Environmental

Regulatory Compliance CE
Compliance
• IEC 60950-1: 2005
• EN 301 113-1 / EN 301 113-2
• EN 301 489-1 v1.9.2
• EN301 489-3 v1.6.1
• EN301 489-7 v1.3.1
• EN 301489-17v2.2.1
• EN301 489-24v1.5.1
• EN55022:2010
• EN55024:2010
• EN 300440-1 v1.6.1 / EN 300440-2 v1.4.1
• EN 300 328 V1.9.1
• EN 301 511v9.0.2
• EN 301908-1 v6.2.1 / EN 301908-2 v6.2.1

FCC Compliance
• FCC Part 15, Subpart B
• FCC Part 15, Subpart C:2015
• FCC Part 15, Subpart C:2014
• FCC Part 2
• FCC Part 22H
• FCC Part 24E

IC Compliance
• ICES-003:2012 Issue 5
• RSS-247 Issue 1
• RSS-GEN Issue 4
• RSS 132 Issue 3
• RSS 133 Issue 6

Certifications
S321+ UHF
• Model: S321+UHF
• FCC ID:2C8S321+UHF
• IC:9586A-S321+UHF

S321+ Non-UHF
• Model: S321+Network
• FCC ID:2C8S321+Network
• IC: 9586A-S321+Network

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

- When using the GSM to receive correction data, this equipment should be installed and operated with a minimum distance of 20 cm between the radiator and your body.

UHF Radio Mode

- When using the 400 MHz radio, M3-TR4 from Satel™, this equipment should be installed and operated with a minimum distance of 24 cm.

This transmitter must not be co-located or operating in conjunction with any other antenna or transmitter.

Modifications not expressly approved by Hemisphere GNSS could void the user’s authority to operate the equipment.

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

This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to Part 15 of 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. If not installed and used in accordance with the instructions, it may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.

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

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

Any changes or modifications not expressly approved by the party responsible for compliance could void the user’s authority to operate the equipment.

Caution: Exposure to Radio Frequency Radiation.

Canada - Industry Canada (IC)

This device complies with RSS 210 of Industry Canada. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

L’utilisation de ce dispositif est autorisée seulement aux conditions suivantes: (1) il ne doit pas produire d’interférence et (2) l’utilisateur du dispositif doit être prêt à accepter toute interférence radioélectrique reçue, même si celle-ci est susceptible de compromettre le fonctionnement du dispositif.

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; consult Safety Code 6, obtainable from Health Canada’s website.

Europe – Declaration of Conformity

This device is in compliance with the essential requirements of the R&TTE Directive 1999/5/EC.

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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Patents
Hemisphere GNSS products may be covered by one or more of the following patents:

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<th>U.S. Patents</th>
<th>Australia Patents</th>
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| 8307535      | Other U.S. and foreign patents pending.

Notice to Customers
Contact your local dealer for technical assistance. To find the authorized dealer near you:
Hemisphere GNSS, Inc
8515 East Anderson Drive
Scottsdale, AZ 85255 USA
Phone: (480) 348-6380
Fax: (480) 270-5070
precision@hgnss.com  www.hgnss.com

Technical Support
If you need to contact Hemisphere GNSS Technical Support:
Hemisphere GNSS, Inc.
8515 East Anderson Drive
Scottsdale, AZ 85255 USA
Phone: (480) 348-6380
Fax: (480) 270-5070
techsupport@hgnss.com

Documentation Feedback
Hemisphere GNSS is committed to the quality and continuous improvement of our products and services. We urge you to provide Hemisphere GNSS with any feedback regarding this guide by writing to the following email address: techsupport@hgnss.com.
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## Terms and Definitions

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

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<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activation</td>
<td>Activation refers to a feature added through a one-time purchase. For features that require recurring fees, see Subscription.</td>
</tr>
<tr>
<td>aRTK</td>
<td>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.</td>
</tr>
<tr>
<td>Atlas</td>
<td>Atlas is a subscription based service provided by Hemisphere.</td>
</tr>
<tr>
<td>Base Station</td>
<td>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.</td>
</tr>
<tr>
<td>BeiDou</td>
<td>BeiDou is a Chinese satellite based navigation system. Global coverage is expected by 2020.</td>
</tr>
<tr>
<td>Datalink</td>
<td>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).</td>
</tr>
<tr>
<td>DGPS/DGNSS</td>
<td>Differential GPS/GNSS refers to a receiver using Differential Corrections.</td>
</tr>
<tr>
<td>EGNOS</td>
<td>European Geostationary Navigation Overlay Service (EGNOS) is a satellite-based augmentation system (SBAS) that provides free differential corrections over satellite in parts of Europe.</td>
</tr>
<tr>
<td>Elevation Mask</td>
<td>Elevation Mask is the minimum angle between a satellite and the horizon for the receiver to use that satellite in the solution.</td>
</tr>
<tr>
<td>Firmware</td>
<td>Firmware is the software loaded into the receiver that controls the functionality of the receiver and runs the GNSS engine.</td>
</tr>
<tr>
<td>GALILEO</td>
<td>Galileo is a global navigation satellite system implemented by the European Union and European Space Agency.</td>
</tr>
<tr>
<td>GAGAN</td>
<td>GPS Aided Geo Augmented Navigation is a satellite based augmentation system (SBAS) that provides free differential corrections over satellite in India.</td>
</tr>
<tr>
<td>GLONASS</td>
<td>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.</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>-----------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>GNSS</td>
<td>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.</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System (GPS) is a global navigation satellite system implemented by the United States.</td>
</tr>
<tr>
<td>Mountpoint</td>
<td>Mountpoints are the specified data streams in Ntrip. Multiple base stations may send data to an Ntrip caster.</td>
</tr>
<tr>
<td>Multipath</td>
<td>Multipath occurs when the GNSS signal reaches the antenna by two or more paths. This causes incorrect pseudorange measurements and leads to less precise GNSS solutions.</td>
</tr>
<tr>
<td>NMEA</td>
<td>National Marine Electronics Association (NMEA) is a marine electronics organization that sets standards for communication between marine electronics. NMEA 0183 is the electrical and data specification for communications between many various marine electronics, such as GNSS receivers.</td>
</tr>
<tr>
<td>Ntrip</td>
<td>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.</td>
</tr>
<tr>
<td>Ntrip Server</td>
<td>The Ntrip server sends data from the Ntrip source (base station) to the Ntrip caster.</td>
</tr>
<tr>
<td>QZSS</td>
<td>Quasi-Zenith Satellite System (QZSS) is a satellite navigation system currently under development in Japan.</td>
</tr>
<tr>
<td>ROX</td>
<td>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.</td>
</tr>
<tr>
<td>RTCM</td>
<td>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.</td>
</tr>
<tr>
<td>RTK</td>
<td>Real-Time-Kinematic (RTK) is a real-time differential GPS method that provides better accuracy than differential corrections.</td>
</tr>
<tr>
<td>SBAS</td>
<td>Satellite Based Augmentation System (SBAS) is a system that provides differential corrections over satellite throughout a wide area or region.</td>
</tr>
<tr>
<td>Subscription</td>
<td>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.</td>
</tr>
<tr>
<td>WAAS</td>
<td>Wide Area Augmentation System (WAAS) is a satellite-based augmentation system (SBAS) that provides free differential corrections over satellite in parts of North America.</td>
</tr>
</tbody>
</table>
Chapter 1: Introduction

Overview and Features
What’s Included
Introduction

Overview and Features

The S321+ is an all-new multi-GNSS, multi-frequency, smart antenna. The S321+ provides robust performance and high precision in 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.

Use the S321+ as a precise base station sending RTK 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 web user interface (WebUI) is used to control, manage, and upgrade the S321+ with new firmware and activations. S321+ is Athena-enabled and Atlas-capable.

Powered by the Eclipse™ P326 OEM board, the S321+ supports 394 channels and can simultaneously track all satellite signals including GPS, GLONASS, BeiDou, Galileo, and QZSS, making them robust and reliable. S321+ comes standard with two long-life lithium batteries providing up to 12 hours of operation. The batteries are hot-swappable, and may be changed while working, maximizing your efficiency and ROI.

The S321+ combines Hemisphere’s Athena GNSS engine and Atlas L-band correction technologies with a new WebUI, offering an unparalleled level of customer-friendly performance.

The ruggedized antenna is designed for the most challenging environments and meets IP67-standard requirements. The S321+ comes in two versions, with 4G LTE optimized for either North American or international locations.

Powered by Athena GNSS engine, the S321+ provides best-in-class, centimeter-level RTK. Athena excels in virtually every environment where high-accuracy GNSS receivers can be used. Tested and proven, Athena’s performance with long baselines, in open-sky environments, under heavy canopy, and in geographic locations experiencing significant scintillation is nothing short of cutting edge.

The S321+ is the ideal positioning system for use in applications such as land or marine survey, GIS, mapping, and construction. Together with SureFix™, Hemisphere’s advanced processor, the S321+ delivers high-fidelity RTK quality information that results in guaranteed precision with virtually 100% reliability.
Athena RTK

The S321+ receiver is powered by the Athena RTK technology. With Athena, S321+ provides state-of-the-art RTK performance when receiving corrections from a static base station or network RTK correction system. With multiple connectivity options, the S321+ allows for RTK corrections to be received over radio, cell, modem, Wi-Fi, Bluetooth, or serial connection. S321+ delivers centimeter-level accuracy with virtually instantaneously initialization times and cutting-edge robustness in challenging environments.

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 that broadcasts corrections over a wireless link to the rover. The localized corrections are processed on the rover to achieve superior accuracy and repeatability. Performance testing has shown exceptional positioning accuracy even in harsh environments.

Athena RTK has the following benefits:

- **Improved Initialization time** - Performing initializations in less than 15 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**

The S321+ receiver also enables users to work with the Atlas service. Atlas is Hemisphere’s industry leading global correction service, which can be added as a subscription to the S321+.

The Atlas system delivers world-wide centimeter-level correction data over L-band communication satellites. With Atlas, S321+ users are able to experience sub-decimeter positioning performance anywhere on earth, without the need to be near a GNSS or communication infrastructure.

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 has the following benefits:

- **Positioning accuracy** - Competitive positioning accuracies down to 2 cm RMS in certain applications
- **Positioning sustainability** - Advanced position quality maintenance in the absence of correction signals, using Hemisphere’s patented technology

The 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 (which takes as less than a few seconds), the receiver is able to 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.
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

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

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<th>940-2181-10</th>
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<td>S321+ (Int'l) Kit</td>
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<tr>
<td>S321+ (Int’l) Smart Antenna</td>
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<td>Power Cable (Alligator Clips)</td>
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<td>Power Cable (Receiver)</td>
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<td>3-Cell Battery</td>
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<th>940-2156-0 Rover Acc</th>
<th>Accessory Only</th>
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<td>5-pin Power Cable (Satel/Rcvr)</td>
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<td>5-pin Power Cable (Serial/Rcvr)</td>
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<td>UHF Antenna (TNC)</td>
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<td>Mini Rotary Table</td>
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<td>External UHF Antenna Bracket Kit</td>
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<th>940-2150-0 Cntrlr (EU)</th>
<th>940-2165-0 Int’l Option</th>
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<td>Carlson SurvCE v5 (w/ NA)</td>
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<td>Athena dFreq RTK Bundle*</td>
<td>163-1045-0</td>
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* Feature activation
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+
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](image)

**Table 2-1: S321+ ports and connections**

<table>
<thead>
<tr>
<th>Port</th>
<th>What to connect</th>
</tr>
</thead>
<tbody>
<tr>
<td>7-pin Diagnostic Port (LEMO)</td>
<td>Diagnostic cable for serial or USB</td>
</tr>
<tr>
<td>5-pin Power/Data Port (LEMO)</td>
<td>External Power, data and radio devices</td>
</tr>
<tr>
<td>GSM Antenna Connector</td>
<td>External GSM antenna</td>
</tr>
<tr>
<td>UHF Antenna Connector</td>
<td>External UHF antenna</td>
</tr>
<tr>
<td>Mounting hole</td>
<td>Pole or tripod mount</td>
</tr>
</tbody>
</table>
Installing/Connecting S321+

Installing Batteries

The S321+ comes standard with two long-life lithium batteries (see What’s Included) providing up to 12 hours of operation. The batteries are hot-swappable, and may be changed while working, maximizing your efficiency and ROI. **Note:** Batteries should be changed within 30 seconds.

The S321+ allows for one battery (11.1 V - 37.74 Wh) to be installed at a time.

When installing a 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.

![Battery installation](image)

**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”. 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 “What’s Included”. 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 2-5: Range pole installation

Connecting to a Power Source

The S321+ has two main power sources. The first being an internal, removable battery 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 2-6: External power connector
Connecting to an External Device

The 7-pin connector is available for diagnostics.

Figure 2-7: Diagnostic 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 2-8: 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 the 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, where:

- The “SIM” card slot is positioned on the left side of the battery opening
- The “SD” 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 2-9: MicroSD/SIM card slot
Resetting the S321+

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

Figure 2-10: S321+ Reset button
Setup and Configuration

Control Panel Overview

You can operate the S321+ using the control panel shown below.

Satellite LED (Green)

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

Static LED (Green)

The Static LED 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.
Bluetooth LED (Blue)

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

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.
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).

![Network LED](image)

**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

<table>
<thead>
<tr>
<th>Type</th>
<th>Icon</th>
<th>Explanation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating mode</td>
<td><img src="image1" alt="Icon" /></td>
<td>Rover mode</td>
</tr>
<tr>
<td></td>
<td><img src="image2" alt="Icon" /></td>
<td>Base mode</td>
</tr>
<tr>
<td></td>
<td><img src="image3" alt="Icon" /></td>
<td>Static mode</td>
</tr>
<tr>
<td>Power status</td>
<td><img src="image4" alt="Icon" /></td>
<td>Full battery power or external power supply</td>
</tr>
<tr>
<td></td>
<td><img src="image5" alt="Icon" /></td>
<td>Battery power remaining ¾</td>
</tr>
<tr>
<td></td>
<td><img src="image6" alt="Icon" /></td>
<td>Battery power remaining 2/4</td>
</tr>
<tr>
<td></td>
<td><img src="image7" alt="Icon" /></td>
<td>Battery power remaining ¼</td>
</tr>
<tr>
<td></td>
<td><img src="image8" alt="Icon" /></td>
<td>The battery needs to be replaced</td>
</tr>
<tr>
<td>Date status</td>
<td><img src="image9" alt="Icon" /></td>
<td>The Rover station is receiving differential</td>
</tr>
<tr>
<td></td>
<td><img src="image10" alt="Icon" /></td>
<td>The base station is transmitting differential</td>
</tr>
<tr>
<td>Date link</td>
<td><img src="image11" alt="Icon" /></td>
<td>UHF, number in right corner indicating the channel</td>
</tr>
<tr>
<td></td>
<td><img src="image12" alt="Icon" /></td>
<td>GPRS module</td>
</tr>
<tr>
<td></td>
<td><img src="image13" alt="Icon" /></td>
<td>External Data Link</td>
</tr>
<tr>
<td></td>
<td><img src="image14" alt="Icon" /></td>
<td>Bluetooth data link</td>
</tr>
<tr>
<td>Difference type</td>
<td><img src="image15" alt="Icon" /></td>
<td>RTCM3.2</td>
</tr>
<tr>
<td></td>
<td><img src="image16" alt="Icon" /></td>
<td>RTCM 3.0</td>
</tr>
<tr>
<td></td>
<td><img src="image17" alt="Icon" /></td>
<td>RTCM 2.3</td>
</tr>
<tr>
<td></td>
<td><img src="image18" alt="Icon" /></td>
<td>CMR</td>
</tr>
<tr>
<td></td>
<td><img src="image19" alt="Icon" /></td>
<td>DGPS</td>
</tr>
</tbody>
</table>
### S321+ Menu Structure and Information

#### Home Page

![S21+ User Guide Chapter 3 – Setup and Configuration](image)

#### Coordinate Information

<table>
<thead>
<tr>
<th>LOC</th>
<th>RAW</th>
<th>RTK</th>
<th>STAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>E</td>
<td>0°00'00.000&quot;</td>
<td>N</td>
<td>0°00'00.000&quot;</td>
</tr>
</tbody>
</table>

#### Current Data Link Status

<table>
<thead>
<tr>
<th>LOC</th>
<th>RAW</th>
<th>RTK</th>
<th>STAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>DiffType: RTCM32</td>
<td>Data: NETWORK</td>
<td>Sta.: No Sats</td>
<td></td>
</tr>
</tbody>
</table>

#### File Information

<table>
<thead>
<tr>
<th>LOC</th>
<th>RAW</th>
<th>RTK</th>
<th>STAT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mode: Base</td>
<td>Bat: 49 %</td>
<td>OSQ: 24 %</td>
<td></td>
</tr>
</tbody>
</table>

#### 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](image)

### 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.
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:

S321XXXXXX
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 S321XXXXXXXX.
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.

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 Logs

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:

Install New Firmware

![Choose File](No file chosen) ![Upload File](

GNSS Registration

GNSS Functionality: 47S:C60;12/31/2019;0;OPT=20Hz;RTK:RAW_DATA:L2:L5;MULTI_GNSS;ATLAS_LBAND;ATLAS_10cm

Auth Code

Submit

Security

- Enable Login Authentication

Old Password:

New Password:

Confirm Password:

Change

View Logs

1. APP Log
   - Download
   - View

2. OS Log
   - Download
   - View

Format Internal Disk

OK

Self Test

OK

Restore Factory Settings

OK

Reset

OK
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 certified Hemisphere GNSS dealers.

![WebUI Settings](image)

- **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
- **Atlas Frequency**: If using Atlas, set to ‘Auto’ to automatically tune to the correct frequency, or manually tune to the correct frequency.
− **Atlas Datum**: if receiving Atlas corrections, you can use the ITRF08 datum, the GDA94 datum, or input custom X, Y, Z offsets. NOTE: this only affects Atlas positions

− **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, the L-band needs to be set to Enable and RTK Timeout should be set to 2700.)*

**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

![Base Position Selection](image)

**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 (.uct) provided by your dealer.

**Note:** The radio frequency should match the transmitting base.

The following dialogue appears:

![Import radio configuration file](image-url)
Next to **Data Link** select **UHF**. The following dialogue appears at the bottom of the page.

<table>
<thead>
<tr>
<th>Radio Channel</th>
<th>2</th>
<th>469.55MHz, 12.5kHz Spacing, 1000mW TX</th>
</tr>
</thead>
<tbody>
<tr>
<td>Radio Mode</td>
<td>PC5</td>
<td></td>
</tr>
<tr>
<td>FEC</td>
<td>ON</td>
<td></td>
</tr>
<tr>
<td>Radio Power</td>
<td>1000</td>
<td></td>
</tr>
</tbody>
</table>

- **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 **External** 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**

<table>
<thead>
<tr>
<th>5-pin cable</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>S321+ Power Cable (Alligator Clips)*</td>
<td>054-0171-0</td>
</tr>
<tr>
<td>S321+ Power Cable (PacCrest/Rcvr)</td>
<td>054-0172-0</td>
</tr>
<tr>
<td>S321+ Power Cable (Satel/Rcvr)</td>
<td>054-0173-0</td>
</tr>
<tr>
<td>S321+ Power Cable (Serial/Rcvr)**</td>
<td>054-0179-0</td>
</tr>
</tbody>
</table>

*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:

![NTRIP Configuration](image)

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 disable or enable Bluetooth. NOTE: Restore Factory Defaults re-enables Bluetooth.
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.

- **NMEA Log**: Store the NMEA or binary messages that are turned on to the internal memory of the receiver or to an SD Card
- **First Storage**: Select if NMEA, binary, or Athena logs should be stored to the internal memory of the receiver or to an SD Card
- **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](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.

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

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.

File is being uploaded...
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 indicates 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 placed 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.

<table>
<thead>
<tr>
<th>Qty</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2 m Survey Pole</td>
</tr>
<tr>
<td>1</td>
<td>Mini Rotary Table</td>
</tr>
</tbody>
</table>
### Table 3-3: Calibration Equipment/Items (per step)

<table>
<thead>
<tr>
<th>Equipment/Items</th>
<th>Step 1 Electronic Bubble</th>
<th>Step 2 Magnetic</th>
<th>Step 3 Magnetic Bias Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Data Collector (running the Windows Mobile or WEHH operating system)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>CalibrationTool</strong> (should be installed on the data collector*)</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>A quality, calibrated tribrach with accurate visuals</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>In Step 1, the tribrach can be set on a solid table or tripod</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A line vial is usually more accurate than a spherical vial.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Solid pole (not less than two meters long with calibrated vial attached)</td>
<td></td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>A connection to a base station using either the S321+’s internal radio, internal GSM cell modem</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>For best performance, the effective distance is less than 1 kilometer (0.6 miles.)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assembly that is included with the S321+ kit.</td>
<td></td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>The four Mini Rotary Bracket components are shown in Figure 3-9.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Table 3-3: Calibration Equipment/Items (per step) (continued)

<table>
<thead>
<tr>
<th>Equipment/Items</th>
<th>Step 1 Electronic Bubble</th>
<th>Step 2 Magnetic</th>
<th>Step 3 Magnetic Bias Angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fully charged S321+ battery</td>
<td>Not battery dependent</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td></td>
<td></td>
<td>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+.</td>
<td>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+.</td>
</tr>
<tr>
<td>An open area free of strong magnetic fields and free of potential for high multipath.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Note:</strong> The farther away you are from a magnetic interference source increases performance.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>For example, it is better to be 20 meters (60 feet) from your vehicle than 5 meters (15 feet).</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Note:

i. A link to the CalibrationTool software can be found in Carlson Knowledge Base Article #1066 which is located at: [http://www.carlonsw.com/?gs=](http://www.carlonsw.com/?gs=)

ii. 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"

iii. 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 1Job button.
After setting or continuing a job, tap the **Equip** tab at the top of the screen. On the **Equip** tab, tap the **3GPS 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:** The wrench and hammer icon allows you 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.

![Quality Tab](image)

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 **Calibration** 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 will start to move as the calibration marks the points.

The progress bar will indicate 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 will start to move as the calibration marks the points.
The progress bar will indicate 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, as 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 be displayed. 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.

**Note:** There is no restriction regarding in which direction the display should be facing during the complete Magnetic Bias Angle calibration process, but it must be facing the user at all times.

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 needs to be between 25° and 35° to collect points, and the device also needs to be tilted in the correct direction to within +/- 10° (eg, 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.

![S321+ Calibration Tool Screen (South)](image)

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.

![S321+ Calibration Tool Screen (West)](image)
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.

![Image of Calibration Tool with Measure Height field]

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.

![Image of Calibration Tool pop-up with correct angle information]
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: Troubleshooting

Table A-1 provides troubleshooting tips for the S321+.

## Table A-1: Troubleshooting

<table>
<thead>
<tr>
<th>Issue</th>
<th>Possible Resolution</th>
</tr>
</thead>
</table>
| 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 turn on  
• Ensure the battery is installed with contacts pointed in the correct direction |
| No data logged, No communication, No valid data | • Check receiver power status  
• Verify that it is 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 higher baud 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 Information 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 B: Technical Specifications
## Appendix B: Technical Specifications

### Table B-1: GNSS Receiver

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receiver type</td>
<td>Multi-Frequency GNSS</td>
</tr>
<tr>
<td>Channels</td>
<td>394</td>
</tr>
<tr>
<td>Positioning modes</td>
<td>RTK, L-band DGNSS, SBAS, Autonomous</td>
</tr>
<tr>
<td>RTK formats</td>
<td>RTCM3, ROX, CMR, CMR+</td>
</tr>
<tr>
<td>L-band formats</td>
<td>Atlas H100, Atlas H30, and Atlas H10</td>
</tr>
<tr>
<td>Update Rate / Recording Interval</td>
<td>Selectable from 1, 2, 4, 5, 10, 20 Hz</td>
</tr>
</tbody>
</table>

### Table B-2: Performance

<table>
<thead>
<tr>
<th>Mode</th>
<th>Specification</th>
<th>Horizontal</th>
<th>Vertical</th>
</tr>
</thead>
<tbody>
<tr>
<td>RTK Performance</td>
<td></td>
<td>8mm + 1 ppm</td>
<td>15mm + 1 ppm</td>
</tr>
<tr>
<td>Static Performance (long occupation)</td>
<td></td>
<td>3mm + 0.1 ppm</td>
<td>3.5mm + 0.4 ppm</td>
</tr>
<tr>
<td>Static Performance (rapid occupation)</td>
<td></td>
<td>3mm + 0.5 ppm</td>
<td>5mm + 0.5 ppm</td>
</tr>
<tr>
<td>L-band Performance&lt;sup&gt;3&lt;/sup&gt;</td>
<td></td>
<td>0.08 m</td>
<td>0.16 m</td>
</tr>
<tr>
<td>SBAS (WAAS) Performance&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
<td>0.3 m</td>
<td>0.6 m</td>
</tr>
<tr>
<td>Autonomous, no SA&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td>1.2 m</td>
<td>2.4 m</td>
</tr>
</tbody>
</table>

### Table B-3: Satellite Tracking

<table>
<thead>
<tr>
<th>Satellites</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>GPS</td>
<td>L1CA, L1P, L2P, L2C, L5</td>
</tr>
<tr>
<td>GLONASS</td>
<td>G1, G2, P1, P2</td>
</tr>
<tr>
<td>BeiDou</td>
<td>B1, B2</td>
</tr>
<tr>
<td>QZSS</td>
<td>L1C, L1CA, L2C, L5</td>
</tr>
<tr>
<td>Galileo</td>
<td>E1BC, E5a, E5b</td>
</tr>
<tr>
<td>SBAS</td>
<td>MSAS, WAAS, EGNOS, GAGAN</td>
</tr>
</tbody>
</table>
### Table B-4: Communication and Port

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connectors I/O</td>
<td>5-pin LEMO connector for external power, data, and external radio devices</td>
</tr>
<tr>
<td></td>
<td>7-pin Lemo connector for diagnostics</td>
</tr>
<tr>
<td></td>
<td>1 SMA antenna connector for internal radio</td>
</tr>
<tr>
<td></td>
<td>1 SMA antenna connector for modem module</td>
</tr>
<tr>
<td>WebUI</td>
<td>To upgrade the software, manage the status and settings, data download, via</td>
</tr>
<tr>
<td></td>
<td>smart phone, tablet, or other electronic device</td>
</tr>
<tr>
<td>TTS</td>
<td>Smart voice broadcast system. <em>&quot;Speaking&quot;</em> receiver</td>
</tr>
<tr>
<td>Reference Outputs</td>
<td>RTCM2.1, RTCM2.3, RTCM3.0, RTCM3.1, RTCM3.2, including MSM</td>
</tr>
</tbody>
</table>

### Table B-5: Radio

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency Range</td>
<td>410 - 470 MHz</td>
</tr>
<tr>
<td>Channel Spacing</td>
<td>12.5 KHz / 25 KHz</td>
</tr>
<tr>
<td>Emitting Power</td>
<td>0.1, 0.2, 0.5 or 1 w</td>
</tr>
</tbody>
</table>

### Table B-6: Wireless

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wi-Fi</td>
<td>Integrated module with internal Wi-Fi antenna</td>
</tr>
<tr>
<td>Bluetooth</td>
<td>Bluetooth 2.1 + EDR Integrated Bluetooth (BT) communication module with</td>
</tr>
<tr>
<td></td>
<td>internal BT antenna</td>
</tr>
</tbody>
</table>

### Table B-7: Cellular

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLS8-E (International)</td>
<td>4G - Penta Band LTE - 800/900/1800/2100/2600 MHz - FDD-Band (20, 8, 3, 7, 1)</td>
</tr>
<tr>
<td></td>
<td>3G - Tri Band UMTS (WCDMA) - 900/1800/2100 MHz - FDD-Band (8, 3, 1)</td>
</tr>
<tr>
<td></td>
<td>2G - Dual Band GSM/GPRS/EDGE - 900/1800 MHz</td>
</tr>
<tr>
<td>PLS8-X (North America)</td>
<td>4G - Penta Band LTE - 700/700/850/AWS(1700/2100)/1900 MHz - FDD-Band (13, 17, 5, 42)</td>
</tr>
<tr>
<td></td>
<td>3G - Tri Band UMTS (WCDMA) - 850/AWS (1700/2100)/1900 MHz - FDD-Band (5, 4, 2)</td>
</tr>
<tr>
<td></td>
<td>2G - Quad Band GSM/GPRS/EDGE - 850/900/1800/1900 MHz</td>
</tr>
</tbody>
</table>
### Table B-8: Power

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery</td>
<td>Hot-swappable 11.1 V - 37.74 Wh intelligent lithium (2 per kit)</td>
</tr>
<tr>
<td>Battery Life</td>
<td>12-hour operation from two batteries with UHF radio in Rx mode</td>
</tr>
<tr>
<td>Voltage</td>
<td>9 to 22V DC external power input with over-voltage protection (5-pin LEMO)</td>
</tr>
<tr>
<td>Charge Time</td>
<td>Typically 7 hours</td>
</tr>
</tbody>
</table>

### Table B-9: Memory

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>SIM Card</td>
<td>User accessible SIM card slot</td>
</tr>
<tr>
<td>Memory</td>
<td>Internal 8GB, accessible through USB and Wi-Fi. External MicroSD card slot supports up to 64 GB.</td>
</tr>
</tbody>
</table>

### Table B-10: Environmental

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Temperature</td>
<td>-30°C to 60°C (-22°F to 140°F)</td>
</tr>
<tr>
<td>Storage Temperature</td>
<td>-40°C to 80°C (-40°F to 176°F)</td>
</tr>
<tr>
<td>Waterproof / Dustproof</td>
<td>IP67, Protect from temporary immersion to a depth of 1 meter</td>
</tr>
<tr>
<td>Shock Resistance</td>
<td>MIL-STD-810G, method 516.6 Designed to survive a 2 m pole drop on concrete floor with no damage; designed to survive a 1 m free drop on hardwood floor with no damage</td>
</tr>
<tr>
<td>Vibration</td>
<td>MIL-STD-810G, method 514.6E-1</td>
</tr>
<tr>
<td>Humidity</td>
<td>Up to 100%</td>
</tr>
<tr>
<td>Inflammability</td>
<td>UL recognized, 94HB Flame Class Rating (3). 1.49mm</td>
</tr>
<tr>
<td>Chemical Resistance</td>
<td>Cleaning agents, soapy water, industrial alcohol, water vapor, solar radiation (UV)</td>
</tr>
</tbody>
</table>

### Table B-11: Mechanical

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size</td>
<td>14.6 D x 14.8 H (cm)</td>
</tr>
<tr>
<td></td>
<td>5.75 D x 5.83 H (in)</td>
</tr>
<tr>
<td>Weight</td>
<td>&lt;1.38 kgs (&lt;3.05 lbs)</td>
</tr>
<tr>
<td>Mounting</td>
<td>5/8&quot;x11, 55° thread angle, stainless steel insert</td>
</tr>
</tbody>
</table>
### Table B-12: Antenna Offsets

<table>
<thead>
<tr>
<th>Item</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phase Center Offset</td>
<td>L1=132mm</td>
</tr>
<tr>
<td></td>
<td>L2=139mm</td>
</tr>
<tr>
<td></td>
<td>R=73mm</td>
</tr>
<tr>
<td></td>
<td>H=105mm</td>
</tr>
</tbody>
</table>

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
4. CMR and CMR+ do not cover proprietary messages outside of the typical standard

![Figure B-1: Antenna Offsets](image)
Appendix C: Radio Mode
# Appendix C: Radio Mode

## Table C-1: Radio Mode

<table>
<thead>
<tr>
<th>Radio Mode</th>
<th>Link Rate</th>
<th>Spacing</th>
<th>Modulation</th>
<th>Scrambling</th>
<th>FEC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trimtalk 1</td>
<td>4800 bps</td>
<td>12.5 kHz</td>
<td>GMSK</td>
<td>On</td>
<td>Off</td>
</tr>
<tr>
<td>Trimtalk 2</td>
<td>9600 bps</td>
<td>25 kHz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>PC1</td>
<td>9600 bps</td>
<td>25 kHz</td>
<td>GMSK</td>
<td>On</td>
<td>On</td>
</tr>
<tr>
<td>PC5</td>
<td>4800 bps</td>
<td>12.5 kHz</td>
<td>GMSK</td>
<td>On</td>
<td>On</td>
</tr>
<tr>
<td>PC-4FSK</td>
<td>9600 bps</td>
<td>12.5 kHz</td>
<td>4FSK</td>
<td>On</td>
<td>On</td>
</tr>
<tr>
<td></td>
<td>19200 bps</td>
<td>25 kHz</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satel 3AS</td>
<td>9600 bps</td>
<td>12.5 kHz</td>
<td>4FSK</td>
<td>On</td>
<td>Off</td>
</tr>
<tr>
<td></td>
<td>19200 bps</td>
<td>25 kHz</td>
<td></td>
<td></td>
<td>On</td>
</tr>
</tbody>
</table>
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