Hemisphere®

875-0357-D

S321 Smart Antenna

User Guide

Revision: A8

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This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

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

This product complies with the essential requirements and other relevant provisions of Directive 2014/53/EU. The declaration of conformity may be consulted at https://hemispheregnss.com/About-Us/Quality-Commitment.

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6469663	7162348	7437230	8085196	8265826	2004320401
6501346	7277792	7460942	8102325	8271194	
6539303	7292185	7689354	8138970	8307535	
6549091	7292186	7808428	8140223	8311696	
6711501	7373231	7835832	8174437	8334804	
6744404	7388539	7885745	8184050	RE41358	
6865465	7400294	7948769	8190337		

Other U.S. and foreign patents pending.

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Contact your local dealer for technical assistance. To find the authorized dealer near you:

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Terms and Definitions

The following table lists the terms and definitions used in this document.

Term	Definition
1PPS	1 pulse-per-second is a pulse that is output by the receiver precisely once a second and is used for hardware synchronization.
Activation	Activation refers to a feature added through a one-time purchase. For features that require recurring fees, see Subscription.
aRTK	aRTK is a Hemisphere GNSS exclusive service that uses Atlas to extrapolate the last RTK correction during an RTK outage so that the length of time an RTK position can be used after an RTK outage is extended.
Atlas	Atlas is a subscription-based service provided by Hemisphere to achieve sub-decimeter accuracy after a twenty-minute convergence period without the need for a base station or datalink.
Base Station	The Base Station is a receiver placed over a familiar point. The base station then provides real-time observations and sends these to nearby RTK rovers via UHF radio or the internet.
BeiDou	BeiDou is a Chinese satellite-based navigation system.
Datalink	Datalink is the device used to send RTK or DGNSS corrections from a base station to one of more rovers. Common datalinks are UHF radio or Ntrip (see Ntrip).
DGPS/DGNSS	Differential GPS/GNSS refers to a receiver using Differential Corrections.
Differential Corrections	A method of improving precision of a GNSS rover. Two GNSS receivers placed in a nearby area will have similar error. A base station is placed over a known point. Since the actual position of the base station is known, error can be calculated, and corrections can then be applied to nearby rovers. This differs from RTK (see section on RTK).
Dual-Frequency	Dual-Frequency use both L1 and L2 signals from GPS satellites, G1 and G2 signals from GLONASS satellites, and B1 and B2 signals from BeiDou satellites. Single frequency receivers will only use L1, G1, and B1.
EGNOS	European Geostationary Navigation Overlay Service (EGNOS) is a satellite-based augmentation system (SBAS) that provides free differential corrections over satellite in parts of Europe.

Terms and Definitions (continued)

Term	Definition
Elevation Mask	Elevation Mask is the minimum angle between a satellite and the horizon for the receiver to use that satellite in the solution. Satellites near the horizon often provide noisy signals and should be avoided.
Firmware	Firmware is the software loaded into the receiver that controls the functionality of the receiver and runs the GNSS engine.
GALILEO	Galileo is a global navigation satellite system implemented by the European Union and European Space Agency. Global coverage is available, and the full constellation is expected by 2020.
GAGAN	GPS Aided Geo Augmented Navigation is a satellite-based augmentation system (SBAS) that provides free differential corrections over satellite in India.
GLONASS	Global Orbiting Navigation Satellite System (GLONASS) is a Global Navigation Satellite System (GLONASS) deployed, and maintained, by Russia. It is comparable to the United States' GPS system.
GNSS	Global Navigation Satellite System (GNSS) is a system that provides autonomous 3D position (latitude, longitude, and altitude) along with very accurate timing globally by using satellites. Current GNSS providers are: GPS, GLONASS and Galileo. BeiDou is expected to have global coverage by 2020.
GPS	Global Positioning System (GPS) is a global navigation satellite system implemented by the United States.
Heading	Heading is the angle between true north and the vector calculated from the primary to secondary antenna.
Heading Bias	Heading Bias is an offset applied to the heading value the receiver calculates.
Mountpoint	Mountpoints are the specified data streams in Ntrip. Multiple base stations may send data to an Ntrip caster. Each base station has a unique Mountpoint.
Multipath	Multipath occurs when the GNSS signal reaches the antenna by two or more paths. This causes incorrect pseudo-range measurements and leads to less precise GNSS solutions.
NMEA	National Marine Electronics Association (NMEA) is a marine electronics organization that sets standards for communication between marine electronics.

Terms and Definitions (continued)

Term	Definition
Ntrip	Networked Transport of RTCM via Internet Protocol (Ntrip) is a protocol for streaming GNSS data over the internet. Ntrip is most often used to stream RTK or DGNSS corrections over the internet.
Ntrip Caster	Ntrip casters receive data from one or more Ntrip servers and the data is available to one or more Ntrip clients. Each data source (Ntrip server) must send the data to a specified Ntrip mountpoint, and the Ntrip client must specify which mountpoint to receive data from. This allows multiple base stations on the same network.
Ntrip Client	Ntrip clients receive data from the Ntrip caster and provide this data (often over GSM or serial) to the GNSS receiver.
Ntrip Server	The Ntrip server sends data from the Ntrip source (base station) to the Ntrip caster.
QZSS	Quasi-Zenith Satellite System (QZSS) is a satellite navigation system currently under development in Japan.
ROX	ROX is a Hemisphere GNSS propriety RTK message format that can be used as an alternative to RTCM3 when both the base and rover are Hemisphere branded.
RTCM	Radio Technical Commission for Maritime Services (RTCM) is a standard used to define RTK message formats so that receivers from any manufacturer can be used together.
RTK	Real-Time-Kinematic (RTK) is a real-time differential GPS method that provides better accuracy than differential corrections.
SBAS	Satellite Based Augmentation System (SBAS) is a system that provides differential corrections over satellite throughout a wide area or region.
Signal-to-Noise Ratio	Signal-to-Noise Ratio (SNR) is the ratio of the message content of the signal against the noise of the signal.
Subscription	A subscription is a feature that is enabled for a limited time. Once the end-date of the subscription has been reached, the feature will turn off until the subscription is renewed.
WAAS	Wide Area Augmentation System (WAAS) is a satellite-based augmentation system (SBAS) that provides free differential corrections over satellite in parts of North America.

Chapter 1: Introduction

Product Overview

Key Features

What's Included in your Kit

Firmware Upgrades

Introduction

This User Guide provides information to help you quickly set up your S321 Smart Antenna.

Note: Throughout the rest of this User Guide the S321 Smart Antenna is referred to simply as the S321.

Product Overview

The S321 is an all-new multi-GNSS, multi-frequency smart antenna designed by and for surveyors. The S321 delivers robust performance and high precision in the field with a compact and rugged package.

With multiple wireless communications ports and an open GNSS interface, the S321 can be used in a variety of operating modes in a network or crew. Use the S321 as a precise base station sending RTK or Atlas L-band corrections to your existing rover network.

Turn S321 into a lightweight and easy to use rover by connecting it to your base via UHF radio or Wi-Fi network. The built-in WebUI is used to control, manage, and upgrade the S321 with new firmware and activations. S321 is Athena enabled and Atlas capable.

Athena RTK

Athena RTK (Real Time Kinematic) technology is available on Eclipse-based GNSS receivers. Athena RTK requires the use of two separate receivers: a stationary base station (primary receiver) that broadcasts corrections over a wireless link to the rover (secondary receiver). The localized corrections are processed on the rover to achieve superior accuracy and repeatability. Performance testing has shown positioning accuracy at the centimeter level.

Athena RTK has the following benefits:

- Improved Initialization time - Performing initializations in less than15 seconds at better than 99.9% of the time
- Robustness in difficult operating environments - Extremely high productivity under the most aggressive of geographic and landscape-oriented environments
- Performance on long baselines - Industry-leading position stability for long baseline applications

Atlas L-band

Atlas L-band corrections are available worldwide. With Atlas, the positioning accuracy does not degrade as a function of distance to a base station, as the data content is not composed of a single base station's information, but an entire network's information.

Atlas L-band is Hemisphere's industry leading correction service, which can be added as a subscription. Atlas L- band has the following benefits:

- Positioning accuracy - Competitive positioning accuracies down to 2 cm rms in certain applications
- Positioning sustainability - Cutting edge position quality maintenance in the absence of correction signals, using Hemisphere's patented technology
- Scalable service levels - Capable of providing virtually any accuracy, precision and repeatability level in the 2 to 100 cm range
- Convergence time - Industry-leading convergence times of 10-40 minutes

S321 is supported by our easy-to-use Atlas Portal (www.atlasgnss.com), which empowers you to update firmware and enable functionality, including Atlas subscriptions for accuracies from meter to sub-decimeter levels.

For more information about Athena RTK, see:https://hemispheregnss.com/Technology For more information about Atlas L-band, see: https://hemispheregnss.com/atlas

WARNING: If your S321 is equipped with a 400 MHz radio you may be required to obtain a valid radio license for your jurisdiction.

aRTK Position Aiding

aRTK is an innovative feature available in Hemisphere's S321 smart antenna that greatly mitigates the impact of land-based communication instability. Powered by Hemisphere's Atlas L-band system service, aRTK provides an additional layer of communication redundancy to RTK users, assuring that productivity is not impacted by intermittent data connectivity.

S321 receives the aRTK augmentation correction data over satellite, while also receiving the land- based RTK correction data. With this, the receiver internally operates with two sources of RTK correction, creating one additional layer of correction redundancy as compared to typical RTK systems.

Once that process is established (less than a few seconds), the receiver can operate in the absence of either correction source, or in other words, the receiver is able to continue generating RTK positions in case the land-based RTK correction source becomes unavailable for a period of time.

Note: To use aRTK, you are required to change the RTK timeout to: 2700 s. This can be accomplished by following the WebUI directions outlined in the Setup and Configuration section of this document.

SureFix RTK Position

To provide high fidelity quality indicators to the users, Hemisphere created an additional processor that runs in combination with the RTK engine, called the SureFix processor.

The SureFix processor takes several inputs, such as GNSS data, data preprocessing results, and generated RTK solutions. The SureFix processor takes all available information and, by using functional and stochastic analysis methods, determines the quality of the current RTK engine solution. These are shown as “SureFix quality indicators”. The SureFix indicators are then combined with the RTK solution before being provided to the user. At the end of the process, the user has access to high fidelity information about the quality of the RTK solution.

What’s Included in your Kit

As per Table 1.1 below, the S321 is available in a variety of kits, with supplementary products sold as “controller/option kits”, “accessory kits” or simply as separate accessories. Contents can change without prior notice. Check the official price list to confirm contents.

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 be charged to less than 30% to meet international air freight requirements.

Table 1-1: S321 parts list

Main Kits	Part Number	940-2145-0 S321U	940-2146-0 S321N	940-2163-0 S321U Int'l	940-2164-0 S321N Int'l
S321 UHF Smart Antenna	752-0006-0	1	-	1	-
S321 Network Smart Antenna	752-0007-0	-	1	-	1
S321 Serial Cable	051-0390-0	1	1	1	1
GSM/WCDMA External Antenna	150-1023-0	1	1	1	1
UHF External Antenna	150-1024-0	1	-	1	-
Athena dFreq RTK Bundle*	163-1045-0	1	1	-	-
Smart Battery	427-0058-0	2	2	2	2
Battery Charger Adapter	427-0060-0	1	1	1	1
Battery Charger	427-0063-0	1	1	1	1
S321 Cigarette Lighter Adapter	427-0064-0	1	1	1	1
Tape Measure	699-0006-000	1	1	1	1
Quick Release	699-0015-0	1	1	1	1
Carry Case	750-0183-1	1	1	1	1
8 GB MicroSD Card	750-1169-0	1	1	1	1
Accessory Kits	**Part Number**	**940-2155-0 Base Acc**	**940-2156-0 Rover Acc**	**Accessor y Only**	
S321 Power Cable (Alligator Clips)	054-0171-0	1	-	-	
S321 5-Pin Power Cable (PacCrest/Rcvr)	054-0172-0	-	-	1	
S321 5-Pin Power Cable (Satel/Rcvr)	054-0173-0	-	-	1	
S321 5-Pin Power Cable (Receiver)	054-0178-0	1	-	-	
S321 5-Pin Power cable (Serial/Rcvr)	054-0180-0	-	-	1	
S321 UHF Antenna (TNC)	150-1026-0	1	-	-	
Mini Rotary Table	699-0014-0	-	1	-	
S321 External UHF Antenna Bracket Kit	710-0136-6	1	-	-	
Controller/Option Kits	**Part Number**	**940-2149-0 Cntrlr (NA)**	**940-2150-0 Cntrlr (EU)**	**940-2165-0 Int'l Option**	
XF3 Pole Bracket Mount	750-0159-0	1	1	1	
XF3 (EU)	750-0177-0	-	1	1	
XF3 (NA)	750-0178-0	1	-	-	
Carlson SurvCE v5.04+ (w/ NA)	750-2022-0	1	-	-	
Carlson SurvCE 5.04+ (w/o NA)	750-2023-0	-	1	1	
Athena dFreq RTK Bundle*	163-1045-0	-	-	1	

Chapter 2: Installation

Ports and Connections
Installing/Connecting S321
Installing UHF and GSM Antennas
Installing S321 on a Tribrach
Installing S321 on a Range Pole
Connecting to a Power Source
Connecting to an External Device
Powering the S321 On/Off
Inserting and Removing the MicroSD/SIM Card
Resetting the S321

Chapter 2: Installation

Ports and Connections

All ports and connections are located on the bottom of the unit, as shown in Figure 2-1. Table 2-1 provides additional information about each port/connection.

Figure 2-1: S321 ports and connectors

Table 2-1: S321 ports and connections

Port	What to connect
7-pin Diagnostic Port (LEMO)	Diagnostic cable for serial or USB
5-pin Power/Data Port (LEMO)	External power, data and radio devices
GSM Antenna Connector	External GSM antenna
UHF Antenna Connector	External UHF antenna
Mounting hole	Pole or tripod mount

Installing/Connecting S321

Installing Batteries

The S321 allows for one battery (11.1 V - 37.74 Wh) to be installed at a time. When installing the battery, ensure the contact points are facing up towards the “Hemisphere” logo. Slide the battery into the designated spot until the “battery tension bar” clicks into place. The projected run time of the battery is 6 hours in the UHF receive mode.

The S321 kit provides two batteries, as noted in the What’s Included in your Kit portion of this User Guide.

Figure 2-2: Battery installation

Installing UHF and GSM Antennas

To install the UHF portion of the S321 antenna, locate the UHF antenna (150-1024-0) from the kit list under What's Included in your Kit. Insert the connector end of the UHF antenna and rotate clockwise to secure the antenna to the S321. To install the GSM portion of the S321 antenna, locate the GSM antenna (150-1023-0) from the kit list under. Insert the connector end of the GPRS antenna and rotate clockwise to secure the antenna to the S321.

Figure 2-3: Installing UHF and GSM antennas

Note: Only one antenna (UHF or GSM) can be connected to the S321 at a time.

Installing S321 on a Tribrach

The S321 mounts flush to the tribrach, by securing the 5/8-11” female metal mounting portion of the S321 to the standard 5/8-11” male portion of the tribrach. Hand-tighten (35-40 in-lbs. of torque) to secure the S321 onto the mount in a clockwise rotation.

Figure 2-4: Installing S321 on a tribrach

Installing the S321 on a Range Pole

Using the standard 5/8-11” mount on the bottom of the S321, you can secure the unit to a field standard 5/8-11” range pole. the S321 should be placed carefully on the range pole, to ensure cross-threading does not occur, while rotating the unit in a clockwise direction.

Hand-tighten (35-40 in-lbs. of torque) to secure the unit.

Figure 2-6: Range pole installation

Connecting to a Power Source

The S321 has two main power sources. The first being an internal, removable battery which is described in the earlier portion of this chapter. The second source of power is the external power cable (054-0171-0). The 5-pin (LEMO) connector allows 9 to 24V of power into the S321.

Figure 2-7: External power connector

Connecting to an External Device

The 7-pin connector is available for troubleshooting, debugging, and USB log downloads.

Figure 2-8: External device connector

Using the Device “FN” and “I” Keys

The on-device menu can be navigated by using the on-device keys. The FN key allows you to scroll through each item on the device menu display. The I key acts as an enter key for selecting to required menu option. The I key also acts as a power key when the menu option of “power” is selected. (See Powering the S321 On/Off below).

Figure 2-9: S321 on-device menu

Powering the S321 On/Off

The S321 has a power-on/off the receiver function and a confirm function:

- **Power-on receiver:** Press **I** key for 1 second, the device will beep three times.
- **Power-off receiver:** Press **I** key for 0.5 seconds to navigate to the main menu screen. Once on the main menu screen push the **FN** key to work the menu box to the I icon. When the box is located over the **I** icon, press the **I** key for 0.5 seconds to turn the device off.

Note: If you hold the "I" button for longer than 0.5 seconds, the device goes into self-check mode. (See "Self-Check" below for more information).

Self-Check: Self Check is a procedure for verifying the correct working of the instrument devices. The program is mainly to predict whether the receiver modules works normal ahead of time or not. The self-checking includes status reviews of GPS, Wi-Fi, Bluetooth, radio, network and sensor, a total of six parts.

Inserting and Removing the MicroSD Card/SIM Card

Caution: Use electrostatic discharge (ESD) protection, such as by wearing an ESD strap that is attached to an earth ground before inserting or removing the SIM card on the S321. If an ESD strap is not available, then touch a metal object prior to accessing the SIM card holder.

The MicroSD card and the SIM card are only accessible by first opening the battery door:

- The "SIM" card slot is positioned on the left side of the battery opening
- The "MicroSD" card slot is positioned on the right side of the battery opening

To remove the MicroSD card or SIM card:

1. Open the battery door
2. Gently push the card in; it will then snap back and slightly out
3. Remove the card

Note: When you insert either card make sure the contacts on the card are facing upwards, towards the top of the unit and the side of the card with the notch first.

To insert the MicroSD card or SIM card:

1. Place the card in its appropriate card slot
2. Gently push the card in until it clicks
3. Close and secure the battery door

Figure 2-10: SIM /MicroSD card slot

Resetting the S321

To reset the S321, lift the battery door and locate the “Reset” button between the SIM card and MicroSD card slots. The reset button will turn the unit off and automatically restart the unit.

Figure 2-11: S321 Reset button

Chapter 3: Setup and Configuration

Control Panel Overview
Setting up the S321
Installing the Base
Installing the Rover
Bluetooth Communication
Hemisphere WebUI
WebUI Settings
Firmware Update
Downloading Static Data
Calibrating S321 Internal Sensors

Chapter 3: Setup and Configuration

Control Panel Overview

You operate the S321 using the control panel shown below.

Figure 3-1: Control panel and display

Satellite LED (Green)

The LED illuminates and stays a solid green color to indicate a signal/satellite lock has been achieved.

Figure 3-2: Satellite LED static LED (green)

It switches on if the static mode is selected and it starts to blink when the receiver is recording data, with the same frequency of the sample rate.

Figure 3-3: Static LED

Bluetooth LED (Blue)

Once you have connected the receiver with the data controller, this LED will illuminate.

Figure 3-4 Bluetooth LED

Wi-Fi-LED (Green)

This indicates the S321 is emitting a Wi-Fi network and is ready to be paired with a Wi-Fi enabled controller or device. By connecting to the S321 device network, you can control the S321 via WebUI. For more information on the WebUI, please see section WebUI.

Figure 3-5: Wi-Fi LED

External Data Link or Internal UHF Radio LED (Green)

The LED is green when the device is selected as an RTK data link, via an external data link or an internal UHF radio link. It begins blinking when the S321 is either transmitting data as a base or receiving data as a rover.

Figure 3-6: Internal UHF radio LED

Network LED (Green)

The light is on when the network module is selected as RTK data link. It starts to blink when receiving and transmitting data. (Download in rover mode and upload in base mode).

Figure 3-7: Network LED

Power

Includes two modes of function:

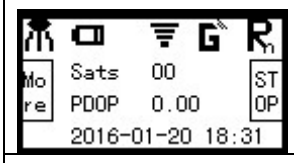
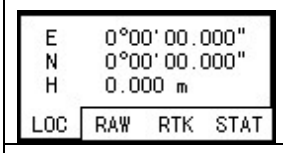
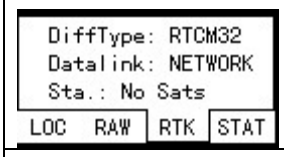
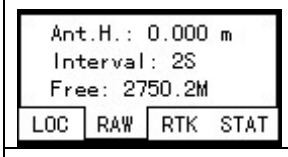
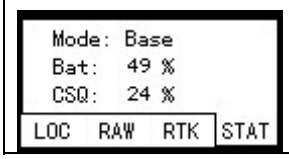
1. LED Display On: Power supply is functioning at full capacity
2. Blinking LEDs and Beeping: Very low power (below 10%)

When the power is below 10%, the LEDs will flash according to sample interval (default is 1 second) and you hear three beeps every 60 seconds.

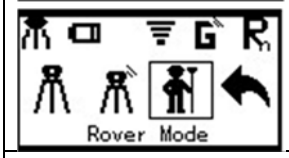
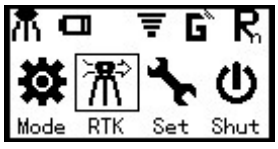
Table 3-1: Definition of icons on the S321 menu

Type	Icon	Explanation
Operating mode		Rover mode
		Base mode
		Static mode
Power status		Full battery power or external power supply
		Battery power remaining ¾
		Battery power remaining 2/4
		Battery power remaining ¼
		The battery needs to be replaced
Date status		The Rover station is receiving differential
		The base station is transmitting differential
Date link		UHF, number in right corner indicating the channel
		GPRS module
		External Data Link
		Bluetooth data link
Difference type		RTCM3.2
		RTCM 3.0
		RTCM 2.3
		CMR
		DGPS

S321 Menu Structure and Information

	Home Page
	Coordinate Information
	Current Data Link Status
	File Information
	Device Status

Operating Mode Settings

 	Switch Operating Modes
 	Switch Data Link

General Settings

 	Wi-Fi
	Backlight
	Language

Setting up the S321

The following figure shows a typical setup for both a base station unit and a rover unit (tripod and pole mount not included, data collect is optional).

The antenna is connected to the bottom of the unit; you have the option of attaching the antenna to the antenna bracket, so the antenna faces upward.

Figure 3-8: Base and Rover setup

Installing the Base

1. Put a tripod on a location with known coordinates or unknown coordinates, attach the receiver to the tribrach.
2. Attach the transmitting radio antenna into the port “UHF”: using the 40cm supporting pole is better, since increases the height of the antenna.
3. Switch on the receiver and select the base working mode.

Installing the Rover

1. Fix the bracket on the pole, fix the hand-held to the bracket, put the rover on the pole and attach the receiving antenna into the port “UHF”.
2. Power-on the receiver and select the rover working mode.
3. Open the hand-held and start the software, then you can set the instruments.

If you want to take very accurate measures (few cm), we recommend using a tripod and put the rover on it.

Bluetooth Communication

If you have a Bluetooth-enabled device, such as a data collector, you can wirelessly communicate with the S321.

When you attempt to connect the S321 to a Bluetooth-enabled device, such as a hand-held data collector, the following S321 Bluetooth information appears on the device:

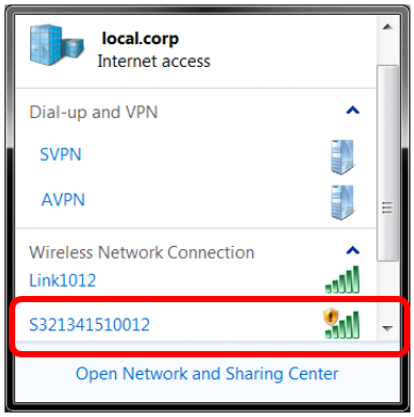
S321 XXXXXX
where “XXXXXX” is the serial number

Hemisphere WebUI

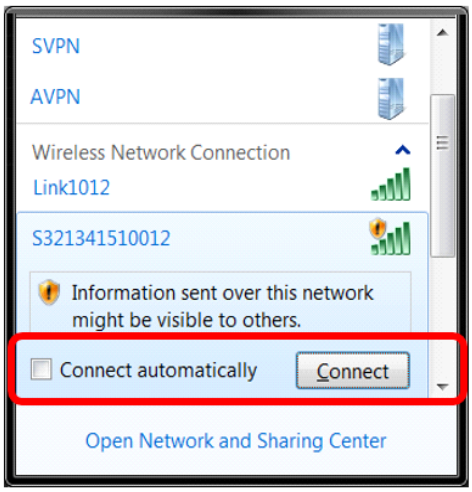
The WebUI can work on any PC, Tablet, or Phone that has Wi-Fi network capabilities.

Initial Setup

Using the Windows Wi-Fi network, locate the Wireless Network Connection labeled S321XXXXXXXXX.



If you want this network to automatically connect, select the “**Connect automatically**” check box before pushing the “**Connect**” button. If not, click on the “**Connect**” button.



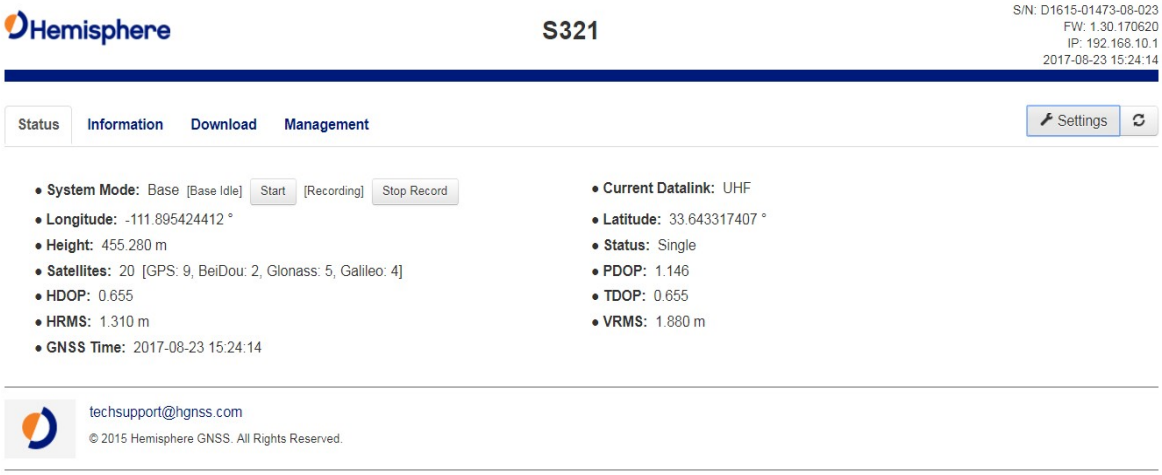
Once connected to your device. Type or copy the following IP address into your URL bar: http://192.168.10.1/

The WebUI will prompt you for a user name and password. The default user name and password are:

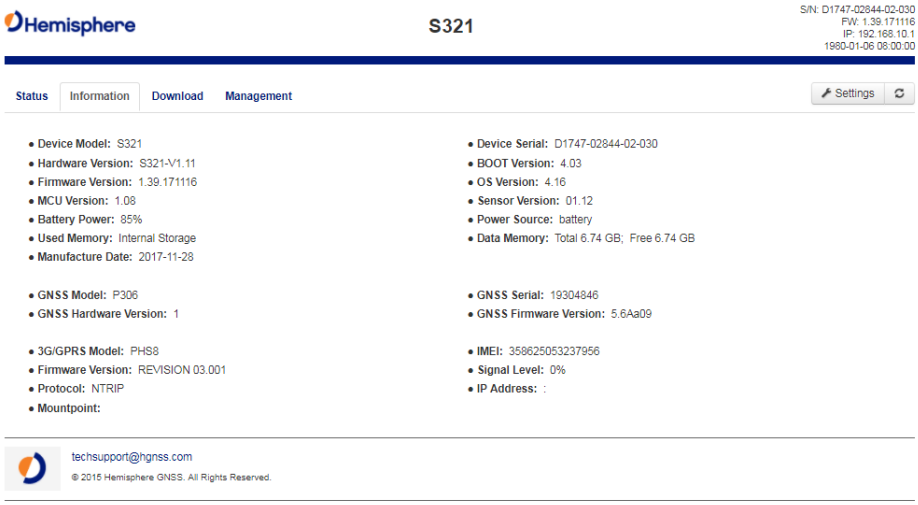
- User Name: admin
- Password:s321

WebUI Start-up

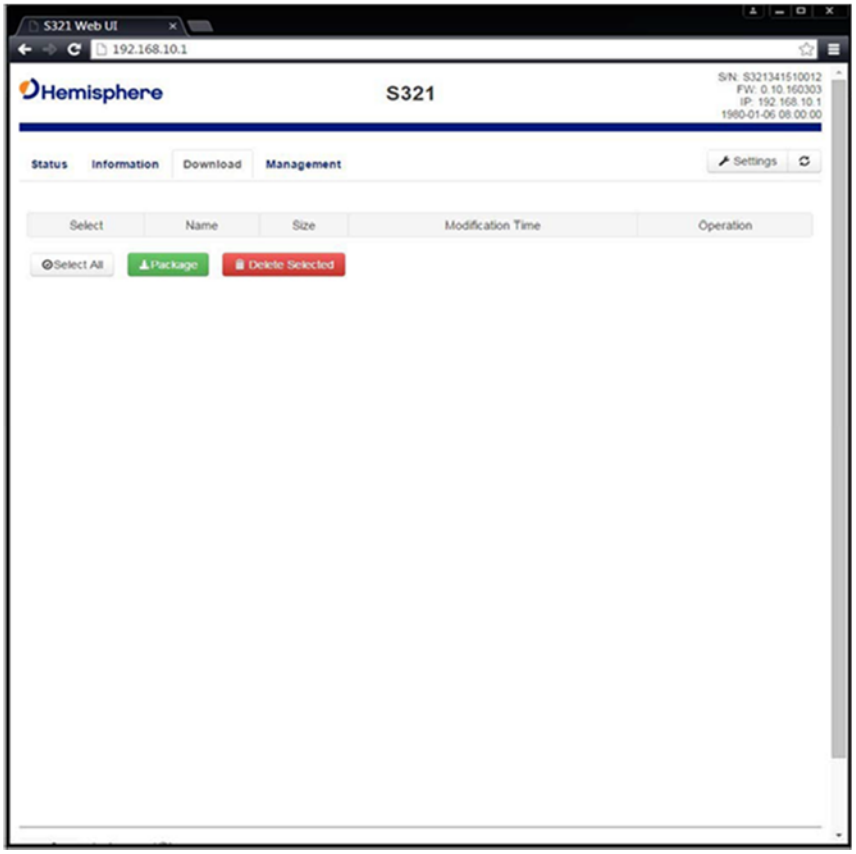
The "**Status**" tab, provides general GNSS information including System mode, Latitude, Longitude, and Height.



The "**Information**" tab contains device and module information, in addition to current software and firmware versions.



The “Download” tab allows you to log and review multiple data files from the on-board memory of the device.



The **Management** tab provides access to the firmware update tools, a terminal to register authorization codes, and password customization to properly secure your device moving forward.

Install New Firmware

This feature allows you to update the menu application software. Once the correct software is selected under the Choose File browser, the Upload File button initiates the update procedure and re-starts the S321 device.

WARNING: Firmware downgrades are not allowed to versions lower than v4.16 (OS), v4.03 (Bootloader), and v1.38.171114 (WebUI).

GNSS Registration

This displays the expiration date of different features which have been subscribed to the S321.

The Atlas expiration date will be displayed under this field. In addition, the ability to update the S321 with new subscriptions is available under the “AuthCode” field. Type the new Atlas code and the device will automatically update.

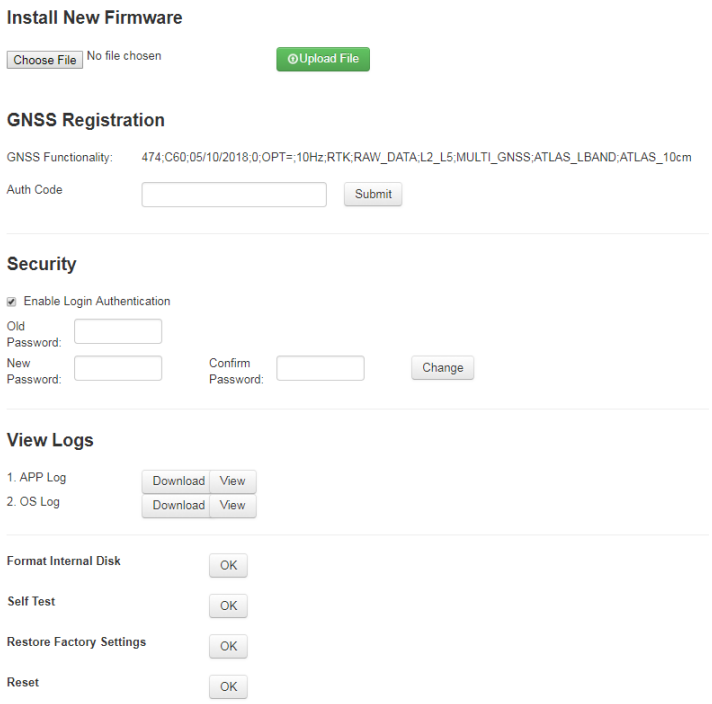
Security

The Security field allows the user to enable or disable login requirements. The user can reset or customize a new password for their device. By filling in the required fields to change the password, Old Password, New Password and Confirm Password.

View Log

The View Logs field allows you to track any activity at the application and OS level. (This is important when troubleshooting any issues.)

Formatting/Self Test/Reset



The **Format Internal Disk** button allows you to reformat the internal hard drive in the S321.

Self-test provides an application review to ensure the device functioning properly (See self-check for more information).

Restore Factory Settings returns the S321 to all default settings and perform a full power cycle.

Reset initiates a complete device shut down, creating a hard reset to the device and stopping any application activity. (See Resetting the S321 for more information).

WebUI Settings

Working Mode: UHF

When using a UHF datalink, channel tables must be configured by a certified Hemisphere GNSS dealer, or by uploading a channel table file provided by a dealer.

Important: The Advanced UHF Settings can only be accessed by Hemisphere GNSS or a certified Hemisphere GNSS dealer.

- **Cutoff Angle**: satellites at a lower angle to the horizon than “5” are not used in the GNSS solution
- **GLONASS**: Enable or Disable the use of GLONASS satellites
- **BeiDou**: Enable or Disable the use of BeiDou satellites
- **Galileo**: Enable or Disable the use of Galileo satellites
- **SBAS**: Enable or Disable the use of SBAS for DGNSS corrections
- **L-Band**: Enable to use Atlas corrections or aRTK
- **RTK Timeout**: this field indicates the amount of time an RTK correction will continue to be used after RTK corrections are lost. (**Note:** If using aRTK, set the L-Band to Enable and RTK Timeout to 2700.)
- **Athena Log**: Record raw data for converting to **Rinex** and post-processing. If “**Yes**” is selected, the following dialogue will display: Access the Rinex converter using the following hyperlink: https://hemispheregnss.com/Resources-Support/Software

- **Point Name:** choose a name for the point that is occupied
- **Antenna Height:** type the height of the antenna in meters (Note: older versions of firmware required millimeters (mm) as seen in the image. Please refer to the unit listed to the right-hand side of the field.)
- **Pdop Threshold:** data will not be logged if the Pdop of the receiver exceeds the user defined value (3.5 is the default value, but this can be changed.)
- **Interval: log** data at intervals of 30s, 15s, 5s, 1Hz, 2Hz, 5Hz, or 10Hz

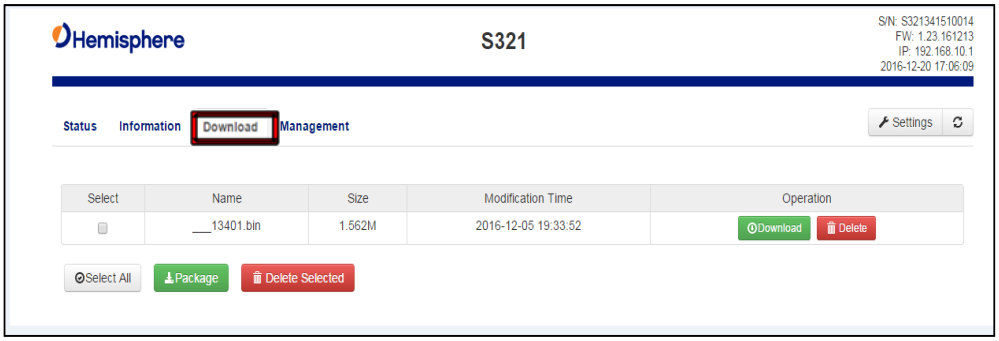
While the receiver is logging data, the WebUI will display [Recording] next to System Mode under the Status tab. To stop recording, click Stop Record.

To download the log, click the "**Download**" tab.

All logs stored on the S321 internal hard drive will display.

Click "**Delete"** to delete the log.

Multiple logs can be downloaded or deleted at one time by selecting the box next to each of the logs and clicking **Package** or **Delete Selected**.



System Modes

The S321 can be configured as a Survey Rover, Base Station, or run a Static Observation.

The Base Position must be configured. Select **Base**, under System Mode, the following dialogue appears:

- **Automatically Start Base**: Set to **Yes** if the S321 should automatically begin broadcasting RTK upon startup. If set to **No**, you must manually start the base every time the unit is powered on.
- **Data Type**: Broadcast RTK via RTCM 2.3 (DGNSS), RTCM 3.0, RTCM 3.2, CMR, CMR+, or ROX (Hemisphere proprietary message format).
- **Site ID**: Base station ID
- **Pdop Threshold**: Only transmit RTK if the PDOP of the base station is less than this value.

To set the base location select one of the following:

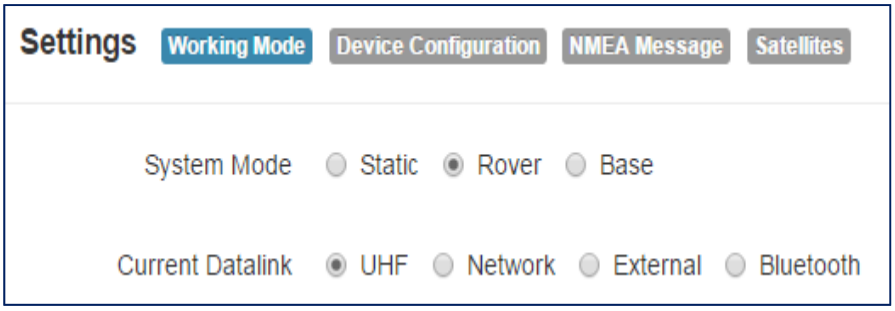
- **Single:** Upon startup, the S321 will average its position, and use that position for the base position.
- **Repeat Position:** is used to input a permanent base station position into the S321. You may type in a latitude, longitude, and altitude, or click "**Current Position**" to automatically populate the field with the current GNSS position.
- **BaseLink:** (Upcoming feature) this feature requires an Atlas H10 (10-centimeter) subscription. Input a Target Accuracy. Once the accuracy of the GNSS position of the receiver has reached the Target Accuracy, the receiver will begin to output RTK based on its calculated position. The accuracy of the GNSS position may continue to improve. If it does improve, a new target accuracy may be entered, and the base position will shift to reflect the new accuracy.

Data Links

The S321 supports the sending and receiving of RTK via the Internal UHF radio, external devices (such as an external radio) via serial, TCP/IP, NTRIP, and Bluetooth (rover only).

Internal UHF

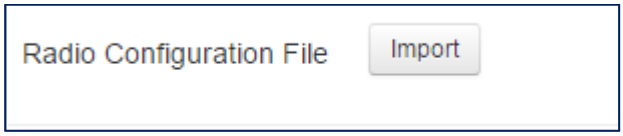
Your S321 comes without a channel table loaded. Only Hemisphere GNSS or a Hemisphere GNSS certified dealer can create the file to upload a channel table.



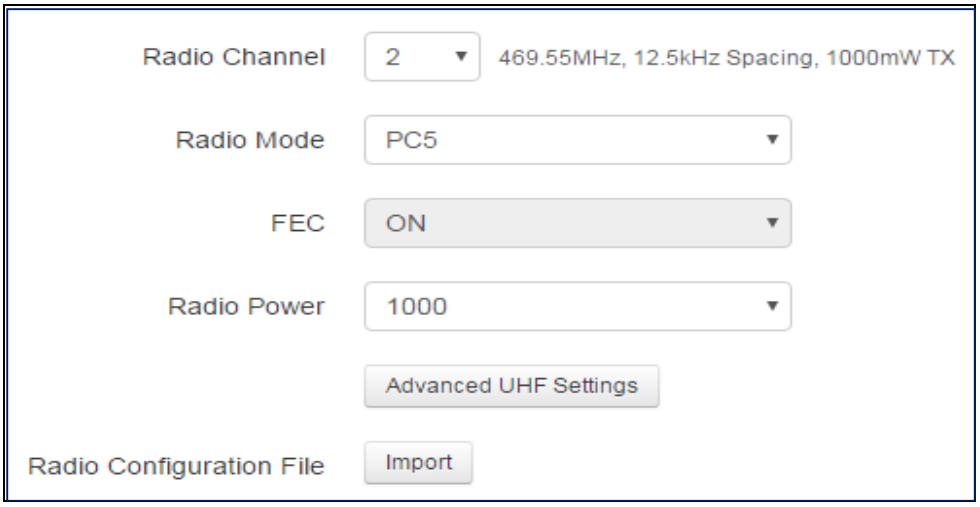
A channel table can be created through the WebUI by a certified Hemisphere GNSS dealer by clicking on **Advanced UHF Settings** and typing a password.

You can also upload by clicking **Import** next to **Radio Configuration File** and uploading a channel table file (.ucf) provided by your dealer.

Note: The radio frequency should match the transmitting base. The following dialogue appears:



Next to **Data Link** select **UHF.** The following dialogue appears at the bottom of the page.



- **Radio Channel:** Select a channel from the channel table provided by your dealer. The frequency, bandwidth, and transmit power (base only) is shown next to the channel
- **Radio Mode:** The S321 supports PacCrest protocols (GMSK and 4-FSK modulation), Satel protocols, and Trimtalk protocols. For a full list of protocols, with descriptions (FEC, Scrambling, over the air link rate, and modulation), please refer to Appendix C.
- **FEC:** Forward Error Corrections
- **Radio Power**: Transmit RTK corrections at 100mW, 200mW, 500mW, or 1W (dependent upon the radio settings and restrictions provided by your dealer). This feature is only displayed when running as a base.

External

If you wish to send RTK corrections out of the serial port (such as to an external UHF radio) instead of to the Internal UHF radio, as explained above, select **Externa**l next to “Current Datalink.”

Select the **baud rate** of the external device and plug that device into 5-pin serial port. (Baud rates range from 9600 bps – 115200 bps.)

The part numbers for the 5-pin cable are as follows:

Table 3-1: S321 5-pin cables

5-pin Cable	Part Number
S321 Power Cable (Alligator Clips)*	054-0171-0
S321 Power Cable (PacCrest/Rcvr)	054-0172-0
S321 Power Cable (Satel/Rcvr)	054-0173-0
S321 Power Cable (Serial/Rcvr)**	054-0179-0

*The above cables come with unterminated power and communication. The alligator clips cable connects to the other cables. Three variations of the cable exist: one variation has a connector (serial) to plug into Pacific Crest radios. The second variation has a connector to plug into Satel radios. The third variation has a standard DB9 connector. Please see a certified Hemisphere GNSS dealer to ensure that the pinout of these connectors matches the pinout of your radio.

**Most radios may require a null-modem adapter.

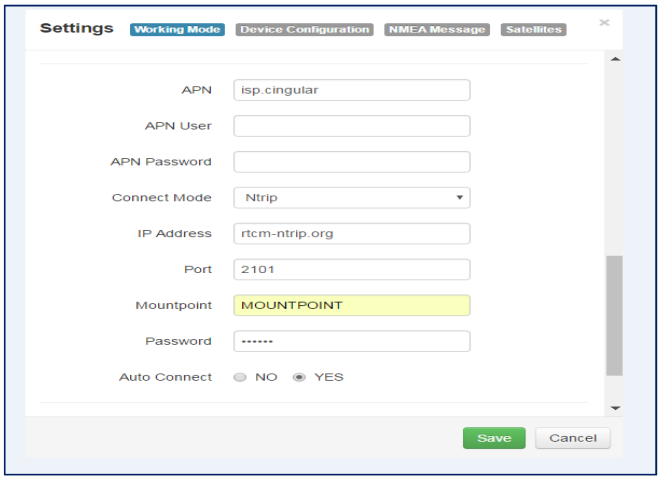
Network

The S321 supports TCP/IP connections for direct connection between base and rovers via cellular as well as NTRIP.

NTRIP

NTRIP requires a specific IP address, username and password. When used as a base, the S321 is an NTRIP server.

Type your **APN User name**, **APN Password**, **IP address**, **Port**, and **Mountpoint**. If a username and password is not required for your APN, you can leave those fields blank. The configuration of NTRIP for a Base is shown below:



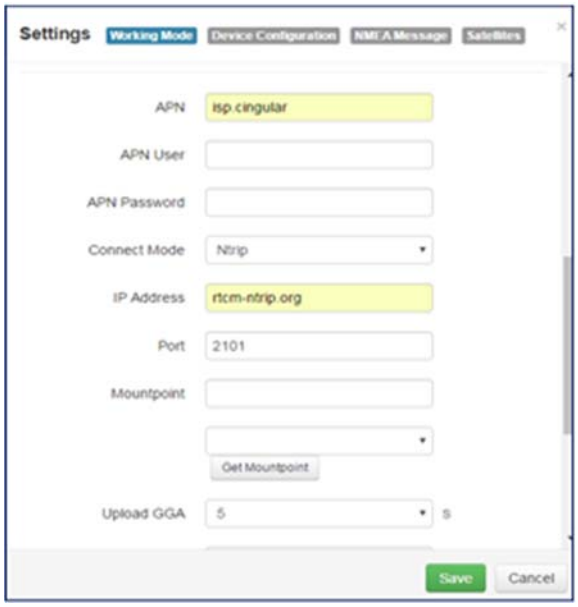
If configuring NTRIP for a Rover, click **Get Mountpoint** to generate a list of available mount points.

Some networks require a GNSS position prior to sending RTK. To send GNSS positions to the network, click on the dropdown menu next to "**Upload GGA**" and select a rate.

Note: The **Auto Connect** identifies that the receiver connects to the network when powered up.

WARNING: If the S321 has not yet established an internet connection via the Internal GSM modem, the **Get Mountpoint** button will not work. You can configure the APN settings while using TCP/IP so that an internet connection is established.

After establishing an internet connection, change **Connect Mode** back to **NTRIP** and proceed with the configuration.

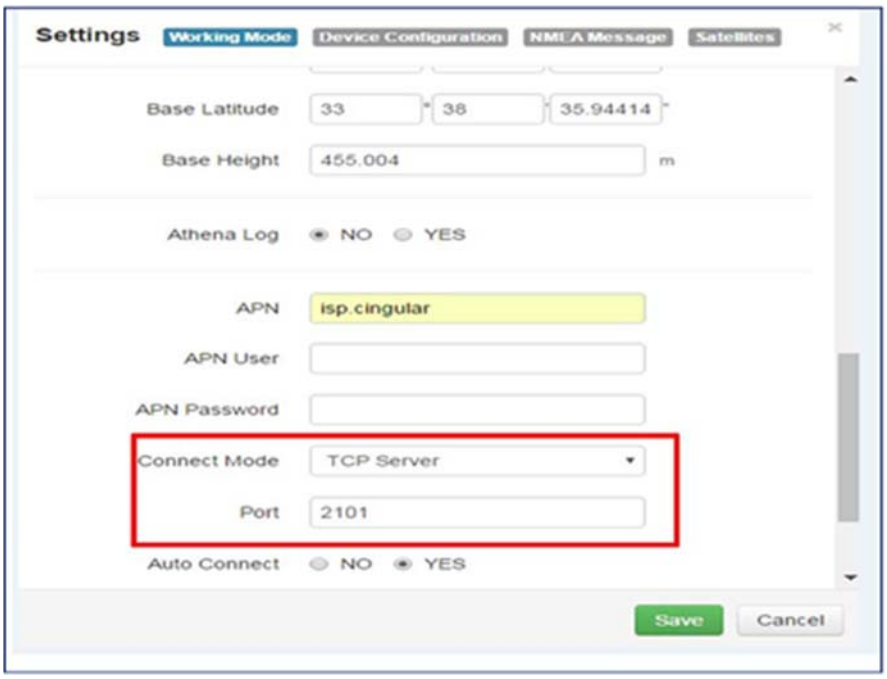


TCP/IP

If running as a base station, select **TCP Server** and type in a **Port**.

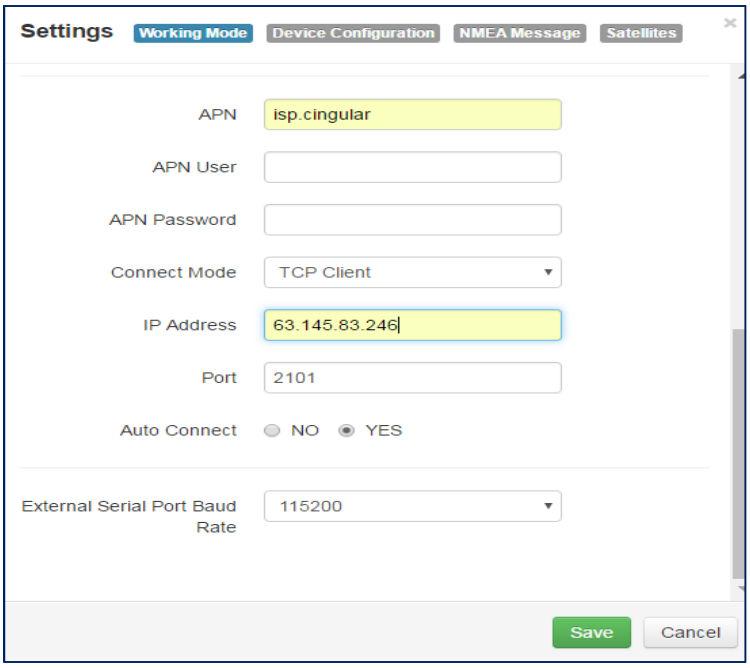
The TCP Server requires that the SIM card provide a public IP address. The public IP address can be found in the "**Information"** tab on the S321 WebUI.

Note: The **Auto Connect** identifies that the receiver connects to the network when powered up.



If the S321 is running as a rover, select **TCP Client** and type in the **IP address** and **Port** of the base.

Note: The IP address and Port of the base can be found under the "**Information"** tab of the base station.



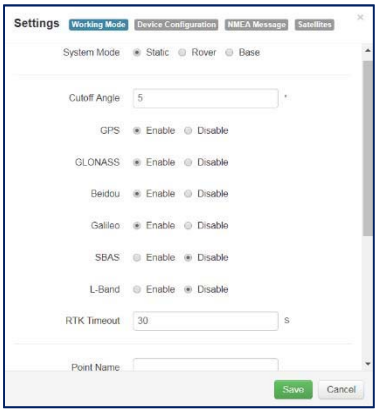
Rover/Bluetooth

The Rover/Bluetooth is typically used with third-party software when streaming network corrections to the data collector internet and then sending them to the S321 via the Bluetooth communication port.

Static

Use Static mode to take a static observation of a point and stop logging (for both base and rover) if the position moves.

Select **Static** next to **System Mode** and configure the log file (to configure a file, refer to Working Mode for instructions).

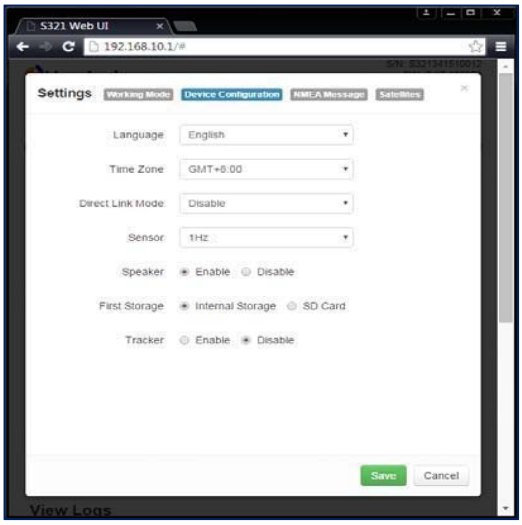


Device Configuration

The “**Device Configuration”** tab allows for custom settings in terms of language, time zones, storage, and several other options.

When enabling the speaker, the S321 relays the status of the positioning via voice updates. Specifically, the S321 will audibly indicate when the receiver is in **Base** or **Rover** mode. Voice indication covers, logging data, and declaring when the S321 has achieved RTK float and RTK fix. This is important when working in a low visibility environment.

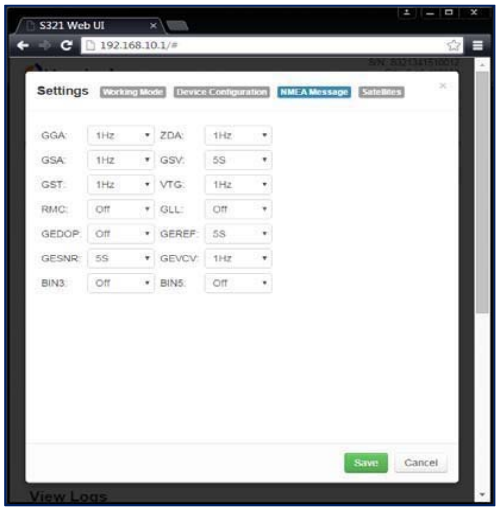
Direct Link Mode enables certain troubleshooting features for Hemisphere GNSS and certified Hemisphere GNSS dealers. In addition, the easy-to-use radio buttons allow you to use tracker and select which mode of data logging storage you wish to use, SD or Internal.



NMEA Message

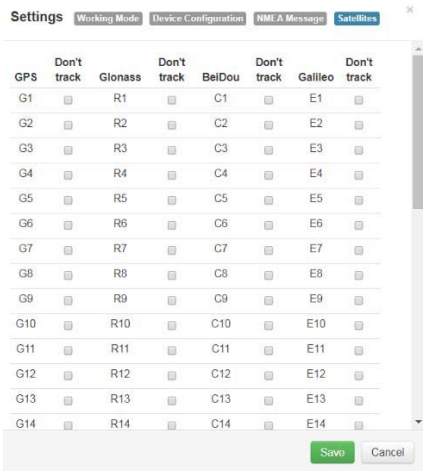
Turn the NMEA messages on.

Note: This function is only available if you have hardware version S321-v1.1 (see "**Information**" tab) or higher, these messages will come out of the 5-pin serial port at the same baud rate as the External Serial Port Baud Rate (as shown above). This function cannot be used if you are using an external device for RTK.



Satellites

If you wish to exclude a specific satellite, select the **Don't track** checkbox next to that satellite in the list.

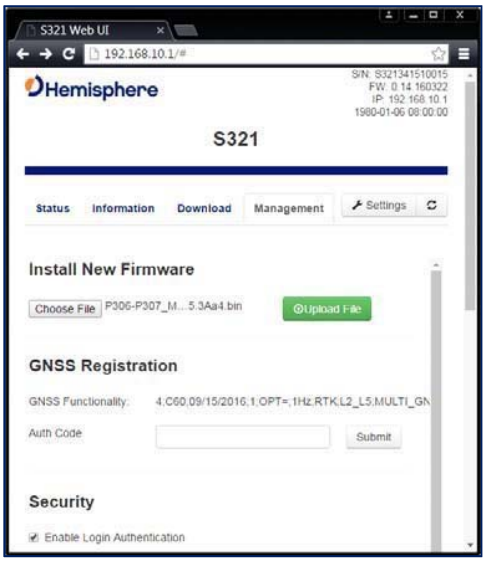


Firmware Update

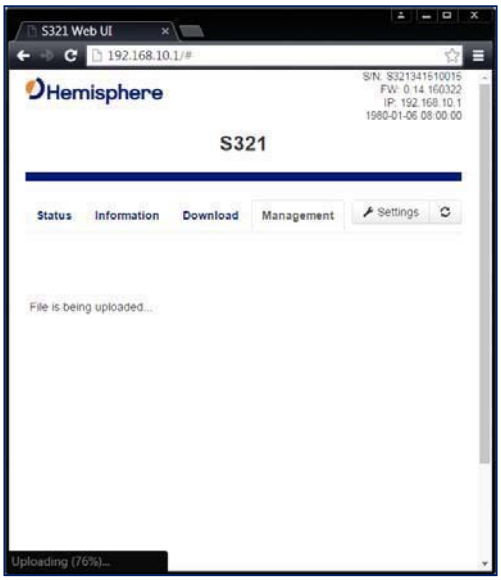
WARNING: Firmware downgrades are not allowed to versions lower than v4.16 (OS), v4.03 (Bootloader), and v1.38.171114 (WebUI).

Updating Firmware via WebUI

Using the "**Management**" tab under the WebUI, select the "Choose File" button to find the appropriate firmware of application software for the S321 device.

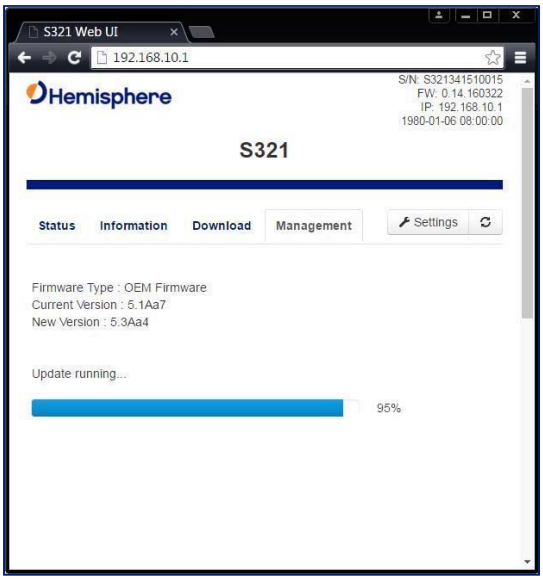


After selecting the correct firmware/software file, click the green "**Upload File**" button.

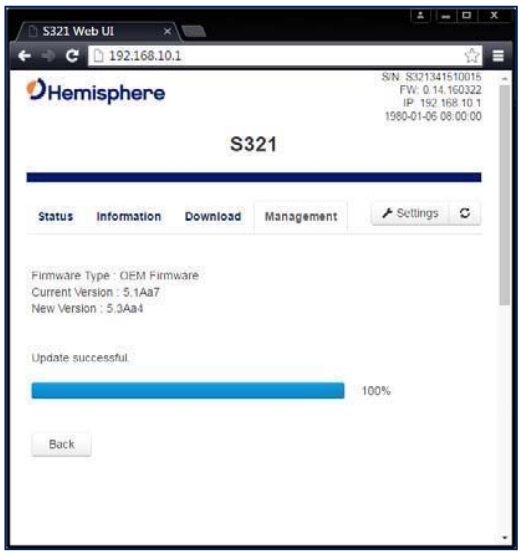


When the file is uploaded, be sure to check the current firmware version versus the new firmware version. When you have ensured the correct files are in place, click "**OK**" button.

A status bar will indicate the level of progress for the updating firmware/software.



When the status bar reaches 100%, the upgrade is complete. The WebUI will indicate "**Update successful**".



Updating Firmware via MicroSD Card

Using the WebUI, select "**Settings**" and "**Device Configuration**". Under "**Device Configuration**", locate the "**First Storage**" option, and select the "**SD Card**" radio button. Click the "**Save**" button at the bottom right of the screen.

Place the upgrade files under "update" folder of the MicroSD card. Version info must be place after the file name and separated by "_". The name must follow the naming convention listed below:

Receiver firmware: S321_update_YYMMDD.bin YY: Year MM: Month DD: Day
e.g. S321_update_160202.bin

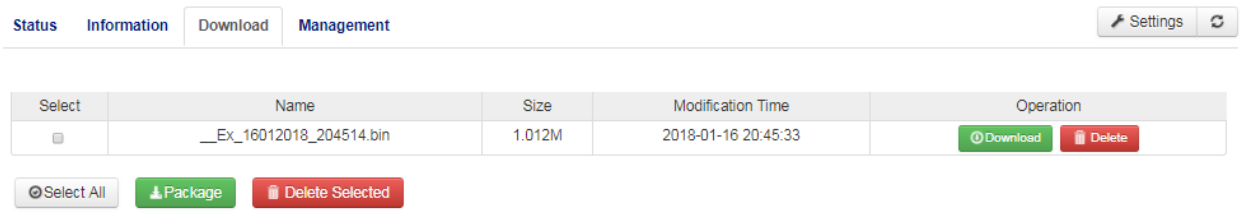
Radio firmware: SATEL_update_XXXXX.bin XXXXX: version
e.g. SATEL_update_V07.27.2.0.8.6.bin

3G module firmware: PHS_update_XXXXX.bin XXXXX: version
e.g. PHS_update_03.001.bin

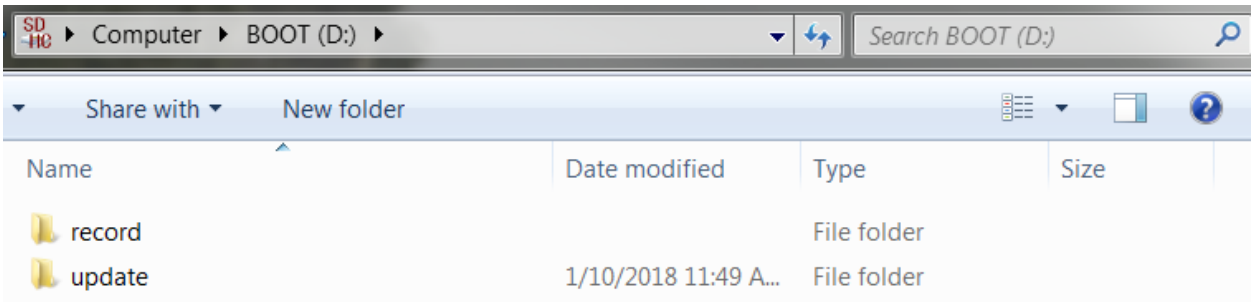
How to Download Static Data

Static data can be logged to the S321 internal memory or to a MicroSD card. If "First Storage" is set to "Internal Storage" (see Device Configuration), the log files save to the internal memory of the S321.

To download the logs, log into the WebUI and click Download.



If "First Storage" is set to "SD Card," the files save to the MicroSD in the S321. If the MicroSD is full, or the S321 does not have a MicroSD card placed inside, the files save to the S321 in a folder called "record."



How to Calibrate S321 Internal Sensors

After the software has been installed, you can calibrate the S321's internal sensors using the **CalibrationTool** software running on a Windows Mobile/WEHH-based data collector. The complete calibration consists of three steps:

Step 1- Electronic Bubble Calibration - calibrates the tilt sensors necessary to use the electronic bubble or Live Digital Level (LDL) feature in **SurvCE**. The Electronic Bubble calibration is the basic, fundamental calibration for any sensor-related commands in **SurvCE**. If you only plan on using the leveling features like LDL (or electronic-bubble), level tolerance checking or auto store by leveling, then you need only perform Step 1 calibration.

The Electronic Bubble Calibration can also be performed from a SurvCE/PC configured with the S321 driver and using the Equip/GPS Utilities/Sensor Calibration/Zero Calibration function. The setup and preparation for Electronic Bubble Calibration from SurvCE/PC is the same as described below for the **CalibrationTool** software.

Step 2 -Magnetic Calibration & Step 3- Magnetic Bias Angle (magnetic declination) adjustment - calibrate the e-compass sensors in the S321 and are only required if you are planning to use **SurvCE's** inclined pole compensation features while taking GNSS measurements in **SurvCE's** Store Points or Stake functions.

Preparation
The following equipment is required to complete all three calibration steps.

Qty.	Description
1	2 m Survey Pole
1	Vertical Rotation Bracket

Table 3-3: Calibration equipment/items (per step)

Equipment/Items	Step 1 Electronic Bubble	Step 2 Magnetic	Step 3 Magnetic Bias Angle
Data Collector (running the Windows Mobile or WEHH	**X**		
CalibrationTool (should be installed on the data collector*)	**X**		
A quality, calibrated tribrach with accurate visuals A line vial is usually more accurate than a spherical vial.	**X** *In Step 1, the tribrach can be set on a solid table or tripod*	**X** *In Step 2, the tribrach should be mounted on a solid tripod*	
Solid pole (not less than two meters long with calibrated vial			**X**
A connection to a base station using either the S321's internal radio, internal GSM cell modem For best performance, the effective distance is less than 1 kilometer (0.6 miles.)			**X**
Assembly that is included with the S321 kit. The four Mini Rotary Bracket components are shown in Figure 3-9.		**X**	
Fully charged S321 battery	Not battery dependent	**X** *In Step 2, the e-compass calibration is tied to each individual battery in use and stored in the GNSS unit by a unique and internal battery ID.* *Step 2 should be repeated for each battery that you will later use in the S321.*	**X** *In Step 3, the e-compass calibration is tied to each individual battery in use and stored in the GNSS unit by a unique and internal battery ID.* *Step 3 should be repeated for each battery that you will later use in the S321.*
An open area free of strong magnetic fields and free of potential for high multipath. **Note:** The farther away you are from a magnetic interference source increases performance. For example, it is better to be 20 meters (60 feet) from your vehicle than 5 meters (15 feet).			

*Note:

- A link to the **CalibrationTool** software can be found in Carlson Knowledge Base Article #1066 which is located at: http://www.carlsonsw.com/?gs=
- Download the **CalibrationTool** software (a zip file) onto your laptop/PC using the link found in the above-mentioned Knowledge Base article. Unzip the downloaded file. This creates a folder titled:*CalibrationTool-160315-2*

- Copy the contents of the *CalibrationTool-160315-2* folder to your data collector. Make a note of the location of this folder on your data collector.

Figure 3-9: Mini-rotary bracket

Using your handheld device, open the **SurvCE** application by tapping on the **SurvCE** icon.

In the **SurvCE** application, tap the **File** tab in the top left portion of the screen. Then, tap the 1**Job** button.

After setting or continuing a job, tap the **Equip** tab at the top of the screen. On the ***Equip*** tab, tap the **3*GPS Rover*** button.

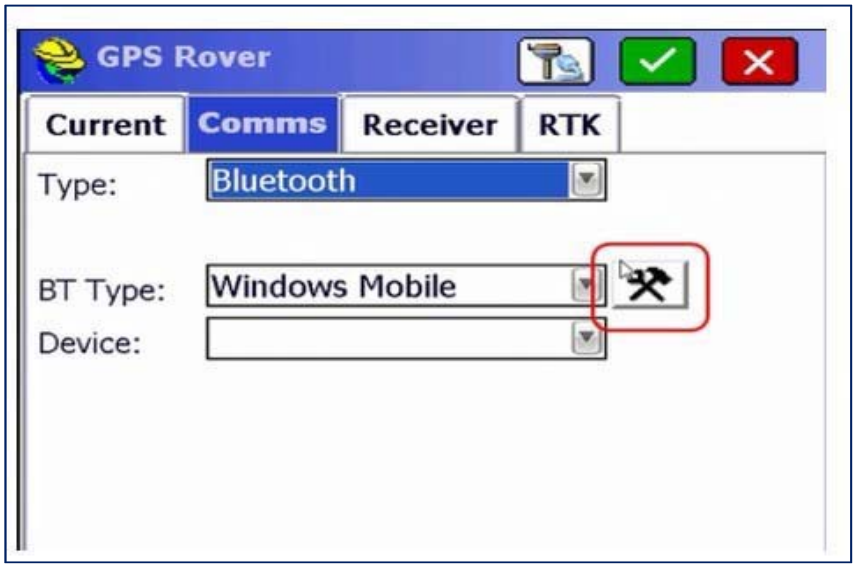
The GPS Rover menu contains four main tabs. The **Current** tab indicates the "current" rover attached to **SurvCE**.

To calibrate your S321, select "**Hemisphere GNSS**" from the **Manufacturer** drop-down list. Select "**S321**" from the **Model** drop-down list.

On the **Comms** tab, select **Bluetooth** from the **Type** drop-down list. Select the "**Windows Mobile**" **BT Type**.

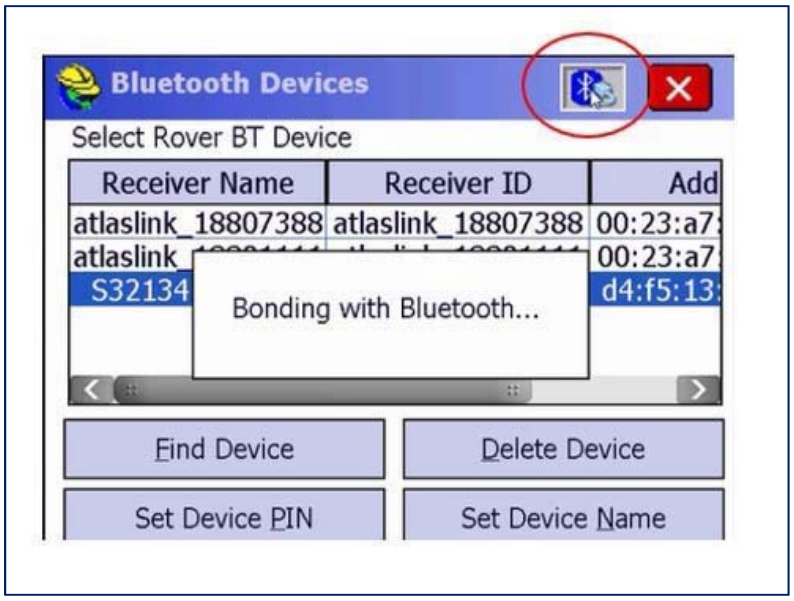
Tap the wrench and hammer icon.

Note: Click the wrench and hammer icon to find your S321 device.

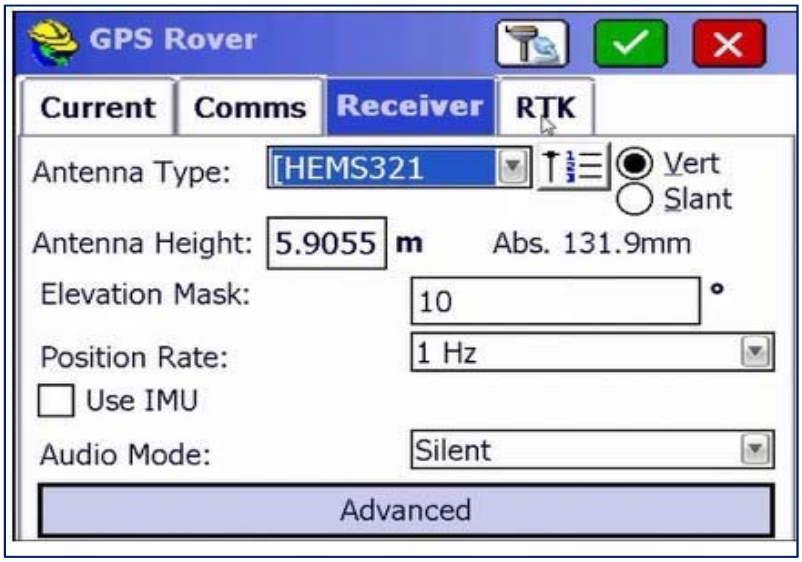


Tap the **Find Device** button and wait for a complete list of devices to generate.

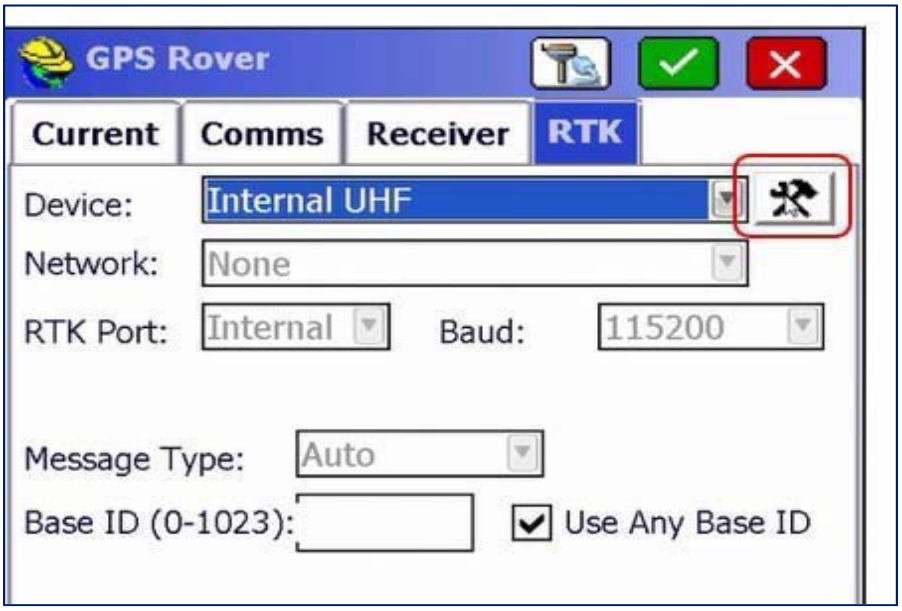
When you see your device on the list, tap the **device name** to highlight it. Then press the **Bluetooth Connect** icon at the top right of the screen.



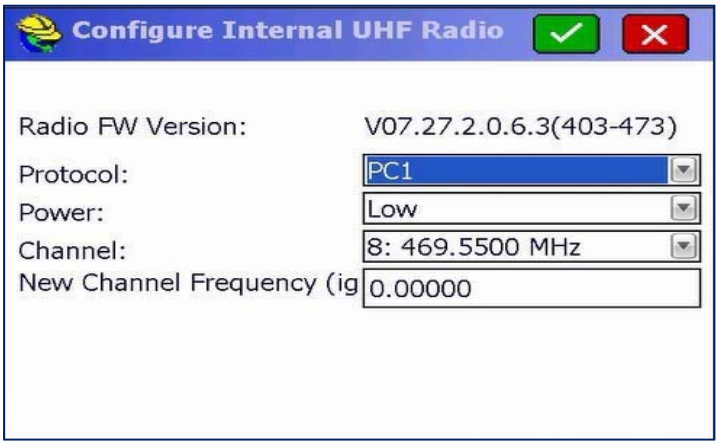
Once Bluetooth has bonded with your device, tap the **Receiver** tab. Under **Antenna Type**, ensure **HEMS321** is selected from the drop-down list.



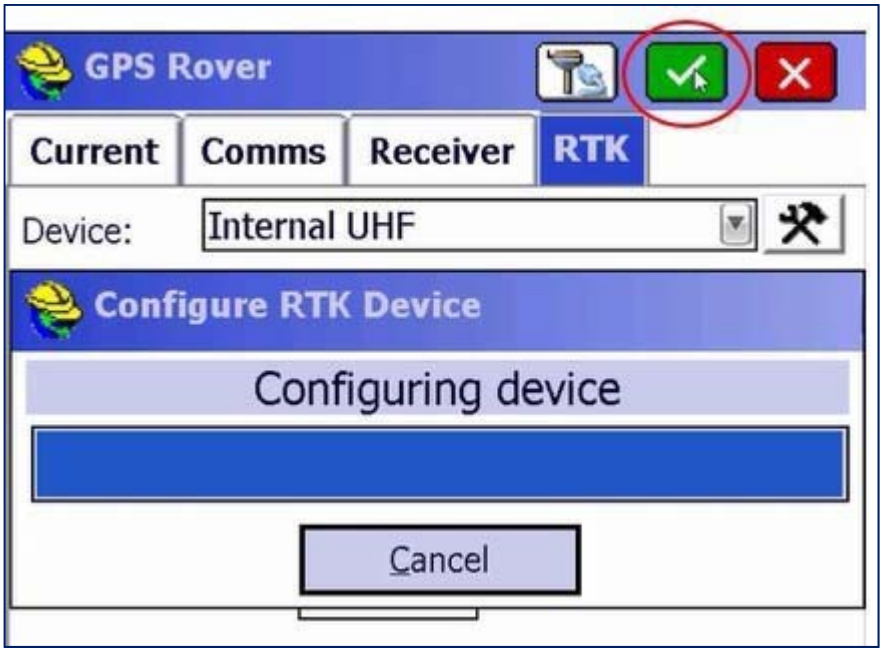
Tap the **RTK** tab. Under **Device**, select "**Internal UHF**" from the drop-down list. Tap the wrench and hammer icon.



The "Configure Internal UHF Radio" menu allows you to set your rover to your desired protocol required to connect to a local base.

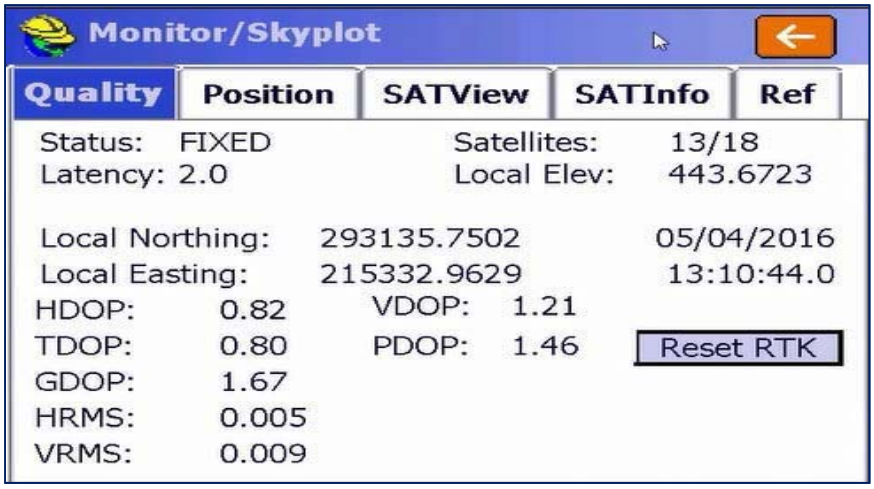


When your desired protocol has been selected, tap the green checkmark at the top of the screen.



When your UHF radio configuration is complete, tap the **Equip** tab (if not already selected) and tap **7 Monitor/Skyplot**.

Under ***Monitor/Skyplot***, tap the **Quality** tab to verify you are tracking Satellites and have a "**Fixed**" position.



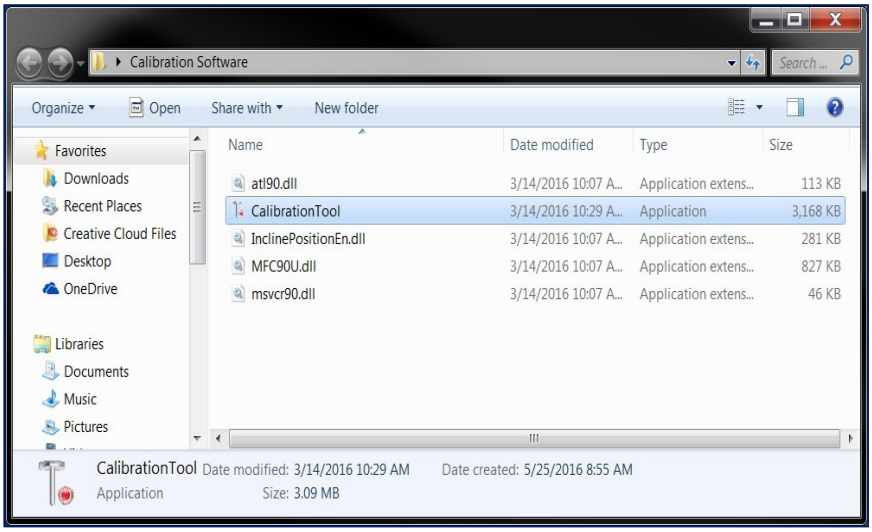
You are now ready to exit **SurvCE**. Tap the **File** tab and tap the **Exit** button in the lower-right portion of the screen.

When prompted with a pop-up asking if you are sure you want to exit, tap the **Yes** button.

Connect your handheld device to your PC via the USB communication cable included with the handheld. After connecting, ensure your Mobile Device Center is open and running on your PC. This allows you to export software to the handheld device.

Select the "**CalibrationTool**" file to export the software to the desired handheld device.

Note: When successfully uploaded to the handheld, the software will appear under the file management section of the handheld.



Calibration Step 1 – Electronic Bubble Calibration

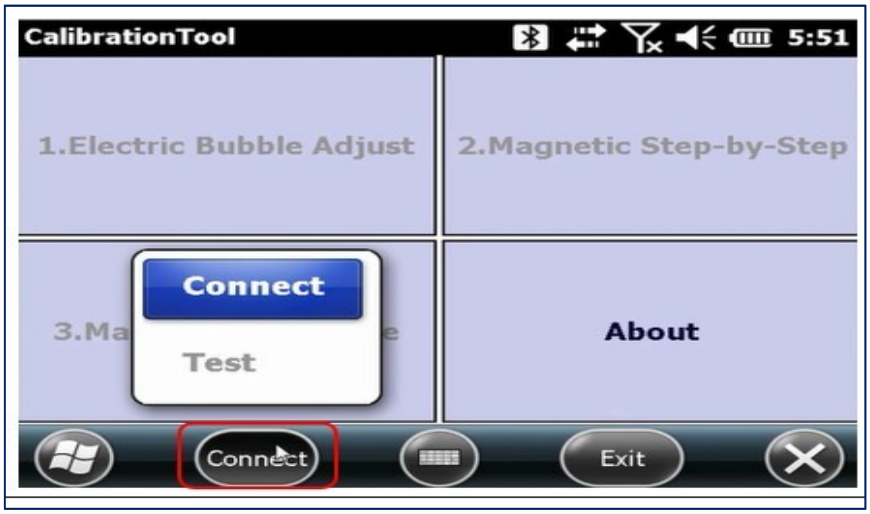
An accurate Electronic Bubble calibration will help ensure successful and accurate calibrations in Steps 2 and 3. The calibration Step #1 can be performed either indoors or outdoors, as it is NOT affected by magnetic noise, and it does not require either RTK corrections or the presence of GNSS signals.

The S321 should be mounted on either a tribrach or pole that has been leveled as accurately as possible. A high quality, calibrated tribrach with an accurate line level in a rotating mount as shown below will provide the best calibration.

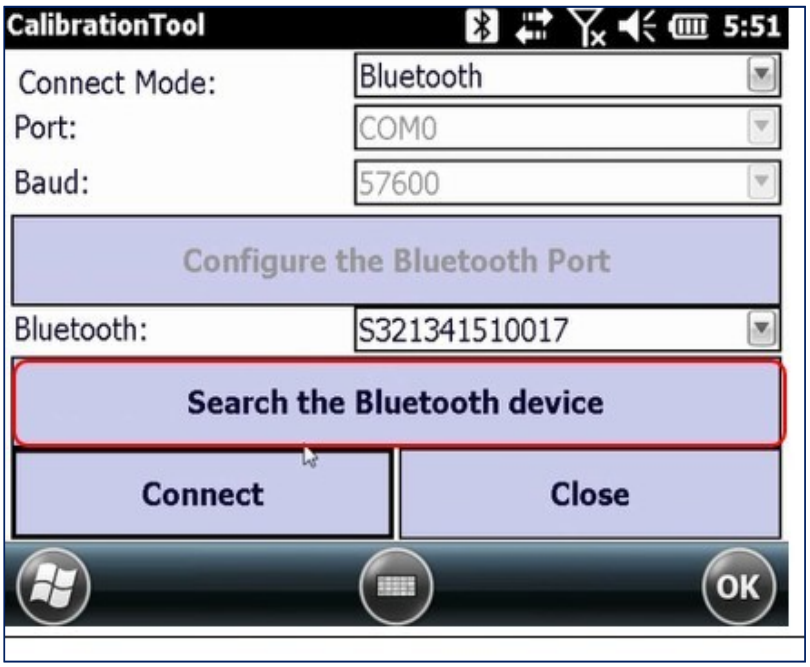
From your handheld device screen. Tap the "**File Explorer**" icon.

Locate the **CalibrationTool** from your list of Calibration Software. Tap the **CalibrationTool** to open the program.

When the **CalibrationTool** launches, you will be required to tap the **Connect** button located at the bottom of the screen. Select "**Connect**" from the drop-down list.



Set the **Connect Mode** to "**Bluetooth**". Next, tap the **Search for Bluetooth device** button. When you locate your S321, press **Connect,** and the calibration will be ready to start.

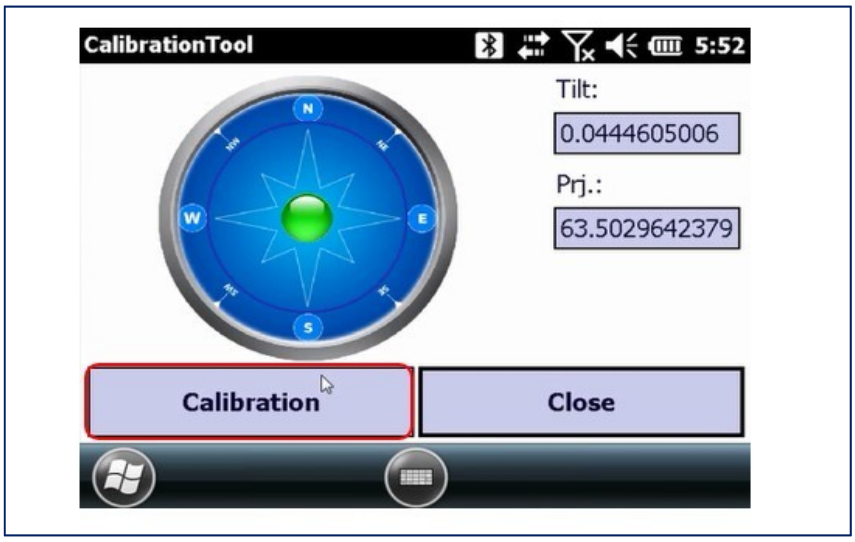


The first portion of the calibration is the **Electric Bubble Adjust**. Tap the **1. Electric Bubble Adjust** button to open the calibration screen.

Holding the survey pole as stable as possible and keeping the green ball in the center of the compass, tap the **Calibration** button. The data collector will sound a tone when the calibration is complete.

If the Tilt values displayed are not close to zero (0.013 or less), then you should press C**alibration** again. The tilt sensors are very sensitive. If the platform is not stable when the S321 is resetting, the tilt values will show greater variation.

Tap the **Close** button to exit out of the first calibration.



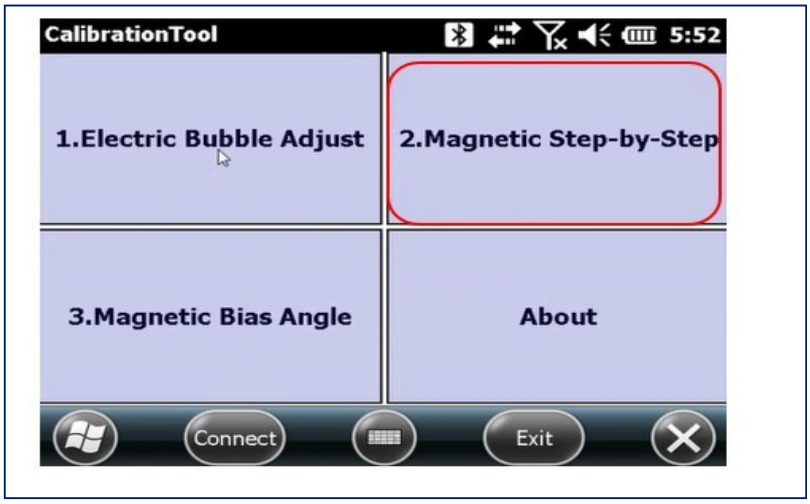
Calibration Step 2 – Magnetic Step-by-Step Calibration

The second portion of the calibration process is the Magnetic Step-by-Step calibration. For this step, a pole or a tripod and tribrach with a small pole extender can be used. If a pole is used, you will need to keep the pole as vertical as possible while rotating the pole.

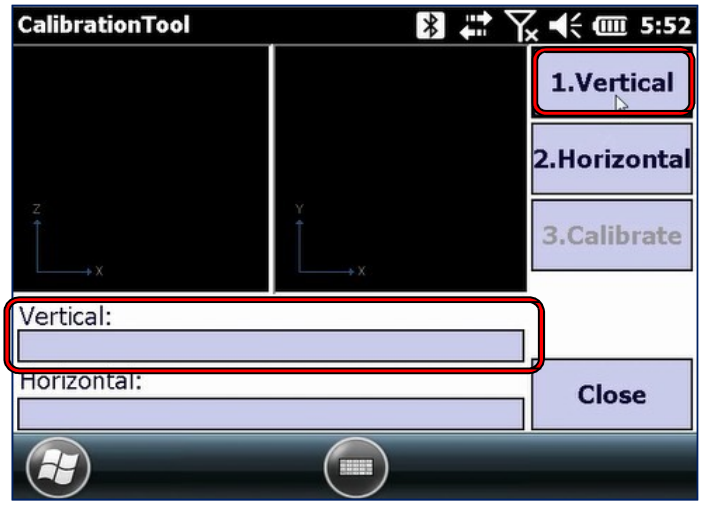
A good way to keep the pole vertical while rotating, is to grab the pole with one hand at face-height while using the fingers of your second hand to rotate the pole.

If your pole is extendable, you can use a bipod to keep the pole vertical, and if you don't lock the extendable top portion of the pole, you can rotate it.

Tap the 2. Magnetic Step-by-Step button to begin.

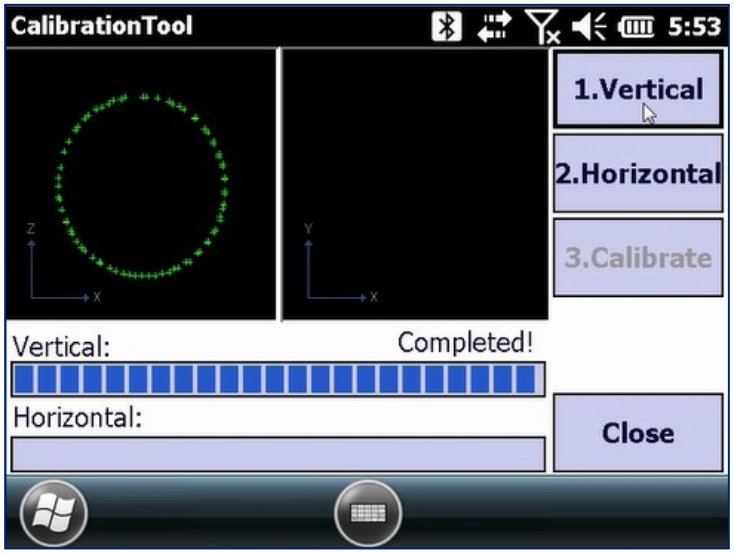


The first magnetic calibration will be the Vertical. Remove the S321 from the survey pole and place it on the Mini Rotary Tool. Connect the Mini Rotary Tool back to the survey pole (see picture in step below for example). Click the **1. Vertical** button and slowly rotate the device clockwise 360° (or more, depending on the progress bar).



Slowly rotate the S321 so that it takes at least 30 seconds to make one complete rotation. The progress bar moves as the calibration marks the points.

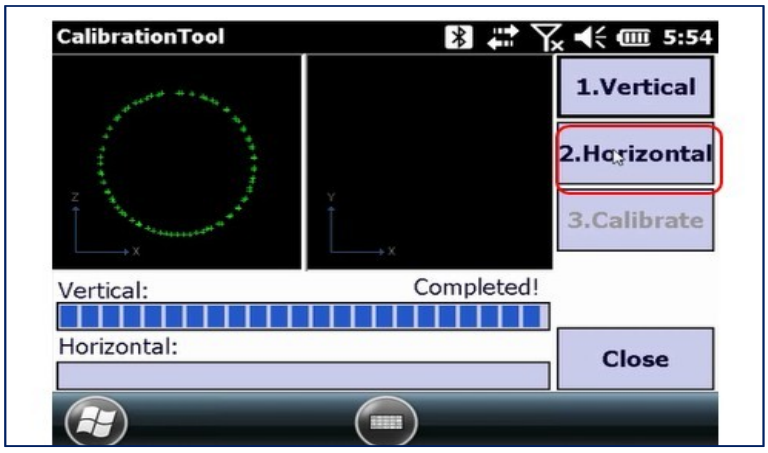
The progress bar indicates when the vertical calibration is complete.



The second magnetic calibration is the **Horizontal**. Place the S321 back onto the survey pole, in the normal orientation.

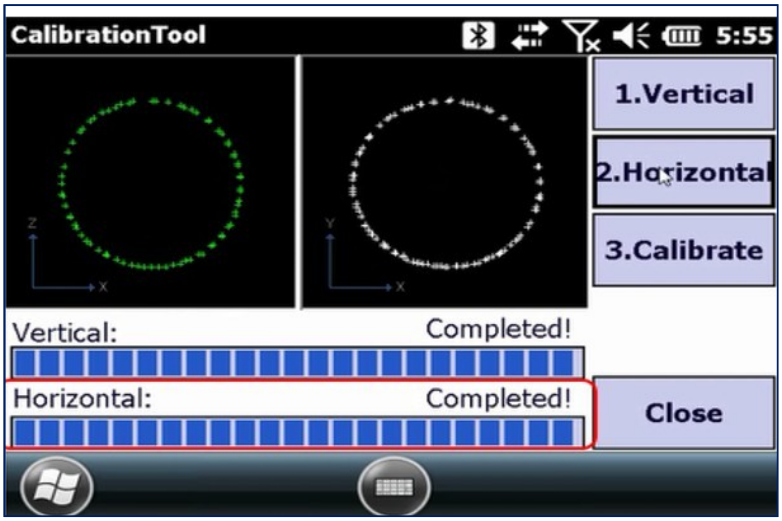
Click the ***2.*** **Horizontal** button and slowly rotate the device clockwise 360° (or more, depending on the progress bar).

Slowly rotate the S321 so that it takes at least 30 seconds to make one complete rotation.

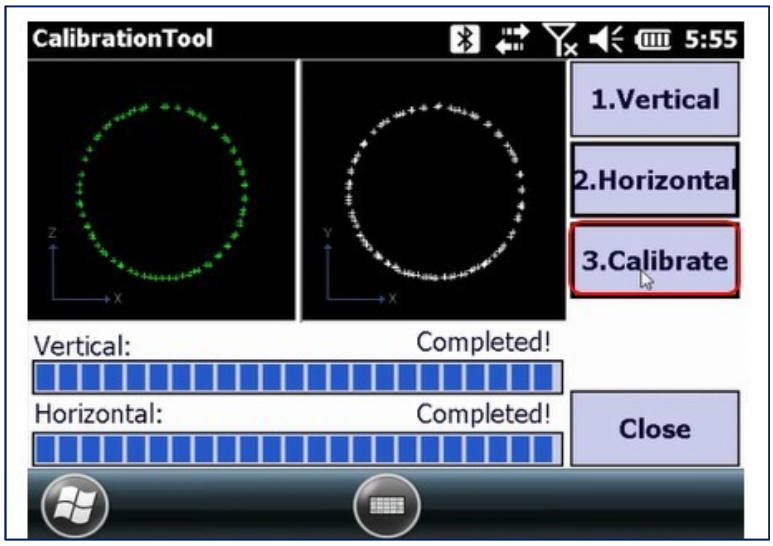


The progress bar moves as the calibration marks the points.

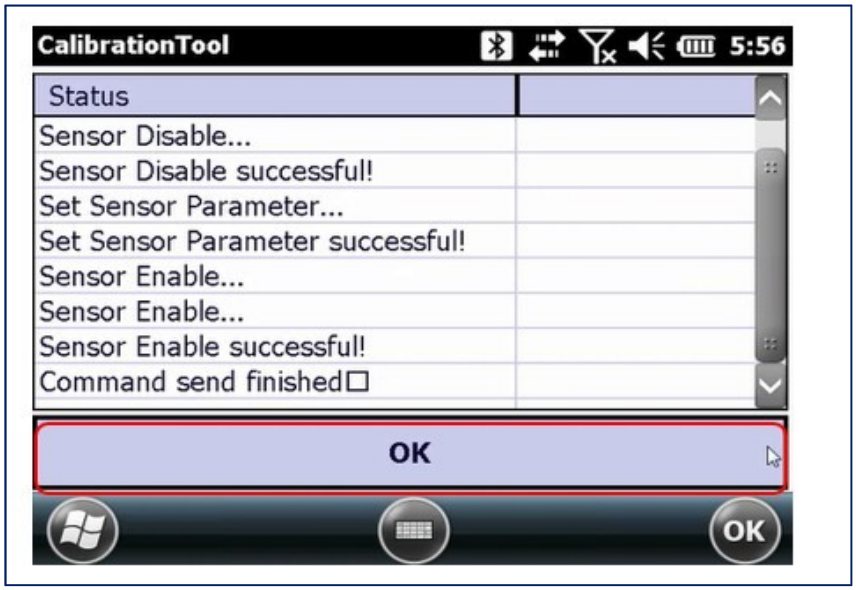
The progress bar indicates when the horizontal calibration is complete.



When the vertical and horizontal calibrations show complete, tap the **3**. **Calibrate** button.



A list of messages will confirm the magnetic calibration was successful. Tap the **OK** button.



Calibration Step 3 – Magnetic Bias Angle Calibration

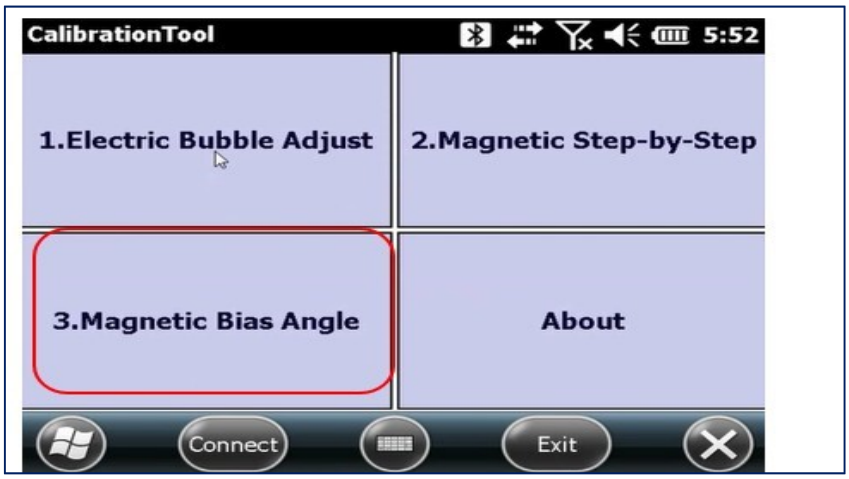
The third and final portion of the calibration process is the Magnetic Bias Angle calibration. Before continuing, make sure the unit is receiving an RTK FIX and is mounted on a pole.

This RTK link must be independent of the data collector. This means you will need to use one of the next two RTK methods: Radio UHF or Internal GSM in receiver.

Note: NEVER use any DCI method. The NTRIP connection will always drop after exiting **SurvCE**.

IMPORTANT: When setting the NTRIP connection from **SurvCE** in the Receiver tab, set the position refresh rate to 1HZ. Setting it to 5Hz has negative effects on a later use of the **CalibrationTool**.

If you are sure the S321 is FIXED, tap the **3. Magnetic Bias Angle** button.



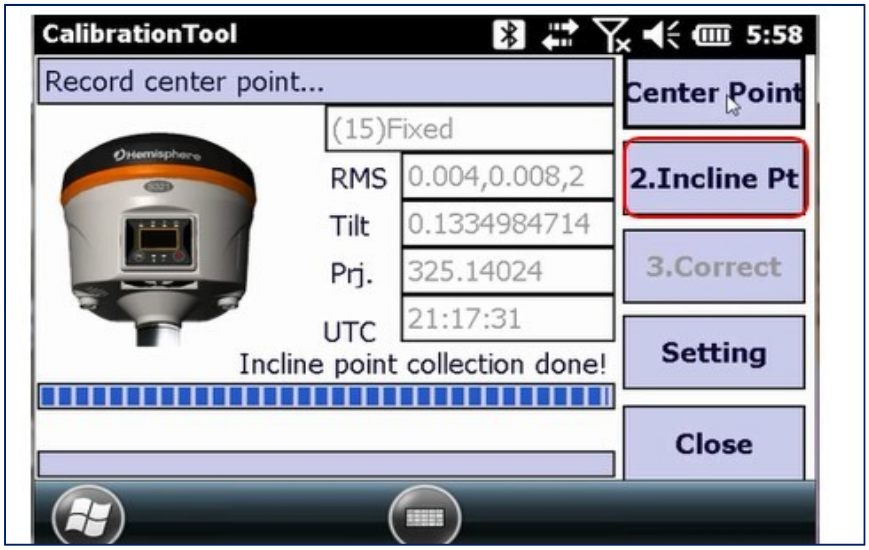
Even though the S321 is in Fixed mode and receiving corrections, the receiver status is not displayed in this version of the tool. The first part of the Magnetic Bias Angle calibration is recording a center point. Hold the device as stable and upright as possible. Tap the **Center Point** button. The center point will record 10 points.

Note: If the receiver is not level or not FIXED, the points will not be captured, and a warning message will display. If points are not being captured, make the necessary adjustments as prompted on the display.

Important: The S321 display should be facing the user at all times.

The second part of the Magnetic Bias Angle calibration is **Inclined Point**. If you're using a bipod, remove the bipod, leaving the pole on the same point.

Tap the **2. Incline Pt** button and hold the survey pole and S321 at the required angle.



The calibration tool requires you to tilt the S321 and survey pole to the **EAST** at approximately 25° to 35° angle.

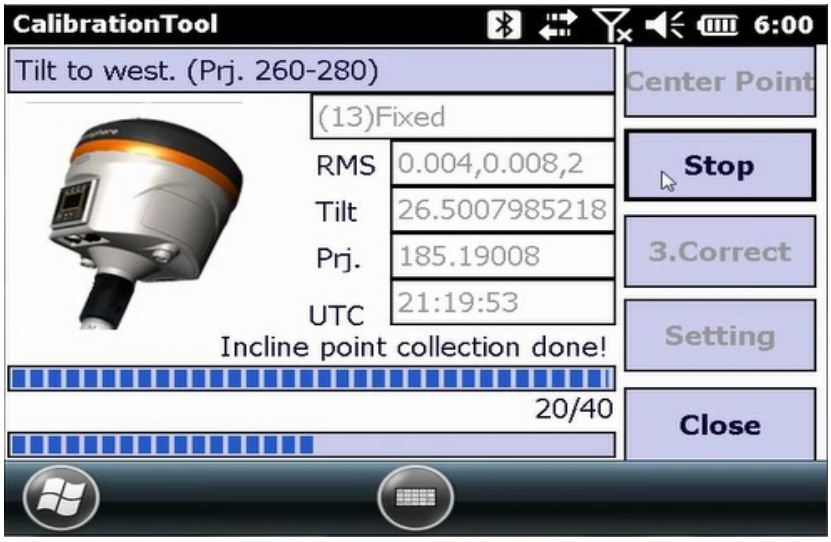
Note: The tilt should be between 25° and 35° to collect points, and the device tilted in the correct direction to within +/- 10° (e.g., between 80°-100° for east,170°-190° for south,…).

Below you will see "**Tilt**" is the angle of the unit, and the "**Prj**" is the direction in which the device is facing.

Note: Each direction (East, South, West, and North) will log 10 points. Keep the device in place until all 10 points are logged.

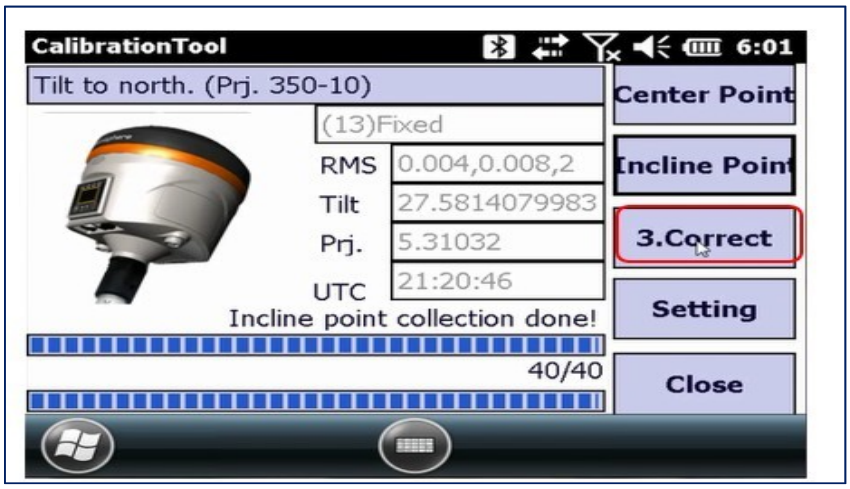
Tilt the S321 and survey pole to the **SOUTH** at approximately 25° to 35° angle. Below you will see "**Tilt**" is the angle of the unit, and the "**Prj**" is the direction in which the device is facing.

Tilt the S321 and survey pole to the **WEST** at approximately 25° to 35° angle. Below you will see "**Tilt**" is the angle of the unit, and the "**Prj**" is the direction in which the device is facing.

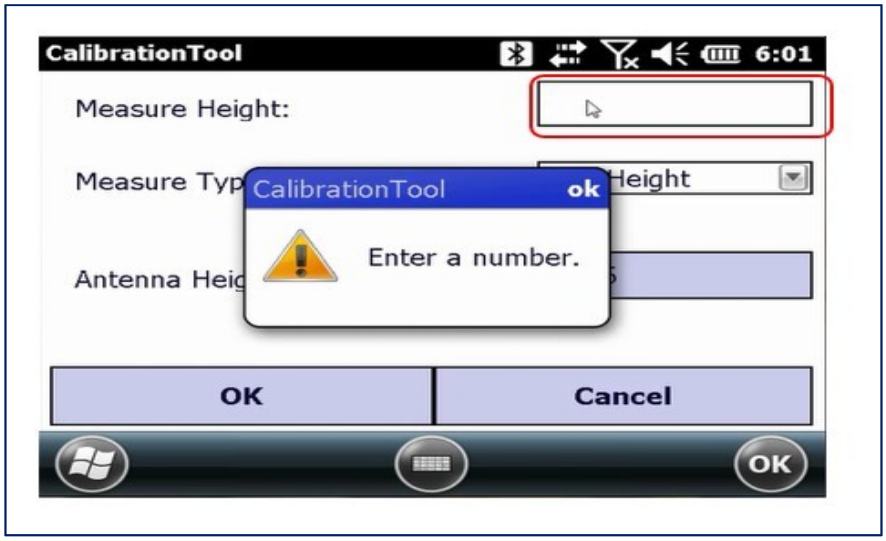


Tilt the S321 and survey pole to the **NORTH** at approximately 25° to 35° angle. Below you will see "**Tilt**" is the angle of the unit, and the "**Prj**" is the direction in which the device is facing.

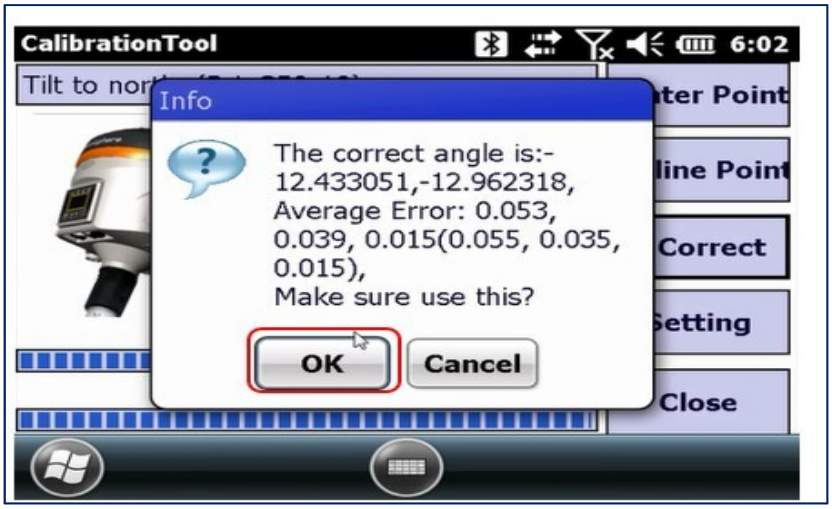
When the Incline Point calibration is complete, tap **3. Correct** to submit the calibration to the S321.



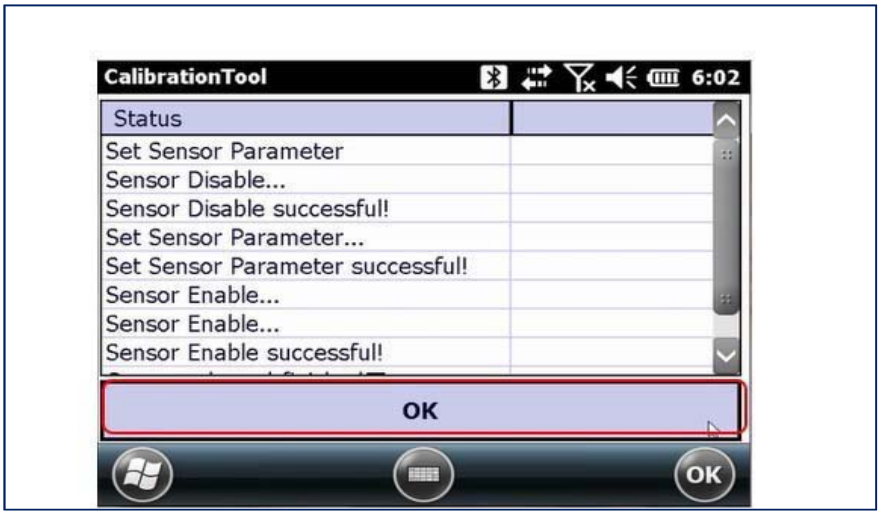
Enter the height of the survey pole (in meters) used for calibration in the "**Measure Height**" field below. Then tap **OK**.

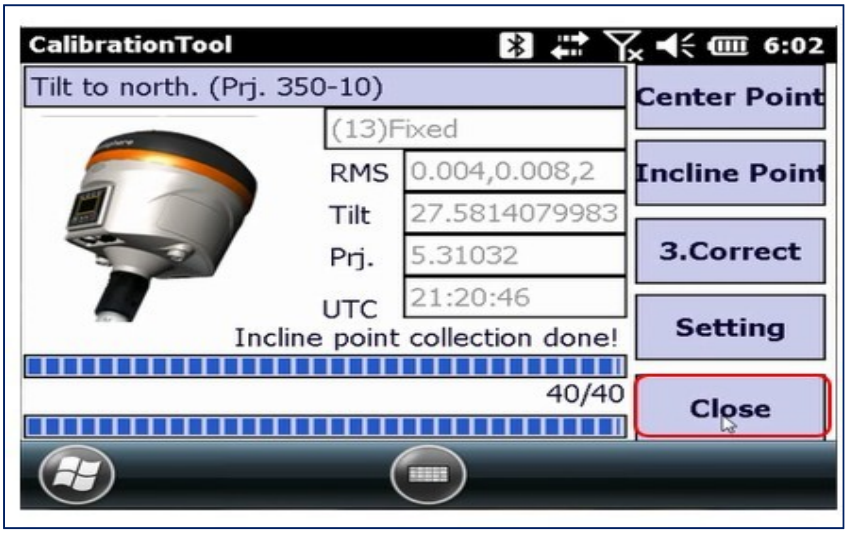


The Magnetic Bias Angle is now complete, and a pop-up will show you the corrections made to the tilt sensor. Click the **OK** button.



A list of messages will confirm the magnetic calibration was successful. Click the **OK** button. Tap the **Close** button to exit the Magnetic Bias Angle screen.





You can now **Exit** the **CalibrationTool** program, and your S321 is 100% calibrated.

Appendix A: Radio Mode

Appendix A: Radio Mode

Table A-1: Radio Mode

Radio Mode	Link Rate	Spacing	Modulation	Scrambling	FEC
Trimtalk 1	4800 bps	12.5 kHz	GMSK	On	Off
Trimtalk 2	9600 bps	25 kHz			
PC1	9600 bps	25 kHz	GMSK	On	On
PC5	4800 bps	12.5 kHz			
PC-4FSK	9600 bps	12.5 kHz	4FSK	On	On
	19200 bps	25 kHz			
Satel 3AS	9600 bps	12.5 kHz	4FSK	On	Off
					On
	19200 bps	25 kHz			Off
					On

Appendix B: Troubleshooting

Appendix B: Troubleshooting

Table B-1 provides troubleshooting tips for the S321.

Table B-1: Troubleshooting

Issue	Possible Resolution
Receiver fails to power	• External power is low • Check charge on external battery and the fuse on the power cable, if applicable • Internal power: Check charge on internal battery • Check all power cables and pins • Try other batteries or cables • Make sure to hold the power button down for a minimum of one full second to power on • Ensure the battery is installed with contacts pointed in the correct direction
No data logged 1. No communication 2. No valid data	• Check receiver power status • Verify that itis locked to 4 or more GPS satellites • Check integrity and connectivity of power and data cable connections • Verify that the baud rate settings match in external device mode • If trying to connect over Bluetooth, ensure Bluetooth module is powered ON and device is paired prior to opening the port
Random data from WebUI or S321 Direct Link mode	• Verify the messages selected in the output messages in the WebUI match what you desire. • Verify the baud rate settings match • Potentially, the volume of data requested to be output could be higher than the current baud rate supports. Try using a higherbaud rate for communications.
S321 will not go RTK Fixed	• If the S321 is “RTK Float”, then it is receiving RTK or Atlas corrections. • If the RTK latency is between 10-15 seconds, these are most likely Atlas corrections. • If the RTK latency is less than 10-15 seconds, the S321 is receiving RTK, but probably will not Fix because of the environment. • If the S321 will not go RTK Float or RTK Fixed, check to ensure the base station is operating. • Verify the settings of the UHF radio at the base and at the rover are the same. • If using a network, check the Cellular Signal Quality (CSQ) under the I**nformation** tab for cellular reception. CSQ can also be viewed on the S321 display screen by pressing the **FN** button. • If using the internal UHF radio, ensure a valid 400MHz UHF antenna is plugged into the SMA connector labeled **UHF**. • If using the Internal GSM modem, ensure that the cellular antenna is screwed into the SMA connector labeled **UMTS**. **WARNING:** The connectors are identical, always check to ensure the correct antenna is screwed into the correct slot. • If using Bluetooth, ensure RTK is reaching the data collector (check the data collector internet or data collector radio).

Appendix C: Technical Specifications

Appendix C: Technical Specifications

Table C-1: GNSS Receiver

Item	Specification
Receiver type	Multi Frequency GNSS
Channels	372
Positioning modes	RTK, L-band DGNSS, SBAS, External RTCM, Autonomous
RTK formats	RTCM2.3, RTCM3.0, RTCM3.x, CMR, CMR+, ROX
L-band formats	Atlas H100, Atlas H30, and Atlas H10
Update rate / recording interval	Selectable from 1, 2, 4, 5, 10, 20 Hz

Table C-2 Performance

Mode	Specification	
	Horizontal	**Vertical**
RTK Performance	8mm + 1 ppm	15mm + 1 ppm
Static Performance (long occupation)	3mm + 0.1 ppm	3.5mm + 0.4 ppm
Static Performance (rapid occupation)	3mm + 0.5 ppm	5mm + 0.5 ppm
L-band Performance[3]	0.08 m	0.16m
SBAS Performance[1]	0.3 m	0.6 m
Autonomous, no SA[2]	1.2 m	2.4 m

Table C-3: Satellite tracking

Satellites	
GPS	L1C/A, L1P, L2P, L2C
GLONASS	L1C/A, L2C/A
BeiDou	B1, B2
QZSS	With future firmware upgrade
Galileo	GALILEO E1BC/E5B/
SBAS	MSAS, WAAS, EGNOS, GAGAN

Table C-4: Communication and ports

Item	Description
Connectors I/O	5-pin LEMO connector for external power supply and external radio devices 7-pin LEMO connector for USB OTG connection and a serial port interface 1 antenna connector for internal radio 1 antenna connector for modem module
WebUI	To upgrade the software, manage the status and settings, data download, via smart phone, tablet or another electronic device
TTS	Smart voice broadcast system. “Speaking” receiver
Reference Outputs	RTCM3.0, RTCM3.2, CMR, CMR+, and ROX (Hemisphere proprietary messaging format)

Table C-5: Radio

Item	Specification
Frequency Range	410 - 470 MHz
Channel Spacing	12.5 KHz / 25 KHz
Emitting Power	0.5 / 1w

Table C-6: Wireless

Item	Specification
Wi-Fi	Integrated module with internal Wi-Fi antenna 802.11 bgn.
Bluetooth	Bluetooth 2.1 + EDR Integrated Bluetooth (BT) communication module with internal BT antenna

Table C-7: Cellular

Item	Description
Type	UMTS/HSPA+ (WCDMA/FDD), GSM/GPRS/EDGE
Supported Frequencies	• UMTS/HSPA+ (WCDMA/FDD) (850, 900, 1900 and 2100 MHz) • GSM (850/900/1800/1900 MHz)

Table C-8: Power

Item	Specification
Battery	Rechargeable 11.1 V - 37.74 Wh
Battery Life	6 hours with one battery and UHF radio in Rx mode
Voltage	9 to 22V DC external power input with over-voltage protection
Charge Time	Typically, 7 hours

Table C-9: Memory

Item	Specification
SIM Card	Accessible SIM card slot
Memory	Internal 4GB or 8GB. Accessible through USB and Wi-Fi External MicroSD card slot supports up to 64 GB.

Table C-10: Environmental

Item	Specification
Operating Temperature	-30°C to 60°C (-22°F to 140°F)
Storage Temperature	-40°C to 80°C (-22°F to 176°F)
Water / Dust Proof	IP67
Shock Resistance	MIL-STD-810G, method 516.6
Vibration	MIL-STD-810G, method 514.6E-I
Humidity	Up to 100%

Table C-11: Mechanical

Item	Specification
Size	14.1 D x 14.0 H (cm) 5.5 D x 5.5 H (in)
Weight	<1.38 kg (<3.05 lbs
Mounting	5/8”x11, 55 ° thread angle, stainless steel insert
Phase Center Offset	GPS L1 and L2 offset below 2.5mm

1 Depends on multi-path environment, number of satellites in view, satellite geometry, and ionospheric activity
2 Depends also on baseline length
3 Requires a subscription from Hemisphere GNSS

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