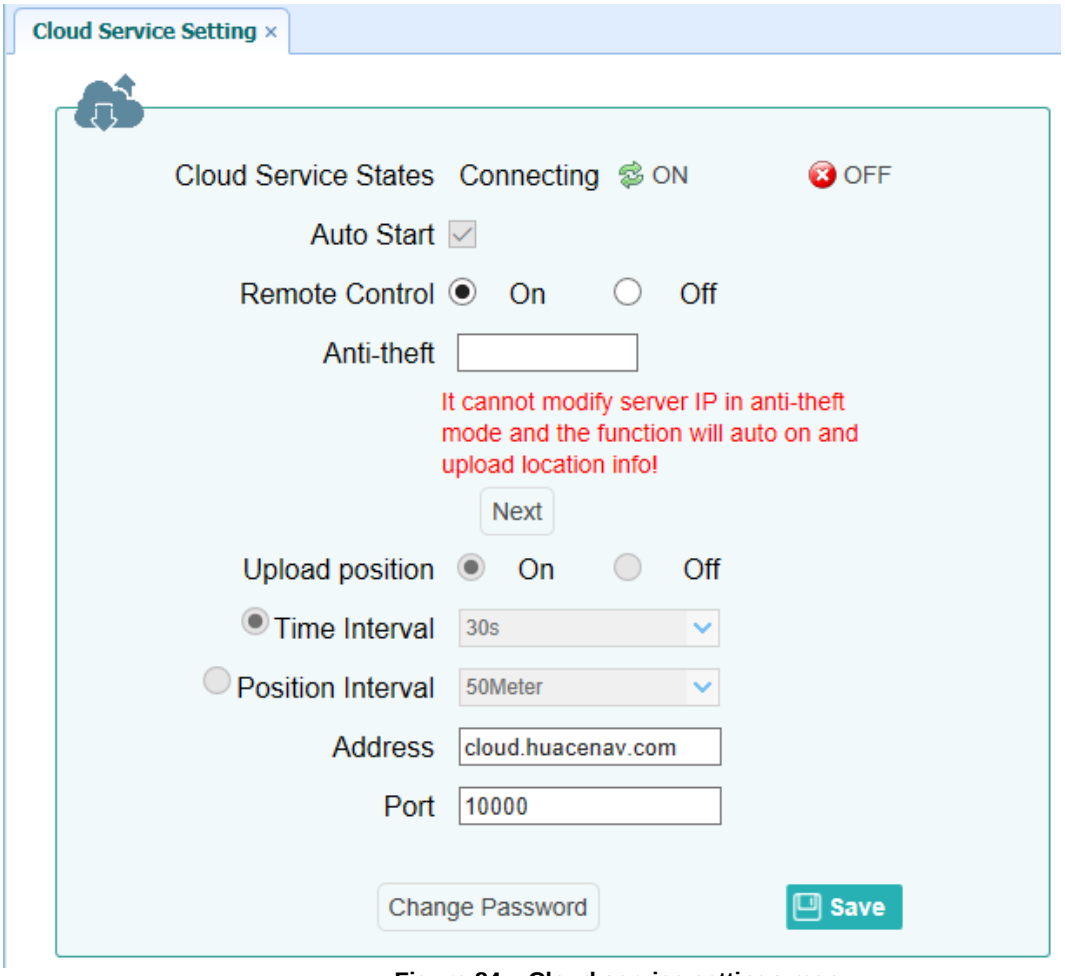


Figure 84 – Cloud service settings menu.

Moving Base Station RTK

The technique of computing the location of the Secondary GPS antenna with respect to the Primary antenna, when the Primary antenna is moving, is often referred to as *Moving Base Station Real-Time Kinematic* (or as *Moving-base-station RTK*, or just *RTK*).

RTK technology is very sophisticated and requires a significant amount of real-time computation – in essence "searching" for the correct solution, within a large number of possible solutions, to the mathematical equations which represent the physical relationships of the G9's two antennae and each visible satellite. The GNSS heading solution is derived from the measured phase difference between the two receiving antennas. We refer to this as the differential phase derived heading.

> ***Note****: The G9's Moving-base-station RTK algorithm uses only GNSS signals to calculate heading. No Differential corrections are used in this calculation, and thus the current DGPS source & signal conditions never affect heading accuracy.*

Determining Speed and Other Navigation Information

The balance of the information that the G9 can output is in general computed from the position and heading data, or obtained directly from data or other information provided by the GNSS satellites.

For example, speed (1) is determined from the measured Doppler of the primary antennas Phase (2)

In contrast, time & date are obtained from data carried on the RF signals from the satellites.

Output Data Formats

NMEA 0183 Output

Many of the NMEA 0183 Standard's "navigation & GPS data" sentences are available on the G9. The list below shows the available sentences and their maximum update rate.

Sentence	Description	Max Rate (Hz)
GPGGA	***Global Positioning System Fix Data***	10
GPGLL	***Geographic Position (Latitude & Longitude)***	10
GPGSA	***GNSS DOP & Active Satellites***	10
GPGST	***GNSS Pseudorange Error Statistics***	10
GPGSV	***GNSS Satellites in View***	10
GPHDT	***True Heading***	10
GPHEV	***Heave in meters***	10
GPRMC	***Recommended Minimum Specific GNSS Data***	10
GPROT	***Rate of Turn***	10
GPVTG	***Course and Speed Over Ground***	10
GPZDA	***Time and Date***	10

Table 11 – NMEA Output Sentences list.

Proprietary Output

A number of proprietary output sentences are available on the G9. Maximum output rates are shown in the far right column, for convenience.

Sentence	Description	Max Rate (Hz)
PTNL,VGK	Time, locator vector, position type, and DOP values	10
PTNL,VHD	Time, azimuth, vertical angle, position type, and DOP values	10
PTNL,GGK	Time, position, position type, and DOP values	10
PTNL,AVR	Time, yaw, Pitch or Roll, range for moving baseline RTK, mode, PDOP, and number of SVs for	10
PTNL,BPQ	Base station position and position quality indicator	10
PTNL,PJK	Local coordinate position output	10
PTNL,PJT	Projection type	10

Table 12 – Proprietary Output Sentences list.

Note: *None of the proprietary sentences are approved by the IEC for marine use.*

Baud rate

The maximum baud rate that can be set is 460800.

Customising, changing and fine-tuning the Configuration

You may change the factory-default configuration of the G9, if you wish!

- ⇒ Many other output sentences can be enabled, and/or the factory-default ones disabled, to suit the requirements of any specific installation.
- ⇒ The output update rate of each enabled sentence may be changed as required.
- ⇒ The port Baud rates can be changed, as required.
  - There may be different Baud rates on each port, if desired.

Care & Maintenance

Care & Maintenance

The G9 Smart Antenna haves been designed to provide many years of reliable service. The following care and maintenance tips will help to ensure the longevity of your compass.

Protection of Wires and Cabling

After installation, ensure that the system components are securely mounted and will not shake loose due to the vibrations that can be expected in a marine vessel.

Ensure that the cable to the G9 is well secured with clamps or alternative fasteners.

Many potential problems can be avoided by ensuring that cabling and wiring do not cause any strain on the connectors.

Periodic Checks

After the first six months of operation, a thorough examination of the entire G9 system MUST BE UNDERTAKEN. Verify that all electrical connections, cables, clamps, mounting brackets, and mechanical connections are secure.

An ANNUAL inspection should be undertaken thereafter.

General Precautions

A few precautions will keep the unit in prime condition:

- ⇒ The G9's enclosure does not require any special maintenance. An occasional cleaning is suggested; use a damp cloth and mild soap.

  Do not use abrasive cleaners or chemicals.

- ⇒ Avoid exposing the enclosure to solvents, acids, and bases – some of these may weaken the plastic.
- ⇒ The G9's enclosure is designed to be weather resistant and splash resistant, but it should not be immersed in water for a prolonged period of time.
- ⇒ Environments exceeding a maximum temperature of 80°C or below a minimum temperature of -40°C MUST BE AVOIDED or the UNIT WILL DAMAGE.

Repair

There are no user-serviceable parts or adjustments inside the G9's enclosure. Should the unit become damaged in any way, return it to an authorized ComNav Dealer.

Fuse Replacement

There are no fuses used inside the G9 itself. However, it is strongly recommended that a fuse (or circuit breaker) be installed in the G9's Power wiring.

If the fuse/breaker blows, determine the cause before replacing/resetting!!

Appendices

Appendices

Appendix 1

Specifications

G9 receiver specification

Parameter	Specification
Multi Frequency GNSS	• All satellites in view simultaneously • GPS L1 C/A, L2C, L2E, L5 • GLONASS L1C/A, L1P, L2C/A, L2P, L3 • Galileo E1, E5A, E5B • Beidou B1, B2 • SBAS MSAS, WAAS, EGNOS, GAGAN
GNSS Performance (RMS)	Horizontal / Vertical
RTK	8 mm + 1 ppm / 15 mm + 1 ppm 2.5 mm +0.5 ppm / 5 mm + 0.5 ppm @ baseline length less than or equal to 300 km
L Band	0.08 m / 0.15 m 0.3m / 0.5 m
Initialization Time Initialization Reliability Initialization Time	• Less than 5 sec • Greater than 99.9% • Less than 10 sec

Table 13 – GNSS Receiver Specifications.

① *Accuracy depends on multipath environment, number of satellites in view, satellite geometry, and atmospheric conditions. Performance assumes minimum of five satellites, coupled with a follow up of recommended general GNSS practices during normal conditions*

Excessive multipath, GPS signal obstructions and/or interference may reduce the performance.

System Interface

Parameter	Specification
Ports	• 2 x 7 pin LEMO (external power, RS232) • 1 x mini USB (data download, update) • 1 x 2 pin LEMO (quick-charge) • 1 x TNC antenna connector (internal radio)
Data Update Frequency	1, 2, 5, 10, 20, 50 Hz
Data Output Protocol	NMEA 0183, proprietary over TCP/IP or UDP, CMR+, SCMRX input and output HCN, HRC, and RINEX static formats NTRIP Client, NTRIP Caster Power
Data Storage	Internal 32 GB High Speed Memory

Data Recording	G9H Handheld Data Collector (optional) Web UI Data Collection Management Software Via smart phone
Network Modem	4G Internal Model Cellular 4G LTE: FDD Band (1,2,3,4,5,7,8,20)
Bluetooth	Internal
Wi-Fi	Internal integrated module w antenna 802.11
UHF Satel Radio	Frequency Range, 410 – 470 MHz Emitting power, 0.5 W to 2 W Protocol: Trimble, Pacific Crest, etc. Range: 5 km optimal conditions

Table 14 – System Interface Specifications

Power

Parameter	Specification
Main Supply Voltage	12 to 36 VDC
Li-Ion Battery Capacity	10,200mAh @ 7.4 V W 2.5 hour charge time
Power Consumption	~ 3.2 W nominal, dependent on user settings
Operating Time on full charge battery	RTK UHF Base: Up to 7 hours RTK Rover: Up to 12 hours
	Static Up to 12 hours

Table 15 – Power Specifications.

Mechanical

Parameter	Specification
Dimensions	16 cm x 15.8 cm x 9.6 cm (6.3 in. x 6.2 in. x 3.8 in.)
Weight	1.5 Kg w battery
Enclosure Rating	IP 67
Operating Temperature	-40°C to +65°C
Storage Temperature	-40°C to +80°C
Humidity	0 to 100%
Shock Resistance	2 m fall onto concrete

Table 16 – Mechanical Specifications.

Appendix 2

Connecting the G9 as a rover (via network mode) and receiving correction data from CORS

In order to connect the G9 as a rover and receive correction data from a nearby station you must perform two configurations. The first is to locate a CORS station near you, and note the caster domain/IP, port number, and username and password. The second configuration is to setup the G9 as a rover.

To setup the G9 as a rover perform the following steps:

1. Insert a SIM card into the G9 sim card slot. Contact the Internet Service Provider and note the APN, dailing number, username and password
2. Turn on the G9 by pressing and holding the G9 power button for 3 seconds
3. Using a computer or mobile device, connect to the G9 receiver's WiFi. The G9 WiFi has the format GNSS-XXXXXX, where XXXXXX is the serial number of the G9.
4. Open a web interface using e.g. Google Chrome and type: 192.168.1.1, type in the username: admin, and password: password to login onto the G9 as shown in the figure 8 below

Figure 85 – G9 log in using Web browser.

4. Go to *Network Setting -> Mobile Network Setting* and setup the SIM card as shown in the Figure below. Enter your internet service provider APN, dialing number, and username and password, and click on Save.

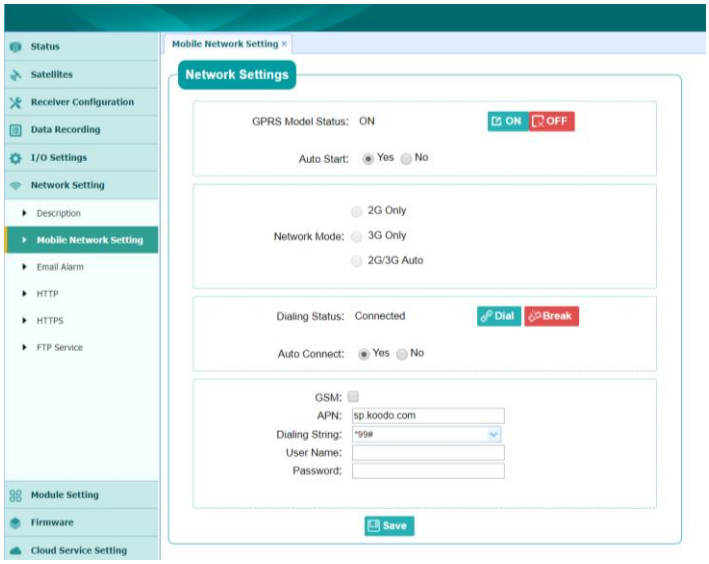


Figure 86 – SIM card setup.

To determine if you are successfully connected to the internet, go to *Network Setting -> Description*. The network info should show that the Dialing status is connected and an IP address is shown.

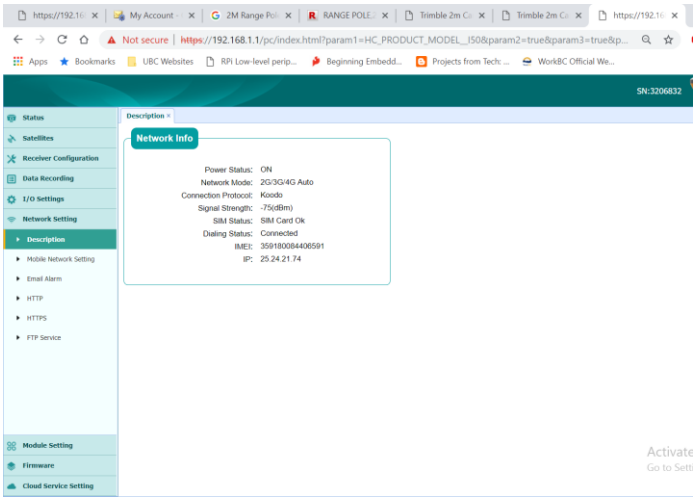


Figure 87 – Successful SIM card connection to cellular network.

5. Go to *I/O Setting* and a list of 15 connection types will show up (see Figure below). We will modify the *RTK Client*

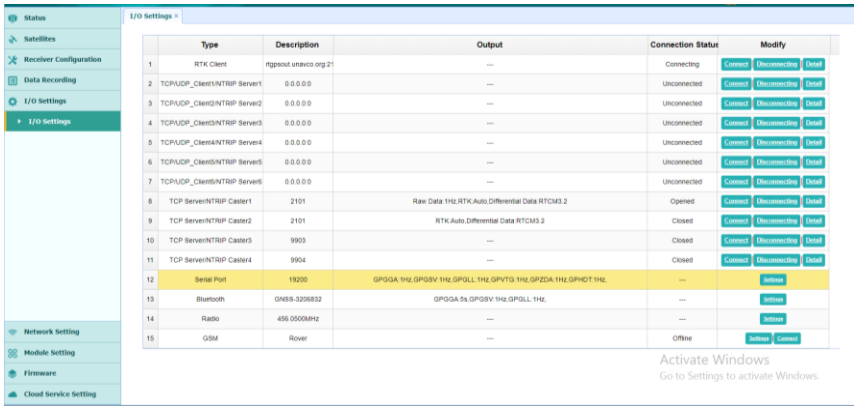


Figure 88 – I/O setting menu.

6. Click on Connect button under the modify tab, and the figure 89 will show. Set the connection protocol to NTRIP, and enter the server IP and port number of the Ntrip caster. For the Mount point, click on *Get* to receive a list of station to choose from, enter username and password. Click confirm.

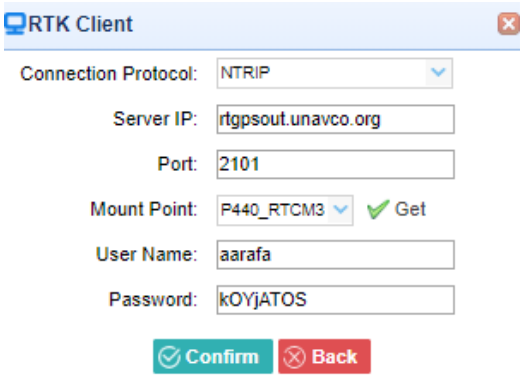


Figure 89 – NTRIP connection protocol setup.

Once Confirmed the *RTK client* will turn green and the connection status will change to *logged In*.

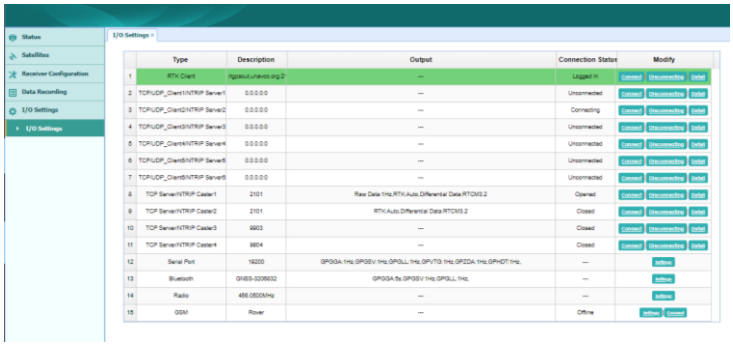


Figure 90 – Sucessful Ntrip connection.

Recording data to the G9 GNSS receiver

To save data the G9, go to *Data Recording,* choose a recording file, and click on ON to start recording data to the internal storage of the G9 as shown in Figure 91 below. To view the saved data, connect the USB cable to the computer.

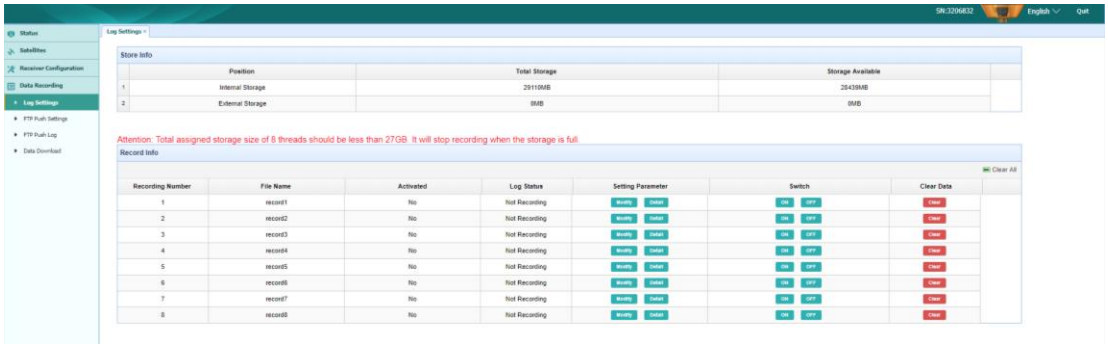


Figure 91 – G9 data recording.

Streaming NMEA serial Data

To stream serial data connect the *PC to GNSS data cable*, go to the IO menu, and click on the Serial port settings. The Figure 92 will show up where you can set the desired NMEA messages, and their update frequency, as well as the serial port baud rate.

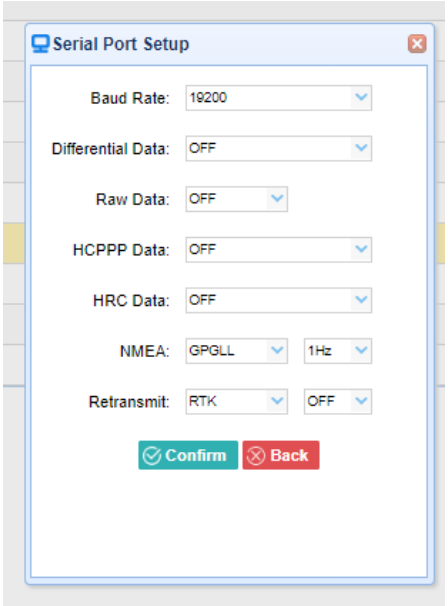


Figure 92 – NMEA setting configuration using serial port.

In order to view the NMEA messages, use a serial terminal program. In this manual Terra Term is used. Select the correct COM port as shown in Figure 92.

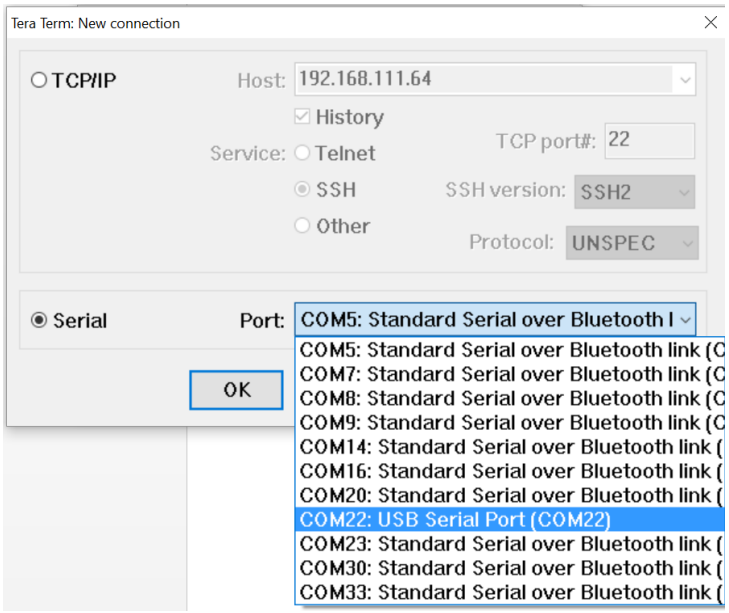


Figure 93 – Select COM port.

Go to the *Setup* tab (Figure 94), and select the baud rate (Figure 95), that matches the G9 baud rate selected in Figure 92. Once configured, the serial data will be streamed as shown in Figure 96.

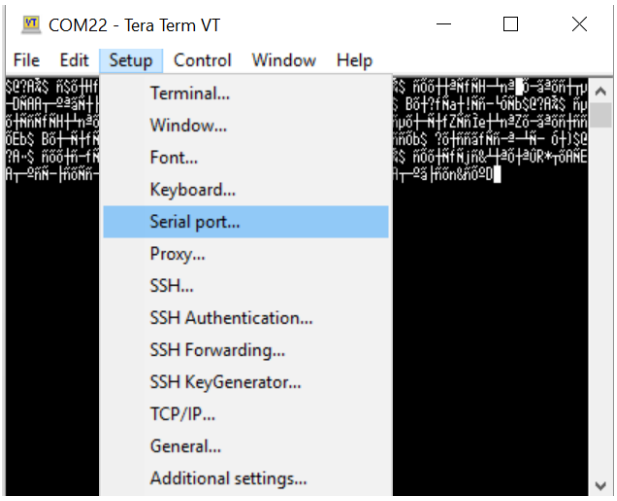


Figure 94 – Serial port configuration menu.

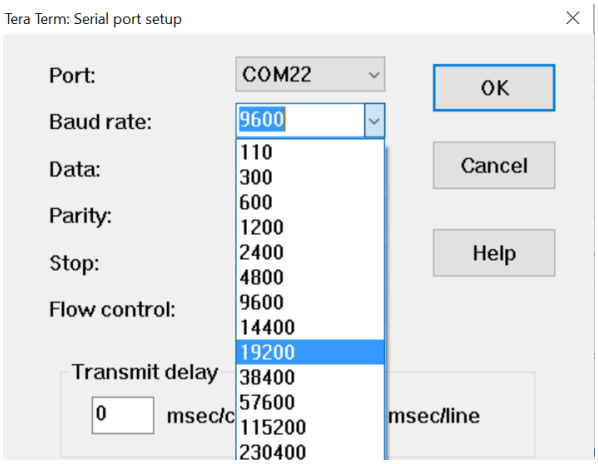


Figure 95 – Select correct baud rate.

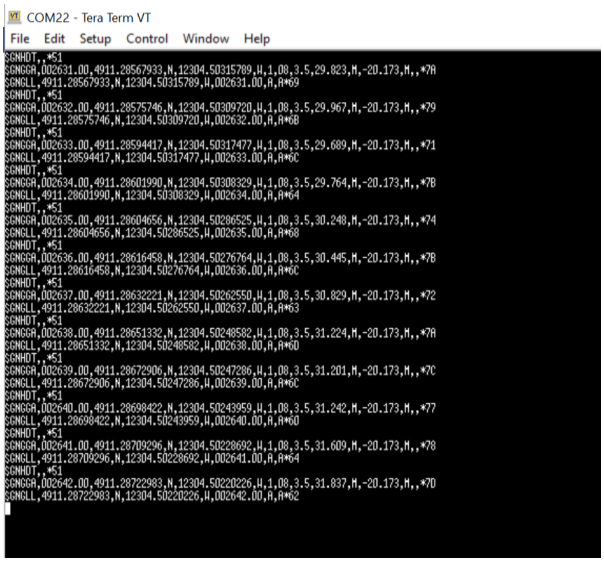


Figure 96 – Streaming NMEA messages using serial terminal.

Appendix 3

Using the G9 in Conjunction with the PDA (Optional)

In this section the process of configuring the G9 via the handheld PDA is illustrated. The following modes of operation are further detailed:

- Rover setup using the PDA cellular network
- Rover setup using the G9 cellular network
- Rover setup using the internal UHF radio

- Base setup using the internal UHF radio
- Base setup using the external UHF radio

Rover Setup using the PDA Cellular Network

Rover installation

1. Screw the G9 receiver on the pole, place the SIM card into designated slot in the PDA as shown in Figure 97.

Figure 97 - PDA showing SIM card and SD card slots.

2. Connect the PDA to the cellular network or to WiFi (if available).

The Wi-Fi key of the receiver is 12345678 by default.

3. Power up the G9
4. Launch the LandStar App on the PDA
5. Tap *Projects* to create or open a project

Figure 98 - Create or open a Project.

6. Tap on *New* to create a new project.

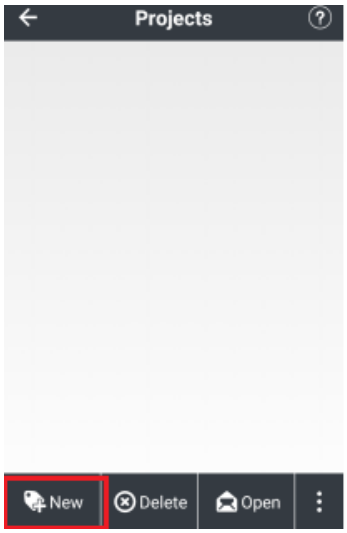


Figure 99 - Create a new project.

7. Enter the project name and author.

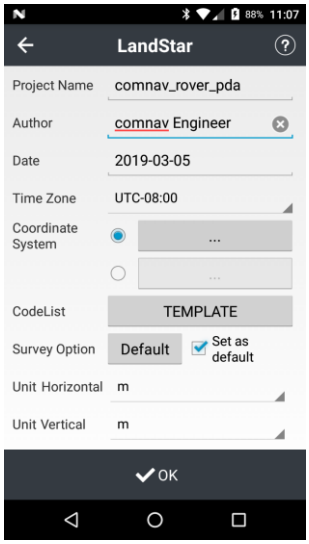


Figure 100 - Project name and author.

8. Tap on the coordinate system to select a coordinate system

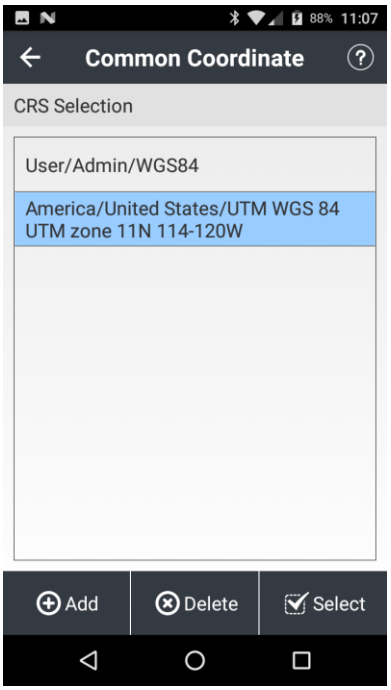


Figure 101 - Coordinate system selection.

9. And click on Accept

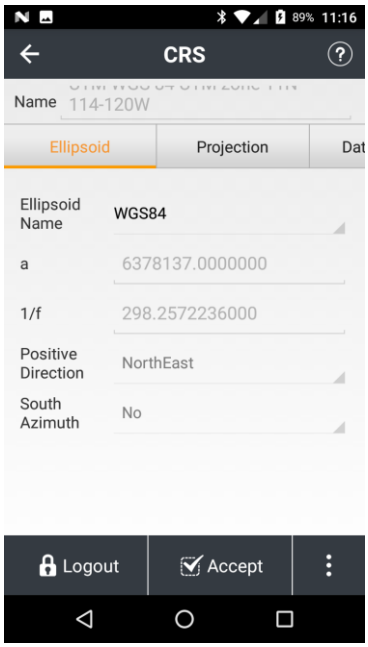


Figure 102 - Accept coordinate system changes.

10. Click on Ok to save the changes

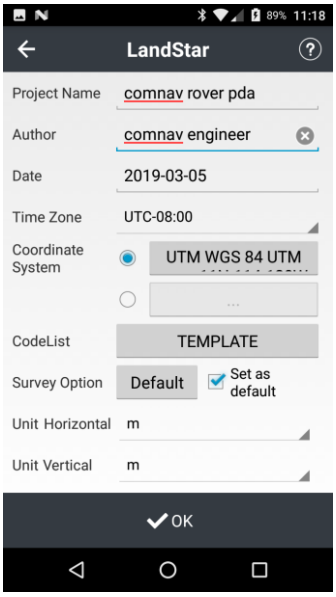


Figure 103 - Save coordinate system changes.

Connect to the G9 Receiver

11. Tap *Config*, and click on *Connect*

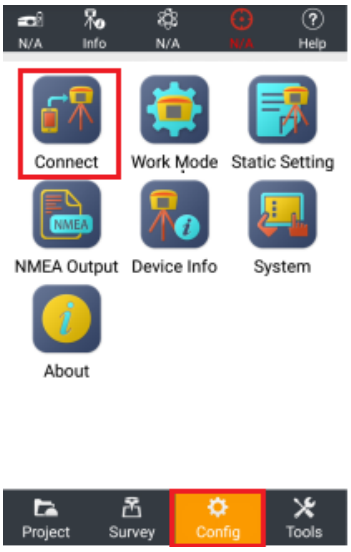


Figure 104 - Connect PDA to G9.

12. Select the following settings:
    a) Manufacturer as ComNav,
    b) Device type: G9GNSS,
    c) Connection type: Bluetooth or WiFi.
    d) Click on the (Bluetooth sign) for Bluetooth/ (wireless sign) for Wifi configuration. Either Bluetooth or WiFi need to be configured for the PDA to communicate with the G9.

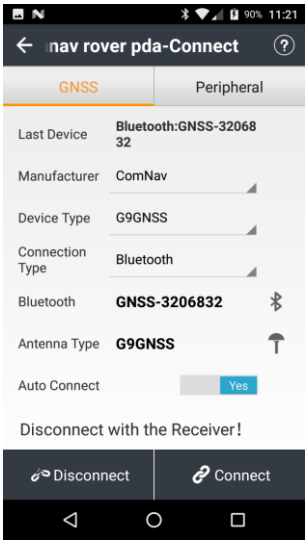


Figure 105 - Select G9 settings.

Create a work mode

13. Click *Config* then select *work mode*

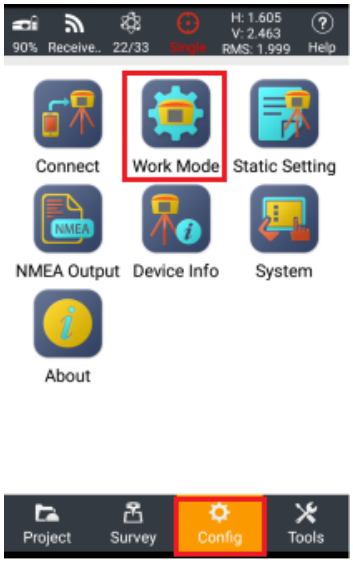


Figure 106 - Work mode selection.

14. Click on *New*

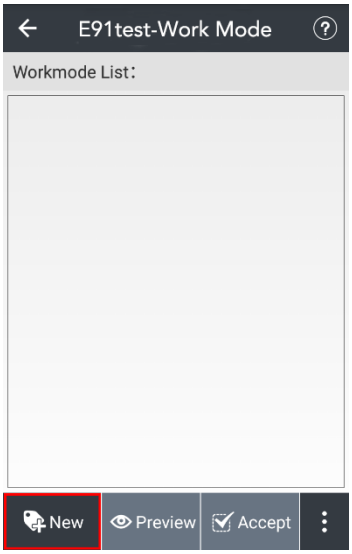


Figure 107 - Select a new workmode.

15. Set the following
    a) Set RTK to ON
    b) Work mode: Auto Rover
    c) Datalink: PDA Network
    d) Protocol: Ntrip
    e) Domain/IP: Ntrip IP
    f) Port: Ntrip port
    g) Click on Arrow down to download the base stations available, and select the desired one.
    h) Enter username and password (If required)

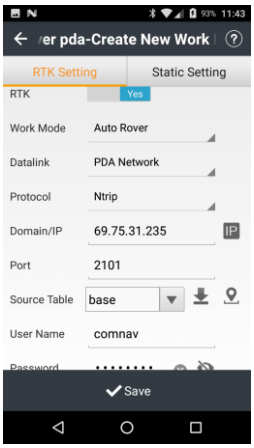


Figure 108 - Rover PDA Network settings.

16. Enter a name for the work mode, and click on Accept
17. If the configuration is correct you should see “Ntrip login successfully” (See Figure 109).

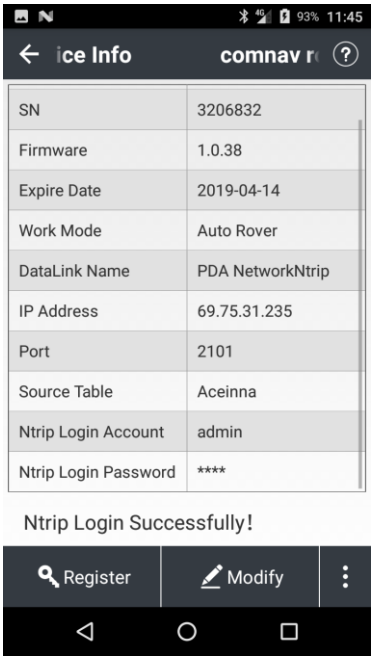


Figure 109 - Ntrip Login Successful message.

18. Solution should change to a FIX

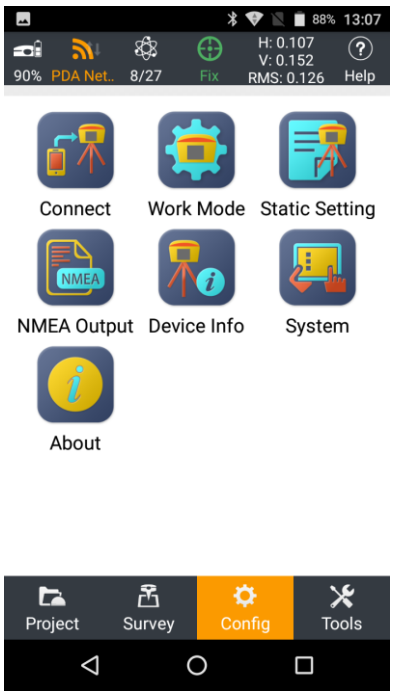


Figure 110 - Position Solution is a FIX.

Start Survey

19. Tap the Survey icon in Figure to start surveying
20. Click on Map

Figure 111 - Start surveying.

Rover Setup using the G9 cellular network

The process of the rover setup using the G9 cellular network is similar to the previous section on *Rover setup using the PDA cellular network* except for the following

- ***Rover Installation*** subsection
  1. Insert SIM card to the G9

- ***Create a work mode*** subsection
  15. Set the following
      a) Set RTK to ON
      b) Work mode: Auto Rover
      c) Datalink: Receiver Network
      d) Protocol: Ntrip
      e) Domain/IP: Ntrip IP
      f) Port: Ntrip port
      g) Click on the arrow to select the APN settings (Contact the Internet service provider to set the APN, Dial number, username and password).
      h) Click on Arrow down to download the base stations available, and select the desired one.
      i) Enter username and password (If required)

Rover Setup using the UHF radio

The process of the rover setup using the UHF radio is similar to the previous section on *Rover setup using the PDA cellular network* except for the following

- ***Rover Installation*** subsection
    1. Attach the UHF whip antenna to the G9 (No need for a SIM card)

- ***Create a work mode*** subsection

  15. Set the following
      - j) Set RTK to ON
      - k) Work mode: Auto Rover
      - **l) Datalink: Radio**

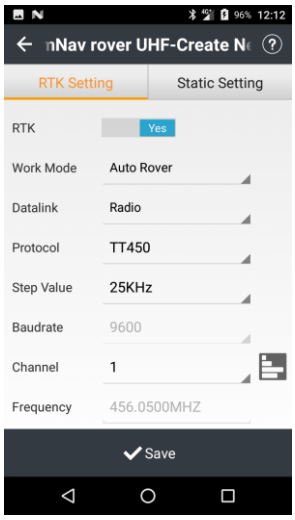


Figure 112 - Rover UHF setting setup.

Base Setup using the UHF radio

The process of the base setup using the UHF radio is similar to the previous section on *Rover setup using the PDA cellular network* except for the following

- ***Base Installation*** subsection
    1. Attach the UHF whip antenna to the G9 (No need for a SIM card)

- ***Create a work mode*** subsection

  15. Set the following
      - a) Set RTK to ON
      - **b) Work mode: Auto Base**

c) Datalink: Internal Radio

Figure 113 - Base setup with UHF radio.

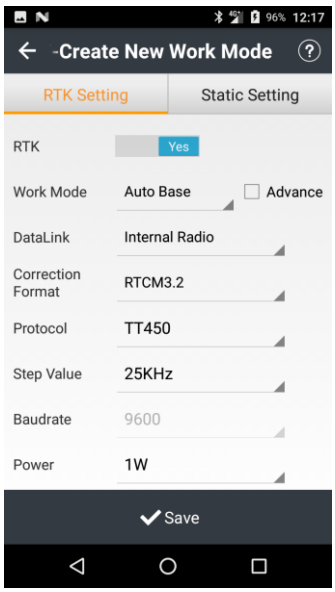


Figure 114 - Base setup with internal UHF radio.

Base Setup using External UHF radio

The process of the base setup using the external UHF radio is similar to the previous section on *Rover setup using the PDA cellular network* except for the following

- ***Base Installation*** subsection
    1. Connect the G9 and datalink via the *GNSS to datalink cable* (see Figures 11 and 115)

- ***Create a work mode*** subsection (see Figure 116)

  15. Set the following

      a) Set RTK to ON

      b) Work mode: Manual Base

      c) Datalink: External Radio

CAUTION – The Datalink Antenna must be connected to the Datalink before the Datalink is powered on; otherwise, the Datalink can be damaged.

Figure 115 - Base setup with external UHF radio.

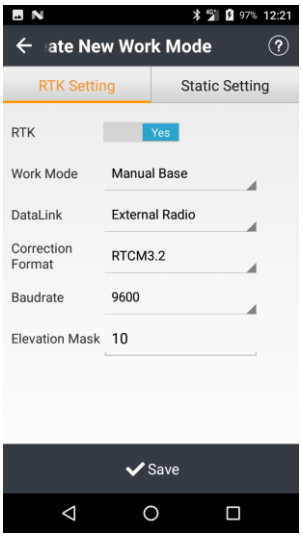


Figure 116 - Base setup with external radio.

Configure the antenna and position as shown in Figure 117.

(1) Choose the antenna type and input the antenna height.

When the receiver is started on the unknown position, choose **[By Number]** or **[By Time]** and click **[Get Position]** to calculate the base coordinates

(2) When the receiver is started on the known position, switch on the **[Manual Input]**, type in the base coordinates or select the point in the point library.

(3) Tap **[OK]**.

Wait until the correction LED of the receiver is flashing green and the TX light of datalink flash, which means the base station configuration is successful.

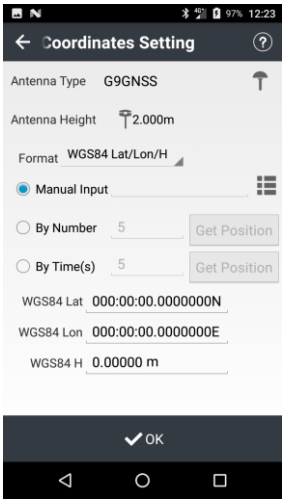


Figure 117 - Coordinate setting for base setup using external radio.

Glossary

Glossary

1PPS Pulse-per-second. Used in hardware timing. A pulse is generated in conjunction with a time stamp. This defines the instant when the time stamp is applicable.

base station Also called heading 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 heading 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 heading 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.

multifrequency 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 ComNav 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.

heading 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 ComNav 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 ComNav 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 heading 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 Heading Station. A VRS system consists of GNSS hardware, software, and communication links. It uses data from a network of heading 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 heading 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.

CE Compliance

This product has been tested and is in compliance with the Navigation requirements of Marine Equipment Directive 96/98/EC and the last modification by Directive 2012/32/EU, and therefore bears the CE-marking.

It has been tested according to the applicable sections outlined under:

ISO 22090-3 Ed. 1.0, 2004 incl. Corr. 1, 2005

IEC 60945 Ed. 4.0, 2002 incl. Corr. 1, 2008

IEC 62288 Ed.1.0, 2008

IEC 61162-1 Ed. 4.0, 2010

IEC 61162-2 Ed. 1.0, 1998

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    c. Shipping, alterations, or incorrect and/or unauthorized service;
    d. Accident, exposure of the Equipment to excessive heat, fire, lightning or other electrical discharge, or water immersion;
    e. Water damage due to failure to fully fasten the plug connected into the Equipment’s power/signal receptacle;
    f. Improper or inadequate ancillary or connected equipment.

OTHER LIMITATIONS AND EXCLUSIONS

1. ComNav does not warrant or guarantee the precision or accuracy of positions, heading, or other GPS-based navigation data obtained when using the Equipment. The potential accuracy of the Equipment, as stated in the Manual, associated ComNav literature and/or Product specifications, provides only an estimate of the highest achievable accuracy based on:
    a. Specifications provided by the US Department of Defence for GPS Positioning;
    b. GPS Receiver specifications provided by the OEM manufacturer;
    c. DGPS service provider performance specifications.
2. The Equipment is not intended for primary navigation or for use in safety of life applications; ComNav does not warrant or guarantee that the Equipment will perform in accordance with the requirements of such usage;
3. ComNav reserves the right to modify the Equipment without any obligation to notify, supply or install any improvements or alterations to existing Equipment.

NO OTHER WARRANTIES

THE FOREGOING WARRANTY IS EXCLUSIVE OF ALL OTHER WARRANTIES AND CONDITIONS, WHETHER WRITTEN, ORAL OR IMPLIED, ARISING BY STATUTE OR OTHERWISE, WITH RESPECT TO THE DESIGN, SALE, INSTALLATION OR USE OF THE EQUIPMENT, INCLUDING BUT NOT LIMITED TO IMPLIED WARRANTIES OR CONDITIONS OF MERCHANTABILITY AND FITNESS FOR THE ORDINARY PURPOSES FOR WHICH THE EQUIPMENT IS USED OR FITNESS FOR A PARTICULAR PURPOSE, AND ANY OTHER OBLIGATIONS ON THE PART OF ComNav, ITS EMPLOYEES, SUPPLIERS, AGENTS, OR REPRESENTATIVES.

LIMITATION OF LIABILITY

The extent of ComNav's liability for damages of any nature to the end purchaser or any other person or entity whether in contract or tort, and whether to persons or property, shall in no case exceed, in the aggregate, the cost of correcting the defect in the equipment or, at ComNav's option, the cost of replacing the defective item. In no event will ComNav be liable for any loss of production, loss of profits, loss of use or for any special, indirect, incidental, consequential or contingent damages, even if ComNav has been advised of the possibility of such damages. Without limiting the foregoing, ComNav shall not be liable for any damages of any kind resulting from installation, use, quality, performance or accuracy of the equipment.

NOTICE OF DEFECT

The Limited Warranty will not apply with respect to any defective Equipment unless written notice of such defect is given to ComNav, by mail to the address for ComNav set forth below, or by facsimile to ComNav at 604-207-8008, and unless that written notice is received by ComNav within ten (10) days of the date upon which the defect first became known to the Purchaser.

Notices sent by mail from within North America will be deemed to be received by ComNav on the seventh (7th) day first following the date of posting. Notices sent by mail from anywhere else in the world will be deemed to be received by ComNav on the tenth (10th) day next following the date of posting. Notices sent by facsimile will be deemed to be received by ComNav on the date of transmission with appropriate answerback confirmation.

REMEDIES NOT TRANSFERABLE

The Purchaser's remedies under this Warranty apply only to the original end-user of the ComNav Equipment, being the Purchaser, and apply only to the original installation of the Equipment. The Purchaser's remedies under this Warranty are not transferable or assignable by the Purchaser to others in whole or in part.

CUSTOMER SERVICE

1. **If you encounter problems during the installation or operation of this product, or cannot find the information you need, please contact ComNav Customer Service**
2. If the Equipment, or any part thereof, proves to be defective within the warranty period, the Purchaser shall do the following:

   Contact Information
   TEL: 604 207 1600
   Fax: 604 207 8008
   Service Email: service@comnav.com

   and,

a. prepare a detailed written statement of the nature and circumstances of the defect, to the best of the Purchaser's knowledge, and including the date of purchase of the Equipment, the place of purchase, the name and address of the installer, and the Purchaser's name, address and telephone number, all to be sent, along with proof of purchase, to ComNav at the address set out below, and within the time limits set out above for Notice of Defect.

ComNav Marine Ltd.
13511 Crestwood Place, Ste 15
Richmond, BC V6V 2G9

WARNING

The Equipment is an aid to navigation only. It is not intended or designed to replace the person on watch. A qualified person should always be in a position to monitor the vessel's heading, and to watch for navigational hazards, and should be prepared to revert to manual steering immediately if an undesired change of heading occurs, if the heading is not maintained within reasonable limits, or when navigating in a hazardous situation.

ALWAYS REMEMBER:

WHENEVER UNDER WAY ON VESSEL OR WHEN VEHICLE IN MOTION, A QUALIFIED PERSON ON WATCH IS REQUIRED BY LAW.

On static applications, the Equipment is an aid to precise position information only. It is not intended or designed to replace the person on watch. A qualified person should always be in a position to oversee and conduct best practices in overseeing and responding to avoiding hazards, preventing extreme deformities while monitoring, or undesired engineering responses causing hazardous or dangerous situations.

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User Notes

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