



# **GNSS Survey Receiver**

User's Guide

Part No. 875-0357-D Rev. A1

## **Environmental**

Temperature – operating -20°C to +40°C

Temperature – storage -40°C to +60°C

Humidity MIL-STD-810F Method 5-7.4

Vibration MIL-STD-810FG Method. 514.6E-1

Loose cargo MIL-STD-810F FIG. 514.5C-5

## **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 301489-17 v2.2.1
- EN301 489-24 v1.5.1
- EN55022:2010
- EN55024:2010
- EN 300440-1 v1.6.1 / EN 300440-2 v1.4.1
- EN 300 328 V1.9.1
- EN 301 511 v9.0.2
- EN 301 908-1 v6.2.1 / EN 301 908-2 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: ZC8S321UHF
- IC: 9586A-S321UHF

### **S321 Non-UHF**

- Model: S321 Network
- FCC ID: ZC8S321Network
- IC: 9586A-S321Network

 **WARNING:** If your S321 is equipped with a UHF 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.*

*This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and your body.*

*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.

## **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, including interference that may cause undesired operation of this device.

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.

This equipment should be installed and operated with a minimum distance of 20 cm between the radiator and your body.

## **Europe – Declaration of Conformity**

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

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Hemisphere GNSS products may be covered by one or more of the following U.S. Patents:

|           |           |           |           |           |
|-----------|-----------|-----------|-----------|-----------|
| 6,111,549 | 6,397,147 | 6,469,663 | 6,501,346 | 6,539,303 |
| 6,549,091 | 6,631,916 | 6,711,501 | 6,744,404 | 6,865,465 |
| 6,876,920 | 7,142,956 | 7,162,348 | 7,277,792 | 7,292,185 |
| 7,292,186 | 7,373,231 | 7,400,956 | 7,400,294 | 7,388,539 |
| 7,429,952 | 7,437,230 | 7,460,942 |           |           |

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  
8515 East Anderson Drive  
Scottsdale, Arizona 85255  
Phone: 480-348-6380  
Fax: 480-270-6070  
[precision@hgnss.com](mailto:precision@hgnss.com)  
[www.hgnss.com](http://www.hgnss.com)

### Technical Support

If you need to contact Hemisphere GNSS Technical Support:

8515 East Anderson Drive  
Scottsdale, Arizona 85255  
Phone: 480-348-6380  
Fax: 480-270-6070  
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## **Chapter 1: Introduction**

Product Overview and Features

What's Included

## Overview and Features

The S321 is an all-new multi-GNSS, multi-frequency survey receiver designed by and for surveyors. The S321 delivers robust performance and high precision in the field 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 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 Wi-Fi network. The built-in web UI 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 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

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 5 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](http://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: <http://hemispheregnss.com/Technology>

For more information about Atlas L-Band, see: <http://hemispheregnss.com/Atlas>

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

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## What's Included

The S321 is available as a single unit or two units (base/rover setup). Figure 1-1 shows the parts included in the single unit kit and Table 1-1 lists the parts included in both kits.



**Figure 1-1: S321 single unit kit**

**Table 1-1: S321 parts list**

| Item | Item                                       | Qty | Part Number |
|------|--------------------------------------------|-----|-------------|
| 1a*  | S321 UHF survey receiver                   | 1   | 752-0006-0  |
| 1b*  | S321 Network survey receiver               | 1   | 752-0007-0  |
| 2    | Smart Battery                              | 2   | 427-0058-0  |
| 3    | Battery Charger                            | 1   | 427-0059-0  |
| 4    | Battery Charger Adapter                    | 1   | 427-0060-0  |
| 5    | 5-pin LEMO to Power/Radio Cable            | 1   | 054-0172-0  |
| 6    | 5-pin LEMO to Power Clips (external power) | 1   | 054-0171-0  |
| 7    | 7-pin LEMO Data Cable (USB and Serial)     | 1   | 051-0390-0  |
| 8    | UHF External Antenna(S321 UHF only)        | 1   | 150-1024-0  |
| 9    | GSM/WCDMA External Antenna                 | 1   | 150-1023-0  |
| 10   | Quick Release 5/8" Mounting Adapter        | 1   | 699-0015-0  |
| 11   | Tape Measure                               | 1   | 699-0011-0  |
| 12   | Carry Case                                 | 1   | 750-0183-0  |
| 13   | 4 GB DSD Card                              | 1   | 750-1168-0  |

\*= The S321 kit comes as either a UHF version or a network version. Only one device is included per kit.



## **Chapter 2: Installation**

Ports and Connections  
Installing/Connecting the S321

## Ports and Connections

All connections and ports 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                                              |
|-------------------------------|--------------------------------------------------------------|
| Data port (7-pin LEMO)        | Data cable for serial or USB (Item H in Table 1-1 on page 4) |
| Power/Radio port (5-pin LEMO) | External Power and Radio devices                             |
| GPRS antenna connector        | External GPRS antenna (Item F in Table 1-1 on page 4)        |
| UHF Antenna Connector         | External antenna (Item C in Table 1-1 on page 4)             |
| Mounting hole                 | Pole or tripod mount                                         |

## Setting Up the Unit

Figure 2-2 shows a typical setup for both a base station unit and a rover unit (tripod and pole mount not included, data collector optional).

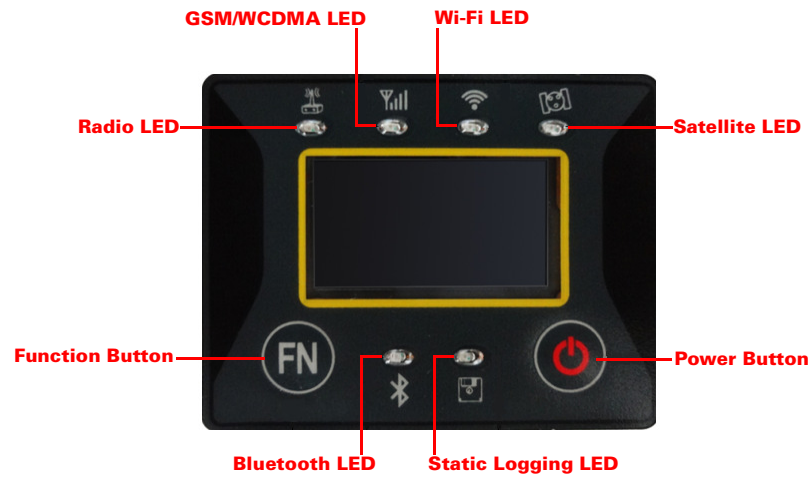
The antenna in Figure 2-2 is connected to the bottom of the unit; you have the option of attaching the antenna to the antenna bracket so the antenna faces upward. See “Attaching the Antenna” on page 7 for more information on attaching the antenna.



**Figure 2-2: Typical base and rover setup**

## S321 Display and Functions

### Interface



#### Satellite LED (Green)

The LED blinks and it shows the amount of locked satellites.



**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.

**Bluetooth LED (Blue)**

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



### Wi-Fi LED (Green)

This is an indicator of a Wi-Fi hotspot or local connection being emitted from your device. By connecting to the S321 device network, you are able to control the S321 via webUI. For more information on the webUI, please see page [\(Insert webUI information page\)](#)



**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)

**External Data Link LED (Green)**

the LED is red when external data link is selected as RTK data link. It starts to blink when there is data transfer ongoing.

**Power LED (Green or Red)**

Includes three modes of function:

1. Green: Power supply is functioning at full capacity
2. Red: Low power (below 20%)
3. Red Blinking and Beeping: Very low power (below 10%)

Usually when the light is red you have approximately one hour of power in reserve. External power and internal battery share the same power light. When the external power is used, the LED indicates external power level. When the power is below 10%, the LED will flash according to sample interval (default is 1 second) and you also hear three beeps every 60 seconds.

### **“F” key: Function Key**

It can switch the different work mode of the receiver and data link mode (radio, network, external (Radio + Network)). Lightly press the F key to voice broadcast current work status.

### **How can you switch the working mode and data link??**

Power on the receiver while pressing F key in the meantime, wait until all lights flash, voice broadcast select the work mode, and then release two keys. Now every time you press the F key, you will see the receiver moving through the three working mode, Press I key to confirm the work mode.

Then voice broadcast select data link, every time you press the F key, and the receiver move through the data link. Press I key to confirm the data link.

The voice broadcast “set Wi-Fi”, press F key to enable or disable it, and press I key to confirm. At last, the voice broadcast “set success”, and lightly press the F key voice broadcast the receiver status.

### **“I” key: Power key**

It has powers on/off the receiver function and has a confirm function.

- **Power on receiver:** Press I key, and all led interval flashing after one beep.
- **Power off receiver:** Long press I key, all led interval flashing and the voice prompted turn off the device. Then press I key to confirm power off.

**Self-Check:** it is a procedure predisposed for verifying the correct working of the instrument devices. The program is mainly to predict whether the receiver modules work normal ahead of time or not. S321 self-checking part includes GPS, Wi-Fi, Bluetooth, radio, network and sensor, a total of six parts?

Operation:

- When the receiver on the work, long press and hold I key until you are prompted turn off the device and release it, then long press I key. You will hear the beep to voice broadcast self-check and release it, then the receiver carry out self-check including GPS module, UHF module, and GPRS module.
- Self-check lasts typically around 1 minute. In the process of self-check, If you have failure in one module, and the voice broadcast the module not work normal, this module led will continue to beep, until the user restart the receiver. If you have found it, please contact public salesmen.
- It means that module works properly if all led is lit and the voice broadcast that module is successful in self-checking (Such as “GPS OK”). The receiver will automatically reboot in 5 seconds after finish all the self-check and begin to work.

---

**Note:** The frequency setting of the internal UHF module is set back to factory default on self-test. Please contact your local dealer to obtain the frequency information in your country.

---

## Work mode settings

The settings of base and rover can be set by hand, the details are as follows:

### Rover mode

Keep pressing I + F keys and wait for all lights flashing and release them, the voice broadcast "select work mode", then press F keys to choose rover mode, press I key to confirm.

### Base mode

Keep pressing I + F keys and wait for all lights flashing and release them, the voice broadcast "select work mode", then press F keys to choose base mode, press I key to confirm.

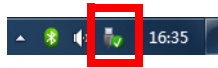
### Static mode

Keep pressing I + F keys and wait for all lights flashing and release them, the voice broadcast "select work mode", then press F keys to choose static mode, press I key to confirm.

## How to download Static Data

You can download static data by Web-UI interface and by USB. For a correct connection between receiver and PC, follow the procedure described below.

At first Turn off the receiver, then connect the cable to the communication interface of the receiver (7-pins Lemo port), then insert the USB port in the PC. The task-bar will show as follows:



The PC considers the receiver as a "media disk", so open the "media disk", and then you can get the data files in the memory.

## HEMISPHERE® Web UI Applications

The user can login HEMISPHERE S321 Web UI by itself, then start for the relevant settings on the web page of S321, it can support multiple user to login at the same time.

The specific steps are:

1. When S321 is in a state of boot, the user can use a mobile phone or computer search the Wi-Fi, which corresponding to the series number of S321 receiver equipment, and connection.
2. In the browser input fixed IP: <http://192.168.10.1>, and login.

The default login values for the receiver are as follows:

User name: admin

Password: S321

(3) After a successful login, you can see the interface as shown in figure 5-1.

### Interface

The receiver interfaces are shown in Fig. 2.6: the left port (5-pins LEMO) is used for external power supply and external radio, the right port (7-pins LEMO) is used for data transferring between receiver and computer or between receiver and the hand-held. The radio antenna interface is in figure 2-5, the network antenna interface is shown in figure 2-6.

## Whats included:

### Batteries

The standard configuration contains two batteries with SN, a slot for charging batteries (named "charger" for simplicity) and an adapter. The battery are "lithium-ion" battery (11.1V-3400mAH;37.7Wh): a technology which has an higher energy-to-weight ratio with respect to NiCd or NiMh batteries, no memory effect, and slow self-discharge when not in use.



**Charger**

The charger can charge both batteries simultaneously. The lights of the charger shows if the battery is being charged (red light CHARGE) or if it's already charged (green light FULL). Red light POWER shows if the charger is powered on and there is also a light which turns on in case of too high temperature (red light TEMP).

**Antennas (UHF (for S321 UHF only) and GSM/WCDMA)**

S321 UHF adopts a UHF all-direction transmitting and receiving antenna. They are suitable for field surveying, light and durable. The gain is 2.15 dBi.



S321 adopts a GSM/WCDMA all-direction transmitting and receiving antenna. It is suitable for field surveying, light and durable, the length is about 20 cm, the gain is around 2 dBi.



### **Receivers cables (LM.GK205.ABL)**

This is a multi-function communication cable: it is used for connecting receiver and computer used for transferring the static data, updating the firmware.



### **Auxiliary cables (LM.GK185.ABL+ LM.GK224.AAZ)**

External power supply cables (LM.GK185.ABL+ LM.GK224.AAZ) can be ordered and used to connect an external battery (red and black clips) to the receiver (small 5-pin LEMO):



### **Other accessories**

The other accessories are: 2.45 m retractable pole, 25 cm supporting pole, two kind of brackets depending on the controller, tribrach with plummet, tripod (wood or aluminum, with quick or twist clamps), connector between receiver and tribrach, and measuring tape, quick release and mini rotary table.

## **Installation of Base and Rover**

### **Optional accessories:**

such as external radio package? rover exclusive accessories? base exclusive accessories.

### **Installation of Base**

1. Put a tripod on a location with known coordinates or unknown coordinates, attach receiver to 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.

### **Installation of Rover**

1. Fix the bracket on the pole, fix the handheld to the bracket, put the rover on the pole and attach receiving antenna into the port "UHF".
2. Power on the receiver and select the rover working mode.
3. Open the handheld and start the software, then you can do the setting of the instruments.

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



## **Chapter 3: Setup and Configuration**

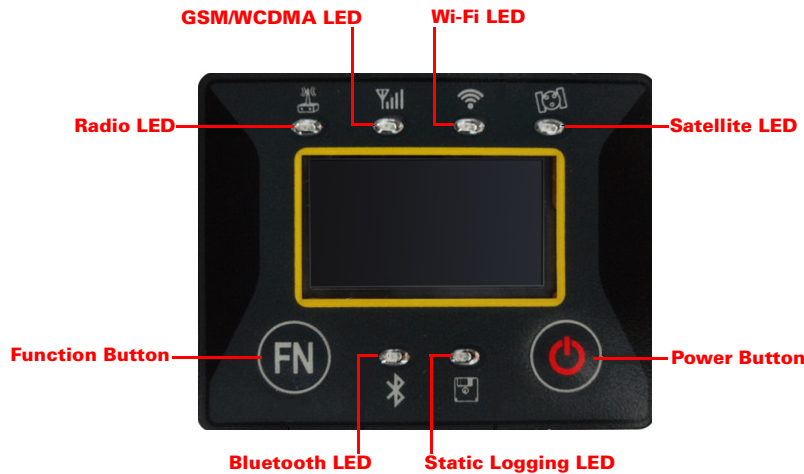
|                                           |
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| Powering the S321 On and Off              |
| Modes of Operation                        |
| Displaying Current Module Status          |
| Changing Module Status                    |
| Tilt Function Control                     |
| Alarm/Buzzer                              |
| Power and Battery Status/Charge           |
| Replacing/Swapping the Batteries          |
| Removing/Inserting the SD Card / SIM Card |
| Bluetooth Communication                   |
| Upgrading S321 Firmware                   |
| GSM Functionality                         |
| Restoring Factory Defaults                |

This chapter describes how to set up and configure the S321 and includes the following sections:

- “Control Panel Overview” on page 12
- “Powering the S321 On and Off” on page 15
- “Modes of Operation” on page 15
- “Displaying Current Module Status” on page 16
- “Changing Module Status” on page 17
- “Tilt Function Control” on page 17
- “Alarm/Buzzer” on page 18
- “Power and Battery Status/Charge” on page 17
- “Replacing/Swapping the Batteries” on page 19
- “Removing/Inserting the SD Card / SIM Card” on page 20
- “Bluetooth Communication” on page 21
- “Upgrading S321 Firmware” on page 22
- “GSM Functionality” on page 24
- “Restoring Factory Defaults” on page 26

## Control Panel Overview

You operate the S321 using the control panel shown in Figure 3-1.



**Figure 3-1: S321 control panel**

The S321 beeps on any key press. Table 3-1 describes the each button and LED on the control panel.

**Table 3-1: S321 control panel items**

| Diagram Item | Name                                         | Description                                                                                                                                                                                                                                                                                                                                           |
|--------------|----------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| A            | Power button                                 | <ul style="list-style-type: none"> <li>If unit is Off, press and hold until unit powers up (until you hear one beep)</li> <li>If unit is On, press and hold for approximately 3 seconds (until you hear three beeps) to turn unit off</li> </ul>                                                                                                      |
| B            | Select button (for Bluetooth/GSM/SD modules) | <p>Allows you to review module status or change the status (power on/off) of a module</p> <p>See “Displaying Current Module Status” on page 16 and “Changing Module Status” on page 17 for more information on the Select button.</p>                                                                                                                 |
| 1            | GSM radio status LED                         | <ul style="list-style-type: none"> <li>Off – GSM module is OFF; or no RTK position computed</li> <li>On (yellow) – floating point RTK position achieved</li> <li>On (green) – fixed ambiguity RTK position achieved</li> <li>Blink (green) – GSM module transmitting/receiving data</li> <li>Pulse (red) – error condition with GSM module</li> </ul> |
| 2            | GPS position status LED                      | <ul style="list-style-type: none"> <li>Off – no position</li> <li>On (yellow) – valid position</li> <li>Blink (yellow) – operating as a base station and converging on reference coordinates</li> </ul>                                                                                                                                               |
| 3            | DGPS position status LED                     | <ul style="list-style-type: none"> <li>Off – no differential corrections available</li> <li>On (green) – differentially corrected position computed</li> </ul>                                                                                                                                                                                        |
| 4            | External power status LED                    | <ul style="list-style-type: none"> <li>Off – external power not present</li> <li>On (red) – external power present and in use</li> </ul>                                                                                                                                                                                                              |
| 5 and 6      | Battery status LED                           | <ul style="list-style-type: none"> <li>Off – battery not present</li> <li>On (green) – battery charge full</li> <li>On (yellow) – battery charge &lt; 50%</li> <li>On (red) – battery charge depleted</li> <li>Blink – battery in use</li> </ul>                                                                                                      |
| 7            | Bluetooth status LED                         | <ul style="list-style-type: none"> <li>Off – Bluetooth inactive</li> <li>On (blue) – active Bluetooth connection</li> <li>Blink (blue) - Bluetooth active and transmitting/receiving data</li> </ul>                                                                                                                                                  |

**Table 3-1: S321 control panel items (*continued*)**

| Diagram Item | Name                  | Description                                                                                                                                                                                                                                                                                    |
|--------------|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8            | SD logging status LED | <ul style="list-style-type: none"><li>• Off – SD card not inserted</li><li>• On (yellow) – SD card inserted, not logging data</li><li>• Blink (yellow) - SD card inserted and reading/writing data to SD card</li><li>• Pulse (yellow) at 5 Hz - SD card inserted and low free space</li></ul> |

## Powering the S321 On and Off

Use the Power button to power the S321 on and off.

To power on the S321:

- Press and hold the **Power** button until the S321 powers up (until you hear one beep).

To power off the S321:

- Press and hold the **Power** button for 3 seconds (until you hear three beeps).

---

**Note:** When you power on the S321 the LEDs go through a 'heartbeat' sequence (each LED lights up in succession); during this time the modules power up and the devices initialize.

---

## Modes of Operation

Table 3-2 lists the modes of operation for the S321.

**Table 3-2: S321 modes of operation**

| Mode Description                                 | Eclipse Software | GSM Mode | UHF Mode | Bluetooth Mode                                |
|--------------------------------------------------|------------------|----------|----------|-----------------------------------------------|
| L-band rover                                     | SBASRTKB         | OFF      | OFF      | ON or OFF                                     |
| Single point data collection for post processing | SBASRTKB         | OFF      | OFF      | ON or OFF                                     |
| RTK Base Station                                 | SBASRTKB         | OFF      | ON       | ON or OFF                                     |
| RTK Rover - UHF                                  | RTK              | OFF      | ON       | ON or OFF                                     |
| RTK Rover - GSM                                  | RTK              | ON       | OFF      | ON or OFF                                     |
| RTK Rover - External corrections via Bluetooth   | RTK              | OFF      | OFF      | ON (both ports - one monitor, one diff input) |
| RTK Rover - External serial corrections          | RTK              | OFF      | OFF      | ON or OFF                                     |

## Displaying Current Module Status

The S321 allows you to quickly review the status of each module (UHF/GSM, mode of operation, Bluetooth, and SD card logging).

To display current module status:

- Press the **Select** button.

The external power status LED is red (the unit is displaying its current status) and the LED of each module will be either OFF (LED not illuminated, module powered off) or ON (LED illuminated, module powered on).

Table 3-3 illustrates the colors of the LEDs for each module.

**Table 3-3: Module status LED color descriptions**

| LED                              | LED Color                | S321 Operation                         |
|----------------------------------|--------------------------|----------------------------------------|
| GSM                              | Off                      | GSM module both off                    |
|                                  | Green                    | UHF radio on (for S321 UHF model only) |
|                                  | Yellow                   | GSM module on                          |
| GPS and DGPS position indicators | Off (both)               | L-band                                 |
|                                  | GPS Yellow<br>DGPS None  | RTK rover                              |
|                                  | GPS None<br>DGPS Green   | RTK base                               |
|                                  | GPS Yellow<br>DGPS Green | e-Dif                                  |
| Bluetooth                        | Off                      | Bluetooth off                          |
|                                  | Blue                     | Bluetooth on                           |
| SD card logging                  | Off                      | SD card logging off                    |
|                                  | Yellow                   | SD card logging on                     |

## Changing Module Status

You change module status by using the Select button to select the module and the Power button to change the module status.

To change module status:

1. Press the **Select** button to display the status of all modules (if the LED is on, the module is on; if the LED is off, the module is off).
2. Press the **Select** button again to select the first module (UHF/GSM).

---

**Note:** When you press the Select button the LED (for the module status you are changing) remains illuminated for 5 seconds, during which time you can use the Power button to change the module status in step 3.

---

3. If you want to change the current module's status, press the **Power** button.

---

**Note:** When you press the Power button the LED (for the module status you are changing) blinks 5 times to indicate a status change.

---

4. Repeat steps 2 and 3 for each remaining module (if desired).

After a status change, the function of the LEDs return to normal mode.

## Power and Battery Status/Charge

LEDs on the console provide power and battery status/charge information based on the color of the LEDs. For example, Figure 3-2 indicates there is no external power, the right battery is fully charged, and the left battery is not present (not in the unit).

**Figure 3-2: No external power, right battery full, left battery not present**

Table 3-4 describes what the power/battery LED colors indicate. The S321 prioritizes power usage to use external power when available, regardless of the status of the internal batteries.

**Table 3-4: Power/battery LED color descriptions**

| LED           | LED Color                                                               | Meaning                                                                                |
|---------------|-------------------------------------------------------------------------|----------------------------------------------------------------------------------------|
| Power         | Off                                                                     | No external power                                                                      |
|               | Red                                                                     | External power present and in use                                                      |
| Left battery  | Off                                                                     | Battery not present                                                                    |
| Right battery | Red                                                                     | Battery very low or fully discharged (unit will beep when both batteries are very low) |
|               | Yellow                                                                  | Battery less than 1/2 charged                                                          |
|               | Green                                                                   | Battery fully charged                                                                  |
|               | <b>Note:</b> A blinking battery light indicates that battery is in use. |                                                                                        |

## Replacing/Swapping the Batteries

If the S321 is off you can replace both batteries at one time. If you want to keep the unit running while replacing the batteries you must replace them one at a time to ensure the unit is receiving power from at least one battery.

To replace/swap a battery:

1. For the battery you want to replace remove the battery tray by squeezing the thumb lever and pulling.
2. Remove the battery from the tray.
3. Insert the new battery.

---

**Note:** When inserting the battery make sure the end with the leads (on top) points away from the tray.

---

4. Replace the tray, making sure the tray snaps into place.

## Removing/Inserting the SD 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 SD card and the SIM card are only accessible by first opening the battery door, where the:

- The “SD” card slot is positioned on the left side Left is labeled “SD”
- Right tray is labeled “SIM”

To remove the SD card or SIM card:

1. Remove the appropriate battery tray.
2. Place the S321 upside down (on its top) to get a better view of the card.
3. Gently push the card in; it will then snap back and slightly out.

---

**Note:** When you insert either card make sure the contacts on the card are facing the top of the unit and the side of the card with the notch goes in first (see figure in step 2 above).

---

4. Remove the card.

To insert the SD card or SIM card:

1. Place the card in its appropriate card slot.
2. Gently push the card in until it clicks.
3. Replace the battery tray.

## 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 handheld data collector, the following S321 Bluetooth information appears on the device:

```
HGPS S321 XXXXXX
```

where “XXXXXX” is the Eclipse board serial number

To complete the connection you must use the correct PIN/Passkey, which is 0000.

Table 3-5 describes the Bluetooth status LED options.

**Table 3-5: Bluetooth LED status**

| LED Colors            | Meaning                                                     |
|-----------------------|-------------------------------------------------------------|
| Off                   | Bluetooth inactive                                          |
| Blue                  | Active Bluetooth connection                                 |
| Blue blinking/pulsing | Active Bluetooth connection and transmitting/receiving data |

## Upgrading S321 Firmware

You can upgrade S321 firmware via serial port or SD card.

### Upgrading S321 Firmware via Serial Port

Before you upgrade verify the S321 is powered off and, if you will not be using external power, both Li-ion batteries are fully charged and inserted into the S321.

1. Download the Autoloader\_S321 executable (.exe file) for the most recent version from the Hemisphere GNSS website at [www.hemispheregps.com](http://www.hemispheregps.com) and save it to your PC.
2. Using the data cable included in your S321 kit, connect the DB9 serial port end of the cable to your PC and connect the other end of the cable to the data port on the S321 (see below):
3. Power on the S321.
4. Double-click the Autoloader\_S321 file you download in step 1 to start the Autoloader program.
5. In the Com Port drop-down box select the appropriate COM port on your PC and then click **Load**.  
The Status area shows the load progress. When loading is complete the following message appears.
6. Click **OK**.
7. In the Autoloader window click **Exit**.

### Upgrading S321 Firmware via SD Card

Before you upgrade verify the S321 is powered off and, if you will not be using external power, both Li-ion batteries are fully charged and inserted into the S321.

1. Download the S321\_Upgrade.zip file from the Hemisphere GNSS website at [www.hemispheregps.com](http://www.hemispheregps.com) and save it to your PC.
2. Unzip the file and extract the contents to the root folder of the SD card, ensuring the same folder structure of the contents on the SD card.
3. Remove the SD card from the PC.
4. If necessary remove the left battery tray from the S321 (the left tray is labeled SD).
5. Insert the SD card into the S321 (see “Removing/Inserting the SD Card / SIM Card” on page 20).
6. Replace the battery tray.
7. Power on the S321.
  - a. The LEDs cycle from left to right while the receiver is reading the upgrade file.
  - b. After the file has passed all internal verifications, the bottom battery LED illuminates green.
  - c. The LEDs cycle from left to right while the file is copied.
  - d. All the LEDs flash quickly to indicate the new firmware file is being committed to the receiver.

- e. After committing the new file to internal memory, the LEDs cycle from left to right one more time before resetting the receiver and returning to the heartbeat sequence.

The upgrade is complete.

## GSM Functionality

This section provides advanced GSM information that requires connection to a PC running either Hemisphere GNSS' PocketMax utility or a terminal program such as HyperTerminal.

This section covers the following topics:

- GSM overview
- GSM modes
- Configuring GSM for NTRIP
- SMS messaging

### GSM Overview

Global System for Mobile Communications (GSM) is a network technology for mobile phone communications. The GSM modem in the S321 is what allows you to connect to a GSM carrier.

The Access Point Name (APN) is a protocol that allows the S321 to access the internet using the mobile phone network. It is a configurable network identifier used when connecting to a GSM carrier. The default APNCFG value is "internet.com". The specific APN required by the S321 depends on your mobile carrier. Check with your mobile provider for details.

### GSM Modes

The GSM module operates in four modes:

- IDLE - Default mode for the module. In this state, the GSM module only attempts to register on the network.
- DIRECT IP - For users who have direct access to a server providing differential corrections.
- LINK - For users to establish a link between two S321 modules directly, where the BASE has a dynamic IP address. You should only use this mode on the rover in a base station / rover setup (use IDLE mode for the base station).
- NTRIP - Used to provide differential correction information to the GPS receiver.

### Configuring GSM for NTRIP

NTRIP (Networked Transport of RTCM via Internet Protocol) is the protocol for transmitting GNSS data over the internet.

---

**Note:** To configure NTRIP you must connect the S321 to a PC running either Hemisphere GNSS' PocketMax utility or a terminal program such as HyperTerminal.

---

To configure NTRIP send the following command:

```
$GSMCFG,NTRIP,[remote host name or IP address],[port number],[mount point name],[[username],[password]]
```

where,

- Remote host name - server name (such as [www.igs-ip.net](http://www.igs-ip.net)) or an IP address
- Mount point name - caster stream name from NTRIP Caster Source Table (you can download a sample source table from <http://www.igs-ip.net:2101/>). If you leave this field blank, the S321 will fetch the caster source table and select the mount point closest to its current position.
- User name and password - authentication with a user name and password is required for most NTRIP casters. You can leave both blank to specify that no authentication is required. The user name and password are case sensitive.

For example, to connect to the CALG0 stream on igs-ip.net send the following command:

```
$GSMCFG,NRTIP,www.igs-ip.net,2101,CALG0,Usrnam,passwd
```

## Configuring SMS Messaging

The S321 supports Short Message Service (SMS) configuration and event updates for both base and rover operations.

When using SMS messaging keep the following in mind:

- The GSM module must be powered on for SMS commands to work correctly.
- You can send SMS messages to the S321 from up to three numbers and these numbers must be added to the S321 approved numbers list.
- By default the approved numbers list is comprised of the first three entries in the SIM card address book. However, for a typical data-only SIM card, the address book of the SIM card will be empty.
- Use the appropriate country code (the following procedures use the “+1” country code for USA/Canada).

### Adding or Overwriting a Number on the Approved Numbers List

You can add a number to an empty slot or overwrite an existing number using the following command:

```
$JSMS,CONFIG,[slot number 1/2/3],[number],[name],[status messages ON | OFF]
```

For example, to add “Service” (USA phone number 999-555-1212) to slot 1 with status messages OFF (or to replace the current number in slot 1) send the following command:

```
$JSMS,CONFIG,1,+19995551212,Service,OFF
```

The status message state (ON or OFF) allows the S321 to send an SMS message back to the number to report information and events on the operation of the unit.

### Displaying the Current List of Approved Numbers

To display the current list of approved numbers send the following command:

```
$JSMS,CONFIG
```

The reply below contains all the information on the configured numbers and may include SIM card address book defaults that you can overwrite with your own information.

```
$>JSMS,CONFIG,1,1,+19995551212,Service,OFF
```

The format of the reply is:

```
$>JSMS,CONFIG,[number of approved numbers],[slot number 1/2/3],[number],[name],[status messages ON | OFF]
```

---

**Note:** The reply contains one line for each number. For example, if there are two approved numbers then the reply will contain a “\$>JSMS,CONFIG” line for each number.

---

### Deleting a Number from the Approved Numbers List

To delete a number from the approved numbers list, send the following command:

```
$JSMS,CONFIG,[1/2/3 or keyword ALL],DELETE
```

For example, to delete the number in slot 2 send the following command:

```
$JSMS,CONFIG,2,DELETE
```

And to delete all numbers from the list, send the following command:

```
$JSMS,CONFIG,ALL,DELETE
```

### Sending an SMS Message to an Approved Number

To send an SMS message to an approved number, send the following command:

```
$JSMS,SEND,[name or phone number or slot number],[message]
```

For example, to send a “This is a test” message to Customer Support (USA phone number 480-348-9919, slot number 2) you can send any of the following commands:

```
$JSMS,SEND,SERVICE,This is a test  
$JSMS,SEND,+14803489919,This is a test  
$JSMS,SEND,2,This is a test
```

## Restoring Factory Defaults

If you need to restore your factory defaults for any reason you can do this via the Control panel.

To restore factory defaults:

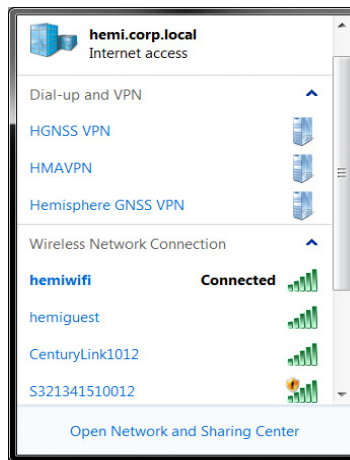
- Press and hold the **Power** button for 10 to 20 seconds and release it while the GPS status and DGPS status LEDs are blinking.

## Hemisphere Web UI

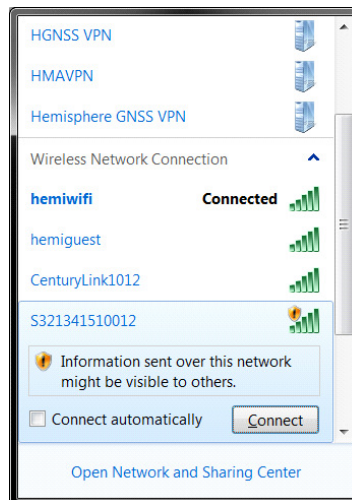
The webUI can work on

### Setup

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

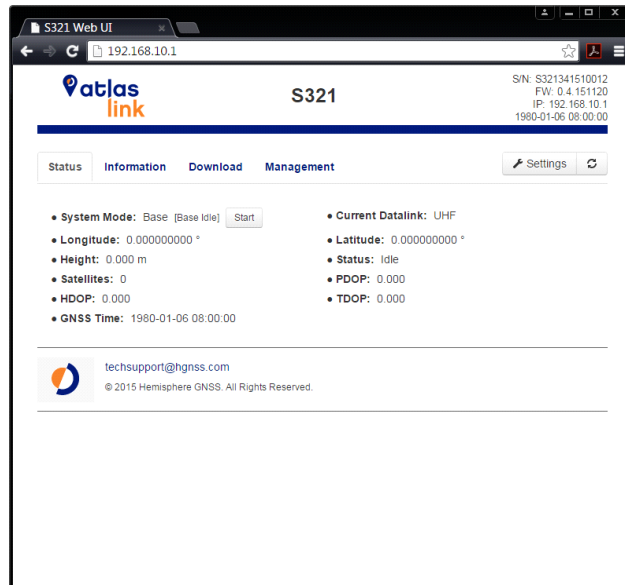


If you want this network to automatically connect, select the “Connect automatically” check box before pushing the “Connect” button. If not, click on the “Connect” button.



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

`http://192.168.10.1/`



### WebUI Startup

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 in order to properly secure your device moving forward.

## **WebUI Settings**

### **Working Modes:**

Base/UHF

Base/Network

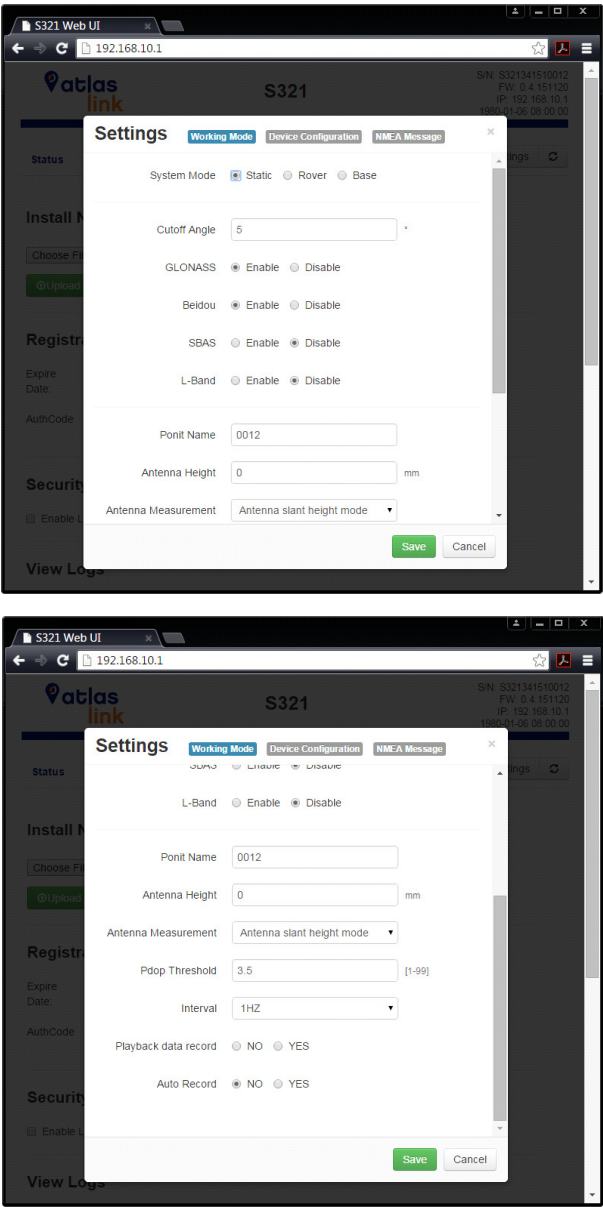
Base/External

Rover/Network

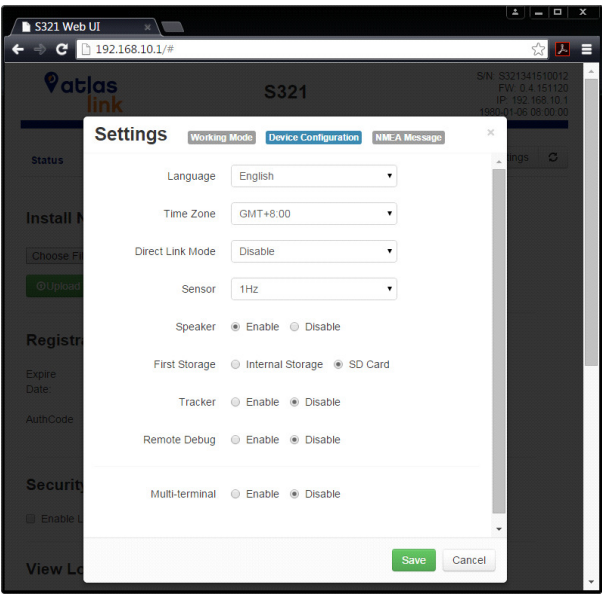
Rover/External

Rover/Bluetooth

Static

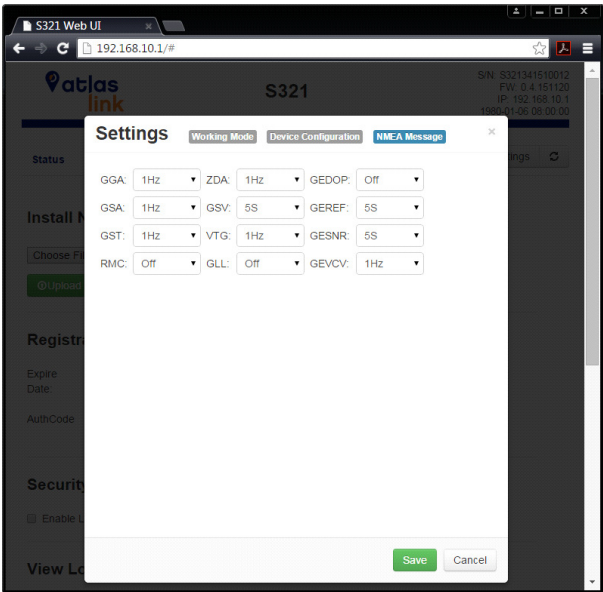


Device Configuration  
Device Configuration



NMEA Message

NMEA Message





## **Appendix A: Troubleshooting**

Table A-1 provides troubleshooting tips for the S321.

**Table A-1: S321 troubleshooting**

| Issue                                                     | Possible Resolution                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|-----------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Receiver fails to power                                   | <ul style="list-style-type: none"> <li>• External power is low</li> <li>• Check charge on external battery and the fuse on the power cable, if applicable</li> <li>• Internal power: Check charge on internal batteries</li> <li>• Check all power cables and pins</li> <li>• Try other batteries or cables</li> <li>• Make sure to hold the power button down for a minimum of one full second to turn on</li> <li>• Ensure batteries are installed with contacts pointed in the correct direction</li> </ul>                                                                                     |
| No data logged<br>1. No communication<br>2. No valid data | <ul style="list-style-type: none"> <li>• (1) Check receiver power status</li> <li>• (2) Verify it is locked to a valid DGPS signal</li> <li>• (2) Verify that it is locked to 4 or more GPS satellites</li> <li>• (2) Check integrity and connectivity of power and data cable connections</li> <li>• Verify that the baud rate settings match</li> <li>• If trying to connect over Bluetooth, ensure Bluetooth module is powered ON and device is paired prior to opening the port</li> </ul>                                                                                                     |
| Random binary data from Eclipse OEM board                 | <ul style="list-style-type: none"> <li>• Verify the RTCM or the Bin messages are not being accidentally output (send a \$JSHOW command)</li> <li>• Verify the baud rate settings match</li> <li>• 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.</li> </ul>                                                                                                                                                                                                                          |
| No GNSS position                                          | <ul style="list-style-type: none"> <li>• Verify the antenna's view of the sky, especially toward SBAS satellites, south in the northern hemisphere</li> <li>• Verify the bit error rate (BER) and lock status of SBAS satellites (this can often be done on the receiving device or by using SLXMon - monitor BER value)</li> <li>• Verify the proper application is running on the Eclipse (SBASRTKB)</li> <li>• Set the satellite selection to automatic mode \$JFREQ,AUTO</li> <li>• Set the differential mode to \$JDIFF,WAAS</li> <li>• Ensure there is SBAS coverage in your area</li> </ul> |
| No DGPS position in external RTCM mode                    | <ul style="list-style-type: none"> <li>• Verify the baud rate of the RTCM input port matches the baud rate of the external source</li> <li>• Verify the pinout between the RTCM source and the RTCM input port (the "ground" pin and pinout must be connected, and the "transmit" from the source must connect to the "receiver" of the RTCM input port)</li> </ul>                                                                                                                                                                                                                                |
| Non-DGPS output                                           | <ul style="list-style-type: none"> <li>• If using RTK, ensure receiver is properly authorized for RTK by sending a \$JI command or a \$JK command</li> </ul>                                                                                                                                                                                                                                                                                                                                                                                                                                       |



## **Appendix B: Technical Specifications**

The following tables provide information on the technical specifications of the S321.

**Table B-1: GNSS receiver specifications**

| Item                             | Specification                                      |
|----------------------------------|----------------------------------------------------|
| Receiver type                    | Multi Frequency GNSS                               |
| Channels                         | 372                                                |
| Positioning modes                | RTK, L-band DGNSS, SBAS, External RTCM, Autonomous |
| RTK formats                      | RTCM3, ROX                                         |
| L-band formats                   | Atlas 100, Atlas 30, and Atlas 10                  |
| Update rate / recording interval | Selectable from 1, 2, 4, 5, 10, 20 Hz              |

**Table B-2: Performance Specifications**

| 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                    | 0.08 m        | 0.16m           |
| SBAS Performance                      | 0.3 m         | 0.6 m           |
| Autonomous, no SA                     | 1.2 m         | 2.4 m           |

**Table B-3: Satellite Tracking**

| Satellites |                              |
|------------|------------------------------|
| GPS        | L1C/A, L1P, L2P, L2C         |
| GLONASS    | L1C/A, L2C/A                 |
| BeiDou     | B1, B2, B3                   |
| QZSS       | With future firmware upgrade |
| Galileo    | With future firmware upgrade |
| SBAS       | MSAS, WAAS, EGNOS, GAGAN     |

**Table B-4: Communication and port specifications**

| Item               | Description                                                                                                                                                                                                                                    |
|--------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Connectors I/O     | 5-pin Lemo connector for external power supply and external radio devices<br>7-pin Lemo connector for USB OTG connection and a serial port interface<br>1 TNC antenna connector for internal radio<br>1 TNC antenna connector for modem module |
| Bluetooth          | 2.1+EDR                                                                                                                                                                                                                                        |
| Wi-Fi              | 802.11 b/g/n                                                                                                                                                                                                                                   |
| Web UI             | To upgrade the software, manage the status and settings, data download, via smart phone, tablet or other electronic device                                                                                                                     |
| TTS                | Smart voice broadcast system.<br>"Speaking" receiver                                                                                                                                                                                           |
| Reference Outputs  | RTCM2.1, RTCM2.3, RTCM3.0, RTCM3.1, RTCM3.2 including MSM                                                                                                                                                                                      |
| Navigation Outputs | ASCII (NMEA-0183) GSV, AVR, RMC, HDT, VGK, VHD, ROT, GGK, GSA, ZDA, VTG, GST, PJT, PJK, BPQ, GLL, GRS, GBS                                                                                                                                     |

**Table B-6: Wireless specifications**

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

**Table B-7: Cellular specifications**

| Item                  | Description                                                        |
|-----------------------|--------------------------------------------------------------------|
| Type                  | UMTS/HSPA/GSM/GPRS                                                 |
| Function              | Voice, SMS, and Data                                               |
| Supported Frequencies | GSM/GPRS(850, 900, 1800, and 1900MHz)<br>WCDMA/HSDPA (850/1900MHz) |

**Table B-8: Power specifications**

| Item         | Specification                                                 |
|--------------|---------------------------------------------------------------|
| Battery      | Rechargeable and dismantle 10.8 V -36.7Wh                     |
| Battery Life | 6 hours with one battery and UHF radio in Rx mode             |
| Voltage      | 9 to 18V DC external power input with over-voltage protection |
| Charge Time  | Typically 7 hours                                             |

**Table B-9: Memory specifications**

| item     | Specification                                                                                         |
|----------|-------------------------------------------------------------------------------------------------------|
| SIM Card | User accessible SIM card slot                                                                         |
| Memory   | Internal 4GB. External Micro SD card slot supports up to 64 GB. User accessible through USB and Wi-Fi |

**Table B-10: Environmental specifications**

| Item                  | Specification                                                                       |
|-----------------------|-------------------------------------------------------------------------------------|
| Operating Temperature | -20°C to 40°C                                                                       |
| Storage Temperature   | -40°C to 60°C                                                                       |
| Water / Dust Proof    | IP67                                                                                |
| Shock Resistance      | MIL-STD-810G, method 516.6                                                          |
| Vibration             | MIL-STD-810G, method 514.6E-I                                                       |
| Humidity              | Up to 100%                                                                          |
| Inflammability        | UL recognized, 94HB Flame Class Rating (3)                                          |
| Chemical Resistance   | Cleaning agents, soapy water, industrial alcohol, water vapor, solar radiation (UV) |

**Table B-11: Mechanical specifications**

| Item                | Specification                                      |
|---------------------|----------------------------------------------------|
| Size                | 14.1 D x 14.0 H (cm)<br>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                   |

<sup>1</sup> Receive only, does not transmit this format.

<sup>2</sup> Depends on multi-path environment, number of satellites in view, satellite geometry, and ionospheric activity.

<sup>3</sup> Depends also on baseline length.

<sup>4</sup> Requires an L-band subscription.

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